Beere Property

Restoration Notes

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on behalf of: Tasman District Council
for: The owners of the Beere Property

July 2004

Introduction

The site was visited as part of the TDC Biodiversity Advice Service as a result of an approach by the landowners. The purpose of this report is to outline the opportunities for restoration of the parts of the property to vegetation communities typical of what once grew here.

The site was visited by John Preece on 28th January 2004, and this report was produced on 12th July 2004.

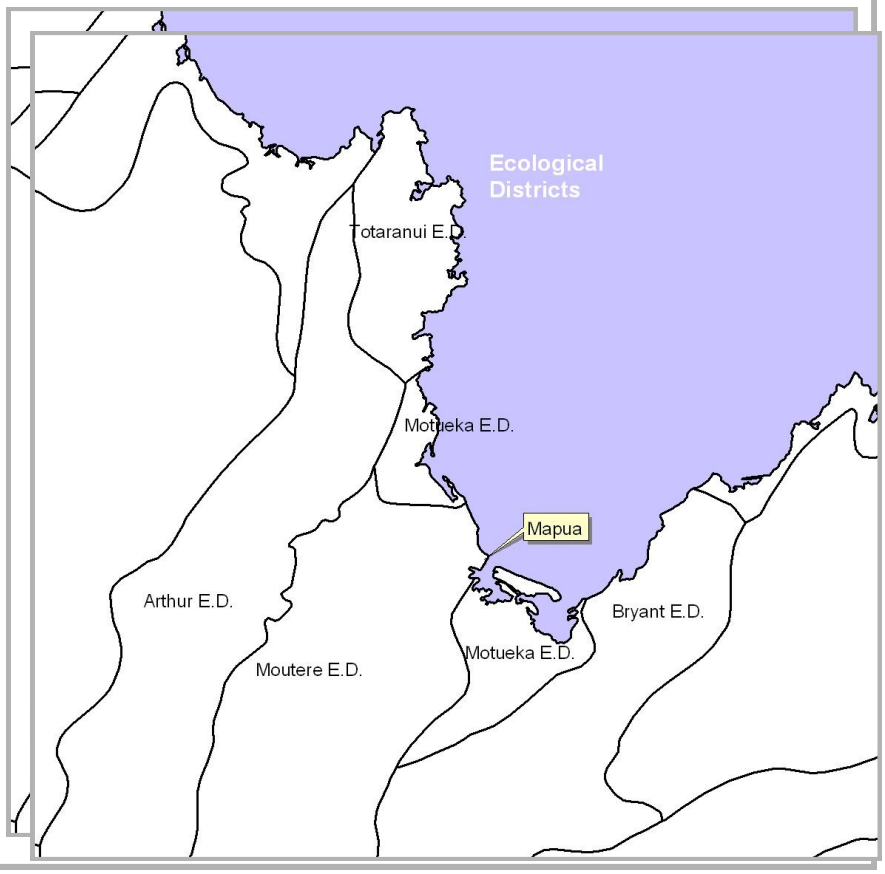
Background

Location details

The wetland is situated near Mapua, about 16km west of Nelson, and about 400m northwest of the township of Mapua. The surrounding land use is dominated by orchards to the west, recreational use of Aranui Park to the immediate north, and residential development to the east and south. The legal description of the land under consideration is Lots 1 and 2 DP1358.

Property in context

The property is in the Moutere Ecological District. Ecological Districts (ED) are a tool used to group areas with similar ecological characteristics together. The map below shows the ED's for lowland Tasman Bay. The geology of this area is characterised by Moutere Gravels, a formation extending from Nelson Lakes National Park through to the coast (best seen at McKee Reserve). This material is glacial outwash from the Southern Alps, and has developed it's own distinctive landform as erosive forces have reshaped the materials originally deposited from glaciers. The hills are rounded, of similar height and regular drainage pattern. Soils are typically of low - moderate fertility, and have clayey textured pale-coloured subsoils with impeded drainage. This is one of the lowest rainfall areas in Nelson, and has high sunshine hours. Rainfall is approximately 920mm and this area is exposed to high rainfall events from the north. The property itself includes the meeting place of three different geological units; the Moutere Gravels on the hills to the west, alluvial deposits derived from the Moutere Gravels on the flats, and beach deposits to the east. These different geologies supported very different communities, with broadleaved coastal forest on the beach deposits (now represented only at McKee Domain), beech forest on the Moutere gravels, and podocarp forest on the alluvial soils (including swamp forest in the wetter areas - now extinct from this ED). Wetland loss from this Ecological District is about 93% - this is further discussed in the section on Potential Values.



Description

This section provides a brief description of the current vegetation and hydrology on the property as well as an overview of the former vegetation present in the surrounding areas.

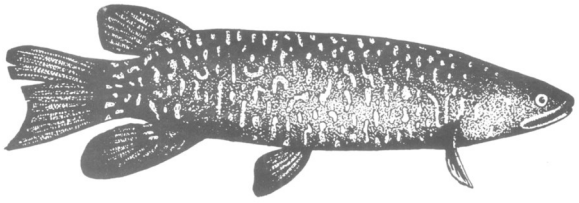
Vegetation

The original vegetation of the flats has been completely removed. Now there is only pasture grasses and sedgeland (*Carex geminata*) as shown on the right. Small clumps of *Carex secta* and the rush *Juncus sarophorus* are found nearby on Aranui Park.

Former Communities

The original vegetation of the flats and most of the surrounding areas has been removed. There are three different geological formations in close proximity to the property. The hills to the west are Moutere Gravels, at least some of which were open when Europeans first arrived. This was almost certainly the result of Maori burning the area. Most of the Moutere Hills grow beech forest. From the north, extending as far as McKee Domain, a narrow tongue of beach deposits extends through the eastern edge of Aranui Park and this property and continues south maintaining a narrow strip to the west of Aranui Road all the way into Mapua, and eastward till it contacts the sand of the dune deposits on the seaward side. On the beach deposits grew coastal forest, of the type now represented only by the small area growing at McKee Domain. Extending down from Seaton Valley and separating the Moutere Gravels from the beach deposits are alluvial deposits derived from the Moutere Gravels. It is these areas which had swamp forest growing on them. So within a few hundred metres was the beech forest on the hills, the kahikatea - pukatea dominated swamp forest on the alluvial flats, and the broadleaved coastal forest on the beach deposits, dominated by titoki, ngaio etc. This made for a little centre of biodiversity centred almost on the property. The map on the opposite page shows the approximate extent of the former forests. This is a best approximation only, and is probably nearer to a pre-Maori state than pre-European.

The streams close to the coast were full of native fish, and it is likely that the main stream draining Seaton Valley would have had several of the species which make up the whitebait catch, including inanga (*Galaxias maculatus*), Banded kokopu (*G. fasciatus*), Giant kokopu (*G. argenteus*) and possibly shortjawed kokopu (*G. postvectis*). Banded kokopu and inanga are still found in the some streams, but Giant kokopu (below) and Shortjawed kokopu now only occur in a small handful of sites in Tasman Bay.



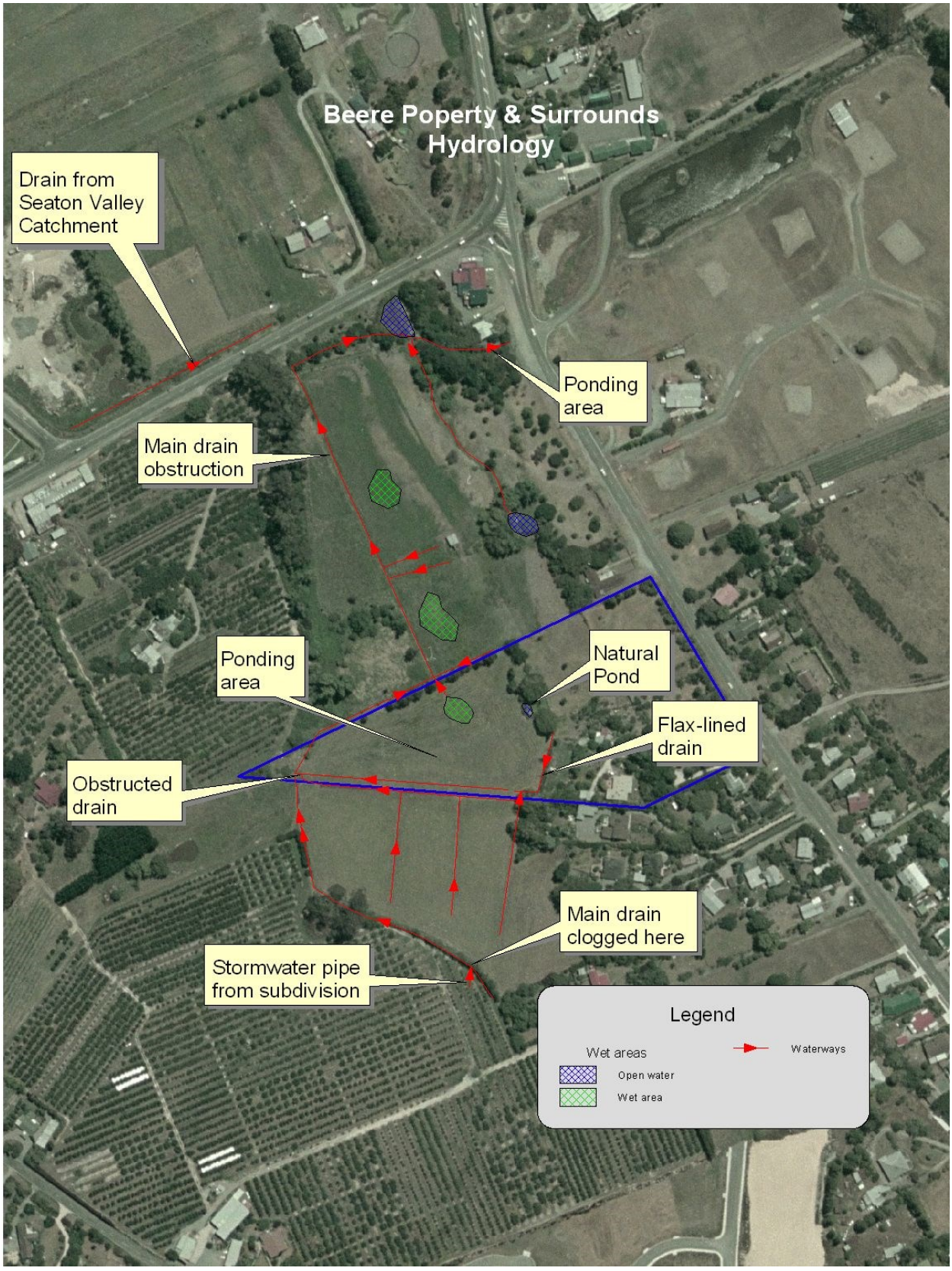
Former Vegetation

Hydrology

The hydrology of the area has been extensively modified to the point where it bears little resemblance to the original situation. This is a low lying area with only a very slight gradient, so it is prone to inundation during and after periods of high rainfall. There are three potential sources of water to the flats; rainwater, groundwater, and surface water. Rainfall in this area is not high compared to areas further inland or to the west. Rainfall by itself would not be sufficient to allow for the development of wetlands in this area. However, surface water makes a significant contribution to the hydrology of the area, especially during rainfall events. The valley of the Moutere River has similar rainfall and now parts are irrigated because water is scarce. Many dams have been created to overcome the water shortage. When the first settlers arrived the same area was considered a major barrier to travel. The Moutere River was "a slow silent stream, too deep to be fordable", and "the wood is wet, cut up by deep watercourses which are rather dangerous to pass by means of felled trees with a load on one's back". The Moutere Valley once had almost 1000ha of wetland, now there are almost none. The factors which sustained this large area of wetland in what is now a dry landscape were the gentle gradient of the valley, the nature of the alluvial soil derived from the Moutere Gravels, and impeded drainage resulting from the vegetation. The key was the gentle gradient and impeded drainage which slowed the water down as it passed through the system resulting in a long retention time for water in the system. The creation of the Company Ditch, numerous other drains, and removal of the vegetation was all it took to convert wetland to dryland. The situation here is somewhat similar in that there is a very low gradient and the same soils, which combined with dense vegetation to slow down the passage of water would have allowed the development of wetlands. Another potential source of water is groundwater. This may be more significant than is immediately apparent. This area is not only flat but also very low lying and possibly has quite a high water table. This would mean that any rainfall and surface water which flows across the flats only has a short distance to infiltrate the soil before it encounters the water table. Therefore relatively small rainfall events can result in a lot of surface water appearing.

The above discussion is largely about the source of the water which flows through the property. There have been many modifications to the hydrology which have resulted in major change to the natural situation. Removal of forest cover and drainage are the major issues, as well as diversion of water through the property which originates in a different catchment. The next page shows the key hydrological features. An example of a drain is shown in the photograph below. This is on the neighbouring property and shows the low gradients and lack of effectiveness in removing water from the area. There are a number of possibilities (discussed later) of changing the flow paths and regime of water flowing through the property (and surrounds) if this is considered desirable.

Hydrology (Cont.)



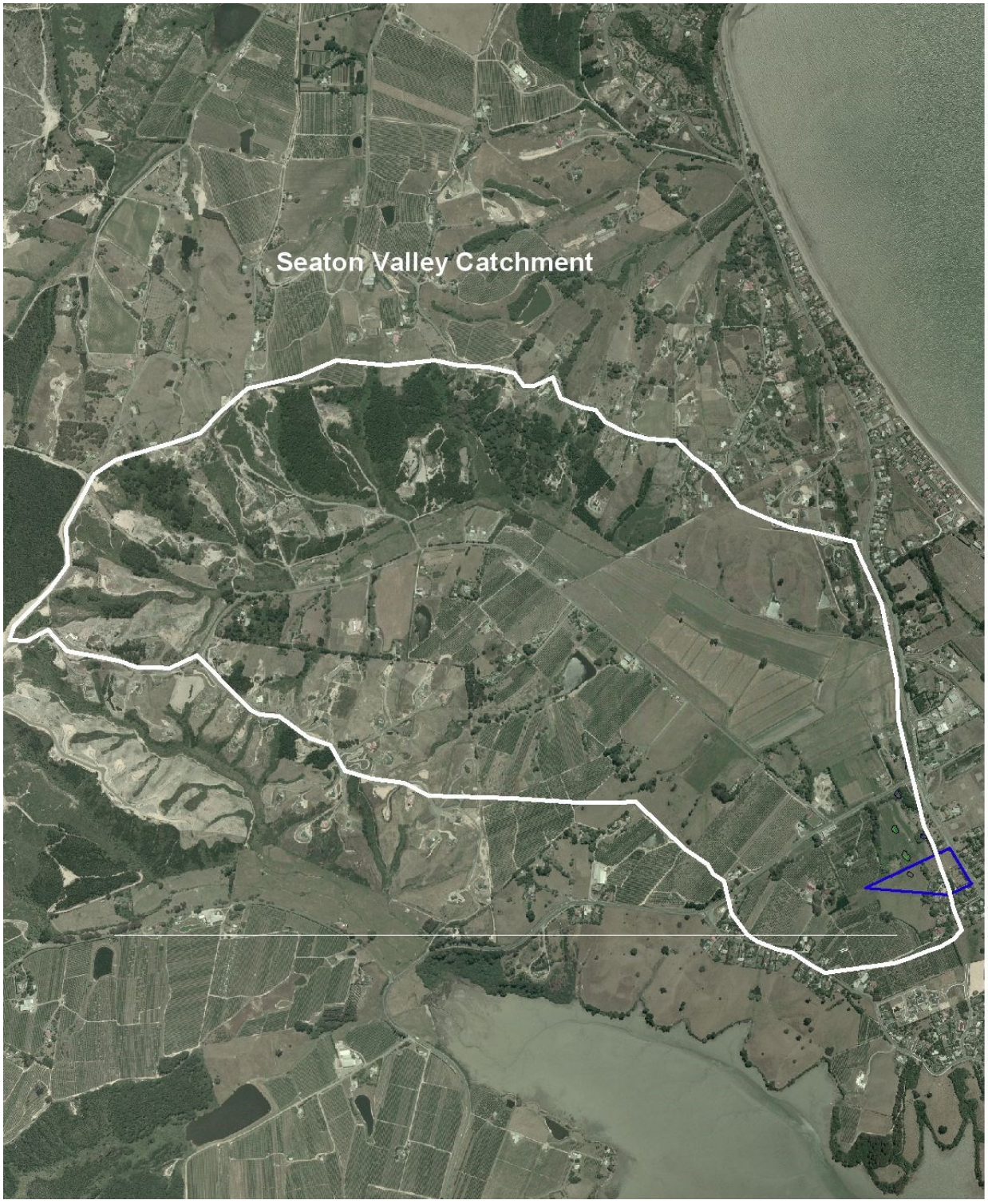
Hydrology (Cont.)

The photos below (taken by David Mitchell) show the amount of surface water flooding which occurs during significant rain events. The top photo was taken on June 29th 2003, and the bottom photo a few days later.

Some discussion as to the origin of water on the property is justified. It is important to understand the origin and passage of water in order to ensure that management of water both on and off the property meets the overall management objectives. It appears that there is a constant base flow in the drains which is derived from groundwater flow from the hills to the west and south. During rain events considerable water is discharged via the pipe which drains the subdivision. Run off from the surrounding area is inhibited by the low gradients, the obstructed drains, and the run off from water from the Seaton Valley Catchment. It is very likely that runoff from Seaton Valley is a significant contributor to water which accumulates south of the main road.

Hydrology (Cont.)

The map below shows the catchment of Seaton Valley and Beere Property/Aranui Park. The area outlined is approximately 317ha, while the Beere Property/Aranui Park part of this is about 28ha.



Restoration Opportunities

There are a number of opportunities for ecosystem restoration and/or creation both within the property and on adjacent areas. One possible vision is the restoration of areas of all three types of forest (swamp forest, coastal forest, and hill forest) which once occurred in this locality. The distribution of these forests was very closely related to the underlying geology. It should be noted that the geology is mapped at a scale better suited to a wider context so the lines shown on the map must be considered as indicative only. A little digging with a spade should easily determine the difference between alluvial soils and beach deposits, and the Moutere Gravels will be on the hills.

On-property

The greatest potential within the property is for the restoration of an area of swamp forest. This is what formerly grew here and restoration is technically possible providing some redistribution of water is practical. There would appear to be very little opportunity for restoration of beech forest on Moutere Gravels because little of it is present on the property, but some suggestions are provided for species to plant in in areas where it would once have grown. There are also some beach deposits on the property. This raises the possibility of restoring some Coastal forest on the property. While this was not part of the original brief very few opportunities exist to create such forest. Another option within the property is the creation of a wetland of a type which was not originally present. Having an open water wetland in the foreground of tall swamp forest creates a fantastic view and shows off the forest to it's best advantage, especially if viewed with some elevation. This photo to the right shows the kahikatea/pukatea swamp forest at Mangarakau, with a fringe of raupo and flax. Such a pond on this site would require some excavation and careful design to avoid water quality and quantity problems. An open water wetland requires excavation to create the depth necessary to prevent plant invasion. There are alternative wetland types which could be created here, including a very dense raupo/flax wetland or a pond to maximise wildfowl.

A further possibility is the establishment of some areas on the property of traditional cultural resources such as harakeke. This would be very much compatible with the overall objectives for the property and fit in well with the swamp forest and wetland concepts.

Off-property

As well as those opportunities on site, there is some potential for both forest restoration and wetland creation off the property. The obvious site is Aranui Park, being in public ownership but currently managed more for recreation than its potential conservation values. It has a substantial area of potential swamp forest and another, smaller area where coastal forest could be re-established. Obviously this is totally dependent on agreement and co-operation from both Tasman District Council and the Mapua-Ruby Bay Reserves Advisory Board. A shared vision is required. The Council have indicated that soon would be an appropriate time to make contributions to the future planning of Aranui Park. The benefit of combining the potential conservation and recreation contributions of Aranui Park and the Beere property are that it is possible to achieve much greater diversity and ecological integrity. The larger an area of forest, the more diversity it has and the more integrity in terms of the ability to provide true forest conditions by reducing light intensity, temperature, wind, and evaporation. There may also be opportunities on adjoining private land. With the proposals for re-zoning there may be neighbours who wish to subdivide and need to make a Reserves contribution. Careful siting of such Reserves contributions could greatly add to the ecological and recreational value of the whole area. Showing that they have thought about where to site reserves so they provide maximum benefit is likely to assist in the processing of any subdivision plan. Some adjacent landowners may like to be involved for other reasons.

The reasons for looking off-site to supplement what could take place on the property are to strengthen the on-site restoration, and to add to the diversity of ecosystems being restored. The table below lists the opportunities available on each property. The purpose of this is not to say what should be, but to point out what could be. By thinking a little wider the end result may be something of extremely high ecological, recreational, and aesthetic value. Even simply making adjoining landowners aware of the opportunities available on their land may be enough to produce a desirable outcome upon subdivision.

Property	Restoration opportunity
Beere	Swamp forest, open water wetland, vegetated wetland, small area of coastal forest
Aranui Park	Swamp forest, coastal forest, open water wetland, vegetated wetland
Brown	Vegetated wetland, open water wetland, swamp forest
Wells	Beech forest, small area of swamp forest

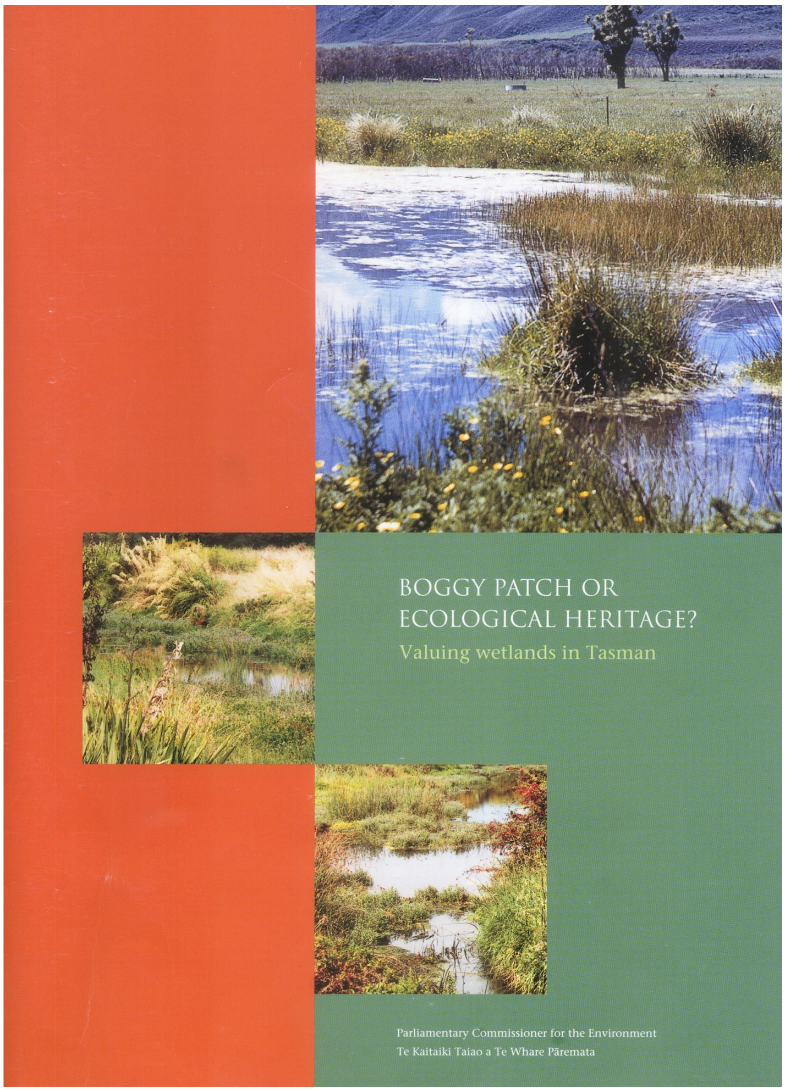
Potential Values

Swamp forest of the type which once grew here no longer occurs in this Ecological District. This is one of the very few sites where restoration of such a forest type is possible; most of the hydrological changes elsewhere are irreversible. Coastal forest is represented only by what occurs at McKee Domain - about 5ha. Beech forest on the Moutere Hills is common further south in the Ecological District but is not found close to the coast in any significant area. To have coastal forest grading into swamp forest, with the possibility of some beech forest on the hills is a rare opportunity, unique to this site. In the long term it would be highly desirable to undertake some restoration of the stream which drains Aranui Park; this flows into Waimea Inlet where another restoration effort is taking place at the causeway. Examples of the type of forest which would have occurred on the wet ground are few and far between. There are none within the Moutere Ecological District, and the closest of any similarity are at Faulkner's Bush near Wakefield and Moss Bush at Riwaka. Faulkner's Bush (shown below right) is beyond the southern limit of pukatea, and probably represents a drier community than that which was present on the Mapua flats. Moss Bush also is drier than Mapua, but both sites have abundant kahikatea. The edge of Mangarakau Swamp (below left) contains both kahikatea and pukatea, but the wetland is of quite a different nature. Restoration of swamp forest, especially if combined with coastal forest is an opportunity which is unique to this location and would be a very significant addition to the conservation values of Tasman District

Potential Values (Cont.)

What is the state of wetlands?

On a world scale, the extent of wetland loss is estimated at about 65%. New Zealand is thought to have lost 85 – 90% of its wetlands, and this is the highest published rate of loss in the world. Many of those remaining are severely degraded. Comparisons between the two major overviews carried out on wetlands over the last 20 years reveal that, despite the advent of the Department of Conservation and the Resource Management Act, there have been few gains for wetlands. The most recent report, from the Office of the Controller and Auditor General, concluded that New Zealand's policies and legislative measures for wetlands do not appear to have been successful in meeting the desired outcome of the RAMSAR Convention (the Convention on Wetlands). At a local level, Tasman District is unusual in that almost two thirds of its land area is in the Conservation Estate. The extent of wetland loss has been estimated as a minimum of 65%. On the lowlands the extent of loss is over 90%, and for private land over the whole District there has been a loss of approximately 97%. Restoration of wetlands of a type which is now locally virtually extinct, combined with another scarce forest type in coastal forest, could potentially result in a very high value conservation area.



Revegetation

There are a number of reasons for planting:

- To attract and retain wildlife
- To re-establish plant communities which were once present in the area
- For landscape purposes to improve the aesthetics of the view from the house and surrounds
- For weed suppression purposes - many weeds are light loving, once they are shaded out it is unlikely they will re-establish
- Establishment of traditional cultural resources

Some plantings are multi purpose; they may achieve all of the above purposes. Revegetation issues are discussed under the headings of planting sites, site notes, spacing, appropriate species, timing, planting strategy, preparation and maintenance, and plant sourcing.

Planting sites

One potential location of planting sites is shown in the map below. The purpose of this is to provide a starting point for further refinement and to begin to establish the potential scale for the restoration activities. It is not intended to be prescriptive at this stage. Putting lines on a map is an effective tool for crystallising thoughts about what is important for management of the property. The

Site notes

The purpose of the following notes is to provide some thoughts about the rationale for planting each site, and the unique features of each site. All sites will contribute to the overall restoration of some key ecological elements of the property. Each site will contribute different features, and collectively they have more effect than the sum of their parts.

Swamp forest

Swamp forest is virtually extinct from Tasman Bay and this property and Aranui Park represent an ideal location to restore this very valuable ecosystem. The site consists of sedgeland and pasture grasses, and is prone to flooding. It is also effectively enclosed within a basin, and therefore has heavy frosts. Some areas are drier than others, and there will be gradations between swamp forest and lowland forest.

Coastal forest

Coastal forest is also much reduced in Tasman Bay, and the opportunities here are significant in terms of adding to the area of this forest type. It is much drier and has less soil than the flats.

Open water

Open water provides the opportunity for a visual feature when viewed from the residential area, and also allows a full sequence from wetland through to forest. This site is currently sedgeland and grassland. Further research will need to be undertaken to determine the optimum site for open water. Appendix 4 provides some principles for best pond design.

Harakeke

The purpose of having an area set aside for harakeke is to establish material which can be used as a cultural resource. In recent times there has also been interest in sustainable harvesting for commercial purposes.

Hill forest

On the hill, which includes the residential area, beech forest would once have grown. Space is limited, but there are possibilities for planting species which are part of the natural suite of species associated with Moutere Gravels.

Spacing

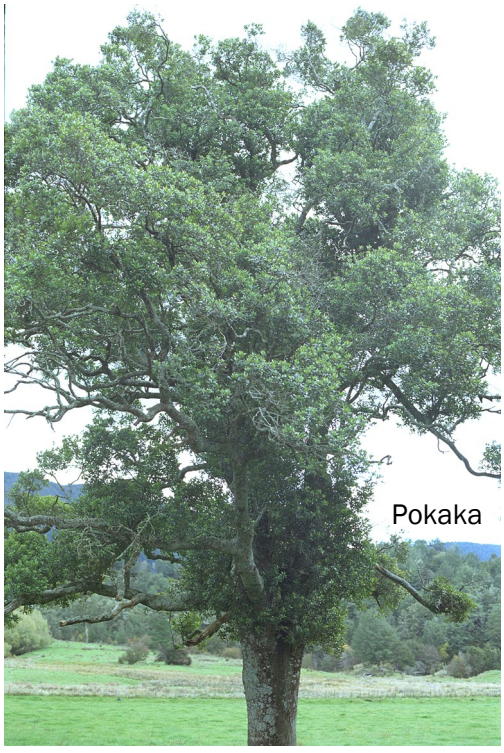
The area occupied by each of these potential revegetation sites is shown in the table below. It also indicates approximately how many plants would be required to plant the sites at varying spacings.

Recommended spacing for wet sites is about 2m between plants, for dry sites about 1m, and for most sites 1—1.5m. The estimates of plant numbers incorporate the spacing above and make allowance for existing plants. In general, the drier the site the closer the spacing. If all the sites shown were planted up at the recommended spacing, a total of about 8,000 plants would be required.

Site	Area (ha)	# Plants —1m	# Plants—1.5m	# Plants 2m	Estimate
Swamp forest	0.695	6950	4650	3450	4500
Coastal forest	0.248	2450	1650	1250	1800
Wetland	0.109	1000	650	500	600
Harakeke	0.157	1550	1050	750	1000
Total	1.189ha	11,950	9,000	5,950	7,900

Timing

Once planted, the key stresses on plants are lack of available water, shelter, and frost. Timing of planting can help alleviate some of these stresses, and may also assist in spreading the workload. Autumn plantings allow the establishment of a good root system while there is still some growth, which helps the plant get through the dry summer typical of the Moutere area. However there is full exposure to the winter frosts, which can be severe in places. Spring plantings avoid the frost but allow little time for root development before the summer. They can be useful where there is plenty of moisture available. Plants in damp conditions tend not to thrive over the cold of winter. Plantings in any wet areas are probably best in spring (September). Any plantings on drier sites would benefit from the extra root development which comes from early plantings (after the rains have come in late April/May). Every site is different and it is worthwhile to trial different planting times. Establishing podocarps can be difficult in wet areas which trap cold air. Podocarps do not like to establish outside the natural frost shadow of existing forest. This is the area a metre or two wide which extends from forest which is frost free. A key to successful establishment is therefore to provide shelter from frost and full sun before they are planted. The initial plantings of colonising species probably need 2 or 3 years before conditions are suitable for planting of the final forest species. Some species do not do well sitting in cold wet soil all winter so are better planted in the spring to avoid either root rot or just plain sulking.



Pokaka

Appropriate species

Each of the planting sites has a group of species best suited to the site. The table below provides suggestions for planting in each of the sites, both for initial plantings and for later when more shelter and shade has been established. This is not an exhaustive list, but will be sufficient to establish a framework of vegetation in each of the sites. Although this is not a full representation of the original communities, these species have a proven revegetation record and will create a functioning ecosystem which will allow the development of more natural communities over time. Full revegetation lists produced by DOC are appended to the report.

	Swamp forest	Coastal Forest	Pond edges	Hill forest
Initial plantings	Flax Karamu Manuka Wineberry Kohuhu Lemonwood Cabbage tree Swamp coprosma	Karamu Kohuhu Kanuka Lemonwood Mapou Akeake Ngaio Manuka Tree lucerne	Flax Cabbage tree Manuka *Carex secta* *Juncus pallidus* Toe toe	Manuka Kohuhu Karamu Lemonwood Tree lucerne
Later plantings	Pokaka Kahikatea Pukatea Rimu Matai Totara	Titoki Matai Black beech		Marbleleaf Black beech

For the swamp forest some species such as rimu, matai, and totara are listed which would normally be considered to belong in a relatively dry environment. These are for the drier sites. Kahikatea and pukatea belong in the wettest sites, with pokaka growing best in damp places.

Preparation and maintenance

Some references are attached in Appendix 3 which include many specifics of revegetation including how to carry out preparation for plantings and maintenance. Any revegetation project should treat some of these books as an investment. The key issue with new

Planting strategy

It is unlikely that all the plants necessary to plant up all possible sites will be available to plant up all at one time. It is worthwhile considering the benefits of planting each site and prioritising areas. One of the key considerations for restoration on this property is the contribution that the plantings could make to landscape values. From the house site virtually all of the plantings will be visible. The plantings which will add most landscape character will be flax and cabbage tree in the short term, and kahikatea in the long term. Cabbage tree are hardy and can be planted in the open, but kahikatea prefer to establish under light shade, so it is an advantage to have some other seedlings underway before planting the kahikatea. In the long term, when shrubland is established, plantings could provide a corridor for birds to travel to and from the house. Research has shown that a number of bird species (bellbird especially) do not like travelling across open areas and establishing a corridor will allow the full range of birds to be seen around the house.

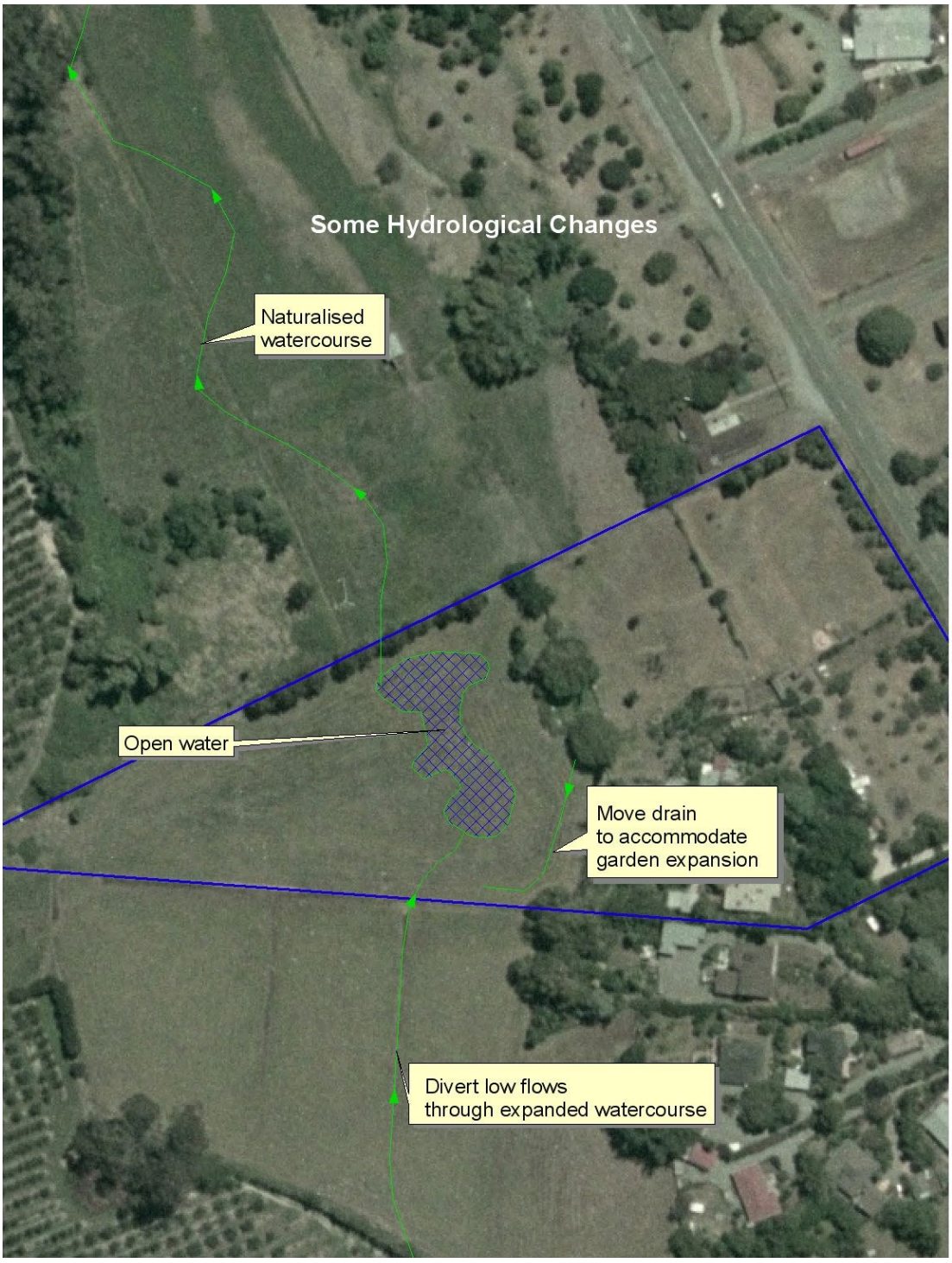
Plant sourcing

There are a number of potential sources for plants. They can be purchased from a nursery for about $1.70 each (bulk price) grown in Rootrainers. This is the best way to purchase most plants, with the exception of some of the larger, forest trees (e.g. kahikatea, beech) which are better grown in planter bags to a larger size before planting. Rootrainers produce plants with well formed roots, they are convenient to handle, take up less space, and have a proven record in revegetation in the Moutere. It is recommended that plants are eco-sourced (see Appendix 6), and one of the local nurseries which will do this is Titoki Nursery. The disadvantage of purchasing from a nursery is that the cost may appear high if there are a lot of plants involved.

An alternative to buying from a nursery is to establish a small nursery at home. This can be a good solution provided it is well set up, and there is somebody who is motivated to provide the labour. These two provisos are essential. Even somebody who is highly motivated will struggle given a poor set up, and the best set up nursery will not grow plants without the motivation and labour of somebody committed to growing the plants. Working in a nursery is good fun and very satisfying, and a large number of plants can be produced from a relatively small area. It is very well suited to the situation where someone is at home on a regular basis. If good systems are put in place, they are not as labour intensive as is commonly thought.

Hydrological Changes

In order to produce the desired results, some changes to the current hydrology are desirable. In general the objective is to divert as much low flow water through the property as possible, while speeding up the discharge of floodwaters. The details of this will depend on the final restoration plan and the willingness of adjacent landowners to participate in this vision. A pre-requisite to restoration and management of the hydrology is to take levels over the area. The map below illustrates some of the possible hydrological changes.



Monitoring

Many restoration/protection projects proceed for several years before it is realised that there is no record of the original state and the changes that have been made as a result of the management regime. Some of the key changes to monitor include the visual appearance from the house, the performance of any plantings, the effectiveness of any weed control, and numbers and species of birds. A simple form of monitoring can be through the establishment of photopoints. This can be achieved very simply by driving 50 x 50 ground treated stakes or waratahs into the ground and using these to take photos at regular intervals (each year, each season etc). Monitoring can provide useful scientific information, but more importantly, is very rewarding for the people actually doing the work.

Other Restoration Projects

The Moutere is an area which has been extensively modified. Few natural areas remain. The recent move from predominantly forestry and farming land use to lifestyle blocks is having a significant beneficial effect on conservation values. There are many individual restoration projects happening (it is estimated that more than a million trees have been planted in the Moutere over the last 15 years) and these are beginning to have an effect on the character of the countryside. In the next 10 years there will be major changes to the quality of habitat available to wildlife, and significant increases to the bird population can be expected.

Sometimes people think that the prospect of restoration of part of their property is overwhelming. The amount of work involved can be daunting, but the key is to build on successes, and to only take on what is practical to maintain.

The photo below shows a damp gully in the Moutere which has been restored from gorse, broom, and blackberry in less than two years.

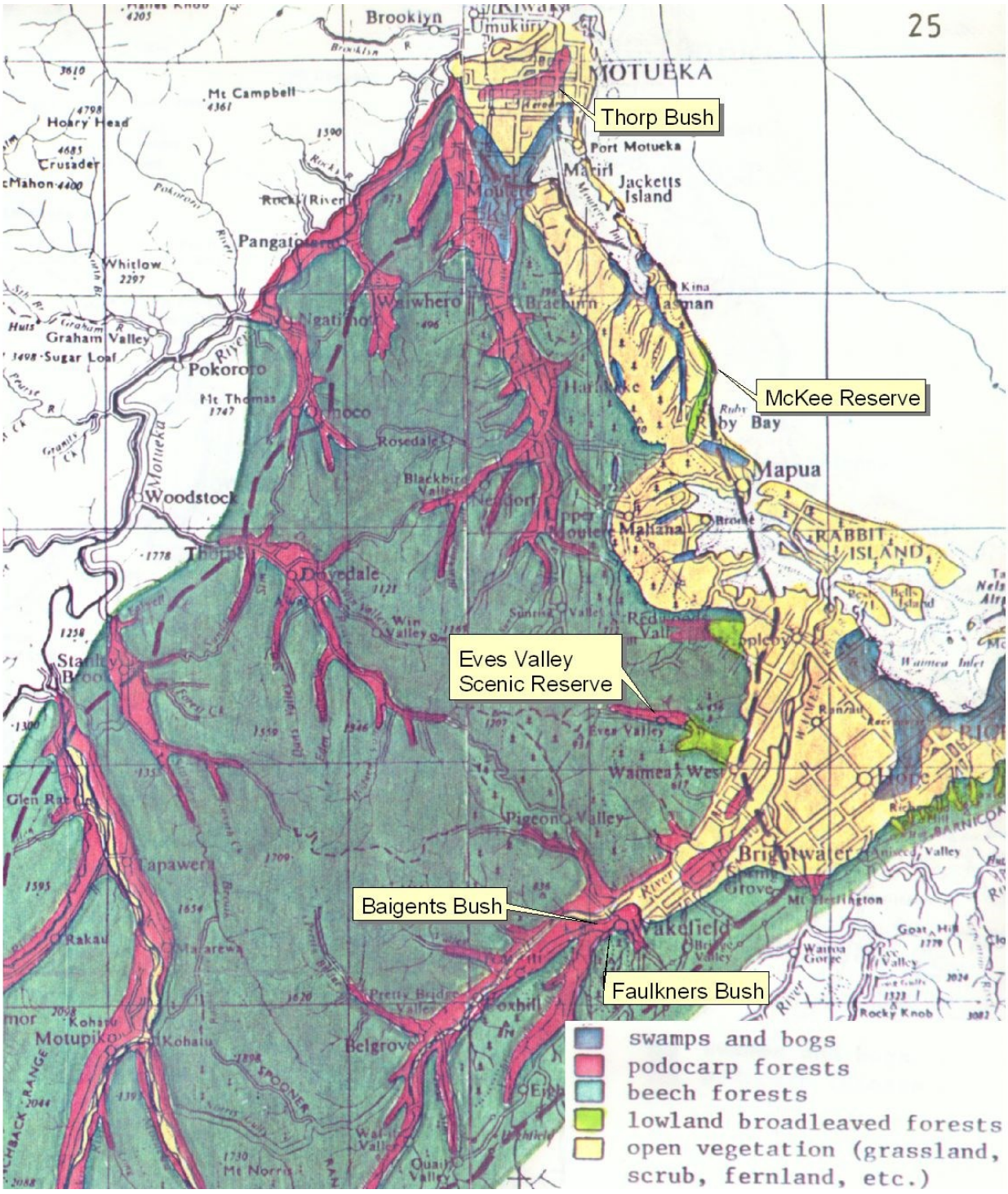
Long term protection - QEII Covenant

If restoration went ahead on a large scale it would be highly desirable to protect the effort by covenanting those areas which had been restored. This would ensure that future landowners could not destroy the restoration works. It may also have the benefit of enabling access to funding to help with the restoration work. This report was produced using funding from the Biodiversity Advice Fund. If landowners are committed to covenanting their area that provides access to the Biodiversity Condition Fund, which includes activities such as revegetation and weed control. This is a contestable fund with no guarantees of success but it may be worth applying. The QEII National Trust is the most commonly used mechanism for covenanting private land. A brochure explaining their work and the process of covenanting is included.

Queen Elizabeth II
National Trust
For open space in New Zealand
Nga Kairauhi Papa

Appendix 1

Former Vegetation of the Moutere Gravels



Appendix 2

Attracting Birds

The Moutere area is rapidly increasing in value to native birds. With lifestyle property developments becoming the dominant use on at least the coastal part of the Moutere Hills, many areas are now being managed sympathetically for their conservation values. The hundreds of thousands of trees which have been planted will become increasingly useful as habitat for birds and the numbers can be expected to increase. Some suggestions for planting are made below—these are specifically meant for planting around house and garden, rather than within the natural areas.

Banksia integrifolia (frost hardy and supplies seasonally important food)

Tree lucerne (*Chamaecytisus palmensis*)

Eucalypt species provide nectar for tui and bellbirds

Kowhai (*Sophora microphylla*)

Flax (*Phormium tenax*)

The Banksia and eucalypts provide seasonally important nectar sources which will encourage birds to stay on the property year round. Kowhai and flax are the native equivalents, and planted close to the house provide great viewing of bellbirds and tui feeding. Tree lucerne provides food for the native bush pigeon (and other species). Tree Lucerne could be tried in any well drained area (not on the valley floor) preferably where there are pockets of soil which are not dominated by clay. They are worth some effort for their ability to attract pigeon. Kowhai and Banksia normally grow on free draining soils, which is sometimes in short supply in the Moutere. Some of the organic soils from pond excavation could be used for some of the species which need more fertility.

Appendix 3

Useful Resources

Subject	Reference
Restoration	Porteous, T. 1993 Native Forest Restoration. A practical guide for landowners. QEII National Trust *The most authoritative book on restoration generally.*
	www.biodiversity.govt.nz/
	Robert Buxton. New Zealand's Wetlands - a Management Guide. *The title is self explanatory.*
	http://www.doc.govt.nz/Regional-Info/010~Canterbury/005~Publications/Protecting-and-Restoring-Our-Natural-Heritage/ Protecting and Restoring our Natural Heritage - A Practical Guide. *An excellent on-*
Identification	Poole, A.L. and Adams, N.M. 1979. Trees and Shrubs of New Zealand. Government Printer. *Covers most of the common species, affordable, uses line drawings.*
	Salmon, J.T. 1980 The Native Trees of New Zealand. Reed. *Probably the most attractive tree book ever produced in New Zealand, full of good photos. Can be inaccurate for some of the lesser known species, expensive, but nice.*
	Smith-Dodsworth, J.C. 1991 New Zealand Native Shrubs and Climbers. David Bateman. *Has a reasonable coverage of the climbers which tends to be lacking in the other books. Picks simple identification features.*
	Wilson, H. 1982 Field Guide - Stewart Island Plants. Field Guide Publications *Although produced for Stewart Island, most of the species in the South Island also occur there and the excellent line drawings are a big help for identification.*
Wetlands	National Wetlands Trust of New Zealand *www.wetlandtrust.org.nz/index.html* *The only organisation with wetlands as the sole focus.*

Appendix 4

Pond design

Parameter	Design feature
Size	Bigger is better - more diversity and long term stability provided by bigger area
Depth	Large shallow areas (less than 25cm) provides feeding areas for wildlife and opportunities for vegetation to establish a wide edge
Temperature moderation	Some areas of 2-3metres depth provides temperature moderation to exposed ponds
Shape	An irregular shoreline maximises the increased diversity and productivity resulting from the edge effect, and helps avoid territoriality in wildfowl, thus increasing the carrying capacity
Edge contour	Edges need to be gently sloping to allow wildfowl easy exit and to maximise edge vegetation providing food and shelter
Connectivity	Use corridors and buffers to allow fish passage and wildlife movement
Water levels	Fluctuating water levels promote diversity and control can assist in establishment of a wide vegetated edge
Fertility	Maximum diversity tends to occur at medium fertility, low or high fertility promotes fewer species
Structure	Greater diversity of structure results in a more diverse community; this can be achieved with depth, shape, islands, vegetation, rocks etc
Disturbance	Less disturbance and fewer structures is better; disturbance inevitably favours weed species

Appendix 5

Nursery Establishment

Establishing a small scale nursery is a practical means of producing plants for revegetation. The establishment of a nursery is considered by first looking at the functions of each of the areas of a nursery, then the physical structure, and finally nursery management. This is only a quick overview, and is not intended to be a complete guide to set up and management of a nursery.

Nursery functions

There are three main areas in a nursery; the shade house, standing out area, and working area.

Shade house

This is the most familiar area of a nursery, with its shadecloth and irrigation system. The main purpose of the shade house is to provide suitable conditions for the germination and growing on of young plants. The shadecloth reduces the intensity of the sun and wind speed creating conditions ideal for propagation of young plants.

Working area

This is the area where plants are potted up, seeds are sown, potting mix mixed, and all materials are stored. A garden shed is useful for storage, while a picnic table which can be moved into the sun or under the shade as conditions dictate is very useful.

Standing out area

The standing out area is an area which is designed to produce hardy plants in the months leading up to planting out. Effectively the plants are put out in the open to cope with natural temperatures and sunlight. It is desirable to do this in several steps to reduce the shock to the plants. Irrigation systems are still essential.

Structures

The main structure is the shade house, but some structures are required for the standing out and working areas.

The base

The engine room of any nursery is the shade house. The key structural elements to the shade house are the base, the supporting structure, the shade cloth, and the irrigation system.

The base has two important functions; to provide good drainage and to suppress weeds. Lots of water is required for irrigation and this needs to drain away to prevent excessive dampness providing breeding grounds for various diseases (especially fungal). Deep shingle is good for drainage (possibly with some actual drains if the underlying soil is poorly draining). It also is effective in suppressing weeds, and other some textiles can be used to perform the same weed suppressing function. Getting the base right can save lots of time in weeding, with a well set up base being basically weed free.

Supporting structure

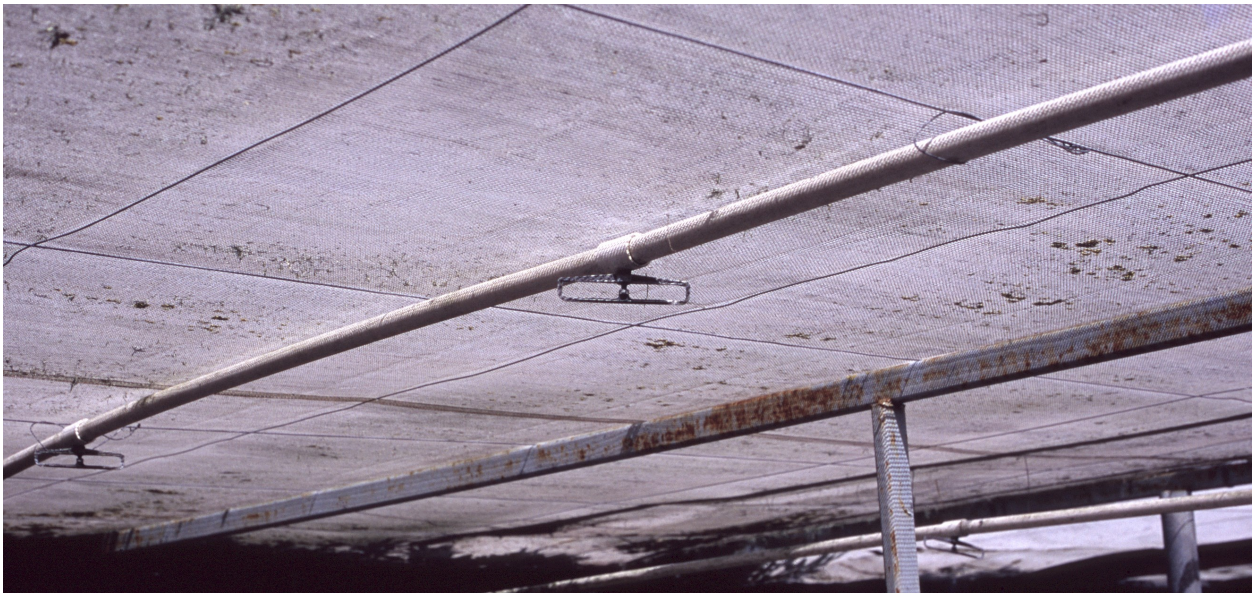
The role of the supporting structure is to support both the shade cloth and the irrigation system, which is usually an overhead system. Because it is constantly exposed to water, resistance to water damage is the key design element. Cost and availability of materials will dictate what type of structure is chosen. The shade house shown in the photo below was largely built from rectangular section steel, welded together, and set in concrete. Other possibilities are iron water pipe, plastic pipe (it can have one end set in concrete, then fill it with hot water and bend it), or ground treated timber. Dimensions depend on what the intended production capacity for the nursery will be. Some idea of the space required could be obtained through visits to the plant nurseries run by TDC, NCC, and DOC Motueka. It is desirable to locate the shade house where it gets plenty of sun.

Shade cloth

The recommended shade cloth is 50% shade, white knitted cloth. Cheaper versions are available, but they are not as good nor do they last as long. The black wind break cloth is not recommended. While it is possible to be innovative and economical in building a shade house, this is one area where economy is not recommended. The white knitted shade cloth in the nursery to the left (DOC, Motueka) has been in place for more than a decade and is still in good condition.

Irrigation system

This is the most critical area of the nursery set up. Many people think it is easy to run a nursery by just giving the plants a squirt every now and then. Invariably it does not work. The key parts to the system are the overhead misters in the shade house (shown below), hose connections for the



working area, the sprinklers for the standing out area (shown right), and most expensively, an automatic watering system. In the shade house the irrigation system must be suitable for germinating seeds, and this means no large drips. A misting system is best. For the stand out area sprinklers with total coverage are required. A hose connection for the working area is necessary to wash tools etc and keep seed trays damp as they are being pricked out. The automatic watering system means that holidays can be taken with relative safety, and the nursery does not become a tie. Cheap ones can be purchased, but the recommendation is to spend in the order of $600—$1000 because these units are reliable, and more sophisticated. Once programmed, they still need to be adjusted for the changing seasons and state of the plants, but the set and forget nature of these systems is worth their weight in gold.

Nursery Management

There is an annual work cycle which starts with collecting seeds from within the same Ecological District. Seeds are ready from about Christmas onwards, depending on the species. There are several patches of bush near to the property which could be used to collect seed from. Seed is then sown in trays, and placed in the shade house. When they have germinated and reached a height of about 5—10cm, they are pricked out into Rootrainers. These are the key to producing large numbers of plants in a small area. They can be purchased new, or it may be possible to get second hand ones from nurseries. Handled carefully, it should be possible to get three seasons use from a Rootrainer. They are best handled in wire baskets, which can be purchased new or welded using No 8 wire. At a pinch packing tape can be used to hold them together. Painting or galvanising considerably prolongs their life. Baskets of plants are placed back in the shade house, where they are left to reach a good height, depending on the species. They are then transferred to the standing out area, where they are hardened off until they are planted out.

It is much cheaper to make potting mix than buy it. A proven mix is equal parts of sand (preferably coarse sand), well rotted sawdust (from untreated pine), and peat. Added to this is some slow release fertiliser. This mix is best made up in bulk at the time of potting up, and it is much better mixed by concrete mixer than by hand.

Normally there are few diseases, but occasionally fungal diseases may be a problem. A fungicide can be used to prevent spreading of the disease. Such diseases are usually an indicator of too much watering or lack of air movement through the shade house.

Some plants are better grown in planter bags than Rootrainers; especially the tall forest trees such as kahikatea. If any beech are grown be sure to include a small amount of soil and leaf litter in the potting mix so that the roots become infected with the appropriate mycorrhiza.

Appendix 6 - Ecosourcing

Eco-sourcing is one of the most important principles of native vegetation restoration. It involves the practice of only using native plants that have been sourced locally from the wild for local revegetation plantings. This includes plants grown from seeds or cuttings that have been collected locally from the wild.

It is important to eco-source for three reasons:

Firstly, it avoids the risk of planting species which are not native to the area, such as karo, North Island lacebark (*Hoheria populnea)*, pohutakawa, rewarewa and northern rata. Some of these species are invasive and may spread into the wild thereby changing the nature of our indigenous plant communities. Such plants will also seriously undermine the purpose of many native revegetation initiatives - to recreate a piece of the original area.

Secondly, it maintains the distinctness of our own local flora. For many species the appearance, physiology, and genetic make-up vary considerably throughout their range in New Zealand. This is true for several commonly used revegetation plants such as kohuhu, lemonwood, flax, cabbage tree, kowhai, manuka, kanuka, and akeake. Many of the distinct local Nelson forms are confined to this area. Local revegetation initiatives are compromised by using different forms from other parts of New Zealand or from unknown origins as it increases the risk of interbreeding with local populations, thereby watering down Nelson's own distinctive wild forms.

The third reason for using locally sourced stock is that, by virtue of their long lineage in Nelson, our local native wild plants are very well adapted to Nelson's environmental conditions. They are, therefore, the best-suited genetic stock for revegetation plantings as they will perform better in Nelson conditions than stock from other sources.

So, as a general principle, when buying or growing native plants for revegetation purposes, use stock that has been sourced as close to the revegetation area as possible, so as to maintain and restore Nelson's own unique natural heritage.

From: Nelson's Natural Heritage, by Shannel Courtney (published in 2003).