An economic evaluation of land use change options

Section A:
Cost-benefit and opportunity cost analysis
– Lake Okareka

Section B:
Economic impact on Rotorua District
and Bay of Plenty Region of water quality induced
changes to land use and tourism in Rotorua Lakes catchments

Final

A report prepared for Environment Bay of Plenty

31 October 2003

Section A:

Cost-benefit and opportunity cost analysis – Lake Okareka

Final

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Environment Bay of Plenty
REGIONAL COUNCIL

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Acknowledgement

Nimmo-Bell has previously undertaken work of a similar nature for Taupo Lake Care Inc. (TLC.) Components of this report rely on the work undertaken for TLC.

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1. Executive Summary

1.1. Introduction

Prepared for Environment Bay of Plenty, this report undertakes an evaluation of several land use change options in the Rotorua Lakes district. Specifically the report covers cost benefit and opportunity cost analysis of several land use change scenarios and having done this, considers the potential cost of land use restrictions and changing land use in the Lake Okareka Catchment.

A separate report completed at the same time includes analysis of the macroeconomic impacts of land use change and considers the potential impact on the economy associated with a change in lake water quality.

1.2. Methodology

Using a financial modelling approach we have assessed the cost/benefit of various changes in land use. This analysis takes account of current land use and the returns able to be generated, the cost of conversion to an alternative land use, the delays in receiving income from that alternative land use, and the returns available from that alternative land use.

We have also considered the impact of a cap on existing land use and intensity and the impact this has on the ability to achieve productivity improvements in the future.

Use of a financial modelling approach is justified as opposed to a market value based approach for several reasons. The most significant of these is that for a market based approach the market would need both time and information to react. In this case it has neither and an alternative approach must be used.

Having examined what a change in land use means for individual parcels of land we have considered the implications on the Lake Okareka catchment. To do this we have made assessments of five future land use scenarios, two with restrictions and two without. By comparing the with and without scenarios we have assessed the potential loss associated with the inability to change to a higher land use where the land is suitable for this, the inability to continue to enjoy productivity gains available under the existing land use, and the cost associated with accepting a lower income from an alternative land use should a change to a less profitable land use be imposed.

1.3. Results

Result tables for a range of land use changes are presented in the body of the report (pages14 to 15). Following is a brief summary of the key points that emerge from this analysis.

- There is a positive benefit of a shift from low intensity sheep and beef to plantation pine forest of $378 per hectare. This needs to be considered alongside the suitability for the same land to move to moderate or high intensity sheep and beef which may provide a greater gain in value.
- All other forestry scenarios result in a net cost of land conversion. This cost is comprised of the negative NPV for the forestry scenarios themselves and

the positive NPV for the pastoral farming operations from which the land is being converted. The suitability of the land for other uses needs to be considered here also. For example, where land currently used for low intensity sheep and beef production is suitable for higher intensity sheep and beef production, the actual cost (including the opportunity cost) of converting to forestry will be considerably higher than the cost shown for moving from low sheep and beef to forestry.

- There is a considerable cost of being prevented from developing undeveloped land where this land is suitable and able to be utilised for moderate or high intensity sheep and beef production, or moderate or high intensity dairy production. We understand however that there are likely to be limited areas of undeveloped land in the Rotorua Lakes catchments that is suitable for conversion to these higher uses.
- Where there is land currently planted in forestry that is suitable for moderate or high sheep and beef or dairy production then there is a cost associated with preventing this land from being utilised in this way in the future.
- There will be a significant cost where there are restrictions placed on land currently in low sheep and beef production and capable of sustainable higher production with capital expenditure. This reflects the significant production gaps between low, and moderate and high intensity, with a significantly lesser corresponding increase in costs.
- The potential cost of preventing a move from moderate to high productivity on sheep and beef is considerably lower than the cost of preventing a move from low to moderate. This is a reflection of the increase in operating costs associated with achieving high productivity. It should be noted however that part of the increase in costs is a return to management and increased stock numbers and therefore a rational approach is still to pursue this option where it is available.
- Preventing a move from moderate intensity sheep and beef to moderate or high intensity dairying where the land has the potential for this change in land use to occur with reasonable levels of capital expenditure will have a significant cost to landowners.
- There will be a considerable loss to landowners where a shift in intensity of dairying is prevented on land that is currently used for dairying and is suited to higher intensity production.

1.4. Lake Okareka Case Study

To consider the loss to landowners in the lake Okareka catchment we have utilised the above analysis and considered various scenarios with and without restrictions. These scenarios are:

<u>Without restrictions</u>

- A moderate change in intensity of land use and productivity gains allowed
- A substantial change in intensity of land use and productivity gains allowed

<u>With restrictions</u>

- A cap on any increase in nutrient output (i.e. no further intensification or productivity gains allowed)
- Conversion of 200 hectares of pastoral land to production forestry
- Conversion of all pastoral land to production forestry.

We have then calculated and compared the productive value of the land under each scenario, taking account of current and potential land use under each. The difference in productive value between the with and without scenarios is the cost to landowners of the restrictions imposed. Results are shown in the following table.

Assessed loss to landowners in the Lake Okareka Catchment

	Land use change without restrictions	
Restriction	**Moderate**	**Substantial**
Cap Nutrient output	$0.7m	$1.0m
200 ha pastoral land to forestry	$1.2m	$1.5m
All pastoral land to forestry	$2.2m	$2.5m

The above results show a range of scenarios. For example, if it is considered there is the potential for a substantial shift in land use without restrictions and the restriction imposed requires all pastoral land in the catchment be converted to forestry, the cost to landowners has been assessed at $2.5m.

The cost of the restriction scenarios shown is made up of several components as follows:

<u>Cap on nutrient output</u>

- The cost of not being able to pursue a higher land use where this potential exists
- The cost associated with a halving of the productivity gains currently being achieved on existing pastoral land.

<u>200 ha pastoral land to forestry</u>

- The cost of not being able to pursue a higher land use where this potential exists
- The cost associated with a halving of the productivity gains currently being achieved on remaining pastoral land
- The cost associated with the loss of all potential productivity gains on that land converted to forestry
- The reduction in income associated with forestry versus sheep & beef.

<u>All pastoral land to forestry</u>

- The cost of not being able to pursue a higher land use where this potential exists
- The cost associated with the loss of all potential productivity gains on the land converted to forestry
- The reduction in income associated with forestry versus sheep & beef.

1.5. Conclusion

There is likely to be a significant loss to the landowners in Okareka with any form of restrictions in land use imposed in order to reduce nutrient inflow to the lake. We have provided an indicative loss in productive value for three scenarios. The actual total loss will be reliant on the final form restrictions take and the method of implementation.

While we have quantified several aspects of the value loss there will be other tangible and intangible factors that need to be considered in determining the final total cost to individual landowners.

For example, in Okareka there is one substantial pastoral farm property which will be impacted on severely. Should the area of this property that falls within the lake catchment be removed from pastoral farming it will have an impact on the profitability of the remaining area. We have not attempted to estimate the cost of this. We are also aware that there has recently been a significant amount of development expenditure on this property. Restrictions may reduce the ability to gain the return on this investment sought and will add to the loss.

While we have attempted to demonstrate the productive value loss in the Okareka catchment, we must stress that there is considerably more work required to determine the actual total loss (including an assessment of those factors highlighted above) than has been possible as part of this work.

2. Introduction

2.1. Background

Nimmo-Bell has been requested by Environment Bay of Plenty (EBOP) to undertake an Economic Evaluation of several Land Use Change Options, which have the potential to reduce agricultural nutrient release to the Rotorua Lakes.

Specifically the evaluation is required to cover:

- Cost-benefit and opportunity cost analysis of several land use change scenarios (identifying the cost or loss in value to land owners).
- The loss in value to landowners in the Lake Okareka catchment should a change in land use be required

Two additional evaluations have been provided and are covered in a separate report. These are:

- A high level analysis of the macro-economic impacts of land use change.
- A high level analysis of the impact on the economy of fixing / not fixing the problem of lakes water quality.

2.2. Scope

2.2.1. Other value drivers

There are several components of land value, including the productive value. Other components will reflect factors such as location, potential alternative uses (including the potential to subdivide) and cultural and emotional factors. While we have highlighted some of the non-productive factors contributing to value in this report we have not attempted to quantify these. These factors are inherently difficult to quantify, however they do have a very real impact on value.

We have examined the impact on value of land use change, the inability to achieve future productivity gains and the inability to pursue an alternative or higher land use in the future where these may increase nutrient output.

2.2.2. Implementation

How any restriction / reduction is implemented will have an impact on the loss. It has been necessary to make certain assumptions in conjunction with EBOP for the completion of this work. The method of implementation requires separate analysis which is beyond the scope of this report.

2.2.3. Cost/benefit to individual land owners / farm properties

The costs / benefits calculated stop at the loss for each land use and rely on modal farms for each land use type. This work will need to be expanded on to determine the loss to individual land owners, taking account of the particular characteristics of each land holding.

2.3. Process/Methodology

In examining the cost of land use change (or imposing restrictions in nutrient output) it is important to consider several areas. These include the loss of production ability and therefore income, loss in the potential to achieve productivity gains in the future, and loss of opportunity to pursue some alternative land use in the future.

Taking account of these factors it is then necessary to consider and compare the "with" and "without" scenarios and calculate the value loss that may result. To undertake such an analysis we have:

- Identified land use types based on those provided in the Terms of Reference (including various levels of dry stock production).
- Developed economic farm surplus (EFS) or equivalent figures for each land use type taking account of land uses and intensity / scale
- Considered what productivity gains may be achieved in the future for each land use
- Provided a summary of potential land use changes and the cost / benefit of these on a per hectare basis.

2.4. Lake Okareka

Having examined what a change in land use means for individual parcels of land we have applied these figures to the land in the Lake Okareka catchment. To do this we have:

- Determined likely change scenarios for each land use assuming no restrictions in nutrient output were imposed (i.e. assessed what future land use potential might be in the Lake Okareka catchment)
- Developed a framework and model to allow the land use change scenarios to be examined and the cost to land owners determined.

3. Rationale for this approach

Any change in the value of land associated with land use restrictions will ultimately be determined by the market price for land in a before and after situation. The cost or benefit of an imposed land use change will ultimately be recognised by the market for the land subject to the change. There are however several reasons why a market assessment is not able to be used to determine the change in value in this way.

For a market to reflect a restriction on the land use it will need time and information. With detail of what and how restrictions will be imposed there is little ability to use a market based approach.

Even if a market existed, there are several other factors that contribute to value and would make it difficult to isolate the impact of the restrictions imposed. Added to this is the fact that there are considerable areas of Maori owned land which seldom sells.

Utilising a financial modelling approach allows us to assess the change in the productive or potential productive value component of capital value which is a major component of the market price for land.

4. Assumptions made

In examining land use in the Rotorua Lakes District there are two significant issues for which we have had to make assumptions. These are discussed as follows:

4.1. Lifestyle blocks

"Lifestyle Blocks" are a significant land use in the Rotorua Lake's catchments. These blocks provide a rural way of life to the owners while the predominant source of income is from employment in wage/salaried positions. In general, the income generated from such blocks tends to be secondary to the non-financial benefits of the "lifestyle" that are able to be enjoyed. We acknowledge however that there will be some economic units among these blocks. The current and potential uses are many and varied and the likewise the levels of nutrient output. It is beyond the scope of this report to consider all of these and each will need to be treated on a case by case basis.

On a per hectare basis the value of the land associated with these blocks is generally well in excess of the value of similar land used for pastoral farming or forestry. This value is driven by supply and demand of blocks and the price of residential real estate. Supply is in turn governed by District Council planning and the ability to subdivide land that is suitable for lifestyle blocks.

The net effect is that where the potential exists for landowners to subdivide and sell lifestyle blocks, this becomes the determinant of the land value.

Rule 11 does not impact on the ability to subdivide land apart from to ensure that the level of nutrient output is not increased. If this increases the cost of on site effluent treatment then this is likely to result in a drop in the value of these blocks by a corresponding amount.

For the purposes of our analysis we have assumed that the potential for lifestyle blocks will not change under rule 11. While it may impact on the value of these blocks it is not likely to impact on the land use undertaken (i.e. if land was best used for lifestyle and this was the key driver of value before rule 11 then this will still be the case after rule 11 is introduced). We understand that EBOP is to commission a separate analysis to assess the implications of allowing further/increased lifestyle development..

4.2. Smaller Parcels of Maori owned land

We acknowledge that there are considerable areas of "smaller" parcels of land within the catchments that are not economic units on their own, which are often farmed in conjunction (through a lease) with other properties and as part of an economic unit.

We have not considered these to be any different to the land owned by that economic unit. The loss in productive value (or potential productive value) through having restrictions imposed will be the same to this land as it would be to an economic unit. The loss will be experienced by the landowners through reduced lease income as opposed to economic returns. On this basis we have not considered these small parcels any differently to larger parcels that form an economic unit.

5. Value factors

5.1. Discussion

An enforced change in land use has the potential to impact on the value to landowners and others who enjoy the district in several ways. These impacts may be on individual landowners or the wider community who enjoy some of the less tangible features of the lakes areas. We have provided a brief discussion on some of the key factors as follows.

5.1.1. Loss of income (resulting in loss of value)

Where land has the benefit to generate income and this is removed or reduced then there will be a reduction in the productive value of the property. The impact on value is able to be found by capitalising the expected returns and comparing the before and after productive value.

5.1.2. Inability to achieve productivity gains

The key areas where income could potentially be lost is where a land use change is enforced on the land owner, or where productivity gains in existing land uses are unable to be achieved due to the inability to increase nutrient outputs.

5.1.3. Loss of ability to change to a higher land use

Where land has the potential (either now or in the future) to change to a higher land use and this potential is removed, then there is likely to be a loss in value also. The most vivid example of this is the prevention of a move from sheep and beef farming to dairy farming.

With technology and market changes there is the potential for an unknown land use or a land use that is not common in the area at present to become a viable farming alternative in the future. Recent examples of these in other regions are the introduction of farmed deer and the production of grapes where they were not previously considered. Owning land without restrictions may allow a shift to new land uses that are not at present considered as alternatives. A component of the land value is based on this flexibility in land ownership. The introduction of restrictions may well reduce this component of the value as future unknown land uses are not able to be undertaken.

5.1.4. Others

There will be several other factors that are likely to impact on any change in value to landowners. While we have not canvassed these factors in detail in the Rotorua district, however, our previous experience in the Lake Taupo catchment suggests these will include:

An example of this may be a reduction of enjoyment associated with the planting of significant areas of pine forest and the impact this has on the visual aesthetics of the area. This is likely to impact on land owners, the wider community and lake users. Notwithstanding this we acknowledge that in some situations planting of trees may enhance the aesthetic values associated with some areas.

While the form and impact of restrictions is unknown, there is likely to be an impact on current land use and enjoyment. This is particularly so where future development is possible however the ability to benefit from this development is unknown due to the unknown impact a restriction in land use may have.

There may well be instances where the viability of smaller farm properties becomes marginal as a result of having to reduce land areas in production or limit production increases on existing areas. The impact of this will depend on how restrictions are imposed.

Many owners of land enjoy the ability to do as they wish with their land and the benefits associated with past effort. Any form of restriction that prevents this has the potential to remove or alter the cultural and emotional value of land ownership.

5.2. Conclusion

The loss of future income, the inability to achieve productivity gains in the future and the loss of flexibility to change land use are factors that we are able to quantify through a financial modelling approach. The other factors outlined are likely to represent a very real cost in many cases however to attempt to quantify these is very difficult and we have not attempted to do so.

6. Land use in the Lakes catchments

6.1. Process

The methodology used requires representative land use systems to be defined. These systems need to consider and represent the land use activities (for example dairy, sheep, cattle, (breeding and finishing), and forestry) within the lakes catchment area as well as the levels of performance (stocking rate, per head and per hectare production) being achieved in those systems. In addition the land use systems defined must take account of the business structures that exist across land in the region because factors such as scale, staff employed and capital structure will impact on the both the need for and ability of land owners to respond to changes in economic events.

The time and resources available for this work placed constraints on the data collection and analyses supporting the representative land uses used here. In the event two members of the research team spent three days in the study area. During this time they met with Regional Council field staff and discussed the available land use information and drove around the lakes catchment with the Council staff and discussed land use and changes that appeared to be occurring.

They met with the management of a large Maori Land Incorporation that was actively involved in land development and farm intensification and were provided with details of the changes that were occurring with their farms. They also met with a representative of the dairy farming community and discussed the development of dairy farming in the region. The farm development plans of a privately owned farm were made available and discussed with the research team. The details of that development and progress made were discussed with the local farm consultant employed to oversee the plan. Discussions were also held with the field staff of the Maori Trustees office and information provided on the operation and farming performance of smaller blocks of Maori owned land.

In addition the research team had access to the farm data and information within the public domain – including the final report from the local Monitor Farm (The Carr property in the Meat and Wool Innovations Monitor Farm Programme), and MAF Farm Monitoring data, in particular the Central North Island Hill Country Model, the Waikato/Bay of Plenty Intensive model and the Waikato/Bay of Plenty Dairy Model.

Forestry information was collected through discussion with foresters, the review of trial information from nearby Tikitere and discussions with Forest Research Inc. staff.

6.2. Results

6.2.1. Representative Systems

After considering the available information it was concluded that the profitability of most pastoral farming activity within the Rotorua Lakes area could be represented by a 400 ha sheep and beef farm at three levels of productivity and a 90 ha dairy farm at three levels of productivity.

The actual farm size of various land holdings will vary around the representative farms but it is assumed that the profitability as defined here on a per hectare basis will be a reasonable assumption given the time and resource constraints of the study.

These models do not contain a deer farming component. While there is a substantial deer farming industry in the general Rotorua/Bay of Plenty area, the Regional Council statistics show a very small component of deer farming within the Lakes catchment (2,300 ha versus 20,900ha sheep and beef and 10,300 ha dairying (including dairy grazing of 2,200ha)). It is assumed that deer farming returns are not substantially different to the long run returns from sheep and beef farming.

Details of each of the representative land use systems are presented in the EFS calculations contained in Appendix 4.

6.2.2. Sheep, Beef and Deer

The low production sheep farm system is characterised by a low stocking rate (9su/ha), low sheep performance (110% lambing) and a high proportion of breeding to finishing animals. Paddock size will be large, soil fertility will be low and some areas may still be partly weed infested.

The movement to moderate production involves a lift in stocking rate (12 su / ha) and increased per head sheep performance (125% lambing). This is associated with increased fertiliser use, weed clearance, extra fencing and in time a higher proportion of finishing beef animals.

High sheep and beef production involves further increases in stocking rate (14 su / ha just below where the Monitor Farm reached) and higher per head sheep performance (140% lambing), and further increases in the proportion of finishing cattle.

6.2.3. Dairy Farms.

Low dairy farm production is defined here at 2.6 cows / ha and 800 kg MS / ha. This level of performance is now readily achieved by most established dairy farms and involves some off farm grazing and minimal bought in feed.

Moderate performance at 3 cows / ha and 1000 kg MS / ha is a level many farms have reached and involves increased off-farm feed support as well as improved on-farm management.

High dairy production (3.4 cows / ha and 1200 kg MS / ha) has been shown to be readily achievable provided that satisfactory on-farm management and off-farm feed support is provided.

6.2.4. Production Forestry

We have considered two production forest scenarios. These are a fully tended *Pinus radiata* forest with a 28 year rotation and a Douglas fir forest with no pruning and a 45 year rotation. We have utilised "Green Solutions Software" developed by Forest Research and discussions with Forest Research staff to populate these models. Full details of the input variables and results are provided in appendix 4.

The models have been used to calculate an expected NPV over infinite rotations, which have then been used to calculate an equivalent EFS figure.

6.2.5. Native Production Forest

A native production forest scenario has been considered with estimates of costs and revenue based on personal discussion and results of a study conducted on plantation kauri. This is based on a rotation length of 60 years. Details of cost and income assumptions are contained in appendix 4.

6.2.6. Native Protection Forest

We have considered the costs associated with the establishment of native protection forest of mixed species. This is based on similar assumptions as the native production forest scenario however includes the establishment of several species and no log revenue.

7. Determining the cost/benefit of land use change

7.1. Methodology

In order to demonstrate the cost or benefit to land owners we have created various scenarios that show the cost or benefit of moving from one land use to another with no other form of restriction.

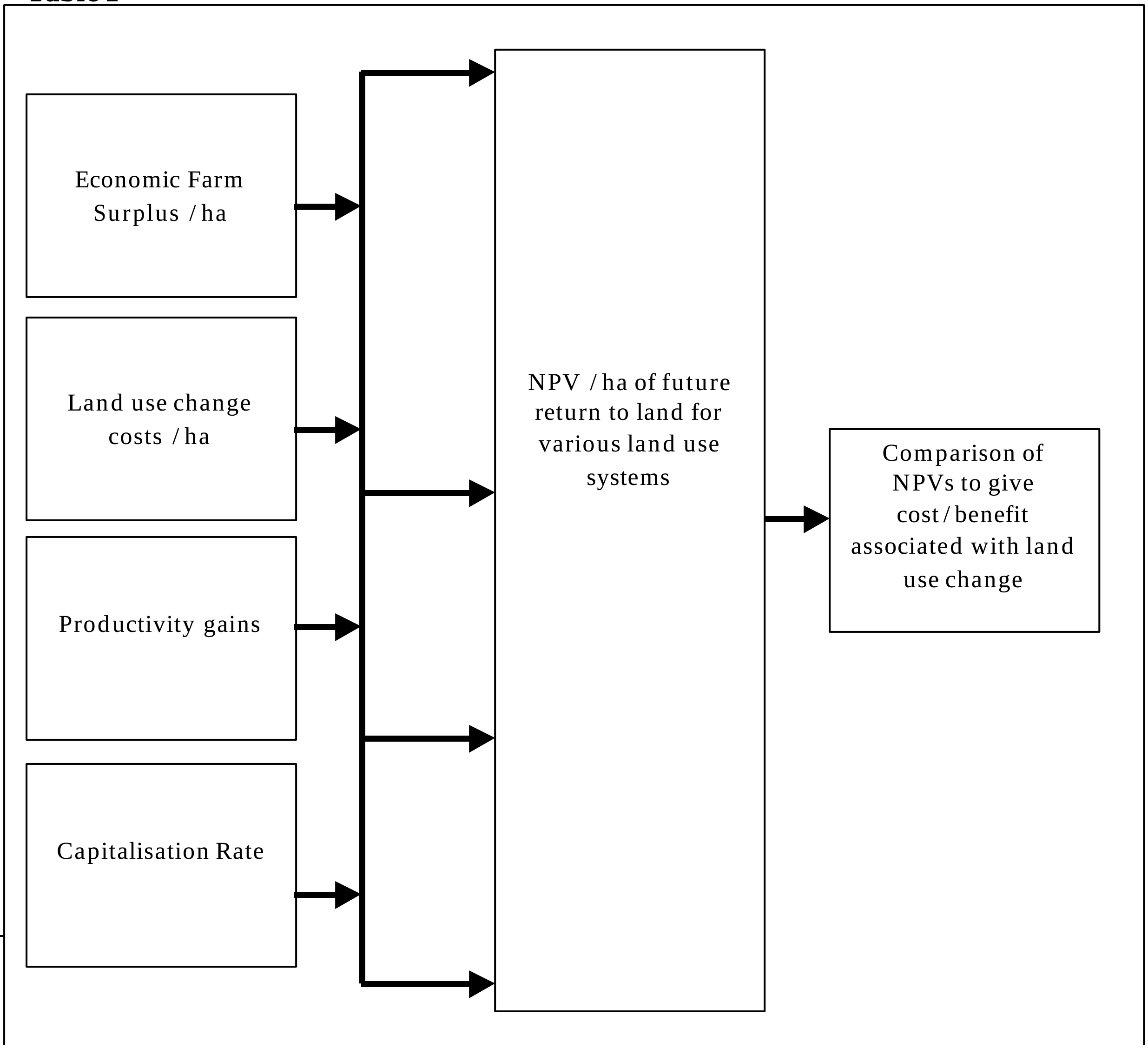
To do this we have calculated Economic Farm Surplus (EFS) figures for each land use type (including an equivalent figure for forestry scenarios). We have then applied a capitalisation rate to each land use to show the productive value of the land under each scenario.

We have then considered the impact of productivity gains and what impact on the productive value of the land this is likely to have if some of these gains are prevented by any form of restriction.

By looking at the difference between the productive value under one land use compared to that of another we are able to show the cost or benefit of that particular shift in land use. Conversely, this is the loss in value to the landowner if the potential to make this shift is removed.

Table 1 below summarises the methodology used while additional detail on the key input variables used to develop the productive values is contained in the following sections.

Table 1



7.2. Input variables

7.2.1. Land uses

We have considered a range of land use types as outlined in section 6.2. There are some scenarios we have not considered as the shift is unlikely to be made. For example, we have not considered a shift from sheep and beef farming to low intensity dairy farming. In this case we do not believe that a new dairy conversion would be undertaken where the resultant property would fit the low intensity model. Tables 4 to 6 below show the scenarios we have considered along with the results.

7.2.2. EFS calculations

EFS calculations have been provided for the following current and potential land uses. These EFS figures represent the return to land and are after the inclusion of a capital charge for the investment in livestock, plant, and in the case of dairy farms, shares in processing. A wages of management figure is included to show a return to the management input. Given that these figures have been deducted from the EFS these figures may appear lower than EFS figures normally quoted.

Table 2

Land use	$EFS/ha p.a.
Pine Forest	$160
Douglas Fir Forest	-$56
Native Production Forest	-$193
Native Protection Forest	-$207
Low Intensity Sheep & Beef	$70
Moderate Intensity Sheep & Beef	$279
High Intensity Sheep & Beef	$319
Low Intensity Dairy	$688
Moderate Intensity Dairy	$785
High Intensity Dairy	$925

The EFS figures for the forestry options are calculated based on the NPV of infinite rotations multiplied by the discount rate to give an annual return per hectare.

Product and input prices

Product prices used in the EFS calculations have been based on 5 year average prices adjusted to 2003 dollars (with the exception of the Milksolids price which has been based on a 10 year average). Full details of the prices used have been provided in appendix 1. Treating product prices in this way reduces the impact of one off highs or lows that may be evident if we were to take a single year only.

Input prices have been based on 2003 dollar figures.

7.2.3. Conversion costs

Conversion costs have been allowed for where there is a shift from one land use to another. These have been spread over a likely conversion period and the income expected adjusted to allow for the delays likely to be experienced from newly converted properties. This includes conversion from one intensity of a land use to a higher intensity where there will be a capital expenditure requirement.

7.2.4. Productivity gains

For any particular land use there is the potential for future productivity gains based on greater or more efficient production. It can be reasonably assumed that production gains will be achieved outside of a shift in land use and that individual land owners will strive to increase productivity over time. Analysis of the productivity gains experienced by each land use over recent years has been undertaken. These productivity gains are those that are currently being achieved across the industry. A brief discussion on these has been provided in appendix 2. In summary, we have assumed productivity gains of 2 percent per annum for sheep and beef units and 3 percent per annum for dairying.

7.2.5. Capitalisation rate

Capitalisation rates have been estimated based on the returns expected from various land uses. Further discussion on the rates used has been included in appendix 3.

Table 3 below summarises the rates used.

Table 3

Land use	Cap rate
Sheep & Beef	6%
Dairy	9%
Forestry	9%

These rates take account of the historical returns achieved by various land uses, the risks associated with each land use and the expected returns.

7.3. Results

7.3.1. Impact of a land use change

Results of the analysis are shown in the following tables4 to 6.

It is important to note that these calculations have been undertaken based on a modal farm for each category. When considering these figures it is necessary to consider the differences between these modal farms and the particular property(s) being considered. They will not be directly applicable to any individual farm property.

Benefit or cost of a shift in land use

Sheep and Beef

Table 4

NPV $/ha	TO		
	Sheep&Beef		
FROM	Low	Moderate	High
Undeveloped land		$3,221	$3,567
Pine Forest		$948	$1,293
Sheep&Beef – Low		$3,447	$3,747
Mod			$345
High			
Dairy Low			
Mod			
High			

Dairy

Table 5

NPV $/ha	TO		
	Dairy		
FROM	Low	Moderate	High
Undeveloped land		$4,123	$5,665
Pine Forest		$2,345	$3,454
Sheep&Beef - Low			
Mod		$470	$2,098
High			
Dairy Low		$1,114	$2,925
Mod			$1,620
High			

Forestry

Table 6

	TO			
NPV $/ha	Pine Forest	Douglas Fir Forest	Native Production Forest	Native Protection Forest
FROM				
Undeveloped land	$1328	-$1,069	-$2,142	
Pine Forest				
Sheep&Beef - Low	$378	-$2,018	-$3,541	-$3,760
Mod	-$3,800	-$6,196	-$7,719	-$7,938
High	-$4,599	-$6,996	-$8,519	-$8,738
Dairy Low	-$7,122	-$10,359	-$11,882	-$12,101
Mod	-$8,377	-$11,732	-$13,255	-$13,474
High	-$10,188	-$13,714	-$15,237	-$15,456

Key points to note are as follows:

The figures shown represent the benefit or cost of a move from one land use to another (NPV $/ha). Allowance has been made for the cost of development to make this move and the resulting income delays likely to be experienced. Figures are shown on a per hectare basis. For example, where there is the potential to move from low intensity sheep and beef to high intensity sheep and beef, there is potential gain of $3,747 per hectare. Likewise, where there is the potential to move from low intensity sheep and beef to high intensity sheep and beef and this shift were to be prevented, then there would be a cost to the landowner of $3,747 per hectare. These figures assume that there is no change to the productivity gains able to be achieved over time in either the current or potential use.

Another example: The cost of converting a 400 hectare moderate sheep and beef property to pine forest would be $3,800 times 200ha ($1,520,000). This assumes a moderate sheep and beef system is maximising the current potential for the land, and that the present owner converts the property to forestry and receives the income at harvest.

Effect of preventing productivity gains

A cap on nutrient output from pastoral farming systems will not only see a cost associated with the prevention of land use (and land use intensity) change, it will also restrict existing land uses from achieving future productivity gains where these are associated with increased nutrient output.

For example, a moderate intensity sheep and beef farm may not choose to intensify through the spending of development capital to reach the high intensity level. It is however likely to continue to increase productivity over time. The ability to do this may be reduced if the level of nutrient outputs allowed is capped at current levels.

We have assumed that sheep and beef productivity gains are on average 2 percent per annum and dairy 3 percent per annum. If we assume that the ability to achieve these gains is halved with a cap on nutrient output then there is a significant loss to landowners. Table 7 below shows the impact of a halving of productivity gains on the productive value of the land.

Table 7

FROM		Cost per ha ($ NPV) of a restriction on incremental productivity gains
Undeveloped land		
Pine Forest		
Sheep&Beef –	Low	$138
	Mod	$549
	High	$628
Dairy	Low	$1,227
	Mod	$1,400
	High	$1,650

We have not included the impact of capping nutrient output associated with forestry operations. We note however that if a 1 percent productivity gain were able to be achieved in forestry production through an increase in nutrient output and this was prevented then the cost to landowners would be approximately $175 per hectare.

With all existing pastoral land uses there is a loss where any restriction is placed on the productivity gains that are able to be achieved from the existing land uses. These productivity gains represent the gains that are likely to be made through continuing the existing land use (as opposed to making a shift between land uses or intensity of land use where additional capital and management input are required).

7.4. Interpreting the Results /Conclusions

There are several issues which the analysis highlights and we provide comment as follows.

1. There is a positive benefit of a shift from low intensity sheep and beef to plantation pine forest of $378 per hectare. This needs to be considered alongside the suitability for the same land to move to moderate or high intensity sheep and beef which may provide a greater gain in value.
2. All other forestry scenarios result in a net cost of land conversion. This cost is comprised of the negative NPV for the forestry scenarios themselves and the positive NPV for the pastoral farming operations from which the land is being converted. The suitability of the land for other uses needs to be considered here also. For example, where land currently used for low sheep and beef production is suitable for higher sheep and beef production, the actual cost (including the opportunity cost) of converting to forestry will be considerably higher than the cost of converting from low sheep and beef to forestry.

3. There is a considerable cost of being prevented from developing undeveloped land where this land is suitable and able to be utilised for moderate or high intensity sheep and beef production, or moderate or high intensity dairy production. We understand however that there are likely to be limited areas of undeveloped land in the Rotorua Lakes catchments that is suitable for conversion to these higher uses.
4. Where there is land currently planted in forestry that is suitable for sheep and beef or dairy production then there is a cost associated with preventing this land from being utilised in this way in the future. It is assumed that this conversion would occur on cut over land.
5. There will be a significant cost where there are restrictions placed on land currently in low sheep and beef production and capable of sustainable higher production with capital expenditure. This reflects the significant production gaps between low and moderate and high intensity, with a significantly lesser corresponding increase in costs.
6. The potential cost of preventing a move from moderate to high productivity on sheep and beef is considerably lower than the cost of preventing a move from low to moderate. This is a reflection of the increase in operating costs associated with achieving high productivity. It should be noted however that part of the increase in costs is a return to management and increased stock numbers and therefore a rational approach is still to pursue this option where it is available.
7. Preventing a move from moderate intensity sheep and beef to moderate or high intensity dairying where the land has the potential for this change in land use to occur with reasonable levels of capital expenditure will have a significant cost to landowners.
8. There will be a considerable loss to landowners where a shift in intensity of dairying is prevented on land that is currently used for dairying and is suited to higher intensity production.

8. Okareka Case Study

Using the financial analysis of land use changes we have applied this to the Lake Okareka catchment in order to determine the loss to land owners.

8.1. Methodology

In order to consider a particular lake catchment it is necessary to make some additional assumptions as outlined below.

8.1.1. Existing Land Use in the Okareka Catchment

Land use areas for the Lake Okareka catchment have been based on data provided by EBOP GIS staff. These figures differ slightly from those in the "Lake Okareka Catchment Management Action Plan" and have been provided based on more up to date information.

Table 8 provides a summary of the land use areas and land use capability classes (LUC) for the catchment.

Table 8

Land use and LUC in the Lake Okareka Catchment (hectares)						
	LUC					Total
LAND USE	3	4	6	7	8	
Pastoral farming	61	100	307	111	10	589
Indigenous forest	3	116	209	388	39	755
Narrow leaved scrub	2	7	41	46	3	99
Planted conifer forest		6	50	27	4	87
Grand Total	66	229	607	572	56	1,530

8.1.2. Potential Land Use in the Okareka Catchment

The land used currently for pastoral farming has a good mix of easier finishing country (LUC class 3 and 4), good breeding country (LUC class 6) with some steeper breeding country (class 7). Overall the pastoral land lends itself well to the high production sheep and beef systems defined in 6.2.2 and Appendix 4

We have developed two potential land use scenarios for comparison with the restriction scenarios. The areas of each resultant land use are shown alongside the restriction scenarios in table 9 below.

While there are other potential land uses (such as protection forestry) we have limited our assessment to three scenarios to demonstrate the impact.

8.1.3. Land use change

To examine the change in value we need to look at “with and without” scenarios. To do this we need to firstly make an assumption of what land use in the catchment may look like in the future without any land use restrictions or purchase of entitlements. Our assessment of the land in the catchment, current land use and the economic drivers of these land uses allows us to make an assessment of the future land use in the catchment (or at least what it may look like all other things being equal).

We then need to compare the productive value of this against land use should restrictions be introduced. To do this we need to make an assessment of what land use would be under these scenarios.

The scenarios we have considered are as follows:

- A cap on any increase in nutrient output (i.e. no further intensification allowed)
- Conversion of 200 hectares of pastoral land to production forestry
- Conversion of all pastoral land to production forestry
- A moderate change in land use without restrictions
- A substantial change in land use without restrictions.

The following table provides a summary of current and future land use in the catchment for each of the above scenarios.

Table 9

Land use in the Lake Okareka Catchment for the five scenarios considered

		Future Land Use Area (ha)				
Existing land use	**Change**	**Cap**	**200ha to forestry**	**All pasture to forestry**	**Mod**	**Subs**
Undeveloped land						
	None	100	100	100	80	50
	To S & B Mod				20	50
Low Int Sheep & Beef						
	None	100	66	0	0	0
	To Forestry		34	100		
	To S & B Mod		0	0	50	
	To S&B High				50	100
Mod Int Sheep & Beef						
	None	490	324	0	245	0
	To Forestry		166	490		
	To S&B High				245	490
High Int Sheep & Beef						
	None					
	To Forestry					
Total Area		690	690	690	690	690

8.1.4. Timing of land use change

While we have made an assessment of what land use in the catchment may look like in the future, the timing of pursuing these land uses and the intensification of existing land use will be dependant on several factors. Changes will occur based on the assumption that long term profitability will have increased. Short term fluctuations in the relative profitability of land uses and the preferences of individual owners are likely to have a significant impact on when this change occurs. To allow for this we have assumed that land use change will occur over a period of 3 years. Likewise, the timeframe over which restrictions occurs may also have an impact. We have assumed in this case that this is imposed immediately however if a delayed or staged implementation was allowed for this may reduce the impact to an individual landowner (this is unlikely to be significant unless the restriction is imposed over a period of several years).

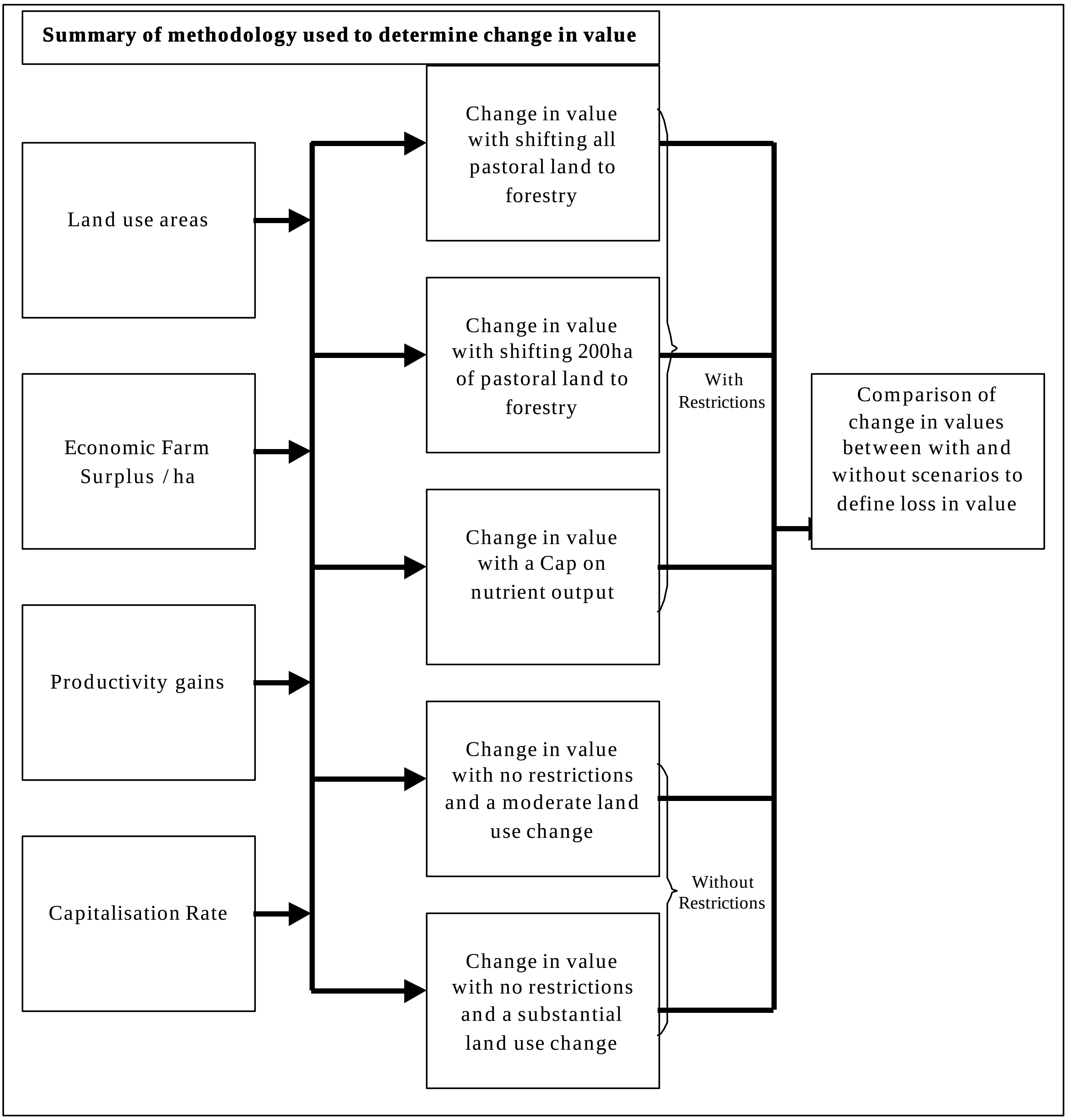
8.1.5. A combined discount rate

Because we are looking at a range of land uses and considering the change in value over time associated with these we need to use a common discount rate across all land uses. In this case we have used 8 percent as being an average of forestry and sheep and beef, given the weighting towards forestry. The choice of this discount rate will have an impact on the results and accordingly we have provided a sensitivity analysis associated with the discount rate.

8.1.6. Combining the factors to determine value

Table 10 below outlines the methodology used. The EFS, land use change capital costs, productivity gains and capitalisation rates used to examine the Okareka catchment are the same as those outlined in previous sections of this report.

Table 10



8.2. Results

Using the parameters discussed a range of loss in value has been calculated and is summarised in table11. These losses in value show the impact of the various restriction scenarios when considered in the context of the potential for future intensification in land use.

Table 11

(NPV $)	**Land use change without restrictions**	
Restriction	**Moderate**	**Substantial**
Cap Nutrient output	$0.7m	$1.0m
200 ha pastoral land to forestry	$1.2m	$1.5m
All pastoral land to forestry	$2.2m	$2.5m

The cost of the restriction scenarios shown is made up of several components as follows:

Cap on nutrient output

- The cost of not being able to pursue a higher land use where this potential exists
- The cost associated with a halving of the productivity gains currently being achieved on existing pastoral land.

200 ha pastoral land to forestry

- The cost of not being able to pursue a higher land use where this potential exists
- The cost associated with a halving of the productivity gains currently being achieved on remaining pastoral land
- The cost associated with the loss of all potential productivity gains on that land converted to forestry
- The reduction in income associated with forestry versus sheep & beef.

All pastoral land to forestry

- The cost of not being able to pursue a higher land use where this potential exists
- The cost associated with the loss of all potential productivity gains on the land converted to forestry
- The reduction in income associated with forestry versus sheep & beef.

Note: The results of this analysis will differ from a simple multiplication of the value change figures presented earlier in the report and the change in land areas. This is because we have assumed land use will change over time and not all at once, and we have included a cap on productivity gains under the restriction scenarios.

8.3. Sensitivity Analysis

A key variable is the discount rate used. We have run a sensitivity analysis over the capitalisation rate used to show the impact of this. We have undertaken this sensitivity analysis for the scenario where 200 ha pastoral land is converted to forestry and for the scenario where all pastoral land is converted to forestry when considered against the substantial land use change. The results of this are presented in table 12 below

Table 12

	Change considered	200ha pastoral land to forestry	All pastoral land to forestry
Most Likely Loss		$1.5m	$2.5
Capitalisation rates	All rates increased or decreased by 1 percent.	$1.0m-$2.3m	$2.0m-$3.2m

9. Conclusion

There is likely to be a significant loss to the landowners in Okareka with any form of restrictions in land use imposed in order to reduce nutrient inflow to the lake. We have provided an indicative loss productive value for three scenarios. The actual total loss will be reliant on the final form restrictions take and the method of implementation.

While we have quantified several aspects of the value loss there will be other tangible and intangible factors that need to be considered in determining the final total cost to individual landowners.

For example, in Okareka there is one substantial pastoral farm property which will be impacted on severely. Should the area of this property that falls within the lake catchment be removed from pastoral farming it will have an impact on the profitability of the remaining area. We have not attempted to estimate the cost of this. We are also aware that there has recently been a significant amount of development expenditure of this property. Restrictions may reduce the ability to gain the return on this investment sought and will add to the loss.

While we have attempted to demonstrate the productive value loss in the Okareka catchment, we must stress that there is considerably more work required to determine the actual total loss (including an assessment of those factors highlighted above) than has been possible as part of this work.

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11. Appendices

Appendix 1 Product prices used

The prices used in the EFS calculations are based on a series of product prices averaged over the past 5 years and corrected for inflation (ref Nimmo-Bell).

The values used are as follows

Cull ewes	$40
Lambs (all grades)	$60
Ewe Hoggets	$75 (lamb price plus $15)
Rams	$420 (7x lambs)
Cull cows	$556 ($2.78/kg net on 200 kg CW)
Weaner heifers	$256 (cull cow less $400)
R3 yr bulls	$1008 ($3.36/kg net on 300 kg CW)
R2 yr bulls	$924 ($3.36/kg net on 275 kg CW)
Br Bulls (sell)	$1154 (R3 yr bull plus $200)
Br Bulls (buy)	$3597 (3x sale price)
Dairy Payout	$4.25/kg MS (based on 10 yr average)
Wool Price	$2.89/ greasy kg net (based on 4 yr average reported for Central NI clip in MAF Farm Monitoring Reports)

Appendix 2 Productivity improvements

Sheepmeat:

Productivity gains through increased lambing percentages since 1990 have been spectacular. The national average is now at 120% - up from 100% in 1990. Improved technologies (e.g. scanning), pasture quality, management and breeding programmes have all played a part in this. The average annual increase in lambing percentage over the period has been 1.6%.

While total sheep numbers have declined since 1990, lambing percentages and higher carcase weights have partially offset the production decline from lower total numbers. While there are fluctuations between seasons, the average annual productivity improvement for carcase weights over the period was 1.5% per annum for lamb, and 1.2% per annum for sheep. For wool, the average gain was 0.7%.

Beef:

The growth in bull beef production is partially responsible for the increased average carcase weights over the period. The general trend is up, although the volatility is linked to both market and climatic conditions (e.g. droughts). Annual average productivity gains for average carcase weights has been 0.6% over the period 1990-2003. Within the specific stock classes (e.g. bull, cow, steers) there will be gains however the data is not available to determine this on a national basis.

The productivity gains from improved calving percentage have been negligible over the period, recording an annual average gain of just 0.1%. This is likely to be a reflection of the increasing influence of dairy beef in total beef production and the fact that where the traditional breeding cow is still run it serves a dual purpose of assisting in grazing management.

We consider an average productivity gain for sheep and beef farm properties is likely to be in the order of 2 percent per annum.

Dairy:

Detailed statistics are collected by Livestock Improvement. The average annual productivity gains in the dairy industry are around 2.6 percent for the 10 year period ending 2001/02. There have been very small gains made over the past two years and excluding these sees the average gain over the past 8 years at 3.4 percent. There are several factors that may account for this including seasonal influences and the large numbers of new conversions. We believe that a long term average of 3 percent per annum is realistic. We note that this is below the industry targeted figure of ____ percent.

Appendix 3 Capitalisation rates

MAF farm monitoring data from 2000 onwards is used to determine productive earnings (expressed as Economic Farm Surplus (EFS) as a ratio of total capital invested in the farming enterprise. In this exercise it was not possible to go back earlier than 2000 as MAF had significantly changed the format of the information and it was not possible to make meaningful comparisons.

Sheep & beef

Sector:	Sheep & beef
Location:	Waikato/Bay of Plenty Intensive
Effective Area ha	300
Stock units wintered/ha	11.1

y.e. June	2000	2001	2002	2003	2004f
EFS total	$ 44,210	$ 100,460	$ 118,270	$ 88,550	$ 89,162
EFS/ha	$ 147	$ 335	$ 394	$ 295	$ 297
Total Farm Capital/ha	$ 4,521	$ 4,831	$ 5,217	$ 6,701	$ 6,723
EFS/total farm capital	3.3%	6.9%	7.6%	4.4%	4.4%

While the average figure calculated here is around 4.5 percent, this is strongly influenced by the 2003 and forecast years. Sustained profitability at this level may well see a realignment of capital values to reflect lower returns. We believe that a capitalisation rate of 6 percent is fair for sheep, beef and deer farming.

Dairy

Data released by DEXCEL shows the volatility in return on capital for dairy farming in the ten year period ending 2002. The range is from –3% to 26% with the average over the period 12%. It is felt that using the average as an indicator of discount rate is on the high side and that a figure half-way between the 12% and the 6% for sheep and beef is more appropriate.

Exotic Production Forest

Time and Risk

Because forests are long term investments there needs to be a way of assessing the current value which takes account of time and risk. Discounting the forest's future cashflows is the accepted technique. The discount rate is the interest rate per annum to the investor if he/she buys in at the valuation derived by discounting the future cashflows at that interest rate.

Crucial to the actual value derived is the discount rate used. The higher the discount rate the lower the value of the forest and conversely the lower the discount rate the higher the value. Also the longer the period until the forest is harvested the greater the impact of the discount rate chosen, particularly at higher discount rates.

Benchmark Risk and Return

The lowest risk on long term investments is given by the rate on long term government bonds, currently around 6%. The government bond rate sets the benchmark. It reflects country risk or more specifically the risk of investing in the government which is the lowest risk in New Zealand. It embodies investors' future expectations about the overall future performance of the economy and other external factors including global financial conditions. All other investments must yield an interest premium above this rate.

The higher the risk the higher the discount rate and the lower the risk the lower the discount rate.

Risks in Forestry

When considering an investment in forestry an investor will expect a higher rate of return than government bonds because the risk is higher. There are particular forestry industry risks such as fire and disease. The uncertainty about future market returns is higher than for many investments because of the greater period of time that often exists before sale.

Forestry investments in New Zealand fall into three broad categories each with a different expected level of return for the perceived level of risk. This risk is embodied in the discount rate.

The three categories are:

- listed forestry stocks e.g. Fletcher Challenge, Carter Holt Harvey, Evergreen
- issues to the public through professionally organised forest partnerships
- private investments which do not involve the issuing of a prospectus.

In general, listed forestry stocks or shares are perceived by investors to be lower risk than formal forestry partnerships which have a lower risk than individual private investments, however, each investment must be considered on its merits. Because of the variation in perceived risk forests in each of these categories will be valued at different discount rates. The reasons for these differences are elaborated below.

Listed Forestry Stocks

Listed forestry stocks are seen as the safest form of forestry investment. The advantages are:

- highly liquid, they can be cashed in immediately
- very flexible, small to very large investment possible
- in a share portfolio seen as counter cyclical.

The risk premium on listed forestry stocks has historically been between 1.5% and 3.5% depending on factors such as:

- the size of the company
- liquidity of the shares / units
- maturity of the forests
- management structure

- quality of the forest and
- distance from port
- diversification by age class and location.

This results in a real post-tax discount rate of between 5.5% and 7.5% based on a government bond rate of 6% and inflation of 2%. Recent sales activity in the forestry sector has seen values crystallised and resulting value write downs. . These sales indicate actual rates of around to 9 percent real post-tax.

Forest Partnerships

Offers to the public through unlisted floats including partnerships, trusts and qualifying companies have become popular over the last few years. They offer an entry to forestry for smaller investors not readily available prior to the more recent listing of specialist forestry companies. In today's market, prospectuses for these offers quote discount rates or internal rates of return (IRR) of between 8.5 and 9 per cent real post-tax.

Attractive features of the better new start partnerships include:

- well located on good land with a high site index
- easy extraction
- close to port
- outlet for sale of units to other partnership members
- professional management with good records of forest operations
- economies of scale through investor aggregation
- potentially better returns compared to private forests through increased marketing muscle
- no requirement for investor involvement
- direct tax benefits
- some liquidity through sell back provision to other partners.

On the other hand, partnerships have disadvantages:

- liquidity is lower than shares
- overheads are high through promotion fees, prospectus costs and statutory supervision costs compared to private investment
- there is little opportunity for hands on involvement
- time horizons are long compared with buying into say, a 10 to 15 year old block of trees
- risks are higher compared with buying into a well established forest
- flexibility is lower as payment schedules are set by the promoter.

Private Investments

The discount rate used to value private forest assets is likely to be higher than listed forest companies or unlisted public investments such as partnerships because investors see higher risks:

- there is a perception that liquidity is lower with no established market at present for smaller individual stands of immature trees
- there is usually less public information available about such forests and their management
- the quality of the forest may be more variable
- financing may be more difficult, particularly for immature forests with long periods of low or negative cashflows
- there is not the protection of a prospectus.

Most investors would therefore expect a discount rate up to several percentage points above those quoted for partnerships ie between 10 and 12 per cent real post-tax. A particularly good forest may well have a discount rate less than this range. Forests that are located far from a port, face access and harvesting difficulties or have been poorly looked after are likely to have discount rates much higher than these and as a result have much lower values.

Summary

The discount rate should be a good indicator of risk in a forest investment. It should reflect the risk to the investor and the degree of liquidity in the investment. Investment theory would lead to the view that listed forest investments should have lower discount rates than less liquid forest partnerships which in turn should have lower rates than individual private forest investments. Particular circumstances may override these norms and investors will look closely at the attributes they desire before making an investment decision.

Source: New Zealand Forestry Exchange 1994 (updated)

Appendix 4 EFS calculations and discussion

The following tables show the EFS calculations for the various land uses considered.

Sheep and Beef Farm Stock Systems

Low Production

	no's	su's	total
ewes	2200	1	2200
ewe hgts	650	0.8	520
w hgts		1	
rams	25	1	25
			2745
cows IC hfrs	75	6	450
dry R2yr hfrs	0	5	
R1yr hfrs	29	4	116
R2yr str/bulls	31	5	155
R1yr str/bulls	32	4	128
bulls	3	6	18
			867
breeding su's	2693		
other su's	919		
ratio	2.93		
ha's	400		
su's/ha	9.03		
sh/beef	0.76	0.24	
Product kg/ha	162		

Moderate Production

	no's	su's	total
ewes	2100	1	2100
ewe hgts	650	0.8	520
w hgts	0	1	0
rams	25	1	25
			2645
cows IC hfrs	100	6	600
dry R2yr hfrs	0	5	0
R1yr hfrs	42	4	168
R2yr str/bulls	75	5	375
R1yr str/bulls	245	4	980
bulls	3	6	18
			2141
breeding su's	2743		
other su's	2043		
ratio	1.34		
ha's	400		
su's/ha	11.97		
sheep/beef	0.55	0.45	
Product kg/ha	297		

High production

	no's	su's	total
ewes	2700	1	2700
ewe hgts	750	0.8	600
w hgts	0	1	0
rams	30	1	30
			3330
cows IC hfrs	0	6	0
dry R2yr hfrs	0	5	0
R1yr hfrs	0	4	0
R2yr str/bulls	225	5	1125
R1yr str/bulls	285	4	1140
bulls	0	6	0
			2265
breeding su's	2730		
other su's	2865		
ratio	0.95		
ha's	400		
su's/ha	13.99		
sheep/beef	0.60	0.40	
Product kg/ha	407		

Sheep and Beef LOW

Revenue			
Sheep Sales			125,745
Cattle Sales			47,449
Wool Sales			35,699
Gross Farm Revenue			208,892
Gross Farm Revenue per Hectare			522
Expenditure		$/su	
Sheep Purchases			3,655
Cattle Purchase			3,597
Wages/ACC		$ 1.50	5,418
Animal Health		$ 2.50	9,030
Electricity		$ 0.65	2,348
Feed		$ 0.40	1,445
Fertiliser		$ 5.00	18,061
Contract/Seed/Regrass		$ -	0
Freight		$ 0.50	1,806
Shearing	per ssu	$ 4.80	13,176
Weed and Pest	per ha	$ 8.00	3,200
Vehicles/Fuel	per ha	$ 29.00	11,600
Repairs and Maintenance			14,150
Administration			8,100
Standing Charges			9,750
Wages of management			40,000
Cap charge for stock,plant	10%	$356,319	35,632
Gross Farm Expenses			180,968
Gross Farm Expenses per Hectare			452
Economic Farm Surplus			27,924
Economic Farm Surplus per Hectare			70

Effective Area (ha)	400
Total Stockunits	3,612
Stockunits per Hectare	9.03

Sheep Sales	Number	Price/Hd	Total
Cull Ewes	468	40	18,720
Ewe Hoggets / 2 ths	11	75	825
Ewe Lambs	560	60	33,600
Wth Hoggets	-	0	-
Wth Lambs	1,210	60	72,600
	2249		125,745

Cattle Sales	Number	Price/Hd	Total
Cull cows	27	556	14899
R3 yr hfrs	-	-	0
R2yr hfrs	-		0
R1yr hfrs	3	256	768
R3yr steers	31	999	30582
R2yr steers	-		0
R1yr steers	-		0
R3yr Bulls	-	1,008	0
R2yr Bulls	-	924	0
R1yr Bulls	-		0
MA Bulls	1	1,199	1199
	61		47449

Stock Purchases	Number	Price/Hd	Total
Rams	9	430	3,655
Br Bulls	1	3597	3597
Bull calves	-	422	0
Steer Calves	-	-	0
	1		3,597

Lambing percentage	110%
Wool Weight	4.50 kg/su
Total kg	12353
Wool Price ($/kg)	$2.89
Sheep Death Rate	6%
Calving percentage	85%
Cattle Death Rate	2%

Stock Class	Numbers	Stockunit	Total				$/su	Total Value
Mixed Age Ewes	1,600	1.0	1,600					
2T Ewes	600	1.0	600					
Ewe Hoggets	650	0.8	520					
Wether Hoggets	-	1.0	-					
Rams	25	1.0	25	2,745	ssu's	$	80	$219,600
MA Cows	75	6.0	450					
R2 Yr Hfrs	-	5.0	-					
R1 Yr Hfrs	29	4.0	116					
R2 Yr Strs	31	5.0	156					
R1 Yr Strs	32	4.0	128					
R2 Yr Bulls	-	5.0	-					
R1 Yr Bulls	-	4.0	-					
Br Bulls	3	6.0	18	867	csu's	$	100	$ 86,719
			3,612					
								$306,319
							Ave/su	84.80

STOCK RECONCILIATION

Class	Open No	Natural Inc	Deaths	Purchase	Sales	Killed	Close No	Class
M A Ewes	1,600		96		468		1,600	M A Ewes
2T Ewes	600		36				600	2T Ewes
Ewe Hogg	650		39		11		650	Ewe Hogg
Ewe Lbs		1210			560		0	Ewe Lbs
Wth Hogg	-		0		-		-	Wth Hogg
Wth Lbs		1210			1210		0	Wth Lbs
Rams	25		2	9		7	25	Rams
MA Cows	75		2		27		75	MA Cows
R2 Yr Hfrs			0					R2 Yr Hfrs
R1 Yr Hfrs	29		1				29	R1 Yr Hfrs
Hfr calves		32			3			Hfr calves
R2 Yr Strs	31		1		31		31	R2 Yr Strs
R1 Yr Strs	32		1				32	R1 Yr Strs
Str calves		32						Str calves
R2 Yr Bulls			0		0		-	R2 Yr Bulls
R1 Yr Bulls			0		0		-	R1 Yr Bulls
Bull calves								Bull calves
Br Bulls	3		0	1	1		3	MA Bulls
	3,045	2,484	176	10	2,310	7	3,045	(0)

Sheep and Beef MODERATE

Revenue				
Sheep Sales			138,285	
Cattle Sales			253,809	
Wool Sales			35,927	
Gross Farm Revenue				428,021
Gross Farm Revenue per Hectare				**1,070**
Expenditure		$/su		
Sheep Purchases			3,570	
Cattle Purchase			87,997	
Wages/ACC		$ 1.50	7,179	
Animal Health		$ 3.00	14,358	
Electricity		$ 0.65	3,111	
Feed		$ 0.75	3,590	
Fertiliser		$ 7.50	35,895	
Contract/Seed/Regrass		$ 0.60	2,872	
Freight		$ 0.50	2,393	
Shearing	per ssu	$ 4.80	12,696	
Weed and Pest	per ha	$ 8.00	3,200	
Vehicles/Fuel	per ha	$ 20.00	8,200	
Repairs and Maintenance			20,000	
Administration			9,171	
Standing Charges			9,750	
Wages of management			45,000	
Cap charge for stock,plant	10%	$ 475,700	47,570	
Gross Farm Expenses				316,551
Gross Farm Expenses per Hectare				**791**
Economic Farm Surplus				111,470
Economic Farm Surplus per Hectare				**279**

Effective Area (ha)	400
Total Stockunits	4,786
Stockunits per Hectare	12.0

Sheep Sales	Number	Price/Hd	Total
Cull Ewes	474	40	18,960
Ewe Hoggets / 2 ths	11	75	825
Ewe Lambs	663	60	39,750
Wth Hoggets	-		-
Wth Lambs	1,313	60	78,750
	2460		138,285

Cattle Sales	Number	Price/Hd	Total
Cull cows	40	556	22484
R3 yr hfrs	-	-	0
R2yr hfrs	-		0
R1yr hfrs	3	256	768
R3yr steers	-		0
R2yr steers	-		0
R1yr steers	-		0
R3yr Bulls	74	1,008	74768.4
R2yr Bulls	167	924	154589.8
R1yr Bulls	-		0
MA Bulls	1	1,199	1199
	286		253809

Stock Purchases	Number	Price/Hd	Total
Rams	9	420	3,570
Br Bulls	1	3597	3597
Bull calves	200	422	84400
Steer Calves	-		0
	201		87,997

Lambing percentage	125%	
Wool Weight	4.70	kg/su
Total kg	12432	
Wool Price ($/kg)	$2.89	
Sheep Death Rate	6%	
Calving percentage	90%	
Cattle Death Rate	1%	

Stock Class	Numbers	Stockunit	Total				$/su	Total Value
Mixed Age Ewes	1,500	1.0	1,500					
2T Ewes	600	1.0	600					
Ewe Hoggets	650	0.8	520					
Wether Hoggets	-	1.0	-					
Rams	25	1.0	25	2,645	ssu's	$	80	$211,600
MA Cows	100	6.0	600					
R2 Yr Hfrs	-	5.0	-					
R1 Yr Hfrs	42	4.0	168					
R2 Yr Strs	-	5.0	-					
R1 Yr Strs	-	4.0	-					
R2 Yr Bulls	75	5.0	375					
R1 Yr Bulls	245	4.0	980					
Br Bulls	3	6.0	18	2,141	csu's	$	100	$214,100
			4,786					
								$425,700

STOCK RECONCILIATION

Class	Open No	Natural Inc	Deaths	Purchase	Sales	Killed	Close No	Class
M A Ewes	1,500		90		474		1,500	M A Ewes
2T Ewes	600		36				600	2T Ewes
Ewe Hogg	650		39		11		650	Ewe Hogg
Ewe Lbs		1312.5			662.5		0	Ewe Lbs
Wth Hogg	-		0		-		-	Wth Hogg
Wth Lbs		1312.5			1312.5		0	Wth Lbs
Rams	25		2	9		7	25	Rams
MA Cows	100		1		40		100	MA Cows
R2 Yr Hfrs	-		0		-		-	R2 Yr Hfrs
R1 Yr Hfrs	42		0				42	R1 Yr Hfrs
Hfr calves		45			3			Hfr calves
R2 Yr Strs	-		0		0		-	R2 Yr Strs
R1 Yr Strs	-		0				-	R1 Yr Strs
Str calves								Str calves
R2 Yr Bulls	75		1		74		75	R2 Yr Bulls
R1 Yr Bulls	245		3		167		245	R1 Yr Bulls
Bull calves		45		200				Bull calves
Br Bulls	3		0	1	1		3	MA Bulls
	3,240	2,715	172	210	2,746	7	3,240	(0)

Sheep and Beef HIGH

Revenue				
Sheep Sales			203,695	
Cattle Sales			414,113	
Wool Sales			48,119	
Gross Farm Revenue				665,927
Gross Farm Revenue per Hectare				1,665
Expenditure		$/su		
Sheep Purchases			3,696	
Cattle Purchase			232,050	
Wages			27,000	
Animal Health		$ 3.50	19,583	
Electricity		$ 0.75	4,196	
Feed		$ 1.00	5,595	
Fertiliser		$ 10.00	55,950	
Contract/Seed/regrass		$ 1.00	5,595	
Freight		$ 0.60	3,357	
Shearing	per ssu	$ 4.80	15,984	
Weed and Pest	per ha	$ 8.00	3,200	
Vehicles/fuel	per ha	$ 25.00	10,000	
Repairs and Maintenance			25,000	
Administration			10,100	
Standing Charges			9,750	
Wa ges of Management			50000	
Cap charge for stock,plan	10%	$ 570,900	57,090	
Gross Farm Expenses				538,146
Gross Farm Expenses per Hectare				1,345
Economic Farm Surplus				127,781
Economic Farm Surplus per Hectare				319

Effective Area (ha)	400
Total Stockunits	5,595
Stockunits per Hectare	14.0

Sheep Sales	Number	Price/Hd	Total
Cull Ewes	538	40	21,520
Ewe Hoggets / 2 ths	5	75	375
Ewe Lambs	1,140	60	68,400
Wth Hoggets	-	0	-
Wth Lambs	1,890	60	113,400
	3573		203,695

Cattle Sales	Number	Price/Hd	Total
Cull cows	-	-	0
R3 yr hfrs	-	-	0
R2yr hfrs	-	-	0
R1yr hfrs	-	-	0
R3yr steers	148	999	148202
R2yr steers	-		0
R1yr steers	-		0
R3yr Bulls	74	1,008	74768.4
R2yr Bulls	207	924	191143.3
R1yr Bulls	-		0
MA Bulls	-	-	0
	429		414113

Stock Purchases	Number	Price/Hd	Total
Rams	9	420	3,696
Br Bulls	-	0	0
Bull calves	285	420	119700
R2 steers	150	749	112350
	435		232,050

Lambing percentage	140%	
Wool Weight	5.00	kg/su
Total kg	16650	
Wool Price ($/kg)	$2.89	
Sheep Death Rate	6%	
Calving percentage	85%	
Cattle Death Rate	1%	

Stock Class	Numbers	Stockunit	Total			$/su	Total Value
Mixed Age Ewes	2,000	1.0	2,000				
2T Ewes	700	1.0	700				
Ewe Hoggets	750	0.8	600				
Wether Hoggets	-	1.0	-				
Rams	30	1.0	30	3,330	ssu's	$ 80	$ 266,400
MA Cows	-	6.0	-				
R2 Yr Hfrs	-	5.0	-				
R1 Yr Hfrs	-	4.0	-				
R2 Yr Strs	150	5.0	750				
R1 Yr Strs	-	4.0	-				
R2 Yr Bulls	75	5.0	375				
R1 Yr Bulls	285	4.0	1,140				
Br Bulls	-	6.0	-	2,265	csu's	$ 100	$ 226,500
			5,595				
							$ 492,900

STOCK RECONCILIATION

Class	Open No	Natural Inc	Deaths	Purchase	Sales	Killed	Close No	Class
M A Ewes	2,000		120		538		2,000	M A Ewes
2T Ewes	700		42				700	2T Ewes
Ewe Hogg	750		45		5		750	Ewe Hogg
Ewe Lbs		1890			1140		0	Ewe Lbs
Wth Hogg	-		0		-		-	Wth Hogg
Wth Lbs		1890			1890		0	Wth Lbs
Rams	30		2	9		7	30	Rams
MA Cows	-		0		0		-	MA Cows
R2 Yr Hfrs	-		0		-		-	R2 Yr Hfrs
R1 Yr Hfrs	-		0				-	R1 Yr Hfrs
Hfr calves		0			0			Hfr calves
R2 Yr Strs	150		2	150	148		150	R2 Yr Strs
R1 Yr Strs	-		0				-	R1 Yr Strs
Str calves								Str calves
R2 Yr Bulls	75		1		74		75	R2 Yr Bulls
R1 Yr Bulls	285		3		207		285	R1 Yr Bulls
Bull calves		0		285				Bull calves
Br Bulls	-		0	-	-		-	MA Bulls
	3,990	3,780	214	444	4,002	7	3,990	-

Dairy - Low Production

Revenue

Milk Sales	308,295	
Dairy Cattle Sales	36,552	
Other		
Gross Farm Revenue		**344,847**
Gross Revenue per Hectare		**3,832**

Expenditure		$/cow	
Stock Purchases			3,000
Wages	per kg MS	$ 0.30	21,762
Animal Health		$ 65.00	15,210
Breeding		$ 28.00	6,552
Dairy Shed Expenses		$ 21.00	4,914
Electricity		$ 30.00	7,020
Feed costs on farm		$ 85.00	19,890
Feed costs off farm		$ 106.00	24,804
Fertiliser	per ha	$ 110.00	9,900
Seed		$ 10.00	2,340
Freight		$ 7.00	1,638
Weed and Pest		$ 7.00	1,638
Vehicles		$ 50.00	11,700
Repairs and Maintenance			14,000
Administration			10,000
Standing Charges			12,000
Wages of Management			50,000
Capital charge stock, plant and shares			66,600

Gross Farm Expenses	**282,968**
Gross Expenses per Hectare	**3,144**
Economic Farm Surplus	**61,879**
Economic Farm Surplus per Hectare	**688**

Milking Area (ha)	90
Milking cows/ha	2.6
Milking Cows (in milk 15 Dec)	234
Total Stock Units	2112
Total Stockunits Per Hectare	23.5
Milksolids per Hectare (kg/ha)	806
Total Milk Production (kgMS)	72,540
Milksolids Payment	$4.25

Stock Sales	Number	Price/Hd	Total
Cull Cows	51	500	25,590
Heifer Calves	45	63	2,854
Bull Calves	105	77	8,108
	202		36,552

Stock Purchases	Number	Price/Hd	Total
Bulls	2	1500	3,000
	2		3,000

Calving percentage	90%
Milk solids kg prod/cow	310
Death rate	3%

Stock Class	Numbers	Stock Units	Total
Cows	234	8	1872
Rg1Yr Hfr	60	4	240
			2112

STOCK RECONCILIATION

Class	Open No	Natural Inc	Death	Purchase	Sales	Close No	Class
Cows	234		7		51	234	Cows
Rg1Yr Hfr	60		2			60	Rg1Yr Hfr
Hf Calves	0	105			45	0	Hf Calves
St Calves	0	105			105	0	St Calves
Br Bulls	4			2	2	4	Br Bulls
	298	211	9	2	204	298	0

Dairy - Moderate Production

Revenue				
Milk Sales			384,413	
Dairy Cattle Sales			41,170	
Other				
Gross Farm Revenue				425,583
Gross Revenue per Hectare				4,729
Expenditure		$/cow		
Stock Purchases			3,000	
Wages	per kg MS	$ 0.30	27,135	
Animal Health		$ 65.00	17,550	
Breeding		$ 28.00	7,560	
Dairy Shed Expenses		$ 21.00	5,670	
Electricity		$ 32.00	8,640	
Feed costs on farm		$ 75.00	20,250	
Feed costs off farm		$ 188.00	50,760	
Fertiliser	per ha	$ 135.00	12,150	
Seed		$ 15.00	4,050	
Freight		$ 10.00	2,700	
Weed and Pest		$ 7.00	1,890	
Vehicles		$ 55.00	14,850	
Repairs and Maintenance			16,000	
Administration			12,500	
Standing Charges			13,000	
Wages of Management			55,000	
Capital charge stock, plant and shares			82,200	
Gross Farm Expenses				354,905
Gross Expenses per Hectare				3,943
Economic Farm Surplus				70,678
Economic Farm Surplus per Hectare				785

Milking Area (ha)	90
Milking cows/ha	3.00
Milking Cows (in milk 15 Dec)	270
Total Stock Units	2432
Total Stockunits Per Hectare	27.0
Milksolids per Hectare (kg/ha)	1005
Total Milk Production (kgMS)	90,450
Milksolids Payment	$4.25

Stock Sales	Number	Price/Hd	Total
Cull Cows	58	500	28,930
Heifer Calves	54	63	3,371
Bull Calves	122	73	8,870
	233		41,170

Stock Purchases	Number	Price/Hd	Total
Bulls	2	1500	3,000
	2		3,000

Calving percentage	90%
Milk solids kg prod/cow	335
Death rate	3%

Stock Class	Numbers	Stock Units	Total
Cows	270	8	2160
Rg1Yr Hfr	68	4	272
			2432

STOCK RECONCILIATION

Class	Open No	Natural Inc	Death	Purchase	Sales	Close No	Class
Cows	270		8		58	270	Cows
Rg1Yr Hfr	68		2			68	Rg1Yr Hfr
Hf Calves	0	122			54	0	Hf Calves
St Calves	0	122			122	0	St Calves
Br Bulls	4			2	2	4	Br Bulls
	342	243	10	2	235	342	0

~~Dairy - High Production~~

Revenue			
Milk Sales			461,678
Dairy Cattle Sales			46,631
Other			
Gross Farm Revenue			508,309
Gross Revenue per Hectare			**5,648**
Expenditure		$/cow	
Stock Purchases			3,000
Wages	per kg MS	$ 0.30	32,589
Animal Health		$ 65.00	19,890
Breeding		$ 28.00	8,568
Dairy Shed Expenses		$ 21.00	6,426
Electricity		$ 32.00	9,792
Feed costs on farm		$ 70.00	21,420
Feed costs off farm		$ 234.00	71,604
Fertiliser	per ha	$ 185.00	16,650
Seed		$ 15.00	4,590
Freight		$ 10.00	3,060
Weed and Pest		$ 7.00	2,142
Vehicles		$ 60.00	18,360
Repairs and Maintenance			18,000
Administration			15,000
Standing Charges			14,000
Wages of Management			60,000
Capital charge stock, plant and shares			100,000
Gross Farm Expenses			425,091
Gross Expenses per Hectare			**4,723**
Economic Farm Surplus			83,218
Economic Farm Surplus per Hectare			**925**

Milking Area (ha)	90
Milking cows/ha	3.4
Milking Cows (in milk 15 Dec)	306
Total Stock Units	2756
Total Stockunits Per Hectare	30.6
Milksolids per Hectare (kg/ha)	1207
Total Milk Production (kgMS)	108,630
Milksolids Payment	$4.25

Stock Sales	Number	Price/Hd	Total
Cull Cows	66	500	32,755
Heifer Calves	61	63	3,824
Bull Calves	138	73	10,052
	264		46,631

Stock Purchases	Number	Price/Hd	Total
Bulls	2	1500	3,000
	2		3,000

Calving percentage	90%
Milk solids kg prod/cow	355
Death rate	3%

Stock Class	Numbers	Stock Units	Total
Cows	306	8	2448
Rg1Yr Hfr	77	4	308
			2756

STOCK RECONCILIATION

Class	Open No	Natural Inc	Death	Purchase	Sales	Close No	Class
Cows	306		9		66	306	Cows
Rg1Yr Hfr	77		2			77	Rg1Yr Hfr
Hf Calves	0	138			61	0	Hf Calves
St Calves	0	138			138	0	St Calves
Br Bulls	4			2	2	4	Br Bulls
	387	275	11	2	266	387	0

	Input Variables	Mean	±
Land & Livestock	Land Value ($/ha)	0	
	Livestock Carrying Capacity (LSU/ha)	8	
	Livestock capital value ($/LSU)	0	
Financial	Annual fixed costs ($/ha)	75	
	Establishment costs (cents/tree)	72	
	Clearfell Logging Cost ($/m^3)	40	
	Production Thin Logging Cost ($/m^3)	50	
	Labour Cost ($/hr)	22	
	Labour Supervision (%)	12	
	Discount rate (%)	9	
Growth & Quality	SBAP	2.1	
	SI (m)	34	
	Clearfell Conversion (%)	88	
	Thinning Conversion Reduction (%)	10	
	B.H. Outerwood Density (kg/m^3)	418	
	Outerwood Measurement Age (yrs)	30	
Silviculture	Rotation (yrs)	45	
	FCS (stems/ha)	400	
	Ht waste thin (m)	12	
	Ht prod. thin (m)	24	
	Waste thin : Total thin stems (%)	50	
	Prune ? (Y/N)	N	
Log Prices	Log Prices global adjustment (%+)	0	
	Pruned Log PLI unit increase	15	
	Pruned (price for PLI = 4)	160	
	S1	225	
	M1a	200	
	M1b	200	
	S2	160	
	L1	140	
	L2a	83	
	L2b	83	
	Ari	60	
	Pulp	35	

None	EFGM $/LSU	IRR %	NPV $/ha	Cost $/m^3	Value $/m^3	Labour hr/ha	BIX cm	Juv. %	SED mm	PLI	Density kg/m^3	MOE
0	-7.2	8.26	-697	47.5	139.8	40.0	3.1	17.8	293	0.0	421	6.3
0	-7.2	8.26	-697	47.5	139.8	40.0	3.1	17.8	293	0.0	421	6.3
0	-7.2	8.26	-697	47.5	139.8	40.0	3.1	17.8	293	0.0	421	6.3
0	-7.2	8.26	-697	47.5	139.8	40.0	3.1	17.8	293	0.0	421	6.3
0	-7.2	8.26	-697	47.5	139.8	40.0	3.1	17.8	293	0.0	421	6.3

None	Initial	Waste thin				Production thin				Clearfell		
	SPH	Age	SPH1	SPH2	DBH	Age	SPH1	SPH2	DBH	DBH	MTH	Vol
0	1,650	14.7	1,581	1,079	14.4	27.9	945	443	26.3	46.7	37.5	909
0	1,650	14.7	1,581	1,079	14.4	27.9	945	443	26.3	46.7	37.5	909
0	1,650	14.7	1,581	1,079	14.4	27.9	945	443	26.3	46.7	37.5	909
0	1,650	14.7	1,581	1,079	14.4	27.9	945	443	26.3	46.7	37.5	909
0	1,650	14.7	1,581	1,079	14.4	27.9	945	443	26.3	46.7	37.5	909

None	Clearfell Log Grade Volumes (m^3/ha)										
	P1	S1	M1a	M1b	S2	L1	L2a	L2b	Ari	Pulp	Total
0	0	114	238	130	2	19	124	122	34	18	800
0	0	114	238	130	2	19	124	122	34	18	800
0	0	114	238	130	2	19	124	122	34	18	800
0	0	114	238	130	2	19	124	122	34	18	800
0	0	114	238	130	2	19	124	122	34	18	800

None	Production Thining Log Grade Volumes (m^3/ha)										
	P1	S1	M1a	M1b	S2	L1	L2a	L2b	Ari	Pulp	Total
0	0	0	0	0	1	0	47	46	66	27	187
0	0	0	0	0	1	0	47	46	66	27	187
0	0	0	0	0	1	0	47	46	66	27	187
0	0	0	0	0	1	0	47	46	66	27	187
0	0	0	0	0	1	0	47	46	66	27	187

Registered to *Nimmo-Bell Ltd, Wellington* NZ Farm Forestry Membership no *47384*

Last updated April, 2003

	Input Variable	Mean	±
Land & Livestock	Land Value ($/ha)	0	
	Livestock Carrying Capacity (LSU/ha)	0	
	Livestock Capital Value ($/LSU)	0	
	Livestock Gross Margin ($/LSU/yr)	0	
	Grazing (Y/N)	n	
Financial	Annual Fixed Costs ($/ha)	100	
	Establishment Costs (cents/tree)	60	
	Logging Cost ($/m^3)	37	
	Labour Cost ($/hr)	22	
	Labour Supervision (%)	15	
	Discount rate (%)	9	
Growth & Quality	300 Index / Site Index	1	0.1
	Site Index (m)	32	
	Conversion (%)	85	
	B.H. Outerwood Density (kg/m^3)	410	
	Outerwood Measurement Age (yrs)	15	
Silviculture	Rotation (yrs)	28	
	Final Crop Stocking (stems/ha)	300	
Log Prices	Log Prices global adjustment (%±)	0	
	Pruned Log PLI unit increase	15	
	Pruned (price for PLI = 4)	135	
	S1	97	
	S2	88	
	S3	63	
	L1	68	
	L2	68	
	L3	64	
	Pulp	40	

I300 / SI	EFGM $/LSU	IRR %	NPV $/ha	Cost $/m^3	Value $/m^3	Labour hr/ha	Grazing % of ha
0.9	#DIV/0!	10.23	1,099	41.5	105.8	93.2	0.0
0.95	#DIV/0!	10.56	1,456	41.3	107.1	93.2	0.0
1	#DIV/0!	10.85	1,802	41.1	108.3	93.3	0.0
1.05	#DIV/0!	11.12	2,142	40.9	109.2	93.3	0.0
1.1	#DIV/0!	11.37	2,479	40.7	110.0	93.3	0.0

I300 / SI	Initial SPH	Thin SPH	Volume m^3/ha	DBH cm	MTH m	BIX cm	Juv. %	SED mm	Density kg/m^3	PLI
0.9	832	312	833	51.1	42.0	5.4	48.4	354	415	6.5
0.95	832	312	881	52.5	42.0	5.8	48.8	363	415	6.7
1	832	312	929	53.9	42.0	6.1	49.2	370	415	6.9
1.05	833	312	976	55.2	42.0	6.3	49.5	378	415	7.1
1.1	833	312	1,023	56.4	42.0	6.6	49.9	385	415	7.3

I300 / SI	Log Grade Volumes (m^3/ha)								
	Pruned	S1	S2	S3	L1	L2	L3	Pulp	Total
0.9	241	36	134	90	40	75	37	56	708
0.95	259	38	121	73	60	97	45	55	749
1	276	39	108	59	83	118	52	54	789
1.05	292	38	94	46	108	138	58	54	830
1.1	308	37	81	36	134	155	62	55	870

*** Value outside recommended range**

Registered to *Nimmo-Bell Ltd, Wellington*   NZ FFA Membership number *47384*   Last updated April 2003

Native Forest Scenario Summary

Two scenarios have been considered for Native forestry. The first is the planting of native areas of mixed species for recreation and enjoyment purposes and the second is the planting of a single species for a similar purpose however allowing for harvest. The following key assumptions have been used in these scenarios.

In both cases a cashflow forecast has been prepared based on 100 hectares and the NPV of future cashflows calculated. No pruning or thinning has been included for the production forest.

To establish native areas it has been assumed that a nurse crop of Manuka would first be established and then under-planted with native species.

Assumption	Native Protection Forest	Native Production Forest
Nurse crop plants per ha	1,000	1,000
Total cost per plant (includes all establishment costs)	$2.55	$2.55
Tree crop cost per plant	$3.00	$3.00
Tree cost establishment cost per plant	$1.05	$1.05
Tree crop stems per hectare planted	300	450
Annual cost post planting per hectare	$12	$30
Clearfell age		60
Volume harvested (m3/ha)		804
Logging costs per ha		$40
Log price ($ per m3)		$300
Discount rate used	9%	9%
NPV for 100 ha	-$230,837	-$214,239

Additional costs associated with the planting and management of a production forest, and the significant delays until harvest result in little difference in the resulting NPVs.

<u>**Section B:**</u>

Economic impact on Rotorua District and Bay of Plenty Region of water quality induced changes to land use and tourism in Rotorua Lakes catchments

Final

31 October 2003

Environment Bay of Plenty
REGIONAL COUNCIL

Nimmo-Bell & COMPANY LTD

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1. Executive Summary

A decline in water quality of lakes in the Rotorua District has impacts on community amenity values and on environmental values. It may also affect the attractiveness of the area to tourists. Nimmo-Bell has been contracted to provide a high level analysis of the macro-economic impacts on Rotorua District and Bay of Plenty Region of water quality induced changes to land use and tourism in Rotorua Lakes catchments. This is the second part of a wider study. The first part evaluates the cost to land owners of a number of land use change scenarios that have the potential to reduce agricultural nutrient release to the Rotorua Lakes.

The report presents estimates of the changes in output, household income, value added and employment associated with potential land use changes in the Rotorua District. These impacts are expressed on a "per '000 ha" basis so that a range of scenarios can be examined for a given catchment by keeping total catchment land area constant and changing the proportion used for each of the various land uses. All impacts are assessed on both a district and regional basis to show the total effects including flow-on effects on other industries in the district or region.

Impacts are separated into farming, forestry and tourism.

An understanding of the structure of the local economy aids in assessing the impacts of changes induced by water quality issues. The sum of value added in Rotorua District amounts to around $1.5 billion which is 26% of the Bay of Plenty Regional total of $5.8 billion and relates to the GDP for New Zealand of $112 billion. Agriculture in the district accounts for $1.5 billion 7.9% and forestry $0.7 billion 4.2% of gross product and when processing is added these sectors account for $1.9 billion 10.1% and $2.2 billion 10.6% respectively. We estimate tourism value added to be around $180 million, which is 12% of Gross District Product. Over the last 15 years employment has been virtually static in the district. While employment in agriculture, forestry and manufacturing has declined, this has been offset by increases in business and professional services with changes in tourism related sectors somewhat mixed. At the regional level a similar picture emerges, but with overall growth of 18% over the period.

The level of changed economic activity is measured by using models based on the Statistics New Zealand national inter-industry model for 1995/96. This has been updated to 2000/01 and incorporating information about the national distribution of industry and an assessed level of district and regional self-sufficiency in 2001. Multiplier analysis is used to measure total economic impacts (output, employment, value added and gross household income). Direct effects lead to indirect effects which arise from spending by businesses to buy additional inputs to increase production. Subsequently, induced effects occur which are the result of increased household income being spent and leading to a further ripple effect of increased output, employment and income. The total economic impact combines these three effects.

The analysis shows there are significant differences in the economic impacts associated with various land uses. Direct employment impacts per 1000 hectares range from 4.3 full time equivalents (FTEs) in low productivity sheep and beef farms to 9.2 FTEs (average over rotation) in forestry to 28 FTEs in dairy farms. Direct value added per 1000 ha / year ranges from $0.27 million in low productivity sheep and beef to $2.0 million in forestry to $3.05 m in high productivity dairying. There are also significant differences in the direct economic impacts for forestry depending on the stage of the rotation. Averaged over the whole rotation the annual employment impact is 9.2 FTEs per 1000 ha, but during establishment the annual average is 6.25 FTEs, but most of the impact is during logging in year 28 at 1,776 FTEs.

We found it very difficult to assess the direct tourism impacts of a decline in water quality in a particular lake as visitors are likely to transfer to other lakes. We have therefore estimated tourism impacts over a range from 2% to 20% decline in tourism numbers over the whole district. For example, if a district wide decline in water quality led to a 2% reduction in tourism numbers then this implies a loss of 115 jobs. At the other end of the scale a 20% decline in tourism numbers implies a loss of 1,150 jobs (which is 4.6% of total jobs in the district).

The total economic impacts (direct, indirect and induced) associated with different land uses vary by much more than do the direct impacts. The total regional employment impacts per thousand hectares vary from:

- 13 FTEs in sheep and beef farming with only half the meat being processed in the region; to
- 38 FTEs in forestry (of which 24 are in processing, and 90 % of the jobs do not occur until harvesting); to
- 82 FTEs in dairy farming with all milk processing occurring in the region.

The effects of tourism could be considerable, but these effects need to be put into the context of the potential effects of land use changes over the areas of land likely to be affected. One way of putting these impacts into perspective is to estimate the area of land that would be needed to be converted from farming to forestry for the loss in value added to be equivalent to the loss in value added through reduced visitor numbers. No one has been able to quantify the relationship between water quality and tourist numbers, but we use scenario analysis to illustrate the possible impacts.

For example: If there is a reduction in water quality in the lakes so that there is a 20% decline in tourism numbers this results in the loss of $58 million value added which is 1% of Gross Regional Product. The equivalent area of dairy farming that would need to be converted for the loss in value added from farming to be equivalent to the losses from tourism is estimated at 11,800ha. This takes into account the loss in value added from dairying ($6.6m per 1,000 ha per annum) less the value added from forestry ($1.7m per 1,000 ha per annum during the first 10 years). If the reduction in tourism numbers is 5% then the equivalent area of dairy land is 3,100 hectares.

The above analysis is a static analysis and in reality the job market and value added is dynamic. So the outcome may be very different due to the interplay of other factors not considered here. There is the question as to how long it would take for the tourism market to revive once the lake quality starts to improve, this likely to be at least 30 years. Also important is whether conversion of agriculture to forestry is the most efficient way of achieving the goal of improving water quality. Other mitigation measures may achieve the goal at lower cost and priorities need to be set so that the most cost affective policies are implemented first. It is critical to ensure that policies are technology open so that improvements in technology are encouraged and the cost of achieving the goal is continuously reduced. An effects based policy is essential if these gains are to be realised.

2. Introduction

A decline in water quality of lakes in the Rotorua District has impacts on community amenity values and on environmental values. It may also affect the attractiveness of the area to tourists.

Nimmo-Bell has been contracted to evaluate a number of land use change scenarios that have the potential to reduce agricultural nutrient release to the Rotorua Lakes. This evaluation is provided in a separate report.

As part of this work EBOP has requested that the following also be undertaken:

- A high level analysis of the macro-economic impacts of land use change.
- A high level analysis of the impact on the economy of fixing/not fixing the problem of lakes water quality.

Nimmo-Bell has engaged Butcher Partners Ltd to assist them in measuring the wider economic impacts of various land uses and of changes in visitor numbers.

2.1. Scope of the Report

This report presents estimates of the changes in output, household income, value added[1] and employment[2] associated with potential land use changes in the Rotorua district . These impacts are expressed on a "per 1,000 ha" basis so that a range of scenarios can be examined for a given catchment by keeping total catchment land area constant and changing the proportion used for each of the various land uses.

2.1.1. Farming Impacts

The estimates are based on district (Rotorua) and regional (Bay of Plenty) economic models which relate changes in output to changes in employment, household income and value added. Direct output from various land uses, and the patterns of expenditure on the inputs for each of these land uses, has been based on modal farm economic farm surplus (EFS) calculations developed for a range of land uses and intensities. These calculations have used long term average income (adjusted for inflation) estimates rather than the figures applying in any particular year. Current day input prices are used. (Refer to separate report Titled: "An economic evaluation of land use change options in the Rotorua Lakes District" for details of the modal farms.)

This farm data has been incorporated into the district and regional economic models to estimate the "multipliers", which incorporate the flow on effects on different parts of the regional economy arising from the increase in farm input purchases, the increases in farm product processing (such as dairy), and the increase in household spending.

2.1.2. Forestry Impacts

These estimates of direct forestry impacts per ha are based on data gathered for work done by Butcher Partners Ltd in Gisborne, Wairoa and Central Canterbury in 1994 to 1996. The Gisborne and Wairoa work in particular assumed a 3 prune and 2 thinning 28 year rotation, and this is the silvicultural model that is expected to be employed in the area around Rotorua Lakes. The flow-on effects of forestry in Rotorua and Bay of

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1 Value added is the returns to labour and capital. It is the equivalent of household income plus profits (before interest, depreciation and tax).

2 Expressed in Full Time Equivalent jobs.

Plenty have been estimated by taking the Gisborne forestry industry input structures, changing them to reflect the greater range of forestry suppliers in Rotorua and Bay of Plenty, and placing them into the 2000/01 regional economic models for Rotorua and Bay of Plenty.

It is interesting to note that forestry input costs have barely moved in the last 8 years. The producers price index (inputs) for forestry and logging was 1,000 in December 1997 and 1,014 in June 2003. In wood product manufacturing the input prices have shifted from 1,000 in December 1997 to 1,055 in June 2003, reflecting the stable or even declining prices of logs. This decline is reflected in the PPI (outputs) index which shows a decline in forestry and logging output prices from 1,000 in Dec 1997 to 935 in June 2003. This of course implies a significant decline in real value when it is noted that the overall PPI (outputs) has risen from 1,000 to 1,129 over the same period.

2.1.3. Tourism Impacts

The strategic impacts of changes to water quality from the perspective of Rotorua tourism have also been considered. A number of key people in the tourism industry were contacted, and the impact of water quality on tourism discussed. These discussions were used to develop scenarios showing the impacts of changes in the number of tourists visiting the district. These scenarios demonstrate a range of possible outcomes which might arise from changes in water quality of the Lakes in the District. The impacts on visitor numbers of a change in water quality is obviously highly subjective and speculative, but we have talked to a number of key players in the Rotorua tourism industry and directly affected businesses (e.g. a camp ground at a lake with poor water quality). Our aim is to give some feel for the significance of the tourism impact compared to other economic impacts arising from land use change strategies to change water quality.

It is obviously impossible to allocate the overall tourism impacts of changed water quality in the Rotorua area to changes in water quality in a particular lake. As a first approximation one might allocate the total impact between the various lakes on the basis of available information about current use of the lakes. Hence changing water quality in a highly used lake is presumed to have a higher economic impact through tourism than is changing water quality in an infrequently used lake. The first problem with this approach is that we have little data on use of the various lakes, and the second problem is that when only a few lakes have poor water quality, the first visitor response is to transfer to another lake. It is only as the alternatives disappear with all lakes getting affected that the tourism impacts become significant.

These percentage changes in tourism numbers were applied to an estimate of the total economic impacts of tourism in Rotorua in order to estimate the economic impacts of the change in tourism. The total economic impacts of Rotorua tourism in 2002/03 were based on estimates of the total economic impacts of tourism in Rotorua in 1999[3] rated up by price changes since 1999 and changes in the number of visitors coming to Rotorua since 1999[4].

[3] Butcher *et al* 2000.

[4] The change in total visitor numbers was assumed to be the same as the change in the number of visitor-nights in commercial accommodation between 1999 and 2003.

3. Structure of the Rotorua and Bay of Plenty Economies

3.1. Gross Rotorua District and Bay of Plenty Regional Product (2001)

The sum of value added in Rotorua District amounts to around $1.5 billion which is 26% of the Bay of Plenty Regional total of $5.8 billion (see Table 1) and relates to the GDP for New Zealand of $112 billion. Agriculture in the district accounts for 7.9% and forestry 4.2% of gross product and when processing is added these sectors account for 10.1% and 10.6% respectively. At the regional level agriculture and food processing account for 15.2% of value added and forestry plus wood processing account for 11.1%. Tourism is not a sector in the National Accounts, but is made up of a combination of sectors including a proportion of wholesale and retail trade, travel, accommodation, restaurants and recreation and culture (Statistics New Zealand, Tourism Satellite Account 1999). In 2000/01 we estimate the direct value added by tourism in Rotorua District to be $135 million and total value added $215 million.

Table 13: Value Added by Sector (2000/01) - $ million

	Rotorua District $m	% of Rotorua	BOP Region $m	% of BOP	Rotorua as % BOP
Agriculture	120.0	7.9	674.8	11.6	17.8
Forestry	63.9	4.2	167.4	2.9	38.2
Other Primary	7.5	0.5	48.3	0.8	15.5
Food Manufacturing	33.7	2.2	208.9	3.6	16.1
Wood and Wood Products	98.0	6.4	478.2	8.2	20.5
All Other Manufacturing	97.0	6.4	393.7	6.8	24.6
Electricity, Gas & Water	13.3	0.9	51.5	0.9	25.8
Construction	57.6	3.8	266.0	4.6	21.6
Wholesale & Retail Trade	231.8	15.2	782.6	13.5	29.6
Restaurants	16.5	1.1	48.1	0.8	34.4
Accommodation	33.0	2.2	50.5	0.9	65.4
Air Transport	24.7	1.6	124.9	2.2	19.8
Other Transport	50.9	3.3	246.2	4.2	20.7
Communications	24.5	1.6	85.7	1.5	28.6
Business & Prof Services	237.9	15.6	844.5	14.5	28.2
Housing	96.3	6.3	375.8	6.5	25.6
Recreation & Cultural Services	58.6	3.9	152.5	2.6	38.4
Health & Education	191.2	12.6	614.1	10.6	31.1
Other Government Services	64.2	4.2	191.8	3.3	33.5
Gross Product	1,520.9	100.0	5,805.4	100.0	26.2

3.2. Employment in Rotorua District and Bay of Plenty Region (1986 - 2001)

The 2001 census reveals that at that time there were 24,966 FTE jobs in the Rotorua District, and this level of employment has been virtually static for the last 15 years. A breakdown by sector (see Table 2) shows that employment in agriculture has declined from 7.7 % of the total in 1986 to 6.7 % in 1996 and to 5.6 % in 2001. The has been a decline of almost 50 % in the number of people employed in forestry (planting growing and managing forests), and a decline of more than 20 per cent in the number of people in manufacturing industries who are employed in processing of farm or forestry products. There have also been very high percentage declines in electricity gas and water (- 74 %) and communications (-75 %), and this mirrors what has happened in many parts of New Zealand since the mid 80s as the government closed post offices and as communications and electricity generation and transmission technology have became more sophisticated and capital-intensive and controlled from larger centres.

In contrast to these declines, there has been high percentage growth in employment in business and professional services (+ 60 %) and more modest growth in recreation and cultural services (34 %). In the tourism-related sectors the picture is somewhat mixed. Employment in accommodation has declined by 8 per cent in the last fifteen years, but employment in retail trade and in restaurants and hotels has increased by 18 per cent.

Table 14 Employment (Full Time Equivalent)+ by Sector: 1986 – 2001

Industry	**Rotorua District**			**Bay of Plenty Region**		
	1986	1996	2001	1986	1996	2001
Agriculture	1,941	1,662	1464	9,753	8,178	8,085
Forestry	1,350	1,092	717	2,676	1,926	1,452
Hunting and Fishing	6	21	9	144	219	171
Mining	24	36	24	90	231	105
Food Manufacturing	420	396	363	2,412	2,325	2,217
Wood and Wood Products	1,779	1,221	1452	5,877	4,080	4,002
All Other Manufacturing	2,181	1,452	1506	6,393	5,214	5,952
Electricity, Gas & Water	234	117	60	726	411	183
Construction	2,022	1,485	1461	6,021	5,901	6,696
Wholesale & Retail Trade	3,735	3,921	4359	11,253	12,870	15,507
Restaurants	648	864	762	1,545	2,388	2,265
Accommodation	1,218	1,197	1122	1,986	1,776	1,719
Air Transport	63	66	267	90	135	1,215
Other Transport	855	723	645	3,348	3,000	2,427
Communications	792	252	195	1,731	732	711
Business & Prof Services	1,731	2,019	2802	4,914	7,008	9,696
Recreation & Cultural	576	738	774	1,140	1,464	1,692
Services	3,324	3,543	3507	8,043	9,534	11,322
Health & Education	2,073	2,463	2229	5,658	7,728	7,917
All Other Services	237	1,569	1,281	627	5,316	4,695
Not Identified						
TOTAL	25,170	24,795	24,966	74,412	80,412	88,002

+ Measured as full time plus half of part time, as at census date (March of the various years). The number of persons employed at census date is between seasonal maximum and minimum. Consequently the census figures are likely to represent a reasonable annual average. Totals may not add, since all individual figures are randomly rounded to the nearest 3.

At the Bay of Plenty regional level, total employment grew by 18 per cent in the period 1986 - 2001. The changes in the mix of industries was similar to that in the district, with employment in agriculture, manufacturing, electricity, and communications having all declined while employment in business and professional services has almost doubled. Regional retail employment has grown by 38 per cent and employment in non-retail services as a whole has grown by 37 per cent. In the tourism-related sectors, regional employment in accommodation has declined by 13 per cent in the last fifteen years, but employment in restaurants has grown by 47 % and in recreational and cultural services has grown by 48 %.

3.3. Tourism in the Rotorua District

3.3.1. National context

Nationally, tourism is now one of New Zealand's largest industries contributing $13.2 billion total expenditure to the New Zealand economy in the year ended March 2000, the latest year for which data is available. In the year ended March 2000, tourism, directly or indirectly, generated 9.7% of New Zealand's GDP and supported an estimated 163,000 full time equivalent jobs, or 10 per cent of all employment[5].

Tourism demand can be broken into two main categories:

- *International Visitors*: In the year ended March 2002 New Zealand received 1.95m visitors[6], 1.0 million whose purpose of visit was holiday. The medium length of stay of holiday visitors is 10 days[7]. The average expenditure of an international holiday visitor is $3,334 per person[8]. International tourism arrivals are forecast to increase by 6% per annum on average over the next 5 years[9].
- *Domestic Tourism:* Domestic tourists are estimated to account for 37 million day trips and 16 million overnight trips per annum, generating $6.3 billion in expenditure[10]. Domestic tourism declined 9% in 2000, but overnight trips are forecast to grow on average 2% per annum over the next 5 years.

3.3.2. Rotorua District

Gaining reliable tourism statistics for Rotorua district is made easier by the work done by Lincoln University in 1999. After extensive analysis of all tourism businesses and surveys of tourism expenditure, they estimated that tourism in Rotorua, in the year to March 1999, was directly responsible for 3,500 FTE jobs, $310 million of output and $126 million of value added, of which $83 million is household income. They also estimated tourism multipliers, and on this basis they concluded that the total impacts of tourism on Rotorua district in 1998/99 were 4,879 FTE jobs, $463 million of turnover and $200 million of value added, of which $125 million is household income.

This data can be rated up to 2002/03 volumes and values by adjusting for changes in visitor numbers since then and increases in expenditure per visitor since then. The Commercial accommodation monitor suggests that the volume of visitors has grown by 18 % from 1998/99 to 2002/03. Over the same period consumer prices have increased by 10 %. On this basis we estimate that the current total economic impacts of tourism in Rotorua district have increased to 5,750 jobs, $601 million of turnover and $260 million of valued added, including $162 million of gross household income.

3.3.3. Forecasts

5 Tourism Satellite Accounts, March 2000. Statistics New Zealand.
6 Inbound Visitor Arrivals to New Zealand, March 2002– Statistics New Zealand.
7 Inbound Visitor Arrivals to New Zealand, May 2000 – Statistics New Zealand
8 New Zealand International Visitor Survey (IVS) –12 months to March 2002 – Tourism New Zealand, May 2002.
9 Tourism Research Council of New Zealand – International Visitor Arrivals to NZ 2001-2007 – McDermott Fairgray Group
10 Domestic Tourism Survey (DTS) 2000 –Gravitis.

The Tourism Research Council is a tourism industry body comprising representatives of operators, Tourism New Zealand and government. Their forecast for growth for the period 2001-2007 is 6% per annum for international visitors and 2% per annum for domestic overnight visitors. On this basis one could expect tourism growth in the Rotorua district to continue, but growth could well be influenced by the quality of the lakes in the district. The significance to visitors of Rotorua lakes is discussed in the next section.

4. Theory and Research Method

The objective of this project was to measure the level of economic activity (employment, output and value added) in Rotorua and Bay of Plenty which is likely to arise both directly and indirectly from different land uses and different levels of tourism. This section describes the general concept of multiplier analysis and the way in which economic models of Rotorua District and Bay of Plenty Region were developed in order to estimate the wider economic impacts of the potential land use and tourism changes.

4.1. Principles of Multiplier Analysis

4.1.1. Direct effects

When businesses or visitors spend money on various services and goods, this generates direct **employment**, **output**, and **value added**.

4.1.2. Indirect effects

The businesses, which sell to farms or tourists, use part of the money received to purchase goods and services from other local businesses which thus increase their income and employment. These "business support" effects are generally termed "**indirect**" effects (A Type I multiplier is the ratio of direct + indirect effects / direct effects). To find out the scale of the indirect effects, one must examine the expenditure patterns of the farms and visitors. What do they buy, and from where do they buy it (in the District / Region or out of the District / Region)?

4.1.3. Induced effects

As businesses expand, they also employ more labour and increase payments to households. The resultant increase in household income and expenditure generates further increases in output, value added and employment in the district / regional economy. These additional effects generated by household spending are termed "**induced**" effects, and their extent depends on the proportion of household spending which is done in the local economy. A Type II multiplier is the ratio of direct + indirect + induced effects / direct effects.

See Appendix 1 for more details.

4.2. Generation of Rotorua District and Bay of Plenty Region Economic Models

The Rotorua District and Bay of Plenty Region economic models generated for this study are based on a national inter-industry model for 2000/01, the national distribution of industry and an assessed level of district and regional self-sufficiency in 2001.

The data on the likely direct spending patterns of farming and forestry gives only the first round of indirect impacts. To estimate the further impacts caused by the spending of businesses further down the chain, an estimate of the probable pattern of their expenditure was developed, on the basis of information that already exists about national average expenditure patterns of businesses of this type and the regional location of businesses that supply those inputs. For example, if 5 % of all farming costs are spent on fertiliser and Rotorua has no fertiliser works, then it can be assumed that this 5 % of costs is imported into the district. If it is known that on average 3 % of farming costs are spent on vets and if Rotorua district is generally 90 per cent self-sufficient in vets, then it can reasonably be assumed that 2.7 % of inputs are produced locally, and a further 0.3 % of inputs are imported into the District.

All the information and assumptions are incorporated into separately estimated District and Region input-output models. These models are generated using an existing national input-output model, information about the regional distribution of employment and output, and a relatively simply mathematical technique called GRIT [11] (Generation of Regional Input-output Tables - which estimates the source of inputs into District industries). This model is then adjusted by incorporating into it information about the likely expenditure patterns of farming and forestry in the district and region. The resultant input-output models can be used to calculate the <u>total</u> effects on all sectors of an increase in output of any single sector. These total effects include the original effect and all the consequential rounds of indirect and induced effects.

In the case of the land uses being considered, estimates of employment and operational financials have been developed. These estimates are used as the basis of inputs into the economic models for the District and Region. Approximations were made as to where the businesses will purchase their goods and services from, and this was based on knowledge of the farming operations in the area. With regard to labour it has been assumed that all farm and forestry labour will live locally, and hence spend locally. Generally, not all household spending is done locally because people sometimes choose to shop and holiday outside the district or region, and some members of small communities use outside professional assistance in order to preserve their privacy. The district and regional economic model takes these factors into account.

4.3. Estimates of Multipliers for Farming and Forestry

Once the farming and forestry expenditure information had been incorporated into the District and Region models, employment, output, value added and household income multipliers for each geographic entity can be estimated using matrix algebra[12]. Type II

11 Developed in Australia and widely used there and in New Zealand. See West et al (1982), or Butcher (1985).

12 Readers who which to know more should consult a text on input - output models. Customised software (e.g. IO7) which undertakes the matrix manipulation is readily available.

multipliers were calculated. It is clear that the increased direct household income from farming and forestry stimulates household spending and hence economic activity in the district, and for this reason it is believed to be appropriate to use Type II multipliers to calculate total economic impacts of land use change.

The multipliers estimated from the District and Region economic models are applied to estimates of the direct employment, output, value added and household income arising from each land use. This generates estimates of total employment, output, value added and household income arising from the land use.

4.4. Estimates of Multipliers for Tourism

We have used the Lincoln University tourism multipliers which they developed for Rotorua district. To get Bay of Plenty regional tourism multipliers we have rated up the district multipliers by factors of 1.05 – 1.13 which reflect the difference between district and regional multipliers in the key tourism sectors of retail trade, accommodation, restaurants and recreation and culture

5. Direct Economic Impacts of various land uses

This section contains a summary of the estimated direct economic impacts per thousand ha for each land use. In the context of this report, “District” refers to the Rotorua district and “Region" refers to the Bay of Plenty region. The impacts are based on the representative farm types and intensities developed. The results outlined here include seven land uses, including three intensities of dairying, three intensities of sheep and beef farming, and production forestry.

5.1. Land Use Impacts per ‘000 Ha

All land use impacts are assessed once a land area is in full production. Any change in land use will have an interim period where there may be significant capital investment and where productivity is moving towards the long-term average.

Showing the economic impacts of forestry is particularly problematic in that there is a modest impact during planting, then a more significant impact during pruning and thinning from years 5 – 10, and then no further impact until harvesting and processing in year 28. For forestry we have shown the effects in an average year, with one twenty-eighth of the total rotation impact occurring in each year.

5.1.1. Farming Impacts

Table 15 Direct Economic Impacts of Farming per ‘000 Ha

	Dairying			Sheep & Beef		
	Low	Med	High	Low	Med	High
Output ($m / year)	3.83	4.73	5.65	0.52	1.07	1.66
Employment (FTEs)	27.80	27.80	27.80	4.30	4.50	6.20
Gross Household Income ($m / year)	0.82	0.95	1.05	0.11	0.14	0.19
Value Added ($m / year)	2.22	2.60	3.05	0.27	0.52	0.65

5.1.2. Forestry Impacts

Forestry impacts are based on expenditure of around $0.60 per stem to clear the ground, buy the tree, plant it and release spray it. At 800 stems per Ha this cost is $480 / Ha, and it takes around 2.3 person days (including employment in the nursery). The costs of pruning are around $300 / prune / Ha, and of thinning are around $150 / thin / Ha giving a total of $1,200 / Ha (3 prunes and 2 thins). Total time taken is around 8.2 days / Ha. Logging is a highly variable cost depending on the terrain. Costs can vary from $10 (easy land with highly mechanised operation) to more than $50 on very steep land. We have assumed an average cost of $24 / tonne for the 795 tonnes of logs per Ha being harvested at age 28 years, or a total cost per Ha of $19,100. We have also assumed productivity of around 30 tonnes per person per day, or 10.5 days / Ha. Freight is expected to cost $8,600 per Ha, with logs being transported 60 km at an average cost of $0.18 per tonne-km. Employment in road freight averages around 5.4 FTEs per $million of turnover, so the employment per Ha is around 10.5 days. Management and overheads are costed in at $100 per Ha per year, and with direct employment at around 10 FTEs / $million this implies 6.4 days over the 28 year rotation. All employment figures in Table 16 are converted to person-years assuming 200 working days per year for in-forest operations and 230 days in freight and forest management. Figures are expressed per 000 Ha for the full rotation of 28 years, and per 1000 ha per year averaged over the rotation.

Table 16 Direct Economic impacts of Forestry per '000 Ha (TOTAL over 28 year rotation)

	Forest Owner	Prep & Plant	Prune Thin	Log	Trans-port	Mgt	Total (rounded)
Output ($m)	73.40	0.48	1.2	19.10	8.60	2.80	106
Employment (job-years)	0	11.50	41.00	132.50	45.10	28.00	258
Gross Household Income ($m)	0	0.38	0.96	5.18	2.09	1.15	9.76
Value Added ($m)	41.20	0.36	0.91	9.54	3.69	1.15	56.90

Table 17 Direct Economic impacts of Forestry per '000 Ha (AVERAGE per year over rotation)

	Forest Owner	Prep & Plant	Prune Thin	Log	Trans-port	Mgt	Total (rounded)
Output ($m / year)	2.62	0.02	0.04	0.68	0.31	0.10	3.80
Employment (FTEs)	0	0.41	1.46	4.73	1.61	1.0	9.20
Gross Household Income ($m / year)	0	0.01	0.03	0.19	0.07	0.04	0.35
Value Added ($m / year)	1.47	0.01	0.03	0.34	0.13	0.04	2.00

Note that during forest establishment (planting, pruning and thinning) total input and output is much lower than the average over the whole rotation. In Table 18 below we assume all planting and tending are undertaken in the first 10 years (and therefore average the total impact over 10 years) and add that to the 28 year average of forest ownership and management to give the impact during establishment.

Table 18 Direct Economic impacts of Forestry per '000 Ha per annum averaged over establishment (first 10 years)

	Forest Owner	Prep & Plant	Prune Thin	Mgt	Sub Total (rounded)
Output ($m / year)	2.62	0.05	0.12	0.10	2.89
Employment (FTEs)	0	1.15	4.10	1.00	6.25
Gross Household Income ($m / year)	0	0.04	0.10	0.04	0.18
Value Added ($m / year)	1.47	0.04	0.09	0.04	1.64

5.2. Conclusion

There are significant differences in the economic impacts associated with various land uses. Direct employment impacts per thousand hectares range from 4.3 FTEs in low productivity sheep and beef farms to 9.2 FTEs in forestry to 28 FTEs in dairy farms. Direct value added per thousand hectares per year ranges from $0.27 m in low productivity sheep and beef to $2.0 m in forestry to $3.05 million in high productivity dairying.

There are significant differences in economic impacts for forestry depending on the stage of the rotation. Averaged over the whole rotation the annual employment impact is 9.2 FTEs per '000 ha, during establishment the average is 6.25 FTEs, but most of the impact is during logging in year 28 at 177.6 FTEs.

6. Direct economic impacts of tourism

6.1. Strategic Value

A great deal of commercial tourism in New Zealand is dependent on providing food and accommodation to visitors. However, food and accommodation are generally what are termed "derived demands". That is, they are demanded by visitors primarily because the visitors are in the vicinity for some reason, and the reason is not generally to stay in a particular hotel or eat at a particular restaurant. The primary demand by visitors is to see things and to undertake activities, and if New Zealand tourism is to continue to expand, the quality of experiences must be maintained, which means maintaining the quality of the resource base.

Discussions with tourism operators has shed little light on the likely impacts of changes in water quality or on land use on the visitor experience. Work by Fairweather *et al* (2000) revealed that visitors were quite accepting of a wide range of land uses. Different visitors appreciated different things, but there was, for example, little evidence that visitors disliked plantation forestry, or preferred one form of farming over another.

A change in water quality can lead to disagreeable odours, health impacts on swimmers, algal blooms and resultant smells, a loss in the quality of the fishery, and health hazards from consuming food caught in the water. Anecdotal evidence suggests that a sufficient decline in water quality does lead to a decline in tourism. Operators on Lake Rotorua felt that there was a significant loss of revenue at the low point of water quality in the early 1990s prior to the commissioning of a new sewage treatment plant. More recently, camp operators at other lakes, such as Rotoiti, have said that the decline in water quality there led to a significant decline in the number of guest-nights.

A review of visitor activities suggests that only a small proportion of international visitor activities are actually based on the lake, which on the face of it might suggest that a decline in water quality would have little impact on visitor numbers. However, if water quality declines to a point where smell can be noticed beyond the lake boundary itself, or if the area gets a reputation for being an unhealthy place, the impacts on visitor numbers could be severe. The position for domestic visitors is believed to be very different, with anecdotal evidence suggesting that large numbers of bach owners and campers in particular use the lakes extensively.

We have no way of knowing how bad water quality would have to become for visitors to be dissuaded from coming to Rotorua. For this reason, we have chosen to consider a range of visitor impacts, ranging from a 2 per cent decline for a significant deterioration of water quality and 20 per cent for very bad water quality. These figures are intended to demonstrate the significance of tourism impacts to changes in water quality compared to the impacts associated with changes in land use to improve water quality.

Of course at the extreme, impacts could be even greater. There are certainly those who recall the situation in early 1990 who believe that had the water quality at the time not been improved, tourism in Rotorua could easily have collapsed (which we take to mean a decline of 50 % or more). We have not quantified a collapse as we believe water quality will not be allowed to reach that state.

6.2. Direct Impact on Tourism Sales

Given the uncertainty of impacts on tourism, we have considered impacts of 2 %, 5 %, 10 % and 20 % of total tourism, with this being the sort of range that could be affected. Note that this is an effect spread across all affected lakes. If only one lake has poor water quality, the effects on the district will probably be quite small because people can transfer to other lakes. However if all lakes are affected, then the potential for transfers is lost and the total impact is likely to be at the upper end of the scale.

Table 19 Direct Rotorua Tourism Impacts Associated with a change in visitor numbers

	2 % decline	5 % decline	10 % decline	20 % decline	Total Rotorua Tourism
Output ($m / year)	8.1	20.2	40.3	80.6	403
Employment (FTEs)	83.0	206.0	413.0	826.0	4,130
Gross Household Income ($m / year)	2.2	5.4	10.8	21.6	108
Value Added ($m / year)	3.2	8.2	16.4	32.8	164

6.3. Conclusion

It is very difficult to assess the direct tourism impacts of a decline in water quality in a particular lake as visitors are likely to transfer to other lakes. We have therefore estimated tourism impacts over a range from 2% to 20% decline in tourism numbers over the whole district. If a district wide decline in water quality led to a 2% reduction in tourism numbers this implies a loss of 83 jobs. A 20% decline in tourism numbers implies a loss of 826 jobs (which is 3% of total jobs in the district).

7. Multipliers and total economic impacts

7.1. Estimates of Farming and Forestry Multipliers and Total Impacts

Once the basic district model had been expanded to incorporate the financial and employment estimates for farming and forestry, it was possible to calculate employment, output, value added and household income multipliers. Multipliers have been applied to the direct impacts (see Table 3 and Table 5) in order to estimate the total impacts, as shown in the following tables. Multipliers for the district are slightly smaller than for the region because of the less diverse manufacturing and services bases of the district.

Farming and Forestry also have "forward linkages" through processing of livestock, milk and logs. We have converted the direct farm and forestry production figures into output of the processing plants, and we have assumed that all milk, half the logs and none of the livestock is processed in the district. (We acknowledge that there is some deer processing within the Rotorua district however we have considered sheep and beef and dairy land uses only). We have also assumed that the balance of the logs are exported in log form and that half of the meat is processed elsewhere in the region (at Rangiuru) and the balance is processed outside the region.

The assumption for meat processing location is based on advice from livestock agents in the district, and reflects the fact that there is no sheep and beef processing plant within the district, and that abut half of all stock are slaughtered outside the region. The assumption about wood processing is based on current data for the region[13]. However, there is enormous uncertainty as to what sort of processing will take place in another 28 years when seedlings planted now will come to maturity. We have assumed that the wood will go to processing in a medium-sized MDF plant, where there is 1 FTE employed for every 900 m^3 logs per annum. A large scale MDF plant would use considerably less labour (around 1 FTE per 1,600 m^3 of logs), while a large scale sawmill would use 1 FTE per 2,000 m^3 of logs, and really large scale saw mills with limited processing can have as little as 1 FTE per 20,000 m^3. From this perspective the processing impact is the upper level of what is likely, and it is quite possible that the impacts will only be half as great or even less.

[13] Gerard Horgan, FRI, *pers. comm.*

Table 20 Total Economic Impacts in Rotorua District per '000 Ha of Farming (including Processing)

	Dairying			Sheep & Beef		
	Low	Med	High	Low	Med	High
Output ($m / year)	11.5	14.2	16.9	0.85	1.5	2.2
Employment (FTEs)	52	57	62	7	8	11
Gross Household Income ($m / year)	1.70	2.10	2.40	0.21	0.24	0.36
Value Added ($m / year)	4.00	4.80	5.60	0.43	0.73	0.90

Table 21 Total Economic Impacts in Bay of Plenty Region per '000 Ha of Farming (including Processing)

	Dairying			Sheep & Beef		
	Low	Med	High	Low	Med	High
Output ($m / year)	12.5	21	25	1.6	3.0	4.6
Employment (FTEs)	56	82	92	10	13	19
Gross Household Income ($m / year)	1.9	2.2	2.6	0.31	0.46	0.67
Value Added ($m / year)	4.3	6.6	7.8	0.6	1.1	1.6

Table 22 Total Economic impacts in Rotorua District per '000 Ha of Forestry (including processing)

	Proc-essing	Forest Owner	Prep & Plant	Prune Thin	Log	Trans-port	Mgt	Total Rounded
Output ($m / year)	4.40	2.62	0.03	0.08	0.97	0.62	0.20	9.00
Employment (FTEs)	27.10	0	0.61	1.60	7.10	3.80	1.70	42.00
Gross Household Income ($m / year)	1.00	0	0.02	0.04	0.27	0.15	0.07	1.60
Value Added ($m / year)	1.60	1.50	0.02	0.05	0.48	0.28	0.09	3.90

Note: the total value added for forestry is $2.25 million per annum per '000 hectares when converted into an annual figure equivalent to sheep and beef and dairy. This takes into account the timing of the various forestry operations including processing over 28 years by discounting the cashflows to an NPV then turning this into an annuity at 9%.

Table 23 Total Economic impacts in Bay of Plenty region per '000 Ha of Forestry (including processing)

	Proc-essing	Forest Owner	Prep & Plant	Prune Thin	Log	Trans-port	Mgt	Total Rounded
Output ($m / year)	3.70	2.62	0.03	0.08	0.94	0.59	0.19	8.20
Employment (FTEs)	24.00	0	0.40	1.60	6.90	3.70	1.60	38.00
Gross Household Income ($m / year)	0.80	0	0.02	0.04	0.26	0.15	0.07	1.40
Value Added ($m / year)	1.30	1.50	0.02	0.05	0.46	0.27	0.08	3.60

Table 24 Total Economic impacts in Rotorua District per '000 Ha of Forestry (establishment phase – first 10 years))

	Forest Owner	Prep & Plant	Prune Thin	Mgt	Total Rounded
Output ($m / year)	2.62	0.08	0.22	0.20	3.1
Employment (FTEs)	0	1.71	4.48	1.70	7.9
Gross Household Income ($m / year)	0	0.06	0.11	0.07	0.2
Value Added ($m / year)	1.50	0.06	0.14	0.09	1.8

Table 25 Total Economic impacts in Bay of Plenty region per '000 Ha of Forestry (establishment phase – first 10 years))

	Forest Owner	Prep & Plant	Prune Thin	Mgt	Total Rounded
Output ($m / year)	2.62	0.08	0.22	0.19	3.1
Employment (FTEs)	0	1.12	4.48	1.60	7.2
Gross Household Income ($m / year)	0	0.06	0.11	0.07	0.2
Value Added ($m / year)	1.50	0.06	0.14	0.08	1.8

7.2. Estimates of Tourism Multipliers and Total Impacts

As only a small proportion of international visitor activities are based on the lakes the greatest impacts are likely to be on domestic visitors and in particular bach owners and campers. Table 14 shows the total impacts of visitor number changes in the Rotorua District.

Table 26 Total economic impacts in Rotorua District of changes in visitor numbers

	2 % decline	5 % decline	10 % decline	20 % decline	Total Rotorua Tourism
Output ($m / year)	12	30	62	120	620
Employment (FTEs)	115	290	575	1,150	5,750
Gross Household Income ($m / year)	3	8	16	33	163
Value Added ($m / year)	5	13	26	52	260

When indirect and induced effects are added to direct effects a 2% decline in tourism numbers in the district is estimated to lead to a loss of 115 jobs, which is 0.5% of total jobs in the district. A 20% decline implies the loss of 1,150 jobs, which is 5% of total jobs.

Table 27 Total economic impacts in Bay of Plenty region of changes in visitor numbers

	2 % decline	5 % decline	10 % decline	20 % decline	Total Rotorua Tourism
Output ($m / year)	14	35	70	140	700
Employment (FTEs)	120	300	600	1,210	6,040
Gross Household Income ($m / year)	4	9	18	36	178
Value Added ($m / year)	6	15	29	58	290

8. Conclusions

The total economic impacts associated with different land uses vary by much more than do the direct impacts. The total regional employment impacts per thousand hectares vary from:

- 13 FTEs in sheep and beef farming with only half the meat being processed in the region; to
- 38 FTEs in forestry (of which 24 is in processing, and 90 % of the jobs do not occur until harvesting);
- to
- 82 FTEs in dairy farming with all milk processing occurring in the region;

The effects of tourism could be considerable, but these effects need to be put into the context of the potential effects of land use changes over the areas of land likely to be affected.

One way of putting these impacts into perspective is to estimate the area of land that would be needed to be converted from farming to forestry for the loss in value added to be equivalent to the loss in value added through reduced visitor numbers. No one has been able to quantify the relationship between water quality and tourist numbers, but we use scenario analysis to illustrate the possible impacts. For example:

8.1. Value Added

If there is a reduction in water quality in the lakes so that there is a 20% decline in tourism numbers this results in the loss of $58 million value added which is 1% of Gross Regional Product.

Medium producing dairying (including processing) has a value added of $6.6 million per 1,000 ha per annum.

During the first 10 years of forest establishment value added per annum is $1.7 million per 1,000ha.

Thus there would be a net loss of $4.9 million per annum per '000 ha converted ($6.6m - $1.7m). (Note that over the whole rotation the annuity equivalent to the NPV over the rotation is $2.2 million per annum.)

This means that 11,800 ha of dairy farming would need to be converted for the loss in value added from farming to be equivalent to the losses from tourism ($58m / $4.9m * 1,000ha = 11,800ha).

If the reduction in tourism numbers is 5% then the equivalent area of dairy land is 3,100 hectares ($15m / $4.9 * 1,000 ha).

8.2. Discussion

The above analysis is a static analysis and in reality the job market and value added is dynamic. So the outcome may be very different due to the interplay of other factors not considered here. There is the question as to how long it would take for the tourism market to revive once the lake quality starts to improve, this is likely to be at least 30 years. Also important is whether conversion of agriculture to forestry is the most efficient way of achieving the goal of improving water quality. Other mitigation measures may achieve the goal at lower cost and priorities need to be set so that the most cost affective are implemented first. It is critical to ensure that the policy is technology open so that improvements in technology are encouraged and the cost of achieving the goal is continuously reduced. An effects based policy is essential if these gains are to be realised.

While it is recognised that there is not an established link between water quality and tourist numbers what we have tried to do is use this example to illustrate the possible impacts.

9. References

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10. Appendix 1: Definitions

Employment

Employment is work done by employees and self-employed persons, and is measured in Full-Time-Equivalent jobs (FTEs). A person working part time all year is deemed to be equivalent to 0.5 FTEs. Where work is seasonal, the conversion to FTEs is based on 12 months work per year. So a seasonal worker working full time for six months per year is 0.5 FTEs, and a part time seasonal worker working ten hours per week for 4 months is 0.1 FTEs.

Output

Output is the value of sales by a business. In the case of wholesale and retail trade, it is the total value of turnover (and not simply gross margins) [14].

Value Added

Value added includes household income (wages and salaries and self-employed income), and returns to capital (including interest, depreciation and profits). It also includes all taxes. Put another way, Value Added is equal to Output less costs other than wages, salaries, depreciation and interest.

Household Income

Household income is the gross income of households. It includes the income of self-employed persons. There is sometimes considerable uncertainty as to the proportion of business income, which goes to households, especially for small businesses. In assessing this proportion, dividends and interest payments have been excluded. Conceptually they should be included, but it is difficult to be clear what proportions have gone to households. When estimating indirect economic impacts, one needs to know the increase in household income, which occurs in the region. Where owners of business capital live out of the district, shares and interest do not form part of the district household income.

Direct Economic Impacts

The direct impact arises from the initial spending by businesses and visitors on the goods and services they want to consume. The direct employment is of people who work directly on farms or in forestry or whoe produce and sell goods and services directly to tourists. The direct output is the value of production by businesses or of purchases made by tourists. The direct value added is the value added on the farms or in the forests or in those businesses which sell direct to tourists.

14 Care has to be taken in combining retail sales figures with employment per $million of output from input - output tables. In these tables, output is generally defined as gross margin. By contrast, business statistics figures usually give employment per $million of turnover.

Indirect Economic Impacts

The indirect impact arises from increased spending by businesses as they buy additional inputs so that they can increase production to meet visitor demand. This indirect effect can be envisaged as an expanding ripple effect. A tourist buys food and drink at a cafe. The cafe has to employ more staff and buy more bread, so the bakery output expands. The bakery has to employ more staff and buy more electricity, so the power company increases its output. The power company has to increase its maintenance, so it employs another person and spends more on a vehicle for that person. All the increased employment, output and value added (apart from that at the cafe) are the indirect effect.

Note that indirect effects only include "upstream" effects (via buying more inputs), but do not include any stimulated development downstream. So although an expansion of activities may lead to more tourists and hence an expansion of accommodation, the extra accommodation is not included as a flow on effect of the activity, and hence is not included in the multiplier.

Induced Economic Impact

The induced impact is the result of increased household income being spent, and leading to a further ripple effect of increased employment, output and income.

Flow on Effects / Upstream Impacts

The sum of indirect and induced effects is sometimes termed the flow on effects, or upstream impacts.

Down Stream Impacts

Impacts which are not driven by an activity's demand for extra inputs, but which might arise as a result of a particular activity, are sometimes called the "Downstream impacts". An example in farming is dairy factories, and in tourism is where demand for an activity leads to an increased demand by visitors for accommodation and food before or after they visit the attraction. The accommodation and food is not an input into the attraction and hence is not an indirect or induced effect of it. It is a downstream effect.

Total Economic Impacts

The total Type I impact is the sum of the direct and indirect impacts, and a Type II impact is the sum of direct, indirect and induced impacts.

Multipliers

A Type I multiplier is the ratio of (direct + indirect) impacts to direct impacts, and a type II multiplier is the ratio of (direct + indirect + induced) impacts to direct impacts. The Type II multipliers include the impact of household spending and hence will always be greater than a Type I multiplier. Both multipliers will always be greater than 1. Note that downstream effects (whether positive or negative) are not included in the multiplier, and must be calculated separately.

11. Appendix 2: Forestry: Total Value Added – NPV and Annuity

Forestry BoP: Total Value Added - NPV & Annuity

	NPV $m per '000 ha	**Anniuity**	**NPV 1st 10 years**	**Anniuity**
7.0%	$28.7	$2.36	$12.2	$1.74
8.0%	$25.0	$2.26	$11.6	$1.73
9.0%	$22.0	$2.17	$11.1	$1.73
10.0%	$19.5	$2.10	$10.7	$1.74

	Total	Plant and Clear	Prune & Thin	Logging	Transport	Processing	Management	Ownership
$m Per Year	3.656	0.019	0.048	0.460	0.276	1.300	0.080	1.473
Rotation	102.368	0.532	1.344	12.880	7.728	36.400	2.240	41.244
Total	102.368	0.532	1.344	12.880	7.728	36.400	2.240	41.244
Year								
1	2.085	0.532					0.080	1.473
2	1.553						0.080	1.473
3	1.553						0.080	1.473
4	1.553						0.080	1.473
5	1.553						0.080	1.473
6	1.956		0.403				0.080	1.473
7	1.553						0.080	1.473
8	1.956		0.403				0.080	1.473
9	1.687		0.134				0.080	1.473
10	1.956		0.403				0.080	1.473
11	1.553						0.080	1.473
12	1.553						0.080	1.473
13	1.553						0.080	1.473
14	1.553						0.080	1.473
15	1.553						0.080	1.473
16	1.553						0.080	1.473
17	1.553						0.080	1.473
18	1.553						0.080	1.473
19	1.553						0.080	1.473
20	1.553						0.080	1.473
21	1.553						0.080	1.473
22	1.553						0.080	1.473
23	1.553						0.080	1.473
24	1.553						0.080	1.473
25	1.553						0.080	1.473
26	1.553						0.080	1.473
27	1.553						0.080	1.473
28	58.561			12.880	7.728	36.400	0.080	1.473