

# **Tiromoana Bush**

## **Restoration Management Plan**

### **July 2017 – June 2022**



Third Five-Year Management Plan  
November 2017

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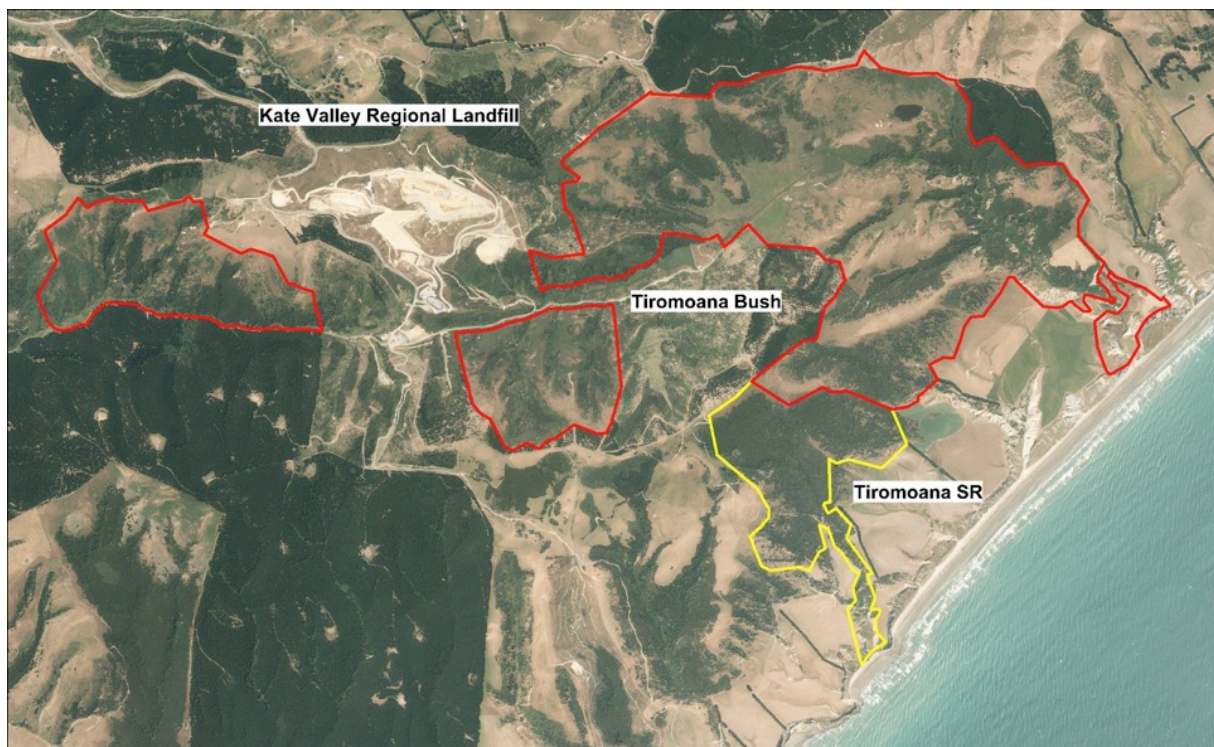
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## CONTENTS

<b>Introduction .....</b>	<b>4</b>
<b>Restoration vision and goals .....</b>	<b>6</b>
<b>Introduction .....</b>	<b>6</b>
<b>Vision .....</b>	<b>6</b>
<b>Thirty-five year outcomes .....</b>	<b>6</b>
<b>Five-year goals .....</b>	<b>7</b>
<b>Implementing restoration .....</b>	<b>11</b>
<b>Animal pest control.....</b>	<b>11</b>
<b>Plant pest control .....</b>	<b>12</b>
<b>Restoration plantings .....</b>	<b>14</b>
<b>Fire management .....</b>	<b>17</b>
<b>Public access.....</b>	<b>17</b>
<b>Monitoring .....</b>	<b>18</b>
<b>Project management .....</b>	<b>19</b>
<b>Appendix 1: Assessment of progress in meeting 2012-2017 restoration goals .....</b>	<b>20</b>
<b>Appendix 2: Common and scientific names .....</b>	<b>25</b>
<b>Appendix 3: Constraints to restoration.....</b>	<b>27</b>
<b>Abiotic constraints .....</b>	<b>27</b>
<b>Biotic constraints .....</b>	<b>28</b>
<b>Socio-economic constraints .....</b>	<b>29</b>

## INTRODUCTION

In 2004 Transwaste Canterbury Ltd., a public-private joint venture company, commenced a comprehensive restoration programme in the Kate Valley Conservation Management Area (henceforth referred to as Tiromoana Bush; Figure 1) as part of the mitigation offered for the establishment of the Canterbury Regional Landfill at Kate Valley. The restoration project became a legal requirement of the resource consent for the operation of the landfill and aims to result in a substantial increase in the overall biodiversity values of Tiromoana Bush within the 35-years of the landfill resource consent. In particular, the management work described in this restoration plan will result in the protection and enhancement of a substantial area of lowland native forest, a regionally rare and underrepresented vegetation type.



**Figure 1.** Location of Tiromoana Bush (red line) in relation to the Kate Valley (Canterbury) Regional Landfill and adjacent public conservation land.

A key assumption underlying the approach being taken to the restoration of Tiromoana Bush is that management works with natural successional processes, using plant and animal pest control to allow natural regeneration and recolonisation by native flora and fauna together with strategically located restoration plantings to facilitate and speed up these natural processes, but letting nature dictate eventual ecosystem composition and structure appropriate to the sites environmental conditions. The restoration being undertaken is a mix of the minimum interference management approach that has been used successfully at Banks Peninsula sites such as Hinewai Reserve and the more active planting approach that has been used successfully at a range of sites throughout New Zealand.

This 2017-2022 restoration plan is the third for Tiromoana Bush. The restoration management work that has been implemented in the thirteen years since 2004 has resulted in a substantial enhancement in native biodiversity at the site. A review of the outcomes of management in terms of the goals included in the 2012-2017 management plan is provided in Appendix 1. The current plan describes the overall vision and outcomes for the Tiromoana Bush restoration project, goals for the current five-year period, and the management actions that will be undertaken in order to achieve these. The basic approach to restoration is the same as in the earlier plans and involves the on-going exclusion of browsing pressure thus facilitating natural regeneration and recolonisation, the establishment of appropriate plant species through strategic restoration plantings, the encouragement of public access and use of the area for recreation, and on-going science and monitoring as tools to support and assess the success of these management actions.

Tiromoana Bush (407 ha) 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 lower Kate Stream and Tiromoana Scenic Reserve (Figure 1). It is located in North Canterbury coastal hill country (Motunau Ecological District, 43° 06' S, 172° 51' E, 0 – 360 m a.s.l.). The underlying geology comprises Tertiary seabed strata dominated by fine-grained compacted sedimentary deposits including limestones and mudstones. Annual rainfall is around 920 mm but with considerable variation both within and between years. The area typically experiences warm dry summers and cool wet winters. Snow is rare although frost can occur in winter, especially in valley bottoms away from the coast. The property had a mixed farming history prior to the start of the restoration project, but was typically farmed as an extensive sheep and beef property although farm productivity was limited to some extent by bad infestations of nassella tussock. The current vegetation is a mix of kānuka<sup>1</sup> and mixed-species shrubland and low forest, expanding areas of gorse and European broom shrubland, restoration plantings and rank pasture. Two ponds are present (Kate Pond and Ella Pond) and an increasing area of wetland vegetation occurs adjacent to Kate Pond. Kate Pond and associated wetland was constructed by Transwaste Canterbury Ltd. as part of the Tiromoana Bush project to enhance the natural wetlands around Ella Pond.

This management 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 management plan provides the general overview of the project while the annual restoration work plans provide the detail on the specific actions that will be undertaken to implement this plan. These work plans are produced annually in June/July, together with a review of the previous year's management work.

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<sup>1</sup> Scientific names of plants and animals mentioned in the text are listed in Appendix 2.



## RESTORATION VISION AND GOALS

### Introduction

Successful restoration is dependent on having clearly defined goals. Goals are important as they enable the success of restoration to be quantified and reported on, as well as allowing the restoration manager to critically evaluate the methods that are being used. 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 changing climate). For the Tiromoana Bush Restoration Management Plan, an overall vision of what the site might be like in 300 years has been developed to guide the project, with specific 35-year and five-year goals identified to assess restoration success against. The five-year goals 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.

The vision and 35-year goals were specified in the decision of the Environment Court granting resource consents for operation of the Kate Valley landfill and have been retained here with a few minor modifications. However, the five-year goals have been altered to reflect evolving emphasis of the restoration project as a result of review of progress over previous management periods.

### Vision

This vision sees Tiromoana Bush in 300 years 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.”*

### 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 Tiromoana Bush (these have been updated slightly from those included in the Environment Court decision as indicated below):

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. The species and abundance of native water birds have also been enhanced<sup>2</sup>.

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<sup>2</sup> Water birds have been added here as they are likely to respond to the wetland restoration efforts.

3. The beech forest remnant known as “Remnant B” has been secured and enhanced in terms of the area of black beech and at least one additional black beech site has been established<sup>3</sup>.
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 Tiromoana (Ella Peak) Scenic Reserve.
5. Restoration plantings have been used to re-establish locally rare vegetation types.
6. The area is being actively used for recreational, educational and scientific purposes.

### **Five-year goals**

In order to meet the 35-year outcomes for the Tiromoana Bush Restoration Plan, 11 goals for the 2017-2022 period have been developed that build on progress over the previous five years. Each goal has a performance indicator that will be used to measure the success of the project against. Five years has been chosen as the appropriate time period for these goals because it is short enough to be realistically achievable, but long enough to measure progress against. Annual restoration work plans will include the specific tasks that are required to achieve these goals.

At the end of the five-year term of this restoration plan (2022), the success of the Tiromoana Bush Restoration Management Plan in meeting these goals will be assessed (2012-2017 assessment is included as Appendix 1). In developing the restoration plan for the subsequent five-years, any reasons why these goals might not have been achieved needs to be evaluated and measures put in place to address them.

Goal 1: Herbivorous mammal pests are controlled to levels that do not threaten the restoration plantings or natural regeneration in Tiromoana Bush.

Explanation: Mammalian pests are the single biggest threat to the success of ecological restoration projects in New Zealand. Herbivores can significantly affect the growth of plantings and natural regeneration while omnivorous pigs can also affect soils and their associated biota. Key herbivores (domestic livestock, deer, pigs, rabbits and hares) will continue to be controlled to levels that do not impact on restoration through exclusion (domestic livestock and deer) and where appropriate, shooting (hares and rabbits). It is hoped that the deer fence will also reduce the ingress of pigs, although this is unlikely to be absolute and more work might be required to both exclude pigs (adding a barbed wire to the base of the deer fence) and eradicate any pigs that gain access.

Performance indicator: Key mammalian herbivores have not adversely affected restoration plantings or natural regeneration and any domestic livestock, deer or pigs found within the deer fence are promptly eliminated.

Goal 2: A detailed assessment of predatory mammals is undertaken as a basis for assessing the need for future predator control.

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<sup>3</sup> This outcome was previously separated into two outcomes but with the same wording.

Explanation: Animal pest management to date has focused on reducing the pressure of herbivores (domestic livestock, deer and pigs). It is likely that the abundance of birds at Tiromoana Bush is currently limited mainly by resource availability, but as the vegetation develops, predator limitation will become more important. Furthermore, if an introduction of a native animal species occurs, then an assessment of mammalian predators will also be required (depending on what species are introduced). It is therefore proposed to undertake an assessment of mammalian predator densities and their likely pressure on fauna as a basis for deciding on future mammal predator control priorities.

Performance indicator: An assessment of mammalian predators has been undertaken.

Goal 3: A systematic approach to plant pest control occurs and key plant pests are controlled to levels that do not threaten restoration or other values.

Explanation: Plant pests threaten the viability of a range of plant communities including regenerating forest, restoration plantings and wetlands, especially through competition, although this plan is pragmatic and recognises that not all exotic plants are necessarily pests. In particular, gorse and European broom are being allowed to expand naturally as they act as a nurse crop for native forest regeneration. However, as the bush is recovering an increasing number of plant pests are being found and surveillance and control of these species in a systematic manner is required for the key species threatening biodiversity values (e.g. wilding conifers, willows, old man's beard, hawthorn, cherry plum).

Performance indicator: A systematic approach to plant pest control has been undertaken that enables key plant pests to be controlled to a level that does not threaten the biodiversity values at Tiromoana Bush.

Goal 4: Restoration plantings focus on restoring kahikatea-dominated forest and associated wetland vegetation across the floor of Kate Valley, and angiosperm forest and associated shrubland and herbaceous vegetation in the coastal zone of lower Kate Stream.

Explanation: It is proposed that future restoration plantings are focused in two areas: (1) Kahikatea-dominated forest and associated wetland vegetation on the damp valley floor above Kate Pond; (2) Coastal low forest, shrubland and herbaceous communities in lower Kate Stream. As part of this goal it is proposed to undertake a review of the restoration plantings undertaken to-date in order to ensure that these are well aligned with our restoration goals and are providing value for the funding that is committed to them.

Performance indicator: Restoration plantings have been established primarily on the floor of Kate Valley and in the coastal zone, and a review of the restoration plantings undertaken to-date has been completed.

Goal 5: Consolidate restoration of black beech.

Explanation: Securing and enhancing the remnant stand of mature black beech (Remnant "B") and establishing at least one additional black beech population is one of the 35-year outcomes (outcome 3) for Tiromoana Bush. Black beech has now been planted in three additional locations at Tiromoana Bush, with plantings showing good growth rates, although no plants have been established adjacent to Remnant "B". There is an on-going seed collection programme from Remnant "B". It is proposed during the period of this management plan that



black beech plants are established adjacent to Remnant “B” and where necessary additional plants are established into the three existing planting areas to ensure that they are of a sufficient size to form viable long-term beech remnants.

Performance indicator: Black beech has been planted adjacent to Remnant “B” and, where appropriate, the three new black beech stands have been enriched through further plantings.

Goal 6: Commence a programme of enriching the existing seral kānuka low forest stands.

Explanation: Seral kānuka stands occur widely across Tiromoana Bush with most stands establishing on eroded sites within pasture in the last 50-70 years. While removal of livestock grazing has seen a rapid response in the understorey of these stands, mahoe is by far the most dominant species with other potential future canopy tree species (lemonwood, five finger, marbleleaf etc) rare. Research trials have shown that the creation of small canopy openings can increase the diversity of regenerating tree species and it is proposed to start using this as an active management tool. Planted tōtara have also performed well in such gaps, and where plants are available, inclusion of 1-2 tōtara plants in gaps will also be undertaken.

Performance indicator: A programme of enrichment through canopy gap creation has commenced, including strategic tōtara planting.

Goal 7: Undertake due diligence work necessary for a possible introduction of a native animal species that is currently absent from Tiromoana Bush.

Explanation: Tiromoana Bush provides the potential for reintroduction of locally extinct fauna (e.g. the snail *Wainuia*, freshwater crayfish, koura, and birds such as tui or the New Zealand robin/toutouwai). However, before this can be undertaken any factors that would threaten the success of such reintroductions would need to be removed (such as predators) and a solid case made for reintroduction as this will involve liaison with Ngāi Tūāhuriri, the Department of Conservation and the local community before it can occur.

Performance indicator: Due diligence has been undertaken to assess the potential of introducing a native animal species that is currently extinct from Tiromoana Bush, including the development of a reintroduction plan if it is deemed that this is appropriate.

Goal 8: Establish additional biodiversity monitoring.

Explanation: A comprehensive monitoring system for vascular plants and birds within existing areas of shrubland and forest, and general land cover monitoring across the whole of Tiromoana Bush has been established. It would, however, be informative for future management if the monitoring network was expanded to include vascular plants in other land cover types (e.g. gorse and broom shrubland) and other animal groups (e.g. invertebrates and reptiles) to enable the success of restoration management to be assessed more widely. This goal seeks to address this issue, while recognising that monitoring does require resources and needs to be undertaken in an efficient manner. In particular there are a wide range of approaches to invertebrate monitoring, many of which involve considerable technical expertise. However, some monitoring of key invertebrate groups (e.g. wetas and snails) and reptiles can provide information on habitat quality. An initial survey of some of these taxa (especially the snail *Wainuia*, weta and reptiles) would provide a useful baseline for developing monitoring.

Performance indicator: At least five vegetation monitoring plots have been established in areas of gorse/broom shrubland to monitor the development of these areas towards native forest. Baseline surveys of the snail *Wainuia*, weta and reptiles have been undertaken.

Goal 9: Better interpret the Tiromoana Bush project to the wider public.

Explanation: The Tiromoana Bush Walkway was upgraded in 2017 with new signage and additional tracks. This upgrade allows for better interpretation of the restoration project and it is proposed to install interpretative material along the walkway that focuses on both the restoration project itself and the importance of the area to Ngāi Tūāhuriri. In addition, the Transwaste Canterbury website provides the opportunity to make further information available to the public on the project.

Performance indicator: Interpretative material has been installed along the walkway and more information on the Tiromoana Bush restoration project has been made available through the Transwaste Canterbury web site.

Goal 10: Tiromoana Bush is used as part of local school and LEARNZ learning programmes.

Explanation: While Tiromoana Bush is well used for university field trips, use by school groups is limited. Tiromoana Bush has been visited by school children through the Untouched World Foundation but this programme has now ceased, and is also included as part of the LEARNZ Virtual Field Trip focusing on waste management. A high priority for this five-year management period is to work with local schools (e.g. Woodend Primary and Hurunui College) to facilitate their use of the area. This will require school visits and provision of information to the schools.

Performance indicator: At least four visits by local schools to Tiromoana Bush occur each year.

Goal 11: Provide support to the development of a wider Motunau Ecological District conservation initiative.

Explanation: The possibility of a wider Motunau Ecological District conservation initiative was discussed at a meeting in May 2017. There was general support for such an initiative, although further details have yet to be developed but it is hoped that this will occur over the next couple of years.

Performance indicator: Support is provided towards the development of a wider Motunau Ecological District conservation initiative as appropriate.

## **IMPLEMENTING RESTORATION**

A number of factors have the potential to constrain or limit the success of management in achieving the 35-year restoration outcomes, and ultimately the long-term vision for the site. Constraints to restoration include those associated with the abiotic, biotic, and socio-economic environment and are discussed further in Appendix 3.

Restoration management involves a range of actions including establishing restoration plantings, plant and animal pest control, monitoring and provision of public access around the site. The specific methods used for these meet current best practice guidelines and are continually reviewed in consultation with the individuals and organisations contracted to implement them. People undertaking specific activities such as plant and animal pest control must have appropriate certification for the use of herbicides and pesticides.

In this section, the management actions that will need to be implemented to achieve the five-year goals outlined earlier are briefly reviewed.

### **Animal pest control**

A number of introduced animal pests including brushtail possums, stoats, ferrets, rats, mice, red and fallow deer, goats, rabbits, hares, pigs, hedgehogs and vespid wasps are likely to be present or border upon Tiromoana Bush. Domestic livestock and domestic and feral dogs and cats may also come onto the site from time to time. The presence of both wild and domestic animals within the restoration area will impact upon the restoration work proposed at Tiromoana Bush.

Animal pest control methods need to 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. 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.

For the period of this management plan the main animal pest control actions will be focused on removing any domestic livestock, feral deer and pigs that are found within Tiromoana Bush deer fence. Occasional control of hares/rabbits and Canadian geese is also undertaken on an “as required” basis. Should domestic livestock be encountered (cattle, sheep and goats have all been seen), then the adjacent farmer is contacted and asked to remove the animals. Deer and pig control is undertaken by qualified hunters only under the control of Canterbury Waste Services (CWS) division of Waste Management NZ Ltd. No other hunting is allowed. All dead deer and pigs are to be removed from the property and disposed of in a suitable manner. The Tiromoana Bush Walkway will be closed during any hunting operations. Rabbit,

hare and Canadian geese control are undertaken by contract shooting on an ‘as required’ basis in Tiromoana Bush as organised by CWS and again the walkway is closed.

A comprehensive assessment of animal pests will be undertaken to determine the distribution and abundance of small to medium sized mammalian pests including brushtail possums, stoats, ferrets, cats, hedgehogs, rats and mice. The methods used will most likely be a mix of tracking tunnels, wax tags and kill traps, with the final methods decided in consultation with the contractor undertaking the work and will follow currently accepted best practice. It is proposed to undertake this assessment over two consecutive summers to account for any between-year variation in pest numbers. The objective of this monitoring is to have objective data to make decisions on future animal pest management and the issues that might need to be dealt with in terms of any faunal reintroduction programme.

### **Plant pest control**

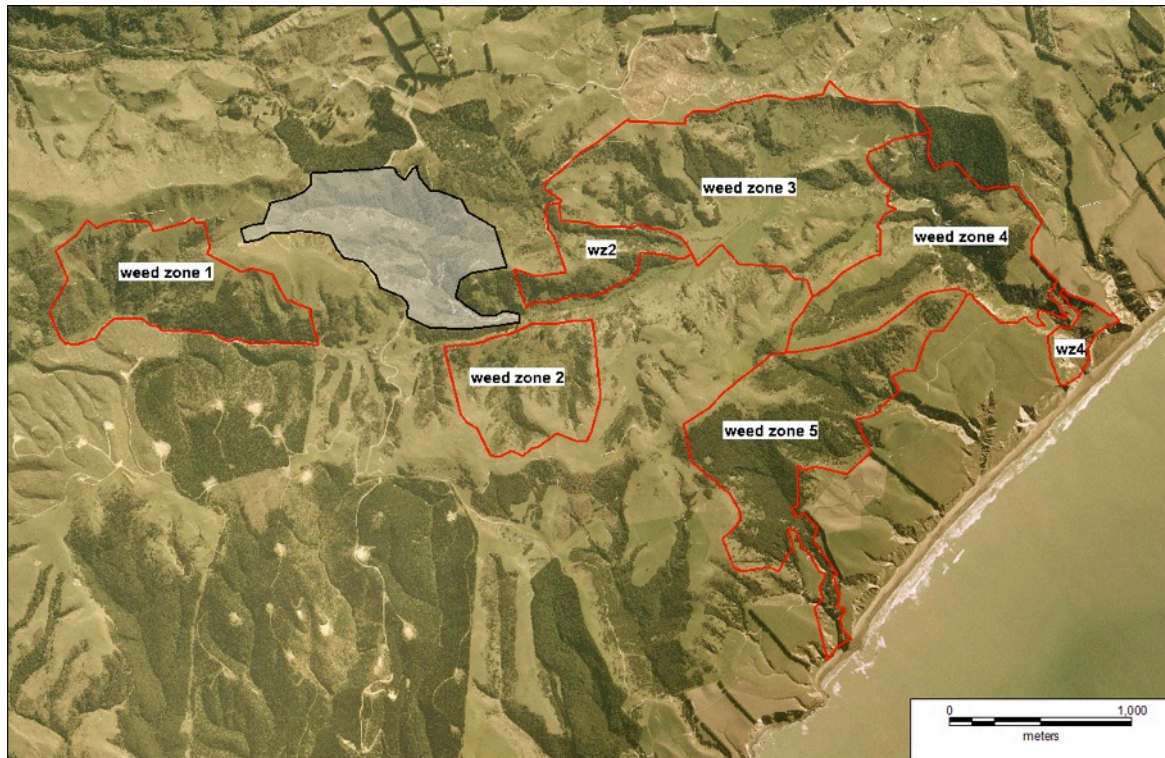
Weed species, especially woody ones, can limit the success of the restoration programme as they out-compete planted species and natural regeneration resulting in reduced growth rates and mortality. However, gorse and European broom can also act as nurse plants for native regeneration and while the succession under their canopy may not be identical to that under native nurse species such as kānuka, they are free and in the long-term do appear to result in the dominance of a native forest canopy so long as fire is excluded. However, several other species of weed are a direct threat to restoration and the objective for Tiromoana Bush is to maintain the site free of all priority weed species.

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.

Woody weeds: Some woody weeds are potentially a serious threat to the long-term composition and structure of the regenerating forest at Tiromoana Bush because they can deflect succession, smother and kill native species or become a permanent but unwanted component of the ecosystems restoration aims to establish. Key woody weeds that are of concern include wilding conifers, willows (crack and grey), cherry plum, hawthorn, willow, and old man’s beard, which are all present at Tiromoana Bush, and barberry and blackberry which although not yet recorded at Tiromoana Bush are present in the wider area.

Woody weeds appear to be becoming more common at Tiromoana Bush, presumably because the absence of domestic livestock means that seedlings are now able to establish and grow. To ensure a coordinated approach to woody weed control, Tiromoana Bush has been split into five zones, with systematic surveillance and weed control undertaken in one zone each year (Figure 2). All weeds are cut and where appropriate stumps are treated with an herbicide gel such as Vigilant®, or for larger trees of wilding conifer or willow, trunks are drilled and an

appropriate chemical injected into the tree. The locations of weeds killed is recorded using GPS to allow rechecking of areas with previous infestations.



**Figure 2.** Woody weed control zones at Tiromoana Bush.

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 Tiromoana Bush, nor do they need to be. Pasture grasses and herbs are managed as part of planting programmes which involves herbicide application prior to planting and depending on the degree of regrowth post-planting herbicide control until plantings are tall enough to suppress these species.

The one herbaceous plant species present at Tiromoana Bush for which there is a specific regulatory requirement for control is nassella tussock. Under the Canterbury Regional Pest Management Strategy there is a requirement for annual control of nassella tussock.

#### 6.2.5 Strategy rules for nassella tussock

- (a) *Land occupiers shall, on all the land they occupy, complete a control programme to prevent nassella tussock plants from seeding by:*
  - (i) *31 October every year within the area delineated on Map 1 Appendix 3.*

Gorse and European broom: Both of these species are being allowed to regenerate across Tiromoana Bush so that they can act as nurse plants for forest regeneration because of (1) the high costs associated with controlling them, (2) the costs involved in undertaking an active planting programme over the areas where they are establishing, and (3) the known ability of gorse and broom to invade rank grassland and provide a suitable environment for indigenous

forest regeneration. However, both species also present a considerable fire risk and a key component of restoration management is to maintain a total-fire ban within Tiromoana Bush and to limit public access during periods of high fire risk.

The operative Regional Pest Management Strategy for Canterbury outlines rules relating to the control of European broom (7.5.5) and gorse (7.6.5). [The two rules are identical in wording and only that for gorse is included here.]

#### *7.6.5 Strategy rules for gorse*

- (a) *Land occupiers shall eliminate gorse infestations that cover up to 50 square metres in area and are greater than five metres from other gorse infestations exceeding 50 square metres in area on the land that they occupy.*

*For the purpose of this rule eliminate means the permanent preclusion of the gorse plant's ability to set viable seed.*

- (b) *Land occupiers shall eliminate gorse infestations on the land that they occupy within 10 metres of any adjoining property occupied by another land occupier where that adjoining property is clear of, or being cleared of, gorse infestations within 10 metres of the boundary between the properties.*

*For the purpose of this rule eliminate means the permanent preclusion of the gorse plant's ability to set viable seed.*

Landowners are, however, allowed to apply for an exemption from this rule as outlined in Chapter 12 of the Regional Pest Management Strategy for Canterbury. In particular it notes that: “Exemptions [may be] sought in situations where gorse and broom provide natural cover and a nursery for regenerating native bush and where exotic forestry is used as a control method. Any such exemptions would need to take account of possible spill-over effects on neighbouring properties.”

An exemption for Tiromoana Bush from clause (a) of these rules has been obtained.

### **Restoration plantings**

This section outlines the broad approach that is being used in establishing restoration plantings in Tiromoana Bush. Active restoration is relatively limited because of the costs involved. The main focus of restoration plantings in this planning period are on valley bottom kahikatea forests and associated wetlands and the coastal area. As well as re-establishing representative vegetation types, restoration plantings provide habitat for native birds. The assumption is that these birds, and some introduced birds, will in turn play a key role in dispersing planted species more widely through Tiromoana Bush. 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:

- Plant ecologically appropriate locally sourced species adapted to local conditions.
- 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.
- Use an herbicide application to kill pasture grasses and forbs prior to planting.
- Include fertiliser tab, and in drought prone sites water retention crystals, as required at planting.
- Undertake post-planting weed control as required.

Collection and propagation of plant material: Species choice for restoration is based on current species distribution patterns at Tiromoana Bush and in comparable sites, coupled with experience from existing restoration plantings at Tiromoana Bush. In addition, species choice is influenced by known growth rates (rapid growth species are preferred because they shade out the grass quicker) and the ability of particular species to provide suitable conditions for subsequent indigenous regeneration. Species choice is also 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. 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 for the site, and be most attractive to seed dispersing birds. The success of different plantings also provides strong guidance on suitable species.

Sources of plant stock for propagation to be grown at Tiromoana Bush are seeds (and cuttings when seeds are not available) from wild plants growing in Tiromoana Bush, 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 appropriate guidelines with regard to *Threatened* and *At Risk* species, and all necessary permits and permissions will be obtained prior to collecting.

Site preparation, planting and post-planting maintenance: The majority of planting sites are covered with pasture grasses, especially cocksfoot. Primary site preparation involves using herbicides to kill these grasses prior to planting. Planting is undertaken manually with spacing appropriate to the species, but typically being around 1.0-1.5 m. Fertiliser tabs are placed in planting holes and water retention crystals used at sites that are likely to suffer summer soil moisture deficits. Post-planting maintenance involves herbicide application or hand weeding where required. However, the basic approach to restoration taken here is that through appropriate site preparation and use of good quality plants, post-planting maintenance 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).

Herbivore control, especially hare control, is required before and during planting. The most effective method has been found to exclude hares through fencing, although protective sheaths do work to some extent. Rabbit/hare repellents have not proved effective at Tiromoana Bush and cannot be relied on to protect plants. Hares are the main issue now as rabbit numbers have declined with the removal of domestic livestock. Regular shooting helps keep hare numbers down.

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 – planning for next year’s requirements.

Winter – site preparation, planting (late-winter).

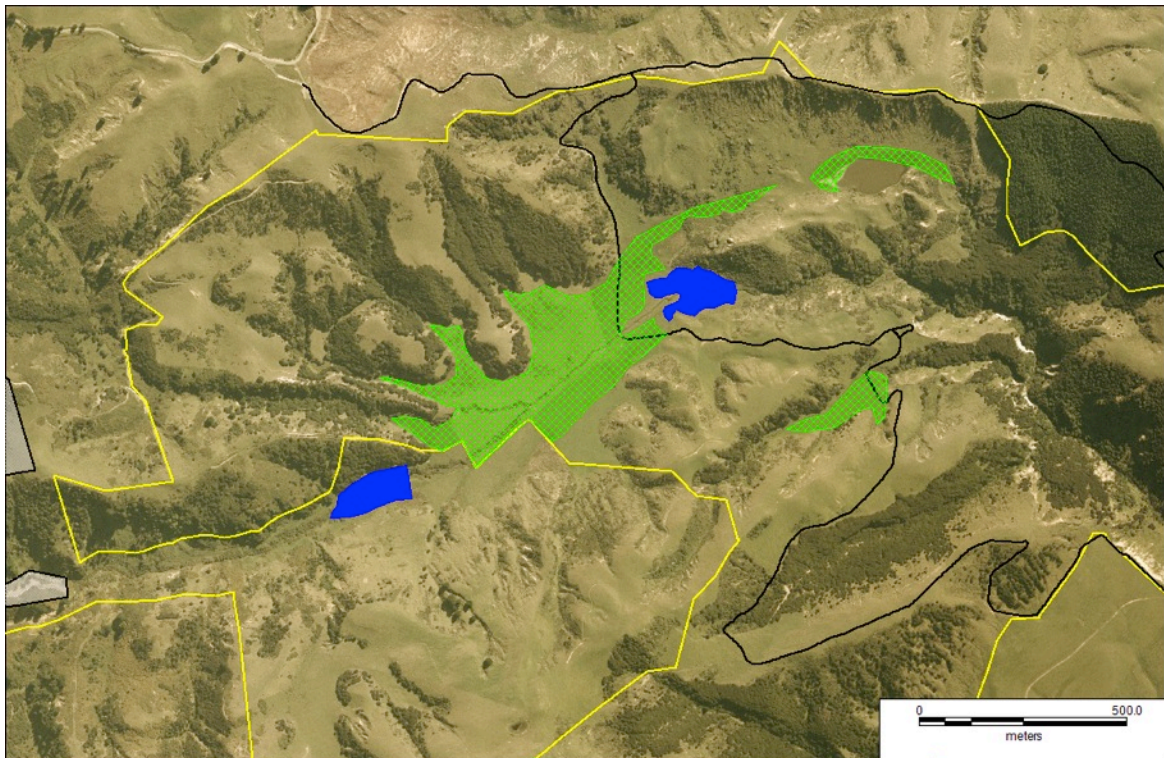
Spring – finish planting, post planting maintenance.

Summer – seed collection, further post planting maintenance.

Planting focus: Restoration planting during the 2017-2022 period will focus on two main areas:

- Establishment of kahikatea forest and associated wetlands across the valley floor above Kate Pond – this will involve kahikatea planted with purei, harakeke, cabbage tree and other appropriate species as available. The main aim is to establish a mixed kahikatea forest-wetland system that will restore a regionally rare forest type while also providing habitat for a range of native fauna. The approximate location of this planting is indicated in Figure 3.
- Planting of coastal forest, shrubland and herbaceous species in lower Kate Valley until there is no more readily planted space available. The intention here is to re-establish a coastal ngaio dominated forest with shrubland and herbaceous communities in more exposed sites.

In addition, further black beech plantings will be established adjacent to Remnant B and some enrichment planting will also be undertaken in regenerating kānuka stands in order to establish future canopy dominants, especially tōtara and matai.



**Figure 3.** Approximate location of mixed kahikatea forest – wetland plantings (green crosshatch) for the 2012-17 period.

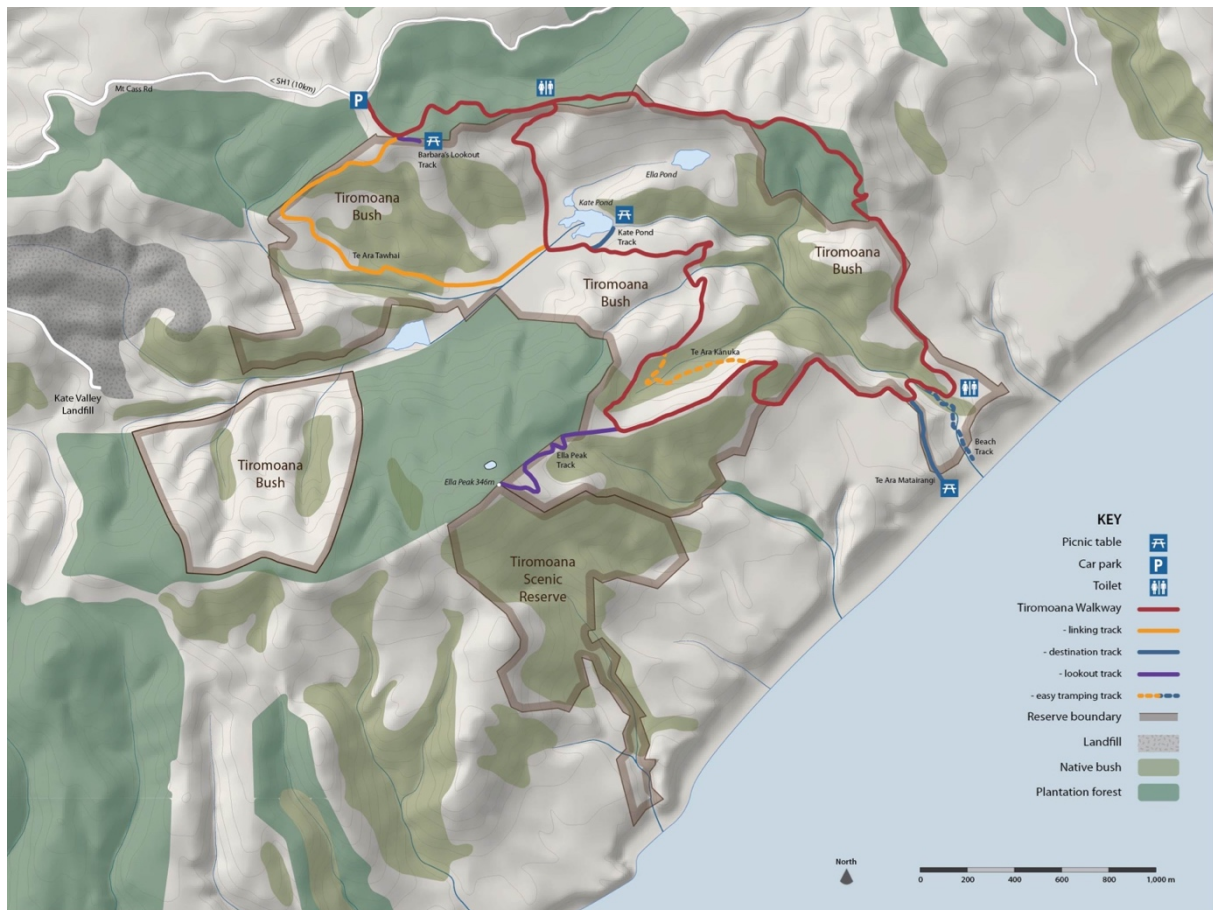
### **Fire management**

Fire is one of the biggest threats to the restoration plantings and also to all other aspects of indigenous biodiversity at Tiromoana Bush. Prevention of fire involves a total fire ban within Tiromoana Bush, liaison with adjacent landowners about the risks that fire poses to the restoration project, maintenance of water supplies on site through the landfill water storage pond and Kate Pond, and restricting public access during periods of high fire risk. In addition, all management access to Tiromoana Bush will be restricted to foot access only during times of high fire risk and no track mowing will be undertaken at this time.

### **Public access**

The Tiromoana Bush walkway has been substantially upgraded with new signs and new tracks (Figure 4). This provides an approximately 2-3 hour round trip, as well as shorter options. The track is open all year except during periods when the fire risk is high (usually January-March). However, public access to the rest of Tiromoana Bush is restricted. Dogs and mountain bikes are prohibited on the track. The track is maintained by mowing at least twice each year, toilets are available and new signs are in place showing the different routes.

Interpretative panels will be located in three locations along the walkway. These will provide information on the restoration project as well as on the importance of this area to Ngāi Tūāhuriri, the iwi with mana whenua over this part of Canterbury.



**Figure 4.** Tiromoana Bush walkway showing the new track options.

Tiromoana Bush has had some use by schools, but this needs to be strengthened. It is proposed that during the life of this management plan that schools will be approached on a more proactive manner with the aim being to ensure that there is at least four school visits each year, and hopefully more than this. To provide better information to schools (and the general public) the part of the Transwaste Canterbury web site that relates to Tiromoana Bush will be enhanced and brought up-to-date in terms of the reports and other information provided on the restoration project.

## Monitoring

Current monitoring within Tiromoana Bush comprises 13 monitoring transects through shrubland and regenerating kānuka forest remnants along which birds are counted at three sites and vegetation is measured at two sites. Bird monitoring occurred for five years (2005-2009) while vegetation monitoring has occurred every 2-3 years since 2007. The bird monitoring is going to be undertaken again in late 2017 and will hopefully be repeated 1-2 further times. Vegetation monitoring includes a 10 x 10 m plot for canopy trees and 1.5 x 1.5 m subplots for seedlings. Monitoring of restoration plantings has also been undertaken and involves variable area plots. These plots are re-measured on an ad-hoc basis. In addition, 13 panoramic photo-points located at strategic vantage points around the site have been rephotographed annually (in December) since 2004 and some ad hoc lizard monitoring has been undertaken.

Additional monitoring represents a trade-off between the resources required and the information that will be obtained. It is proposed to establish vegetation monitoring plots in areas of gorse and broom shrubland as a basis for assessing long-term successional development in these communities. These will involve the same methods as those used in the existing forest and shrubland vegetation monitoring plots. It is also proposed to undertake some additional animal monitoring depending on advice from relevant experts.

### **Project management**

The key component of annual management of Tiromoana Bush is the production of an annual work plan and report on the previous years' work. This is a requirement under the resource consent for the Kate Valley Regional Landfill and must be submitted to Hurunui District Council annually for approval. In the past a Tiromoana Bush Advisory Committee has met twice each year to review progress with restoration work, provide advice on the restoration management programme and review the annual work plan prior to it being sent to council for approval. This committee has not met now for several years and some consideration needs to be given to whether it should be reformed or whether another form of project over-sight is required. The committee had membership from Hurunui District Council, Department of Conservation, QEII National Trust, SCION Research, Waiora Forest Landscapes, University of Canterbury and CWS. However, several of the people involved have since retired or moved to other jobs.

The day-to-day management of the restoration project is the responsibility of CWS/Waste Management NZ Ltd. who receive an annual budget for this work from Transwaste Canterbury Ltd. However, the majority of the actual restoration work is undertaken by external contractors (plant propagation, weed control etc.) and is coordinated by Professor David Norton for CWS and Transwaste Canterbury Ltd.

The current Tiromoana Bush Restoration Management Plan runs for five years from July 2017 and will be reviewed in the middle of 2022.



## **APPENDIX 1: ASSESSMENT OF PROGRESS IN MEETING 2012-2017 RESTORATION GOALS**

***Summary: The major focus over the 2012-2017 management plan period has been on completing the deer fence and upgrading the walking track. Both projects have taken up substantially more resources and time than was originally anticipated, but have been prioritised over other activities identified in the management plan. As a result, some proposed management actions have been deferred and not completed in the 2017-2022 management plan period. However, other activities such as plant and animal pest control, restoration planting and monitoring have continued. The following notes summarise progress against the ten 2012-2017 management goals and serve as a basis for the development of management goals for the 2017-2022 period.***

Goal 1: Herbivorous mammal pests are controlled to levels that do not threaten the restoration plantings or natural regeneration in Tiromoana Bush while a detailed assessment of predatory mammals has been undertaken as a basis for assessing the need for future predator control.

Performance indicator: Key mammalian herbivores have not adversely affected restoration plantings or natural regeneration.

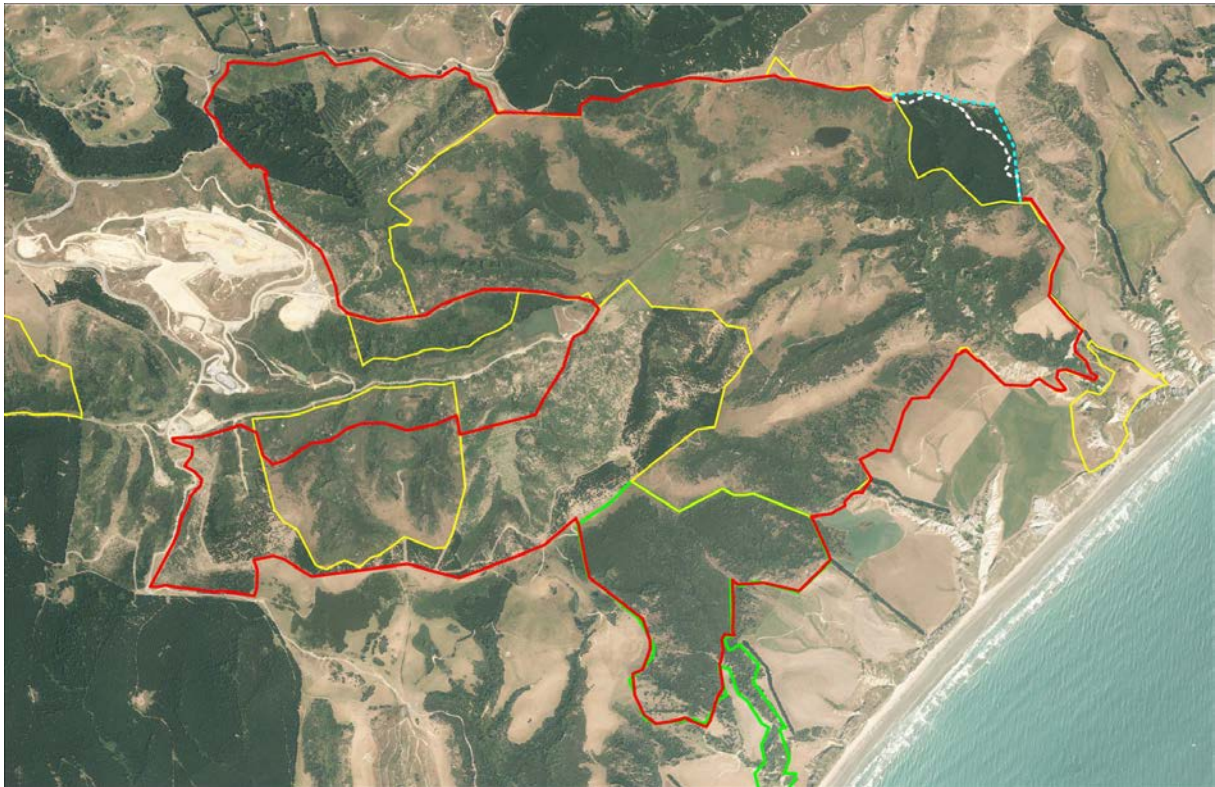
*2012-2017 outcomes: Restoration plantings and natural regeneration has been largely unaffected by mammalian herbivores, with some local exceptions. Domestic livestock have not been a major issue over this management period. When incursions have occurred, animals have usually been removed quickly and damage has been minimal. Development of a clearer understanding between Transwaste Canterbury and the adjacent farmer over these issues has helped. Feral deer have had a localised impact, but less so during this management period than previously. The major concern in the last five years has been about pigs which have caused substantial damage to the soil and ground vegetation in some parts of Tiromoana Bush. Their impacts are addressed more specifically in the 2012-2017 management plan.*

Goal 2: The core area of Tiromoana Bush has been enclosed with deer fencing to provide greater security from browsing animals including domestic livestock, and feral deer and goats.

Performance indicator: A deer fence has been constructed around the perimeter of at least the core area of Tiromoana Bush and deer have been eliminated from this area.

*2012-2017 outcomes: 15.5 km of deer fence has been constructed around Tiromoana Bush, with only one 800 m section around the Ella Pond plantation still requiring completion (Figure A1). Because the fence has yet to be completed, deer and pigs have not been removed from the bush. The final section of deer fencing will be completed by the end of 2017 and removal of deer and pigs will occur after that.*





*Figure A1. Completed deer fence (red line) and likely final section around the Ella Pond plantation (dotted blue line). Yellow lines mark the boundary of Tiromoana Bush and green line the boundary of Tiromoana Scenic Reserve.*

Goal 3: A systematic approach to plant pest control has been implemented and key plant pests are controlled to levels that do not threaten restoration or other values.

Performance indicator: A systematic approach to plant pest control is undertaken that enables key plant pests to be controlled to a level that does not threaten the biodiversity values at Tiromoana Bush.

2012-2017 outcomes: *Annual plant pest control has been implemented over this management period with one weed control zone visited each year. No plant pests are considered to threaten the outcomes of the restoration project at the present time, however, ongoing vigilance is required and plant pest control will continue.*

Goal 4: Shift the focus of restoration plantings towards restoring kahikatea-dominated forest and associated wetland vegetation across the floor of Kate Valley.

Performance indicator: At least 3000 plants are established annually, with ideally >50% being planted into the valley floor above Kate Pond including kahikatea, harakeke, purei and cabbage tree.

2012-2017 outcomes: *This shift in planting focus is occurring with substantial numbers of plants now being established onto the valley floor above Kate Pond. However, total numbers of plants established each year is usually <1000 and the efficacy and role of restoration plantings will be reviewed over the 2017-2022 management period.*

Goal 5: Consolidate restoration of black beech.

Performance indicator: Black beech has been planted adjacent to Remnant “B” and the two new black beech stands have been enriched through further plantings and are showing good height growth.

*2012-2017 outcomes:* The two new black beech stands are growing well with excellent height growth and plant survival (tallest plants are now >5 m in height; Figure A2). No black beech plants have been established adjacent to Remnant “B” because of access issues but this will be addressed in the 2017-2022 management period.



*Figure A2. Strongly growing black beech.*

Goal 6: Develop a plan to manage the pine plantation at the north-eastern corner of Tiromoana Bush in a manner that complements the restoration goals for Tiromoana Bush.

Performance indicator: A plan has been developed and implemented to manage the pine plantation at the north-eastern corner of Tiromoana Bush that complements the ecological goals within Tiromoana Bush.

*2012-2017 outcomes:* The Transwaste Board has decided not to harvest this pine stand at the present time and until a decision has been reached on its eventual fate, further planning here has been deferred.

Goal 7: Undertake due diligence work necessary for a possible introduction of a native animal species that is currently absent from Tiromoana Bush.

Performance indicator: Due diligence has been undertaken to assess the potential of introducing a native animal species that is currently extinct from Tiromoana Bush, including the development of a reintroduction plan if it is deemed that this is appropriate.

*2012-2017 outcomes: Some initial discussions with Ngāi Tūāhuriri have occurred, with a suggestion that freshwater crayfish, koura, might be an appropriate species. This will be followed up during the 2017-2022 management period.*

Goal 8: Establish additional biodiversity monitoring.

Performance indicator: At least five vegetation monitoring plots have been established in areas of gorse/broom shrubland to monitor the development of these areas towards native forest. Baseline surveys of the snail *Wainuia*, weta and reptiles have been undertaken, methods for invertebrate monitoring have been evaluated and some invertebrate monitoring has been established.

*2012-2017 outcomes: A pilot study of invertebrates in Tiromoana Bush was established in 2017 and will be used as the basis for establishing longer-term monitoring. Because of other priorities, no other new monitoring was established although existing monitoring has continued. Monitoring will be strengthened over the 2017-2022 management period.*

Goal 9: Expanding public access and availability of interpretive material.

Performance indicator: Complete negotiations with the adjacent farmer to allow public access around Tiromoana Bush during the lambing season and establish at least three information panels along the main walking track that explain the restoration work.

*2012-2017 outcomes: This has been a major management focus over the 2012-2017 period. Access to the walkway through lambing was successfully negotiated with the adjacent farmer and the walkway is now available to the public all year except during periods of high fire risk. Part of the negotiation involved shifting the existing coastal lookout track from the north side of Kate Stream to the south side. Rather than establishing information panels, the decision was made to undertake a full upgrade of the walking track with new signage (Figure A3) and an additional shorter track that descends from Barbara's Gate to the floor of Kate Valley close to Remnant "B". Information panels will be installed in 2017-2018.*





*Figure A3. The new information board at the start of the Tiromoana Bush walkway.*

Goal 10: Have local schools use Tiromoana Bush as part of their learning programmes.

Performance indicator: At least one local school is using Tiromoana Bush at least one each year.

2012-2017 outcomes: *This has not been progressed but is addressed through the 2017-2022 management goals.*

## APPENDIX 2: COMMON AND SCIENTIFIC NAMES

### Plant names

\*naturalised (exotic) species

barberry*	<i>Berberis</i> spp (incl <i>B. glaucocarpa</i> & <i>B. darwinii</i> )
black beech	<i>Fuscospora solandri</i>
blackberry*	<i>Rubus fruticosus</i> agg.
cabbage tree (ti kouka)	<i>Cordyline australis</i>
cherry plum*	<i>Prunus cerasifera</i>
cocksfoot*	<i>Dactylis glomerata</i>
crack willow*	<i>Salix fragilis</i>
elderberry*	<i>Sambucus nigra</i>
European broom*	<i>Cytisus scoparius</i>
five-finger	<i>Pseudopanax arboreus</i>
golden akeake	<i>Olearia paniculata</i>
gorse*	<i>Ulex europaeus</i>
grey willow*	<i>Salix cinerea</i>
harakeke (flax)	<i>Phormium tenax</i>
hawthorn*	<i>Crateagus monogyna</i>
kaihikatea	<i>Dacrycarpus dacrydioides</i>
kānuka	<i>Kunzea robusta</i>
mahoe	<i>Melicytus ramiflorus</i>
matai	<i>Prumnopitys taxifolia</i>
nassella tussock*	<i>Nassella trichotoma</i>
ngaio	<i>Myporum laetum</i>
old man's beard*	<i>Clematis vitalba</i>
podocarp	Native conifer in family Podocarpaceae (e.g. tōtara)
purei	<i>Carex secta</i> and <i>Carex virgata</i>
tōtara	<i>Podocarpus totara</i>
wilding conifers*	Mainly <i>Pinus</i> species
willow*	<i>Salix</i> species

### Animal names

\*naturalised (exotic) species

cat*	<i>Felis catus</i>
deer*	Family Cervidae (e.g. red deer)
dog*	<i>Canis familiaris</i>
fallow deer*	<i>Dama dama</i>
ferret*	<i>Mustela furo</i>
goat*	<i>Capra hircus</i>
hare*	<i>Lepus europaeus occidentalis</i>
hedgehog*	<i>Erinaceus europaeus occidentalis</i>

kereru (NZ pigeon)	<i>Hemiphaga novaeseelandiae novaeseelandiae</i>
korimako (bellbird)	<i>Anthornis melanura melanura</i>
lagomorphs*	Hare and rabbit
mice*	<i>Mus musculus</i>
mustelid*	Stoat, ferret and weasel
pig*	<i>Sus scrofa</i>
piwakawaka (fantail)	<i>Rhipidura fuliginosa</i>
possum (brushtail)*	<i>Trichosurus vulpecula</i>
rabbit*	<i>Oryctolagus cuniculus cuniculus</i>
rat*	<i>Rattus rattus</i>
red deer*	<i>Cervus elaphus</i>
riorio (greywarbler)	<i>Gerygone igata</i>
rodent*	Mice and rats
stoat*	<i>Mustela erminea</i>
ungulates*	Deer and goats
vespuid wasps*	<i>Vespula germanica</i> & <i>V. vulgaris</i>
weasel*	<i>Mustela nivalis vulgaris</i>
weka	<i>Gallirallus australis</i>



## APPENDIX 3: CONSTRAINTS TO RESTORATION

This section outlines those factors that are likely to limit the success of management in achieving the 35-year restoration outcomes, and ultimately the long-term vision for the site. Constraints to restoration include those associated with the abiotic, biotic, and socio-economic environment.

### **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 about 920 mm, but with considerable inter- and intra-annual variation. Soil moisture deficits are common during summer and restoration plantings and natural regeneration are particularly vulnerable to soil moisture deficits, especially during the initial stages of establishment. Soil moisture levels are strongly affected by the existing 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 (e.g. ngaio).

Response: *The primary response to dealing with soil moisture deficits and frost is to only use plants adapted to conditions at Tiromoana Bush, including sourcing all plant material locally. Additionally, all plants are hardened off before planting, planting is timed to occur so that plants are well established before summer droughts but are not planted until after the worst of winter frosts, herbicide is used to kill the grass sward before planting, and post-planting herbicide application is used reduce competition with exotic plants.*

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 Tiromoana Bush 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 including restricting public access during high fire risk periods, enforcing a total open fire ban in Tiromoana Bush, 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. The adjacent farm is an organic farm so there are also issues associated with spray drift from any spraying for restoration affecting their land.

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. Liaising with the adjacent farming when any spraying is undertaken on Tiromoana Bush.*

## **Biotic constraints**

Constraint: One of the major factors that limits restoration success is browsing and predation by introduced animals, including domestic livestock, 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: Animal pest control is currently being undertaken through exclusion of large herbivores by the deer fence around the perimeter of the core area of Tiromoana Bush and some targeted control of pigs and hares/rabbits. In addition, extensive animal pest control is undertaken in association with management of the 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. 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, elderberry, wilding conifers, willow, cherry plum, blackberry, barberry old man's beard) to expand their range and displace native vegetation in Tiromoana Bush.

*Response: Grasses are sprayed prior to establishment of restoration plantings to reduce competition, while post-planting weed control is also undertaken. Regular surveys and control operations are 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. 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. Non-local plants may also be less suitable for local native fauna, especially invertebrates. However, there is also evidence that inclusion of some non-local genetic material might buffer restoration plantings against future climate change. For all of these reasons 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), but including a small proportion of non-local material to ensure a 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 Tiromoana Bush or, when not available, from the Motunau Ecological District), but also including a small component of genetic diversity from sites further afield (e.g. elsewhere within Canterbury).*

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, with years of heavy seed production separated by one or more 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 – this applies especially to black beech.*

Constraint: The development of associations between planted species and 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 absence of mycorrhiza may be a limiting factor for some restoration plantings.

Response: *Problems associated with mycorrhizal infections do not usually occur with natural regeneration, but can be an issue for plantings. Nursery propagation of seedlings for restoration will include appropriate inoculation for mycorrhiza.*

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. 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 at Tiromoana Bush, 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.*

Constraint: Introduction of a new animal species could fail.

Response: *Before any reintroduction is undertaken, and resources committed, a detailed due diligence assessment will be undertaken that assess biotic and socio-economic risks to ensure that actions can be implemented to reduce these as much as possible.*

### **Socio-economic constraints**

Constraint: The success of the Tiromoana Bush Restoration Project is dependent on the availability of sufficient funding to cover the cost of management activities.

*Response: Transwaste Canterbury Ltd. fund the on-going conservation management work and every effort will be made to ensure that this funding is increased in line with the consumer price index so that sufficient funding is available to continue the restoration management work required to meet the goals in this management plan.*