Lake Hume Land and On-Water Management Plan: Establishing the Social/Community and Economic Context

Lin Crase and Brian Furze

La Trobe University

PO Box 821 Wodonga

A MDFRC Consultancy report for Goulburn-Murray Water
Private Bag 2,
Wodonga, VIC, 3691

March 2006

The Murray-Darling Freshwater Research Centre

LA TROBE UNIVERSITY

Lake Hume Land and On-Water Management Plan: Establishing the Social/Community and Economic Context

A report prepared on behalf of the Murray Darling Freshwater Research centre for Goulburn-Murray Water by La Trobe University

For further information contact:

A/Prof Lin Crase or Dr B. Furze
La Trobe university
PO Box 821, Wodonga, VIC, 3689

e-mail: **B.Furze@latrove.edu.au**
L.Crase@latrobe.edu.au

March 2006

Acknowledgements

We would like to thank Dr Ben Gawne for providing the cover photographs.

EXECUTIVE SUMMARY

The potential for conflict over the management of water storages has prompted some agencies to embark on significant consultation exercises to both test the preferences of the wider community and inform the citizenry of potential changes. In this context, Goulburn-Murray Water (GMW), the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) and the Murray-Darling Basin Commission (MDBC) released an *Issues Summary Paper* as part of the development of a land an on-water management plan for Lake Hume in January 2005.

Managing the complex and often contradictory ways people value and use water requires an understanding of economic and social/community dimensions. This in turn requires an understanding of the relationships between: economic valuations; social values; community dynamics; natural resource management approaches; and political processes. The specific application of this to water in turn recognises water as: a public and private good; encompassing issues of scale and spatial issues; encompassing a complex relationship between self-interest and rationality; making a significant contribution to individual and community identity.

The Economic Context

A range of economic data was used to establish the economic relationships between water quality in Lake Hume and the various user groups. These data included property values and travel expenditures by recreational users.

Hedonic prices for having lake access and views
Models were developed that employed the hedonic pricing technique to unbundle the economic value of having access to the foreshore of the lake and/or views. This procedure was undertaken on the assumption that related markets (i.e. the market for real property) would encapsulate the economic benefits of having access to the foreshore and /or views, at least from a property owner's perspective.

No statistically significant or reliable relationship could be identified within these data which would support the hypothesised economic relationship. This could be taken to imply that there is only weak economic advantage enjoyed by property owners from this source or (more likely) the data set was deficient.

Travel costs by recreational users
The data collected on travel expenditures were more revealing. In essence, these data showed that direct recreational benefits enjoyed by visitors to the lake ran at about $3 million per annum. Importantly, these benefits were reduced when the lake had less in storage and if there was an algal bloom incident. In broad terms the impact a 50% reduction in storage or an algal bloom reduced recreational benefits by about $1 million.

These results are drawn purely from an economic perspective and by analysis of related markets. They do not account for wider values - such as existence or option values. Similarly, theses estimates make no attempt to unbundle or enumerate wider community attitudes to the resource.

The Social/Community Context

In-depth interviews elicited a diversity of responses, attitudes and actions. However five 'clusters' of issues were identified as important.

Low water levels

The social, community and recreational impacts of low water levels as perceived by respondents were varied. Whilst there are obviously economic costs associated with lower water levels, it is important to highlight that for many respondents, the water level of the Lake was not always an issue.

What Lake Hume means to individuals: economic, ecological, social and recreational values

The interviews highlighted the diverse, and sometimes contradictory, values which people associated with Lake Hume. Whilst it is self-evident that this research methodology will elicit values towards the Lake that are generally positive (given where the interviews were conducted and given the aims of this research), it also highlighted the multidimensionality of values and attachments associated with Lake Hume.

Importantly, the research has begun to uncover some of the breadth of values which people attach to the Lake. These obviously include economic and recreational values, but the important connection between these and ecological values emerge. So too do the complexities of the ways individuals define, in their own minds and in their own words, such ideas as 'the public good', the responsibilities (and the rights) of irrigators, and perceived problems with Lake management.

This diversity reminds us that the social/community context is not something which can be understood purely in terms of 'community engagement' or 'community consultation' as they are, almost by definition, unable to unearth the diversity of attachments to, and values surrounding, the Lake.

What Lake Hume means for others

The 'other' is a concept used to describe people/groups whose characteristics, actions, values or expectations don't fit with those of the respondent.

Whilst respondents identified end-users/irrigators as 'others' whose use of, and rights to, water impacted very directly on their own rights as users, many also identified that the Lake was originally built for this very reason. Hence,

for some respondents, the public good nature of water (through, say, recreational activities, aesthetic values etc) could be set aside from the individual rights of irrigators. However, irrigators also have a role to play in the management of Lake Hume, by ensuring they are efficient in their water use.

There was also a strong sense of needing to balance the needs of a variety of users whether they be irrigators or recreational users who undertake perceived inappropriate activities (four-wheel driving, speeding boats, leaving rubbish etc).

This serves to highlight the contradictory uses of the Lake, and the contradictory values within identified groups (such as recreational users) and reminds us that the labels or categories we employ are not homogenous.

Tensions between user expectations and connections to space/environment

The interviews highlighted concerns over the management of Lake Hume. Part of this dimension is spatial – management of Lake Hume and Dartmouth, the influence of downstream users, debates over the rights of users of Lake Hume, and part of this was attached to the management of water within the Lake.

Pollution and environmental values

Pollution means different things to different people (for example, blue-green algae is important to some but not to others, some see powerboats as sources of noise pollution, others see them as their recreation) though it would be possible to say there was a generalised concern about pollution.

One of the results of the in-depth questions related to that of blue-green algae. As could be expected, there was a variety of responses, ranging form the 'it has no impact on my activities' to it being a 'sign of a sick system'. However, the issues surrounding Lake Hume were often identified as being other than blue-green algae – for example, silting, pollution from speed boats, the ecological impacts of water level inconsistencies.

Another important aspect to this was related to the environmental impacts of Lake Hume. Whilst there was concern about pollution *within* the Lake respondents did not identify Lake Hume itself as having a negative impact on the environment.

INTRODUCTION

There are few natural resources that have attracted more attention from Australian policy makers in the last decade than water. Of particular significance have been concerns about the continued and excessive extraction of water for productive pursuits and the consequent deterioration in the quantity and quality of the resource available for other users. This has manifested in a series of reforms, the most recent being the responses of the various states to the National Water Initiative, with its strong focus on allocating additional water to achieve environmental amenity.

At the regional level, state and federal agencies are responding to the shift away from water 'development' to water 'management' by reappraising the manner in which infrastructure has been historically utilised. In particular, water infrastructure which formerly has been geared towards the productive requirements of irrigation is being viewed as an instrument for achieving other ends. In some instances 'early' releases from storages are now being used to better mimic natural flows and thereby rejuvenate degraded wetlands (see, for example, MDBC 2005). However, these changes have not gone without attracting criticism from other constituents who see water held in storages as a recreational good, or security for irrigation.

The potential for conflict over the management of water storages has prompted some agencies to embark on significant consultation exercises to both test the preferences of the wider community and inform the citizenry of potential changes. In this context, Goulburn-Murray Water (GMW), the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) and the Murray-Darling Basin Commission (MDBC) released an *Issues Summary Paper* as part of the development of a land an on-water management plan for Lake Hume in January 2005. The purpose of the issues paper was to "help involve people in the development of the management Plan for Lake Hume" (GMW 2005, p.1). In order to gather pertinent data on the values held by different parties affected by the management of Lake Hume, a group structure was designed to elicit information from various sources. Amongst these, was a group of technical advisors responsible for identifying and filling important knowledge gaps about the operation of Lake Hume. This report presents the results of work conducted by members of that advisory group to:

- Further understand the range of social relationships and socio-cultural values which form part of the use and value of Lake Hume
- Identify some of the implications of these for the management of Lake Hume
- Identify key economic relationships inherent in the management and use of Lake Hume
- Identify key economic implications of altered resource management.

The report comprises six additional parts. In section one we introduce important social and economic frameworks which are used in the study of water. In section two the salient features of Lake Hume and the range of

values considered in this study are introduced. Section three provides an overview of the methodological elements of the work. Comments on data sampling and a description of the operational components of the study are offered in section four, as are the results. A discussion of these results is provided in section five before offering some brief concluding remarks in section six.

SECTION ONE : FRAMEWORKS FOR STUDYING THE SOCIAL, COMMUNITY AND ECONOMIC DEBATES

Framing the Debates: the social/community and economic context
Understanding such a complex set of issues such as those introduced above requires a framework which incorporates key aspects to water, water management and the socio-cultural and economic values underpinning water.

The socio-economic dimensions to water management, as well as to natural resource management more generally, have been discussed in various research reports, academic conferences, by water managers and the like for many years. Whilst it is not necessary to dwell on the intricacies of these debates in this report, we provide a brief overview of the key outcomes of this discourse. These are introduced in this section.

These outcomes consist of two components: a generalised framework which sets the scene for understanding the dimensions to human/ecological relations and the management of these, and a more applied approach which takes these generalised dimensions and focuses them on water and water management.

The generalised framework highlights the multidimensional and integrated approach needed to recognise the socio-economic, social, economic and political aspects to natural resource management. The argument goes that each of the following needs to be integrated if sustainable natural resource management is to occur.

a) Community

Whilst the idea of community engagement is now part of natural resource management orthodoxy, 'community' is a somewhat problematic term and can be used in a number of different ways: as a geographic location (for example, the spot on the map that is Adelaide); an environmental way (for example, the 'communities of the upper Murray need this water'); as having national significance (the Australian community); and, in the sociological view, a local set of social and economic relationships which extends beyond the geographic location or environmental context.

The latter definition opens the door to an understanding of the ways people live their lives in a geographic location and in a particular natural environment and, importantly the significance of this to them. Further, by understanding community as a local set of social relationships, it also allows us to move away from romanticised notions of community to look at issues of power and influence, winners and losers and local agenda setting.

b) An active civil society

Civil society is the scene of people's values, beliefs, actions and aspirations. It is related to, but not the same as, community. An active civil society signals an engagement with values which underpin sustainability, and which underpin equitable outcomes. It is people resolving environmental problems and groups of people improving their capacities for self-management, monitoring and evaluation.

c) Natural resource management models

The facilitation of sustainable futures requires models of natural resource management incorporating an awareness of the complex relationship between conservation and socio-economic development agendas. It is thus not only a matter of bringing people into the natural resource management orthodoxy, but critically reflecting on these orthodoxies, questioning the extent to which the very concept of natural resource management needs to be rebuilt, in what ways it should be rebuilt, and who should be involved in the rebuilding.

d): Ecosystems as social constructs

Nature provides the environmental context within which humans live their lives. The ways we view or value nature reflects community processes, civil society, our norms and values, historical processes and the like. Thus an ecosystem has inherently social, economic and political characteristics as well as ecological ones. Each of these aspects to an ecosystem must be integrated to achieve a sustainable future.

e) The economic dimension

One of the key components to a sustainable future is obviously the economic system. In policy and in popular belief the market has been identified as being the basis for sustainability. The relationship between the market and social/environmental values, policy and sustainability therefore becomes an important dimension to sustainability.

f) The role of the state and policies

Governments have an important role to play in the facilitation of sustainable futures. An important aspect to consider in this is the extent to which policy is proactive and the extent it is reactive. More proactive policy is likely to occur with the integration of the above dimensions.

Framing the Debates: the specific context of water

The shifting of water management away from localised approaches to experts with specialised knowledge has moved water management away from a holistic enterprise to a specialised one (see, for example, Strang [2004], various publications by IUCN, Asia Wetlands Bureau, The World Bank). Whilst this is a response to historical forces such as developments in

engineering and ecological knowledge, it is also a response to socio-economic, cultural, and political changes.

Further, people's connections with water, in this case Lake Hume, take place within a cultural landscape which is influenced by social, spatial, political and economic arrangements as well as being formed by individual beliefs and knowledge, as well as ecological constraints and opportunities. Hence, on the one hand, Lake Hume has physical characteristics which reflect social and historical ideas about agriculture, Australian development options, political values etc. On the other, the Lake has many symbolic characteristics, tied into individual, community and regional identities, recreational and agricultural values, social and historical meanings and the like.

It is these very things which influence human values and act to facilitate or constrain the attitudes and actions necessary for people to become much more actively involved in change agency (that is, to alter values and behaviours). Of course, the current debates around Lake Hume epitomise this. The following therefore represents key components to the socio/community and economic context to water use and management as it is related to Lake Hume.

a) The paradox of 'pure public good' and 'exclusive economic good'

Water ownership and management is a debate about the tensions inherent in water as a pure public good and as a private, tradeable good. It is thus a debate about tensions between individual rights and responsibilities and collective rights and responsibilities.

At one level this is self-evident (for example, if you think about the issues surrounding upstream and downstream users). However, this dualistic notion doesn't always incorporate what are some very significant complexities. For example, what is the extent individual users see water as encompassing both collective and individual rights (rather than one or the other)? To what extent do some people/users cede their 'right' as a user (for example, recreational fishers) to other groups (for example, downstream irrigators)? Why do they do this? These complexities highlight the ways in which people, groups and communities identify and interpret notions of 'rights' and 'responsibilities'. It also identifies a potential danger in assuming that individuals or groups see these issues in purely dualistic ways.

b) Issues of scale

There is an issue of scale in water management and use. As resource management has shifted out of local communities and into larger and centralised national and international organisations, the defining of problems and issues becomes abstracted from the realities of local issues.

Thus, an important aspect to water management becomes the extent to which the water management process is able to incorporate the complexities of the socio/community and economic contexts as well as the extent to which its approaches seek to re-localise management and incorporate local voices and experiences into the management regimes put in place. Of course, one of the

difficulties with this will be the ability to incorporate the specifics of highly-localised issues into a broader management framework.

Community consultation initiatives and community representation on management committees provide an important part of this process. However, the extent to which these formalised approaches are able to incorporate the subtle and often contradictory nature of water use and value is an important issue to be continually addressed.

c) Self interest and irrationality

Policy makers and environmentalists sometimes tend to see unsustainable water use in terms of either individual self-interest (a 'tragedy of the commons') or as irrational behaviour. However, social research has highlighted that it may be neither, that these dualistic ideas mask sets of values which are rational for the individual, which are rational for local communities and which sometimes highlight a yearning for some kinds of reconnection with nature. The fact that water use and management can still be unsustainable even within these, highlights the importance of understanding the patterns of social, economic and political relations. In other words, it is possible people's values or connections with water may provide a basis for sustainable water use, but the ways the economic, political or management system are patterned results in unsustainable use, disengagement or conflict.

d) Water and the construction of identity

Water plays an important part in the construction of identity at individual, community, regional, national and international levels. The role water plays in this identity will have significant implications for the ways individuals, groups and communities engage with water and its management, how they will react to alterations to the use and management of water, and how they will ultimately internalise and act on environmental values.

There is some suggestion in the literature (see especially Strang 2004) that the relationship between water and identity also provides a vehicle for people to develop, and act on, more universalist ideas about a common good and common concerns about environment. This is partly because water, and rivers especially, move beyond specific localities in their journeys, thus potentially binding upstream and downstream users.

Using These Frameworks Within this Report

It is not within the ambit of this report to elaborate on all these frameworks and their applicability to Lake Hume, though it is important to recognise that they exist and underpin people's socio-cultural, economic and ecological values in relation to Lake Hume.

However, these have influenced both the approach to, and interpretation of the results within, this report.

SECTION TWO: LAKE HUME

Lake Hume is located upstream of Albury and is the major regulating structure on the River Murray. Construction of the Dam commenced in 1919 with storage capacity being increased in 1924 and 1961 such that the dam now has the potential to store 3038 GL (MDBC 2004). The dam was originally designed to enhance navigation and foster irrigation development. In addition, it has developed into a major recreational site being popular for a range of water pursuits (Loder & Bayly 1979).

The dam typically fills in winter and spring with average inflows being approximately equal to storage capacity. Additional flows derive from diversions from Dartmouth Dam via the Mitta Valley and transfers from the Snowy Mountains Scheme. Water is generally drawn down for irrigation during late Spring and Summer – this is also the peak recreational season (Pak-Poy & Kneebone 1990).

The operation of the storage to service the needs of irrigators has given rise to several environmental concerns. Firstly, the wetting and drying cycles of ephemeral wetlands below the Dam has been radically modified by the management regime. Second, the 'peaks' and 'troughs' have been removed from the Murray flow pattern impacting on a range of ecological systems (Gippel and Blackham 2002). Third, accelerated channel erosion has been observed in the Mitta Mitta River as a results of the drawdown of water in Dartmouth Dam to top up Hume. Fourth, bank instability in the River Murray has also been attributed to the rapid draw down of water from Hume.

In addition, to disturbing flow parameters in downstream environments, there is also concern about the deterioration of water quality within the reservoir itself. In a review of the biophysical studies undertaken of Lake Hume, Howitt, Baldwin and Hawking (2005) chronicle the changes in major water quality parameters. Of particular interest they found that:

- Turbidity levels have increased, primarily due to the transformation of the catchment above the dam;
- Inorganic suspended materials enter primarily from the River Murray followed by the Mitta Mitta River, with most material being deposited within the Lake;
- Surface water temperatures are warmer in the Lake than in waters upstream, the difference being as much as 3-4 degrees Celsius at the dam wall in the warmer months;
- Stratification, where warm water overlies cooler bodies of water, is common and the maximum temperature difference between surface and bottom water is in the order of 3-8 degrees Celsius in summer;
- Stratification potentially gives rise to cold water pollution downstream but also depletes oxygen concentrations in the water at the bottom of the Lake;

- Hypoxia (the depletion of oxygen in the bottom waters) has been shown to mobilize and/or transform nutrients associated with algal blooms deriving from lake sediments;
- There are likely to be considerable stores of phosphorous in the sediment of the Lake;
- The early 2000's were punctuated by a number of High Alert cyanobacteria blooms in the Lake, occurring when the dam was at low levels;
- The pH of the water in the Lake shows signs of gradual decline with acidification of water looming as a potential problem.

Any decline in water quality within the Lake, particularly in the form of blue-green algal blooms, is of interest from a socio-economic perspective on several fronts. The presence of blue-green algae significantly increases the cost of producing potable water and the population of Albury-Wodonga must foot this bill. In addition, there is likely to be detrimental impact on recreational users, which clearly embodies a socio-economic dimension. Yet another potential issue is more basic – whilst blue-green algal blooms are symptomatic of environmental stresses, to what extent are they seen as being a 'problem' and if so, what type of 'problem' are they?

And yet improving water quality in Lake Hume is no easy task. A survey of the current activities associated with the water in the Lake, the land in upstream catchments and the bed of the Lake implies that enhancing water quality must come at some cost to current users. In particular, agricultural practices that abut the foreshore and the upstream catchment may require significant modification. The deforestation of these regions accompanied by extensive livestock grazing is often cited as a cause of gully and bank erosion, which adds to the sediment in the lake – the main source of nutrients. Grazing stock also add nutrients and pathogens to the water through urine and faeces extruded on the foreshore or in the upper catchment. However, given the substantial stores of nutrients in the existing sediment any adjustments to human activity may fail to yield results for decades or possibly centuries.

In order to appreciate the impact of any changes emanating from a land and on-water management plan it is necessary to identify some of the complexities found within the socio-community dimensions to Lake Hume, and the agricultural land use values attributed to the status quo. In addition, it was anticipated that enumerating the recreational benefits of enhanced water quality and specifying the costs of water treatment would provide insights into the effect of measures to enhance water quality via altered behaviour[1].

[1] The work undertaken in this case was not a complete benefit cost analysis, nor did it seek to provide in-depth analysis of socio/community dimensions. Rather, the intent was to provide some of the groups involved in the collaborative development of the management plan access to additional information that was not readily available elsewhere.

SECTION THREE: METHODOLOGY

In keeping with the need to understand complex socio/community and economic relationships a multi-method qualitative and quantitative approach was taken.

The socio/community dimensions
In keeping with reflexive qualitative approaches (which use broad questions to elicit what is sometimes called 'rich and deep' information), the methodology focused on the following:

- stakeholder group's and individual's understanding of issues involved in Lake Hume water management and quality
- the relationship between water management, water quality and individual/group activities/interests;
- individual/group ideas of what could and should be done;
- individual/group concerns over the future of Lake Hume and its water quality.

These formed the basis of the research process, formal, semi-structured and unstructured interviews and interpretation/analysis.

A number of specific methodologies were used within the above framework and interviews were conducted during January and February 2006. These two months were chosen because they incorporate both holiday and non-holiday times and hence a variety of users. In all, 45 in-depth interviews were undertaken in towns beside Lake Hume, at lakeside reserves on both the NSW and Victorian side, and in Albury/Wodonga. It should be noted that at this time the water level at Lake Hume was high, and this may have affected people's responses.

Meetings with identified stakeholders
These meetings with representatives of stakeholder groups were designed to understand the positions of these groups on Lake Hume water quality.

Opportunistic unstructured interviews.
These took place at Lake Hume (for example, with recreational users) and in towns and cities within close proximity to Lake Hume (Albury, Wodonga, Belbridge, Bethanga, Ebden and Tallangatta)

Interviews obtained using snowballing technique.
Respondents from the above interviews were asked who else may be interested in being interviewed for this. Further interviews were conducted with a sample of those identified.

Sampling and Operationalising TCM and Hedonic Pricing

As noted earlier, the chosen economic techniques rest on being able to statistically unbundle the relationships between behaviour in related markets and the value/item of interest. In the case of the hedonic pricing exercise, the goal is to establish the part-worth value of 'lake frontage' and 'lake views' as a component of the wider property market in the region. By way of contrast, the travel cost component of the work endeavours to establish the value of recreational visits based on visitation patterns and travel costs associated with visiting the site. Each exercise has specific data requirements and the procedures undertaken to source these data are briefly described here.

Hedonic pricing data
Data for the hedonic pricing models was collected between October and December 2005. In the first instance, property data were obtained from a proprietary source that listed over 275 sales in the region of interest. The data set comprised information on the purchase price, zoning, location, area and the identity of the purchaser. Accordingly, it was anticipated that this would provide a useful foundation to which additional information, like housing details, travel distances to major centres, agricultural improvements and the like could later be added. In order to expand upon the original property data, the real estate records were matched with listed phone numbers and a brief supplementary questionnaire was developed. This was also expected to provide the opportunity to collect data that could be used to account for the heterogeneity of purchasers.

The questionnaire specifically sought information about the productive and recreational benefits of lake's frontage and the extent to which the property owners had access and views of the Lake. *A priori*, it was anticipated that these attributes would be positively related to property values in the region.

Unfortunately, the process of matching records with phone lists proved problematic, not least because the original data set was outdated in some cases. To overcome these difficulties an attempt was made to expand the data set by collecting information via in-person visits to properties in the vicinity of Lake Hume. Given the budget for the work, this was limited to single site visits during daylight hours by trained field staff. Despite the low non-response rate from respondents who were contactable, this procedure yielded a little over 100 complete responses at the conclusion of the data collection phase.

Travel cost data
Travel cost data were collected throughout January 2006. This comprised the administration of an in-person survey at several sites and at varying times around the foreshore of the Lake. Popular boat ramps, picnic areas and viewing points were the main locales.

Respondents were asked the usual array of questions for an exercise of this nature – i.e. distance travelled, primary purpose of the visit, number of individuals in their group and the like. In addition, respondents were asked specific details about their contingent visitation behaviour in relation to the presence of algal blooms and the water level of the Lake relative to its full

capacity. In the case of algal blooms, respondents were asked a simple dichotomous choice question as to whether they would have undertaken the visit if they were aware of a blue-green algae alert. Accordingly, these data could be used to estimate any aggregate reduction in demand for recreational services.

The impact of the water level on visitations was measured by asking a series of questions. First, respondents were asked if they checked information about the level of the dam before visiting. Second, for those who gathered such information in advance, a series of iterative questions were asked to establish the 'reservation level' at which visitations would cease. The iterative questions were administered consecutively in ascending and descending order to minimise the impact of any starting point bias from this type of question.

SECTION FOUR: RESULTS

The following discusses the outcomes of the research.

Values
Understanding values as they relate to Lake Hume formed an important part of the research. Values have both socio/community/cultural dimensions as well as economic components. Thus, the research has focused on these dimensions.

Agricultural landuse values
Water quality in Lake Hume is, in part, a function of the agricultural land use activities that circumscribe the lake – albeit a delayed response. The main agricultural practice is cattle grazing with some grazing of sheep. In Victoria, landholders hold licenses to use the foreshore land. On the northern side of the Lake (in NSW), landholders have freehold title above the full supply level and easements to access land when the water is below its peak capacity. Fluctuations in the level of the Lake provide opportunistic grazing for riparian landholders as well as access to water for stock and domestic purposes (GMW 2005, p. 13).

Focus sessions with landholders revealed that some placed considerable value on the grazing and water access enjoyed by having land that abuts the Lake. Assuming that property markets operate reasonably competitively, a proxy for these values could be attained by unbundling the value of land in the area and isolating that component that related to Lake access. This would then provide an estimate of the capitalised value of these access rights and give policy makers some idea of the economic consequences of decisions that might limit landholder access in the future.

In addition to providing insights to the value of agricultural access to the land that adjoins the Lake, applying this technique offered the potential to investigate the aesthetic values of the Lake from the perspective of nearby landholders.

This approach to value estimation is termed hedonic pricing. It generally involve a special survey to collect data (or the use of existing data if it is available) on house and land attributes, including environmental data and the estimation of a hedonic price equation indicating the price of houses and land as a function of attributes using regression analysis. Implicit prices for each attribute can then be calculated through partial derivatives. These implicit prices are generally used as willingness to pay values, which are considered a reasonable approximation when prices do not vary with the amount of environmental quality, when changes in environmental quality are small or when households are similar[2] (Abelson 1996).

[2] "However, the implicit price schedule is not a demand curve, but a set of points on a demand curves of many households. Only if households have similar demand

The outcome of statistical approaches to hedonic pricing may be sensitive to variable selection, variable measurement and the choice of functional form and full hedonic price studies require considerable data and resources. As identified by Bennett (2005, pp. 245-246) there are relatively few published cases where the hedonic price method has been invoked in Australia. In part, this reflects the difficulty of assembling data that is capable of accounting for the multiple attributes that make up a real estate transaction.

It is also worth noting that a variety of social values underpin these economic values. For example, a person who identifies closely with Lake Hume for whatever reason may have this connection translated into a different economic value than someone who doesn't. The dynamics of the social values of Lake Hume are discussed in more detail later in the report.

Recreational values

As noted earlier, Lake Hume attracts large numbers of recreational users who enjoy water pursuits such as swimming, boating, fishing and canoeing. In order to gauge the economic value of these activities the study proposed using the travel cost method (TCM). The TCM comprises two steps. The first step is to examine the relationship between the rate of visitation to a site and the return costs of travelling to the site. This gives rise to what is referred to as the "whole experience" demand curve (Sinden and Worrell 1979; Hufschmidt et al 1983) and can be used to define one point on the true demand curve for the subject site i.e. the number of visits to the site at the current price level (Hufschmidt et al 1983).

The visitation rate – travel cost relationship can then be used to estimate other points on the demand curve i.e. the number of visits that would be made to the site if varying levels of hypothetical entry fees were being charged (Bennett et al 1996). This step allows the entire Marshallian or normal demand curve to be derived. The area under the demand curve estimates the consumer surplus or economic benefit that accrues to the visitors to the site.

This research has incorporated some further information related to recreational values which have been derived from the qualitative methodology. This has provided some insights into why people use Lake Hume for recreation, how they interpret their rights to recreation and the extent management issues, such as water level, impacts on their recreation.

---

functions (i.e. similar incomes, preferences etc) will the implicit price curve be the same as the demand curve. If household demands for environmental goods differ, the benefits of non-marginal changes in the supply of environmental goods are the sum of the appropriate areas under the demand curve for each household. This would generally be different from the product of the estimated hedonic price per unit of environmental good and the change in the number of units provided. Ideally we would then estimate the aggregate demand schedule for the environmental good" (Abelson 1996).

Water treatment costs
The identification of algae in raw water is usually followed by the dosing of potable water with powder-activated carbon. Data on the expenditures by local water authorities to deal with algae incidents have been sourced, although not reported here.

Quantitative Results
The following analysis is divided into the two main elements of the study – considering land use values via the hedonic pricing approach and recreational values using the TCM.

Hedonic Pricing
A number of hedonic price models were analysed. Earlier models included a wide number of variables with latter models omitting statistically insignificant variables. Model 1 (below) included 16 explanatory variables. Most of these were in binary form with zero representing absence and one representing presence of the particular attribute. For zoning, zero represented non-urban and one represented urban.

Table 1 – Hedonic Pricing Results

	MODEL 1		**MODEL 2**	
Multiple R	0.664894		0.598802	
R Square	0.44208403		0.358563	
Adjusted R Square	0.30475087		0.333893	
Standard Error	259364.093		253870.2	
Observations	82		82	
F-stat	3.219062		14.53401	
F- significance	0.000433		1.31E-07	
	Coefficients	*P-value*	*Coefficients*	*P-value*
Intercept	390,817	0.07	219,898	0.004283
Area (ha)	1,887	0.00	1,807	1.66E-05
Zoning	-67,659	0.48		
FRONTAGE	-58,826	0.45		
Views	-110,448	0.15		
HOUSE	285,628	0.00	247,718	6.25E-05
POWER	-96,190	0.57		
PHONE	110,455	0.45		
TOWN WATER	-132,872	0.33		
SEWAGE	101,512	0.36		
STOCKYARDS	-139,118	0.40		
MACHINARY SHEDS	129,705	0.30		
SHEDS	-27,373	0.86		
OTHER	-147,023	0.35		
RD SEALED	15,994	0.92		
HOW FAR (kms)	-12,771	0.13	-9,725	0.010141
HOW LONG (minutes)	1,313	0.88		

From Table 1 it can be seen that model 1 has an adjusted R squared of 30% indicating that only 30% of the variation in property price is explained by the estimated equation. Furthermore, most explanatory variables, including the presence or absence of a view or lake frontage are statistically insignificant at the 5% level. Nevertheless, the F statistic indicating that all coefficients in the equation are significant at the 1% level.

Model 2 which focuses on statistically significant or close to significant variables from Model 1 provides marginally more explanatory power, with an adjusted R squared of 33% and a significant F statistic. The three explanatory variables, area, presence of a house and the distance of the property to a major town are all statistically significant at the 1% level.

In all models that were analysed frontage to the Lake proved insignificant at the 5% level. In some models the presence of a view to Lake Hume was a statistically significant variable, however, the sign did not meet *a prior* expectation. This suggests some underlying multi-collinearity between some of the variables in the data set.

Travel Cost Method

For the travel cost study the data was sorted into eight zones, as shown in Table 2. The pattern of visitation of the sample was extrapolated to the estimated annual visits of 100,000. Population of each zone was obtained from ABS regional profile data for each zone. The visitation rate for each zone was then estimated by dividing the estimated annual visits for each zone by the population for each zone.

The travel cost estimate from each zone was based on the return distance to Lake Hume from a mid-point in each zone, estimated number of cars per group and occupants per car and operating costs of a standard vehicle per km. An estimate of the opportunity cost of time was added to the standard vehicle cost estimated. This estimate of opportunity cost of time was based on the composition of vehicle occupants (adults and children), estimated travel time and a per adult and per child opportunity cost of time.

Travel costs and opportunity costs of people's time were apportioned based on whether the visit to Lake Hume was the primary purpose of the group's trip or not.

Table 2 - Travel Cost – Visitation Rate Data

Zone	No. of Groups	Sample Visits	Annual Visits	Popn.	Sample Visits per (000) Popn.	Annual Visits per (000) Popn.	Return Distance (km)	Estimated Travel Time (Hours)	Apportion Travel Cost and Opportunity Cost of Time
1.Albury	19	120	7,752	72,811	1.6	106.5	44	0.6	5.1
2. Ballarat/Geelong	19	141	9,109	406,466	0.3	22.4	820	11.7	77.1
3. Central Victoria	23	212	13,695	198,504	1.1	69.0	518	7.4	67.3
4. Melbourne	113	737	47,610	3,418,022	0.2	13.9	672	9.6	75.2
5. SW and Mornington Peninsula	9	85	5,491	266,074	0.3	20.6	978	14.0	106.9
6. SW NSW	13	94	6,072	283,298	0.3	21.4	484	6.9	45.4
7. Wodonga	20	132	8,527	47,528	2.8	179.4	58	0.8	5.8
8. Sydney	3	27	1,744	4,198,543	0.0	0.4	1,168	16.7	157.4
Total	219	1,548	100,000						

Notes:

1. Travel time was calculated based on vehicle travelling 70 kilometers per hour.
2. Cost of travel time was assumed to be 35% of the average hourly wage rate. The opportunity cost of travel time for children was assumed to be 25% of that for adults. This approach was based on Cesario (1976) and Abelson (1986).
3. Distances travelled are based on approximate travel distances in UBD (2001) Concise Motoring Atlas of Australia.
4. Populations are based on ABS regional profile estimates.
5. A vehicle travel cost of $0.20 per km used.

Table 3 – Regression Analysis of the Annual Visitation Rate - Travel Cost Relationship

	TC Co-effic. (P value)	Constant (P value)	R squared	F stat
Base	-0.03 (0.003)	5.3 (0.00007)	0.80	24.4
50% Water Level	-0.03 (0.04)	5.2 (0.003)	0.53	6.7
10% Water Level	-0.04 (0.0003)	5.1 (0.00003)	0.89	53.1
Algae Alert	-0.03 (0.0001)	4.31 (0.00005)	0.84	31.3

Note: The preferred functional form for all travel cost visitation rate relationships was log-linear

Four functional forms were used for the visitation rate- travel cost relationships and the demand curve i.e. linear, log-linear, linear-log and double log. In addition to estimating the base visitation from the data, additional estimates were made under a scenario when the reservoir was at 50% of its full capacity, when it held 10% of capacity and when an algae alert was known to the respondent.

For the visitation rate – travel cost relationship, log-linear was the preferred function form for all scenarios (with the exception of the 50% water level scenario where the linear-log functional form was preferable) based on P-value, R squared and F stats. However, for simplicity a common functional form (log-linear) has been reported here.

Table 4 – Regression Analysis of Demand Curves

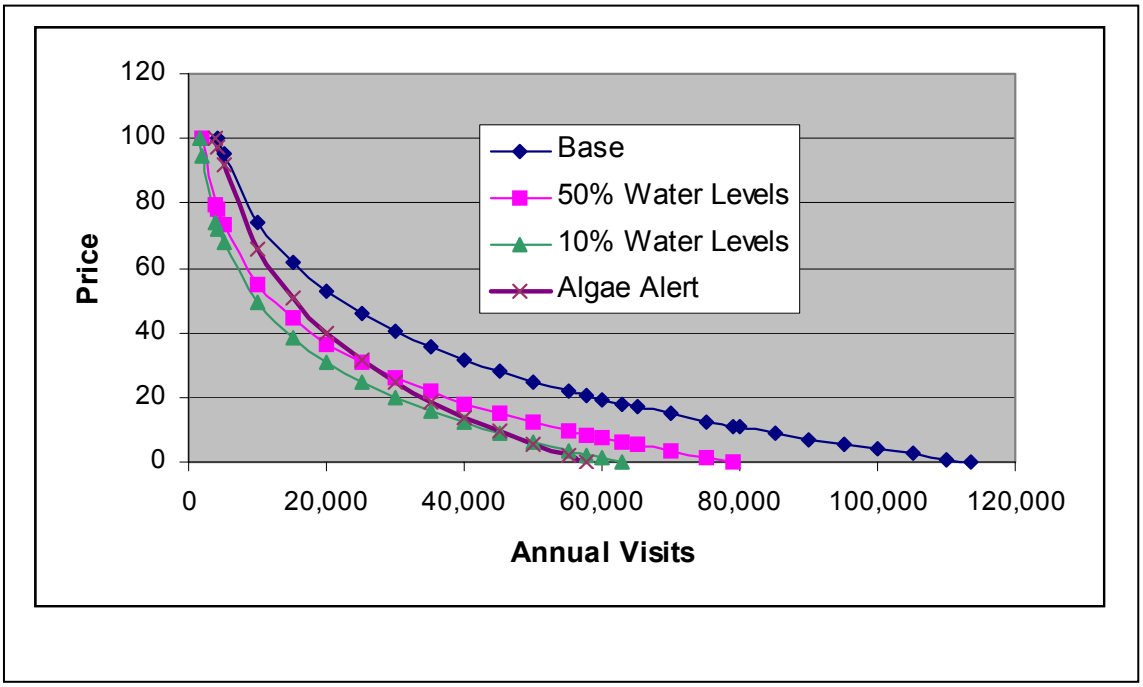
	LN Visits (P value)	Constant (P value)	R squared	F stat
Base	-30.4 (5.63E-62)	354.4 (3.44E-63)	1.0	44444403
50% Water Level	-26.6 (5.63E-62)	300.3 (2.03E-63)	1.0	44444403
10% Water Level	-26.7 (5.63E-62)	295.6 (1.92E-63)	1.0	44444403
Algae Alert	-37.4 (5.63E-62)	410.5 (5.10E-63)	1.0	44444403

Note: The preferred functional form for all demand curve was linear-log.

The use of the log-linear function form for the visitation rate- travel cost relationship, resulted in the linear-log function form being preferable for the demand curve estimates, with highly significant coefficients and constants and perfect explanatory power of regressions.

The demand curves for the base situation and three scenarios are depicted graphically in Figure 1 below.

Figure 1 – Demand For Visitation to Lake Hume Dam



The area under the demand curves gives the total annual consumer surplus for each scenario and enables calculation of the consumer surplus per visit. Because the linear log function form results in the demand curve being asymptotic to the price axis an arbitrary price cut-off (of $100) was necessary to enable calculation of the area under the demand curves. The resulting estimates are given in Table 5.

Table 5 – Consumer Surplus Estimates

Scenario	Annual Consumer Surplus	Consumer Surplus Per Visit
Base	$3,304,254	$33
50%	$2,042,103	$20
10%	$1,638,803	$16
Algal alert	$1,993,998	$20

Results of the Qualitative Methodologies

A series of small case-studies provide additional information related to the values people ascribe to Lake Hume. These cases can be found in Appendix one and have been chosen as they exemplify significant issues and/or important examples of these values. Each case consists of both a summary of the respondent's views and a number of important questions raised by what the respondent has said.

The results of the interviews identified a number of respondent-identified important issues: water levels; economic, ecological, social and recreational values; rights of other users; management of Lake Hume and Dartmouth; and pollution. These are elaborated in the following discussion.

SECTION FIVE: DISCUSSION

The following section discusses the findings of the research and highlights some of the implications of these for the management of Lake Hume.

Discussion: Economic data

The hedonic price analysis was unable to establish any significant plausible relationship between property value and Lake frontage or views of the Lake. This stands in contrasts with anecdotal evidence from real estate agents that both attributes add at least some value to properties enjoying these features. As we have already suggested, one possible explanation for this resides in the data itself which provided a relatively restricted sample for analysis. While data on 101 properties was collected, it was not always complete. Moreover, a large number of complete responses were proffered by smaller properties, presumably less concerned about revealing the values ascribed to their lake-related activities. Some characteristics of the data are summarised below.

Table 6 – Characteristics of the Hedonic Pricing Data

Item	No.
Sample	101
Useable sample	82
Properties larger than 3 ha	18
Lake Frontage	19
View of the Lake	55
Urban properties	54
Properties with houses	49

In addition to problems with the sample, it is also feasible that the value of lake frontage is less significant than originally hypothesised. From an agricultural perspective fluctuating water levels bring both benefits and costs – the latter in the form of constant repairs to fencing to enclose stock, moving pumps and the like. Moreover, the costs associated with maintaining the foreshore when recalcitrant campers and boat users treat all foreshore as common property can be non-trivial. As one landholder poignantly noted "*it's like being a part-time park ranger*".

By way of contrast, the TCM models were statistically significant and met all *a priori* expectations. Importantly, the analysis estimated that the demand curve for visits to Lake Hume would shift leftwards as conditions at the dam decline, either because of the reduction in the water level or the presence of an algae alert. The end result would not only be reduced visitation levels and hence a reduction in total annual consumer surplus, but also a reduced consumer surplus per visit for those who persisted in visiting the site at times of reduced environmental quality. This is the pattern that would be expected when environmental quality of a recreation site is reduced (Asian Development Bank 1996).

The TCM information provides important indicative data on the impact of degraded water quality in Lake Hume. These data can assist decision makers in establishing the acceptable trade-offs between maintenance of the

status quo and alternative management of the site. More specifically, the data indicate that retaining additional water in storage in Lake Hume bestows significant benefits on recreational users, as does a reduced incidence of algal blooms. Clearly, resolving the balance between managing the site to accommodate these preferences and using the infrastructure to meet the needs of other users remains the challenge of the groups currently developing the management plan for the Lake.

It should be noted that there are several caveats to these findings. First, there is an indirect overlap between what is valued by the TCM and what is valued by the hedonic pricing method. This arises because recreation benefits assessed by means of the TCM may be partially capitalised in property value improvements. Double counting will occur if both values are estimated, however, this overlap is not complete. The property valuation method fails to pick up significant relationships beyond a relatively small zone of influence while the travel cost method performs better with greater distances, but does not capture the value of views for properties close to the subject land (or the cost of noise and congestion) (Allen et al 1985). In the current context the performance of the hedonic pricing models renders this caveat obsolete.

Second, the data collection phase for this study was concentrated at a time when the reservoir enjoyed relatively high levels of storage and in a season of peak recreational use. This occurred because of the operational constraints imposed on the work. Consequently, the available data is skewed in favour of respondents who make use of the resource during the summer months and when there is ample water in storage[3].

Discussion: the Socio/Community Context

As expected, the in-depth interviews elicited a diversity of responses, attitudes and actions. The case studies described, as well as interviews not represented by the case studies, have highlighted five 'clusters' of issues which are important.

Low water levels

The social, community and recreational impacts of low water levels as perceived by respondents were varied. Whilst there are obviously economic costs associated with lower water levels, it is important to highlight that for many respondents, the water level of the Lake was not always an issue.

Fishers

Serious fishers were able to identify alternative locations (either on the Lake or on the streams). However, a number of the respondents who identified with the Lake as a fishing space were concerned about the impacts of changing water levels on fish breeding. For example,

[3] The alternative, of sampling across several seasons with varying water levels is not feasible in the current context. Moreover, the resources attendant on such an approach makes it implausible for most applications of the TCM. In this case we have employed contingent questions on the level of the reservoir to form estimates of different demand functions.

> *(I) used to be able to catch trout "off my back porch" but "the system" changed and now you have to go up the Mitta for trout. Dirt only flows one way, and when the lake started silting up the carp appeared. You can chase Redfin but it gets harder and harder with the levels fluctuating wildly. You can always go to the actual river if the level in the lake gets too low, but with the silt problem even that's not much of an option these days.* (case 5)

and

> *Consistent water levels allow weed beds to take hold, and where weed beds take hold reliable fishing follows. The fisherman doesn't need to hunt the fish down from session to session.* (case 10).

Passive recreation such as walking dogs or picnicking occurred irrespective of the level of the Lake, and as one of the respondents said, some opportunities close with a lower water level but others open.

The complex nature of the relationship between water level and some recreational use is highlighted in the following example, a group of campers at one of the caravan parks. This group, consisting of four families from Melbourne, had been coming to the Lake for eight years. For this group, the purpose of the holiday was to meet up again, re-establish old friendships, spend time socialising and generally 'relaxing'. For these, Lake Hume is a backdrop. If the water level is too low, it means they swim in a pool or don't swim. If the fishing is no good, they do other things. Hence, at least for this group, the connection with Lake Hume remains a backdrop to their (re)connections with each other. This appears to be the opposite to general expectations of the relationship between camping, the water's edge and holiday-makers.

What Lake Hume means to individuals: economic, ecological, social and recreational values

The interviews highlighted the diverse, and sometimes contradictory, values which people associated with Lake Hume. Whilst it is self-evident that this research methodology will elicit values towards the Lake that are generally positive (given where the interviews were conducted and given the aims of this research), it also highlighted the multidimensionality of values and attachments associated with Lake Hume.

For example, Lake Hume is profoundly tied up with individual identity formation and individual biography for case 7,

> *Mum would have lunch ready on our return to the tent, and if the morning involved a catch it usually found its way on to the BBQ for dinner. The boat would be dragged out at Ludlow's at last light.*

and

> *Long summers as an adolescent, chasing the city girls at the Caravan Park* (case 2).

For some, it is also a source of community and social integration. For example, case 16 sees the lake as a source of

> *continuity & pride.*

For case three, the lake is intrinsically tied to the identity of Tallangatta (though it should be noted that this identity is not shared by all people).

Importantly, the research has begun to uncover some of the breadth of values which people attach to the Lake. These obviously include economic and recreational values, but the important connection between these and ecological values emerge. So too do the complexities of the ways individuals define, in their own minds and in their own words, such ideas as 'the public good', the responsibilities (and the rights) of irrigators, and perceived problems with Lake management.

This diversity reminds us that the social/community context is not something which can be understood purely in terms of 'community engagement' or 'community consultation' as they are, almost by definition, unable to unearth the diversity of attachments to, and values surrounding, the Lake.

What Lake Hume means for others

The definition of the 'other' in the interviews highlighted some of the contradictions inherent in the social/community context. The 'other' is a concept used to describe people/groups whose characteristics, actions, values or expectations don't fit with those of the respondent. Employing the 'other' provides an opportunity to assess issues of power and marginality as well as the language which supports/critiques this.

As can be seen in the case studies, whilst respondents identified end-users/irrigators as 'others' whose use of, and rights to, water impacted very directly on their own rights as users, many also identified that the Lake was originally built for this very reason. Hence, for some respondents, the public good nature of water (through, say, recreational activities, aesthetic values etc) should be set aside for the individual rights of irrigators.

For example:

> *Boating, swimming and fishing are great activities but we need to be realistic: feeding a nation is very important. However, we also need to be realistic about how food is produced. Irrigators do waste water, and this also needs to be addressed* (case 3*).*

However, as case three intimates, the irrigators also have a role to play in the management of Lake Hume, by ensuring they are efficient in their water use.

Case one went further:

> *We are at the whim of the weather as to how much water is available in any year but regardless; the "managers" of the water will use it. If 40% is good for everyone down the line, they won't turn around and tell the irrigators "you are over irrigating, change your methods". No, they'll bow to economy and lobbying, and drain this end down to 5-7%. The big joke is of course that they'll drain the Hume before Dartmouth starts sending water through, then when NSW decides it's time to start making money they'll open up at their end and send as much silt as water into the system. The lock at Tallangatta is a good idea, especially as they were promised a lake when the town was moved.*

Case one also highlights another issue which emerged in the interviews (and which is discussed later) – that of the management of Lake Hume and Dartmouth.

The strong sense of needing to balance the needs of a variety of users can be summed up by case seven:

> *The Weir was built to provide for the irrigators, as a side effect yachties, skiers, fishers and sundry get to do their thing at least some of the time. Maybe the balance could swing more towards recreation rather than money but it's a complex system straddling two states, so good luck!*

The 'other' was also identified by some respondents as recreational users who undertake inappropriate activities (four-wheel driving, speeding boats, leaving rubbish etc).

Case 14 sums this up:

> *Sometimes you have to walk a bit further to get your feet wet, but it's all good. The biggest threat to enjoyment here is "dogs and dog owners". Dog owners wouldn't take their mutts to the pool and let them off the leash, so why do they do it here. Dogs splash by you unheeding, they crap and piss where they want, they start barking matches with each other, and sometimes end up in a brawl. All this while their stupid owner looks on lovingly! Piles of Beam cans after late night sessions is bad, rutted shoreline from motor-cross hoons is bad…these things*

might eventually lead to restricted access to the lake. However, dogs will make any access unbearable

This serves to highlight the contradictory uses of the Lake, and the contradictory values within identified groups (such as recreational users) and reminds us that the labels or categories we employ are not homogenous.

Tensions between user expectations and connections to space/environment

The values surrounding Lake Hume represent a diversity of community and individual attachments. They also represent the ways locations, individuals and communities experience socio/community structures and institutions such as the economic system, the political system, historical processes and natural resource management models.

In the case of Lake Hume, the additional dimension is spatial – management of Lake Hume and Dartmouth, the influence of downstream users, debates over the rights of users of Lake Hume, and spatial dimensions to historical processes (was Tallangatta promised a Lake? How does one community define itself *vis-à-vis* Lake Hume and how does that compare to another?). These issues came through as significant issues in some of the interviews, especially the relationship between the management of Lake Hume and Dartmouth:

> *(I) cannot see how turning a two-catchment system (not counting down stream) into a three-catchment system is going to make any difference. The problem is system wide and covers everything from lack of coordination of the weirs at this end, to waste at the irrigators' end. Monetary profit needs to be taken out of the equation when considering the health of the river system.* (case 12).

And

> *If Dartmouth keeps dragging my soil down river there will definitely be a problem in the long run; the whole system will silt up. Both weirs need to be governed together. It's not just a problem of low water down here. A few years back Dartmouth held on to its water despite the fact that it was running at over 105% capacity and backing up over farming land. It takes 5 or 6 days to kill grass under fresh water. A large part of my property was under water for two weeks. Total cost to me...$100,000.* (case 2).

Pollution and environmental values

Many of the respondents had something to say about pollution. However, it was by no means consistent across all respondents. As the case studies highlight, pollution means different things to different people (for example, blue-green algae is important to some but not to others, some see

powerboats as sources of noise pollution, others see them as their recreation) though it would be possible to say there was a generalised concern about pollution.

Perhaps one of the results of the in-depth questions related to that of blue-green algae. As could be expected, there was a variety of responses, ranging form the 'it has no impact on my activities' to it being a 'sign of a sick system'. However, the issues surrounding Lake Hume were often identified as being other than blue-green algae – for example, silting, pollution from speed boats, the ecological impacts of water level inconsistencies.

Another important aspect to this was related to the environmental impacts of Lake Hume. Whilst there was concern about pollution *within* the Lake respondents did not identify Lake Hume itself as having a negative impact on the environment. Whilst this in itself is not surprising, given where interviews were undertaken and what the main focus of the discussions were, what did emerge was the extent some respondents tied the economic benefits of the Lake (for example, for irrigators, for recreationalists) to concerns about pollution.

Unresolved Issues: the social/community context

A number of questions which may be important to consider in the further development of the management approach to Lake Hume are found at the end of each case study in appendix 1.

SECTION SIX CONCLUSION

The management of water held in storages is under scrutiny in many regions, often in response to concerns about the deleterious environmental impacts of water infrastructure and its historical management. In the case of Lake Hume, the response of agencies has been to assemble a number of groups to develop a management plan that might best address the conflicting aspirations of water users.

On the one hand there is a presumption that access to the lake's frontage bestows benefits to landholders, particularly agricultural users who enjoy opportunities grazing and access to stock and domestic water supplies. Similarly, is has been assumed that property owners gains some aesthetic benefits from views of the water body. This report explores these values by applying a hedonic pricing technique on the assumption that such values would be capitalised into the price paid for real property in the study region. Nevertheless, the data provided no evidence of these hypothesised relationships.

Alternatively, it was hypothesised that the water held in the reservoir also bestowed benefits on recreational users of the resource. To assess the extent of this benefit the TCM was employed. Modelling of these data point to recreational values of about $3 million p.a. when the Lake is near capacity and when the threat of algal contamination is low. In addition, a diminution of the water level to about half reduces the value of these benefits by about a third, as does a single incidence of blue-green algae.

The challenge for policy makers is to harness this information in order to develop a management regime which appropriately addresses the suite of demands on the water held in Lake Hume. The difficulty is that these demands originate at the intersection of historical processes, individual values, community identity and political priorities. The further development of the management plan not only needs to recognise the economic costs and benefits of options, but also the unresolved social and community issues which this report has raised.

In light of the probably longevity of some of the drivers of the eutrophication of the Lake and its sediment, this remains a formidable challenge.

APPENDICES

APPENDIX 1: CASE STUDIES OF INDIVIDUAL VALUES RELATED TO LAKE HUME

The cases are written as either the respondent's direct words (italicised and indented) or 'the essence of what is said'. Additionally, some preliminary interpretation of these cases is included where relevant.

Case 1:
Case 1 is a male in his sixties who lives on Lake Hume.

For case one, Lake Hume means:

> *Lake Hume is an icon! It's what brings people to the North-East region. Just look at any series of posters advertising Albury or Wodonga and one of them will be a panoramic shot of a very full Hume Weir with very green hills in the background. The reality is very different: tourism gets lip service only from those that manage water flow in this region. There is no regard for the amenity of users other than irrigators further down stream.*

For this person, Lake Hume is integral to the identity of this region. However, he has identified the ways the management of the water is contested and embedded in the economic and political arrangements within which the lake is managed. This is further evident in the following:

> *We are at the whim of the weather as to how much water is available in any year but regardless; the "managers" of the water will use it. If 40% is good for everyone down the line, they won't turn around and tell the irrigators "you are over irrigating, change your methods". No, they'll bow to economy and lobbying, and drain this end down to 5-7%. The big joke is of course that they'll drain the Hume before Dartmouth starts sending water through, then when NSW decides it's time to start making money they'll open up at their end and send as much silt as water into the system. The lock at Tallangatta is a good idea, especially as they were promised a lake when the town was moved.*

It is important to note that case one believes Tallangatta was promised a lake as part of the relocation from Old Tallangatta. This is at odds with some other respondents, and represents an important reminder that the interpretation of history has an important role to play in the creation of attachments to place, ideas about fairness and to views of water management and managers.

The importance of recreation and tourism have also been identified by case one. For example:

As the water level drops boating and sailing become more dangerous, and you have to chase the fish rather than fish for them. Sailing can become impossible in some years. There are not enough lower level boat ramps. Not surprising, given the short sightedness of local government. After a few years of low levels the local government decides it would be a good thing to put up some money for low level ramps, by the time the allocation is passed the level will be back up again and the allocation goes into consolidated revenue. They need to hold $20,000 somewhere until the level gets down then act quickly.

For case one, the iconic nature of the lake is not enough to protect it from mismanagement and also the influence of downstream irrigators. Not only are these an issue of scale for case one, they are also issues of the socio-economic and political power of some users. This is a theme which he continued with the following comment:

The amenity of all water users must be taken seriously and the two weirs must be coordinated.

It is worthwhile noting that the issue of the coordination of Lake Hume and Dartmouth was an on-going issue with a number of respondents. For case one, this coordination would go a long way in overcoming blue-green algal blooms as well as silting.

The views of case one raise the following:

- To what extent can the coordination of the management of the Lake(s) be integrated across levels of government and agencies?
- What is the relationship between tourism and Lake management?
- What are the threats to Lake Hume's 'iconic' status and how are these currently being managed?

Case 2

Case 2 is a cattle farmer in his sixties who lives in one of the valleys.

For case two, Lake Hume means:

Long summers as an adolescent, chasing the city girls at the Caravan Park

For case two, the lake played an important part in the formation of his adolescent identity both as a male and as a rural male. And it still plays an important part, albeit in a somewhat different guise now. Case two still water skis or spots for his son occasionally, so he is still a recreational user of the Lake. However, his recreational use has been reduced because:

there's trout in the Mitta and none down here, so I spend far less time on the Hume than when I was a youngster.

Like many others, case two has concerns about the management of the Lake:

> *When the water is low it becomes too dangerous to ski. Why not let the water level rise and fall consistently across the whole system?*

Whilst this concern is obviously related to recreational use, case two has further concerns related to the economic impacts of the Lake's management in relation to his agricultural activities:

> *If Dartmouth keeps dragging my soil down river there will definitely be a problem in the long run; the whole system will silt up. Both weirs need to be governed together. It's not just a problem of low water down here. A few years back Dartmouth held on to its water despite the fact that it was running at over 105% capacity and backing up over farming land. It takes 5 or 6 days to kill grass under fresh water. A large part of my property was under water for two weeks. Total cost to me...$100,000.*

It is important to note that this represents both an economic and an ecological concern. He also looks to a more integrated management system between Lake Hume and Dartmouth:

> *A steady, system wide management is better*.

This may help resolve blue-green algal blooms, though he did not necessarily see blue-green algae as a crucial issue for the Lake.

The views of case two raise the following:

- To what extent is the management of Lake Hume and Dartmouth integrated?
- What are the assumptions, priorities and values underpinning the management of Lake Hume and Dartmouth?
- In what ways does Lake Hume contribute to identity formation in individual users?
- How does geographic location and historical time change this?

Case 3

Case three is a joint interview conducted at Tallangatta. The respondents are two women in their seventies.

For case three, Lake Hume means:

> *A sad loss of material heritage! You can move weatherboard homes, but brick pubs, brick post offices, stone council chambers and local offices present too great a challenge. All the rate notices for old*

Tallangatta were scheduled for burning prior to the move, only some of this important historical material was saved.

Here case three touches on the importance of the Lake to community identity. But they also spent a lot of the interview discussing how it contributes to individual identity. For example, they still walk around the shores of the Lake, and talked about how they enjoyed the boating competitions which were held in January. Interestingly, they also identified the Lake as an important meeting place for young people, both in terms of local youth and the 'boy meets girl' scenario of holiday romances.

Case three cannot totally understand the concerns for the level of the lake.

Old Tallangatta didn't have a lake, and new Tallangatta was never promised a lake. The understanding all along was that the changes to the township were all for the benefit of the irrigators down stream.

This is an interesting comment in the context of the relationships between Lake users and downstream users. It also highlights the ways the values and attachments to the Lake are in part historically determined. These continue to underpin values.

Case three are happy if there's water at Tallangatta until January. The water is not the only reason for tourist activity in the region, highlighting day tours through wineries, state & national parks, the high country, and places of natural and historical interest. This raises an important issue – to what extent can local tourism (and the subsequent tourist dollars which come locally) be separated between Lake-based and region-based and, hence, what role does the iconic nature of the Lake play in this?

Both respondents consider silting of the Lake to be a real problem, with neither supporting the building of a lock across the Narrows, as this would only speed up the silting process. Both call for the integration of the management of Dartmouth and Lake Hume.

However, both ask for a sense of realism and balance in the management of the Lake:

Boating, swimming and fishing are great activities but we need to be realistic: feeding a nation is very important. However, we also need to be realistic about how food is produced. Irrigators do waste water, and this also needs to be addressed.

Here the respondents have identified the sometimes contradictory uses of water as well as the multidimensional issues of management.

The views of case four raise the following:

- How do individuals in lakeside communities identify with and use Lake Hume?

- Are these different to those of reserve users?

- How might this diversity of views be incorporated into management?

Case 4:
Case four is a US born German citizen on holidays with his German fiancée and her brother.

For case four, Lake Hume means:

> *A wonderful surprise along the way. We came out of the Snowy Mountains looking for a place to stop and relax. We saw this large blue bit on the map and headed for it. It's awesome, beautiful and FREE! We are taking a break for a couple of days of swimming and relaxing before we head into Melbourne*
>
> *This is our first time, so we aren't aware that some years we may have been disappointed. On the other hand, there's so much natural beauty around here that a lack of water wouldn't probably matter. Put an air conditioned and licensed Brahthaus (a bar and grill) up in those hills and we probably would've been as happy. Beautiful views across the lake and hills versus beautiful views across the flats and hills…who cares?*

Case four highlights an interesting aspect to the Lake and its relationship to tourism. For case four, the Lake (that is water) is somewhat irrelevant to the experience. Even though this respondent was interviewed whilst he was swimming, the water itself was possibly less important than the total landscape. This raises an interesting issue as to the impact low water may have on the multiple ways people value the Lake. It is also an issue which has emerged in later cases and other interviews.

The views of case four raise the following:

- How important is water level to Lake Hume users and how do they adapt to changes with this?

Case 5
Case five is a 44 year old man interviewed at a Victorian lakeside reserve.

For case five, Lake Hume means:

> *A changing asset to be cherished in good times*

Case five fishes and shoots duck on the lake, but has never sailed or skied there. The 'changing asset' of the above quote reflects the fact that he

used to be able to catch trout "off his back porch" but "the system" changed and now you have to go up the Mitta for trout. Dirt only flows one way, and when the lake started silting up the carp appeared. You can chase Redfin but it gets harder and harder with the levels fluctuating wildly. You can always go to the actual river if the level in the lake gets too low, but with the silt problem even that's not much of an option these days.

Case five has identified an ecosystem issue, tied into a recreational impact. He believes this is a result of the management of the Lake and the relationship between Lake Hume management and the management of Dartmouth. He also sees blue-green algal blooms as being caused by similar management issues. This is a theme which was particularly evident in this location.

Further, case five recognises that the water in the Lake is a finite resource with multiple calls on it, though there may be an engineering solution which would resolve his specific issues:

There's obviously not enough water to go round, but if they did put a lock in the narrows and let the water build up behind it over time then the fish would have a place to establish. Yellow Belly might start to increase in number behind the lock.

This engineering solution was offered by the respondent in the spirit of trying to maintain fishing activities on the Lake and at the same time ensuring a more constant water level at the location.

The views of case five raise the following:

- How do users understand and identify the range of environmental problems facing Lake Hume?
- How can these be incorporated into management processes?

Case 6

Case six is a group interview with three mid-adolescent girls. For these, Lake Hume means:

Neutral territory and a place to mix

The girls use the lake as a meeting place. Though two of them have pools in their backyards the lake offers a neutral place away from parents' eyes and ears. They ski occasionally, depending on whose boat is being offered.

These girls represent an example of the ways in which the lake can be tied very directly into an influence on individual identity. The Lake provides a background to increasing independence, peer socialisation, and generalised 'hanging around together'.

The Lake's part in the girl's summer identity is often centred on socialising, but:

> *if the water drops early it's not the end of the world. The pools are always there if you need a swim, and the talent at the Caravan Park hasn't been very good lately.*

All three girls plan to move away from Tallangatta as soon as possible; they see issues involving the lake as belonging to those who will 'stick around'. Hence, for the girls, the Lake occupies what is a contradictory place. On the one hand, it forms the backdrop to recreation, identity formation and socialisation. Yet, the girls see it is occupying only a transitory space in their lives – something that is used whilst living geographically close but left to others' concerns once they leave the area. This is a different relationship to the Lake to case seven.

The views of case six raise the following:

- To what extent can the management of Lake Hume incorporate environmental education in keeping with the inter-generational nature of sustainable development and resource management?

- How do individuals in lakeside communities use the Lake and how does this contribute to identity formation?

Case 7

Case seven, a woman in her late 30s and a long term resident close to the lake, attaches a great degree of individual identity and individual biography to Lake Hume. It means both 'tradition and family'.

Case seven remembers being out on the lake almost every weekend when she was growing up. Boating and water skiing when safe, fishing most of the time, and fossicking for old objects snagged on trees as the water level dropped. Most weekends her father would drop the boat in at Ludlow's and they'd head about 3 kilometres to "their spot" and set up a day tent.

> *Mum would have lunch ready on our return to the tent, and if the morning involved a catch it usually found its way on to the BBQ for dinner. The boat would be dragged out at Ludlow's at last light.*

Case seven prefers to swim in a pool these days, but if she found

> *a fella with a boat I'd be back on the lake skiing in a flash.*

Case seven cannot remember a time when the family could not go out for the day. Sometimes a storm would interrupt proceedings, but 'that's the weather so what are you going to do?' If the water level dropped then it might become

dangerous (in amongst the trees) to try some activities but other opportunities opened up.

According to case seven, recreation on Lake Hume is tied to rainfall:

> *We did what we could, given the circumstances. A whole year without skiing would've been bad*

but case seven can't remember one prior to her father's death.

When asked about the management of Lake Hume, case seven says:

> *The Weir was built to provide for the irrigators, as a side effect yachties, skiers, fishers and sundry get to do their thing at least some of the time. Maybe the balance could swing more towards recreation rather than money but it's a complex system straddling two states, so good luck!*

Obviously the role the Lake plays in case seven's attachment to place is significant. Importantly, the case also highlights the multi-dimensional characteristics of these attachments: water skiing, fishing, barbeques, picnics etc. All these can be described as recreational activities, but have an important additional set of values: attachment to place and sense of self via identity formation. This multi-dimensionality is summed up in the above comment highlighting the fact that when some opportunities closed due to low water levels others opened up.

The other thing case seven highlights is the ways people interpret what the Lake not only means for them, but also for others. Her comments recognise an issue of scale (downstream users), multiple rights of users and to use, and the need to balance these out. It could be that this case also begins a recognition of the ways river management is by definition a bringing of competing values and groups together.

However, for case seven, blue-green algal blooms are signs of a system under stress. Whilst she admittedly knew little about blue-green algae, she was concerned that it was an indicator of the Lake being polluted or managed inappropriately.

The views of case seven raise the following:

- How can people's use of the Lake over generational time be better understood in order to plot the changing uses/values of the Lake?

Case 8

Case eight is a family (two parents aged in their thirties and three young children) interviewed at one of the NSW reserves.

Case eight come to the Lake because it is a 'less formal place to relax'. The reserve is a less crowded alternative to the public pool and the surrounds are

more natural and peaceful. The reserve is one of the better ones for the family because it is well serviced and has substantial shallows for their youngest to play in. The reserve provides a place where they can swim, boogie board, cool down and picnic. They'll usually bring visitors to the region here at some time during their stay.

For case eight, the water level has not been an issue in the ways they use the Lake, though they have only been in the area for the last 12 months.

They only identified one potential problem. Neither feel comfortable with the level of powerboat activity on the lake; not because of annoyance but because the powerboats represent a possible threat to the integrity of the environment (blown engines, oil spills, fuel spills). They understand it would be impossible to get rid of the powerboats.

The views of case eight raise the following:

- How do people's use of, and values towards, Lake Hume change over time?

- Is this different for new users (for example, case eight) and long-time users?

Case 9

Case nine are two men who have been friends since school and who now live in separate towns near the lake. They were interviewed whilst sharing some stubbies at one of the reserves after work, mid-week.

For both, Lake Hume means:

Human sanctuary

As with many other respondents, a lot more time was spent on or around the lake when these two were younger. Now the reserve is a halfway mark where the two of them can meet (away from their respective spouses, as was pointed out by one of them) and 'chew the fat over a couple of beers'.

Hence, Lake Hume has been, and still is, intrinsic to their individual identities, to there friendship, and to the ways in which (and indeed which) topics get discussed when 'chewing the fat'. Hence, it acts as an important location for maintaining value systems/belief systems, developing a broad range of ideas and generally reinforcing dominant values.

These two don't get the opportunity to catch up very often, but they have been struck by the frequency with which they discover rubbish in the area when they do get the chance to come (they assure me that they always take out whatever they bring in). This concern about inappropriate use (ie, leaving rubbish rather than taking it out) represents a clash between user

expectations and connections to space/their environment, and is also something which comes up regularly in interviews.

They've been able to come to the reserve for a catch-up unhindered, and hope that there would never be any restriction to doing so because of a littering problem.

The demands of establishing their respective businesses means they don't have time to think much about the actual weir, but both hope it will be there in one form or another when their own kids eventually arrive. The Lake's value and importance to these two hence takes on an inter-generational quality. However they were not totally confident about what the future may hold, given the sometimes inappropriate uses of the Lake (not only rubbish, but the management of the Lake and water use by downstream irrigators, blue-green algal blooms).

The views of case nine raise the following:

- In what ways does the Lake provide a backdrop to broader social values and experiences (that is, values and experiences not related to the Lake)?

Case 10
Case 10 is a male who has been living in the area for the last 22 years. He was interviewed in Wodonga.

For case 10, Lake Hume means:

> *A bloody lot! Livelihood and recreation: work and play!*

Case 10 fishes and hunts duck on the lake. He regularly uses Kookaburra Point, Ebden, Ludlow's point and Tallangatta.

Case 10 has never been unable to get out for a fish if he wanted. The local fishermen know where to go to get onto the water if the level is low (boat ramps may not always be involved). If the level of the lake is consistently low over time then case 10 knows there is an economic impact with lost trade for retailers from family oriented fishing and the passing trade from holiday-makers. However, he believes trade from locals and serious fishermen/shooters remains constant under any circumstance.

Case 10 is concerned that if the water level in the lake doesn't have some sort of consistency (or at least a narrower band of level variation) then it will never become a good fishery:

> *Consistent water levels allow weed beds to take hold, and where weed beds take hold reliable fishing follows. The fisherman doesn't need to hunt the fish down from session to session.*

According to case 10, the lock on the narrows is a good idea.

Building up a consistent water level (it doesn't need to be 100%) behind the lock could create the conditions necessary to see the reintroduction of Yellow Belly succeed at a much faster rate.

Case 10 understands that Lake Hume was commissioned for irrigation and that therefore all uses are very rainfall dependent. However, he'd like to see a system where it never happens that one part of the system sits at 7% while others sit at close to 100%.

Case ten highlights the ways in which many people's attachments to Lake Hume are a mixture of economic, recreational, ecological and social values. These also reflect the ways the mixture of these values are difficult to categorise as 'irrational' or 'self-interested'.

The views of case 10 raise the following:

- How are recreational users, such as fishers, heterogenous?
- How does this impact on uses and economic benefits?

Case 11

Case 11 is a male in his mid-forties, interviewed in Wodonga. For case 11, Lake Hume means:

The local fishing hole

Case 11 prefers to fish other places than Lake Hume, but

the lake is local and when it's full enough it's also big enough that you can get out and drop a line without fear of interruption.

Local knowledge means that case 11 is rarely unable to get onto the water for a fish. However, he points out that just because you can get on the water doesn't mean that you'll find anywhere decent to drop a line. Maybe designating a realistic minimum level (his suggestion was 40%) in the Lake would allow for reasonable fishing most of the time.

Case 11 is concerned about the lake silting up and proposes that Lake Hume and Dartmouth need to be managed in a more integrated manner. Case 11 thinks the lock at the narrows is a bad idea if Hume and Dartmouth don't start coordinating. The lock will just become an accelerated silting point, and case 10's weed beds will just be killed off every time Dartmouth sends another slurry down stream.

His final comment is

The system under discussion is a very complex one, addressing the issues as if they're in separated boxes...(and he shrugs).

The views of case 11 raise the following:

- To what extent is the management of the Lake Hume/Dartmouth system integrated?

Case 12

Case 12 agreed with a lot of case 11 and case 10. However he:

> *cannot see how turning a two-catchment system (not counting down stream) into a three-catchment system is going to make any difference. The problem is system wide and covers everything from lack of coordination of the weirs at this end, to waste at the irrigators' end. Monetary profit needs to be taken out of the equation when considering the health of the river system.*

Case 12 was one of the few respondents in the interviews to specifically make the connection between what he sees as the economic imperative of downstream irrigators and its negative environmental consequences. Whilst others have identified irrigation as an issue, it has been often couched in terms of needing to balance the economic and water needs of irrigators with other users. In case 12's mind, water is overwhelmingly a pure public good, not an individual economic good.

Case 13

Case 13 are an English couple who have been living in the area for 25 years. For them, Lake Hume means:

> *A showpiece*

Case 13 will very occasionally take a stroll at a nearby reserve, but their main use of the weir is as a showpiece for friends visiting from England. Hence, for this couple, Lake Hume forms part of local and regional identity (and possibly Australian identity) rather than individual identity.

The kinds of activities case 13 undertakes are not water-level specific. Walking doesn't require high water levels, but

> *one just needs to be careful not to go just following a weekend (when rubbish and dog droppings are at a peak). Regardless of the level elsewhere on the lake, one can always bring one's guests to the dam itself for a bit of a show. The surrounds are now nice enough for a quiet BBQ mid-week.*

However, they recognise that changing water levels will have an important impact on some developments around, and uses of, the Lake.

If you could keep a reasonable level in the lake at all times then the development going on around the lake would make sense. As it is, these new developments (relying on the water as a drawcard) seem doomed to failure.

Whilst this comment appears self-evident, it should be noted that this couple, who predominantly had little individual connection to the Lake, was still able to identify management challenges and were concerned about where the Lake's management was heading.

The views of case 13 raise the following:

- What is the extent of lay-knowledge about the management of Lake Hume?
- How is this generated?
- How can this be harnessed for the management of Lake Hume?

Case 14

Case 14 is a couple in their mid forties who were paddling at a reserve.

Case 14 use the reserve as a (cooling and relaxing) place for an after dinner stroll on late spring and summer evenings. Sometimes dinner in the form of a picnic will be consumed at the reserve.

The concerns of case 14 are focused on the uses of the lake:

Sometimes you have to walk a bit further to get your feet wet, but it's all good. The biggest threat to enjoyment here is "dogs and dog owners". Dog owners wouldn't take their mutts to the pool and let them off the leash, so why do they do it here. Dogs splash by you unheeding, they crap and piss where they want, they start barking matches with each other, and sometimes end up in a brawl. All this while their stupid owner looks on lovingly! Piles of Beam cans after late night sessions is bad, rutted shoreline from motor-cross hoons is bad…these things might eventually lead to restricted access to the lake. However, dogs will make any access unbearable.

For case 14, the public good dimension to the Lake is under threat by inappropriate recreational use and the 'hoon factor' (as they described it). It also highlights the complex nature of public good issues – the multidimensional uses within a 'public good' framework by a variety of individuals and groups with a variety of motivations, understandings and consequently actions.

For case 14, the drainage of the lake is also problematic:

The weir serves a specific purpose but I can't see how draining it near to empty on a regular basis can be good. I guess the end users don't care as long as they get what they paid for. Pity there isn't a more win/win way of doing things.

The views of case 14 raise the following:

- What is the extent of the conflict between Lake Hume recreational users?

Case 15

Case 15 is a fifty year old male interviewed whilst walking his dog at one of the NSW reserves.

For case 15, Lake Hume means:

A great resource, catering to many

He walks his two dogs and his son's dog at the reserve every day. This provides good exercise for all concerned. The dogs will walk, but might also swim if the reserve is relatively empty (and the good thing about this reserve is that it's one of the quieter reserves).

Sometimes case 15 needs to walk a bit further to give the dogs a chance to get wet, but this just means everybody gets more exercise. His main concern is about the misuse of the Lake and its foreshore by recreationalists, and if it will lead to restrictions. He cites rubbish being left, four-wheel drives rutting the foreshore, and general hooning.

Once again, case 15's concerns represent concerns over competing recreational values and contradictory uses and activities.

Case 16

Case 16 is a woman in her late forties. She was interviewed in one of the small towns beside the lake. For case 16, Lake Hume means:

continuity & pride

Case 16 sees the Lake, and the community she belongs to, as a place where everyone can belong, if only for two weeks of each year. She encourages the continuity of connection of families both in town and out. Hence, the Lake has an important role in community identity.

Her own connection to Lake Hume is also important. Her grandfather worked on the wall. Moreover, her grandfather's brother-in-law was the stonemason who stamped the dates in the pylons at each end of the Bethanga Bridge. Hence, the Lake plays an important role in her own biography and identity.

She describes the people who bring their powerboats and four-wheel drives to the lake at the weekend as

> *City boys with their toys.*

However she is at pains to point out that this is not a derogatory comment as she believes the Lake can provide connections for all. Not only is it a public good, it is also a way to bring a variety of people together and maintain social connections with each other, within their communities, and with the Lake.

Case 16 fears for the health of the lake because of the constant draining and refilling. She wonders why this storage "makes the sacrifice". That is, she wonders why there are three bodies of water between here and the end user with such fluctuating capacities. She also believes the authorities need to reconsider the volume of water sold to and possible wastage by the end user. She is particularly concerned about blue-green algal blooms and what the mean not only for the health of the Lake, but symbolically for lake users.

The views of case 16 raise the following:

- What are the characteristics of the socio-economic relationships between Albury/Wodonga and lakeside communities?

References

Abelson, P. (1986) The Economic Evaluation of Roads in Australia, Australian Professional Publications, Sydney.

Abelson, P. (1996) Project Appraisal and Valuation of the Environment: General Principles and Six Case Studies in Developing Countries, Macmillan Press Ltd, Great Britain.

Allen, P., Stevens, T.H., More, T.A. (1985) Measuring the Economic Value of Urban Parks: A Caution, Leisure Sciences, Vol. 7, No. 4, pp. 467-477

Asian Development Bank (1996) Economic Evaluation of Environmental Impacts, ADB, Manila, Philippines.

Bennett, J. (2005) Australasian Environmental Economics: Contributions, conflicts and 'cop-outs', Australian Journal of Agricultural and Resource Economics, Vol. 49, No. 3, pp. 243-262

Bennett, J., Gillespie, R., Powell, R. and Chalmers, L. (1996) The Economic Value and Regional Economic Impact of National Parks, Australian Journal of Environmental Management Vol. 3, No. 4, pp. 229-239.

Blanch, S (2002) A brief history of the development of rivers for irrigation in the Murray-Darling Basin and the environmental consequences today. Paper presented at Mekong Dialogue Workshop: International transfer of river basin development experience: Australia and the Mekong Region.

Cesario, F. (1976) Value of Time in Recreation Benefit Studies, Land Economics, Vol. 52(1): 32-41

Gippel C. and Blackham D. (2002) Review of Environmental Impacts of Flow Regulation and Other Water Resource Developments in the River Murray and Lower Darling System, Final report by Fluvial Systems Pty Ltd, Stockton, to MDBC, Canberra

Goulburn-Murray Water (2005) Lake Hume Land and On-Water Management Plan – Issues Summary Paper, Information Circular produced by GMW for DIPNR and MDBC, Canberra

Howitt, Baldwin and Hawking (2005)

Hufschmidt, M., James, D., Meister, A., Bower, J. (1983) Environment, Natural Systems, and Development; An Economic Valuation Guide, John Hopkins University Press, Baltimore and London.

Loder and Bayly Planning and Engineering Consultants, Snowy Mountains Engineering Corporation, Peat Marwick Mitchell Services (1979) 'Lake Hume

Recreation Study – A Summary', Lake Hume Recreation Co-ordinating Committee, Wodonga.

MDBC (2004) Design and Operation of Hume Dam, 27/1/2006, http://www.mdbc.gov.au/river_murray_system/hume/hume_design.htm

MDBC (2005) Barmah-Millewa Forest to Receive Healthy Flood, 10/12/2005, http://www.mdbc.gov.au/__data/page/15/barmah_release_131005.pdf

Pak-Poy & Kneebone Pty Ltd (1990) Economic Study of Changed Operational Strategies for Hume and Dartmouth Reservoirs, Final Report, MDBC, Canberra.

Strang, V (2004) *The Meaning of Water* Berg, Oxford.

Sinden, J. and Worrell, A. (1979) Unpriced Values: Decisions without Market Prices, John Wiley and Sons, Toronto.

UBD (2001) Concise Motoring Atlas of Australia,