REPORT

WAIMEA WATER AUGMENTATION COMMITTEE

Lee Dam Feasibility Study
Terrestrial Ecology Effects Assessment

Report prepared for:

WAIMEA WATER AUGMENTATION COMMITTEE

Report prepared by:

TONKIN & TAYLOR LTD

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1 Introduction

1.1 Background

In 2007 Tonkin & Taylor Ltd (T&T) and its sub-consultants completed a Phase 1 pre-feasibility evaluation of a number of options to provide water storage for long-term irrigation and community supplies in the Waimea Basin, Tasman District. The evaluation was undertaken on behalf of the Waimea Water Augmentation Committee (WWAC). The overall principle of the study was to identify and develop a water augmentation scheme to capture water for storage and release that water back into the Waimea River system during periods of high water demand and/or low natural water flows to augment those supplies, either directly or via recharging of the groundwater system.

The outcome of that Phase 1 study was to focus feasibility investigations on a water storage dam and reservoir site located in the upper Lee River Catchment, a tributary of the Waimea River.

In 2007 WWAC initiated Phase 2 of the study, to take the Lee River investigation programme to a feasibility level.

This report presents the results of terrestrial ecology investigations completed as part of the Phase 2 feasibility study. It is based on a potential dam on the Lee River in Tasman District, at a site approximately 300 metres upstream of the confluence of Anslow Creek and the Lee River. The required storage capacity of the reservoir has been determined to be approximately 13 million m^3, with a normal top water level to approximately RL 197m. The reservoir would extend approximately 4km upstream from the dam, and cover an area of approximately 65 hectares (based on normal top water level).

Figure 24727.400-1 (Appendix A) shows the location of the proposed dam, and the indicative reservoir extent.

1.2 Project scope

This report presents the findings of terrestrial ecology investigations undertaken by T&T and Uruwhenua Botanicals (Dr Phillip Simpson). Site investigations were carried out on 14 - 17 March 2008 and 19 March 2009. The findings of the field investigations are based on site walk-overs, field sampling and visual assessments. Published literature was gathered from previous work undertaken at the site and surrounding area, including by the Department of Conservation (DOC) and Tasman District Council (TDC). The project scope included:

- Site visits to survey existing terrestrial habitats, vegetation (including rare and endangered plants), lizards, birds, and plant and animal pests; and
- Evaluation of habitat values and indigenous vegetation in a district, regional and national context and the effects of the proposed dam and associated reservoir on these values.

The survey was carried out within the area of the proposed water storage reservoir and dam and native forest areas surrounding this footprint. Observations were also made of vegetation quality in areas downstream from the proposed reservoir in order to evaluate the potential downstream effects of the water augmentation scheme on significant plant communities and to identify potential sites for mitigation off-sets to compensate for loss of vegetation and wildlife within the footprint of the development.

The areas potentially affected by the development include the area encompassing the dam, reservoir, borrow areas and construction and storage areas. In addition, areas of slope instability, which could in future require some management, are included in this assessment, thereby providing a conservative estimate of the area of potential vegetation and wildlife removal. Together, these areas are referred to as 'the development footprint'.

The riparian areas downstream of the proposed dam are also included as a separate element of the ecological assessment, in terms of potential indirect effects of the altered river flow regime on riparian vegetation downstream from the development.

Changes to the existing roading and access layout on site are not included in this assessment of ecological effects. Access requirements will be confirmed at the detailed design stage for the dam and reservoir, and while indicative route placements have been identified, actual locations and routes will be dependent on agreements with landowners.

Mechanisms for achieving mitigation for the loss of vegetation and habitats within the footprint and from potential indirect effects downstream are outlined at the end of this report. More detailed descriptions of opportunities for mitigation form a separate report entitled "Lee Dam Feasibility Study: Enhancement Opportunities Scoping Plan".

Potential effects on the aquatic ecology and values of the Lee River are the subject of a separate assessment undertaken and reported on by Cawthron Institute.

2 Approach to values assessment

2.1 Ecological values assessment

This ecological assessment considers the actual and potential effects of the proposed Lee dam and associated reservoir on the natural values and natural resources of the site. Specific reference is made to indigenous vegetation, habitats of indigenous animals, and threatened and protected species as required under assessments of environmental effects (AEE) within the context of the Resource Management Act 1991 (RMA).

The purpose of this study is to provide guidance as to the scale and degree of importance of ecological effects resulting from the proposed development. The ecological issues raised in the report are evaluated and discussed in relation to levels of ecological importance (significance) as is typically interpreted from Section 6c of the RMA, on the assumption that the investigation results may form the basis for an application for resource consents.

The proposed reservoir is approximately 4 km long with a normal maximum water depth of approximately 50 m, comprising that part of the Lee River from Anslow Creek in the north to a narrow forested gorge approximately 3.5 km to the south. Ecological field survey work was concentrated within the footprint of the reservoir, dam, borrow areas, and construction and storage areas ('the development footprint'), as well as surrounding and downstream native forest areas. Field survey work was undertaken by ecologists at T&T and Dr. Philip Simpson of Uruwhenua Botanicals Ltd.

2.2 Vegetation

Vegetation assessment was undertaken using literature review from local authorities and scientific sources, analysis of aerial photographs and field survey. The literature and aerial photograph review helped identify habitats of interest in the wider Lee River Catchment area and enabled targeted field survey in areas where indigenous habitats or species of significance were likely to occur. It also provided information on landscape scale concepts such as connectivity and ecological representativeness and significance.

Fieldwork was undertaken by Uruwhenua Botanicals on 14 and 15 March 2008 and 19 March 2009. The latter survey was undertaken to extend the previous survey area as a result of a change in location of the proposed dam site in response to geotechnical investigations. The fieldwork aimed to:

- Confirm information from existing literature and to fill gaps where literature records were absent,
- Identify the key values of vegetation present which are likely to be affected by the proposed dam and reservoir,
- Determine the significance of the vegetation values at risk from the proposal,
- Assess the potential effects of an altered flooding regime on vegetation communities, and
- Identify possible measures to be employed to mitigate effects on significant vegetation.

The full reports of the surveys undertaken by Uruwhenua Botanicals are included as Appendix B.

The field survey consisted of a walkthrough of the study area, focussing on the areas that will be affected by the proposal, including the reservoir area, dam footprint and spillways and construction borrow areas.

Field observations of the study area were recorded by photographs (included within Appendices B), and tape recordings of verbal notes. An assessment of ecological (primarily botanical) significance was conducted using the following criteria:

- Representativeness: the degree to which the site represents a good example of one of the characteristic types of native vegetation in the district.
- Rarity: the presence of rare species or communities.
- Diversity and pattern: whether there is a notable range of species and habitats.
- Distinctiveness/special ecological characteristics: the presence of any features that make the site stand out locally, regionally or nationally.
- Size and shape: the degree to which size and shape influence the character and viability of the vegetation.
- Connectivity: the degree of ecological connection with surrounding areas.
- Sustainability: the degree to which the site possesses resilience to maintain its ecological integrity and processes.

Each of these criteria was assessed at each site and ranked as Low, Medium or High significance, and an overall ranking was given. This framework for assessing significance follows the significance criteria promoted by Norton and Roper-Lindsay 2004 which is widely used throughout New Zealand in assessments of ecological significance.

A more recent framework for assessing significance of sites within the Tasman area has been developed for Tasman District Council by M. North (2009). That framework generally follows the Norton and Roper-Lindsay approach; however it provides clearer definition of terms and broadens the categories to better incorporate national, regional and local measures of significance. These Tasman Significance Criteria have been applied to vegetation types (c.f. sites as undertaken by Dr. Simpson in this study). The results are in broad agreement with the significance rating given by Dr. Simpson for areas within the project site. The significance criteria obtained from applying the Tasman Significance Criteria have been used in the calculations for assessing the nature and scope of offset mitigation regarded as appropriate for the project (these are reported on in a separate report produced by T&T entitled 'Lee Dam feasibility study: Enhancement opportunities scoping plan').

The conservation status of plants recorded in the surveys was determined using de Lange *et al*. 2009 which updates and supersedes the previous threatened vascular plant listing (de Lange *et al*. 2004; repeated in Hitchmough *et al*. 2007) for New Zealand.

2.3 Terrestrial fauna

2.3.1 Birdlife

A literature search of past studies and potential species present was undertaken to ensure field surveys were targeted to likely species. Bird surveys were undertaken by a T&T ecologist on 14, 15 and 17 March 2008. Species were surveyed at 12 sampling stations using replicated standard five-minute counts spaced at least 200m apart. The bird count

stations were located along the length of the study area, and are identified as BC1-BC12 on Appendix A; Figure 24747.400-2.

The presence of any notable bird species observed outside of the five-minute counts was also recorded.

Additional information was obtained where possible for the presence of species of birds which are likely to be less frequent in the survey area, such as falcon, kiwi, kaka and blue duck (whio).

The conservation status of birds recorded in the surveys was determined using Miskelly *et al*. 2008 which supersedes all previous New Zealand bird threat classification listings for New Zealand (Williams & Given 1981; Molloy & Davis 1992, 1994; Hitchmough 2002; Hitchmough *et al*. 2007).

2.3.2 Lizards

DOC publications and the DOC Herpetofauna National Database were searched for records of native lizards at the development site and in nearby locations to direct field surveys and to identify the potential presence of species of high conservation interest.

A field survey was undertaken by a T&T ecologist on 14, 15 and 17 March 2008 within an area of approximately 30 ha along the Lee River from below the proposed dam up to the beginning of the steep-sided gorge within the Public Conservation Land (Mt Richmond Forest Park). Refer to Figure 24727.400-2 for the extent of the fauna surveys. Passive and active survey techniques were used:

- Passive survey by day using either binoculars or a torch, searching foliage, tree trunks, cracks and crevices for resting lizards, and rock areas for basking or foraging skinks and geckos.
- Passive survey by night using a powerful hand-held spotlight and a head-mounted spotlight with binoculars to detect body form, eye-shine and movement of active lizards, particularly *Naultinus* and *Hoplodactylus* geckos.
- Active searching involved the disturbance of habitat through the lifting of rocks and logs to detect resting lizards. All materials disturbed were replaced to their original positions following investigation. Any sign of lizards such as faecal pellets or sloughed skin was also recorded.

The lizard survey was undertaken under DOC permit number NM-22516-FAU (dme-253628) held by Graham Ussher of T&T.

2.3.3 Bats

The likelihood of bats being present within the study area was assessed by consultation with bat experts, literature review and a search of DOC's National Bat Database.

2.3.4 Invertebrates

The presence of invertebrates of significance was assessed through a literature search and discussions with DoC staff at the Nelson Conservancy office. Based on this information surveys or trapping for specific species was not considered necessary.

2.3.5 Animal pests

Ink pad tracking tunnels (Gotcha Traps Ltd; The Black Trakka) were set out over 3 nights (14th, 15th ad 16th March 2008) to detect animal pests through the development footprint area. Thirty tunnels were set out as lines of 10 tunnels with each line at least 500 m apart and individual stations on each line 50m apart, in accordance with the DOC protocol "Using tracking tunnels to monitor rodents and other small mammals" for rodents (Gillies and Williams 2008). The animal pest monitoring locations are identified as A1-A10 (line A), B1-B10 (line B) and C1-C10 (line C) on Appendix A: Figure 24747.400-2.

General field observations for signs of pests were also noted during the field investigations, including foliage browse, rooting sign, faecal pellets, tracks and wildlife predation.

3 Terrestrial ecological values overview

3.1 Overview and historical values

The project study area is within the Bryant Ecological District in the Nelson Ecological Region. The district is characterised by steep hill country rising to over 1600 m and draining to the north-west. It has complex geology with soils of a correspondingly varied structure and fertility. The climate is generally sunny and sheltered with warm summers, mild winters and moderate rainfall. Lower slopes are typically farmed or in exotic forestry.

The study area itself comprises the mid-altitude areas of the Lee Catchment above the farmland areas and above the confluence with the Wairoa River (see Appendix A; Figure 24747.400-1). Land use within the catchment is predominantly exotic forestry and regenerating native forest following past clearance for former agricultural activities. Remnants of native forest also stand in discrete patches, especially along riparian areas, and become progressively larger and more linked further up the catchment.

The upper part of the Lee Catchment, as with other catchments draining the Richmond Range, is public land managed by DOC as the Mt Richmond Forest Park, covering some 180,000 ha. The Forest Park supports largely unlogged beech and podocarp forest with elements of broadleaf forest at lower latitudes and alpine vegetation at high altitudes. The Park is well used by the public for tramping, fishing and hunting with a network of tracks and approximately 30 huts. However, there is little direct access between the Lee Catchment and the Forest Park due to lack of public access in the lower catchment.

3.1.1 Vegetation overview

Walls and Simpson (2004) describe the vegetation of the Bryant Ecological District prior to human-modification in the Tasman District Biodiversity Overview.

Areas below the bushline (an altitude of approximately 1200-1300 m) would have been almost entirely covered in forest. The alluvial valley flats and terraces supported podocarp forests of totara, matai, rimu, miro and kahikatea. Mixed beech-podocarp forest would have covered the hills, dominated by black beech in drier sites, hard beech in wetter lowland places, and red beech and silver beech on cooler mid-altitude slopes. Mountain beech was dominant on upland slopes, along with southern rata, Hall's totara and pahautea (mountain cedar). In sheltered coastal gullies, pockets of broadleaved forest would have been established, containing tawa, titoki, pukatea, nikau, hinau and tree ferns, with large podocarps.

The nationally important areas of underlying ultramafic rock would have been occupied by distinctive forest and shrubland, stunted by the unusual soil conditions and containing species associations rarely found elsewhere. Freshwater wetlands occurred in the valleys and would have included fertile lowland swamps with kahikatea, harakeke, cabbage tree and tussock sedge. Rivers and streams with their riparian ecosystems would have made up only approximately 1 % of the district.

Since the arrival of humans, most of the lowland forests and wetlands of the Bryant Ecological District have been removed or modified. What remains are fragments of beech forest, lowland broadleaved forest and podocarp forest, and a few small freshwater wetlands. There are considerable tracts of mid-altitude forest remaining, with native secondary regeneration occurring. Higher altitude ecosystems are present but much

diminished in ecological quality by the impacts of introduced mammals including feral deer and goats, brush tailed possums, rats and mustelids. Mt Richmond Forest Park, which adjoins the study area in the upper reaches of the Lee and proposed reservoir, protects most of the indigenous ecosystems that remain in the Ecological District.

The Wairoa Gorge (the adjoining gully system to the west of the study area) is significant in botanical history, with a number of species first collected and described from there (i.e. the area is the type locality for these species). Simpson (2008, see Appendix B) proposes a number of reasons for this:

- the comparatively mild temperatures allow more northern species to grow in the area, making this the southern limit for a number of species including tanekaha, white maire and black maire;
- the geological and climatic diversity supports regionally and nationally rare species, such as NZ shovel mint, and fierce lancewood;
- the unique mineral belt of ultramafic rock supports unique plant communities; and
- the steep slopes have in places been saved from clearance for agriculture and forestry and retain their original native forest cover.

While the Lee Valley is less known and studied, it potentially shares many of the botanical values of the Wairoa Gorge.

The greatest vegetation biodiversity is usually found in the lowland zone, which is generally below 600 m altitude, with many coastal lowland species capable of extending up to 300 m altitude. The dam and reservoir footprint is within the 300 m contour and is therefore within the zone of the greatest potential for biodiversity within this Ecological District.

3.1.2 Wildlife overview

The wildlife of the Nelson region is described by Walker (1987) in the New Zealand Wildlife Service's Fauna Survey Unit Report No. 42.

As with many parts of New Zealand, native fauna in the Nelson region was severely affected by the introduction of mammalian predators that coincided with European settlement during the 19th Century. By the 1900s, kokako, New Zealand thrush, New Zealand quail (now extinct), saddleback, kakapo and bush wren had more or less disappeared from the Nelson region.

The greatest impact of these predators peaked prior to the 1920s as vegetation clearance and habitat modification became the more important factor affecting bird numbers.

The New Zealand Wildlife Service fauna survey (Walker 1987) lists bird species identified in the vicinity of the site, including the following threatened species (Miskelly *et al.* 2008): black shag, little shag, western weka, south island kaka, kea, long-tailed cuckoo, south island rifleman, and NZ pipit.

Other fauna species of note that were present in the Nelson region at the time of the Walker 1987 survey included large endemic land snails, Nelson cave spiders, five gecko species (common gecko, forest gecko, Nelson green gecko, *Hoplodactylus tuberculatus*, and Marlborough green gecko) and four skink species (common skink, brown skink, speckled skink, spotted skink). In addition the Richmond Range is within the area of historical distribution for the long-tailed bat (Molloy 1995) and may have also once supported lesser short-tailed bats.

While the study area is not classified as a Site of Special Wildlife Interest (SSWI), two SSWIs are located in the adjoining hinterland, including the Western Richmond Range site (SSWI site 269) which is rated as 'outstanding'. In 1987 that 86,000 ha site had a wide range of native bird species recorded including kaka, falcon, blue duck and kea.

4 Vegetation assessment

4.1 Overview

The Lee River is one of several north-facing catchments of the Richmond Range, and one of many such forested catchments of similar altitude within the Nelson-Marlborough Region. The importance of this part of the upper South Island is acknowledged as an environmental limit for many species and an area where species and plant communities are not seen elsewhere with such diversity and richness.

This project has provided the means to greatly increase knowledge of the special values of the Lee catchment, and indeed the Richmond Range. Whilst the resources available to this project have not allowed survey of adjoining catchments in similar detail, we anticipate that similar values exist there in common with the Lee River area. With this in mind, we have nonetheless taken a precautionary approach to assessing significance of botanical features (and fauna) within the development footprint.

The degree of vegetation clearance across the site is discussed in the following section. Approximate areas of the environments within the development footprint were calculated from desk-top mapping and ground truthing and the resulting vegetation boundaries mapped onto a GIS base from which parcel and environment areas were calculated.

The vegetation survey work undertaken by Uruwhenua Botanicals is summarised in the following sections and is included in full in Appendix B. Species of botanical interest are summarised and discussed in Section 4.3. Areas of botanical interest are discussed in Section 4.4 with the locations of these areas shown on Figure 24727.400-4.

4.2 Likely extent of vegetation clearance across site

The overall area within the development footprint is 87.7 ha of which 68.7 ha are terrestrial vegetated environments and 19 ha is river bed and roadways.

Approximately half of the land supports indigenous woody vegetation (26.6 ha) with the remainder supporting (or until recently supported) radiata pine (39.3 ha), Douglas fir (2.4 ha) or grassland (0.3 ha). The areas around the dam and the lower reservoir are dominated by exotic plantation forestry; however these areas also support some of the areas of greatest value for indigenous habitats, especially riparian and flood plain environments (see Section 4.4).

Nearly 95% of all vegetation and over 85% of the indigenous vegetation within the development footprint is on privately owned or Crown land leased for forestry. The area of indigenous vegetation that lies within the Public Conservation Land (Mt Richmond Forest Park) at the head of the reservoir is comparatively small (less than 4 ha) by virtue of its long, yet narrow form through the steep upper catchment area.

The area of vegetation within the Mt Richmond Forest Park proposed for inundation comprises approximately 0.002% of the Park. The area of indigenous vegetation within the overall Lee catchment proposed for clearance under this potential development scheme (26.9 ha including woody and grass vegetation) comprises less than 1% of the remnant indigenous vegetation (much of which is within the upper Lee catchment area).

4.3 Species of botanical significance and interest

As anticipated from survey work of the Wairoa and cursory examination of the lower Lee Catchment (Simpson 2006), the upper Lee River area within the development footprint supports a range of species of botanical significance, and others of botanical interest.

Species considered to be of botanical significance are listed in Table 4.1 with their qualifying features.

4.3.1 New Zealand shovel mint

NZ shovel mint is listed as nationally threatened of critical status (Hitchmough *et al.* 2007). The key threat to existing populations is the loss of habitat. Williams (1992) reports that habitat degradation from stock trampling, pig rooting and associated effects of browsing mammals (e.g. opening of the understorey to wind and drying effects) are key threats to the persistence of the 11 known populations in the Nelson/Marlborough region. The effects of introduced mammals, as well as the lack of clear understanding of the range and regional status of shovel mint, have been identified by DOC as key constraints to effective conservation of this species. Botanical surveys conducted as part of this project have added the Wairoa and Lee River as new recorded locations for shovel mint, with the Lee River populations comprising some of the most widespread and apparently dense populations known to date.

This project has assisted with identifying several new populations hitherto unknown. However the proposed development will also remove some of these populations through the construction and operation of the dam and reservoir. Populations of shovel mint below the dam and along the riparian areas to Lucy Creek suffer from the effects of pig browse and therefore offer an opportunity to improve the health of remaining known populations on the Lee River.

The riparian habitats found to support shovel mint along the Lee River are not unique – both LENZ and aerial photography show that similar areas exist along other river areas within the Mt Richmond Forest Park, particularly along the Roding and Pelorus Rivers. Survey work undertaken by DOC over past years has established the presence of shovel mint in the Roding catchment, but has not found it in other catchments of Mt Richmond Forest Park (S. Courtney, DOC, pers. comm.).

4.3.2 Scented broom

Scented broom is distributed across the southern part of the North Island and the northern and western areas of the South Island and is generally associated with river terraces, flats and streams and forest margins (Poole and Adams, 1994). The presence of a large population in the Lee Catchment is regarded of regional importance (Simpson 2008). The removal of scented broom from the proposed development footprint represents the loss of approximately one-third of the known area of scented broom within the catchment; however individuals were also found downstream of the proposed dam and substantial populations were also found in the adjoining Wairoa catchment (Simpson 2006). The loss of scented broom from within the proposed development footprint represents a moderate loss of known populations of this species within the local area; however there are ample opportunities to include this species within planting and revegetation programmes that arise out of the project in adjoining or off-site mitigation programmes.

4.3.3 Sand coprosma

Sand coprosma is listed as a Nationally At Risk (Declining) threatened species. For the purposes of this assessment we have followed the most up-to-date taxonomy for this species (de Lange *et al.* 2009). It is therefore considered that the population found within the footprint of the proposed reservoir is part of the *Coprosma acerosa* complex, a nationally distributed species found in coastal areas and inland river bedrock and levees. The sand coprosma population within the project footprint is regarded as being of moderate conservation significance.

In the approximately 6km of the Lee Catchment surveyed, one population was found, covering a river gravel bed approximately 2,500m^2 in area. This was discovered in the upper reaches of the Lee River (Simpson 2009), near the upper extremity of the predicted reservoir inundation level. In the Wairoa Catchment, one plant was on fractured bedrock within the flood zone (Simpson 2006). Both locations are in keeping with the habitat description for this species (Poole and Adams 1994). High definition aerial photography of the upper Lee catchment indicates at least 15 other similar sized gravel bed areas above the extent of the reservoir. Likewise, aerial photography of the Pelorus River within contiguous indigenous forest (not plantation or farmed areas) shows at least 22 similar-sized gravel beds and many other smaller sites, and at least 30 sites up Hackett Creek and Browning Stream adjacent to the Serpentine River. Similar habitat is abundant through adjacent and nearby catchments indicating that the opportunities for sand coprosma to be present are numerous. Failing its presence in those areas, these areas may offer opportunities as potential planting sites of propagated material.

4.3.4 Euchiton polylepis

Euchiton polylepis is associated with gorge turf communities and is listed as a Nationally At Risk species which is naturally uncommon. Its distribution is not well understood through Mt Richmond Forest Park and it is suspected that populations may exist elsewhere (S. Courtney, DOC, pers. comm.). This species was not recorded within the dam or reservoir footprint during surveys undertaken for this project. However DOC staff have sighted this species in the vicinity of the proposed dam (S. Courtney, DOC, pers. comm.). Given the uncertainty over its distribution within the proposed footprint and the likelihood that it is present elsewhere in the Lee and other nearby catchments, the significance of this species at the proposed project area is considered to be low.

Table 4.1 Plant species of botanical significance

Vegetation feature	Level of significance of plants at the site	Notes	Overall scale of ecological effect
NZ shovel mint	Nationally threatened: Nationally critical. **High level of significance**	Regional endemic, 12 known sites in the Nelson area (Simpson 2006), although its distribution is poorly understood (Williams 1992).	**High** - removal of a large proportion of the population within the Lee Catchment. The Lee population comprises one of only a few populations of this regionally endemic species
Sand coprosma	Nationally threatened: Declining **Moderate level of significance**	Very good population in upper reaches of proposed reservoir. Likely to be only	**Moderate** – no other populations are currently known to exist within the Lee Catchment, although habitat appears to be

Vegetation feature	Level of significance of plants at the site	Notes	Overall scale of ecological effect
		present on unstable flood-prone gravel accumulations.	present in upstream areas that could support sand coprosma. The species is nationally distributed and the Lee population comprises a small proportion of known populations or individuals.
Scented broom	Regionally threatened (NB. not nationally threatened) **Moderate level of significance**	Restricted to the northern South Island, locally rare.	**Moderate** – found in the southern North Island and the northern and western areas of the South Island, although the size of the Lee population is regionally significant
Euchiton polylepis	Nationally At Risk: Naturally uncommon **Low level of significance**	Associate with flood-tolerant gorge turf plant communities.	**Low** – not found during survey, but may be present. Distribution is not well understood so maybe more widely distributed in Mt Richmond Forest Park than currently recognised.

4.3.5 Species of interest

Species of interest (i.e. species not listed as threatened species, but which have particular distributions of note in the Lee Catchment) within the proposed development footprint include the following:

- *Australina pusilla,* a nationally widespread herb species that is locally rare in the Tasman District and largely confined to fertile flats under podocarp forest.
- Several ferns, including crepe fern and the toothed spleenwort that are locally uncommon.
- Tanekaha is at its southern limits in the Nelson area. The development site supports a number of areas of regenerating tanekaha with mature individuals below the proposed dam site unlikely to be affected by the development. A small grove of mature individuals exists in the upper Lee River area also well above the proposed reservoir extent.
- Dwarf mistletoe is known to parasitise myrtle and mapou. The species is present outside of the development footprint, with good populations below the proposed dam site and in the Wairoa Catchment. It is also likely to be present in other un-surveyed catchments.

4.3.6 Species not detected during the botanical survey

Species of significance or interest that were searched for during the survey but were not found within the development area include swamp mahoe (but present in the Lee Valley Reserve downstream of the dam), *Brachyglottis sciadophila (*a scrambling daisy of forest margins), white maire (although specimens were found around Lucy Creek below the proposed dam), black maire, *Teucridium parvifolium* a shrub of riparian forest margins and scrub, fierce lancewood and *Coprosma obconica* shrub that is largely confined to alluvial and riparian open dry forest and tall scrub.

4.4 Areas of botanical interest

The most significant areas of native vegetation within the development footprint are located within four areas, described as Sites 2-5 as shown on Figure 24727.400-4.

An assessment of overall ecological significance (low/medium/high) is given to each site considered to be botanically significant. The ranking is based on the criteria listed in Section 2.2.

4.4.1 Site 2

Site 2 is located partly within the development footprint, and the lower riparian areas will be inundated by the proposed reservoir. Approximately 1 ha of Site 2 will be retained, while approximately 3 ha will be directly affected by the dam construction and reservoir filling.

The vegetation covers the riparian margins and steep hillslopes, and is generally dense black beech forest with scattered red and silver beech and tanekaha, with other species of note being shovel mint and scented broom. Overall the site is considered to be of medium-high significance.

4.4.2 Site 3

Site 3 is considered to be of very high ecological significance, containing both remnant and regenerating riparian kahikatea forest with an understorey of large populations of shovel mint and *Australina pusilla*. Other locally rare species include mature miro, pokaka and mature kaikomako. The entire 4 ha site will be inundated by the proposed development.

4.4.3 Site 4

Site 4 is located upstream from the bridge across the Lee River and extends to the upper limit of previously disturbed land (Site 5). The site consists of two vegetation zones that will be largely inundated, except for a band of modified kanuka on the true left bank:

- Riparian bush (original and secondary), consisting of black, hard and red beech with kanuka and kahikatea. Wetlands are established on wet riparian terraces. Only a small portion of this vegetation will be inundated.
- A river-bed island covered by kanuka forest. The island is at times inundated by natural flood events and will be totally inundated under the proposed reservoir. It contains a unique assemblage of vegetation, with tutu, regenerating shrubs typical of both fertile lowlands and cold soils, and dense ground cover rich in species of *Carex* and *Uncinia*.

Overall, Dr Simpson considers Site 4 to be of high ecological significance.

4.4.4 Site 5

Site 5 comprises the area from the upstream extent of Site 4 to the upper extent of the reservoir. The river flows through a confined gorge for most of this area affected by the reservoir, with most of the riparian zone being near vertical bedrock with open shrubland of mahoe, kanuka and kowhai.

The forest type is beech podocarp of considerable diversity, with a narrow band of broadleaved forest species close to the river. The species near the water are short-lived and adapted to flood disturbance, with the species mix changing with increasing altitude.

The true left side of the valley has been disturbed by fire along most of its length within Site 5, although patches of original beech/matai forest remain particularly upstream of the reservoir limit. Kanuka forest has replaced the burnt forest.

The vegetation along the open riverbed is distinctive, consisting of dense turf with scattered seedlings of forest species and flood tolerant shrubs. Of note is sand coprosma growing on relatively unstable beds of small boulders and sand. This species is nationally threatened (de Lange *et al.* 2009) and locally uncommon, occurring in only one place within the entire development footprint area.

Dr. Simpson considers Site 5 to be ranked as 'high' for all of the significance assessment criteria.

4.4.5 Vegetation types

The analysis of sites above provides a site-based level of significance that incorporates the multiple attributes of the one or more vegetation types within that site. For the purposes of planning for future mitigation opportunities, such as restoration of particular vegetation types, indigenous vegetation within the proposed development site was mapped according to vegetation community (using Land Environments of New Zealand Level IV as a basis; LENZ), and the Tasman Significance Criteria applied.

The results are in general agreement with the site-based assessment of significance provided by Dr. Simpson. Alluvial, riparian and river island forest remnants score the highest with hill-slope beech forest scoring the lowest. Listed threatened species in each of the former habitats, and/or the high ranking of the environment by LENZ contributed to high scores for the former, while the absence of noted threatened species within hill-slope forest and its wide distribution in the local area contributed to a moderate-low overall significance score for hill-slope forest.

Table 4.2 Plant species of botanical significance

Vegetation feature	Level of significance (using the Tasman Significance Criteria)
Alluvial forest	High LENZ Acutely Threatened vegetation type
Riparian podocarp forest	High LENZ Chronically Threatened vegetation type
River bed island forest	Moderate LENZ Chronically Threatened vegetation type
Flood zone turf communities	Moderate Widespread but specialised on high energy bedrock substrates
Hill-slope beech forest	Moderate-Low LENZ >30% protected regionally/locally

4.5 Vegetation below the proposed dam

The potential effects of the proposed dam and reservoir on downstream vegetation are linked primarily to the potential changes in the downstream flow regime. These changes have implications for maintaining eroded riverbank areas and adding sediment, rocks and large organic materials below the dam as would happen naturally in a flood event, as well as playing a role in the removal of other less flood-tolerant species (particularly invasive weed species and other early colonisers).

Flow modelling from the proposed dam (based on river flow records from January 1958 to November 2007) predicts that the reservoir is expected to be full and spilling approximately 82% of the time, with almost no change to the current river flows during the winter and spring months and relatively small changes to flow regimes during the summer and autumn months.

Where the number of spill-over events is less than the number of small natural 'freshes' this reduction in intensity and frequency of floods could have a negative impact on the wetland turf vegetation and some of the shrubs that need wet conditions such as scented broom. However, it is also possible that the reservoir will actually reduce the impact of drought by releasing more water than would normally be flowing at such dry times.

While a close watch on any changes in weed growth is important, Dr. Simpson regards it as doubtful that the dam and reservoir will have a negative impact on the riparian vegetation and species composition. However, owing to the uncertainties, a monitoring programme should be put in place to assess the health of downstream turf communities and riparian shrubs of importance in order to more accurately determine the long-term effects of the dam on this vegetation type.

4.6 Vegetation not within the proposed development area

As part of the site survey, vegetation in the general area surrounding the dam and reservoir was surveyed. The following notes provide a basis for identifying potential areas for ecological restoration and enhancement, should mitigation areas be required to compensate for the loss of ecological values within the development footprint. The survey results also assist in giving a district context to the potential losses.

4.6.1 Site 1

Site 1 extends downstream from the dam for a distance of approximately 1 km.

The vegetation in Site 1 includes a variety of original and secondary riparian flats forest and rocky gorge habitats, with species of note including shovel mint, dwarf mistletoe, tanekaha and *Olearia paniculata*. Species of particular note found in the lower Lee Catchment include: white maire, dwarf mistletoe, swamp mahoe, akeake, tanekaha, lowland totara, small-leaved milk tree and ngaio.

Overall Dr Simpson considers the site to have medium significance.

This site will not be affected by the proposal.

4.6.2 Between Lucy Creek and Site 1

The native vegetation downstream from Site 1 to the confluence with Lucy Creek consists of continuous native riparian vegetation of variable quality, dominated by weeds in parts

but with areas of significant vegetation as described below. Overall, Dr Simpson considers the vegetation in this area to be of high significance.

The following vegetation features are of note:

- The shaded and moist areas of bedrock support diverse communities of dense low turf plants. The vegetation is best developed close to the water, but similar turf communities extend into the crevices of drier areas.
- The wet and dry turf communities grade into shrubland, creating a distinct zone close to the water that is periodically flooded during high flows. Species of note include scented broom and southern rata.
- A small alluvial flat bearing original forest is located approximately 200 m upstream from the Lucy Creek confluence. Species of note include white maire, dwarf mistletoe, swamp mahoe, tanekaha, lowland totara, small-leaved milk tree. Shovel mint is present but pigs have damaged much of the forest floor habitat. Supplejack is also present, which is uncommon in the Lee.
- Most of the left bank and parts of the right bank support a zone of secondary forest. The vegetation contains a mix of lowland and montane species, including some coastal species and species rare in the Lee Catchment. Species of note include shovel mint, akeake, tanekaha, lowland totara, ngaio and titoki.
- Lower Lucy Creek contains several features that are not otherwise found in the Lee Catchment, including mature rimu and miro, young lowland and Hall's totara, tanekaha and kamahi. A single adult female white maire is present, with many seedlings regenerating beneath. Locally uncommon shrubs include horopito and shining karamu, and locally distinctive fern flora is established.

This site will not be affected by the proposal.

4.6.3 Upper parts of site 4

The hill-slopes of Site 4, well back from the upper limit of the proposed reservoir, support an excellent example of beech-matai forest. This block is privately owned and connects with Mt Richmond Forest Park to the west. Vegetation ranges from riparian beech forest to a mature black beech-matai forest. A large sandstone bluff supports a well-developed and notable matai forest with a broadleaf understorey that included titoki and two species of climbing rata. Dr Simpson comments that the matai forest is "probably unequalled in the Nelson region" and is of regional or possibly national significance, being almost pure matai in places with large trees that have been spared from logging.

The upper parts of Site 4 will not be affected by the proposal.

4.7 Summary of effects on vegetation

The vegetation cover in the upper Lee River Catchment has been modified greatly over much of its area, through the removal of indigenous forest cover and replacement with exotic plantation forestry. Within the development footprint indigenous forest remnants remain largely in riparian areas with increasing areas and connectivity further up the catchment towards and within the Mt Richmond Forest Park.

The Lee, as with other adjoining catchments (Philip Simpson, pers. comm.), is characterised by high plant species diversity and local rarity – this makes most remaining and regenerating vegetation special to some degree by virtue of its existence. All of the remnant areas surveyed have been degraded through the actions of exotic weeds and

animal pests, some to the point that pest animal rooting and browse may present serious threats to the continued local existence of ground-dwelling plants such as NZ shovel mint.

Species of significance within the development area include three threatened plant species recorded from the site during these surveys, two of which are found in other areas of the Lee, mostly below the proposed dam site. NZ shovel mint and sand coprosma are both nationally threatened (rated as nationally critical and declining, respectively, in de Lange *et al*. 2009), while scented broom is considered regionally threatened. *Euchiton polylepis* is a naturally uncommon species which may be present at the site, but is also likely to be present elsewhere where turf communities exist.

Without appropriate mitigation, the likely effects of the proposed development on the vegetation elements of the Lee River will be moderate overall, with varying degrees of severity of adverse effect between plant species and communities, as described in Table 4.3 below.

Table 4.3 Summary of effects on vegetation prior to mitigation

Vegetation element	Effect of development	Overall scale of ecological effect
Indigenous vegetation	Permanent removal: 26.9 ha	Moderate – result will be a minor reduction in overall catchment indigenous vegetation, but a more substantial reduction in indigenous riparian vegetation.
Exotic vegetation	Permanent removal: 41.7 ha	Minor
Shovel mint	Removal of a large proportion of the population within the Lee Catchment	High – The Lee population comprises one of only a few populations of this regionally endemic specie.
Sand coprosma	Removal of the only known population in Lee Catchment	Moderate – no other populations are currently known to exist within the Lee Catchment, although habitat appears to be present in upstream areas that could support sand coprosma. The species is nationally distributed and the Lee population comprises a small proportion of known populations or individuals.
Scented broom	Removal of one of many populations within the Lee Catchment	Moderate – found in the southern North Island and the northern and western areas of the South Island, although the size of the Lee population is regionally significant.
Euchiton polylepis	Removal of gorge turf communities with which it is associated	Low – not found during survey, but may be present. Distribution is not well understood so may be more widely distributed in the Forest Park than currently recognised.
Alluvial forest	(Acutely Threatened habitat type). Removal of regenerating and mature examples in the upper Lee.	High – Removal of even small areas of this nationally significant vegetation type is significant. Areas downstream lend themselves to restoration.

Vegetation element	Effect of development	Overall scale of ecological effect
Riparian kahikatea forest	(Chronically Threatened habitat type). Removal of mature forest fragments along the river, including one of the best examples of kahikatea forest in the Lee Catchment	High – Kahikatea is present in areas upstream and downstream of the dam and reservoir, including several areas where vigorous regeneration of young kahikatea is occurring.
Flood zone turf communities	Removal of substantial communities and habitat, although good quality examples exist downstream from the dam	Moderate – Excellent examples exist downstream of the dam site, although the persistence of these under potentially altered flow regimes is currently uncertain.
River-bed island forest	(Chronically Threatened habitat type). Removal of the only example of this within the mid/upper Lee catchment area.	Moderate – Examples of this habitat type exist in the Wairoa and other catchments.
Hill-slope beech forest	Removal of primary, mature secondary and regenerating stands throughout the development area	Moderate-Low – hill-slope beech forest is abundant within the Lee Catchment, adjoining Wairoa Catchment and other nearby catchments.

The options for ecological restoration work within the Lee River Catchment are many and varied. Most actions that include assisting with the establishment of native forest or improving the health of existing remnants are likely to have demonstrable benefits for the threatened species mentioned here and for better ensuring the sustainability and persistence of vegetation types and wildlife within the Lee Catchment. These options are assessed further in the accompanying Technical Report 'Enhancement Opportunities Scoping Plan' prepared by T&T ref. 24727.408.

5 Fauna assessment

5.1 Avifauna

5.1.1 Survey results

The area surrounding the upper Lee River supports a number of native and introduced birds. During the site investigation and five-minute counts, the following birds were identified (N=native; E=exotic). Full results of the five-minute counts are included as Appendix C, with the locations of the 12 bird count stations shown on Figure 24727.400-2 in Appendix A.

- Australasian Harrier – N
- NZ Bush Falcon – N
- Bellbird – N
- Fantail – N
- Grey warbler – N
- Silvereye – N
- Blackbird – E
- Chaffinch – E
- Goldfinch – E
- California quail – E

The results of the five minute counts are summarised as follows:

- Of the eight bird species recorded during the five minute counts, over half (five) of the species are native to New Zealand.
- Of the 130 individual birds counted, the most commonly recorded species were bellbird (33 birds), silvereye (28 birds) and goldfinch (30 birds).
- The most widely distributed species were bellbird, fantail and silvereye, recorded at 10, 10 and 7 of the 12 stations, respectively.
- The greatest number of birds was recorded at BC9, in the forest to the north of Site 1, where 25 individuals were recorded during the five-minute counts.
- High proportions of native bird species were recorded at BC4, BC6, BC7, BC8 (no exotic birds were recorded at these stations) and BC11 (where only one of the 12 birds recorded was exotic).
- In contrast, the bird counts at BC3 were dominated by exotic species, with exotic birds comprising 80% of the 15 individuals recorded. BC3 is located at the south-eastern edge of Site 3, adjoining Waterfall Creek, within vegetation dominated by kanuka, pine and gorse with other weeds present on the edges.
- One Australasian Harrier was seen at BC12, at the southern end of Site 1. The five-minute counts at this station recorded a good diversity of bird species (seven species) with a high proportion of native birds (85 % of birds recorded were native).
- All of the birds recorded are species typical of disturbed environments and are commonly found within rural, plantation forestry and fragmented native forest landscapes. Only the New Zealand Bush Falcon is listed as a threatened species (nationally vulnerable, Miskelly *et al*. 2008).

New Zealand Falcons were observed on several occasions during the survey. A single falcon was disturbed on the ground on a road cutting through pine forest, and two falcons were seen nearby the next day hunting over a large cut-over pine area. The falcons observed during the study were seen over the lower and mid sections of the proposed development area as well as extensive areas of hill-slope plantation forest on either side (see Figure 24727.400-4).

The magnitude of proposed forest removal (68.6 ha including plantation and indigenous forest) most likely comprises only a very small part of the overall range of these falcon (assuming that they are resident). The area that they were most frequently seen within was recently logged plantation forest and young planted pine forest of a scale at least equal to the vegetation clearance proposed for the development footprint, suggesting that falcon in this area use modified environments and are flexible in their use of a landscape that is stripped of vegetation on a cyclical basis. The development of the reservoir will constitute a permanent loss of nesting and hunting ground, rather than the current temporary loss from cyclical plantation forestry. Mitigation measures that are suggested at the end of this report, especially those that involve improving the health of wildlife populations that may provide food for falcon, are one means of compensating for this potential loss of resources.

Blue duck (whio) were neither seen nor heard during the survey, adding further support to the results of a survey conducted by DOC (Barker in Gaze 2006) and reinforcing trends seen with blue duck decline in other parts of Nelson-Marlborough area. The DOC survey used a trained detection dog and an experienced blue duck surveyor to search the Wairoa and mid sections of the Lee River within and below the proposed extent of the reservoir. Despite there being reasonable habitat for blue duck, none was detected (Barker in Gaze 2006). The Blue Duck Recovery Plan (Adams *et al.* 1997) records 6 pairs being present in the Wairoa area, with another 11 pairs in the Pelorus area. However, known trends in blue duck numbers within the Richmond Range and elsewhere indicate that blue duck have been steadily declining in numbers throughout this area.

Recent records of blue duck in the Wairoa and Lee catchments indicate that sufficient habitat exists although conditions are not favorable for the establishment of a self-supporting population, most likely due to the lack of sustained predator control. The sighting of a family of blue duck in the Lee around 2005 (email observation from Ross Holloway to Peter Gaze, DOC Nelson dated 2007) clearly indicates that habitat is present and that mitigation should be considered for the loss of potential blue duck habitat within the footprint of the dam and reservoir.

5.1.2 Effects on avifauna

The diversity of birds within the development footprint is a typical representation of species which inhabit developed landscapes. Most are either exotic species of no conservation importance or are native species which are common in forested and farmland environments.

NZ falcons were found within the development area, although the small size of the area proposed for clearance compared to the availability of adjoining exotic and native forest in this and other catchments suggests that any loss of foraging or nesting environment is likely to be minor in itself.

Despite this, the loss of approximately 68.7 ha of vegetation represents a permanent loss of food resources and nesting habitats, with native forest areas most likely providing a disproportionately higher benefit to local birdlife by virtue of nectar, fruits and diverse

invertebrate food sources. The removal of this vegetation for the dam and reservoir will contribute to ongoing fragmentation of indigenous forest along the Lee River, by removing connections between the Richmond Forest Park and lowland areas.

When taken in the local context (the upper Lee), the proposed development represents a moderate loss of resources, especially riparian forest, for birds. Measures to compensate for the loss of vegetation communities adopted for this project are likely to also contribute towards compensating for the loss of available bird nesting and foraging areas, especially if such measures include pest control within native forest areas, and/or conversion of plantation forestry back to native forest.

5.2 Reptiles

5.2.1 Survey results

The search of DOC publications and the DOC Herpetofauna National Database revealed there are no records of lizards in the upper Lee Catchment area. The general area is deficient of records, although from records around the Richmond/Nelson/Richmond Range area, habitat may be present for species including forest gecko, common gecko, Nelson green gecko, speckled skink, spotted skink, and common skink.

The field surveys for lizards were undertaken in near-perfect search conditions, with still, clear and mild nights and clear days with ample opportunity for sun-basking by lizards. The surveys were undertaken by an experienced herpetologist (Graham Ussher of T&T) with assistance by DOC staff responsible for reptile surveys in the Nelson area (Ivan Rogers – DOC Motueka). Search efforts were concentrated around areas where lizards are typically present in reasonable numbers – for example grassland areas with scattered logs, north-facing shattered rock faces, hanging bark from trees, and forests edges for nocturnal gecko activity.

Despite the excellent conditions, no sightings or sign of lizards was detected. While the absence of geckos (or their conspicuous sign) can possibly be explained by the history of the site with extensive vegetation modification and lack of pest mammal control, the absence of skink sign is more perplexing.

The complete lack of lizard sign mirrors the low success rate of more extensive surveys undertaken by DOC within the Motueka DOC administration area between 2006 and 2008 (detailed below), which included surveys of the Bryant and Richmond Ranges to the east of the Lee River (I. Rogers, DoC, pers. comm.)). Despite previous records of skink presence, intensive surveying of Mt Duppa by DoC revealed no records. One skink, presumed to be *Oligosoma spp.*, was sighted in May 2008 near the summit of Mt Malita. In February 2008, a population of *Hoplodactylus* geckos was found inhabiting rocky bluffs near the summit at an altitude of approximately 1400 m, including one 'Marlborough mini' gecko. Skinks were also recorded in the area. These results represent a substantial survey effort over many weeks by DOC and demonstrate the cryptic nature of lizards in this area or their naturally low abundance.

In his report on the effects of native logging in Westland forests, experienced reptile expert Tony Whitaker (Whitaker 1997, 1999) noted the extremely low density of lizards in Westland beech forests, even where forests were old-growth stands with minimal apparent modification.

It is inconceivable that lizards are not present over at least some of the area proposed for development in the Lee Catchment. However, given the reasonably high level of effort

and intensity of localised searching and subsequent lack of results from the survey, it is apparent that any lizards present must be in very low densities.

5.2.2 Effects on reptiles

All lizards in New Zealand are protected under the Wildlife Act 1953 from deliberate destruction of habitats or individuals. Where development is proposed, projects are increasingly required by authorities to capture and relocate lizards prior to habitat clearance. In the case of this project, the scale of the development and the lack of sign of lizard presence mean that efforts to find and relocate lizards is likely to be both expensive and potentially unproductive. In lieu of lizard relocation efforts, projects elsewhere faced with this dilemma have instead opted for the improvement of nearby lizard habitat as a means of benefiting nearby populations and compensating for loss within the development footprint. This is a mechanism that may be an option for this project, and is commented on further in the accompanying Technical Report 'Lee Dam Feasibility Study: Enhancement Opportunities Scoping Plan' prepared by T&T ref. 24727.408.

5.3 Effects on bats

Bat surveys were not specifically undertaken for this project; however several information sources can inform the likelihood of bats being present at the site.

DOC's National Bat Database does not contain any records for bats within the Lee River Catchment, which could indicate either that no bat surveys have been undertaken in this area or that no bats are present in the area.

Recent survey by bat expert Brian Lloyd as part of wider bat surveys in the Nelson area has shed light on the presence of bats in the Mt Richmond Forest Park. Surveys over the summer months of 2008/2009 using electronic bat detectors found that long-tailed bats were abundant in the Pelorus Catchment, absent in the Wairoa Catchment and absent in the lower reaches of the Lee (below Lucy Creek) (B. Lloyd, pers. comm.). Based on the intensity and frequency of detections in the catchments either side of the Lee, and the propensity for long-tailed bats to travel great distances when foraging, Mr. Lloyd's initial interpretation of these results is that the Lee Catchment is not likely to sustain a large population of bats, especially in the lower and mid sections around Waterfall and Flat Creeks where original vegetation cover has been so heavily modified. The upper sections of the Lee River at the head of the proposed reservoir may support populations of long-tailed bats, given their proximity to the upper Pelorus Catchment and the lack of forest disturbance in that area.

Southern short-tailed bats are listed as Nationally Endangered in the Department of Conservation New Zealand Threat Classification Systems List 2005 (Hitchmough *et al* 2007). Early and ongoing decline in populations has been attributed to habitat loss and felling of roosting trees, disturbance of bat roosts, and impacts of introduced predators and competitors (O'Donnell 2000). The long-tailed bat is widely distributed throughout the mainland, while the lesser short-tailed bat is found only at a few scattered locations including north-west Nelson.

The habitat use patterns of the long-tailed bat are relatively well known. Numerous studies of long-tailed bats indicate that the bats are generally associated with indigenous forest, primarily roosting in cavities of old trees within native forest (O'Donnell 2001). More recent research indicates that the bats may also feed and roost within exotic trees and forest, predominantly crack willow but also radiata pine, wattle, gum and white

poplar (O'Donnell 2001, Sedgeley and O'Donnell 2004, S. Strang, pers. comm.). Due to their selection of specialised roosts, high mobility, low levels of roost re-use, and large home ranges with little overlap, it is likely that large areas of mature forest are required to sustain bat populations (Sedgeley and O'Donnell 1999).

Relatively little is known about lesser short-tailed bats' habitat requirements or temporal patterns of activity. However, research indicates that short-tailed bats focus their foraging activity in forest interiors, in contrast to long-tailed bats that are better suited to foraging flight in forest edge and gap habitats due to their poor manoeuvrability (O'Donnell and Christie 2006).

The effect of the proposed development on bats can be inferred given the likelihood that long-tailed bats are present in the upper parts of the Lee Catchment and most likely in low numbers or absent from the mid sections of the Lee where the bulk of the vegetation clearance is proposed.

If patterns of habitat use follow trends seen elsewhere, then bats may only be using the pine forest areas as foraging areas with potential roost sites in some areas of older-growth riparian native forest. In the upper catchment area (in the gorge area within Mt Richmond Forest Park), bat abundance may be greater with the mature trees likely to be required to be cleared for the project supporting a greater number of bat nesting and roosting sites. The clearance of 26.9 ha of indigenous vegetation and 41.7 ha of exotic forestry is unlikely to result in a substantial loss of bat foraging habitat, given the abundance of forested areas (with streams and open forestry roads for foraging lines) available elsewhere in the catchment. In addition, the development of the reservoir will potentially minimise the loss of edge feeding environments by creating a long and highly incised edge environment ideally suited for foraging by bats (O'Donnell 2001).

In a national context, the presence of bats (if assumed) within the Lee catchment represents only one of several population known from the Mt Richmond Forest Park, and is one of many throughout the wider Nelson/ Marlborough area.

A survey for bats has been recently approved by WWAC and will be undertaken in the Lee Catchment during summer 2009/2010.

5.4 Terrestrial invertebrates

The paucity of site-specific information for terrestrial invertebrates makes assessments of significance difficult; especially for places such as the Lee Catchment where lack of easy access means that records are even more difficult to come by. Coupled with the cost of undertaking comprehensive surveys for invertebrates (which were beyond the resources for this project), assessments of the likely significance of the Lee development site for species has relied upon information (see below) provided by invertebrate specialist Ian Millar (DOC Nelson) and from published literature (largely DOC's Threatened Invertebrate Classification List dated 2001).

Species of conservation importance that are known from the surrounding area (e.g. Mt Richmond Forest Park or the Bryant Range) are:

- The forest ringlet (butterfly) *Dodonidia helmsii*.

This species is still extant in the Richmond Range (and possibly the Bryant Range) at high altitudes and was probably once present in the Lee, given that its main foodplant in this area, the forest tussock *Chionochloa cheesmanii*, is present. However this species is unlikely

to be present currently due to the large numbers of introduced wasps in low and medium altitude beech forest with abundant honeydew. This species is patchily distributed through the North Island and in the north-west South Island and appears to be in general retreat throughout its range, probably from predation of the caterpillars by wasps. It is presently rated in conservation category 4 (serious decline).

- The large landsnail *Wainuia urnula* '*nasuta*'

This species is known sparsely from various sites in the Richmond Range and is found occasionally in the Wairoa Catchment. Specific known sites in the local vicinity are Mt Richmond and the east branch of the Wairoa River. Given the high levels of pig activity noted throughout the proposed development area it is unlikely that a population of any size would be present in the proposal site and there are no reports from the Lee catchment of which DOC is aware. The species is rated in conservation category 5 (gradual decline).

- Carabid ground beetles

A series of rare or little-known species of ground beetles (family Carabidae) of potential conservation interest, all in the genus *Mecodema*, are known from sites along the western Bryant Range, although generally at higher altitudes than the proposed Lee dam and reservoir site. These include:

  - *Mecodema proximus* (category 6, sparse) known from Saddle Hill and D'Urville Island;
  - *M. pulchellum* (category 6, sparse) known from Saddle Hill, Mt Stokes and possibly Mt Richmond;
  - *M. dunense* (category 7 range restricted) known from the Dun Mountain - Wooded Peak area); and
  - *M. rugiceps anomalum* (unrated) known from the upper Maitai, Opouri Saddle and Kahikatea Peak, Picton.

- Robber fly, *Zosteria novazealandica*

This is New Zealand's largest species of robber fly and is known from just a single specimen taken on the Dun Mountain track in 1932. This is the only New Zealand species of an otherwise Australian genus, suggesting the specimen could have been a vagrant, but if so there is no known matching species in Australia. At 22mm long it is substantially larger than other New Zealand robber fly species. It is listed as category 8 (data deficient).

Overall, the likelihood of the above species being present within the project area is regarded as slight. For most of the above species, past records have been at higher altitudes, or the level of forest clearance and conversion to forestry would have removed much of the suitable habitat. The level of pig damage and lack of wasp control means that the likelihood of forest ringlet butterflies or landsnails being present is slim.

5.5 Summary of effects on fauna

Overall, the potential or actual effects of the proposed Lee dam and reservoir on fauna are regarded as being minor.

The diversity of birds recorded from the site is indicative of a highly modified environment with predominantly exotic birds or native species characteristic of rural locations.

The threatened NZ bush falcon was recorded on two occasions. The availability of habitat for this species is not expected to be severely affected, given the typically large home range of the species (Seaton 2007) relative to the proposed inundation area and the forested nature of the catchment, above, below and adjoining the proposed reservoir. Other species of interest recorded historically from the wider Forest Park area, including kaka and kea were not detected in this survey or by previous work by DOC on and around the proposed development footprint. Blue duck were not recorded during these surveys; however recent records indicate that they occasionally use the area, and that the loss of potential blue duck habitat from the development of the site should be taken into consideration as part of mitigation planning.

Lizards were not detected from the site, despite excellent search conditions and two experienced lizard surveyors (one of whom was DOC staff). The lack of lizards detected from the site mirrors poor search results obtained by DOC from elsewhere in the local area. While lizards must be present on site, they are likely to be in very low densities, suggesting that efforts to mitigate adverse effects on populations resident within the proposed reservoir area are better directed towards improving neighbouring lizard habitats rather than investing substantial resources to locate and move lizards within the footprint (if indeed any exist).

Long-tailed bats have recently been recorded from a nearby catchment. There is circumstantial evidence and evidence from elsewhere to support the possibility of bats being present on the site, particularly in the upper reaches of the proposed reservoir on the DOC estate (with its larger, old-growth trees). A survey planned for Dec 09/Jan10 should provide clarity over the presence of bats and significance of the project footprint area for bats that use that area.

6 Weed and animal pests

6.1 Weed pests

The vegetation surveys identified a number of weed plants within the study area.

The weed species recorded from the site which are having, or have the potential to cause, ecological impacts on natural systems include:

- Gorse - around roads and plantation pine areas where it is being progressively displaced by native vegetation and shaded out as pine stands develop.
- Blackberry – scattered and locally abundant in areas of high ground disturbance e.g. forestry areas.
- Old man's beard – present in the reservoir footprint area and also downstream of the dam. This pest is seriously impacting on the quality of indigenous vegetation.
- Hawthorn – localised
- Barberry – localised
- Wilding pines – found in several of the sites identified as being botanically significant.
- Willow – scattered along the river, mostly downstream of the proposed dam site.
- Poplar – scattered along the river, mostly downstream of the proposed dam site.
- Broom – around roads and plantation pine areas, mostly in the lower reaches around the dam and lower reservoir and downstream to Lucy Creek.

Of these weed plants, four are listed as environmental pests in the Tasman-Nelson Regional Pest Management Strategy 2007-2012 (RPMS): gorse, blackberry, old man's beard and broom.

Where weed control is proposed as a measure to improve the health of existing vegetation communities or as part of revegetation planting programmes, all of the above listed weeds, in addition to those listed in the RPMS, should be controlled. Refer to the accompanying Technical Report 'Lee Dam Feasibility Study: Enhancement Opportunities Scoping Plan' prepared by T&T ref. 24727.408.

6.2 Animal pests

The presence of animal pests was recorded during targeted pest surveys (spot-lighting and tracking tunnels) and general notes of pests or their sign were made during the vegetation survey.

Pigs, goats and deer – These ground-based browsers are having a large impact on the vegetation of the study area, with evidence or direct sightings of goats, deer and feral pigs. Pigs and goats in particular are attributed with severely affecting the regeneration of the forests; for example Dr. Simpson notes that pig impact is significant on NZ shovel mint populations (such as in the lower Lee Catchment) and *Astelia* (such as at Site 3). Pig rooting is severe in most riparian areas to the degree that it is likely to be contributing to increased sediment runoff into the river and is resulting in the uprooting of seedlings, saplings and undermining of large trees. Large areas of pig rooting in some areas are creating canopy gaps which are starting to be colonised by invasive weeds.

Possums –Possums were frequent within the study area (as observed during spotlight lizard searches) and possum sign locally abundant. In addition, 6 out of the 30 tracking tunnels recorded clear possum sign (prints and scratch marks in the ink). There is no systematic programme for controlling possums in the Lee Catchment of the wider Mt Richmond Forest Park (M. Heine, DOC, pers. comm.).

Rats and mice – Tracking tunnel results show a low level of rats (four out of 30 cards tracked). Mice were recorded at 14 of the 30 tunnels, illustrating their high presence at this site.

7 Summary and conclusions

The natural vegetation and wildlife communities within the Lee Catchment vary greatly in ecological value and significance, ranging from areas of significant original native forest (such as high quality matai associations and headwater DOC estate) to regenerating native forest and weed infested vegetation and pine plantations.

The proposed development footprint covers only a small proportion of the available riparian areas of the Lee River, and even less of the hill-slope forest types; however, some of the areas that are proposed for removal are significant to some degree, whether it be of local, regional or national importance.

For both plants and animals, most species recorded from the site are represented elsewhere in the Lee Catchment, the Wairoa Catchment, or are likely to be present in the other unsurveyed parts of the extensive catchments and interior of Mt Richmond Forest Park. The detailed botanical surveys undertaken for this project have provided information from the Wairoa and the Lee catchments. Surveys of both areas have recorded significant species previously not known from those locations. Given that the area surveyed in both of these surveys is less than 200 ha of the Forest Park (i.e. 0.1%of the Forest Park land area), and that similar or better quality catchments exist, it seems highly unlikely that the significant species and communities recorded in the Lee are not also present elsewhere in the Forest Park.

Species of significance identified from this ecological assessment of the proposed Lee River development area include three species of plant (NZ shovel mint, sand coprosma and scented broom) and one species of bird (NZ falcon). All are listed as threatened species. In addition, the site supports habitat for blue duck, and although sightings of blue duck have been made in recent years in the Lee and adjoining catchments, none were recorded during these surveys. All threatened species found are represented elsewhere in the local area, meaning that the proposed development site does not constitute the only, or likely significant portion of the range of this species in the region, or at a national scale. That is, there is no plant or animal species that is threatened with extinction by the development of the Lee River dam and reservoir.

The presence of long-tailed bats at the site (especially in the upper reaches on DOC estate) seems likely given their presence in the Pelorus catchment. The likely effects on the overall bat populations in the Mt Richmond Forest Park from loss of habitat is considered to be minor given the comparatively large areas they are known from and the large areas of habitat in which they may be present within Mt Richmond Forest Park.

The loss of vegetation (both exotic and indigenous) will constitute a reduction in the availability of habitat for wildlife and plant communities and result in the loss of old-growth forest and the richness of species that live and use these areas. Conservation managers apply a range of techniques to improve the availability of resources and the health of populations, and many of those tools can be applied to this project in assisting to minimise the overall net effect of the proposed development.

Without the following mitigation measures, the overall potential and actual effects of the proposed development on plant and animal communities is likely to be moderate. Development of a package of measures to mitigate the ecological effects of the development is currently under way.

Suggested measures to compensate for the adverse ecological effects of the development include:

- Replanting areas into indigenous vegetation to provide medium-term and long-term replacement of the resources lost from undertaking vegetation clearance for the dam, reservoir and associated structures;
- Covenanting important ecological areas identified from this survey, including, for example, the area around Lucy Creek, downstream forest remnants or the Site 4 matai forest;
- Undertaking plant weed control to improve the health of remnant vegetation communities in the vicinity of the development site and to reduce the incidence of weed invasion into Mt Richmond Forest Park;
- Controlling feral browsing animals (deer, goats, pigs, and possums) to low levels to encourage regeneration of understorey and ground tiers and thus provide a means of reducing the short-term effects of habitat and resource loss of wildlife until planted areas mature;
- Controlling introduced predators including mustelids, rodents and wasps in areas where conservation gains can be realised for threatened wildlife;
- Implement species-specific protection measures, such as pig control to protect populations of NZ shovel mint and procuring cuttings or seed, propagating and planting of sand coprosma, scented broom and other significant plant species using stock within the proposed development footprint and planting these around the new reservoir as appropriate; and
- Considering the opportunities for restoration of off-site areas as compensation for the loss of ecological values within the development footprint. This may include downstream areas of riparian margin, lowland forest or wetland systems or other areas where regulatory authorities deem restoration to be of greater importance than restoring areas within the upper and mid Lee Catchment.

With the adoption of many of the measures above, the overall net effect of the proposed development on the terrestrial ecology values of the Lee Catchment site can be considered to be no more than minor.

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9 Applicability

This report has been prepared for the benefit of the Waimea Water Augmentation Committee with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR LTD

Environmental and Engineering Consultants

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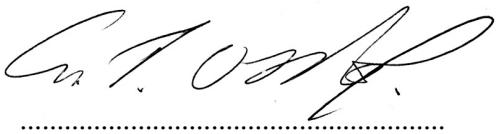

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Graham Ussher

Restoration Ecologist

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Ecologist

Authorised for Tonkin & Taylor by:

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Sally Marx

Project Director

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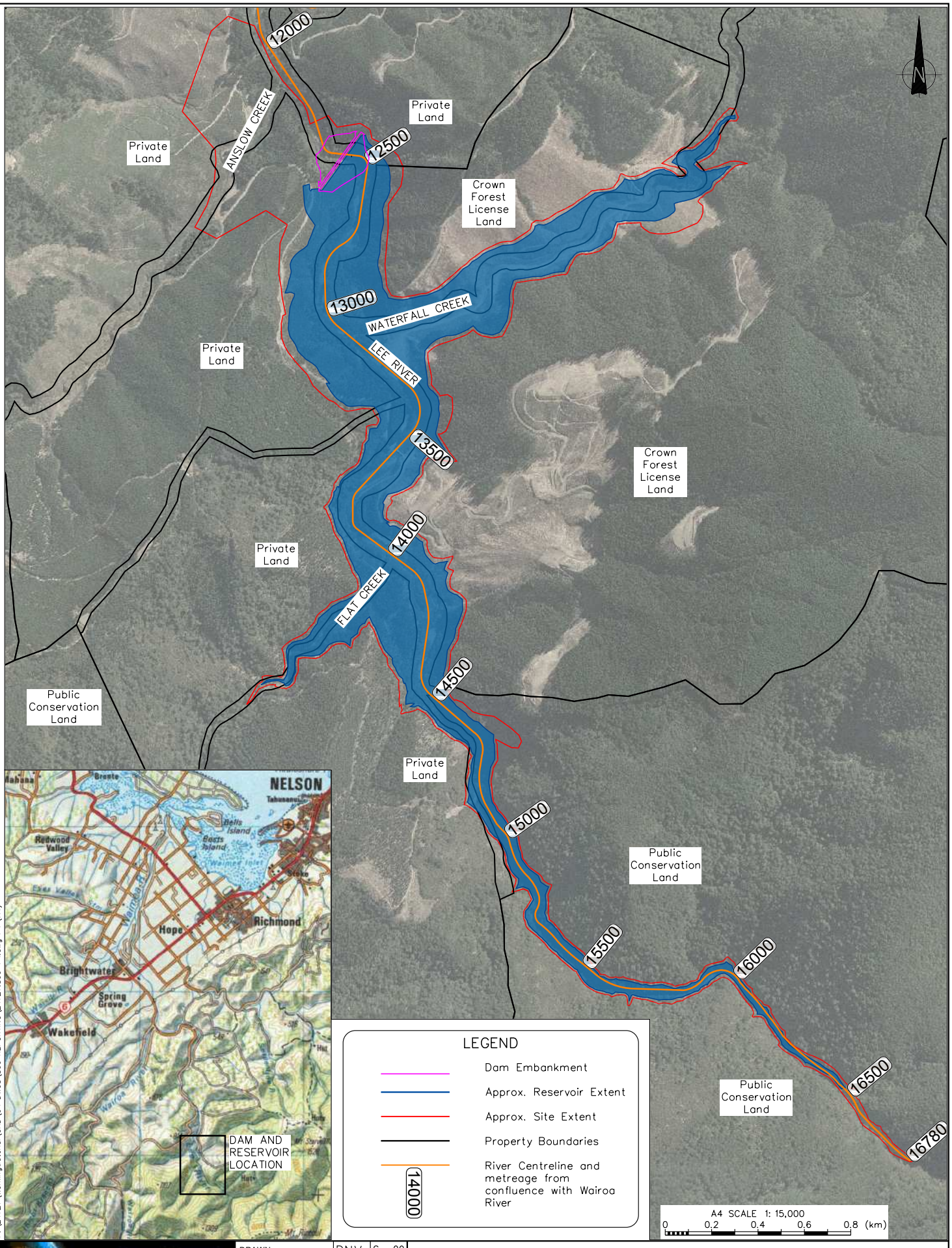
Appendix A: Figures

- **Figure 24727.200-1 Site location plan**
- **Figure 24727.200-2 Botanical and wildlife survey areas**
- **Figure 24727.200-3 Vegetation within the development footprint**
- **Figure 24727.200-4 Features of ecological interest**



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WAIMEA WATER AUGMENTATION – PHASE 2

SITE LOCATION PLAN

FIG. No. FIGURE 1

REV. 0

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LUCY CREEK
WATERFALL CREEK
ANSLOW CREEK
FLAT CREEK

A10 A9 A8 A7 A6 A5 A4 A3 A2 A1 BC1
BC2
B10 B9 B8 B7 B6 B5 B4 B3 B2 B1 BC4 BC3
C1 C2 BC5 C3 C4 BC8 BC6 C5 C6 C7 C8 C9 C10 BC7

LEGEND

- Proposed Dam and Spillways
- BC6 Bird Count Station
- C4 Tracking Tunnel Line
- Vegetation Survey Area

Wildlife Survey

- Day
- Night

Notes:

A3 SCALE 1:15,000

0 0.2 0.4 0.6 0.8 1 (km)

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BOTANICAL AND WILDLIFE SURVEY AREAS

FIGURE No. 24727.400-F2 Rev. 0

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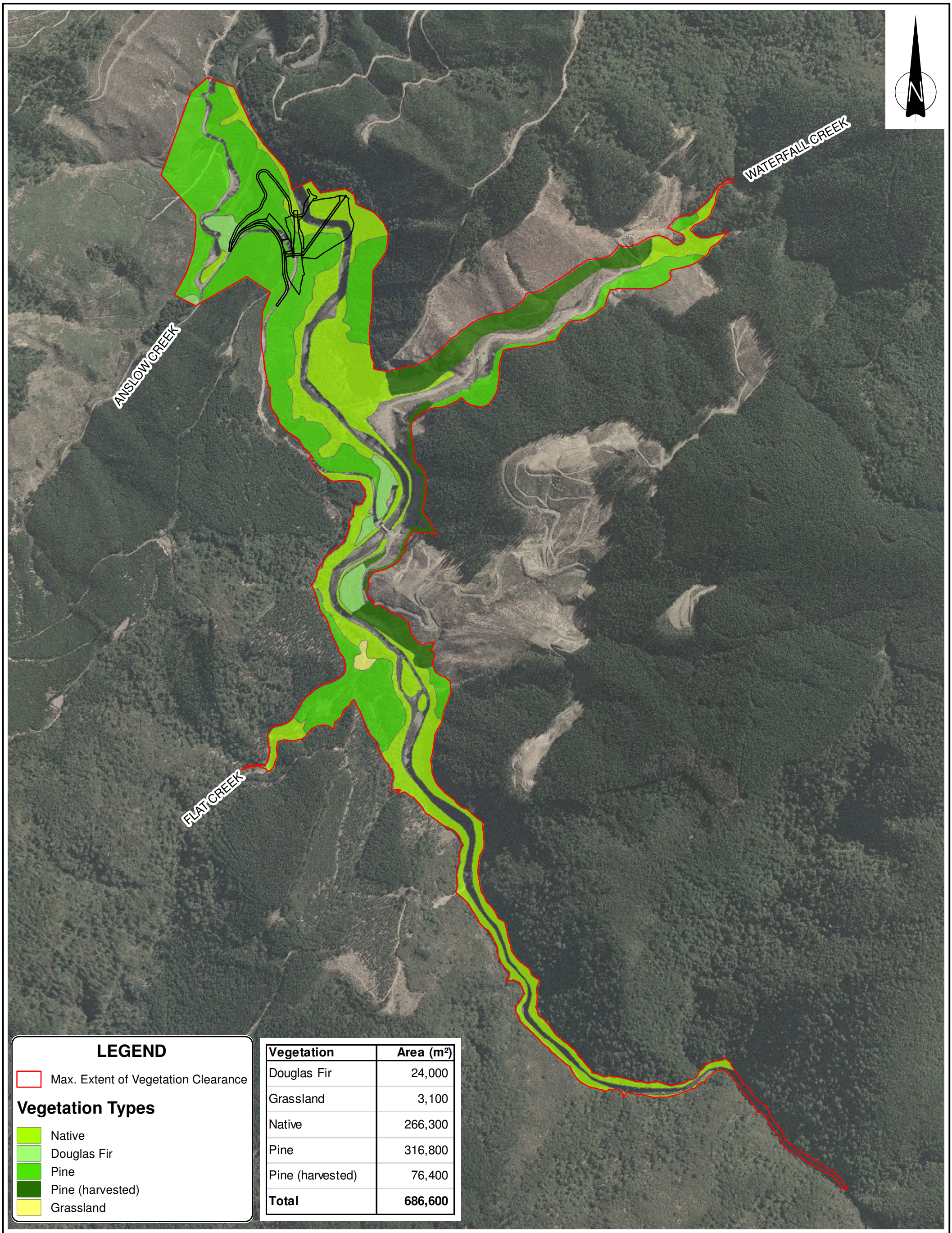

LEGEND

Max. Extent of Vegetation Clearance

Vegetation Types

- Native
- Douglas Fir
- Pine
- Pine (harvested)
- Grassland

Vegetation	Area (m²)
Douglas Fir	24,000
Grassland	3,100
Native	266,300
Pine	316,800
Pine (harvested)	76,400
Total	**686,600**

Notes:

A3 SCALE 1:10,000

0 0.1 0.2 0.3 0.4 0.5 (km)

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VEGETATION WITHIN DEVELOPMENT FOOTPRINT

FIGURE No. 24727.400-F3 Rev. 0

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Remnant indigenous forest comprising rimu and black beech, swamp forest and kahikatea as well as southern rata and white maire

LUCY CREEK

N

Site 1
Beech and kanuka forest on riparian flats including regenerating tanekaha, NZ shovel mint, dwarf mistletoe and golden akeake

Site 2
Beech riparian and hillslope forest including tanekaha, abundant scented broom, NZ shovel mint and kahikatea

WATERFALL CREEK

Mature kahikatea swamp and riparian forest including abundant NZ shovel mint

ANSLOW CREEK

Site 3
Regenerating black beech under mature kanuka with localised NZ shovel mint

One falcon observed on 14 March 2008

Two falcons observed on 15 March 2008

Site 4
Matai forest including scented broom in riparian areas and exceptional matai forest on upper hill-slope areas

Site 4
Kanuka island including fertile lowland and cold montane wetland groundcover species

Site 4
Wetland terraces

FLAT CREEK

Site 5
Original and regenerating beech forest

Coprosma acerosa

LEGEND

- Features of ecological interest
- Proposed Dam and Spillways
- Approx. Reservoir Extent

Notes:

A3 SCALE 1:15,000

0 0.2 0.4 0.6 0.8 1 (km)

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WAIMEA WATER AUGMENTATION COMMITTEE
WAIMEA WATER AUGMENTATION PHASE 2

FEATURES OF ECOLOGICAL INTEREST

FIGURE No. 24727.400-F4 Rev. 0

Appendix B: Botanical reports

- **Philip Simpson. May 2008. The Lee River dam and reservoir: Impacts on the vegetation at the site and downstream. Uruwhenua Botanicals Ltd.**
- **Philip Simpson. April 2009. Lee River water augmentation proposal report on the vegetation along the upper reach of the proposed reservoir. Uruwhenua Botanicals Ltd.**

THE LEE RIVER DAM AND RESERVOIR

Impacts on vegetation at the site and downstream

Philip Simpson
Uruwhenua Botanicals
Pohara

Coprosma grandifolia, an important riparian coloniser in the Lee

May, 2008

CONTENTS

1. Introduction

This report is Phase II of a study "to assist Tonkin and Taylor to undertake a feasibility study for the Waimea Water Augmentation Committee (WWAC) of water augmentation in the Waimea Catchment, Tasman District." The specific objective of Phase I was " to undertake a comparative assessment of indigenous vegetation values [of affected parts of the Wairoa and Lee Rivers] to assist WWAC in choosing a preferred site for the construction of a water harvesting and storage reservoir." The Phase I ecological study of the vegetation ("Botanical values of the Wairoa and Lee River valleys: assessment in relation to possible dam and reservoir sites", Philip Simpson, May 2006) revealed that both catchments had similarly high values in the proposed dam and reservoir sites. In fact the report concluded that **"**Overall, bearing in mind the somewhat subjective nature of comparative assessment, the Lee is the most valuable area botanically". This conclusion was based mainly on ecological diversity and species rarity. However, the differences between the sites were comparatively minor, and in the end other factors led to WWAC concluding that the Lee offered the best opportunities for a dam and reservoir.

The objectives of the Phase II study are:

1. To undertake a detailed survey of the vegetation at the dam site, the associated construction areas, and the reservoir (including a buffer zone).
2. To identify the effects of the dam and reservoir
3. To identify any adjacent areas that should be protected by tenure change or covenant
4. To assess the impact on the riparian vegetation of the altered flow regime downstream from the dam
5. To recommend possible mitigation actions

2. Methods

Field observations were undertaken over a two-day period, March 14-15, 2008, in the company of Tonkin and Taylor Restoration Ecologist, Graham Ussher. Large-scale aerial photographs were used to map indigenous vegetation along the dam and reservoir areas. Although logging has taken place during the time since the previous report was prepared most of the vegetation remains intact. In fact access to the river and views of parts of the vegetation have been improved by logging and associated tracking. As with the first field survey a photographic record was made and notes were recorded on tape.

Except for the extreme upper portion of the proposed reservoir, which lies within DOC land and access is restricted by the gorge topography, the stretch of river from Lucy Creek downstream from the dam to the gorge near the upper limit of the proposed reservoir, was traversed. The Lee reservoir would be about 3.5km long with a maximum depth of about 50m. Assessments of impacts on native vegetation were made on this basis.

A detailed description of the vegetation along most of the route was included in the Phase I report. These areas were revisited and in general the assessments confirmed. One of the areas (the left-bank hillslope of Site 4) was explored in more detail. The riparian vegetation downstream from the proposed dam site as far as and including the lower part of Lucy Creek, was also examined in more detail. Original or modified boundaries of the significant sites identified in Phase I have been drawn onto aerial photographs. The text below includes the original descriptions of the key sites, slightly modified in places owing to new information gained during the second survey.

The following criteria are used in assessing site significance. Each site is ranked, low, medium or high for each criterion and an overall ranking is also given.

(a) *Representativeness****: does the site represent a good example of one of the characteristic types of native vegetation in the district?***

(b) *Rarity****: are there rare species or communities?***

(c) *Diversity and pattern****: is there a notable range of species and habitats?***

(d) *Distinctiveness/special ecological characteristics****: are there any features which make the site stand out locally, regionally or nationally?***

(e) *Size and shape****: how do size and shape influence character and viability?***

(f) *Connectivity****: what is the degree of ecological connection with surrounding areas?***

(g) *Sustainability****: does the site possess the resilience to maintain its ecological integrity and processes?***

Each of these criteria is assessed at each defined botanically significant site and ranked low (L), medium (M) or high (H), and sometimes at an intermediate rank. A low does not mean that the site has low ecological significance but is low relative to a medium or high ranking. Only those places regarded as significant have been included in the sites.

3. Ecological context

The proposed dam site and reservoir lie within the Bryant Ecological District: steep hill country with complex geology and a mild climate. Details about the Lee River are included in the Phase I report, where features are compared with the Wairoa catchment. It was concluded that: "When physical elements such as altitude, topography, geology and aspect are combined there appears to be an impression that the Lee offers a more favourable environment for ecological diversity and vegetation development."

Upstream from the proposed dam site the Lee catchment covers about 8000ha, including about 1000ha modified by bush clearance (Appendix 1, Map 1). The river drains parts of the western flank of the Richmond Range, from Bishops Cap to Old Man (1544m). The northern boundary cuts across NE trending ranges that form the headwaters of the Pelorus River and crosses a series of peaks such as Slaty Peak (1551m) and Mt Starveall (1500m) on which fires in support of former grazing have

depressed the natural bushline. Much of the Lee flows east to west. Hence, in terms of aspect the Lee presents a dominance of west and north-facing slopes. These physical features influence the local climatic and hydrological patterns. Clearly the catchment rises to a medium-high altitude and receives a relatively high annual rainfall, in the order of 2000mm, rising to 2500mm at the head probably reflecting the direct exposure to NW weather patterns. However, the limited extent of high ground restricts the significance of winter snowfall.

The geology is an important factor in consideration of physical character. The Lee lies within the Ward Formation, sandstone of Triassic age (about 250 million years old), influenced to some extent by the adjacent ultramafic zone to the west and the Marlborough schist zone to the east. According to IGNS Map 9, Nelson, 1998, the Ward Formation (Lee) consists of "bedded indurated sandstone". In notes to accompany "Red Hills" (Sheet N28 BD, Geological Map of New Zealand 1:50 000, 1982) Mike Johnston writes "The [Ward] formation is similar to the Star Formation, but differs in that it is less massive, green sandstone is not as abundant or as coarse grained, and alternating sandstone-siltstone sequences are more widespread."

This translates into important features of the topography. Much of the Lee flows through bedrock (which is a regional feature of rivers draining the Richmond Range, for instance the Wairoa, Pelorus and Maitai, and is presumably a reflection of recent and perhaps ongoing uplift). However, the slopes are not particularly steep, are often covered by a thick colluvium of shattered talus rock and there is a tendency create river flats from this fine material.

In vegetation terms the lowland zone is generally defined as being below 600m and many coastal lowland species can extend up to 300m. Hence, these are levels where biodiversity of forest species is usually greatest. The dam and reservoir footprint is within the 300m contour, and is therefore well within the zone of greatest potential species diversity. All the formerly agricultural land has either reverted to indigenous scrub or has been further developed into exotic forest. Many roads have been built to service the logging industry.

The overwhelming feature of the vegetation is the proportion of natural cover in indigenous bush. Only about 12% (about 1000ha) has been cleared, all of this within relatively contiguous parts of the lower valley immediately upstream from the proposed dam site. Again, topographical and climatic factors appear to have influenced the pattern because clearance was mainly limited to the easier, warmer slopes. A riparian strip runs along the main riverbanks within the disturbed zone and a narrow band of bush has been left along most of this strip. Most of the catchment is administered by the Department of Conservation, while most of the disturbed zone is privately owned (Appendix 1, Map 2).

4. General characteristics of the flora

The Wairoa Gorge has figured prominently in the history of botany of northern South Island, with a number of species first collected and described from there (the 'type locality'). There are several reasons for this. Firstly, the central New Zealand location (Latitude 41^{o}- 42^{o} S) places the area in a comparatively mild temperature regime nationally, compared to places further south, which means that it is the southern limit,

or almost so, of a number of generally more northern species. Examples are tanekaha (celery pine, *Phyllocladus asplenioides*), white maire (*Nestegis lanceolata*), and black maire (*Nestegis cunninghamii*). Secondly, there are some species that are restricted to northern South Island (e.g., *Scutellaria novae-zelandiae, Carmichaelia odorata*) or are generally rare nationally (such as the fierce lancewood, *Pseudopanax ferox*), owing to the geological and climatic diversity. Thirdly, the unique 'mineral belt' of ultramafic rocks, which create soils that restrict tree growth and favour low-fertility-demanding species, crosses the area at a low, accessible altitude, offering interesting local plant communities and some endemic species. Fourthly, the Wairoa and Lee Rivers have cut a route through the low hills bordering the settled Waimea Plain, and the steep or shaded slopes encountered along the route have often been retained in native forest, providing scenic and botanical values seldom seen close to intensively developed areas. Groves of totara and kahikatea, clusters of kowhai and hillsides of low mixed lowland forest of titoki and ngaio with a range of rare species (e.g., *Teucridium parvifolium, Melicytus micranthus*) are present, and several areas have been protected. Finally, the Wairoa Gorge has attracted visitors because of its scenic beauty and the recreational opportunities it provides.

While the Lee valley is generally less well known, largely because of private access, it shares many of the botanical values of the Wairoa and is a very scenic small river.

The general forest type in the Bryant and adjacent ecological districts is defined by John Wardle in "The New Zealand Beeches (NZ Forest Service, 1984) as "mixed beech with broad-leaved hardwoods and/or softwoods", most commonly "hard beech-black beech-podocarp forest". Within this broad category, black beech/matai forest is the most distinctive community and is typical of lowland forests in the Nelson hills, although now largely cleared for agriculture and forestry.

The mineral belt band of ultramafic rocks crosses the catchment downstream from the proposed dam site. The vegetation associated with these rocks has largely been disturbed by fire. However, distinctive secondary vegetation has returned to the lower slopes, dominated by manuka, akeake, tanekaha and flax. Where the vegetation has been cleared for forestry, the pines require top-dressing for adequate growth, illustrating the low-fertility of the ultramafic soil.

Although there are some protected areas of vegetation (recreation reserves, private reserves) along the lower Lee, the catchment is very weedy in the lowland settled zone, with hawthorn, barberry and old mans beard dominant over remnants of riparian forest consisting of scattered beech and podocarps. Gorse, blackberry and old mans beard extend up the valley into the area under consideration, often associated with roads and forestry development.

Together the special features of the Lee within and immediately adjacent to the dam and reservoir footprint impart a strong degree of local and regional significance and even some aspects that are nationally significant. These values are summarised in the Table below. The presence of black maire, *Teucridium parviflorum* and *Pseudopanax ferox* in the adjacent Wairoa catchment, but not to date seen in the Lee, enhances the overall significance of the area.

Vegetation Feature	Local	Regional	National
Good population *Scutellaria*			X
Sth limit White maire			X
Sth limit tanekaha			X
High quality matai forest		X	X (site 4 only)
Good population *Carmichaelia odorata*		X	
Kahikatea alluvial forest		X	
Melicytus micranthus present		X	
Ultramafic habitat nearby		X	
Diverse divaricating shrubs	X		
Low altitude riparian southern rata	X		
Coastal species extend inland	X		
Good population *Australina*	X		
Good population dwarf mistletoe	X		

Significance of features of the vegetation, flora and habitats of the Lee Footprint area

5. Overall character of the vegetation in the footprint area

In general there is a narrow band of native vegetation along both sides of the Lee River from Lucy Creek upstream to the continuous native forest on the DOC land that covers a vast proportion of the Lee Catchment. In places the riparian bush has been completely converted to pines or has become weedland (gorse and blackberry). Patches of dense bracken fern occur. In other places the riparian band of native trees expands upslope along small gullies, or forms a hill-side patch. In one area (Site 4) the hill-side bush is continuous with the DOC hinterland. While much of the riparian band occupies lower hill-slopes, there are also small alluvial flats and terraces, and a flood-prone island.

The riparian band consists mostly of scattered or continuous beech trees (hard, black, and silver, with a few red beech in places) associated with scattered podocarps, especially kahikatea and matai, with less common tanekaha, rimu and occasionally lowland totara and Hall's totara. With the beech and podocarps are scattered broadleaved species such as kowhai, titoki, and mahoe, and associated with these are understorey shrubs like rohutu and several *Coprosma* species, especially *C. grandifolia*.

A strictly riparian band of tutu and native broom is characteristic and on shaded patches of moist bedrock a turf of low-growing herbaceous species is present.

Where the original forest has been removed but not planted in pines, kanuka forest is characteristic. Generally the kanuka is in an advanced stage of regeneration into tall forest, especially beech, matai and tanekaha. The ground cover beneath the kanuka

supports many ferns and patches of *Scutellaria*. In other words, kanuka forest is an important forest type in the area. Where the pines have been recently logged native understorey species have been exposed, including tree ferns, marbleleaf, mahoe and tree fuchsia. These will rapidly form a forest cover in the absence of further pine planting, and if weed growth is controlled.

The riverine landscape created by native vegetation, outcrops and gorges of bedrock, large boulders, stretches of smaller rounded rocks and a water system that includes meanders, deep pools, small rapids and stretches of quiet smooth water, is, in combination, extremely attractive.

6. The lower Lee.

The following notes are included because the possible mitigation package that might include activities well outside the footprint area.

From its confluence with the Wairoa upstream to the confluence of the Roding river, the Lee has a very weedy vegetation dominated by hawthorn, willows and old mans beard with only scattered indigenous trees such as kowhai, lowland totara, kanuka, kohuhu and cabbage trees. Further inland a few black beech enter along with matai and kahikatea but in general the river channel has little indigenous quality. Upstream from the Roding the indigenous character improves and there are several reserves. O'Neill's Bush is a private reserve dominated by matai, kahikatea, pokaka, lemonwood and kowhai. The Lee Valley Reserve (TDC) has an excellent collection of divaricating shrubs including *Melicytus micranthus*, *Coprosma crassifolium* and *Melicope simplex*, along with the small lowland tree *Streblus heterophyllus*. These species indicate a fertile environment, hot and dry in summer but cold in winter. Black beech dominates the canopy, and it often shows signs of die-back, probably caused by the summer drought of 2000-1.

The old serpentine quarry marks a zone of ultramafic rock and its associated belt of melange where ultramafic and sedimentary rocks are mixed. The area has a strange, disturbed vegetation with manuka and kanuka, secondary akeake, scattered young tanekaha and clumps of flax, *Phormium cookianum*. This community reflects a combination of factors - infertile, acidic and perhaps seasonally water-logged soil and open vegetation for light-requiring species.

High quality native vegetation begins a few hundred metres below the proposed dam site, at Lucy Creek. Here, a remnant of dense rimu and black beech forest occurs and the latter extends in a band up the right bank of the Lee, with several young and old trees of tanekaha. Large rimu and kahikatea occur at the Lucy-Lee confluence. Numerous rimu of all sizes extend up Lucy Creek. Of particular significance is an adult tree of white maire, with numerous seedlings beneath. The riparian forest along the Lee includes a grove of southern rata forming an open zone of about ten trees up to 6m tall. This species is characteristic of upper ridges within the catchment all along the Richmond Range and extends along the descending rivers on open bedrock.

A small alluvial flat on the right bank supports an important remnant of swamp forest composed of large kahikatea, matai and beech. The understorey is particularly interesting because it includes a grove of semi-mature white maire and numerous

saplings. White maire reaches its south-west limit in New Zealand within the Lee and nearby catchments. (It is otherwise restricted in the South Island to small stands – often individual trees – in the Marlborough Sounds. Black maire features in the lower Wairoa and at Linkwater and Kaikoura, again occurring as isolated trees, and narrow-leaved maire is extremely rare and limited in the South Island to scattered trees on the Waimea plains and north of Kaikoura.) Several important understorey shrubs occur in this bush including *Melicytus micranthus* (swamp mahoe), which is present as a single individual (it is also present in the TDC reserve down on the lower Wairoa), *Coprosma areolata* (sometimes supporting dwarf mistletoe), small-leaved milk tree (*Streblus heterophyllus*), *Melicope simplex* and rohutu (*Lophomyrtus obcordata* and *Neomyrtus pedunculata*). This patch of bush is similar to one upstream, described below (Site 3) as the "Scutellaria capital of the world") but almost lacks this species and therefore offers an opportunity for a significant restoration project once the severe impact of feral pigs is overcome.

Surrounding the forest is a zone of regenerating native shrubland/forest composed of akeake, mahoe, tanekaha, karamu, bracken fern and interestingly ngaio. Ngaio, akeake and titoki are three species of characteristically coastal trees, indicating that in the relatively benign climate of the lowland part of the Lee catchment, coastal forest once extended well inland. (A fourth coastal species, tree daisy, *Olearia paniculata*, occurs as two specimens just upstream, unfortunately in the inundation zone, again suggesting that replanting downstream would be appropriate mitigation action.)

The dense rimu, mature tanekaha and kahikatea, white maire, swamp mahoe and southern rata and the ngaio are all significant elements to the site. It is unlikely that the site will be influenced by the dam but it is very important that damage is minimised during the construction phase. (See also Section 10 on the impact of altered flow regimes on riparian vegetation.)

Just to the south of Serpentine Road is a gully of dense hard beech forest with scattered rimu and mature matai, and towards its base large kahikatea and tanekaha, the latter strongly riparian in distribution. Immediately below the dam site there is disturbed riparian black beech forest with scattered kahikatea, matai, tanekaha and lowland totara (close to the inland limit –one of the species usually restricted to below 300m).

The "Probable Borrow Site" (figure) is located on the left-bank slope above the riparian bush that features the southern rata, ngaio and akeake. I t will be important that any material is pulled back from the slope and does not intrude into the riparian vegetation.

7. Vegetation at the dam site (photo 8)

Although the actual dam is likely to be relatively narrow, the construction zone is likely to extend about 100m both upstream and downstream from the dam itself and presumably all the vegetation within this 200m stretch will be removed. That upstream from the dam will be inundated. The vegetation at the dam site differs only in detail from that which is characteristic of the riparian strip in general along both sides of the river. On the true right there is a narrow band of beech forest, mostly black beech with scattered rimu and matai trees and understorey or overhanging small

trees of lemonwood, kowhai, marbleleaf and whiteywood, associated with shrubs of tutu, and *Coprosma* (*C. robusta* and *C. grandifolia*). This riparian band extends upstream for several hundred metres (part of Site 1 in the Phase I report). Upslope, pines cover the hillside.

On the true left side the original vegetation has been cleared and replaced by kanuka forest, which is discontinuous in places with patches of blackberry and gorse. However, within the kanuka there are seedling black beech, matai and broadleaf, associated with understorey shrubs such as *Coprosma rhamnoides* and *C. rotundifolia* (an alluvial flat species), rohutu, occasional horopito (a montane species) and many ferns and ground cover species including the shovel mint, *Scutellaria*. This vegetation is also continuous with similar riparian vegetation both upstream and downstream.

In the vicinity of the dam, the pines on the true left have been logged and in their place a dense cover of introduced species (grasses and herbaceous plants) and native understorey species have established. The natives include tutu, lemonwood, mapou, whiteywood, marbleleaf, wineberry and karamu, with tree-ferns (*Dicksonia fibrosa*) in the wetter places. Potentially damaging weeds include gorse, old mans beard, barberry, blackberry and wilding pines. It is this vegetation that will be growing around the future lake edge so it will be important to control the introduced species and encourage the native forest species (see Recommendations on Mitigation)

8. Vegetation of proposed borrow sites

Two borrow sites ("probable" and "possible") have been identified. The "probable" site is situated on the true left hill-slope some 500m below the dam site, straddling the existing road, and is located entirely within pine forest. The eastern boundary of the site borders a wide zone of native vegetation that forms part of the riparian zone below the dam (Section 9). This is a very important area of native vegetation dominated by kanuka but with regenerating rimu, beech and tanekaha, several lowland species such as ngaio, titoki, akeake and rangiora, and along the river edge a population of southern rata. This vegetation is an integral part of what may become 'protected' vegetation below the dam and reservoir and care will be needed to avoid damage during the 'borrowing' phase of dam construction.

The "possible" borrow site is located above the existing road some 500m downstream from the "probable" site and occurs entirely within pine forest. However, it lies adjacent to an area of original beech forest and a larger zone of secondary vegetation established on ultramafic 'melange' substrate.

9. Between Lucy Creek and the proposed dam. (Maps 3,4; photos 1-7)

Riparian native vegetation is almost continuous along both sides of the river down to Lucy Creek and somewhat beyond. The quality is variable and some areas are dominated by gorse, barberry and blackberry usually in the space between native bush and pines. An old pack track runs along the right bank and parts of this are smothered by weeds. The river is exceptionally scenic with shingle flats, large boulders and areas of bedrock, many deep pools and small areas of rapids. The native vegetation mostly lies on the lower hill-slope but there are also small areas of alluvial flat. The right

bank supports mainly original forest, while the left bank is predominantly secondary forest, some of it well developed.

9.1 Bedrock turf communities (photo 15). Where bedrock is shaded and moist small zones of dense low turf plants occur. These are variable in composition and can be dominated by any combination of a large range of species: mosses, liverworts, *Raoulia glabra*, species of *Epilobium*, *Colobanthus, Leptolepis* and *Hydrocotyle*, *Anaphalioides trinervis*, *Dichondra repens*, *Haloragis micranthus*, *Nertera depressa*, *Viola cunninghammii* and others. The vegetation is best developed close to the water where it is constantly drenched, but it extends up onto drier areas where it occupies crevices and the composition changes. Drier, sunny rocks support species such as *Wahlenbergia gracilis*, *Muehlenbeckia complexa* and *Rhytidosperma* grasses (In the lower Wairoa this habitat supported *Coprosma brunnea*, but this species has not definitely been identified in the Lee.)

9.2 Riparian shrubland (photo 14). The wet and dry turf communities grade into shrubland where-ever a secure root-hold is possible, creating a very distinct zone that is periodically flooded. In wet shaded places *Carmichaelia odorata* is common, often bordered by *C. australis* where the habitat is drier. Scattered in wet places is bush tussock (*Chionochloa cheesemannii*). The dominant species is tutu, which forms a more or less continuous band along the riverbank. *Coprosma grandifolia* and in drier places *C. robusta* (karamu) are widespread colonisers, along with *Hebe stenophyllum*. Kowhai and rohutu (*Lophomyrtus obcordata*) frequently establish in the riparian shrubland, and if they survive floods they eventually form small trees. (Adult kowhai are uncommon, but young ones are plentiful.) Another strictly riparian species is southern rata. A population of 10 or more trees up to 6m tall occurs on both banks just above the Lucy Creek confluence. This is a light-demanding tree that is more common at higher elevations where is occupies bluffs and open ridges, but it descends to low levels through the bedrock gorges and can be quite common on the more open ultramafic rocks of the mineral belt. Its presence in the lower Lee offers an excellent prospect for restoration.

The issue of the potential impact of an altered flow regime on the strictly riparian communities is addressed below (Section 11)

9.3 Alluvial flat. About 200m upstream from the Lucy confluence on the right bank there is a small alluvial flat bearing original bush. It is dominated by mature (up to 1m DBH) and young kahikatea. Other mature trees are black beech, tanekaha, matai, lowland totara and miro. Understorey trees include kaikomako, mahoe, mapou and the rare white maire (*Nestegis lanceolata*). There is a grove of many young adult maire and numerous seedlings and saplings. An adult tree with innumerable seedlings underneath occurs in Lucy Creek, and may be the source of the population. Tall shrubs in the understorey include *Coprosma areolata* (often parasitised by dwarf mistletoe, *Korthalsella lindsayi*), *Coprosma rotundifolia*, *Streblus heterophyllus* (small-leaved milk tree, which is rare in the Lee), rohutu, *Neomyrtus pedunculata*, *Melicope simplex* and most surprisingly a small number of swamp mahoe, *Melicytus micranthus* (a rare species found also in the TDC Recreation Reserve downstream). This is a unique collection of high fertility alluvial shrubs. *Scuttelaria novae-zelandiae* (the Nelson endemic shovel mint) occurs around the edge of the flat but

unfortunately pig rooting, tracking and wallowing have destroyed most of the forest floor habitat. Supplejack is present, another uncommon species in the Lee.
This site is similar to the alluvial flat vegetation upstream (Site 3) that is in the pathway of the reservoir, identified in the Phase I report as a highly significant area.

9.4 Secondary forest. Most of the left bank and several areas along the right bank support a narrow to quite broad zone of secondary forest, usually dominated by kanuka but with a wide range of species. Young rimu are particularly common in places and in more fertile places young matai are prominent, while young kahikatea occupy scattered moist flats and young tanekaha is widespread. Both halls totara and lowland totara are present, and young black beech occurs sometimes with hard beech, red beech and silver beech. Lemonwood (*Pittosporum eugenioides*), kohuhu (*P. tenuifolium*), lancewood, broadleaf, marbleleaf, mapou, five-finger, kaikomako, kamahi and whiteywood are common to rare broad-leaved trees. Some coastal-lowland species are present including ngaio, akeake, rangiora and titoki. (*Olearia paniculata* is another coastal species that occurs downstream in the Lee but is restricted to only two trees above the dam site.) Shrubs include *Raukaua anomalus*, *Leucopogon fasciculatus* and *Leptecophylla juniperina* (both commonly called mingimingi) are scattered occasionally throughout. Climbing white rata is a feature in places and bush cabbage tree is occasional. *Astelia fragrans*, iris, blueberry and *Scutellaria* are scattered ground species.

Some areas extend well upslope and small areas of pines are planted below the road. Patches of wilding pines also occur. It may be possible, following logging, to expand the area of secondary bush, given the apparent diversity of species, including some that are rare in the Lee. The mix of lowland and montane species is evident including some coastal species.

9.5 Lower Lucy Creek. Much of Lucy Creek catchment has been converted to pines, but a small area of original and secondary bush remains around the confluence with the Lee and secondary vegetation extends downstream on the right bank. The bush contains several features that are otherwise not seen in the Lee. The most significant feature is the large number of rimu trees of all sizes from seedlings to trees with a DBH of up to 80cm. They are associated with mature miro and young totara (Hall's and lowland), matai, kahikatea and tanekaha. Kamahi is a feature too (uncommon elsewhere) and a single adult female white maire has produced many seedlings (collected and being grown on for possible restoration planting). Horopito and *Coprosma lucida* are uncommon shrubs for the lower Lee. The fern flora is distinctive with crepe fern (*Leptolepis hymenophylloides*), *Pneumatopteris pennigera* and kidney fern not found elsewhere during the survey.

9.6 Summary. The native vegetation downstream from the proposed dam site to Lucy Creek, is described in some detail for several reasons:

- There is concern that the changed flow regime may negatively impact on the strictly riparian vegetation exposed to flooding.
- The area has original alluvial flat habitat with mature kahikatea forest (similar to that upstream that will be inundated by the reservoir)
- There is a wide diversity of species including iconic species nationally or regionally, such as tanekaha, white maire, swamp mahoe and shovel mint.

- There is great potential to create a pine-free and weed-free reserve that is representative of the lowland part of the catchment.

Tabulated ranking of the assessment criteria using the scale: L=Low, M=Medium, H=High.

Criterion	**Ranking**
Representativeness	H
Rarity	H
Diversity and pattern	H
Distinctiveness/special ecological characteristics	H
Size and shape	M
Connectivity	M
Sustainability	H
Overall significance	**H**

10. Significant natural sites of the reservoir footprint area

10.1 Site 1. (Map 3, photos 9-12)

This site extends from the dam site upstream on both sides of the river for about 1 km. It includes a variety of original and secondary riparian flat forest and rocky gorge habitats and incorporates major bends in the river. The botanical elements are:

1. Right bank beech forest (black dominant with silver and hard), with matai and kahikatea, kowhai and a range of broadleaved species. Damaged by old mans beard.
2. Left bank kanuka forest. Extremely dense understorey of regenerating matai and tanekaha, a range of broadleaved understorey trees, divaricating shrubs (*Melicope simplex*) and a wide variety of ferns. One patch of *Scutellaria.* Dense riparian strip of *Lophomyrtus obcordata* (rohutu), some trees with masses of dwarf mistletoe, *Korthalsella lindsayi*, which also grows on mapou. Excellent quality secondary forest, destined to become tanekaha and matai dominant.
3. River gorge low forest, on the left bank of the major river bends: kanuka wineberry and marbleleaf dominant secondary forest with two akiraho trees (*Olearia paniculata*) a lowland element not found elsewhere in the catchment (but present below the confluence of Wairoa and Lee).
4. Old kanuka on right bank river flat, 10-12m tall with a very dense *Coprosma rhamnoides* understorey, regenerating matai and mahoe (whiteywood), and a dense moist ground cover of *Uncinia* spp, *Asplenium bulbiferum*, *Hymenophyllum scabrum* and moss.
5. Riparian beech forest, narrow strip on both banks: black beech forest with riparian broadleaved species including tree fuchsia, tutu, mahoe, lemonwood and pate.

Tabulated ranking of the assessment criteria using the scale: L=Low, M=Medium, H=High.

Criterion	**Ranking**
Representativeness	M
Rarity	H
Diversity and pattern	M
Distinctiveness/special ecological characteristics	M
Size and shape	L
Connectivity	L
Sustainability	M
Overall significance	**M**

Site 1 covers 3-4ha in area. All of the site will be inundated.

10.2 Site 2. (Map 3,4; photos 13-17)

This site is riparian as well as a steep hill-slope. It includes an old pack track to Waterfall Creek Hut. Dense black beech forest with scattered silver and red beech and a few smaller tanekaha, halls totara (possibly hybrids with lowland totara) and kamahi lines the river. At the northern end are several emergent rimu. The forest floor supports many ferns including *Blechnum volcanicum* and *B. colensoi*. The rocky river bank has a large population of *Carmichaelia odorata*, a locally rare species. Dense mats of a variety of small plants cover the rocks, including a hybrid swarm of *Anaphalioides bellidioides* x *A. trinervis* and both parent species. *Scutellaria* grows sparingly on rocky outcrops within the bush along with *Myosotis forsteri* and *Stellaria decipiens*. Areas of talus support open forest dominated by tree fuchsia, with shrublands of *Coprosma rotundifolia*, *C. crassifolium* and *C. propinqua* (otherwise not common in the area). Matai occurs in gullies at the southern end with scattered kahikatea on the disturbed flat.

Tabulated ranking of the assessment criteria using the scale: L=Low, M=Medium, H=High.

Criterion	Ranking
Representativeness	H
Rarity	M-H
Diversity and pattern	M
Distinctiveness/special ecological characteristics	M
Size and shape	M
Connectivity	L
Sustainability	H
Overall significance	**M-H**

The site covers 3-4 ha. About 1ha of steep bush will survive above the lake surface, consisting of beech (black, hard and red) and matai.

10.3 Site 3. Waterfall Creek flat and riparian forest. (Map 3; photos 18-23)

This site consists of riparian kahikatea forest in two left bank areas, one mature, one regenerating, and a zone of kanuka forest with emerging black beech on the Waterfall Creek flat, right bank.

10.3.1. Access to the kahikatea swamp forest is via a steep descent through young pine forest heavily infiltrated with gorse, and thence through *Carex virgata* wetland on a slope seepage. The forest is a riparian band of tall kahikatea about 50m wide, associated with rimu, mature miro (a rare tree in the area), silver beech and black beech. Understorey trees are marble-leaf, pokaka (not seen elsewhere in the footprint area), mahoe and myrtle with some lancewood and lemonwood. Mature kaikomako (rare on the valley floor grows here under the kahikatea. *Dicksonia fibrosa* is prominent. There is an amazingly dense shrub zone dominated by *Raukaua anomalus*, *Coprosma rotundifolia, C. lineariifolia, Neomyrtus pedunculata*, horopito and halls totara, with a lot of silver beech regeneration. The ground is rich in *Astelia fragrans*, crown fern, *Asplenium bulbiferum* (a lowland element) and *Leptolepis hymenophylloides*. This must be the *Scutellaria* capital of the world for there are dozens of plants, but there is a strong presence of pigs so that ground plants and regenerating trees are at risk. This wet river flat is as good as it gets and is such a rarity in New Zealand now. The riparian edge has common broom, kowhai and lemonwood with a grove of bush snowgrass (*Chionochloa cheesemanii*) along the edge.

10.3.2. Kanuka forest, Waterfall Creek Flat. This was once black beech forest but was seemingly cleared for grazing (patches of tall fescue remain), and is now covered almost completely with 10 m tall kanuka. The understorey is extremely dense *Coprosma rhamnoides* with patches of *Helichrysum lanceolatum* and *Leptecophylla juniperina*, and *Lycopodium scariosum* indicating cold dry conditions. However there are groves of dense *Astelia* some devastated by pigs. In places black beech is regenerating and in one area of older trees *Scutellaria* occurs, although not yet in the

kanuka. The kanuka extends up the slope in places and there are patches of black beech too.
10.3.3. Left bank, pole kahikatea. The Lee has several remnant patches of young kahikatea 10-15 m tall, probably dating from the first land clearance. Where they are dense the understorey is quite open, the litter preventing an understorey. In places *Lophomyrtus* forms an under canopy and *Carex virgata* and *Blechnum novae-zelandica* a ground cover. *Urtica incisa* occurs and there are large patches of the regionally uncommon *Australina pusilla*.

Tabulated ranking of the assessment criteria using the scale: L=Low, M=Medium, H=High.

Criterion	**Ranking**
Representativeness	H
Rarity	H
Diversity and pattern	H
Distinctiveness/special ecological characteristics	H
Size and shape	M
Connectivity	M
Sustainability	H
Overall significance	**H**

Site 3 measures about 4 ha and has very high ecological value. It is a remnant of mature and regenerating kahikatea forest with a unique understorey containing a large population of *Scutellaria* and *Australina*. All will be inundated.

10.4 Site 4. (Map 3,4; photos 24-27)

Only parts of this site were looked at in detail during the survey for the Phase I report. The site is located upstream from the bridge across the Lee and extends to the upper limit of disturbed land (Site 5). It consists of three zones:

1. riparian bush, both original and secondary;
2. a river-bed island covered by kanuka forest;
3. a large, steep hill-slope of beech-matai forest.

10.4.1. The riparian forest is a narrow band of black, hard and red beech, with patches of secondary kanuka and some emergent young kahikatea, and kowhai hanging over the water. While present on both sides of the river it is discontinuous in places where logging, pines or Douglas fir encroach into the riparian zone. There are also patches of eucalypts. Very good kanuka is present especially on the left bank with a dense understorey of mingimingi and in places silver fern and whiteywood. Young matai is prominent. On wet riparian terraces there are wetlands with *Carex* and *Uncinia* species, *Blechnum novae-zelandiae* and cold soil shrubs such as rohutu (*Neomyrtus pedunculatus*), *Myrsine divaricata* (not seen further downstream) and horopito. These are montane species reaching down into colder, lower country. Apart from patches of

pines and eucalypts the native vegetation is in places up to 100m wide, only a small portion of which will be inundated.

10.4.2. The kanuka island is located on a broad stretch of river where the channel divides during floods. There would be times when water flows across the site and in all probability the life span is naturally limited to a few decades. The whole island will be inundated by the reservoir.

It is a unique place. The border is lined by a dense thicket of tutu and in places bush snowgrass is prominent (suggesting a potential in stabilizing the future reservoir margin). Beneath the kanuka there is regeneration of lemonwood, matai and red beech. The shrubs are either fertile lowland species such as *Coprosma rotundifolia* and *Melicope simplex*, or cold soil species like *Raukaua anomalus* and horopito. *Urtica ferox* indicates a disturbed fertile site. The most prominent aspect is the dense ground cover, which is again a mix of fertile lowland and cold montane wetland species. The former include *Astelia fragrans*, a rich carpet of bush rice grass *Microlaena avenacea*) and *Blechnum fluviatile*, while the latter group is represented by a very dense cover of sedges such as *Carex virgata*, a broadleaved carex and several species of *Uncinia*. A more detailed survey of these sedges would be worthwhile, in case there are some rare species in this distinctive habitat.

10.4.3. Beech-matai hill-slope. The Phase I report dealt only with the riparian portion of this site and the full extent and connections with higher ground was not surveyed, although it was appreciated that a sizable area would remain above the level of inundation. This block of land is jointly owned by Stanley, Mitchell and Irvine. It links to DOC land to the west. A mosaic of native and pines cover a hill-slope upstream linking to the riparian area described as 10.4.1. Parts of the native bush have been logged, probably 10-20 years ago.

At the base of the site a large outcrop of bedrock extends into the river, creating a bend and a very deep pool. The bedrock itself is clothed in turf species and has a good population of *Carmichaelia odorata* and *C. australis*, and, interestingly, stunted shrubs of kamahi.

The riparian bush is mainly black beech, with some hard beech and a mix of lowland species including broadleaf, whiteywood, tree fuchsia and kaikomako. The ground is steep with shattered talus rocks and has a range of dry slope species such as *Helichrysum lanceolatum*, mingimingi, native iris and shield fern, *Polystichum richardii*. A road traverses the slope about 50 m above the river and the inundation line is about 10m below the road. This lies just downslope from a very large rimu tree.

Above the road the dry talus surface continues upslope. Native logging has occurred and the vegetation is mostly secondary, dominated by dense regeneration of matai seedlings, saplings and young trees. Some of these have been damaged by goats. In places a deep surface layer of fragmented rock causes instability across the slope, suggesting that good quality vegetation will be important for slope stability above the reservoir.

Further up the slope the vegetation is less disturbed with many young matai, mature lancewood, marbleleaf, heketara (*Olearia rani*) and whiteywood beneath black beech.

Eventually a mature black beech-matai forest occupies the moist gully, with scattered mature rimu and miro and dense climbing rata. A feature is a large sandstone bluff with water seeping from it into a moist gully. This supports an exceptionally well-developed matai forest with an understorey of titoki, pigeonwood, kaikomako and whiteywood. Two species of climbing rata occur (*Metrosideros diffusa* and *M. perforata*), the latter not seen elsewhere during the survey. The vegetation indicates a warm, moist lowland environment with fertile soil. On drier land mature beech forest occurs, including black (large specimens), hard, red and silver.

The matai forest is almost pure in places with numerous majestic trees over a metre in diameter rising 20 m to the first branch. Such forest is probably unequalled in the Nelson region. Fortunately it has been spared from logging even though tracks enter the area from above and rimu stumps are present nearby. On one track a large specimen of old mans beard illustrates the potential danger of machines entering into bush. Mostly the tracks are overgrown.

The beech-matai forest links to the west with continuous beech forest on the DOC estate along the divide between the Lee and the Wairoa. As further elaborated in the section on mitigation the matai forest could potentially be added to the DOC estate and a track formed to the matai to take in its splendid character.

In the Phase I report the site was ranked as follows:

Tabulated ranking of the assessment criteria using the scale: L=Low, M=Medium, H=High.

Criterion	**Ranking**
Representativeness	M
Rarity	L
Diversity and pattern	M
Distinctiveness/special ecological characteristics	M
Size and shape	M
Connectivity	H
Sustainability	H
Overall significance	**M-H**

In this report it is ranked as follows:

Criterion	Ranking
Representativeness	H
Rarity	M-H
Diversity and pattern	H
Distinctiveness/special ecological characteristics	H
Size and shape	M-H
Connectivity	H
Sustainability	H
Overall significance	**H**

The higher ranking relates to the large area of original bush, especially matai forest, the potential for bush regeneration on small areas presently planted in pines or eucalypts, and the continuity with DOC administered land.

10.5 Site 5. (Map 3,4; photo 28)

This site represents the original forest cover of the Lee catchment, which accounts for 88% of the area, virtually all of which is DOC administered land. Continuous original beech forest (black, hard, red and silver, the composition changing with aspect and altitude) is characteristic of this vast area. The river flows through a confined gorge for most of the reservoir-impacted part of this site, which extends about 1km upstream from the upper limit of Site 4. The lower end borders the disturbed riparian land of Site 4, with predominantly matai treeland and kanuka secondary forest. Mature matai trees occur where the lower hill slopes are coated with colluvium. However, most of the riparian zone is more or less vertical bedrock and supports an open treeland/shrubland of whiteywood, kanuka and kowhai. In the lower part of this site the reservoir will be about 5m deep and less than 50 m wide. This scale will diminish upstream and the impact on vegetation will be minimal as the riparian zone is predominantly solid rock. Should the reservoir length be significantly reduced in size this site may not be influenced at all. A small population of tanekaha has been reported at a major fork in the river about 3km upstream, but this is well beyond the footprint area of the reservoir.

Tabulated ranking of the assessment criteria using the scale: L=Low, M=Medium, H=High.

Criterion	Ranking
Representativeness	H
Rarity (unknown)	M
Diversity and pattern	H
Distinctiveness/special ecological characteristics (unknown)	M
Size and shape	H
Connectivity	H
Sustainability	H
Overall significance	**H**

11. Impact on flood-prone vegetation

Well below the formerly proposed dam site on the Wairoa River, Mr Shannel Courtney (Department of Conservation) observed a population of *Coprosma brunnea*, growing on periodically flooded bedrock that was sufficiently fractured to provide rooting places for these small shrubs. The species has not been observed elsewhere in the Wairoa or in the Lee, but indicates that there will be a range of species in limited habitats that add significantly to the biodiversity of the area and its overall ecological value.

At issue is whether a changed flow regime will alter the habitat of species such as *Coprosma brunnea,* which require regular flooding in order to maintain the open habitat. A particular danger is colonisation by exotic weeds, such as gorse.

Flooding is a natural feature of rivers. Floods not only maintain the bed-rock gorge systems but also supply boulders for the maintenance of rapids, sediment and logs for river flat rejuvenation, silt for the gorge turf plants described above (which are a characteristic feature of bed-rock lined rivers), water and nutrient for wetlands and seeds for riparian species dispersal (for instance kowhai and beech). Floods recharge the river system and revitalise the riparian vegetation. The reservoir will alter the flooding pattern to an unknown degree but will presumably halt the downstream movement of rocks and perhaps logs. It is probable that the bed-rock confined nature of the river will minimise changes in the riverbed and adjacent riparian zone.

Sections 9.1 and 9.2 above describe vegetation within the flow regime of the Lee that is periodically subject to intense flooding that:

- Keeps the habitat open and exposed to full light
- Irrigates roots that are otherwise embedded in solid rock crevices
- In times of low-flow provides water for low-growing mat plants that create a flood resistant turf
- Provides a habitat for a special range of species
- Eliminates or restricts the growth of weed species that would otherwise occupy the habitat of native species

- Allows a buffer vegetation adjacent to more slowly developing bush further away from the river bank
- Helps to protect alluvial deposits from instability and therefore helps to maintain the water quality of the river.
- Creates a unique habitat for animal life, including insects and fruit-eating birds.

The reservoir is designed to release water slowly throughout the summer and therefore provide a constant water supply for irrigation on the plains below. When the reservoir is full the river flow downstream will be normal. When it is partly or completely empty the reservoir will need to fill before the downstream parts receive additional flow after rain. Plants growing on rock in the flood zone are regularly exposed to dry conditions and are adapted to them. However, extreme drought can be influential. Drought in 2000-1 resulted in the loss of many black beech trees along the terrace of the lower river, opening the canopy and allowing the influx of weed species.

In all likelihood, the flood regime of the river will not be greatly altered by the dam and reservoir. This is because the reservoir will generally be kept full and the spill-over during flooding events will carry the same amount of water as normal. This means that most of the bullet points above will be unaffected. However, it is probable that the number of spill-over events will be less than the number of small 'freshes' because some of the latter will simply fill the reservoir without going over the dam. In this sense the low-flow periods will be extended. If so this could have a negative impact on the wetland turf vegetation and some of the shrubs that need wet conditions such as *Carmichaelia odorata*, Nelson's native broom. However, it is also possible that the reservoir will actually reduce the impact of drought by releasing more water than would normally be flowing at such dry times.

While a close watch on any changes in weed growth is important, it is doubtful that the dam and reservoir will have a negative impact on the riparian vegetation and species composition. However, owing to the uncertainties, a monitoring programme should be put in place. This might involve transect and photo-point measuring every six months, perhaps timed to reflect normal maximum and minimum river flows.

12. Recommendations on mitigation

The proposal offers opportunities for mitigation. The survey has identified a number of ecological issues that ideally should be addressed. Some of these occur within the footprint area and relate to adequate functioning of the proposed system. Others lie outside the footprint area and relate to degraded ecological conditions elsewhere in the catchment, both above and below the footprint. Still others are in adjacent land and relate to recreational opportunities that improved access to the Lee might provide.

12.1 Pest control. The vegetation is severely impacted by pigs and there are also deer and goats present. The Lee River appears to have ideal habitat for blue duck and, as proven elsewhere, intensive predator control can lead to the successful establishment of blue duck. Predator control of possums, stoats and rats would improve the habitat for fauna.

12.2 Weed control. Old mans beard is present in the footprint areas and also downstream where it is seriously impacting on the quality of the riparian vegetation. Barberry, hawthorn, gorse, broom and blackberry are other weeds that compromise the indigenous character of the area although they are less ecologically damaging. Wilding pines feature in several of the sites identified as botanically significant. Willow and poplar are scattered along the river.

12.3 A buffer zone around much of the reservoir is likely to be composed of regenerating native vegetation that develops after pines are logged (photo 29). However, wilding pines and old mans beard will also establish after logging and will need to be removed. The dam and reservoir should have public access and support weed-free native forest. Some of the area lying above the proposed water-line is potentially unstable colluvium that could slump with the saturated lower slope. Dense, stable vegetation will help mitigate against this possibility.

12.4 The old pack track which follows the right bank from Lucy Creek to Waterfall Creek could be cleared of weeds and eroded parts restored for public access.

12.5 The native vegetation below the dam could become the "Lee River Riparian Reserve".

12.6 A "Mountains to the Sea" philosophy could be put in place. At present the "mountain" part of the catchment is in original condition, but the seaward portion from Lucy Creek downwards is mostly seriously degraded ecologically. The Waimea estuary into which the Waimea River flows is regarded as a wetland of national importance

12.7 Some of the pine areas below the main access road could be purchased after logging and regenerated to native forest. This is especially true below the dam, and also parts of Site 4.

12.8 Roads and forestry operations have encroached on important ecosystems along the river flats. A clear separation between developed areas and protected riparian areas (minimum 20 metres?) is required.

12.9 Species establishment. Some species are present in the catchments in very small numbers, and some have probably been eliminated from the disturbed areas. Black maire along the Wairoa, might well have once extended into the proposed footprint zone of the Lee, for instance. Lower in the Wairoa ribbonwood and narrow-leaved lacebark have almost been eliminated. Large areas of riverbank are virtually devoid of any indigenous species, and where the river crosses the Waimea Plain indigenousness is completely lacking. Species that might be propagated and replanted around the reservoir include kahikatea, matai, white maire, black, hard, red and silver beech, kowhai, lemonwood, akeake, ngaio, akiraho (*Olearia paniculata*).

12.10 Species rescue. Some older specimens (up to a metre tall) growing in the inundation area could be wrenched several months before removal and relocated, e,g, tanekaha, matai, totara. Small seedlings of many species could be transplanted to a nursery for growing on and eventual replanting

12.11 A large number of fine timber trees will need to be removed from the valley floor and lower slopes: beech (four species), tanekaha, kahikatea, matai, rimu, totara, kanuka and others. The timber should be made available for public good development including boardwalks, seats, shelters and interpretation facilities.

12.12 Site 4 includes two very important habitats. **The kanuka in-stream island** is basically a cold fertile wetland and the ground cover is rich in species of *Carex* and *Uncinia*. A survey at the appropriate time for species identification should be carried out in order to identify the full range of species in case there are rare or even endemic species growing in this habitat that will be inundated.

12.13 The other part of Site 4 of importance is the **matai forest**. This essentially pure stand is regionally or even nationally significant. It is presently in private ownership. Because it is contiguous with the Lee hinterland administered by DOC (the ridge separating the Lee and Wairoa) a land purchase option seems appropriate. Also a track to the matai forest is desirable. Furthermore, upstream there are several patches of riparian or hill-slope bush that ultimately link to the matai- beech forest but the integrity of these is modified by pine and eucalypt patches. When these are logged a land transfer would greatly increase the area of protected land bordering the footprint area.

13. Conclusions

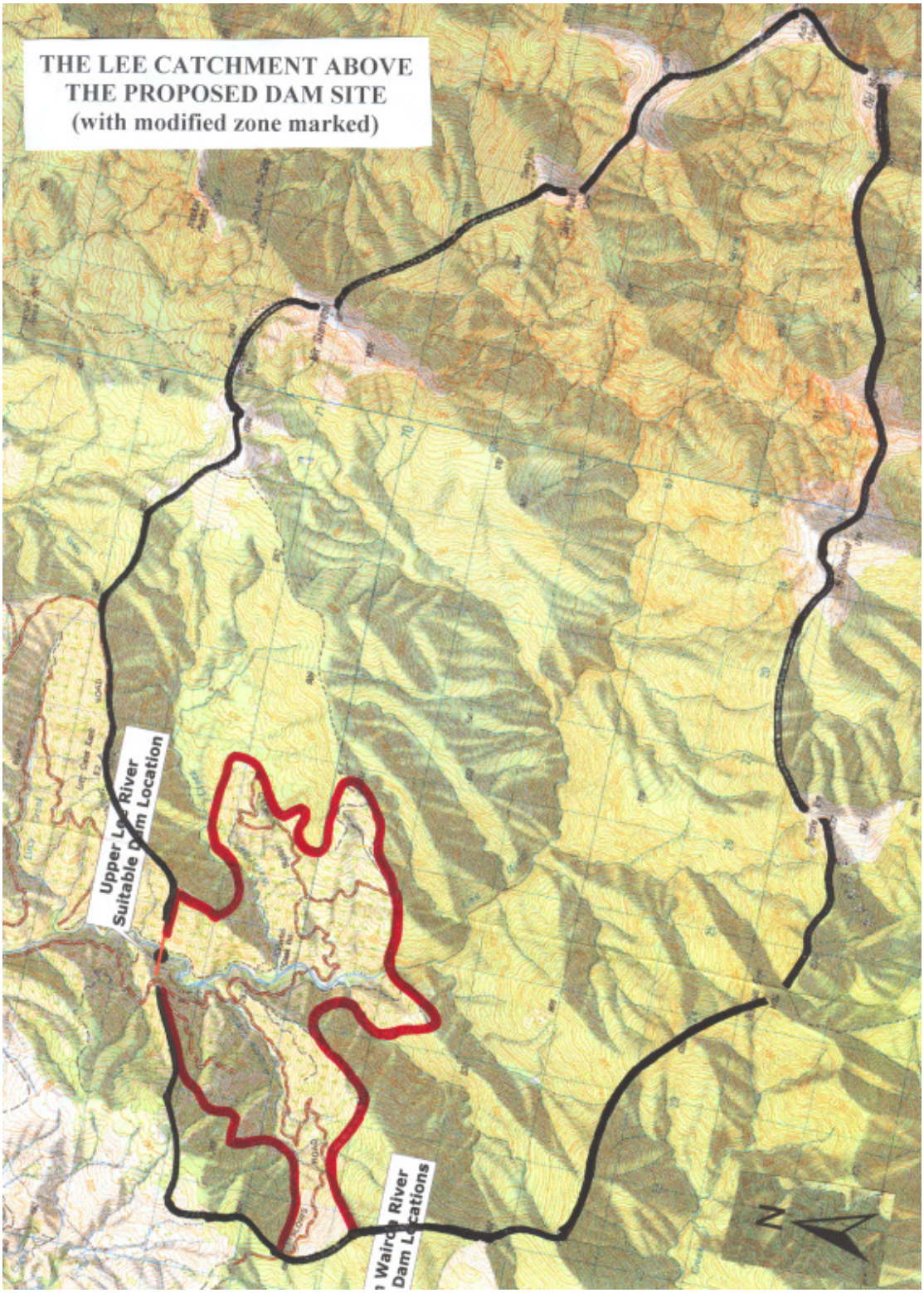
1. Most of the dam and reservoir footprint area of the Lee is botanically significant because it has a good range of ecosystems, and good populations of rare or distinctive species.
2. Site 1 will be inundated; Site 2 will mostly be inundated except for 1ha of beech-podocarp forest on the true right hill-slope; Site 3 will be inundated; the riparian and river flat areas of Site 4 will be inundated except for a band of modified kanuka forest along the left-bank, and most of the critically important true left hill-slope will remain; the immediate riparian zone of Site 5 will be inundated but because the river follows a bed-rock gorge through this site the overall impact will be slight.
3. The downstream impacts on flood-prone vegetation of the changed river flow regime are difficult to judge but overall do not seem to be critically important, but monitoring, for instance establishing and maintaining photo-points, will be needed.
4. Native riparian bush from the dam downstream to and including the lower Lucy Creek is highly significant and should be protected and enhanced. Similarly, the true-left hill-slope matai forest of Site 4 should be protected.
5. Weeds, animal pests such as pigs, and forestry activities are damaging the natural ecosystems.
6. A mitigation package could focus on these issues (including predator control), as well as land protection and recreational asset development, including native forest establishment within the footprint area and restoration beyond the footprint area, especially an ecological restoration programme downstream, and the re-introduction of appropriate animal and plant species such as blue duck and black maire.

APPENDICES

1. **MAPS**

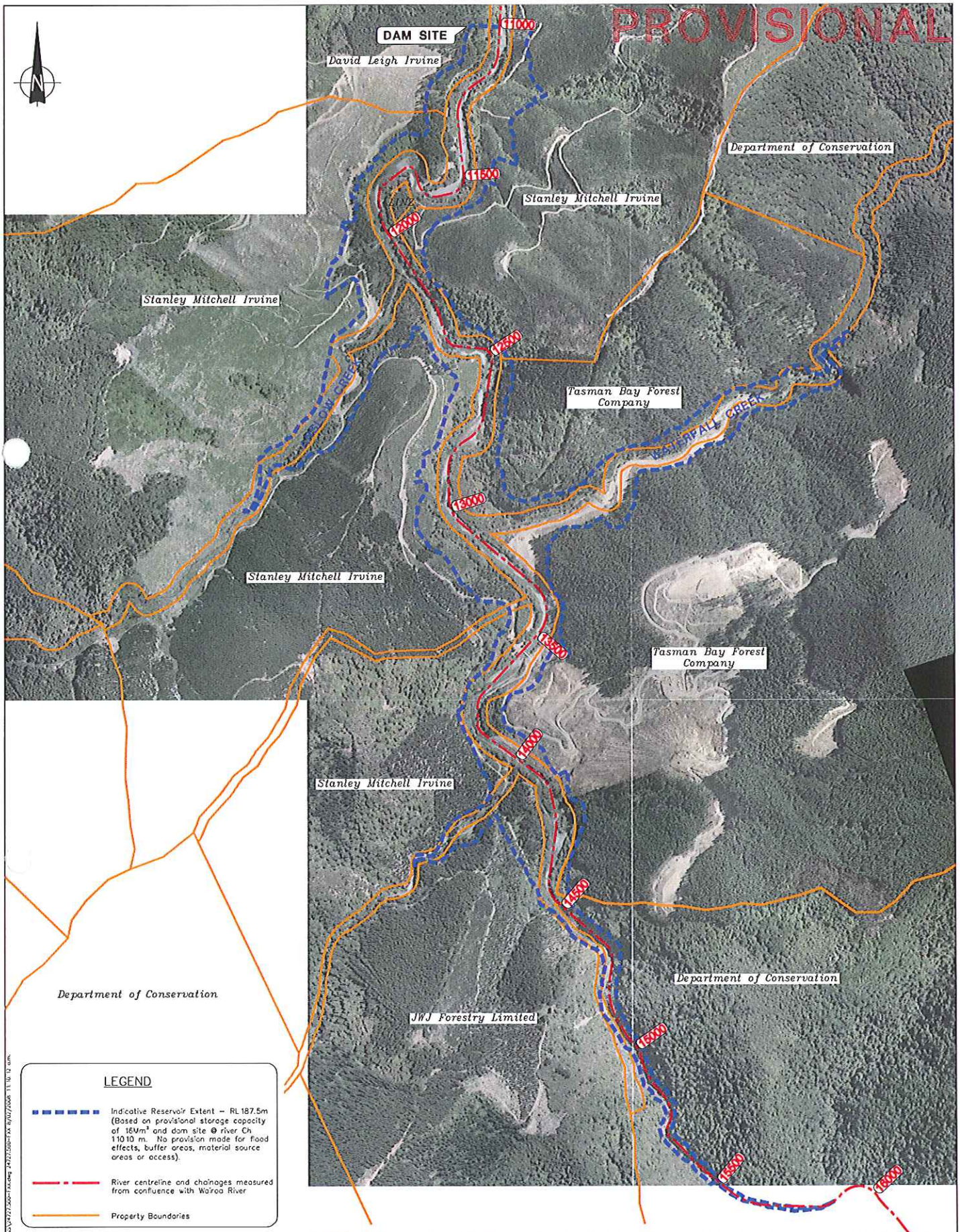
   Map 1: The Lee catchment above the proposed dam site
   Map 2: Land Tenure

2. **PHOTOGRAPHS**



MAP 1: Boundary of the Lee Catchment, with the area now dominated by forestry, and the site of the proposed dam, highlighted.

MAP 2: Land tenure in the Lee Catchment in the vicinity of the proposed dam and reservoir.



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Tonkin & Taylor
Environmental & Engineering Consultants
Auckland Hamilton Nelson Wellington Christchurch Whangarei

WAIMEA WATER AUGMENTATION COMMITTEE

WAIMEA WATER AUGMENTATION PHASE 2

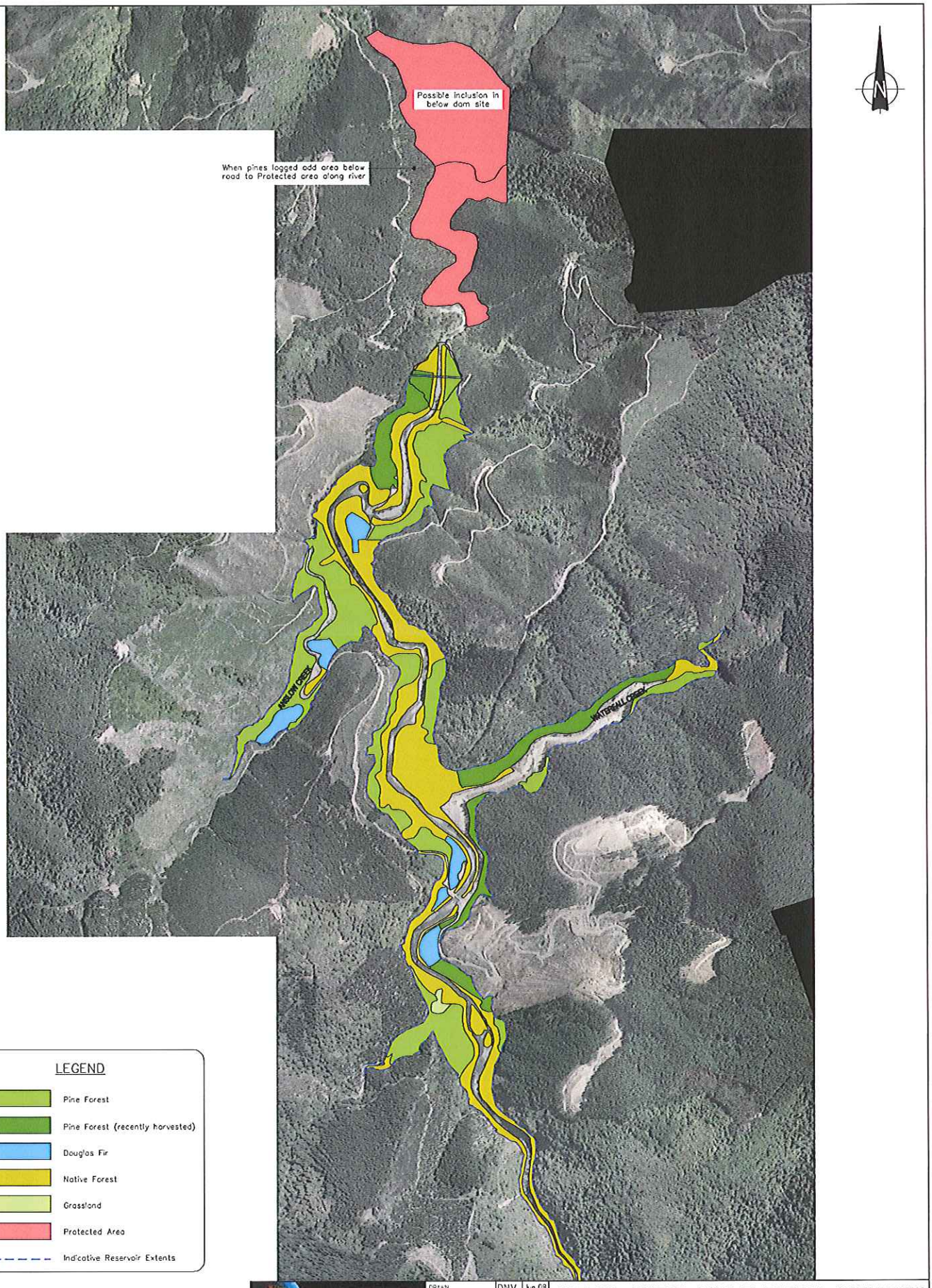
LEE RIVER

Indicative Reservoir Extent

FIG. No. 24727.500-FXX

REV. 0

MAP 3: Areas of significant native vegetation below the proposed dam and within the footprint area of the reservoir



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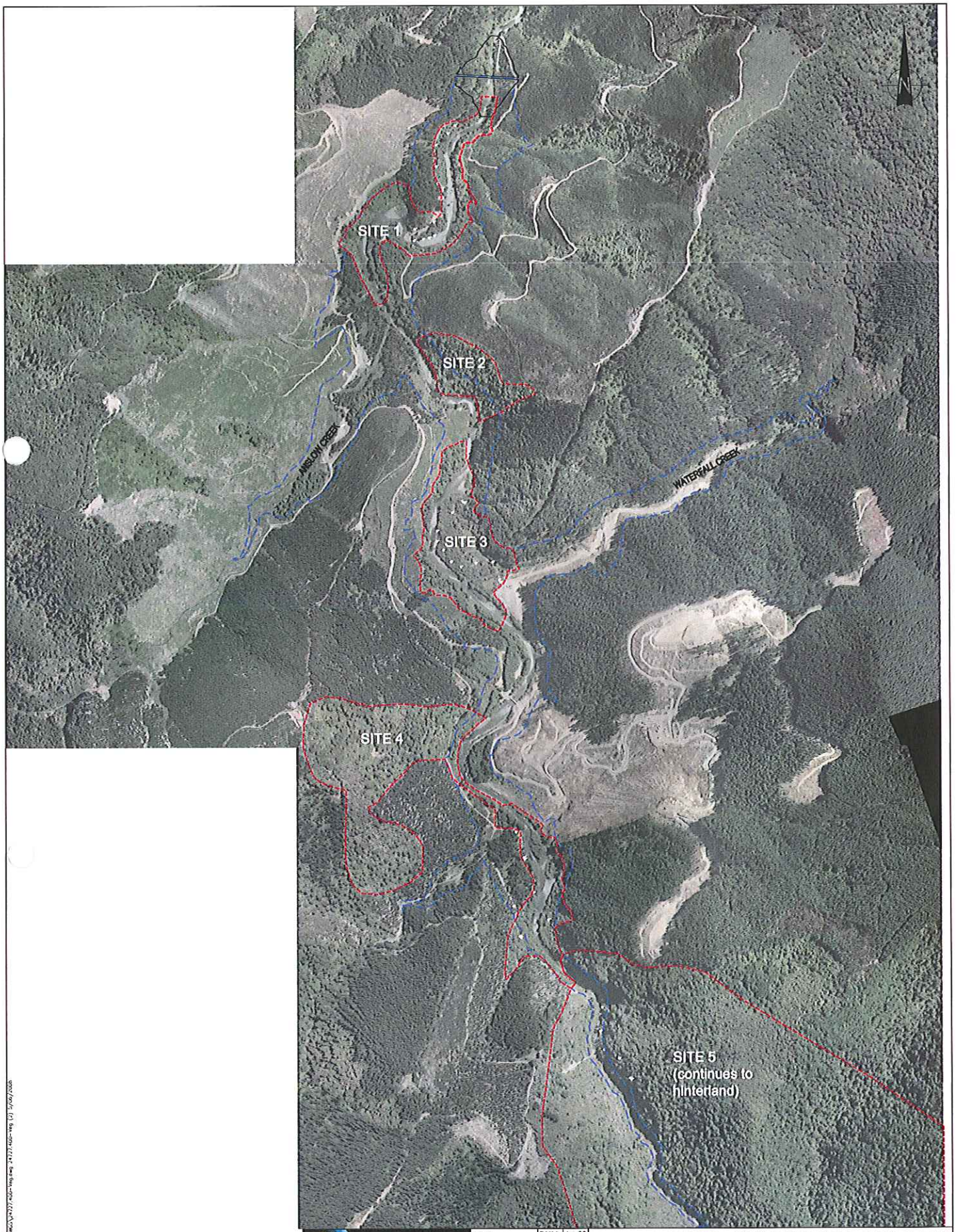
PROJECT No. 24727.400		

WAIMEA WATER AUGMENTATION COMMITTEE
WAIMEA WATER AUGMENTATION PHASE 2
LEE RIVER
Vegetation Mapping

FIG. No. 24727.400–Veg REV. 0

MAP 4: Areas of significant vegetation remaining above the water-line of the proposed reservoir



SCALE 1: 10,000
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WAIMEA WATER AUGMENTATION COMMITTEE
WAIMEA WATER AUGMENTATION PHASE 2
LEE RIVER
Vegetation Monitoring Sites

FIG. No. 24727.400-Veg2 REV. 0

Appendix II: Photographs

1. Lucy Creek at its confluence with the Lee. A small area of bush remains with a high concentration of rimu trees of all ages, as well as kahikatea, tanekaha, matai and miro. The presence of white maire also makes this an important place. The Lucy bush links to significant riparian bush along the Lee and also expands down the valley into a sizable area of secondary native vegetation

2. Lucy Creek tumbles through dense riparian bush to join the Lee. This small patch of beech forest contains numerous podocarps, especially rimu, rare species such as white maire and a set of ferns not seen elsewhere during the survey, including kidney fern. Privately owned it links with the riparian strip to form a potentially important reserve.

3. White maire (*Nestegis lanceolata*) is extremely rare in the Nelson region. Only this tree in Lucy Creek, and a grove just upstream along the Lee were found during the survey. Black maire, also rare is found in the lower Wairoa and narrow-leaved maire is found on the Waimea plain: all at or near their southern limit, making this part of Nelson nationally significant.

4. Seedlings of white maire growing beneath the parent tree along Lucy Creek. While presently very close to local extinction these seedlings could be used for replanting around the perimeter of the future reservoir, or further downstream on fertile alluvial flats where the former habitat would have been.

5. A grove of 10-20 southern rata (*Metrosideros umbellata*) grows along a short stretch of riparian bush just upstream from the confluence of Lucy Creek. While not seen elsewhere in the footprint area, southern rata has descended along the open riverbank bedrock from higher levels. At 140m asl it is here growing well within the lowland zone, along with coastal species such as akeake and ngaio.

6. An original patch of mature alluvial flat kahikatea forest (similar to Site 4) downstream from the dam site. A place of rich understorey diversity including white maire, *Coprosma areolata*, *Melicytus micranthus* and *Scutellaria* combining into a unique regional flora but now virtually extinct. The old pack track passes behind and this would make a wonderful site for interpretation.

7. The kahikatea swamp forest is not only relished by understorey species of plant but also wild pigs, which track, root and wallow throughout and have nearly destroyed the potential habitat of *Scutellaria* and prevent seedling establishment of rare species such as *Melicytus micranthus*, of which only one individual remains. Pig and other pest control is a potential mitigation action.

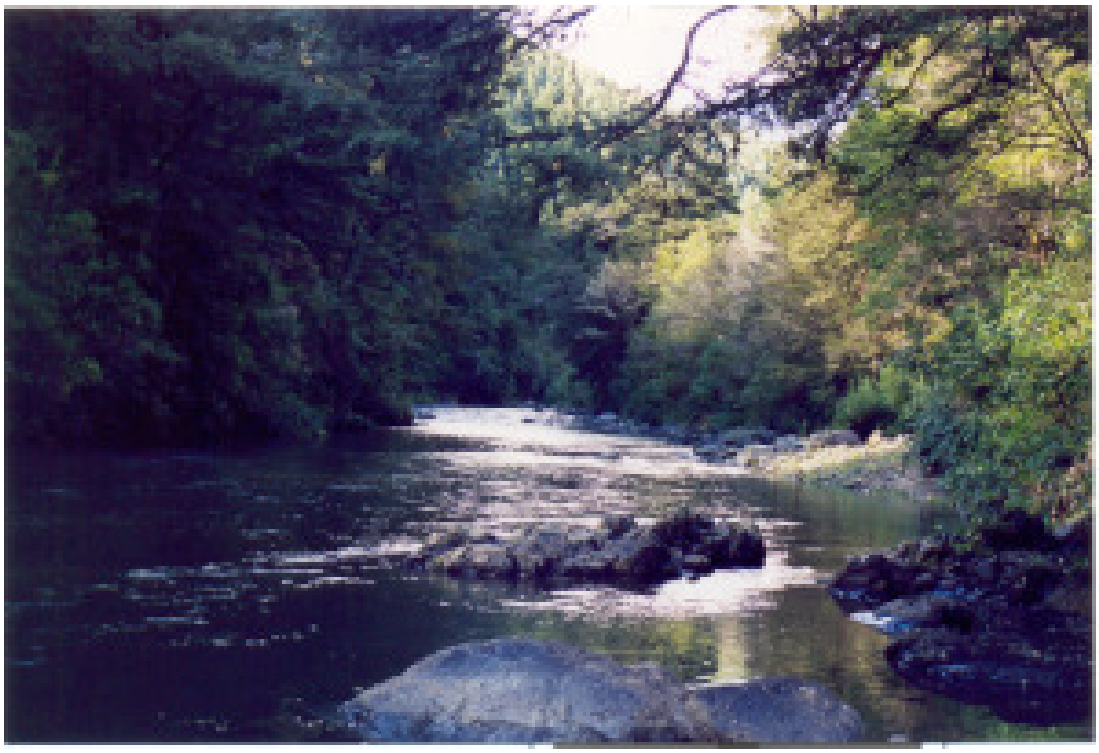
8. The proposed dam site across the Lee River. Here forestry has encroached closely onto the riparian strip and native vegetation is limited to a thin band of black beech, a rimu and scattered kanuka. This is the type of vegetation developed to a greater or sometimes lesser degree that occurs along the entire length of the proposed reservoir.

9. The Lee just upstream from the proposed dam site. The dam site itself is not ecologically important but immediately upstream there are several different forest habitats of significance, including beech forest (in which old mans beard is a problem), kanuka (with *Scutellaria*, and matai and tanekaha regeneration and *Lophomyrtus* bearing a large population of the threatened dwarf mistletoe *Korthalsella lindsayi*) and river gorge vegetation including *Carmichaelia odorata*, a locally rare species, and the only akiraho observed in the valley (*Olearia paniculata*, generally coastal tree). The reservoir at this point will be about 50m deep.

10. *Scutellaria novae-zelandiae* growing under kanuka and beech on a river flat in Site 1. This species is found only in the northern South Island and is mainly limited to alluvial forest on fertile sites. It forms small patches and is widely scattered in small populations. This survey indicates that the Lee has a very good population in at least five sites. Other good sites are in the Tinline (a tributary of the Pelorus) and the Hackett, indicating that this part of northern SI is the centre of its distribution. The only other good population occurs in Upper Takaka. The best site in the Lee is in mature podocarp forest. In kanuka there are few patches, indicating that it is just entering this habitat, but as the podocarps (especially matai) increase then more *Scutellaria* will establish. There are scattered plants below the dam site but most are above and will be inundated. Pig rooting is ruining potential habitat downstream

11. One of the most widespread small trees along the riparian edge is myrtle (rohutu, *Lophomyrtus obcordata*). Older plants are parasitised by the dwarf mistletoe, *Korthalsella lindsayi*, a nationally threatened species. In Site 1 the mistletoe also grows on mapou (*Myrsine australis*) and below the dam site it grows on *Coprosma areolata*. This photograph shows that it can grow very densely on some plants. But it is inexplicably absent from many plants in this area and is completely absent from large parts of the country. The open edge of the riparian habitat is one factor that favours its establishment. Rohutu itself is a very important forest species because it bears large numbers of berries that are eaten by bellbirds and tui. Its seedlings establish in open riverbank rock crevices and silt so that the natural flooding regime of a river is important for its survival.

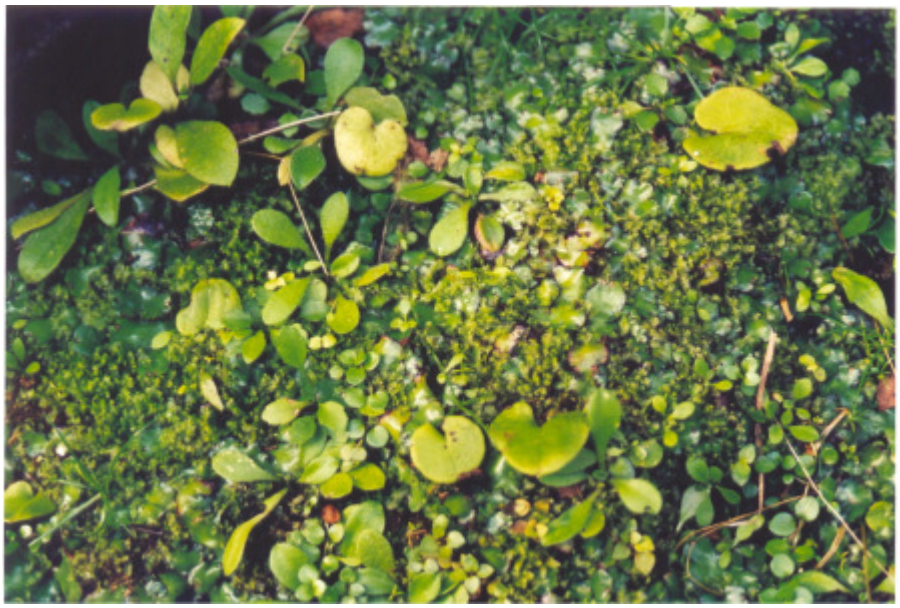
12. A typical stretch of the Lee River at the upper end of Site 1, showing beech forest on both sides of the river. The shade cast by intact forest is an important factor in the colonisation of the banks after flooding and also helps to limit weed establishment.



13. Site 2 in the Lee is a dense patch of beech forest on the right bank. Here the black beech is associated with a mature tanekaha (centre). Note the flood line vegetation of light-demanding tutu and both *Coprosma robusta* and *C. grandifolia*, and note the lancewood, a relatively uncommon species in these forests. Seed from this tanekaha and the few other mature specimens nearby are resulting in dense colonisation of kanuka forest downstream (Site 1). Although tanekaha grows in the open scrub on the mineral belt soils downstream, almost all the individuals along the Lee are strictly riparian, because they need light to get established and moist soil. Mature tanekaha occurs near Lucy Creek and is reported from a major fork upstream beyond the impact of the reservoir, but a large part of the riparian Lee population will be inundated. Tanekaha is one of the more special New Zealand trees. It is commonly known as 'celery pine' because its green shoots have the appearance of celery leaves, even though they are technically flattened stems. It is not a pine but a podocarp. The wood grain is exceptionally straight, making a valuable timber, and a scientific tool for assessing climate change. Maori had very high regard for tanekaha ("Tane's strength"), the name perhaps reflecting the very regular and upright growth. It was reportedly planted in places where its tannin would stain mud black for use as a dye. The inner bark produced a red-brown dye, as well as medicine for gastric and birth related problems, and the wood, while very strong, could be carved and shaped for taiaha and tokotoko. Tanekaha occurs in scattered places throughout North Island but in South Island only in small parts of the western Sounds, the eastern Nelson Valleys and NW Nelson. In all these places it is associated with low fertility rocky places with open vegetation, especially the mineral belt. In Nelson it is limited to the Maitai, Roding and Lee Valleys, all places that the mineral belt crosses. Its absence from the Wairoa is unexplained, but such gaps are typical of a plant nearing its southernmost distribution where minor environmental fluctuations can have dramatic impact. The genetic value of species at their limits is potentially significant in a changing world. Owing to its important place in New Zealand natural and cultural history, the loss of tanekaha is not to be taken lightly. Its presence in the Lee makes this place nationally significant.

14. Where floods in the Lee surge high up the solid rock banks they create an open habitat for the nitrogen-fixing tutu and native broom, two species of which occur here, *Carmichaelia odorata* (foreground), a local species, and *C. australis*, a more widespread species. Where the solid rock remains moist and with crevices protected from the scouring caused by floodwater, a carpet of 'gorge turf' or 'riparian turf' species can develop. The Lee is a very good habitat for this community (see detail in photograph 15). This community will be eliminated by inundation within the footprint, but does occur downstream. There is a question as to whether it will re-establish along the new water level within the footprint, or will be impacted by any change in the flooding regime downstream. Note that the turf community extends down to the edge of the water even at times of low-water level after a dry summer. In a reservoir situation the draw-down could be substantial during dry periods (because that is when the irrigation needs are greatest), the scouring action of floods may be reduced, and the deposition of silt on the inundated area will be more constant. Hence it may be difficult for the 'gorge turf' community to develop on the new surface.

15. The ‘gorge turf’ community. In this image there is a carpet of moss and liverworts with several spider orchid leaves (*Corybas macranthus*), rosettes of *Craspedia minor* and *Lagenophora pumila* (centre, left) creeping *Epilobium nerteroides* and *Nertera depressa*, and grassy tufts of *Colobanthus apetalus*. A seedling *Coprosma grandifolia* is present and often in these places myrtle, tutu, and wineberry seedlings also occur (species that colonise open edges). In other examples a dense mat of *Anathalioides bellidioides* and *A. trinervis* and hybrids occur along with *Oxalis magellanica*, *Oreomyrrhis colensoi*, *Pratia angulata*, *Leptinella mediana*, *Raoulia glabra* *Hydrocotyle* sp., *Ranunculus* sp. and *Viola* sp. In other words, this is a species-rich habitat adapted to a most tempestuous environment.



16. *Scutellaria* growing on a rock ledge in dense beech forest in Site 2. This habitat is actually a cut rock ledge along the pack-track to Waterfall Creek. Other specimens occur along the track. It is possible that it became established when the track was more open and more light entered the site, because it is not a typical place for this species. However, it does indicate that even rare species can grow in places with human disturbance so that reintroduction into places where is has been lost is a possibility. Patches may well be able to be transplanted.

17. Associated with the *Scutellaria* shown in the previous photograph is this sward of *Myosotis forsteri*, a widespread species but uncommon locally. Here it is associated with maiden hair fern, *Adiantum cunninghamii.*

18. Site 3. This is an extremely important site. In the foreground is a riparian strip of mature podocarp forest dominated by kahikatea. Within, there is a dense shrub zone, and a large population of *Scutellaria*. Kahikatea swamp forest would have been characteristic of the many small alluvial flats along the Lee. An excellent but pig-damaged example occurs below the dam site. Across the river is the flat (more or less a fan) formed by Waterfall Creek. This area was presumably farmed at one time but has now been colonised by multiple-age kanuka within which new beech forest is developing. Black beech along the river is a *Scutellaria* habitat. Upstream there is riparian beech forest with regenerating kahikatea. The wilding pines present on the flat could easily be removed as part of a mitigation package.

19. Site 3. Interior of the podocarp forest. A wide range of small-leaved shrubs characterises this place, including *Raukaua anomalus*, *Coprosma rotundifolia*, *C. linariifolia*, *Lophomyrtus obcordata*, and *Neomyrtus pedunculata*. Kaikomako, tanekaha and pokaka are significant trees and horopito is a relatively uncommon shrub locally. The ground has a rich carpet of ferns, including *Blechnum colensoi* and *Polystichum vestitum*, and *Hebe vernicosa* is a sprawling ground shrub. The species combination suggests a cold, wet environment (a swamp forest) but with warm, dry periods on fertile soil.

20. Site 3. An unusual feature along the riverbanks is the presence of bush snow tussock, *Chionochloa cheesemanii*, growing among the young tutu. While the tussocks get periodically flattened by floods the underground parts are protected by the pavement of boulders. Such a habitat could probably not be regenerated along the edge of a reservoir where silt rather than rocks will accumulate. However, this species is worth experimenting with as a stabilising plant.

21. *Astelia fragrans* occurs widely in the area on moist fertile ground, here under kanuka and black beech. While healthy in this instance wild pigs can devastate these colonies, uprooting and eating the fleshy rhizomes and leaving behind a carpet of dead clumps. Pig control is badly needed in the Lee and could form part of a mitigation package to rid the area of pests, including predators that have accounted for the loss of blue ducks from the Waimea River system.

22. The upper portion of Site 3, where some mature podocarps remain, but the dominant feature is the large number of regenerating kahikatea along the left bank. Kahikatea would have been a characteristic species on the many small flats along the Lee, but they have largely been eliminated. They were probably logged but in some areas small adults remained that have become seed sources for the new generation. Kahikatea was a sought after timber for both construction and manufacture and has been virtually eliminated from large parts of New Zealand, including the Tasman District. Note the grove of pole black beech in the kanuka on the right bank (left). Abandoned farmland can quickly revert to important indigenous habitat.

23. Beneath the kahikatea forest of site 3 the ground can be almost bare providing habitat for the mat-forming *Australina pusilla* a nationally widespread species but locally rare in the Tasman District, being largely confined to fertile flats under podocarp forest.

24. Towards the upper end of the proposed reservoir a very significant tract of bush extends up the left-bank slope above the potential water line (part, Site 4). The bush covers a thick layer of fragmented rock and the moist, warm NE-facing slope supports an almost pure stand of large matai trees. A distinctive understorey of titoki, pigeonwood, kaikomako and whiteywood, with much supplejack and climbing tangles of two rata species underscores the warm, fertile nature of the site. Such matai groves are rare in New Zealand today and this site must represent one of national importance. Although privately owned the bush extends back into DOC land. Its purchase and the building of a 'Matai track' in order to appreciate it, could be part of a mitigation package.

25. It is rare to see a grove of dense matai trees at full maturity, trunks a metre thick and 20m to the lowest branch. They grow in a specially favourable site in the Lee where moisture, warmth and fertility combine to create perfect conditions, reflecting the kind of benign environment that the Nelson region originally provided for native plants and the reason why so many northern species reach into the region as well as endemic and other nationally rare species resulting in high species diversity.

26. Logging of some of the rimu occurred near the matai of site 4, some 10-20 years ago, leaving tracks to regenerate native bush. Here a mature old mans beard has also established from seed brought in by machinery.

27. The left bank riparian zone of Site 4 includes well-developed secondary forest, mainly kanuka with some original beech and kowhai. The upper portion of this will not be inundated. However, older scattered pines and some eucalypts encroach into the native vegetation, and once these are removed the quality of the bush will improve.

28. The upper portion of the reservoir footprint in the Lee follows a narrow gorge with indigenous forest on both sides continuous into the elevated hinterland. Here, on the lower edge of the bush, matai forms a riparian band below kanuka forest. The reservoir will be at most 5m deep and 50m wide at this point, diminishing upstream. The impact will be on the immediate riparian vegetation such as turf, but will be relatively minor.

29. When pines are logged, dense vegetation develops on the bare ground. Much of this is herbaceous weed growth, but a lot is regenerating native bush composed of ‘scrub hardwoods’ like tutu, wineberry, marbleleaf and tree ferns. This will mature into dense forest around the reservoir margin as long as weed growth, especially wilding pines and old mans beard, are controlled

Lee River Water Augmentation Proposal: report on the vegetation along the upper reach of the proposed reservoir

Philip Simpson
Uruwhenua Botanicals
April 25, 2009

Background.

The March, 2008 report described significant vegetation sites from Lucy Creek downstream from the proposed dam site, upstream to approximately the upper limit of the proposed reservoir. This upper limit approximates the beginning of a solid bedrock gorge. Below this point the river valley is wider and the riverbed includes many areas of boulders. Alluvial flats are typical, although in general relatively narrow and often discontinuous. The original proposed dam site proved unsuitable and an alternative site was investigated about one kilometre upstream. Repositioning the proposed dam upstream means that the upper reach of the reservoir will extend further upstream by about a kilometre. This additional stretch winds through a narrow forested valley, all of it included in Department of Conservation administered land. The present report comments on the vegetation along this upper reach. The site was visited on March 19, 2009, after a relatively prolonged dry period when the water level was low.

Physical features

The river flows in a solid rock bed for more or less the entire distance. Often the river has carved out deep pools, but there are also areas of rapids over boulders, and some small sandy and boulder beaches. In general continuous vegetation forms about 3m above the current water level. During a flood the water would flow through the lower part of the vegetation, and completely cover the turf patches that form on shaded sandy banks, and areas of scattered shrubs growing in the bedrock crevices. There is only one place where walking access along the river is completely blocked by deep water. This is at the downstream end of the site where the bedrock forms a narrow gorge and deep pools 3m deep occur. Above this gorge to the upper limit of the proposed reservoir, access along the riverbank is possible, with caution. The river and valley are highly scenic.

There is a diversity of rock types in the riverbed, dominated by green sandstone. The steep slopes adjacent to the river are often bluffy, and elsewhere there is a shallow colluvium over the surface. Side streams are few and enter steeply, including waterfalls. For the most part the river follows a SE to NW course. This means that sunshine can penetrate into both banks of the valley with a little more exposure onto the true left bank. Altitude is about 200masl at the upper limit, lowering to about 170masl at the entrance to the gorge. Given the high ridges above the valley and the cold air drainage, the altitude is sufficient for a change from lowland bioclimatic conditions to montane along this stretch of valley. The true left side of the valley has been disturbed by fire along most of its length, although there are increasingly large patches of original bush, that eventually dominate upstream from the reservoir limit.

Vegetation

The basic forest type is beech/podocarp. This varies according to proximity to the river, bluff systems, altitude and land use history. Close to the river there is a narrow zone of broadleaved forest species. These are more short lived than the beech and podocarps and are adapted to flood disturbance, but they also extend upslope onto bluffs. The species include broadleaf, whiteywood, kaikomako, titoki, kowhai, lancewood and others. A subcanopy of tall coprosmas (*C. lineariifolia, C areolata, C. rotundifolia*) is well developed in places along with myrtle and mapou, and there is often a rich ground cover of shrubs (including rangiora and bush cabbage tree), ferns (including filmy ferns, crown fern, crepe fern and kidney fern – the last two species seen previously only along Lucy Creek) and sedges (especially *Uncinia banksii*). The broadleaved forest changes with increasing altitude with greater kamahi in the canopy, and horopito and pokaka in the understorey. Along the river tutu and wineberry are present forming a marginal band of young trees, where shrubs of *Coprosma robusta* and *C. grandifolia* are also prominent. Southern rata is present occasionally (as it is downstream near Lucy Creek). Climbing white rata is common. Scattered through the broadleaved forest are beech (black, red and silver), matai and rimu, but these are more pronounced upslope away from the river. Both lowland totara and Hall's totara are present, and miro becomes dominant over rimu with increasing altitude. No tanekaha is present although it is recorded near a stream confluence about two km upstream, and is quite common downstream. No locally endemic shovel mint (*Scutellaria)* was observed

On the true left bank, the original beech podocarp forest has mainly been burnt, and kanuka forest has replaced it, with remnant trees and groves of red beech, black beech and matai. The understorey is well developed with a dense shrub layer of *Coprosma rhamnoides* and *Helichrysum lanceolatum*. Kowhai and matai regeneration is present, and a grove of the tall grass *Microlaena polynoda*, not seen previously in the survey, adds a locally distinctive feature. As with disturbed forest downstream the ultimate forest will be dominated by matai.

The vegetation along the open riverbed is distinctive, and consists of patches of dense turf with scattered seedlings of forest species and flood tolerant shrubs, mainly native brooms. The turf grows mainly on moist patches of sandy soil and consists of a wide range of low-growing species such as species of *Ranunculus*, *Nertera*, *Leptinella, Craspedia, Oreomyrrhis, Hydrocotyle*, comb fern (*Ctenopteris heterophylla*), mosses and liverworts, and seedlings of pate and wineberry. This is distinctive vegetation that tolerates intensive flooding but is dependent on the stability afforded by the smooth bedrock around the silty patches of soil. It merges with similar vegetation on the actual banks of the forest-river transition where forest floor species like bush rice grass become more common.

Where there are relatively stable beds of small boulders and sand, creeping woody plants gain a hold, including *Muehlenbeckia complexa* and *Coprosma acerosa* (named *C. brunnea* in earlier reports). The latter is especially significant. It occurs in only one place within the entire dam and reservoir footprint area, on a bedrock protected sand/boulder beach on the true left bank, 500m downstream from the proposed upper limit of the reservoir.

Distinctive features of the vegetation /flora

There are several distinctive or notable features of the vegetation and flora:

1. The area continues the pattern observed downstream of beech forest associated with podocarps, notably matai, but including some rimu, lowland and Hall's totara and, upstream, miro. Regenerating matai is a feature of disturbed areas.
2. The area includes a transition from lowland to montane species, and therefore has considerable species diversity.
3. Two trees of southern rata occur in a strictly riparian habitat where the canopy is open. This species occurs again near Lucy Creek.
4. Other locally uncommon species are kidney fern, crepe fern, *Coprosma areolata*, *Raukaua anomalus*, *Microlaena polynoda*. These are not threatened species but have not been seen much along the Lee.
5. The flood zone turf is very well developed in patches of protected soil within the bedrock river bed.
6. A very good population of the nationally threatened species *Coprosma acerosa* (*brunnea*) is present on one gravel beach.

Tabulated ranking of the assessment criteria using the scale: L=Low, M=Medium, H=High.

Criterion	**Ranking**
Representativeness	H
Rarity	H
Diversity and pattern	H
Distinctiveness/special ecological characteristics	H
Size and shape	H
Connectivity	H
Sustainability	H
Overall significance	**H**

Impacts of the Reservoir

The reservoir will be about 20m deep at the bottom of the gorge. The existing flood zone measures about 3m vertically before forest vegetation occurs. Within this 3m the turf patches and scattered shrubs of mainly native brooms (*Carmichaelia australis* and *C. odorata*) will be inundated. The main forest vegetation impacted is that dominated by broadleaved species such as whiteywood, titoki, broadleaf, tutu and wineberry. This is vegetation that grows in the relatively youthful zone that is occasionally opened up by flooding and slope instability. It contains greater species diversity than forest higher up the slope owing to the diversity of habitats (e.g., wetlands on small terraces, areas open to high light), relatively plentiful moisture, and higher soil fertility created by deposits from the river and higher slopes. Some older,

larger trees (red, black and silver beech, matai, rimu and miro) will be inundated in this zone, but these species are more common higher up the valley sides.

The most significant impact on a particular species is on the single population of *Coprosma acerosa,* a species defined in the New Zealand Threatened Plant list (2009) as "at risk, declining". (This species was previously named *C. brunnea*, characterised by a small growth form and dark brown to blackish leaves and stems; but more recently it is named as a distinct form of *C. acerosa*, which exists through New Zealand in a wide variety of forms.) This population covers about 0.25ha of beach gravel. The reason why it is present appears to be the fact that the rivers swings to the true right around a bend at this point enabling the gravel to be deposited on the protected true left leeward side. Furthermore, the water-side edge of the gravel bed is uniquely protected by a bed-rock ledge. These two features combine to create a long-term open habitat that, while regularly inundated, has enabled the establishment and survival of this uncommon species. It has not been reported further upstream. Within the Wairoa catchment, in addition to this site, a minor population grows on bedrock in the lower Wairoa.

Mitigation

Two species will be eliminated from the footprint, southern rata (that exists as two trees), and *Coprosma acerosa* (one population). Southern rata occurs below the proposed dam site and is likely to survive, and is also probably present upstream beyond the reservoir footprint. There is potential for this species to be propagated and replanted above the new waterline at the new forest edge. The best protection for the coprosma is to ensure that the reservoir level does not inundate the site. If this is not possible then the species could be propagated and re-established in the flood zone upstream or below the proposed dam. However, the rarity of this species indicates that it has very specific habitat requirements and translocation is unlikely to be successful in the long term.

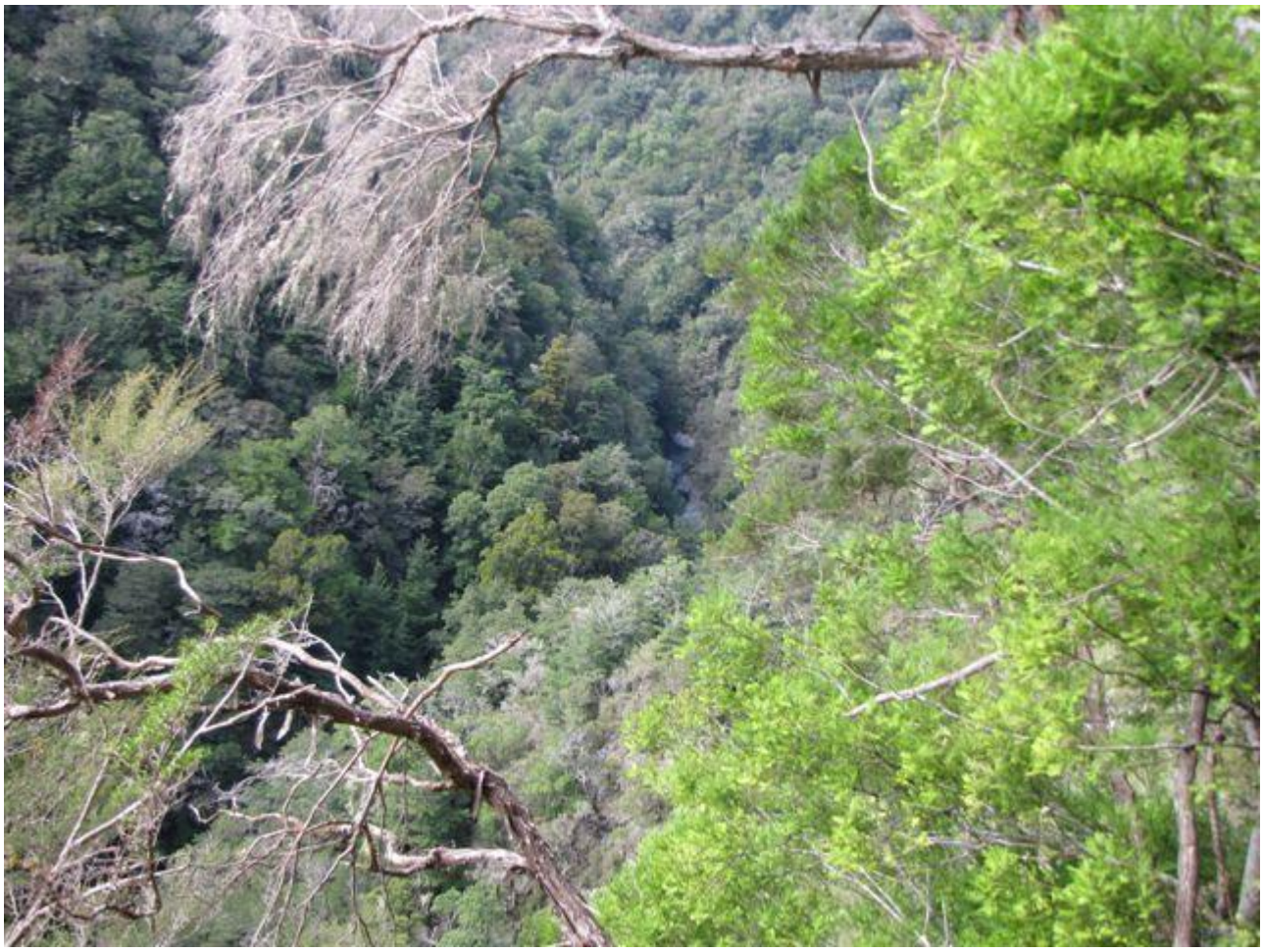
Conclusion

1. Section 10.5 Site 5 in the report "The Lee River Dam and Reservoir: impacts on the vegetation at the site and downstream" (March 2008, Philip Simpson), needs to be supplemented by this report. The ecological assessment remains "High" with additional information on the range of vegetation types and species composition, including rare species.
2. The redefined Site 5 consists of a broad riparian zone of species-rich broadleaved forest, grading upslope on the true right side into beech podocarp forest, and on the true left side into a mosaic of secondary kanuka forest and beech podocarp forest. The dominant podocarp is matai. The site includes both lowland and montane species.
3. The most significant impact of the proposed reservoir is the inundation of the only known site within the Lee catchment of the 'at risk, declining' species, *Coprosma acerosa*. A reduction in the upper limit of the reservoir could protect this habitat.

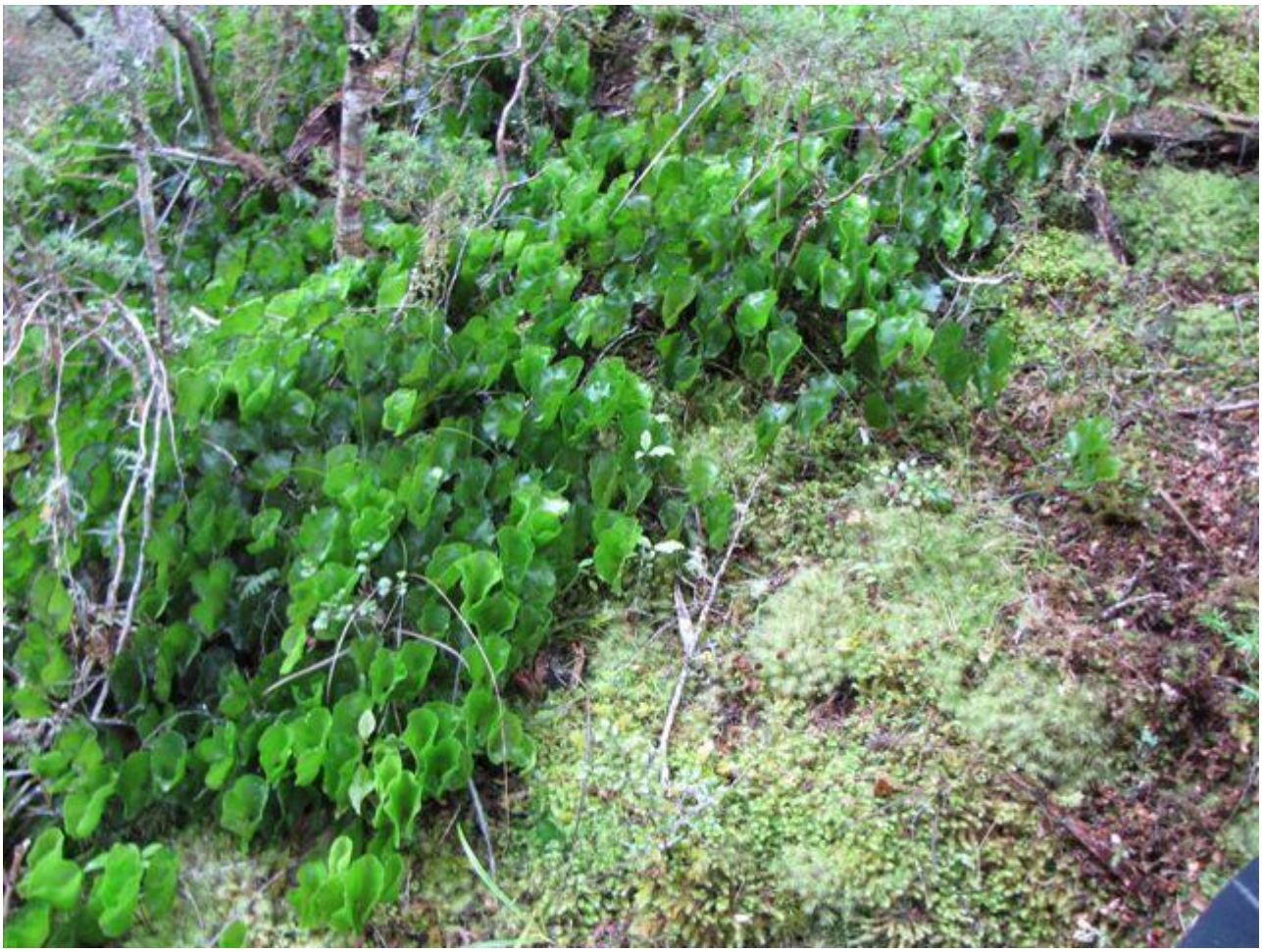
Appendix: Additional Photographs of Site 5.

1. A typical stretch of the Lee within Site 5, showing a bed-rock encased river bed and deep pools separated by small rapids. The smooth bedrock is mostly devoid of vegetation except for patches of turf where fine sand is stabilised. There is a narrow zone of shrubs and seedlings between the bare rock and the forest edge. The native bush along the river consists of high light requiring species, which are mostly fast growing small trees, but there are also long-lived beech and podocarps in places. The diversity of light, soil conditions and vegetation age encourages species diversity in the riparian zone.

2. The river follows a narrow course through the bush. On the true right (left in the image) the bush is dominated by podocarps on the lower slope (rimu, matai, and totara) and beech higher up, while on the true left (right in the image) the bush is secondary kanuka forest with scattered patches of beech and matai. The narrow zone of broadleaved riparian trees is hidden in this image by larger trees.



3. The kidney fern is present in shaded rocky places on the forest floor. In the Lee it has been seen also in Lucy Creek below the proposed dam site, but is otherwise very local in the lowland area. It is one of several ferns that are locally uncommon, such as crepe fern and the toothed spleenwort, *Asplenium polyodon.* Local rarity (whether of otherwise common or rare species nationally) is a feature of the flora in this catchment and is one reason for its distinction.



4. Southern rata (centre, rear) occurs as two individual trees along the reservoir area, growing in a strictly riparian habitat owing to their high light requirement. This species descends the river valley from higher altitudes, reflecting the cool climate caused by cold air drainage, and reaches the lowland zone only here and near Lucy Creek. This species could be used to re-establish bush along the reservoir margin. This individual looks as if it has been browsed by possums. Goats and pigs are also present.

5. *Coprosma acerosa* (formerly *C. brunnea*), is defined by the New Zealand Threatened Plant List (2009) as “at risk, declining”. This decline is due to loss of habitat and animal browsing. Usually it grows in small wiry open patches, but here is forms large patches with well-developed stems that are strong enough to withstand flood damage and vigorous enough to grow through a new cover of sand and gravel.

6. A sharp bend in the river takes the flood water away from this bank, while a flanking ledge of bedrock protects the bed of sand, gravel and boulders that is deposited during inundation. This special combination of factors creates the perfect habitat for a large population of *Coprosma acerosa*, the only such place so far found in the Lee River catchment. This population grows just below the upper limit of the proposed reservoir, and a change in the size of the reservoir could protect this site from permanent inundation.

Appendix C: Bird count survey results

Table C1: Bird count survey results – March 2008

		Total number of birds recorded at each bird count station during the 5-minute count surveys												No. of individuals counted	No. stations recorded at	
		BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9	BC10	BC11	BC12		Count	%
Bellbird	native	5	2	2	3	2	4	2	1	5			7	33	10	83%
Blackbird	exotic	1								1	1		1	4	4	33%
Chaffinch	exotic	2	2			3								7	3	25%
Fantail	native	2	1	1	2	1	3			2	3	2	4	21	10	83%
Goldfinch	exotic		5	12						10		1	2	30	5	42%
Greywarbler	native						1		2	1		1	1	6	5	42%
Harrier	native												1	1	1	8%
Silvereye	native	1	1			3	6			6		8	3	28	7	58%
No. individuals		11	11	15	5	9	14	2	3	25	4	12	19	130		
No. species		5	5	3	2	4	4	1	2	6	2	4	7	8		

Appendix D: List of species mentioned in the report

Table D1: Plant and animal species mentioned in this report

Common name	Alternative common name	Scientific name
Native vegetation		
akeake		*Dodonaea viscosa*
akiraho	golden akeake	*Olearia paniculata*
black beech		*Nothofagus solandri var. solandri*
black maire		*Nestegis cunninghamii*
cabbage tree	ti kouka	*Cordyline australis*
climbing groundsel		*Brachyglottis sciadophila*
crepe fern		*Leptopteris sp.*
dwarf mistletoe		*Korthalsella clavata*
fierce lancewood		*Pseudopanax ferox*
flax	harakeke	*Phormium tenax*
Hall's totara	Mountain totara	*Podocarpus cunninghamii*
hard beech		*Nothofagus truncata*
hinau		*Elaeocarpus dentatus*
horopito		*Pseudowintera spp.*
kahikatea		*Dacrycarpus dacrydioides*
kaikomako		*Pennantia corymbosa*
kamahi		*Weinmannia racemosa*
kanuka		*Kunzea ericoides*
kowhai		*Sophora spp.*
mahoe		*Melicytus ramiflorus*
mapou	red matipo	*Myrsine australis*
matai		*Prumnopitys taxifolia*
miro		*Prumnopitys ferruginea*
mountain beech		*Nothofagus solandri var. cliffortioides*
myrtle		*Neomyrtus pedunculata*
ngaio		*Myoporum laetum*
nikau		*Rhopalostylis sapida*
no common name known		*Australina pusilla*
no common name known		*Coprosma obconica*
NZ shovel mint		*Scutellaria novae-zelandiae*
pahautea	mountain cedar	*Libocedrus bidwillii*
pokaka		*Elaeocarpus hookerianus*
pukatea		*Laurelia novae-zealandia*
red beech		*Nothofagus fusca*
rimu		*Dacrydium cupressinum*
sand coprosma		*Coprosma acerosa*

Common name	Alternative common name	Scientific name
scented broom		*Carmichaelia odorata*
shining karamu		*Coprosma lucida*
silver beech		*Nothofagus menziesii*
Small maidenhair		*Adiantum diaphanum*
southern rata		*Metrosideros umbellata*
supplejack		*Ripogonum scandens*
swamp mahoe		*Melicytus micranthus*
tanekaha		*Phyllocladus trichomanoides*
tawa		*Beilschmiedia tawa*
Teucridium		*Teucridium parvifolium*
titoki		*Alectryon excelsus*
toothed spleenwort		*Asplenium polyodon*
totara		*Podocarpus totara*
tutu		*Coriaria aborea var. arborea*
white maire		*Nestegis lanceolata*
Exotic vegetation		
crack willow		*Salix fragilis*
radiata pine		*Pinus radiata*
wattle		*Acacia spp.*
gum		*Eucalyptus spp.*
white poplar		*Populus alba*
gorse		*Ulex europaeus*
blackberry		*Rubus fruiticosus agg.*
old man's beard		*Clematis vitalba*
hawthorn		*Crataegus monogyna*
barberry		*Berberis glaucocarpa*
willow		*Salix spp.*
poplar		*Populus spp.*
broom		*Cytisus scoparius*
Birds		
Australasian harrier		*Circus approximans*
bellbird		*Anthornis melanura*
black shag		*Phalacrocorax carbo*
blackbird		*Turdus merula*
blue duck	whio	*Hymenolaimus malacorhynchos*
bush wren		*Xenicus longipes*
california quail		*Callipepla californica*

Common name	Alternative common name	Scientific name
chaffinch		*Fringilla coelebs*
fantail		*Rhipidura fulginosa*
goldfinch		*Carduelis carduelis*
grey warbler	riroriro	*Gerygone igata*
kaka		*Nestor meridionalis*
kakapo		*Strigops habroptilus*
kea		*Nestor notabilis*
kiwi		*Apteryx spp.*
kokako		*Callaeas cinerea*
little shag		*Phalacrocorax melanoleucos*
long-tailed cuckoo		*Eudynamys taitensis*
New Zealand bush falcon		*Falco novaeseelandiae*
New Zealand pipit		*Anthus novaeseelandiae*
New Zealand quail		*Coturnix novaezelandiae*
New Zealand thrush	piopio	*Turnagra capensis*
saddleback		*Philesturnus carunculatus*
silvereye	wax-eye	*Zosterops lateralis*
south island rifleman		*Acanthisitta chloris subsp. chloris*
weka		*Gallirallus australis*
Bats		
Long-tailed bat		*Chalinolobus tuberculatus*
Short-tailed bat		*Mystacina tuberculata*
Lizards		
brown skink		*Oligosoma zelandicum*
common gecko		*Hoplodactylus maculatus*
common skink		*Oligosoma nigriplantare polychroma*
forest gecko		*Hoplodactylus granulatus*
Marlborough green gecko		*Naultinus manukanus*
Nelson green gecko		*Naultinus stellatus*
rough gecko		*Naultinus rudis*
speckled skink		*Oligosoma infrapunctatum*
spotted skink		*Oligosoma lineoocellatum*

Common name	Alternative common name	Scientific name
Animal pests		
Feral Deer		different genera
Feral goat		*Capra hircus*
Brush tailed possum		*Trichosurus vulpecula*
Rat		*Rattus spp.*
Mustelids	Ferrets, stoats, weasels	*Mustela spp.*
Feral pig		*Sus scrofa*