Preserving the Whangamarino Wetland - An Application of the Contingent Valuation Method

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ABSTRACT

This thesis essentially describes the principal competing uses of the Whangamarino Wetland and derives estimates of the national economic benefit provided by each use. The wetland is a large swamp area in the upper North Island of New Zealand and provides an important wildlife habitat for many varied plants and animals. The wetland also has significant potential for agricultural and horticultural development as well as providing benefits in the form of fishing revenues and flood control.

This study describes the major uses of the wetland in detail and goes on to apply economic evaluation techniques to each of them. Particular emphasis is placed on applying the Contingent Valuation Method (CVM) to evaluate the non-market benefits from preserving and improving the wetland as an environmental amenity. The CVM is discussed in detail with its theory, strengths, and weaknesses highlighted.
A commentary on the methodology used in applying the CVM proceeds to outline the derivation of the national sampling frame, the design and implementation of the postal survey questionnaire and the results obtained.

Information collected in the postal survey is examined to derive an understanding of how much and why, people value the wetland. A socio-economic profile of the respondents to the survey is generated in order that a judgement can be made on whether the postal survey technique has validly captured a national opinion.

The study proceeds to aggregate the national economic benefits of the wetland in the form of Net Present Values (in January 1987 dollar terms, using a 10% discount rate). These values are then compared to illustrate how preservation of the wetland is likely to provide significantly greater social benefits than agricultural development benefits.

The study continues by discussing national preferences of wetland use and making recommendations on wetland management

in the future. A critique on applying the CVM in a New Zealand context is presented as a conclusion to the thesis.

CHAPTER 1

STUDY BACKGROUND AND MOTIVATION

1.1 Objectives of the Thesis

The Whangamarino Wetland will be described in detail in Chapter 3 but briefly it is a large swamp area in the Lower Waikato Basin which has been reduced by agricultural development to about 68% of its original size. Many agencies and authors consider the wetland unique and rank it at, or near, the top of New Zealand's freshwater wetlands. The wetland also offers opportunities for increased agricultural and horticultural production mainly through drainage development. Such development, it is maintained (Waikato Valley Authority, 1981), would lead to an irreversible change with regards to the wetland habit.

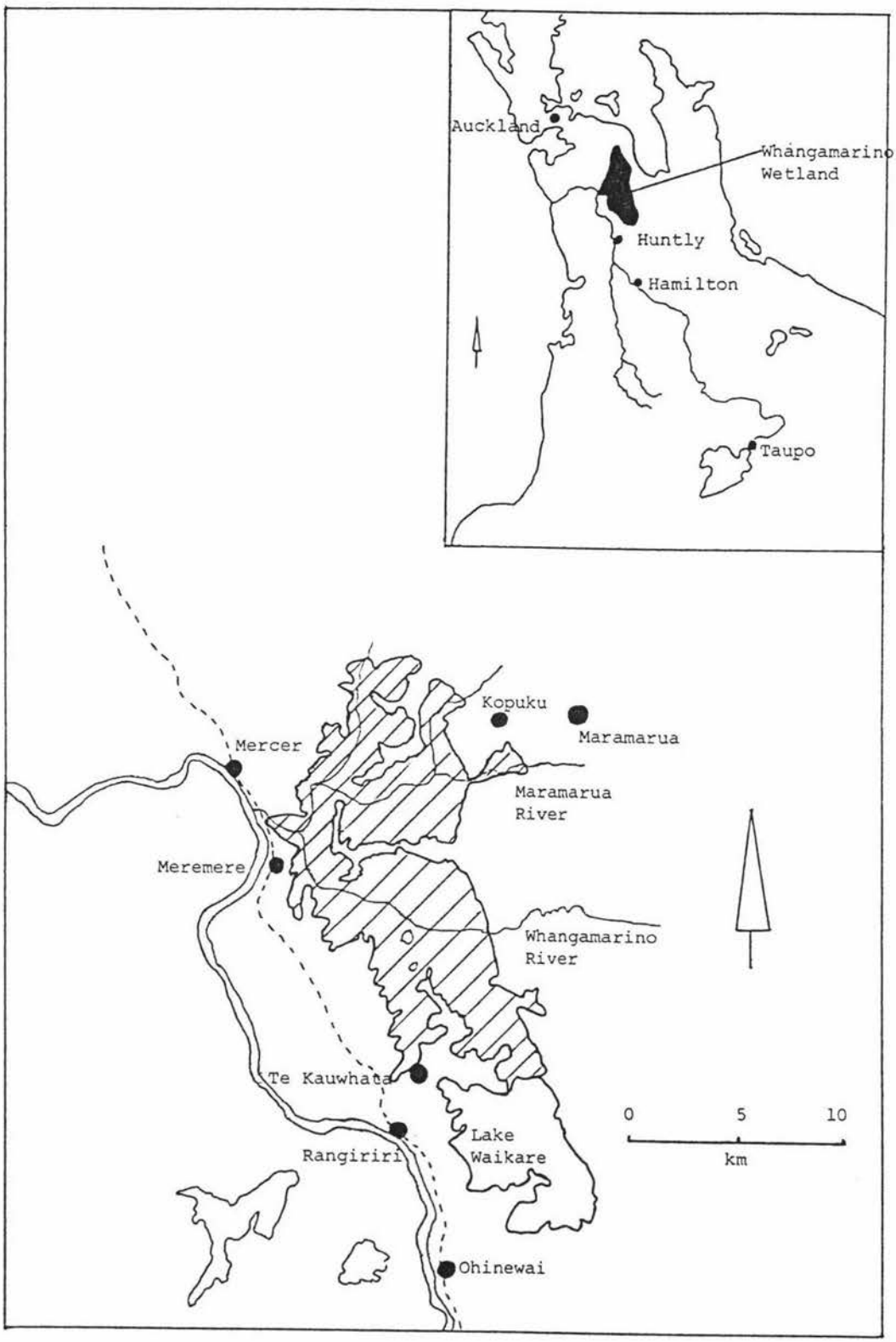
In the mid-1980's two private land owners, with significant tracts within the wetland, applied for the necessary water rights to drain and develop wetland for dairy farming. The water rights were initially granted but were appealed against by various environmental and acclimatisation agencies. The matter was referred to the Planning Tribunal, a body set up to administer the Town and Country Planning and Soil and Water Statutes. The Tribunal finally decided, in November 1985, to cancel the granted water rights.

It is of interest to quote from that decision by the Tribunal[1]:

"....The decision requires weighing the advantages against the disadvantages so that it best accords with the objects and purposes of the Act in the circumstances of the case. The advantage here is the creation of productive farmland from the present unproductive land while the disadvantages

(1) Digest of Planning Tribunal Decisions, No. 28, Ministry of Works and Development, May 1986.

Figure 1.1 LOCATION OF THE WHANGAMARINO WETLAND



Source: Waikato Valley Authority, 1981

being the reduction of an important wetland with consequent diminution in ecological values. This means weighing values of assessment in monetary terms against values not capable of monetary assessment. The appellants consider the swamp to be of national importance and should not be drained further.

The Tribunal's earlier decision considered that while the Act does not overlook fisheries and wildlife habitats, promoting soil conservation and drainage are given greater importance. The appellant's land does not have unique characteristics nor is it so large a section of the swamp that their preservation is the more important factor.

The Court of Appeal said; (1) the Act cannot achieve permanent protection of a wetland but will protect it to the extent that a water right is refused; (2) the appellants are entitled to oppose individual applications; (3) the refusal of rights would not deprive the applicants of anything but would deny them privileges; (4) the Tribunal was wrong to give the promotion of soil conservation and drainage of land a greater importance to the safeguarding of fisheries and wildlife habitats.

The Tribunal now concludes that the disadvantages from the exercise of the right outweigh the advantages and that the appeals be allowed by refusing the rights sought by the applicants.....

....Its ecological loss would be more significant than the benefits from the exercise of rights. The appeal area is not large but would have qualitative loss of substantially greater significance than the quantitative loss ....Further, the grant of rights would cause an irreversible change of character to the land as its ecological value could not be restored....

....The Tribunal considers the decision to be unsatisfactory as the mere refusal of rights is not sufficient to preserve the swamp ecosystem. A comprehensive evaluation of the importance of the various parts of the swamp and the local and national importance of preserving it is required...."

The decision plainly states that the natural ecological/ habitat functions of the wetland have values for their own intrinsic properties, and that these values are greater, in this case, than the economic values of developing them through drainage. Although the Tribunal has set a precedence it does concede that an evaluation problem does persevere in that their decision embodies subjective assessment of the comparative values of the different options namely, to preserve/conserve or to develop. With reference to the last paragraph of the above quotation it can be seen that the decision is reflecting the more general, established need to provide indications of value for many so called "intangible" aspects of resource use and allocation.

As an economist working in the New Zealand agricultural sector the author became very familiar with proposals for the development of natural resources to increase agricultural output. In particular, the exploitation of soil and water resources for irrigation, drainage, water supply and catchment schemes played a large part in the author's normal work-load. These schemes were primarily community schemes involving a social cost-benefit analysis approach to determine the net national worth of the investment. The economic analyses carried out were normally specifically market-based in that the land uses were valued from an agriculturally productive viewpoint.

However, as the environmental "ethic" (or awareness) developed both in the author and the agency which employed him, the Economics Division of the Ministry of Agriculture and Fisheries, the production of externalities from economic actions or changes became an issue which both parties became interested in. Simultaneously the demand for inclusion of environmental, or non-market, values in national decision-making was increasing. It was in this environment that the controversy surrounding the Whangamarino Wetland occurred.

The competing useage of the wetland appealed to the Economics Division as a particularly suitable situation whereby the application of non-market evaluation techniques

could be carried out, thus adding to the range of the Division's analytical "tools". In addition, the study could be designed to assist the Lands and Survey Department (now the Department of Conservation) in the preparation of their management plan for the wetland (Department of Lands and Survey, 1986b).

From this viewpoint the major objectives of the thesis were identified as being to apply and test the suitability of the Contingent Valuation Method (CVM) to the wetland, and to measure all major economic benefits of the wetland as well as elicit information on awareness and attitudes to derive management recommendations.

Associated goals to attaining these objectives include:

(a) Selection and application of a non-market valuation method which would be appropriate for use within the Regional and Resource Section of the Economics Division (the Economics Consultancy Unit). The technique would need to be theoretically sound, practically straightforward and quick, and relatively inexpensive.
(b) Estimation of economic measures of market and non-market benefits associated with alternative uses of the wetland, from the national viewpoint. These economic measures to include both user and non-user values as appropriate.
(c) Elicit information on current public awareness, use and attitudes to wetland management. By incorporating these views together with the empirical analysis it is intended to make recommendations on the various use options and management of the wetland.

As a means to achieving the above aims a significant part of the thesis will be devoted to:

- identification of the wetland resources and presentation of their principal elements and uses.

- describing the conflicts of interest of the alternative uses of the wetland.

1.2 Outline of the Thesis

Chapter Two introduces a range of non-market evaluation techniques and briefly describes their principal elements and applications. The Contingent Valuation Method (CVM) is then described in detail with various sections covering the important properties (strengths and weaknesses) and concepts of the technique, as well as the application of the CVM in evaluating the wetland.

Chapter Three describes the study area, in this case the Whangamarino Wetland, with an emphasis on the natural, physical and environmental uses and properties of the area. Institutional and administrative constraints are also examined, with comment on the management of the wetland concluding the chapter.

Chapter Four presents the evaluation approach methodology used to obtain economic measures of the various uses of the wetland. The uses evaluated include those associated with preservation/conservation, flood control, commercial fishing and agricultural production.

Chapter Five expands on the previous chapter and actually applies the methodology in deriving dollar values for the four principal identified uses. The values resulting are from the national viewpoint, in Net Present Value terms (using a 10% discount rate), and presented in January 1987 dollars.

Chapter Six concludes the study with a discussion on the various value elements of the wetland and presents an overall value to the nation of preservation rather than development. A discussion of the objectives set and how they have been met is presented along with a description of national preferences and attitudes to preserving the wetland. Ideas on wetland management are expounded before concluding with a critique on using the CVM in a New Zealand context.

CHAPTER 2

NON-MARKET EVALUATION

This chapter will briefly describe the various types of non-market evaluation methods currently available with an emphasis on the most widely used techniques. New Zealand economists, planners and other researchers started using some of these techniques only during the past few years with Gluck (1975), a visiting Australian, producing one of the first attempts when evaluating the Rakaia River recreational fishery. Since then other local researchers such as Harris and Meister (1981), Harris (1983), Kerr, Sharp and Gough (1986) and Cairns (1985) have used non-market techniques for valuing, principally, water-based recreational amenities (Kerr, Sharp and Goughs' work centred on the value of the Mount Cook National Park).

The major part of the chapter however will be devoted to a discussion of one particular non-market valuation technique, the Contingent Valuation Method (CVM). This discussion will include an examination of the CVM strengths and weaknesses, examples of its use in recent research and its possible application in valuing the Whangamarino Wetland. Additional aspects touched on include the association between the field of experimental economics and the CVM, as well as the accuracy of the CVM when calibrated against alternative methods of economic measurement.

2.1 DESCRIPTION OF THE TECHNIQUES USED

The efficient allocation of resources requires some indication of value that society places on goods and services. These values can often be found by observing market prices. However, for some types of goods no market exists. Public goods fall into this category often being provided by Government (e.g. defence) or are naturally occurring (e.g. clean water). Public goods have the property of being non-excludable in that it is physically

impossible or prohibitively expensive to exclude consumption by any individual. Environmental amenities are frequently classified as public goods.

In the absence of direct market prices for public goods a number of methods have been developed to obtain benefit (or demand) information. These include surrogate market approaches (Hufschmidt, James, Meister, Bower and Dixon, 1983) such as hedonic pricing and the travel-cost approach. They have a common feature in that the prices of substitute or complementary goods are used to value an unpriced environmental good. Another category of methods is generally known as the survey based techniques. These use surveys (either postal, individual or telephone) and games to help determine people's preferences and thereby place values on environmental/public goods. These approaches include trade-off games, costless choice, priority evaluation, Delphi techniques and Contingent Valuation/ Bidding Games.

Before going on to discuss some of these techniques in more detail it is useful to clarify that all the above value measures attempt to estimate consumer surplus i.e. the total amount willing to be paid for a given quantity of goods, over and above their cost, rather than go without the goods. Figure 2.1 below illustrates the situation where aggregated maximum willingness to pay (WTP) for a public good can be measured from a demand curve. Assuming a zero price, the total consumers surplus equates to the whole area under the demand curve i.e. OAEQ*. This is a measure of the total value of the commodity to society.

Figure 2.1 Demand Curve for a Public Good

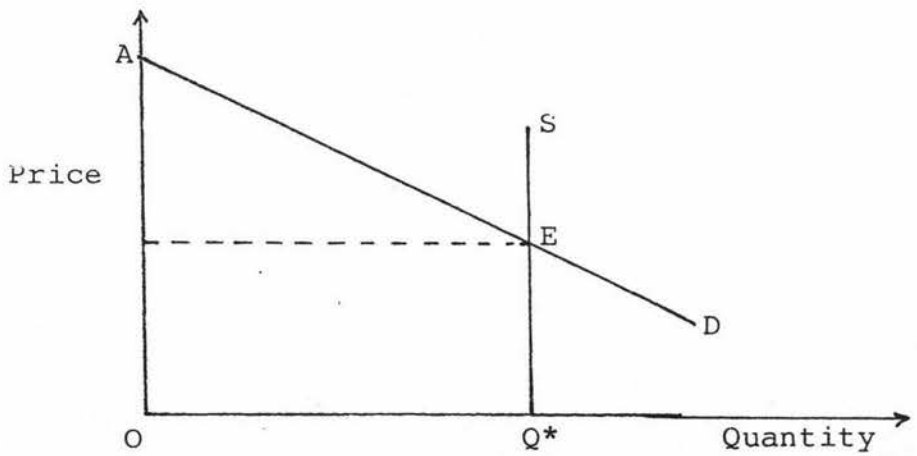
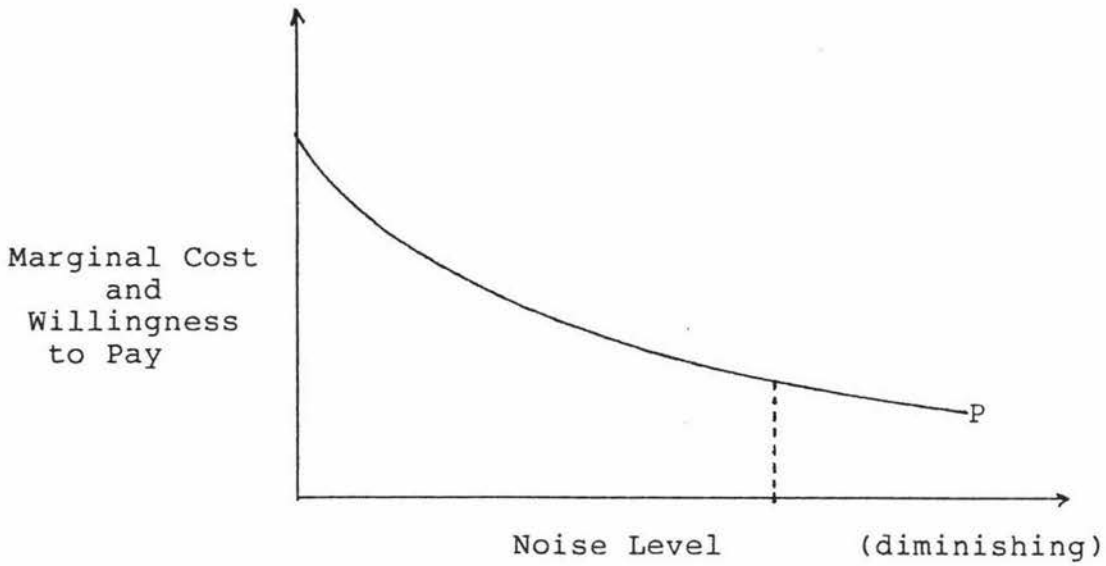


Figure 2.2 Marginal Cost of Noise Level Function



As Harris (1983) explains, the consumer surplus concept employs the Marshallian demand curve theory which may need to be modified if it is suspected that expenditure on the public good is a substantial part of total expenditure. If this is the case then acquisition of the public good will affect consumption of other commodities, will change the consumer's real income, changing the marginal utility of money and thus the position of the demand curve. This situation has led to the establishment of Hicksian measures of consumer surplus; compensating variation/surplus and equivalent variation/ surplus (the distinction between variation and surplus measures are explored more fully in later sections). Essentially, the compensating measures are related to the money transfers needed to keep the individual at the same utility level as in an initial situation, whereas the equivalent measures are related to the monetary equivalent of a change in welfare to a final level of utility.

When it comes to choosing which is the correct measure to use, Kerr (1986a) points out that using the Kaldor-Hicks cost-benefit criterion identifies compensating values as being the correct ones. However, he generally agrees with Rowe, D'Arge and Brookshire (1980) in that several practical studies have shown that the difference between equivalent

and compensated measures are insignificant (within 10% of each other). Hufschmidt et al. considered that in most practical cases the distinction can be ignored and in any case it is virtually impossible to derive either of the Hicksian functions empirically. However, if it is suspected that income elasticity or the size of the consumers surplus is large enough to produce an inaccurate estimate, then being aware of the deviations from Marshallian consumer surplus will allow some indication of the direction of bias i.e. equivalent variation < consumer surplus < compensating variation.

The evaluation techniques will now be discussed beginning with the surrogate market methods:

(a) Hedonic Pricing

This technique recognises that commodities have bundles of characteristics and the demand for the commodities are dependent on these attributes e.g. the price of a house is determined by its attributes. By isolating the particular attribute of interest and then varying it (say by moving further away from or nearer to a noisy highway) while maintaining the other housing attributes, then it is possible to measure the marginal price of noise by determining how the price of houses is affected by noise levels. Given certain assumptions on markets (some would say strict assumptions) then households will locate so that the marginal cost of an improvement in noise levels is equal to the household's willingness to pay for a marginal improvement (see Figure 2.2).

The technique is attractive in that it is fundamentally market based and appropriate for localised valuations. However, it requires good market information on the attribute being valued and a significantly sized market of the 'implicit' good. The data requirements are also very demanding and analysis requires sophisticated statistical modelling.

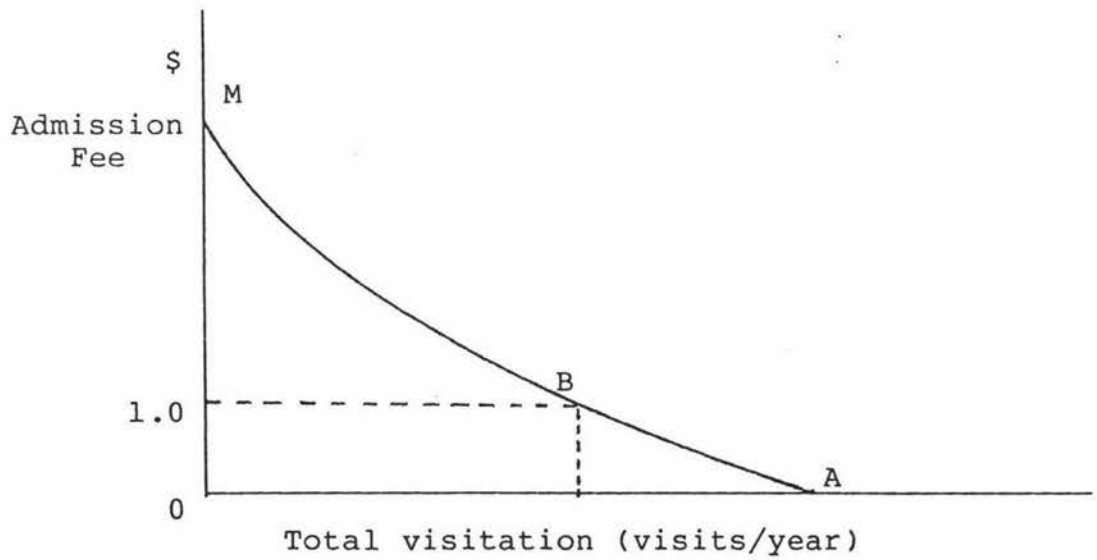
(b) Travel-Cost Method

This technique depends on the identification of a specific

site demand curve. This in turn is dependent on the assumption that use of the site is dependent upon the costs incurred in that use. The further away potential users of the site live, the less is their demand, or expected use, of the good. In regard to consumer surplus, the most distant user with the highest travel cost is assumed to have the lowest consumer's surplus. Ipso facto, those living closer have lower travel costs and larger consumer's surplus.

Using participant surveys, the method discovers how the number of visits vary in response to an increased price for visiting the site. The initial demand curve generated can then be used to estimate actual visitor numbers and how they would change with increases in admission price (Harris and Meister, 1981). Figure 2.3 below illustrates the classical demand curve produced with the area under the curve being an estimate of the total consumer's surplus enjoyed by present users.

Figure 2.3 Example of Demand Curve Derived Using the Travel-Cost Method



As in other valuation methods shortcomings are apparent particularly the underlying assumptions that tastes are similar for all populations, single objective visits to the site apply, and consumers respond to an entry fee in similar fashion to an increase in travel costs. Other factors,

including income, education, age, etc., will obviously influence people's demand for recreation. The travel-cost method is also constricted in that it does not measure any non-user values associated with the amenity.

Survey based techniques will be briefly introduced in the following sections:

(a) Trade-Off Games

These involve the determination of individual preferences from among various outcomes e.g. a certain quantity of money and a certain quantity of an environmental good. The technique essentially varies systematically the money value level until the individual is indifferent between particular combinations of money and environmental good. The value of interest is the trade-off in money that an individual makes for the increase in the quantity of the environmental good. By interviewing an adequately sized, representative population sample, an estimate of aggregate willingness to pay for the increased quantity can be obtained.

(b) Costless Choice

This method uses direct questioning to determine preferences between various quantities of goods. The choice is costless in that the comparison is between alternatives which are desirable and free. To maintain the above analogies, one of the alternatives can be an unpriced, environmental good, while the other can be a physical good. By keeping the quantity of the environmental good constant and varying the other, a type of bidding game is effected. The difference (from the CVM game as will be explained) is that the individual will not have to pay anything to receive the good, nor will he or she lose any presently existing environmental good if the physical good is chosen. In this way nobody loses and thus minimizes some of the biases found in bidding games which combine a desirable with an undesirable outcome.

(c) Delphi Technique

This technique consists of assembling a group of experts and

then asking them independently to place values or prices on one or several goods. The initial outcomes are presented to the group, outlying values are explained/rationalised by the appropriate expert and then the group members independently re-evaluate and make new value judgements. Through successive rounds the hope is to minimise the variance of the outcome. The essence of the method is its neutrality using only indirect communication to avoid personality and group confrontation to influence the decision process. The accuracy of the method depends greatly on the quality of the panel, its ability to reflect society's values and the facilitation of the process.

It becomes quite apparent that the survey based techniques rely heavily on the individual's placement of hypothetical values in hypothetical situations. Not surprisingly then, several problems arise from this synthetic character which have led to criticisms of their use because of various biases. These biases, or the major ones, will be discussed in detail in the following section which cover the principal survey based technique i.e. Contingent Valuation.

2.2 Selection of the Contingent Valuation Method for the Study

2.2.1 A Historical Perspective

Generally speaking the development of the CVM arose from the application of benefit-cost procedures associated with environmental, or public goods. With market prices not available for such goods various techniques were devised for measuring social welfare (benefits) for inclusion in decision-making, and the CVM was one of these. Relatively little attention had been paid to public goods and their relationship to social welfare until 1954 when Samuelson began to explore this relationship (Cummings, Brookshire and Schulze, 1986). His initial findings were essentially pessimistic about the use of surveys to obtain such values despite Ciriacy-Wantrup, in 1952, (Cummings et al., 1986) being a little more optimistic albeit recognising elements

of potential strategic and "academic" difficulties. It would appear that Samuelson's arguments were compelling until the late 1960's-early 1970's when Clawson and Knetch popularised the Travel-Cost Method, circa 1966, and Rosen introduced the Hedonic Pricing Method, circa 1973. At about the same time work carried out by Knetsch and Davis (implementing Ciriacy-Wantrup's survey suggestions), Bohm (testing and rejecting the strategic bias hypothesis) and Randall, Ives and Eastman's (1974) refinements of the survey method, all provided intellectual impetus in promoting the public goods valuation issue, particularly the methodological issues, to its present position.

The structure for surveys set out by Randall et al. would appear to provide the basis of contemporary survey work described as CVM's. In particular, Randall et al. used a questionnaire design which attempted to frame willingness to pay questions in the context of a hypothetical or contingent market. The approach was also novel in that it tried to elicit "behavioural revelations" rather than the traditional attitudinal opinions. Another direction taken by Randall et al. which has heavily influenced following research was their suggestion that the CVM could be applied to the task of valuing a far wider range of environmental goods than those amenable to cross-checks via other methods (e.g. Travel-Cost Method). This concept was quickly adopted by other scholars and the CVM has been applied in innovative and imaginative ways since e.g.:

- Daubert and Young (1981); benefits of instream river flows.
- Harris (1983); valuing water pollution control.
- Bishop, Heberlein, Welsh and Baumgartner (1984); value of recreational hunting.
- Kerr and Sharp (1987); user and non-user values of a river valley.
- Walsh, Gillman and Loomis (1984); recreation use and existence values of wilderness areas.

2.2.2 The Technique, Its Strengths and Weaknesses

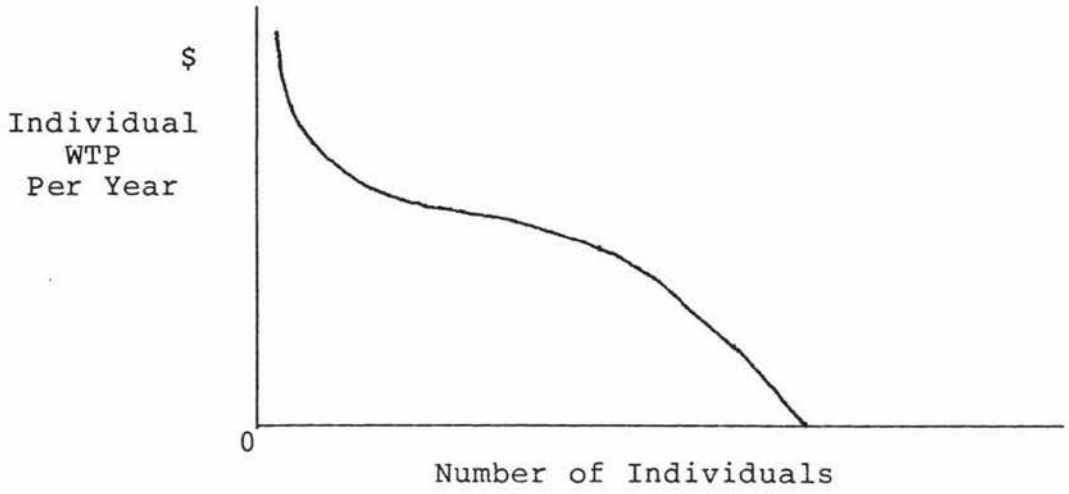
Application of the CVM involves the use of surveys as

a means of deriving estimates of social benefits attributable to a public or other non-market good (Cummings, Cox and Freeman, 1986). Typically applied, the CVM is designed around the notion of a contingent market which represents the hypothetical opportunity for transactions between an environmental good such as a wetland, and WTP (i.e. income). The method assumes that persons respond to the contingent market just as in real market transactions, where the usual conditions in consumer behaviour hold such as utility maximisation subject to an income restraint. The essence of the CVM is succinctly expressed by Randall et al. as follows:

> "Contingent valuation devices involve asking individuals, in survey or experimental settings, to reveal their personal valuations of increments (or decrements) in unpriced goods by using contingent markets. These markets define the good or amenity of interest, the status quo level of provision and the offered increment or decrement therein, the institutional structure under which the good is to be provided, the method of payment, and (implicitly or explicitly) the decision rule which determines whether to implement the offered programme. Contingent markets are highly structured to confront respondents with a well-defined situation and to elicit a circumstantial choice contingent upon the occurrence of the posited situation. Contingent markets elicit contingent choices."

By surveying a sample of the population, the method can produce an aggregate value of their maximum WTP (annually) for the preservation of current amenities, or hypothetical increases in them. The value reported is assumed to correspond to the point of indifference between having that amount of income or the environmental amenity (Walsh, Gillman and Loomis, 1982). As Hufschmidt et al. report, the individual bids can be summed to provide an aggregate bid schedule which is a surrogate for an income-compensated demand curve (see an example in Figure 2.4):

Figure 2.4 Representative Aggregate Bid Schedule



The curve depicted in Figure 2.4 traces out the number of individuals willing to pay a particular amount of money. For this study the household unit is used instead of the individual. The curve is not a proper demand curve but simply an illustration of the bid distribution. By multiplying the number of individuals (households) willing to pay a certain amount by that amount, and then scaling the sum of these upwards, a national evaluation is obtained. This total value is taken to represent the consumer surplus generated by wetland preservation and includes both user and non-user values. When valuing the 'improved' wetland (see Section 4.1(b)) the bid curve is likely to move outwards as the total valuation increases.

Over the past few years many studies have used the CVM both for estimating benefits as well as testing various aspects and characteristics of the method. Naturally, the question of whether consumers reveal their true WTP or not has generated a substantial amount of controversy, with some economists remaining suspicious that mis-stated valuations may be prevalent. However, Randall, Hoehn and Brookshire (1983) make a valid point when commenting:

> "...that the best-known alternative methods are themselves subject to limitations and criticisms ...The

comparison is not between contingent valuation and a perfect alternative. Rather, it is among techniques which are all imperfect, but in different ways."

According to Cummings et al., concerns regarding the validity of the CVM to yield meaningful measures of public-good benefits mainly arise from the two major behavioural assumptions underlying its use i.e.:

- Subjects can (and have incentives to) determine their preference orderings between the public and all other relevant goods and services (Freeman, 1979).

- Subjects will not behave strategically, that is offer WTP, or Willingness-to-Accept Compensation (WTA), values which are intended to bias survey results (Rowe and Chestnut, 1983).

CVM WEAKNESSES

The misgivings about the accuracy of the CVM, arising from these above assumptions, are commonly expressed by way of the following major weaknesses of the method: (It should be noted however that even Freeman, one of the strongest academic critics of CVM, considers the method contains incentives for accurate responses, albeit relatively weak ones).

Strategic Bias: This occurs when individuals attempt to influence the outcomes or results by not responding truthfully. They could do this by overstating true WTP in order to gain a desired change, or they could understate values in order to prevent a change they oppose. Tests for this type of bias can be carried out by examining the distribution of bids and querying the respondents on new bids. Empirical tests for strategic bias have not found it to be a major problem (Hufschmidt et al., 1983), and Schultze, D'Arge and Brookshires' (1981) review of six CVM studies also concluded that "strategic bias in revealing consumer preferences is not likely to be a major problem". The general consensus of the latest thinking on the subject (Cummings, Brookshire and Schultze, 1986) is that strategic

bias is insignificant in purely hypothetical or contingent market settings i.e. the potential for strategic bias is diminished the more hypothetical the setting. It would appear then that trade-offs exist between strategic bias and hypothetical bias. This is discussed below.

Hypothetical Bias: This criticism has been apparent since the inception of the CVM but is unavoidable in a process in which actual market behaviour is not measured. This problem can be exacerbated in instances where subjects are unfamiliar with the public good in question. For these reasons it is important that the respondents are presented with a credible, simulated "market", described in sufficient detail to allow the individual to evaluate the alternatives and provide realistic estimates. Harris (1983) expected that correct design of the questionnaire could minimize the problem. This conclusion is supported by Cummings et al. (1986) in a "at best" situation where strict methodology conditions are met, while the "at worst" situation indicates that research evidence provides equivocal results.

Instrument Bias (or Payment Vehicle Bias): The CVM involves asking respondents their WTP through a specific mode of payment e.g. taxes, electricity bills, entrance fees. If a respondent has a particular dislike, or affinity, for the payment mode provided, a bias in revealed preferences may result. In his recent work Sandrey (1986) concluded that a "very considerable degree of vehicle bias" was introduced into a study comparing travel-cost and direct-questioning methods. From this and other studies, Bennet (1984), Walsh (1986) and Harris (1983), it is plainly important to select a payment vehicle which is acceptable, realistic and neutral. An alternative method in evading instrument bias can also involve the provision of payment mode options from which respondents can choose.

Information Bias: This results from incomplete or misleading statements about the proposed changes or alternatives. This may lead to a discrepancy in the respondents' bids. To counter the problem the respondents

need to be consistently well-informed on the situation they are valuing, and presented with visual aids (maps, photo-graphs) to ensure a consistent interpretation (Bennet 1984; Harris 1983; Randall et al. 1974). Cummings et al. (1986) provide some interesting comment on the subject in that they concede that information bias per se is unlikely, principally because one would expect different descriptions, hence different commodities, to provoke modified bids. Their most telling points however emphasise the need to balance the subject's need for information with his/her capacity to absorb and process the information. Similarly they stress that interpretations of CVM results to environmental changes other than those specifically described in the CVM instrument should be avoided.

Starting Point Bias: This occurs when an iterative bidding game is used to extract WTP. The initial bid presented to the respondents can possibly influence their answers in that the interviewer, or questionnaire, is indicating an acceptable level of bid and the respondents react accordingly. While it appears that many researchers consider the problem is able to be controlled by careful design and testing, it is still a pertinent problem in that some recent work by Boyle, Bishop and Welsh (1985) showed that starting point bias was evident in three CVM studies they were examining. The latest consensus is that although Starting Point Bias can be a problem (Cummings et al., 1986) control is available through proper payment card design.

The above biases cover the major problem areas in CVM but several other factors, or elements, need to be noted and taken into account when using the CVM. Briefly they include:

Protest Bidding: The analyst needs to discover the reasons behind zero bids and remove those from respondents who are objecting to the hypothetical market or payment vehicle rather than genuinely valuing the amenity at zero.

Interviewer Bias: In the iterative bidding game approach the interviewer should not influence the level of bid by

indicating "acceptable" bids, for example. Such bias can be overcome or minimised by careful training of interviewers and of course, avoided by using a postal survey.

Incremental Values: If valuing several alternatives in one particular CVM vehicle then the order of presentation may influence the level of response. This can be tested for by changing the order of presentation and examining the statistical differences.

Non-Response Bias: Edwards and Anderson (1987) highlight the problems caused by this survey bias. If systematic differences between respondents and non-respondents exist then inferences based on responses can be invalidated. They remark that social psychology and marketing research reveals that non-respondents often differ significantly from respondents on age, educational level, socioeconomic status and interest and participation in the subject of the survey.

Ideally (funds and time permitting) it could be possible to eliminate non-respondents through an extensive series of follow-ups. It would appear that although the potential for non-response bias in the CVM is recognized (Schulze et al., 1981), most studies that estimate aggregate values seem to ignore its potential and tacitly assume that there are no important differences between respondents and non-respondents. Edwards and Anderson note that bias for a population parameter is directly related to the percentage of non-respondents and to the difference between the parameter value for respondents and non-respondents. In this context it is possible to increase bias when attempting to reduce the proportion of non-respondents. However, Edwards and Anderson go on to conclude that this inverse relationship is unlikely in state-of-the-art surveys which achieve high response rates.

Some of the more practical problems associated with the CVM include being labour intensive, especially if interviewing is involved, time-consuming in that describing and rationalising the method to respondents is necessary, and,

following from these two aspects, expensive to carry out on any sort of large scale. These issues played a significant part in adopting a mail survey approach for this study, along with using open-ended questioning to minimise interviewer and starting-point bias.

CVM STRENGTHS

The CVM has been principally used in the United States of America particularly since 1979 when the United States Resource Council authorised the use of the CVM, and established procedures for its application to outdoor recreation problems. In adopting the CVM as a valid evaluation technique the Council recognised that it has several advantages over other non-market methods including:

- the method is virtually independent from secondary data which allows it to be applied to a wide range of public and open-access "goods".
- evidence exists which shows that the CVM is capable of generating values which compare well with analogous values obtained from alternative market-based methods (Cummings, Cox and Freeman, 1986; Schulze, D'Arge and Brookshire, 1981). Randall et al. (1983) found that CVM results were not only systematic but were consistent with actual behaviour and produced value information which performed well under test.
- the CVM currently provides the only flexible technique for estimating the value of environmental resources to both users and non-users. These non-use benefits are commonly referred to as preservation values and include the following categories:

  Option Value: This is normally defined as an annual payment (a kind of insurance premium) which retains the option of possible future recreation use, in addition to any expected consumer surplus.

  Existence Value: This is the WTP for the knowledge that a natural environment is protected even though no recreation use is actually contemplated.

Bequest Value: Commonly described as the WTP for the satisfaction derived from endowing future generations with a particular amenity.

Problems do remain regarding the theoretical measurement of these non-use values although it is becoming accepted that the value levels can be substantial and should be included in resource management decisions. For example, Walsh et al. (1982) applied procedures for assessing preservation values in his study of Colorado wilderness protection and showed that the values could be successfully tested and confirmed.

- In response to the biases mentioned above in the "weaknesses" section it should be stated that recent research work (Bishop and Heberlein in Kerr and Sharp, 1987; Cummings et al., 1986; Schulze et al., 1981) have generally failed to establish strong evidence that these biases are significant, particularly strategic bias. Where well-designed sampling, survey and questionnaire techniques are used it is apparent that the CVM can produce useable values which are accurate, in the terms of magnitude sense, and unbiased enough to be used for decision-making purposes.

2.2.3 The Concepts of Willingness to Pay and Willingness to Accept (Compensation)

These concepts were introduced earlier in the study (see Section 2.2.2), however given the apparent increasing disparity between willingness to pay (WTP) methods and those measured by willingness to accept compensation (WTA) queries, it is valuable to examine their derivation and theoretically correct application. The concepts both relate to asking consumers appropriate questions to derive the values they place on supporting a given economic change (or proposal) or opposing a given economic change.

When assessing a change in economic welfare it is, or was, generally accepted that WTP or WTA methods acted equally as well so long as income and wealth effects were small. The maximum sum an individual would be willing to pay for

an improvement was accepted as an appropriate measure of a gain, while the minimum compensation demanded to accept it was the proper measure of a loss. However, given the assumed equivalence between the two measures it has become customary to use WTP estimates to assess both gains and losses. This practice appears to have been justified on the pragmatic grounds that WTP measures are "easier" (Knetsch, 1985) and that they correspond more closely to people's market exchanges and are consequently more familiar.

In recent years however, various researchers including Knetsch (1985), Gregory (1986), Gluck (1975) and numerous authors in the text edited by Cummings, Brookshire and Schulze (1986) have reported substantial differences in people's responses to payment and compensation in the context of economic losses. As Knetsch affirms, "The empirical evidence supports neither the assumption nor the practice." Instead, the results from numerous tests using varied survey and real exchange experimental techniques to value a wide array of both public and private goods, show that the minimum payments people require to give up assets or entitlements can commonly exceed the maximum amounts they would pay to retain the same rights. These disparities can be substantial with Gregory mentioning instances where WTA exceeds WTP by 5-17 times while Knetsch states magnitudes of 3-15 times. These differences appear to exceed any argument that income or wealth effects could have any important influence.

Table 2.1 below has been compiled to illustrate the disparities:

Table 2.1 Measures of WTP and WTA

Study	WTP	WTA	$\frac{WTA}{WTP}$
	($)	($)	
Hammack and Brown (1974) (Wildfowl and Wetlands)	247.00	1044.00	4.2
Sinclair (1976) (Fishery Resource)	35.00	100.00	2.9
Rowe, D'Arge and Brookshire (1980) (Visibility)	4.75	24.47	5.2
	6.54	71.44	10.9
	3.53	46.63	13.2
	6.85	113.68	16.6
Bishop and Heberlein (1979) (-)	21.00	101.00	4.8
Brookshire, Randall and Stoll (1980)	43.64	68.52	1.6
(Elk Hunting)	54.07	142.60	2.6
	32.00	207.07	6.5
Knetsch and Sinden (1984) (-)	1.28	5.18	4.0
Gluck (1975) (Fisheries Resource)	68.11	608.67	8.9

The observed differences in evaluations due to the measurement basis have some obvious implications. One of these is that assessment of welfare losses can be systematically understated if the normal, WTP measure is used inappropriately. Proposals or changes having net negative consequences will therefore be unduly encouraged. Similarly damages may be underassessed, compensation awards may be too small, and regulations and legal rules may often provide inappropriate incentives.

Despite this evidence of disparity most economists have retained their faith in the equivalence of "properly measured" payment and compensation prices (Gregory, 1986). They typically accord the disparity to income effects or persistent response bias, or simply claim the results are

irrelevant. However, it appears that the empirical evidence being produced lately, and much of it aggregated for discussion and criticism in Cummings, Brookshire and Schulz (1986), is beginning to modify the accepted view that WTP should be used ad infinitum and without due qualification. Some recent papers by Knetsch, Gregory and also the text of Cummings, Brookshire and Stoll, where Kahneman (Pages 186-190) explains his "prospect theory", really highlight the problems and biases caused by the disparity and try to explain the differences by way of "loss aversion", "buying and selling discrepancy" and "reluctance to trade".

Gregory, in particular, has identified some of the conventional interpretations of the disparity in the following manner:

(a) Consumer's surplus is a normative construct, subject only to internal tests of consistency. Devotees of this argument consider that survey results which violate the theoretically derived limits between WTP and WTA measures can only provide evidence of measurement error. However, the relevance of any theory depends on its predictive ability and the appeal of its assumptions. In this sense Gregory joins Kahneman and Knetsch in questioning the traditional utility and welfare theories behind the Hicksian consumer's surplus framework. In their view exploration of modifications in the theory would enable it to more closely predict observed behaviour.

(b) Measurement errors are endemic to contingent valuation and other survey procedures, so empirical results demonstrating a disparity are invalid. It is certainly no secret that systematic distortions can threaten the design and interpretation of the CVM. These include strategic, information, instrument, anchoring and hypothetical biases. However, evidence regarding the actual occurrence and impact of these potential biases is mixed, with properly designed surveys minimizing if not eliminating them. Gregory also adds an alternative view to the skepticism regarding the reality of the difference between WTA and WTP, by suggesting

that the responses will vary because they call into play psychologically different mechanisms for evaluating the worth of the good.

(c) The elegance and scope of the conventional theory make it superior to alternative models of welfare change. It would appear that some doubts are persisting regarding the assumptions and relevance of this theoretical base. There are questions regarding the shape of the indifference curve at the reference level of the commodity, whereby if it is kinked at the present endowment then a close relation would no longer be expected between WTP and WTA. Similarly, if WTP and WTA measures are not symmetric with respect to the implied rights of individuals, a difference in responses is not illogical.

(d) Contingent approaches used in valuing non-market environmental goods are sufficiently unlike market exchanges that results are not comparable. In short they often propose non-marginal changes, involve non-routine or ethically sensitive options and generally require an individual to make a choice relatively quickly without learning or consultation. In reply Gregory argues that:

- access to data from market exchange processes does not necessarily guarantee a clear depiction of the value of a good or service (e.g. the parameter errors of demand equations).
- the relevance of the traditional market model itself is suspect, in that many environmental amenities are purchased as public goods in a "referendum-like" content.
- in studies that have evaluated environmental goods more like ordinary private commodities (e.g. hunting permits) significant differences in WTP and WTA have been obtained.
- experiments (carried out by Gregory) found consistent WTA levels greater than WTP for a diverse set of commodities including environmental and material goods. Substantial differences in WTP and WTA were also found

using alternative payment vehicles and different question phrasing. The results demonstrated that responses to hypothetical and actual questions were very similar. The disparity persisted even when the participants had more time and information to formulate their responses.

In short, it does not make good sense, or science, to reject contingent survey results out of hand. Evenmore, it is apparent that differences in assessed levels of WTP and WTA for similar "goods" cannot be easily dismissed with traditional arguments. The latest literature does indeed promote two types of characteristic choice behaviour which could explain the large disparities between the two measures. The first is that people evaluate changes primarily in terms of gains and losses from some neutral reference point rather than as comparisons between final states, as is usually assumed. The second, is that losses from this reference point often appear to be more important than commensurate positive changes. These concepts have their basis in the theory of consumer surplus and the various associated Hicksian forms. Consequently, the models developed by Randall and Stoll (1980) are examined below to clarify the basis and correct approach required. In their publications Kerr (1986), Sinden (1978) and Gluck (1975) adopt similar theoretical bases although using different terminology.

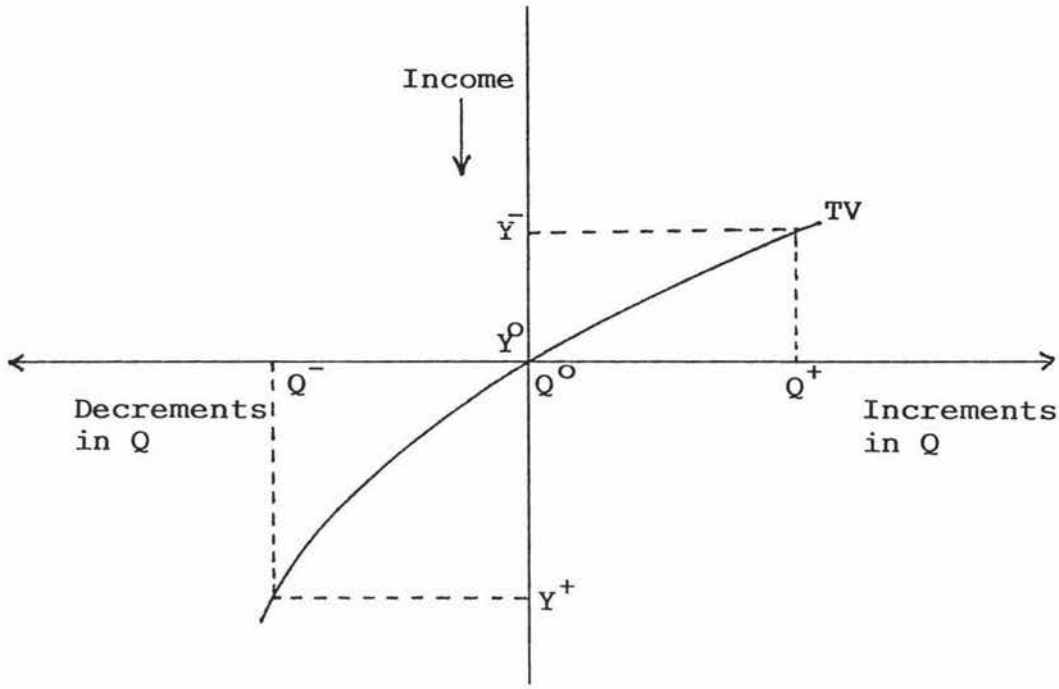
Firstly we focus on an individual and the effect on his welfare of a proposed change in the level of a service or commodity. Consider the individual who enjoys a specified level, Q, of this service. Additionally, he enjoys a given quantity of the Hicksian "all other goods" numeraire, Y, which we shall call income. His level of utility thus depends on his income and quantity of service upon which we focus.

$$\text{i.e. } U = U(Q,Y)$$

The individual is thus at the origin in Figure 2.5 below, which can be defined as his welfare level in the "without

project". It is interesting to note the beginning of similarities in approach between Figure 2.5 and the "neutral reference point" mentioned in paragraph 4 on Page 46.

Figure 2.5 The Total Value Curve for Increments and Decrements in Provision of a Service (Q)



The total value curve (TV), or bid curve, is of positive slope given that the service is a commodity and the individual is not satiated in the considered range. The TV curve is an indifference curve passing through the individual's initial state

$$\text{i.e. } U(Q,Y) = U(Q^-, Y^+) = U(Q^+,Y^-)$$

We can see that $Y^\circ - Y^-$ is the WTP to obtain an increase in the level of the service from Q° to Q^+.

Similarly, $Y^+ - Y^\circ$ is the WTA, or amount of money, to induce the individual to accept voluntarily a decrease in the level of service from Q° to Q^-.

In other terms:

WTP is the total value of an increment from Q° to Q^+.
WTA is the total value of a decrement from Q° to Q^-.

In a traditional market environment, and if Q^+-Q° and $Q^\circ-Q^-$ were one unit changes, then WTP is equal to the buyer's best offer and WTA is equal to the seller's reservation price.

Hicksian Measures of Consumer Surplus

Hicks identified four measures of consumer's surplus. These are, with definitions:

(i) Equivalent Surplus: The amount of compensation, paid or received, which would bring the consumer to his subsequent welfare level if the change did not take place. No adjustments in the consumption set is permitted.

(ii) Equivalent Variation: Similar to (i) except that adjustments in the consumption set are allowed.

(iii) Compensating Surplus: The amount of compensation, paid or received, which would keep the consumer at his initial welfare level if the change did take place. No adjustments in the consumption set is permitted.

(iv) Compensating Variation: Similar to (iii) except that adjustments in the consumption set are allowed.

The important points to remember when considering what is the theoretically correct measure lie in deducing if:

(a) Adjustment in the consumption set is possible. The nature of the good will determine this aspect.
e.g. indivisible, lumpy goods such as air quality, hydro-lakes etc., will allow no intermediate adjustments in commodity holdings therefore the Hicksian surpluses are pertinent.

and if

(b) The reference level of welfare is the initial level or the subsequent level.
i.e. if initial level then it's a compensating value, and if subsequent level then an equivalent value.

The compensating measure, by using the initial welfare level as the reference level, measures the welfare impact of change as if the individual had a right to his initial level of welfare (i.e. as if he had the choice of keeping what he has or voluntarily trading for changes).

The equivalent measure, by using the subsequent level of welfare as the reference level, treats the individual as if he had only a right to his subsequent welfare level (i.e. as if he must accept his subsequent situation, or seek to trade his way back to his initial situation).

We now have the ability to decide which measurement value is appropriate given the type of change and the population we would be asking. However, we must decide which one of the four is the correct measure for decision-making in a cost-benefit framework. The Kaldor-Hicks criterion (of Pareto-improvement) which indicates that for a change to be worth-while, it should be possible to transfer income so that no-one is made worse off after a change, and some one is made better off, is consistent with the Hicksian compensating measures. That is, for losers to be no worse off they must remain on their original utility curves.

To clarify these relationships, take for example a proposal which would divert a wildlife habitat (e.g. a wetland!) to some alternative use, effectively destroying its usefulness as a habitat. The benefit-cost analyst needs to know the value of the losses which would be suffered by an individual enjoying the wildlife amenities provided. The model introduced in Figure 2.5 will be the analysis framework.

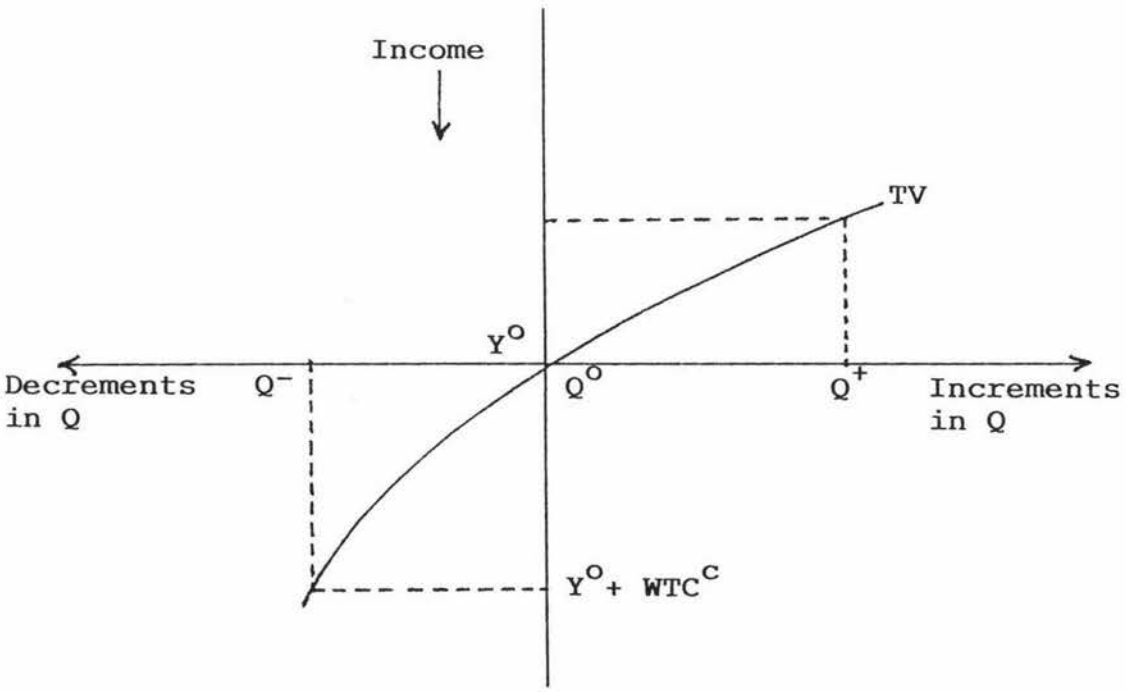
Starting conditions and assumptions include:

(a) the individual gains no benefit from the project.
(b) in the "without project" situation the individual has the utility level U (Q°,Y°).
(c) given a specified level of Q, optimising adjustments in Q are impossible. The value measured will therefore be a "surplus" one.

We now proceed to determine the welfare impact of the proposed change using the various Hicksian measures:

First Situation: We will determine his WTA the proposed change given that his reference level of welfare (or his presumed right) is Q°,Y°. By our definitions above, the measure will thus be a compensating value. Q°,Y° is also the initial welfare level, while Q^{-} indicates the level of amenity the individual would enjoy after he has accepted the compensation. If he is compensated with an amount exactly equal to his WTA, his after compensation income would equal $Y^{\circ} + WTA^{C}$ (the superscript c denotes a compensating measure). As Gluck would describe it, the WTA^{C} is the willingness of the individual to sell his hypothetical right to enjoy the habitat (see Figure 2.6 below):

Figure 2.6 Willingness to Accept Compensation Derivation

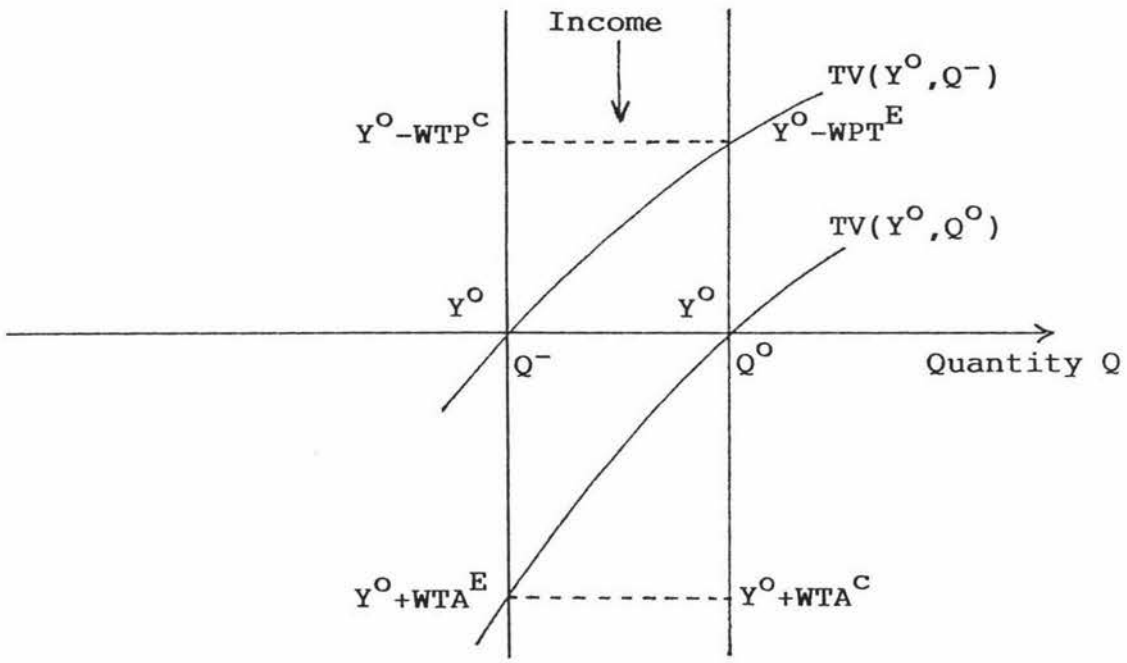


Second Situation: We will use the individual's willingness to pay to avoid a loss, or reduction, in the wildlife amenity. His WTP to avoid a less preferred situation assumes that the individual must accept the less preferred situation or pay to avoid it. Thus the reference level of

welfare is the proposed, or subsequent, welfare level. In this sense we are saying the individual does not have the right to his initial level ($Y^{\circ}Q^{\circ}$) and must buy, or trade, his way back to it (or as Gluck would say, his willingness to buy the right to enjoy the amenity). So, this second measure will be an equivalent value depicted WTP^{E}, with the "E" indicating that the it is an equivalent measure where the presumed right is the subsequent level of welfare, Q^{-},Y°.

Figure 2.7 shows how another TV curve is necessary to find the WTP^{E}.

Figure 2.7 Willingness to Pay Derivation



To illustrate how the other Hicksian measures fit into the model we can consider a different project, that is one where it is proposed to increase the level of habitat amenities, from Q^{-} to Q°. Therefore, following our previous format;

Third Situation: The individual has a presumed right to his initial situation, $Y^{\circ}Q^{-}$, and is willing to pay for increments in his amenity services up to level Q°. The measure will therefore be a compensating surplus, i.e. WTP^{C}. The WTP^{C} is the amount of money he will pay to purchase the right to the extra amenity.

Fourth Situation: The individual's willingness to accept compensation in lieu of a promised increment in amenity from Q^- to Q° can also be illustrated as WTA^E. Here, the presumed right is to the subsequent welfare level and the measure is therefore an equivalent one. WTA^E is the amount of money he will sell his presumed right for.

The situations depicted in Figure 2.7 are relevant when comparing two alternative levels of provision of a good. Randall and Stoll provide a concise description of the measures which assist in understanding what is happening i.e.

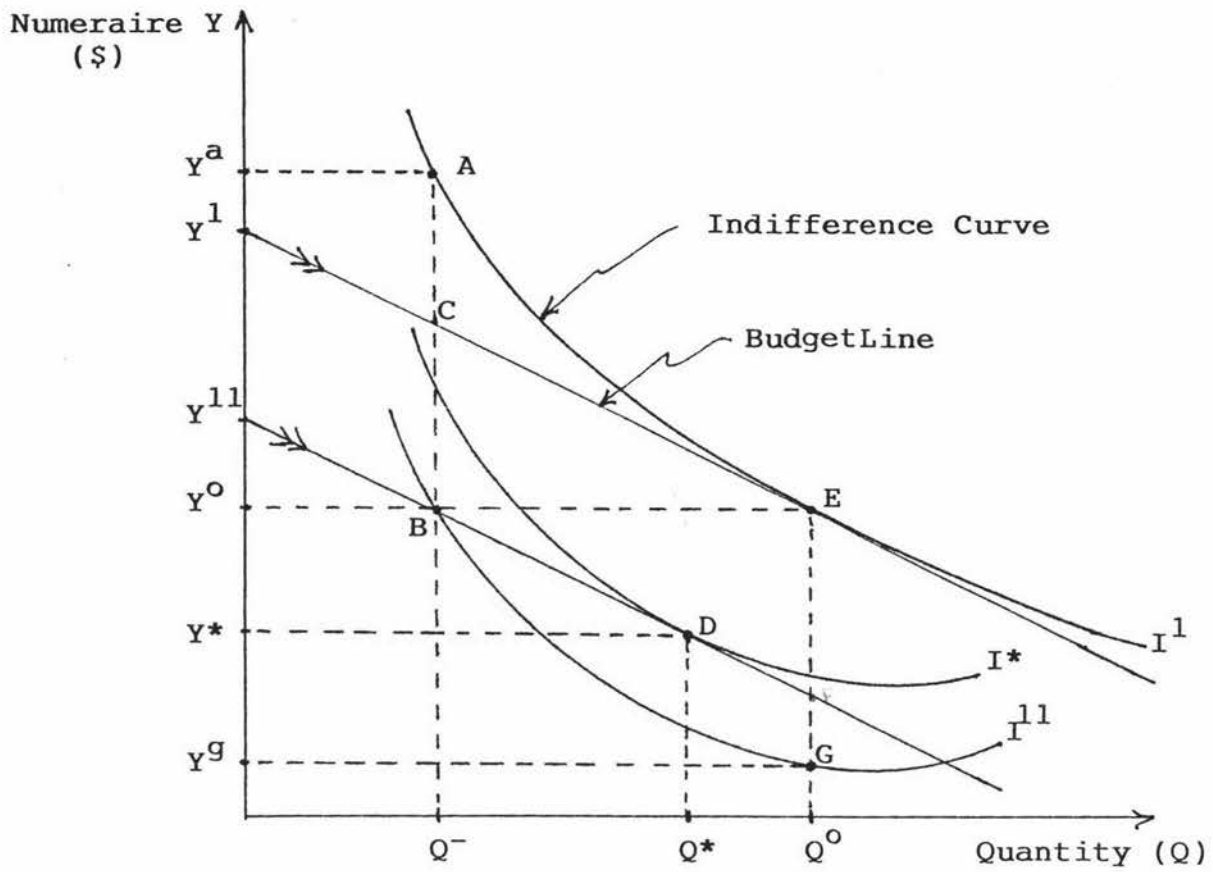
WTP^C = obtains the preferred level
WTP^E = avoids the less preferred level

WTA^C = amount to accept the less preferred level
WTA^E = amount to forgo the preferred level

Figure 2.7 suggests that in comparing a pair of alternative levels of a service then $WTP^C = WTP^E$ and $WTA^C = WTA^E$. Most authors would agree that a general rule of $WTP \leq M \leq WTA$ also stands, where M is the Marshallian Consumer Surplus, and that WTP=WTA only in very restrictive circumstances where quantities of perfectly divisible goods are traded in infinitely large, frictionless markets e.g. currency (possibly).

So far we have illustrated the situation depicting only the surplus measurements, and it would be helpful to examine briefly the Hicksian variation concept where consumption adjustment is allowed after the proposed change. This would be appropriate for example, if an entrance fee to a forest park was being considered whereby consumers could adjust their visitation rate at the new price. In this case the increased price simulates a loss in ability to purchase the good. Diagramatically the situation is shown below in Figure 2.8:

Figure 2.8 Derivation of Value Measures with Consumption Adjustment



Firstly consider a proposed programme which would reduce the service flow, or amenity, from Q° to Q^- while leaving the individual's Y at the same level, Y°.

The proposal would move the individual from E to B, lowering his welfare level to I" (from I'). However, he will be able to trade along his new budget line until he reaches D and achieves welfare level I^* and holds Q^* of the amenity. Given this ability to adjust the consumption set then:

WTP^E (equivalent variation) = EF (i.e. to avoid the less preferred level)

WTA^C (compensating variation) = BC (i.e. amount to accept the less preferred level)

and $WTP^E = WTA^C$=Y'Y" in this restrictive case of frictionless markets, divisible goods and very large

markets.

Now consider a good, such as a wildlife habitat, which can only be held in the amounts Q° or Q^{-} i.e. an indivisible or lumpy good. The surplus measures are now the pertinent ones and the budget lines are meaningless.

WTP^{E} (equivalent surplus) = EG (or $Y^{\circ}Y^{g}$)

WTA^{C} (compensating surplus) = AB (or $Y^{\circ}Y^{a}$)

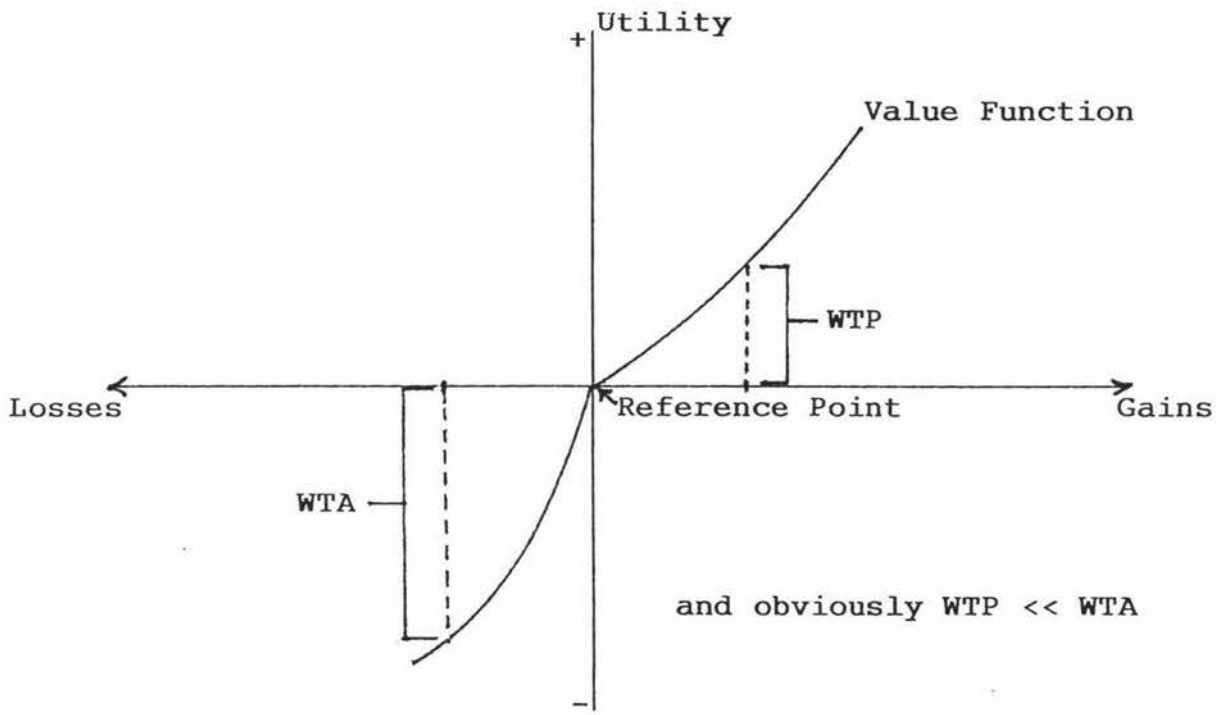
Note that the WTA^{C} is larger in absolute terms than the WTP^{E}, particularly as the convexity of the indifference curves increase. Also, the surplus terms are larger than the variation values. As Sinden (1978) notes, more convex curves may well be associated with the goods and services of unique natural resources. The implication is that individuals may be willing to sacrifice large amounts of money for the first unit or to require greater and greater amounts (compensation) for the withdrawal of more and more units of these resources. However, goods with ready substitutes may have less convex curves because the first extra unit and the last in withdrawal are more replaceable. Following this argument it is important to realize the possibility of increasing differences between WTP and WTA as the uniqueness of the resource increases.

Aligned with this type of argument is Kahneman's (Cummings, Brookshire and Schulze, 1986) "prospect theory" wherein he provides a descriptive framework for analysing preferences. A significant feature of the theory is that in its evaluation function, outcomes are expressed not in terms of final asset positions (as in utility theory) but in terms of the gains or losses that they represent from some neutral reference position. Already we can see the similarities to Randall et al.'s model already presented.

Moreover the prospect theory assumes the value function is steeper for losses than for gains, so that an unpleasant change in status will have a more extreme response than an "objectively" equivalent desirable change. As a result, the

theory predicts that WTA will be greater than WTP, where WTA deals with a potential loss while the latter deals with a gain. A common example is "...the aggrevation that one experiences in losing a sum of money appears to be greater than the pleasure associated with gaining the same amount". This argument strongly suggests that there is a "kink" in the value function at the reference point as shown below in Figure 2.9:

Figure 2.9 Illustration of Kahneman's "Prospect Theory"



Given all that has been stated regarding the correct measures of consumer surplus and the disparity between WTP and WTA values, it remains that the compensating measures are the ones which satisfy the Pareto-optimal criteria i.e. either WTA^C or WTP^C. The weight of opinion, particularly those expressed in Cummings et al., favour the use of WTP measurements despite a growing realisation that WTA measurements can be the theoretically correct method and that consistent and large differences between WTP and WTA are being generated. However, as Kerr (1986) points out, in practice it may not be possible to find the theoretically correct measure (i.e. compensating) and either consumer

surplus or equivalent measures are used. The theoretical framework presented above can show that in some cases the differences between the measures are insignificant allowing them to be used interchangeably. However, the analyst should be aware of what type of value he is measuring and if this is the theoretically correct one, and be able to explain and qualify his results if there are implications of under- or over-assessment. Until research and experimental studies can integrate the WTP and WTA disparities, that is the large differences not explained by income and wealth factors, with conventional welfare theory it appears that WTA measures will be met with more than a little skepticism and that WTP measures will predominate.

2.2.4 Validation and Accuracy of Contingent Valuation

The accuracy of the CVM is a recurring theme in published research papers, conferences and textbooks. The objective is to somehow capture a "true" evaluation of preferences by simulating a market framework. In this market context it is hoped that the individual will introspectively balance the utilities foregone as a result of paying for the good, with the utilities gained from acquiring it. Therefore we have the extensive arguments for designing and using the CVM in situations of subject familiarity and the credibility of payment and payment modes. It should be noted though that assessing whether the CVM values are accurate requires some sort of true standard to measure against. It is apparent that apart from limited results from laboratory and field experiments involving private goods, these measures are not available (Cummings, Brookshire and Schulze, 1986).

V. Kerry Smith (in Cummings et al., 1986) does make the point that much of economists' "hard" data may be subject to the same type of criticism, as do estimates from indirect market methods. In this context it would appear that the general view concedes that the CVM may yield value estimates that are as accurate as those derived from indirect market methods. Similarly, the concensus of opinion appears to be comfortable with the suggestion that the method produces order of magnitude estimates. However, Cummings et al.

(1986) are prepared to argue that error ranges are much smaller and suggest that in most instances CVM values are within ±50% of values derived from alternative methods for estimating preference revealed values. It should be noted that much of this opinion is subject to the CVM satisfying particular criteria in its design, application and analysis. These criteria have been termed Reference Operating Conditions, or ROC's, and are outlined below as they represent the approach that evolved during this study as well as being useful (if not mandatory) for future CVM studies.

Table 2.2 Reference Operating Conditions

1. Subject(s) must understand, be familiar with, the commodity valued.
2. Subject(s) must have had (or be allowed to obtain) prior valuation and choice experience with respect to consumption of the commodity.
3. There must be little uncertainty.
4. WTP, not WTA, measures are elicited.
5. Payment vehicles must be well-defined and credible.
6. Application must involve:
   (a) No basis for starting points or anchoring.
   (b) "Appropriate" information concerning the commodity and the valuation process.
   (c) Initial, non-iterated valuations.
7. Subjects to be given as simple a choice as possible.
8. Outliers should not unduly influence the result.
9. Subjects allowed to abstain from the valuation process.
10. Subjects must view questions as being sufficiently hypothetical so as not to provide incentives for strategic behaviour.
11. "Close" correspondence between attitudes and behaviour is required.

2.2.5 Contingent Valuation Application in the Wetland

When deciding on the appropriate value to use in the study, the early literature and case studies examined strongly

advocated the WTP approach. The WTA measurement was not ignored in these publications but was usually accompanied by many qualifications and doubts about the validity of the values being found. It was in this context that a WTP approach was adopted. With the benefit of better knowledge (principally through the opportunity to study later reference material) this researcher would probably adopt both types of approach (WTP and WTA) in a split-sample study. However, it is opportune to present now the type of measurement derived in this study, and the theoretically correct value, if this is found to be any different.

As Walsh (1986) maintains, the appropriate question regarding reduced recreation opportunities and resources depends on property rights and the resource decision to be made. The original wetland can be viewed as an amenity comprising both publicly owned (Crown) and privately owned land. The increase in agricultural areas traditionally involved the drainage and establishment of pasture on wetland areas. This diminished both the quantity and quality of the remaining wetland. The right, or legal liability as Gluck (1975) would express it, to drain and develop their own land has been vested with the agriculturalists even though such development has created cost externalities in reducing the amenity value of the resource. The tenure of the wetland remains, today, a mix of private and public land. However, the recent decision of the Planning Tribunal to disallow private wetland development which impinges on and diminishes the recreational and environmental values of the total wetland area (principally Crown land), effectively removes, or transfers, the agriculturalists' property rights (to drain) from the farmers to the public.

In this context if the farmers persist in draining and developing their properties then they have to "purchase" the legal right to do so from the public. Any value question to the public, given such a proposal, should therefore be one examining what they would be willing to "sell" this right for, in other words a <u>WTA</u> measure. The WTA would be

a compensating surplus measure since consumption-set adjustment would be unlikely, and the measure uses the initial welfare level as the reference level. The values would represent the public's willingness to accept a less preferred level of amenity.

If the property rights of drainage, and by implication the right to produce externalities, remained with the farmers then in order to determine the wetland's value a WTP question would be required of the public. This would be an equivalent surplus measure with the reference welfare level being the subsequent one. The responses would represent the public's willingness to purchase the rights to development and hence avoid a less preferred level of welfare.

However, the theoretical argument doesn't end here as the Crown (via the Department of Conservation) deem it necessary to hold all the rights to certain private properties within the wetland to not only maintain and preserve the existing amenity values but to expand and improve them. To do so they have to purchase the rights and by our definitions this also requires a WTP measure of the public's preferences. The measure would be a compensated surplus and would represent the amount generated to purchase a preferred level of welfare. The reference welfare level is the initial level.

Thus, it would appear that given certain assumptions on who holds the property rights, and what the proposal/proposed change is, then the theoretically correct measures can be quite different; see Table 2.3 below:

Table 2.3 Value Measures Under Different Conditions

Holder of Property Rights To:		Proposed Loss/Reduction in Wetland	
Drainage	All Others	Measure for Preservation Value	Measure for Improvement Value
(a) Public	Private	WTA^{CS}	WTP^{CS}
(b) Private	Private	WTP^{ES}	WTP^{CS}

In Table 2.3 above the measures in (a) represent the actual legal situation at present, although the judicial transfer of drainage rights from the farmer to the public has not been widely tested other than by the two property owners holding critical (in respect of amenity values) areas of the wetland. Given this, the WTA^{CS} and WTP^{CS} are the theoretically correct approaches.

The questionnaire used in the CVM survey deliberately describes the situation of potential wetland loss with no mention of property rights. It was expected that respondents would allocate property rights according to their own knowledge, values and judgement, although this researcher considered that most people would allocate rights to drain one's own farmland to the owner of that land. Under these conditions, (b) the preservation value measure is a WTP equivalent surplus one, where we are deriving offers of amounts to avoid a less preferred welfare level.

The WTP question for valuing an improved wetland must be considered as an extra benefit measure than that of the amount offered to preserve the wetland. The measure is a compensating surplus one where the amounts are offered to obtain a preferred level of welfare. The sequence of the questions in the questionnaire (WTP for preservation comes first) reinforces the respondent's perception of his

reference welfare level as being his initial one. That is, the respondent has already "paid" for preservation of the wetland (now his initial level) and is then queried about his WTP extra to obtain extra "benefits". In this context the study measures the values shown in (b) and hence will theoretically undervalue the preservation value of the wetland through not using a WTA^{CS} measure. The survey value of an improved wetland (WTP^{CS}) will however, coincide with the theoretically correct measure.

CHAPTER 3

DESCRIPTION OF THE STUDY AREA

3.1 LOCATION, TENURE AND ZONING

Before taking the non-market valuation approach any further, it is pertinent at this point to describe the wetland in more detail. The reader can then appreciate a more complete 'picture' of the wetland's uses, values and both physical and administrative constraints.

3.1.1 Location

The Whangamarino Wetland lies some 65 kilometres south of Central Auckland and a similar distance north of Hamilton (see Figure 1.1). It occupies some 10,320 ha of the lower section of the Whangamarino River catchment which drains an area of around 500 km^2. The catchment includes hill country to the east and north, and marshy country on the east side of the Waikato River from Ohinewai to Mercer. The Wetland is very low-lying with the highest point being only seven metres above sea level (asl), or 3.3 m above the Whangamarino outlet to the Waikato River (Waikato Valley Authority, 1981). Most of the undeveloped wetland, about 7,000 ha, lies in the Waikato County with the balance in Franklin County.

3.1.2 Tenure

Of the original 10,320 ha wetland, which was all formerly Crown land, only 4,960 ha remain under the Crown. About 320 ha of this is above the wetland margin and can be considered dry land. The remaining 5,680 ha is in private ownership, with the Auckland Acclimatisation Society having purchased 730 ha over the years of 1964, 1975 and 1976.

The Crown land was administered by the Land Settlement Board which was serviced by the Department of Lands and Survey until 1987, with the Department of Conservation now taking this role. Some 720 ha of the Crown wetland is held under 19 leases/licences, for grazing purposes, by private

Figure 3.1 DIVISION OF THE WETLAND BY TENURE

Source: Lands and Survey, 1986

landowners. Table 3.1 below clarifies this situation while Figure 3.1 illustrates the division of the wetland by tenure.

TABLE 3.1: WETLAND AREAS OF DIFFERENT LAND TENURE

Crown Land			
4960 ha less 320 ha above wetland margin =		4640 ha	(45.0%)
Private Land			
Stopbanked and developed:	2,620 ha		(25.3%)
Not stopbanked but developed:	730 ha		(7.1%)
Not developed:	1,600 ha		(15.5%)
Held for conservation (AAS):	730 ha		(7.1%)
	5,680 ha =	5,680 ha	
	Total =	10,320 ha	(100.0%)
General Usage			
Conservation (Crown + AAS) =		5,370 ha	(52.0%)
Agricultural/Other (Private, Developed) =		3,350 ha	(32.5%)
Uncommitted (Private, Not Developed) =		1,600 ha	(15.5%)
		10,320 ha	(100.0%)

Source: Department of Lands and Survey, 1986a and 1986b.

It is obvious from the above table that management and administration of the Crown (or public) areas of the wetland cannot fail to have important impacts on privately owned areas. With over half of the wetland (55%) in private ownership any proposals aimed at preserving or conserving the wetland, either in total or only the Crown portion, will impinge on the intentions and rights of individual owners.

Also, as Harvey (1984) points out, the large proportion of the wetland which is both privately owned and as yet unprotected by stopbanks, i.e. about 33% of the total remaining undeveloped wetland, is significant. In particular the lengthy wetland margin, comprising the more

fertile mineralised soils, is considered to be especially valuable as a wildlife habitat (WVA 1981, Lands and Survey 1986b, Cheyne 1981). If private development of these margins, or even other less well-endowed areas, takes place through stopbanking and/or drainage, then a situation is created where an infringement of public rights occurs through a deterioration of the natural values of the Crown wetland. This property right argument, whether viewed as the private owner impinging on public rights or the Crown denying private rights, has been the contentious issue underlying the latest litigation regarding competing uses of the wetland. The subject of alternative and/or competing wetland use will be a persistent theme of this treatise.

3.1.3 Zoning

The wetland is affected by the following regional and distinct planning schemes provisions (Lands and Survey 1986b):

(a) Auckland Regional Planning Scheme: A wetland of international significance; policy is for protection.
(b) Waikato United Council Regional Planning Scheme (Proposed): The wetland is identified as a "landscape interest area", for wildlife in particular.
(c) Franklin County District Planning Scheme: The wetland is zoned "Rural" in which primary production and reserves are provided for.
(d) Waikato County District Planning Scheme: A "Rural A" zoning is applied to the wetland, in which farming has predominance over reserves or conservation uses.
(e) Waikato Valley Authority: The Authority resolved, in 1983, to promote management to protect existing wetland ecosystems. As mentioned later, the flood ponding requirements of the wetland (60.5 million m^3) impose land use constraints.

It can be seen that no uniform zoning practice applies to the wetland. However, most schemes, with the Waikato County District Planning Scheme being the exception, do emphasise to a greater or lesser extent the wildlife/conservation

aspects of the area. While it would appear desirable to have a uniform zoning criteria over the wetland where local authority approvals were required, it may not be essential for management given the apparent provisions for conservation/recreation use in general. The strategy of establishing the total remaining, undeveloped wetland (belonging to the Crown) as a reserve, or similar protected status, could circumvent potential zoning and predominant-use arguments. The status would need to be powerful in the sense of the ability to override the local regional and district schemes, and should need to be well justified in providing a net welfare gain to New Zealanders.

3.2 GEOLOGY, SOILS AND CLIMATE

Much of the information presented here has been derived from the publications; "Whangamarino Wetland Draft Management Plan" (Lands and Survey, 1986a and 1986b) and the "Whangamarino Swamp Resources Study" (Waikato Valley Authority, 1981). The section will cover only the most pertinent resource data.

3.2.1 Geology

The Wetland is formed within a shallow depression bounded on the east by the Maungaroa Fault and to the west by a range of low hills from Te Kauwhata to Meremere. To the east of the swamp is the Hapuakohe Range which provided the eroded clays and silts that form the base of the wetland. A few "islands" of this siltstone emerge within the wetland. More recent Waitemata sediments form the base of the low hills on the other sides of the wetland. Also above the eroded clay and silt base are gravels, sands and clays which form emergent islands of high ground in the wetland.

Table 3.2 below presents a simplified outline of the various geological layers, or strata, involved in the area.

TABLE 3.2: Strata Sequences of the Wetland

Age	Lithology (Rock Composition)	Thickness (metres)
Post Glacial	Swamps, Peats	20 m approx
Pleistocene to Pleiocene	Conglomerates) Pumaceous sediments)	300 m approx
Paeroa	Sandstone) Siltstone) Sandstone)	260 m approx
Landon	Siltstone (calcareous)) Mudstone) Siltstone)	570 m approx
Arnold	Siltstone) Waikato Coal Measures	60-90 m approx

Source: Waikato Valley Authority, 1981

The geological implications are developed further in the following section concerning soils. However, it is appropriate to examine the relevance of the coal strata at this stage.

Most of the Whangamarino Wetland overlies the Whangamarino Coalfield with a small area in the northeast included in the Maramarua Coalfield. The coal is found at an average depth of 800 metres, with a range between 400m-1000m. The field is regarded as unminable because of the great depth of the seams and is considered to be of low priority for exploitation.

In regard to present coal extraction operations the wetland is affected, significantly, by the presence of the opencast mine at Kopuku, to the east of the wetland. Impacts from this operation include dumping of overburden, discharge of turbid water or noxious materials, and the coal transport operation across the wetland, i.e. the road and cableway (Harvey, 1983).

Other energy development proposals include a new power station southwest of Meremere, implying increased use of

PLATE 1

DAIRY FARMING ON THE WETLAND BOUNDARY

A view from the northern end of the wetland. The dairy farm is elevated above the Northern and Southern Phase soils (see Figure 3.2). Note the change in vegetation at the farmland-peatland interface.

the causeway, while the Ohinewai coalfield southwest of Lake Waikare is also being evaluated for opencast extraction. In short, the wetland is strategically located amidst several present and proposed major energy developments which have, or will have, adverse affects on the wetland (Lands and Survey 1986).

3.2.2 Soils

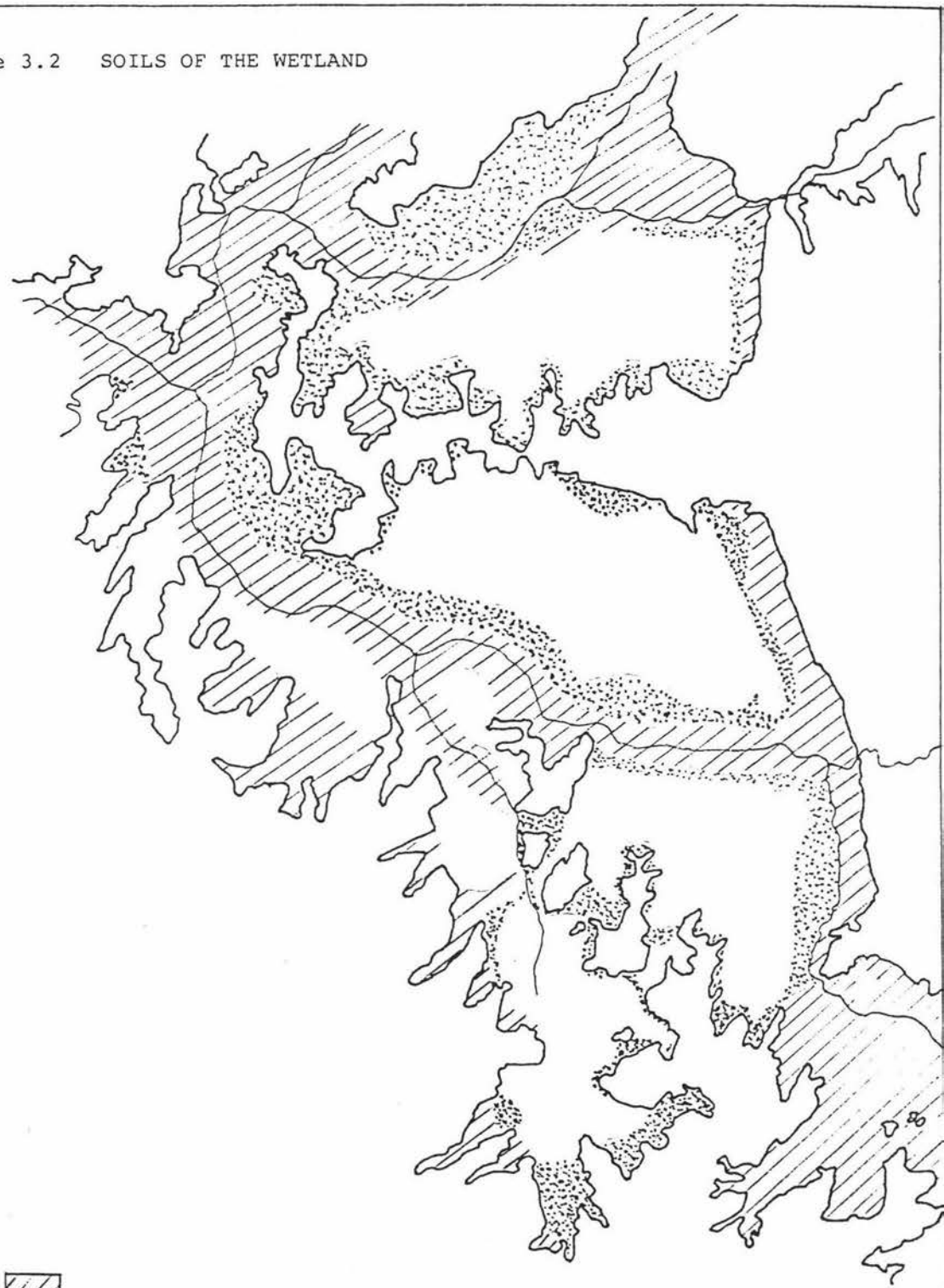
A report on the soils of the Reao Arm area of the wetland is given by the New Zealand Soil Bureau (in Waikato Valley Authority 1981) and has been adopted by subsequent reports to represent the wetland as a whole. The soils are generally types of peat which are significantly more varied than those of the classic dome peats of Mōanatuatua, Rukuhia and the Hauraki Plains. This is due to the wetland not being "domed", consequently the soils are subject to the effects of fluctuating ground water levels and periodic inundation by sediment and nutrient-laden surface waters. Sediment input in flood water from Lake Waikare and the Maramarua and Whangamarino Rivers has profoundly influenced the soil characteristics.

Three types of soil are classified, being gradational from enriched to unmodifed. They are detailed below and illustrated in Figure 3.2:

Mercer Soils: Recent soils from alluvium, close to main streams, mineralised (50%) and underlain by peat. They have the most potential for agriculture, and wildlife habitat as they lie alongside the principal waterways and are botanically rich.

Northern Phase Peat Soils: These have a surface sediment layer up to 0.3 metres thick, a mineral content between 25%-30% and occur concentrically around the wetland and areas affected by nutrient runoff. Dense stands of manuka are typical of the more decomposed soils while scattered willows and sedges inhabit the more sediment enriched areas.

Figure 3.2 SOILS OF THE WETLAND



Mercer or Developed

Northern Phase

Southern Phase

Source: Waikato Valley Authority, 1981

Southern Phase Peat Soils: These occur away from the nutrient enriched areas and are on a highly fibrous mat of decomposed peat, with less than 25% mineral content. They usually support stunted rushes and reeds, and predominate in the central wetland area.

Above the wetland margin, soils are generally secondary podzolic soils (to the southeast) or brown granular loams and clays derived from volcanic ash.

Harvey (1984) considers that the Mercer soils are the most suitable for development although they provide the greatest flood storage function. The Northern Phase Soils are considered to be only marginal for development, while Harvey discounts the development potential (for pastoral land use) of the Southern Phase Peats.

The characteristics and nature of the peat soils are critical in determining the development potential and use of the wetland. These aspects will be covered more fully in Section 3.3: Present Land Use and Agricultural Development.

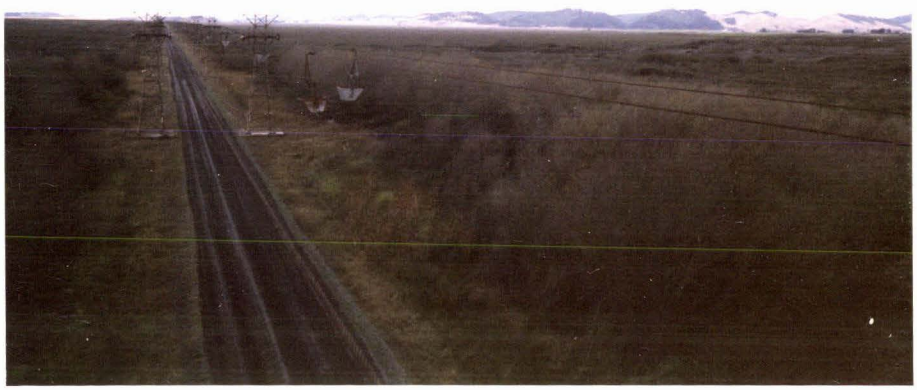
3.2.3 Climate

The general climate is similar to much of the Waikato Basin. The temperatures are mild with mean daily values ranging from about 19°C in summer to around 9°C in winter. The average annual rainfall is 1200 mm with a winter maximum of 130 mm (June) while the summer maximum is 70 mm (January). Occasional flash floods carry large volumes of silt into the swamp from the eastern hills, affecting soil formation particularly in the wetland adjacent to hills and river channels. The wetland is affected by the level of the Waikato River, and under natural conditions water flows back up the Whangamarino River to the wetland when the Waikato River is high. This flow is now modified by man-made structures which will be covered more fully in Section 3.5.

Winter fogs are common, while frosts are infrequent especially in the lower catchment areas. The prevailing

PLATE 2

THE MEREMERE COAL ROPEWAY AND CAUSEWAY



A view from one of the ropeway support pylons looking eastward across the wetland (see Figure 3.4). The southern phase soils extend on the right hand side.

winds are westerlies, while the average annual sunshine hours total between 2050-2150 hours.

3.3 PRESENT LAND USE AND AGRICULTURAL DEVELOPMENT

This section is particularly important in establishing how the characteristics of the wetland have determined its use as well as how people have modified the environment for their purposes. Consequently, the study will discuss development techniques and constraints quite fully, and then explain the types of externalities caused by such operations on the natural wetland values. The land use capability of the wetland will also be discussed using the Ministry of Works and Development Land Use Capability Data as covered in Waikato Valley Authority (1981).

3.3.1 Present Land Use

In general terms the present commercial use of the wetland and adjoining areas mainly involves agricultural or horticultural operations. There is a significant commercial fishery which will be discussed in Section 3.4 below. Overall there are some 76 properties within, adjacent to or near the wetland, with 34 of these physically adjoining the Crown land in the wetland. The use of the wetland, from an agricultural sense, is broadly dependent on whether the area is above or below the wetland margin and whether it has been drained and developed. Table 3.3 below presents an estimation of the types of land use:

TABLE 3.3: Present Use of the Wetland

Crown Land	ha	%
Unused	3,323	32.2
Grazing Lease/Licence (Dry cows or heifers)	699	6.8
Adverse Occupation (Dry cows or heifers)	280	2.7
State Coal	274	2.6
Wildlife Service Lease (Willow control trial)	38	0.4
Coalfield Lease	35	0.4
	4,640	45.0
Private Land		
Dairying (factory supply)	1,280	12.4
Sheep and Beef	1,414	13.7
Horticulture, Cash Cropping, Market Gardening	656	6.3
Coalfield	370	3.6
Auckland Acclimatisation Society	730	7.1
Undeveloped Wetland	1,230	11.9
	5,680	55.0
	10,320	100.0

Sources: Department of Lands and Survey, 1986a and 1986b.
Waikato Valley Authority, 1981.
Harvey, 1983.
Tilsley and Findley, 1981.

The 'adverse occupation' of the Crown land describes the situation where private farmers allow their livestock to stray onto the wetland. The coalmines, both State and privately owned, use their properties (adjoining the wetland) for dumping overburden from open-cast mining operations. The potential problem of turbidity and noxious pollution of waterways from the mines remains a concern to the Crown. The Wildlife Service presently leases a small area of the wetland (38 ha) in which it carries out some willow-control grazing trials.

The Auckland Acclimatisation Society is the largest private landowner in the wetland. The Society purchased its holdings in 1964, 1975 and 1976 with the intention of providing hunting areas and carrying out waterfowl management. However, due to uncertainty of water levels within the wetland they have not developed the area for recreational use.

Much of the large horticultural/market garden/cash cropping area is in the Motukaraka Flood Protection Scheme (about 94%) which has been drained, stopbanked and developed since 1967. The Motukaraka Scheme is only one of nine similar schemes which, in total, have reduced the area of the wetland by around 2670 ha (approximately 25%).

The balance of the wetland that is not used either agriculturally, horticulturally or for mining purposes fulfills several other imporant roles. It provides a habitat and food source for native and introduced bird, fish and aquatic life. It is used for recreational hunting and fishing, and also plays an important part in the commercial eel fishery based in Huntly. The wetland is also an integral part of the Lower Waikato-Waipa Flood Control Scheme. These functions of the wetland will be elaborated on in the sections below.

3.3.2 Agricultural Development

As previously mentioned, about 2640 ha of the wetland have been converted into productive farmland. These areas are mainly on the periphery of the wetland where the peats are shallower and there is more alluvial material hence more fertility. The general sequence of development is initiated by the establishment of stopbanks, then the installation of appropriate drainage systems (pumps and ditches for example) followed by vegetation clearance and the removal of stumps and buried timber. The ground is then worked up, topdressed and sown into pasture. Fencing and stock water supply make up the final major requirements.

The operations are very similar for horticultural use although the presence of stumps and buried timber are likely

to seriously interfere with harvesting equipment. Development for both horticultural and agricultural use is expensive and fraught with many difficulties due to shrinkage, compaction, low pH and fertility (especially the Northern and Southern Phase peats) as well as the problems of buried timber and stopbank collapse.

The areas most suitable for possible agricultural development correspond to the areas of Mercer soils (see Figure 3.2). The Northern Phase peats could, with sufficient care and finance, be successfully developed into productive farmland albeit at a high cost. The Southern Phase peats, making up the central wetland areas, are very deep and unconsolidated and hence have a high potential for subsidence. With their low natural fertility and acidic nature they are not recommended (Waikato Valley Authority, 1981) for development.

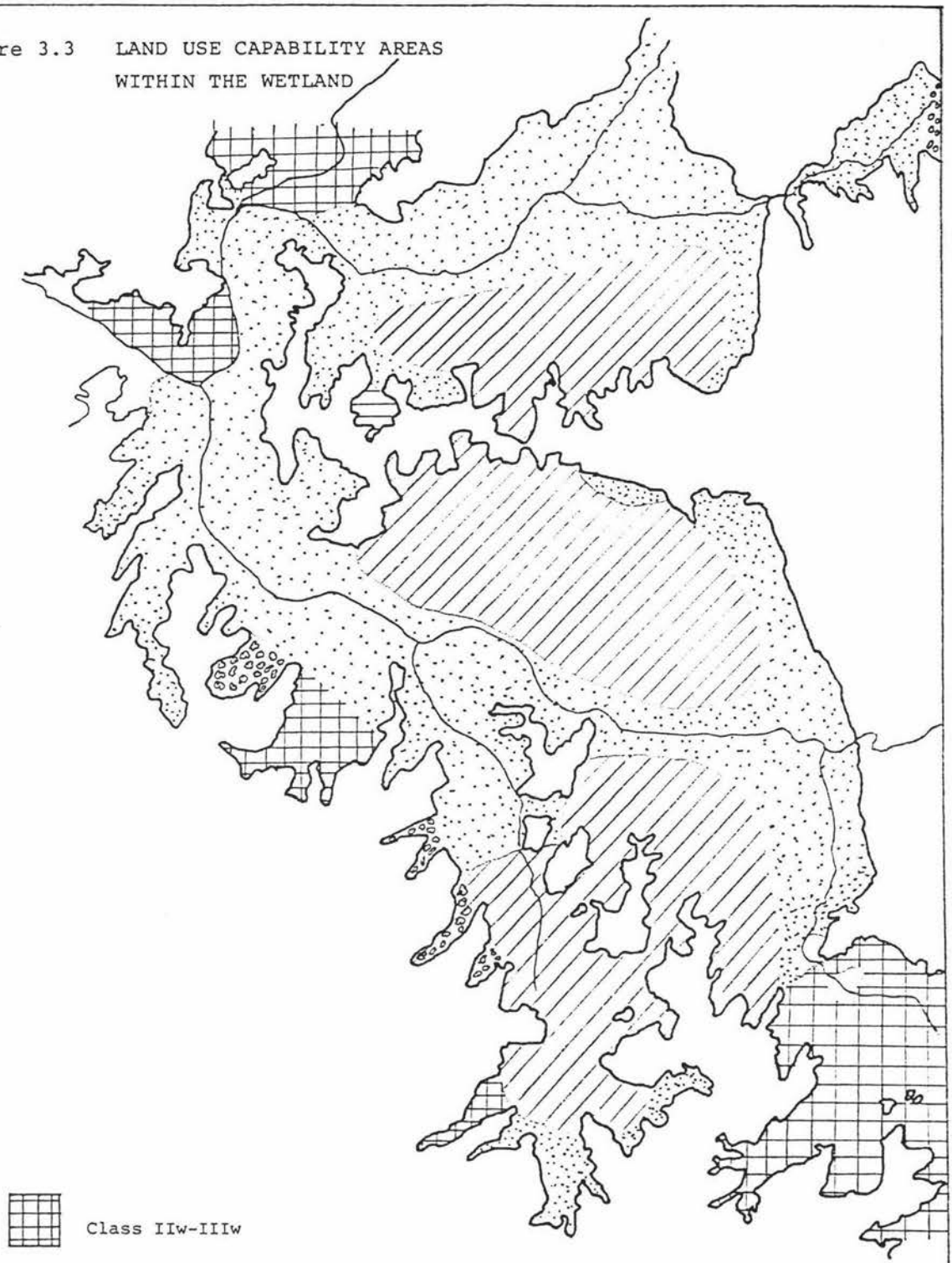
With regard to the most likely land development options involving the wetland it appears that the principal authors, i.e. Waikato Valley Authority (1981), Harvey (1983) and Lands and Survey (1986b), consider dairying to be the major one with provision for more intensive uses such as horticulture, cash cropping and market gardens only on a small scale.

It is pertinent, and useful, at this stage to examine the Land Use Capability (LUC) measures of the wetland. The LUC is a measure of the land's present capacity to sustain agricultural production determined largely by physcial attributes such as soil type and depth, wetness, slope, stability and climate (Ministry of Works and Development, 1971). Figure 3.3 presents an indication of land use capability based on present knowledge and land protection. A brief explanation of the capability classes is as follows:

Class IIw and IIIw - On Protected Land

This includes the existing flood protection/drainage schemes and produces good pastures and crop yields. Controlled drainage is required to prevent flooding in winter and avoid

Figure 3.3 LAND USE CAPABILITY AREAS WITHIN THE WETLAND



Source: Waikato Valley Authority, 1981

drying-out in summer. The low mineral content is a limitation along with stump problems. These areas are already committed for agricultural development. The IIw class are parts of the upper Motukaraka Scheme and the stopbanked area at the eastern end of Island Block Road. These are capable of supporting cropping.

Class IIIw - In Marginal Areas

These are small areas around the swamp edges and are often drained, not protected by stopbanking and usually in pasture/swampy pasture. If carefully managed some cropping is possible.

Class VIw

This includes the Mercer soils and the less fertile Northern Phase soils. They are often flooded in winter but clear in the summer allowing cattle to graze. Indicative of comparatively 'dry' and fertile soils, and capable of being developed into pasture.

Class VIIw

Principally areas in the centre of the wetland. Development is extremely difficult (and costly), and on the less fertile Southern Phase soils any returns would be lower.

By examining and comparing Figures 3.2 and 3.3, it becomes obvious that capability patterns reflect major changes in the soil type and drainage features. Development is limited by the very high water table, frequency of flooding, physical limitations of the peat soils and, of course, the costs.

3.4 FISHERIES WITHIN THE WETLAND

Strickland in WVA (1981) gives a detailed account of the fisheries resource of the wetland. His survey work recorded about 18 species of fish ranging from eels and catfish through to trout and the likely endangered Black Mudfish. Several species of Crustacea were also recorded including the Koura, fresh water crabs and two types of shrimp. At

present there is very little recreational fishing in the wetland apart from local residents fishing for eel and mullet. However, the habitat does support a variety of coarse exotic fish, such as the rudd, which are recognised overseas as sport species but not yet sought by local anglers.

3.4.1 Commercial Fisheries

The wetland, Lake Waikare and their catchments form part of the largest eel fishery in New Zealand. In 1979 the eel harvest was approximately 163 tonnes with 78 tonnes originating in the Whangamarino Wetland and 85 tonnes from Lake Waikare. At that time the wetland fishery supported four full-time fishermen and an unknown number of part-timers and amateurs. The wetland catch quoted above applies only to the full-time fishermen. Peak fishing times occur when high water levels in the wetland begin to drop and there is movement of fish from flooded areas into permanent water channels, where there is the greatest fishing pressure. The WVA (1981) considers that there is a need for the vast wetland areas to periodically flood and be left as a food source for eels and other fish species. This management implication of the wetland is supported by some latest information provided by the Lower Waikato Eel Fishermen's Association (pers. comm. Mr R Clark).

Mr Clark reports that yields have dropped drastically to about 10-15 tonnes for the 1986 season with an even lower yield predicted for 1987. The number of full-time fishermen have decreased to two, while at least two other part-timers fish the area. The Association considers that the decline in yields are principally due to:

- exceptionally dry seasons occurring in four out of the previous five years, i.e. no flooding of the swamp for a "reasonable" duration.

- the WVA study revealed artificially high yields, as at the time of the survey fishing pressure was extreme and at an unsustainable level.

- the minimum size of eel that processors would accept was increased from 150 gm to 250 gm (as of October 1986). Only about 20% of the eels from both Whangamarino and Lake Waikare meet this criteria.

The Association note that eel fishing can be extremely unpredictable and is closely related to weather conditions over a twelve-month period. It would also appear that the Lake Waikare yield was artificially high (at 85 tonnes) with a 20 tonne yield being more sustainable given favourable conditions.

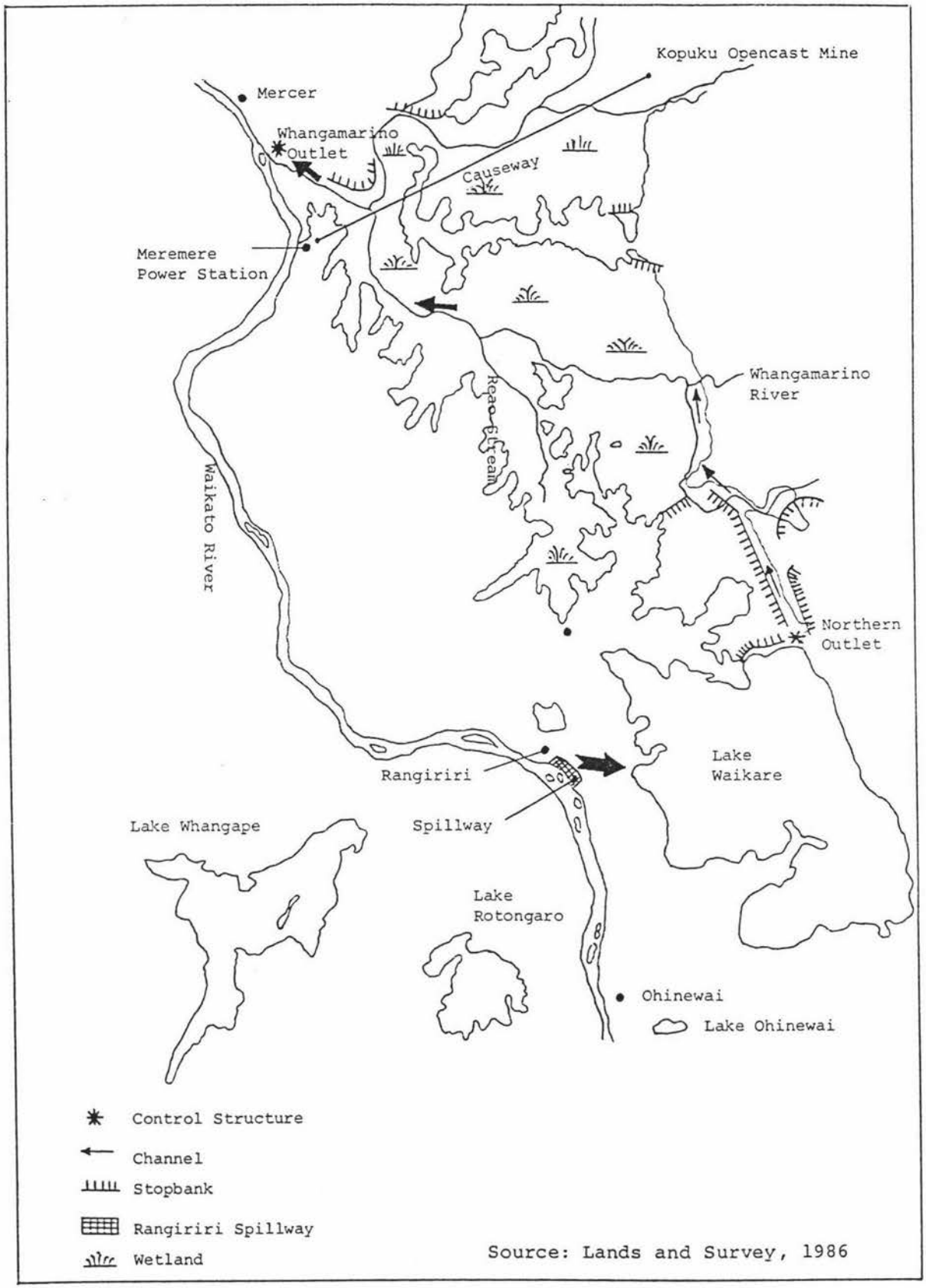
With regard to grey mullet fishing the WVA Report (1981) reported a 1979 dollar value of fish harvested at $17,500, however no weight yields were given. The mullet fishing is mainly in the lower reaches of the Whangamarino and Maramarua Rivers. They enter these areas during the early summer months depending on the operation of the floodgate at the confluence with the Waikato River.

The catfish potential was considered by the local fishermen (WVA 1981) to be greater than that for eels. The yields being caught (by net) by eel fishermen exceeded the weight of eels being caught. However, the Association reports that, to date, the catfish industry is non-existent and it appears that predictions of a $177,000 annual value (WVA 1981) were both optimistic and premature.

3.5 HYDROLOGICAL PROPERTIES OF THE WETLAND

The Whangamarino Wetland has, historically, performed a flood storage function. In the natural state - pre 1959 - the Waikato River, when in high flow conditions, would flow into Lake Waikare north of Ohinewai by means of reverse flow up the Te Onetea and Rangiriri Streams, which normally drained the lake. The lake levels would rise until overland flow occurred into the Whangamarino Wetland.
Simultaneously, as the Waikato River rose the flows reversed up the Whangamarino River and the wetland acted as a ponding area for direct Waikato River flow (see Figure 3.4).

Figure 3.4: HYDROLOGICAL ASPECTS OF THE WETLAND



With the construction of the Lower Waikato-Waipa Flood Protection Scheme (LWWFPS) the flood-storage function of the wetland was formally recognised and designed into the operation of the scheme. Controlling the ponding function was achieved in part by erecting a control structure at the confluence of the Waikato and Whangamarino Rivers which prevented direct backflow by the Waikato River. At the same time a control structure at the outlet of Lake Waikare and a spillway at Rangiriri, allowed spilling of flood water into the lake to reduce the peak river flood by 15%. The designed storage capacity of the wetland is 60 million cubic metres which transposes to some 6,500 hectares of wetland. This imposes a major constraint to any development intentions within the wetland although it does not rule out development completely (in theory), i.e.:

Crown Land (inside wetland margin)	= 4,640 ha
Acclimatisation Society	= 730 ha
Private Ownership	= 2,330 ha
Total Remaining Unprotected Land	= 7,700 ha

On this basis, it is obvious that only 1,200 ha of the remaining unprotected wetland (ie 7,700 ha less 6,500 ha) can be fully developed without compromising the flood storage requirement. The implication to private landowners is such that only 51.5% of their land can be developed while, ipso facto, any development of Crown land would directly prevent private landowners from developing a proportionate area. We have, therefore, a situation in which property rights are likely to be denied no matter what option prevails.

Some of the other major impacts that the LWWFPS has had on the wetland include:

- increased ponding in Lake Waikare at peak floods but an overall lower lake level and more rapid drainage into and through the wetland.

- lowered bed levels in the Meremere-Mercer reaches of the Waikato River, through river training works and sand

abstraction, have meant a lowering of the wetland water levels by 0.74 metres over the past ten years. While this rate of drop is expected to decline it poses considerable threat to the 'natural' systems of the wetland and its value as a wildlife habitat (Lands and Survey 1986b).

The available information appears to confirm that water in the wetland now recedes more quickly while the durations of inundation are shorter, with some once permanently wet areas drying up in summer. As the Lands and Survey (1986b) point out, the existing control structures are designed to control water inflow, not to control water outflow and cannot be readily used to provide a more permanent, managed water level which ensures an adequate wetland ecosystem. Harvey (1983) takes a stronger view, considering that damage to the wetland, particularly through lowered water levels, will soon become irreversible.

3.6 THE FLORA AND FAUNA RESOURCES OF THE WETLAND

3.6.1 Vegetation Patterns

Strachan in WVA (1981) describes the types of vegetation and their relationships to the various areas of the wetland. It is apparent that vegetative patterns are closely linked to the range of existing wetland conditions between the extremes of acidic bog and mineralised swamp. It is argued by Strachan, and Ogle and Cheyne (1981) that these extremes lead to a diversity of plant life and a subsequent enhancement of the wetland value. The acid peat bogs contain relatively few plant species with most of those present being indigenous. They include sedges, rushes, ferns and manuka as the dominant species.

The mineralised swamps support a more diverse range of plants, many of which are exotic species. Willows dominate in some areas, while in others herbaceous vegetation predominates. These include water plantain, buttercup, sedges and rushes as well as various grasses which all become abundant in summer and autumn as water levels drop. It is noted (Cheyne, 1981) that seed production from these

and other herbs is of great importance to waterfowl. Scattered stands of kahikatea, kowhai and other indigenous trees are present and are believed to have once occupied extensive areas. Strachan proceeds to note various species of particular interest currently in the wetland. These are:

- Water milkfoil: Very rare throughout New Zealand.
- Baumea huttori (a sedge): This has a threatened habitat and the large, unmodified peat bogs of the Whangamarino must be an important stronghold.
- Tetraria capillaris (a sedge): This has a threatened range of abundance.
- Corybas unguiculatus (an orchid): An endangered plant but recently sighted in the Reao Arm.
- Lycopodium serpentinum (a club moss): An endangered plant almost destroyed but discovered in the Reao Arm.
- Bladderwort: Rare and localised.

In addition to those species already mentioned, the wetland also has a rich selection of lichens and mosses, which include recently discovered and unusual species.

3.6.2 Aquatic Vegetation

According to Harper, in WVA (1981), there were 19 types of macrophytes found in a survey of the wetland. These included submerged and free floating plants. The flowing water, rivers and streams of the wetland contained vegetation consisting of extensive rafts of both submergd and semi-emergent plants extending from the banks. Many of the waterways discoloured by peat supported various species tolerant to turbid water conditions. The large, open-water areas contained submerged species, while in areas protected from the wind there was free-floating species associated with semi-emergents. In small ponds and sheltered open water areas, often at swamp edges and in areas bordered by willows, free-floating species, collectively known as duckweed, formed a complete coverage.

3.6.3 Aquatic Fauna

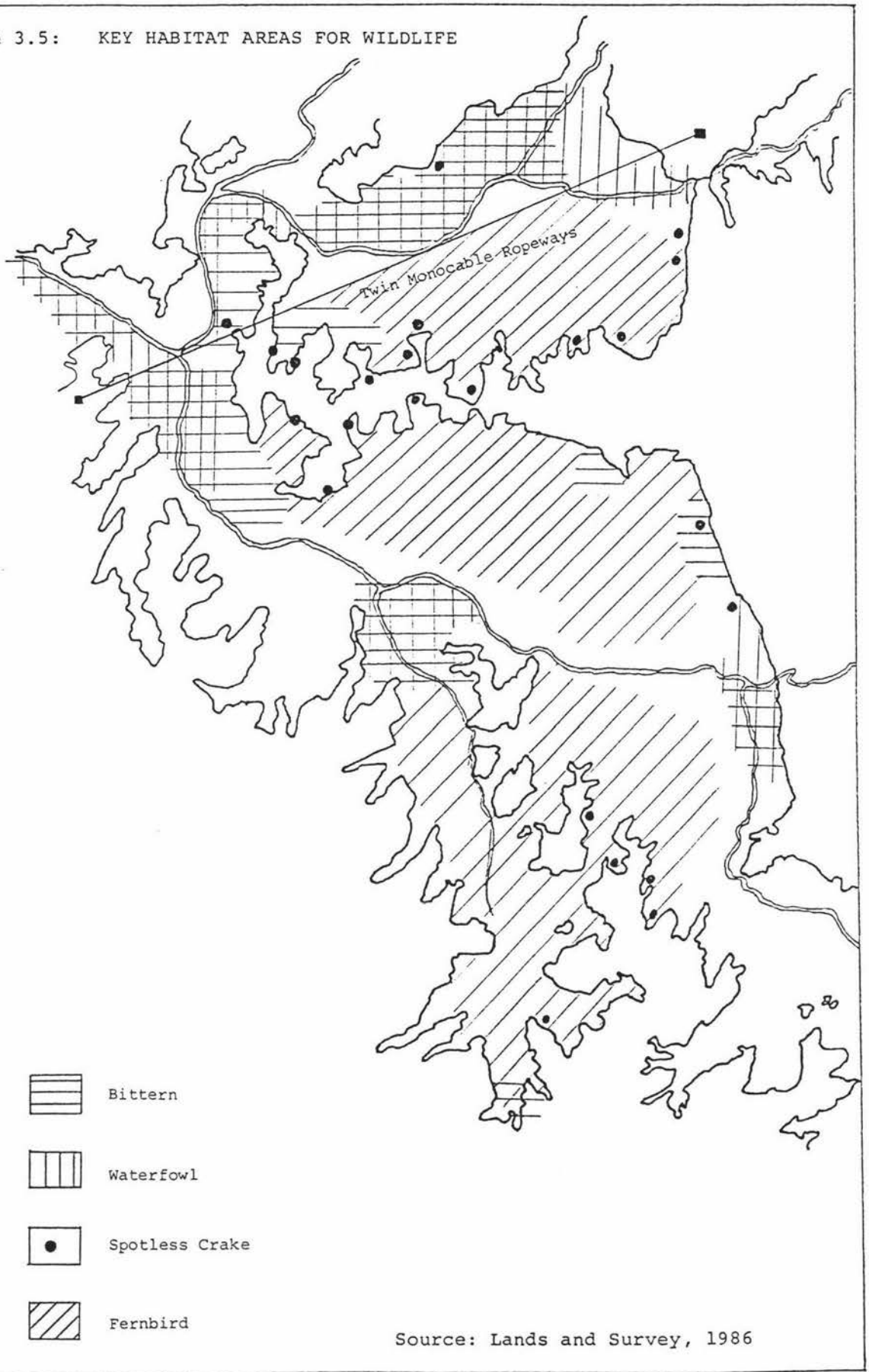
Generally speaking, the biology of New Zealand wetlands is

relatively unknown. However, the work of Town in WVA (1981) and Town (1981) presents the results of original survey work of the wetland. Some of the more pertinent findings are summarised below to illustrate the faunal variety:

- Seven species of molluscs were found.
- A common crayfish was present, while large numbers of shrimps appeared periodically in the Whangamarino River.
- Seven species of water flea were found, while two species of Australian green bell frogs were recorded.
- Eighteen species of fish were found, while the Black Mudfish was found in both permanent and temporary water bodies. Due to its small distribution, likely endangered status and a general lack of information on its habitat requirements the Black Mudfish is regarded by the Ministry of Agriculture and Fisheries as of national importance. Mosquito fish were the most common being an aggressive species inhabiting rivers, tributaries, drains and permanent ponds. Smelt, whitebait, catfish and goldfish were common.

Town emphasises the uniqueness of the wetland faunal communities and their sensitivity to wetland development particularly for agriculture. He considers that the aquatic fauna of wetland pools was impoverished compared to that of the larger associated waterways typical of the Waikato region. With regard to the invertebrate population of the wetland, Town stresses their considerable ecological significance in serving as food for animals, processing dead organic matter and physically modifying the habitat and improving its carrying capacity. The invertebrate distribution and abundance are dependent on wetland size and location to other wetlands, amongst other factors. While no information exists on the minimum size at which wetlands remain floristically and faunistically similar to large areas of wetland, Town stresses that wetland size is vital to the maintenance of a marsh fauna. He also points out that vegetation structure in wetlands strongly influences invertebrate production such that invertebrate density is

Figure 3.5: KEY HABITAT AREAS FOR WILDLIFE



Source: Lands and Survey, 1986

highest where plant species are intermingled and where floral complexity offers abundant micro-habitats.

3.6.4 Wildlife

The majority of this section is devoted to discussion of the birdlife in the wetland as, according to Ogle and Cheyne (1981), WVA (1981), Lands and Survey (1986a and 1986b) and Cheyne (1981), the wetland is considered to be one of the outstanding waterbird habitats of New Zealand and meets several criteria for it to be considered of "international importance".

The inter-relationships between the waters of the lower Waikato River and lakes, and the Whangamarino Wetland are particularly important as species move into the wetland in autumn when food is abundant and water levels rise. Many remain to breed in the spring, after which the majority return to more extensive open-water areas or coastal locations. The wetland has a diversity of habitats which cater for a large variety of birds. In addition to the willow forests, manuka shrublands, rushlands and herbfields, there are seasonally-extensive open water areas. The large wetland "blocks" are of a magnitude to absorb some of the direct and indirect disturbance of man's activities and provide substantial edge habitat which produces herbacious vegetation under regular flooding (Lands and Survey, 1986b), all being generally valuable to birds.

About 56 species of birds have been recorded in the wetland with detailed information on their density and distribution presented in WVA (1981) and Cheyne (1981) in particular. Figure 3.5 illustrates the key habitat areas for four of the more important species while presented below are some notes on species of particular interest:

Australian Bittern: This is a fully protected species in New Zealand and the wetland contains some 20-25% of the total population. They are native birds and usually found in the semi-mineralised and mineralised bog.

Spotless Crake: These are native, fully protected and restricted to swamp margins which provide smaller habitats

than that of the bittern.

North Island Fernbird: Some 4,000 pairs, one of the largest populations in New Zealand, are estimated to inhabit the wetland. Fully protected, they are relatively immobile and totally dependent on existing vegetation.

Grey Teal: Fully protected, the winter populations amount to around 5% of the national total. The mineralised areas are especially important for their habitat.

Black Swan: At peak times, i.e. winter, spring and high water periods, it is estimated that the wetland contains around 7% of the national population.

New Zealand Shoveler Duck/Grey Duck/Mallard: All game birds, these heavily populate the wetland in winter and spring providing popular recreational use. In Figure 3.5 they are categorised together as 'waterfowl'.

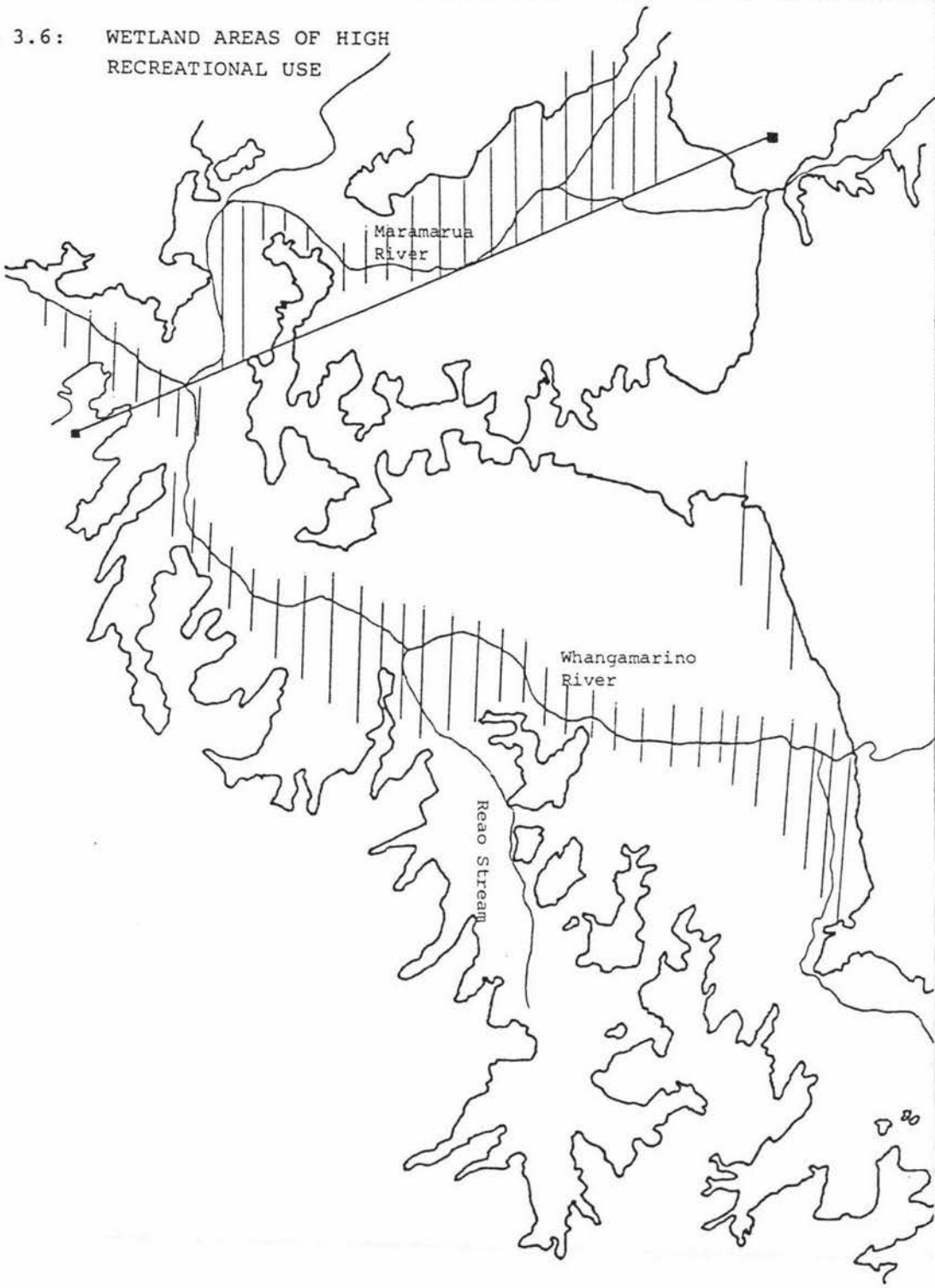
There are other diminishing, rare or endangered species inhabiting the wetland in small numbers. These include the brown teal, white heron, banded rail and New Zealand Dabchick amongst others.

From the information and evidence available, the New Zealand Wildlife Service (WVA 1981) has determined that the Whangamarino Wetland meets several criteria of the International Union for the Conservation of Nature (IUCN) and considers the wetland to be of international importance and recommends retention of the wetland complex as a wildlife habitat.

3.7 PUBLIC AND RECREATIONAL USE

Cheyne (1981), and also Cheyne in WVA (1981), outlines the principal public uses of the wetland which cover a wide range of activities with waterfowl hunting predominating. He stresses the observation that the wetland is within reasonable distance (80 km) of about one million people (e.g. Auckland, Hamilton) with the implication that

Figure 3.6: WETLAND AREAS OF HIGH RECREATIONAL USE



Areas Subject to Most Recreational Use

Source: Lands and Survey, 1986

potential uses, particularly "passive" ones, are significant to future wetland management. The various public uses and recreational pursuits in the wetland are briefly covered below:

Gamebird Hunting: This is reported as the largest recreational activity with a 1979 survey indicating that some 700 hunters spent around 11,172 days (in total) in the wetland. This was both in hunting and preparing shelters/maimais. Most had hunted the area for 9-10 years with less than 25% living close to the wetland. The mineralised areas near stream margins or on the wetland margin were particularly popular. This is reflected in Figure 3.6 which illustrates the wetland areas subject to most recreational (overall) use. The associated activity of gundog trials involved some 600 recreation days annually (including trialists and spectators). The wetland margin is a similarly popular area, with the South Auckland Gundog Club wishing to develop a permanent site.

Boating: Egan and Egan, in WVA (1981), describe the recreational potential for this use as insignificant. The majority of boating is related to hunting, and any increase in power-boating would conflict with wildlife conservation.

Fishing: Very little recreational fishing occurs apart from eel and mullet fishing by local people.

Ornithology, Nature Appreciation and Aesthetic Appeal: At present visits to the wetland for these purposes are limited. However, it is considered (WVA 1981; Lands and Survey 1986b) that these pursuits, along with educational and scientific interests, have great potential especially if the faunal and flora resources of the area are appropriately promoted.

The CVM Survey to be described in Chapters 4 and 5 is used to investigate how people perceive the wetland's values and the extent to which they use it. This will provide an interesting comparison with some of the views presented in this section.

3.8 WETLAND MANAGEMENT AND CONSTRAINTS

At present management of the wetland is undertaken by three agencies; the Department of Conservation (formerly the Department of Lands and Survey), the New Zealand Wildlife Service and the Auckland Acclimatisation Society (on its own land areas). Some private adjoining landowners also manage their wetland areas for conservation purposes (Lands and Survey, 1986b).

The activites of the Department of Conservation include willow control on the south bank of the Maramarua River, fire control, recreation management (including hut licensing and inspection) and the issuing of licences and leases for grazing. The Wildlife Service monitors the wildlife, promotes wildlife values and enforces the provisions of the Wildlife Act of 1953. The Auckland Acclimatisation Society manages its own lands to provide gamebird habitat and shooting stands. However, due to uncertainties regarding water levels, and low water levels, over recent years, development has been minimal. While this Society expresses a strong conservation ethic and believes in developing the total wetland as a reserve, they have also issued medium to long term tenancies to hunters so that they may develop shooting sites and ponds (Harvey, 1983). The Waikato Valley Authority's activity is primarily involved with controlling water levels in the wetland and the allocation of water rights (or otherwise) for proposals using and/or impacting on the natural water resources of the region.

The management and use of the wetland takes place within several kinds of constraints. These include the obviously physical constraints such as soils, climate, topography and hydrological requirements for example, but also include other less obvious statutory and administrative restrictions. Tenure is one of these limitations as, at present, the majority of the wetland is "unalienated" Crown land which is open to a variety of development possibilities and is weak in its protective constraints (Lands and Survey 1986b). Other New Zealand wetlands of international

significance, e.g. the Waituna Wetland in Southland, are either nature reserves or scientific reserves. The appropriate tenure option is itself complicated by the range of management and use provisions which need to be accommodated. The multiple uses of the wetland include activities which can be "rival uses" in the sense that flood-ponding requirements eliminate areas from agricultural development. Similarly, habitat protection can exclude recreational entry.

Section 3.1.3 discussed the multiple zoning practices that affect the wetland. However, given that the schemes, under which the zoning is applied, have the same basic philosophy and provide for conservation and recreational uses then no insurmountable problem should exist.

There are of course existing statutory constraints which direct and guide the use of the wetland. These include:

The Town and Country Planning Act 1977: Operating primarily through the regional and district planning schemes, this Act requires that the wetland be managed to ensure the preservation of its special values.

The Waikato Valley Authority Act 1957: This makes provision for the Regional Water Board, i.e. the WVA, to control the water which drains into and forms the Waikato River and its tributaries and for the protection of property from damage by floods.

The Water and Soil Conservation Act 1967: Promoting a national water policy, this Act provides for the conservation, allocation, use and quality of natural water as well as the conservation of soil, flood prevention and control of natural water uses and drainage of land.

The Wildlife Act 1953 and Wildlife Regulations 1955: The Act generally controls the waterfowl hunting acitivity in the wetland. It specifies wildlife that are partially protected, gamebirds, etc., but states that those not specified are protected. The Act also provides for the

establishment of acclimatisation societies. The Regulations elaborate on licences, fees and the running of acclimatisation societies amongst other matters.

The Harbours Act 1950: This is specifically applicable to any proposal to place a structure in tidal water or in the bed of a navigable river. As the Whangamarino River is both tidal and navigable, any structure to control wetland levels would require a licence.

While the above regulations summarise the legislative constraints (or protections, depending on how you view the use of the wetland) currently affecting the wetland, the stated aim of the Department of Conservation (Lands and Survey, 1986b) is to change the wetland from unalienated Crown land to Reserve under the 1977 Reserve Act. Generally speaking, this would allow a change in management direction from non-use (apart from leased grazing and hunting) to management specifically for conservation purposes. Classifications within the Act would allow scientific and experimental activities in parts of the wetland while wildlife, botanical and recreational purposes would be provided for in other areas. The major management issues arising from these intentions are fully discussed in Chapter 6 but it can be mentioned at this stage that certain levels of commercial activities, such as fishing and limited grazing, can be accommodated within these classifications.

The following Chapter 4 will present the approaches used in estimating the values of the principal uses of the wetland as introduced in this chapter.

CHAPTER 4

EVALUATION FRAMEWORK AND METHODOLOGY

This chapter is concerned with discussing and explaining the approaches adopted in estimating dollar values associated with the various uses of wetland. Previously, in Chapter 3, we were made aware of the different, and in some cases competing, uses of the wetland including for example agricultural development versus conservation/recreation and flood control. Each of these uses produces a net benefit flow for consumption by individuals either directly or indirectly. As Walsh (1986) explains it, the direct consumption refers to the flow of goods or services experienced from the particular area of interest. Indirect consumption on the other hand, is described as consisting of two broad types. Firstly, indirect use refers to the flow of information about the resources and its consumption indoors (or as I would prefer it described, off-site). Examples include reading, viewing and conferring with others about the resource. The second type of indirect use has been called a preservation value (Walsh 1986; Gilliman and Loomis 1982) and refers to the fact that many individuals benefit from knowing that certain resources, particularly recreational and environmental ones, are protected. These preservation values could be considered as a stock of knowledge or "psychic capital", as Walsh (1986) describes them, and have already been discussed in more detail in Section 2.2.2.

Measuring the different types of values or benefits requires a variety of techniques as some of the consumption flows have easily identifiable market prices while others, the preservation value for example, are non-market public goods. The balance of this chapter is therefore devoted to describing the benefit estimation techniques used in valuing the major consumption flows, both direct and indirect, from the wetland.

4.1 THE PRESERVATION VALUE OF THE WETLAND - THE CONTINGENCY EVALUATION METHOD

The Contingent Valuation Method (CVM) was described in some detail in Chapter 2, therefore this section will focus on its application in deriving a preservation value for the wetland. This value will measure both users and non-users monetary values of the wetland. To apply the method a representative sample of the national population of households was asked direct questions about their maximum annual willingness-to-pay (WTP), contingent on hypothetical changes in the amenity i.e. the wetland. The hypothetical changes in this case included:

(a) Development of the wetland for agriculture causing large areas of the natural wetland to be lost leading to permanent changes making it less suitable for leisure, wildlife and scientific uses. In short a decrease in quantity and quality of the natural environment.

These diminishments are very difficult to define precisely in quantitative terms due mainly to a lack of historical data and lack of knowledge regarding the complex and delicate ecological relationships within the wetland (Lands and Survey, circa 1985; WVA 1983). However, Cheyne in WVA, 1983 attempts to explain the connections between natural habitat values and development thus:

"The wildlife resources have changed over the years as a result of mainly habitat loss due to wetland drainage, and the introduction of exotic plants and animals. The relative size of bird and fish populations is related directly to the amount and quality of habitat available and if habitat alterations occur corresponding changes in the wildlife populations will result. Indigenous wildlife are more sensitive to these habitat losses and less capable of adapting than exotic species".

Cheyne goes on to discuss the impacts of flood protection and drainage in particular and concludes that these modifications have resulted in both a direct loss of wetland

area and a reduction in the natural flow to, and depth of water in, the remaining lakes and swamps. Additionally, he considers that natural seasonal fluctuations in water levels have often been altered and there is now a lower mean water level in the majority of wetlands in the lower Waikato River system. In this context Cheyne describes wildlife habitats as having only a certain capacity to support animals which are dependent on the quantity and quality of available habitat. A reduction in area causes a proportionately similar decline in animal numbers or carrying capacity. Using this principle he estimates that since the last century the regional wetland populations (of dwelling native wildlife) have suffered losses in the order of 80%. In the Lower Waikato-Waipa River basin these losses are estimated at around 40%. These figures do not include the wetland areas (e.g. Whangamarino) that still exist but suffer consistently low water levels and livestock incursion. Overgrazing and heavy pugging can destroy ground cover and habitat (e.g. black mudfish) while excessive, or early grazing, disturbs nesting waterfowl (Lands and Survey, circa 1985).

It is noted that domestic livestock can be beneficial to wildlife populations, particularly waterfowl, in the sense that open pasture areas are retained, nutrient enrichment is increased and plant diversity is maintained (Lands and Survey, 1986). However, the concensus of opinion as apparent in the references cited in this section, considers that livestock use of a wetland and the preservation/enhancement of the natural wetland values are strongly incompatible except in circumstances where strict grazing control can be used as a wetland management tool.

The other hypothetical situation was:

(b) An improvement in the wetland by increasing the quality and quantity of the natural areas through prevention of agricultural development, decreasing areas presently farmed and provision of better public services.

The WTP reported is assumed to correspond to the point of indifference between having that amount of income or the utility gained from the defined environmental amenity.

In the study the WTP questions were directed at households randomly selected from throughout New Zealand. Respondents were shown maps illustrating three scenarios within the wetland i.e. the existing situation; the future situation with increased agriculture; and the future situation with development and agricultural areas decreased. The hypothetical situations were designed to be as realistic and credible as possible (Bennett 1984, Harris 1983, Randall et al. 1974, Gendall pers. comm.) and the WTP questions were preceded by statements briefly describing the competing uses of the wetland.

Respondents were told that their WTP money would go into a special Trust to be used exclusively for the purpose of preserving and improving the wetland. This was considered a relatively neutral payment method compared to rates, taxes or entrance fees (Sandrey 1986, Harris 1983, Walsh 1986). They were asked to assume that this payment method was the only possible way to finance wetland protection. This was designed to minimise the incidence of zero bids as protests against the particular payment method. Respondents unwilling to pay to preserve or improve wetland areas were asked why in order to identify genuine zero valuations as opposed to those protesting against the method or survey 'bidding game'. The individual bids were aggregated to represent the total consumer surplus of the wetland and estimated in dollar terms by multiplying the offered WTP amounts by the associated numbers of households (Hufschmidt et al., 1983). This total value was then scaled upwards to represent a national value. Socio-economic information on the surveyed households was collected in order to examine the relationship between WTP and variables such as age, income, sex and membership of an environmental organisation (Walsh, 1986).

Information on the present use of the wetland and how strongly households value it was also collected. Attitudes

and comments on wetland management and future use was requested. The survey concluded with a 'feedback' section designed to obtain respondents' opinions on the actual design and format of the questionnaire (Heberlein and Baumgartner, 1978; Gendall, 1986). This was particularly valuable when pre-testing the questionnaire.

The principal objective of the contingent valuation exercise was to derive a national dollar value for the wetland which embodied both user and non-user preferences for the existing recreational/ environmental benefits. The procedural steps in applying the CVM were as follows:

(a) Choice of Technique: The CVM was the preferred technique mainly because it is the only method which can measure both user and non-user values, including some estimation of option, existence and bequest values. Exploring the use of CVM in a New Zealand context was an added incentive for using the technique as it is relatively novel. Applying a CVM can be labour intensive, time consuming and therefore expensive. For these reasons a mail survey approach was adopted which would minimize cost (e.g. by avoiding interview and travel costs) and, with experience, allow a relatively rapid method to be established. The iterative bidding methods used in personal interviewing was replaced by open-ended questioning on maximum WTP.

(b) Questionnaire Design: The work of Heberlein and Baumgartner (1978), Walsh et al. (1982), Harris (1983) and Walsh (1986) was heavily drawn on to develop a suitable questionnaire and survey method. The key features of the questionnaire were:

- it had to ask the appropriate questions in a clear, easily understood manner. (Comment: the language used had to be modified to incorporate simple, non technical expressions, acknowledging the national average reading age of approximately 13 years (pers. comm. P. Gendall).

- it had to explain lucidly the reason for the survey and impress the importance of responding.

- it had to contain a realistic and credible description of the public good (i.e. the wetland) and then generate a plausible contingent market for it.

- it had to minimise the potential for biases that have attracted criticism of the CVM i.e. hypothetical, instrument, information and strategic bias. These have been described previously in Chapter 2.

- it had to be attractive, appeal to the respondent and be easy to complete.

It can be seen that designing a questionnaire to fit the above criteria, as well as containing enough descriptive text to allow the respondent enough information for the mental cogitations required in a CVM, was not a simple task. However, using examples from case studies (Walsh 1982, Harris 1983, Randall et al. 1974), pertinent literature (Walsh 1986, Bishop et al. 1984, Gregory 1986, Sandrey 1986 and Cummings et al. (editors) 1986) advice from relevant specialists (pers. comm. Gendall, Kerr and Sandrey) and personal experience from numerous surveying exercises as an agricultural analyst, a preliminary questionnaire was prepared along with a covering letter. These are shown in Appendices 1(a) and 1(b) respectively. Following a pilot test of the questionnaire (which will be discussed in detail below) and comments from selected individuals, a final questionnaire and covering letter was prepared. These appear in Appendices 1(c) and 1(d) respectively. The covering letter was designed to inform and motivate the respondents by explaining the usefulness of the research and the importance of their views.

(c) Questionnaire Testing: The preliminary, or pilot, questionnaire and covering letter was sent to forty households sampled from the total sampling frame (see part (d) below). The selection was not completely random, with ten respondents from each of four different regions (Auckland, Hamilton, Palmerston North and Dunedin) being sampled. This was deliberate in order to examine location

and regional influences on responses. However, the individual households were selected from each region on a randomized interval basis. Some pertinent results from this pilot survey are given in Tables 4.1 and 4.2.

Table 4.1 Results from Pilot Survey

	Auckland (%)	Hamilton (%)	P.North (%)	Dunedin (%)	Total (%)
Valid Responses:	50.0	30.0	60.0	60.0	50.0
Not Found:	0	20.0	0	10.0	7.5
Non Response:	30.0	50.0	30.0	20.0	32.5
Invalid:	20.0	0	10.0	10.0	7.5
	100.0	100.0	100.0	100.0	100.0

Note: The overall response rate, once the 'not found' households are excluded, rises from 50% to 54.1%.

The response rates were encouraging overall, however the lowest rate of 30% for Hamilton area was surprising given the intuitive expectation that proximity and controversy may have induced a larger return. However, it can be seen that a relatively large proportion (20%) of Hamilton households were not found, i.e. no one at the address, or address not found. Of the total valid proportion, 75% participated in the WTP bidding game with 25% protesting the WTP concept (usually because "it is unfair"). It was pleasing to see that using a payment vehicle such as the Trust appeared to be successful. The WTP bids ranged from $1 to $150 per annum for wetland preservation, with extra bids for improving the wetland ranging from $1-$50 per annum. These bids were considered acceptable with no outliers, or suspiciously high values consistently showing up.

The survey responses to Question 26 concerned opinions on the structure and composition of the questionnaire. These were included as a feedback system to identify problem areas that could be modified in the final questionnaire. Table 4.2 sets out the response details to this set of queries:

Table 4.2 Pilot Survey Responses to Questionnaire Format

	Agree (%)	Disagree (%)	Don't Know (%)	Missing Value (%)
Some Questions Hard to Understand:	20	65	5	10
Questionnaire Parts Hard to Follow:	20	55	5	20
Questionnaire Too Long:	15	65	0	20
Survey Topic Interesting:	65	15	5	15
Enjoy Filling Out Questionnaire:	55	10	20	15

The results shown in Table 4.2 were also encouraging in the sense that relatively large proportions of respondents were finding the survey topic interesting and enjoyed completing the questionnaire. At the same time, the majority didn't consider the questionnaire, or parts of it, hard to understand or follow. However, it was felt that the 20% of respondents who did find some questions, or parts of the questionnaire difficult to follow, should be acknowledged and modifications made. This view was reinforced by the comments received from Kerr and Gendall particularly (personal communication). The non-response rate of 32.5% (overall) also suggested that efforts at lowering the "costs" of completing the questionnaire were warranted. With all these in mind several strategies were carried out, these included:

- redesign of both the covering letter and questionnaire to allow easier comprehension, a smaller number of questions and more stress on the importance of completing the questionnaire.

- two "in-house" informal surveys of firstly Ministry of Agriculture and Fisheries staff, and secondly a local community discussion group. The groups were presented with copies of the pilot questionnaire and specifically

asked to comment on the most appealing colour (from a range of white, blue, green, yellow and pink); the usefulness of the maps, this was a feature that Gendall (pers. comm.) considered to be potentially confusing; and the difficulty in understanding the questions.

- a redesign of the reminder letters to emphasise the importance that all households respond. The tone of the letters was intended to be slightly more "pleading". The reminder letters have been included in Appendix 1(e).

The results of the informal group testing confirmed the pilot survey results with respect to the understanding of questions, while also indicating that 72% of valid respondents found the maps easy to follow with 67% finding the maps useful in assisting their understanding of the situation. The colour preferred by most people was blue.

(d) Questionnaire Implementation: As the reader would have gathered a postal survey was the implementation technique, with an initial questionnaire and covering letter being mailed to the selected household. About one month after this initial contact a reminder letter was sent to non-respondents encouraging a response. Twenty one days after this, a replacement questionnaire with a more emphatic covering letter was sent to all non-respondents. In all cases a postage-paid reply envelope was included, using Massey University letterhead and stationery. Gillman, in Walsh et al. (1982), followed this last contact with a final certified (registered) letter with a replacement questionnaire, however time and budget constraints excluded that option from this study. In his CVM study of 1982, Walsh et al. achieved a 41% response rate using similar methods, while Kerr in his CVM work on the Kawarau Gorge Hydro Development proposals (Kerr and Sharp 1987) received around 37% valid responses. In this context the final response rate of approximately 54% achieved in this study indicates that the technique was relatively successful and could, with additional strategies such as newspaper

promotion and telephone follow-up, achieve response rates in the 60-70% region, as Dillman managed.

An integral part of implementing the CVM study was the identification of the sampling frame and the selection of an appropriate sample. The purpose of the study was to estimate the extent of national values and preferences therefore some sort of listings of all New Zealand households was necessary to use as the sampling frame. The 1987 Population Census was the best available but cost considerations ruled this out. The other options included the telephone directories and the Parliamentary Electoral Rolls. The latter was excluded because of its obsolescence and very large percentage of duplicate listings, in an individual sense (pers. comm. Duoba). The telephone directories were accepted as a sampling frame on the basis that they were reasonably up to date, reduced the duplicate household problem, the number of unlisted households are relatively few and the sampling costs were acceptable. While not being a complete frame for the survey i.e. the Household Expenditure and Income Survey (Statistics Department 1986) indicates that in 1984 94.2% of households did have telephones, a rise of 4.3% since 1976. At an average annual rate of 0.54% increase, the number of households with telephones in 1987 could be extrapolated to be around 96% of the national total. To represent national estimates the survey findings will need to be scaled/weighted upwards where appropriate empirical information is required e.g. WTP for wetland preservation; total numbers using the wetland.

The sampling procedure was discussed with and finalised by the Department of Statistics. The details of the procedure are presented in Appendix 2, however a brief description of the method follows. Firstly, the various districts represented in the telephone directories were geographically ordered (as far as possible) from North to South. Then, the number of pages in each district were calculated and incorporated in a cumulative total which represented the total national household listings. From here, a systematic

selection of 200 pages was made from a random start. From each of these 200 pages a subsample of seven listings was made using similar systematic selection from a random starting point. This yielded a preliminary random sample of 1400 households. The target number of households to contact was 1300, therefore the extra 100 was designed to allow for businesses and non-household listings to be accommodated in a sub-sampling exercise. The final number selected was 1289 households as the number of non-household listings had been under-estimated. The districts selected and the relevant number of listings are given in Appendix 2. The sample size of 1300 originally selected, represented approximately 0.13% of New Zealand households (the 1986 N.Z. Official Yearbook noted a total of 1,003,113 for 1981). Of the 1300 households it was considered that about 23%, or 300, would be ineligible or not returned thereby leaving a total of 1000 for study purposes. The 1000 (net) was also thought to be a reasonable number to process in a limited time period. As it eventuated the response rate was lower at 54%, with only 659 valid returns. Once the 1289 sample listings had been identified, the total number of addresses (under the title of "The Householder", or the actual name, as necessary for rural deliveries) was loaded into a (Prime) computer labelling system. This allowed multiple labelling to be efficiently operated.

A pilot survey was initiated to 40 households. The correspondence included a covering letter, a questionnaire and a postage-paid reply envelope. Approximately 15 days later a first reminder was posted to non-respondents. About 42 days after this a second reminder letter plus another questionnaire with a postage-paid envelope was mailed to non-respondents. Fifteen days were allowed from this point as a cutoff time, after which responses would not be accepted.

The main, and final, survey was carried out in identical fashion except that the large numbers of documents caused processing problems resulting in a longer than desirable interval between the initial posting and the first reminder.

The first mailing went out over the first two weeks in April 1987. Approximately 20 days later the first reminder was posted to non-respondents, then 21 days later the second reminder plus a replacement questionnaire was mailed. For future mail survey work the researcher would recommend that the time between the first two contacts be around 10-15 days (Walsh et al. 1982; Heberlein and Baumgartner 1978) in order to maximise the respondents' awareness of the survey. From this point approximately 5 weeks were allowed before a cutoff date (the 22nd June) became operable. For the final survey the postage-paid return envelopes were changed from brown, Government (OHMS) stamped items to white envelopes bearing the Massey University embossing. This was done in order to reinforce the non-Government, professional research image with the intention of increasing response rates (Gendall 1986).

The coding of the survey data from the questionnaire onto code sheets was then carried out by the researcher. The code sheets and coding category format were both designed by the researcher and appear in Appendix 1(f).

4.2 THE WETLAND AS A FLOOD CONTROL FACILITY - ALTERNATIVE COST TECHNIQUE

As mentioned previously the wetland is an important component of the Lower Waikato-Waipa Flood Control Scheme (WVA 1981 and 1983) through its use for storage of flood waters. An article in Soil and Water (1986) confirms this valuable function of the wetland when discussing high water levels experienced in the Waikato River in June 1986. A quote from the article:

"In July, flows in the lower Waikato River reached levels similar to those reached during major floods in the 1950's. But, because of the Lower Waikato-Waipa Flood Control Scheme, these extremely high flows caused only minimal damage".

The wetland is given a specific mention thus:

"The Whangamarino Swamp, centre of national action for its conservation, reached its highest level for ten years causing some concern for the safety of the low section of the nearby Swan Road Stopbank .... However, thanks to the flood defences, no major damage was recorded".

It is quite clear that the capacity of the wetland to act in such a role would be compromised by any further development into agricultural/horticultural use through stopbanking and/or drainage. In such a situation storage capacity is reduced which increases the probabilities of overtopping of stopbanks, which would in turn lead to extra economic costs through flood damage. Alternatively, given that wetland storage is reduced, the protection levels of the scheme (or parts of it) would need to be increased to compensate for loss of the wetland's function. In either case an extra economic cost is experienced which is the basis of the approach adopted in valuing this particular use of the wetland.

Following the ideas of Mishan (1975) and Hufschmidt et al. (1983) a straight-forward alternative cost technique is used, in that it is assumed that the scheme's protection level would be maintained by adding to protection structures as appropriate. This assumption is the most realistic strategy (pers. comm. Mr R. Sledger, WVA Engineer) as well as being the easier to measure. For our purposes the extra costs of additional scheme works have been identified by the Waikato Valley Authority, given the situation where the total wetland ponding capacity has been removed. This extra cost represents a proxy of the maximum benefit consumption flows. For interests sake, the alternative evaluation method would assume that with no wetland storage capacity available, flood probabilities and likely areas inundated (in the event of a flood of a particular size) would increase. Such flood events and their economic impacts could be estimated using predictive techniques. The extent and types of damage (e.g. crop and livestock loss, building and machinery destruction, rural and urban transport impedance etc.) could be identified and the

economic costs attached to each. In this sense the alternative technique measures the wetland's benefit consumption flows in the form of saved flood damage costs. This alternative, as well as being unrealistic, is technically more difficult to model and measure, and likely to be politically unacceptable.

The methodology used for the alternative cost technique followed these lines:

(a) Adoption of an alternative cost framework to represent the flood storage value of the wetland.
(b) Identify the particular capital works required to maintain protection levels given a loss of the wetlands ponding function.
(c) Estimate the additional costs, both capital and maintenance, of these works in January 1987 dollar terms.
(d) Apportion the schedule of works over time, and use discounted cash flow techniques to calculate a Present Value of the extra costs.
(e) Incorporate the Present Value obtained as an element of the net national benefit of the wetland.

Section 5.2 presents the details of the costs and calculations carried out.

4.3 COMMERCIAL FISHING VALUES - MARKET VALUE

Section 3.4.1 outlines the basic elements of commercial fishing within the wetland both at present and as estimated in 1979. Table 4.3 below summarizes this information:

Table 4.3 Commercial Fishing in the Wetland

		1979	1987
Eel catch:	Whangamarino:	78 tonnes	10-15 tonnes
	Lake Waikare:	85 tonnes	12 tonnes
Grey Mullet:	Wetland:	$17,500 (unprocessed value)	$10,000 (est.) (unprocessed value)
Catfish:	Wetland	85 tonnes (est.) (processed potential value of $85,000)	unknown (no market existing)

Sources: Waikato Valley Authority, 1981.
The Lower Waikato Eel fishermen's Association (pers. comm. 1987)

With regard to the eel fishery, the Lower Waikato Eel Fishermen's Association (LWEFA) considers that the Lake Waikare sustainable yield is around 20 tonnes per annum with about 18 tonnes per annum from the Whangamarino Wetland. Information on the grey mullet yields and values was not accurately known while the catfish industry was considered to be non-existent. However, the LWEFA did express an interest in any potential catfish markets as at present fishermen dump all of such species caught (pers. comm. Mr Robert Clark). With regard to the scenarios described in the questionnaire i.e. Maps A, B and C, the evaluation framework will comprise the following steps:

(a) Determine the likely, realistic commercial fishing operations that will be a permanent consumption flow from the wetland.
(b) Estimate the likely sustainable yields of these operations and obtain appropriate prices which reflect a net benefit to the nation. These prices will of course depend on the end use of the catch and will need

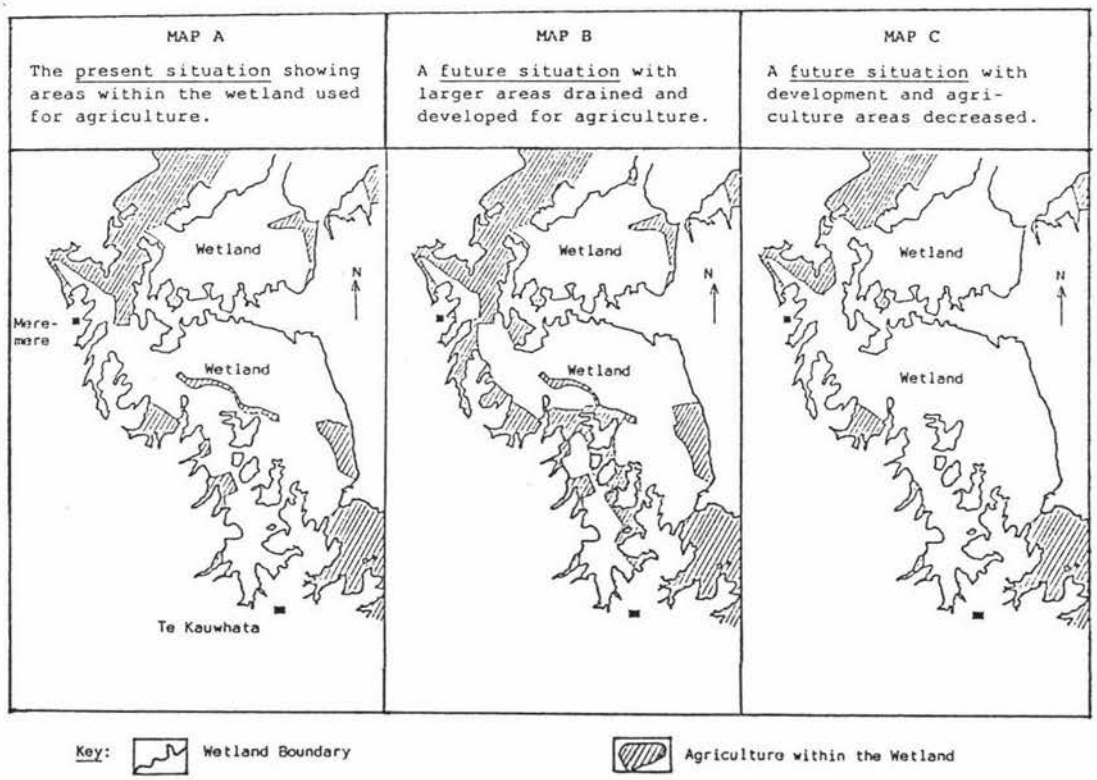
to consider the part that domestic consumption, in particular, plays in the disposal of the product, e.g. do fishermen's households consume a lot of mullet?

(c) Calculate the annual net benefit to the nation from the wetland's commercial fisheries and, through discounting, derive a Present Value.

4.4 AGRICULTURAL VALUE-BENEFIT/COST ANALYSIS

To identify and estimate the effects of wetland preservation on agricultural production two important assumptions were made. The first relates to the situation, or condition of the wetland as illustrated in Map A of the survey questionnaire. The maps are reprinted below in Figure 4.1.

Figure 4.1 Present and Future Development Situations in the Wetland



Map A shows the present situation with respect to agricultural production on both Crown and private lands. The respondent is asked to assess their WTP to avoid the situation depicted in Map B. The assumption made is that the two maps realistically and adequately describe the present and future agricultural production levels. Similarly, the second assumption that Map C effectively describes production under preserved, improved wetland is important when converting the visual differences into empirical ones. These differences are described in more detail below and were principally derived from Harvey 1983 and 1984, Lands and Survey 1985 and 1986, and Waikato Valley Authority 1981:

Map A: (the present situation) models the areas, both developed and undeveloped, on Crown and private land which are used for agriculture/horticulture. These areas include Crown grazing leases and licences as well as private drainage development. The minimum water level criteria required for flood storage functions is 3.62 m above sea level (WVA, 1981) which constrains new development of the wetland to 1200 hectares or less. This water management level also implies that some currently grazed areas will be no longer accessible.

Map B: (the future developed situation) models the areas likely to be developed in the future in addition to those presently farmed. These developed areas are assumed to be all privately owned wetlands given the priority and emphasis placed by the Crown on conservation/environmental values. The 3.62 metres WVA criteria remains thereby limiting development to 1200 ha or less, and causing currently grazed areas to be flooded.

Map C: (the future situation with diminished agriculture) models the wetland with no further development, a decrease in grazing leases and licences from the Crown and an increase in the flooding of currently farmed areas. In this instance the WVA minimum criteria is modelled at 4.25 metres above sea level (Harvey 1983) in a management option to restore water levels in the wetland.

The overall framework of the evaluation will be similar for both scenarios. That is, the first scenario estimates the value of lost and foregone agricultural production in preserving the wetland in much of its present condition. The second scenario estimates the value of lost and foregone production from preserving and improving the wetland's natural values. The method will follow these steps:

(a) Identify the areas of wetland, in hectares, that will be affected in each scenario. Determine what proportion of the total areas will suffer a reduction in agricultural production in the form of a decrease in current yields or a decrease in predicted future yields if development was intended.
(b) Establish what types of enterprises (e.g. dairy, beef, cropping) are associated with the reduction in current and future yields.
(c) Determine the most appropriate evaluation system that will capture the economic loss of reduced yields e.g. buy extra grazing or accept reduced milkfat yields in the case of a grazing area loss.
(d) Apply these systems to the appropriate areas and farming operations to get estimates of revenue losses. The accounting levels will be at F.O.B. values as at January 1987. The timing of the revenues will depend on whether the opportunity costs of foregone production are from current or future operations. If current, then immediate losses will occur, while foregone development revenues will need to be spread over an appropriate time period. Ipso facto, the type and costs of intended wetland development will also need to be identified and evaluated over appropriate time horizons.

The exercise is essentially a standard cost-benefit analysis of an agricultural investment opportunity. Any associated costs and benefits such as livestock salvage, extra (or saved) maintenance costs, livestock capital costs etc. will be described and included in the analysis. The outcome will be a schedule of benefit and cost flows over time, which will be discounted to provide a national net present worth of the foregone agricultural production.

This chapter has described the framework and methodology that will be used in placing values on the wetland's main uses and resources. Undoubtedly it will not capture all the values inherent in the wetland as many people and organisations will receive other benefits and amounts of welfare from different elements in the wetland than those mentioned here e.g. the genetic pool value. However, it is considered that the principal uses and values of the wetland have been identified and a defensible approach established to measure these values. The next chapter will itemize and enumerate the elements outlined here and also explain the origins of the particular prices and costs used.

CHAPTER 5

EVALUATION AND PRESENTATION OF RESULTS

This chapter will employ the techniques outlined in Chapter 4 in enumerating the wetland values specifically for environmental, agricultural, fishing and flood control purposes. In addition to presenting dollar estimates of the wetland's attributes, a discussion of the factors affecting the levels of contingent valuation (in preserving the wetland) will be of particular interest. Accompanying this discussion will be information concerning the survey responses to particular questions on general usage and management perceptions of the wetland. The chapter will conclude with an estimate of the aggregate net national value of the wetland (in $1987 terms) which will incorporate the identified consumer costs and benefits generated by preserving the wetland.

5.1 THE CONTINGENT VALUATION AND WETLAND PRESERVATION VALUES

As noted in Chapter 4, Section 4.1(d), the valid response rate to the postal survey was around 54%. A total of 1,289 questionnaires were sent out and of these 659 were valid responses. A breakdown of response category is given below in Table 5.1.

Table 5.1 Contingent Valuation Survey - Response Categories

Number not reaching destination (Unknown, Incomplete Address)	=	71	(5.5%)
Refusal	=	65	(5.0%)
Non-Returns	=	494	(38.3%)
Valid Returns	=	659	(51.1%)
		1,289	(100.0%)

If the questionnaires that did not reach the intended households (71) are excluded from the response calculations, the survey achieves a 54.1% valid response rate. It was intended to carry out a telephone survey of those households not returning the questionnaire, particularly as they represent a significant proportion of the total sample (that is approximately 38%). Unfortunately both time and resource constraints meant that this intention had to be foregone. The implications to the results of the study are not insignificant and are discussed in depth in Chapter 6. It can be mentioned at this stage however, that in not knowing whether systematic differences exist between respondents and non-respondents, the potential for non-response bias remains. As Edwards and Anderson (1987) mention, a good deal of research in social psychology and marketing has revealed that non-respondents often differ from respondents in social characteristics such as age, educational level, and, of particular concern, interest and participation in the subject of the survey.

5.1.1 Survey Results

This section will present information drawn from the postal survey and which relates to environmental awareness, attitudes and preferences. Socio-economic data will also be collated and comparisons made with national statistics where appropriate. In order to examine the geographical disposition of the survey, in an attempt to ascertain whether a representative "spread" throughout New Zealand has been achieved by the survey method, Table 5.2 below has been constructed:

Table 5.2 National Population Spread Compared with Survey Coverage

Area	1986 Census[1] Largest Population Aggregations (%)	1987 Postal Survey Coverage[2] Mailed Out (%)	1987 Postal Survey Coverage[2] Valid Response (%)
Auckland	26.9	25.1	24.0
Wellington	10.6	10.5	11.7
Christchurch	10.1	10.1	10.6
Hamilton	5.1	3.0	3.8
Napier/Hastings	3.5	4.0	5.2
Dunedin	3.4	3.4	3.5
Palmerston North	2.8	2.9	3.2

(1) These proportions are based on per capita aggregations.

(2) These proportions are of household numbers derived from the sampling frame.

From the above table it does appear that the postal survey distribution has reflected the actual population spread as revealed in the 1986 Census[1] suggesting that the sampling procedure has successfully selected a representative national listing. There are variations between the proportions as shown in Table 5.2, however given that the area definitions, or boundaries, as used by the Census and the telephone listings (see Appendix 2) are very unlikely to be identical, the closeness of the sample statistics to the population parameters is considered satisfactory.

Overall, about 40% replied to the initial contact made, with the balance responding to the reminder letters. The average response time was 34 days from the postage date, although

(1) Monthly Abstract of Statistics, June 1987

the standard deviation at 22 days indicates a fairly large distribution spread. Being aware or unaware of the wetland before the survey had no significant effect on the response time for those responding to the initial contact i.e.: -

Responding Initially and Aware:

Average response time = 10.67 days

Responding Initially and Unaware:

Average response time = 10.06 days

For those responding to the reminder letters a significant difference in response time was apparent between those aware compared to those unaware of the wetland i.e.: -

Responding to Reminder and Aware:

Average response time = 46.6 days

Responding to Reminder and Unaware:

Average response time = 51.5 days

Awareness and Use of the Wetland (Relating to Part I of the Questionnaire). Approximately 30% of respondents were aware of the wetland before being involved in the survey. This leaves the majority of respondents (70%) relying only on the information contained in the survey material to formulate their values of the wetland. This aspect of the survey relates to the issue of information bias discussed in Chapter 2. In such a situation as this, the respondent and hence the valuation is heavily reliant on what the questionnaire presents to him/her. The implications of this are drawn out in Chapter 6.

In regard to current use of the wetland only 2.59% of the respondents spent any time at all in the wetland. Ipso facto the situation exists where a vast majority of those surveyed do not use the wetland (97.41%), nor are they aware of it according to the previous paragraph. The survey information revealed that total use of the wetland, as measured in person-days (P.D.'s), amounted to 171 P.D.'s over the previous twelve month period. The detailed

activities that these P.D.'s relate to are shown, in proportion, below in Table 5.3:

Table 5.3 Recreational Use of the Wetland

Activity	Proportion of Total Person-Days (Per Annum)
Hunting	40.95%
Boating	10.5%
Nature Appreciation	9.4%
Birdwatching	7.0%
Photography	5.8%
Fishing	5.8%
Camping	5.8%
Education	2.9%
Other	11.7%

It is pertinent to inspect the origin of the respondents using the wetland therefore Table 5.4 has been compiled in order to outline the user-origin as well as present the scaled national estimates of total users in P.D.'s:

Table 5.4 Origins and National Estimates of Recreational Users

District	Proportion of Total Person Days (%)	(No.)	Scaling Factor	National Estimate of Person Days (Nos.)
Auckland	63.2	108	370.4	40,003
Hamilton	5.8	10	57.9	579
Hamilton Districts	9.9	17	74.7	1,270
Rotorua Districts	4.7	8	30.5	244
Palmerston North	0.6	1	42.7	43
Wellington	15.8	27	154.0	4,158
	100.0	171		46,297

It is observed that all the users originate in the North Island with an emphasis on central-northern regions which is not unexpected given the wetland's location. It is interesting to note that the Wellington usage is almost solely for hunting, which (in conjunction with Table 5.3) emphasises the reputation of the wetland as a waterfowl area. The calculation of the scaling factors are shown in Appendix 3 and when applied indicate that approximately 46,000 person-days are currently enjoyed in recreational activities. This is a significant number as it exceeds the WVA (1981) estimates for hunting by over 300%. When examining the survey responses to the possible use of the wetland in the future, a large number of respondents indicate they may do so for a variety of activities. Table 5.5 sets out some relevant information:

Table 5.5 Future Use of the Wetland for Recreation (Measured in numbers of Households)(1)

Activity	North Island	South Island	Total
Hunting	29	14	43
Boating	44	18	62
Gundog Trials	14	1	15
Fishing	53	32	85
Photography	102	35	137
Birdwatching	78	18	96
Scientific Purposes	13	6	19
Teaching and Education	56	16	72
Nature Appreciation	193	59	252
Painting	3	0	3
Camping/Hiking	10	20	12
Others	7	1	8
Totals	602 (74.9%)	202 (25.1%)	804 (100%)

(1) Some households are included in more than one activity measure.

It would seem from Table 5.5 that upon being made aware of the location and properties of the wetland, a great number of households express an intention of possible use in the future. The potential users are predominantly from the North Island, while the activities attracting most interest are photography, birdwatching, nature appreciation, fishing, and teaching and education. This would reflect a broader based range of activities with less emphasis on the more "athletic" pursuits i.e. current users were predominantly hunting, boating, birdwatching or appreciating nature.

Valuing the Whangamarino Wetland (Relating to Part II of the Questionnaire) This section was included in the questionnaire to motivate respondents into thinking about why, and how strongly they value the wetland. It was

Table 5.6 Responses to Reasons for Valuing the Wetland

Specific Reason	Percent Responding					Average	Standard Deviation	Ranking
	Not Important(1)	Moderately Important(2)	Very Important(3)	Extremely Important(4)	No Opinion			
Protecting Rare Wildlife:	4.9	11.6	26.8	49.8	7.0	3.31	0.88	1st
Protecting Wildlife Living Areas:	5.3	12.7	31.0	44.4	6.6	3.22	0.89	2nd
Conserving for Education and Science:	7.3	21.7	36.5	27.4	7.0	2.90	0.91	5th
Providing Scenic Beauty:	10.7	26.0	30.4	26.0	6.8	2.77	0.98	6th
Providing Commercial Income:	38.8	31.9	13.2	7.3	8.9	1.88	0.94	10th
Providing Recreational Opportunities:	13.5	33.8	28.6	17.5	6.7	2.53	0.96	9th
Option to go there in future:	15.1	25.4	25.9	25.1	8.6	2.67	1.05	7th
Knowing the Wetland exists:	16.4	27.7	26.4	19.1	10.4	2.54	1.02	8th
Knowing Future Generations will have the wetland:	7.7	19.1	27.3	37.6	8.4	3.03	0.98	4th
Others:	13.6	4.6	9.1	40.9	31.8	3.13	1.22	3rd

intended that this would better prepare the respondent for the immediately following section where they are asked to place a monetary value on the wetland. By examining the responses it is possible to draw conclusions about the relative strengths of the various value-reasons and then compare these strengths with the willingness-to-pay amounts and proportions. Table 5.6 summarizes the reasons why the wetland is valued (or otherwise) by the people of New Zealand. Surveyed households rated the relative importance of each reason on a four-point scale, with (1) not important, (2) moderately important, (3) very important, and (4) extremely important. The average ratings are shown along with the standard deviation and the proportion with "no opinion", while the relative ranking appears last.

Clearly, the population surveyed values the multiple purposes of the wetland. The most important reasons reported for valuing the wetland, in order of importance, were to protect rare wildlife, protect wildlife living areas, other reasons (including prevention of dairy development; banning hunting; close proximity to population centres), and knowing that future generations will have the wetland.

The values associated with preservation/conservation were generally ranked higher than recreation use values. Providing recreational opportunities only ranked ninth, and having the option to go there in the future was ranked seventh. The least important reason reported was to provide commercial income.

The results certainly suggest that the wetland provides significant levels of preservation benefits to New Zealanders over and above the benefits accruing to recreational users of the wetland. This outcome could be construed as not surprising given that around 70% of New Zealanders were unaware of the wetland's existence and therefore have never consumed any of its "user" benefits. However, the fact remains that protecting more wildlife and their habitats are ranked several levels higher than any

user value and suggest that the populace is environmentally altruistic.

Information On Households Responding (Relating to Part III of the Questionnaire) Table 5.7 below has been compiled in order to compare the survey sample socio-economic information with that of the New Zealand population data:

Table 5.7 Comparison of Sample and Population Parameters

Variable	Sample	Population
Male/Female Ratio:	58.8/41.2	76.1/23.9[1]
Average Age (years:	46.3	47.0[2]
Age Distribution (years)	(%)	(%)
15-19	1.4	8.3[2]
20-39	38.4	31.4
40-54	28.1	14.7
55-64	15.1	8.3
65+	16.8	9.8
Average Size of Household:	2.93	2.98[3]
Median Household Income:	$20,000-$29,000	$28,393[2]
Income Distribution[4]		
1st decile	Under $10,000	$8,660
2nd and 3rd decile	$10,000-$19,000	$12,890-$15,930
4th and 5th decile	$20,000-$29,000	$20,260-$25,130
6th and 7th decile	$30,000-$39,000	$29,460-$34,640
8th decile	$40,000-$49,000	$40,860
9th decile	$50,000-$59,000	$51,000
10th decile	$60,000+	$51,000+
Occupation of Respondent	(%)	(%)
Home Duties	15.9	15.6
Retired/Superannuitants	22.9	13.9
Unemployed/Beneficiary	2.3	3.1
Semi-skilled worker	3.5	17.0
Sales/Clerical	8.5	23.0
Technical/Skilled Worker	9.5	11.0
Business Proprietor/ Self Employed	4.2	1.9
Business Manager/Executive	4.5	5.4
Teaching/Nursing/ Police/Service Worker	9.9	8.3
Professional/Senior Government Official	4.8	7.7
Labourer/Domestic Worker	5.3	16.3
Farm Owner/Manager	6.0	5.8
Student	1.7	4.6
Others	0.8	3.8

(1) Sex of "Head of the Household" as defined in N.Z. Household Expenditure and Income Survey 1984-85, Department of Statistics, 1986.
(2) As defined in Reference stated in (1) above.
(3) New Zealand Official Yearbook 1986-87.
(4) Using deciles to examine the distribution was necessary to arrive at a common basis for comparisons given the variety of formats of the information. The population data used Reference (2) as well as the prevailing weekly wage index contained in the Department of Statistics Information Release, Cat. No. 09.501, September 1987, to adjust the incomes to June 1987 dollar terms.

The information indicates that about 60% of the respondents were male, although they are represented at about 76% in the population data. Any bias resulting was considered insignificant as the correlation coefficient produced was small (-0.045), although the negativity indicated that females may pay less for wetland preservation.

The average age of the household respondent, at 46.3 years, was very similar to that of the population at 47.0 years. The age distribution groupings were however dissimilar in that the older age groupings were generally over-represented. This could be expected as the younger age groups are less likely to participate in a "head of the household" role. Correlation analysis between age and WTP indicated an insignificant, although negative, relationship (-0.116 coefficient).

The average size of the household was almost identical to the population statistic with only a 0.05% difference. This could reflect the acknowledged declining birth rate and family size in New Zealand (Dept. of Statistics, 1987).

The median household incomes for both sample and population were similar. The comparison of income distributions was very difficult as the official statistical publications were formated in various but dissimilar methods. However, it is felt that the sample distribution reflects the national distribution closely enough to allay fears of over-representation of particular income groups.

The occupational data provided significant problems in matching sample data with official published data. In particular the occupational type groupings were difficult to aggregate by comparative purposes and the finalised proportions, as presented in Table 5.7, required (at times) subjective allocations of job-types into population categories. It would appear that over-representation of retirees/superannuitants and self-employed/business proprietors has occurred in particular. On the other hand, under-representation of semi-skilled workers, sales/clerical

workers and labourers/domestic workers is indicated. For the other categories it appears that, in general, proportional representation has been approximated.

Looking at the data contained in Tables 5.2 and 5.7, it is possible to conclude that the sample data represents the national population to, at the least, an acceptable level. In particular it is apparent that the geographical spread of the sample is accurate; the average size of the household is very similar; and the household income distribution, which can determine the ability and willingness to pay of a household, reflects the population spread acceptably.

The responses to the question regarding membership of an environmental organisation by members of the household produced a low proportion, about 14%, as belonging while 86%, of course, didn't. Similarly, the query regarding whether household members used other wetlands for recreational activities produced a low positive response rate of around 19%. This information suggests that the large majority of people being surveyed will not naturally be particularly sympathetic to environmental preservation, and will also be heavily dependent on the survey design and information to motivate them enough to sensibly value the contingent market commodity.

Comments on Management and Use of the Wetland

Only approximately 26% of respondents entered any reply to this question in the survey. The replies were categorized into 16 groupings, which are presented in Appendix 4 along with the proportions of households giving that specific response. The broad thrust of the views will be summarised as follows:

- Approximately 89% of responses generally supported environmental preservation and recreational use of the wetland (i.e. Codes 1, 6, 8, 11, 12 and 13 of Appendix 4).
- About 10% of responses considered agricultural and horticultural development important (i.e. Code 2 in

Appendix 4).

- Around 33% of responses suggested not enough knowledge available to make a proper decision and that it is a local issue only (i.e. Codes 3, 4, 5, 7 and 9).
- About 14% of responses objected to the survey and considered the approach too nosey and biased (i.e. Code 14).

Generally, the responses can be seen to be in favour of preserving the wetland for recreational use. It should be borne in mind though that these responses represent only 25.6% of the total households replying to the survey as around 75% of respondents did not complete this question. The potential for bias therefore exists in this area.

The final section of the questionnaire was included to collect some information on respondents' perceptions of the questionnaire design and format, which would be useful for future work. Briefly, most people (75.0%) did not find the questions hard to understand, with 15.8% of no opinion. Similarly, the majority of people (76.0%) did not find parts of the questionnaire hard to follow, with 16.2% of no opinion. About 68% of respondents thought that the questionnaire was not too long while 20.6% were of no opinion. These results were encouraging and generally improved upon (if only slightly) the favourable responses received from the pilot survey (refer Table 4.2).

Public Willingness to Pay to Preserve the Wetland

This section analyses the responses to the willingness to pay question which asks people to contribute to an independent Trust solely for preservation purposes. Specifically they are initially asked to ascertain the amount of money that they would forego (on an annual basis) in order to maintain the current wetland.

A large proportion of respondents (72.8%) gave zero WTP bids implying a zero valuation of preserving the wetland. However, from the relevant query contained in the questionnaire it was discerned that about 24.8% of these

zero valuations were actually households who objected to other elements of the questionnaire rather than giving a legitimate zero valuation. These were eliminated from the calculations of total WTP as their zero bid would incorrectly contribute to actual, aggregated WTP. The various reasons for zero bidding are presented below in Table 5.10, with Reasons 1-6 considered as being valid zero valuations, while Reasons 7-11 were judged to be invalid zero bids.

Table 5.8 Reasons for Zero WTP Valuation

Reason	Proportion of Households(1) (%)
1. Do not receive any benefit/ no value gained	7.2
2 Cannot afford to pay	34.0
3. Unlikely to receive future benefits/too old	6.6
4. Not interested in preserving the area	15.0
5. Prefer agricultural development	1.6
6. Give higher priority to local areas/ projects	8.4
7. Prefer payment by rates/other methods	5.3
8. Only pay if reserved as a sanctuary/ sacred to Maoris	0.6
9. Others (not enough data; unproven value)	2.7
10. Prefer payment by user-pay method	3.0
11. Prefer payment by taxes/State/ Government	15.6
	100.0

(1) Some households gave more than one reason for zero WTP. This table is compiled using the first reason stated on the premise that it was the primary one.

The table shows some interesting points in that a large proportion of valid zero bids were due to income constraints and no interest in preservation. The invalid zero bids were dominated by Reasons 7, 10 and 11 (totalling about 88% of all invalid zero bids) which object to the payment method used. This suggests that a great deal of invalid zero-bidding could be eliminated by using a selection of payment methods, ideally including the ones stated by respondents in Table 5.8 above.

By this stage the number of valid WTP bids totalled 537 with 67.2% of these having a zero valuation of the wetland. The rest (32.8%) have varying valuations and these, and their relevant proportions are shown below in Table 5.9:

Table 5.9 Willingness to Pay for Wetland Preservation

WTP Amount ($)	(1) Proportion of Households with Valid Responses (%)	Number of Households
0	67.2	361
1	0.7	4
2	0.9	5
3	0.2	1
4	0.2	1
5	3.5	19
10	8.4	45
12	0.4	2
13	0.2	1
14	0.2	1
15	0.4	2
20	6.5	35
25	0.8	5
30	0.7	4
50	4.1	22
52	0.2	1
62	0.2	1
75	0.2	1
100	3.4	18
120	0.2	1
150	0.4	2
200	0.2	1
250	0.2	1
260	0.2	1
500	0.4	2
Total	100.0	537

(1) Rounded percentages

It can be seen in the table above that respondents tended to value and use the more "popular" amounts such as $5, $10, $20, $50 and $100. This suggests that when people are faced with an unusual evaluation exercise they may revert to thinking in more comfortable and familiar lump-sum amounts. Generally speaking the spread, or range, of the bids is very pleasing in that no obvious ridiculously high bids have been reported. The two questionnaires containing the $500 bids were examined closely and confirmed as being valid (as any can be given the inherent hypothetical nature of the CVM). The sample average household bid was $12.68, with a standard deviation of $41.37 indicating an exceedingly wide

distribution spread of bids likely to be heavily influenced by the zero bid proportion.

To obtain an estimate of the total national value of the wetland the aggregate sample total was calculated by multiplying the actual bid by the frequency of household response, and summing. This produced a sample total of $6,811. To represent the national estimate a scaling factor of 1868.0 was used i.e. 1,289 households were surveyed originally which provided 659 valid questionnaires, of these 122 were excluded because of invalid zero bids (98%) and missing values (2%) thereby leaving 537 households in the sample. This number was divided into the total number of households, 1,003,113 according to Department of Statistics (1986), or $\frac{1,003,113}{537}$, which produced a scaling factor of of 1868.0. Applying this to the aggregate bid of $6,811 produces a national total value of $12,722,948.

Public Willingness to Pay for an Improved Wetland

A similar procedure of estimation and scaling was applied to the data resulting from Question 20 of the questionnaire where an "improved" wetland was described and willingness-to-pay to achieve this situation was requested. The sample average bid was $6.31 per household with a standard deviation of $28.97. The sample aggregate bid amounted to $3,132. Using a scaling factor of 2022.4, i.e. of the 659 valid questionnaires available, 164 were either invalid zero bids (97%) or missing values (3%). This left 496 valid bids which are outlined below in Table 5.10. The scaling factor was calculated as being $\frac{1,003,113}{496} = 2022.4$.

Table 5.10 Willingness to Pay for Wetland Improvement

WTP Amount ($)	(1) Proportion of Households with Valid Responses (%)	Number of Households
0	81.9	406
1	0.8	4
2	1.2	6
3	0.2	2
5	2.6	13
10	4.8	24
20	1.8	9
25	0.2	2
30	0.6	3
40	0.2	1
50	2.4	12
75	0.2	1
100	2.0	10
120	0.2	1
150	0.2	1
500	0.2	1
Totals	99.5	496

(1) Rounded percentages

Applying the scaling factor to the aggregate bid of $3,132 produced a national total of $6,334,157.

The combination of both bids produced a total of $19,057,105 which can be interpreted as the national value, in consumer surplus terms, of preserving and improving the wetland as described in the questionnaire. Table 5.11 below has been compiled to allow easy reference to the above WTP estimates as well as to illustrate the impact of including non-respondents as valid zero-bids. This is discussed in the section below.

Table 5.11 Dollar Values of WTP for Wetland Preservation and Improvement

	Non-Respondents Excluded	Non-Respondents Included(1)
Wetland Preservation		
Per Household ($ per annum)	12.68	6.61
National Total ($)	12.72 m	6.63 m
Wetland Improvement		
Per Household ($ per annum)	6.31	3.16
National Total ($)	6.33 m	3.17 m

(1) Included as genuine zero bids

The national values so far estimated are based on the sample survey estimates which are in turn supported by the basic assumption that the non-respondents, approximately 38% of the original 1,289 households surveyed, would simulate the distribution of bids as produced from respondent households. This assumption has no empirical, or even conjectural, basis given that a non-respondent follow-up survey was unable to be carried out. However, it is useful to examine the implications of posing a "worst-case" situation where all the non-respondent households are assumed to place no value on the wetland, that is, a genuine zero value. In monetary terms this would diminish the value of preserving the wetland by 47.9% to $6.61 per household per annum and produce a national value of $6,626,762 per annum.

Using a similar approach for valuing the improved wetland would decrease the national value by 49.9% to $3,173,485 per annum. Building in these effects to the study can at least present decision-makers with a range in value in order that they can trade-off more objectively against other values and uses.

At this stage it is pertinent to examine the responses to Question 19 of the survey which asks households to apportion their WTP bid between several purposes. The purposes were

described in such a fashion as to be able to discern whether people are valuing the wetland for actual use purposes, either now or in the future, or valuing it for purely preservation purposes i.e. the existence and bequest values previously described. The results are set out in Table 5.12 below as the average amounts that respondents allocated (of their bids) to each purpose.

Table 5.12 WTP Proportions for Specific Purposes

Purpose	Proportion (%) Average	Std Deviation
Payment for household use this year	5.5	13.4
Payment for option to future use	16.3	19.7
Payment to know it exists (but never use)	25.0	22.3
Payment to preserve for future generations	53.2	26.3

These results complement those obtained when asking for reasons for valuing the wetland and reported on Page 103. The most important reasons were associated with preservation/conservation values with actual use values appearing relatively low in the rankings although option payments for future use were reasonably ranked.

Using the average rankings in Table 5.12 it is interesting to apportion the national aggregate preservation value accordingly:

		Nationally	Per Household
Payment for household use this year	=	$699,762	$0.70
Payment for option to use in the future	=	$2,073,841	$2.07
Payment to know the wetland exists	=	$3,180,737	$3.17

Payment to preserve for future generations	=	$6,768,608	$6.75
Total	=	$12,722,948	$12.69

The application of this exercise to the WTP for an improved wetland should be resisted as the query posed in the questionnaire was directed only at the preservation preferences of the respondents. In the context of improving the wetland, the increment of $6,334,157 p.a.is one guide to the scale of national resources which could be allocated to such a strategy.

So far, the values estimated have been presented in terms of annual dollar payments. To convert these payments, which can also be considered as representing benefit/welfare flows from the wetland, into a present day asset value a 10% discount rate has been applied over a 50 year period.

The 10% discount rate is recommended by Treasury when carrying out national investment analyses. The rate is intended to reflect the national social time preference for money although the true level remains a topic for considerable debate. A lower level is often argued, particularly for environmental, non-renewable resources. In this sense the 10% level may underestimate the long term benefits of preserving the wetland.

The results in terms of Present Value dollars are given below in Table 5.13:

Table 5.13 Present Value (PV) Estimates of the Wetland

	Non-Respondents Excluded	Non-Respondents Included(1)
Wetland Preservation		
Total National PV	$126.135 m	$65.698 m
Wetland Improvement		
Total National PV	$62.797 m	$31.462 m

(1) Non-respondents included as genuine zero-bids

These values are carried forward to Chapter 6 where they are incorporated into the net national value estimate of the wetland.

In order to examine whether particular characteristics of the respondents influenced their WTP for preservation or improvement of the wetland a series of correlation coefficients were produced. These are presented below in Table 5.16:

Table 5.14 Correlation Analysis of Factors Influencing WTP

Factors	Correlation Coefficient (r) Value	
	WTP Preservation	WTP Improvement
Location[1]	-0.052	-0.034
Reasons for Valuing the Wetland		
Protecting Rare Wildlife	0.099	0.091
Protecting Wildlife Habitats	0.126	0.116
Education and Science	0.074	0.064
Scenic Beauty	0.023	0.057
Commercial Income	-0.088	-0.050
Recreational Opportunities	0.040	0.040
Option for Future Use	0.145	0.126
Existence Knowledge	0.090	0.098
Ensuring Future Generations will have the Wetland	0.125	0.083
Socio-Economic Elements		
Sex[2]	-0.045	-0.008
Age	-0.116	-0.089
Size of Household	0.089	0.045
Household Income	0.194	0.186
Member of Environmental[3] Organisation	-0.177	-0.135
Use Other Wetlands for Recreation[3]	-0.166	-0.132

(1) The negativity indicates a lower WTP as we move geographically south.
(2) Codings were: Male = 1, Female = 2
(3) Coded as: Yes = 1, No = 2

With reference to the above table it is of interest to note the general low values of all the coefficients. In this sense there is no evidence suggesting that any of the factors strongly influence the willingness to pay level, or variation in the level. However, of use is the sign of the r value which at least can be interpreted in signifying which direction a variable will influence willingness to pay. We can observe: that household's WTP will decline the further south of the wetland; respondents placing higher values on the commercial potential of the wetland tend to

bid less; as age increases it is evident that willingness to pay is likely to decline; and males are likely to bid more than females. Of particular interest are the last two factors which would indicate that respondents who belong to an environmental organisation and respondents who use other wetlands for recreation show a trend to lower WTP valuations of the Whangamarino Wetland. Intuitively one would expect the opposite effect. However, it may be that these people do not expect to have to pay for a traditionally 'free good' and although prepared to enter the CVM game their bids remain very much related to previous expectations. It should be stressed that the individual r coefficients are very small and the survey information does not therefore explain the variation in WTP levels very strongly. However, the signs of the coefficients remain similar for both the WTP (Preservation) and WTP (Improvement) columns, so some significance can be apportioned to the direction of bid that the factors influence.

5.2 THE FLOOD CONTROL VALUE OF THE WETLAND

As previously described in Chapter 3 the wetland is an integral part of the Lower Waikato-Waipa Flood Control Scheme. The importance of the wetland in this particular function lies in its capacity to receive waters spilled from Lake Waikare during high flood flows. Chapter 4, Section 4.2 outlines the evaluation framework used and this section is devoted to carrying out the evaluation.

In adopting an alternative cost framework the initial assumption was made that the total wetland area would be completely unavailable for a ponding strategy. This situation is currently unrealistic as will be explained later on. However, it does represent a situation which produces the maximum alternative costs necessary, hence a proxy of the maximum benefits.

From discussions with Mr R. Sledger (Chief Engineer) and Mr G. Knighton (Planner) of the Waikato Valley Authority,

the specific sections and portions of the existing flood protection scheme that would need upgrading were identified. Similarly, particular operations such as some maintenance functions were specified as being no longer necessary. Mr Sledger's knowledge and familiarity with the flood protection scheme was particularly valuable especially as one alternative examined by the WVA during the planning stages of the scheme assumed that the wetland would not be available for flood storage.

Using this knowledge and the scheme costs appearing in Waikato Valley Authority (1983), the cost of additional works were identified, scaled up to represent January 1987 dollar terms by the Construction Cost Index (Ministry of Works and Development Series) and spread over a construction period of five years. Both the extra and saved maintenance costs were converted to January 1987 dollar terms and proportioned according to the level of capital works. The saved maintenance costs were based on historical data while the extra maintenance costs were estimated at 1% of capital works. This relatively low level (1%) represents a marginal increase (pers. comm. R. Sledger) as, for example, larger stopbanks have similar maintenance costs as small stopbanks. Appendix 5 presents a listing of the additional works and their costs in both actual $ terms and January 1987 $ terms. It should be noted that the "Actual Stopbanking and Capital Works ($)" column in Appendix 5 has been estimated using total works cost multiplied by 0.35 to produce the upgrading cost (pers. comm. R. Sledger). This 0.35 factor is common to all portions except the Huntley West area (stopbanks, pumps and drainage) which attracted a 0.50 factor (pers. comm. R. Sledger). It can be seen from Appendix 5 that these costs will total around $10 million.

In addition to these costs there must be added an amount designated to raising the level of the Rangiriri Spillway (see Figure 3.4). Using similar scaling estimation this cost amounts to $398,818 which brings the total extra capital cost to around $10.5 million. This amount was divided equally over a five year capital works period while

the extra maintenance costs accumulated proportionately to a maximum $104,825 per annum in year 5. The saved maintenance costs were similarly accumulated over five years reaching a maximum of $64,628 in year 4, the earlier period being due to immediate cessation, theoretically, of existing maintenance on the obsolescent works. Table 5.15 below presents these cost flows in the year applicable. A 50 year scheme life is assumed with no salvage benefits accruing at the end of this period.

Table 5.15 Additional Flood Control Costs ($1987)

Year	Extra Capital Works	Rangiriri Spillway	Extra Mainten-	Saved Mainten-	Net Extra* Costs
0	2,016,730	79,764	0	12,925	2,083,568
1	2,01,6730	79,764	20,965	25,851	1,091,608
2	2,016,730	79,764	41,930	38,777	2,099,647
3	2,016,730	79,764	62,895	51,703	2,107,686
4	2,016,730	79,764	83,860	64,628	2,115,726
5	0	0	104,825		40,917
50	0	0	104,825	64,628	40,917
51	0	0	0	0	0

* Saved Maintenance is deducted from total additional costs.

Sources: 1. Lower Waikato, Waipa Flood Control Scheme Review - Part B, Economic Evaluation, WVA, 1983.

2. Personal communication, Mr R. Sledger (Engineer) and Mr G. Knightson (Planner), Waikato Valley Authority.

The Net Extra Costs were discounted to a Present Value using a 10% discount rate. This resulted in a Present Value of $9,020,007 which represents the full value of the wetland's ability (that is the 6,500 ha capacity) in functioning as a flood ponding area. It is the cost the nation would face in providing equivalent flood protection if the wetland was completely unavailable. Given the physical constraints to wetland development (soil type and peat depth for example) it is unlikely that all the wetland will be converted into

agricultural use. However, any marginal decrease in ponding area is assumed to have a proportional associated economic effect modelled through a marginal increase in upgrading costs. This theme will be explored in Chapter 6 when the various "value" elements of the wetland are amalgamated.

5.3 THE COMMERCIAL FISHING VALUE OF THE WETLAND

Using the methodology and information presented in Sections 3.4 and 4.3, an estimate of the national value from fish species, exploited in the commercial sense, is given below. With respect to the scenarios depicted in the three maps of Figure 4.1 on page 92, it needs to be made clear that the precise effects on the fishery's value of "moving" from Map A to Map B, or Map A to Map C, are largely unknown, with only broad estimates based on local knowledge providing the impact parameters. There has been no fishery survey work done in the wetland since 1979 and no monitoring of fish prices or volumes in recent years. Consequently, the valuations presented are very much dependent on the information provided by Mr R. Clarke, a local eel fisherman and Secretary of the Lower Waikato Eel Fishermen's Association. In this regard Mr Clarke's data are considered to be the best, currently available estimates.

According to Clarke (1987) and WVA (1981) the water level and duration of wetland innundation is very important in determining the sustainable yield of the wetland. This relationship is primarily one of greater available feeding areas and resources producing larger numbers of fish which meet the size criteria required particularly for eels (Clarke, 1987). By maintaining the wetland in its present land use format and managing the water level at 3.62 m a.s.l., i.e. Map A situation maintained instead of a future situation depicted by Map B, the sustainable yields and value estimates are as follows:

Eels: Sustainable Yield = 18 tonnes per annum
Price to Fishermen = $2.50 per kg
Costs to Fishermen = $1.80 per kg (boats, vehicles, gear)

Net return = $0.70 x 18,000 kg
= $12,600 per annum

Discounting this amount at 10% for a 50 year period results in a Present Value of $124,927

Grey Mullet: Sustainable Yield = 20 tonnes per annum
Price to Fishermen = $2.30 per kg
Cost to Fishermen = $1.80 per kg

Net return = $0.50 per kg x 20,000 kg
= $10,000 per annum

Discounted @ 10% for 50 years produces a Present Value of $99,148.

It should be noted that FOB prices for the two species were not available as were the pertinent value-added costs and margins. Consequently, the above data may under-estimate the national value in the sense that an FOB price level may well include a profit margin above all domestic costs of capture and processing.

Catfish: At present there is no market for the catfish and no immediate or medium term prospects for any being established (Clark, 1987). Dumping of catfish back into the wetland rivers is the common disposal method at present, therefore no value has been apportioned.

As the hypothetical future situations "transforms" the wetland from Map A to Map B, where flooded areas and inundation periods are diminished, it is expected that sustainable yields would similarly fall. Just how much they fall is difficult to determine in any accurate empirical sense given the lack of population dynamics and biological information. For the study purposes the lower estimates as expressed by Clarke (1987) have been adopted. These were

related to an exceptionally dry period of nil flooding of the swamp in four out of five seasons. The yields are as follows:

Eels = 10 tonnes per annum
Grey Mullet = 15 tonnes per annum

The economic consequences of these assumptions are transformed into a Present Value of $80,310 which represents the estimated loss in fishing values if the wetland is drained and developed as shown in Map B.

i.e. Eels: (18 minus 10) tonnes p.a. x $0.70/kg = $5,600 p.a.
Mullet: (20 minus 15) tonnes p.a. x $0.50/kg = $2,500 p.a.
Total = $8,100 p.a.
Discounted (at 10%, 50 years) = $ PV 80,310

If we now examine the future situation depicted in Map C, where agricultural areas and development is decreased, we are still faced with the problem of determining suitable yield estimates. In situation Map C the wetland managed water-level is around 4.25 metres a.s.l. (a 17% increase from 3.62 metres a.s.l. in Map A) which would provide significantly larger areas of open-water and permanently flooded habitats (Harvey, 1983). This would obviously provide a greater potential for population increases in the terms of both individual size and total numbers. Just how large this potential is, is unknown at present and arbitrary estimates have been used where mid-points between Map A yields and 1979 yields are adopted and then added to present yields i.e.

Eels: [(78t-18t)÷2] + 18t = 48 tonnes p.a.
48,000 kg x $0.70/kg = $33,600 p.a.

Grey Mullet: [35t-20t)÷2] + 20t = 27.5 tonnes p.a.
27,500 kg x $0.50/kg = $13,750 p.a.

Total = $47,350 p.a.

Discounted (10%, 50 years) = $PV 469,466

The two Present Values are carried through to Chapter 6 where an aggregation of the various estimates are reconciled

under different scenarios and assumptions of wetland usage.

5.4 THE AGRICULTURAL VALUES OF THE WETLAND

As explained in Chapter 4 (Section 4.4) a cost/benefit approach has been adopted in assessing the likely agricultural values of the wetland. These values are primarily production based and do not include other more "social merits" (or demerits) associated with farming in the area. It is unknown what sign or size these would be and it is assumed that they would be greatly outweighed by the market-based production values. The valuations are presented from a marginal viewpoint in that the changes in land utilization associated with a change in scenario (e.g. Map A to Map B) are identified and evaluated.

The first scenario, entitled Model P, can be considered as the preservation situation, and involves the modelling and estimation of the agricultural benefits and costs associated with a change from Map A to Map B (see Figure 4.1). The net values estimated are of course the opportunity costs of present agriculture in addition to future agricultural development revenues which will be foregone if the wetland is preserved in its current conditions.

MODEL P (Preserve)
The major elements include:

(a) Wetland Water Level: This is a managed level at 3.62 metres a.s.l. and implies a deliberate effort to maintain adequate inundation areas and periods for habitat survival.

(b) Flood Ponding Storage: The WVA requires an estimated 6,500 hectares of the wetland to meet its flood control responsibilities which implies a maximum wetland area for development of 1,200 hectares (see Section 3.5).

(c) Agricultural Production: The Crown is unlikely to allow significant areas of the wetland under its jurisdiction to be developed, hence it is assumed that any development will

be of privately-owned areas. Following from (b) above, the maximum area is taken as 1200 hectares. While there is little current information about farmers' intentions, Harvey's (1983 and 1984) data was used to estimate likely future development at around 600-800 hectares over the next 5 years, given that the necessary water rights are granted. Both the benefits and costs associated with intended wetland development will be estimated and included as opportunities foregone.

The implications of the points raised in (a), (b) and (c) above are set out below in terms of physical and economic impacts:

(i) Adverse Occupation: It is assumed that stricter control of grazing leases/licences will stop the illegal, and sometimes deliberate, straying of stock into the wetland. This has the effect of diminishing the number of stock units in the wetland by 700 stock units (Harvey 1983 and 1984, Lands and Survey 1986) on an area of around 280 hectares. The economic effects associated with 'displacing' these stock are modelled using the partial budgets appearing in Appendix 6. It is assumed that the displaced stock will be either grazed on other leased areas or retained on the home farm. The proportions have been equally divided between each strategy and result in the following:

Purchase Grazing = 350 su x \$22.32 = \$7,812 p.a.
Retain on Home Farm = 350 su x \$24.35 = \$8,523 p.a.

Total = \$16,335 p.a.

(ii) Water Level Management: Retaining a water level of 3.62 metres a.s.l. in the wetland will cause permanent wetness or flooding to 512 hectares, both private and Crown, that had been previously grazed (Harvey 1983). The grazing loss evaluation method is identical to that of (ii) above and results in the following:

Purchase Grazing:

Crown (190 ha) - 475 su x $22.32 = $10,602
Private (66 ha)- 263 su x $22.32 = $5,870

Retain on Home Farm:

Crown (190 ha) - 475 su x $24.35 = $11,566
Private (66 ha)- 263 su x $24.35 = $6,404

Total = $34,442 p.a.

(iii) Development: The development option chosen to model in this exercise is an increase in factory-supply dairy farming (Harvey 1983 and 1984, WVA 1981 and 1983). The model includes marginal increases in existing dairy farm areas and thereby does not incorporate increased fixed costs of new milking-sheds, housing and other 'lumpy' infra-structure costs. The development costs have been presented in detail in Appendix 7 and are summarised below (in 1987$'s):

		Cost Per Hectare
Stopbanking and capital works	=	$508
Clearing, Stumping and Cultivation	=	$2,280
Pasture Establishment	=	$353
Others (Fencing, Water Supply, Culverts, Races)	=	$950
	Total =	$4,091
Annual Maintenance (Fertilizer, Fencing, Drains, Pastures)	=	$490 p.a.

The additional stock are assumed to be bought in, and of course sold after the 50 year model period, therefore the capital costs and salvage values of livestock are presented in Appendix 8. In brief, they are:

Capital Cost Dairy Cow Herd = $76.38/su
Salvage Value Dairy Cow Herd = $68.93/su

The estimated benefits are calculated from a gross margin approach detailed in Appendix 9 and result in a return of

$77.55/su increase.

In formulating the predicted cash flows of the development from wetland to productive pasture, several important parameters are adopted. These include:

(a) Land development is completed, in equal proportions per year, over a period of five years.
(b) The livestock increases occur over five years starting from one year after development is initiated i.e.

Year:	0	1	2	3	4	5	6
Carrying Capacity (su/ha):	0	12.0	13.4	14.8	16.2	17.6	19.0

(c) The extra livestock revenues begin the year after the livestock have been purchased and are cumulative until year 11 when they reach a maximum.
(d) The stock unit decreases associated with the cessation of adverse occupation and the revised water level management are taken as occurring immediately (i.e. year 0) and persisting through to year 50.

Appendix 10 contains the estimated cash flows for the situation where 1,200 hectares are developed. If the area developed is varied the model treats such changes in a simplistic, linear fashion with the NPV varying in direct proportion. This approach may well overestimate the revenues from agriculture development as it could be expected that with very large wetland areas being developed then the more difficult tracts i.e. the acid peat bogs of great depth, could prove less lucrative to develop because of unstable stopbank foundations, greater shrinkage, lower nutrient status and lower carrying capacity. The end result being higher costs and lower benefits. Table 5.16 below shows the associated NPV's generated using Model P and assuming different development magnitudes. Model I, the "Preserve and Improve" scenario is also depicted in a similar fashion in Table 5.16.

Table 5.16 Net Present Value (NPV) Versus Hectares Developed

Area Developed (ha)	Model P (Preservation) NPV ($ million)	Model I (Preserve and Improve) NPV ($ million)
600	1.495	1.616
800	1.826	1.947
1200	2.487	2.608
2500	4.636	4.757
5000	8.768	8.890
6500	11.248	11.369

The above table will be referred to more fully in the discussion concluding this chapter, meanwhile the formulation of Model I will be explained.

MODEL I (Preserve and Improve)

This second scenario represents not only preserving the wetland in its current condition but "improving" it as defined by achieving Map C rather than Map B (as shown in Figure 4.1), and as described in the questionnaire thus: "...to improve the wetland both as a place for birds, animals and plants to live, and for people to enjoy. This would mean stopping agricultural development and decreasing areas presently farmed, while also providing better public services such as buildings and walkways. In addition the improved wetland would have larger areas of open-water and safer sites for threatened wildlife." The intention of such a description was to offer a 'commodity' which would provide a flow of higher quality environmental services to society. The implication is that these services are of higher value, as in fact they would necessitate certain additional investment spending and denial of alternative opportunities in order to provide the amenity, and hence provoke a higher WTP from society. The agricultural implications follow closely those identified for Model P except for a higher

managed water level and a larger area of currently farmed grazing loss. The elements of Model I are presented below:

(a) Wetland Water Level: This is managed at 4.25 metres a.s.l. (0.63 metres greater than Model P) with the specific objective of not only maintaining inundation areas for habitat survival but also generating habitat enhancement through greater expanses of suitably preserved plant and animal breeding areas (Harvey, 1984).

(b) Flood Ponding Storage: The WVA requirement of some 6,500 hectares still applies. However, this requirement now exists under the circumstances where a greater area, or more accurately volume, of the wetland is already being used for environmental purposes. The inference is that a greater area of potential agricultural development will be unattainable because of this flood prevention strategy. Harvey (1984) equates the flood "volume" and flood "area" requirements and using his indices it is possible to estimate that managing the water level at 4.25 metres a.s.l. signifies a maximum wetland area for development of around 1000 hectares (c.f. 1,200 hectares in Model P).

(c) Agricultural Production: Given the additional constraints discussed in (b) above the agricultural development implications are identically modelled, with respect to type of enterprise expanded and likely wetland development operations, as adopted in Model P. There are however particular differences involving the scale of current and potential agricultural use which are defined in the following sections.

(i) Adverse Occupation: This is an identical impact as that defined in Model P involving an area of 280 hectares (700 stock units) and amounting to an annual grazing displacement cost of $16,335.

(ii) Water Level Management: Now managed at 4.25 metres a.s.l. the wetland will cause permanent wetness or flooding to about 709 hectares of currently grazed land. This is an extra 197 hectares, compared to Model P, comprising both

Crown and private land. The total loss in grazing is equivalent to 2,000 stock units being displaced at an annual cost of $46,667.

(iii) Development: An identical approach is adopted regarding the analytical framework of future agriculture development as that given in Model P. However, with a greater area being flooded working in conjunction with the continuing WVA need for flood ponding capacity, then Model I confers a larger opportunity cost from foregone development. Table 5.16 presents the Model I results given various levels of lost development potential.

In concluding this section it is appropriate to establish the level of agricultural values which are deemed most appropriate to carry forward into an overall wetland valuation. In formulating the values under Model P and Model I, a simple, linear approach is used which is unlikely to accurately simulate the intricate (dis)economies of very large scale wetland development. Although the results of developing 6,500 hectares of wetland are presented above, it should be made quite clear that they are based on limited underlying assumptions and are useful only in the broadest sense. However, in considering lower levels of development of around 600-800 hectares, it is felt that the models are more useful in that their basis originated from similar scale development (Tilsley and Findley, 1981) and they also reflect the likely scale intended by farmers (Harvey, 1983). Consequently the 600 hectare level is adopted for Model P, and the 800 hectare level adopted for Model I.

i.e.
Model P (Preservation) : $NPV 1.495 million
Model I (Preservation and Improvement): $NPV 1.947 million

These values represent the estimated economic loss to the nation from denying agricultural development to proceed as depicted in Figure 4.1.

To conclude this chapter a summary of the estimated aggregate net national value of the wetland is given:

	Preservation of the wetland ($NPV)
WTP - Contingent Valuation	126,135,000
Commercial Fishing Use	143,765
Flood Control Use	8,187,460
Less	
Agricultural Production Foregone	1,495,000
Net National Value	132,971,225

CHAPTER 6

THESIS DISCUSSION AND CONCLUSIONS

This final chapter will draw on all of the preceding material of the study to present the outcome of meeting the identified objectives and goals as given in Section 1.1. As a concluding section some comments and ideas will be presented regarding the application of the CVM in New Zealand both during this specific study and in the future.

6.1 MEETING THE OBJECTIVES AND GOALS

6.1.1 Selection and Application of a Non-Market Valuation Method

The Contingent Valuation Method (CVM) was eventually selected as an appropriate method on the basis of it allowing certain objectives to be met. The most important of these objectives was to discern the non-user value of the wetland. It was suspected that this value could be empirically significant which has been borne out in that altruism appears to play a large part in respondents' attitudinal and bidding responses (see Tables 5.6 and 5.14). The CVM is the only technique that can extract both user and non-user estimates in any rigid, theoretical framework. The CVM, despite the criticisms and weaknesses discussed in Section 2.2.2, has its origins in utility theory and the Marshallian consumer surplus concepts, therefore the technique also satisfies a requirement for a genuine theoretical base.

One of the considerations in choosing a technique was that of cost, and the CVM was attractive in the sense that the application method chosen, i.e. postal survey, avoided expensive interviewer employment and travel costs while at the same time accumulating national (geographically speaking) value estimates.

The CVM was also considered to be relatively quick, given the constraint of cost, in that a well-organised and planned

postal survey could return acceptable response rates in a reasonable time i.e. 3-4 weeks from first posting. It should be emphasised though that correct and timely survey procedures are mandatory to achieve this (see Section 4.1).

In regard to the analytical aspects of the CVM these were considered to be relatively straightforward and unsophisticated particularly if the survey data can be manipulated by one of the many statistical or survey analysis programmes available on either micro or mainframe computers. The difficult decision area regarding the application of CVM appeared to be in understanding the issues involved in whether a WTP or a WTA question should be adopted and what the value implications were in each case. This problem has historically been avoided by simply assuming that a WTA approach would not be credible in that their "variance" is greater than a WTP measurement (Cummings et al., 1986). The need for greater research and experimental work in this area is apparent and would be a fascinating extrapolation of this study. So, for the present-day researcher a WTP approach is the one generally advocated, with qualifications necessary if major deviations due to variance from the strict theoretical procedure are suspected. The CVM was thus considered to be a useful tool for economic analyses given the intended application.

It is worthwhile to note that the application system chosen in this case, a postal survey, is vulnerable to achieving low response rates which, understandably, can influence the empirical credence of the results. Edwards and Anderson (1987) note that substantial degrees of bias can exist even at 60%-80% response rates - rates that environmental economists usually consider to be acceptable.

6.1.2 Identifying the Wetlands Resources and Uses

This information was gained by a thorough examination of the publications on the wetland, two trips to the area and various discussions with planners, engineers, conservators and wildlife officers. Only one farmer in the wetland was contacted and interviewed although it had been planned, in

the preliminary stages, to sample survey the farming population. This strategy was abandoned however at the request of the then Department of Lands and Survey which administered the large Crown land areas in the wetland and who had just been through prolonged legal problems concerning the allocation of water rights to develop parts of the wetland. It was argued by the Department that research particularly of the type intended in this study, could antagonise local land-owners further and jeopardize the Department's efforts to compile and implement their management plan for the wetland. This was thought to be a reasonable viewpoint and their request was accepted, particularly as the study was heavily dependent on the expertise and information available from the Department.

Chapter 3 encapsulates the information actually gathered in identifying the wetland's resources and uses. It depicts the wetland as being very much a multi-purpose, multi-value amenity in that its natural resources afford or contribute to flood-protection, agricultural production, commercial fishing, as well as recreational and aesthetic pursuits. The flora and fauna existing in, and using the wetland are very varied representing a wide range of species forming complex communal habitats.

Looking at the wetland from a more traditional "exploitable" viewpoint we observe that it contains a range of soils, some of which are more valuable from both a natural habitat and agricultural potential aspect than others, and the valuable resource coal. The coal itself is at present infeasible to extract, however the potentially developable areas for farming purposes provides the catalyst for the land use conflict between agricultural exploitation and preservation/ conservation.

6.1.3 Measuring the National Value of the Wetland

Chapter 4 provides the methodology and approaches used in estimating the dollar values of the wetland. The values identified were associated with four principal origins of benefit flows i.e. agricultural production, commercial

fishing, flood protection and environmental amenity. The environmental amenity value captures the recreational user-value as well as the non-user value gained from people's welfare gains in knowing the wetland exists, ensuring its existence for future generations and in keeping open the option to visit it (use it) in the future. For our purposes these are lumped together and termed the "preservation" value.

Chapter 5 then proceeds to outline the application of the methods given in Chapter 4 resulting in Net Present Value (NPV) estimates (in January 1987 dollar terms). The NPV's are calculated and presented in such a way as to represent two different scenarios. The first scenario is titled the "Preservation Option" and measures the value of the wetland as if it were preserved, in perpetuity, in its present-day condition. The second scenario is termed the "Improved Option" and represents not only preserving the wetland but "improving" it along the lines described in the questionnaire (Question 20) and Chapter 4, Section 4.1(b). This improvement scenario was included to obtain information on the level of resources that could be justified in managing or expanding the natural habitat areas in such a way as to provide a better "quality" wetland. These strategies could include property purchases to eliminate threats to wildlife habitat.

The national valuations are given below in Table 6.1 under the appropriate headings with a listing of the different elements making up the valuation. Explanations and qualifications are given as appropriate:

1. Table 6.1 on Page 138 should read as follows:

Table 6.1 National Valuations of the Wetland

	Preservation Option ($NPV)	Improvement Option ($NPV)
WTP Preservation Non-Use	98,637,570	}188,932,000
WTP Recreational Use	27,497,430	}
Commercial Fishing Use	143,765	389,156
Flood Control Use	8,187,460	7,909,644
Less		
Agricultural Production Foregone	1,495,000	1,947,000
Net National Value	132,971,225	195,283,800

The commercial fishing values are net values, in that the fishing activity and revenues associated with not preserving or improving the wetland (i.e. Map B) are extracted from the estimated revenues associated with fishing the wetland in the preserved present conditions or the improved condition as shown in Maps A and C.

The flood control values are based on the assumption that the land lost from flood control facilitation use is 600 hectares and 800 hectares (respectively for Maps A and C) incurred in maintaining the wetland's water level at 3.62 metres and 4.25 metres respectively. This will impinge on the 6,500 hectare requirement for flood-flow storage and represents a 9.23% and 12.31% decrease in the capacity of the wetland respectively. This is subsequently extracted from the NPV's estimated using the alternative cost technique.

The agricultural production foregone is represented by Model P and Model I in Chapter 5. These assume 600 hectare and 800 hectare lost development opportunities respectively, along with other lost grazing possibilities.

The total national preservation value of the wetland is estimated at around $133 million, with the WTP Preservation Value of $98.6 million dominating. With non-respondents included in the WTP estimates at a zero value, the total national preservation value was diminished to approximately $72.5 million.

2. Paragraph two on Page 139 should read:

"The total national improvement value of the wetland is estimated at around $195 million. With non-respondents included in the WTP estimates at a zero value the total national improvement value was decreased to around $104 million."

The magnitudes of the aggregate values shown above are relatively high when compared to the more "market value" uses the wetland is put to. With a total value in the tens or hundreds of millions of dollars, and a large proportion of this being non-use originated, it appears that the Planning Tribunal's decision to disallow drainage rights to private developers was indeed the correct one from an economic allocation point of view. In reference to the arguments presented in Section 2.2.3 regarding the WTP versus the WTA concepts and the theoretically correct measure to use in this study, it is pertinent to point out that the WTP measures gained will underestimate the national preservation value. The WTA measure was the theoretically correct one to use in the preservation option, while the WTP measure, used in the improvement option, was actually the theoretically correct one for that situation.

To test how the national value looks in a "worst case" situation Table 6.2 sets out the value elements as before (in Table 6.1) given that the total undeveloped wetland, about 7,000 hectares, would be completely developed for agriculture, as described in the study model, if legally possible.

Table 6.2 National Values Given Complete Wetland Development into Agriculture

	Preservation Option ($NPV)
(1) WTP Preservation Non-Use	51,375,836
(1) WTP Recreational Use	14,322,164
Commercial Fishing Use	469,466
Flood Control Use	9,020,007
Less	
Agricultural Production Foregone	11,248,000
Net National Value	63,939,473

(1) Non-respondents included as genuine zero bids

The results above clearly indicate that the recreational/ preservation values, in association with fishing and flood control use values, are significantly greater than that from agricultural opportunities. The equity, or distribution effects, are not discussed.

6.1.4 Public Attitudes to the Wetland

The material presented in Chapter 5 concerning the survey responses regarding use and reasons for valuing the wetland, indicates that even though the public do not visit the wetland to any significant degree, they do express a strong ethic towards acknowledging the non-user values of such an amenity. This emphasis is carried through to their expressed attitudes as given in answer to Question 24 of the questionnaire where it requests comments on the management and use of the wetland. Appendix 4 details the type and proportion of responses.

The general attitude of those replying to Question 24, only about 26% of valid respondents, was one of supporting

environmental preservation and recreational use of the wetland. This attitude was reflected in a high proportion of the responses in that around 75% of those completing the question replied in such a manner. About 5% of the responses indicated support for agricultural development of the wetland, while 10% expressed that they did not have the knowledge available to make a national decision and considered it a local issue. Several respondents did not actually answer the question as asked, but strayed into other areas concerning the survey itself and the type of information being asked. A certain amount of survey resistance was expressed at this stage also.

It should be acknowledged that with only around 25% of respondents revealing their preferences to management and use of the wetland, and a very high proportion of these favouring preservation/conservation, it is quite possible that a survey bias is present. It may be that only those respondents who favour preservation are motivated enough to complete the question. This is a distinct possibility and one which not a great deal can be done to confirm, deny or remedy. However, by examining the responses to Questions 6-15 (Valuing the Wetland) and Question 19 (Proportions of WTP for a particular purpose) it is possible to discern a general placement of value on preservation/conservation purposes. Thus, it is concluded that the public attitude to the wetland is much more in favour of environmental continuity and preservation than exploiting it for agricultural or horticultural development purposes.

6.1.5 Recommendations on Wetland Use and Management

In a succinctly comprehensive paper, Nelson (1986) identifies the conflicting policy issues related to wetland drainage versus preservation in the United Kingdom and United States of America. At present there are incentives provided by both Governments (from different departments albeit) for both purposes. Nelson appeals for elimination of such competition between drainage and preservation incentives of government agencies which can act to drive compensation payments higher than necessary. In the New

Zealand environment, institutionally speaking, many of the incentives for drainage development have already been eliminated (e.g. Grants and taxation incentives). In addition, with the Planning Tribunal decision on the Whangamarino Wetland setting a precedence in that non-market values were adjudged to be higher than market related benefits, it does appear that wetlands in New Zealand are being recognised and appreciated to a greater extent than in the above two countries.

From the monetized values in Section 6.1.3 it is quite clear that the social value of the wetland, preserved as a wetland, is very much greater than any benefits attributable to developing it for agriculture, as modelled. Examining the monetized benefit streams further it is observed that "improving" the wetland, as described in the questionnaire, will provide extra economic benefits of considerable magnitudes, i.e. approximately $69 million. These two aspects plus the public attitudes expressed in Section 6.1.4 provoke the first recommendation:

Recommendation One: The wetland should be preserved as an environmental amenity in, at least, its present condition where the permanent water-level is maintained at 3.62 metres above sea level. It would be economically efficient to raise the permanent water-level of the wetland to 4.25 metres above sea level if the social cost(1) of doing so is less than $69 million in Present Value terms.

The study information on how and why the public valued the wetland indicated that much of the benefit flow was originating from the non-use aspects of the wetland. In particular, the protection of wildlife species and habitats, the preservation for future generations, for science and

(1) The social cost could include extra flood gates, property purchase or compensation for other private rights that are lost.

education purposes, and the general non-exploitable properties of the wetland, in the traditional sense, were all highly emphasised. The WTP responses corroborated these attitudes with a large proportion (around 78.2%) of the average bid being associated with preservation, non-use values. These preferences suggest the basis for the second recommendation:

> Recommendation Two: The wetland should be managed with a view to ensuring protection and preservation of wildlife habitats especially in regard to rare or endangered species. The use of the wetland for scientific and educational purposes could be enhanced, while managing the wetland for commercial purposes is not encouraged.

The study did corroborate the importance of the wetland as a popular hunting area for the (nationally small) proportion of households using or visiting the area at present. However, information on future use of the wetland did indicate that the emphasis on wetland use could change in favour of more aesthetic pursuits such as photography, bird-watching and nature appreciation. These observations prompt the third recommendation:

> Recommendation Three: The wetland should be managed to preserve and enhance the use of the wetland for gamebird hunting only if such use does not deteriorate the value of the wetland as an aesthetic, educational, wildlife habitat. Similarly, commercial fishing in the area, which is likely to benefit from wetland preservation and higher permanent water levels, should not be at the expense of disturbed or disappearing habitats and needs to be managed accordingly.

There is no doubt that the wetland plays an important role in the flood protection strategy of the Lower Waikato-Waipa River Flood Protection Scheme. This value is near the ten million dollar level, in present value terms, and appears to be a function of the wetland which can be managed to both the wetland's and the scheme's advantage. However, conflict can be present even in this situation if it is necessary,

for flood storage capacity for example, to keep the permanent water-level of the wetland below an optimal datum with respect to the environmental wetland values. This situation gives rise to the fourth recommendation:

Recommendation Four: The wetland should be managed to ensure continued provision of appropriate flood protection capabilities. The implications of this are that a 3.62 metres a.s.l. datum should be the minimum permanent water level in the wetland while a 4.25 metres a.s.l., which would add a net social benefit of $PV69 million, is economically attractive. In these strict terms the preservation of the wetland's environmental values could take precedence over the flood control values.

The study indicated that few New Zealand households were aware of the wetland before the survey i.e. 30%, and an even lower proportion used or visited the area (only about 2.6%). However, the survey did show that potential useage was significantly greater once households had been made aware of the wetland's existence and resources. This applied in both the North and South Islands. This situation suggests the fifth recommendation:

Recommendation Five: The Whangamarino Wetland should be promoted for its unique environmental resources and opportunities to pursue aesthetic and educational activities. The provision of these benefit consumption flows will however need to be managed in balance with, and giving accordance to, the sensitivity of habitat and the strong emphasis placed on non-use values as indicated in the survey response.

With the stating of the above recommendations this section of the chapter is concluded. It is considered that the objectives of the study have been achieved with considerable information and data being generated to both assist decision-makers in value-conflict situations and to provoke analysts into considering use of the CVM in economic analytical methods.

6.2 Applying the CVM in a New Zealand Context

This section has been included to present various comments and ideas regarding the use of the CVM in the course of this specific study and for future use in New Zealand.

Firstly, it is felt that the CVM was successful in generating sensible, consistent responses to both the attitudinal questions and the WTP queries. The respondents' attitudes were corroborated by using a questionnaire structure which extracted preference information in different sections and formats which essentially allowed the researcher to place greater confidence on the values described. The WTP values actually offered were considered "sensible" in that the highest bids were two households willing to pay $500 per annum for wetland presentation. These were validated as being acceptable bids. The average bid for preservation was around $12.70 per year per household which, intuitively, appears reasonable.

The sampling frame used was the household telephone listings on a geographically-ordered national basis. This appeared to work well in selecting a representative sample of New Zealand households at a reasonable cost. The sample size at around 1,300 households was considerable and posed logistical problems in administering and analysing the survey information, particularly for only one person. It is suggested that smaller sample sizes be considered for future national work as long as statistical significance can be maintained.

The high non-response rate at about 38% was disappointing especially given the efforts placed on survey and questionnaire design and methodology. To maximise response rates, and minimise the potential for non-response bias, it is suggested that rapid follow-up letters and strategies are implemented after the initial questionnaire is sent out. In addition a format for collecting information on non-respondents should be part of the study e.g. telephone survey; small postcard questionnaire alternative. It should be stressed that these strategies are in addition to initial careful and comprehensive questionnaire and survey design.

At the present time the WTP approach is generally mooted, rather than the WTA query, for the CVM. It is suggested that as experimental economics and research work progress, then the WTA approach may well become accepted as both the theoretically and practically correct approach to adopt in the relevant situation. Anyone anticipating applying the CVM should be aware of any recent publications on this issue and design their study appropriately.

Using the CVM in conjunction with a cost-benefit approach, as in this study, did seem to work. However there are some issues which need to be explored further in future applications such as this. For example, the real values of the benefit flows need to be examined further as it is likely they could rise because wetlands are irreproducible and may not have close substitutes (Thibodeau and Ostra, 1981). Similarly the rising environmental awareness and increased appreciation of natural wildlife habitats over time can increase the perceived value of wetlands. For analytical purposes this implies some sort of discount rate for environmental goods being tied to an analysis of future demand. While it may be infeasible for the analyst to carry this out, it would be valuable to make themselves aware of any recent or established advances in this aspect.

In conclusion it is considered that the CVM has been successfully applied in this study to produce results supporting the subjective decision of the Planning Tribunal. It has been shown that the public benefits, in toto, are considerably greater than the value of the land for likely development. Economic efficiency dictates the preservation of these wetlands (Thibodeau and Ostra, 1981).

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APPENDIX 1(a)

PRELIMINARY POSTAL QUESTIONNAIRE

Project Number: _____

WHANGAMARINO WETLAND QUESTIONNAIRE

The purpose of this survey is to describe how the people of New Zealand use and value the Whangamarino Wetland. Please answer all appropriate questions. If you don't understand a question, explain your answer by writing in the margin. Use the enclosed postage paid envelope to return the questionnaire after you have completed the questions.

PART I: Awareness and Use of the Wetland

1. Before reading this letter were you aware of the existance of the Whangamarino Swamp? (✓)
   Yes ☐
   No ☐

2. For each of the activities listed below, indicate in Column A the average number of days per year that members of your household would spend utilising the wetland. If no time is spent in the wetland leave the column blank.

	A No Days	B (✓)	C (✓)
Game bird hunting			
Boating			
Gundog trials			
Fishing			
Photography			
Birdwatching			
Scientific research			
Teaching and Education			
Nature Appreciation			
Others (please specify) _____			
_____			
_____			
_____			

3. Which one of the activities above do you consider to be the main reason for your household using the Whangamarino Wetland? (Tick tne one that applies in Column B)

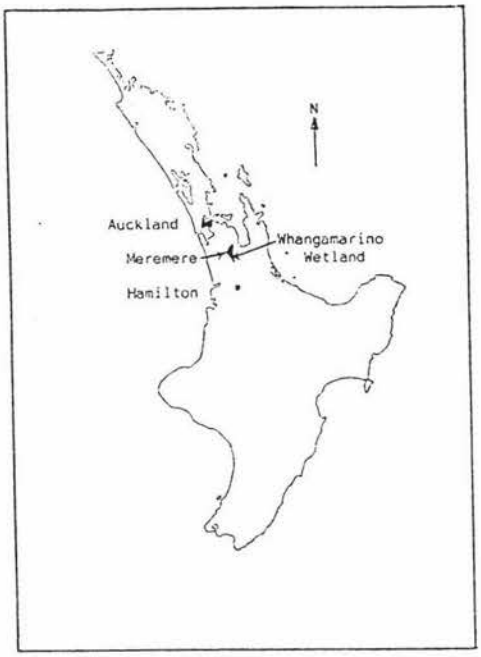
4. If your household members intend to visit the wetland in the future, what are the activities they will participate in? (Tick those that apply in Column C)

PART II: Valuing the Whangamarino Wetland

Many reasons have been given for valuing the existing Whangamarino Wetland. For each of the possible reasons below tick the box which best describes how important it is to your household:

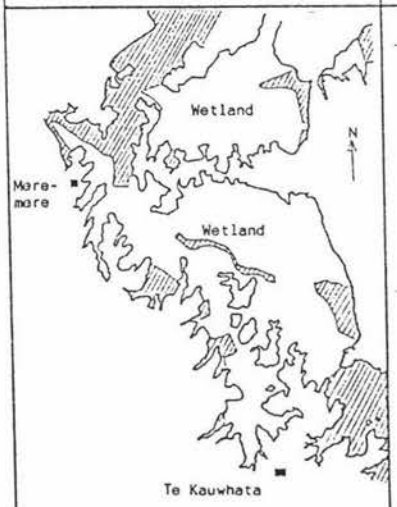
Reasons for Value	Importance: Not Important	Moderately Important	Very Important	Extremely Important	No Opinion
	(✓)	(✓)	(✓)	(✓)	(✓)
5. Protecting rare and endangered species:	☐	☐	☐	☐	☐
6. Protecting wildlife habitat:	☐	☐	☐	☐	☐
7. Conserving natural areas for educational and scientific study:	☐	☐	☐	☐	☐
8. Providing scenic beauty:	☐	☐	☐	☐	☐
9. Preserving unique plant and animal relationships and genetic strains:	☐	☐	☐	☐	☐
10. Providing commercial income (tourism):	☐	☐	☐	☐	☐
11. Providing spiritual inspiration:	☐	☐	☐	☐	☐
12. Providing recreational opportunities: (hunting, fishing, wildlife viewing)	☐	☐	☐	☐	☐
13. Providing flood control services:	☐	☐	☐	☐	☐
14. Knowing that in the future you have the option to go there if you choose:	☐	☐	☐	☐	☐
15. Knowing that the wetland exists:	☐	☐	☐	☐	☐
16. Knowing that future generations will have the wetland:	☐	☐	☐	☐	☐
17. Others (please explain)					
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐

LOCATION MAP



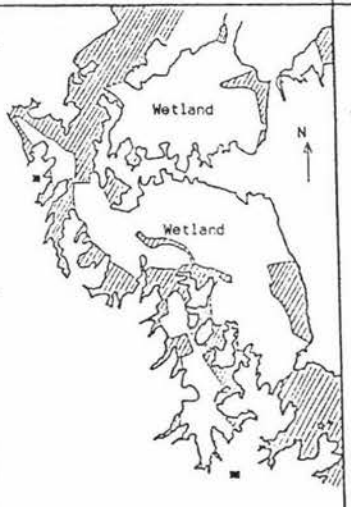
MAP A

The existing situation showing areas within the wetland that are farmed or leased for grazing.



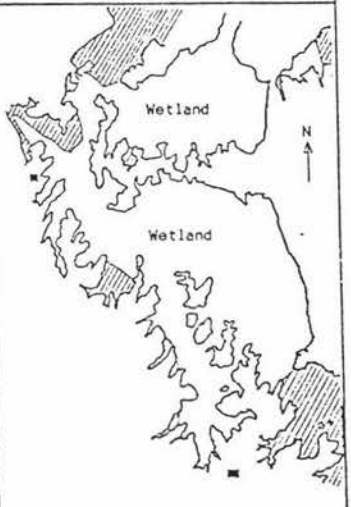
MAP B

A future situation with increased areas drained and developed for agriculture.



MAP C

A future situation with development restricted and grazing leases cancelled.



Key: Wetland Boundary

Agriculture within the Wetland

PLEASE KEEP IN MIND THE NEXT SEVERAL QUESTIONS ARE A HYPOTHETICAL EXERCISE INTENDED TO PROVIDE AN ECONOMIC MEASURE OF HOW STRONGLY YOU VALUE THE PRESERVATION OF THE WHANGAMARINO WETLAND.

Over the past few years there has been increasing pressure to develop large parts of the wetland for agriculture, principally dairying. The benefits of this include increased regional income and job opportunities, while the negative effects (or costs) would be an irreversible change in the nature of the swamp with reduced scientific, recreational and natural habitat functions.

By protecting the wetland area as it exists at present (see Map A), this will prevent feasible development to the situation as shown in Map B.

18. Assume that the only way to protect the wetland is for all New Zealand households to contribute into a special Trust to be used exclusively for that purpose. What is the maximum amount of money your household would pay annually into this Trust?

$	p.a.

19. As people value the protection of the wetland for several purposes, what proportion (%) of the maximum amount reported above in Question 18, would you assign to each of the following purposes?

(a) Payment to visit the existing wetland area this year: _____ %

(b) Payment for the option to visit the existing wetland area, in the future should you choose: _____ %

(c) Payment to preserve the wetland for the value of knowing it exists as a natural habitat for plants, fish, wildlife, etc: _____ %

(d) Payment to preserve the wetland for the value of knowing that future generations will have such an area: _____ %

TOTAL: 100 %

20. In Question 18, you reported the maximum amount of money you would pay to protect the Whangamarino Wetland in its present condition. By both protecting and managing the wetland it is posible to enhance and improve the wetland as a natural habitat and recreational area. This would mean better facilities (eg buildings, boardwalks), increased open-water recreational areas, secured sensitive habitats and other conservation work. In this respect could you report the <u>additional</u> amount (over and above that given in Question 18) that you would pay annually for the enhanced wetland (as shown in Map C):

$	p.a.

21. If your answer to Questions 18 and 20 was zero, answer this question, otherwise skip to Question 22. Did you answer zero because ... (please tick or explain reason)

☐ : You do not receive any benefits from protection of the wetland

☐ : Your cost of living is already too high.

☐ : You have a right to the wetland and it is unfair to expect to pay for its protection

☐ : Disagree with the payment method, ie Trust fund.

☐ : Unlikely to receive any future benefits from the wetland.

Others: (please explain) _____

_____

_____

PART III: Information About Your Household

The following questions ask for some information which will be held confidential and will not be personally identifiable in the study.

22. Please describe yourself and members of your household in terms of the following characteristics:

Household Member		Male (✓)	Female (✓)	Age	Main Occupation	Employment (✓)		
						Full time	Part time	Unemployed
Yourself								
Family members in household	1							
	2							
	3							
	4							
	5							
	6							
	7							

23. What is your annual household income this year (before taxes)?

	(✓)
Less than $10,000	☐
$10,000 - $19,000	☐
$20,000 - $29,000	☐
$30,000 - $39,000	☐
$40,000 - $49,000	☐
$50,000 - $59,000	☐
$60,000 and over	☐

24. Do any members of your household:

	Yes (✓)	No (✓)
belong to an environmental organisation?	☐	☐
use wetlands for sport and recreation?	☐	☐

25. Do you have any further comments on the management and use of the wetland?

_____

_____

_____

Finally, we would be interested in your opinions about this questionnaire.

26. Please indicate whether you agree or disagree with each of these statements:

	Agree (✓)	Disagree (✓)	Don't Know (✓)
(a) Some of the questions were hard to understand			
(b) Some parts of the questionnaire were hard to follow			
(c) The questionnaire was too long			
(d) The topic of the survey was interesting			
(e) I enjoyed filling out the questionnaire			

APPENDIX 1(b)

PRELIMINARY COVERING LETTER

Dear Householder

WHANGAMARINO WETLAND SURVEY

Massey University is carrying out a national survey to provide information on the value and uses of the Whangamarino Wetland. This is a large area (7,100 hectares) in the Waikato region considered by many to be of international environmental importance. The wetland is an outstanding waterbird habitat containing rare and uncommon plant and aquatic life. Scientific and educational groups regularly visit the area, while hunting, fishing and bird-watching are popular.

Over the past years about 30% of the wetland has been drained and developed for agriculture, mainly dairying. The pressure for development remains today and if it proceeds is likely to lead to irreversible changes in the nature of the wetland. While agricultural development will increase regional income and job opportunities, it will also reduce the recreational, scientific and habitat values of the wetland.

To conduct this survey we need your help and would be very grateful if you would answer the enclosed questionnaire and return it in the postage-paid envelope provided. The answers you give will be strictly confidential and only used in the form of group statistics.

Thank you in advance for your co-operation. We look forward to receiving your completed questionnaire as soon as possible.

Yours sincerely

Bill Kirkland

W Kirkland
SENIOR AGRICULTURAL ECONOMIST

A. D. Meister

Dr A D Meister
READER IN NATURAL RESOURCE ECONOMICS

APPENDIX 1(c)

FINAL POSTAL QUESTIONNAIRE

Project Number: _____

WHANGAMARINO WETLAND SURVEY

April 1987

Instructions: Please answer the following questions by either ticking a box or writing in the space provided. If you don't understand a question please explain your answer by writing in the margin.

PART I: Awareness and Use of the Wetland

1. Before reading this survey were you aware of the existence of the Whangamarino Swamp? (√)

Yes ☐
No ☐

2. How many days in the last 12 months have members of your household spent in the Whangamarino Wetland? ..... days

If your answer is "none" or "zero", go to Question 5.

3. For each of the activities listed below, indicate in column A the number of days in the last 12 months that members of your household spent in the wetland:

	A No. Days	B (√)	C (√)
Game bird hunting	____	___	___
Boating	____	___	___
Gundog trials	____	___	___
Fishing	____	___	___
Photography	____	___	___
Birdwatching	____	___	___
Scientific research	____	___	___
Teaching and Education	____	___	___
Nature Appreciation	____	___	___
Others (please specify) _____	____	___	___
_____	____	___	___
_____	____	___	___
_____	____	___	___

4. What is the main activity for which your household uses the Whangamarino Wetland? (Tick the one that applies in Column B)

5. Show any activities that your household may use the wetland for in the future? (Tick those that apply in Column C)

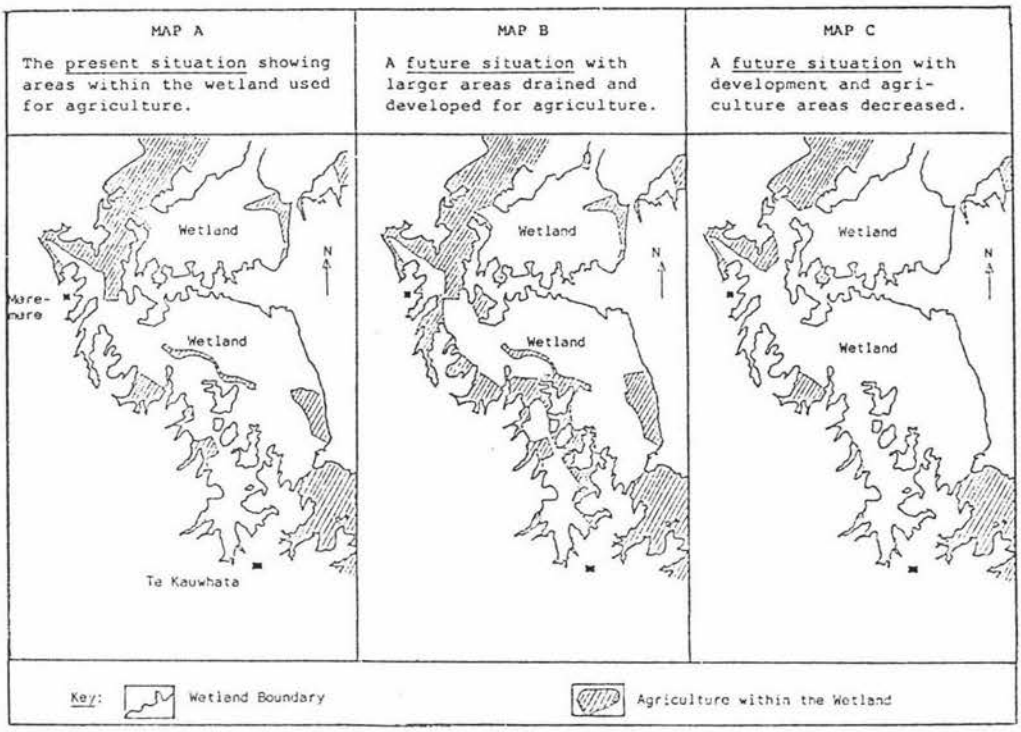
PART II: Valuing the Whangamarino Wetland

Many reasons have been given for valuing the existing wetland. For each of the possible reasons below tick the box which best describes how important it is to your household:

Reasons for Value	Importance: Not Important	Moderately Important	Very Important	Extremely Important	No Opinion
	(√)	(√)	(√)	(√)	(√)
6. Protecting rare wildlife:	☐	☐	☐	☐	☐
7. Protecting wildlife living areas:	☐	☐	☐	☐	☐
8. Conserving natural areas for educational and scientific study:	☐	☐	☐	☐	☐
9. Providing scenic beauty:	☐	☐	☐	☐	☐
10. Providing commercial income (tourism):	☐	☐	☐	☐	☐
11. Providing recreational opportunities: (hunting, fishing, wildlife viewing)	☐	☐	☐	☐	☐
12. Knowing that in the future you have the option to go there if you choose:	☐	☐	☐	☐	☐
13. Knowing that the wetland exists:	☐	☐	☐	☐	☐
14. Knowing that future generations will have the wetland:	☐	☐	☐	☐	☐
15. Others (please explain)					
16. _____	☐	☐	☐	☐	☐
17. _____	☐	☐	☐	☐	☐

3.

Over the past few years there has been increasing pressure to develop large parts of the wetland for agriculture (usually dairying). The benefits of this include increased regional incomes and more jobs, while the disadvantages would be a permanent change in the type and area of the wetland making it less suitable for leisure, wildlife and scientific uses.



Assume that the only way to preserve the existing wetland (see Map A) is for all New Zealand householders to pay each year into a special Trust to be used only for that purpose. The Trust will be independently run and will guarantee the protection of the existing wetland. If households do not pay into the Trust, development will proceed to permanently change the wetland losing much of its present value (see Map B).

18. Would your household be willing to pay into the Trust?:

if [YES] ↓

if [NO] → Go to Question 21

What is the maximum amount your household would be willing to pay each year into this Trust for preserving the wetland in its present condition?:

[$..... year]

19. What proportion (%) of the maximum amount stated above in Question 18 would you share-out between each of the following purposes:

(a) payment for your household's use this year: _____%

(b) payment for the option to use the wetland in the future, should you choose: _____%

(c) payment to know the wetland exists, even though your household will never use it: _____%

(d) payment to preserve the wetland in its existing state for future generations: _____%

TOTAL: 100%

20. In Question 18 you gave the maximum amount your household would be willing to pay to preserve the Whangamarino Wetland in its present condition. However, by spending more money it would be possible to improve the wetland both as a place for birds, animals and plants to live, and for people to enjoy. This would mean stopping agricultural development and decreasing areas presently farmed, while also providing better public services such as buildings and walkways. In addition the improved wetland would have larger areas of open-water and safer sites for threatened wildlife.

Would your household be willing to pay more than the amount you reported in Question 18 to improve the wetland?

if [YES] ↓

if [NO] → Go to Question 21

What is the maximum extra amount (over and above the amount you stated in Question 18) that your household would be willing to pay each year into the Trust for the improved wetland?:

[$..... year]

21. Would you please explain why your household is not willing to pay to preserve or improve the Whangamarino Wetland. (If your household is willing to pay to preserve, but not to improve the wetland, could you please explain why your household is not willing to pay to improve it):

_____

_____

_____

_____

_____

_____

PART III: Information About Your Household

The following questions ask for some information which will be held confidential and will not be personally identifiable in the study. We need this information to make sure that we have a sample which represents all New Zealanders.

22. Please describe yourself and members of your household in terms of the following characteristics:

Household Member		Male (✓)	Female (✓)	Age	Main Occupation
Yourself					
Family members in household	1				
	2				
	3				
	4				
	5				
	6				
	7				

23. What is the <u>total</u> income of everyone in your household this year (before taxes)?

	(✓)
Less than $10,000	☐
$10,000 - $19,000	☐
$20,000 - $29,000	☐
$30,000 - $39,000	☐
$40,000 - $49,000	☐
$50,000 - $59,000	☐
$60,000 and over	☐

24. Do any members of your household:

	Yes (✓)	No (✓)
(a) belong to an environmental organisation (like Greenpeace or the Forest and Bird Society)?	☐	☐
(b) use wetlands other than Whangamarino for sport and recreation?	☐	☐

Do you have any further comments on the management or use of the Whangamarino Wetland?

_____

_____

_____

Finally, we would be interested in your opinions about this questionnaire.

25. Please indicate whether you agree or disagree with each of these statements:

	Agree (✓)	Disagree (✓)	No opinion (✓)
(a) Some of the questions were hard to understand			
(b) Some parts of the questionnaire were hard to follow			
(c) The questionnaire was too long			

THANK YOU FOR YOUR HELP

PLEASE RETURN YOUR COMPLETED QUESTIONNAIRE
IN THE ENVELOPE PROVIDED (NO STAMP IS NEEDED)

APPENDIX 1(d)

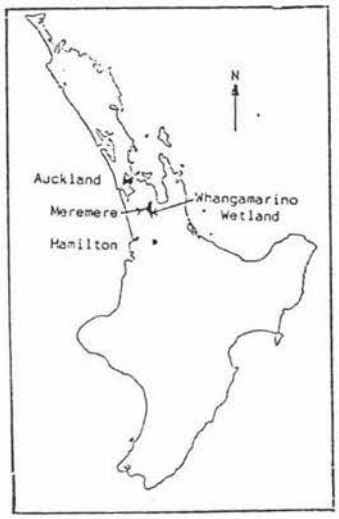
FINAL COVERING LETTER

DEPARTMENT OF AGRICULTURAL ECONOMICS
AND BUSINESS

April 1987

WHANGAMARINO WETLAND SURVEY

Dear Householder



We are carrying out a national survey to find out the value and uses of the Whangamarino Wetland. This is a large area of swamp-land in the Waikato region considered by many to be internationally important. The wetland is an outstanding water-bird location and has both rare and uncommon plant and animal life. Scientific and educational groups often visit the area; while bird-watching, fishing and hunting are popular.

Over the past years about 30% of the wetland has been drained and developed for agriculture (mainly dairying). The pressure for development continues and if it goes ahead is likely to lead to permanent changes in the type and area of the wetland. While more farming will increase the region's income and job opportunities, it will make the wetland much less suitable for wildlife, scientific and leisure uses. With unlimited development the wetland, as it exists today, is likely to be lost.

Our research is very dependent upon you completing the questionnaire and your household's views and opinions are very important. We would be grateful if the questionnaire can be filled in on behalf of your household and returned in the postage-paid envelope provided.

Thank you in advance for your co-operation. We look forward to receiving your completed questionnaire as soon as possible.

Yours sincerely

Dr A.D. Meister
Reader in Natural Resource Economics

W. Kirkland
Researcher

APPENDIX 1(e)

SURVEY REMINDER LETTERS

April 1987

Dear Householder

WHANGAMARINO WETLAND SURVEY - REMINDER LETTER

You should have received in the mail a copy of a questionnaire in regard to our study of the Whangamarino Wetland. To date we have not received any reply from you so this letter is to kindly urge you to fill in the questionnaire and return it in the postage-paid envelope as soon as possible.

Your reply is very important to both the success of the survey and the ongoing research concerning the wetland. The conflicting pressures on the use of the wetland remain today and your opinions and views are needed to help assess the values represented by the wetland.

If you have already returned your questionnaire please ignore this letter.

Thank you for your co-operation.

Yours sincerely

W. Kirkland

(W Kirkland)
RESEARCHER

May 1987

WHANGAMARINO WETLAND SURVEY

****
*
* Please return your completed questionnaire even *
* if you do not know of the wetland at present.   *
*
****

We still have not received a reply to the questionnaire we sent you asking about your use and values of the Whangamarino Wetland. However, because it is so important that all our questionnaires are returned, I am writing to you again to ask for your co-operation.

The enclosed questionnaire will only take a few minutes of your time to fill out and will contribute greatly to the success of our study. I would be grateful if you could answer the questionnaire and post it back as soon as possible.

Yours sincerely

(W T Kirkland)
RESEARCHER

Encl

APPENDIX 1(f)

WHANGAMARINO CODE SHEET

1. Code No. [ ][ ][ ][ ] 4
2. Response [ ]
3. Time [ ]
4. Aware [ ]
5. Days [ ][ ][ ]

		12 A 13
6.	Hunting	: [ ][ ]
7.	Boating	: [ ][ ]
8.	Gundog	: [ ][ ]
9.	Fishing	: [ ][ ]
10.	Photography	: [ ][ ]
11.	Birdwatching	: [ ][ ]
12.	Science	: [ ][ ]
13.	Education	: [ ][ ]
14.	Nature	: [ ][ ]
15.	Sights	: [ ][ ]
16.	Painting	: [ ][ ]
17.	Motorcycle	: [ ][ ]
18.	Hike	: [ ][ ]
19.	Camp	: [ ][ ]
20.	Others	: [ ][ ] 41

		42B
21.		[ ]
22.		[ ]
23.		[ ]
24.		[ ]
25.		[ ]
26.		[ ]
27.		[ ]
28.		[ ]
29.		[ ]
30.		[ ]
31.		[ ]
32.		[ ]
33.		[ ]
34.		[ ]
35.		[ ] 56

		57C
36.		[ ]
37.		[ ]
38.		[ ]
39.		[ ]
40.		[ ]
41.		[ ]
42.		[ ]
43.		[ ]
44.		[ ]
45.		[ ]
46.		[ ]
47.		[ ]
48.		[ ]
49.		[ ]
50.		[ ] 71

		1
51.	Rare	[ ]
52.	Areas	[ ]
53.	Science	[ ]
54.	Beauty	[ ]
55.	Commerce	[ ]
56.	Recreation	[ ]
57.	Option	[ ]
58.	Exist	[ ]
59.	Future	[ ]
60.	Others	[ ] 10

		11
61.	WTP	[ ][ ][ ]
62.	% Use	[ ][ ]
63.	% Option	[ ][ ]
64.	% Exist	[ ][ ]
65.	% Future	[ ][ ] 21

66. WTPX [ ][ ][ ] 22

WHANGAMARINO CODE SHEET (Cont)

2

25

67. Not WTP
68. " "
69. " "
70. " "
71. " "

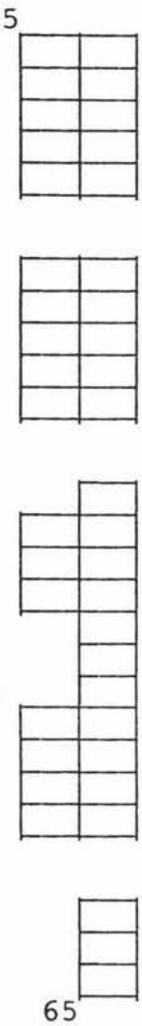
72. Not WTPX
73. " "
74. " "
75. " "
76. " "

77. Sex
78. Age
79. Occupation
80. H.H. Size
81. H.H. Income
82. Environment
83. Wetlands
84. Comments
85. "
86. "
87. "

55

88. Hard
89. Follow
90. Long

65



RESPONSE CATEGORIES FOR CODE SHEET

Variable Number	Name	Response	Code Number
2	Response	I (Initial) R (Reminder)	= 1 = 2
4	Aware	Yes No Missing Value	= 1 = 2 = *
5 6-20	Days) A)	None	= 0
21-35 26-50	B) C)	If an activity is indicated then insert If no activity is indicated insert	= 1 = 0
51-60		For each reason for value, use 1-5 to indicate answer, ie: Not important Moderately important Very important Extremely important No opinion Missing value	 = 1 = 2 = 3 = 4 = 5 = *
61	WTP	$ amounts or if zero	= 0
62-65	%	If blank or zero	= 0
66	WTPX	$ amounts or if zero or blank	= 0
67-71	Not WTP	The various reasons for zero bids are: Do not receive any benefits/ no value gained Cannot afford to pay Unlikely to receive future benefits/ too old Not interested in preserving the area Prefer agricultural development Give higher priority to local areas/ projects Prefer payment by rates/other methods	 = 1 = 2 = 3 = 4 = 5 = 6 = 7

Variable Number	Name	Response	Code Number
67-71 (cont)	Not WTP	Only pay if established as a sanctuary/sacred to Maoris	= 8
		Others	= 9
		No reasons given	= 0
		Prefer payment by user-pays	= 10
		Prefer payment by taxes/Govt./State	= 11
72-76	Not WTPX	The codes are the same as for 67-71	
77	Sex	Male	= 1
		Female	= 2
		Missing value	= *
79	Occupation	Home duties	= 1
		Retired/Superannuitant	= 2
		Social Welfare Beneficiary/Unemployed	= 3
		Semi-skilled worker	= 4
		Clerical/Sales Employee	= 5
		Technical or skilled worker	= 6
		Business Proprietor or Self Employed	= 7
		Business Manager or Executive	= 8
		Teaching/Nursing/Police/Armed Services or other trained service worker	= 9
		Professional person or Senior Government Official	= 10
		Labourer, Manual, Agricultural or Domestic Worker	= 11
		Farm Owner or Manager	= 12
		Student	= 13
		Others	= 14
		Missing value	= *
81	HH Income	Less than $10,000	= 1
		$10,000-$19,000	= 2
		$20,000-$29,000	= 3
		$30,000-$39,000	= 4
		$40,000-$49,000	= 5
		$50,000-$59,000	= 6
		$60,000+	= 7
		Missing value	= *

Variable Number	Name	Response	Code Number
82 83	Environment) Wetlands)	Yes No Missing value	= 1 = 2 = *
84-85	Comments	Highly relevant to preserve for future/maintain as at present/ retire for the future: Important to preserve but consider agricultural and horticultural development Questions and Questionnaire ambiguous and not clear Not enough knowledge of wetlands from the survey Distance precludes use/not acquainted with the area Excursions and trips a possibility No interest in North Island issues Enough agricultural production to meet domestic and export markets Important local issue only Willingness to pay is dependent on the number of similar areas/ proposals Supports maintenance through Govt./ user-pay Support preservation if recreational use guaranteed Encourage science, environmental awareness and public visits Survey had environmental bias/too nosey/objected to money request Well thought out survey Others	= 1 = 2 = 3 = 4 = 5 = 6 = 7 = 8 = 9 = 10 = 11 = 12 = 13 = 14 = 15 = 16
88 89 90	Hard Follow Long	Agree Disagree No opinion Missing value	= 1 = 2 = 3 = *

APPENDIX 2

POPULATION SAMPLING PROCEDURE

All the telephone directories (excluding "yellow pages") for New Zealand were collected, checked for completeness and non-duplication. The districts in the directories were broadly ordered geographically from North to South as shown in Table A1.

Table A1 Geographical Ordering of Telephone Districts

North Island			South Island		
Directory and Date	District	Number of Pages	Directory and Date	District	Number of Pages
Northland '86	Districts	55	Nelson '86	Takaka	6
	Whangarei	65		Motueka	11
				Nelson	60
Auckland '85	Warkworth	18		Murchison	3
	Great Barrier	3			
	Helensville	7	Blenheim '86	Blenheim	40
	Hibiscus Coast	25			
	Auckland	896	West Coast '86	Westport	10
	Pukekohe	35		Greymouth	18
				Hokitika	
Waikato, Thames Valley, K.Country '86	Hamilton	139	Christchurch '86	Culverden	5
	Districts	179		Kaikoura	5
				Cheviot	3
				Amberley	7
				Darfield	7
				Rangiora	19
Bay of Plenty '86	Tauranga	98		Christchurch	363
	Rotorua	58		Akaroa	4
	Districts	73		Chatham	2

Gisborne '86	Gisborne	42
	Ruatoria	5
Taranaki '86	New Plymouth	74
	Districts	46
Wanganui '86	Wanganui	50
	Districts	81
Hawkes Bay '86	Wairoa	11
	Napier/ Hastings	135
	Waipukurau	16
	Dannevirke	12
Manawatu '86	Palmerston North	102
	Districts	7
	Levin	35
Wairarapa '86	Pahiatua	12
	Masterton	34
	Featherston	11
Wellington '86	Paraparaumu	31
	Wellington	373
	Ashburton	31
Timaru/ Oamaru '85	Districts	22
	Timaru	48
	Oamaru	23
Dunedin '86	Districts	54
	Dunedin	133
Invercargill '86	Districts	56
	Invercargill	70
	Total Pages =	1,009
	Total Pages =	2,678

Source: Department of Statistics (personal communication, 1986).
New Zealand Telephone Directories (1985-86)

Table A1 indicates that the total number of relevant pages (of listings) is 3,687. Of these 72.6% correspond to North Island listings, while 27.4% relate to South Island numbers. These proportions are significantly close to the total population distribution which, as estimated in March 1985 (1986-87 N.Z. Official Yearbook), were 25.9% in the South Island and 74.1% in the North Island.

The procedure then systematically selected 200 pages of these total relevant pages i.e.:

$$I \text{ (interval)} = \frac{3,687}{200} = 18.44 \text{ (rounded to 18)}$$

A random start (R) was selected, using ordinary random number tables, within the range [1,2,3....I]. A sequence of 200 numbers was then formed where: R, R+I, R+2I..... R+199I, generated 200 numbers associated with a unique page in the telephone districts. For any of these sequence numbers, the first number in a cumulative total of pages column which was equal to or greater than that sequence number, was found. The row in which the number was found gives the district. The district page number is the sequence number less the previous row's cumulative page value plus the starting page value for the selected district, minus one.

Once the 200 pages were selected the number of relevant entries were estimated i.e. for district d, and page p, the number listings = L(d,p). The interval (I) was calculated where:

$$I(d,p) = \frac{L(d,p)}{7}$$

For each such page a random start, R(d,p), was selected from the range [1,2,3....I(d,p)]. A sequence of numbers was then generated where: R(d,p), R(dp)+I, R(d,p)+2I....R(d,p)+6I, corresponded to seven relevant listings.

The survey preliminary probability associated with a household from district d, page p, is:

$$W(d,p) = \frac{1}{200} \times \frac{7}{L(d,p)} \times \frac{1300}{1400}$$

e.g. For the Auckland urban area L(d,p) had a mean value of 255 listings per page (with a standard deviation of around 64).

Therefore $\underline{W(d,p) = 0.000127}$

The final, or actual, probability factor is calculated using a different formula:

$$W^*(d,p) = W(d,p) \times \frac{V\%}{100}$$

where V% = the response rate to the survey.

e.g. for Auckland urban area: $W^*(d,p) = 0.000127 \times \frac{54}{100}$

$$\underline{W^*(d,p) = 0.000068}$$

APPENDIX 3

SCALING FACTORS FOR WETLAND USE

From the population sampling procedures shown in Appendix 2 it is possible to determine the proportion of national households represented in each of the districts using the wetland i.e.:

District	Proportion of Total National Households (%)
Auckland	24.3
Hamilton	3.8
Hamilton Districts	4.9
Rotorua Districts	2.0
Palmerston North	2.8
Wellington	10.1

The survey data was generated from a sample of 659 households representing 0.000656 of the total national estimate of 1,003,118 (Department of Statistics, 1986). To generate a district scaling factor the inverse of 0.000656 (or 1524.4) is multiplied by the proportion of the total national households the district represents

e.g. Auckland: Factor = 1,524.4 x 0.243

= 370.4

APPENDIX 4

SURVEY COMMENTS ON MANAGEMENT AND USE OF THE WETLAND

Type of Opinion	Proportion of Those Expressing such a View (%)
1. Highly relevant to preserve for the future/maintain as at present/retire for the future	62.7
2. Important to preserve but consider agricultural and horticultural development	10.1
3. Questions and Questionnaire ambiguous and not clear	1.8
4. Not enough knowledge of the wetland from the survey questionnaire	14.2
5. Distance precludes use/not acquainted with the area	7.1
6. Excursion and trips a possibility	3.6
7. No interest in North Island issues	3.0
8. There is enough agricultural production to meet domestic and export needs	9.5
9. The wetland is an important local issue only	6.5
10. Willingness to pay is dependent on the number of similar areas and proposals requiring preservation	1.2
11. Supports maintaining the wetland by national/Government responsibility, or by user-pays method	4.7
12. Support preservation only if recreational uses guaranteed	0.6

13. Encourage scientific research, environmental awareness and public visits	8.2
14. Survey had environmental bias/was too nosey/ objected to asking for money	14.2
15. Well thought out survey	5.9
16. Others	2.4

APPENDIX 5

COSTS OF ADDITIONAL FLOOD CONTROL WORKS

Actual Year[1] of Cost (Dec.)	Construction[2] Cost Factor	Actual Stopbanking and Capital Works ($)	1987 Stopbanking and Capital Works ($)
1963	12.000	38,500	224,399
1964	11.345	225,773	1,201,158
1965	10.714	225,773	1,134,350
1966	10.425	225,773	1,103,752
1967	10.189	277,473	1,263,135
1968	9.643	242,640	1,027,500
1969	8.824	276,073	1,043,487
1970	7.826	282,407	942,817
1971	6.801	282,407	819,333
1972	6.444	180,707	546,950
1973	5.708	36,507	72,934
1974	4.839	13,767	23,316
1975	3.988	13,767	19,216
1976	3.448	0	0
1977	2.974	0	0
1978	2.695	113,042	139,098
1979	2.215	199,117	181,053
1980	1.776	203,234	147,729
1981	1.492	214,867	130,180
1982	1.343	134,542	63,240
1983	1.330	0	0
1984	1.222	0	0
1985	1.098	0	0
1986	1.000	0	0
		3,186,369	10,083,650

Sources:
1. Lower Waikato, Waipa Flood Control Scheme Review, Part B - Economic Evaluation, Technical Report No. 25, WVA, 1983.
2. Ministry of Works and Development's Construction Cost Index (Series).

APPENDIX 6

PARTIAL BUDGET OF DISPLACED LIVESTOCK

Assume: All the livestock displaced are replacement R2 year heifers (16-20 months).
Half of the livestock are shifted to purchased grazing.
Half of the livestock are retained on the home farm.
The average R2 heifer = 3.4 stock units (s.u.).
The seasonal grazing requirement is December through April.

Alternative 1 : Purchased Grazing (Per 100 head)

Grazing Period (Dec-April) = 22 weeks
Grazing Cost @ $3.00/hd/week = 100 x 22 x $3.00
= $6,600

Plus: transport (25 km each way) = $9.90/hd x 100
= $990

Therefore Total Cost = $7,590, or $22.32/s.u.

Alternative 2 : Retain on Home Farm (Per 100 head)

Grazing Requirement = 100 hd x 154 days x 6 kg Dry Matter/hd/day
= 92,400 kg DM

Milkfat Equivalent = 92,400 ÷ 50 (i.e. 1 kg milkfat requires 50 kg DM)
= 1,848 kg MF

Therefore Total Cost = 1,840 kg MF x $4.48/kg (FOB less costs)
= $8,279, or $24.35/su

Sources:
1. Messrs J. Neild and J. Hall, Agricultural Consultants, Ministry of Agriculture and Fisheries, Palmerston North and Hamilton respectively.
2. Ministry of Agriculture and Fisheries, Technical Paper 2/87, 1987.
3. Sheep and Cattle Nutrition, Agricultural Research Division, Ministry of Agriculture and Fisheries, Ruakura (circa 1984).

APPENDIX 7

WETLAND DEVELOPMENT - OPERATIONS AND COSTS

(a) Stopbanking: The stopbanking costs have been estimated from Tilsley and Findley (1981) where the development costs associated with flood control and drainage of the Motukaraka portion of the wetland are presented. The Ministry of Works and Development's Construction Cost Index has been used to update costs to January 1987 terms.

i.e. Stopbanking and Capital Works = $460,000 x CCI of 1.6981

= $781,126 (Jan. 1987)

The area protected = 1,538 ha

Therefore average cost per hectare = $508 per ha.

(b) Clearing, Stumping and Cultivation	$/ha
Network Drainage[1] ($250 x CCI 1.3900)	348
Initial Crushing and Burning	170
Stumping (chipping, or removal, stack and burn)	1,274
1st Rotary hoe	165
Lime (material and spreading)	180
2nd Rotary hoe	116
Harrow	27
	2,280

(c) Pasture Establishment	
Roll, sow and harrow	27
Seed	92
Fertilizer	234
	353

(d) Other Initial Development	$/ha
Fencing	542
Water Supply	53
Culverts	110
Race formation	245
	950

Grand Total ((b) + (c) + (d)) = $3,583/ha

(e) Annual Maintenance Costs

Fertilizer	129
Drain, Fence and Pasture Maintenance	361
	490

Sources: 1. Lower Waikato, Waipa Flood Control Scheme Review, Part B - Economic Evaluation.
2. Tilsley and Findley, 1981.
3. Personal communication, C. Hadley, Agricultural Consultant, MAF, Hamilton.

APPENDIX 8

LIVESTOCK CAPITAL COST AND SALVAGE VALUE

(a) Capital Cost (Per 842 Stock Units)

	$
80 milking cows @ $560	44,800
20 R2 year heifers @ $532	10,640
23 R1 year heifers @ $346	7,958
	63,398
Plus:	
Cows transport (25 km) @ $8.36/hd	669
R2 yr heifer (25 km) @ $6.62/hd	132
R1 yr heifer (25 km) @ $4.93/hd	113
Total Cost =	64,312
Capital Cost Per Stock Unit =	76.38

(b) Salvage Value

Cows:	Saleyard Value @ $560	44,800
	Less transport @ $8.36	669
	Less commission @ 7%	3,136
		40,995
R2 yr Heifers:	Saleyard Value @ $532	10,640
	Less transport @ $6.82	136
	Less commission @ 7%	745
		9,759
R1 yr Heifers:	Saleyard Value @ $346	7,958
	Less transport @ $4.93	113
	Less commission @ 7%	557
		7,288
	Total Per 842 su =	58,042
	Therefore Salvage Value Per su =	68.93

Sources: 1. Ministry of Agriculture and Fisheries, 1984.

2. _____,
Technical Paper 2/87, 1987.

3. _____,
Technical Paper 1/87, 1987.

APPENDIX 9

GROSS MARGIN - FACTORY SUPPLY DAIRY COW

Assumptions: Milkfat per cow = 150 kg
Calving % = 95%
Death Rate = 3%
Replacements = 20%
Stock Units = 8.42 su

Revenue to FOB		$
150 kg milkfat @ $7.13		1,069.50
0.71 bobby calf @ $65.00		46.15
0.20 cull cow @ $579.00		115.80
	Total Revenue =	1,231.45
Costs Works to FOB		
150 kg milkfat @ $2.44		366.00
0.71 bobby calf @ $31.00		22.01
0.20 cull cow @ $205.00		41.00
		429.01
On-farm Costs		
Artificial Insemination		18.00
Animal Health		22.00
Shed Expenses		10.00
Power		20.00
Feed		45.00
Transport (milkfat @ $0.21)		31.50
Transport (0.2 cow @ $14.98)		3.00
		149.50
	Total Costs =	578.51
	Gross Margin Per Cow =	652.94
	Gross Margin Per Stock Unit =	77.55

Sources: 1. Whangamarino Rural Water Supply Scheme, Resource Use Paper 5/84, P.K. Wilson, Ministry of Agriculture and Fisheries, 1984.

2. Livestock and Cropping Gross Margins - 1986/87 Manawatu, Ministry of Agriculture and Fisheries, 1986.

3. Product Price Assumptions 1987. Technical Paper 2/87, Ministry of Agriculture and Fisheries, 1987.

APPENDIX 10 REVENUE AND DEVELOPMENT CASH FLOWS (1200 hectares)

Year:	0	1	2	3	4	5	6	7	8	9	10	11	49	50	51
Area Developed (ha):	240	240	240	240	240	0									0
Stopbanking and Capital Works ($):	121920	121920	121920	121920	121920	0									0
Pasture Development ($):	859920	859920	859920	859920	859920	0									0
Annual Maintenance ($):	0	117600	235200	352800	470400	588000									588000
Livestock Capital ($):	0	219974	245638	271302	296965	322629	102655	76991	51327	25664	0				0
Development Revenues ($):	0	0	223344	(increasing incrementally to)									1768140	1768140	0
Adverse Occupation & Flooding ($):	0	50783												50783	0
Livestock Salvage ($):	0												0	1572000	0

Present Value of Development Costs (at a 10% discount rate) = $10,090.071

Present Value of Development Revenues (at 10%) = $12,579,149

Therefore Net Present Value = $2,487,078

Note: The Net Present Value is positive indicating an Internal Rate of Return above 10% (it actually approximates 13.7%)