Land Use Succession in the Marlborough Sounds

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1. Introduction

Much land in the eastern Marlborough Sounds is currently covered by radiata pine forest (either planted or self-sown), or secondary forest and scrub (often mixed with gorse). Because of low returns for radiata pine (exacerbated in these areas by high harvesting and transport costs), some landowners are considering subdivision and alternative land uses following harvest. Alternative land uses following subdivision include continuing in radiata pine forestry, the establishment of mixed forests of indigenous and exotic tree species, and restoration of indigenous forest and wildlife. Each of these has a different mix of economic, environmental and social outcomes.

Marlborough District Council (MDC) want land-use change to be managed to ensure the best possible economic, environmental and social outcome. In the Marlborough Sounds, vegetation transition from radiata pine forest involves containing natural radiata pine regeneration, minimising the impacts of land disturbance from harvesting, and successfully establishing an alternative land cover. This transition needs to occur without compromising environmental values (e.g., soil and water), and ideally with increases in some of these values (e.g., biodiversity).

This report is a preliminary exploration of issues and possible approaches to facilitating environmentally and economically sound transitions in vegetation cover. It is recommended that MDC now approach Envirolink for a medium advice grant to consolidate and expand on the available information, as the basis of strategy development.

2. Background

Land-use changes occur when there is market demand for a legal use that is economically viable. Under the MDC Marlborough Sounds Resource Management Plan, subdivision of land zoned Rural 1 is a controlled activity to a minimum size of 30 hectares. With the current low levels of return for production forestry and the increasing value of coastal property, more land owners are likely to consider subdivision to 30-hectare small-holdings.

MDC have received a subdivision application from Sounds of Forests (SOF) for a property of 400+ ha of moderate to steep hill country at Oyster Bay, Port Underwood. The property consists of a mix of regenerating native forest, radiata pine plantation, and recent pine forest cutover. The planned subdivision is for 11 lots of 30+ ha. MDC have initiated a land-use succession project using the SOF subdivision application as a case study, with the objective of developing best practice land management guidelines for land-use changes of this type.

The Foundation for Research Science and Technology (FRST) has established a research fund (Envirolink) to fund research organisations to provide Regional Councils with advice and support for research on identified environmental topics and projects. The scheme supports Regional Councils in two areas of environmental management: adapting management tools to local needs, and translating environmental science knowledge into practical advice.

A $5,000 (excl. GST) grant has been made to MDC to help them identify the information needs and receive advice on science that may be able to support the land-use succession project. This report summarises findings from visits by Landcare Research and Massey University staff to the Marlborough Sounds in April and May 2006.

3. Objectives

This report:

- reviews the drivers, processes, and impacts of land-use change in the Marlborough Sounds.
- identifies the contribution existing science knowledge can make in developing best practice land-management guidelines, and the areas in which knowledge is lacking.
- proposes a series of activities to facilitate the development of best practice land-management guidelines and to initiate research to address knowledge gaps.

4. Methods

Michael Krausse (Landcare Research) and Iona McCarthy (Massey University) visited Port Underwood and Blenheim on 10 April 2006. During the visit they viewed the SOF property and met with Paul Millen (Millen Associates Ltd, contracted to MDC as project coordinator), Mike Bell (MDC Biosecurity officer), Dave Stark (Valuer, Alexander Hayward Ltd), Ron Sutherland (Executive Officer, Marlborough Forest Industries Association), Paul Williams (RMco and consultant to SOF), and Ian Shapcott (MDC Policy Analyst and project manager).

Bruce Burns (Landcare Research) visited Port Underwood and sites in Queen Charlotte Sound with Paul Millen on 12 May 2006.

This report is based on observations and discussion during those visits, a brief review of relevant research, and reflections on the critical factors in the land-use change processes that were observed.

5. Results

5.1 Drivers, processes, and impacts of land use change in the Marlborough Sounds.

The determinants of land use and land-use change are complex. A simple model of land-use change that incorporates elements commonly considered to be involved is that of Stavins and Jaffe (1990) in which land use is related to expected net returns, the costs of land-use change, and the relative risk of alternate land uses, i.e. factors that determine expected utility. Recent research supports this. Kerr and Hendy (2004) use product price indices as surrogates for net returns and show there is a good relationship between sheep and beef prices and the share of rural land in this use, with land-use share lagging prices by 3–4 years.

The relationship between forest product prices and the share of land in forestry is, however, less clear. The rate of new planting appears to be reasonably closely related to forest product prices but the total share of forestry has increased steadily until very recently, regardless of short-term price fluctuations. The latter trend may be abating. Recent years have seen conversions of forest land to pastoral use in the central North Island with increased prices for dairy, sheep and beef products and improved conversion methods making conversion economically viable. The SOF proposal to convert land to coastal small-holdings in the Marlborough Sounds could be seen as consistent with a trend for movements in expected net returns to drive land use.

The conversion costs of land-use change are likely to result in some inertia in the responsiveness to changes in net returns between land uses. In the case of long-lived crops like forests, land tends to be converted at the point of harvest, which in turn is sensitive to prices at maturity. The age-class distribution of forests in Marlborough District, including the Sounds, highlights the increase in the area of forest reaching harvest age at the present time.

Table 1: Area/Age-class Distributions in Marlborough as at 1 April 1999

	Age class (years)											
Territorial Authority	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-50**	**51-60**	**61-80**	**Total**
Marlborough District	25 131	10 405	12 810	9046	9129	4438	333	50	18	20	9	71 389
Total (ha)	**46 742**	**26 909**	**25 762**	**26 375**	**27 335**	**15 411**	**2750**	**570**	**321**	**123**	**192**	**172 490**

Source: Ministry of Agriculture and Forestry

An additional source of revenue that may in future influence returns to particular land uses is the growing number of ecosystem markets being established worldwide. Examples of these include active Carbon markets in Europe and Australia, markets for wetland restoration and pollution emissions credits in the USA, markets for trading salinity credits in Australia, and market-based mechanisms for purchasing biodiversity conservation and water quality protection in Central America and Australia (see **http://www.ecosystemmarketplace.com/**). Elements of this approach are being considered in New Zealand for managing water quality issues in Lake Taupo and the Rotorua Lakes.

The processes of land-use change observed during our visits to the Marlborough Sounds are summarised in Figure 1. The costs of land-use change do not all fall on the land owner or potential purchaser. The environmental costs of vegetation transition and the construction of impervious surfaces (batters, roads, house sites, roofs etc) – increased surface runoff, potential sedimentation, changes in the resident population and in employment, visual and amenity impacts – can be significant and are borne by the wider community. Quantifying these is difficult and very limited data are available that are directly relevant to New Zealand or to the particular context of the Marlborough Sounds. A summary of the methods used to quantify some of these values is included in Appendix 1.

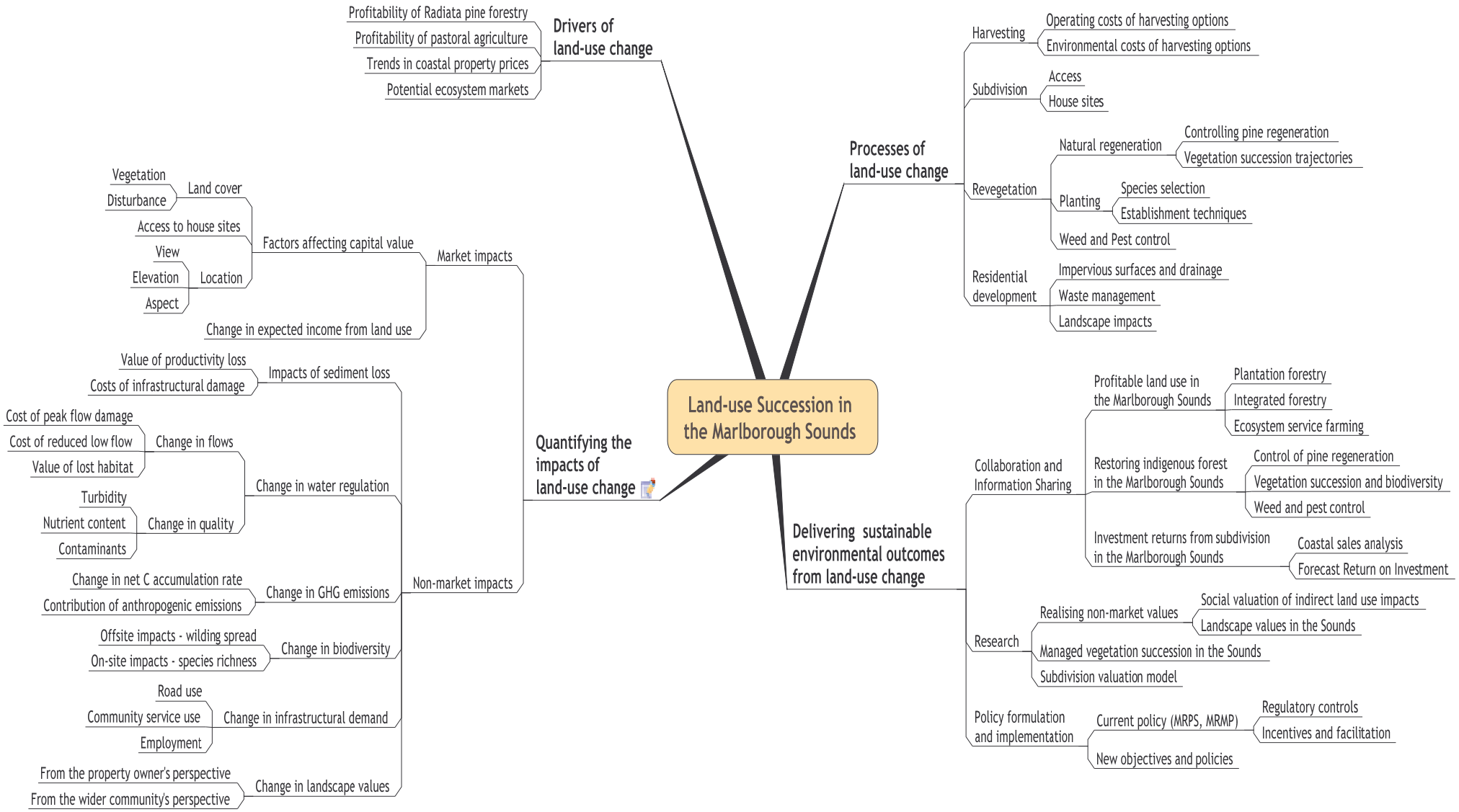

Fig. 1 Aspects of Land-use Succession in the Marlborough Sounds

5.2 Existing knowledge

A number of sources of information exist or could be reasonably easily collated to support landowner and Council decision making on land-use change and subdivision. Fundamental questions for any landowner considering land-use options are the profitability of the alternatives, the expenditure or investment required, and the impact of land use on property value.

Profitability of land use alternatives in the Marlborough Sounds

The present land-use pattern in the Sounds is, in part, the product of a series of Government-led encouragement schemes. In some cases the expectations created at the time of development have not been realised. The MDC would benefit from up-to-date, independent information on these issues to support planning and policy development, and could provide this to landowners.

1. Plantation forestry with *Pinus radiata*

The two major issues with respect to the profitability of radiata pine in the Marlborough Sounds are (1) the impact of forecast long-term log and timber prices and extraction costs on expected rates of return on investment, and (2) wood quality characteristics of logs grown in the Sounds and their implications for silviculture rotation length and value.

Data and potential sources are as follows:

- Current growing and extraction costs (Marlborough Forest Industries Association or local consultants).
- The quality and value of logs produced from the Marlborough Sounds (Marlborough Forest Industries Association or local consultants).
- Forecasts of the long-term outlook for radiata pine log and timber prices (Ministry of Agriculture and Forestry, DANA consulting).
- Expected rates of return for alternative productive enterprises, e.g., pastoral farming (Local agricultural consultants).

2. Alternative approaches to forestry

There are a number of potential models for this approach. Tai Tane Forest in Queen Charlotte Sound, and the Miller report on the Millig property in Keneperu Sound are two examples. The latter includes a detailed economic analysis by Wrightson Forestry Services. Regular review of the operational costs and log-price forecasts used in that report would provide a valuable dataset for MDC staff and new landowners. The principles of integrated or landscape-based forest design have been described and used for over 30 years and there are a number of consultants experienced in their use in New Zealand. MDC could consider contracting the development of a specific set of design guidelines for the Marlborough Sounds.

Data and potential sources are as follows:

- Species selection and growing costs (ENSIS, Marlborough Forest Industries Association, local consultants).
- Forecasts of the long-term outlook for specialist species timber prices (ENSIS, Ministry of Agriculture and Forestry, NZ Farm Forestry Association).
- Landscape planning principles for the Marlborough Sounds (Local consultants, Lincoln University).

3. Ecosystem markets

Ecosystem markets are being rapidly developed in Australia, Europe, and North America, and are being considered in New Zealand. The inclusion of additional revenue streams for non-consumptive services provided by a land use may alter its profitability relative to alternative land uses or its ability to return a level of profitability above a trigger-level. A review of markets and projects being implemented in Australia and North America would provide MDC with models of incentive mechanisms that might be appropriate in the Sounds, and a summary of prices already being achieved would provide land owners with some indication of the type and magnitude of possible future revenue opportunities.

Data and potential sources are as follows:

- Valuation of ecosystem services in New Zealand – methods and studies to date (Landcare Research, Lincoln University)
- Principles and options for the use of market based instruments to purchase ecosystem services (Landcare Research, The Treasury)
- Case studies of Australian ecosystem service markets (Victoria Department of Primary Industries, Landcare Research)

Key issues for vegetation management

1. Management of *Pinus radiata*

The three major issues for radiata pine are determining what areas of pine can be harvested, managing pine regeneration after removal, and removing pine forest that can not be harvested.

Guidelines to determine which pine is potentially harvestable would be based on both environmental and economic considerations. Harvesting some pine blocks should perhaps be avoided for environmental reasons, e.g., harvesting on steep slopes or around waterways may lead to undesirable degradation of soil and water values. It may be unprofitable to harvest other pines under current economic conditions of high extraction and transport costs.

The spread and invasion of pine is determined by its ecological characteristics. Understanding these characteristics can lead to effective management strategies to prevent or reduce the spread of pine. Pines do not generally invade intact forest (Richardson et al. 1994). Invasion generally occurs after some form of disturbance, such as fire or logging, causes soil disturbance and creates gaps in the canopy. The vast majority of seed falls close to the parent tree, although a few seed can be dispersed long distances by the wind. Seedlings develop best in full sunlight and the best seedling bed is moist mineral soil free of competing vegetation. However, seed is not persistent in the seed bank (Moles & Drake 1999), so there is a short invasion window after disturbance when a site is particularly susceptible to pine invasion. These considerations suggest that pine management is possible to prevent pine spread. This could be accomplished by not allowing an invasion window to open up (e.g., poisoning or ring-barking pines in situ), or managing regrowth before cones are produced. Further work would be necessary to document and photograph a range of situations in the Sounds that could be presented to landowners as case studies. These would vary in terms of management approach (e.g., different ways of controlling pines and their consequences) and at different times since that management approach was applied.

Data and potential sources are as follows:

- Control of pine wildings (MDC, ENSIS, Landcare Research)
- Control of pine regeneration (Landcare Research, ENSIS, Local consultants)
- Removal of mature pine forest without harvesting (Landcare Research, ENSIS, local consultants)

2. Vegetation succession and biodiversity

The main issues with current vegetation succession in the Marlborough Sounds are the absence of seed sources of many formerly dominant and long-lived forest species (Walls & Laffan 1986), small populations of some important seed-dispersing birds, e.g., kereru for tawa, and the probable inability of the beech species to naturally disperse into secondary forest because of the absence of their mycorrhizal symbionts in the soil. As well, many successions begin with gorse, which has an influence on the trajectory of succession (Williams 2005). The current dominant species in forest successions in most places in the Sounds are a number of pioneering short-lived shrub hardwoods, e.g., five-finger, mahoe, wineberry, koromiko, and tree ferns (mainly mamaku). Without some form of intervention (e.g., planting, seeding) to facilitate the introduction of species of more developed indigenous forest, many areas may not reach the potential biodiversity values of which they are capable (or at least within a reasonable timeframe).

Landowners in this area do not have clear guidelines to (1) evaluate what possible options for vegetation cover could occur on their properties, and (2) manage those vegetation transitions. A second-stage Envirolink project would allow the development of these guidelines based on existing management experience and information, and the presentation of these guidelines to landowners. Again, a range of situations would be documented and photographed in the Sounds and presented to landowners as case studies. In this case successional changes with time in vegetation communities would be documented. Such information could be presented to landowners in workshops or in an information leaflet.

Data and potential sources are as follows:

- Vegetation successsions (Landcare Research)
- Management guidelines (Landcare Research, Local consultants)

3. Other biodiversity options

Particular vegetation and pest management options incorporated into land management can have significant effects on wildlife populations. Many bird species are limited by predation, and many initiatives within New Zealand now significantly reduce predator numbers (including mustelids, cats, possums and ship rats), which results in increased bird populations. One model is to intensively manage a core area for bird populations that then contributes to increased bird presence over a larger region (the 'halo' effect). The various peninsulas of the Marlborough Sounds make the area ideal for such an initiative.

Food resources may not limit population size but do determine bird movement, and therefore the ability of birds to disperse seeds. Planting bird-attractant plants as part of vegetation management may help disperse seed throughout the region.

Data and potential sources are as follows:

- Species selection (Landcare Research)
- Pest control strategies (Landcare Research, MDC)

Subdivision in the Marlborough Sounds

There are two issues to consider in relation to the potential for subdivision of large properties in the Sounds. The first is the likelihood of such subdivisions increasing in number under current planning rules. The second is the impact of subdivision on the District economy, infrastructure and rural environment.

1. The economics of rural subdivision

An increase in rural subdivision in the Sounds is likely if net returns from subdivision are greater than net returns from alternative land uses. The SOF case study provides an opportunity to investigate the economics of rural subdivision in the Sounds first by assessing value pre-subdivision based on analysis of larger Sounds property sales. This value can then be compared with value of the subdivisible block using hypothetical subdivision budget and discounted cash-flow methodology. This analysis will provide an indication of the land owner's return on property development.

Data and potential sources are as follows:

- Analysis of sales in the Marlborough Sounds area and other relevant coastal sales information (e.g., CHH recent coastal sales) (Alexander Hayward Ltd, Massey University)
- Subdivision development costs (Property developer)
- Economic evaluation of subdivision alternatives (Massey University, Landcare Research)

2. The impacts of rural subdivision

The Marlborough Sounds Resource Management Plan has as a key objective the protection of the character and amenity of rural areas. The aim of the associated policies is to "maintain existing and encourage new activities and sources of employment; allow sustainable distribution of utilities and services; and protect rural resources". The economic impact of a reduction in the area of plantation forestry can be estimated using regional input output analysis and income and employment multipliers for the forestry sector. The impact on infrastructure (roads, schools, and utilities), the visual effect of buildings and ancillary structures, and the change in rural character including privacy, rural outlook, spaciousness, and quietness, are less easily quantified.

Data and potential sources are as follows:

- Regional economic impact of land-use change (Landcare Research)
- Social impacts of land-use change (Taylor Baines, Lincoln University, Landcare Research).

5.3 Supporting Research

Realising non-market values

The range of non-market values associated with rural land use in the Marlborough Sounds (Figure 1) is not unique. The relative importance of the individual values is, however, quite different from that in other contexts. Of particular importance in the Sounds is the impact of land use on visual amenity, on biodiversity and on social infrastructure (roads, employment) while impacts on carbon sequestration are less important (moving one forest type to another). Impacts of land use on sediment movement and water quality are critical in the Sounds, given the steep slopes and sensitive marine environments. MDC have existing land disturbance, vegetation removal, and riparian management controls that are designed to manage these

effects. While the process of vegetation transition from one forest cover to another may result in significant increases in sedimentation or deterioration in water quality over a limited period, long-term rates of sediment loss should not be significantly affected.

Potential economic valuation research that would assist the Project

- Realising landscape values associated with different land uses by:
    - quantifying landscape values using a stated preference survey of residents, visitors, and tourists (ferry passengers). The survey could use a series of alternate landscape options, including the following elements: houses and buildings, jetties, shrubland, wilding pines, forest plantations, and indigenous forest
    - evaluating alternative methods of linking land-use policy to landscape values.
- Realising the biodiversity conservation values associated with alternate land uses by:
    - identifying an appropriate biodiversity index for Marlborough Sounds environments
    - assessing the biodiversity status of pastoral farms, forest plantations, shrubland, and regenerating indigenous forest
    - evaluating alternative methods of linking payments to increased levels of biodiversity.

Rural subdivision model for the Marlborough Sounds

The SOF subdivision provides an extremely useful case study. Vegetative cover varies widely between the surveyed lots, and as these lots sell the price that the market places on different vegetative covers can be derived. There is also variation in elevation, view, aspect and access to house sites between the lots that contribute a significant part of the property value. Analysis of this information, together with other relevant local and national sales information and development-cost data, can be used to build a model to assess how return on development is likely to vary with cover and house site characteristics.

This will provide useful information for property owners contemplating subdivision, helping them pre-plan roading, logging and post-harvest management to maximise development return. The case study will also provide information on the management and development of small holdings to maximise owners' return on investment in the current market.

Potential Property Valuation Research that would assist the Project – SOF case study:

- Interview the purchasers to identify features on which they placed importance when buying the property
- Combine harvest and post-harvest management costs with income from sales of small holdings to assess return on investment in a subdivision development
- Gather data on purchasers plans for property management and development
- Build a profile of return on investment in a small holding for the range of land uses identified, allowing for properties of varying slope, aspect, access and soil type.

6. Conclusions

MDC have subdivision controls in place that provide a framework to maintain rural character and amenity. These controls are underpinned by the goals of sustaining the potential for productive use, protecting vegetation cover (for both visual amenity and soil and water conservation purposes), and avoiding conflict between adjoining activities.

The subdivision of large properties into small-holdings has the potential to introduce a range of new landowners with limited experience and knowledge of rural land use and management. These owners may require additional support and information to ensure the objectives of the Resource Management Plan are met. The Oyster Bay case study provides an opportunity to:

- examine the economic, environmental and social outcomes of a subdivision decision,
- develop guidelines for future subdivisions in the Marlborough Sounds, and
- explore the potential for innovative policies and programmes to influence environmental outcomes.

This discussion paper has reviewed the complex array of factors involved in the process of land-use change in the Marlborough Sounds. It identifies areas of existing knowledge that could help MDC and landowners in land-use policy and land-use decisions, and proposes some additional research to support the process. The development of new policies and programmes would be a second phase to the process, based on the foundation of existing knowledge and research proposed in this report.

7. Recommendations

That the MDC request an Envirolink medium advice grant to support the preparation and presentation of information on:

- profitable land-use options for the Marlborough Sounds
- restoration of indigenous forest in the Marlborough Sounds
- subdivision in the Marlborough Sounds

That MDC, Landcare Research and Massey University:

- agree on a set of research priorities, and
- jointly seek funding to initiate a small number of high priority research projects to support the land-use succession project.

8. Acknowledgements

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Appendix 1 Methods for Valuing Forest Ecosystem Services

Valuation approach	***Methods* – what is valued**	***Examples of application***
Market prices Values directly based on market prices of goods or benefits, or indirectly analysing costs or benefits of maintaining non-market assets	*Preventative expenditure:* costs to prevent environmental damage	Pest control; erosion control
	Productivity method: change in production due to environmental impact	Effects on tree growth due to nutrient deficit
	Human capital approach: effects of environmental conditions in health	Health costs of pollution-related illnesses
	Replacement cost: cost to replace something damaged	Cost to restore tracks lost in harvesting
	Opportunity cost: alternative uses	Value of preserving forest blocks
Surrogate market Values indirectly using any indicator that can reflect what people are willing to pay to avoid adverse environmental effects	*Travel cost:* environmental good in terms of cost associated with travel and time	Recreation value of plantation forest blocks
	Hedonic price: environmental quality based on property prices or wages	Landscape value of plantations
	Proxy good: marketed good to estimate value of environmental good	Value of recreational amenities in plantations
Stated Preferences Determines the strength in consumer's preferences for goods and services that are not currently marketed or closely related to any marketed goods.	*Contingent valuation:* preferences for goods and services that are not marketed	Value of conservation of habitats forest state
	Contingent ranking: Preferred rank alternatives for resource allocation	Most valuable environmental assets in plantations
	Trade-off game: choice between alternatives reflecting benefits and costs	Value of water quality protection
	Choice experiments: choice of alternatives based on their attributes	Value of erosion control by plantations

Source: Rivas Palma R 2005. Social and environmental valuation as a tool for forest management. New Zealand Journal of Forestry 50(1): 23–26.