2009

OPPORTUNITIES FOR ECOLOGICAL RESTORATION OF LONGBUSH RESERVE AND THE WAIKERERU HILLS

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SUMMARY OF MANAGEMENT PRIORITIES

The following priorities have been ranked with reference to the long-term objectives of the Longbush/Waikereru restoration project. When resources are tight, higher priority management actions should take precedence over lower priority management activities. However, when funding does become available it is important to incorporate lower priority activities into current management plans (concept adapted from Rate *et al*. 2008).

Very high priority: Pest control in Longbush Reserve

- Continue to control vertebrate predators to near nil densities.
- Continue to exclude vertebrate grazers from entering the reserve.

Very high priority: Weed control within Longbush Reserve

- Continue systematic surveillance and control of weeds within Longbush Reserve.

High priority: Project funding

- Prepare an initial budget for the proposed restoration activities.
- Begin applying to appropriate funding organisations.

High priority: Additional pest control

- Extend current pest control to include the 113 ha Waikereru Reserve. Pest control should target rats, mustelids, feral cats, possums and feral goats.

High priority: Cessation of livestock grazing

- Remove domestic livestock from the Waikereru Reserve. Ensure the fence is maintained to prevent livestock from re-entering the reserve.
- Cull feral goats from within the reserve.

High priority: Additional weed control

- Extend current regime of surveillance and control to include the Waikereru Reserve.
- Systematically monitor the Waikereru Reserve for weed invasion following the removing of livestock.

Medium priority: Kiwi/weka proof fence

- Construct a kiwi/weka proof fence around the perimeter of the Waikereru hills.

Medium priority: Species translocations

- Set goals and time lines for potential re-introduction of each species.
- The order of specific translocations will depend on the ecology and life history traits of each species.
- Habitat features within Longbush/Waikereru will need to be appropriate for each species before translocation is considered.
- Species such as weka, North Island robin and kiwi would provide ideal advocacy species for the project.

Medium priority: Monitoring

- Record the location and condition of threatened plant species present within Longbush/Waikereru.
- Undertake annual surveys of threatened birds, lizards, invertebrates and bats within Longbush/Waikereru.
- Monitor the establishment rate of plantings and the success rate of previously controlled weed infestations.
- Maintain permanent photo points.

Medium priority-Low priority: Additional planting

- Maintain current efforts of planting at the base of the Waikereru reserve.
- Additional planting up the Waikereru gully systems could be considered once the project progresses.

Low priority: Tracks

- Extend and maintain the current Longbush Reserve track.
- Construct a network of tracks in the Waikereru hills. This could include a lookout on the ridgeline.

Low priority: Signage and interpretation material

- Provide appropriate signage both informative and regulatory (e.g. 'No dogs permitted within the reserve'). Regulatory signage will be particularly important once rare species such as kiwi and weka are re-introduced. Informative signage will help raise public awareness and support for the project.

Low priority: Visitor infrastructure

- As the project progresses and visitor numbers increase, suitable infrastructure, such as toilets and areas for rubbish disposal may need to be provided to ensure the ecological values of the site are not compromised.

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1.1 Physical setting

1.1.1 Site location

Longbush Reserve and the Waikereru hills are located at the southern end of the Waimata Valley, 8 km north-west of Gisborne city (Figure 1). These sites lie within the Waiapu Ecological District in the East Coast Ecological Region.

Longbush Reserve *c.* 15 ha runs adjacent to the Waimata River and the Waikereru hill block *c.* 113 ha is situated west of the reserve. Together Longbush and the Waikereru hills compose an area of *c.* 128 ha (Figure 2).

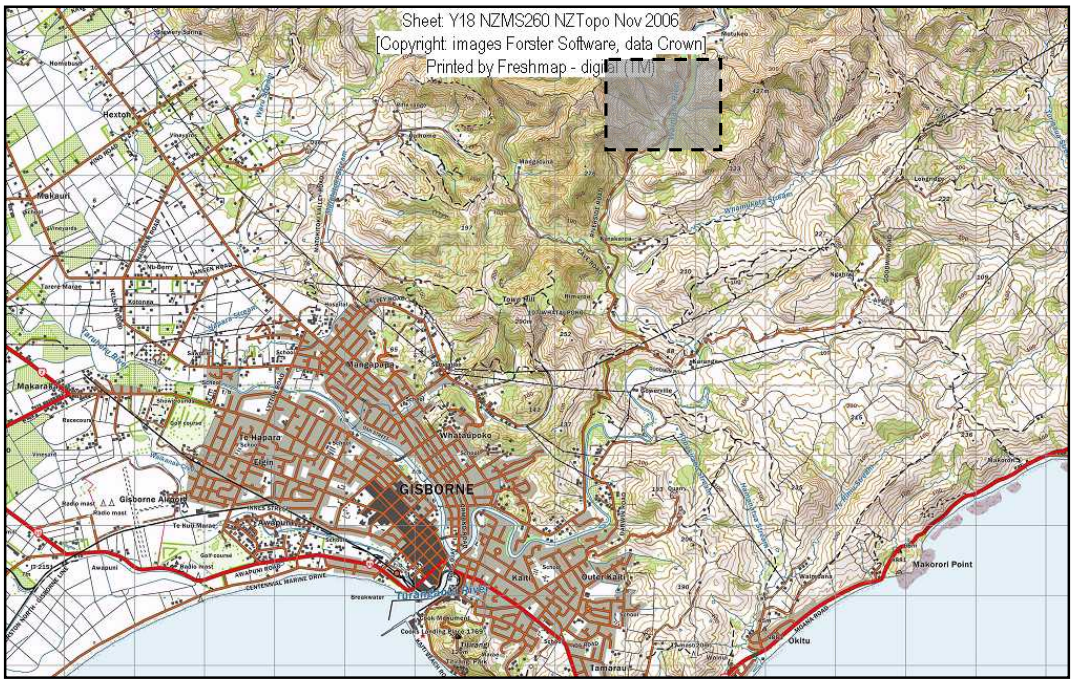

Figure 1: Overview map of the location of Longbush/Waikereru in relation to Gisborne city.

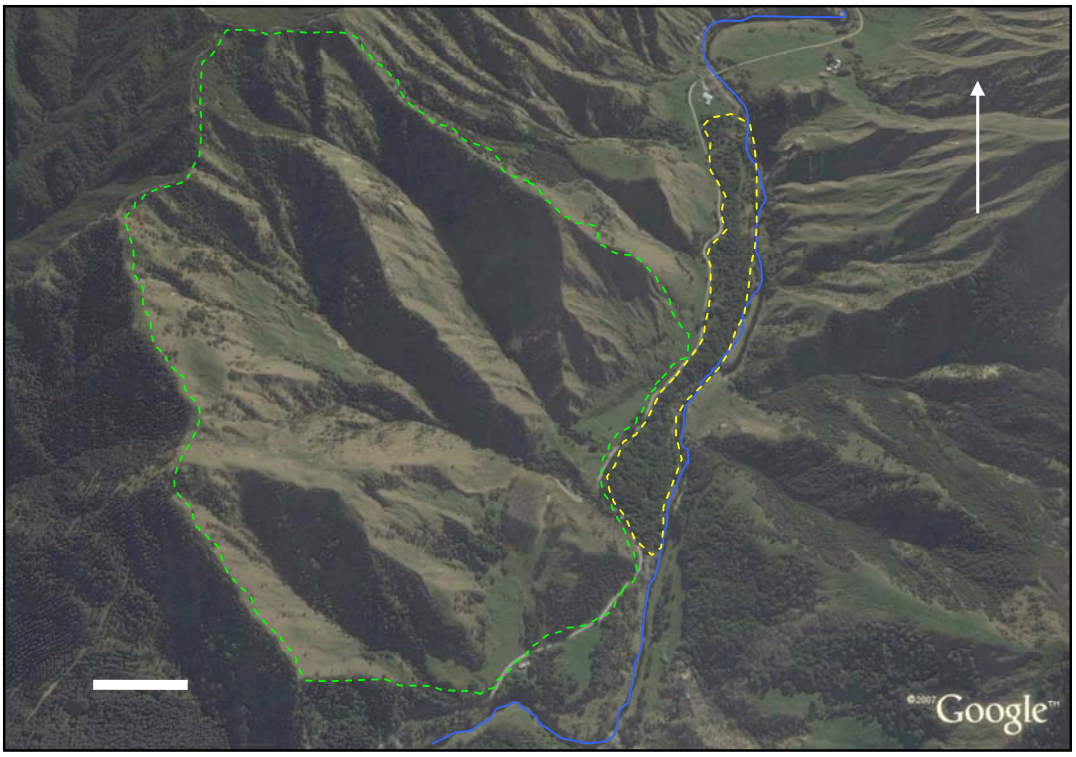

Figure 2: Composite aerial photograph of the project area. Longbush Reserve (*c*. 15 ha) is illustrated in the yellow dashed line while the Waikereru hills (*c*. 115 ha) are illustrated in the green dashed line. The solid blue line shows the path of the Waimata River. The scale bar equals approximately 200 m.

1.1.2 Geology & soil

The geological sequence of the Waiapu Ecological District is dominated by sandstones, mudstones and limestones (Moore and Mazengarb 1992). Many of these rock sequences have been subject to folding, fracturing and shearing, which has formed sequences with often complex internal structuring (Moore and Mazengarb 1992). Most areas within the Waiapu Ecological District are extremely erosion-prone. Rivers in the region therefore frequently carry high levels of suspended sediment. Sediment loads in the waterways of this region have been described as some of the highest in New Zealand (Gomez *et al*. 1999).

Soils within the Waimata Valley consist largely of well-drained alluvial sediment with *c.* 19% clay content (Ekanayake and Phillips 1999). Volcanic ash deposits are common in the Waiapu Ecological District but in the hill country are generally only found on ridge crests or pockets of rolling land (Leathwick *et al.* 1995). The northern paddock in Longbush is comprised of volcanic ash (R. Thorpe, pers. comm.).

The Longbush Reserve is situated on an alluvial terrace composed of loose mudstone (Leathwick *et al.* 1995). The Waikereru hills drain three small creek systems into the Waimata River, these creeks cut through inter-layered beds of siltstone and mudstone.

1.1.3 Climate and weather

The Waiapu Ecological District has a temperate climate with hot dry summers and mild winters. The mean annual temperature is *c.* 14°C with a yearly rainfall of *c.* 1200 mm (New Zealand Meterological Service 1986). Rain is more common during the winter months and gradually increases with progression inland to higher altitudes (Leathwick *et al*. 1995).

1.2 Background

1.2.1 Pre-human flora and fauna and its vulnerability

Prior to forest clearance, lowland Poverty Bay would have been covered in mature podocarp-hardwood forest. Peat core samples taken from the area indicate that matai (*Prumnopitys taxifolia*) and kahikatea (*Dacrycarpus dacrydiodes*) were historically dominant (McGlone *et al.* 1984). Common species found on well drained alluvial terraces like Longbush Reserve would have included tawa (*Beilschmiedia tawa*), titoki (*Alectryon excelsus*), puriri (*Vitex lucens*), matai and totara (*Podocarpus totara*). On the hill faces, kohekohe (*Dysoxylum spectabile*), karaka (*Corynocarpus laevigatus*), puriri, kowhai (*Sophora spp.*), ngaio (*Myoporum laetum*), mahoe (*Melicytus ramiflorus*) and five finger (*Schefflera digitata*) would have dominated (Clarkson and Clarkson 1991). Kanuka (*Kunzea ericoides*) forest would have been common around forest margins and in areas of steep or unstable terrain. Today's critically endangered plants, such as kakabeak (*Clianthus puniceus),* William's broom (*Carmichaelia williamsii*), Cooks scurvy grass *(Lepidium olearaceum*) and *Plantago picta* were likely to have been abundant with a lack of mammalian browsers present.

The wildlife on the plains and surrounding hills would have been extremely diverse. Several species of moa were present in the Poverty Bay area, including large bush moa (*Dinornis novaezealandiae*) and little bush moa (*Anomalopteryx didiformis*) (Huynen *et al.* 2006). A range of land-based bird species including brown kiwi (*Apteryx australis*), kaka (*Nestor meriodonalis*), kakapo (*Strigops hibroptilus*), huia (*Heteralocha acutirostris*), kokako (*Calleaus cineria wilsoni*) and weka (*Gallirallus australis*) would have also been numerous and widespread.

Within coastal forests tuatara (*Sphenodon punctatus*) and a plethora of lizard species would have been abundant as well as millions of pelagic seabirds, in particular petrels (*Pterodroma spp*.) and shearwaters (*Puffinus spp.*). Massive volumes of guano, produced by these seabirds would have fertilised the forests and created productive nutrient-rich soils. At night the forest would have been an unruly clamour of seabirds, kiwi (*Apteryx spp.*), ruru (*Ninox novaeseelandiae novaeseelandiae*), laughing owl (*Sceloglaux albifacies*) and stridulating tree weta (*Hemideina spp.*).

During the last 800 years New Zealand's natural habitats have been dramatically modified by humans. To produce horticultural and agricultural land, forests were burnt and felled while wetlands were drained. Indigenous forest clearance on the East Coast intensified around 1880, reaching its peak between 1890 and 1910 (Clarkson

and Clarkson 1991). Now only a fraction of original forest cover is still intact and of the surviving forest the majority has been severely degraded.

Humans also introduced pest weed and animals species. Exotic species have been directly implicated in the ongoing decline and mass extinction of New Zealand's endemic wildlife. When Maori arrived in New Zealand in 1200-1300 they introduced kiore or Pacific rat (*Rattus exulans)* and kuri or Pacific dog (*Canis lupus familiaris*). Europeans arrived in the early to mid 19th century along with a plethora of mammalian predators such as stoats (*Mustela erminea*), ferrets (*Mustela furo*), possums (*Trichosurus vulpecula*), Norway rats (*Rattus norvegicus*), cats (*Felis catus*), ship rats (*Rattus rattus*), house mice (*Mus musculus*) and hedgehogs (*Erinaceus europaeus occidentalis*). Europeans also brought a suit of vertebrate grazers including goat (*Capra hircus*), pig (*Sus scrofa*), horse (*Equus ferus caballus*), sheep (*Ovis aries*) and cattle (*Bos primigenius*).

Sub-fossil records indicate that many species extinctions occurred soon after the arrival of the first human settlers. New Zealand's endemic wildlife had not evolved in the presence of mammalian predators and most could not adapt to prevent population crashes, local extinctions and then total extinctions from occurring. By the early 1900's, 32% of all the land-based avifauna were extinct including 14 species of moa, the huia, piopio and many others. The cause of these extinctions was predominantly human hunting, predation by introduced mammals and the loss of habitat. Most locally extinct species that still survive nationally appear to have disappeared from Poverty Bay by the early 1930's.

1.2.2 Significance of Longbush/Waikereru to the Waiapu Ecological District

Today indigenous vegetation in the Waiapu Ecological District is reduced to isolated primary remnants and small patches of secondary scrub. Most of the cleared land has been converted to farming and more recently exotic forestry.

The biodiversity values and indigenous habitats of the Poverty Bay region have been described as 'Acutely Threatened' (Dr W.Green, '*LENZ Threat Category'*) with less than 10% indigenous cover remaining. Despite human modification, the biodiversity values of the Longbush/Waikereru area are still very high and regionally significant. In 2005 Longbush Reserve was recognised as a Priority 1 RAP (recommended area for protection) by the Department of Conservation. Conservation action should be a priority at Longbush/Waikereru as many of the species present are classified as threatened with Category A, B or C rankings (Tisdall 1994).

1.2.3 Human settlement in the Longbush/Waikereru area

Prior to 1887, Waikereru/Longbush and the surrounding land 'Whataupoko block' were under Maori ownership in the rohe of Whanau a Iwi, in the hapu of Te Aitanga a Mahaki (Jackman 1999). In 1886 Raharuhi Rukupo (a local chief), contracted Henry Parker and Robert Thelwall to establish a sheep farm on the area that is now Longbush/Waikereru (Jackman 1999).

There is a significant assemblage of archaeological sites at Longbush/Waikereru which indicate Maori occupation and settlement in pre-European times. Pa hill was probably a small unfortified Maori village that centered around the cultivation of kumara and harekeke/New Zealand flax. Archaeological features still present today include a series of pits and terraces (Jackman 1999). Stock trampling, burrowing from rabbits and land erosion has, however, compromised the integrity of many of these sites.

In 1887 Jack Dunlop purchased the Waikereru block *c*. 3330 acres (Tombleson 1997), this area included Longbush Reserve and the Waikereru hills. Henry Hegarty and son William immigrated from Australia and bought the land in 1923. By this time the land was predominately pasture with only remnant patches of indigenous vegetation. The Hegartys were attracted to the property because natural springs on the Waikereru hills meant cattle had a year round water reserve (J. Hegarty pers. comm.). The Waikereru hills were, however, steep which made farming difficult (J. Hegarty pers. comm.). Cattle, sheep (Romney and Cheviot) and then Angora goats were run on the hills before the Hegarty's finally sold the property in the early 1990s (Tombleson 1997). A 1988 aerial photograph of the region illustrates the barren and erosion-prone Waikereru hill block next to Longbush Reserve (Figure 3).

Figure 3: An aerial photograph taken in 1988 of the Longbush/Waikereru area.

1.3 Longbush restoration project

Dame Anne and Jeremy Salmond purchased Longbush Reserve and the Waikereru hills in 2000. In 2002 they placed Longbush Reserve under a QEII covenant and in 2006 covenanted a further 113 ha 'the Waikereru hills'. Anne and Jeremy are in the process of forming an independent Charitable Trust that will certify the project as a separate legal entity. Funding will be used to manage and restore the covenanted sites. It is Anne and Jeremy's intention that once the Trust's long-term viability is secured, the covenanted areas will pass into the Trust's ownership.

The western ridge of the Waikereru hills joins a large block of indigenous podocarp forest which has recently been placed under a QEII covenant by the landowner Kate McDonald. Weed and animal pest control will soon begin in the McDonald forest block. Together Longbush, Waikereru hills and the McDonald block will effectively form a *c.* 330 ha reserve of protected indigenous forest. The Waikereru/Longbush project alone will produce the largest fully protected area of indigenous forest in the Turanga and Waiapu Ecological Districts (Turanaganui).

1.3.1 Project objectives

The vision for the Longbush/Waikereru area is to provide a unique 130 ha predator free sanctuary where the endemic biodiversity of the East Cape can be restored to its modern day potential. The site will include a range of locally extinct species within a predator controlled and weed-free forest ecosystem.

The objectives for this site can be divided into two broad categories: Ecological and Community-based.

1.3.1.1 Ecological Objectives

Maintain and enhance the existing biodiversity values of Longbush/Waikereru and the surrounding region through:

1) Control and surveillance of invasive weeds
2) Removal of vertebrate grazers
3) Controlling mammalian predators to near nil densities
4) Re-introducing locally rare or nationally threatened species that would have naturally occurred in the area
5) Restoring the ecosystem to a level where plants and animals begin dispersing outside of the controlled area and into the surrounding landscape
6) Encouraging population growth of locally rare or nationally threatened species; eventually using the re-introduced population to provide a source population for other local conservation projects
7) Restoring the forest to a self-sustainable level, where minimal human management is necessary

1.3.1.2 Community Objectives

1) Encourage regulated public access to Longbush/Waikereru. Manage access to ensure the ecological integrity of the site is not diminished.
2) Encourage hands-on community involvement in the restoration project e.g. planting days, flora and fauna surveys.
3) Continue to maintain a positive relationship with local iwi, The Department of Conservation and the Gisborne District Council.
4) Continue to provide local weavers managed access to the 'Rene Orchiston collection'.
5) Encourage school groups to visit the area with their teachers.
6) Work with the local council to initiate a community-driven riparian restoration project 'Making Longbush Longer'.
7) Provide interpretative material to educate visitors and regulate public activities within Longbush/Waikereru.

3 VEGETATION AND HABITATS

Four broad vegetation zones have been identified and described from the Longbush/Waikereru area. A map of the vegetation zones is presented in Figure 4.

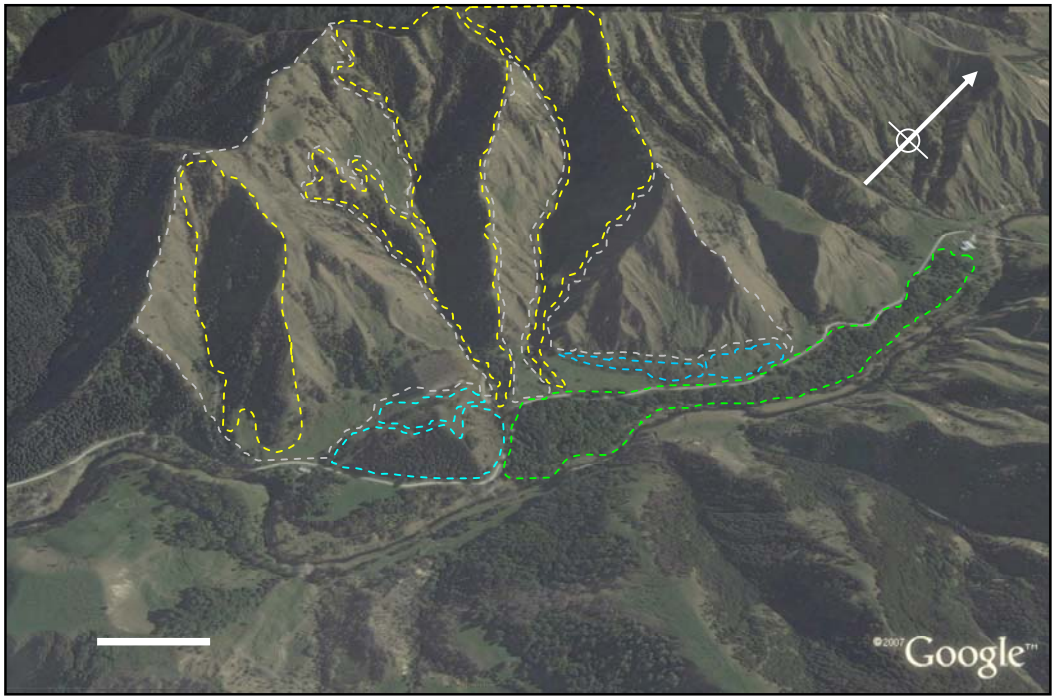

Figure 4: Composite aerial photograph showing the approximate distribution of different habitat types within Longbush/Waikereru. Green outline = Longbush Reserve; yellow outlines = Waikereru gully remnants; white outlines = pasture; and blue outlines = plantings. . The scale bar equals approximately 200 m.

3.1 Longbush Reserve

Leathwick *et al*. (1995) describes Longbush Reserve as "a narrow strip of modified riparian forest on an alluvial terrace". The forest canopy consists of kohekohe, karaka, tawa, titoki and mahoe (Figure 5). Often dense stands of kahikatea, nikau, kawakawa, lacebark, pigeonwood and rangiora constitute an emerging under-storey. Other common species present include whau, miro, ngaio, mamaku and kowhai.

Endemic orchids are abundant within Longbush. In December 2003, 40 individual black orchids were recorded at three sites. During December 2004, 160 plants were recorded at the same three sites. Orchid abundance has continued to increase annually since 2004. The re-establishment of orchids at Longbush is believed to be a product of sustained control of rats and possum that browse on the orchids' large tubers.

Figure 5: View from Pa hill of the southern end of Longbush Reserve.

3.2 Waikereru gully remnants

The pattern and structure of vegetation in the Waikereru gullies is a product of historical land clearance combined with current environmental pressures, wind, soil moisture, erosion and stock grazing.

On the lower reaches of all three gullies, canopy species include titoki, mahoe, kohekohe, kanuka, putaputaweta and pepper tree. While under-storey species include, mamaku, lancewood, kawakawa, rangiora, tutu and toitoi. In areas tutu is particularly dominant.

The gullies grade into essentially monocultures of kanuka at the top ridgeline of the reserve (Figure 6). At the edges of the gully fragments kanuka seedlings and tauhinu are abundant amongst the grazed pasture. Large areas of all three gully systems are carpeted in Mexican daisy.

Figure 6: Dense stands of kanuka are present at the top of the Waikereru gully systems.

3.3 Pasture land

Exotic pasture grasses comprise a large area of the Waikereru hill block. Patches of the pasture have been infested with stands of ink weed and variegated thistle, while close to the forest margin the pasture grasses are covered in dense beds of Mexican daisy.

3.4 Plantings

A large number of native trees and shrubs have been planted, including an arboretum, which contains a range of locally and nationally significant indigenous species (Figures 7, 8, 9, & 10).

Longbush/Waikereru is home to a rare collection of harakeke/New Zealand flax - 'The Rene Orchiston collection'. This collection contains over 60 varieties of harakeke, which are carefully maintained by local weavers from Ngati Porou. The collection is regarded as a national taonga or treasure. For more information on the Rene Orchiston collection please refer to Scheele (2005).

Figure 7: Plantings at the northern end of the arboretum opposite Longbush Reserve.

Figure 8: 'Released' native trees in a clearing at Longbush Reserve (left). Students from Tai Rawhiti Polytechnic planting kahikatea at the base of the Waikereru hills (right).

Figure 9: Plantings on the Longbush Reserve forest margins.

Figure 10: Native trees planted as part of the arboretum at the base of the Waikereru hills.

4 FLORA

4.1 Species present

Longbush and the Waikereru hills contain at least 81 species of vascular plant, of which 63 are indigenous (Table 1) and 18 are exotic (Table 2).

Table 1: Indigenous vascular flora present in Longbush Reserve. Initial plant inventory compiled by K. Whaley & M. Piper, QEII Trust, 2005. List augmented by B. Stanley, Department of Conservation, 2002; and A. Salmond, 2009.

Common name	Species
Titoki	*Alectryon excelsus*
Tawa	*Beilschmiedia tawa*
Rangiora	*Brachyglottis repanda*
Putaputaweta	*Carpodetus serratus*
	Coprosma rhamnoides
Karamu	*Coprosma robusta*
Ti/Cabbage tree	*Cordyline australis*
Tutu	*Coriaria arborea*
Karaka	*Corynocarpus laevigatus*
Kahikatea	*Dacrycarpus dacrydioides*
Kohekohe	*Dysoxylum spectabile*
*Whau	*Entelea arborescens*
Hangehange	*Geniostoma ligustrifolium var. ligustrifolium*
Porokaiwhiri/pigeonwood	*Hedycarya arborea*
Houhere	*Hoheria spp.*
Rewarewa	*Knightia excelsa*

Kanuka	*Kunzea ericoides*
Kawakawa	*Macropiper excelsum*
Mahoe/whiteywood	*Melicytus ramiflorus*
Mapou/red matipo	*Myrsine australis*
Weeping mapou	*Myrsine divaricata*
*Narrow-leafed maire	*Nestigis montana*
*Kaikomako	*Pennantia corymbosa*
Tauhinu	*Ozothamnus leptophyllus*
Kohuhu	*Pittosporum tenuifolium*
Matai	*Prumnopitys taxifolia*
Horoeka/lancewood	*Pseudopanax crassifolius*
Nikau	*Rhopalostylis sapida*
*Pate, five-finger	*Schefflera digitata*
Kowhai	*Sophora spp.*
Turepo/small-leaved milktree	*Streblus heterophyllus*
Puriri	*Vitex lucens*
¤Hinau	*Elaeocarpus dentatus*
Mamaku	*Cyathea medullaris*
Common maidenhair	*Adiantum cunninghamii*
Hen and chickens fern	*Asplenium buliferum subsp. gracillimum*
Hanging spleenwort	*Asplenium flaccidum*
	Asplenium oblongifolium
Green Bay kiokio	*Blechnum triangularifolium*
Mokimoki/fragrant fern	*Microsorum scandens*
Tarawera/button fern	*Pellaea rotundifolia*
Gully fern	*Pneumatopteris pennigera*
	Polysticum spp.
Bracken	*Pteridium esculentum*
Kidney fern, konehu	*Pyrrosia eleagnifolia*
	Adiantum Cunninghamii
	Anathropteris lanceolata
Climbing convolvulus	*Calystegia turguriorum*
	Clematis spp.
Pohuehue	*Muehlenbeckia australis*
NZ jasmine	*Parsonsia heterophylla*
Kohia/Native passionfruit	*Passiflora tetrandra*
Supplejack	*Ripogonum scandens*
	Carex spp.
NZ calceolaria	*Jovellana sinclairii*
Meadow rice grass	*Microlaena stipoides*
Panic grass	*Oplismenus hirtellus*
Hook grass	*Uncinia spp.*
Bush rice grass	*Microleana avenacea*
Bamboo grass	*Oplismensus imbecillus subsp. imbecillus*
	Hydrocotyle moschata
Green hooded orchid	*Pterostyllis banksii*
Huperei, Black orchid	*Gastrodia cunninghamii*

Table 2: Exotic flora present in Longbush Reserve and the Waikereru hills. List compiled by S. Sawyer, Ecoworks NZ.

Common name	Species
Blackberry	*Rubus fruiticosis*
Briar rose	*Rubus rubiginosa*
Cotoneaster	*Cotoneaster glaucophyllus*
German Ivy	*Senecio mikanioides*
Japanese honey suckle	*Lonicera japonica*
Wild plum tree	*Prunus spp.*
Alder	*Aldus acuminata*
Silver poplar	*Populus alba*
Variegated thistle	*Silybum marianum*
Jerusalem cherry	*Solanum diflorum*
Mexican daisy	*Erigeron karvinskianus*
Old man's beard	*Climatis vitalba*
Pampas	*Cortaderea selloana*
Periwinkle	*Vinca major*
Wandering Jew	*Tradescantia fluminensis*
Willow	*Salix fragilis*
Fig	*Ficus spp.*
Scotch thistle	*Cirsium vulgare*

4.1.1 Rare or threatened species

Longbush Reserve contains a number of locally uncommon species such as the green hooded orchid (*Pterostyllis banksii*) and black orchid (*Gastrodia cunninghamii*) (Figure 11).

Other rare species have recently been re-introduced to the area. For example East Coast kakabeak (*Clianthus punicieus*), which is listed as nationally critical and William's broom (*Carmichaelia williamsii*), which is listed as nationally endangered (Figure 12).

Figure 11: Black orchid (left) and green hooded orchid (right) which are now abundant within Longbush Reserve.

Figure 12: East Coast kakabeak (left) and William's broom (right) both in flower on the gastropod free island below Pa hill.

4.1.2 Weed species

Eighteen species of adventive weed have been recorded at Longbush Reserve (Table 2); several of these are regarded as highly invasive and five of these species are listed on the National Plant Pest Accord. Including old mans beard, pampas, Mexican daisy, Japanese honeysuckle, and wandering Jew. All of these species have been the focus of sustained control efforts in the Longbush Reserve. At present weeds are not controlled in the Waikereru hill block.

5 FAUNA

5.1 Avifauna

Twenty-eight species of avifauna have been recorded at Longbush Reserve and the Waikereru hills, of these species 16 are indigenous (Table 3) and 12 are exotic (Table 4). In October 2009 ten pairs of North Island robin (*Petroica australis longipes*) will be transferred to Longbush. A programme of soft release and acoustic anchoring will be used in an attempt to contain the birds within the predator controlled area.

Table 3: Indigenous avifauna recorded in the Longbush/Waikereru area.

Common name	Species	National threat category
Grey warbler	*Gerygone igata*	Not threatened
Kaka	*Nestor meridionalis septentrionalis*	Nationally endangered
Kereru/New Zealand pigeon	*Hemiphaga novaeseelandiae*	Gradual decline
Piwakawaka/Fantail	*Rhipidura fuliginosa placabilis*	Not threatened
Bellbird	*Anthornis melanura*	Not threatened
Tui	*Prosthemadera novaeseelandiae*	Not threatened
Paradise shelduck	*Tadorna variegata*	Not threatened
Kingfisher	*Todiramphus sanctus*	Not threatened
Whitehead	*Mohoua albicilla*	Not threatened
Pied tom tit	*Petroica macrocephala toitoi*	Not threatened
Morepork/ruru	*Ninox novaeseelandiae*	Not threatened
New Zealand falcon	*Falco novaeseelandiae*	Nationally vulnerable
Australasian harrier	*Circus approximans*	Not threatened
Welcome swallow	*Hirundo tahitica neoxena*	Coloniser
Shining cuckoo	*Chrysococcyx lucidus*	Not threatened
Silvereye	*Zosterops lateralis*	Not threatened

Table 4: Exotic avifauna recorded in the Longbush/Waikereru area.

Common name	Species
House sparrow	*Passer domesticus*
Skylark	*Alauda arvensis*
Greenfinch	*Carduelis chloris*

Yellowhammer	*Emberiza citronella*
Starling	*Sturnus vulgaris*
Blackbird	*Turdus merula*
Song thrush	*Turdus philomelos*
Pheasant	*Phasianus colchicus*
Magpie	*Gymnorhina tibicen*
Indian myna	*Acridotheres tristis*
Goldfinch	*Carduelis carduelis*
Chaffinch	*Fringilla coelebs*

5.2 Other indigenous fauna

The Longbush/Waikereru area is also home to lizards, bats and a healthy assemblage of invertebrates, including several species of regional significance (Table 5).

Table 5: Regionally significant indigenous fauna recorded in the Longbush/Waikereru area.

Common name	Species	National threat category
Long tailed bat	*Chalinolobus tuberculata*	Nationally vulnerable
Forest gecko	*Hoplodactylus granulatus*	Range restricted
Grey gecko	*Hoplodactylus maculatus*	Not threatened
Auckland tree weta	*Hemideina thoracica*	Gradual decline

5.2.1 Threatened fauna

Eight nationally threatened or locally uncommon species have been recorded at Longbush and Waikereru. These species include:

1) **Whitehead/Popokatea** (*Mohoua albicilla*)
Status: Locally uncommon

Whitehead are not classified as nationally threatened, however, are locally rare in Poverty Bay. Whitehead are rarely sighted within Longbush Reserve and currently no resident population exists. With sustained pest control and habitat enhancement it is hoped that a local population may eventually re-establish. Whitehead feed predominately on insects found in the canopy of mature indigenous forests (Kinsky and Robertson 1987). The mature canopy species present within Longbush may therefore provide whitehead with an important food source.

2) **New Zealand wood pigeon/Kereru** (*Hemiphaga novaeseelandiae*)
Status: Gradual decline

Kereru are in gradual decline nationally (Hitchmough *et al*. 2005) but appear to be abundant within Longbush and the Waikereru hills. The removal of cats from this area is probably increasing adult kereru survivorship. Females in particular are vulnerable to cat predation when nesting. Predator control is also likely to lead to higher rates of fledgling success and increased juvenile recruitment.

The resident population of kereru in Longbush/Waikereru has the potential to act as a source population to nearby forest fragments. Kereru play an important role in plant pollination and seed dispersal. Several species, which produce large fruits, rely almost entirely on kereru for their dispersal (Clout and Hay 1999).

3) **North Island kaka** (*Nestor meridionalis*)
Status: Nationally endangered

North Island kaka are seasonal visitors to the Poverty Bay area. Intensified predator control may encourage a kaka population to re-establish in the Longbush/Waikereru forest. Kaka are nationally endangered (Hitchmough *et al*. 2005). Their establishment in areas in which predators are controlled should therefore be encouraged.

Kaka could be translocated to this site to encourage a new population to establish. Whether this species needs to be translocated will depend on whether natural colonisation is successful. As the forest matures at Longbush/Waikereru more kaka are likely to visit each year and potentially become resident.

4) **North Island pied tom tit/Miromiro** (*Petroica macrocephala toitoi*)
Status: Locally uncommon

Pied tom tit were recently (May 2009) sighted at the top of the Waikereru hills. In recent years tom tit have not been recorded in the Longbush area. Tom tit are locally uncommon and their wide-scale establishment in the Longbush/Waikereru area should be encouraged. This population could be re-stocked (supplemented) if it does not colonise Longbush/Waikereru naturally. To supplement the current population, priority should be placed on sourcing birds from local genetic stock. If birds were transferred they would need to be carefully disease screened to prevent harming the resident population.

5) **New Zealand falcon/Karearea** (*Falco novaeseelandiae*)
Status: Nationally vulnerable

New Zealand falcon are listed as nationally vulnerable (Hitchmough *et al*. 2005), however, sightings are common in the Longbush/Waikereru

area. Further targeted research is necessary to determine the size of the resident population.

6) **Forest gecko** (*Hoplodactylus granulatus*)
Status: Range restricted

Forest gecko (Figure 13) are listed as having a restricted range nationally (Hitchmough *et al*. 2005). Longbush Reserve contains one of the only recognised populations of forest gecko in the Poverty Bay/Tai Rawhiti area. This remnant population of forest gecko should benefit from sustained pest control and forest restoration. Artificial cover objects ('ACO's' designed by J Frank, Victoria University) have been placed in Longbush to allow on-going surveys of gecko populations.

Figure 13: A forest gecko.

7) **Long tailed bat** (*Chalinolobus tuberculata*)
Status: Nationally vulnerable

Long tailed bat are listed as nationally vulnerable (Hitchmough *et al*. 2005) but are widespread in the North Island (Daniel and Williams 1984). The success of long-tailed bat is undoubtedly due to their ability to live in a variety of different habitats. Long tailed bat have been recorded in lowland and montane indigenous forest, limestone caves, exotic plantations, scrubland and even farm shelterbelts (Daniel and Williams 1984). Predation by rats, stoats and feral cats is one of the major threats affecting the survival of long tailed bats (Molloy *et al.* 1995). Predator control in the Longbush/Waikereru area will

almost certainly benefit local bat populations. To date no formal survey has been carried out to assess the relative abundance of bats in the area.

8) **Auckland tree weta** (*Hemideina thoracica*)
Status: Gradual decline

Auckland tree weta are listed as having a restricted range nationally (Hitchmough *et al*. 2005). Tree weta appear to be abundant at Longbush. At night from October-May stridulating male weta can be commonly heard throughout the reserve. It is likely that this species has benefited considerably from predator control during the last six years. Research has shown that tree weta can made up at least 26% of a ship rats diet (Daniel 1973). Tree weta will also be predated by mustelids, cats, mice and hedgehogs. All of these species except mice are currently controlled within Longbush. Weta monitoring is carried out by recording the occupancy rates of artificially housing; approximately 40 weta 'condos' and 20 drilled logs have been installed throughout Longbush (Figure 14).

Figure 14: 'Weta housing' drilled log (left) and weta condo (middle). A large male Auckland tree weta (right).

5.3 Vertebrate pests

5.3.1 General

Thirteen species of vertebrate pests have been identified within Longbush Reserve and the Waikereru hills (Table 6).

Table 6: Exotic mammalian pests identified in Longbush/Waikereru.

Common name	Species
European rabbit	*Oryctolagus cuniculus*
Feral goat	*Capra hircus*
Sheep	*Ovis aries*
Brushtail possum	*Trichosurus vulpecula*
Norway rat	*Rattus norvegicus*
Ship rat	*Rattus rattus*
Mice	*Mus musculus*
Stoat	*Mustela erminea*
Ferret	*Mustela furo*
Weasel	*Mustela nivalis*
Feral cat	*Felis catus*
European hedgehog	*Erinaceus europaeus*
European hare	*Lepus europaeus*

5.3.2 Vertebrate predators

In May 2003 a trapping regime, targeting vertebrate predators was established within Longbush. Predator control has recently begun in the Waikereru hills (May 2009), and further intensive predator control is planned (see Appendices II).

5.3.3 Vertebrate grazers

Longbush Reserve is fenced to exclude livestock. Trapping within Longbush ensures the effect of possum browsing is minimal. The Waikereru hills are currently grazed by sheep and feral goat. In December 2008 sixty goats were culled from the Waikereru hills.

6 ECOLOGICAL MANAGEMENT

6.1 General

A number of mitigation opportunities are feasible at this site. This section outlines the current site management and provides recommendations for future management (concept adapted from Rate *et al*. 2008).

6.2 Predator control

Since the arrival of humans, native wildlife on the East Coast has been severely reduced in number, distribution and diversity through habitat loss, introduction of mammalian predators and direct exploitation by humans. Exotic mammalian predators have been implicated in the mass extinction of New Zealand's endemic

flora and fauna. The introduction of species such as domestic cats (*Felis catus*), possums (*Trichosurus vulpecula*), rats (*Rattus* spp.), mice (*Mus musculus*) and mustelids would have no doubt devastated populations of indigenous wildlife in the Longbush/Waikereru region.

6.2.1 Current status

The main threat to the continued survival of endangered species in the Longbush/Waikereru area is predation by introduced mammals. Nine mammalian predators have been identified in the Longbush/Waikereru area. Of these, cats, rats, possum and mustelids (ferret, stoat and weasel) probably have the greatest impact on sensitive indigenous species currently present. These species suppress populations of native wildlife directly through predation and indirectly through food and habitat competition.

The predator control line in Longbush consists of permanent kill traps which target 1) possum; 2) feral cats; 3) rats; and 4) mustelids. Traps are cleared and re-baited every four weeks.

1) **Possum** - Possum are an opportunistic predator of native bird eggs and nestlings (Cowan 2001). Possum compete with native species for roosting sites and can crush the eggs and chicks of cavity nesting bird species. Possum also prey directly on seeds and seedlings which can suppress the level of forest regeneration. Uncontrolled, possum can cause complete defoliation of indigenous forest canopies.

   Control method - Timm's possum kill traps are spaced at 100 m intervals throughout Longbush Reserve (Figure 15).

Figure 15: A possum caught in a Timm's kill trap.

2) **Feral cats** - Feral cats pose a severe threat to New Zealand's endemic wildlife. Feral cats prey on a range of species including kereru, kiwi, petrels, skinks, geckos, saddleback, stitchbird, weta and even species of native fish. Cats are long-lived and can have large home ranges of up to 350 ha (S. Sawyer pers. comm.).

Control method - Conibear feral cat traps are spaced at 200 m intervals throughout the Longbush Reserve (Figure 16).

Figure 16: A feral cat caught in a conibear box trap (left). A feral cat caught in a raised conibear trap (right).

3) **Rats** - Three species of rat exist in New Zealand, Pacific rats, ship rats, and Norway rats. Two species have been recorded in Longbush, Norway rats and ship rats. Ship rats are highly arboreal, whereas Norway rats are almost exclusively found on the ground. In New Zealand rats have decimated endemic fauna and in some areas are subject to ongoing control programmes by the Department of Conservation (Clapperton 2006). Rats are prolific predators of native forest birds, seabirds, lizards, bats and insects. Rats also prey heavily of indigenous seeds and seedlings.

Control method - Tree and ground set Victor professional rat traps are currently spaced at 50 m intervals throughout the Longbush Reserve these target both Norway and ship rats (Figure 17). Bait stations (Diphacinone [0.05g/kg]) have also been used to ensure rodent populations are controlled to very low levels.

Figure 17: A ship rat caught in a tree set Victor snap trap (left). A Diphacinone [0.05g/kg] bait block used to control rodents.

4) **Mustelids** - Mustelids (stoats, ferrets and weasels) are relentless predators. Their prey includes invertebrates, reptiles, native fish, birds and bats. Stoats, in particular, are the primary predators of juvenile kiwi and other ground nesting bird species. Stoats have been directly implicated in the extinction of indigenous bird species such as bush wren and laughing owl. Stoat are also responsible for the dramatic decline of many other species for example takahe, kokako, kakapo, kakariki and kiwi spp..

Control method - Double set no. 6 Fenn, mustelid tunnels are spaced at 200 m intervals throughout the Longbush Reserve (Figure 18).

Figure 18: A mustelid tunnel set with no. 6 Fenn traps (left). Patsy Matthews from Ecoworks NZ re-baits a mustelid tunnel (right).

Predator control is currently (June 2009) being established in the Waikereru hills (see Appendices II).

6.2.2 Management recommendations

Current pest control in the Longbush Reserve should be maintained and predator control should continue to be established in the Waikereru hill block. This would undoubtedly benefit indigenous birds, lizards, insects and bats as well as encourage the re-generation of indigenous flora.

To ensure low predator densities are being maintained, vertebrate predator numbers should be monitored every 3-4 months. If predator numbers are high, additional effort should be made to reduce predator densities to levels that are deemed acceptable. A range of techniques could be implemented to monitor animal pest densities:

1) Rodents – Tracking tunnels
2) Possum – Residual trap catch indices
3) Mustelid – Trap catches or tracking tunnels
4) Cats – Sand pads

To ensure density indices are comparable over time, it is important to sustain monitoring effort at a constant level over the long-term.

6.3 Vertebrate grazers

Browsing mammals have devastated indigenous forests in New Zealand (King 1990). Species that pose an ongoing threat include feral livestock (cattle, sheep, deer, pigs and goats) (Parkes 2001), possums (Cowan 2001), rabbits and hare. Feral and domestic livestock browse and trample indigenous seedlings and shrubs which can rapidly reduce a forests health. Livestock can also increase erosion levels, which leads to loss of top soil and an increase in the sediment load of local water catchments.

Possum browse heavily on the flowers, foliage, fruits and seedlings of a number of indigenous species of flora. Loss of foliage contributes to a decrease in the volume of litter on the forest floor with consequential reductions in nutrient cycling (Cowan 2001). As well as providing direct competition for native bird species, possum browsing on flowers and fruits may severely reduce rates of seed dispersal.

6.3.1 Current status

Longbush was fenced in 2001 and livestock are now excluded. Since the cessation of livestock grazing a dense indigenous under-storey has regenerated (Figure 19). Predator trapping has also ensured that the effect of possum and rodent browsing is kept minimal. Saplings of tree species that are sensitive to possum impacts, such as titoki and kohekohe are now commonly found on the forest floor.

As of June 2009 domestic sheep still graze the Waikereru hill block. Feral goats are common in this area (Figure 19), other vertebrate grazers such as possum and rabbit are also uncontrolled. Vertebrate grazers are having a detrimental impact on the health of the Waikereru indigenous forest. Long-term livestock grazing reduces indigenous biodiversity (Smale *et al.* 2008). Grazers encourage weed dispersal, and trample and browse native saplings. These factors all inhibit the regeneration of native forest and encourage erosion. Rabbits and rats are also likely to feed on indigenous seeds and seedlings thus further preventing the re-establishment of natives.

By 2010 the Longbush Ecological Trust is to remove all livestock (domesticated and feral) from the Waikereru hills and begin a programme of vertebrate pest and weed control.

Figure 19: A dense indigenous under-storey dominated by kawakawa has re-generated in Longbush Reserve since the cessation of livestock grazing (left). Feral goats are still common in the Waikereru hills (right).

6.3.2 Management recommendations

1) Ensure livestock remain excluded from Longbush Reserve. Maintain the Longbush trap line to ensure populations of possum and rats are kept at low levels.
2) Continue with the plan to retire Waikereru hills from livestock grazing. Cull feral goats from the hills and monitor regularly to prevent their re-establishment.
3) Control possums, rats and rabbit on the Waikereru hill block (refer to Appendices II for the proposed pest control regime for the Waikereru

hills). Additional rabbit and hare control may be necessary around new plantings to ensure plant survival rates are high.

6.4 Threatened fauna

6.4.1 Current status

Seven out of the eight nationally threatened or locally uncommon species identified within Longbush/Waikereru will all be benefiting from the current vertebrate pest control. These species will also be benefiting from habitat enhancement achieved from weed control and the removal of livestock.

The single sighting of tom tit was made at the top of the Waikereru hills where there is currently no weed management or exclusion of herbivorous grazers. Predator control is also only just being established at this site.

6.4.2 Management recommendations

Maintain a record of sightings for all threatened and locally uncommon species. A record would assist in the monitoring of these species as well as provide valuable information on their distribution and favoured habitats. Sightings could be recorded by both staff who assist in the management of the Longbush/Waikereru area or by members of the general public.

The Longbush website (www.longbushreserve.org) could potentially provide a useful platform for members of the public who wish to share a threatened species sighting with other Longbush supporters. Web-mapping could also provide Longbush supporters with the approximate location of different species within the reserve.

Vertebrate predator control would benefit the population of tom tit at the top of the Waikereru forest block. Maintained predator control may eventually allow tom tit to re-establish down the valley and into Longbush Reserve.

6.5 Indigenous re-vegetation

6.5.1 Current status

1) Indigenous re-vegetation began in 2000 with eco-sourced trees and shrubs first planted by the Thorpe family. Since 2001 students from the Conservation Corps at Tai Rawhiti Polytechnic have been involved in ongoing planting. Indigenous plantings have created wildlife corridors along three main stream systems, which run down the Waikereru basin and into the Waimata River. The middle and northern stream edges have been fenced and re-planted while the banks of the southern-most stream have been allowed to naturally regenerate. Over 2000 eco-sourced trees have

been planted at the base of Pa hill (Figure 20), and numerous other trees have been planted along the edge of Longbush Reserve. A range of species have been planted including titoki, five finger, rimu, matai, lancewood, totara, kahikatea, lemonwood, cabbage tree, lacebark, kohuhu and many more. When necessary the planted trees have been 'release sprayed' using a 1% Buster™ herbicide mix.

Figure 20: A photo taken in 2006 immediately following the planting of Pa hill (top); a photo taken in June 2009 of Pa hill plantings (lower).

The next stage of re-vegetation will occur in 2010. This will involve planting at the base of the middle and the northern gully systems which run down the Waikereru hills. In the middle gully plantings will consist of black and hard beech, while the northern-most gully will be planted in podocarps. The pasture *c*. 80 ha surrounding the two gully systems will then be retired from livestock grazing and allowed to regenerate to indigenous forest. Natural re-generation should occur relatively quickly in most areas, particularly at the top of the Waikereru hills where kanuka seedlings are abundant. John Hegarty, a previous owner of the property, mentioned that it was "an ongoing battle to maintain the kanuka re-growth". By removing vertebrate grazers, kanuka re-generation can now be encouraged.

2) To monitor the change in vegetation over time 10 permanent photo points have been established on the Waikereru hills. The site of each photo point was marked and the GPS location and photo orientation recorded (see Appendices IV). The GPS location of each photo point is accurate to +/- 6 m. Photo point sites were selected that were deemed representative of the project area. Over time photo point data

will allow localised changes in ecological communities to be seen, as well wide-scale changes in vegetation structure to be observed.

Several plant species are highly palatable to browsing mammals such as titoki, fivefinger and kamahi. Recovery of these species is a useful indicator of an increase in forest health following pest control.

6.5.2 Management recommendations

1) Restoring the Waikereru hills to semi-coastal indigenous forest, should be a priority and one of the main long-term objectives for this project. To achieve this objective, ongoing planting should be encouraged on the Waikereru hill block. The plan to retire the surrounding pasture from livestock grazing should be maintained, and the boundary fence maintained to prevent the re-establishment of feral and domestic livestock. Planting species such as lacebark, koromiko, kowhai, flax and putaputaweta would also provide a seasonal food source for native birdlife.

2) Every 2-3 years photos should be taken at each photo point, on the same orientation and preferably during the same season. The locations of permanent photo points must always be kept accessible and clearly marked.

   Vegetation monitoring should be implemented on a regular basis so that the success of re-vegetation work can be assessed over time. Monitoring should be systematic and does not have to require significant resources. The purpose of vegetation monitoring is to check recent plantings, record failures and note any weed encroachment. Weed infestations should be recorded using GPS so that control operations can be implemented efficiently. GPS coordinates would also allow the success of weed control to be verified in the following year.

6.6 Weed control

6.6.1 Current status

Since March 2003 weed species have been controlled in Longbush by Jeremy and Anne Salmond and Ecoworks NZ Ltd. The exotic weed species present in Longbush were affecting the indigenous forest in a number of ways. Exotic vines like old mans beard and Japanese honey suckle were forming dense masses that covered large areas of the indigenous canopy, sub-canopy and shaded the under-storey. If uncontrolled, species like old man's beard could eventually have caused the canopy to collapse. Within Longbush Reserve invasive ground-cover species like wandering Jew and

periwinkle carpeted large areas of the forest floor. These species smothered indigenous species and suppressed the regeneration of indigenous trees and shrubs.

During 2003, Ecoworks NZ Ltd. commenced a sustained campaign to control and eventually eradicate all invasive weed species at Longbush. Weeds are now almost completely eradicated from within Longbush Reserve, although the reserve is regularly monitored for weed re-invasion. Weeds are not currently controlled on the Waikereru hill block. In a preliminary survey of the Waikereru hill block Ecoworks NZ Ltd. staff found large patches of Mexican daisy covering the ground at the pasture-forest verge (Figure 21). Grazing by sheep and feral goat may currently suppress other weed species from establishing at Waikereru (see Appendices V for a weed map of the Waikereru hills).

Figure 21: A dense mat of Mexican daisy prevents indigenous re-generation on the pasture forest verge of the Waikereru Reserve.

6.6.2 Management recommendations

In Longbush Reserve weed control has achieved excellent results so far. To prevent weed re-invasion and establishment, however, monitoring and control must be maintained over the long-term.

Once domestic and feral livestock are removed from the Waikereru hills weeds may become increasingly established. Control will be necessary to ensure invasive weeds

do not establish and prevent the re-generation of indigenous forest. The infestation of Mexican daisy on the edges of the Waikereru bush blocks should also be controlled. The removal of Mexican daisy would allow for an indigenous ground cover to re-establish, which in turn would provide a higher quality of habitat for terrestrial invertebrates and ground-based lizards.

Control methods for all weed species identified at Longbush/Waikereru are outlined in Appendices III.

6.7 Current re-introductions

6.7.1 Current status

1) Endangered William's broom and critically endangered East Coast kakabeak have been planted on a small island in the pond below Pa hill (Figure 22). Terrestrial gastropods (snails and slugs) have been eradicated from the island. Snails in particular will feed on the leaves, stems and soft bark of kakabeak. Weeds are also controlled on the island when necessary.

Figure 22: The gastropod-free island next to Pa hill.

2) Currently no species of indigenous fauna have been re-introduced to the Longbush/Waikereru area. By the end of 2009 the Longbush Ecological Trust in association with Bill and Sally Gaddum and Ecoworks NZ Ltd. aim to re-introduce North Island robin (*Petroica australis longipes*) to Longbush. North Island robin are locally extinct in the Turanga Ecological District although this species is relatively abundant in the Motu area, northwest of Gisborne. Wild pairs will be caught and then released into central Longbush. Birds will also be colour-banded and disease screened prior to release. To discourage birds from dispersing outside of the predator-controlled area a speaker system will be set up to play North Island robin calls 'acoustic anchoring'. The success of the re-introduction will be monitored by a group of volunteers. Sightings of individual birds will be recorded

every second day for two weeks following the release and then weekly, for a period of 2-3 months. Once robin become established in the area sightings will allow for robin territories to be mapped.

6.7.2 Management recommendations

1) Ensure the island below Pa hill remains terrestrial gastropod and weed free. Once both kakabeak and William's broom become established at the site there may be potential to use the seed source to establish a second plantation in the Longbush/Waikereru area.

2) Continue with the plan to re-introduce robins to Longbush in late 2009. Maintain low predator densities following robin release. The extension of predator control to include the Waikereru hill block would increase the chance of robin survival if birds dispersed outside of Longbush Reserve.

6.8 Proposed re-introductions

One of the major objectives of this project is to re-introduce locally extinct/locally uncommon species back to the Longbush/Waikereru area. The aim behind these proposed re-introductions is to create viable, self-supporting populations that may eventually act as source populations for other local conservation initiatives. The re-introduction of iconic or charismatic species such as kiwi, saddleback, North Island robin, tuatara and weka will also be useful in attracting public awareness and support for the project.

A permit from the Department of Conservation is required for all species translocations. Translocations must follow the department's standard operating procedure (see DOC 2004). Local iwi will also need to be appropriately consulted in regards to the planning and relocation of species.

The following section contains an outline of the species which may be suitable to re-introduce to the Waikereru/Longbush Reserve. This list is by no means exhaustive and as the project progresses further suitable species may be added to this list. This list is not ranked in any order of translocation priority. The exact order of translocation priority should be decided by the Longbush Ecological Trust after discussion with independent consultants and species experts.

6.8.1 Avifauna

1) **North Island robin/Toutouwai** (*Petroica australis longipes*)
National threat status: Not threatened

Prior to the arrival of humans North Island robin were almost certainly widespread in the forests throughout Poverty Bay. Decline of East Coast robin populations has been caused by habitat fragmentation and degradation, and predation by introduced mammals. North Island robin have been locally extinct in the Turanga Ecological District for at least 50 years, and are now uncommon in the Waiapu Ecological District. Longbush/Waikereru is situated on the edge of the Waiapu and Turanga Ecological Districts. This project hopes to create a predator-free reserve where a self-supporting robin population can establish. If predator control is maintained, and habitat corridors are created, robin may eventually disperse back into the Turanga District.

By the end of 2009 robin would have been re-introduced to Longbush Reserve. To supplement the population at Longbush a further translocation could be made to establish a population on the Waikereru hill block. The seral broad leaf and kanuka forest present on the Waikereru hills would provide an abundant source of invertebrates for the insectivorous robin to feed on. Predator control is currently being established in the Waikereru hills by Ecoworks NZ Ltd. staff. Once predator numbers have been sustained at low levels robin could be re-introduced. North Island robin are also an excellent advocacy species as they are friendly and conspicuous.

2) **North Island saddleback/Tieke** (*Philesturnus carunculatus rufusater*)
National threat status: Range restricted

Saddleback were first successfully translocated in the 1960's (Merton 1965) and have been translocated a number of times since e.g. Tiritiri Matangi Island, Mokoia Islands, Ulva Island, Karori and Orokonui. Saddleback are facultative cavity nesters, and because of this, eggs, chicks and nesting adults are particularly vulnerable to predation by rats, stoats and weasels. Saddleback are weak fliers and spend large amounts of their time foraging on the ground. These life history traits mean they are also prone to predation by feral cat.

Saddleback are insectivorous and would thrive in the Longbush/Waikereru habitat providing near nil predator densities are reached and maintained. Saddleback would have been widespread in this area prior to human inhabitation. This therefore represents an ideal opportunity to re-introduce this species back to Poverty Bay after

at least 100 years absence. The nearest potential source population of North Island saddleback to Gisborne is Whale Island.

3) **Stitchbird/Hihi** (*Notiomystis cincta*)
National threat status: Nationally endangered

Prior to human arrival hihi would have been found throughout the North Island mainland. Like saddleback, hihi nest in cavities which makes them particularly susceptible to predation by ship rats. Recent research has shown that hihi are also susceptible to avian diseases such as aspergillosis and coccidiosis (Taylor *et al*. 2005).
Until mature forest develops across the reserve supplementary feeding and nest boxes may be necessary to sustain a population of hihi in Longbush/Waikereru. There have been a number of translocations of hihi (e.g. Mokoia, Kapati, Karori and Tiritiri Matangi Islands) all of which have required ongoing support and intervention.

Longbush and Waikereru are large enough to hold a sustainable population of hihi. Establishing self-sustainable hihi populations is one of the main objectives of the Hihi Recovery Group. The long-term aim of re-introducing hihi to Longbush/Waikereru would be to eventually use this site as a source population for other mainland restoration projects. Hihi would probably have to be sourced from an island population like Tiritiri Matangi. Re-introduction of hihi could only occur once predators have been reduced to near nil densities and have been maintained at that level. Hihi have been successfully re-introduced to the Waitakere Ranges 'Ark in the Park', an un-fenced reserve where predator densities are controlled to low levels.

Hihi are a management-intensive species. This does not, however, mean that they should be overlooked when it comes to potential Longbush/Waikereru re-introductions. Separate voluntary groups may need to be established to oversee the day-to-day monitoring and maintenance of management-intensive species like hihi.

4) **North Island brown kiwi** (*Apteryx mantelli*)
National threat status: Serious decline

Brown kiwi and little spotted kiwi were once widespread throughout the North Island (Worthy and Holdaway 1993). Sub-fossil bones found in the lower reaches of the Waimata River indicate kiwi were once common in the coastal forests around Gisborne. Kiwi are now locally extinct in the Gisborne district and the remnant populations that do persist on the East Coast are extremely threatened. Stoat, dogs and ferrets have been directly implicated in the decline of kiwi nationally. Kiwi chicks under 1100 grams are particularly vulnerable to predation

by stoat, ferrets and feral cats. Extensive predator control in the Waikereru hills provides an opportunity to re-introduce kiwi to the Gisborne area. The Waikereru hills could be fenced with a kiwi/weka proof fence to ensure individuals stayed within the predator-controlled site (Figure 23). Kiwi are a national icon and their re-introduction would undoubtedly raise the profile of the Longbush/Waikereru project.

North Island brown kiwi could be sourced from Matawai. This would involve radio-tagging wild adults and monitoring nest sites. Eggs could then be removed from the nests and taken to Rotorua Captive Rearing Unit where they would be incubated and reared in captivity. Chicks could be released into the Waikereru hill block once they weighed over 1100 grams. This site could also be used to re-habilitate injured birds.

If kiwi were introduced to this site domestic pets such as dogs would need to be strictly prohibited and signs to this effect would need to be maintained at entrance points surrounding the reserve.

Figure 23: Potential route for a kiwi/weka proof fence.

5) **Grey-faced petrel/Oi** (*Pterodroma macroptera gouldi*)
National threat status: Not threatened

Prior to human arrival, grey-faced petrel would have been one of the most abundant and conspicuous species present within coastal ecosystems. Nowadays grey-faced petrel colonies are rare on

mainland New Zealand and until recently absent from the Poverty Bay. Grey-faced petrel are common on offshore islands but only on those in which mammalian predators are absent.

Adult petrels are highly philopatric; this means most birds will return to the site where they fledged to breed. Translocation of petrels involves moving pre-fledgling chicks from a source colony and hand feeding these chicks within artificial burrows until they fledge. This requires a large commitment and the success of a translocation will only be evident over a long time period. Fledgling birds will go to see for two to six years before returning to their natal colony. Despite the long time frame involved in this approach, several sea bird colonies have been successfully established using this method (e.g. fluttering shearwater).

In 2003 Ecoworks NZ Ltd. staff used acoustic attraction to successfully re-establish a colony of grey-faced petrel on Young Nicks Head (Figure 24). It is hoped that the Young Nicks Head grey-faced petrel colony may eventually act as a source population for the Longbush/Waikereru restoration project. The two projects have formed a valuable partnership thus far. In 2008 Longbush tree weta were used as a source population for re-introduction into Young Nicks Head predator-free enclosure.

Figure 24: A Young Nicks Head grey-faced petrel (left). Cole Sawyer next to a grey-faced petrel on Young Nicks Head (right).

6) **North Island rifleman/Titipounamu** (*Acanthisitta chloris*)
National threat status: Gradual decline

The rifleman is New Zealand's smallest passerine and one of only two extant species of endemic wren. The species has a fragmented distribution and is uncommon in the Turanga and Waiapu Ecological Districts. In areas where rifleman are locally extinct translocation is an effective method to re-establish viable populations. For example South Island rifleman were successfully translocated to Ulva Island in Paterson's Inlet following nearly 100 years absence.

The restoration of Waikereru/Longbush provides an opportunity to re-establish a large and viable population of rifleman in the Gisborne area. The re-introduction to Longbush/Waikereru would be a direct measure to buffer further decline of East Coast rifleman populations. Rifleman are cavity nesters, therefore until the forest matures on the Waikereru hill, artificial cavities may need to be provided.

Rifleman have been recorded locally in Rimuhau forest - this site could potentially act as a source population for Waikereru/Longbush. A second potential source population exists on Bill and Sally Gaddum's property in Matawai.

7) **Red-crowned parakeet/Kakariki** (*Cyanoramphus novaezelandiae*)
National threat status: Not threatened
&
8) **Yellow-crowned parakeet/Kakariki** (*Cyanoramphus auriceps*)
National threat status: Gradual decline

Red-crowned and yellow-crowned parakeets would almost certainly have been numerous in Poverty Bay forests prior to the arrival of humans. Kakariki are now seldom heard or seen in the Gisborne region. This project aims to re-establish a self-supporting kakariki population in Longbush/Waikereru area.

Both species are cavity nesters and prefer to live in mature forest, but will live and breed successfully in scrub and seral forest if artificial nest boxes are provided (e.g. Tiritiri Matangi Island). In the absence of mammalian predators kakariki, like most species of parakeet, have a high reproductive output. Providing mammalian predators were maintained to low densities, kakariki could become abundant within Longbush/Waikereru in a short period of time.

Red-crowned parakeets have been successfully translocated to a number of sites including Mt Bruce and Tirittiri Matangi Island. At present fewer translocations have been carried out for yellow-crowned

parakeet (McHalick 1998). Kakariki breed well in captivity which means local breeders may be able to supply a founder population, provided birds were vet screened prior to release.

9) **North Island weka** (*Gallirallus australis greyi*)
National threat status: Nationally endangered

North Island weka (Figure 25) are listed as Nationally Endangered and are therefore a high priority for conservation action. Prior to human arrival it is likely that weka were widespread throughout the North Island. However, by the 1930s weka had all but disappeared from the North Island, with populations remaining in Northland and Poverty Bay. Between 1953 and 1981 the Poverty Bay population expanded but collapsed between 1983 and 1990 (Beauchamp *et al.* 1999). Weka are now rare in the Gisborne area with populations at less than 5% of their 1981 peak (Beauchamp *et al.* 1999). Currently the future of weka in the Gisborne area looks bleak. Recruitment appears to be non-existent with young birds being killed in their first couple of months (Beauchamp *et al.* 1999). Predation by introduced mammals, traffic kills and disease are probably the main causes of weka decline.

Figure 25: A North Island weka.

This project has the potential to halt weka decline in the Gisborne area. Weka could be managed in the Waikereru hill block by building a weka/kiwi proof fence around the reserve's perimeter (Figure 23). The

Waikereru hills are large enough to support a sustainable weka population which over time could be used as a source population for other local conservation projects. The nearest appropriate source population would be in the forest/rough farmland of the Motu/Toatoa hill country *c.* 2000 birds (Beauchamp *et al.* 1999).

10) **North Island fernbird/Matata** (*Bowdleria punctata vealeae*)
National threat status: Sparse

Fernbird are an endemic species of warbler found throughout the North Island but are locally uncommon in the Waiapu Ecological District. Threats to surviving fernbird populations include predation from introduced mammals and habitat loss. Introducing fernbird to the Longbush/Waikereru Reserve would benefit local populations and help buffer further decline. Fernbird could potentially be sourced from Matawhero Loop Wildlife Management Reserve in Gisborne.

11) **North Island kokako** (*Callaeas cinerea wilsoni*)
National threat status: Nationally endangered

Kokako are Nationally Endangered with only *c.* 400 pairs surviving in the wild (Innes and Flux 1999). Kokako are generally found in mature indigenous forest but have established successfully in shrublands and seral forest on Tiritiri Matangi Island. The main cause of kokako decline has been predation by ship rats and possums with breeding success closely related to the intensity of predator control (Innes *et al*. 1999).

Translocation is a proven technique for the establishment of kokako populations. The re-introduction of kokako to Longbush/Waikereru would be a long-term goal. Mammalian predator densities would need to be effectively nil to ensure nesting success was high. Kokako are a large bird and forage over a considerable range, therefore the forest on the Waikereru hills would need to mature before a viable population could persist at this site.

6.8.2 Herpetofauna

12) **Green gecko** (*Naultinus elegans punctatus*)
National threat status: Gradual decline

The green tree gecko (*Naultinus elegans*) is found throughout the North Island. However the distribution of *N. elegans punctatus*

(Figure 26) is restricted to the East Cape, Hawkes Bay and the southern North Island. Green gecko populations are declining as a result of habitat destruction and predation by introduced mammals. Longbush/Waikereru could potentially hold thousands of green gecko and help secure the conservation status of this species on the East Coast.

Several species of gecko, including green, have been successfully translocated to a number of reserves in the past. For example, green tree gecko to Tawharanui Regional Park and Wellington green gecko and Duvaucel's gecko to Mana Island. Ecoworks NZ Ltd has had experience in translocating gecko, successfully re-establishing a population of green gecko within Young Nicks Head enclosure (*c*. 35 ha) in 2007.

Figure 26: A green tree gecko.

Captive breeding of green gecko could be used to kick start a population at Longbush/Waikereru. Ecoworks NZ Ltd. has the appropriate facilities and is currently managing a breeding programme for Young Nicks Head restoration project. Captive breeding can, however, require significant investment in time and resources. Providing an abundant source population could be identified it may be preferable to collect wild green gecko, and transfer these directly to the release site.

13) **Duvaucel's gecko** (*Hoplodactylus duvaucelii*)
National threat status: Sparse

Duvaucel's gecko are the largest species of New Zealand gecko reaching up to *c*. 300 mm in length. Fossil evidence suggests that Duvaucel's gecko were once found throughout the North Island. Predation by introduced mammals has, however, reduced its distribution to a number of predator-free off-shore islands (Towns and Daugherty 1994).

A predator-proof enclosure within Longbush/Waikereru would be necessary to house this species, unless predators were to be effectively eradicated from the site and prevented from re-invading.

Duvaucel gecko could potentially be sourced from Korapuki Island in the Mercury Island group. This is the largest and closest natural population to Longbush/Waikereru. Alternatively Duvaucel gecko could be sourced from local breeders. The long-term genetic viability of captive breed populations is, however, unknown.

14) **Tuatara** (*Sphenodon punctatus*)
National threat status: Range restricted

Tuatara were once abundant in the Gisborne region but went rapidly extinct following the arrival of the first humans. All that remains of tuatara on the East Coast is sub-fossil bones, which have been found in several Maori midden sites around Poverty Bay (Clarkson and Clarkson 1991).

Re-introducing tuatara to Longbush/Waikereru would be a long-term objective. Prior to re-introduction it would be important to ensure that habitat factors were suitable for tuatara to live and breed. For example by ensuring healthy populations of invertebrate and lizard were present. Artificial burrows could also be provided until natural burrows were dug. Tuatara appear to re-establish best when they are released in association with burrowing pelagic seabirds (Gaze 2001). It may therefore be necessary to transfer grey-faced petrel to the site and allow them to establish, before considering the re-introduction of tuatara.

For a threatened species like tuatara to be re-introduced to Longbush/Waikereru predators would need to be all but eradicated from the site. If predator densities were deemed too high to re-introduce tuatara, a small predator-proof enclosure could potentially be built at the site. An enclosure could also house other rare or predation-prone species such as Duvaucel's gecko. The Tuatara Recovery Group would need to be consulted in regards to which tuatara species would be best suited to transfer to the Longbush/Waikereru area.

6.8.3 Invertebrates

Natural recovery of most species of invertebrate is preferred over translocations. A key constraint in translocating invertebrates is the lack of reliable monitoring methods to determine if a transfer is successful. A comprehensive survey of invertebrates is necessary to identify which species are present. Some species can survive in very low numbers in sub-optimal habitats and then take time to recover, while others may recover quickly. With the removal of mammalian predators, many species of invertebrate will re-colonise naturally. However flightless species in particular may require translocation. New Zealand weta are ideal invertebrates to translocate. Weta can be captive-bred, and appear to establish readily after being moved to new locations (Field 2001).

A number of nationally threatened or locally rare invertebrate species such as peripatus, burrowing weta, Raukumaru tusked weta, giant weta and *Powelliphanta* spp. may be suitable to re-introduce to Longbush/Waikereru. Re-introductions of these species should only occur after a Longbush/Waikereru invertebrate inventory has been compiled.

6.8.4 Flora

If mammalian pest densities can be controlled to low levels, Longbush/Waikereru have the potentially to act as a valuable refuge for the translocation of threatened East Coast plants. Threatened species such as wood rose (*Dactylanthus taylorii*) or white mistletoe (*Tupeia Antarctica*) may still exist in Longbush/Waikereru. Remnant plant populations may provide an important seed source to artificially establish new populations. Following the removal of mammalian pests it would be worth carrying out an extensive vegetation survey, particularly on the Waikereru hill block, which has not been managed intensively until now. Translocations should only be considered once thorough searches fail to find any natural populations.

6.9 Community involvement

6.9.1 Current status

To date this project has gained a great deal of positive support from the Gisborne community. A website has been developed (www.longbushreserve.org) to ensure the supporters of Longbush/Waikereru are kept up to date with restoration news, events and progress. School groups are encouraged to visit the reserve to experience a protected indigenous forest ecosystem. The Tai Rawhiti Polytechnic Conservation Corp and the Turanga-Ararau PTE also undertake a considerable amount of voluntary work at this site. As part of their course students are involved with planting native trees and trapping possums within Longbush Reserve.

Eventually Anne and Jeremy are keen to extend Longbush Reserve through planting on the esplanade alongside the river to the south end of the gravel road. This would

be a community-driven riparian restoration project 'Making Longbush Longer'. This project would require the permission and support of Gisborne District Council.

Currently local weavers have managed access to the Rene Orchiston flax collection.

6.9.2 Management recommendations

1) Encourage landowners in the surrounding region to carry out pest control on their land to minimise predation risk of animals which disperse outside of the predator-controlled area. Landowners in the area could also be encouraged to plant native trees on their property. Creating a mosaic of viable habitat will allow species within Longbush/Waikereru to disperse outside of the central reserve once populations reach carrying capacity.

2) Support for the project could be gained by encouraging visitors to participate in hands-on restoration activities. Working days could be held to get volunteers involved in tasks like planting or animal surveys. A range of survey methods could be implemented depending of the skill and experience of the volunteers. The Gisborne Ornithological Society has expressed an interest in monitoring bush birds within the reserve. Other groups such as Forest and Bird and the Ecological Society of New Zealand may also be interested in becoming actively involved in the project.

3) Funds could be raised (membership, donations, or subscriptions) through developing a 'Friends of Longbush/Waikereru' network. A public newsletter could be sent once or twice a year to keep supporters up-to-date with the progress of the project. Financial support from a source such as this could be used for day-to-day maintenance costs. Non-directed funding will be important to maintain certain aspects of the project over the long term. In most instances funding agencies will only provide money for task-specific purposes e.g. to build a fence rather than maintain a trap line.

4) Continue to build and maintain strong and healthy relationships with local iwi, The Department of Conservation, The Gisborne District Council and surrounding landowners.

6.10 Visitor access, facilities and interpretation

A track system has been developed within Longbush and kissing gates have been installed to allow ease of public access (Figure 27). Anne and Jeremy plan to establish a user friendly track at the north end of the bush, crossing the first stream on a small pole bridge, and the second gully on a swing bridge.

Figure 27: Kissing gates at the entrance of Longbush Reserve.

Currently no track system exists through the Waikereru hills. A network of tracks could be developed through the Waikereru hills, each track highlighting a different aspect of the restored landscape. These tracks could vary in difficulty level from short walks, to longer day walks. A look out could be constructed at the top of the Waikereru hills, overlooking the Waimata Valley on one side and Poverty Bay flats on the other (Figure 28 & 29). Interpretation material could eventually be made available with a map and description of each track.

Figure 28: Panoramic view of the Waimata Valley from the top ridgeline of the Waikereru hills.

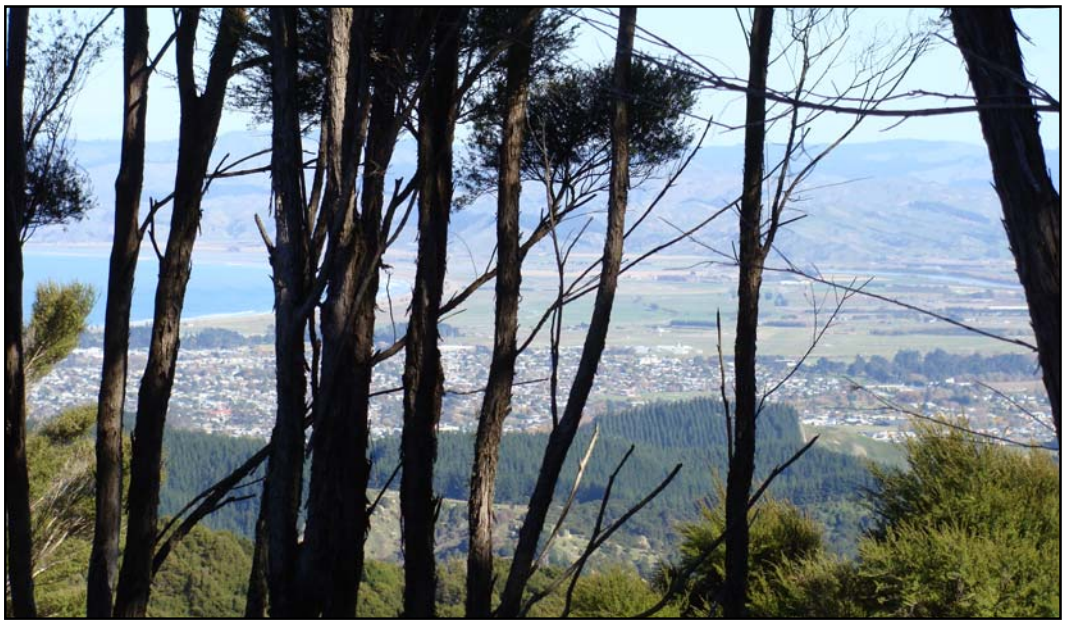

Figure 29: Panoramic view of Poverty Bay flats from the top ridgeline of the Waikereru hills.

It will be important to make sure the ecological integrity of the site is not degraded as the project progresses and public visitor numbers increase. With increased visitor numbers, it will eventually be necessary to provide adequate infrastructure such as toilets and areas to dispose of rubbish. It would be important to ensure that any development is sustainable and maintenance is ongoing.

The provision of informative interpretation material should be a priority at this site. The subjects of interpretative material could range from forest restoration, threatened species recovery, species re-introductions, Maori settlement, land use change, weed management, pest control etc. The Longbush Ecological Trust could work together to determine which forms of interpretative material will best enhance visitor experience and increase public awareness. Once rare species like kiwi or weka are transferred to the site, it will be important to provide interpretative material explaining why domestic pets such as dogs should not be taken into the reserve. Messages like this could be further conveyed in brochures, interpretation displays, newsletters and through the trust's website.

6.11 Project funding

6.11.1 Current status

To date this project has been largely privately funded by Anne and Jeremy Salmond with contributions from the Biodiversity Condition Fund and QEII (Table 7).

Table 7: Outline of project funding for the Longbush/Waikereru project to date.

Protection and Enhancement expenditure 2000-2009	
Plant supplies	$27,808
Planting costs	$8,000
Fencing	$178,063
Maintenance of ecological reserves	$152,433
Sub total	$366,304
Grants received 2000-2009 to support these costs 2000-2009	
QEII	$9,600
Biodiversity Condition Fund for Pa Hill 2006	$10,000
Biodiversity Condition Fund for wildlife corridors 2007-2008	$34,198
Sub total	$53,798
Total invested in Longbush by J. & A. Salmond 2000-2009	
TOTAL	$312,506

6.11.2 Management recommendations

There is currently a range of funding opportunities available for projects such as this:

1) **Supporters**

With the establishment of the Longbush Charitable Trust, supporters will be able to donate towards the Longbush/Waikereru project.

2) **Funding agencies**

There are several funding agencies that could potentially provide financial assistance for this project (Table 8). Funding is more likely to be obtained for specific components of the restoration project rather than day-to-day maintenance.

Table 8: Potential funding agencies for the Longbush/Waikereru restoration project.

Fund Name	Details	Administrator
Biodiversity Condition Fund	To enhance management of indigenous biodiversity outside public conservation lands.	Department of Conservation, Gisborne and Wellington
Sustainable Management Fund	Funding to support groups in taking practical actions that produce long-term environmental benefits.	Ministry for the Environment
NZ Lottery Grants Board	Projects which promote, protect and conserve New Zealand's natural, physical and cultural heritage.	Department of Internal Affairs
Mazda Foundation	Assistance towards the maintenance and improvement of the natural environment.	Mazda New Zealand
Where There's Water' Community Environmental Grants	Provide funding to help the community understand, maintain, protect and improve their water environment.	BOC Gases
Birdlife international community conservation fund	Provide assistance for community projects which conserve or restore globally threatened bird species and/or important bird areas in New Zealand and the Pacific Islands region	Forest & Bird, New Zealand

3) **Corporate sponsors**

John Thorpe (Anne Salmond's brother) wine-maker and owner of The Gisborne House of Wine, has dedicated a royalty from four of his premium wines to the restoration of Longbush/Waikereru. This project has also been sponsored by The Waimata Cheese Company, which is owned by Richard (John's twin brother) and his wife Carol Thorpe. Further corporate sponsors may wish donate funds for certain aspects of the Longbush/Waikereru project. While others could provide discounts on goods and services such as planting supplies or chemical for weed control. High visitor numbers will ensure good exposure for corporate sponsors.

Anne and Jeremy Salmond are in the process of forming a Charitable Trust this will certify the project as a separate legal entity. Forming an independent trust will also mean the project has charitable trust status (for IRD purposes), which many funding agencies either require (therefore tax deductible donation) or look upon more favourably than providing direct funding to private landowners.

The fact that both the Longbush Reserve and the Waikereru hill block have been placed under a QEII covenant will strengthen future funding applications. Covenant status remains in place in perpetuity this ensures the ongoing protection of the area. Covenant status also gives funding agencies confidence that funding invested into a project is secured into the future, and is not being used for private financial gain.

7 SUMMARY

The Longbush/Waikereru Reserve is a unique asset for the Gisborne community in terms of the recreational and education values it provides, as well as the rare biodiversity values it harbours. Despite the impact of human activities over a long period of time, a great deal of biodiversity still remains intact at Longbush/Waikereru, which has the potential to act as an 'Ark' for rare and threatened species in the Tai Rawhiti district. The focus of this project should be to maintain and enhance the current biodiversity values at this site to achieve positive conservation gains and promote environmental awareness. To date substantial progress has been made within Longbush Reserve. It is now important to build on this foundation and begin restoration of the Waikereru hills (see Appendices I for potential strategic direction).

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9 APPENDICES

I POSSIBLE STRATEGIC DIRECTION

Timeframe	Administrative	Ecological	Community-based
Year 1	-**Establish Longbush Ecological Trust (LBET)** -**Funding applications** --BCF (bids due 01/07/09) --Birdlife fund (bids due 31/07/09) --SMF (bids open 10/09, close 01/10) --NZ lottery (funding committee meets 4x year) --Mazda (3x year, 31 March, 30 June and 30 September) --Where there's water grant	-**Species introductions** -Translocate Nth. Is. robin to LB -**Management of Waikereru** -Remove vertebrate grazers from Waikereru -Begin predator control on Waikereru -Initial weed control on Waikereru --Target M. daisy -**Annual maintenance** --Weed & predator control in LB --Fencelines	-**Make property owners in the surrounding area aware of the project** --Encourage their participation -**Baseline flora and fauna surveys in LB and Waikereru** -**Encourage OSNZ to begin banding forest birds**
2-5	-**Annual funding bids** -**5-year review of management plan** --On track to achieve objectives? --Adapt plan if necessary --Review financial status of project	-**Construct kiwi/weka proof fence around Waikereru** -**Species introductions** --NI saddleback --NI rifleman --Green gecko --NI brown kiwi --NI weka --Kakariki (yellow- & red-crowned) --NI fernbird --Wood rose --White mistletoe -**Annual maintenance** --Weed & predator control in LB & Waikereru --Photo points --Fencelines	-**Upgrade LB track** --Provide signage and interpretative material within LB **-Initiate Community-driven riparian restoration project** -**Establish 'Friends of LB'** --Biannual newsletter/email?? **-Annual survey of flora and fauna within LB and Waikereru** -**Outcome monitoring of re-introduced species**
6-10	-**Annual funding bids** **-10-year review of management plan** --Review efficacy of current management with reference to long term objectives --Update plan if necessary --Review financial status of project	-**Species introductions** --Grey-faced petrel --Hihi --Tuatara --Duvaucel's gecko --Invertebrates ---Giant or raukumara-tusked weta?? -**Annual maintenance** --Weed & predator control in LB & Waikereru --Photo points --Fencelines	-**Establish Waikereru track system** --Waikereru signage and interpretative material **-Annual survey of flora and fauna within LB and Waikereru** -**Outcome monitoring of re-introduced species**
10+	-**Aim to be financially secure** -**Revise and update management plan when necessary**	-**Species introductions** --NI kokako --Little spotted kiwi?? **-Annual maintenance** --Weed & predator control in LB & Waikereru --Photo points --Fencelines -**Established populations to act as sources for other restoration projects**	-**Visitor infrastructure** --Toilet/changing facilities --Rubbish disposal --Picnic area?? **-Annual survey of flora and fauna within LB and Waikereru** -**Outcome monitoring of re-introduced species**

II VERTEBRATE PEST CONTROL: WAIKERERU HILLS

The control of introduced vertebrate pests, such greatly enhances the biodiversity of a site. Vertebrate pest control at this site would consist of a combination of kill traps, bait stations and shooting.

All trap catches must be recorded and should include the following information:

1) Date
2) Trap number
3) Species caught
4) Sex of species

It is important to maximise trap efficiency by selecting the correct trap type, bait, layout, seasonal timing, and length of operation. The efficacy of any trapping regime should be assessed by monitoring the change in relative density of pest numbers over time. Warning signs must also be visible to ensure visitors are aware of pest control operations.

Species targeted on the Waikereru hills would include 1) rats (Norway and ship rats), 2) feral cats, 3) possums, 4) mustelids (stoats, weasels and ferrets), and 5) feral goats.

1) **Rats** (Norway rats *Rattus norvegicus* and ship rats *R. rattus*)

Norway rats arrived in New Zealand with the first Europeans between 1790-1800 and are the largest of New Zealand's rat species, with adult males weighing an average of 179 grams. Ship rats arrived and became established almost 100 years after Norway rats; adult male ship rats weigh approximately 100 grams.

Control

Establish permanent bait stations (Diphacinone [0.05g/kg]) at 100 m intervals along the proposed trap lines Figure 30. Bait stations could initially be monitored fortnightly. However, once rat densities have been reduced to desirable levels, monitoring could be extended to once every 2-3 months.

2) **Feral cats** (*Felis catus*)

Control

Conibear 110 mm kill traps are an effective way to control cats. These can be baited with chopped pilchard, beef mince, fish-flavoured tinned cat food or minced rabbit. Individual cats may be shy of specific trap layouts, variation in trapping methodology is therefore vital. The two conibear designs suggested for the Waikereru hills are a) raised set and b) box trap. These trap setups could be alternated at 300 m intervals along the proposed trap lines (Figure 30).

Conibear raised set – When kill traps are in an area where farm dogs, children, ground nesting birds, or other protected species are present, traps must be set a minimum of 1 m off the

ground. Traps can be set at the top of a wooden ramp, which consists of 800 mm x 150 mm x 25 mm H3 radiata pine. The ramp should run at a 10-15° angle and extend from the tree 40 mm below the trap. The lower end should be nailed to the top of a 50 x 50 mm tanalised wooden fence batten driven into the ground (to a depth of 200 mm).

Conibear box trap – The Conibear box trap consists of a large plywood box with a conibear trap placed at one end of the box. The box is made of tanalised H3, 17 mm plywood. The dimensions of the box are 400 mm x 400 mm x 800 mm. One end of the box is covered in 13 mm square aviary mesh, which is stapled in place. The mesh has a 250 mm x 250 mm square hole cut at the bottom centre to allow un-hindered access for cats. The other end of the box is closed with a piece of plywood which holds the trap bracket.

When using a Conibear box trap a warning sign must be stencilled on the lid with black spray paint e.g.:

DANGER: TRAPS!
PLEASE DO NOT TOUCH
WAIKERERU RESERVE

3) Possum (*Trichosurus vulpecula*)

Control

Waikereru is a relatively large area which requires a sustained control method implemented over a long period. Night shooting over several nights would quickly reduce possum densities. This could be followed up with permanent kill traps which would control any transient animals that may enter the forested block at a later date. There are number of kill trap designs that could be used effectively on the Waikereru hills. These include Conibear, Timm's traps and Steve Allen Kill Traps.

Possum traps should be set at 200 m intervals along the proposed trap lines (Figure 30), and at the base of mature mahoe, karamu, five-finger, karaka or kohekohe. These species are target food trees for possum. Trapping should also take place at the base of 'call trees'. Call trees are used by male possums to secure territories and attract mates. Call trees are often on a slight angle and can be generally identified by the scratch marks on the bark and faecal pellets on the main trunk.

4) Mustelids (ferrets *Mustela furo*, stoats *M. erminea*, weasel *M. nivalis*)

Ferrets are the largest mustelid in New Zealand, reaching lengths of 550 mm (nose to tip of tail). Males are noticeably larger than females, averaging 1100-1300 grams with females ranging between 400-1100 grams. Ferrets are variable in colour, typically with a white/cream undercoat and a darker coat of brown guard hairs. Stoats are smaller than ferrets and range in size from 350-400 mm (nose to tip of tail). Males are generally larger than females, with males weighing an average of 325 grams and females an average of 205 grams. Stoats are chestnut brown in colour with a cream underbelly. Weasels are the smallest mustelid to be

introduced to New Zealand. Weasel are similar in appearance to stoat, however, are smaller and do not have a black bushy tail.

Control

The most effective control method for use on all species of mustelid is either 'No. 6 Fenn' traps or 'DOC 200' kill traps, placed in the centre of a wooden set tunnel (described below), and baited with a single 'punctured' hen's egg.

The set is a wooden tunnel, 600 mm in length and constructed of treated, H3 radiata pine. Box dimensions are: 200 x 25 mm for the sides and 250 x 25 mm for the base (rough sawn H3). The lid is made of 17 mm plywood and cut 600 x 250 mm. The box is screwed together using square drive screws. A warning sign must be stencilled on the lid with black spray paint e.g.:

DANGER: TRAPS!
PLEASE DO NOT TOUCH
WAIKERERU RESERVE

A plastic triangular track marker must also be screwed onto the lid with the trap number engraved into it. The lid is screwed at diagonally opposite corners with a square drive 40 mm screw, to prevent access to anyone other than the trapper. Mustelid traps should be placed at 200 m intervals along the proposed Waikereru trap lines (Figure 30).

5) Feral goat (*Capra hircus*)

Control

Feral goat should be culled from the Waikereru Reserve. Complete eradication should be possible at this site. The area must however be monitored regularly to prevent their re-establishment.

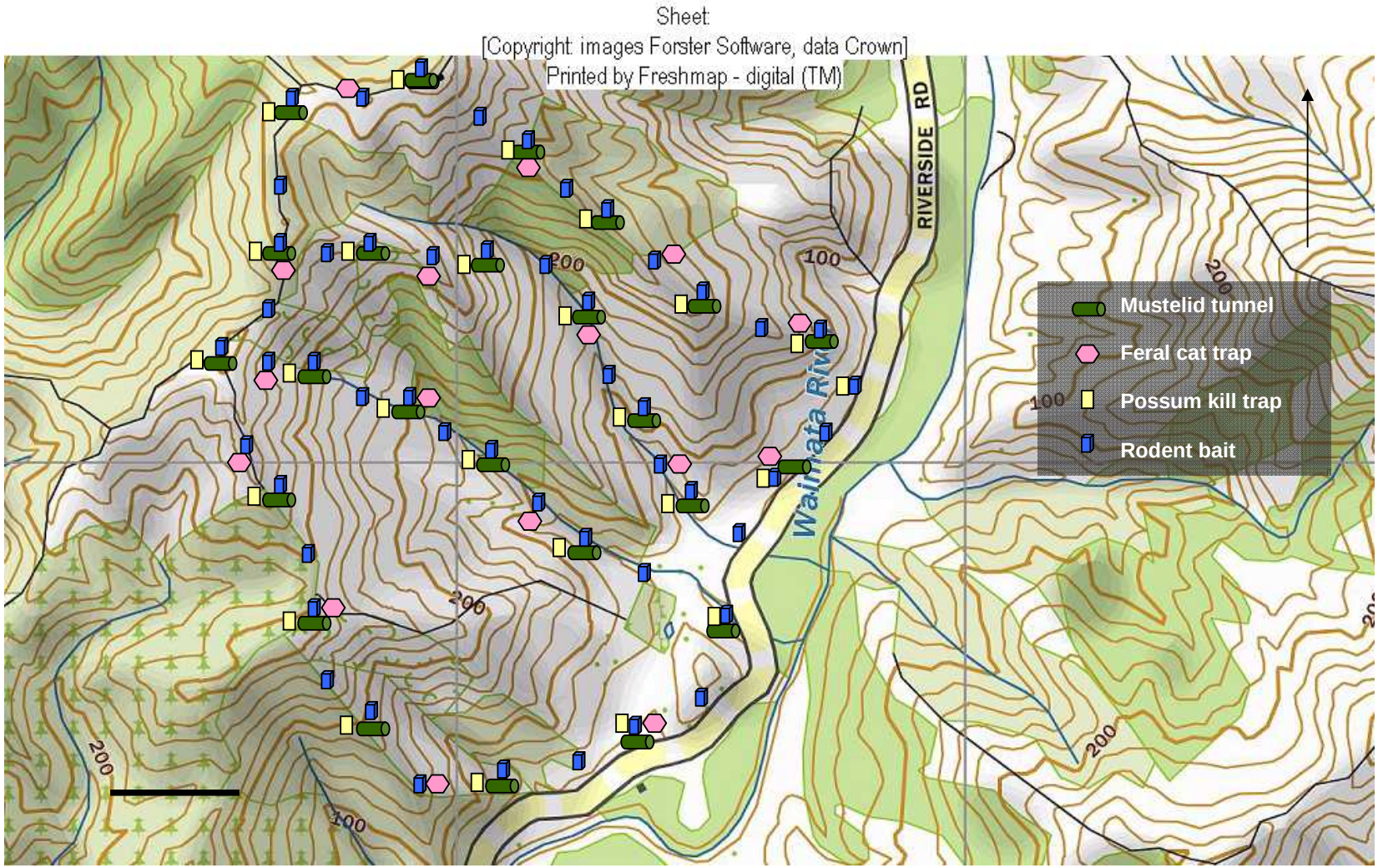

Figure 30: Proposed trap lines for the control of mammalian pests on the Waikereru Reserve. Rodent baits spaced at 100 m intervals, mustelid tunnels at 200 m intervals, cat traps at 300 m intervals and possum kill traps at 200 m intervals. The scale bar equals 250 m.

III WEED CONTROL METHODS FOR THE RECOVERY OF NATIVE FLORA IN LONGBUSH RESERVE AND THE WAIKERERU HILLS

Species	Control Method
Blackberry	Spray, Tordon Brushkiller, 60mls/10 litres + 10mls Pulse + 10mls dye.
Briar rose	Spray, Tordon Brushkiller, 60mls/10 litres + 10mls Pulse + 10mls dye.
Cotoneaster	Stump cut and paint, 10 g Escort/5 litres + 10mls Pulse + 10mls dye.
German Ivy	Spray Escort, 5g/10 litres + 10mls Pulse + 10mls dye.
Japanese honey suckle	Spray 100mls/ 10 litres Glyphosate + 10mls dye, or vine cut and paint with Glyphosate.
Wild plum tree	Stump cut and paint, Grazon or Tordon 20%
Alder	Stump cut and paint, Grazon – neat (100%), or bore chainsaw bar into trunk and fill with 12% Grazon mix.
Silver poplar	Stump cut or ring bark and scarf below ring and paint Grazon – neat (100%) with paint brush.
Variegated thistle	MCPA or Versatile 1%-100mls/10 litres + Pulse + dye
Jerusalem cherry	Spray Grazon, 40mls/10 litres + 10mls Pulse + 10mls dye
Mexican daisy	Spray 0.3% (30mls/10 litres) Glyphosate + dye.
Old man's beard	Spray with 1.5% Glyphosate + Pulse + dye. Cut and paint large vines with Vigilant gel.
Pampas	Spray, full coverage, 1.6% Glyphosate + Pulse + dye.
Periwinkle	Spray 2.5% (250 mls/10 litres) Glyphosate, + Pulse + dye.
Wandering Jew	Spray 60mls Grazon/10 litres + Pulse + dye.
Willow	Stump cut and paint 1 litre Glyphosate + 200mls Pulse/10 litres water.
Fig	Stump cut and paint with Vigilant gel.
Scotch thistle	MCPA or Versatile 1%-100mls/10 litres + Pulse + dye

IV PHOTO POINT DATA

Site	Location	Photo ID	Orientation	Notes
1	E2950359 N6275767	4261	290°	-Photo point on fence post near poplars, looking up middle gully.
2	E2950306 N6276211	4262	0°	-View of the northern slope of the middle gully. Tutu, kanuka and Mexican daisy dominant.
3	E2950240 N6275820	4263	55°	-View looking down the middle gully with kanuka dominant on the northern slope. Kanuka seedlings are abundant amongst pasture on the southern slope.
4*	E2950050 N6275820	4264	5°	-View of upper northern face of the middle gully. Face dominated by kanuka, mahoe, mamaku, tutu and rangiora. Open pasture and kanuka regeneration in foreground.
		4265	105°	-View looking down the middle gully towards poplars. Consisting largely of grazed open pasture and some kanuka.
5	E2949804 N6275891	4266	60°	-Photo point on ridgeline fence. Open kanuka stands dominant. Large patches of inkweed present amongst grazed pasture.
6	E2949664 N6276346	4274	20°	-Photo point just below ridgeline fence. Kanuka seedlings and pasture grasses in foreground.
7	E2949668 N6276481	4288	125°	-Photo point nailed on fence post just down from the north-western reserve boundary. View looking down the northern gully system.
8	E2949971 N6276728	4289	25°	-Photo point attached to a large lancewood in the upper forest of the northern gully. Mexican daisy carpets large areas of the forest floor. Kawakawa, mahoe, lancewood, kanuka and mamaku dominant.
9*	E2950064 N6276497	4294	110°	-Photo point on southern stream bank of northern gully. View of the northern bank, dominated by kawakawa, pepper tree, putaputaweta, rangiora, mahoe, kohekohe and titoki.
		4295	35°	-View looking down the gully on the northern stream bank. The ground is covered in a dense mat of Mexican daisy.
10*	E2950106 N6276428	4297	245°	-Photo point below the main wedge of bush on the northern gully. View of recently subsided land covered in regenerating forest. Tutu, toitoi and kanuka are dominant.
		4298	310°	-View looking up the northern gully and the main forested block, which is surrounded in grazed pasture.
11	E2949959 N6275557	1557	160°	-Photo point at the base of an old hollow kohekohe. View of southern face of the southern gully, dominated by pasture with stands of variegated thistle.
12	E2949758 N6275674	1563	108°	-Photo point on old fence post on the ridgeline between the southern and middle gullies. View looking down the southern gully.

*Two photographs were taken at sites 4, 9 and 10. All photo points are marked with a single orange plastic triangle.

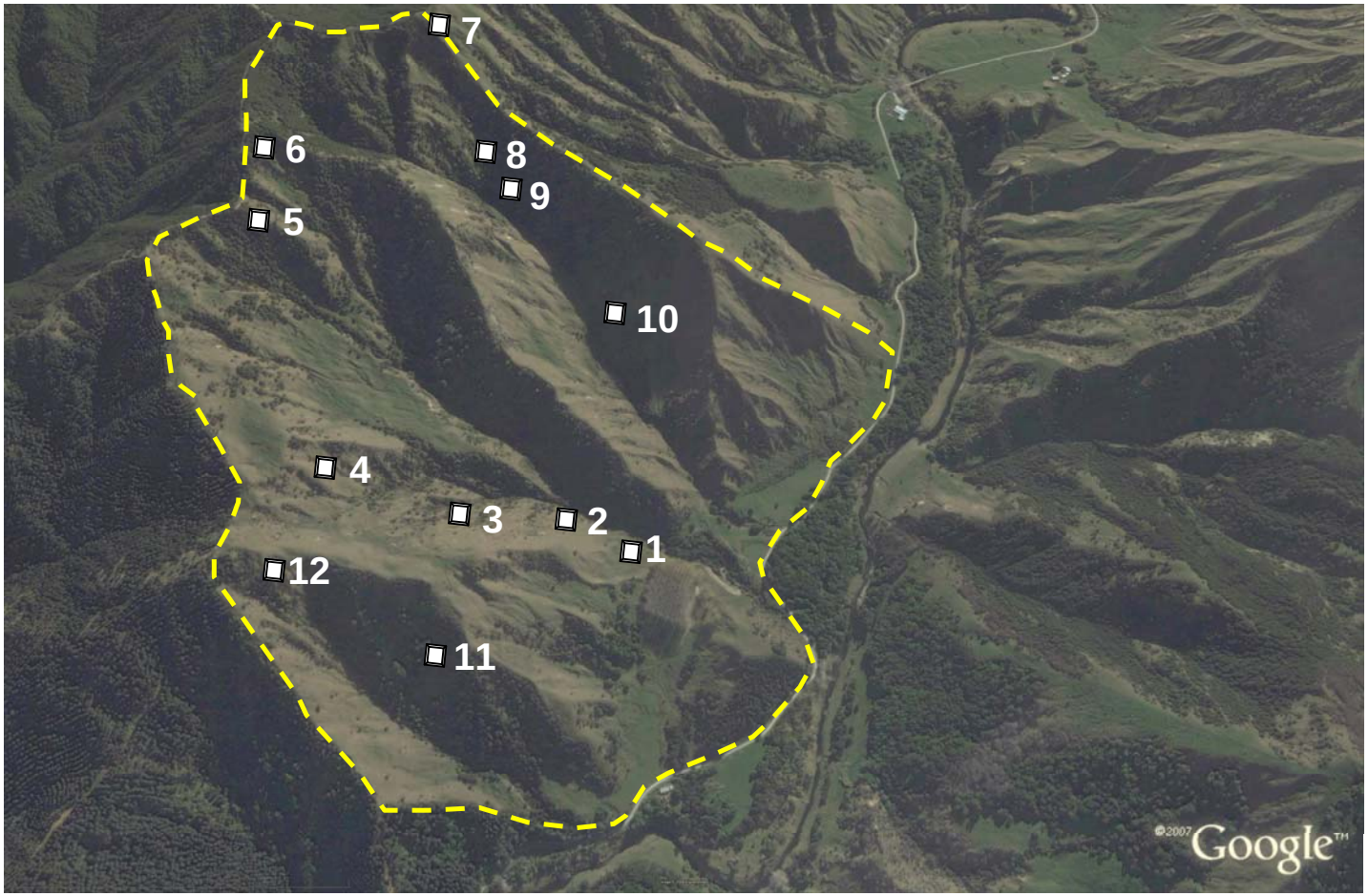

Figure 31: Composite aerial photograph of Waikereru/Longbush Reserve. The relative location of each permanent photo point is shown (1-10).

Figure 32: Photo point 1 (Camera settings: focal length = 18mm; shutter speed = 1/100; aperture = f/3.5).

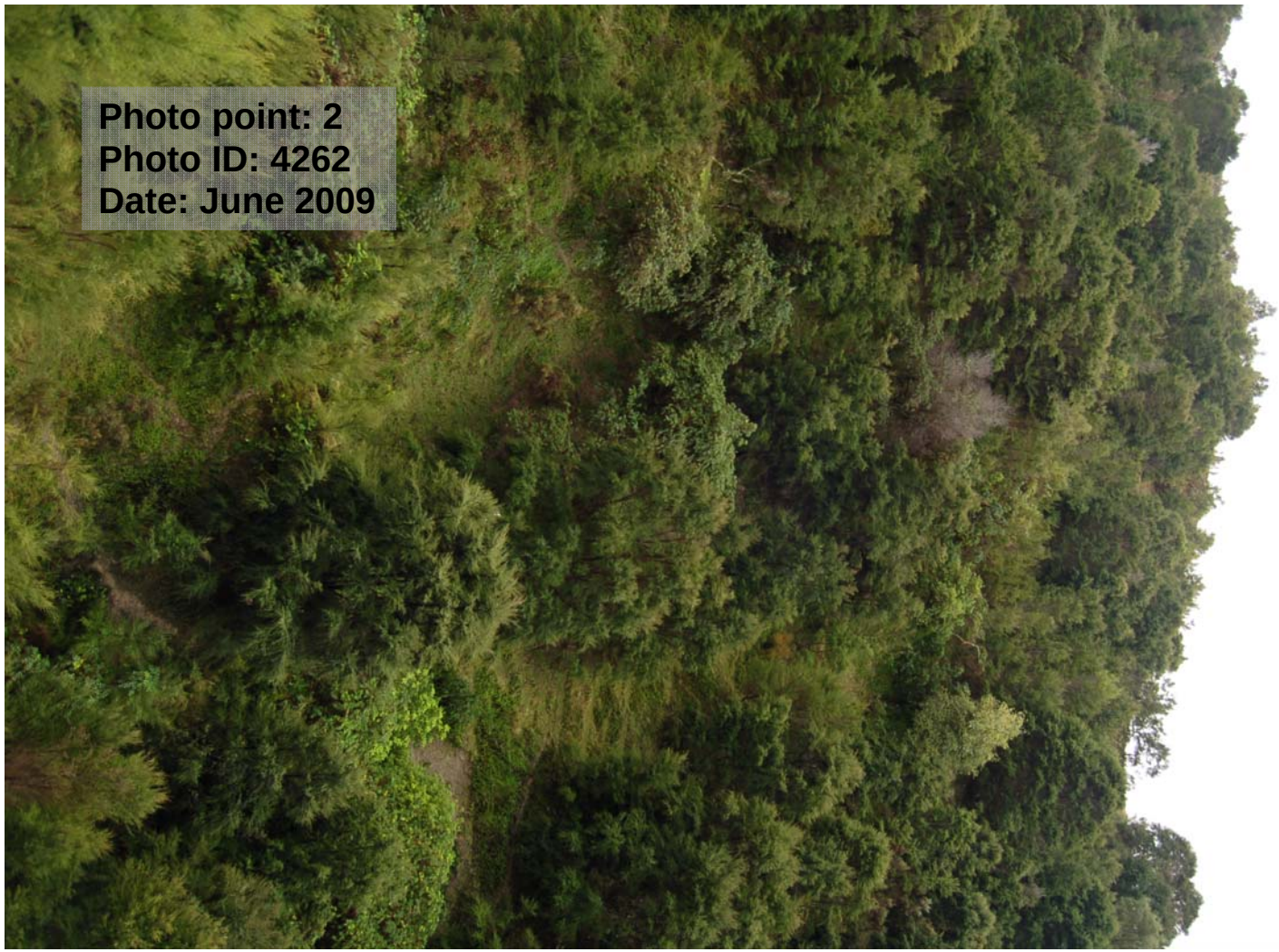

Figure 33: Photo point 2 (Camera settings: focal length = 18mm; shutter speed = 1/40; aperture = f/3.5).

Figure 34: Photo point 3 (Camera settings: focal length = 18mm; shutter speed = 1/160; aperture = f/3.5).

Figure 35: Photo point 4 (Camera settings: focal length = 18mm; shutter speed = 1/160; aperture = f/3.5).

Figure 36: Photo point 4 (Camera settings: focal length = 18mm; shutter speed = 1/160; aperture = f/3.5).

Figure 37: Photo point 5 (Camera settings: focal length = 18mm; shutter speed = 1/60; aperture = f/3.5).

Figure 38: Photo point 6 (Camera settings: focal length = 18mm; shutter speed = 1/160; aperture = f/3.5).

Figure 39: Photo point 7 (Camera settings: focal length = 18mm; shutter speed = 1/125; aperture = f/3.5).

Figure 40: Photo point 8 (Camera settings: focal length = 18mm; shutter speed = 1/40; aperture = f/3.5).

Figure 41: Photo point 9 (Camera settings: focal length = 18mm; shutter speed = 1/25; aperture = f/3.5).

Figure 42: Photo point 9 (Camera settings: focal length = 18mm; shutter speed = 1/80; aperture = f/4.5).

Figure 43: Photo point 10 (Camera settings: focal length = 18mm; shutter speed = 1/25; aperture = f/7.1).

Figure 44: Photo point 10 (Camera settings: focal length = 18mm; shutter speed = 1/160; aperture = f/7.1).

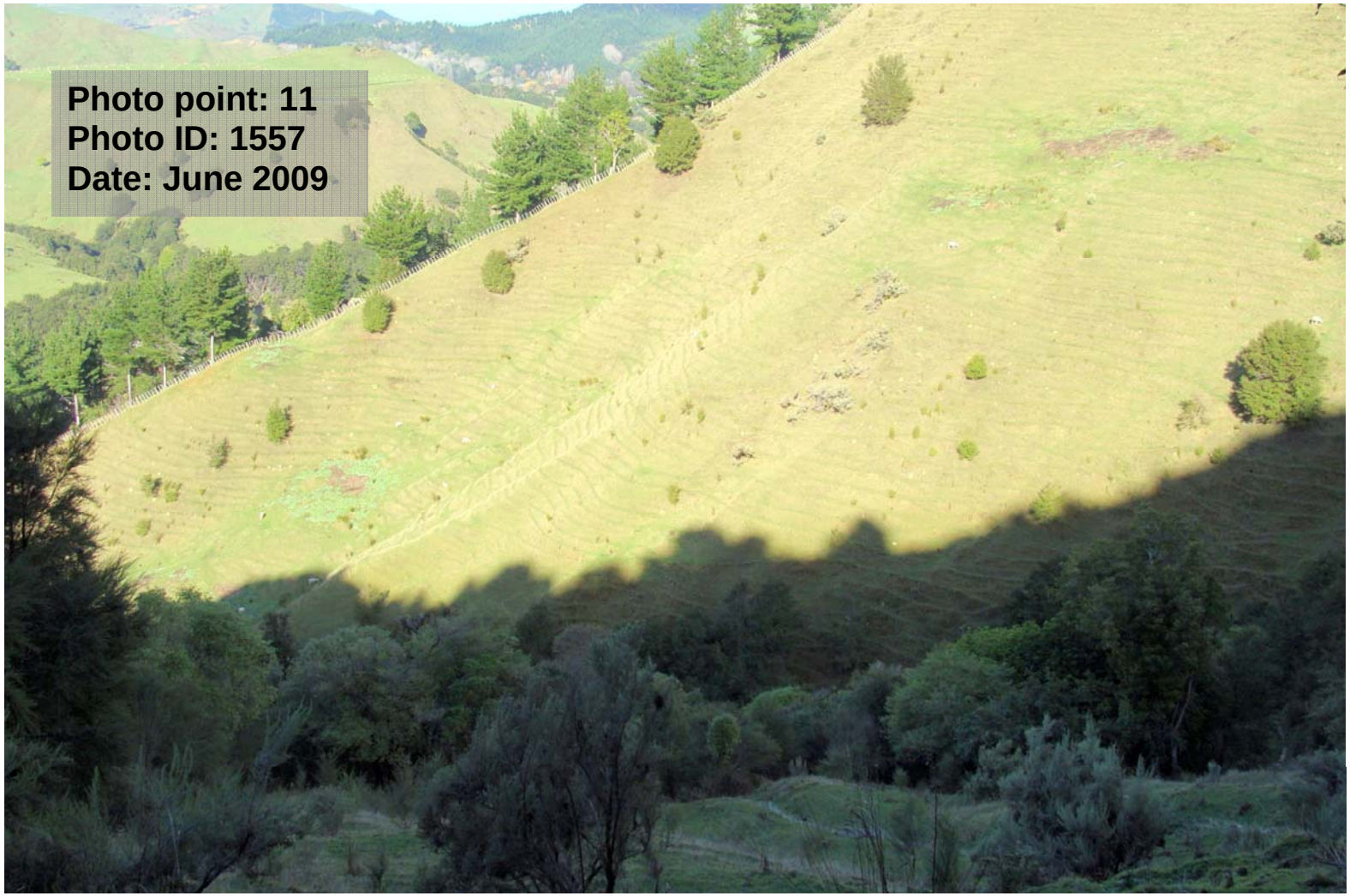

Figure 45: Photo point 11 (Camera settings: focal length = 6.3mm; shutter speed = 1/125; aperture = f/8.0).

Figure 46: Photo point 12 (Camera settings: focal length = 6.3mm; shutter speed = 1/400; aperture = f/3.5).

V WAIKERERU WEED MAP

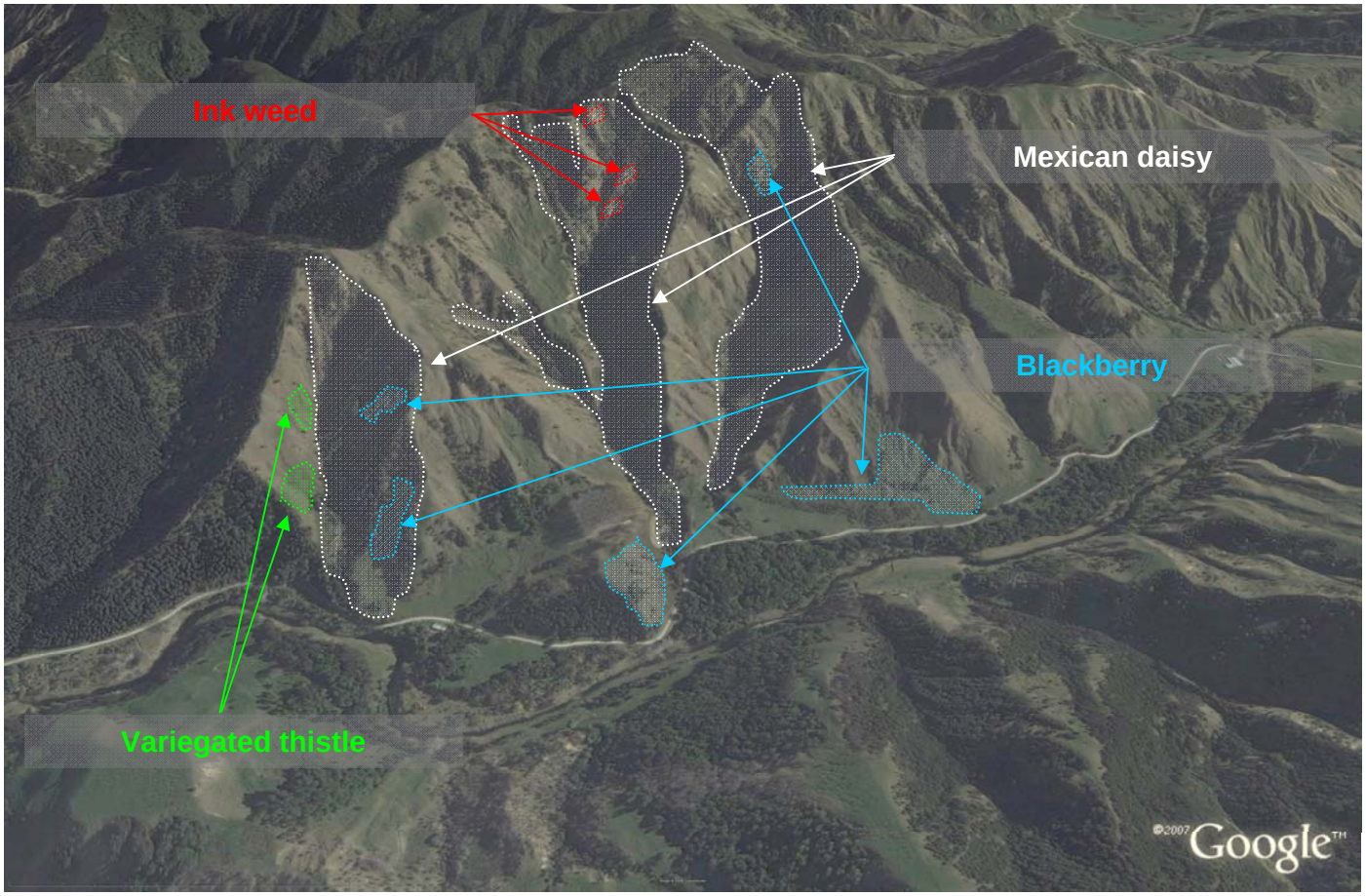

Figure 47: Diagrammatic weed map showing the approximate locations of sites in which certain weed species have been identified. Infestations of Mexican daisy carpet large areas on the forest/pasture verge. Smaller patches of ink weed, blackberry and variegated thistle are also present.