Appendix 32: Non-Market Values

1. Introduction

The objective of this paper is to identify the scope and size of non-market values (NMV) associated with restoring and protecting the health and wellbeing of the Waikato River. The Waikato River provides a range of benefits that are difficult to measure in monetary terms – in economics these are called non-market values. They include positive benefits such as recreation, ecosystem services[1], aesthetics, intrinsic/existence[2], legacy/bequest[3], historical and cultural/spiritual values.[4] They also include negative benefits (e.g., intensive land use has significant non-market costs in terms of reduced water quality and quantity). The reason these costs and benefits are not currently included in the formal economy (e.g., in Gross Domestic Product (GDP)) is that there are no markets where they are regularly bought and sold, and hence the price that people are prepared to pay for them cannot easily be determined.

This section complements the economic analysis of the direct costs and benefits undertaken in the economic modelling.

The practical use of economic valuation is assessing incremental change arising from a policy change, and not at valuing an entire ecosystem (TEEB, 2009). The purpose of economic valuation in policy decisions is to provide information on the impact of the change, and not to value the entire site or resource. For example, in this Study the aim is to value the change in the health and wellbeing of the Waikato River and not to attempt to value all the goods and services provided by the river.

This paper is structured as follows. Firstly, the concept of total economic value (TEV) is introduced to provide context and a structure to the range of values. This is followed by case study examples of the various types of values grouped under ecosystem services, farming impact on the environment and indigenous biodiversity values. Next, economic impacts are discussed including how NMVs can, in the future, be incorporated into GDP, the aggregate measure of economic wellbeing, using the concept of the Genuine Progress Indicator (GPI). There is a discussion of the implications of quantifying changes in NMVs for the Waikato River and also a brief overview of the impact of the Emissions Trading Scheme.

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[1] Ecosystems provide a range of resources and processes such as drinking-water, waste assimilation and treatment, nutrient and soil cycling, pollination, and many others. Collectively these are known as ecosystem services.

[2] Intrinsic/existence values refer to values ascribed by people to something simply because it exists even if they never experience it directly.

[3] Legacy/bequest values refer to the values people ascribe to maintaining something for future generations.

[4] This refers to values from all cultures.

2. Total economic value

Non-market values are important and need to be considered alongside market values in decision making. The total economic value (TEV), which incorporates both market and non-market values of a natural resource, is grounded on the utility of the resource. This utility ranges across a spectrum of values grouped as active use and passive use values (see Figure 1).

Active use values are classified as direct use, indirect use and option value.[5] Direct use values are consumptive and production related (e.g., agriculture, fisheries, water supply, engineering) and are mostly captured in market values. Direct use value changes have been quantified and are expressed in monetary terms as NPV where NPV is defined as the discounted sum of direct benefits minus direct costs.

Indirect use values are functional benefits that support or protect direct use activities (e.g., recreation, water retention, nutrient recycling).

Option value relates to the benefits of preserving the natural resource for a potential future direct and indirect use (e.g., native plant biodiversity as future source of medicines).

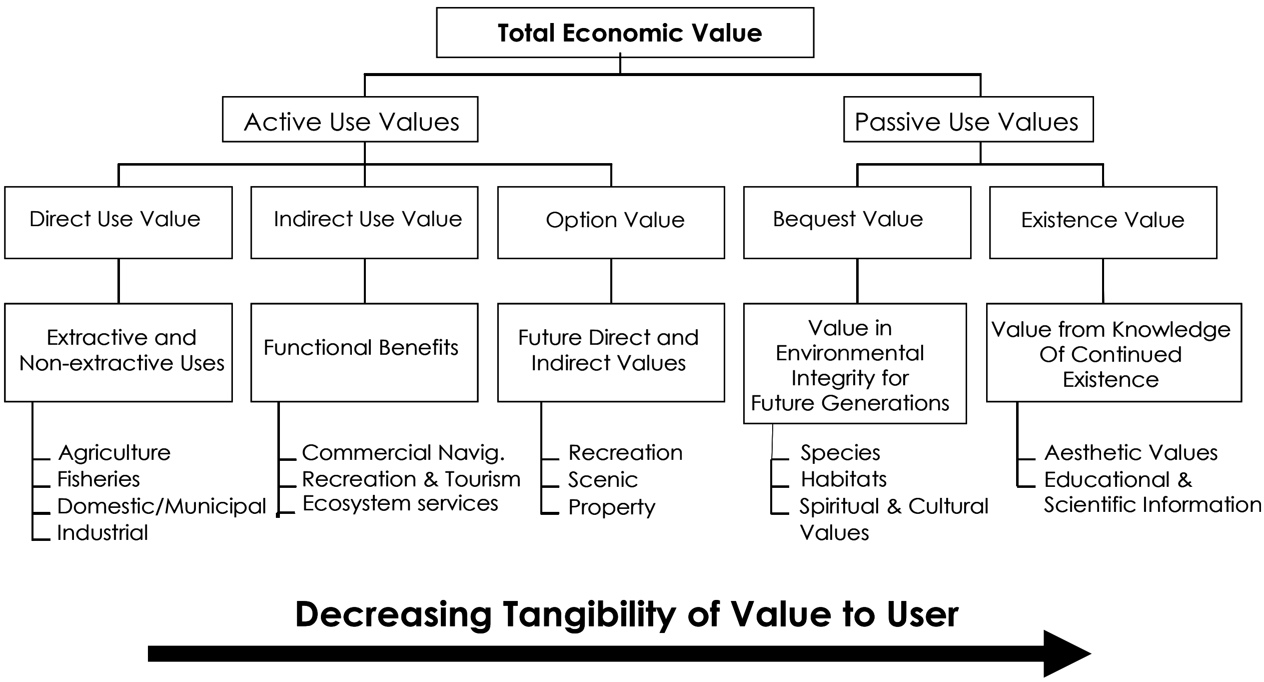


Figure 1: Total economic value (sourced from EVRI, 2009).

[5] Studies cited later in the Report have slightly different classification of value. One will classify option value under passive use. Another will classify recreation and cultural value as direct use value.

Passive use values are classified as bequest value (e.g., preservation for future generations, including spiritual and cultural values) and existence/intrinsic value (e.g., aesthetic, habitat, biodiversity).

It is important to note that the way in which economists categorise these values is to recognise the spectrum of total economic value. Traditionally, only the direct active use values are estimated in cost benefit analysis because there are market prices that can be applied to quantity changes to estimate changes in value.

Most of the values in Figure 1 must be valued indirectly through non-market valuation techniques. The Study team did not attempt to estimate dollar amounts for non-market values because the relevant data was not readily available and there was not enough time or budget to undertake the necessary survey and analysis work. However, the Study team did undertake a qualitative analysis of the main non-market values (costs and benefits) that may be relevant to the project and this analysis is set out below.

3. Case studies

3.1 Ecosystem services

Natural capital encompasses ecosystems, biodiversity[6] and natural resources. Natural capital provides benefits that sustain societies through the provision of ecosystem services to society. The foundation of valuing these ecosystem services is scientific information that assesses the physical impact of changes to service provision and places a dollar value on the change. Studies that attempt to estimate the value of ecosystem services focus on active direct and indirect use values. Passive values such as cultural and spiritual values that help make up 'wellbeing' are not quantified and this means that estimating the value of ecosystem services in comparison with the direct costs of restoration underestimates the value of restoration.

The value of ecosystem services is context specific and not uniform universally. This means that economic values are not intrinsic to the ecosystem but are linked to the utility and welfare it provides. This utility is influenced by the number of people who benefit and the socio-economic context including cultural and spiritual aspects. For example, the service 'water regulation' (regulation of hydrological flows such as provisioning of water for agricultural, industrial and transportation use) is an essential component for some locations but only an incidental service in others. Furthermore, the people who were surveyed in the Study location may have markedly different incomes and cultural backgrounds that could result in significantly different willingness to pay for changes to environmental values. As a result, applying values estimated for one primary study site to another policy site (which is the

[6] Biological diversity (biodiversity) is the variety of all living things (plants, animals, fungi and microorganisms) and the ecosystems where they live (A strategy for New Zealand's biodiversity, www.biodiversity.govt.nz).

subject of a decision) using the benefit transfer technique can only be done if suitable adjustments are made that take into account both the differences in the sites and the populations affected (TEEB, 2009).

A policy change does not necessarily result in the loss of ecosystem service(s). Ecosystems have built-in resilience in the face of changing environmental conditions and disturbances. But, while there is uncertainty on threshold levels, the critical point at which the ecosystem is significantly changed, a precautionary approach is recommended (TEEB, 2009).

Ecosystem services can make up a significant component of total economic value. The case studies set out below illustrate this significance.

Case study 1

The direct and indirect use value of ecosystem services for the Manawatuu-Whanganui region has been estimated at $6 billion per year (2006 dollars) using the rapid assessment method – benefit transfer (van den Belt et al., 2009). Market-based direct use values, such as food and raw material production, were based on regional GDP figures. Non-market direct (e.g., recreation, water regulation) and indirect use (e.g., erosion control, nutrient cycling) values were derived from a global meta analysis by Costanza et al., (1997).

The ecosystem service value for the Manawatuu-Whanganui region is still considered conservative as it does not include some direct and indirect use values for some ecosystem types. More important, it does not account for passive values (e.g., cultural and spiritual aspects of water) due to lack of primary valuation studies (van den Belt et al., 2009). Such passive values can be significant as is shown in the next case study.

Table 1 shows the per hectare annual value of ecosystem services by type of ecosystem. These figures have been updated from 2006 prices using the all groups' consumer price index (CPI).

Case study 2

A contingent valuation study of the Whangamarino wetland in an unpublished Master's thesis quoted by Schuyt and Brander (2004) showed passive use values exceeded active use values. As an annual benefit, the passive use (preservation) value of the Whangamarino wetland was assessed as 2.7 times greater than the active use value (recreation, flood control and fishing). The high passive value might have been influenced by the ecological significance of this wetland.

Table 1: Annual value per hectare of ecosystems services in the Manawatuu-Whanganui region (2010 prices).

Ecosystem service	Direct	Indirect	Total
Wetlands	$5,900	$42,400	$48,300
Estuarine	2,000	24,000	26,100
Horticultural	21,100	100	21,200
Lakes	14,000	6,900	20,900
Rivers	14,000	6,900	20,900
Coastal	600	9,400	10,000
Exotic forests	500	2,000	2,500
Native forests	200	2,100	2,300
Dairy	1,600	500	2,100
Scrub	300	900	1,200
Cropping	900	100	1000
Sheep and beef	300	500	800

Source: updated from van den Belt et al., (2009).

The Whangamarino wetland presents a case study of the ecosystem services provided by flood control on the lower Waikato River (Department of Conservation, 2007). Its ability to store water during peak flows results in reduced public works on floodgates (estimated at millions of dollars) and less damage to surrounding farmland (avoided flooding of 7,300 hectares estimated at $5.2 million). Other ecosystem services provided by the wetland include:

- Raising water tables for irrigation during dry periods.
- Carbon sequestration (0.5 tonnes per hectare per year from peat bogs).
- Gamebird hunting (tens of thousands of gamebirds each year).
- Recreational and commercial fishing (tuna).
- Attraction for overseas tourism (bird watching).
- Habitat for diverse native wetland birds and other threatened/uncommon wetland birds (hosts 20 percent of New Zealand's breeding population of native wetland birds).
- Diverse freshwater fish fauna (threatened black mudfish).
- 239 wetland plant species (60 percent indigenous; a number are rare).

Case study 3

This case study has shown that improving drinking-water quality beyond mandated minimum standards can provide benefits that exceed the costs. Such benefits need to include non-market values such as health and quality of life (Silverman, 2007).

The survey conducted before and after a water treatment upgrade in a city in Ohio, United States, revealed:

- Enhanced public satisfaction with a high-profile public interest issue around improved water quality.
- Potential health benefits to the community through risk reduction in exposure to toxic substances.
- While water bills increased, this is more than offset by savings from lower use of bottled water and home water treatment systems.

Case study 4

Patterson and Cole (1998) estimated the annual value of the Waikato region's ecosystem services at $9.4 billion (1997 dollars), which equates to $12.6 billion in 2010 dollars. Table 2 shows the per hectare values related to the river in 2010 dollars updated from 1997 prices using the all groups CPI index. These estimates include both direct and indirect use values (Environment Waikato, 2010) but not passive values.

This analysis used the same global meta analysis data (Costanza et al., 1997) as the Whanganui study and therefore the same caveats apply.

Table 2: Annual value derived from ecosystem services in the Waikato region.

Ecosystem type	Total value $/ha/yr	Total $ million	% or Total Value
Lakes and rivers	25,808	2,431	19.8
Forests	3,144	2,421	19.8
Agricultural/horticultural	1,441	1,913	15.6
Freshwater wetlands	52,141	1,586	12.9
Coastal marine area	655	1,458	11.9
Near coastal zone	10,481	1,199	9.8
Estuarine	60,787	1,131	9.2
Other:			
Scrub	655	72	0.6
Seagrass/algal beds	50,961	28	0.2
Cropland	183	12	0.1
Mangrove	24,891	4	0.0
Total		**12,254**	**100.0**

Source: Patterson and Cole (1998), updated to 2009 prices using the CPI All Groups Index.

In a more recent study McDonald and Trinh (2008) applied similar methodology to Patterson and Cole to the upper Waikato catchment using 2004 prices. Direct values were based on the System of National Accounts (SNA) data and indirect values from Costanza et al., (1997) as refined by Balmford et al., (2002).

These four ecosystem services case studies all use average values based on international meta analysis. They are useful when considering a change to land use such as converting dairy land to forestry, but unfortunately they are not very helpful in assessing changes to the quality of ecosystem services, which is a significant component of the river clean-up.

3.2 Impact of farming on the environment

Farming has both positive and negative impacts on total economic value. There are positive direct active use values from the income derived from farming and there are negative indirect costs from environmental degradation. In addition, passive use values, such as aesthetics, are also affected. These passive values are the most difficult to assess but can be quantified using stated preference techniques such as choice modelling to determine willingness to pay (WTP). In the two case studies below a range of non-market values are quantified including indirect, indirect active use values and passive values.

Case study 5

One such study has been carried out by the University of Waikato and Environment Waikato (Marsh et al., 2009). This survey attempted to estimate the willingness to pay for improvement in water quality in the Karaapiro (upper) catchment of the Waikato River, focusing on Lakes Arapuni and Karaapiro. The research was based on the Choice Modelling method of NMV and resulted in the following attributes being quantified without and with improved water quality:

- Suitability for swimming and recreation (probability of health warnings: one in two years improved to one in 50 years).
- Water clarity (visibility under water: one metre improved to four metres).
- Ecological health (percentage of excellent readings: less than 40 percent improved to more than 80 percent).
- Jobs in dairying (percentage of jobs lost: 0 percent to 20 percent).
- Cost to households (dollars per year for the next ten years).

In total 178 or 2.3 percent of households (HHs) were surveyed in the catchment. The statistical analysis of the survey produced a model with a good fit to the data providing a high degree of confidence in the result. The average WTP for improvement in quality were:

- Suitability for swimming $161per HH per year for 10 years
- Water clarity $65
- Ecological health $145
- Jobs in dairying –$190

Thus the combined WTP to improve water quality was $371 per household per year for ten years. But if the quality improvements resulted in a 20 percent loss of jobs in dairying then overall WTP was reduced by $190 per household per year. Over the 7,802 households in the Karaapiro catchment this aggregates to $2.9 million per year for quality improvements and $1.5 million for loss of jobs, with a present value (PV) after discounting at eight percent of $21.0 million and $10.9 million respectively.

It should be noted that the Karaapiro catchment covers the area from Lake Arapuni to the Karaapiro Dam including tributaries and that this is only a fraction of the 'upper catchment' used in the economic model. This means that the $21 million for Lake Arapuni to the Karaapiro Dam cannot be compared with the direct cost estimates in the economic model. Also, these WTP estimates are conservative as they do not include recreational values for the catchment streams, which are to be the subject of further research. Also it is likely that non-residents, such as tourists and recreational users of the lakes, will hold NMV for water quality in the lakes. These values have not been counted and will vary greatly.

When these NMV are put alongside the direct farm costs and benefits for the upper catchment estimated in Scenario 2 and 3 (see Section 6) there is still a considerable gap before benefits exceed total costs of cleaning up the farm nutrient, sediment and effluent issues.

It should be noted that while the direct costs and benefits are quantified over 30 years the indirect and passive values estimated in the choice modelling study were elicited by asking for willingness to pay over only 10 years, thus the two sets of figures are not directly comparable.

Case study 6

In another study a choice modelling survey was used to explore New Zealanders' willingness to pay for sustainable dairy and sheep and beef cattle farming (Takatsuka et al., 2007). This study surveyed randomly selected New Zealand residents to determine their WTP for:

- Improved water quality (0 to 30 percent reduction in nitrate leaching).
- Reduced methane emissions (0 to 30 percent reduction).
- Reduced demands by agriculture for surface water and groundwater (0 to 30 percent reduction in water for irrigation).
- More diverse rural landscapes (0 to 30 percent more trees).

In total, 312 of 1,008 survey forms were returned providing a 31 percent response rate and a sample representing 0.02 percent of New Zealand households. The model coefficients were significant at the 10 percent level. However, the adjusted R-squared was low (0.03–0.05) implying that the model had a low level of explanation of respondent response. The results showed that people were not WTP amounts when improvements were made on individual attributes. However, they were WTP significant amounts when combined improvements (all at 30 percent change) were made in all four environmental areas. The combined WTP for respondents relating to the Waikato was $157 per household per year over five years. This translates to a regional WTP of $107 million in PV terms.

Indigenous biodiversity values

Case study 7

Patterson and Cole (1999) estimated that the value of land-based indigenous biodiversity in New Zealand was $46 billion per year (in 1994 dollars). This was broken down into direct use, indirect use and passive use values. Direct uses, valued at $9 billion per year, included food, raw materials and timber from land use. Indirect uses accounted for the largest value at $30 billion per year and included ecosystem services such as climate regulation, erosion control, soil formation, nutrient retention, waste treatment, pollination and biological control. Passive use values, estimated at $7 billion per year, included option value (option for future use), existence/intrinsic value (preserving biodiversity for its own sake) and bequest value (preserving for future generations).

This study indicates that indirect values significantly exceed direct use values, at 65 percent of total value compared with 20 percent, with passive values making up 15 percent.

Case study 8

Kaval et al., (2007) estimated that households (HHs) in Greater Wellington are willing to pay additional rates per year for biodiversity enhancement (i.e., planting scheme) on private and public land. The survey conducted in 2007, showed the average amounts were $174 per HH per year for planting schemes on public lands and $166 per HH per year on planting schemes on private lands. Over 60 percent of respondents were willing to pay for these schemes.

The information provided in the survey showed that residents feel strongly about biodiversity in New Zealand and are willing to give up a proportion of their income to support it.

Case study 9

Nimmo-Bell (Bell et al., 2009) developed a database of non-market values covering four diverse ecosystems and 16 attributes, including 13 biodiversity values. The ecosystems and attributes valued included:

• South Island high country	Plants, insects and fish.
• Beech forest	Increased or decreased bird and insect abundance, wasp stings.
• Coastal marine	Shellfish, coastal vegetation, recreational fishing and children's ability to paddle.
• North Island urban lake[7]	Avoidance of hydrilla; loss of charophytes, birds, fish and mussels.

The primary purpose of this database is for Biosecurity New Zealand to estimate the economic value of biosecurity response activities affecting indigenous biodiversity. The database will also be useful for other decision making involving changes to indigenous biodiversity by organisations such as Department of Conservation and regional councils.

This study showed the residents of the Waikato are willing to pay significant amounts to prevent exotic weed infestations in waterways and avoid the loss of native species (see Table 3).

Table 3: Willingness to pay by Waikato regional household to protect indigenous biodiversity

Attribute	WTP per year over 5 yrs	PV* of WTP/HH	Aggregate over 157,000 HHs
Avoidance of hydrilla	$234	$1,009	$158m
Loss of charophytes	$146	$630	$99m
Loss of a native bird species	$138	$595	$93m
Loss of a fish or shellfish species	$120	$517	$81m

* Discount rate eight percent, 157,000 households in the region.
Source: Bell et al., (2009).

In another component of this study Kerr and Sharp (2008) showed that people in the South Island are willing to pay significant sums for changes to bird and insect populations. An interesting observation from this study is that birds were valued higher than insects and that avoiding the loss of birds or insects was valued more highly than increases in the populations of birds or insects (see Table 4).

[7] Lake Rotoroa (Hamilton lake).

Table 4: Willingness to pay by South Island households for changes in bird and insect populations

Species	Mean annual value per HH	PV @ 10 percent over 5 years	Aggregate over 300,000 HH
Few birds	-$300	-$1250	-$375m
Plentiful birds	$120	$500	$150m
Few insects	-$150	-$625	-$195
Plentiful insects	$90	$375	$113m

Source: Kerr and Sharp (2008).

Transferring the results from such choice modelling studies is complex and open to many criticisms. However, these results indicate that passive values for changes to environmental attributes such as aesthetics and biodiversity are significant and need to be taken into account when considering policy changes that will affect the environment.

4. Economic impacts of non-market values

A change to Gross Domestic Product (GDP) is a typical way to assess how a nation's wellbeing is changing. Gross Domestic Product, however, focuses on market values and does not distinguish between desirable welfare-enhancing activities against undesirable welfare-reducing activities (Costanza et al., 2004). For example, expenditure on prisons adds to GDP, while the benefits of reducing the jail population are not counted.

In order to better reflect over-all wellbeing, alternative, more holistic measures have been devised. For example, the Genuine Progress Indicator (GPI) measures net human welfare that covers both positive and negative contributors to human welfare. This includes both market and non-market values. For example, non-market services of parents (i.e., unpaid work) caring for children does not increase GDP but if the parent decides to work and pay for child care, GDP increases. GPI attempts to include unpaid services, such as child care. Genuine Progress Indicator also attempts to include the non-market values provided by the environment.

Genuine Progress Indicator is one approach to estimating changes in total wellbeing at the national level. Another measure is Gross National Happiness (GNH), which is a unique official statistic monitored in Bhutan (Adams, 2010). In New Zealand, as in other developed countries, there are no official wellbeing statistics estimated at the regional or national level. However, a GPI has recently been completed for Environment Waikato, but unfortunately the results are not yet available. The work was undertaken by the New Zealand Centre for Ecological Economics (NZCEE) and Market Economics Limited (MEL) as part of the SP1 FRST programme.

In the economic impacts section of this Study the direct benefits and costs associated with Scenarios 2 and 3 are taken two further steps, which are to assess the flow-on effects to the regional community through indirect and induced effects. In the first place, there are the indirect effects on industries supplying goods and services up-stream of the direct effects (e.g., firms supplying fencing materials for riparian planting on farms) and down-stream of the direct effects (e.g., dairy processing). Secondly, there are induced effects as households spend the income from wages from these industries creating another round of economic activity in consumption. Normally only market-based costs and benefits are assessed in this way. The analysis could be extended to include non-market values, which would result in a GPI type approach as per the ANCEE and Market Economics Limited study referred to above.

Restorative actions for improving the health and wellbeing of the Waikato River could be included in a GPI for the region. Such activities would include, for example:

- Reduced nutrient and effluent inflows from dairying.
- Reduced sediment loads from hill country farming.
- Improved drinking-water quality on marae (sacred meeting place).
- Better access to the river for social and cultural activities.
- Improved aesthetics from riparian planting.
- Restoration of the ecological functions of wetlands and shallow lakes.
- Restored tuna and whitebait fisheries.

5. Implications for the Waikato River

The case studies presented indicate that the indirect and passive non-market values are likely to be highly significant and of comparable size to the direct market values. The latter have been quantified in dollar terms but at this stage the former have not.

It is worth mentioning that there are non-market costs as well as non-market benefits. For example, the 'business as usual' scenario is likely to have significant non-market costs in terms of loss of opportunity for recreation, adverse effects on the environment, and adverse effects on community wellbeing.

The case studies on indirect values, especially ecosystem services, indicate that these indirect values can exceed direct values. For example, for Case study 1, wetlands are estimated to have an annual direct value of $5,900 per hectare and indirect value of $42,400 per hectare. On the other hand, dairy has a direct value of $1,600 per hectare and an indirect value of $500 per hectare.

On this basis, society would be better off shifting dairy land into wetlands. This would involve the community making a trade-off by reducing regional income from dairying and increasing non-market values from wetland through increased ecological services. At face value this analysis may seem counter-intuitive. If it were true then dairy farms would/should be converted into wetlands. It arises because wetlands are now so scarce that the marginal benefit/cost ratio of preservation/recreation is higher than the marginal benefit/cost of dairy pasture. A strong case may be made to convert some dairy land to wetland. But eventually the marginal value of lost dairy production will exceed the marginal value of the benefits from additional wetland.

Riparian planting along streams improves ecosystem services. The direct costs under Scenario 2 amount to a PV of $16.1 million. Based on a shift from pasture to native plantings the indirect values change from $500 per hectare to $2,100 per hectare (Whanganui data), a net increase of $1,600 per hectare. Taken over the 412 hectares converted to native under Scenario 2, this results in a PV of $3.3 million (assuming the benefits are received in years 11 to 30). Similarly, for Scenario 3 where 1,450 ha are converted from pasture to native, the direct cost is $43.6 million and the indirect benefit $11.3 million. This comparison does not include the benefits from the improved water quality in the river. Consequently, the benefits to ecosystem services of riparian planting ($3.3 million for Scenario 2) and ($11.3 million for Scenario 3) significantly underestimate the full indirect benefits.

The two scenarios put forward in this Report identify combinations of activities that will improve the quality of the river. Scenario 2 is less costly than Scenario 3 and will result in significantly less progress towards the goal of a river that is swimmable and the community are able to take food from it, over its entire length. The cost abatement information in the appendices highlights the trade-off between cost and benefit.

The willingness to pay survey in Case study 5 indicated that upper catchment respondents were willing to pay $21 million (in PV terms) for improvements in water quality, clarity and ecological health of Lakes Arapuni and Karaapiro. Case study 6 indicates that the willingness to pay for improvement in water quality, reduced GHG emissions, reduced demand for irrigation water and more diverse landscapes, when extrapolated over the Waikato region, could be in the order of $107 million (in PV terms). Case study 9 indicates that the willingness to pay for the passive values of waterways (protecting indigenous plant and animal species) in the Waikato region could be in the range of $80 to $160 million (in PV terms). Also, actions taken that would increase the number of native birds and insects in the region (e.g., riparian planting and lake restoration) would have benefits of a similar magnitude.

Unfortunately, it is not possible to add these indirect and passive values together in the same way that the direct costs can be added together. This is because of the overlap in types of benefit and the different methodologies used to derive them. Extrapolating from specific case studies derived in different regions and countries assumes that the sites and attributes are similar and the populations are similar. In many instances the validity of such assumptions may not stand up to close scrutiny. Nevertheless, the quantum of these indirect and passive values is significant when compared with the direct costs.

Another important qualification with the studies on ecosystem services is that average values are used that have been derived from international meta analysis, and thus these figures do not take into account the degraded nature of the Waikato catchment's ecosystem services. This suggests that the marginal benefit/cost ratio for restoration activities in the Waikato is likely to be higher than the figures used because of the degraded nature of the Waikato catchment's ecosystem services. However, to confirm this it is necessary to undertake a study to benchmark the actual value of ecosystem services in the catchment and then assess how these values change due to the mitigation activities.

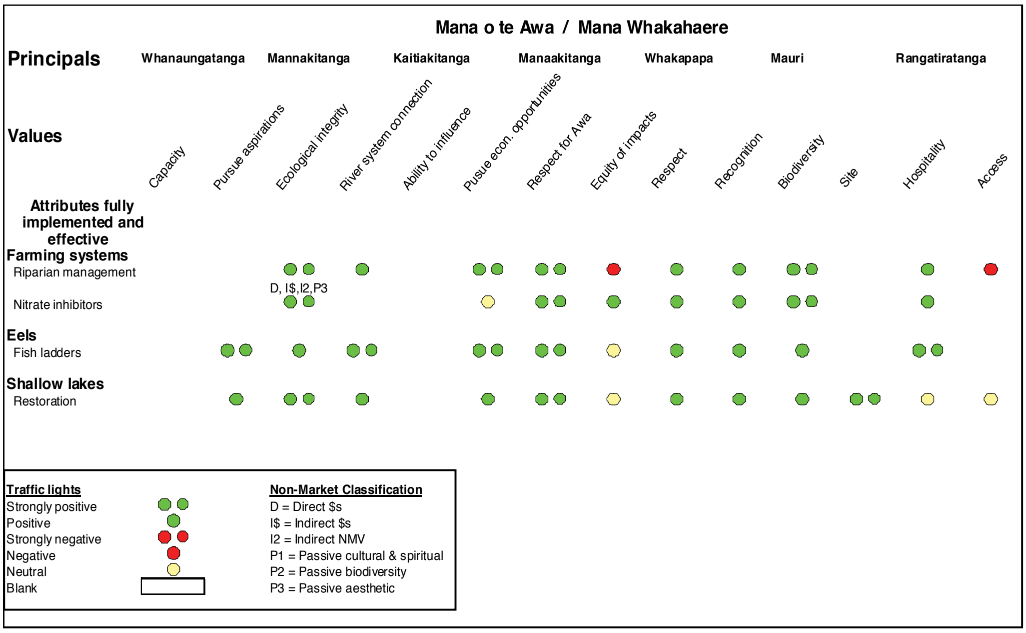
Because non-market valuation studies are expensive and time consuming, very few are undertaken in New Zealand. This means that secondary sources of information are utilised, with estimates that do not provide similar degrees of robustness compared with direct cost estimates. One of the key issues is whether stakeholders in the Waikato region share the same views of the environment as the respondents in the case studies (such as the averages sourced from a global meta analysis). This question would normally be answered by conducting surveys. However, this Study was not in a position to conduct such surveys; although it may be possible for surveys to be conducted as part of the clean-up of the Waikato River.

While all peoples place an intrinsic value on indigenous biodiversity, attempting to estimate dollar values for these can be highly sensitive. For Maaori, such intrinsic values are an integral part of their belief system being based on principles such as kaitiakitanga (guardianship). Some things many people regard as being beyond dollar values. For these, the political process is the way that society ultimately resolves the trade-offs between conflicting values. However, in order to make sustainable progress, political decisions need to be well informed.

One way to compare non-market and market costs and benefits is through the Report Card. This requires that targets be set for non-market and market indicators, and the current state be reported in relation to the target. For example, an important non-market value is safety for swimming for which an indicator is the *E. coli* concentration with the target (safe guideline) value being a median of 125 CFU per 100 millilitres. Measurements of 125, 500, 1000, 5000 and 10000 CFU per 100 millilitres might be assigned scores of A, B, C, D and E. A market indicator might be average household income, for which values of ($thousands) $60, $50, $40, $30 and $20 could be assigned scores of A, B, C, D and E. In this way different types of indicator can be compared. The validity of this approach depends on being able to select targets and scale indicators in a sensible manner. It does not solve the problem of estimating the value of safe swimming.

Another way to display and compare costs and benefits is to use the traffic light approach. This uses green, amber or red symbols to show how a group of restoration actions affects values or high level principles. An example is provided in Table 5. Here four actions are scored: riparian management, nitrate inhibitors, fish ladders and shallow lake restoration. The classification of non-market values are added for one cell – the impact of riparian management on ecological integrity. Tables can be replicated and used to compare Scenarios 1 to 2 to 3.

Table 5: Example of a traffic light approach – linking actions to values.



The following issues have been identified from the case studies:

- What are the relative orders of magnitude between non-market values? – Similar order of magnitude.
- Are the potential non-market benefits likely to exceed the net direct quantified costs and benefits estimated in the previous section? – Possibly.
- What further work needs to be done to quantify the non-market values associated with the project? – Surveys of willingness to pay for changes to river quality.

6. Conclusions

Non-market costs and benefits need to be anchored on the ecological assessment of the changes to the environment and stakeholder perceptions of these changes. This is because the economic assessment of non-market values is essentially grounded on human welfare change.

All the restoration activities considered in Scenarios 2 and 3 have clear positive impacts on non-market values in the catchment. Based on a review of nine case studies (three in the Waikato) the value of these benefits is likely to be of a similar magnitude to the direct market costs of the restoration actions assessed in the economic model. However, the results of the nine studies cannot be compared directly with the costs of restoration because different methods were used and some of the measures overlap.

The benefits estimated by the nine studies reviewed almost certainly underestimate the true non-market benefits of restoration for two reasons. First, they omit some of the values that are important in the Waikato (e.g., fisheries). Second, they include ‘ecosystem services’ that help support communities, but they do not consider cultural and spiritual values that are an important part of community wellbeing.

Consequently, the total benefits including ‘ecosystem services’ and the benefits to community wellbeing are likely to be higher than the direct costs of restoration for some of the restoration actions. Those actions where the Study team consider this to be the case are the ‘priority actions’ identified in Section 7.

7. Climate change, the ETS and forestry and agriculture – implications for the Waikato River

Material for this section has been drawn from Ministry of Agriculture and Forestry’s website.[8]

7.1 Climate Change

‘Climate change’ is the phrase used to describe changing climate patterns that can be attributed to human activity that alter the earth’s atmosphere and are beyond natural climate variations observed over comparable time periods. While New Zealand’s greenhouse gas (GHG) emissions in a global context are small, at 0.2 percent of the world’s total, on a per-person basis the level of emissions ranks New Zealand 12th in the world. Also, the pattern of GHG emissions in New Zealand is quite unlike any other developed country in that methane and nitrous oxide from agricultural activity account for 48 percent of total emissions (Ministry of Agriculture and Forestry, 2010a).

7.2 The Emissions Trading Scheme

In September 2007, the government released a comprehensive statement on climate change which set targets for reducing New Zealand’s greenhouse gas emissions. The announcements included details of a range of initiatives across all sectors, including a proposed New Zealand Emissions Trading Scheme (ETS) and a Plan of Action for Sustainable Land Management and Climate Change (Ministry of Agriculture and Forestry, 2010b). The ETS is a price-based mechanism for greenhouse gases and is a key part of overall climate change policy. Forestry is the first sector to be involved in the ETS.

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[8] http://maf.govt.nz/climatechange/agriculture/agriculture-in-nzets-guide/page-03.htm#P111_12341 and http://www.maf.govt.nz/sustainable-forestry/ets/

7.3 Forestry in the ETS

The forest estate is already a significant store of carbon and there is potential for this to grow further with farm and larger-scale plantings of both exotic and indigenous forest species. For this reason, it was the first sector to enter the ETS – effective 1 January 2008 (Ministry of Agriculture and Forestry, 2010c).

Forest owners either automatically (pre-1990) or voluntarily (post-1989) become participants in the ETS depending on the date the forest was established, the type of forest owned (or leased, or held under a forestry right), and whether any deforestation has occurred. Forest land is defined as being at least one hectare with forest species that have (or are likely to have at maturity) a crown cover of more than 30 percent on each hectare; a crown cover with an average width of at least 30 metres and be capable of reaching five metres in height at maturity.

Post-1989 forest owners can register their forest and receive Carbon Accounting Unit (CCU) credits on an annual basis as carbon is accumulated by the forest. These can be sold as Kyoto compliant units. The current price of a CCU is $25 per tonne. The amount of carbon accumulated each year reaches a maximum of around 37 tonnes per hectare a little after mid-way through the 26 year rotation of a typical pruned *Pinus radiata* regime. These units can be sold as they are earned or banked to meet the liability at harvest when around two thirds of the credits must be paid back. The remaining one third (related to the part of the tree remaining in the ground) is required to be paid back over time in line with decay and return to carbon dioxide. The delay between selling units and repaying them offers forest owners a cash flow stream that could significantly improve the economics of forestry.

7.4 Agriculture in the ETS

The ETS for agriculture includes greenhouse gases from pastoral agriculture, horticulture and arable production. Methane from livestock emissions and nitrous oxide from animal urine, dung and synthetic fertiliser are the primary sources. Although the agricultural sector as a whole also produces carbon dioxide emissions through energy and fossil fuel use, for the purposes of the New Zealand ETS, the term 'agricultural emissions' refers to methane and nitrous oxide only.

The ability to trap heat from the sun is measured over a one hundred year period and is called Global Warming Potential (GWP). Carbon dioxide has a GWP of one. Methane captures the heat from infrared radiation more effectively than carbon dioxide with a GWP of 21. Nitrogen in the form of nitrous oxide is even more effective with a GWP of 310. In New Zealand agriculture, methane is twice as important as nitrous oxide on a total output basis.

Participants can voluntarily report their emissions in 2011 and are required to report their emissions from 2012 though to 2014, but they are not required to pay for their emissions in these years. Agriculture fully enters the scheme in 2015.

Agriculture sector participants will be eligible to receive a free allocation of Kyoto compliant units called New Zealand Units (NZUs) from the Government to help significantly reduce the cost of participation in the New Zealand ETS. Allocation will be on an intensity basis, meaning participants receive an allocation that is linked to their output. The assistance level will start at 90 percent of the sector's baseline and will phase out at 1.3 percent per year from 2016. The baseline and other details are yet to be established.

7.5 Implications for the Waikato River

The link between GHG abatement policies and improvement in the quality of the river is that for the most part actions taken to reduce GHG emissions are also likely to reduce inputs of nitrogen, phosphorus, sediment and faecal organisms to waterways, with benefits for water quality (Wilcock et al., 2008).

7.5.1 Forestry

For forest land owners, the ETS is said by the Government to offer significant opportunities for land development and economic growth. However, even after the start of the scheme there is considerable uncertainty surrounding the economics. This is primarily because of the considerable time lag between when CCUs may be sold as the forest grows and when they must be paid back at harvest. If the price of carbon rises in real terms then forest owners could face potentially significant liabilities at the time of timber harvest which must be balanced against the earnings from harvested logs. Alternatively if the price of carbon falls over time then forest owners could receive extra returns over the length of the rotation (Table 6).

The table below for a pruned regime over 26 years highlights the range in returns from carbon credits under four price scenarios, assuming a step change in the price of carbon at the time of timber harvest. The landowner can choose not to harvest trees if the returns from this action (i.e., carbon credits) exceed the net earnings from log sales minus carbon credit repayments.

Table 6: The impact of carbon credit unit price changes on forestry net present value.

Carbon Credits \$/tonne CO_2 (2010 prices)		NPV/ha @ 8 percent
Sell price	**Purchase price**	
25	25	812
50	50	4,300
25	50	-1,405
50	25	6,518

Despite these uncertainties, the ETS may provide cashflow enabling farmers of marginal hill country pasture to change to a land use that is economically sustainable and has major benefits for the Waikato River.

7.5.2 Agriculture

While the forestry sector is seen to be a beneficiary of the ETS, the agriculture sector sees it as a significant threat to international competitiveness. New Zealand is the only country to have committed to an 'all gases all sectors' ETS scheme. Potentially, this places New Zealand agriculture at a disadvantage in international markets as other countries will be, in global warming terms, subsidising their agriculture while New Zealand continues its policy of fully exposing agriculture to market forces without subsidies. In the early years of the scheme, during the phase in, the direct impact may be low in financial terms because farmers will not have to pay the full cost. However, the bureaucracy around the ETS is likely to be a significant burden even if the recording is done at the processor level. For the policy to be effective, the costs must be passed back to farmers so that behaviour changes and emissions are reduced.

A major concern of farmers is that the technologies do not exist for them to reduce emissions and that the scheme should not be initiated until these are available.

Considerable research has been conducted on actions that might improve farming emissions, and results are starting to become available. De Klein and Eckard (2008) report that of the currently available technologies, nitrification inhibitors, managing animal diets and fertiliser management show the best potential for reducing emissions in the short term. They also note that abatement technologies that increase the efficiency of nitrogen within the soil-plant system are likely to increase pasture and/or animal productivity, which in turn, is likely to increase methane emissions. Thus a whole-farm systems approach is necessary to ensure that total emissions abatement is achieved.

Monaghan et al., (2007) indicated that under current pricing structures, nitrification inhibitors are likely to be a cost effective option for grazing systems in some parts of New Zealand, while wintering pads generally reduce farm profitability. Given that current technologies may deliver up to 15 percent reduction in N_2O, which translates to only a two to four percent decrease in overall emissions, further research is needed before farmers will be convinced to change their management systems.

While nitrate inhibitors are practical on flat land, this is not the case on hill country that is too steep for tractors. This poses an additional challenge for sheep and beef farmers on hill country to reduce emissions. It also improves the relative profitability of forestry on hill country.

Changing land use from intensive pasture-based systems to forestry has the potential to have the greatest impact on GHGs, but at a major cost in lost income. Converting dairy systems to forestry can have up to a 90 percent decrease in nitrogen while converting sheep and beef to forestry reduces nitrogen by around 65 percent. In addition, converting Class 3 sheep and beef can have a beneficial effect on waterways by halving sediment loads (Monaghan, pers. comm., 2010).

Given the significant uncertainty that surrounds the ETS it was decided to exclude it as a consideration in the quantitative economic analysis of the report. Firstly, while forestry is currently in the ETS, agriculture is not and there is no surety over if/when it will be. Secondly, the price likely to be paid for carbon credits over the 30 years of the study is extremely uncertain. Thirdly, the current economic impact (input/output) model is not able to accommodate GHG. Fourthly, New Zealand's approach to GHG may change; for example, to align more closely with the policies of the country's major trading partners.

The consequences of including GHGs in the quantitative analysis would likely be as follows. Firstly, forestry would be more attractive financially (assuming that the price of carbon does not rise significantly between the sale and purchase back of credits at harvest without a compensating increase in the price of harvested logs). Secondly, if forestry becomes more attractive there would likely be more sheep/beef to forest conversions on hill country and greater benefits in terms of reduced erosion and nitrogen input. Thirdly, it is likely to make pastoral farming less attractive financially than has been estimated in which case there may be less intensive pastoral farming as farmers seek alternative enterprises with lower GHG emissions. This will have benefits in terms of reduced stock numbers, lower nitrogen leaching and lower faecal microbe run-off into waterways.

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