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PRIVATE AND SOCIAL VALUES OF WETLANDS RESEARCH REPORTS

Non-market values of wetlands: A choice modelling study of wetlands in the Upper South East of South Australia and the Murrumbidgee River floodplain in New South Wales

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Abstract

Community decisions about wetland management are based on weighing up the benefits and costs of alternative wetland management strategies. But not all wetland benefits and costs are easily compared as wetlands provide both monetary and non-monetary benefits. In this Research Report, estimation of non-monetary values are described for two case study areas, the Upper South East (USE) of South Australia and the Murrumbidgee River Floodplain (MRF). Estimation of non-monetary benefits of management changes commenced with selection of a methodology appropriate to the types of values being considered. Implementation of the selected methodology, Choice Modelling, is described including the goals of the valuation exercise, questionnaire design and survey management. Model results are used to estimate sample non-monetary values for the two case study areas. Significant non-monetary values are reported for wetland management changes in both the USE and MRF case study areas. These non-monetary values provide a basis for the estimation of the net benefit from changing wetland management in the next two Research Reports.

About the Private and Social Values of Wetlands Research Project

Wetlands generate values enjoyed by their owners and the wider community. Individual wetland owners manage wetlands for income generating purposes such as grazing and in some cases hunting and eco-tourism. These are private values from wetlands. Private owners, through the way they manage their wetlands, can change the availability of their wetlands for recreation or wildlife habitat that the community enjoys. These are social or community values of wetlands. In this project, the trade-offs wetland owners and the community face when making decisions about how to use their wetlands are being examined. This information will help the community to achieve better use of wetland resources on private lands.

There are five main steps to achieving our main goal of better wetland resource use on private land:

1. Model the changes in the physical attributes of wetlands resulting from alternative uses (biophysical modelling);
2. Estimate the community's value of the commercial (private) and non-market (social) outputs of alternative wetland uses (economic valuation);
3. Incorporate the value estimates into the biological modelling framework to establish the value trade-offs of alternative uses (bio-economic modelling);
4. Investigate alternative institutional frameworks that would give private wetland owners incentives to manage their wetlands in ways which maximise net community benefit; and,
5. Generalise the research findings to wetlands Australia wide.

Two case studies in differing locations with differing mixes of alternative wetland uses and wetland values have been selected for analysis:

- The Upper South East (USE) of South Australia; and,
- The Murrumbidgee River floodplain between Wagga Wagga and Hay in New South Wales

1 Introduction

Society faces a range of choices about how it uses wetland resources. Different mixes of wetland uses generate differing sets of values to wetland owners and to the wider community. In previous Research Reports of 'The Private and Social Values of Wetlands' research project, the current and potential biophysical characteristics of wetlands were examined in two study areas:

- The Upper South East of South Australia (USE) (Research Reports 1 and 2): and,
- The Murrumbidgee River Floodplain in New South Wales (MRF) (Research Reports 4 and 5).

The biophysical outcomes of alternative wetland management strategies for the USE and the Murrumbidgee River Floodplain have been assessed (Research Reports 3 and 6). In this report, the response of one subset of social values, environmental values, to changes in the biophysical outcomes is considered.

Community decisions about wetland management will be improved if they are based on weighing up the relative outcomes of available alternatives. Benefit-cost analysis is concerned with an assessment of the relative merits of alternative wetland management strategies. A change in management from one alternative to another will lead to a change in the extent and mix of values enjoyed by wetland owners and the wider community. The concept of change within a benefit-cost analysis framework is integrated using the concept of change at the margin. Changes at the margin are the changes to the set of outputs resulting from a change in inputs.

In order to aggregate monetary and non-monetary benefits and costs within a benefit-cost framework it is necessary to estimate both monetary and non-monetary values. The focus of this Research Report is on the potential non-monetary benefits and costs of management change for wetlands in the two case study areas. An important component of the research is the estimation of these non-monetary values in a way that can be compared against monetary values that can be drawn from these wetlands.

The values generated by wetlands consist of those that are traded within the market place (monetary values) and values that are not traded within markets (non-monetary values). Monetary values are relatively easily identified and assembled, from information generated within markets. However, non-monetary values are more difficult to define and estimate. Environmental values fall into this class.

Previous Research Reports (Research Reports 2 and 5) in this series have addressed the issue of monetary and non-monetary values drawn from wetlands by wetland owners. In this Research Report, the focus is on environmental values drawn from wetlands by the wider community. The research in this report builds on the estimation of monetary and non-monetary values of duck hunters in the Upper South East of South Australia (Research Report 7).

The next section of this report provides a brief background that explains the rationale and structure within which the values are estimated. The third section of the report discusses the theoretical requirements and selection of an appropriate valuation methodology. The methodology is developed in the fourth section including survey development, design and sample construction. The resulting non-monetary wetland valuation estimates are reported in Sections 5 (USE) and 6 (MRF). Section 7 places the non-monetary valuation estimates in the wider context of wetland management and the next phases of 'The Private and Social Values of Wetlands' research project.

2 Background

When undertaking a benefit-cost analysis, the initial issue is to define the alternative management options that are available. The alternative management options will lead to differing biophysical outcomes from a continuation of current management. The differing biophysical outcomes yield differing sets of values to wetland owners and the wider community. By examining how the alternative outcomes differ from a continuation of current wetland management (known as the "business as usual" or BAU case) the values that change can be identified and valued. The outcomes that change as a

result of altering wetland management are referred to as attributes. Once the relevant attributes have been identified, the BAU can be determined in terms of these attributes.[1]

Sections 2.1 and 2.2 of this report briefly identify the set of alternative management strategies. The changes in biophysical attributes that would occur if these strategies were adopted are also defined. The outcomes of the alternative strategies are compared against the BAU outcomes. In the final part of this section, the various attributes that need to be estimated in monetary terms for inclusion in the benefit-cost analysis are examined. That is, the environmental values that the remainder of this Research Report focuses on are identified.

2.1 Wetlands in the Upper South East region

In the USE large areas of wetlands have been cleared, drained and converted to pasture for agricultural production. Only about 44,000 hectares of healthy wetlands, or less than seven percent of the original wetland area, will remain in the region. The conversion of wetlands to pastoral production was motivated by the private values so obtained. However, the private and social values generated by natural wetlands in the region have been significantly reduced. The issue is whether the balance between private and social values is optimal. If not, society may wish to encourage alternative wetland management practices that will lead to increased net benefit to society as a whole.[2]

Table 1: Difference between 'BAU' and alternative strategies in the USE

Descriptive Attributes	**Unit**	**Wetland retention**	**Pro-wetlands**	**Wetlands and remnants**	**Cumulative farm forestry**	**Farm forestry alone**
Agricultural pasture	ha	0	-12,633	-29,725	-44,725	-15,000
	(%)	*(0.0)*	*(-2.3)*	*(-5.5)*	*(-8.2)*	*(-2.8)*
Healthy wetlands	ha	12,633	25,267	28,425	31,584	3158
	(%)	*(28.6)*	*(57.1)*	*(64.3)*	*(71.4)*	*(7.1)*
Degraded wetlands	ha	-12,633	-12,633	-15,792	-18,950	-3158
	(%)	*(-66.7)*	*(-66.7)*	*(-83.3)*	*(-100.0)*	*(-16.7)*
Healthy remnants	ha	0	0	51,275	51,275	0
	(%)	*(0.0)*	*(0.0)*	*(100.0)*	*(100.0)*	*(0.0)*
Degraded remnants	ha	0	0	-34,183	-34,183	0
	(%)	*(0.0)*	*(0.0)*	*(-100.0)*	*(-100.0)*	*(0.0)*
Farm forestry	ha	0	0	0	15,000	15,000
Annual pasture	ha	0	0	0	-15,000	-15,000
	(%)	*(0.0)*	*(0.0)*	*(0.0)*	*(-100.0)*	*(-100.0)*
Perennial pasture	ha	0	0	0	15,000	15,000
Total productivity	dse	-16,392	-79,629	-257,444	-258,231	2346
	(%)	*(-0.5)*	*(-2.4)*	*(-7.7)*	*(-7.7)*	*(0.1)*
Number of ducks hunted	No.	1400	2600	2900	3300	300
	(%)	*(50.0)*	*(66.7)*	*(100.0)*	*(100.0)*	*(-50.0)*
Other hunting	ha	0	0	51,274	51,274	0
	(%)	*(0.0)*	*(0.0)*	*(294.5)*	*(294.5)*	*(0.0)*
Fencing required	km	442	948	2289	2399	111
Total tourist numbers	No.	11,900	26,150	35,150	35,150	0
	(%)	*(187.4)*	*(411.8)*	*(553.5)*	*(553.5)*	*(0.0)*
Improved conservation status of species*	No.	15	17	22	22	0

* Conservation status of flora vertebrate and fauna species only

In Research Report 3, a set of potential management strategies was identified for the USE. The strategies considered changes to USE resource management including:

- Improved management of existing wetlands;

[1] If any management changes have already been decided upon then the BAU case is includes such changes.

[2] For more information about the actual and potential characteristics of wetlands in the USE, see Research Report 3.

- Improved management of existing remnant vegetation;
- Conversion of agricultural pasture to wetlands;
- Conversion of agricultural pasture to revegetation; and
- Large scale farm forestry and other deep-rooted perennial species.

Other management changes were rejected because they would not have a significant impact on the biological factors that drive wetland values, or they were not sufficiently differentiated from one or more of the above set.

The grouping of various levels of these management changes together into defined strategies together with their impacts on the biological factors that drive wetland values is termed biophysical modelling. The change in biophysical outcomes of the alternative strategies that were defined for the USE compared to the 'no change in wetland management' option is reported in Table 1. The BAU in the USE (no change to wetland management option) is a shift to improved management of some wetlands as planned under the flood and salinity control scheme (Upper South East Dryland Salinity and Flood Management Plan Steering Committee 1993) because these changes are already under-way.

Table 1 includes several environmental outcomes such as the area of healthy wetlands, the area of healthy remnant vegetation, the conservation status of species and, to some extent, the number of waterbirds hunted. Changes to these environmental outcomes in the USE are estimated in this report. For example, if the 'wetlands and remnants' management strategy were adopted the area of healthy wetlands would increase by 28,425 ha, the area of healthy remnants by 51,275, the number of endangered species fall by 22 but approximately 6000 more ducks would be hunted. The changes in environmental outcomes are compared at a point in time 30 years from now.

2.2 Wetlands on the Murrumbidgee River Floodplain

There are about 47,000 hectares of wetlands on the MRF between Wagga Wagga and Hay (Thornton and Briggs (1994) adjusted in Research Report 6). Many of these wetlands have been subject to degradation because of current and historical land and water management practices. Only about 2500 hectares of wetlands remain healthy. As in the USE region, the change in land and water management was motivated by private values generated from irrigation, grazing and timber production. However, unlike the USE region where the private values are confined to wetland owners, private values in the Murrumbidgee are divided between wetland owners (benefits resulting from grazing, logging and some irrigation) and irrigators downstream. The social values of wetlands have fallen because of reduced bird breeding, fish breeding and reductions in water quality and wetland health. The community may wish to consider institutions and incentives that would alter land and water management practices and potentially lead to increased benefit to society as a whole.

A set of alternative management strategies was also derived for the MRF. These strategies were reported in Research Report 6. On the MRF the strategies considered were:

- Return natural flooding to some wetlands;
- Reduce or remove the impact of grazing on wetlands;
- Reduce or remove the impact of timber harvesting on wetlands; and,
- Combined strategies comprising the three strategies above.

Additional strategies were rejected on the basis that they either would not have a significant impact on the biological factors that drive wetland values, or they were not sufficiently differentiated from one or more of the above set.

The change in biophysical outcomes for the MRF compared to the 'no change in wetland management' option is reported in Table 2. The definable impacts were regarded as those that would occur over a 15-year period (rather than the 30-year period used for the USE). The shorter time period relates to the relatively faster response anticipated in the MRF wetland systems. The scientific uncertainty with respect to the environmental outcomes on the MRF is much larger than in the USE. As a result, significant uncertainty as to the biological outcomes remains. This uncertainty will need to be taken into account when reporting the expected benefits of adopting alternative management strategies.

Table 2: Difference between 'BAU' and other strategies on the MRF

Descriptive Attributes	Unit	Water management	Grazing management	Timber management	Combined strategies
Water purchased from	Ml	41,700	0	0	41,700
irrigation	*(%)*	*(1.7)*	*(0.0)*	*(0.0)*	*(1.7)*
Set stocking rate	ha	0	-8259	0	-8259
	(%)	*(0.0)*	*(-38.1)*	*(0.0)*	*(-38.1)*
Rotational or crash	ha	0	-2296	0	-2296
grazing management	*(%)*	*(0.0)*	*(-9.6)*	*(0.0)*	*(-9.6)*
No grazing	ha	0	10,555	0	10,555
	(%)	*(0.0)*	*(172.4)*	*(0.0)*	*(172.4)*
No logging	ha	0	0	8745	8745
	(%)	*(0.0)*	*(0.0)*	*(42.5)*	*(42.5)*
Fallen timber harvesting	ha	0	0	-596	-596
	(%)	*(0.0)*	*(0.0)*	*(-18.0)*	*(-18.0)*
Sustainable timber	ha	0	0	-6111	-6111
Harvesting	*(%)*	*(0.0)*	*(0.0)*	*(-42.6)*	*(-42.6)*
Unsustainable timber	ha	0	0	-2039	-2039
harvesting	*(%)*	*(0.0)*	*(0.0)*	*(-50.0)*	*(-50.0)*
Total productivity	dse	0	-15,539	0	-15,539
	(%)	*(0.0)*	*(-28.1)*	*(0.0)*	*(-28.1)*
Sawn timber yield	ha	0	0	-15,280	-15,280
	(%)	*(0.0)*	*(0.0)*	*(-43.9)*	*(-43.9)*
Residual timber yield	ha	0	0	31,156	31,156
	(%)	*(0.0)*	*(0.0)*	*(-42.7)*	*(-42.7)*
Fencing required	km	0	718	0	718
	(%)	*(0.0)*	*(42.0)*	*(0.0)*	*(42.0)*
Environmental Outcomes					
Healthy wetland area	ha	2500	6500	0	11,000
	(%)	*(100.0)*	*(260.0)*	*(0.0)*	*(440.0)*
Number of water and woodland birds	(%)* change	50.0	25.0	25.0	75.0
Number of native fish	(%)* change	50.0	25.0	25.0	100.0

* Percentage changes from current numbers.

Note: The outcome of the combined strategies may differ from the sum of the individual strategies due to synergistic effects.

Table 1 includes several environmental outcomes such as the area of healthy wetlands, the number of water and woodland birds, the number of native fish, and to a lesser extent the quantity of timber harvested. Changes to these environmental outcomes on the MRF are estimated in this report. For example, if the 'combined strategies' were adopted the area of healthy wetlands would increase by 11,000 ha, the number of water and woodland birds increase by 75% and the number of native fish increase by 100%.

2.3 Estimating the change in value if alternative management strategies are implemented

Each of the alternative management strategies in the USE and the MRF will lead to an alternative set of biophysical outcomes from the status quo as indicated in Tables 1 and 2. The change in biophysical outcomes indicates how much better (or worse) a strategy is, in physical terms, when compared to the BAU or 'no change to management' strategy. The comparison point for the current population is the outcomes associated with the BAU position at a defined future point in time. A future point in time is used because the outcomes generated by the BAU management strategy will continue to change over time. The difference between the status quo and alternative management strategies is referred to as the margin. It is the value of this marginal change in outcomes that is being quantified as a measure of which strategy is preferred (when compared against the available alternatives). The range of environmental outcomes for which the marginal change must be defined is indicated in Tables 1 (for the USE) and 2 (for the MRF).

Conversion to a common comparative unit

Once the physical marginal change has been defined these changes must be converted to a common unit of value to enable comparison. An increase in waterbird numbers can only be compared with a reduction in agricultural production by conversion to a common unit of value. Economists use dollar values as the common comparative unit. Estimation of the monetary values of the changes identified in the biophysical modelling phase of the project is part of the economic modelling phase.

It is important to recognise that the economic modelling component involves the estimation of the change in community well being that would result from each potential management strategy. Economic modelling is based on the theory of economic surpluses. An economic surplus occurs where either the producer or consumer of goods or services receives a net benefit from adoption of a strategy. That is, a consumer surplus exists where consumers receive benefits in excess of the costs (monetary and non-monetary) while a producer surplus exists where the benefits of production (in terms of sale of goods and services and any other benefits) exceeds all costs of production (monetary and non-monetary).

To simplify the economic modelling, the values to be estimated are divided into monetary and non-monetary values. Monetary values are estimated within the market place. Non-monetary values are more difficult to estimate. Furthermore, not all values can be strictly divided into monetary or non-monetary values. In some cases the producer surplus may be monetary while the consumer surplus is non-monetary. Hence some values (for example tourism) are part private and monetary (producer surplus from accommodation etc.) and part public and non-monetary (consumer surplus from wetland visitation). The environmental values that are the focus of this report (indicated in Tables 1 and 2) are non-monetary social values. The next section focuses on the selection of an appropriate methodology for estimating these values in monetary terms.

3 Method selection

The environmental values in Tables 1 and 2 are split between pure private values and social values. Values that are purely private are those held by the owners of the wetlands. The trade-offs associated with the values of wetland owners are reported in Research Reports 2 and 5 for the USE and MRF respectively. Social environmental values include all values that extend to individuals other than wetland owners. Hence such values can also be private values and include hunting, non-monetary tourism and recreation values, aesthetic and non-use values such as existence and biodiversity values. In Research Report 7 an estimate of the consumer surplus associated with hunting was reported (Whitten and Bennett 2001). Hence the remainder of this Research Report focuses on the estimation of social, non-monetary, tourism, aesthetic and non-use values of wetlands in the two case study areas.

3.1 Revealed and stated preferences

The techniques available to estimate the value changes associated with changes in the environmental outcomes can be divided into two main groups: those using revealed preferences and those using stated preferences (see The environmental outcomes for which monetary estimates are reported in this Report do not rely on marketed goods in any way except for tourism benefits. Hence demand for these outcomes is not revealed in the market place and cannot be estimated via revealed preference methods.

Box 1 for more information). For changes in environmental outcomes to be estimated by revealed preferences, they need to be directly related to actions in the market place. For example, in the travel cost analysis of hunting in the USE region, the benefits of hunting lead to decisions by hunters to spend money on petrol, food, hunting fees and other items in order to participate in the Wetlands and Wildlife Organised Shoot.

A second issue is that markets normally cover actions that have already occurred. It would not be possible to estimate the potential willingness to pay for hunting via the travel cost method if hunting did not already occur. Hence, the impacts of a future change that would enhance hunting opportunities could not be estimated using this methodology without extrapolation.

The environmental outcomes for which monetary estimates are reported in this Report do not rely on marketed goods in any way except for tourism benefits. Hence demand for these outcomes is not revealed in the market place and cannot be estimated via revealed preference methods.

Box 1: Revealed and stated preferences

Revealed preferences: Demand for the environmental outcome is *revealed* via behaviour in a market necessary to enjoy the environmental good (Turner, Pearce and Bateman 1994). For example, the value of a wetland view can be estimated by comparing the price of houses with a view to similarly located houses with no view of the wetland (using the hedonic price method). Another example of revealed preferences is the costs incurred by visitors to a wetland (estimated with the travel cost method). This method was used to value hunting in the USE wetlands in Research Report 7.
Stated preferences: Demand for the environmental outcome is estimated via a survey of the community in which respondents *state* their preference about environmental outcomes. For example, the value of a change in an environmental outcome is estimated by asking a sample of the community about their willingness to pay to achieve, say, a specified increase in waterbird breeding events, or to prevent a specified reduction in waterbird breeding events.

3.2 Stated preference methods

Stated preference techniques avoid direct use of the market place. They involve individuals being asked, in a survey, to place a value on the change in environmental outcomes (Turner, Pearce and Bateman 1994). The use of surveys allows alternative environmental outcomes that are not related to markets in any way to be compared (Morrison, Blamey, Bennett and Louviere (1996)). There are five main stated preference techniques. They can be divided between contingent valuation (CV) based methods and conjoint based methods. The advantage of CVM methodology is that it is well known in Australia and internationally with a relatively extensive listing of applications. However, the CVM can only assess the outcomes of one proposed alternative management strategy at a time. Hence, use of CVM to value the potential changes summarised in Section 2 would require a separate survey for each strategy –a prohibitively expensive strategy. CVM is outlined in more detail in Appendix 1.

There are four potential conjoint methods that can be used: contingent ranking, contingent rating, paired comparison and choice modelling (CM). Each method involves respondents evaluating a number of alternative management strategies but only CM directly generates theoretically unbiased estimates of the willingness to pay (WTP) of each option (providing a BAU option is included) (Morrison, Blamey, Bennett and Louviere 1996). CM involves a sample of people being asked to choose their preferred option from a sequence of sets of alternatives. The alternatives are described in terms of a common set of outcome 'attributes' that take on different levels in each alternative. By analysing the trade-offs respondents are willing to make in their choices, it is possible to generate estimates of value so long as one attribute is monetary. The unbiased WTP estimates generated by CM is suited for use in a BCA framework. CM also provides additional information about preferences for the components (attributes) that make up the outcome. This information can be used in two ways:

1. To develop new management strategies leading to outcomes preferred to those initially examined.
2. To compare other management options that may arise against those initially tested (so long as the outcomes of these new options can be measured and described using the same attributes as the existing options).

Each of the conjoint methods is described in more detail in Appendix 1. The next section of the paper discusses the application of CM to the problem identified in Section 2.

4 Methodology

In Section 3 the advantages and disadvantages of alternative estimation methods were discussed leading to the selection of CM as the most appropriate methodology. In this section an overview of the application of CM to the environmental valuation problem, summarised in Section 2 is provided. More detail about attribute selection, survey design and implementation can be found in Appendix 2. The major components in the application process are research design, attribute selection, attribute levels, questionnaire design and survey implementation.

4.1 Overview of Choice Modelling theory

The underlying theoretical basis of CM is random utility analysis.[3] Random utility analysis states that consumers make choices that would lead to their utility being maximised. That is, consumers will choose option 'A', if, and only if, option 'A' generates at least as much utility as any other option. The utility generated by an option is assumed dependent on the characteristics or attributes of the good (x), the characteristics of the individual (s) and an unobservable component (e). The unobservable component is assumed random and usually assumed independently and identically distributed (IID). Hence, the utility of option 'A' can be specified:

$U_A = V(X_{A,} S_A) + e_A$ where 'V' is an indirect utility function.

In addition, the probability that an individual 'i' will choose option 'A' from the set of choices 'J' is:

$P(A|A, A \in J) = P[(V_{Ai} + e_{Ai}) > (V_{Ji} + e_{Ji})]$

That is, the probability that an individual will choose 'A' from the set of options J is equal to the probability that the utility they obtain from 'A' (including the random component) is higher than for

Estimation of choice probabilities is via a multinomial logit model as follows:

$P_A = \exp(\lambda V_A) / \Sigma\exp(\lambda V_J)$

Where: $j = 1,\ldots,n$

V = the systematic component of utility

λ = a scale parameter that is usually arbitrarily set to 1

Multinomial logit models rely on the independence of irrelevant alternatives (IIA). IIA arises from the assumption independence and identical distribution (IID) of the error term. IID of the error term means that it has an 'extreme value error distribution' (Ben-Akiva and Lerman 1993). IIA means that the probability of choosing an alternative is dependent only on the options from which a choice is made, and not on any other options that may exist. If IIA is violated, the estimates derived from the model could be biased and not generate accurate values for inclusion in cost benefit analysis. IIA violations can be corrected for via the use of more complicated nested logit models.

4.2 Research design

The most critical elements of the research design are the definition of the BAU and alternative outcomes. These elements define the change in attributes that is to be valued. These elements were discussed in Section 2 of this Research Report and in more detail in Research Reports 3 (USE) and 6 (MRF). Bennett (1999) indicates that there are two further questions regarding research design that need to be answered:

1. Are there specific features of the outcomes to be valued that might change the values associated with other features? For example, the inclusion of water skiing in a survey primarily relating to the fishing and passive recreation in an area might lead to a significant reduction in the value of fishing and/or other passive recreation.
2. What is the geographic extent of the values to be estimated? That is, how far from the wetlands do the benefits extend?

In the USE case study the inclusion of increased hunting as a potential outcome of changed management may cause a problem. This is because some individuals may view the inclusion of hunting as eliminating values associated with other outcomes such as increased healthy wetland area or improved conservation of endangered species. In the MRF, the perceived impact of the outcomes on farm viability could lead to similar impacts. In both cases, the use of focus groups to define the nature and likely significance of these effects is important. The findings of the focus groups undertaken for this study are discussed in Sections 4.3 and 4.4.

The geographic extent of the values to be estimated is unclear for both the MRF and the USE. Prior studies indicate that the values associated with wetlands with similar characteristics extend beyond the region within which they are located (See for example Morrison, Bennett and Blamey (1998), Bennett,

[3] The information about CM is primarily drawn from Bennett (1999) and Morrison *et al.* (1996).

Blamey and Morrison (1997) and Stone (1992)). In some circumstances, for example where migratory birds are involved, the values may extend beyond Australia. The likelihood of low per capita values and the practicalities of overseas surveys normally limit the estimation of values to those held within Australia.

The treatment for both potential problems is to conduct parallel surveys. The surveys differ in terms of outcomes and in terms of the population sampled. This strategy can be expensive. So the trade-offs associated with ensuring an appropriate research design versus cost-effective valuation must be carefully considered. The use of focus groups can be instructive in determining the trade-off.

4.3 Attribute selection

In Section 2, the changes in environmental outcomes to be valued were briefly summarised. These outcomes must be defined succinctly to allow the environmental goods to be assessed and compared. The definition is generally via the use of several attributes. The attributes of significance to policy makers must be communicable to the wider community and wetland owners and be measurable (Bennett 1999). The attributes selected for inclusion in the choice modelling survey must fulfil two similar objectives:

- They must represent changes in outcome that respondents value (that is they must have meaning to respondents) (Bennett 1999); and,
- They must cover the range of changes in outcomes that are of significance to respondents.

An overview of the process followed in selecting attributes is provided in this section and more detail is provided in Appendix 2.

Focus groups

Focus groups were convened in order to ensure attribute selection was not biased by the previously determined policy attributes and to assist in designing the survey (see Box 1). Four focus groups were held: two in Canberra and one each in Adelaide and Griffith. Each group consisted of 8 to 10 people that were loosely representative of the population eligible to vote in terms of age and sex. During the recruitment of participants incentive payments ($35 per participant) were mentioned after the person had agreed to attend. The focus groups were structured into three sections: attribute selection and ranking, assessment of information provided to respondents and tests of questionnaire design.

Box 1: Focus groups

Focus groups are a planned discussion involving between eight and ten participants. A Facilitator guides the discussion. Groups are held in a neutral, non-threatening environment. Participants are encouraged to share their opinions and attitudes about the topic being discussed –in this case wetlands. Groups are often held in specially designed rooms where participants seated around a large table and last between one and a half and two hours. Groups are generally audio or video recorded to allow opinions expressed to be examined in detail. (Morrison, Bennett and Blamey 1997a)

The attributes selected following the focus groups must be measurable as shown in Tables 1 and 2 in order to facilitate the BCA. The attributes selected for inclusion following the focus groups are shown in Table 3. Because the nature of the wetland management changes proposed was taken to imply an adverse impact on farmers a 'farmers leaving' due to management changes replaced an earlier draft attribute (water diverted from irrigation). The 'farmers leaving' attribute was designed to increase the plausibility of the survey. This was despite the modelling indicating a very small impact on farm production.

Table 3: USE and MRF survey attributes

Attributes for USE survey	Attributes for MRF survey
• Cost to the respondent • Area of healthy wetlands • Area of healthy remnants • Threatened species that will benefit • Number of ducks hunted	• Cost to the respondent • Area of healthy wetlands • Population of native water and woodland birds • Population of native fish • Number of farmers leaving

4.4 Survey design

The design and structure of the questionnaire is determined, in part, by the intended survey methodology. Preliminary quotations from a number of market research firms indicated that any type of individual approach would be outside the project budget (for example face to face, drop-off pick-up and drop-off mail-back). The detailed information that respondents are required to use along with the inherently difficult nature of the trade-offs required in the CM process also precluded telephone-based surveys. Hence, the selected survey delivery mechanism was mail-out, mail-back. The survey[4] consisted of the following sections (based on Bennett (1999)):

- Letter of introduction;
- Preamble including background and contextual information (framing);
- Statement of the problem;
- Statement of the potential solution;
- Introducing the choice sets;
- The choice sets;
- Debriefing questions;
- Socio-economic and attitude based data; and,
- Opportunity for additional feedback.

Each of the sections above were developed and refined in three main phases:

1. An initial survey draft was designed based on questionnaire designs from Blamey, Rolfe, Bennett and Morrison (1997) and Morrison *et al.* (1997a).
2. The draft questionnaires were answered and feedback collected as part of each focus group. The draft surveys were then refined prior to the following focus group. Focus group discussion targeted the preamble, statements of the issue and solution and the choice sets.
3. The final questionnaire was formatted into the layout required to undertake a mail-based survey. A graphic design artist undertook the final questionnaire preparation phase in close consultation with the authors.

Detailed information on each part of the survey design is provided in Appendix 2 and some discussion of the most important section, the choice sets, is provided below.

The choice sets

The choice sets are the heart of the CM questionnaire and are designed to elicit the choice based information. The trade-offs that are expected of respondents are difficult. Hence, simplicity and clarity are two key aspects of choice set presentation. Choice set methodology followed Bennett (1999). Choice sets were generically labelled (except the BAU option) and a 'blocked' fractional factorial design was used in the survey. A draft choice set format was developed based on previous CM surveys from the Choice Modelling Research Project. Because these questions are the most important part of the questionnaire, and because they are often difficult for respondents to answer, a number of alternative formats were designed and trialed during the focus groups. The initial draft version, shown in Respondents found the initial design difficult to interpret and answer. Particular problems related to respondents' difficulties in identifying what they received for payment of the levy. It was also apparent the numerical presentation of the trade-offs caused some participants difficulty. Responses included "the hectare numbers are too much", "it seemed like a mathematics test rather than an opportunity to write down an opinion", and, "I would like to see the results of spending my money

Figure 1, has the options read vertically and is based on absolute quantities.

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[4] Copies of the questionnaires are available from the authors.

Figure 1: Draft choice set question for USE questionnaire

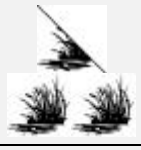
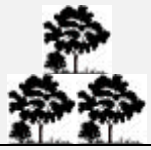
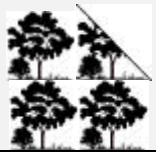
Outcome	**Option A Current management**	**Option B Changed management**	**Option C Changed management**
• One-off levy on your income	$0	$20	$50
Change in:			
• Area of healthy wetlands	***44,000 Ha***	***55,000 Ha***	***75,000 Ha***
• Area of healthy remnant vegetation	***52,000 Ha***	***70,000 Ha***	***85,000 Ha***
• Threatened species that benefit	0	6	22
• Hunting in wetlands	6000	9000	9000
Which option do you prefer? *Tick one box only*	☐	☐	☐

The final choice set design shown in Figure 2 was achieved after several iterations. The design shown in Figure 2 has several key differences to the initial design:

1. The choice options are read horizontally;
2. The labels 'What I pay' and 'What I get' clarify the trade-offs facing respondents; and,
3. Icons represent the attribute levels. The icon levels were shown in a key that folded out to allow respondents to view it while completing the choice sets (shown for the USE in Figure 3).

Participants in the final focus group indicated they had no particular problems answering the question, commenting it was "clear enough" and "easy to answer". Despite the confidence achieved that respondents would have few difficulties answering the choice set debriefing questions were included to assess any such difficulties. This was the first environmental CM survey in Australia to use the pictorial approach to introducing trade-offs.

Figure 2: Final choice set design for USE questionnaire

6. Suppose options A, B and C are the **ONLY** ones available, which would you choose?	**I Pay** Levy	**What I get** Healthy wetlands	Healthy remnant vegetation	Threatened species that benefit	Ducks hunted	**I would choose** *Tick one box only*
Option A: No Change	**NIL**			**NIL**		G¹
Option B						G²
Option C						G³

Note: The symbols were related to the quantitative numbers in the preamble of the survey and reminded of the key to the numbers in the introduction to the choice sets.

Figure 3: Foldout symbol key used in questionnaire

Symbol key

(for questions 6 to 10)

Healthy wetlands		*= 22,000 Hectares (55,000 acres)*
Healthy remnant vegetation		= 25,000 Hectares (60,000 acres)
Threatened species that will benefit		= 6 Species
Ducks hunted		= 3000 Ducks

A summary of the situation

Healthy wetlands	*44,000 Ha.*
Healthy remnant vegetation	50,000 Ha.
Total number of threatened species	24*
Ducks hunted	6000

** Includes several species that would become extinct in the Upper South East (but not Australia)*

4.5 Survey implementation

The sample frame determines who is to be surveyed. Previous studies have indicated that the values held for wetlands are likely to differ in relation to the geographic proximity of the respondent (see for example Rolfe and Bennett 2000). To account for this in the USE, surveys[5] were undertaken in the Naracoorte (800), Adelaide (800) and Canberra (400). For the MRF surveys were undertaken in Griffith (800), Wagga Wagga (800), Canberra (800) and Adelaide (400). The cross-samples can be used to test hypotheses about the effects of distance on values.

Both the USE and MRF surveys were undertaken as mail out/mail back.[6] This survey format decision was based on the relative costs of obtaining a suitable sample size and feedback received in focus groups. The White Pages based 'Australia on Disk' was used to derive a sample of some 2,000 names and addresses for the USE surveys and 2,800 for the MRF surveys. Due to the costs associated with survey production, only one mail out of the survey followed up by two reminders spaced at two and three and a half weeks after the initial mail out were undertaken. The initial mail out was undertaken on the sixth and seventh of March 2000. Reminders were sent on 17 and 27 March 2000.

Having designed the questionnaire and collected the data, the next phase of the research is to prepare and analyse the data and is discussed in the next section of this research report.

[5] Sample sizes are given in brackets for each sub-sample area.

[6] Barbara Davis and Associates were contracted to coordinate the survey logistics.

5. Environmental values for the Upper South East of South Australia

5.1 Response rate

The response rate for the USE is summarised in Table 4. A total of 2,000 surveys were mailed out, 247 were returned to sender and 542 surveys were returned for a response rate of 30.8%. The response rate is relatively consistent across all samples and questionnaire versions. The response rate compares favourably with other mail out CM surveys in Australia.

Table 4: Response rate for USE survey

Sample	Number mailed out	Undelivered*	Successful	Response rate
Adelaide	800	98	225	32.1%
Naracoorte	800	78	207	28.7%
Canberra	400	67	110	33.0%
Total	*2000*	*247*	*542*	*30.8%*

* Undelivered surveys were those returned to sender.

5.2 Sample characteristics and representativeness

Respondent characteristics are shown in Table 5. Seventy eight percent of respondents had visited the USE region. Canberra residents were much less likely to have visited the region (37.3%) or to visit the region in the future (only 25.5% say they will). Only a small proportion of respondents indicated they are likely to hunt ducks in the future.

The mean age of respondents was 51 years (median 50) and 58.1 percent of respondents were male. The median age of respondents was uniformly six to nine years older than the population. The income level of respondents was also generally higher than the wider population. The education qualifications of respondents were skewed towards higher levels with 27.4% having tertiary or higher qualifications.

Table 5: Summary of USE respondent demographics

	Yes	No	Maybe
Have you visited the USE region?	78.4%	21.6%	n.a.
Will you visit the USE in the future?	63.7%	8.9%	27.4%
Have you ever hunted ducks?	15.2%	84.8%	n.a.
Will you hunt ducks in the future?	4.7%	95.3%	n.a.
	Male	**Female**	
Survey answered by	58.1%	41.9%	

Respondent age		Education	
under 25	2.4%	Completed primary only	5.1%
24-34	14.6%	Completed Year 10/Junior/Intermediate	19.1%
35-44	19.1%	Completed Year 12/Senior/Leaving	21.0%
45-54	26.5%	Diploma or certificate (trade qualification)	21.3%
55-64	15.1%	Tertiary degree	27.4%
65-74	13.8%	Other qualifications	5.0%
75 or over	8.4%		

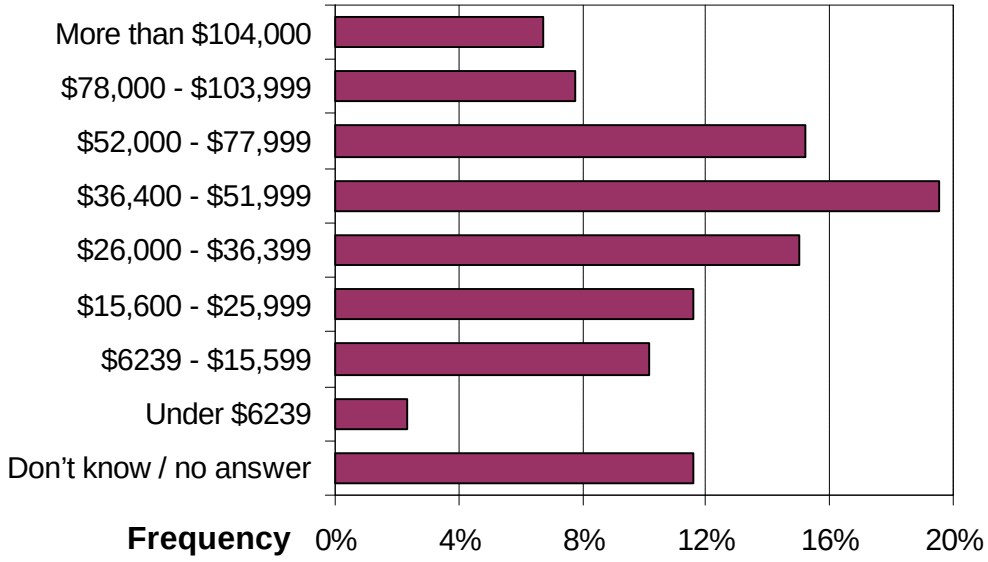
The income distribution of respondents is shown in Figure 4. The median income bracket is $36,400 to $51,999. This is higher than the national median of just over $34,322. The Canberra sub-sample is higher again at $52,000 to $77,999, which is comparable to the difference between Canberra incomes and the national average.

Table 6: Representativeness of sample (USE)

	ACT	ACT sample	Naracoorte	Naracoorte sample
Age	39	48	43	50
Sex (%Male)	48.7%	50.5%	51.0%	61.1%
Income	$48,699	$52,000-77,999	$28,647	$36,400-51,999
Tertiary education	23.9%	46.1%	5.1%	16.0%
	Adelaide	**Adelaide sample**	**Australia**	**Sample**
Age	43	49	42	50
Sex (%Male)	47.8%	59.9%	48.9%	58.1%
Income	$30,971	$36,400-51,999	$34,322	$36,400-51,999
Tertiary education	10.4%	29.7%	11.0%	27.4%

Notes: Age and percentage male is reported for individuals over 17 years of age.
Income is median annual income.
For all samples, the sample is significantly different from the population age at the 95 percent level of confidence, except for gender in the ACT.

Figure 4: Income distribution of USE respondents



5.3 Results

Data preparation and analysis

The initial data received from the survey report comprised the survey version, the question number and the respondent choice. The respondent choice signifies the alternative preferred by the respondent. In order to conduct the analysis, this information must be combined with the attribute information for the alternative selected and the alternatives that were not selected. Hence, for each choice set response, three lines of data are created: one for the preferred alternative and two for the alternatives that were rejected. Variation in attribute levels and socio-economic variables do not explain all of the choice variation. That is, unobserved explanatory variables will remain. Constants, known as 'alternative specific constants' are included to account for this additional variation within the modelling procedure. Each constant is coded one for the change options and zero otherwise.

Socio-economic variables are also included in the model to account for differences in preferences between respondents. Some of the socio-economic variables were also re-coded to zero-one dummy variables (such as education, gender and location). A second group of variables that is included are called attitudinal variables. These variables are included to help indicate whether respondents protested against the payment vehicle or the design of the survey. Socio-economic and attitudinal variables that are included in the modelling process can be interacted with the ASC terms.

Alternatively, they can be interacted with the attributes, as are *Wgreen* (green with wetland area) and *Dhhunt* (ducks hunted with hunt) in this application. Definitions of the variables used in the modelling process are provided in Table 7.

Table 7: Definition of all variables included in the USE modelling process

Variable	**Definition**
Cost	Size of levy
Wetlands	Area of healthy wetlands (hectares)
Remnants	Area of healthy remnant vegetation (hectares)
Species	Number of threatened species that benefit
Duck hunt	Number of ducks hunted
ASC	Alternative specific constant for options 2 and 3
Age	Age of respondents
Sex	Gender of respondent (1 for female, 0 for male)
Income	Log of respondent income
Canberra	Dummy variable equals 1 for Canberra else zero
Naracoorte	Dummy variable equals 1 for Naracoorte else zero
Tert	Dummy variable equals 1 for tertiary education else zero
Trade	Dummy variable equals 1 for diploma/trade qualification else zero
Hschool	Dummy variable equals 1 for high school qualifications else zero
Other	Dummy variable equals 1 for other educational qualifications else zero
Visit	Dummy variable equals 1 for respondents who visited the region else zero
Intended visit	Dummy variable equals 1 for respondents who intend to visit the region else zero
Hunt	Dummy variable equals 1 for respondents who reported hunting ducks else zero
Green	Dummy variable equals 1 for respondents who indicated they preferred conservation in decisions between conservation and development else zero
NDT	Dummy variable equals one for respondent indicating they either do not trust government to make levy one-off or protested against the payment vehicle on other grounds else zero
Confusion	Dummy variable equals one for respondent reporting they were confused about survey design or information else zero
Wgreen	Green * Wetlands
Dhhunt	Hunt * Duck hunt

Once the data were prepared, an initial series of models was run using the following generic model:

Status quo: $V_1 = ß_1$ Cost + $ß_2$ Wetlands + $ß_3$ Remnants + $ß_4$ Species + $ß_5$ duck hunt

Alternative 2: $V_2 =$ ASC + $ß_1$ Cost + $ß_2$ Wetlands + $ß_3$ Remnants + $ß_4$ Species + $ß_5$ duck hunt + $ß_i$ ASC (socio-economic and attitudinal variables)

Alternative 3: $V_3 =$ ASC + $ß_1$ Cost + $ß_2$ Wetlands + $ß_3$ Remnants + $ß_4$ Species + $ß_5$ duck hunt + $ß_i$ ASC (socio-economic and attitudinal variables)

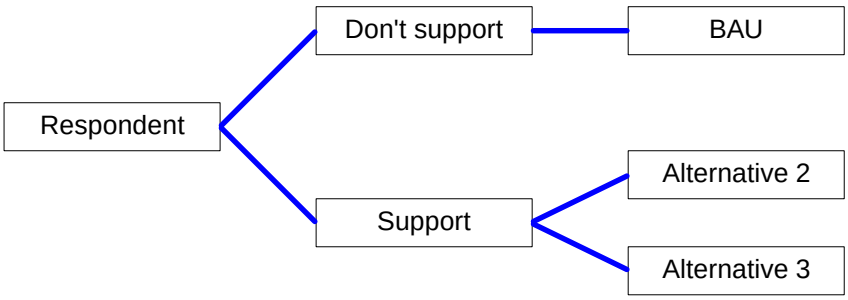
Because the choice sets in the survey were generic, the ASC term in alternative 2 and 3 is the same. If the choice sets were labelled (for example as 'some wetlands', 'most wetlands') the ASC terms would be modelled as different. A second set of preliminary models was run including *Wgreen* and *Dhhunt*. *Wgreen* was included as the first models indicated the wetland area variable was not significant. The *Wgreen* variable separates out the values of pro-conservation respondents for additional healthy wetland area. *Dhhunt* was included to separate an hypothesised positive component of the number of ducks hunted relating to duck hunters from the negative component relating to the remainder of the population.

The multinomial logit (MNL) model was estimated using the LIMDEP statistical software package. The results from the preliminary modelling process indicated that the 'assumption of independence of irrelevant alternatives' was violated (IIA violation).[7] IIA violations lead to biased estimates of coefficients and inaccurate estimates of willingness to pay. One strategy to avoid IIA violations is to develop a nested logit model. A nested logit model estimates the MNL model as a two-stage process.

[7] Testing of the best performing multinomial logit model using the test procedure developed by Hausman and McFadden (1984) showed IIA violations at the 1 and 5 percent level.

In the first step respondents choose between supporting or not supporting the proposed management changes. If respondents chose to support the proposed management changes, they then choose between alternatives two and three. This choice path is shown below in Figure 5. The choice at the first level (between support and don't support) is hypothesised to be explained by socioeconomic variables (such as age, sex, income and location) and attitudinal variables (such as not trusting government, being confused by the choices in the survey or some other protest against the proposal). Choices at the second level (between alternative two and alternative three) are explained by the levels of the attributes (wetland area, remnant area, endangered species that benefit and number of ducks hunted).

Figure 5: Tree diagram for nested multinomial logit model



The results for the nested logit model are reported in **Error! Reference source not found.**. The coefficients for all of the attributes in the choice sets, except the area of healthy wetlands, are significant at the one-percent level. All coefficients except wetland area have the expected sign.[8] The overall model result is also significant at the one-percent level as shown by the chi-squared statistic. The explanatory power of the model is very high with an adjusted rho-squared of 32.8 percent.[9] The nested structure of the model is also highly significant with the inclusive value parameter significant at the one-percent level.

The negative cost coefficient indicates that respondents are less likely to choose options as cost increases. Likewise, respondents are less likely to choose options with larger numbers of ducks hunted. Similarly, respondents are more likely to choose options with larger numbers of endangered species protected and larger areas of healthy remnant vegetation. The positive *Wgreen* coefficient indicates that respondents who indicated they favour conservation over development also value increased wetland area. The positive *Dhhunt* coefficient indicates that duck hunters value increased numbers of ducks hunted.

Theory provides guidance as to the expected sign of the socioeconomic and attitudinal variables. Respondents who were confused, did not trust the government, or protested against the payment vehicle (the levy) would all be more likely to support the BAU approach and hence possess a positive coefficient when predicting the likelihood of supporting BAU. The significance of these variables indicates that despite the careful design and proofing of the survey an element of confusion and protest remained. Individuals with higher incomes should be more likely to support the proposal hence a negative income coefficient.[10] Intended visitors would also be expected to support changed management as a reflection of their option values, again a negative coefficient is expected. Education, gender and location dummies were insignificant with the exception of the Canberra dummy. Variables that were insignificant at the 15 percent level were removed and the model re-estimated. Movements

[8] A potential reason for a negative wetland coefficient is that some respondents may be recalling the (undesirable) appearance of saline wetlands that can be seen from the major roads through the region.
[9] Rho-squared is similar to R^2 in standard regression analysis. It is equal to one minus the ration of the unrestricted log-likelihood ratio over the restricted log-likelihood ratio. Rho-square values between 20 percent and 40 percent are considered extremely good fits (Henscher and Johnson 1981).
[10] The expected sign of the coefficient depends on which branch of the nested logit model the socio-economic coefficients are placed. If they are placed on the change options rather than the BAU the expected sign would be the opposite to those above.

in the adjusted rho-square were used to assist decisions about the explanatory value of the variables removed.

Results of USE nested multinomial logit model

Variables	Coefficient	Standard error
Utility functions		
ASC	0.203*	0.695E-1
Cost	-0.131E-1*	0.536E-5
Wetlands	-0.161E-4*	0.414E-5
Remnants	0.121E-4*	0.416E-5
Species	0.632E-1*	0.617E-2
Duck hunt	-0.572E-4*	0.121E-4
Wgreen	0.359E-4*	0.616E-5
Dhhunt	0.968E-4*	0.314E-4
Branch choice equations		
ASC	7.624*	1.153
Income	-0.683*	0.993E-1
Intended visit	-0.510*	0.158
Age	-0.147E-1*	0.479E-2
Confusion	0.381*	0.141
NDT	2.357*	0.150
Canberra	-0.338+	0.190
Inclusive value parameters		
Support	0.995*	0.618E-1
No support (fixed parameter)	1.000	0.000
Model statistics		
N (choice sets)	2385	
Log L	-1337.703	
Adjusted rho-square (%)	32.882	
Chi-square (constants only)	1329.599*	

Note: ASC_1 is coded one for 'Alternative 2' and zero otherwise;
* indicates significance at the one percent level; and
+ indicates significance at the ten percent level.

Location hypothesis tests

Hypothesis tests can be conducted to test the impact of distance on respondent values as indicated in Appendix 2. Hypothesis tests were conducted by testing the significance of dummy variables (t-statistics) for individual sub samples and jointly using a log-likelihood ration test (chi-square). Results are reported in Table 8.

Table 8: USE location hypothesis tests

Location	Significance
Adelaide	0.359[*]
Naracoorte	0.699[*]
Canberra	0.075[*]
All	0.202[#]

[*] = Probability values of t-statistics.
[#] = Probability of chi-square test statistic (likelihood ratio test).

All location variables are insignificant at the 5 percent level but Canberra is significant at the 10 percent level. The location dummies are also jointly insignificant at the ten-percent level using the likelihood ratio test.[11] While Canberra residents were expected to have a lower willingness to pay based on their distance from the USE these affects are likely to have been confounded by differences in

[11] Details of the test can be found in standard econometric texts including Ben-Akiva and Lerman (1993 p.168).

taste. One indication of differences in taste is provided by the results to Question 20 in the survey as shown in Table 9. Canberra residents are more likely to favour conservation than Adelaide residents are. Similarly, Adelaide residents are more likely to favour conservation than Naracoorte residents are. This is confirmed by a chi-squared test of association that indicates that the difference in distributions is significant at the one-percent level (χ^2 probability 1.973E-2). Hence, residents who live further from the USE wetlands may be willing to pay more to achieve conservation confounding the effects of distance. Morrison, Bennett and Blamey (1997) found a similar effect when valuing the Gwydir Wetlands where Sydney residents were willing to pay more than residents of Moree despite the significant difference in distance from the wetlands. Rolfe and Bennett (2000) also found the same effect.

Table 9: Question 20 from USE survey: "When thinking about issues where there are trade-offs between conservation and development do you:"

	Canberra	**Adelaide**	**Naracoorte**
Favour development	0%	2%	3%
Favour conservation	48%	35%	25%
Favour development and conservation equally	52%	63%	72%
Chi square test of association probability = 1.973E-2			

Estimation of willingness to pay

The results of the CM estimation can be used to estimate two types of values:
1. Implicit prices: the willingness to pay for a unit change in a single attribute; and,
2. Compensating surplus: the change in welfare, measured in dollars, resulting from a change in management.

In this section, the implicit prices and a sample of the compensating surplus are estimated.

Implicit prices (IP) are the marginal rates of substitution between the non-marketed attributes and the monetary attribute. The marginal rates of substitution are derived as the partial differentiation of the attribute of interest with respect to utility. Hence, in a model without any socioeconomic interactions with the attributes, they are estimated as the ratio of the coefficient of a non-monetary attribute and the coefficient of the monetary attribute:

$$IP = ß_{\text{non-monetary attribute}} / ß_{\text{monetary attribute}}$$

Confidence intervals can also be calculated for the implicit price estimates following the procedure developed by Krinsky and Robb (1986).[12] Implicit price and confidence intervals for the USE attributes are presented in Table 10. The results indicate that respondents were willing to pay $0.92 for an extra 1000 hectares of remnant vegetation and $4.81 to benefit an additional threatened species. Respondents who indicated they were pro-conservation were willing to pay $2.73 more for an additional 1000 hectares of wetlands than other respondents, that is, $1.51 for an additional 1000 hectares of healthy wetlands. Remaining respondents were willing to pay minus $1.22 and the average willingness to pay across the whole sample was minus $0.61 per additional 1000 hectares of healthy wetlands. The average willingness to pay for an additional 1000 hectares of healthy wetlands was not significantly different from zero at the 95 percent level. Similarly, duck hunters were willing to pay $7.37 more than non-hunters for an additional 1000 ducks hunted for a net price of $3.01. Non duck hunting respondents were willing to pay $4.35 to have 1000 fewer ducks hunted for an average of minus $1.79 per additional 1000 ducks hunted. The willingness to pay of duck hunters and the average willingness to pay were not significantly different to zero at the 95 percent level.

The marginal rates of substitution can also be used to estimate the trade-offs between differing attributes. For example, respondents are willing to trade-off:

[12] To estimate confidence intervals a random draw (of 200 in this case) of parameter vectors is made from a multivariate normal distribution with a mean and variance equal to the ß vector and a variance-covariance matrix from the estimated nested logit model. Implicit prices can then be estimated using these parameter vectors and confidence intervals can be calculated.

1 additional threatened species benefits = 5,219 ha of extra remnant vegetation = 2,684 fewer ducks hunted (at the mean coefficient)

Table 10: Estimates of USE Implicit Prices

Attribute	Mean IP	95% Confidence Interval	
		Upper	Lower
Wetland area (non-green respondents per 1000 ha)	-$1.22	-$0.53	-$1.92
Wetland area (green respondents per 1000 ha)	$1.51	$2.35	$0.66
Wetland area (average per 1000 ha)	-$0.61*	$0.05	-$1.24
Remnant area (per 1000 ha)	$0.92	$1.54	$0.25
Species (per specie)	$4.81	$5.70	$3.94
Ducks hunted (non hunters per 1000)	-$4.35	-$2.62	-$6.07
Ducks hunted (hunters per 1000)	$3.01*	$7.35	-$1.34
Ducks hunted (average per 1000)	-$1.79*	$0.06	-$3.49

Note: Prices are in dollars at year 2000 levels estimated at the sample mean.
* Implicit price is not significantly different from zero at the 95 percent level of confidence.

Compensating surplus is the appropriate estimate of the willingness to pay for a change from the current situation.[13] The willingness to pay for a change from the current situation incorporates others reasons why respondents might (or might not) choose to make the change that are incorporated in the ASCs, socioeconomic and attitudinal variables. Compensating surplus estimates are calculated using:[14]

$$CS = -1 / \text{marginal utility of income} * (V_C - V_N)$$

$$CS = -1 / ß_{cost} * (V_C - V_N)$$

Where: V_C represents the utility of the BAU option
V_N represents the utility of the new option

To demonstrate the methodology the CS is calculated for one alternative management strategy from Table 1, 'wetlands and remnants'. The BAU situation and the situation under wetlands and remnants are shown in Table 11.

Table 11: USE BAU situation and situation after change to wetlands and remnants strategy

Attribute	BAU	Wetlands and remnants
Area of healthy wetlands (ha)	44,000	72,425
Area of healthy remnants (ha)	50,000	101,275
Threatened species that benefit	0	22
Number of ducks hunted	6,000	12,000

The utilities under BAU and after the implementation of the 'wetlands and remnants' strategy are calculated as follows. BAU utility (V_C) is estimated by substituting the coefficients and attribute levels (except cost) for the current situation. The calculation of the utility of the BAU situation also includes the other determinating factors (ASC, socioeconomic and attitudinal variables). The socioeconomic variables are included at their mean values as follows:

$$V_C = ASC + (ß_{wetland\ area} * \text{Wetland area} + ß_{remnant\ area} * \text{Remnant area} + ß_{species} * \text{Species} + ß_{ducks\ hunted} * \text{ducks hunted} + ß_{wgreen} * \text{Wetland area} * \text{proportion respondents green} + ß_{Dhhunt} * \text{ducks hunted} * \text{proportion respondents who hunt}) + (\Sigma\ ß_{socioeconomic\ \&\ attitudinal} * \text{Socio-economic and attitudinal}) + (ß_{log\ income} * \log \text{income} + ß_{intended\ visit} * \text{intended visit} + ß_{age} * \text{age} + ß_{canb} * \text{Canberra residents} + ß_{conf} * \text{confused respondents} + ß_{ndt} * \text{protest respondents})$$

$$= 7.624 + (-0.161E\text{-}4 * 44{,}000 + 0.121E\text{-}4 * 50{,}000 + 0.632E\text{-}1 * 0 - 0.572E\text{-}4 * 6000 + 0.359E\text{-}4 * 44{,}000 * 0.348 + 0.968E\text{-}4 * 6000 * 0.158) + (-0.683 * 10526 - 0.510 * 0.645 - 0.147E\text{-}1 * 49.850 - 0.338 * 0.223 + 0.381 * 0.313 + 2.357 * 0.255)$$

[13] The measure of compensating surplus calculated is the Hicksian surplus. If the marginal utility of income is assumed constant across the ranges estimated then the Hicksian surplus and the Marshallian surplus are equivalent. The Marshallian surplus is commonly known as the consumer surplus.
[14] Estimation of consumers surplus from CM results is based on the assumption that the $ß_{monetary\ attribute}$ equals the marginal utility of income.

= 0.219

The new utility is calculated by multiplying the IV parameter by the new attribute levels:

V_N = IV parameter * (ASC_1 / 2 + ß$_{wetland\ area}$ * Wetland area + ß$_{remnant\ area}$ * Remnant area + ß$_{species}$ * Species + ß$_{ducks\ hunted}$ * ducks hunted + ß$_{wgreen}$ * Wetland area * proportion respondents green + ß$_{Dhhunt}$ * ducks hunted * proportion respondents who hunt)
= 0.995* (0.203 / 2 - 0.161E-4 * 72,425 + 0.121E-4 * 101,275 + 0.632E-1 * 22 –0.572E-4 * 12,000 + 0.359E-4 * 72,425 * 0.348 + 0.968E-4 * 12,000 * 0.158)
= 1.946

Hence, the CS for the change from the BAU to wetlands and remnants is calculated:

CS = 1/(-0.131E-1) * (0.219 –1.946)
= $131.43

The mean willingness to pay of respondents to move from the BAU scenario to the wetlands and remnants outcome is $131.43. Confidence intervals can be estimated for the CS using the same methodology as for the IP. The 95 percent confidence interval for the CS is $112.63 to $157.38. Note that this is the mean willingness to pay of the sample. Since the means of the sample socioeconomic characteristics differ from the means of the population, the mean willingness to pay of the sample will also differ from the population mean. To calculate a mean CS for a population the same formula is used but population means are incorporated rather than the sample means. For example, the mean willingness to pay for the South Australian population is $109.29 (assuming identical visit intentions).[15] As indicated, some degree of confusion and protest remains amongst respondents that created a form of BAU bias. By setting attitudinal variables that incorporate these elements to zero, a protest-free estimate of compensating surplus can also be calculated. The protest-free CS is $180.50, a difference of $49.00 indicating that protests do have a significant impact on estimates.

Population willingness to pay data can be aggregated to determine the willingness to pay of the wider community to achieve management changes. For example, aggregating the willingness to pay across the South Australian population generates an aggregate willingness to pay of $18.8 million dollars (assuming non-responses have zero willingness to pay and not adjusted for protest responses). That is, the population of South Australia as a whole is willing to pay $18.8 million to move from the BAU option to the Wetlands and Remnants option. Aggregate willingness to pay can be compared to aggregate costs in a cost benefit framework to assess whether the community as a whole is likely to benefit from the proposed change to management. This comparison is the focus of Research Report 9, which will detail the cost benefit analysis of alternative management outcomes in the USE.

6. Environmental values for the Murrumbidgee River Floodplain

6.1 Response rate

The response rate for the MRF is summarised in Table 13. Two thousand eight hundred surveys were mailed out, 378 were returned to sender and 732 surveys were returned for a response rate of 30.2 percent. The response rate is relatively consistent across all samples except the Griffith sample (22.0 percent). The relatively low Griffith response rate is partly due to a survey assembly error that was not discovered until responses were being processed.[16] The response rate compares favourably with other mail out CM surveys in Australia and the USE response rate.

[15] To estimate a mean willingness to pay for the SA population mean values from the 1996 Census for gender, age, income (adjusted to 2000 using the CPI), duck hunting were used and the Canberra proportion set to zero.

[16] Some pages of the questionnaire were stapled into the booklets upside down. The error was only present in MRF version 5 that were sent to Griffith and led to a response rate of 10.4 percent for Version 5 in Griffith.

Table 12: Response rate for MRF survey

Sample	Number mailed out	Undelivered*	Successful	Response rate
Griffith	800	113	151	22.0%
Wagga Wagga	800	96	232	33.0%
Canberra	800	121	229	33.7%
Adelaide	400	48	120	34.1%
Total	*2,800*	*378*	*732*	*30.2%*

* Undelivered surveys were those returned to sender.

6.2 Sample characteristics and representativeness

Respondent characteristics are shown in Table 13. Seventy-seven percent of respondents had visited the MRF region. As would be expected the proportion of respondents who had visited the region was highest in Wagga Wagga and Griffith (93 percent) and lower in Canberra (67 percent) and Adelaide (47 percent). Likewise Adelaide residents are much less likely to visit the region in the future (33 percent say they won't versus less than ten percent for the remainder of the sample).

Table 13: Summary of MRF respondent demographics

	Yes	No	Maybe
Have you visited the MRF region?	77.4%	22.6%	n.a.
Will you visit the MRF in the future?	63.3%	10.5%	26.3%
	Male	**Female**	
Survey answered by	60.9%	39.1%	

Respondent age		Education	
under 25	2.3%	Completed primary only	4.2%
24-34	11.0%	Completed Year 10/Junior/Intermediate	15.5%
35-44	24.7%	Completed Year 12/Senior/Leaving	15.6%
45-54	23.3%	Diploma or certificate (trade qualification)	21.9%
55-64	17.3%	Tertiary degree	37.9%
65-74	12.9%	Other qualifications	4.8%
75 or over	8.4%		

Table 14: Representativeness of MRF sample

	ACT	ACT sample	Wagga Wagga	Wagga sample	Griffith	Griffith sample
Age	39	48	39	49	41	52
Sex (%Male)	48.7%	61.8%	48.5%	55.8%	50.3%	66.2%
Income	$48,699	$52,000-$77,999	$32,850	$36,400-$51,999	$33,163	$36,400-$51,999
Tertiary education	23.9%	52.3%	8.9%	28.4%	6.1%	26.0%

	Adelaide	Adelaide sample	Australia	Sample
Age	43	52	42	50
Sex (%Male)	47.8%	60.2%	48.9%	60.9%
Income	$30,971	$36,400-$51,999	$34,322	$36,400-$51,999
Tertiary education	10.4%	42.5%	11.0%	37.9%

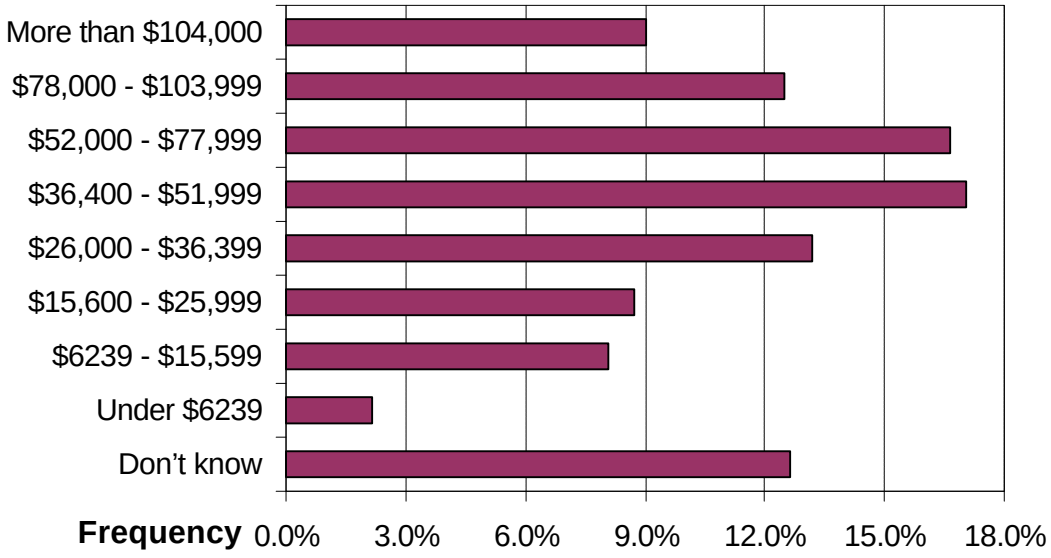
Notes: Age and percentage male is reported for individuals over 17 years of age.
Income is median annual income.
For all samples, the sample is significantly different from the population age at the 95 percent level of confidence.

The mean age of respondents was 51 years (median 50) and 60.9 percent of respondents were male. The median age of respondents was uniformly eight to eleven years older than the population. The income level of respondents was also generally higher than the wider population. The education

qualifications of respondents were skewed towards higher levels with 37.9% having tertiary or higher qualifications.

The income distribution of respondents is shown in Figure 6. The median income bracket is $36,400 to $51,999. This is higher than the national median of just over $34,322. The Canberra sub-sample is higher again at $52,000 to $77,999, which is comparable to the difference between Canberra incomes and the national average.

Figure 6: Income distribution of MRF respondents



6.3 Results

Data preparation and analysis

The same data preparation was undertaken with the MRF survey data as for the USE. Definitions of the variables used in the modelling process are provided in Table 15.

Once the data were prepared, an initial series of models was run using an equivalent generic model to the USE. A number of alternative model structures were also tested on the MRF data because:

1. There were no interaction terms (such as *wgreen* and *dhhunt* in the USE model) providing a much simpler model structure.
2. The range over which the attribute levels was estimated was larger for the MRF than the USE. Theory indicates declining utility from additional units of goods. That is, additional units of attributes should yield progressively smaller additions to total utility. Because a linear function yields identical additional amounts across the range estimated it is less likely to be appropriate for estimates across a large change in attribute levels.

The generic model structure selected was:

Status quo: $V_1 = ß_1$ Cost + $ß_2$ * 1 / Wetlands + $ß_3$ * 1 / Birds + $ß_4$ * 1 / Fish + $ß_5$ * Farmers leaving

Alternative 2: V_2 = ASC + $ß_1$ Cost + $ß_2$ * 1 / Wetlands + $ß_3$ * 1 / Birds + $ß_4$ * 1 / Fish + $ß_5$ * Farmers leaving + $ß_i$ ASC (socioeconomic and attitudinal variables)

Alternative 3: V_3 = ASC + $ß_1$ Cost + $ß_2$ * 1 / Wetlands + $ß_3$ * 1 / Birds + $ß_4$ * 1 / Fish + $ß_5$ * Farmers leaving + $ß_i$ ASC (socioeconomic and attitudinal variables)

The generic model structure uses a 1/*x* form for the *wetland area*, *birds* and *fish* attributes and gave the best fit for the data. The 1/*x* form allows diminishing marginal values for progressive increases in attribute levels. That is, as the increase in the attribute grows larger the willingness to pay for additional increases grows smaller. Note that the farmers leaving and cost attributes remain linear due to the zero starting coefficients.

Table 15: Definition of all variables included in the MRF modelling process

Variable	Definition
Cost	Size of levy
Wetlands	Area of healthy wetlands (hectares)
Birds	Number of native birds as a percentage of pre-1800 numbers
Fish	Number of native fish as a percentage of pre-1800 numbers
Farmers leaving	Number of farmers who leave as a result of management changes
ASC	Alternative specific constant for options 2 and 3
Age	Age of respondent
Sex	Gender of respondent (1 for female, 0 for male)
Adelaide	Dummy variable equals 1 for Adelaide else zero
Canberra	Dummy variable equals 1 for Canberra else zero
Griffith	Dummy variable equals 1 for Griffith else zero
Visit	Dummy variable equals 1 for respondents who visited the region else zero
Intended visit	Dummy variable equals 1 for respondents who intend to visit the region else zero
Income	Log of respondent income
Tert	Dummy variable equals 1 for tertiary education else zero
Trade	Dummy variable equals 1 for diploma/trade qualification else zero
Hschool	Dummy variable equals 1 for high school qualifications else zero
Other	Dummy variable equals 1 for other educational qualifications else zero
NDT	Dummy variable equals one for respondent indicating they either do not trust government to make levy one-off or protested against the payment vehicle on other grounds else zero
Confusion	Dummy variable equals one for respondent reporting they were confused about survey design or information else zero
Levy	Dummy variable equals one where respondent indicated levy is not a good idea else zero

The assumption of IIA was also tested. The results from the initial modelling process indicated that the 'assumption of independence of irrelevant alternatives' was violated.[17] A nested logit model was then developed using the same methodology as for the USE survey data (reported in Section 5.3). The choice path used is the same as for the USE.

The results for the nested logit model are reported in Table 16. The coefficients for all of the attributes in the choice sets are significant at the one-percent level. All coefficients have the expected sign. The overall model result is also significant at the one-percent level as shown by the chi-squared statistic. The explanatory power of the model is very high with an adjusted rho-squared of 33.6 percent. The nested structure of the model is also highly significant with the inclusive value parameter significant at the one-percent level.

The negative cost coefficient indicates that respondents are less likely to choose options as cost increases. Likewise, respondents are less likely to choose options with more farmers leaving. The negative coefficients for wetland area, birds and fish are a reflection of the functional form and indicate respondents are more likely to pay for options with more healthy wetlands, birds and fish, but at a decreasing rate.

Theory provides guidance to the expected sign of the socio-economic and attitudinal variables. The signs indicate a positive, or negative, influence on the likelihood of choosing the BAU branch over a change to management. Respondents who could not afford to pay the levy or did not trust the government would all be more likely to support the BAU and hence possess a positive coefficient. The significance of these variables indicates that, as for the USE survey, the careful design and proofing of the survey was not sufficient to eliminate protest. Respondents who consider the levy a bad idea will also be more likely to choose the BAU branch. Individuals with higher incomes should be more likely

[17] Testing of the best performing multinomial logit model using the test procedure developed by Hausman and McFadden (1984) showed IIA violations at the 1 percent level.

to support the proposal hence a negative income coefficient. There are no strong priors for the age coefficient.

Table 16: Results of MRF nested multinomial logit model

Variables	Coefficient	Standard error
Utility functions		
ASC	0.120#	0.532E-1
Cost	-0.122E-1*	0.570E-3
1 / Wetlands	-7831.35*	829.351
1 / Birds	-0.508*	0.110
1 / Fish	-0.328*	0.495E-1
Farmers leaving	-0.700E-1*	0.892E-2
Branch choice equations		
ASC	5.809*	0.992
Income	-0.345*	0.716E-1
Intended visit	-0.444*	0.109E-1
Age	0.101E-1*	0.349E-2
Tertiary education	-0.216+	0.112
NDT	1.553*	0.106
Levy	2.111*	0.110
Griffith	0.539*	0.124
Adelaide	-0.228	0.141
Inclusive value parameters		
Support	0.465*	0.686E-1
No support (fixed parameter)	1.000	0.000
Model statistics		
N (choice sets)	3148	
Log L	-2400.297	
Adjusted rho-square (%)	33.58	
Chi-square (constants only)	2445.566*	

Note: ASC_1 is coded one for 'Alternative 2' and zero otherwise;
* indicates significance at the one percent level;
# indicates significance at the five percent level; and,
+ indicates significance at the ten percent level.

Intended visitors were hypothesised to support changed management as a reflection of their option values. A negative and significant coefficient in the *intended visit* coefficient verifies this hypothesis. Respondents with tertiary education were also hypothesised to support changed management (a result also shown in other surveys such as Rolfe and Bennett (2000)). The negative tertiary coefficient supports this hypothesis but is only significant at the 10-percent level. Adelaide residents are also more likely to support changes to management despite the distance from the wetlands.[18]

The Griffith location dummy variable is also significant and negative indicating a lower willingness to pay for Griffith residents. Due to the low response rate from Griffith, the model was examined carefully prior to inclusion of this dummy variable. Specifically the model was re-estimated with the Griffith data only and with the Griffith data excluded. The coefficients did not differ significantly in these models so the Griffith data and dummy variable were included. Other education and some location dummies were insignificant and were removed from the final model. Variables that were insignificant at the 15 percent level were removed and the model re-estimated. Movements in the adjusted rho-square were used to assist decisions about the explanatory value of the variables removed.

Location hypothesis tests

Hypothesis tests can be conducted to test the impact of distance on respondent values. Hypothesis tests were conducted by testing the significance of dummy variables (t-statistics) for individual sub samples

[18] This could be due to a perceived impact on Adelaide water quality as Adelaide water is drawn from the Murray River of which the Murrumbidgee is a major tributary.

and jointly using a log-likelihood ratio test (chi-square). All location variables were separately significant at the 10 percent level except Canberra. However, joint tests revealed that the strength of the Griffith and Adelaide dummy coefficients was driving the significance. Hence, the final model only includes Griffith and Adelaide dummy variables for location.

While Adelaide and Canberra residents were expected to have a lower willingness to pay based on their distance from the wetlands, these effects may have been confounded by differences in taste. One indication of differences in taste is provided by the results to Question 16 in the survey as shown in Table 17. Canberra residents are most likely to favour conservation followed by Adelaide, Wagga Wagga and Griffith.[19] Hence, residents who are further from wetlands may be willing to pay more to achieve conservation confounding the effects of distance (see for example Morrison, Bennett and Blamey (1997), Rolfe and Bennett (2000)).[20]

Table 17: Question 16 in questionnaire: "When thinking about issues where there are trade-offs between conservation and development do you:"

	Canberra	**Wagga Wagga**	**Griffith**	**Adelaide**
Favour development	2%	4%	1%	1%
Favour conservation	40%	27%	21%	35%
Favour development and conservation equally	58%	69%	78%	64%

Estimation of willingness to pay

As for the USE survey data the results can be used to estimate both implicit prices and the compensating surplus associated with a change in management. Implicit prices are estimated as the rate of change in the attribute divided by the rate of change of the cost coefficient. The rate of change is found by differentiating the utility function with respect to the specified attribute. Hence the implicit price formula (given the 1/*x* inverse functional form) for *wetland area, birds* and *fish* is:

$$IP = - (-ß_{\text{non-monetary attribute}} / \text{attribute level}^2) / ß_{\text{monetary attribute}}$$

Because the implicit price is related to the level of the attribute, the implicit price will change across the range of areas evaluated. Implicit price estimates for farmers leaving are calculated using the same formula as used in Section 5. Implicit price and confidence intervals for the MRF attributes are presented in Table 18. The estimates for wetland area, birds and fish are evaluated at the midpoints of the attribute levels evaluated in the survey. The results indicate that respondents are willing to pay $11.39 for an extra 1000 hectares of healthy wetlands, $0.55 for a one percent increase in the number of native birds, $0.34 for a one percent increase in the number of native fish and $5.73 to have 1 less farmer leave. As indicated, the IP for *wetland area, birds* and *fish* vary in relation to the size of the attribute. For example, at the midpoint (7,500 hectares of healthy wetlands) the *wetland area* IP is $11.39 per 1000 hectares. At the BAU level (2,500 hectares of healthy wetlands) the willingness to pay is $102.53 for an additional 1,000 hectares. While at the maximum level in the survey (12,500 hectares of healthy wetlands) the IP is $4.10 for an additional 1,000 hectares.

The marginal rates of substitution can also be used to estimate the trade-offs between differing attributes. For example, at the survey midpoints respondents are willing to trade-off:

> 1 more farmer leaving = 503 ha of extra healthy wetlands = 10.4% extra native bird numbers = 17.0% extra native fish numbers

[19] As indicated previously, Adelaide residents may also perceive an impact on the quality of their domestic water.

[20] A second factor that potentially affected the results is the reliance of Griffith on the irrigation industry. Respondents may have perceived that increasing wetland health would result in a reduction in water available for irrigation and hence a personal cost to Griffith residents.

Table 18: Estimates of MRF Implicit Prices

		95% Confidence Interval	
Attribute	**Mean IP**	**Upper**	**Lower**
Wetland area (per 1000 ha)	$11.39	$13.71	$9.05
Number of native birds (per 1%)	$0.55	$0.79	$0.35
Number of native fish (per 1%)	$0.34	$0.45	$0.24
Farmers leaving (per farmer)	-$5.73	-$4.21	-$7.35

Note: Prices are in dollars at year 2000 levels and evaluated at the midpoint of the levels surveyed.

Compensating surpluses are calculated using the methodology explained in Section 5.3. To demonstrate the methodology the CS is calculated for one alternative from Table 2, the 'water management' strategy. The attributes under the BAU situation and the situation under water management scenario are shown in Table 19. The mean willingness to pay of respondents to move from the BAU scenario to the 'water management option' is $121.40. Confidence intervals can be estimated for the CS using the same methodology as for the IP. The 95 percent confidence interval for the CS is $136.53 to $108.75. Note that this is the mean willingness to pay of the respondents.

Table 19: MRF BAU situation and situation after change to water management strategy

Attribute	**BAU**	**Water management**
Area of healthy wetlands (ha)	2,300	5,000
Number of native birds (% pre 1800 pop.)	40%	60%
Number of native fish (% pre 1800 pop.)	20%	30%
Number of farmers leaving	0	0

Since the means of the sample socioeconomic characteristics differs from the means of the population, the mean willingness to pay of the sample will also differ from the population mean. To calculate a mean CS for a population the same formula is used but population means are incorporated rather than the sample means. For example, the mean willingness to pay for the Murrumbidgee population (statistical district) is $118.40 (assuming identical visit intentions).[21] As indicated some degree of confusion and protest remains amongst respondents. By setting attitudinal variables that incorporate these elements to zero, a protest-free estimate of compensating surplus can also be calculated. The protest-free CS is $199.90, a difference of $78.50 indicating that protests do have a significant impact on estimates.

Population willingness to pay data can be aggregated to determine the willingness to pay of the wider community to achieve management changes. For example, aggregating the willingness to pay across the Murrumbidgee population generates an aggregate willingness to pay of $5.98 million dollars (assuming non-responses have zero willingness to pay and setting the Adelaide proportion to zero and not adjusting for protests). That is, the population of the Murrumbidgee statistical district as a whole is willing to pay $5.98 million to move from the BAU option to the water management option. Aggregate willingness to pay can be compared to aggregate costs in a cost benefit framework to assess whether the community as a whole is likely to benefit from the proposed change to management. This comparison is the focus of Research Report 10, which provides details of a cost benefit analysis of alternative management options for the MRF.

7 Conclusions

Non-monetary values of potential wetland management changes in the USE and MRF are estimated in this report. These values were estimated using a choice modelling survey of individuals living in Canberra, Adelaide, Wagga Wagga and Griffith for the MRF and Canberra, Adelaide and Naracoorte for the USE. The use of choice modelling surveys facilitates estimation of dollar values for a range of

[21] To estimate a mean willingness to pay for the Murrumbidgee statistical area population, mean values from the 1996 Census for gender, age, income (adjusted to 2000 using the CPI) were used and the Adelaide proportion set to zero.

non-monetary values held by the community. These non-monetary values can be used to estimate the dollar values associated with the outcomes of different wetland management strategies.

In both the USE and MRF, respondents held significant values for non-monetary wetland outputs. In the USE significant positive values were held for remnant vegetation and endangered species. Some respondents also held significant and positive values for additional areas of healthy wetlands. Other respondents held significant negative values for additional duck hunting. In the MRF, respondents held significant positive values for additional areas of healthy wetlands and larger bird and fish populations. Respondents were also willing to pay to reduce the number of farmers that could leave due to wetland management changes. In both the USE and MRF, the size of the values was affected by income, age, intention to visit the wetlands and to a lesser extent location. The willingness of respondents to pay for management changes was also impacted by their degree of trust in the payment vehicle and its management by government.

The estimates that are reported in this Research Report comprise the major estimate of non-monetary values to the wider community from changes to wetland management. These values will be incorporated with other estimates of non-monetary benefits (such as hunting, reported in Research Report 7) and estimates of monetary benefits and costs in a cost benefit framework. The non-monetary values estimated will be used in this context to provide advice to policy makers about the aggregate costs and benefits of pursuing alternative wetland policy. The outcomes of the cost-benefit analysis will be reported in the next two research reports.

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Appendix 1 Stated preference techniques for non-market environmental values

There are five main stated preference techniques available:

- Contingent valuation
- Contingent rating
- Contingent ranking
- Paired comparison
- Choice modelling

These techniques have been grouped into contingent valuation (CV) based methods and conjoint based methods. These valuation methods and their applicability to the non-market environmental values valuation problem are briefly discussed in this Appendix.

Contingent valuation

"The contingent valuation method (CVM) involves asking a sample of respondents whether (or how much) they are willing to pay to prevent or obtain a particular environmental outcome" (Morrison *et al.* 1996). The response of the sample is used to estimate the aggregate value of the change in the environmental good. A CVM study will generally contain several elements (Morrison *et al.* 1996):

- A description of the status quo and of any changes that will result from the proposed changes to management;
- A question to determine the willingness to pay of respondents;
- Questions to proof theoretical relationships;
- Questions to ensure an appropriate sample (these may form part of the previous element); and,
- Analysis of the responses based on random utility theory.

The advantage of CVM methodology is that it is well known in Australia and internationally with a relatively extensive listing of applications. However, the CVM can only assess the outcomes of one proposed alternative management strategy at a time. The CVM does not provide information about which environmental attributes are most valued that could be used to improve potential management strategies. If CVM were used to value the potential strategies summarised in Section 2, a separate survey would be required for each strategy –a prohibitively expensive strategy.

Conjoint-based methods

Conjoint-based methods overcome the problem of the number of alternative management strategies that can be tested in each survey. Four potential methods of this category are available. Each method involves respondents evaluating a number of alternative management strategies. In brief the potential methods are:

- Contingent Rating: Respondents are asked to rate each of a number of options according to how much they would prefer them using a rating scale. Marginal rates of substitution between attributes can be derived. Because the ratings are relative (respondents do not express willingness to pay, only level of preference), unbiased estimates of the relative value of each option cannot be estimated.
- Contingent Ranking: Respondents are asked to rank three or more alternatives from least preferred to most preferred. Like contingent rating, contingent ranking allows estimation of marginal rates of substitution between attributes but cannot be used to estimate unbiased estimates of willingness to pay.
- Paired Comparison: Respondents are asked to rate the difference between two options on a rating scale. As with contingent ranking and contingent rating, paired comparison facilitates estimates of the marginal rates of substitution but is unable to generate unbiased estimates of values.
- Choice Modelling (CM): Respondents are asked to choose their most preferred option from a number of alternatives. If one of the alternatives is "choose neither", or "BAU", the marginal rates of substitution estimated are unbiased (also referred to as absolute). So the marginal rates of substitution can be used to estimate the value of changes in the individual attributes and the aggregate value of different options.

The major difference between CM and the other conjoint-based methods is the welfare measure that is derived by the method. Contingent Ranking, Contingent Rating and Paired Comparison all provide a relative measure of welfare. Specifically the three methods allow comparison of the alternative management outcomes that are tested, but no comparison against any additional alternatives that might become available at a later date. CM produces an absolute value (as does CVM). The absolute value is more useful for comparison against later options and/or for benefit transfer purposes.

Box A1: Relative preferences and absolute values

Relative preferences allow a ranking of the options surveyed. The preferences measured for each option are relative in the sense that they only relate to the other options within the survey. The preferences do not relate to options outside the survey and therefore cannot be compared against such options. Relative values cannot be used for comparison against aggregate values in a benefit-cost framework.

Absolute values are an aggregate value of each option. The aggregate value facilitates comparison amongst the options tested and also against any other aggregate values produced via other studies (for example a CVM). The aggregate values can be input into a benefit-cost study for comparison against other aggregate values for alternative uses or management strategies.

The data produced by the methods have strongly differing characteristics for policy use. Relative preferences allow the management outcomes that were included in the survey process to be compared and ranked. The highest ranked management outcome may then be selected and implemented. However, the relative preferences cannot be directly input into a benefit-cost framework for comparison against absolute values. There is no capacity to compare the values of the ranked outcomes to their costs. CM not only allows comparison of the outcomes selected within a benefit-cost framework, but also provides additional information about preferences for the components (attributes) that make up the outcome. This information can be used in two ways:

1. To develop new management strategies that would lead to outcomes preferred to those initially examined.
2. To compare other management options that may arise against those initially tested (so long as the outcomes of these new options can be measured and described using the same attributes as the existing options).

CM provides information that is far more useful for policy development, particularly as input to the benefit-cost framework. This is especially the case as policy development also incorporates additional factors, such as equity considerations, that allow intensity of preferences to be incorporated. CM was the valuation technique selected to value the environmental values associated with the alternative management outcomes summarised in Section 2.

Appendix 2 Attribute selection and survey design

A2.1 Attribute selection

The environmental outcomes that were to be valued were briefly summarised in Section 2. These outcomes must be defined succinctly to allow the environmental goods to be assessed and compared. The definition is generally via the use of several attributes. The attributes are chosen to cover aspects of the outcomes that are of value to the community. The attributes must also have meaning to the community to convey this value. Attributes must also be relevant in a policy context (Bennett 1999). That is, the attributes must conform to the style of the biophysical modelling undertaken. The remainder of this section describes the selection of the attributes that are used to define the outcomes in the questionnaire design.

Attributes of significance to policy makers

The attributes of significance to policy makers must be communicable to the wider community and wetland owners and be measurable. In Research Reports 3 and 6 the environmental outcomes of alternative management strategies are described using a number of measures including:

- Area of healthy and degraded wetlands;
- Area of healthy and degraded remnant vegetation;
- Number of ducks hunted;
- Area of wetlands and/or remnant vegetation where other hunting is undertaken;
- Improved conservation status of fauna and flora species;
- Numbers of water and woodland birds;
- Number of native fish; and,
- The quantity of water purchased from irrigation.

These attributes were selected and refined via discussions with wetland owners, community and government wetland managers and scientists working in the region. These attributes will be input into the policy making process and must be useful in this context. These selection and review processes were conducted as follows:

1. Initial attribute selection was via discussions with wetland owners within the regions. These discussions were undertaken as part of fact-finding field trips. The initial attributes were proofed in surveys of wetland owners reported in Research Reports 2 and 5. The range of attributes of importance to wetland owners provides a basis for describing values to both policy makers and the wider community.
2. The second element of selecting attributes was via discussions with government officers and individuals (other than wetland owners) involved in wetland management in the case study areas. These discussions commenced with fact finding field trips where individuals where asked about the most important management issues and outcomes for wetlands in the region. They were refined via a presentation to groups of individuals involved in wetland management followed by discussion about the research (in February 1998 for the USE case study and July 1999 for the MRF case study). Final refining was conducted via reviews of and feedback from Research Reports 3 and 6.
3. Scientists with expert knowledge about the case study areas were the final input to selection of attributes with policy relevance. Scientists provided input about the impacts of management changes on environmental outcomes and helped ensure all outcomes that would change were included. The expert input also assisted with the review process for Research Reports 3 and 6.

The set of attributes of policy relevance may not be the same as those valued by the wider community. Hence, a second, independent, attribute selection process was also undertaken. This process is described in the next section.

Attributes of significance to the community

The attributes selected for inclusion in the choice modelling survey must fulfil two similar objectives:

- They must represent changes in outcome that respondents value (that is they must have meaning to respondents) (Bennett 1999); and,
- They must cover the range of changes in outcomes that are of significance to respondents.

The process followed to select attributes of policy significance provides some guidance as to the range of attributes that are likely to be of importance to the community. However, it is important not to bias the selection of attributes by providing a range of preconceived attributes from which to choose. Four focus groups were convened in order to ensure appropriate attribute selection and to assist in designing the survey.

Focus group logistics

The focus groups held and the case study area they focused on are shown in Table A2.1 below. The Canberra focus groups were held in a boardroom at a local club and were jointly facilitated by the authors. The Adelaide group was held in a specially designed room and the Griffith group in a conference room at a local motel. The principal author of this report facilitated the Adelaide and Griffith groups. An additional observer was present at both the Adelaide and Griffith groups. All groups were audio recorded.

Table A2.1: Focus group logistics

Location	Study area	Date	Time
Canberra	USE	3/2/00	6:30-8:00pm
Adelaide	USE	10/2/00	6:00-7:30pm
Canberra	Murrumbidgee floodplain	17/2/00	6:00-7:30pm
Griffith	Murrumbidgee floodplain	22/2/00	6:00-7:30pm

Local professional recruitment agencies were used to recruit each of the focus groups. In each case the recruitment agency was asked to select a sample of 8 or10 people that was representative of the population eligible to vote in terms of age and sex. Participants were recruited to 'A University of New South Wales focus group'. If more information was required, they were told the group would be discussing issues relating to natural resources in Australia. Incentive payments ($35 per participant) were mentioned after the person had agreed to attend.

Participants in the Canberra group were selected from a list compiled for this purpose by the agency, in Adelaide via telephone calls and in Griffith via contacts of the agency. The Griffith method is not ideal however it is a pragmatic approach given the difficulties involved in recruitment in a country town. Eight people attended the Canberra and Griffith focus groups and nine people attended the Adelaide focus group.

Attributes arising from focus groups

The focus groups were structured into three key sections: attribute selection and ranking, assessment of information provided to respondents and tests of questionnaire design. Selection and ranking of attributes are discussed in this section of the Research Report. Other issues raised in the focus group are examined later in this report. The results presented below were obtained from the first three focus groups while the fourth (the Griffith group) focused on proofing the survey.

Focus groups began with the facilitator introducing himself and any observers before providing the following background information to participants:

- Research is being conducted by The University of New South Wales;
- All information provided is confidential;
- There are no incorrect answers;
- Asking permission to record the meeting;
- Area of research (community attitudes to natural resource management); and,
- Project funding from a Commonwealth Government Research Grant.

Participants were then asked what they thought of when wetlands were mentioned. Responses were grouped between:

- Water, water paths (streams, rivers and river banks);

- Types of wetlands such as ponds, swamps and marshes;
- Wildlife –especially bird life but also waterbird breeding, fish, lizards insects and frogs;
- Vegetation –trees, plants and reeds;
- Conservation in various forms including sustainability, national parks, 'set aside', inaccessibility, natural areas and empty spaces;
- Tourism and recreation (a refreshing place to be);
- Pollution, land degradation and salinity;
- Filtering and treated effluent;
- Research and education; and,
- Valuable resources.

The list compiled was extensive and contained many similar items. Respondents were asked to indicate which attributes were the most important. The following were rated most important:

- Wildlife;
- Breeding (as a sign of continued wetland health);
- Conservation;
- Education; and,
- Control of pollution (where wetlands are artificially created).

There was little or no difference in the responses between the Canberra and Adelaide groups. The exception was the importance of pollution control and the related mention of a wetland area known as Dry Creek and its surrounds that has received some media exposure recently in Adelaide.

In the USE case study, the scientific input to the attributes indicated the inter-linked nature of outcomes for wetlands and remnant vegetation. Hence, the first two focus groups (Canberra and Adelaide) were also asked what they thought of when native vegetation was mentioned. Native vegetation was elaborated as being 'the patches of native vegetation left after clearing for agriculture'. Responses were grouped between:

- What was left after clearing –'dust bowl', debris, stumps, emptiness and wastage in the clearing process;
- The left over vegetation and its usefulness –islands of vegetation, a memory of what the land was like, a safe haven for animals and areas not suitable for farming;
- Other rural vegetation such as windbreaks, wildlife corridors and regeneration;
- Where the remnants are –roadsides, cemeteries, hobby farms;
- What the clearing is for –impact on agricultural production;
- Whether the vegetation is replaceable and the trade-offs involved in clearing; and,
- Problems after clearing such as erosion and weeds.

Again the most important were determined:

- Wildlife corridors;
- Impact on agricultural production;
- Size of remnants; and,
- Windbreaks.

Refining the focus group attributes

The attributes revealed by asking 'what participants thought of…' helped to define what is important to the community about wetlands. But participants were not placed in a position of choosing between alternatives with differing outcomes when indicating what was important about wetlands. Placing participants in this position would reveal information about the importance of other outcomes. These outcomes may not be in wetlands but they could change as a result of changing wetland management.

To place participants in the position of choice they were given a map of the relevant study area and prompted with the following information:

> "The main reason for tonight's discussion is that we are designing a questionnaire about these issues. The questionnaire will be going out to a wide section of the community, including Canberra. So we are interested in what you think needs to go in the

> questionnaire. We want to find out what you think is important about the issue and what information needs to go in the questionnaire.
>
> Suppose the government is proposing to spend money on wetlands in New South Wales. The area we are considering is the Murrumbidgee Floodplain. It is shown on the Map we have distributed. What sort of information would you need to know to assess or judge whether the government action is successful? Please write down the first 4 or 5 things that you would need to know."

Respondents indicated the following questions would need to be answered to help make a judgment about spending money on wetlands:

- What is in the area now?
- What is the aim of spending the money?
- Why is this area being targeted (and why now)?
- What will the benefits be (to the environment, farmers, fishing, tourism, local business)?
- How will any changes affect farmers (and the local population)?
- What access is there to the wetlands and how would this change (including entry fees)?
- Who will take long term responsibility (will government commit long term)?
- What actions will be taken to protect the wetlands (and/or remnants)?
- How much money is to be spent and what will it be spent on (will this be enough money)?
- What levels of government will be involved (Federal, State, Local)?
- Will it be sustainable in the long term?
- Who will undertake the management –do they have sufficient expertise?
- Will the outcomes be transferable across Australia?
- What steps will be taken to ensure success (and prevent funds being wasted)?
- Will there be local input and use of local expertise?
- Do farmers cause the problem?

To refine this list participants were asked to nominate which questions are the most important for deciding about spending on wetlands. The following information was ranked most highly:

- The cost and who would pay;
- Why it is being undertaken and why in that area;
- The benefits to the land and environment and why;
- Then benefits to humans and why; and,
- How the project would be implemented and managed (that is, will it be sustainable and done properly).

The combination of the most important aspects about wetlands and the questions about spending on wetlands provide a basis for the information that must be provided in the questionnaire. The attributes discussed above are condensed into a draft list for each case study area in the next section.

Draft attributes

The focus groups and expert input were used to select a draft set of attributes for the case study areas. Some important questions raised above (such as, why that particular area, how the project will impact on farmers and how the project will be managed) were not included in these lists. These factors are not expected to change under alternative management strategies and hence do not comprise part of the attributes that are traded-off within the choice modelling process. However, these issues must also be satisfactorily addressed within the questionnaire.

For the USE region the draft attributes selected were:

- Cost to the respondent;
- Area of healthy wetlands;
- Area of healthy remnants;
- Threatened species that will benefit; and,
- Number of ducks hunted.

The draft attributes selected for inclusion in the MRF survey were:

- Cost to the respondent;
- Area of healthy wetlands;
- Population of native water and woodland birds;
- Population of native fish; and,
- Water purchased from irrigators.

The next section discusses design of the questionnaire. The section also discusses how the draft attributes are incorporated into the questionnaire and proofed in focus group analysis.

A2.2 Survey design

In this section the design of the mail-out, mail-back survey is described with reference to the sections used to describe the questionnaire. The sections discussed (based on Bennett (1999)) are:

- Letter of introduction;
- Preamble including background and contextual information (framing);
- Statement of the problem;
- Statement of the potential solution;
- Introducing the choice sets;
- The choice sets;
- Debriefing questions;
- Socio-economic and attitude based data; and,
- Opportunity for additional feedback.

As indicated in Section 4, the sections of the questionnaire were developed and refined in three main phases:

1. An initial survey draft following previous CM questionnaire designs;
2. Refining questions and design following focus group discussions; and,
3. Final questionnaire formatting and design using a graphic artist.

The development of each section of the survey is described in detail in this section. A draft of the letter of introduction is provided in Appendix 3 and the USE and MRF questionnaires in Appendices 4 and 5 respectively.

Letter of introduction

The letter of introduction accompanies the questionnaire. The letter was designed to:

- introduce the issue;
- the purpose of the survey;
- how the survey is being undertaken;
- who is undertaking the survey;
- how the results of the survey will be used; and,
- the role of the respondent in the survey.

The letter also includes a contact point in order to allow feedback and answer queries they may have. The letter should ideally encourage respondents to return the survey based on the importance of their contribution and confidence in the team undertaking the survey.

Some rephrasing of the draft introductory letter was undertaken after focus grouping to ensure clarity and to cover all concerns raised.

Preamble

The preamble is designed to provide general information about the case study area, specific information about the attributes that are traded-off and reinforce elements of the introductory letter. The preamble concludes with a contextual question relating to visitation of the study areas. Information about the case study area that is provided in the preamble (and later in the questionnaire) also seeks to help frame the issue by providing information that will allow respondents to ‘frame’ the issue being examined. Framing relates to how the issue is perceived relative to other issues and demands on the resources of the respondent. Appropriate framing is necessary to facilitate decisions by respondents about trade-offs between the issue in question and other potential issues.

The main purpose of the preamble is to provide baseline information about the issue. The preamble is designed to answer the questions: 'What is in the region now?' and, 'What will happen if nothing is changed?' The description was based around an introduction of the area and the problem followed by a description defining each attribute and the impact of BAU.

The preamble was carefully examined in all focus groups leading to several major changes. The main outcomes from the focus groups for the USE preamble included:

- Improved time location (use of 'before 1900' rather than 'originally);
- Inclusion of both imperial and metric area measures;
- Changing hunting terminology from 'waterfowl' to 'ducks' to reduce confusion between threatened species and duck hunting; and,
- Rewording to simplify and improve readability.

Focus groups confirmed that a potential problem existed regarding the use of a 'duck hunting' attribute. However, the Adelaide focus group was markedly less concerned about the inclusion of hunting. Hence, debriefing questions relating to hunting were included in the survey. These are further discussed below in the section relating to debriefing questions.

Changes arising from focus group analysis were more extensive for the MRF survey. The initial attribute 'water diverted from irrigation' was found to be a causally prior attribute. Causally prior attributes are those that are taken to 'indicate' other changes. The 'water diverted from irrigation' was taken to indicate an adverse impact on farmers, rather than an environmental improvement. Furthermore, the nature of the wetland management changes proposed was also taken to imply an adverse impact on farmers. Hence 'farmers leaving' due to management changes replaced the 'water diverted from irrigation' attribute. The 'farmers leaving' attribute was designed to increase the plausibility of the survey. This was despite the modelling reported in Research Report 6 indicating a very small impact from water diversions and changes to wetland management on total farm production in the region.

Other changes to the draft MRF preamble resulting from focus group analysis included:

- Improved time specification (use 'pre 1800 ' rather than 'originally);
- Inclusion of both imperial and metric area measures;
- Changing the framing of wetland importance from comparison with Ramsar listed wetland areas to listing in the 'Directory of Important Wetlands in Australia' (Commonwealth Government 1997);
- Additional context relating to the functions of floodplain wetlands in riverine ecosystems; and,
- Rewording to simplify and improve readability.

Two contextual questions conclude the preamble. These questions have two purposes:

1. they are inserted after a relatively large amount of information has been read in order to provide a break; and,
2. the results of the question indicate whether recreation use or potential use values are involved in the decisions made later in the survey.

The visitation question was chosen as it is unlikely to bias responses to later questions.

Statement of the problem

This section of the questionnaire is designed to narrow the issue under analysis to the problem for which a solution is sought. The section includes a statement outlining:

- What the problem is;
- Why the problem will continue; and,
- What outcomes will occur if the problem is solved.

Analysis of this section in focus groups led to the following changes being made:

- Rephrasing of the problem as 'the issue' in the MRF due to the negative connotations with the use of 'problem' particularly in conjunction with the farmers leaving attribute;
- Improved balance between environmental and farming outcomes in the MRF survey;
- Minor rewording in the USE and MRF surveys.

The statement of the problem is followed by a question to break the reading into smaller blocks and to assist respondents in feeling that they are progressing in completing the questionnaire. The question elicits respondents' interest in the problem being considered and may provide feedback in conjunction with debriefing questions later in the questionnaire.

Statement of the potential solution

This section of the questionnaire presents a hypothetical solution to the respondents. However, the potential solution must be perceived as realistic by respondents in order to elicit a rational response to the 'choice modelling' portion of the questionnaire. The potential solution is comprised of two parts:

1. A section identifying a set of potential management changes that could be used along with the types of impacts they would have on wetland owners. In this section, the area where the levy will be spent is identified and a plausible payment vehicle is developed.
2. A section explaining the payment vehicle and how it would impact on the respondent.

Between and after these sections a question is included to further break up the reading involved and to test the plausibility of the proposed solution and payment vehicle.

Bennett (1999) emphasises the importance of testing for bias using focus groups. One reason is that it is difficult to detect whether respondents do not return surveys due to perceived bias or for other reasons (for example, no value is placed in the issues in question). Focus group analysis of this section lead to the following changes being made:

- Compensation to farmers on the MRF was reinforced to reduce a perceived bias against farmers; and,
- A 'quality assurance' statement was included in both the USE and MRF questionnaires to increase respondent confidence that the levy would be spent in accordance with the description provided.

The payment vehicle selected was a 'one-off levy on all income tax payers –including your household in the 2000-2001 taxation year'. The payment vehicle was selected to be plausible across all samples. A consistent protest against the payment vehicle was detected across all focus groups. However, despite intensive discussion in all groups no improved payment vehicle that could be used across all samples could be derived. The issue of appropriate payment vehicles is a consistent problem in the design of CM studies and it appears a second best solution must be accepted. If the levy was to be locally collected and spent, then local institutions were suggested as the appropriate collection and distribution agents. Questions 4 and 5 were reworded following focus group analysis to explicitly refer respondents to the case study areas and the changes to management.

Introducing the choice sets

Because the choice sets contained in CM based questionnaires will be unfamiliar and may be confusing to respondents a short section introducing them is included. The section specifies what is being asked, what information is provided, where more information can be found and how the questions are structured. A statement reinforcing the framing of the CM questions is also included. Discussion and feedback in the focus groups indicated little change to this section although the phrasing was edited into a clearer format between groups.

The choice sets

The choice sets are the heart of the CM questionnaire and are designed to elicit the choice based information. The trade-offs that are expected of respondents are difficult. Hence, simplicity and clarity are the two key aspects when presenting choice sets.

When deciding on the presentation of choice sets an early decision must be made as to whether they are to be labelled or not. A compromise decision was made for both the USE and MRF questionnaires. The 'BAU' choice set was labelled 'Option A: no change' while the remaining choice sets were generic and referred to as 'Option B' through 'Option K'. This meant that 'Option A' was labelled as a status quo option while the other options were not labelled. This choice was based on concerns that labelling would be perceived as either adding information or, would elicit an emotive response. Furthermore, there were no clear labels to apply to the alternative choice sets.

Once a basic presentation structure has been designed, the next issues are how many alternatives are to be presented in each choice set and how many choice sets are to be presented to each respondent. Previous CM studies offer some guidance along with focus group discussions. The main decision underlying design of the choice sets is decisions about attribute levels.

Attribute levels and integration into questionnaire format

The final step in preparing attributes for incorporation in a draft survey is selection of appropriate levels. Attribute levels define the degree of change to be tested in the questionnaire framework. Bennett (1999) indicates that attributes can be included either qualitatively or quantitatively. Quantitative measures are based on some type of physical measure (such as area, number or percentage change in numbers). Qualitative measures are normally based on general outcomes, for example the suitability of wetlands for bushwalking or bird watching.

The measures available for inclusion in the survey are derived from the output of the biophysical modelling summarised in Section 2 above. In both study areas, the measures relating to each attribute were quantitative but differed in the type of measure as shown in Table A2.2. All measures are absolute in the USE survey, while in the MRF the population of water and woodland birds is referenced to pre-European numbers. For example, the benefit to endangered species in the USE is measured by the number of species that would benefit. In the MRF the benefit to native fish is measured as a percentage of the pre 1800 population that would result. Hence, a doubling of native fish from the BAU is an increase from 20 percent to 40 percent of the pre 1800 population. While use of percentages is potentially problematic, there were no significant problem detected during focus group analysis.

Table A2.2: Attribute measures

Attribute	**Measure**
USE case study	
Cost to the respondent	Dollars
Area of healthy wetlands	Area (Ha and Acres)
Area of healthy remnants	Area (Ha and Acres)
Threatened species that will benefit	Number of species
Hunting of waterfowl	Number hunted
Murrumbidgee floodplain case study	
Cost to the respondentλ	Dollars
Area of healthy wetlands	Area (Ha and Acres)
Population of native water and woodland birds	Percentage of pre-European number
Population of native fish	Percentage of pre-European number
Number of farmers leaving	Number leaving

The range of the attributes was also determined with reference to the biophysical modelling process. The biophysical model indicates the range of values that can be expected under the outcomes of the management strategies (with the exception of the cost to respondents and the number of farmers leaving in the MRF case study). The range for the dollar cost to respondents was determined from previous choice modelling studies. Focus group analysis indicated a significant rejection at the maximum value of $200 as is required for theoretical validity. The range for the 'farmers leaving' attribute was set to retain plausibility and minimise protest associated with the attribute.

Box A2.1: Experimental design

Choice modelling is based on "the estimation of a response between the probability of a choice being made and the relative levels of the attributes in the alternative chosen" (Bennett 1999, p. 13). To determine how variations in each attribute alter the choices made by respondents a large number of systematic changes in the level of different attributes must to be examined. Specifically the set of changes should include all possible combinations of attribute levels –known as a 'full factorial'. In many cases this is not possible due to the large number of possible combinations. In such cases a 'fractional factorial' is used. The structured way in which the attribute levels are transformed into ***experimental design***' (Bennett 1999).

The final step in setting attribute levels is determination of appropriate increments between the maximum and minimum levels. The number of increments is determined in part by the experimental design (see Box A2.1 for more information). A further consideration is the difference between the maximum and minimum values in the range. The experimental design chosen was a three level design for both the USE and Murrumbidgee floodplain studies. The attribute levels used could then be defined and are shown in Table A2.3.

Table A2.3: Attribute levels for USE and Murrumbidgee floodplain questionnaires

Attribute	No Change	Range 1	Range 2	Range 3
USE case study				
Cost to the respondent	$0	$20	$50	$200
Area of healthy wetlands	44,000 ha	55,000 ha	66,000 ha	77,000 ha
Area of healthy remnants	50,000 ha	75,000 ha	87,500 ha	100,000 ha
Threatened species that will benefit	0	6	12	24
Hunting of waterfowl	6,000	3,000	9,000	12,000
Murrumbidgee floodplain case study				
Cost to the respondent	$0	$20	$50	$200
Area of healthy wetlands	2500 ha	5000 ha	7500 ha	12,500 ha
Population of native water and woodland birds	40%	50%	60%	80%
Population of native fish	20%	30%	40%	60%
Number of farmers leaving	0	5	10	15

Having selected the attribute ranges and levels, they need to be integrated into the survey design. The full factorial is far too great a load for each individual respondent to bear. Bennett (1999) outlines two strategies for overcoming the respondent burden:

1. Use a fractional factorial; and,
2. Where the fractional factorial remains too large, segment the fractional factorial into blocks.

A 'fractional factorial' presents only a selected portion of the choice sets to respondents. The advantage of a fractional factorial is reduced respondent burden. The disadvantage is that it may not identify all of the relationships between the attributes. Hence, a random fractional factorial may not accurately represent respondents choices. Fractional factorial designs that minimise these disadvantages are available from design catalogues such as Hahn and Shapiro (1966).

Even after a factorial design has been used, the number of choice sets may remain too large for individual respondents. A strategy to reduce the burden is to ask a number of different respondents to answer a 'block' of the fractional factorial. For example, dividing the factorial into five blocks would require five respondents to cover all the choice sets. However, a much larger sample size is required to achieve the required data.

Once it is decided to 'block' the fractional factorial, a mechanism to divide the choice sets into the blocks is required. Bennett (1999) indicates this can be via either a specific strategy or an expansion of the fractional factorial known as 'the simultaneous method'. A strategy of combining every fifth strategy into a block was followed after removal of implausible and dominated alternatives. Implausible alternatives are those for which the alternatives do not make sense. For example, both alternatives in a choice set are identical. Dominated alternatives are those for which the levels of all attributes improve at a reduced trade-off in terms of cost. Two alternatives were removed from both the USE choice set leaving a 25 choice sets that were divided into five blocks. That is, five versions of each survey. However, a dominated choice set remained in the MRF choice sets in order to retain balanced blocks. Bennett (1999) indicates that retaining dominated choice sets is unlikely to cause significant problems in questionnaires.[22]

[22] An additional problem resulting from deleting dominated and/or implausible choice sets is that the experimental design may be non-orthogonal. Non-orthogonal designs result in unreliable models from the choice sets.

The nature of the choice sets has now been established including the basic information to be presented in each question. However, the nature of the trade-offs requested of respondents remains inherently difficult. That is, way that the information is presented can make answering the questions much easier for respondents. This issue is discussed in the next section.

Choice set question design

A draft questionnaire was designed based on previous CM surveys.[23] One version of the initial draft was shown in Section 4 as Figure 1. Because these questions are the most important part of the questionnaire and because they are regarded as difficult for respondents to answer, they were closely examined during the focus group analysis.

The initial focus group for the USE study (held in Canberra) indicated that significant problems existed with respect to the choice sets. Respondents found the question difficult to interpret and answer. Particular problems related to respondents' difficulty in identifying what they received for payment of the levy. It was also apparent the numerical nature of the trade-offs caused some participants difficulty – one respondents stated "the hectare numbers are too much". The critical assessment of the choice set design prompted a search for innovative solutions to the problem.

At the second focus group (held in Adelaide) respondents were asked to answer a draft questionnaire containing the original draft choice sets. A similar theme emerged from the responses: "it seemed like a mathematics test rather than an opportunity to write down an opinion", and, "I would like to see the results of spending my money … what I get for what I pay". After discussion of the draft choice set respondents were given an identical question in pictorial format together with a key identifying the numerical relationships with the pictures. The response to the pictorial format was favourable. However, it remained clear that respondents found the questions difficult to interpret.

A number of different choice-set formats were developed prior to the third focus group. There were two main aims underlying the alternative formats:

1. To incorporate feedback from the Adelaide focus group; and,
2. To trial alternative presentations of information. For example, the choice set in Figure 1 is a vertical, absolute number based, choice set. One alternative format was horizontal pictorial based, and the other vertical, pictorial but indicated the marginal change in attributes rather than the totals in Figure 1.

Focus group analysis indicated that the horizontal format was a significant improvement. The group especially liked the incorporation of summary labels for the attributes indicating "I pay" and "What I

A slightly modified version of the horizontal, pictorial format questionnaire was trialed at the final focus group held in Griffith. The group indicated they had no particular problems answering the question. Comments included "clear enough" and "easy to answer". Hence, significant confidence that respondents would not have difficulty interpreting and answering the choice sets was achieved. An example of the final choice set is shown in Section 4 as Figure 2.

Despite the level of confidence in the choice sets, it is important to assess the responses of respondents and attempt to determine any perceived bias. These issues are discussed in the next section.

Debriefing questions

Debriefing questions are designed to assess bias or protests within the survey results. In particular debriefing questions should address (Bennett 1999):

- Problems with the payment vehicle used;
- Problems with overriding effects of a single attribute;
- Whether the information provided was sufficient;
- Whether respondents felt the questionnaire was biased; and,

[23] These surveys are reported in the "Choice Modelling Research Report" series. Contact Professor Jeff Bennett for further information –contact details are inside the title page of this research report.

- Whether respondents were confused by, or did not understand, the information in the questionnaire.

Payment vehicle protests arise where respondents reject the proposed improvements because of the payment mechanism. Hence the true willingness to pay could be underestimated.

Overriding effects of a single attribute are termed 'lexicographic preferences'. That is, no matter what the levels of attributes, respondents always selected the option that contains the most of the attribute they consider important. Focus group analysis indicated some respondents might hold lexicographic preferences against duck hunting and might oppose any increase in the number of ducks hunted in the USE. Therefore, a level with fewer ducks hunted was included in the USE questionnaire. The USE questionnaire also included a debriefing question relating to duck hunting to identify the impact of such preferences. Focus groups indicated the potential for a similar problem relating to farmers leaving in the MRF but it was judged not sufficiently likely to justify inclusion of an additional question.

The remaining issues are self-explanatory and a simple question relating to each was included in the questionnaire.

Socio-economic and attitude based data

A section seeking socio-economic and attitudinal data complete data collection in the questionnaire. The data collected were:

- Age;
- Postcode;
- Sex;
- Highest level of education attained;
- Household income;
- Environmental attitudes; and, in the USE questionnaire,
- Whether respondents had or intended to hunt ducks.

Data relating to age, sex, education and income are used to assess the representativeness of the sample. These data together with environmental attitudes and duck hunting are also used as potential explanatory factors. The postcode of respondents is used to assess whether distance affects the estimated values.

A note thanking respondents for their input and a space to write any comments concluded the survey.

Once the survey draft was completed, a graphic designer prepared it for printing. The graphic designer's role was twofold:

1. To increase retention and response rate by designing a layout and colour scheme that was pleasing to the eye of respondents.
2. To prepare the document for professional printing.

It is important that such a survey is perceived as professional and well managed by respondents in order to increase response rates.

A2.3 Survey implementation

Once the questionnaire design was completed the next issue is survey implementation. Survey implementation involves decisions about who is to be sampled, how large a sample is required and how is the questionnaire to be delivered. Previous choice modelling research[24] provided some guidance relating to the issues, each of which is discussed below.

[24] These surveys are reported in the "Choice Modelling Research Report" series. Contact Professor Jeff Bennett for further information –contact details are inside the title page of this research report.

Sample frame

The sample frame determines who is to be surveyed and how many. Previous studies have indicated that the values held for wetlands are likely to differ in relation to the geographic proximity of the respondent (see for example Rolfe and Bennett 2000). These studies also indicate that individuals who are geographically distant from these wetlands hold significant values. Use values (relating to recreation in particular) are likely to be higher for locals but non-use values may not be. Hence, it is important that respondents are drawn from populations within and outside the case study areas.

Focus group analysis also gives some guidance as to the likely values held and therefore the likely response to the survey. The initial Canberra focus group was critical of the survey, in part because the USE was "too far away". As a result the survey strategy shown in Table A2.4 was constructed. A minimum of 30 questionnaires of each version is required to achieve a statistically significant sample. Despite this constraint, a small cross sample in the major population centres was used to gauge the level of interest and value for the wetlands within an interstate population.

Table A2.4: Sample frame

Sample	Case study	Minimum total Questionnaires
Adelaide	USE	150
Naracoorte	USE	150
Canberra	USE	50
Canberra	MRF	150
Wagga Wagga	MRF	150
Griffith	MRF	150
Adelaide	MRF	50

The cross-samples can be used to test hypotheses about the effects of distance on values. The following hypotheses will be tested:

1. USE hypothesis 1: Naracoorte values differ from the remainder of the sample.
2. USE hypothesis 2: Adelaide values differ from the remainder of the sample.
3. USE hypothesis 3: Canberra values differ from the remainder of the sample.
4. MRF hypothesis 1: Griffith values differ from the remainder of the sample.
5. MRF hypothesis 2: Wagga Wagga values differ from the remainder of the sample.
6. MRF hypothesis 3: Canberra values differ from the remainder of the sample.
7. MRF hypothesis 4: Adelaide values differ from the remainder of the sample.

Questionnaire delivery

Once an appropriate sample frame has been determined, the next question is how to obtain the sample. Potential delivery mechanisms include mail out/mail back, personal drop-off/pick-up and personal interview. The complex nature of the issues in the survey precludes use of telephone survey techniques.[25] When deciding amongst these methods a variety of factors need to be weighed up including:

- The cost of achieving the sample;
- Whether any biases are likely; and,
- The accuracy and timeliness of the response.

Mechanisms involving personal contact with respondents are relatively high cost. However, they do ensure a relatively high response rate and potentially, a more complete cross section of the community is represented. The personal contact aspect can also potentially introduce 'interviewer bias' (although this is minimised with drop-off/pick-up surveys) and may not allow sufficient time for respondents to contemplate their answers. Mail based surveys address cost, 'interviewer bias' and time concerns. The disadvantages of mail based surveys are the potential for a low response rate (and hence a sampling bias) and are relatively time expensive as the period from commencing the survey mail out to final responses are received can be six or more weeks.

[25] Mixed techniques where telephone pre-tests are used to establish a sample may be a potential future option for this type of survey.

Both the USE and MRF surveys were undertaken as mail out/mail back.[26] The decision was based on the relative costs of obtaining a suitable sample size and feedback received in focus groups. A mail based sample cost between 50 and 60 percent of either method involving personal contact. Focus group analysis indicated the final questionnaire version would be relatively well received as a mail based survey and was likely to achieve a suitable response rate.

Having established the delivery mechanism the final stage prior to undertaking the survey is to determine the mechanics of the survey. There have been very few CM applications undertaken in Australia using mail-based methods to provide guidance for acceptable response rates. Lockwood and Carberry (1998) achieved completed survey response rates of 46.8 and 53 percent in two surveys, however a survey conducted by Rolfe and Bennett (2000) achieved approximately 17 percent. A conservative approach to the mail out sample was used based on a response rate of approximately 20 percent for each of the main samples. Response rates on cross samples (the USE in Canberra and MRF in Adelaide) were assumed lower at approximately 15 percent. The required mail out derived is shown in Table A2.5. The five versions of each survey were randomly assigned across each sample.

Table A2.5: Mail out survey sizes

Sample	Case study	Minimum sample	Number mailed out
Adelaide	USE	150	800
Naracoorte	USE	150	800
Canberra	USE	50	400
Canberra	MRF	150	800
Wagga Wagga	MRF	150	800
Griffith	MRF	150	800
Adelaide	MRF	50	400

The means of deriving the sample must next be determined. It was anticipated that the electoral role would provide the most accurate listing of the name and address of potential respondents in each study area. However, the cost associated with compiling an electronic listing from microfiche was significant. Therefore, the 'white pages' of the telephone directory were used for each study area. The white pages are available in electronic form as 'Australia on disc'. A sample of some 2,000 names and addresses for the USE and 2,800 for the MRF was randomly selected according the areas in Table A2.5 to participate in the survey.

To increase response rates reminders, or a second copy of the survey, are normally sent to potential respondents. Due to the costs associated with survey production, only one mail out of the survey followed up by two reminders spaced at two and three and a half weeks after the initial mail out were undertaken. The initial mail out was undertaken on the sixth and seventh of March 2000. Reminders were sent on 17 and 27 March 2000. Respondents were mailed; a letter of introduction, a questionnaire and a reply paid envelope. While some respondents may have found it difficult to respond within this time-period, the short time-period means they are likely to recall receiving the survey. A copy of the reminder card is included as Appendix 5.

[26] Barbara Davis and Associates were contracted to coordinate the survey logistics.

Appendix 3 Copy of introductory letter (MRF)

Stuart Whitten
School of Economics and Management
University College
The University of New South Wales
Canberra, ACT, 2600

Dear Title Surname,

Your household has been selected at random to be a part of a survey about community values of land management. We would like your input to help us determine how the community feels about land management and its wider impacts on the natural environment.

In this questionnaire you will be asked questions about land management in a particular region of Australia, the Upper South East of South Australia and how you feel about its implications on the natural environment.

You don't need to know about land management and there are no right or wrong answers –we are interested in your views.

Your input will be used to help assess how society feels about the trade- offs being made in land management and to estimate the values held by the community for various land management options.

If you have any questions regarding this survey please call Stuart Whitten on 02 6268 8073 or email sm.whitten@adfa.edu.au.

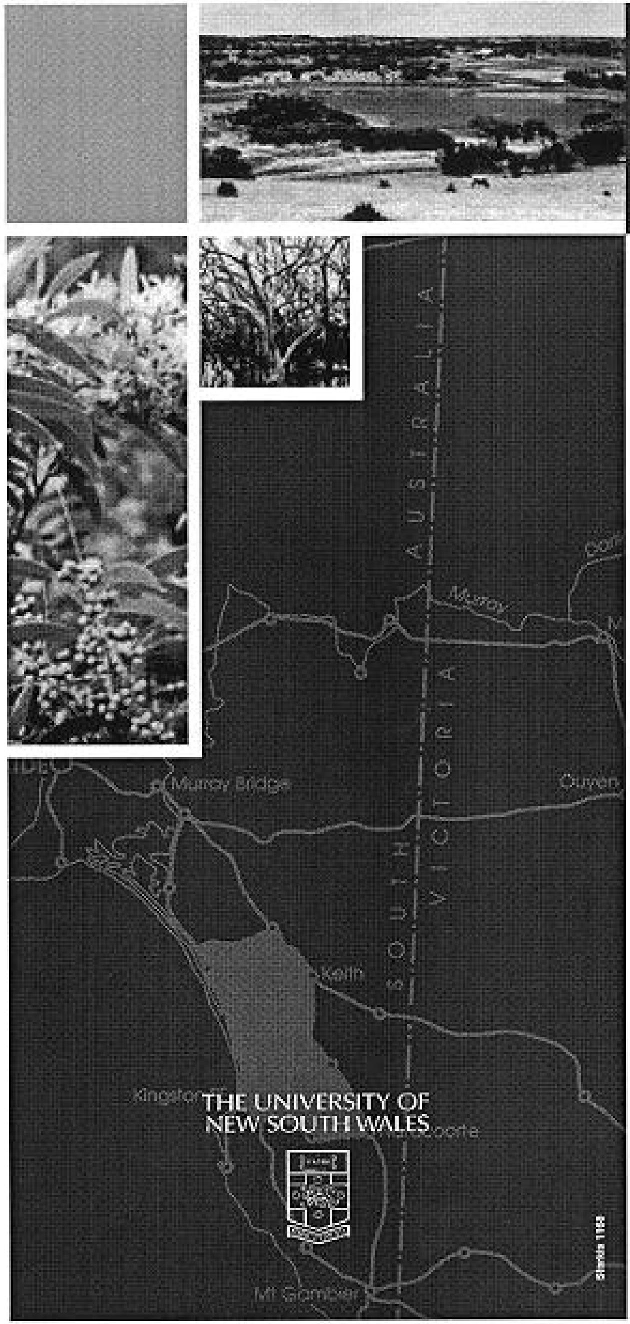
All your answers will be kept strictly confidential

We hope you enjoy doing this questionnaire and thank you very much for taking part in the survey.

Yours sincerely,

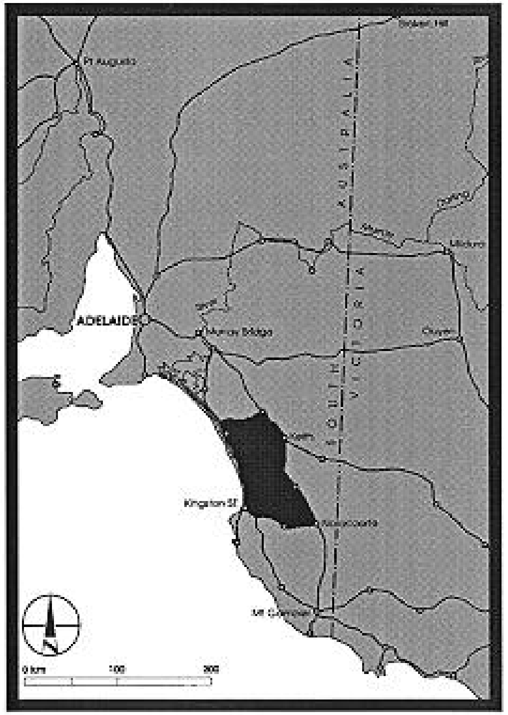
Stuart Whitten
Research Officer
The University of New South Wales

Appendix 4 Copy of USE questionnaire



Land management in the Upper South East of South Australia

A survey of **community** attitudes



THE UNIVERSITY OF
NEW SOUTH WALES

The Upper South East of South Australia

The Upper South East of South Australia is located between the Murray Mallee and the Coorong and Southern Ocean (see the cover map).

The main enterprise in the region is beef production followed by sheep for meat and wool. There are 1.3 million sheep and 180,000 cattle in the region. About 18,000 people live in the Upper South East and there are more than 400 farms in the region. Due to decreasing profits from farming in recent years the total number of farms and population in the region has been falling.

The region contains a number of different sorts of wetlands. These wetlands are internationally recognised as important conservation areas.

Healthy wetlands in the region are important for waterbird feeding and breeding as well as a drought refuge for waterbirds from inland Australia. Many wetland areas have been converted to pasture and grazing.

Symbol key

(for questions 6 to 10)

Healthy wetlands	= 22,000 Hectares (55,000 Acres)
Healthy remnant vegetation	= 25,000 Hectares (60,000 Acres)
Threatened species that will benefit	= 6 Species
Ducks hunted	= 3000 Ducks

A summary of the situation

Healthy wetlands	44,000 Ha.
Healthy remnant vegetation	50,000 Ha.
Total number of threatened species	24*
Ducks hunted	6000

** Includes several species that would become extinct in the Upper South East (but not Australia)*

Area of healthy wetlands

Before 1900 there were approximately 500,000 hectares (1.25 million acres) of wetlands in the Upper South East. This area will have declined to 44,000 hectares (110,000 acres) in 30 years time. The area of healthy wetlands is affected by grazing practices, draining and the management of native vegetation, weeds and feral animals. By returning natural wetting and drying, excluding (or reducing) grazing and controlling weeds and feral animals, the area of healthy wetlands could be increased.

Area of healthy remnants

Remnant vegetation is the native vegetation left after clearing for farming. The area of healthy remnant vegetation is related to grazing practices, management of native vegetation, weeds and feral animals. There are 51,000 hectares (125,000 acres) of healthy remnant vegetation in the Upper South East. By rehabilitating existing vegetation that has been damaged by grazing and weeds and revegetating areas to link remaining remnant vegetation, the area of healthy remnant vegetation could be increased.

Threatened species

Without changes to land management in the Upper South East region, 19 species will be threatened and 5 will become extinct in the Upper South East in the next 30 years (but not in other parts of Australia).

Species that will become extinct in the Upper South East include the Mallee-fowl, Beautiful Firetail, Glossy Ibis and Australasian Shoveler. The population of many other species of birds, mammals, reptiles, plants, insects and other biota would also continue to fall. If management is changed, the population of some species could be maintained or improved.

Hunting of waterfowl

Wetlands in the region produce or shelter large numbers of ducks. About 6000 ducks will be hunted each year if there is no change in wetland management. Controlled hunting of ducks does not significantly affect the numbers of waterfowl or the number of species present in the area. Changing management in the region could change the number of ducks hunted in wetlands.

Thank you for your help in completing this questionnaire.

Please write any comments about this survey on this page.

What this survey is for

We want to know your views on options for managing land in the Upper South East region of South Australia.

How you were chosen

You were chosen at random from your local telephone directory.

What we ask you to do

Any member of your household over eighteen years can complete this survey. Answering this survey is voluntary. You don't need to know about land management and there are no right or wrong answers—we are interested in your views.

The survey should take about 15 minutes to complete.

If you have any questions, please...

Call: Stuart Whitten,
The University of New South Wales
(02) 6268 8073.

All your answers will be kept strictly confidential.

Return this survey by...

Please place your completed survey in the enclosed stamped, self-addressed envelope and post it to us by 16th March 2000.

We hope you enjoy completing this questionnaire and thank you for helping us with our survey.

To start, we want to ask you about your experience of the Upper South East region. Please read the information about the region in the fold-out cover.

1. Have you visited the Upper South East region?

   Tick one box only

   Yes ☐ 1

   No ☐ 2

2. Do you think you will visit the Upper South East region in the future?

   Tick one box only

   Yes ☐ 1

   No ☐ 2

   Maybe ☐ 3

The problem in the Upper South East

- A large proportion of wetlands and remnants has been degraded, the population of native species has declined and hunting opportunities reduced.
- There are no current restrictions on the way landholders can manage wetlands and remnant vegetation *except* that native vegetation cannot be cleared without a permit.
- If current land management practices were changed, the state of the environment in the region could be improved. There could be:
  - More healthy wetlands
  - More healthy remnant vegetation
  - More threatened species could survive
  - More opportunities to hunt ducks.

3. How interested are you in land management in the Upper South East of South Australia?

   Tick one box only

   Very interested ☐ 1

   Moderately interested ☐ 2

   Slightly interested ☐ 3

   Not at all interested ☐ 4

Options for changing land management

- Farmers could use land management practices that would improve the environment including:
  - Fencing wetlands and remnants to stop sheep and cattle from entering
  - Returning natural wetting and drying to wetlands
  - Revegetating links between wetlands and remnant vegetation
  - Controlling weeds and feral animals.
- Different management practices will have different impacts on the Upper South East region.
- It would be costly for farmers to use these practices.
- If farmers use these practices, governments could compensate them for their increased costs.

4. Should farmers be paid compensation if they are made worse off by these changes?

   Tick one box only

   Yes ☐ 1
   No ☐ 2
   Maybe ☐ 3

How these options affect you

- Governments do not have the money to make compensation payments out of existing tax revenues.
- The Commonwealth Government could collect a one-off 'Upper South East Land Management Levy' on all income tax payers—including your household—in the 2000–2001 taxation year to pay for the compensation.
- The size of the levy would depend on which land management practices were used.
- The money from the levy would go into a special trust fund only used to change land management practices in the Upper South East region.
- An independent body, like the CSIRO, would make sure the money was spent properly.

5. Is an Upper South East Land Management Levy a good idea?

   Tick one box only

   Yes ☐ 1
   No ☐ 2
   Maybe ☐ 3

Options for changing land management

- Farmers could use land management practices that would improve the environment including:
  - Fencing wetlands and remnants to stop sheep and cattle from entering
  - Returning natural wetting and drying to wetlands
  - Revegetating links between wetlands and remnant vegetation
  - Controlling weeds and feral animals.
- Different management practices will have different impacts on the Upper South East region.
- It would be costly for farmers to use these practices.
- If farmers use these practices, governments could compensate them for their increased costs.

4. Should farmers be paid compensation if they are made worse off by these changes?

   Tick one box only

   Yes ☐ 1
   No ☐ 2
   Maybe ☐ 3

How these options affect you

- Governments do not have the money to make compensation payments out of existing tax revenues.
- The Commonwealth Government could collect a one-off 'Upper South East Land Management Levy' on all income tax payers—including your household—in the 2000–2001 taxation year to pay for the compensation.
- The size of the levy would depend on which land management practices were used.
- The money from the levy would go into a special trust fund only used to change land management practices in the Upper South East region.
- An independent body, like the CSIRO, would make sure the money was spent properly.

5. Is an Upper South East Land Management Levy a good idea?

   Tick one box only

   Yes ☐ 1
   No ☐ 2
   Maybe ☐ 3

What do you think?

We want to know what you think about possible ways of managing land in the Upper South East of South Australia. To do this we have prepared five sets of possible options. We will describe each option by giving you information about:

- Cost to you of a one-off levy on your income
- The area of healthy wetlands
- The area of healthy remnant vegetation
- The number of threatened species that will benefit
- The number of ducks hunted

Please read the fold out cover to find out details of the current situation for the Upper South East and for the symbol key.

There are many ways to repair the wetlands and remnants in the Upper South East. Because there are so many options we ask you to consider only three at a time in questions 6 to 10.

When deciding on the options you prefer, keep in mind your available income and all other things you have to spend money on.

6. Suppose options A, B and C are the **ONLY** ones available, which would you choose?

	I pay	What I get				I would choose
		Healthy wetlands	Healthy remnant vegetation	Threatened species that benefit	Ducks hunted	*Tick one box only*
Option A (No change)	**NIL**					☐[1]
Option B	$20					☐[2]
Option C	$50					☐[3]

7. Suppose options A, D and E are the **ONLY** ones available, which would you choose?

	I pay	What I get				I would choose
		Healthy wetlands	Bird numbers	Native fish numbers	Farmers leaving	*Tick one box only*
Option A (No change)	**NIL**					☐[1]
Option D	$20					☐[2]
Option E	$20					☐[3]

8. Suppose options A, F and G are the **ONLY** ones available, which would you choose?

	I pay	What I get				I would choose
		Healthy wetlands	Bird numbers	Native fish numbers	Farmers leaving	*Tick one box only*
Option A (No change)	**NIL**					☐[1]
Option F	$50					☐[2]
Option G	$20					☐[3]

9. Suppose options A, H and I are the **ONLY** ones available, which would you choose?

	I pay	What I get				I would choose
		Healthy wetlands	Healthy remnant vegetation	Threatened species that benefit	Ducks hunted	*Tick one box only*
Option A (No change)	**NIL**					☐ 1
Option H	$50					☐ 2
Option I	$20					☐ 3

10. Suppose options A, J and K are the **ONLY** ones available, which would you choose?

	I pay	What I get				I would choose
		Healthy wetlands	Healthy remnant vegetation	Threatened species that benefit	Ducks hunted	*Tick one box only*
Option A (No change)	**NIL**					☐ 1
Option J	$200					☐ 2
Option K	$20					☐ 3

11. When answering Questions 6 to 10, did you always choose **"Option A: No Change"**?

Tick one box only

Yes ☐ 1

No ☐ 2

If you answered 'Yes', which statement most closely describes your reason for doing so?

Tick one box only

I support land management but cannot afford any of the levies mentioned ☐ 1

I did not know which option was best so I stuck to the current situation ☐ 2

I don't trust government to make a levy one-off? ☐ 3

Some other reason. Please specify ☐ 4

_____

_____

_____

_____

_____

12. When answering Questions 6 to 10, did you always choose the option with the smallest number of **"Ducks hunted"**?

Tick one box only

Yes ☐ 1

No ☐ 2

If you answered 'Yes', which statement most closely describes your reason for doing so?

Tick one box only

I oppose waterfowl hunting in wetlands ☐ 1

I object to waterfowl hunters benefiting from government spending ☐ 2

Some other reason. Please specify ☐ 3

_____

_____

_____

_____

_____

13. Tick the box closest to your view for **each** statement:

	Yes	No	Maybe
I needed more information than was provided	☐ 1	☐ 2	☐ 3
The information was biased against wetlands	☐ 1	☐ 2	☐ 3
The information was biased towards wetlands	☐ 1	☐ 2	☐ 3
I found questions 6 to 10 confusing	☐ 1	☐ 2	☐ 3
I understood the information in the survey	☐ 1	☐ 2	☐ 3

You and your background

In this section of the questionnaire, we ask you a few questions to make sure the people we are surveying are from a wide range of backgrounds.

14. What is your age? _____

15. What is the postcode of your residential address?

_____

16. What is your sex?

Tick one box only

Female ☐ 1

Male ☐ 2

17. Have you ever hunted ducks?

Tick one box only

Yes ☐ 1

No ☐ 2

18. Do you think you will hunt ducks in the future?

Tick one box only

Yes ☐ 1

No ☐ 2

19. What is the **highest** level of education that you have obtained or are obtaining?

Tick one box only

Completed primary only ☐ 1

Completed Year 10/Junior/Intermediate ☐ 2

Completed Year 12/Senior/Leaving ☐ 3

Diploma or certificate (trade qualification) ☐ 4

Tertiary degree ☐ 5

Other (please specify) ☐ 6

_____

_____

_____

20. When thinking about issues where there are trade-offs between conservation and development do you:

Tick one box only

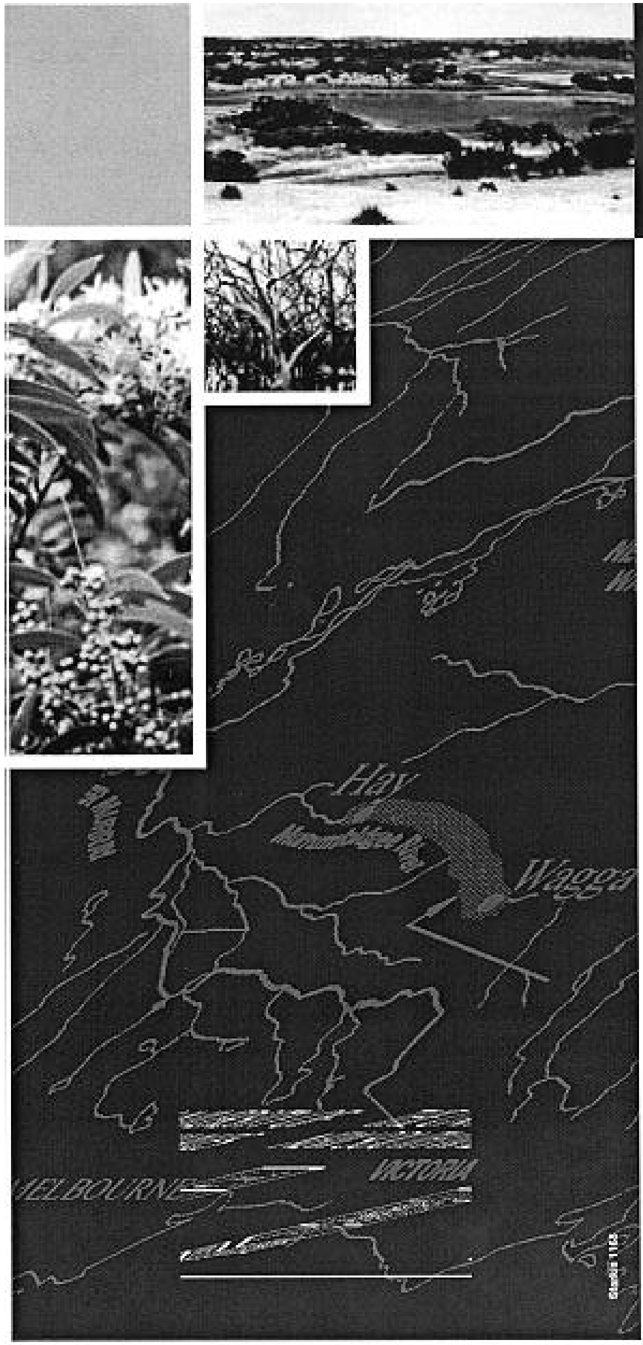
- Favour development ☐ 1
- Favour conservation ☐ 2
- Favour development and conservation equally ☐ 3

21. Which of the following categories does your total household income (before tax) fall into, that is, the total income of all people in the household?

Tick one box only

- Under $6239 ☐ 1
- $6239 – $15,599 ☐ 2
- $15,600 – $25,999 ☐ 3
- $26,000 – $36,399 ☐ 4
- $36,400 – $51,999 ☐ 5
- $52,000 – $77,999 ☐ 6
- $78,000 – $103,999 ☐ 7
- More than $104,000 ☐ 8
- Don't know ☐ 9

Appendix 5 Copy of MRF questionnaire

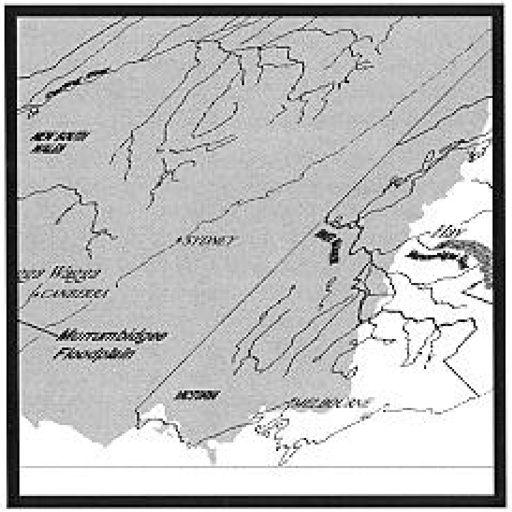


Wetlands on the Murrumbidgee River floodplain

Wagga Wagga to Hay in New South Wales

In this questionnaire we are interested in your views on land management along the **Murrumbidgee River floodplain** between Wagga Wagga and Hay.

This is shown on the map below.



The main enterprise on the floodplain region is beef production followed by sheep for meat and wool. Over 100,000 people live on or near the Murrumbidgee River floodplain in this region.

The wetlands in the region are of national importance and are listed in the 'Directory of Important Wetlands in Australia' by the Commonwealth Government. Farmers or State Forests of New South Wales own the wetlands.

Most floodplain wetlands have been degraded by a combination of grazing, timber harvesting and reduced flooding. Healthy wetlands in the region are important for waterbird feeding and breeding, fish habitat and breeding and wetland vegetation. The wetlands would historically flood and then dry providing food and home for water birds. Wetlands in State Forests can be visited. Farmers who allow visitors may also benefit from tourism.

Symbol Key

(use for questions 6 to 10)

Area of healthy wetlands		= 2500 Hectaress (6000 Acres)
Water and woodland birds		= 20% pre 1800 bird numbers
Native fish		= 20% pre 1800 fish numbers
Farmers leaving		= 5 farmers

A summary of the situation

Area of healthy wetlands	2500 Hectares (6000 Acres)
Water and woodland birds	40% pre 1800 numbers
Native fish	20% pre 1800 numbers
Farmers leaving	No farmers leaving

Area of healthy wetlands 

Originally there were about 47,000 hectares (115,000 acres) of healthy floodplain wetlands on the Murrumbidgee floodplain. Now there are about 2500 hectares (6000 acres) of healthy wetlands. Returning natural flooding and drying patterns, excluding (or reducing) grazing, controlling weeds and feral animals and removing timber harvesting could increase the area of healthy wetlands.

Water and woodland birds 

Water and woodland birds use wetlands on the Murrumbidgee floodplain for feeding and breeding. With no change to management over the next 15 years the number of wetland and woodland birds in the region would continue to fall to 40% of historic levels. Some species such as the Superb Parrot would become extinct in the region. Changing land use and water management to return flooding and drying patterns could increase the number of birds.

Fish populations 

The wetlands on the Murrumbidgee River floodplain were important native fish habitat and breeding places. However, changed land and water management practices will reduce the number of native fish to 20 percent of historic numbers by 2015. By returning natural flooding patterns and changing grazing and timber management practices fish numbers could expand again.

Impact on farmers 

About 2500 farmers in the region irrigate from the Murrumbidgee River and about 70 farmers own wetlands on the floodplain. Water could be bought from farmers so that natural flooding and drying patterns are returned to wetlands. Changing grazing management practices could reduce the number of livestock. Some farmers could sell their farms and leave the region. The number of farmers who would leave depends on the mix of management changes used. Compensation could be paid to farmers who are made worse off by these changes. Some farmers could benefit from extra tourists visiting their wetlands.

Thank you for your help in completing this questionnaire.

Please write any comments about this survey on this page.

What this survey is for

We want to know your views on options for managing wetlands on the Murrumbidgee River floodplain.

How you were chosen

You were chosen at random from your local telephone directory.

What we ask you to do

Any member of your household over eighteen years can complete this survey. Answering this survey is voluntary. You don't need to know about land management and there are no right or wrong answers—we are interested in your views.

The survey should take about 15 minutes to complete.

If you have any questions, please...

Call: Stuart Whitten,
The University of New South Wales
(02) 6268 8073.

All your answers will be kept strictly confidential.

Return this survey by...

Please place your completed survey in the enclosed stamped, self-addressed envelope and post it to us by 16th March 2000.

We hope you enjoy completing this questionnaire and thank you for helping us with our survey.

To start, we want to ask you about your experience of the Murrumbidgee floodplain. Please read the information about the region in the fold out cover.

1. Have you visited the Murrumbidgee River or floodplain?

   Tick one box only

   Yes ☐ 1

   No ☐ 2

2. Do you think you will visit the Murrumbidgee River or floodplain in the future?

   Tick one box only

   Yes ☐ 1

   No ☐ 2

   Maybe ☐ 3

The issue on the Murrumbidgee River floodplain

- A large proportion of the wetlands has been degraded and the populations of native birds, fish plants and animals species have declined.
- There are no current restrictions on the way landholders can manage wetlands except that native vegetation cannot be cleared without a permit.
- If current wetland management practices are changed, the state of the environment in the region could be improved. There could be:
  - More healthy wetlands
  - More water and woodland birds
  - More fish in the wetlands and river.
- But
  - some farmers could change their wetland management
  - some farmers could sell their properties and leave the region.

3. How interested are you in wetland management on the Murrumbidgee floodplain?

   Tick one box only

   Very interested ☐ 1

   Moderately interested ☐ 2

   Slightly interested ☐ 3

   Not at all interested ☐ 4

Options for changing management

- Farmers could adopt management practices that would improve wetland health, including:
  - Fencing wetlands to stop sheep and cattle from entering
  - Returning natural flooding patterns on some of the floodplain
  - Leaving fallen logs to improve habitat—especially for fish
  - Controlling weeds and feral animals.
- Different management practices will have different impacts on the environment and economy of the Murrumbidgee region.
- It would be costly for farmers to use these practices.
- If farmers use these practices, governments could compensate them for these increased costs.
- Farmers who sell their properties because of the changes could also be compensated.

4. Should farmers be paid compensation if they are made worse off by these changes?

   Tick one box only

   Yes ☐ 1
   No ☐ 2
   Maybe ☐ 3

How these options affect you

- Governments do not have the money to make compensation payments from existing tax revenues.
- The Commonwealth Government could collect a one-off 'Murrumbidgee Wetland Management Levy' on all income tax payers—including your household—in the 2000–2001 taxation year to pay for the compensation.
- The size of the levy would depend on which management practices are used.
- The money from the levy would go into a special trust fund only used to change wetland management practices on the Murrumbidgee River floodplain.
- An independent body, like the CSIRO, would make sure the money was spent properly.

5. Is a Murrumbidgee Wetlands Management Levy a good idea?

   Tick one box only

   Yes ☐ 1
   No ☐ 2
   Maybe ☐ 3

What do you think?

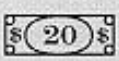
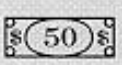
We want to know what you think about possible ways of managing wetlands on the Murrumbidgee River floodplain. To do this we have prepared five sets of possible management options. We will describe each option by giving you information about:

- Cost to you of a one-off levy on your income
- The area of healthy wetlands
- The number of water and woodland birds
- The number of fish
- The number of farmers leaving

Please read the fold out cover to find out details of the current situation for the Murrumbidgee River floodplain and for the symbol key.

There are many ways to repair the wetlands on the Murrumbidgee River floodplain. Because there are so many options we ask you to consider only three at a time in questions 6 to 10.

When deciding on the options you prefer, keep in mind your available income and all other things you have to spend money on.

6. Suppose options A, B and C are the **ONLY** ones available, which would you choose?	**I pay**	**What I get**				**I would choose** *Tick one box only*
		Healthy wetlands	Bird numbers	Native fish numbers	Farmers leaving	
Option A (No change)	**NIL**					☐[1]
Option B						☐[2]
Option C						☐[3]

7. Suppose options A, D and E are the **ONLY** ones available, which would you choose?

	I pay	What I get				I would choose
		Healthy wetlands	Bird numbers	Native fish numbers	Farmers leaving	*Tick one box only*
Option A (No change)	**NIL**					☐[1]
Option D	$20					☐[2]
Option E	$20					☐[3]

8. Suppose options A, F and G are the **ONLY** ones available, which would you choose?

	I pay	What I get				I would choose
		Healthy wetlands	Bird numbers	Native fish numbers	Farmers leaving	*Tick one box only*
Option A (No change)	**NIL**					☐[1]
Option F	$50					☐[2]
Option G	$20					☐[3]

9. Suppose options A, H and I are the **ONLY** ones available, which would you choose?

	I pay	What I get: Healthy wetlands	What I get: Bird numbers	What I get: Native fish numbers	What I get: Farmers leaving	I would choose *Tick one box only*
Option A (No change)	**NIL**					☐[1]
Option H	$50					☐[2]
Option I	$20					☐[3]

10. Suppose options A, J and K are the **ONLY** ones available, which would you choose?

	I pay	What I get: Healthy wetlands	What I get: Bird numbers	What I get: Native fish numbers	What I get: Farmers leaving	I would choose *Tick one box only*
Option A (No change)	**NIL**					☐[1]
Option J	$200					☐[2]
Option K	$20					☐[3]

11. When answering Questions 6 to 10, did you always choose **"Option A: No Change"**?

Tick one box only

Yes ☐ 1

No ☐ 2

If you answered 'Yes', which statement most closely describes your reason for doing so?

Tick one box only

I support wetland management but cannot afford any of the levy amounts ☐ 1

I did not know which option was best so I stuck to the current situation ☐ 2

I don't trust government to make a levy one-off? ☐ 3

Some other reason. Please specify ☐ 4

_____

_____

_____

_____

_____

12. Tick the box closest to your view for **each** statement:

	Yes	No	Maybe
I needed more information than was provided	☐ 1	☐ 2	☐ 3
The information was biased against wetlands	☐ 1	☐ 2	☐ 3
The information was biased towards wetlands	☐ 1	☐ 2	☐ 3
I found questions 6 to 10 confusing	☐ 1	☐ 2	☐ 3
I understood the information in the survey	☐ 1	☐ 2	☐ 3

You and your background

In this section of the questionnaire, we ask you a few questions to make sure the people we are surveying are from a wide range of backgrounds.

13. What is your age? _____

14. What is the postcode of your residential address?

_____

15. What is your sex?

Tick one box only

Female ☐ 1

Male ☐ 2

16. When thinking about issues where there are trade-offs between conservation and development do you:

Tick one box only

- Favour development ☐ 1
- Favour conservation ☐ 2
- Favour development and conservation equally ☐ 3

17. What is the **highest** level of education that you have obtained or are obtaining?

Tick one box only

- Completed primary only ☐ 1
- Completed Year 10/Junior/Intermediate ☐ 2
- Completed Year 12/Senior/Leaving ☐ 3
- Diploma or certificate (trade qualification) ☐ 4
- Tertiary degree ☐ 5
- Other (please specify) ☐ 6

_____

_____

_____

18. Which of the following categories does your total household income (before tax) fall into, that is, the total income of all people in the household?

Tick one box only

- Under $6239 ☐ 1
- $6239 – $15,599 ☐ 2
- $15,600 – $25,999 ☐ 3
- $26,000 – $36,399 ☐ 4
- $36,400 – $51,999 ☐ 5
- $52,000 – $77,999 ☐ 6
- $78,000 – $103,999 ☐ 7
- More than $104,000 ☐ 8
- Don't know ☐ 9

Appendix 6 Questionnaire reminder used for USE and MRF surveys

Front side:

If Undeliverable please return to:
PO Box 156
Campbell ACT 2512

Postage Paid Australia

ID: ###
Name
Address 1
Address 2

Rear side:

FRIENDLY REMINDER

Recently we mailed you a survey on Wetlands and Land management in the Upper South East of South Australia, and as your views are very important to us, I'm sending this little prompt. Be assured your answers will be kept confidential.

Should you have already responded then…..THANKS!!!
If not, please complete the questionnaire and return to: Professor Jeff Bennett
Reply Paid 919
PO Box 156
Campbell ACT 2612

If you have any questions please call: Stuart Whitten on (02) 6268 8073

University College

The University of New South Wales

Yours faithfully

Jeff Bennett

Previous Research Reports in the Series

Whitten, S.M. & Bennett, J.W. (1998). *Wetland Eco Systems and Landuse in the Upper South East of South Australia*, Private and Social Values of Wetlands Research Report No. 1, University College, The University of New South Wales, Canberra.

Whitten, S.M. & Bennett, J.W. (1998), *Farmer Perceptions of Wetlands and Wetland Management in the Upper South East of South Australia*, Private and Social Values of Wetlands Research Report No. 2, University College, The University of New South Wales, Canberra.

Whitten, S.M. & Bennett, J.W. (1999). *Potential Upper South East Regional Wetland Management Strategies*, Private and Social Values of Wetlands Research Report No. 3, University College, The University of New South Wales, Canberra.

Whitten, S.M. & Bennett, J.W. (1999). *Wetland Eco Systems and Landuse in the Murrumbidgee catchment –Wagga Wagga to Hay and including Mirrool Creek*, Private and Social Values of Wetlands Research Report No. 4, University College, The University of New South Wales, Canberra.

Whitten, S.M. & Bennett, J.W. (2000). *Farmer Perceptions of Wetlands and Wetland Management on the Murrumbidgee River between Wagga Wagga and Hay including Mirrool Creek*, Private and Social Values of Wetlands Research Report No. 5, University College, The University of New South Wales, Canberra.

Whitten, S.M. & Bennett, J.W. (2000). *Potential Wetland Management Strategies –Murrumbidgee Floodplain Wagga Wagga to Hay*, Private and Social Values of Wetlands Research Report No. 6, University College, The University of New South Wales, Canberra.

Whitten, S.M. & Bennett, J.W. (2001). *A travel cost study of duck hunting in the Upper South East of South Australia*, Private and Social Values of Wetlands Research Report No. 7, University College, The University of New South Wales, Canberra.