

BOTANICAL VALUES OF THE WAIROA AND LEE RIVER VALLEYS

Assessment in relation to possible dam and reservoir sites

Philip Simpson



Coprosma grandifolia, an important riparian coloniser in the Wairoa-Lee

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1. Introduction

The purpose of this report is “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 is “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.”

Field observations were undertaken over a three-day period, April 20-22, 2006, during fine weather and at a time when the water level was low following a considerable period with little rain. Nevertheless, both rivers were carrying a substantial volume of water, so that places for crossing on foot were few and needed to be selected with care. Substantial rain has fallen since the field survey. The first day was in the company of Department of Conservation botanist, Shannel Courtney, who provided invaluable comments on the plant species present and their local significance, as well as important community types, and broader aspects of the ecological setting. Conversations with a number of local residents and workers provided interesting background, especially with regard to the history of the area.

Discussion with Mr Courtney identified a range of aspects that needed to be considered, including

- The diversity of plant communities and species of the sites
- The presence of rare, threatened or otherwise unusual species
- The ecological context of the natural areas, their continuity with others, and their condition, especially with regard to weeds and animal pests
- The local, regional and national significance of the features observed

The brief not only specified that the key places for investigation were the proposed dam sites and the ‘footprint’ of the reservoirs, but also the stretches of river bank immediately downstream from the dam sites, recognising that patterns of plant distribution and condition might be influenced by changes in the water flow regime from season to season. The Brief notes that following a decision on which river is chosen a more detailed study of the ecological resources will be undertaken, documenting more exactly what features will be lost or possibly compromised. The proposal on which the survey was based indicated that the Wairoa reservoir would approximate 5km in length and have a depth at the dam site of about 60 m, and the Lee reservoir would be about 3.5km long with a maximum depth of about 50m. These figures are maxima and the likely to be less in the final scheme. Hence the impacts on the vegetation are likely to be less than originally proposed, especially at the upper end of the reservoirs.

Vehicle access along the true left bank of both rivers facilitated the mapping of the vegetation pattern with ease, while foot access to individual sites and places without road access was usually possible, but with some exceptions owing to the danger of river crossing and /or the limited time available. Observations were recorded on tape, through photographs of important features and species, and the boundaries of natural sites were drawn onto field topographical maps supported by aerial photographs. These boundaries are recorded in Maps 4 and 6. Geological mapping was also used (Map 3).

The word “riparian” is used repeatedly throughout the report. Strictly speaking the term refers to the immediate river-bank. However it has a broader use in relation to “riparian strips”, which are often measured as 20m wide. In this report the term is used in a general sense to indicate vegetation in the immediately vicinity of the river and usually influenced in one way or another by the river (e.g., intermittent flooding of a river flat).

The following criteria are used in assessing small to large sites on private land throughout the Nelson and Marlborough Districts, and seem to be suitable for the present assessment. 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 connections 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. The ranking is relative to each other. For instance a low does not mean that the site has low ecological significance but is low relative to a high ranking. Only those places regarded as significant have been included in the sites.

2. Ecological context

The two sites lie within the Bryant Ecological District: steep hill country with complex geology and a mild climate.

MAP 1 shows those parts of the Wairoa Left Branch (actually the true right, or “Eastern” branch) and Lee catchments upstream from the proposed dam sites, and locates the catchments in a regional geographical setting. Both rivers drain parts of the western flank of the Richmond Range, the Wairoa from Red Hill (1790m) to Bishops Cap (1425m), and the Lee from Bishops Cap to Old Man (1544m), a combined length of about 30 km of high peaks above natural bushline and forested ridges and saddles. The western boundary of the Wairoa follows a high ridge to Mt Ben Nevis (1619m) and thence along Gibbs Spur, and in places along this boundary the natural bushline has been reduced a little by fire. The northern boundary of the Lee 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.

The Wairoa generally flows south to north, while much of the Lee flows east to west. Hence, in terms of aspect there is a tendency for the Wairoa to exhibit a high proportion of shaded south-facing slopes, while the Lee presents a dominance of west and north-facing slopes. These physical features influence the local climatic and hydrological patterns. Clearly the catchments rise to a medium-high altitude and receive a relatively high annual rainfall, in the order of 2000mm. However, the limited extent of high ground restricts the significance of winter snowfall. Part of the Wairoa is enclosed behind the Ben Nevis Range while the Lee is more open to the north and west. Hence, the Wairoa is probably a colder habitat than the Lee and this may restrict soil fertility. The two catchments are similar in size. The Wairoa measures approximately 90,000ha, while the Lee is about 85,000ha. The greater heights reached by the Wairoa and the southerly aspect may account for the overall greater river flow than in the Lee, but the rain shadow impact influencing the former may reduce this difference. In fact, an isohyet map supplied by Tasman District Council (MAP 2) shows that the head of the Lee has the highest rainfall of the whole area, up to 2500mm, probably reflecting the direct exposure to NW weather patterns.

The geology is an important factor in consideration of physical character. Map 3 indicates that the relevant part of the Wairoa lies mainly in the Star Formation of the Caples Group, while the Lee lies within the Ward Formation. These Formations are sandstones of Permian and Triassic age, respectively (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. However, according to IGNS Map 9, Nelson, 1998, the Star Formation (Wairoa) consists of “poorly bedded sandstone”, while 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.”

Although there is little chemical difference between the two the impact of age and bedding appears to be reflected in the topography of the two catchments. The older, Wairoa rocks are harder and the slopes generally steeper than the Lee (away from the Richmond Range headwaters) with a larger proportion of bluffy country and colluvial slopes composed of large rock fragments. The younger Lee rocks on the other hand, with narrower bedding, are softer, erode more uniformly into more gentle slopes covered by a finer texture of colluvium.

This translates into differences in topography. Although both rivers flow for much of their length through bedrock (which is a regional feature of rivers draining the Richmond Range, for instance the Pelorus and Maitai, and is presumably a reflection of recent and perhaps ongoing uplift) the Lee has generally lower altitude, more gentle, even slopes and a greater tendency to create river flats. The Wairoa, on the other hand, has a higher overall altitude, steeper slopes, numerous bluff systems, more hard rock gorges and fewer alluvial river flats.

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, although the soils of both areas are mapped as Pelorus Steepland soil.

This summation needs to be tested by more detailed study than has been possible in this survey to date.

MAP 1 indicates the broad pattern of natural vegetation as well as the overall incursion of bush clearance at first for grazing, with minor impacts from mining and milling. The 300m and 600m contours have been highlighted. This is because 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 footprints are within the 300m contour, and are therefore well within the zones of greatest potential species diversity. All the formerly agricultural land has either reverted to indigenous scrub or been further developed into exotic forest. Many roads have been built to service the logging industry.

The overwhelming feature of the vegetation in the two catchments is the proportion of natural cover in indigenous bush. Only about 10% (Wairoa about 7000ha, or 8%; Lee about 10 000ha, or 12%) has been cleared, all of this within relatively contiguous parts of the lower valleys immediately upstream from the proposed dam sites. Again, topographical and climatic factors appear to have influenced the pattern. Clearance was mainly limited to the easier, warmer slopes which in the Wairoa are more restricted than in the Lee. On the other hand, recent logging has had a disproportionate impact on the Wairoa because log-handling skid-sites have been concentrated along the few river flats. Natural areas in the lower part of the Wairoa tend to remain in larger blocks, while in the Lee natural areas are more scattered along the river valley in smaller areas.

3. 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 41-42 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*) and black maire (*Nestegis cunninghamii*). Secondly, there are many species that are restricted to northern South Island (e.g., *Scutellaria novae-zelandiae*) or are generally rare nationally (such as the fierce lancewood *Pseudopanax ferox*), owing to its 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 has 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., *Teucrium 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.

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 both catchments downstream from the proposed dam sites. 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 Wairoa and Lee, both catchments are very weedy along their lower reaches 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 valleys into the area under consideration, often associated with roads and forestry development.

4. The natural sites in the footprint areas of each catchment

4.1 The Lee (MAP 4 and 5)

Below the proposed dam. 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 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 water-logged soil and open vegetation for light requiring species.

A few hundred metres below the proposed dam site, high quality native vegetation begins. At Lucy Creek a remnant of dense rimu and black beech occurs and the latter extends in a band up the right bank of the Lee, with several young and old trees of tanekaha. (Photograph 1) Large rimu and kahikatea occur at the Lucy-Lee confluence. Surrounding the forest is a zone of regenerating native shrubland/forest composed of akeake, mahoe, tanekaha, karamu, bracken fern and interestingly ngaio. The dense rimu, mature tanekaha and kahikatea 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.

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).

MAP 4, Site 1.

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. (Photograph 2)
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* (Photograph 3). Dense riparian strip of *Lophomyrtus pedunculatus* (rohutu), some trees with masses of dwarf mistletoe, *Korthalsella lindsayi*, which also grows on mapou (Photograph 4). 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.
4. Old kanuka on right bank river flat of bend 10-12m tall with a very dense *Coprosma rhamnoides* understorey, with regenerating matai and mahoe, 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.

MAP 4, Site 2.

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 (Photograph 6). At the northern end are several emergent rimu. Both *Metrosideros diffusa* and *M. colensoi* occur. (The latter is generally on limestone. Many of the kowhai in both the Lee and Wairoa approach *Sophora longicarinata* in leaf form suggesting the nearby occurrence of limestone, which is scattered through the local landscape but not in the two areas under consideration.) 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 (Photograph 7). 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 (photograph 8). *Scutellaria* grows sparingly on rocky outcrops within the bush along with *Myosotis forsteri* and *Stellaria decipiens* (photographs 9 and 10). 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. All but the mid to upper part of the matai gully at the southern end will be inundated.

MAP 4, Site 3. Waterfall Creek flat and riparian forest.

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.

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 (photograph 11). Understorey trees are marble-leaf, pokaka, mahoe and myrtle with some lancewood and lemonwood. The only mature kaikomako seen in the valley (in contrast to its common presence in the Wairoa) 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 (photograph12). 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 (photograph 13).
2. Kanuka forest, Waterfall Creek Flat (photograph 11, 15). This was once black beech forest but was seemingly cleared for grazing (patches of tall fescue remain), and now covered almost completely with 10 m tall kanuka. The understorey is extremely dense *Coprosma rhamnoides* with patches of *Helichrysum lanceolatum* and *Cyathodes juniperina*, and *Lycopodium scariosum* indicating cold dry conditions. However there are groves of dense *Astelia* some devastated by pigs (photograph 14). 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.

3. Left bank, pole kahikatea (photograph 15, 16). Both the Lee and the Wairoa have 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* (photograph 17).

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.

MAP 4, Site 4.

This is a riparian forest zone of beech and kahikatea, and a very steep left bank hill slope of beech matai forest with large rimu and a canopy of mahoe kohuhu and wineberry.

The riparian forest is a narrow band of black and red beech on both sides of the river with emergent kahikatea and kowhai hanging over the water. Riparian kanuka occurs upstream with an understorey dominated by *Leucopogon fasciculata* and regenerating matai.

An island of kanuka occurs within the river bed with the only population of *Urtica ferox* seen in the Lee.

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

Site 4 measures about 3ha in area. All but the upper left bank slope will be inundated.

MAP 4, Site 5 (photograph 18).

The lower end of this site borders the disturbed land, and matai treeland and kanuka secondary forest covers the lower portion. However, continuous original forest extends up the rest of the valley. Mature matai trees occur on the hill slopes and these are likely to feature along the river for some distance, particularly on a small flat at the confluence of a major tributary just within the reservoir footprint. The gorge nature of the terrain prevented inspection of the undisturbed forest but it is expected that it is similar to the most-inland zone of the Wairoa, with continuous beech forest to a high altitude. A small population of tanekaha has been reported at a major fork in the river about 3km upstream. It is likely that the major part of the tanekaha population occurs within 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

The site is extensive and has high ecological value. The proposed reservoir will form a narrow, shallow waterway that will inundate the immediate riparian zone for about 1km but will have little overall impact on the forest. Should the reservoir length be significantly reduced in size this site will not be impacted.

4.2 The Wairoa (MAPS 6 and 7)

Below the proposed dam sites.

Downstream from the junction of the left and right branches of the Wairoa the valley is relatively broad with cultivated flats and the river encased in a box canyon. On these flats (now well above the river level) two characteristic open plain trees occur, ribbonwood (*Plagianthus regia*) and narrow-leaved lacebark (*Hoheria angustifolia*). These are both relatively uncommon, and do not occur in the Lee. Near the river patches of kahikatea and silver beech occur but overall the riparian zone is weedy. Beyond the sealed road totara and kowhai forest occurs with titoki and kohuhu, and the amount of forest gradually increases with important groups of black maire and at Pig Valley Bridge *Streblus heterophyllus*. Neither of these are known from the Lee. Kawakawa and rangiora are lowland plants of the understorey, and again, these do not appear to occur in the Lee. Whole hillsides are covered with secondary forest composed of totara, kowhai, kanuka, lemonwood, akeake and mahoe. On one river terrace in a privately owned patch of bush, specimens of *Scutellaria*, *Brachyglottis sciadophila*, *Teucrium parvifolium*, *Coprosma obconica* and *Pseudopanax ferox* have been found. These are all threatened species and only the first has been located in the Lee. The Wairoa Gorge is the type locality of *Coprosma obconica*. Any change in the flooding regime of the river will not influence these populations. There is one place, however, a Department of Conservation Reserve, where a second patch of *Teucrium* grows close to the river and could be influenced by increased flooding (Courtney, pers. comm.)

Immediately below the two alternative proposed dam sites, the river cuts eastward across the ultramafic zone with similar open and disturbed vegetation of flax, manuka and akeake, as in the Lee, although without tanekaha. Beyond this zone the river cuts through a very narrow gorge of hard rock and assumes a south to north course and it is here that the dam sites are proposed.

MAP 6, Site 1: The dam sites (photographs 19, 20).

The lower site is located on a steep spur descending on the right bank. The area is exceptionally scenic although somewhat disturbed, especially along the left bank. (Owing to the narrow steep nature of the valley sides the access road follows the left bank up the river and virtually all the native vegetation has been removed. Hence nearly all the natural values lie on the right bank, in contrast to the Lee.) The black beech- matai-kahikatea forest is somewhat open and rocky with akeake and kanuka visible.

The lower dam site is below the junction of a large tributary that is enclosed in a dense riparian strip of black beech forest, continuous into the eastern hinterland. Slopes along the left bank of the tributary carry extensive secondary kanuka forest. This valley would be inundated for about 1km. The kanuka forest extends southwards along the Wairoa right bank and it is here, a hundred metres or so upstream from the lower site, that the alternative dam site is located. The kanuka has scattered wilding pines and a variety of emerging broadleaved trees such as akeake and lemonwood. A narrow strip of black beech forest extends along the river with a notable component of miro, lowland totara and a single hinau (the only specimen seen). Rangiora (a lowland species) and white rata occur in the understorey along with silver fern. The left bank of the Wairoa at the proposed dam sites is disturbed weedland, apart from occasional scattered beech.

Immediately upstream from the kanuka forest is a large block of original forest continuous from the river edge upslope to the forested wilderness of the Richmond Range. The slope adjacent to the river is dominated by matai and black beech and forms a spectacular example of a characteristic

vegetation type of the region. Rimu is a component and silver, hard and red beech are also present. (photographs 21-23). In places both sides of the river carry original forest, creating an extremely scenic area (Photograph 24). Kaikomako is an important riparian tree and lancewood is prominent, but there is no tanekaha.

Upstream a rocky spur extends the right bank to create a broad bend in the river (photograph 25). This spur has been burnt and is covered in low kanuka forest, which also extends up the right bank slope with good regeneration of marbleleaf, a large population of *Hebe stenophylla* on the rocky talus slope and scattered matai. On the dry spur shrubs of *Hebe divaricata* are prominent.

Opposite the spur, on the left bank is a steep talus slope descending from a high bluff. Tree fuchsia is characteristic with broadleaved species such a pate, mahoe and marble-leaf. High up there is an extensive patch of *Metrosideros colensoi*. Such talus slopes are characteristic of the Wairoa and where the forest has been burnt support large expanses of *Hebe stenophylla*.

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

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

The site is extensive and the lower slopes and riparian zones will be inundated, although the mid-slope and upper part of the key matai forest will remain.

MAP 6, Site 2 (Photograph 27)

The site consists of a moist, gentle slope river, leading to flats on both sides of the river. It is one of the few flats along the river with any natural values because logging sites have destroyed most of these areas. The remains of an old bridge are present indicating a former settlement, presumably a farm. The vegetation is characterised by a strip of young kahikatea, 3-20m tall, associated with kaikomako, lancewood, kohuhu and lemonwood with scattered black and silver beech and some regenerating matai and rimu. A sward of *Carex geminata* covers the left bank flat.

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

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

The site measures less than 1ha in area. It will be inundated by the reservoir.

MAP 6, Site 3. (Photographs 28-30)

This site extends from a hill slope of regenerating forest on the right bank below Gibbs Creek, upstream to include riparian forest along both banks and small wet flats along both banks. The riparian forest consists of black and red beech with kamahi prominent. The right bank hillslope is regenerating bush dominated by bracken and kanuka with extensive patches of *Hebe stenophylla*, but notably with many emerging lemonwoods that will eventually form a distinctive forest type. The wet flats support young kahikatea and swards of *Carex geminata*. One has a very small remnant of manuka and raupo, not seen elsewhere in the valley. Logging has impacted severely on the site and broom is widespread. (The presence of broom on logged land in the Wairoa contrasts with the gorse characteristic of similar sites in the Lee, and suggests that the Wairoa has either a drier climate or greater soil drainage, or both.)

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

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

Site 3 measures about 20 ha in area but is connected to a much larger natural area to the east. Only the lower slope and riparian zone will be impacted.

MAP 6, Site 4.

The site includes an extensive area of regenerating lemonwood forest on the slope and a gully of black beech forest with extensive bluffs. These are connected by a narrow, disturbed riparian zone of black beech forest, on both sides of the river, including one of the only surviving forest-covered river flats which is a wet ferny place notably with *Lophomyrtus obcordata* (bearing *Korthalsella lindsayi*) and *Neomyrtus pedunculata* –which has otherwise been lost lower in the valley. A population of *Arthropodium candidum* (notably large and possibly representing a form “*A. bulbosum*” originally described only from the Wairoa Gorge) occurs along with the ground orchid *Pterostylis alobula* (photograph 31). These details are recorded because river flat forest in the lower Wairoa has been almost entirely removed and they indicate the type of diversity that would have existed.

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

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

The site measures 2-3 ha in area. The gully will remain but the riparian zone will be inundated.

MAP 6, Site 5.

This site is the lower part of continuous original forest extending throughout the upper catchment (photograph 32). The proposed reservoir will form a shallow waterway along about 1km of river and will inundate the gorge sides and some low-lying flats and shaded rocky areas. These are major sites for “gorge turf” species characteristic of periodically flooded bedrock (species of *Nertera*, *Epilobium*, *Anaphalioides*, *Oreomyrrhis*, *Craspedia*, etc) and these will probably re-establish on higher rocks exposed by a new flooding regime, although this is unknown.

The lower right bank is a slightly modified flat with kahikatea forest and an understorey of supplejack, pate with associated rimu and miro forming good lowland forest. (photograph 33). The river is lined by a flood zone of tutu with a good population of the locally rare *Carmichaelia odorata*. The beech forest is mainly black with some red. Kowhai and myrtle occur in the riparian zone, the latter supporting a large population of dwarf mistletoe.

A public walking track follows the left bank through hard and silver beech with a dense understorey of *Coprosma grandifolia* and other coprosma species, horopito, and many ferns and sedges on the forest floor. This is excellent undisturbed beech forest with a rimu component.

The contour map indicates that there are no river flats within the footprint area of Site 5 beyond that at its lower end, but flats do occur immediately beyond the upper limit of the proposed reservoir and these are likely to carry kahikatea and matai. However, they will not be influenced.

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

Should the reservoir prove to be shorter in length and lower in depth than originally conceived then there will be minimal, if any, impact on this site.

5. Downstream impacts

Well below the proposed dam sites on the Wairoa, Mr Courtney observed a small population of *Coprosma brunnea* (which was not observed elsewhere in either catchment, indicating that there will be a range of species that are widely scattered but which nevertheless add significantly to the biodiversity of the area and its overall ecological value). These were growing on periodically flooded bedrock that was sufficiently fractured to provide rooting places for these small shrubs.

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 keep the site open (from colonisation by exotic weeds for instance). 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. In this sense the low-flow periods will be extended but it is doubtful that the river, flowing over bedrock, will influence the water regime along its banks. Plants growing on rock in the flood zone are regularly exposed to dry conditions and are adapted to them. 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.

Flooding is a natural feature of the 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 logs. It is probable that the bed-rock gorge nature of the two rivers will minimise changes in the riverbed and adjacent riparian zone.

6. Summary of Ecological Assessment

The following Table lists all the individual rankings for each criterion for each site. The ecosystems in both catchments are representative of those characteristic of the district, there is a considerable element of rarity and distinctiveness in the sites. They are often diverse in species composition, and although often small and fragmented, most sites are sustainable.

Criterion	Wairoa	Lee
Representativeness	H,M,H,M,H	M,H,H,M,H
Rarity	H,L,L,M,H	H,M-H, H,L,M
Diversity and pattern	H,L,M,M,H	M,M,H,M,H
Distinctiveness/special ecological characteristics	H,M,M,M,H	M,M,H,M,M
Size and shape	H,L,M,L,H	L,M,M,M,H
Connectivity	H,L,L,M,H	L,L,M,H,H
Sustainability	H,L,M,M,H	M,H,H,H,H

Clearly, the footprint areas of both catchments have a considerable degree of botanical significance. The key features are as follows:

In the Lee, Site 1 has *Scutellaria*, regenerating tanekaha and matai, the only observed plants of akiraho and overall a diverse range of ecosystems. Site 2 is a sustainable beech forest with mature tanekaha, *Scutellaria*, and matai. Site 3 is an intact river flat kahikatea forest with a good population of *Scutellaria* and *Australina*. Site 5 is continuous natural bush.

In the Wairoa, Site 1 is a large area with mature matai and beech forest. Site 2 is regenerating kahikatea forest. Site 3 is regenerating lemonwood forest as well as river flat beech and kahikatea, and Site 5 is continuous bush.

At the start of this survey the general impression the botanical values of the two catchments in the footprint areas was that the Wairoa is the more important:

- the whole catchment is larger,
- the amount of water in the system is greater,
- some downstream parts of the catchment have greater natural character, with a greater diversity of species (black maire for instance),
- more is known about the Wairoa (the occurrence of rare species for instance)
- and the entrance onto the footprint area is dominated by a large natural area with exceptional scenery.

Comparative assessment depends, in part, on which criteria are regarded most highly. If the large size and continuity of natural areas is paramount then Wairoa is the most important. But if diversity and rarity are more highly valued then the Lee is uppermost in value. The two critical differences are central Lee sites and the lower Wairoa site. In the former an original kahikatea river flat forest with a good population of *Scutellaria* and *Australina*, plus a significant part of the southernmost South Island tanekaha population will be lost to inundation. In the Wairoa the regionally uncommon

matai forest will suffer. However, only the lower portion will be completely lost, and most will remain. Both rivers have exceptionally high values at the head of the footprint area, and there is a likelihood that neither area will be seriously damaged, if at all. The Wairoa has distinctive species diversity lower in the catchment, but outside the footprint area.

Overall, bearing in mind the somewhat subjective nature of comparative assessment, the Lee is the most valuable area botanically.

7. Ideas on mitigation

The proposal offers opportunities for mitigation in one or other of the two catchments, and/or downstream from the footprints. The survey has identified a number of ecological issues that ideally should be addressed. The following list includes ideas rather than recommendations.

- Pest control. The vegetation is severely impacted by pigs and there are also deer and goats present. Both rivers appear to have ideal habitat for blue duck and, as proven elsewhere, intensive predator control can lead to the successful establishment of blue duck
- Weed control. Old mans beard is present in the footprint areas and also downstream and 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 rivers.
- Roads and forestry operations have encroached on important ecosystems along the river flats and on the lower slopes above the rivers. A clear separation between developed areas and protected riparian areas (minimum 20 metres?) is required.
- 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 extended into the proposed footprint zone, 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. There is unlimited opportunity for ecological restoration in the catchments.

8. Conclusions

1. The Lee is botanically more significant than the Wairoa because it has a greater range of ecosystems, good populations of rare or distinctive species and overall is in better condition than the Wairoa.
2. The downstream impacts of the changed river system are difficult to judge but overall do not seem to be critically important, but more research is needed.
3. Weeds, animal pests such as pigs, and forestry activities are damaging the natural ecosystems.
4. A mitigation package could focus on these problems, including restoration outside the footprint areas, especially an ecological restoration programme in the lower catchments, and the re-introduction of appropriate animal and plant species such as blue duck and black maire.

APPENDICES

APPENDIX 1. Preliminary notes on the vegetation of the two sites. Based on notes by Shannel Courtney, Department of Conservation, April, 2006

Upper Wairoa River (Site 15)

- The mixed broadleaf podocarp forest within the potential reservoir footprint is notable for its relative lack of beech species and high concentration of matai and totara.
- Other locally or regionally threatened species are present in the vicinity of the potential dam site including the tree black maire, the shrubs *Carmichaelia odorata* var. “*glabrata*”, *Melicytus micranthus* and *Coprosma brunnea*, and the fern *Adiantum diaphanum*
- The flood zone below the potential dam and reservoir has a distinctive combination of flood tolerant shrubs and herbs suited to hard rock substrates. These communities are endemic to Nelson and are expected to extend from the potential dam site to part way down the lower Wairoa Gorge (Shannel Courtney, pers. comm.). These communities require flooding to prevent exotic swarding grasses and woody plants becoming established and displacing the herbs and shrubs. Nationally threatened plant species in this zone include:
 - *Scutellaria novae-zelandiae*, a member of the mint family now confined to 12 lowland alluvial sites in the Nelson/Marlborough region.
 - *Brachyglottis sciadophila*, a scrambling daisy of forest margins
 - *Teucrium parvifolium* a shrub of riparian forest margins and scrub.
- Other nationally threatened plant species in the riparian zone within the lower to mid-Wairoa River (on terraces above (higher than) the area likely to be affected by altered flow regime) include:
 - *Coprosma obconica* (type locality in Wairoa Valley) a shrub that is largely confined to alluvial and riparian open dry forest and tall scrub
 - *Pseudopanax ferox*, a small tree with a widespread but sporadic distribution in NZ

Upper Lee (Site 11)

- Within the potential reservoir footprint black beech forest occurs with scattered red beech, rimu and matai along riparian (alluvial terrace) margins and on hill slopes; mixed shrublands dominated by akeake on ultramafic mélange; broadleaved shrubland with scattered beech on sandstone spur slopes.
- The riparian strip extends through sandstone, ultramafic and mélange substrates.
- The flood zone below the potential dam site has similar flood tolerant communities as the Upper Wairoa but they may be less intact and there is a considerable exotic element to the vegetation including grasses, broom and gorse.
- With the exception of *Melicytus micranthus*, there are no known locations of rare or threatened plants, but insufficient work has been undertaken to confirm this, and all species listed above for Site 15 Wairoa could occur in this catchment. Particular attention should be paid to the ultramafic substrates which may support flora of significance.

APPENDIX 2: Maps 1-7

APPENDIX 3: PHOTOGRAPHS (1-33)

1. Lower Lucy Creek and the confluence with the Lee. This area is below the proposed dam site and should not be influenced by the dam or the reservoir unless there is damage during construction. It is an important area because the black beech forest contains many rimu, large kahikatea and there is a riparian strip of mature tanekaha. Secondary bush nearby has ngaio which does not extend further upstream.



2. 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.



3. *Scutellaria novae-zelandiae* growing under kanuka and beech on a river flat in Site 1, Lee. 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 four 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. This particular site has been encroached by road widening in preparation for logging, and one conclusion from this survey is that logging activities need to be much more aware of the natural values of both the Lee and Wairoa river valleys.



4. One of the most widespread small trees along the riparian edge in both the Wairoa and Lee, is myrtle (rohutu, *Lophomyrtus obcordata*), and in both places it is parasitised by the dwarf mistletoe, *Korthalsella lindsayi*, a nationally threatened species. In Site 1 of the Lee the mistletoe also grows on mapou (*Myrsine australis*), and 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 silt so that the natural flooding regime of a river is important for its survival.



5. 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.



6. 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. 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 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.



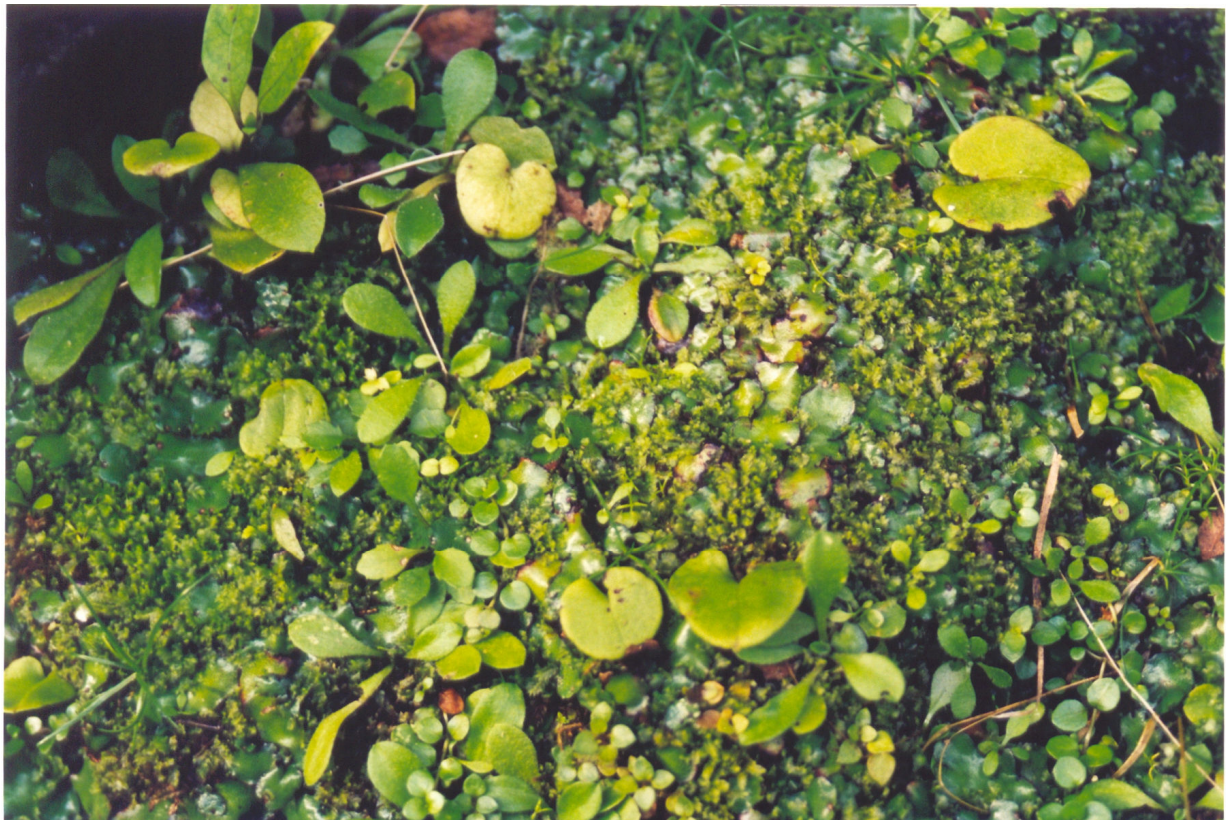
7. Where floods in the Lee and Wairoa surge high up the solid rock banks they create an open habitat for the nitrogen-fixing tutu and native broom, two species of which occur here, *Carmichaelia odorata* (foreground), a local species, and *C. australis*, a more widespread species. Where the solid rock remains moist and with crevices protected from the scouring caused by floodwater, a carpet of ‘gorge turf’ species can develop. Both rivers are very good habitats for this community (see detail in photograph 8). This community will be eliminated by inundation, and there is a question as to whether it will establish along the new water level. 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 will be substantial during dry periods, the scouring action of floods will be reduced, and the deposition of silt on the inundated area will be more constant. Hence it is likely that the ‘gorge turf’ community will not develop on the new surface.

Carmichaelia odorata

This species was formerly known as *C. glabrata*. It is distributed in the Pelorus, Sounds, Maitai, Lee, Wairoa and Golden Bay areas: in other words a ‘top of the south species’ (like *Scutellaria*). In the Lee and Wairoa it occurs in good populations along the bedrock riverbanks, but only where the original vegetation remains undisturbed. Masses of young leafy seedlings occur along the bush edges, but adults require more open rocky sites with their roots secured in cracks. It is a characteristic riparian species and will be lost to inundation, but may well regenerate along the new water line. The upper altitudinal limit was not determined. The population is probably greater along the Wairoa because more of the maximum footprint area remains in bush, but nevertheless is also prominent in the Lee, so that it does not alter the overall ecological assessment of the two catchments.



8. 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* spp. In other words this is a species-rich habitat adapted to a most tempestuous environment.



9. *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 it has been lost is a possibility.



10. 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*.



11. Site 3, Lee. 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*. This is the only example of this habitat in the Lee and Wairoa, but they would have once been a characteristic feature. Wild pigs are causing a lot of damage. 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.



12. Site 3, Lee: interior of the podocarp forest. A wide range of small-leaved shrubs characterises this place, including *Raukaua anaomalus*, *Coprosma rotundifolia*, *C. linariifolia*, *Lophomyrtus*, and *Neomyrtus pedunculata*. Kaikomako, tanekaha and pokaka are significant trees and horopito a 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.



13. Site 3, Lee. An unusual feature is the presence of bush snow tussock, *Chionochloa cheesemanii*, along the riparian edge among the young tutu. While the tussocks get periodically flattened by floods the underground parts are protected by the pavement of large boulders. Such a habitat could probably not be regenerated along the edge of a reservoir.



14. *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 Wairoa river system.



15. The upper portion of Site 3, Lee 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 both the Lee and the Wairoa, but they have largely been eliminated in the latter. 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.



16. 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.



18. 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 beneath kanuka forest.



19. The lower dam site on the Wairoa, chosen because of the hard rock bluffs that descend on both sides of the river creating a narrow gateway. Black beech and rimu are the dominant trees. A large creek joins from the right bank, and the reservoir would extend up this creek for several hundred metres.



20. The alternative dam site on the Wairoa is just around the corner. The area is dominated by extensive regenerating kanuka in which wilding pines are a feature. Along the river bank there is a strip of beech forest, including the only specimen of hinau observed during the survey. Its presence manifests a feature of the Lee and Wairoa valleys, that generally uncommon or locally rare associations of plants can be expected, including southern limits of species such as black maire.



21. Site 1, Wairoa, is the most highly rated site in the survey because part is characterised by matai forest associated with black beech and rimu. Here it creates an almost pure canopy along the right bank of the river. At this point the reservoir is likely to be over 30 metres deep, so that the lower part of the matai forest will be lost. Matai forest is rare in New Zealand but was characteristic of fertile places in the Tasman District. A detailed survey of this site might reveal rare species such as *Scutellaria*.



22. A large matai and rimu emerge above the black beech forest of Site 1, Wairoa. This forest extends upstream for over 1km, and upslope into the untouched wilderness of the Richmond Range. This is the largest area of indigenous habitat within the footprint areas of both the Lee and Wairoa (outside the upper limit, that would be little changed).



23. Close to the river matai is associated with silver and red beech. Silver beech often grows along the riparian zone as a result of cold air drainage creating a habitat like that at a higher altitude, while red beech benefits from the abundant moisture of the valley floor. The forests of the Wairoa are characterised as mixed beech- podocarp forests because of a wide range of species combinations, reflecting a generally favourable climate with mild moist conditions. Bluffs are a feature of this catchment.





24. Part of Site 1 in the Wairoa has bush on both sides of the river. This is not common because road access is limited to the left bank, bluffs restrict the road to the lower slope, and hence the bush has been mostly destroyed along the left bank. Where it occurs the valley takes on a particularly healthy appearance.

25. A distinctive feature in Site 1 of the Wairoa is a rocky spur that causes the river to flow in an uncharacteristic bend. One day it will cut through the neck of the spur and create an ox-bow wetland filled with kahikatea forest! But at present the spur is regenerating kanuka forest after a fire that extended up the adjacent slope as well, presumably during the farming phase but potentially of natural origin. The open kanuka provides a habitat for a good population of *Hebe divaricata*, otherwise uncommon in the area. This whole spur is likely to be inundated by the reservoir.



26. A feature of the Wairoa is the presence of talus slopes of angular rock spreading out beneath bluffs. The bluffs are a manifestation of old hard rock that mostly lacks narrow bedding, in contrast to the Lee. This feature has far-reaching consequences on the shape of the land, and the human uses of it, and is the reason why the flats along the Wairoa have been cleared of their forest and continue to be used as skid sites for logging. However, the talus slopes create a distinctive habitat for species that like a very permeable substrate with plentiful moisture. Fuchsia (featured here) and Kaikomako are species that like these conditions and this is one reason why the latter is more abundant in the Wairoa than the Lee. *Metrosideros colensoi*, usually a species found in limestone areas, features at the crest of this slope. The kowhai of the Wairoa shows affinity to *Sophora longicarinata*, also mostly a limestone species. Limestone is scattered through the eastern Nelson hills but is not mapped for the Wairoa. Hence the composition of the vegetation may be reflecting migration from nearby sites with distinctive soil. Tanekaha on the nearby ultramafic zone offers another example. Features like this help to explain the complex and distinctive pattern of plant distribution in this area.



27. Site 3, Wairoa combines regenerating swamp forest on a river flat, with regenerating bush on the slope. The swamp forest is dominated by kahikatea, shown here associated with a sward of *Carex*, perhaps *C. geminata*. The slope behind, probably once farmland, has been covered in bracken fern, but a distinctive feature is the large number of lemonwood trees, that will soon merge to form a lemonwood dominant forest, an unusual forest type. Lemonwood is a feature of the Wairoa and Lee forests. Across the base of the slope is an area of talus and on this is growing a large mass of *Hebe stenophylla*. This is an unusual and characteristic feature of the secondary vegetation of the Wairoa.



28. Regenerating kahikatea along the Wairoa right bank, with matai, rimu lancewood and broadleaf as well as the ubiquitous flood zone tutu. This vegetation will be inundated by the reservoir.



29. The upper part of Site 3, with regenerating kahikatea on the left bank of the Wairoa, the only place along the footprint where this occurs. Off-cuts from logging reflect one of the threats to this population. In places along the river these piles of debris extend into the river, and one of the possible features of a mitigation package is to encourage greater awareness of leaving the riparian zone undisturbed. Note the broom, which widely covers recently logged slopes, often with woolly mullein, both species being indicators of dry soil, perhaps caused by the coarse nature of the rock fragments within it.



30. Part of Site 3 is a wetland with raupo and manuka, common species but unusual in this environment but nevertheless adding to the complexity of the local biodiversity and therefore to be valued, and not covered in logging spoil.



31. Riparian forest along much of the footprint area of the Wairoa is lacking, but where it occurs (Site 4) uncommon species can be found, such as this group of green-hooded orchids, *Pterostylis alobula*. In the same patch of bush an exceptionally large ‘lily’ *Arthropodium candidum* was collected, and it was later discovered that a specimen from the Wairoa Gorge collected in 1950 was named *A. “bulbosum”*, although the distinction is not now maintained. However, this demonstrates once again that unusual varieties and combinations are a feature of places like the Wairoa where a distinctive set of environmental characteristics prevail.



32. The upper part of the footprint enters the undisturbed forest that clothes almost the entire upper Wairoa catchment, as in the Lee.



33. Site 5. A river flat with kahikatea forest, albeit somewhat disturbed, shows its relationship with the hill-slope beech forest behind. This is the edge of human impact in the Wairoa and few parts of New Zealand are able to demonstrate this interaction between lowland podocarp and hinterland beech forest. Supplejack grows in the understorey and a riparian band of myrtle provides a habitat for dwarf mistletoe.