TRANSWASTE CANTERBURY LTD

KATE VALLEY CONSERVATION MANAGEMENT AREA (CMA)

Tiromoana Bush Restoration Project

Management Plan

Report prepared for Transwaste Canterbury Ltd.
by
Dr David A. Norton
School of Forestry, University of Canterbury
Private Bag 4800, Christchurch
david.norton@canterbury.ac.nz

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Abbreviations

The following abbreviations/acronyms are used in this document.

AHB	Animal Health Board
CMA	Conservation Management Area
DOC	Department of Conservation
ECan	Environment Canterbury
GPS	Global positioning system
SNA	Significant natural area

1. Introduction

1.1 Background

As part of the mitigation for the establishment of the Canterbury Regional Landfill at Kate Valley, Transwaste Canterbury Ltd. has committed to undertaking a comprehensive restoration programme of conservation, protection and restoration that will, within the 35-years of the landfill resource consent, result in a substantial increase in the overall biodiversity values of the Kate Valley Conservation Management Area (CMA). In particular, the Tiromoana Bush Restoration Plan will result in the protection and enhancement of a substantial area of lowland forest, a nationally rare and underrepresented vegetation type. This plan describes the vision and outcomes proposed for the Tiromoana Bush restoration, and the methods that will be used to achieve them.

A key assumption underlying the approach to the restoration of Tiromoana Bush is that restoration will work with natural successional processes, using strategically located plantings to facilitate and speed up these natural processes in conjunction with proactive plant and animal pest control, but letting nature sort out eventual ecosystem composition and structure appropriate to the sites environment (Norton 1997). The restoration intended here is a mixture of the minimum interference management approach that has been used successfully at Banks Peninsula sites such as Hoon Hay Valley and Hinewai Reserve (Williams 1983, Wilson 1994, Dungan et al. 2001), and the more active planting approach that has been used successfully at sites as diverse as Kennedy's Bush Scenic Reserve, Port Hills (Reay & Norton 1999), and mine sites near Westport (Theinhardt 2003, Phipps 2003). The basic approach to restoration is to remove browse pressure allowing natural regeneration, and establishment of appropriate species for restoration plantings in strategic locations, so that these species facilitate subsequent plant and animal establishment.

1.2 Restoration location

The Kate Valley CMA (410 ha; Figs 1 & 2) includes the majority of the catchment of Kate Valley below the landfill, as well as a small area adjacent to Selby Road and the coastal faces connecting Ella Bush SNA with Ella Peak/Tiromoana Scenic Reserve. For management purposes, the Kate Valley CMA has been divided into seven zones:

- Zone 1 (black beech Remnant "B", 10 ha).
- Zone 2 (inland faces including Ella Pond SNA, 92 ha).
- Zone 3 (Kate Valley flats, 20 ha)
- Zone 4 (coastal faces including Ella Bush SNA, 140 ha)
- Zone 5 (lower Kate Valley, 14 ha)
- Zone 6 (inland faces south of Remnant "B", 70 ha).
- Zone 7 (Selby Road faces, 64 ha)

These zones form the basis for management with different management activities occurring in each zone as discussed further below.

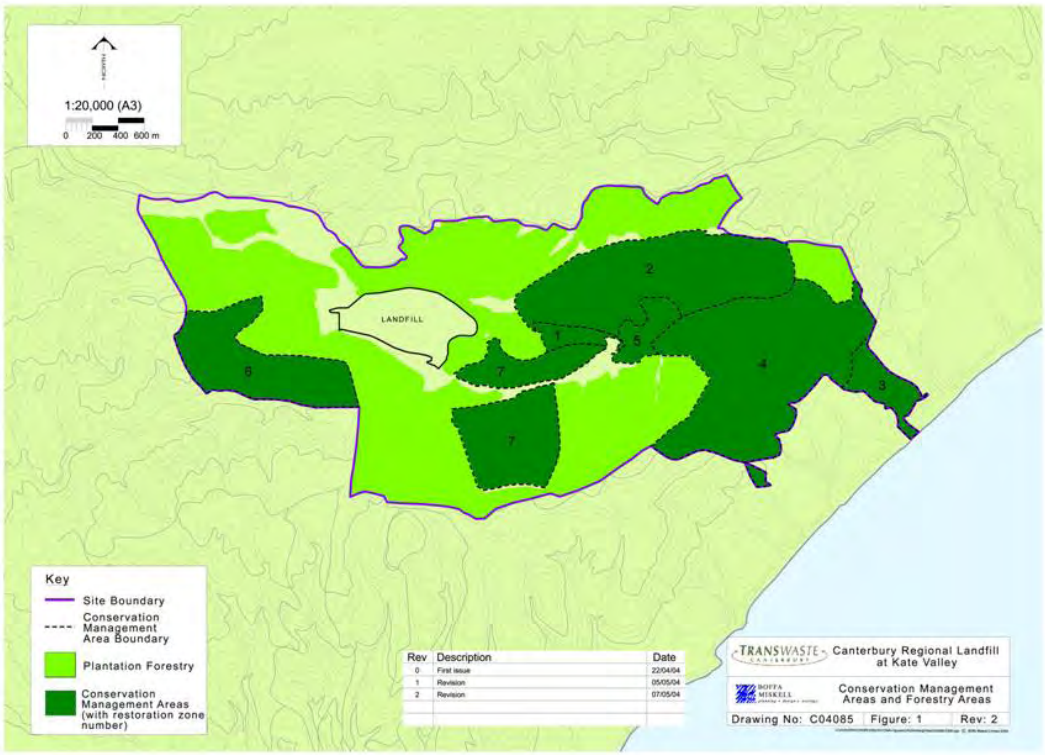


Figure 1. Location of Kate Valley landfill, CMA and plantation forestry areas (CMA management zones are numbered).

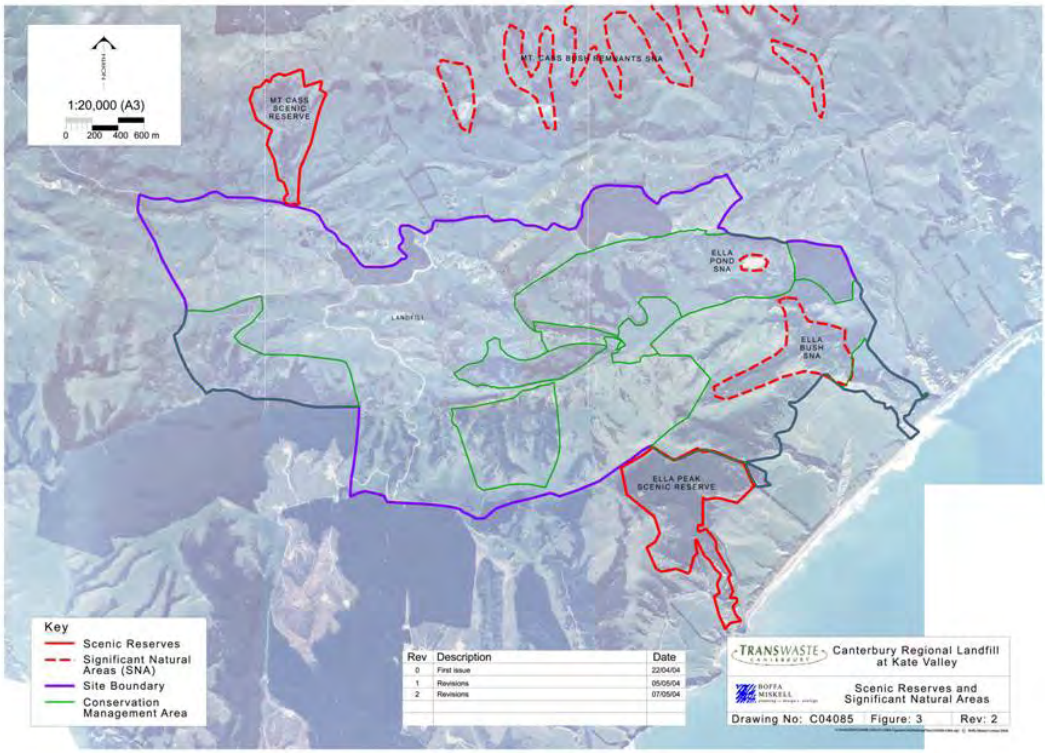


Figure 2. Location of Kate Valley CMA (green lines) in relation to adjacent scenic reserves and Significant Natural Areas identified in the Hurunui District Plan.

1.3 Legal requirements for restoration

The legal requirement for the Tiromoana Bush Restoration Plan is outlined in the resource consent associated with the Kate Valley landfill. Specifically the resource consent requires:

> "The Consent Holder shall provide for the long term protection, restoration and management of a Conservation Management Area in Kate Valley. The area is identified on Supplementary Drawing 10, dated September 2003, entitled "Kate Valley Conservation Management Area", and comprises approximately 410 hectares in area. For the absence of doubt, the "Kate Valley Conservation Management Area" shall incorporate the area of approximately 50 hectares shown as within Zone 4 in Supplementary Drawing 10, which is to the south-east and outside of the Kate Valley Site as identified in the applications for resource consent. The Consent Holder shall at its cost:

(a) register a covenant in a form to be approved by the Manager, Hurunui District Council, which provides legal protection in perpetuity of the Kate Valley Conservation Management Area, prior to the acceptance of first waste.

(b) provide boundary fencing around the entire Conservation Management Area within two years of the issuing of this consent and prior to the acceptance of first waste.

(c) permanently remove grazing from the Conservation Management Area upon completion of the boundary fencing, and prior to the acceptance of first waste.

(d) fence Beech Remnant A to ensure cessation of grazing within the remnant within two months of the issuing of this consent.

(e) preserve Beech Remnant A for the longest practical period until its removal is required by landfill development. This period is to be at least five years from the acceptance of first waste.

(f) commence collection of beech seeds and other suitable material from Beech Remnant A in the first seed season after issuing of this consent, and continue annually until the remnant is removed, or sufficient suitable material has been gathered to achieve the relevant Restoration Plan outcomes, whichever comes first.

(g) within two years of the issuing of this consent, and prior to the acceptance of first waste, commission and submit to the Council, a detailed restoration plan ("the Restoration Plan") for the Kate Valley Conservation Management Area prepared by a qualified Ecologist experienced in restoration ecology, for certification by the Manager, Environmental Services.

(h) incorporate in the Restoration Plan the following vision and long term outcomes, and will provide a detailed programme of activities to be carried out in the first five years of landfilling:

- **Vision**

  In 300 years time the Kate Valley Conservation Area will be restored to a predominantly forest ecosystem, including coastal broadleaved, mixed podocarp-broadleaved and black beech forests, where dynamic natural processes occur with minimal human intervention, where the plants and animals typical of the Motunau Ecological District persist without threat of extinction, and where people visit for recreation and to appreciate the restored natural environment.

- **Outcomes**

At the end of the 35 year consent period, the following outcomes will have been achieved within the Kate Valley conservation area:

- Vigorous regeneration will be occurring within the existing areas of shrubland and forest sufficient to ensure that natural successional processes are leading towards the development of mature forest appropriate to local conditions.
- The existing korimako (bellbird) population has expanded and kereru (native pigeon) are now residing within the area.
- The beech forest remnant known as "Remnant B" has been secured and enhanced.
- Restoration plantings and natural regeneration will have been sufficient to ensure good connectivity of regenerating forest between Remnant "B", Ella Bush SNA and Ella Peak Scenic Reserve.
- At least one additional black beech site has been established.
- The area is being actively used for recreational, educational and scientific purposes.

(i) commence and continue implementation of the Restoration Plan in accordance with the priorities and timeframes outlined in the Restoration Plan. These will include:

- incorporating an annual report on progress on the Restoration Plan into the annual Landscape Report to the Council, which is required by Condition 15 of this consent.
- sourcing all plant species used for planting either from Kate Valley itself or from the southern part of the Motunau Ecological District.
- initiating and continuing animal and plant pest control programmes within the Conservation Management Area during the operating life of the landfill.
- providing for carrying out beech propagation and seedling transplant from Remnant A into the Conservation Management Area with appropriate support/buffer planting over the period until Remnant A is removed by landfill construction.
- providing controlled public access for recreational, educational and scientific use to the Conservation Management Area by a walking track within the Area linking Mt Cass Road to the coast.

(j) The costs of the obligations arising under this condition are to be funded directly by the Applicant, with such funding being independent of and not reliant upon cashflow from the landfill."

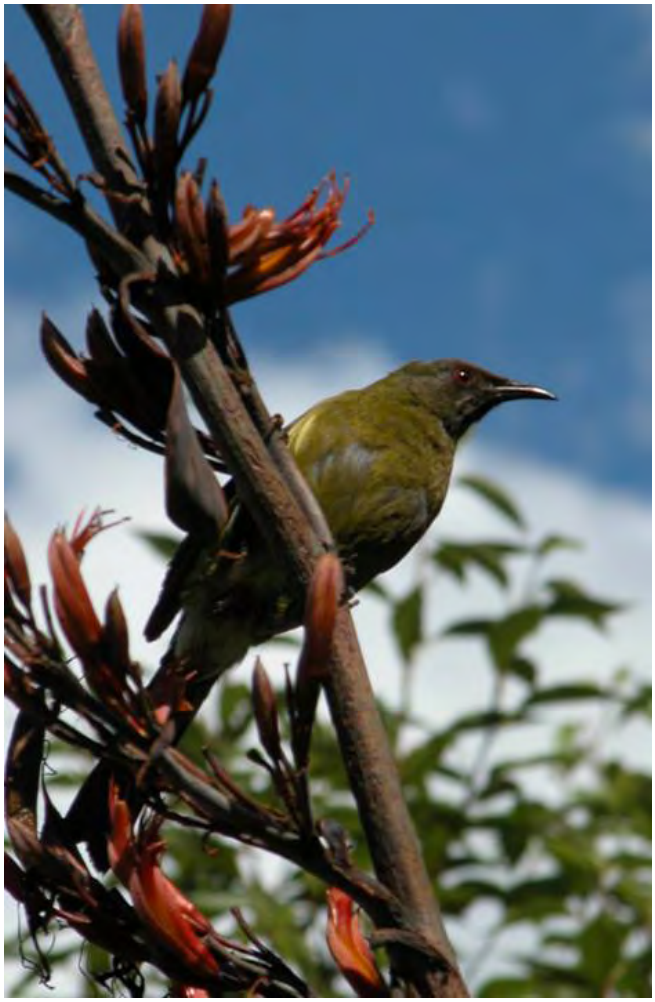
1.4 Plan structure and relationship to annual work plan

The restoration plan is the guiding document for restoration. It provides the overview of the approach that will be taken in restoration, but is not prescriptive as it is difficult to predict in advance changing circumstances that might result as restoration develops, or changing biotic and abiotic factors that might influence restoration. The restoration plan provides the general overview of the project while the annual restoration work plans will provide the detail on the specific actions that will be taken to implement this plan. This restoration plan will be revised as required in response to changing circumstances (e.g., environmental), and experience derived from the restoration and associated research (Section 10).

1.5 Overall approach to management

Management of the Kate Valley CMA will involve several components including plant and animal pest control, active planting, natural regeneration resulting from stock removal and

animal pest control, and facilitation of public access to the area for recreation, education and research purposes. This plan outlines the general approach that will be taken to implementing this management.



2. Restoration vision and outcomes

2.1 Background

Successful restoration is dependent on having clearly defined goals. Such goals are important as they enable the success of the restoration to be quantified and enable the restoration manager to critically evaluate the methods that are being used in restoration. It is useful to set goals within a broader vision of what the site might be like at some stage in the future. However, it is not possible to use such a vision to assess the success of restoration because of the long time-frames involved and because of the uncertainties over future conditions (e.g., as a result of climate change). For the Tiromoana Bush Restoration Plan, an overall vision of what the site might be like in 300-years time has been developed to guide the project, with specific 35-year and 5-year goals or outcomes identified to assess restoration success against. The 5-year outcomes are the most specific, while the 35-year outcomes are more indicative and are likely to be modified depending on the development of the restoration.

2.2 Vision

This vision sees the Kate Valley CMA in 300 years time restored to a predominantly forest ecosystem (including coastal broadleaved, mixed podocarp-broadleaved and black beech forests) where dynamic natural processes occur with minimal human intervention, where the plants and animals typical of the Motunau Ecological District persist without threat of extinction, and where people visit for recreation and to appreciate the restored natural environment. This vision is illustrated in Figs 3 & 4.

Figure 3. Current and projected ecosystem pattern looking northwest across the upper part of Kate Valley.

Figure 4. Current and projected ecosystem pattern looking southwest from Ella Pond into the upper part of Kate Valley.

2.3 Thirty-five year outcomes

At the end of the 35-year resource consent period of the Kate Valley landfill, the following outcomes will have been achieved within the Kate Valley CMA as a direct result of the Tiromoana Bush Restoration Plan:

1. Vigorous regeneration will be occurring within the existing areas of shrubland and forest sufficient to ensure that natural successional processes are leading towards the development of mature lowland forest appropriate to local conditions.
2. The existing korimako (bellbird) population has expanded and kereru (native pigeon) are now residing within the area.
3. The beech forest remnant known as “Remnant B” has been secured and enhanced in terms of the area of black beech.
4. Restoration plantings and natural regeneration will have been sufficient to ensure good connectivity of regenerating forest between Remnant “B”, Ella Bush Significant Natural Area (SNA) and Ella Peak Scenic Reserve.
5. At least one additional black beech site has been established.
6. The area is being actively used for recreational, educational and scientific purposes.

2.4 Five-year outcomes

In order to meet the 35-year outcomes for the Tiromoana Bush Restoration Plan, eight outcomes for the first five years have been developed. Each outcome has a performance indicator that can be used to measure the success of the project in achieving the outcome. Five years has been chosen as the appropriate time-period for these outcomes because it is short enough to be realistically achievable, but long-enough to see real changes in the area. For this reason, intervals of five-years are the chosen period to measure the achievement of the restoration goals within the plan. Annual restoration work plans will include the specific tasks that are required to achieve these outcomes.

At the end of the five-year term of this restoration plan, the success of the Tiromoana Bush Restoration Plan in meeting these outcomes needs to be carefully assessed. In developing the restoration plan for the subsequent five-years, the reasons why these outcomes might not have been achieved needs to be evaluated and measures put in place to address these.

Outcome 1: Appropriate restoration planning has been implemented.
Explanation: The size of the conservation area being managed (c. 410 ha), the public interest in this area, and the diversity of management actions required to meet the 35-year goals requires formalised management planning and review to be undertaken on an annual basis.
Performance indicator: The Tiromoana Bush Restoration Plan and annual work plans have been completed, and the Advisory Group has been established and has reviewed the implementation of the restoration work annually.

Outcome 2: The ecological integrity of both the existing remnants of native woody vegetation and the restoration plantings has been secured.
Explanation: At present the area is heavily grazed by cattle and sheep which are having a significant adverse impact on ecosystem condition, especially through hindering natural successional processes. Additionally, domestic stock will have a significant adverse impact on restoration plantings should they have access to planted areas. Removal of all domestic stock is therefore a high management priority.
Performance indicator: The Kate Valley CMA is free of all domestic stock, and if they do enter the area, they have been quickly and efficiently removed and the reasons for their ingress (e.g., damaged fence) has been remedied.

Outcome 3: The Kate Valley CMA is kept free of high priority animal pests, while other animal pests are controlled to levels that do not threaten the restoration or other values of the area.
Explanation: Animal pests are the single biggest threat to the success of ecological restoration, as well as natural successional processes. Herbivores can significantly affect the growth of plantings and natural regeneration while predators have devastating impacts on fauna.
Performance indicator: Kate Valley CMA has been kept free of the high priority animal pests identified in the restoration plan, or if they have established, they have been quickly and efficiently removed.

Outcome 4: Plant pests are controlled to levels that do not threaten restoration or other values.
Explanation: Plant pests also threaten the viability of both regenerating forest and restoration plantings, especially through competition, although this plan is pragmatic and recognises that

not all exotic plants are necessarily pests. In fact, the restoration plan highlights the role that gorse can play in assisting restoration.
Performance indicator: Key plant pests identified in this plan are controlled to a level that does not threaten the restoration or other values of the Kate Valley CMA.

Outcome 5: Restoration plantings covering an area of at least 5 ha are growing vigorously, and strategically located enrichment plantings have been established as plants become available.
Explanation: One of the primary objectives of restoration is to establish plantings to enhance connectivity between existing native shrubland and forest remnants and to enhance the black beech remnant (Remnant "B"). This outcome sees the planted area amounting to at least 5 ha in five years time. In addition, it is proposed to establish enrichment plantings of key native species such as totara, matai and kowhai to facilitate long-term succession and to provide food resources for native birds.
Performance indicator: The planted area exceeds 5 ha with planting survival >50%, and some enrichment plantings have been undertaken.

Outcome 6: A biodiversity monitoring programme has been established that enables the success of the restoration programme to be quantitatively assessed.
Explanation: Monitoring is an integral part of restoration management as it allows the success of the methods used to be assessed, and modified as appropriate, and it provides a means to report on this success to the various groups with an interest in the restoration project. Monitoring, however, needs to be carefully targeted to ensure that it can supply meaningful information that informs management without being an unreasonable cost of restoration.
Performance indicator: A monitoring programme has been established and all base-line monitoring completed and, re-measurements undertaken as appropriate.

Outcome 7: The community of interest, including the local community as well as the broader Canterbury community are well informed about the restoration project.
Explanation: Restoration is an exciting activity, especially as the outcomes are almost always positive (cf., some threatened species work) and results can be seen in only a few short years. Awareness of the restoration project will therefore hopefully result in an increase in support for restoration, and in the longer-term the use of the project for educational and scientific purposes.
Performance indicator: Appropriate methods have been used to increase the awareness of the community in the Tiromoana Bush Restoration Project, including signage on the Mt Cass Road, production of a regular newsletter, and establishment of a web page.

Outcome 8: The Kate Valley CMA is being used for passive recreation, and for educational and scientific purposes.
Explanation: The Kate Valley CMA has considerable potential for passive recreation (e.g., walking) and the opportunity exists for the public to access, on foot, a spectacular section of coastline not normally accessible, as well as to view native forest ecosystems and some unusual geological features. In addition, the area provides considerable educational and research opportunities.
Performance indicator: A walking track has been established that links Mt Cass Road with the coast, and the Kate Valley CMA is being used at least twice per year by schools/tertiary institutes for educational purposes and at least two scientific studies have been established in the area.

3. Ecological context

3.1 Background

There is little information available on the ecological characteristics of the Kate Valley CMA or of the broader Motunau Ecological District. The following notes are based on information that was collated as part of developing the resource consent application for the Kate Valley landfill. Other information on the area includes generalised geological, soil and climate maps and general information on vegetation pattern and vegetation history in North Canterbury.

3.2 Physical environment

The Kate Valley CMA is located in coastal North Canterbury in the Motunau Ecological District (Lowry Ecological Region). This ecological district comprises coastal hills and valleys, all below 600 metres asl, drained mostly to the east by small rivers. The geology is highly varied including greywacke, argillite and Tertiary sedimentary rocks, Quaternary outwash gravels, and coastal gravels and sands. The Kate Valley CMA is located within very old (1.8 to 65 million years) former seabed strata on the coastal side of Mt Cass and is consequently underlain by generally fine-grained compacted sedimentary deposits. The valley has moderately steep sides with surface erosion evident. Soils are broadly described as Stoneyhurst Hill soils, dominated by sandy loams.

The coastal environment consists of narrow sand and shingle beaches covered at high tide (Russell & Brown 1990). The beaches are backed by coastal cliffs up to 60 metres high. Slumping has occurred in the cliffs of the lower reaches of Kate Valley and nearby streams.

The annual rainfall of Kate Valley is 921 mm (1986-2000 average), although as with the rest of Canterbury, there is considerable variation both within years and especially between years. The area typically experiences very warm dry summers and cool wet winters. Snow is rare, although frost can occur in winter, especially in valley bottoms away from the coast.

3.3 Vegetation history

Information from pollen analyses and from a reconstruction of the potential vegetation cover of New Zealand, suggests that the Motunau Ecological District would have been covered by an almost continuous mantle of forest prior to human settlement. The only parts that would have lacked forest would have been bluffs, recently disturbed sites (e.g., slips along the coastal faces) and wetlands. The most specific information on the pre-human vegetation of the Motunau Ecological District comes from a pollen diagram from Swinton Park Amberley (Moar 1971), some 10 km southwest of Kate Valley. This pollen diagram shows the dominance of *Podocarpus* and *Nothofagus* pollen in the regional pollen rain and based on this it was suggested that the pre-human vegetation of the surrounding landscape was forest dominated by totara, matai and black beech. The more general reconstruction of the potential vegetation cover of New Zealand (Leathwick 2001) shows the Motunau Ecological District as supporting a mixture of lowland conifer forest and conifer/*Nothofagus solandri* forest.

This information together with information on the current distribution and composition of forest remnants suggests that the predominant pre-human vegetation would have been mixed podocarp-broadleaved forest with totara and matai occurring as emergent trees over a diverse

canopy including kowhai, lemonwood, kohuhu, lowland ribbonwood, mahoe, five-finger and broadleaf amongst others. Examples of this forest type can be seen today on the southeast facing slopes under the Mt Cass-Totara ridge 2 km northwest of Kate Valley. This forest type would have occurred on both limestone and loess substrates. In coastal sites, ngaio would have been the dominant canopy species (e.g., as seen today in the lower part of Kate Valley). Black beech forest is likely to have been of more limited extent, being confined to well-drained ridge crests and terrace faces and to substrates formed on low-fertility sediments.

The fossil evidence suggests that deforestation of the Motunau Ecological District was primarily by fire. This appears to have been the case throughout the eastern South Island, with a peak in burning occurring 500-700 years before present (Ogden et al. 1998). All the scientific evidence suggests that these fires were associated with early Maori settlement (Molloy et al. 1963, McGlone 1983, Ogden et al. 1998). This deforestation would have resulted in a dramatic reduction in forest cover and an expansion of tussock grassland and shrubland. While some forest regeneration would have occurred after fire, subsequent fires would have limited this. The vegetation encountered by the first European visitors to the Motunau Ecological District most likely comprised a mixture of short tussock grassland, cabbage tree treeland, mixed shrubland, kanuka regenerating forest, mixed podocarp-broadleaved forest, coastal broadleaved forest, and black beech forest.

3.4 Current vegetation pattern

Pasture and extensive grazing of sheep and cattle dominate the area around Kate Valley, the hill country between State Highway 1 and the coast. The steepness and erodability of the hills has limited the intensity of agriculture and therefore retained a stronger native vegetation component than in the more rolling hills and plains to the west and south. The larger areas of native vegetation in the Kate Valley CMA are discussed below (Section 3.7), while other native vegetation is generally limited to smaller patches of gully and riparian shrublands, scattered matagouri shrublands on steep faces, scattered tussocks on higher slopes, and wetland species in riparian and seepage areas.

The Kate Valley catchment, within which the Kate Valley CMA is largely located, comprises approximately 815 ha of modified farmland. The current vegetation is dominated by exotic pasture, although eight main vegetation types (with approximate percentage of land cover in brackets) are present:

- Exotic pasture (60%)
- Kanuka shrubland and mixed kanuka dominated broadleaved forest (15%)
- Matagouri/*Coprosma* (grey) shrublands (10%)
- Gorse shrubland (7%)
- Conifer plantations (3%)
- Wet pasture (3%)
- Native dominated wetlands (<1%)
- Black beech forest (<1%)

Exotic pasture is dominated by exotic grasses, clover and herbs and varies with moisture levels and exposure. In a few areas scattered silver tussock is present. Most of the gorse shrublands comprises a variable density canopy of gorse with grasslands interspersed in more open areas.

The kanuka shrublands and forests range from kanuka monocultures to more mixed stands with cabbage tree, small leaved *Coprosma* species, native broom, matagouri and taller stands with putaputaweta, five finger, mahoe and prickly mingimingi. The extent of understorey varies, presumably related to grazing pressures. Down-stream from Ella Bush SNA species associated with the coastal environment are evident including ngaio and golden akekae.

The grey shrublands are scattered within the valley with the most extensive areas on the north facing slopes of Ella Peak. They are generally open and interspersed with areas of pasture. Matagouri dominates and is found in association with *Coprosma crassifolia*, *Coprosma propinqua*, shrub pohuehue, native broom and occasional gorse. Silver tussock is also present. The conifer plantations are predominantly radiata pine, and some native species such as small leaved *Coprosma* species have colonised the understorey. The wetland areas are described below.

The black beech remnant known as Remnant "B" is dominated by black beech with other prominent woody species including kanuka, red matipo, soft mingimingi, mahoe, kohuhu, lemonwood and lancewood. Black beech is more abundant on ridges, where it can form a continuous canopy, while broadleaved species are more abundant in the gullies. The understorey of the beech area is sparse, although there can be local thickets of soft mingimingi and other species, but there is little evidence of recent beech regeneration. The black beech remnant is located amongst stands of kanuka and broadleaved species.

3.5 Fauna

A range of common native and exotic bush and open pasture bird species is present including bellbird, silvereye, grey warbler, fantail, chaffinch, yellowhammer, spur-winged plover, paradise shelduck and magpie. The invertebrate fauna of the beech remnant has been surveyed and comprises common species typical of both beech forest and the surrounding pasture. A population of the native carnivorous land snail *Wainuia edwardii* has been recorded near the road at Mt Cass/Tiromoana Scenic Reserve (DOC record December 2001). This is an outlying population of a species whose main distributional range is centered around Kaikoura. However, no snails have been found within the Kate Valley CMA, probably because potential habitats are restricted relative to the Mt Cass site due to historic and current grazing.

3.6 Waterways and Wetlands

Small streams incise the hill slopes forming tributaries to the main Kate Valley stream, which flows east to the coast. The upper reach descends through gorse and pasture dominated area to the middle reach, which is in a wide flat pastoral area. Prior to agricultural development this is likely to have supported an extensive wetland. The stream is now restricted to a small incised straight channel (probably artificially created). Below this area and the rock outcrops associated with the Ella Ponds, the stream descends down a waterfall and then, relatively steeply, through areas of shrubland and low forest. For the last 300 m, the stream meanders through pasture with steep eroding coastal cliffs to a sandy beach and the sea.

A freshwater fish fauna typical of soft sedimentary catchments in Canterbury is present in the area (NIWA 2000). All the species found (by electric fishing) are native and are mainly marine migratory species (ie., have part of their life cycle at sea). Only shortfin eel and upland bully (the only species that is not marine migratory) were occasional to common in the middle

reaches and rare to occasional in the upper reaches of the stream. In the lower reaches inanga, longfin eel, shortfin eel, common bully, upland bully and black flounder (rare) were also found. While not recorded from this stream, the habitat is typical for, and may support, lamprey, common smelt and giant bully.

The waterways are subject to high turbidity during times of high rainfall and runoff from the catchment. The low pasture dominated vegetation type intercepts less rainfall than a shrubland or forest community. This increases the amount of direct runoff and therefore silt load at times of high rainfall, although water quality should improve as reafforestation occurs.

The Ella Pond complex consists of a permanent and an ephemeral pond and a connecting area of wetland vegetation. It was formed as a result of slumping of the adjacent side slope, which blocked the drainage of streams flowing to the coast. The ponds and wetlands formed behind the slumped material, which separates them from the Kate Valley stream. The slump landslide also reversed the flow so Ella Pond is now “up-valley”, that is the ponds drain down towards the Kate Valley stream, rather than the stream flowing into the ponds and wetland area.

While the area is evidently affected by grazing there is still a strong native vegetation component including patches of purei, *Juncus gregiliflorus*, and other rushes and sedges, and one patch of raupo. Ella Pond flows down towards the middle reaches of the Kate Valley stream, where the wetland/wet pasture is dominated by pasture grasses with occasional rushes. Ella Pond is likely to have only limited fish species present given its location above the waterfall and limited connectivity with the Kate Valley stream. Eel may be present and it is possible habitat for banded kokopu although there is limited debris that would provide the appropriate habitat diversity. Mallard ducks, paradise shelducks, little shag, kingfisher, welcome swallow, and white-faced heron have been seen associated with Ella Ponds.

3.7 Adjacent natural areas

Nearby documented areas of high ecological value (Fig. 2) include two scenic reserves administered by DOC (Mt Cass/Tiromoana Scenic Reserve and Ella Peak/Tiromoana Scenic Reserve) and other areas listed in the Hurunui District Plan as Significant Natural Areas (Mt Cass Bush remnants, Ella Pond and Ella Bush). The Tiromoana Scenic Reserves were identified for reserve status in 1981 at the time of the creation of the Tiromoana title. The ecological values of Mt Cass bush remnants, Ella Bush and Ella Pond were identified by the former New Zealand Wildlife Service as Special Sites of Wildlife Interest, a list of areas that provide important habitat for wildlife. This restoration plan aims to provide connectivity between three of these sites, Ella Peak/Tiromoana Scenic Reserve, Ella Bush and Ella Pond which lie within or adjacent to the Kate Valley CMA.

4. Constraints to restoration

4.1 Background

This section outlines those factors that are likely to limit the success of management in achieving both the 5- and 35-year restoration outcomes, and ultimately the long-term vision for the site. Constraints to restoration include those associated with the abiotic (climate, fire and spray drift), biotic (grazing from domestic stock, animal pests, plant pests, planting stock availability and mutualisms), and socio-economic (security of tenure and funding) environment. A clear recognition of these constraints is essential to ensure that restoration is implemented in a manner that addresses them all.

4.2 Abiotic constraints

Constraint: Climate is likely to limit natural regeneration and restoration through low soil moisture availability and frost. The annual rainfall for Kate Valley is 921 mm. Soil moisture deficits are common during summer and in some years can lead to marked dieback in native vegetation. Restoration plantings and natural regeneration into grassland are particularly vulnerable to soil moisture deficits, especially during the initial stages of establishment. Soil moisture levels are strongly affected by the present vegetation. In particular, soils under grass swards are very dry because the dense grass root mat quickly takes up any water that reaches the ground. In addition, winter frost can be a major source of mortality for some species in restoration plantings, especially for species such as ngaio.

Response: While mortality of natural regeneration can occur during particularly dry summers, the increasing cover of both native and exotic shrubland across the Kate Valley CMA in recent years suggests that this is not a major limitation. The primary response to dealing with soil moisture deficits and frost in the restoration plantings is to only use plants adapted to conditions in the Kate Valley CMA, including sourcing all plant material locally. Additionally, all plants will be hardened off before planting, planting will be timed to occur so that plants are well established before summer droughts but are not planted until after the worst of winter frosts, herbicide will be used to kill the grass sward before planting, and hand weeding and mulches will be used after planting as required to reduce competition for water. Watering will also be used during particularly bad droughts as required.

Constraint: Because of the frequent occurrence of long dry periods during summer, and the presence of gorse shrubland which burns readily, a wildfire could rapidly sweep through the Kate Valley CMA destroying restoration plantings and natural regeneration.

Response: Ensuring that no burn-offs occur elsewhere on Transwaste Canterbury Ltd. land, liaising with adjacent landowners about the threat of burn-offs to restoration, informing the public of the fire danger through appropriate signs and other means, enforcing a total open fire ban in the Kate Valley CMA, and maintaining water reservoirs for fire fighting purposes.

Constraint: Because adjacent land uses include pastoral farming and forestry, weed spraying in adjacent areas has the potential to damage natural regeneration and restoration plantings if drift occurs.

Response: Liaising with adjacent landowners about the threat of spray-drift to restoration, and ensuring that any spraying undertaken on Transwaste Canterbury Ltd. land (e.g., associated with plantation forestry or the landfill) does not impact on the restoration area.

4.3 Biotic constraints

Constraint: Grazing by domestic stock (sheep and cattle) is presently a major limitation to natural regeneration, with most areas of regenerating forest and remnant forest having severely grazed understories. In addition, domestic stock can quickly destroy young restoration plantings if they gain access to these.

Response: All domestic stock will be removed from the Kate Valley CMA at the start of the restoration project and fences will be regularly inspected to ensure that they do not gain entry in the future. Should domestic stock be found in the restoration area, they will be quickly removed.

Constraint: One of the major factors likely to limit restoration success, including restoration through natural regeneration, is browsing and predation by introduced animals, especially possums, ungulates (deer and goats), lagomorphs (rabbits and hares), mustelids (stoats, ferrets and weasels) and rodents (rats and mice). Browsing reduces viability and growth rates of plants, especially young ones, while the impact of predation on invertebrate, reptile and bird species influences restoration success as these species play key roles in ecosystem processes such as pollination, seed dispersal and nutrient cycling.

Response: An ongoing and comprehensive animal pest control programme will be undertaken within the Kate Valley CMA. In addition extensive animal pest control will be undertaken in association with management of the adjacent landfill.

Constraint: Introduced plant species have the potential to severely limit the restoration success. A number of grass species are highly invasive and competitive (e.g., browntop and cocksfoot) and can lead to the loss and poor health of plantings. There is considerable potential for invasive woody species already present, or present in adjacent areas (e.g., hawthorn, European broom, wilding conifers, willow and old man’s beard) to expand their range and dominate large parts of the Kate Valley CMA.

Response: Grasses will be sprayed prior to the establishment of restoration plantings to reduce competition, while some hand weeding together with mulches will be used to reduce subsequent grass growth as required. Regular surveys and control operations will be undertaken for other identified problem weeds, especially woody weeds, with the aim of eradicating those species identified as a management priority.

Constraint: Several studies have commented on the importance of using planting stock of local genetic origin in restoration projects because of concerns about local adaptation and maintenance of genetic integrity of existing plant populations (Timmins & Wassilieff 1984, Simpson 1992, Harris 1997). Planting of non-local material may result in loss of local adaptations (e.g., to particular environmental conditions) and eventually could lead to a loss of overall genetic variation within particular species. It is therefore prudent to use plant material of local origin as local plants will be better adapted to local conditions than non-local plants (e.g., resistance to salt spray) and as a safe-guard for maintaining genetic diversity.

Response: To ensure that plants are adapted to local environmental conditions and to minimise the loss of genetic variability only locally sourced planting material will be used for the restoration plantings (preferably from within the Kate Valley CMA or, when not available, from the coastal flanks of the southern part of the Motunau Ecological District).

Constraint: In using seed for propagation a key constraint for some species is year-to-year variation in seed production (called masting). Beech in particular is mast seeding (Allen & Platt 1990), with years of heavy seed production separated by several years with little or no seed production.

Response: Where seed is to be used as the basis for plant propagation, consideration of mast years will be undertaken as part of propagation planning. In addition all efforts will be made to utilise plant material from Remnant "A" over the 10-year period before it is removed.

Constraint: The development of associations between planted species and various mycorrhizal fungi is important for restoration success. Mycorrhizal fungi are associated with plant roots and play a key role in nutrient uptake for many native plants. The importance of mycorrhizal fungi in restoration plantings is poorly understood, although research suggests that an absence of mycorrhiza may be a limiting factor for some species including beech and kanuka.

Response: Problems associated with mycorrihizal infections do not usually occur with natural regeneration, but can be an issue for plantings. Where possible, nursery propagation of seedlings for restoration will include inoculation with forest organic matter sourced from Remnant "A" to ensure the presence of mycorrhiza (especially for beech and kanuka). In addition, coarse woody debris from Remnant "A" and forest organic matter will be collected prior to the removal of Remnant "A" and spread through areas of restoration plantings and regenerating forest to facilitate the spread of indigenous biodiversity and/or to provide habitat for indigenous species to utilise.

Constraint: A key premise of restoration is that management will speed up the natural processes of succession by establishing a cover of woody plants that will encourage the development of mature shrubland and forest. While some of the species that occur in these forests are wind pollinated and dispersed, others require birds for either pollination and/or dispersal. The importance of birds for dispersing seeds into restoration plantings has been highlighted in several studies (e.g., Reay & Norton 1999). However, severe predation pressure appears to have reduced bird numbers to levels that may be limiting these processes and hence have the potential to limit restoration success. Furthermore, a diversity of plants is required to support viable bird populations in the Kate Valley CMA, especially in order to provide seasonally scarce food resources (e.g., at times when flowers or fruit are naturally scarce).

Response: Undertake predator control to reduce direct impacts on indigenous birds and use strategic planting of key food resources for these birds where food resources are considered to be insufficient.

4.4 Socio-economic constraints

Constraint: The success of the Tiromoana Bush Restoration Project will not be realised for many years after the end of the life of the Kate Valley landfill. There is therefore potentially uncertainty over the long-term security of the restoration site beyond this time-frame.

Response: The Kate Valley CMA will be covenanted through an appropriate organisation (e.g., QEII National Trust) to ensure that the tenure of the site as a conservation area is secured in perpetuity.

5. Plant and animal pest management

5.1 Introduction

Invasive plant and animal species are widely regarded as the single biggest threat to New Zealand's indigenous biodiversity (MfE 1997). These invasive species also threaten restoration projects such as that at the Kate Valley CMA as invasive weeds can out-compete and suppress plantings, while invasive animals browse plantings and seriously impact on key pollinators and dispersers in the surrounding forests. Incursions of domestic stock can have similar impacts to invasive animal herbivores. Because of the importance of invasive species, this section provides a detailed overview of how they will be managed as part of the Tiromoana Bush Restoration Project.

5.2 Domestic stock management

Domestic stock will be removed from the Kate Valley CMA at the outset of the restoration project. This will involve upgrading existing fencing and installation of new fencing where required. Once adequate fencing is in place, all domestic animals will be mustered out of the area. All fences will be established or maintained to a sufficient standard to ensure that stock are not able to readily re-enter the area and all gates not required for management purposes will be removed to prevent accidental entries by stock. Those gates that are required for management purposes will be locked to ensure that they are not left open accidentally. Because of the importance of Remnants "A" and "B" as seed sources ("A") and as the nucleus for restoration ("B"), grazing will be excluded from these areas as soon as resource consents for the Kate Valley landfill have been granted.

Any subsequent incursions of stock will be quickly dealt with by removing the animals and repairing fencing as required. Annual inspections of all boundary fences will be undertaken to minimise the likelihood of such excursions and those involved in the management of adjacent areas will be informed of the desire to keep the Kate Valley CMA free of domestic stock.

In places where plantings associated with the Kate Valley Landscape Management Area adjoin the Kate Valley CMA, it should be possible to rationalise fencing to ensure that stock are excluded from both areas where required.

5.3 Animal pest management

A number of introduced animal pests including brushtail possums, stoats, ferrets, rats, mice, red and fallow deer, goats, rabbits, hares, pigs, hedgehogs and vespulid wasps are likely to be present or border upon the Kate Valley CMA. Domestic and feral dogs and cats may also come onto the site. The presence of both wild and domestic animals within the restoration area will impact upon the restoration work proposed at this site. This section outlines the objectives for animal pest management and the programme that will use to achieve these objectives. The objectives for animal pest management are to reduce the impact of herbivores on the restoration plantings, and the impact of herbivores and carnivores on indigenous plant and animal species within regenerating forests.

The approach to animal pest management recognises that different animal pests pose differing threats to restoration and indigenous biodiversity. A prioritisation system will therefore be

used for management work based on likely threats of individual pest species. The priority ranking and objectives for control of each pest will be reviewed annually to allow for adaptive pest management.

The overall approach to animal pest control will meet accepted best practice standards (e.g., as defined by ECan or DOC) and the methods used will be kept under regular review through an adaptive management approach. All animal pest control programmes will meet the legislative conditions and requirements set by the relevant Acts and Regulations of Parliament including the Wild Animal Control Act 1977, the Resource Management Act 1991, the Health and Safety in Employment Act 1992, the Biosecurity Act 1993, the Hazardous Substances and New Organisms Act 1996, the Animal Welfare Act 1999, and the Pesticides (Vertebrate Pest Control) Regulations 1983. All pest control operators will be required to have appropriate pesticide licences where required. Details of the methods to be used for animal pest control will be developed with the contractors undertaking the work and will be based on current best practice guidelines. Some methods that might be appropriate are outlined in Appendix 2.

Introduced pests targeted for control are split into two management groups: High priority (possums, stoats, ferrets, weasels, rats, rabbits, hares, feral deer, feral goats, wasps); Low priority (feral cats, feral dogs, feral pigs, hedgehogs, mice). The priority ranking for each pest animal will be reviewed annually. Some pest species (e.g., possums, cats, rats and mice) can be encouraged into an area by the presence of rubbish, especially organic rubbish. Obviously the presence of a major landfill adjacent to the restoration area will act in this way. However, Transwaste Canterbury Ltd. will establish a major ongoing animal pest control operation as part of landfill management.

Brushtail possums: Brushtail possums are present throughout the Kate Valley CMA. They are a direct threat to restoration plantings and general biodiversity values, in particular regenerating forest and birds. They also constitute a threat to neighbouring land holders in terms of production (damage to young pine trees and spread of bovine Tb) and biodiversity values on their land. Because of previous records of bovine Tb in cattle in the Kate Valley area, an ongoing possum control operation occurs on the property including the Kate Valley CMA and as a result possum numbers are very low. It is intended that this operation will continue for the foreseeable future. The effectiveness of possum control will be monitored through assessing biodiversity response (Section 9). Should monitoring indicate that the current level of possum control is insufficient to sustain biodiversity values then the current possum control operation will be reviewed. Should the decision be made to crease the bovine Tb based control operation, then a replacement operation will be implemented for the Kate Valley CMA.

Stoats, ferrets and weasels (mustelids): Mustelids are likely to be widely distributed through the Kate Valley CMA, although probably at low numbers. Numbers will also fluctuate considerable between years depending on food availability. Mustelids are a direct threat to biodiversity values within the area, especially native birds and larger invertebrates. They are also implicated in the transmission of bovine Tb. These species are known to have relatively large home ranges (e.g., 60-200 ha for stoats) and to move considerable distances while foraging or while dispersing as juveniles. Mustelid control will be undertaken throughout the Kate Valley CMA and the success of the control will be assessed through forest bird monitoring (Section 9.4).

Rats: Rats directly affect biodiversity through predation of fauna, but also impact upon plant regeneration processes through seed predation (and hence could impact on the restoration plantings by limiting subsequent regeneration). Further, they are a key food source for other predators (especially stoats), in effect buffering higher numbers of these predators. Rat control will be undertaken throughout the Kate Valley CMA and the success of the control will be assessed through forest regeneration and forest bird monitoring (Section 9).

Hares and rabbits: Hares and rabbits constitute a direct threat to restoration plantings. Unfortunately hares in particular are difficult to control, but these pests will be controlled as impacts dictate. Impacts will also be minimised through the use of appropriate retardant pastes on restoration plantings. Hare and rabbit impacts will be directly monitored as a part of restoration monitoring (Section 9.3).

Feral deer and goats: Feral deer (red and fallow) and goats are likely to be present within the general area, and to pass through the Kate Valley CMA from time to time. These species can cause damage to biodiversity values, and also pose a threat to restoration success. They are also known to be reservoirs for bovine Tb. Control will be opportunistic in nature, and will involve hunting when animals are known or thought to be present. Where appropriate, local hunters will be encouraged to undertake this control. The benefits of any control will be based on assessment of the number of animals killed versus the number seen, as well as through monitoring of forest regeneration (Section 9.2).

Vespulid wasps: Wasps are present primarily in remnant “B” and constitute a threat to biodiversity values (in particular native birds and invertebrates) within this area through competition for food resources and predation. They also constitute a direct threat to health and safety of people working in the area. Control will involve the active seeking out and locating nests and treatment with a suitable poison each summer (December – April). Wasp numbers will be monitored qualitatively based on their perceived abundance.

Feral cats, feral dogs, feral pigs, hedgehogs and mice: These animals are either known to be present in the Kate Valley CMA, but difficult to control (mice and hedgehogs), or may occasionally be present in the general area (feral cats, dogs and pigs) and as such may spread into the Kate Valley CMA. Control will not be implemented directly for these species although it is expected that feral cats, hedgehogs, and mice will be caught as a consequence of other control programmes including those associated with the landfill. Should feral dogs or pigs be seen they will be actively hunted. Dogs will be prohibited from the Kate Valley CMA walking tracks (Section 7).

5.4 Plant pest management

Weed species present a very real threat to the success of any restoration programme as they can out-compete the planted species resulting in reduced growth rates and mortality. However, it needs to be acknowledged that for gorse at least, the eventual succession appears to be to indigenous forest. However, several other species of weed are a direct threat to restoration (both plantings and natural regeneration) and the highly modified nature of Kate Valley means that these species are already present in large numbers. The objective of weed management is therefore to maintain the Kate Valley CMA free of all priority weed species. Three groups of weed species are discussed here – woody weeds, pasture grasses and gorse.

All plant pest control will meet national and regional legislative requirements, especially any obligations imposed through the Regional Pest Management Strategy, and will follow best-practice guidelines. All staff involved in weed control work will be required to have appropriate licences for handling any chemicals involved. Details of the methods to be used for plant pest control will be developed with the contractors undertaking the work and will be based on current best practice guidelines. Some methods that might be appropriate are outlined in Appendix 2.

Woody weeds: These are weed species that are known to cause problems in similar environments and therefore pose a threat to biodiversity values, including restoration plantings, at this site. Woody weed species known to be present in the Kate Valley CMA (early 2004) include wilding conifers, European broom, hawthorn, willow, blackberry and old man's beard.

Three main approaches will be taken to prevent the establishment and spread of woody weed species in the Kate Valley CMA:

1. An initial programme of control to eliminate all woody weeds from the Kate Valley CMA will be undertaken during the first year of the restoration plan, with a follow-up operation in the second summer. The objective of this phase is to eliminate woody weed seed sources.
2. A regular surveillance programme will be undertaken to monitor the establishment of woody weed species and control will be implemented as required. To facilitate this, a field guide to all woody weed species will be produced during the first year.
3. The list of woody weeds will be reviewed annually as part of the overall restoration review (Section 10.4) and updated as necessary.

Pasture grasses and herbs: Pasture grasses are efficient competitors for water, as well as nutrients and light, and can restrict the growth of new plantings. However, there is little likelihood that any of the widespread grasses can be eliminated from the Kate Valley CMA, as many have very effective vegetative reproduction and spread by means of their rhizomes. Almost all species also reproduce effectively by seed (and have excellent dispersal mechanisms) and many maintain large numbers of seeds in persistent soil seed banks, so they regenerate readily by these sources. Herbaceous plants provide similar threats as grasses with some species having the potential to smother restoration plantings. Persistent soil seed banks and good dispersal mechanisms (especially by wind; e.g., thistles) again creates the potential for long-term re-infestation. Control of these species will therefore focus on removing them prior to the establishment of restoration plantings and restricting their re-establishment and growth after planting until plantings are tall enough to suppress them.

Gorse: While widely regarded as a plant pest, gorse offers considerable potential as a nurse species for restoration of indigenous forest. Gorse has been used successfully in this capacity at Hinewai Reserve on Banks Peninsula (Wilson 1994) and it is proposed that gorse will play a similar role in the Tiromoana Bush Restoration Project. Gorse will be used as a nurse plant because of the high costs associated with controlling gorse and of implementing an active planting programme covering >100 ha, and the known ability of gorse to invade rank grassland and provide a suitable environment for indigenous forest regeneration. However, gorse also presents a considerable fire risk and a key component of restoration management is to vigorously maintain a total-fire ban within the Kate Valley CMA. In addition gorse adjacent to boundary fences will be managed in a manner consistent with ECan boundary gorse control requirements.

6. Establishing restoration plantings

6.1 Introduction

This section outlines the broad approach that will be used in establishing restoration plantings in those parts of the Kate Valley CMA that have been identified for active restoration. Rather than being prescriptive (e.g. specifying how many plants will be planted where and when), this section outlines the approach that will be taken to restoration in sufficient detail to allow annual restoration plans to be written. However, the details on actual propagation and planting methods will be left to the annual work plans, although some indicative methods are outlined in Appendix 3. The general approach to planting is initially discussed, followed by more detailed comments on the main activities involved in restoration: collection and propagation of planting material, site preparation, planting, and post-planting maintenance. More general information on restoration methods is provided in Porteous (1993).

6.2 Planting Approach

Active restoration planting will be of limited extent and will be undertaken to achieve the following outcomes:

- Expand the area of black beech forest at Remnant “B” (Zone 1)
- Establish an additional area of black beech forest somewhere within Zone 2.
- Fill key gaps between the regenerating kanuka areas across the inland faces (Zone 2)
- Form a riparian buffer along the coastal section of Kate Valley Stream (Zone 6)
- Establish indigenous vegetation within and around the margin of the Kate Valley wetland (Zone 3)
- Establish podocarps into the existing kanuka stands (especially Zones 2 and 4).
- Provide year-round food resources for korimako and kereru (throughout).

A variety of planted species will be used to buffer the restored system against the vagaries of reproduction failure of individual species and to provide a diverse habitat for indigenous birds through all seasons. The assumption is that these birds, and some introduced birds, will, in turn, play a key role in dispersing planted species more widely in the Kate Valley CMA. Among indigenous birds, kereru are frugivores and herbivores, while korimako and silvereye are frugivores and nectarivores. Piwakawaka (fantail) and riorio (grey warbler) are insectivores and it is assumed that a diversity of planted species is also required to support them as some of the invertebrates that are their prey are likely to be plant host-specific.

The general approach to planting encompasses five steps:

1. Plant ecologically appropriate species adapted to dry conditions. Some more sensitive species can be planted in sites that naturally accumulate water or on shady aspects where evaporation is lowest.
2. Plant in late winter/early spring to avoid winter frosts but provide the longest possible time for root systems to develop before summer droughts occur. Each plant should be in a slight hollow, to allow rainwater to accumulate.
3. Before planting, use herbicide to kill grass to lessen the competition for water while the tree or shrub establishes. Planted trees and shrubs may be given added assistance through the use of mulches to improve soil moisture conditions, and fertiliser will be applied during planting to ensure good initial root growth.

4. If necessary, plants can be aided during establishment in very dry seasons with the cautious use of irrigation from the existing farm water system that is present within the Kate Valley CMA.
5. Some release weeding is usually necessary to clear back encroaching grass after planting. In order to avoid plant losses it is important to restrict the numbers planted to those that can be properly maintained. Once their root systems develop (over the first three growing seasons) they should survive grass competition.

6.3 Collection and propagation of planting material

The remnants of indigenous forest and areas of regenerating forest in the Kate Valley CMA, together with other forest remnants in the general area and experience with other restoration projects in similar environments (e.g., on Banks Peninsula) will be used to select species for restoration. Species choice will focus on those that are adapted to local conditions and that will grow rapidly and provide suitable conditions for subsequent indigenous regeneration. In addition species choice will be influenced by a need to ensure that sufficient food resources are available to sustain a korimako population in the area and to provide conditions suitable for the establishment of a local kereru population. Table 1 provides an initial list of species for planting. This list is likely to evolve as the restoration proceeds depending on the success of initial plantings and on the success of the landscape plantings outlined in the Kate Valley Landscape Management Plan.

Table 1. Indicative list of species for use in restoration plantings.

Species	Main slopes & spurs (Zones 1 & 2)	Lower slopes & valley bottoms (Zones 1 & 2)	Coastal lower Kate valley (Zone 6)	Wetland (Zone 3)
black beech	●			
broadleaf	●	●		
cabbage tree	●	●	●	●
five-finger	●	●	●	
golden akeake			●	
harakeke		●	●	●
kahikatea		●		
kaikamako		●	●	
kanuka	●		●	
kohuhu	●	●	●	
korimiko		●	●	●
kowhai	●	●	●	●
lancewood	●	●	●	
lemonwood	●	●		
lowland ribbonwood	●	●		
mahoe	●	●	●	
manuka		●		●
matai	●	●		
narrowleaved lacebark	●	●		
ngaio	●	●	●	
purei		●	●	●
totara	●	●		

Overall species choice represents a balance between those species that will grow best under the prevailing environmental conditions, are likely to contribute most to meeting the restoration goal, and be most attractive to seed dispersing birds. At a local site level, species choice needs to consider the main limitations to plant growth (moisture, frost, exposure, infertility and competition) associated with particular microsites. This can be guided by the success of restoration plantings as they are established as well as the general ecology of species in remnant coastal forest in the Motunau Ecological District. However, species choice needs to be regularly reviewed based on the performance of plantings, especially during dry years, and the availability of propagated material. Table 4 in the Kate Valley Landscape Management Plan provides details on the specific composition of different planting areas that are likely to be relevant to the restoration plantings.

An additional consideration in determining species for planting is the need to ensure that year-round food supplies are available for species such as korimako and kereru. There is a considerable amount of information available on the diet of these birds (Baker 1992, 1999, Murphy & Kelly 2001, Sutherland 2002) and this information will be used to ensure that sufficient food resources are available year-round to sustain them. In particular, strategic plantings of key species such as kowhai will be undertaken.

Sources of plant stock for propagation to be grown in the Kate Valley CMA are seeds and cuttings from wild plants growing in the same area, or within the southern part of the Motunau Ecological District. Where seed supplies are inadequate or where seed germination is poor, cuttings will be used for propagation so long as sufficient material is available from the collection site. All collection of material for propagation will follow the guidelines in Norton et al. (1994) or other appropriate guidelines, and all necessary permits and permissions will be obtained prior to collecting (e.g., from adjacent Scenic Reserves). The contracted plant propagator will collect all material for propagation.

This project will require a substantial number of plants to be collected and propagated. This work will be undertaken by an experienced plant propagation contractor. Decisions on appropriate methods for plant collection and propagation will be based on discussions between Transwaste Canterbury Ltd. staff and the contracted plant propagator. While it would be desirable for all stages of plant propagation to be undertaken on site, it is likely to be logistically more realistic for propagation to be undertaken off-site where an existing infrastructure is available. The preference of Transwaste Canterbury Ltd. is for all propagation work to be undertaken in the local area. All plants will need to be hardened off in an open site that experiences environmental conditions similar to those in the Kate Valley CMA prior to planting.

6.4 Site preparation and planting

The majority of planting sites are covered with pasture grasses. The main species are perennial grasses with a mat of underground rhizomes (browntop, red fescue, field poa, cocksfoot). These grasses compete vigorously for the limited available water resources and they can smother young plantings, while their presence makes planting physically difficult. Primary site preparation involves removing these grasses permanently from the planting sites. More details on the methods for grass control are provided in Appendix 3.

Planting methods, including fertiliser use and mulching, will in general be similar to those outlined in the Kate Valley Landscape Management Plan. Decisions on appropriate methods will be based on discussions between Transwaste Canterbury Ltd. staff and the contracted plant propagator and/or planter. In general, plantings will be at a 1.5 m spacing, with fertiliser added prior to planting and mulching used to reduce grass competition and minimise water loss.

The underlying approach to restoration taken here is through appropriate site preparation and use of good quality plants, post planting management should be kept to a minimum. The intention is that once established, the restored areas should require minimal direct human intervention unless something unexpected occurs (e.g., an extreme weather event). However, some post-planting management will be required to deal with drought years, weed invasion, nutrient deficiencies and major planting failures. Monitoring (Section 9) also represents a form of post planting management.

The timing of restoration activities during the year is largely dictated by climatic conditions and the plant growth patterns. The annual work cycle is focussed on late-winter/spring planting with the aim of gaining full benefit from the period when soil moisture is likely to be at a peak. However, plants must also be suitably hardened off prior to planting in order to withstand conditions at the time of planting. Sites protected from severe frost may be planted in late July, but in more frost-sensitive sites planting should be delayed until August or September. The following is a summary of the main restoration activities and their timing.

Autumn - site preparation, planning for next years requirements.
Winter – hardening off, transport of plants to site, planting (late-winter).
Spring – finish planting, post planting maintenance.
Summer – seed collection, general maintenance, provision of water during dry periods.

Animal and plant pest control is undertaken throughout the year depending on the specific control method and the activity of the species involved (see Section 5).

Inter-planting will be used to enrich areas of gorse and regenerating kanuka. In gorse, enrichment plantings will involve cutting lines or strips through the gorse and establishing indigenous plants along these. The intention here is to speed up the replacement of gorse by indigenous vegetation, but continuing to utilise the gorse for shelter. Strategic plantings of later canopy dominants, especially totara and matai, will also be made into areas of regenerating kanuka forest. In these instances, small clearings will be made in the kanuka canopy to enhance light levels and thus aid growth of the planted species.

Remnant “A” provides a valuable resource for restoration. Where possible plants will be removed from remnant “A” and transplanted into appropriate sites in the restoration area, while seed and cuttings will be extensively collected from here over the period before it is removed. Soil duff from Remnant “A” will be used to inoculate nursery grown plants, especially of kanuka and black beech. Close to the time of removal, as much of the forest organic material and coarse woody debris as possible will be salvaged from Remnant “A” and spread through accessible parts of the restoration area and regenerating forest. This should facilitate regeneration in these areas and also help transfer some of the fauna associated with Remnant “A”. Advice will be sought at the time this occurs on the best approaches to do this.

6.5 Fire

Fire is one of the biggest threats to the restoration plantings and also to all other aspects of indigenous biodiversity within the Kate Valley CMA. Prevention of fire will involve a total fire ban within the Kate Valley CMA, Liaison with adjacent landowners about the risks fire poses to the Tiromoana Bush Restoration Project, maintenance of mown strips along the sides of all roads within the property owned by Transwaste Canterbury Ltd., maintenance of cleared (mown or bared to soil) strips at least 10 m wide between plantation forest and the Kate Valley CMA, and maintenance of water supplies on site through the water storage pond associated with the landfill. The Kate Valley landscape Management Plan provides further details on fire management.

7. Public access

Transwaste Canterbury Ltd. is committed to establishing recreational opportunities and facilitating public use as part of the management of the Kate Valley CMA. It will develop a track down Kate Valley to the coast. It will also outline the options to enhance use of the area for educational and scientific purposes.

A public walking track linking Mount Cass Road and the coast will be established within two years of the commencement of the restoration programme. This track will incorporate existing sections of farm track as well as some newly established track. The walking track will pass close to the Ella Ponds and Ella Bush SNAs, and provide access to the coast and Ella Peak Reserve along spur tracks. The final location of the track will be determined based on site inspections. However, it is not proposed to allow open public access to the whole of the Kate Valley CMA because of the risk of fire and to protect the security of restoration operations (e.g., areas of new plantings), and public use of the track system will be controlled. Dogs will be prohibited.

Interpretation information will be provided on the restoration project in a number of forms including the positioning of interpretation panels along the walking track and through making brochures available. Details will be developed in consultation with the Restoration Advisory Group and identified in the annual restoration work plans.

Use of the area for educational and scientific purposes will also be fostered by encouraging visits by local Canterbury schools (in conjunction with the landfill and waste education programmes) and through inviting teachers and scientists to visit the site.

8. Restoration zoning

Management of the Kate Valley CMA will be based on seven management zones (Fig. 1). Each zone has different attributes, restoration goals and management actions which are summarised in this section (Table 2).

Table 2. Summary of restoration actions by zone

Management action **Zone**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Planting of black beech	●	●					
Planting of forest species	●	●			●		
Planting of wetland species		●	●				
Plant and animal pest control	●	●	●	●	●	●	●
Natural regeneration	●	●	●	●	●	●	●
Monitoring	●	●	●	●	●	●	●
Recreational access		●		●	●		

8.1 Zone 1 (black beech Remnant "B")

Description: This zone (8 ha) comprises the black beech remnant known as remnant "B" and a small area of shrubland and pasture around this.
Goal: Enhancing the existing black beech remnant.
Management actions: Additional plantings of black beech both within the remnant and on adjacent sites, as well as plantings of other indigenous species (e.g., kanuka, mahoe, fivefinger, kohuhu) into adjacent pasture areas.

8.2 Zone 2 (inland faces including Ella Pond SNA)

Description: This is a large area (107.5 ha) encompassing the faces from remnant "B" around to and including Ella Pond SNA. The area is characterised by substantial patches of regenerating kanuka forest with pasture between. Some areas of gorse are also present.
Goal: Reconnect the existing forest remnants through active restoration and natural regeneration so that there is continuous forest between remnant "B" and Ella Bush SNA. Establish a second population of black beech.
Management actions: Restoration work will focus on connecting the existing patches of regenerating forest by planting fast growing indigenous species into pasture areas and encouraging natural regeneration. Species choice for plantings will depend on site, with species such as kanuka, mahoe, five-finger, lemonwood and kohuhu planted on the faces, kowhai, kaikamako, kahikatea and ngaio on the lower slopes and valley bottoms, and harakeke (flax) in the wettest sites. Totara and matai will also be planted into these areas, as well as into existing regenerating forest. Indigenous species will be planted into areas of gorse regeneration as required. In addition a site will be selected for establishing a second population of black beech which will then be planted.

8.3 Zone 3 (Kate Valley flats)

Description: This small unit (17.2 ha) comprises the flat valley floor of the middle reaches of Kate Valley stream. These flats were probably formed when the Ella Ponds landslide dammed Kate Valley, creating a wetland system up-stream of the landslide. Farm management

activities have resulted in the stream being realigned and drainage ditches created, but the area still supports wet grassland.
Goal: Active restortation of the Kate Valley wetland.
Management actions: Landfill management will result in the establishment of a weir at the end of this area which will result in wetter conditions over much of this site. Restoration will then focus on actively restoring wetland vegetation dominated by herbaceous species such as harakeke and purei, with appropriate marginal woody vegetation (e.g., kahikatea, manuka, korimiko and cabbage tree). The possibility of reinstating the meandering course of the Kate Valley stream will be evaluated.

8.5 Zone 4 (coastal faces including Ella Bush SNA)

Description: The lower part of Kate Valley including the Ella Bush SNA and the coastal faces around to Ella Peak Scenic Reserve (142 ha). The current vegetation is a mixture of regenerating forest (mainly centred on Ella Bush SNA) and pasture covered faces. Moderate amounts of native shrubland and gorse are present amongst the pasture.
Goal: Facilitate natural regeneration to native forest.
Management actions: Restoration work will involve animal and plant pest control only, allowing forest regeneration to otherwise occur naturally. Gorse will be allowed to invade pasture areas as it provides a good nurse for indigenous regeneration.

8.5 Zone 5 (lower Kate Valley)

Description: This small zone (14 ha) encompasses the lowermost part of Kate Valley to the coast. The vegetation here has a strong coastal component with ngaio and golden akeake prominent in the main forest remnants.
Goal: Actively re-establish a riparian corridor up the stream from the coast connecting through to Ella Bush SNA and Zone 4.
Management actions: Active planting of appropriate coastal forest species such as ngaio and golden akeake to establish a riparian forest between the coast and Ella Bush SNA.

8.6 Zone 6 (inland faces south of Remnant “B”)

Description: The south facing slopes between Zone 1 and Kate Valley stream (61 ha). The current vegetation is a mixture of pasture and shrubland with kanuka prominent.
Goal: Facilitate natural regeneration to native forest.
Management actions: Restoration work will involve animal and plant pest control only, allowing forest regeneration to otherwise occur naturally. Gorse will be allowed to invade pasture areas as it provides a good nurse for indigenous regeneration.

8.7 Zone 7 (Selby Road faces)

Description: North facing slopes with a strong shrubland component (71.5 ha).
Goal: Facilitate natural regeneration to native forest.
Management actions: Restoration work will involve animal and plant pest control only, allowing forest regeneration to otherwise occur naturally. Gorse will be allowed to invade pasture areas as it provides a good nurse for indigenous regeneration.

8.8 Time line

The following timeline indicates the activities that will be undertaken during the first five years of the restoration. Full details will be included in the annual restoration work plans.

Year 0 (2004-05)
Management planning
Prepare Year 1 (2005-06) CMA work plan.
Initial meeting of CMA Advisory Group.

Monitoring
Remeasure photopoints.
Establish initial permanent plots.
Establish bird monitoring lines.

Plant and animal pest control
Complete all fencing to secure CMA and remove all domestic stock.
Survey CMA for priority weeds to be controlled in next year.
Continue with possum control through CMA as part of property possum control operation.

Plant propagation and planting
Collect any available beech seed.
Propagate beech seed.
Collect cuttings and seeds from species for general restoration plantings.
Propagate collected cuttings and seeds.

Recreation/community relations
Finalise track location/route and mark on the ground.
Prepare initial newsletter outlining scope and approach of project.

Year 1 (2005-06)
Management planning
Prepare Year 2 (2006-07) CMA work plan.
Hold meeting of CMA Advisory Group.

Monitoring
Remeasure photopoints.
Establish further permanent plots.
Establish restoration planting monitoring plots as required.
Remeasure bird monitoring lines.

Plant and animal pest control
Prepare field guide to weed species in CMA.
Undertake control of priority weeds identified during Year 0 survey.
Continue with possum control through CMA as part of property possum control operation.
Implement mustelid and rodent control.

Plant propagation and planting
Collect any available beech seed.
Propagate beech seed.

Collect cuttings and seeds from species for general restoration plantings.
Propagate collected cuttings and seeds.
Undertake initial restoration plantings (target = 1 ha plus interplantings plus beech).

Recreation/community relations
Finish track development including signs etc.
Prepare 2005/06 newsletter on project.
Prepare brochure outlining scope and approach of project.
Establish web page that focuses on the CMA.

Year 2 (2006-07)
Management planning
Prepare Year 3 (2007-08) CMA work plan.
Hold meeting of CMA Advisory Group.

Monitoring
Remeasure photopoints.
Establish further permanent plots.
Establish restoration planting monitoring plots as required.
Remeasure existing restoration planting plots.
Remeasure bird monitoring lines.

Plant and animal pest control
Undertake any follow-up control of priority weeds as required.
Continue with possum control through CMA as part of property possum control operation.
Continue with mustelid and rodent control.

Plant propagation and planting
Collect any available beech seed.
Propagate beech seed.
Collect cuttings and seeds from species for general restoration plantings.
Propagate collected cuttings and seeds.
Undertake restoration plantings (target = 1 ha plus interplantings plus beech).

Recreation/community relations
Prepare 2006/07 newsletter on project.

Year 3 (2007-08)
Management planning
Prepare Year 4 (2008-09) CMA work plan.
Hold meeting of CMA Advisory Group.

Monitoring
Remeasure photopoints.
Establish further permanent plots.
Establish restoration planting monitoring plots as required.
Remeasure existing restoration planting plots.
Remeasure bird monitoring lines.

Plant and animal pest control

Undertake any follow-up control of priority weeds as required.
Continue with possum control through CMA as part of property possum control operation.
Continue with mustelid and rodent control.

Plant propagation and planting
Collect any available beech seed.
Propagate beech seed.
Collect cuttings and seeds from species for general restoration plantings.
Propagate collected cuttings and seeds.
Undertake restoration plantings (target = 1 ha plus interplantings plus beech).

Recreation/community relations
Prepare 2007/08 newsletter on project.

Year 4 (2008/09) – same as year 3

Year 5 (2009/10)
Management planning
Prepare Year 6 (2008-09) CMA work plan.
Hold meeting of CMA Advisory Group.

Monitoring
Remeasure photopoints.
Undertake first 5-year permanent plot re-measurements.
Establish restoration planting monitoring plots as required.
Remeasure existing restoration planting plots.
Remeasure bird monitoring lines.

Plant and animal pest control
Undertake any follow-up control of priority weeds as required.
Continue with possum control through CMA as part of property possum control operation.
Continue with mustelid and rodent control.

Plant propagation and planting
Collect all usable plant material from Remnant A prior to its removal.
Utilise salvaged material from Remnant A in restoration and regenerating forest areas.
Propagate beech seed.
Collect cuttings and seeds from species for general restoration plantings.
Propagate collected cuttings and seeds.
Undertake restoration plantings (target = 1 ha plus interplantings plus beech).

Recreation/community relations
Prepare 2009/10 newsletter on project.

9. Monitoring

9.1 introduction

A comprehensive monitoring programme will be established to assess the success of the restoration work. Monitoring will focus on the recovery of forest remnants and regenerating forest areas, the success of the restoration plantings themselves (e.g. plant survival), and on the abundance and distribution of particular plant and animal groups (e.g. abundance of key species such as korimako and regeneration of indigenous forest species in existing regenerating forest). It is not proposed to undertake specific animal or plant pest monitoring; rather the success of animal and plant pest control will be assessed by the response of indigenous biodiversity to this control. This section provides an overview of the approach that will be taken to monitoring.

9.2 Regeneration monitoring

For a representative selection of regenerating forest areas, permanent plots will be established. Because permanent plots are time-consuming to establish and to re-measure, it is proposed to establish no more than five each year with a five-year re-measurement cycle. Thus the total number of permanent plots will be 25. The methods for establishing permanent plots are outlined in Appendix 4. Plots will be established in proportion to the area of regenerating forest types present.

9.3 Restoration monitoring

Permanent 10 x 10 m plots will be established within the restored areas to monitor the overall success of the plantings. These plots will be used to assess both the survivorship and growth of the plantings and the establishment of ecosystem processes within the plantings (see Appendix 4 for more details). Permanent plots take time to measure and it is important that the number of plots established is sufficient to allow assessment of planting success but not too many as to become logistically difficult to manage. Permanent plots should be measured annually, at least during the first 5-10 years after planting. It is important that the same methods are used for measurements in subsequent years. It is proposed that at least two plots are established in the area planted in each year.

9.4 Photopoints

Permanent photopoints will also be located throughout the Kate Valley CMA as a means to document the change that occurs as a result of restoration work. Initially photopoints will be established at a number of sites throughout the Kate Valley CMA and used to follow overall change. In addition, photopoints will be established at each permanent monitoring plot location. In order for successive photos to be taken at the same location, all photopoints will be permanently marked with stakes and located using GPS.

9.5 Focal species monitoring

Focal species monitoring will focus on the abundance of korimako and kereru as indicators of the overall success of the restoration project. It is proposed that monitoring will be based on walking defined transects and will involve a distance sampling method (Barraclough 2000) to

incorporate a probability of detection and to reduce the problems of confusing relative abundance for conspicuousness. The final number of transects has yet to be determined, but they will include the major regenerating forest areas within the Kate Valley CMA. Counts on each line will be replicated at least three times. Counts will be carried out at the same sites each survey and will be undertaken at the same time (October/November) each year.

10. Project management

This section outlines the manner in which the Tiromoana Bush Restoration Project will be managed and the way in which its success will be assessed.

10.1 Project management

A Canterbury Waste Services Ltd. staff member will have responsibility for day to day management of the land resources owned by Transwaste Canterbury Ltd, including the Kate Valley CMA. This person will have the responsibility to liaise with contractors involved in plant propagation and animal and plant pest control. This person will, with specialist input as required, prepare the report on the preceding years work and draft the work plan for the next years work. This person will also undertake monitoring, with specialist input as required, and will undertake regular inspections of fences, restoration plantings, and will maintain the public walking track and signage and other publicity information. It is also likely that this person will have a role in liaising with schools and scientists. The staff member involved is also likely to be responsible for management of the landscape management area and the general management area (including plantation forests), thus facilitating coordination in management activities across these different parts of the greater Kate Valley area.

10.2 Annual restoration plan

The restoration plan is the guiding document for restoration. It provides the overview of the approach that will be taken in restoration but is not a prescriptive document as it is difficult to predict in advance changing circumstances that might result as restoration proceeds or changing biotic and abiotic factors that might influence restoration. Annual restoration work plans will provide these prescriptive details. The restoration plan provides the general overview of the project while the annual restoration work plans will provide the detail on the specific actions that will be taken to implement the restoration plan.

10.3 Land tenure

Within the first year of the life of the Tiromoana Bush Restoration Project, Transwaste Canterbury Ltd. will enter into an appropriate covenant (to the approval of the Hurunui District Council) to ensure the long-term legal security of the site. This covenant will outline the long-term vision for the Kate Valley CMA and will provide legal protection of the area in perpetuity.

10.4 Restoration review

An Advisory Group will be established at the outset of the Tiromoana Bush Restoration Project with the role of undertaking an annual review of all restoration activities over the previous year (including monitoring and research results) and approving the next years annual restoration work plan. This group will include experts in restoration and related sciences, and representatives from the local community, Hurunui District Council, Department of Conservation and Transwaste Canterbury Ltd. The Advisory Group will also suggest any changes to the main restoration plan as required and will undertake the review of this plan in ten-years time.

10.5 Public relations

Transwaste Canterbury Ltd. are committed to making the restoration project and the results that arise from the restoration widely known. This is important for several reasons; because it enables ownership of the project by local communities, it permits transparency in terms of project management, and it allows sharing of the results that arise from the project with other restoration projects. It is proposed that information about the restoration project will be disseminated through a range of tools include information signs along the walking track (Section 7), newsletters and brochures. It is proposed to produce a newsletter on the project at least annually which will be sent to local residents, schools and to other people who have expressed an interest in the restoration. A brochure outlining the goals and approach of the project will also be produced and circulated to the same group, and additional brochures will be produced as the project proceeds. A web page will be established that provides regularly updated information on the project including copies of all plans and reports relating to the project.

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APPENDIX 1: COMMON AND SCIENTIFIC NAMES

Plant names
*naturalised (exotic) species

black beech	*Nothofagus solandri* s.l.
blackberry*	*Rubus fruticosus* agg.
broadleaf	*Griselinia littoralis*
broadleaved trees	Angiosperm trees excluding beech
browntop*	*Agrostis capillaris*
cabbage tree (ti kouka)	*Cordyline australis*
clover*	*Trifolium* species
cocksfoot*	*Dactylis glomerata*
conifer	Genalic term for cone bearing trees such as pine and podocarp
European broom*	*Cytisus scoparius*
field poa*	*Poa pratensis*
five-finger	*Pseudopanax arboreus*
golden akeake	*Olearia paniculata*
gorse*	*Ulex europaeus*
grey shrublands	Shrublands comprising small-leaved species (e.g., *Coprosma* species)
harakeke (flax)	*Phormium tenax*
hawthorn*	*Crateagus monogyna*
kaihikatea	*Dacrycarpus dacrydioides*
kaikomako	*Pennantia corymbosa*
kanuka	*Kunzea ericoides*
kohuhu	*Pittosporum tenuifolium*
koromiko	*Hebe salicifolia*
kowhai	*Sophora microphylla*
lancewood	*Pseudopanax crassifolius*
lemonwood (tarata)	*Pittosporum eugenioides*
lowland ribbonwood	*Plagianthus regius*
mahoe	*Melicytus ramiflorus*
manuka	*Leptospermum scoparium*
matagouri	*Discaria toumatou*
matai	*Prumnopitys taxifolia*
narrowleaved lacebark	*Hoheria angustifolia*
native broom	*Carmichaelia australis*
ngaio	*Myporum laetum*
old man's beard*	*Clematis vitalba*
podocarp	Native conifer in family Podocarpaceae (e.g., totara)
prickly mingimingi	*Cyathodes juniperina*
purei	*Carex secta* and *Carex virgata*
putaputaweta (marbleleaf)	*Carpodetus serratus*
radiata pine*	*Pinus radiata*
raupo	*Typha orientalis*
red fescue*	*Festuca rubra*
red matipo	*Myrsine australis*
rimu	*Dacrydium cupressinum*
rush	Family Juncaceae with *Juncus* spp the most common (both

	native and exotic)
sedge	Family Cyperaceae with *Carex* and *Uncinia* species the most common (mainly native)
short tussock	Primarily *Poa cita* (silver tussock)
shrub pohuehue	*Muehlenbeckia complexa*
silver tussock	*Poa cita*
soft mingimingi	*Leucopogon fasiculatus*
thistles*	*Cirsium* species
totara	*Podocarpus totara*
wilding conifers*	Mainly *Pinus* species
willow*	*Salix* species

Animal names

banded kokopu	*Galaxias fasciatus*
black flounder	*Rhombosolea retiaria*
cat*	*Felis catus*
chaffinch*	*Fringilla coelebs*
common bully	*Gobiomorphus cotidianus*
common smelt	*Retropinna retropinna*
deer*	Family Cervidae (e.g., red deer)
dog*	*Canis familiaris*
ferret*	*Mustela furo*
giant bully	*Gobiomorphus gobioides*
goat*	*Capra hircus*
hare*	*Lepus europaeus occidentalis*
hedgehog*	*Erinaceus europaeus occidentalis*
inanga	*Galaxias maculatus*
kereru (NZ pigeon)	*Hemiphaga novaeseelandiae novaeseelandiae*
kingfisher	*Halcyon sancta vagrans*
korimako (bellbird)	*Anthornis melanura melanura*
lagomorphs*	Hare and rabbit
lamprey	*Geotria australis*
little shag	*Phalacrocorax melanoleucos brevirostris*
longfin eel	*Anguilla dieffenbachii*
magpie*	*Gymnorhina tibicen*
mallard duck*	*Anas platyrhynchos platyrhynchos*
mice*	*Mus musculus*
mustelid*	Stoat, ferret and weasel
paradise shelduck	*Tadorna variegata*
pig*	*Sus scrofa*
possum (brushtail)*	*Trichosurus vulpecula*
rabbit*	*Oryctolagus cuniculus cuniculus*
rat*	*Rattus rattus*
riorio (greywarbler)	*Gerygone igata*
rodent*	Mice and rats
shortfin eel	*Anguilla australis*
silvereye (waxeye)	*Zosterops lateralis*
spur-winged plover*	*Vanellus miles novaehollandiae*
stoat*	*Mustela erminea*

ungulates*	Deer and goats
upland bully	*Gobiomorphus breviceps*
wasps*	*Vespula germanica* & *V. vulgaris*
weasel*	*Mustela nivalis vulgaris*
welcome swallow	*Hirundo tahitica neoxena*
white-faced heron	*Ardea novaehollandiae novaehollandiae*
yellowhammer*	*Emberiza citronella*

APPENDIX 2: METHODS FOR ANIMAL AND PLANT PEST CONTROL

The following notes provide a brief summary of some of the approaches available for animal and plant pest control. Final details will be determined in consultation with the pest control operator and taking into account current regulatory and legislative requirements and will be included either within the contacts for the work and/or the annual restoration plans.

Brushtail possums: Control may involve the use of elevated leg-hold traps or cyanide paste/pellets either in bags or bait stations on a three-month cycle through the area.

Stoats, ferrets and weasels (mustelids): Control may involve using traps which are arranged in pairs in trapping tunnels, with an appropriate bait as a lure (e.g., eggs or rabbit meat). Traps should be located along ridge-lines with no more than 500 m between trap lines and 100 m between traps along lines. The traps should be run continuously and checked monthly.

Rats: Snap traps (e.g., Victor professional double spring) in tunnels should be spaced at 50 m intervals along the mustelid lines and checked monthly.

Hares and rabbits: Hares and rabbits can be controlled using spot-light shooting along vehicle tracks within the Kate Valley CMA at three-monthly intervals or as impacts dictate. Impacts on restoration plantings can be minimised through the use of appropriate retardant pastes on restoration plantings. Poisoning may also be undertaken (e.g., Pindone) where it is felt that this might be an effective control method.

Feral deer and goats: Control will be opportunistic in nature, and will involve hunting when animals are known or thought to be present.

Vespulid wasps: Control will involve the active seeking out and locating nests and treatment with carbol (or similar approved pesticide) each summer.

Priority weeds: Control will most likely involve cutting of plants and the painting of their stumps using an appropriate approved herbicide, or spraying using an approved herbicide such as Tordon, Escort or similar.

Pasture grasses and herbs: Control will preferably involve killing these species using herbicide (e.g., Gallant, Glyphosate or similar approved herbicide) in late summer-autumn (March – May) prior to planting, although mowing may be initially required at some sites. Mulch can be used to provide some control of regeneration if required, or, alternatively, further applications of grass- and herb-specific herbicides can be used if regeneration starts to smother plantings. For long-term control of grasses and other herbaceous problem plants, the restoration plantings should suppress and eventually eliminate the herbs on the planting areas.

Gorse: As it is proposed to use gorse as a nurse plant for native forest regeneration, control will be limited. However, where control is required (e.g., adjacent to boundaries or tracks) this will involve regular spraying using Tordon, Escort or similar approved herbicide.

APPENDIX 3: PLANTING METHODS

The following notes provide a brief summary of some of the approaches available for propagation and planting. In general, methods will follow the approach outlined in the Kate Valley Landscape Management Plan. However, final details will be determined in consultation with the propagation and planting contractors and will be included either within the contacts for the work and/or the annual restoration plans.

Propagation: Plants will most likely be container grown as this ensures that a good supply of soil and nutrients are available for plant growth during the first year. Where required (especially for kanuka and black beech), nursery raised plants will be inoculated with forest duff sourced from Remnant "A" to ensure mycorrhizal infections are present. The final size of plants for planting out will depend on the growth rates of the species used and the nature of the site being planted, although past experience suggests a minimum height of 30 cm. At this stage it is envisaged that except for slower growing species such as the podocarps, most planted material will be one or two years old at the time of planting.

Site preparation: The most efficient way to achieve this is to spray the entire planting site with an appropriate approved herbicide. Other approaches to site preparation that can be used include weed-eating, grubbing, and combinations of cutting and spraying. Weed-eating and grubbing appear less effective than spraying and usually require considerable post-planting releasing as herbaceous plants quickly grow back. Spot-spraying experiences some of the same difficulties as weed-eating and grubbing in terms of weed re-growth. Extensive spraying of the whole planting area appears to result in the best establishment of plantings and the least requirement for post-planting release. Experience at other sites suggests that control of grass species should be undertaken in late summer-early autumn prior to planting to ensure that there is sufficient growth in the grass mat for effective chemical uptake and that the grass mat has died and started to breakdown before late-winter planting.

Planting: Plants in pots or planter bags always require planting holes while root-trainers can be planted into slots made using a long-bladed spade (the H technique). However, on sites with stony or stiff topsoil layers the best practice is hole digging in either case. The bottom of holes should be well dug-over in order to provide a good medium for initial root growth. Individual planting sites are arranged in a matrix of triangles to avoid rows of plants, although terrain irregularity, shifts in orientation and other variables usually create a non-regular pattern. Plant spacing will usually be 1.5 m in order to achieve a closed canopy relatively quickly. A slow-release fertiliser pellet will be placed, on level sites, in the bottom of each planting hole as each plant is put in, or on sloping sites in a spade slit slightly upslope from the plant. During drought years, strategic watering of new plantings will be undertaken utilising the existing farm water supply.

Mulching: This can be used to conserve moisture in summer and suppress weed growth around the base of the plants. A variety of mulching methods are available including dead grass, weed mats, wads of newspaper, fruit separators, and squares of old carpet. Carpet mats have been used successfully on Quail Island and involve 60 x 60 cm squares placed with carpet side down to discourage weed seed germination on the carpet itself, but are tedious to prepare. Weed mats are too expensive and although newspaper is relatively cheap, it is tedious to apply and does not last long. If used, mulching should be undertaken either at planting or as soon after as possible. The decision to use mulching needs to be made at the time of first planting and in consultation with the plant propagation contractor. If used,

mulching methods should be reviewed regularly depending on past success and availability of material for this.

Post-planting maintenance: The two key areas where this is likely to be required relates to water and competition. If mulching is not used, then release spraying will be required until the plants are taller than the grass sward. During particularly dry years some watering may also be required. A good water supply is available on site from the existing farm water supply and should be sufficient to provide irrigation water if required. However, watering will only be required during particularly dry periods and when plantings are young as the soil water storage capacity should be sufficient to maintain the plantings otherwise. Decisions on when to use irrigation need to be made based on a good understanding of current soil water status and on the condition of plantings.

Blanking: Where significant mortality has occurred during the first year after planting, blanking will be undertaken to replace lost plants in the next year. It is considered better to consolidate existing plantings than establish new ones. However, in some sites the replacement could be done 4-5 years after initial planting.

APPENDIX 4: MONITORING METHODS

The following notes provide a brief summary of some of the approaches available for monitoring. Final details will be included in the annual restoration work plans.

Monitoring will be based on permanently marked plots (10 x 10 or 20 x 20 m in size). The location of each monitoring plot will be marked with a permanent metal stake in the ground at each corner and the position of the plot will be fixed using a Global Positioning System (GPS). Methods for plot measurement will follow those described by Handford (2000).

Regeneration monitoring plots: Within each plot individual woody plants > 1cm diameter at 1.4 m will be permanently marked and measurements made of diameter, height and condition. Permanent marking will involve tagging individual shrubs or trees by nailing a numbered tag into the trunk (allowing sufficient room for tree growth) and recoding the position on an x-y grid system. A number of regeneration plots (4-10) will also be established to assess the densities of regenerating vegetation and will involve permanently marked 1 x 1 plots within the main plot. Seedling and sapling numbers will be counted by species in two height classes (<10 cm tall, 10 – 50 cm tall) but not permanently marked. A list of all species present in the plot will also be made to include species not recorded in the permanent measurements (e.g., herbaceous plants and lianes).

Restoration planting monitoring plots: Within each of these plots all planted plants will be permanently tagged and a number of plant growth attributes measured (e.g., plant height, canopy spread and basal diameter). In addition, several indicators of ecosystem health will also be assessed including natural regeneration of indigenous plant species (an indicator of seed dispersal and habitat quality), and litter coverage and depth (an indicator of nutrient cycling). Final details on these will be determined at the time the plots are established.