Natural areas of Waipu Ecological District

Reconnaissance Survey Report for the Protected Natural Areas Programme

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Jenny Lux, Tim Martin, and Sarah Beadel

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Cover photograph: Fairy tern next to pingao at Waipu (Jan 2003). Photo taken by Katrina Hansen.

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Foreword

The Waipu Ecological District PNAP survey report was prepared by Wildland Consultants Ltd under contract to the Department of Conservation.

This report forms part of a series of reconnaissance survey reports for the Protected Natural Areas Programme (PNAP) in the Northland Conservancy of the Department of Conservation. It describes the significant natural areas of the Waipu Ecological District (ED). The natural areas were surveyed during the late spring and early summer of 2006. There has been no previous comprehensive survey and review of ecological information of this geographical area. This report will help conserve natural areas by providing a significant information resource to stake-holders such as landowners, iwi, the Department of Conservation, Whangarei District Council, Kaipara District Council, Northland Regional Council, resource management planners, interest groups, and the general public.

Waipu ED is typical of the Eastern Northland Ecological Region in that it contains a mixture of low forested ranges, alluvial plains, estuaries, coastal dunelands, and coastal cliffs. There are several very diverse, large, and good-quality examples of lowland forest in the ED, which contain small, rocky streams that are the northern stronghold for Hochstetter's frogs (this is the only population of this species in Northland, and the northern limit for it nationally).

As with most of Northland, extensive areas of indigenous habitat have been cleared and modified since human settlement. This survey has shown that habitats such as freshwater wetlands, alluvial floodplain forest, and coastal forest next to estuaries are now very rare. Several of these habitats are important for the survival of endangered species.

This study provides an objective assessment of the natural areas that remain, protected and unprotected, their value as representative examples of our natural heritage, and their relative ecological significance. The focus of the Protected Natural Areas Programme is to provide this information and guidance. The challenge then is for the community to work collaboratively to protect and enhance these natural areas.

Chris Jenkins

Conservator Northland

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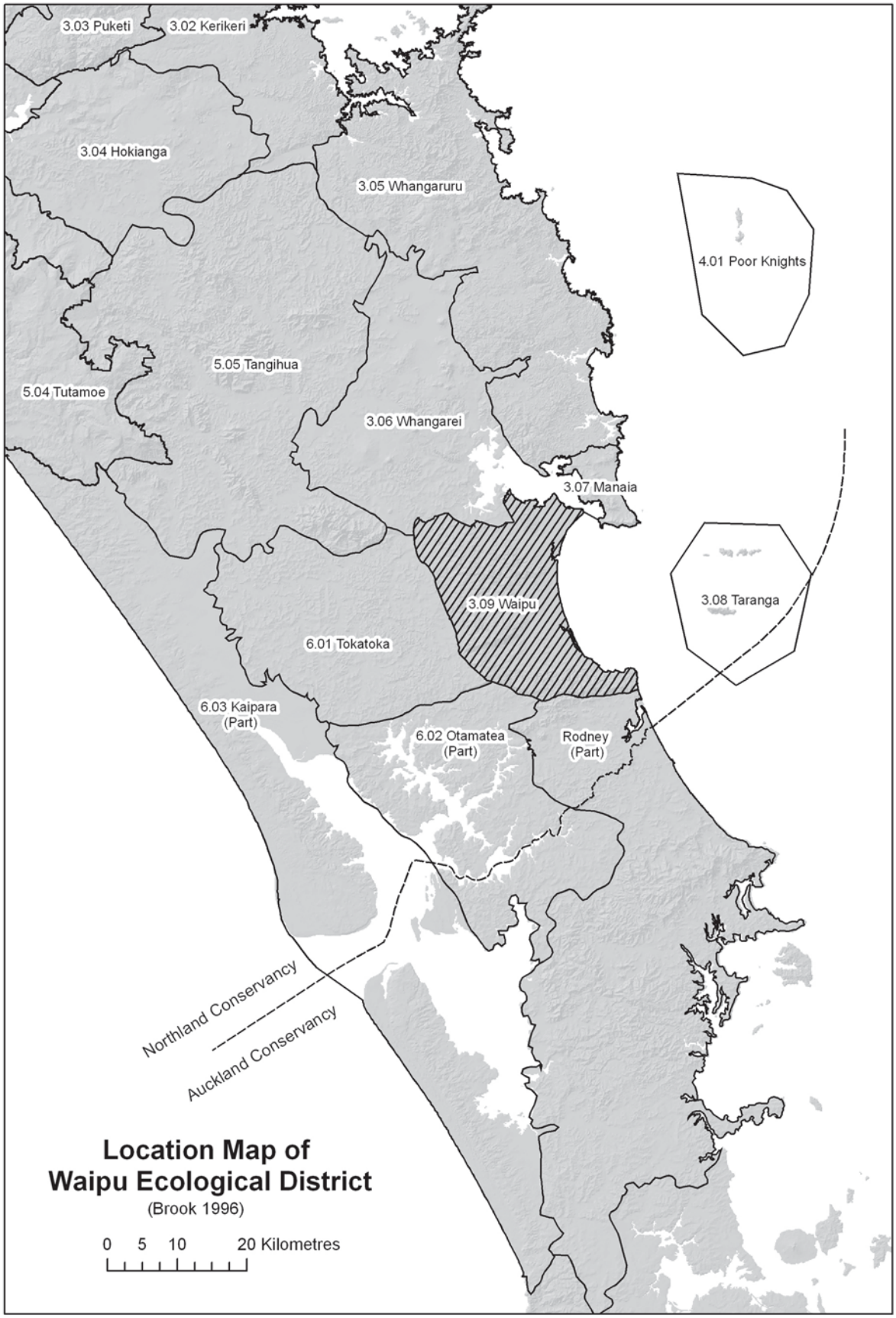
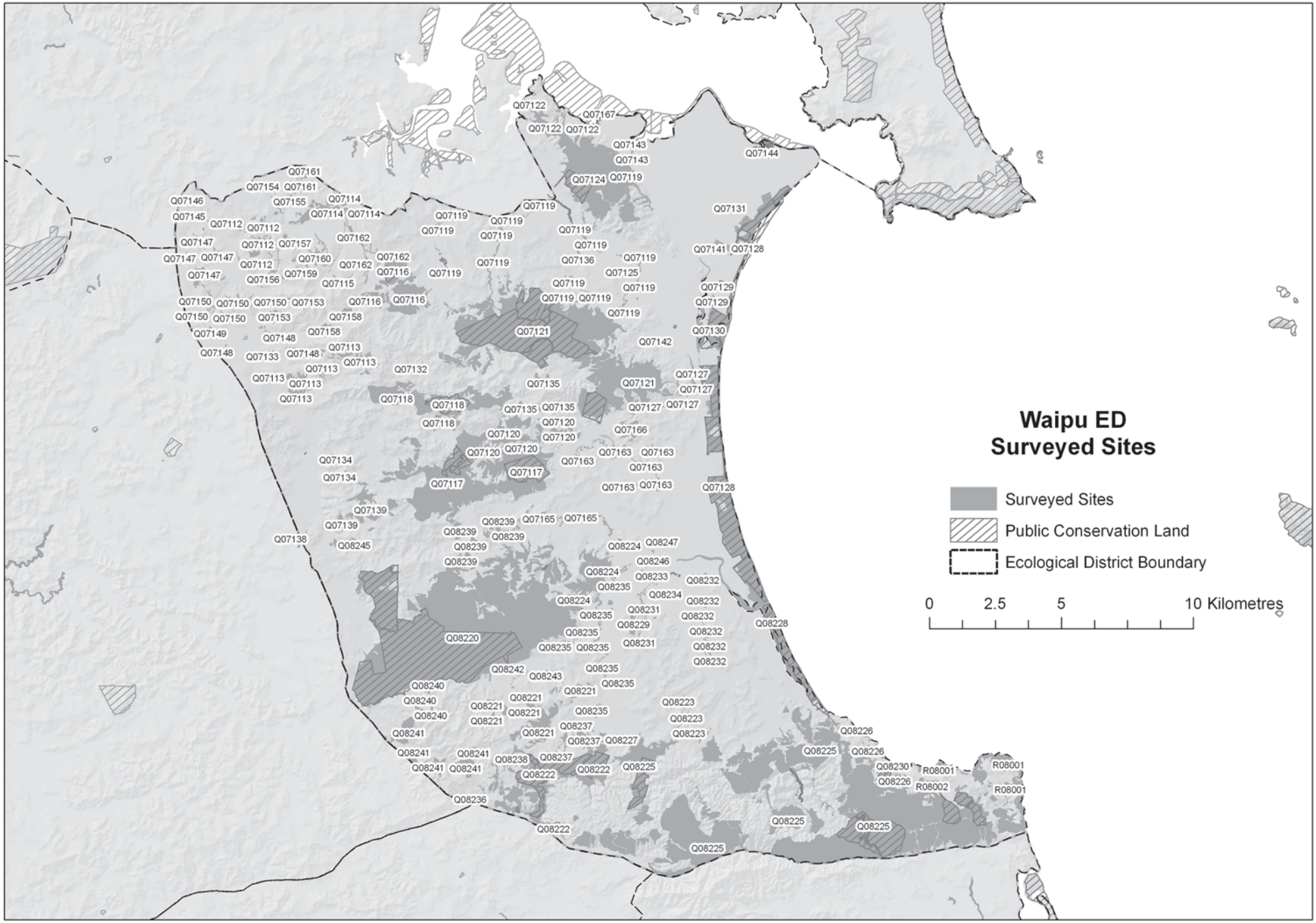


Map 1 (above). Location map of Waipu Ecological District.

Map 2 (opposite). Map of surveyed sites, Waipu Ecological District, including land administered by the Department of Conservation. Note that the representation of protected areas is indicative only and should not be taken to accurately delineate these areas.


Waipu ED
Surveyed Sites
Surveyed Sites
Public Conservation Land
Ecological District Boundary
0
2.5
5
10 Kilometres

Abstract

Waipu Ecological District (*c.* 49,413 ha) is located in the Eastern Northland Ecological Region. It is centred on the catchments flowing into Bream Bay (south of Whangarei Harbour), extending from moderately dissected ranges up to 400 m elevation in the west, through low rolling hill country, down to alluvial plains and coastal dunelands in the east. Whangaruru and Whangarei Ecological Districts lie to the north, Tokatoka Ecological District lies to the west, and Otamatea and Rodney Ecological Districts lie to the south.

Natural areas of ecological significance in Waipu Ecological District were identified using information from a reconnaissance survey undertaken over the late spring and early summer of 2006, together with information from a range of ecological reports, databases and unpublished information. A total of 86 natural areas covering 14,045 ha were identified. Of these, 57 are considered to be of particular ecological significance (Level 1 sites).

Waipu Ecological District comprises several moderately large tracts of indigenous forest on small east-west trending ranges (e.g. Ruakaka Forest, Mareretu Forest, Brynderwyn Hills), a prominent coastal headland (Bream Tail), a 23.5 km-long sweep of coastal duneland and beaches, two major river estuaries which provide important bird habitat (Ruakaka and Waipu River Estuaries), small areas of estuarine habitat on the southern Whangarei Harbour margin, tiny remnants of alluvial floodplain forest and treeland, several small and degraded freshwater wetlands, and the last remaining dune lake in the Eastern Northland Ecological Region (Ruakaka Racecourse Dune Lake).

Much of the former indigenous biodiversity of Waipu ED has been lost. At present, 28.4% of the land cover is indigenous vegetation or habitats, which is mainly concentrated in the inland hill country above 100 m asl, and on the coastal dunelands and estuaries. Freshwater wetlands and floodplain forests, which would formerly have been extensive on the lowland plains, are now severely reduced in extent and in poor condition.

Only 31.4% of the identified natural areas are currently legally protected, however these are largely in areas where most indigenous habitat remains (i.e. hill country and dunelands). Priority areas for protection therefore include forest and shrubland on alluvial plains, freshwater wetlands, forest and shrubland on hill country below 100 m asl, forest adjacent to estuaries, and a range of unique coastal habitats on Bream Tail.

The physical and legal protection of priority areas for protection would constitute an important first step in safeguarding remaining indigenous biodiversity. However, even if all priority areas were protected, there would still be a need for ecological restoration of wetlands, ecological corridors, linkages, and buffers to promote better connectivity between inland hill country, alluvial plains, and the coastal dune system.

1. Introduction

1.1 THE PROTECTED NATURAL AREAS PROGRAMME

The Protected Natural Areas Programme (PNAP) was established in 1982 to implement Section 3 (b) of the Reserves Act 1977:

> *Ensuring, as far as possible, the survival of all indigenous species of flora and fauna, both rare and commonplace, in their natural communities and habitats, and the preservation of representative examples of all classes of natural ecosystems and landscape which in the aggregate originally gave New Zealand its own recognisable character.*

The goal of the programme is:

> *To identify and protect representative examples of the full range of indigenous biological and landscape features in New Zealand, and thus maintain the distinctive New Zealand character of the country* (Technical Advisory Group 1986).

The specific aim of the PNAP is to identify, by a process of field survey and evaluation, natural areas of ecological significance throughout New Zealand which are not well represented in existing protected natural areas, and to retain the greatest possible diversity of landform and vegetation patterns consistent with what was originally present. To achieve this, representative biological and landscape features that are common or extensive within an Ecological District (ED) are considered for protection, as well as those features which are special or unique.

As knowledge and information about the presence and distribution of biota such as invertebrates and bryophytes is limited, the protection of the full range of habitat types is important for maintaining the diversity of lesser known species.

This report differs from many PNAP reports in that:

- it is based mainly on a reconnaissance survey supplemented by existing published and unpublished information; and
- it includes descriptions of all natural areas within the study area.

The natural areas described have been evaluated and ranked using two levels of significance, based on specified criteria (see Section 2). This approach was adopted so that the survey report better meets the broader information requirements of the Department of Conservation arising from the Resource Management Act 1991 (RMA), the Convention on Biological Diversity (1992), and the more recent New Zealand Biodiversity Strategy (2000).

The Purpose and Principles of the RMA 1991 are set out in Part II of that Act and include:

- safe-guarding the life-supporting capacity of air, water, soil and ecosystems;
- the preservation of natural character of the coastal environment, wetlands and lakes and rivers and their margins;

- the protection of outstanding natural features and landscapes;
- the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna;
- intrinsic values of ecosystems;
- maintenance and enhancement of the quality of the environment.

Of particular relevance is Section 6 (c) of the RMA 1991, which lists as a 'matter of national importance':

> *The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.*

The Convention on Biological Diversity (1992), under the auspices of the United Nations Environment Programme, has promoted the concepts of biodiversity and ecosystems. These concepts are reflected in this report by the number of sites, their size, and the emphasis on buffers and linkages in the identification and assessment of sites.

1.2 ECOLOGICAL REGIONS AND DISTRICTS

New Zealand's physical environment is very diverse and this is reflected in the considerable diversity of indigenous plant and animal communities. In recognition of the biogeographic differences between various parts of New Zealand, a classification of Ecological Regions and Districts has been established (McEwen 1987).

An Ecological District is a local part of New Zealand where the topographical, geological, climatic, soil and biological features, including the broad cultural pattern, produce a characteristic landscape and range of biological communities. Ecological Districts are grouped together into a series of Ecological Regions on the basis of shared general ecological and geological characteristics. In some cases, a single very distinctive Ecological District is given the status of Ecological Region to emphasise its uniqueness (Technical Advisory Group 1986).

The New Zealand Biological Resources Centre coordinated the mapping of the country into more than 268 Districts in 1982. Ecological Regions and Districts in northern New Zealand have since been redefined to more accurately classify ecological variation within the Northland and Auckland areas (Brook 1996).

The PNAP uses the division of Ecological Districts as a framework throughout the country for determining ecological significance, including representativeness.

1.3 CONTENTS OF THIS REPORT

This report presents the findings of the reconnaissance phase of the PNAP survey of the Waipu Ecological District. The methods and terminology follow those defined and specified in the Whangaruru Ecological District PNAP report (Booth 2005) and the Otamatea Ecological District (Northland) PNAP report (Lux & Beadel 2006). This report includes maps and brief descriptions of all of

the indigenous natural areas within the Ecological District which were surveyed during the late spring and early summer of 2006, together with descriptons of the main vegetation types, and information on threatened species and other taxa of scientific and/or conservation interest.

Soil sites of international, national or regional significance are derived from Arand *et al.* (1993). Important geological sites and landforms within the Northland Region, including internationally, nationally and regionally significant sites are derived from Kenny & Hayward (1996). See Appendix 8.4 for ranking criteria.

1.4 WAIPU ECOLOGICAL DISTRICT

Waipu Ecological District (*c.* 49,413 ha) is centred on the catchments flowing into Bream Bay, and extends from moderately dissected ranges up to 400 m asl in the west, through low rolling hill country, down to alluvial plains and coastal dunelands in the east. A 23.5 km-long sandy beach extends most of the length of Bream Bay from Marsden Point in the north down to Waipu Cove in the south. The northern boundary of the ED is formed by the southern coastline of Whangarei Harbour, and the southern boundary is delineated by the Brynderwyn Hills, which extend out to a rocky coastal headland named Bream Tail.

Waipu ED adjoins five other Ecological Districts: Whangaruru and Whangarei to the north, Tokatoka to the west, Otamatea to the southwest and Rodney to the south.

Results of this study show that, of the natural areas identified, 90.4% (12,699 ha) are forest or treeland, 5% (708 ha) are shrubland, 0.8% (116 ha) are freshwater wetland, 1.8% (257 ha) are estuarine, 1.7% (239 ha) are duneland, and 0.2% (26 ha) are rockland. The total area of sites recorded in this report is 14,045 ha (28.4% of the Ecological District).

Significant features of this Ecological District include:

- Several large, diverse, lowland forest tracts are present on moderately-dissected east–west trending hill country, which is the major landform in the ED. These include areas such as Waipu Caves Forest (371 ha), Takahiwai Forest (637 ha), North River Forest (973 ha), Ruakaka Forest (1699 ha), Mareretu Forest (2,820 ha), and the Brynderwyn Hills Forest Complex (3,308 ha).
- Bream Tail is a the only prominent coastal headland in Waipu ED, with diverse coastal forest, treeland, and shrubland remnants, two small wetlands, and extensive rocky cliffs and outcrops interspersed with small sandy beaches. The vegetation of this site has close affinities with that of Taranga (Chicken) Island, which lies approximately 13.5 km offshore to the northeast. Grey-faced petrels probably nest here (Andrea Booth pers. comm.).
- Waipu ED is the northern limit of distribution for Hochstetter's frog, and populations in streams in the Brynderwyn Hills are the northern stronghold for the species (Avi Holzapfel pers. comm.). Waipu ED is the only part of Northland where this species occurs.

- Holocene dunelands and beaches behind Bream Bay are extensive, although highly modified. They support small areas of *Kunzea ericoides* var. *linearis* forest, which is a distinct variety of kanuka specific to coastal sandy soils in the northern North Island.
- The Ruakaka and Waipu River estuaries are important breeding sites for variable oystercatchers and northern New Zealand dotterels, as well as feeding grounds for low to moderate numbers of national and international migrant wader species. Waipu River Estuary is the only breeding site for the acutely threatened New Zealand fairy tern in Waipu ED, and one of only four breeding sites for the species nationwide. A shorebird protection programme is in place at both estuaries, but is more intense at the higher value Waipu River Estuary site.

2. Methods

2.1 GENERAL APPROACH

Between 1994 and 1996, reconnaissance surveys using rapid semi-quantitative methods were carried out in 12 Ecological Districts in the northern sector of the Northland Conservancy, to obtain information on the composition, extent and ecological values of indigenous natural areas. A rapid survey method was selected by the Department of Conservation (DOC) because of time constraints for the field survey, the extensive areas to be covered, and ease of application to all natural areas. These methods were also specified by DOC for the current study, in order to achieve consistency in the type of information on natural areas over several decades.

Natural areas were identified using recent aerial photography (orthophotography flown in January 2004, or where not available, flown in July 2002) and data collected as part of the Sites of Special Biological Interest (SSBI) surveys. Sites were identified irrespective of land tenure. Consequently, all natural areas, including those administered by the Department of Conservation, as well as other protected areas, were surveyed using the same methods. This provided a consistent approach to determine the representativeness of all natural areas.

Each site was mapped, allocated a generic number, and described. Following evaluation (see Section 2.4 below), sites were grouped into levels of ecological significance (Level 1 or 2). Scientific names of species for which common names have been used can be found in Appendix 8.6 (Common Plant Names) or Appendix 8.7 (Checklist of Fauna Species).

Extensive use was made of information from biological databases and information systems such as the SSBI, the Bioweb Threatened Plants Database, the Herpetofauna Database, the NIWA Freshwater Fish Database, published information and Department of Conservation internal files and reports. Herbarium records from Auckland Institute and Museum (prefixed 'AK') were

also consulted. Geographical and geological information was gained from existing published and unpublished maps.

Although most sites were not surveyed in detail, a large amount of information was collected, considerably expanding the ecological information base for the Ecological District. It is important to note that as with any large scale survey, it is possible that some significant natural areas may have been overlooked

2.2 CONSULTATION WITH LANDOWNERS

Personal contact with all landowners was not possible because of the magnitude and geographic range of the surveys being undertaken. Therefore, all ratepayers were advised by mail by way of a letter (Appendix 8.2) informing them of the survey programme and the reason for it. The letter was signed by the Northland Conservator of DOC and provided contacts for further information. A press release on the survey methods and a photograph of the survey team was issued and featured in the local newspapers (Appendix 8.2). In several instances permission for access was sought from landowners in person and this was always given.

Patuharakeke are the tangata whenua of Waipu ED. Consultation letters were sent to Ngatiwai, Patuharakeke, and Te Uri O Hau. A consultation meeting was undertaken by DOC with Patuharakeke Trust Board on 7 July 2006.

2.3 DATA ACQUISITION AND ANALYSIS

Methods followed those prescribed by DOC, as described in Booth (2005).

A rapid reconnaissance field survey was carried out to record and map the ecological and geomorphological characteristics, broad habitat type and canopy vegetation of each identified natural area. Most of this work was carried out using telescopes and binoculars from vantage points on public roads or farm tracks.

Two sites were not surveyed in this manner due their isolation and/or lack of visibility from public roads and access restrictions. In these instances, sites were identified and described from aerial photographs using nearby sites on similar topography as a guide. Information on some of these sites, therefore, remains limited, and it is likely that some vegetation types/ecological units present were not identified.

Natural areas were mapped using six broad categories of habitat type: forest, shrubland, rockland, freshwater wetland, duneland and estuary (see Appendix 8.8 for definitions of terms). At each site, the composition and relative abundance of canopy plant species was recorded on the field survey sheet (Appendix 8.1) in the following four categories: greater than 50% cover was described as 'abundant'; 20–50% cover as 'common'; 5–20% cover as 'frequent'; and less than 5% cover as 'occasional'.

Canopy composition based on percentage cover abundance is widely considered to be an appropriate method of describing forest stands. This

technique and variations of it have been used to describe canopy composition both within New Zealand (see Atkinson 1962, 1985; Leathwick & Rogers 1996; Park & Walls 1978) and in other parts of the world (see Kershaw & Looney 1985; Mueller-Dombois & Ellenberg 1974). The specific technique for vegetation description at each site is based on the approach described in Myers *et al.* (1987).

This semi-quantitative method was selected by DOC because it could be implemented over large areas with a small number of field surveyors during a limited time period, and could be applied to all vegetation types irrespective of the height of the canopy. More detailed, and therefore more time-consuming and expensive methods, would not necessarily provide more useful information for assessing representativeness. The disadvantage of this survey approach is that it does not provide a great deal of information on the distribution of uncommon or threatened canopy and understorey species, nor does it provide full information on the distribution of bird species or other fauna. Fauna observations were incidental only.

Species present in the 'abundant' and 'common' columns of the field survey forms were used to define the vegetation type of each ecological unit. 'Abundant' species appear first in the vegetation type name, followed by 'common' species in their relative order of cover. The standard technique of identifying emergent features in the canopy (i.e. /) was excluded from these specific methods. Details of vegetation types and geological units within each site were entered into an Excel spreadsheet. Geological units were classified into 16 categories and vegetation/habitat types into 259 categories (see Table 2). Some sites had only one vegetation type on one geological unit, while others had multiple of each. Sorting of these ecological units gave information on their frequency and extent in the study area. This information was used to determine the representativeness of each ecological unit (see Section 5. Summary and Conclusions, Table 2 (p. 266) Ecological units recorded in Waipu Ecological District and protection status.

For the purpose of evaluation of representativeness and description, 'coastal' ecological units are those units which occur less than 1 km from the coast, whereas 'inland' ecological units occur 1 km or more from the coast. However it must be acknowledged that this is an arbitrary division. Some 'inland' ecological units will also have some coastal influence, because of the narrowness of the Northland Peninsula, and the fact that all areas within Waipu ED are within 16 km of the coast.

Other relevant information such as fauna observations, threats and landowner information collected incidentally was also recorded on the survey sheet for each site. Once the field reconnaissance or survey had been completed, sites were numbered and information from other databases and information systems was incorporated into the site descriptions. Completed field survey forms are held by the Department of Conservation, Northland Conservancy Office, Whangarei.

2.4 CRITERIA FOR ASSESSMENT OF HABITAT SIGNIFICANCE

Assessment criteria follow Booth (2005).

The natural areas described in this report meet at least one of the following criteria:

- They are predominantly of indigenous character, by virtue of physical dominance or species composition in the canopy.
- They provide habitat for a threatened indigenous plant or animal species.
- They include an indigenous vegetation community or ecological unit, in any condition, that is nationally uncommon or much reduced from its former extent.

The conservation values of these areas were assessed using a two-level classification of habitat significance based on the PNAP ecological criteria of representativeness, rarity and special features, diversity and pattern, naturalness, habitat structure and characteristics important for the maintenance of ecosystems (i.e. buffer, linkage or corridor, size and shape) (see Table 3, p. 298).

The PNAP criterion of long-term viability has not been included in Table 3. Long-term viability was considered under the umbrella of representativeness, diversity and pattern, naturalness, size and shape. Table A outlines the links between PNAP criteria and the Level 1 and 2 criteria.

2.4.1 Level 1 sites

A level one site contains significant vegetation and/or significant habitats of indigenous fauna and is defined by the presence of one or more of the following ecological characteristics:

1. Contains or is regularly used by critical, endangered, vulnerable or declining or naturally uncommon taxa (i.e. species and subspecies), or taxa of indeterminate threatened status nationally.
2. Contains or is regularly used by indigenous or endemic taxa that are threatened, rare, or of local occurrence in Northland or in the Ecological District.
3. Contains the best representative examples in the Ecological District of a particular ecological unit or combination of ecological units.
4. Has high diversity of taxa or habitat types for the Ecological District.
5. Forms ecological buffers, linkages or corridors to other areas of significant vegetation or significant habitats of indigenous fauna.
6. Contains habitat types that are rare or threatened in the Ecological District or regionally or nationally.
7. Supports good populations of taxa which are endemic to Northland or Northland-Auckland.
8. Is important for endemic and indigenous migratory taxa.
9. Covers a large geographic area relative to other similar habitat types within the Ecological District.

2.4.2 Level 2 sites

A Level 2 site is a natural area that supports populations of indigenous flora and fauna not identified as meeting the criteria for Level 1. It is a site which:

- contains common indigenous species but which is not one of the best representative examples of its type;
- may be small and isolated from other habitats;
- may contain a high proportion of pest species;
- may be structurally modified, e.g. forest understorey grazed;
- has not been surveyed sufficiently to determine whether it meets the criteria for Level 1 sites.

TABLE A: LINKS BETWEEN THE PNAP CRITERIA AND LEVELS 1 AND 2.

PNAP CRITERIA	LEVEL 1	LEVEL 2
Representativeness*	Contains the best representative examples in the Ecological District of a particular ecological unit or combination of ecological units. (3) Supports good populations of taxa which are endemic to Northland or Northland–Auckland. (7)	Not one of the best examples of its type in the Ecological District.
Rarity and special features	Contains or is regularly used by critical, endangered, vulnerable, or declining, or naturally uncommon taxa (i.e. species and subspecies), or taxa of indeterminate threatened status nationally (1). Contains or is regularly used by indigenous or endemic taxa that are threatened, rare, or of local occurrence in Northland or in the Ecological District (2). Contains habitat types that are rare or threatened in the Ecological District or regionally or nationally (6). Is important for endemic and indigenous migratory taxa (8).	Does not regularly contain, or there is no currently known threatened, rare, or species of local occurrence. Contains common habitat types. No currently known special features.
Diversity and pattern	Has a high diversity of taxa or habitat types for the Ecological District. (4).	May contain only one habitat type and/or have a low diversity of taxa relative to other areas of a similar type.
Naturalness	Exhibits a higher level of naturalness than other examples of its type.	Exhibits a lower level of naturalness than other examples of its type.
Buffering/corridors and linkages	Forms ecological buffers, linkages or corridors to other areas of significant vegetation or significant habitats of indigenous fauna.(5)	May be heavily impacted by external influences or may be fragmented and isolated from other natural areas.
Size and shape	Covers a large geographic area relative to other similar habitat types within the Ecological District. (9)	Is likely to be small relative to other similar examples of its type, or if large, is not the best example of its type and meets no other criteria for a Level 1 site.
Long-term ecological viability	If the long-term viability of the site is high or medium, it is likely to meet one or more of the other criteria above, or if low, may nevertheless be the best or only example of its type in the Ecological District.	May require a high degree of management to achieve viability or may never be viable under present circumstances or, if viable, may not meet any other criteria for a Level 1 site

* Best representative examples include sites with the highest level of naturalness, diversity, in the best condition, and with values other than ecological values such as cultural and amenity values (where known).

2.5 UPDATING OF DATA

Natural ecosystems are dynamic and forever changing, both physically and biologically. Some areas are very dynamic (e.g. wetlands are particularly susceptible to changes in ground water hydrology), whilst others (e.g. forests) change more gradually. The status and composition of species also changes over time and this could result in changes in the conservation value of some habitats.

Human-induced changes and activities, both within or adjoining significant natural areas, can accelerate the processes of change. Fire, followed by the invasion of adventive weeds, can dramatically modify shrublands. Drainage of adjoining land can alter the water tables of wetlands, thereby lowering the quality of the habitat and facilitating the establishment of weeds. Ongoing piecemeal destruction or modification of habitats and sustained grazing of forest remnants will, in the long term, completely eliminate some habitats.

The natural areas identified in this survey will therefore require regular monitoring of species and habitat composition and condition, and continued assessment of their ecological significance. Over time, it is possible that, Level 2 sites may qualify as Level 1 sites, or that Level 1 sites could lose their high level of significance.

3. Ecological character

3.1 TOPOGRAPHY/GEOLOGY

The geology of Waipu ED is dominated by a series of east-west trending, moderately dissected ranges up to 400 m elevation, that typically have steep fault-bounded southern faces and more gently sloping northern sides. They comprise Mesozoic Waipapa Terrane greywacke overlain by thin and laterally discontinuous Eocene-Oligocene Te Kuiti Group glauconitic sandstone and limestone sequences, and by thicker lower Miocene Waitemata Group sandstone and mudstone sequences. Low rolling hills near Waipu are formed of Cretaceous-Paleocene allochthonous sedimentary rock units, and Lower Miocene dacite intrusions are present at Bream Tail.

The east coast has a 23.5 km-long sandy beach backed by dunefields and extensive alluvial flats of Late Pleistocene and Holocene age, extending from the mouth of Whangarei Harbour south to Waipu Cove, and a steep rocky coastline with pocket and gravel beaches around the Bream Tail coastal headland. Small estuaries are present at the mouths of the Ruakaka and Waipu Rivers.

3.2 CLIMATE

3.2.1 General

Northland's climate is influenced by its northerly location (latitudes 34°S to 36°S), the narrowness of the peninsula (no areas are more than 50 km from the sea), and its generally low topography (most areas are below 150 m asl).

Summers are warm and humid, and winters mild. Mean annual air temperatures vary from 14.0°C to 16.0°C. Air frosts are infrequent in Northland, but ground frosts (± 1°C at 2.5 cm above ground) are not uncommon, especially inland. Annual sunshine hours vary little across Northland, with 2,000 at low altitudes, decreasing to 1,700 at higher altitude sites.

Rainfall peaks in winter, with the driest seasons being summer and early autumn, and there are usually one or two "dry spells" (periods of fifteen or more consecutive days with less than 1mm of rain on any one day) between December and March. Mean annual rainfall ranges from 1,200 mm to 2,400 mm. The predominant winds are from the southwest, with inland areas being more sheltered than exposed coastal sites (mean annual wind speeds range from 10 to 30 km/hour). Gale force winds can occur at any time, but are most common in winter. The occurrence of fog and thunderstorms varies from 1 to 75 and 3 to 16 days per year, respectively (Moir *et al.* 1986).

3.2.2 Climate of Waipu Ecological District

Few climate records are available for the Waipu Ecological District, but some general comments can be made.

Mean monthly wind speed at Marsden Point (the north-eastern corner of Waipu ED) was 18 km/h between 1969 and 1978, but mean speeds are likely to be lower in less exposed parts of Waipu ED (e.g. the mean monthly wind speed at Whangarei Airport, just outside Waipu ED, was 10 km/h over the same period). Mean annual rainfall parallels orography, increasing from 1368 mm at Waipu Cove (coastal) to around 1800 mm on hill country further inland. Monthly rainfall at Waipu Cove is highest between May and August (range 123–168 mm) and lowest between November and February (range 81–97 mm). Mean annual air temperatures in eastern Northland (including Waipu ED) vary from 15.5°C 16.0°C, similar to the Aupouri Peninsula and slightly warmer than western Northland (Moir *et al.* 1986).

3.3 VEGETATION

3.3.1 Historical

A vegetation history specific to Waipu ED has never been written, and the best information available about the extent of natural vegetation and the changes wrought on it comes from pollen studies, and the accounts of early European settlers.

During several millennia prior to the human settlement of New Zealand, which occurred around 800 years before present (BP) (McGlone & Wilmshurst 1999),

most of Waipu ED would have been clothed in a dense mantle of forest, from the ridge crests down to the dunelands along Bream Bay. In earlier times, however, the extent of forest had waxed and waned with the changes in the Earth's climate. During the most recent ice age (14,000–10,000 years BP) harsher climatic conditions forced the forests into sheltered pockets and valleys, with vast areas of fern and shrubland in between (Dodson *et al.* 1988). The beginning of the Holocene (10,000 years BP) saw a return to warm, humid and equable conditions, which allowed forest to expand from these refuges onto hillslopes and down to the coast. The sea level stabilised around 6000 years BP, and the climatic conditions which we know today were similar to those that the first Polynesian explorers encountered.

Pollen and charcoal analyses from Northland show that the fire and fire-tolerant heathland which was abundant during the last ice age, decreased during most of the Holocene, and then dramatically increased after the arrival of humans (Dodson *et al.* 1988). During the Polynesian period (800–200 years BP), approximately 50% of the forest in New Zealand was cleared by fire, but most of this was concentrated in the lowlands (McGlone 1983). Most of Waipu ED lies below 100 m asl, and it is likely that large portions of the ED were burnt at that time.

A pre-human vista of Waipu ED may have looked something like this: Tall, densely wooded kauri–podocarp–broadleaf forest on the inland hill country grading into alluvial terraces covered in dense totara, taraire and kahikatea forests with patches of kowhai nearest the river margins; steep coastal hills clothed in large sprawling pohutukawa in mixtures with puriri, kohekohe, karaka, nikau, taraire, tawapou, coastal maire, large-leaved milktree and kowhai; steep coastal cliffs with scattered pohutukawa, shrubs and tussocks such as harakeke and *Chionochloa bromoides*; Holocene dunefields supporting mosaics of *Kunzea ericoides* var. *linearis* forest and flammable indigenous shrublands dominated by manuka; older (Pleistocene) consolidated dune ridges covered in pohutukawa forest overhanging estuaries with open mudflats and small areas of mangrove and saltmarsh; mobile dunes supporting extensive spinifex, pingao, and shore spurge with occasional sand pimelea and *Austrofestuca littoralis*; riverine raupo reedlands, marshes, and pools alongside meanders; and series of palustrine dune wetlands in interdune hollows and occasional deeper dune lakes.

The Waipu area is part of a wider geographic area characterised by Ngati Wai occupation, economic activity or ancestral links encompassing coastal lands and islands from Whangaroa in the north, to Tamaki (Auckland) in the south, and eastwards to Hauturu (Little Barrier) and Aotea (Great Barrier) (Te Ara 2007).

The area around the present day Waipu township was settled by Scottish Highlanders who arrived in the period 1854–1860 after an approximately 40-year migration with short-lived settlement in Nova Scotia (Canada) and Australia. Six ships brought almost a thousand pioneering agriculturalists who rapidly set to work clearing the native vegetation for farming and gardening. Within three years grass seed was widely sown and substantial wheat crops were being harvested and exported.

McKenzie (1942, first edition from 1935) gathered original commentaries from the Scottish settlers, which give some insight into the vegetation of Waipu ED at that time.

'Some of the settlers were fortunate enough to secure land that had been cleared by the Maoris at some time in the past and which was covered with nothing more formidable than tea-tree (manuka, Leptospermum scoparium), scrub and bracken fern (Pteris aquilina). (...) Most of the land, however, was covered in virgin forest, but that fact had no terror for our sturdy settlers who were all, or nearly all, skilled axe-men.'

Settlers typically made a small clearing for a hut (usually split native logs roofed with raupo, nikau or shingles), and then cleared bush at an average rate of 'two acres or more a week'. Trees were felled, left to dry and burnt in a great fire around early March. Stumps were laboriously removed once roots had rotted. Often fires got out of hand and moved into standing bush, which was undesirable as it left half-destroyed forest with 'worthless second growth and fern' underneath it, which was harder to clear. Thus the best land in Waipu ED was cleared of its forest cover, and the remainder was used as a larder and timber resource:

'Wild pigs and native pigeons were plentiful in the bush. Wild ducks were numerous in the streams and so were eels. Those who lived near the coast had an abundant supply of sea fish.'

'...children found pleasure in foraging for the fruit of tarairi, tawa, karaka, titoki, ramarama, kahikatea, bush-lawyer, etc., the edible bracts (tawhara) of kiekie and the very young buds of the nikau palm...'

Permanent houses were constructed of mature kauri, totara, and puriri. Northern rata, puriri, manuka, and taraire were chopped for firewood. Of the latter, McKenzie (1942) writes:

'The taraire (Beilschmiedia tarairi) is practically restricted to the northern half of the Auckland province. It covered all the alluvial flats at Waipu.'

Wild cattle and pigs introduced by the settlers began causing damage to forest regenerative processes from very early on, as this quote illustrates:

'Cattle often throve well on native vegetation without the European grasses sown by the settlers. Fences were needed to protect crops from live stock and, in some instances, from wild pigs which were numerous in the bush at that time.'

The area around the Waipu settlement was part of the Auckland province kauri timber boom of the 1870s-1890s. The 'Waipu hills' (now known as Brynderwyn Hills) had 'heavy timber', with several early access roads heading up from Waipu settlement (Mabbett 1981). It is likely that most of the less fertile hill country of Waipu ED (i.e. Brynderwyn, Mareretu, North River, Ruakaka and Takahiwai) was cleared or logged-over during the late 1800s, following lowland clearance for agriculture several decades earlier. However, Waipu was not as important a timber area as other areas further north, which drew many Waipu men away from home to work as bushmen (McKenzie 1942). Due to the world-wide economic depression in the latter 19th century, agriculture had become less profitable. Kahikatea and totara forests now remaining on alluvial flats

probably regenerated on some of the disused agricultural land at that time. Commercial export of dairy products began in 1901, starting the trend towards nutrient enrichment which now affects all lowland streams and floodplains in Waipu ED.

A history of the Great North Road through the Waipu area explains how the original road used to be through Waipu Gorge, but the Brynderwyn deviation was built during the great depression in 1938. A bush track from Mangawhai to Waipu (behind Bream Tail) was constructed around 1873 (Mabbett 1981).

Although major clearance for agriculture was already finished by the early 1900s, further piecemeal clearance and drainage of wetlands continued into the twentieth century. Conversely, some areas on hill country were abandoned in the mid-twentieth century, and are now in *c.* 50 year-old kanuka forest, for example around Brynderwyn Hills Forest Complex - Part G (Q08/225g) and in the Caves Road Forest (Q07/120).

3.3.2 Broad pattern

Currently the vegetation of Waipu ED is almost entirely secondary in origin. The largest areas of indigenous vegetation are on hill country above 100 m asl, while the remaining landforms have small and highly modified examples of their former vegetation.

Large tracts of secondary indigenous forest and treeland are present on the major east-west trending hills. Kanuka, kauri, rimu, tanekaha, rewarewa, and totara associations are common on ridges within these ranges, whilst upper hillslopes support forest dominated by totara, kanuka, and/or mamaku, and lower hillslopes and gullies have broadleaf forest dominated by species such as taraire, towai, puriri, nikau, and tawa, often containing kahikatea. There are relatively few shrublands. On the Bream Tail coastal headland there are several coastal forest types which are not represented anywhere else in Waipu ED. However many of these sites are degraded due to fragmentation, grazing, and the presence of mammalian pests.

Vegetation on alluvial flats is limited to a few, scattered forest and treeland remnants along riparian margins, and occasional tiny stands of kahikatea and totara on floodplains away from main river channels.

Freshwater wetlands have been greatly reduced from their former extent, and several constructed ponds and dams now supplement this habitat for aquatic species. There are very few areas of natural or semi-natural wetland remaining; only five small examples within the coastal zone (including one dune lake), and nine small examples further inland. Raupo reedland is the most common wetland type.

The coastal dunelands are dominated by gorse–pampas scrub on backdunes and mixtures of indigenous and exotic grasses and herbs on the foredunes. There are also small islands of *Kunzea ericoides* var. *linearis* forest and exotic forest and treeland.

Estuaries support mosaics of saltmarsh vegetation at their margins, with the main types being mangrove shrubland and forest (although very little of the latter), and rushlands composed of oioi and sea rush. These estuaries are

sandier than comparable sites further north in Eastern Northland Ecological Region, hence glasswort herbfield and sandflats are more extensive.

3.3.3 Main vegetation types

OVERVIEW

This study recorded 249 different ecological units in Waipu ED, and these are listed in full in Table 2 (page 266), with representative units shown in bold. The following paragraphs describe the present-day vegetation patterns of Waipu ED and highlight distinctive ecological units.

For the purpose of evaluation of representativeness and description, 'coastal' ecological units are those units which occur less than 1 km from the coast, whereas 'inland' ecological units occur 1 km or more from the coast (see Table 2). However it must be acknowledged that this is an arbitrary division. Some 'inland' ecological units will also have some coastal influence, because of the narrowness of the Northland peninsula, and the fact that all areas within the ED are within 16 km of the coast.

FRESHWATER WETLANDS

Freshwater wetlands were documented at 24 sites within Waipu ED covering a total of 116 ha. It is considered that 16 of these are natural or semi-natural in origin, covering approximately 45 ha. Constructed wetlands were included because they either support indigenous vegetation or provide habitat to indigenous fauna. Prior to agricultural clearance, riverine and palustrine wetlands are likely to have been relatively extensive on the *c.* 7000 ha of alluvial plains and *c.* 2000 ha of coastal duneland in Waipu ED. It is estimated that in the whole of Northland only about 5% of the original freshwater wetlands (including lakes) remain, which is lower than the national estimate of 10% of freshwater wetlands remaining (Conning 2001).

Raupo reedland is the most common wetland vegetation type, and tends to be associated with valley floor alluvium (especially gullies in farmland), but also occurs around the margins of a dune lake margin and in a small dune slack. The presence of raupo is an indicator of moderate to high nutrient status (Johnson & Gerbeaux 2004), and in Waipu ED agricultural run-off often contributes to this.

Coastal freshwater wetlands

Within the coastal zone there are only five 'natural origin' wetlands, each with a quite different character. McEwan Road (Q07/131) and Sime Road (Q07/141) Wetlands are the two smallest; being tiny dune slack wetlands barely over half a hectare. The former has an island of manuka shrubland at its centre surrounded by *Azolla filiculoides*-burr reed herbfield and *Eleocharis sphacelata* reedland; while latter is dominated by *Eleocharis sphacelata* reedland and *Baumea articulata* reedland. Doctor's Hill Road Wetland (Q07/127) is by far the largest in the coastal zone (17.6 ha of wetland habitat), filling a gully draining into Ruakaka River Estuary (Q07/130). Its main vegetation types are reed sweetgrass grassland (exotic) and raupo reedland, with small areas of *Baumea articulata* reedland and bracken fernland. The fourth natural wetland is the only dune lake in the whole Eastern Northland Ecological Region (Ruakaka Racecourse Dune Lake Q08/129), which is mostly open water but has raupo and lake clubrush reedlands around the margins, all of which are infested with alligator weed.

Together with the two large constructed wetlands in the northern/central coastal dunelands of Waipu ED (Northland Port Corporation Ponds Q07/164 and Semenoff Sand Supplies Ltd ponds Q07/128), these sites form an important wetland bird habitat network for species such as Australasian bittern. The fifth semi-natural coastal wetland site is located on Bream Tail Coastal Headland (R08/001) and constitutes two gullies with moderately degraded (grazed) raupo reedland, and small patches of *Baumea* sp., *Juncus* sp., *Cyperus ustulatus* and manuka–harakeke-ti kouka shrubland. Small areas of marsh clubrush sedgeland also occur at the edges of some estuaries in freshwater seepages.

Inland freshwater wetlands

Most freshwater wetlands in the inland areas of Waipu ED are small, degraded patches of raupo reedland, harakeke flaxland, reed sweetgrass grassland or *Polygonum* sp. (exotic) herbfield. Impacts include grazing and nutrient enrichment through animal faeces and urine, and mineral fertilizers.

There are two higher quality wetlands which stand out from the rest at an Ecological District scale. Glenmohr Road Wetland (Q08/223) has the largest raupo reedland in the ED, which is spread patchily along 2 km of farm gully, sheltered on one side by plantation forest. The Upper Mangawai River Wetlands (Q07/138) have two large wetland remnants, each dominated by harakeke flaxland with patches of kahikatea–harakeke treeland, and peripheral areas of grazed reed sweetgrass grassland. This wetland has a reasonable diversity of emergent woody species including occasional manatu, kowhai, pukatea, ti kouka, manuka, and *Coprosma propinqua* var. *propinqua*, with only a few invasive crack willows.

ESTUARINE VEGETATION AND HABITATS

Estuarine vegetation occurs at five sites in Waipu ED, as follows: two large river mouth estuaries on Bream Bay (Waipu River Estuary and Sandspit Q08/228 and Ruakaka River Estuary Q07/130), two small stream mouth estuaries on the southern margin of Whangarei Harbour (Blacksmith's Creek Estuary Q07/144 and Takahiwai Stream Estuary Q07/143)*, and another small site on the harbour margin (Takahiwai Saltmarsh and Shrubland Q07/167).

Two vegetation types common to the four largest estuaries are mangrove shrubland and different combinations of oioi and sea rush (e.g. a mosaic of sea rush rushland and oioi rushland, or a more blended sea rush-oioi rushland type). Mangrove forest only occurs in upper reaches of the larger two estuaries of Waipu and Ruakaka, and even then, these are tiny stands compared with those present in other Northland estuaries.

Another widespread vegetation type is glasswort herbfield, which often occurs on upper tidal sandy substrates or shellbanks, or on the edges of sandy estuarine channels Glasswort may also occur in association with mangrove seedlings and pneumatophores, although it does not tolerate a lot of estuarine mud. Waipu and Ruakaka estuaries, and Mangawhai estuary which lies to the south in Rodney ED, are considered 'sandy estuaries' in terms of bird habitat (Richard Parrish pers. comm.), and this is also reflected in the vegetation.

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* Note that only these small portions of Whangarei Harbour are within Waipu ED.

The Waipu River Estuary is the largest of all estuarine sites and has the only examples of sea rush rushland (i.e. 3-4 ha of pure sea rush), sea rush-*Austrostipa stipoides* rushland, sea primrose-remuremu herbfield, knobby clubrush-tall fescue sedgeland, and subtidal beds of sea grass grassland. It also has a large area of intertidal flats covered in the invasive saltwater paspalum. Although not listed as a vegetation type in any other estuary, saltwater paspalum forms a component of many saltmarsh, mangrove and mudflat communities in Waipu ED, and poses several threats to indigenous flora and fauna. The Ruakaka River Estuary has a few distinctive vegetation types including small areas of pure saltmarsh ribbonwood shrubland, *Austrostipa stipoides* tussockland, and some manuka shrubland and gorse scrub perched on an estuarine island. Takahiwai Stream Estuary is perhaps the least disturbed estuarine system in Waipu ED due to its relative remoteness from urban areas, but is relatively small. Blacksmith's Creek Estuary and Takahiwai Saltmarsh and Shrubland are more modified than the other three sites, the latter having been carved up with drains.

DUNELAND VEGETATION AND HABITATS

Waipu ED has extensive Holocene and Pleistocene dunelands covering the wide sweep of Bream Bay from One Tree Point and Marsden Point in the north to Waipu Cove in the south, and extending inland for several kilometres. A few smaller bays with Holocene beach sands are present at Lang's Cove, Anderson's Cove and Bream Tail. Wild duneland vegetation has been reduced to a strip that runs parallel to the beach. The strip can be as narrow as 1 m (for example in front of beachfront buildings at Waipu Cove), or up to 800 m wide (in the Ruakaka Conservation Area). Modifications which have restricted the duneland vegetation include roading, clearance for farming, grazing, industrial establishments, a power station, a golf course, a race course, a refuse station and landfill, campgrounds, recreational buildings, parkland, and residential housing. The majority of Waipu ED dunelands are now dominated by exotic plant cover, although a moderate diversity of indigenous species and vegetation types still remains.

For this study the dunelands of Waipu ED were divided into two major sites: Ruakaka Dunelands (Q07/128 - from Marsden Point to the northern side of the Waipu River) and Waipu River Estuary and Sandspit (Q08/228 - from Waipu River Estuary to the southern end of Waipu Cove). The Ruakaka Dunelands are characterised by large areas of exotic gorse–pampas scrub on the backdunes, with scattered patches of bare sand, *Kunzea ericoides* var. *linearis* forest (a threatened variety of kanuka specific to coastal sandy soils), harakeke-gorse shrubland, radiata pine forest, maritime pine treeland, brush wattle-Chinese privet-mapou scrub, tree privet-Chinese privet scrub and several other smaller exotic vegetation types. The main vegetation types on the foredunes within this site are spinifex grassland, pohuehue shrubland, pohuehue-*Coprosma acerosa* shrubland, knobby clubrush-pohuehue sedgeland, sweet vernal-harestail grassland, and harestail-gazania-marram grassland, all harbouring many exotic species. *Coprosma acerosa* is present at one site but was probably previously much more widespread in Waipu ED (Lisa Forester, NRC, pers. comm.). The Waipu Sandspit is characterised by a lack of exotic scrubby vegetation, more extensive shifting sands and spinifex grassland, large areas of purple groundsel-South African iceplant herbfield, and smaller areas dominated by buffalo grass or South African iceplant in association with mainly exotic species. Both sites

have scattered remnants of the previously more common pingao sedgeland. Old records of *Pimelea arenaria* (1899) and *Austrofestuca littoralis* (1973) at Ruakaka show that these species and their types were once present, however they have now almost completely disappeared from Waipu ED sand dunes.

Lang's Beach (Q07/235) has a tiny sand dune with harestail-spinifex grassland and pingao sedgeland (probably planted), and the Bream Tail Coastal Headland (R08/001) beaches are sometimes backed by small dunes with pohuehue-buffalo grass shrubland. Both these sites have occurrences of *Carex pumila* sandfield in the upper intertidal zone.

Some planting of indigenous species has occurred in recent times along Waipu ED coast, probably with a view to restoring dune vegetation. Species recorded in plantings include pingao, spinifex, *Austrofestuca littoralis*, and *Carex testacea*. Planting appears to be quite limited in extent, although this can be difficult to determine over time if locally sourced species are used and natural ecological patterns are followed.

ALLUVIAL LANDFORM VEGETATION

The area of indigenous vegetation on alluvial flats and gullies remaining in Waipu ED is approximately 360 ha, occurring within 28 different sites. The sites are usually divided into several separate remnants. Alluvial flats are the most productive land and would have been the first to be cleared and the most zealously maintained through time.

Coastal alluvium vegetation

The only vegetation recorded on coastal alluvium is kanuka shrubland on the border of Takahiwai Stream Estuary (Q07/143) and at Blacksmith's Creek Estuary (Q07/144), and a patch of manuka-harakeke shrubland in the latter. All of the alluvial flats next to Ruakaka River Estuary (Q07/130) and Waipu River Estuary and Sandspit (Q07/228) are devoid of indigenous vegetation.

Inland alluvium vegetation

The most common vegetation types present on broad alluvial river plains adjoining the coastal dunelands (Holocene and Late Pleistocene alluvium and/or estuarine deposits) are mixtures of secondary totara, kahikatea, and kanuka, as in the following: kahikatea forest and treeland, kahikatea-totara forest and treeland, totara forest and treeland, totara-kanuka forest, kanuka-kahikatea forest, and totara-kahikatea forest. There is no mature forest remaining on alluvial flats. Totara and kahikatea are hardy podocarp species which are resistant to trampling and grazing, hence their dominance within grazed riparian forests and treelands along rivers in the Waipu ED lowlands. Previously species such as taraire, titoki, kowhai, manatu, puriri, turepo, ti kouka, karaka, mapou, matai, houhere, and pukatea would have formed a greater part of the normal canopy diversity of alluvial plain forests. At present, there are only very tiny remnants of the following habitat types which approximate the former vegetation (though in much poorer condition): taraire forest, titoki-kowhai-totara forest, titoki-totara forest, puriri-totara treeland, totara-taraire-kanuka treeland, kahikatea-puriri treeland, and kowhai-kahikatea forest. A very unusual occurrence is that of kauri forest on alluvium in the Waiotira Stream Forest Remnants (Q07/148), because kauri is usually associated with infertile, dry soils.

Within small pockets of Holocene alluvium in smaller streams the main vegetation types are heavily dominated by kahikatea and nikau, such as in kahikatea–nikau forest in Q07/113, nikau forest in Q08/222, and kahikatea forest in Q08/220 and Q07/147. There are occasional mature trees (especially kahikatea and totara) in these alluvial pockets within larger forest tracts.

HILL VEGETATION

The majority of the terrain of Waipu ED is hilly, and hill country is where most indigenous vegetation remains or has been allowed to regenerate since logging and burn-offs in the 1800s and 1900s. The series of east–west trending moderately dissected ranges still supporting large forest remnants begins with Takahiwai Forest (Q08/124) in the north and continues southwards through Ruakaka Forest (Q07/121), Waipu Caves Forest (Q07/118), North River Forest (Q07/117), Mareretu Forest (Q08/220) (the largest continuous area of indigenous forest) and ends in the south with the Brynderwyn Hills (a mosaic of indigenous forest and radiata pine plantations, with the indigenous parts described in 12 separate sites in this study). Rolling hill country, such as in the west of the ED around Mangapai, Springfield, and Ruarangi, or in the foothills of the previously listed sites, has been more heavily deforested compared with the steeper more elevated land.

Coastal hill vegetation

Indigenous hill vegetation within the coastal zone was recorded at the following sites: Takahiwai Forest (Q07/124) (northern side) and Pakauhokio Knoll Forest (Q07/122) next to Whangarei Harbour in the north; low consolidated sand ridges next to Ruakaka River Estuary (Q07/130) and Waipu River Estuary and Sandspit (Q08/228) within Bream Bay; lower parts of Brynderwyn Hills Forest Complex - Part G (Q08/225g); and Bream Tail Coastal Headland (R08/001) in the south.

Takahiwai Forest (Q07/124) has one of the largest areas of coastal kanuka forest, with kauri–kanuka forest dominant on many of the ridges. These types are also common further inland, but here they are likely to have a different suite of species regenerating through them due to the coastal influence. Small patches of more diverse totara–puriri forest and karaka–nikau–kanuka forest remain in the gullies and gully heads. These broadleaf forest types would have been more extensive in the area before widespread human disturbance. Pakauhokio Knoll Forest (Q07/122) is mainly degraded kanuka forest.

Pleistocene consolidated sand ridges next to the two large estuaries have been largely cleared, but some parts still support relatively healthy pohutukawa forest and treeland with associated species such as totara, houpara, karaka, kawakawa, kahakaha, *Astelia banksii*, karo, hangehange, *Coprosma macrocarpa*, mamaku, and harakeke. There are, however, some very weedy areas of totara–pohutukawa forest at Ruakaka River Estuary (Q07/130) infested with species such as gorse, wild cherry, crack willow, woolly nightshade, brush wattle, radiata pine, and pampas.

Brynderwyn Hills Forest Complex - Part G (Q08/225g) has the largest area of coastal kanuka forest overall. Lang's Beach Coastal Forest and Shrubland (Q08/226) has a small area of coastal kanuka shrubland, and two distinctive coastal forest types. Within a Queen Elizabeth II Open Space Covenant in Q08/226

there is a small stand of pohutukawa-rimu forest with frequent totara and puriri, and occasional kauri, kowhai, kahikatea, and rewarewa. Pohutukawa forest at the northern end of Lang's Beach is growing on limestone, and is particularly lush, with an understorey of kohekohe, houpara, nikau, mamaku, kawakawa, hangehange, and kiekie, but it also harbour smothering infestations of many weed species, including ginger, garden nasturtium, cotoneaster, agapanthus, tuber ladder fern, arum lily, and hydrangea. Further north on this coast, healthier areas of pohutukawa forest on spectacular limestone formations have been described (Forester 2007).

Bream Tail Coastal Headland (R08/001) supports the widest variety of coastal hill forest, shrubland, and rockland vegetation, most of which is unique in Waipu ED. The only vegetation similar to that in other sites is kanuka shrubland and kanuka forest which makes up about one fifth of the site. Bream Tail's vegetation has affinities with that of Taranga (Hen) Island (Wright 1978), although most of it is in poorer condition due to fragmentation, grazing, and mammalian pests. The following points highlight some of the uncommon ecological units within the site; for a full description see Section 4.1 Site Descriptions.

Ecological units recorded on the open coastal hillslope at Bream Tail Coastal Headland (R08/001) that are not present elsewhere in Waipu ED:

- Substantial areas of nikau–karaka–pohutukawa–mahoe treeland interspersed with large patches of exotic grasses, indigenous ferns, and regenerating shrubs; also contains occasional elements of the original coastal forest, e.g. ti kouka, kawakawa, kohekohe, puka, puriri, taraire, harakeke, kahakaha, kahikatea, totara, tawapou* (Forester *et al.* 2001) and coastal maire* (Forester *et al.* 2001) (the latter two plant species are both regionally significant).
- Gullies with dense nikau forest; dead or dying pohutukawa often emergent.
- Kanuka–puriri–pohutukawa forest with frequent kowhai and totara.
- Puriri forest with frequent totara, kowhai and nikau.
- Dense, healthy pohutukawa forest with an understorey of houpara, harakeke, hangehange, and nikau (only one small area; several degraded examples are also present).
- Kanuka–tawa forest with frequent puriri and occasional rimu and kauri.
- Extensive coastal cliff habitat with rocky outcrops rising above intertidal platforms; harakeke and pampas common, *Chionochloa bromoides* and *Astelia banksii* frequent.
- Hangehange–harakeke shrubland with frequent ti kouka and pampas.
- Harakeke–pampas flaxland.
- Harakeke–kawakawa flaxland.

Ecological units recorded at the back of the coastal hillslope at Bream Tail Coastal Headland (R08/001) that are not present elsewhere in Waipu ED:

- Taraire forest with frequent puriri, nikau, and kohekohe, and occasional puka, rewarewa, kahakaha, mamaku, karaka and *Metrosideros perforata*.

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* Not seen in this survey.

- Taraire–totara–puriri forest with frequent kahikatea and occasional pukatea, karaka, tawa, white maire, lancewood, rewarewa, ti kouka and mapou.
- Nikau–mahoe forest with frequent puriri, kahikatea, pate, supplejack, and mamaku, and occasional puka, pukatea, miro, ponga, karaka, tawa and *Metrosideros perforata*.
- Puriri–rewarewa–pohutukawa forest with occasional emergent northern rata and kauri (distinctive because pohutukawa and northern rata are present in the same vegetation type).
- Kahikatea forest with frequent rewarewa, puriri and nikau, and occasional pukatea, miro, and puka.
- Kauri–kanuka forest with occasional tanekaha, totara, rimu, puriri and mamaku.

Inland hill vegetation

On the inland hills of Waipu ED, the following vegetation pattern is typical: ridges and upper hillslopes covered in secondary kanuka forest in association with young emergent kauri, tanekaha, and rimu (these species sometimes exclude kanuka entirely on the ridge crest); recently disturbed ridges with kanuka and/or manuka shrubland; hillslopes supporting forest dominated by totara, kanuka, and/or mamaku; lower hillslopes and gullies with broadleaf forest dominated by species such as taraire, towai, puriri, nikau, and tawa, often containing kahikatea; disturbed gullies or gully heads with shrublands of pate, mahoe, hangehange, and mamaku; totara-dominant forest on pasture margins and in many of the smaller, heavily grazed forest remnants. These patterns are summarised in more detail in the following points, which list the main vegetation types on different topographic positions.

Common vegetation types on inland hill country in Waipu ED:

Ridges and upper hillslopes

- Kanuka forest
- Kauri forest
- Tanekaha forest
- Rimu forest
- Combinations of kanuka, kauri, tanekaha, and rimu, sometimes including rewarewa and/or totara
- Kanuka shrubland
- Manuka shrubland

Mainly on hillslopes, but also on ridges

- Kanuka–mamaku forest
- Kanuka–totara forest and treeland
- Kahikatea–totara forest and totara–kahikatea forest, sometimes in association with kanuka or taraire
- Kanuka–totara–mamaku forest
- Totara forest and treeland, sometimes in association with puriri, mamaku, kanuka, rewarewa, rimu, taraire, tanekaha, and/or radiata pine
- Totara–kanuka forest and treeland, including associations with kahikatea and mamaku

- Shrublands with a range of species, e.g. kanuka, manuka, mamaku, mahoe, pate, hangehange, mapou, ponga, mingimingi, and gorse

Mainly on hillslopes, but also in gullies

- Taraire–tawa forest and tawa–taraire forest
- Towai forest and towai–mamaku forest
- Taraire forest, including various associations with totara, kahikatea, kanuka, mamaku, rimu, rewarewa, and nikau
- Totara–taraire forest
- Totara–mamaku forest
- Mamaku forest, including various associations of mamaku with kanuka, mahoe, mapou, rewarewa, and ponga

Gullies

- Taraire forest
- Taraire–puriri forest
- Puriri forest and puriri–nikau forest
- Kahikatea forest
- Nikau–mamaku forest, nikau–ponga forest and ponga–nikau forest
- Shrublands with mamaku, pate, mahoe, and hangehange

Ecological units on inland hill country which are considered unusual or uncommon in Waipu ED:

- Bracken–tangle fern fernland in Q07/137
- Mahoe–totara–kohuhu shrubland in Q07/112
- Rockland at Q07/132
- Kahikatea-pukatea forest in Q07/122
- Kohekohe forest at Q08/224 and Q08/225c
- Kohuhu forest at Q08/225c
- Miro–tawa–rewarewa forest at Q08/225c
- Nikau forest in Q07/120
- Nikau–rewarewa forest in Q08/225f
- Puriri–taraire–rewarewa–totara–nikau–mamaku forest in Q08/225c
- Rewarewa–mamaku–tarata forest in Q08/225c
- Rewarewa–tanekaha forest in Q08/225f
- Rimu–rewarewa–tanekaha forest in Q08/225a
- Taraire–tawa–rewarewa–mamaku forest in Q08/220
- Tawa–nikau forest in Q08/225c
- Tawa–rewarewa–mamaku–ponga–nikau–kohekohe forest Q08/225h
- Ti kouka–putaputaweta–manuka shrubland in Q08/221

3.3.4 Species of botanical interest

The Brynderwyn Hills Forest Complex (Q08/225) is a stronghold for *Hebe macrocarpa* var. *macrocarpa*, which is a regionally significant plant species

(Lisa Forester, NRC, pers. comm.). Makamaka reaches its southern limit of distribution in this site (Lisa Forester, NRC, pers. comm.).

3.3.5 Threatened plant species

The current threat status of species listed below follows de Lange *et al.* (2004). Appendix 8.3 gives the definitions of threat categories as set out in Molloy *et al.* (2002).

CHRONICALLY THREATENED

Pingao *Desmoschoenus spiralis* (Gradual Decline)

Pingao, or golden sand sedge, is found in small patches spread along the seaward sand dunes of Bream Bay and on small beaches around the Bream Tail coastline. Pingao would once have been more common, but this species has declined dramatically throughout its natural range. Threats include competition from weeds, dune stabilisation and compaction, harvesting, trampling, vehicle traffic, browsing animals, rodents eating seeds, and lack of seed set due to distance between populations (NZPCN 2007).

***Doodia squarrosa* (Gradual Decline)**

Doodia squarrosa is a small tufted fern with a local, discontinuous distribution in coastal and lowland forests of the North Island, and tends to be found near water (Allan 1982). It is threatened by loss of habitat through weed invasion (NZPCN 2007). It was recorded in 1992 at North River Forest (Q07/117) (SSBI Q07/H059), but may be more widespread in Waipu ED.

***Kunzea ericoides* var. *linearis* (Serious Decline)**

This kanuka variety was originally recognised and described by Thomas Kirk as a 'very slender' tree, with 'leaves very narrow linear' (Allan 1982), and is known to occur from Pakiri and Pouto northwards on coastal, sandy habitats (NZPCN 2007). In Waipu ED it is the dominant species in scattered patches of dune forest amongst gorse–pampas shrubland on the sand dunes behind Bream Bay. Its main threats are habitat loss and harvesting for firewood (NZPCN 2007). The north-eastern coast of Waipu ED is one of the strongholds for this subspecies (Peter de Lange pers. comm.).

Mida *Mida salicifolia* (Gradual Decline)

Mida, a small, shiny-leaved tree, is a generalist root parasite which is naturally sparsely distributed in lowland to lower montane forests of the North Island. It is extremely palatable to possums and goats. It is known from eleven different forested sites in Waipu ED from the Brynderwyn Hills in the south to Pokapu Hill in the north, generally in forest without stock grazing in the understorey.

***Pimelea arenaria* (Gradual Decline)**

Pimelea arenaria, also known as sand daphne, is a low, spreading, silky-haired shrub in the daphne family that grows on coastal sand dunes. It is endemic to the North Island and has two distinct forms, of which one is further restricted to Northland. Its major threats are habitat loss (e.g. through development of dunes and plantings to stabilise moving sand) and disturbance of habitat by vehicles (Forester and Townsend 2004). It is also be adversely affected by browsing and grazing mammals, seed destruction by rodents, and competition from marram

grass (NZPCN 2007). There are few plants on the beach near Ruakaka (Q08/128) (Lisa Forester, NRC, pers. comm.).

AT RISK

Anzybas rotundifolius (Sparse)

Formerly known as *Corybas unguiculatus* (Moore & Edgar 1970), this tiny, winter-flowering spider orchid is only known from a few localities in the North Island, mostly from Warkworth northwards (NZPCN 2007). In Waipu Ecological District, it was recorded in the Marunui QEII Open Space Covenant within Brynderwyn Hills Forest Complex - Part H (Q08/225h) in 1990 (Jones 1991).

Doodia mollis (Sparse)

This is another small tufted fern in the genus *Doodia* (see *D. squarrosa* above) (Allan 1982). It also has a localised distribution in moist forest habitats of the northern North Island, and is often found in association with the most common *Doodia* species, *D. australis* (NZPCN 2007). In Waipu ED, *D. mollis* is known from four sites: Waipu Gorge Forest Remnants (Q08/222) (recorded in 1985, AK 175781), North River Forest (Q07/117) (recorded in 1992, SSBI Q07/H059), Bream Tail Coastal Headland (R08/001) (Forester *et al.* 2001), and Waipu Caves Forest (Q07/118) (current survey, AK 298335).

Monoao *Halocarpus kirkii* (Sparse)

Monoao is an uncommon podocarp which has a northern distribution and is associated with kauri forest. It was recently found in Waipu ED at Waipu Gorge Forest Remnants (Q08/222) (Wilcox 2006, AK 295324). This species is naturally sparsely distributed.

Kawaka *Libocedrus plumosa* (Sparse)

This podocarp species has a disjunct biogeographic range (restricted to Northland and Northwest Nelson) where it is found in localised patches within coastal to lowland forest. In the north it often occurs in association with kauri. Within Waipu ED it is known from Mareretu Forest (Q08/220) (recorded in 2001, SSBI Q08/H001), Waipu Gorge Forest Remnants (Q08/222), and various points along the Brynderwyn Hills Forest Complex including in Q08/225d (Kendrick and Young 2006), in Q08/225g (recorded in 1992, SSBI Q08/H053), in Q08/225c (recorded in 1997, SSBI Q07/H021), in Q08/225e (Peter Anderson, DOC, pers. comm.), and in Q08/225a (current survey). This species is naturally sparsely distributed, and appears to regenerate well after disturbance.

Parapara *Pisonia brunoniana* (Sparse)

Known also as the 'bird-catcher' due to its propensity to catch small birds and insects in its sticky seeds (which are adapted to dispersal via large sea birds), this small, shiny-leaved tree is only known from scattered locations on the Northland mainland, and occurs mainly on offshore islands in the north. It has suffered a range contraction from the Auckland, Coromandel and East Cape regions where historical records show it used to occur (NZPCN 2007). The 1994 record from Bream Tail Coastal Headland (R08/001) is probably its southernmost modern record on mainland New Zealand (DOC Bioweb database). Its large leaves are especially palatable to browsing animals such as possums, goats and other feral livestock, and its leaves and seeds are also eaten by rodents (NZPCN 2007).

***Streblus ?banksii* × *S. heterophyllus* (*Streblus banksii* - Sparse)**
This is a hybrid between an 'at risk' tree species, large-leaved milk tree (*Streblus banksii*) and a common tree species, turepo (*Streblus heterophyllus*), that was collected from Bream Tail Coastal Headland (R08/001) in the current survey (AK 298332). This hybrid has been noted previously at Bream Tail (Forester *et al.* 2001). Large-leaved milk tree is extremely uncommon on the mainland, where it is threatened by rodents, possums, goats, and deer (NZPCN 2007). Large-leaved milk tree has never been recorded in Waipu ED, however it occurs on Bream Head (Manaia ED), and on the pest-free Taranga Island, 13.5 km offshore of Bream Tail (Wright 1978).

***Tetragonia tetragonioides* (Sparse)**
This species is known as 'New Zealand spinach' or 'kokihi', but should not be confused with the common New Zealand spinach *Tetragonia implexicoma*. *T. tetragonioides* occurs throughout New Zealand on coastal rocks and sandy habitats, where its main threat is habitat disturbance. In the current survey it was recorded on coastal rocks around Bream Tail Coastal Headland (R08/001), but may also occur in Waipu ED along the sand dunes behind Bream Bay.

***Chionochloa bromoides* (Range Restricted)**
This tussock grass is a specialist of coastal cliffs and bluffs. It is endemic to the north of the North Island where it is confined to northern offshore islands and mainland headlands south to Leigh on the east coast and Maunganui Bluff on the west coast (Edgar & Connor 2000). In Waipu ED it occurs locally at Bream Tail Coastal Headland (R08/001).

***Nematoceras rivulare* (Data Deficient)**
This spider orchid (formerly known as *Corybas rivularis*; Moore & Edgar 1976) occurs in the North Island probably from Taranaki north, on mossy rock banks close to water level or in year-round seepage on mud-flow in native forest (NZPCN 2007). Within Waipu ED it has been recorded at Mareretu Forest (Q08/220) (recorded in 2001, SSBI Q08/H001) and North River Forest (Q07/117) (recorded in 1992, SSBI Q07/H059).

3.3.6 Regionally significant plant species

The following species are included in a draft list of regionally significant species prepared by DOC Northland Conservancy (DOC in prep.).

Azolla filiculoides
This is an indigenous floating water fern species; a similar exotic species (*A. pinnata*) has out-competed it in many potential habitats. In Waipu ED *A. pinnata* is present in most areas of standing water, whilst *A. filiculoides* was only found at McEwan Road Wetland (Q08/131) during the current survey. There are no other records of this species in the ED.

Brachyglottis kirkii* var. *angustior
Brachyglottis kirkii var. *angustior* is a narrow-leaved, ground-dwelling variety of a fleshy-leaved shrub in the daisy family. This species is quite palatable to browsers such as goats and possums, and is uncommon in Northland. It has been recorded at three sites in Waipu ED, but is likely to be more common than this suggests: Waipu Gorge Forest Remnants (Q08/222) (DOC internal files

1997), North River Forest (Q07/117) (recorded in 1992, SSBI Q07/H059), and Brynderwyn Hills Forest Complex – Part D (Q08/225d) (Kendrick and Young 2006). The other variety (*Brachyglottis kirkii* var. *kirkii*) is ranked as being in Serious Decline (not recorded in Waipu ED).

Coprosma acerosa

Coprosma acerosa is a sprawling, small-leaved shrubby ground cover which occurs frequently in the sand dunes of Ruakaka Dunelands (Q07/128), Ruakaka River Estuary (Q07/130), and Waipu River Estuary and Sandspit (Q08/228). Its threats include rabbit/hare browse, competition from invasive weeds, and destruction of dune habitat. *Coprosma acerosa* has all but disappeared from dunes in Auckland and was probably previously much more widespread in Waipu ED (Lisa Forester, NRC, pers. comm.).

Coprosma rigida

Coprosma rigida is an erect small-leaved, divaricating shrub found throughout the North and South Islands although it is relatively uncommon in Northland. In Waipu ED it has been recorded in Takahiwai Forest (Q07/124) (Lisa Forester, NRC, pers. comm.), Mareretu Forest (Q08/220) (recorded in 2001, SSBI Q08/H001), Bream Tail Coastal Headland (R08/001) (Boffa Miskell 2003), Waionehu Stream Forest Remnants (Q08/232) (current survey, AK 297990), and SH1 Forest Remnants (Q08/233) (current survey, AK 298333).

Coprosma parviflora

Coprosma parviflora is a small-leaved, divaricating shrub which occurs only in Northland and north Auckland. It was recorded in Brynderwyn Hills Forest Complex – Part G (Q08/225g) in the current survey, and in Brynderwyn Hills Forest Complex – Part D (Q08/225d) in another recent survey (Kendrick and Young 2006).

Gully tree fern *Cyathea cunninghamii*

This is a very tall, narrow-trunked tree fern (when mature), similar to mamaku (*Cyathea medullaris*), but with thinner stipes and shorter fronds that curl upwards slightly at the ends. It is usually sporadic within its distribution (North, South and Chatham Islands, also Australia). It is known from the following sites in Waipu ED: Mareretu Forest (Q08/220), North River Forest (Q07/117) (recorded in 1992, SSBI Q07/H059), Ruakaka Forest (Q07/121) (recorded in 1991, SSBI Q07/H055), Brynderwyn Hills Forest Complex – Part A (Q08/225a) (recorded in 1993, SSBI Q08/H021), and Brynderwyn Hills Forest Complex – Part C (Q08/225c) (recorded in 1997, SSBI Q07/H021).

Epacris pauciflora

This is a slender, small-leaved shrub up to 2 m tall which usually occurs on nutrient-poor soils, and is naturally sparsely distributed in the North and South Islands. It was recorded in 2006 in the Waipu Gorge Forest Remnants (Q08/222) (AK 295325).

Tree fuchsia *Fuchsia excorticata*

Tree fuchsia is a small tree (up to 12 m tall) found in forests throughout New Zealand. It has orange-coloured peeling bark, multi-coloured flowers, dark purple berries, and soft, deeply-veined leaves that are white underneath. Its foliage is very palatable to possums and stock, which are the main threats to the species. It occurs locally in forests in Waipu ED, and has been recorded from

most of the larger forested sites, though generally occurring in low numbers at any one site.

Hebe macrocarpa* var. *macrocarpa
This is a northern North Island endemic thick-leaved (almost fleshy-leaved) shrub to 2.5 m tall with larger capsules than other similar *Hebe* species, e.g. *H. stricta*. It is threatened by browsing mammals such as goats and possums. This species occurs in at least five sites in Waipu ED: Mareretu Forest (Q08/220) (recorded in 1999, AK 248072), Waipu Gorge Forest Remnants (Q08/222) (DOC internal files 1997), North River Forest (Q07/117) (recorded in 1992, SSBI Q07/H059), Waipu Caves Road Sandstone Knoll (Q07/132) (current survey, AK 298337), and the Brynderwyn Hills Forest Complex (including in Q08/225d (Kendrick & Young 2006), in Q08/225j (recorded in 1965, AK 121839), and in Q08/225e) (current survey, AK 298338)). The Brynderwyn Hills are a stronghold for this species (Lisa Forester, NRC, pers. comm.).

Loxsoma cunninghamii
This delicate fern has wide, light green fronds with whitish undersides. It is a North Island endemic (belonging to an endemic genus), which prefers open habitats such as clearings, open forest and stream banks. It is uncommon in Northland, and in Waipu ED it has only been recorded from Waipu Gorge Forest Remnants (Q08/222) in 1985 (AK 176354).

Carmine rata *Metrosideros carminea*
This is a tall epiphytic rata vine with carmine flowers in late winter/early spring. This species is threatened by possum browse and is uncommon in Northland. In Waipu ED it is known from Waipu Gorge Forest Remnants (Q08/222) (recorded in 1933, AK 102216), Brynderwyn Hills Forest Complex – Part A (Q08/225a) (recorded in 1993, SSBI Q08/H021), Waipu Caves Road Sandstone Knoll (Q08/132) (current survey), and Waipu Caves Forest (Q07/118) (current survey, AK 297995).

Northern rata *Metrosideros robusta*
This is a tall, often emergent, red-flowered forest tree which sometimes begins life as an epiphyte. It has palatable foliage, and possums have been the main agent of its destruction throughout the country. It has been eliminated or severely reduced in abundance in most mainland indigenous forests in Northland. It has been recorded at nine sites in Waipu ED during the current survey, but is uncommon at these locations and often in poor health.

Coastal maire *Nestegis apetala*
This is a small (to 6 m tall) coastal tree endemic to northern New Zealand which has been mostly eliminated from the mainland. Decline in the abundance of this species has been attributed to seed predation by rats (Campbell & Atkinson 2002). Coastal maire occurs frequently on pest-free marine islands offshore of Waipu ED, such as Taranga Island (Wright 1978), and was recorded on Bream Tail Coastal Headland (R08/001) in 2001 (Forester *et al.* 2001), but was not seen during the current survey.

Hard beech *Nothofagus truncata*
Hard beech is closely related to red beech (*N. fusca*), and is patchily distributed in lowland to lower montane forest from Northwest Nelson to the Hihi

Peninsula, Northland in the North Island. This species is very uncommon north of Auckland. There are two 1993 records from opposite ends of Waipu ED: Takahiwai Forest (Q07/124) (SSBI Q07/H047) and Bream Tail Coastal Headland (R08/001) (SSBI R08/H008). It is also present at Ruakaka Forest (Q07/121) (Peter Anderson, DOC, pers. comm.).

Oxalis magellanica

This is a small, white-flowered herb found in damp places such as streamsides and grassland; recorded only from North River Forest (Q07/117) (recorded in 1992, SSBI Q07/H059) and Waipu Gorge Forest Remnants (Q08/222) (current survey, AK 297992) in Waipu ED.

Pelargonium inodorum

This is an annual to biennial low-growing sparsely hairy herb with pink to red flowers, known only from Brynderwyn Hills Forest Complex - Part I (Q08/225i) in Waipu ED (recorded in 1993, DOC Bioweb 2007). It occurs locally in open habitats such as gumland and grassland throughout New Zealand, but is not common in Northland.

Kaikomako *Pennantia corymbosa*

Kaikomako is small, slender tree (up to 10 m) with a divaricating juvenile stage that is widespread in lowland New Zealand. An adult was noted at Paparoa Road Riparian Forest Remnants (Q07/152) during the present study, and it has also been reported from Caves Road Forest (Q07/120) (Ian Fox pers. comm.).

Whaririki *Phormium cookianum*

Also known as mountain flax, this species is closely related to harakeke. In comparison with the latter, its foliage is smaller, not so stiff, and inclined to droop, while its seed capsules are pendulous rather than upright. It is often common on coastal cliffs and mountain slopes in the North, South and Stewart Islands, however in Northland it is generally restricted to higher altitudes (Wendy Holland pers. comm.). It has only been recorded once in Waipu ED in 1993 (SSBI R08/H008), on coastal cliffs at Bream Tail Coastal Headland (R08/001).

Manatu *Plagianthus regius*

Also known as ribbonwood, this is a tall tree typical of lowland forest on fertile soils throughout the country. It has become less common through severe reduction of riverine floodplain forest. This species was recorded at seven sites in Waipu ED in the current survey.

Tawapou *Pouteria costata*

This coastal, shiny-leaved tree (up to 20 m tall) is endemic to northern New Zealand and has large red-brown berries that are a favourite with rats. As a result of seed and seedling predation and loss of habitat, these trees are becoming increasingly uncommon in Northland. The species is very uncommon on the mainland, but is frequent on Taranga Island (Wright 1978) which is 13.5 km offshore of Bream Tail Coastal Headland (R08/001). Bream Tail Coastal Headland is which is the only place it has been recorded in Waipu ED (recorded in 1993, SSBI R08/H008).

Pratia angulata
This is a small, creeping herb with white flowers and purplish-red berries that commonly grows in lowland to subalpine damp places throughout New Zealand, but is uncommon in Northland. In Waipu ED it is known from Takahiwai Forest (Q07/124) (recorded in 1993, SSBI Q07/H047), Brynderwyn Hills Forest Complex - Part D (Q08/225d) (Kendrick & Young 2006), and Cove Road Shrubland and Forest (R08/002) (current survey).

Schizaea bifida
This is a tiny, forked comb fern typical of lowland heathy clay and pumice soils in the North Island and the tip of the South Island (also Australia). It was recorded in the Brynderwyn Hills Forest Complex – Part I (Q08/225i) in 1999 (AK 244703).

Burr reed *Sparganium subglobosum*
This is a monocotyledon which occurs locally in wetlands throughout the North Island and upper South Island. It is known as burr reed, for its rounded, white burrs (flower heads) appearing in late spring. Its main threat is habitat loss and modification. Within Waipu ED a substantial population (*c.* 0.4 ha) was noted at McEwan Road Wetland (Q08/131) during the current survey (AK 297989).

Suaeda novae-zelandiae
This is succulent saltmarsh herb that occurs locally in upper intertidal areas of the North Island and the South Island. It is locally common in estuaries along the Whangarei coast (Lisa Forester, NRC, pers. comm.). It was found at Blacksmith's Creek Estuary (Q07/144) on the Whangarei Harbour during the current survey (AK 297982), but probably also occurs at the other estuaries.

Maire tawake *Syzygium maire*
This tree species is a North Island and South Island lowland swamp forest specialist which is now uncommon due to the destruction and modification of its habitat. Remaining habitat is still under threat from drainage and clearance. In Waipu ED maire tawake has been noted in Takahiwai Forest (Q07/124) (recorded in 1993, SSBI Q07/H047) and Ruakaka Forest (Q07/121) (recorded in 1991, SSBI Q07/H055).

Arrow grass *Triglochin striata*
This is a small salt meadow monocotyledon, which grows on mudflats in sparse swards like a tiny grass (although it is not a grass), and is often mixed with other salt meadow herbs such as sea primrose and remuremu. Its main threat is competition from invasive weeds, for example saltwater paspalum. In Waipu ED it is known from Ruakaka Racecourse Dune Lake (Q07/129) (current survey, AK 298334) and Waipu River Estuary and Sandspit (Q08/228) (recorded in 1992, SSBI Q07/H051).

3.3.7 Threatened and regionally significant plant species not recorded for some time in the Ecological District

Sand tussock *Austrofestuca littoralis* (Gradual Decline)
This grass species used to occur throughout the country on coastal sand dunes. However, it is very palatable to grazing and browsing mammals and is also a poor competitor with introduced marram grass and is susceptible to fire, so its

range has been severely reduced. Natural populations of this species have not been seen in this ED recently (the most recent record is from 1973 on estuary sands on the southern side of the Ruakaka River Estuary (Q07/130) (DOC Bioweb 2007)). However, it has been planted at Bream Tail and Waipu Cove, with little success.

***Grammitis ciliata* (regionally significant)**
This small fern was collected from Robert Hastie Memorial Scenic Reserve (in Brynderwyn Hills Forest Complex – Part J, Q08/225j) in 1965 (AK 121745), but has not been recorded since.

3.4 FAUNA

3.4.1 Overview of indigenous fauna

Information on indigenous fauna in this report has been compiled from the following sources:

- Sites of Significant Biological Interest (SSBI) files held at the Northland Conservancy office, Department of Conservation.
- The Northland Region Ornithological Society of New Zealand (OSNZ) Newsletter *Amokura*.
- Classified summarised notes (CSN) from *Notornis* (the national journal of OSNZ.
- The Department of Conservation Bioweb Herpetofauna database (DOC 2007).
- 'Uncommon and rare land snails in the Northland Region of New Zealand, and an assessment of conservation management priorities' (Brook 2002) and personal communications with Fred Brook.
- The New Zealand Freshwater Fish Database (NIWA 2007).
- Incidental field observations during November 2006 (current study).
- Surveys and incidental observations by Dr Ray Pierce between 1987 and 2007.
- Surveys and incidental observations by Richard Parrish (DOC) between 1979 and 2007.
- Observations by Peter Anderson (DOC), Katrina Hansen, and John Kendrick.
- Records from unpublished technical reports, including those by Wildland Consultants Ltd.

A comprehensive discussion and checklist of fauna, particularly invertebrates, is beyond the scope of the present study. The descriptions for each site detail known threatened fauna and provide some records of non-threatened species. There are very few records of reptiles and invertebrates, irrespective of their prevalence, and it is recognised that they are a significant facet of indigenous ecosystems which are often overlooked. Indigenous New Zealand insects are our largest fauna group, and are intimately associated with indigenous habitat, carrying out a wide range of roles in ecosystems. In addition to their consumption of live plant material, they are involved in pollination, breakdown of leaves, litter and logs, soil formation, general scavenging, parasitism, and predation, as well as providing the main food for birds, lizards, and most freshwater fish (Watt 1975). It is generally acknowledged that although there

are many 'generalist' species of insects, the great majority have particular habitat requirements that restrict their populations in both space and time. With the present state of knowledge of these species, the protection of a diverse and representative range of habitat types is considered the most important strategic approach to provide a minimum basis on which populations can be maintained.

The Waipu and Ruakaka River Estuaries are small in extent, but are critical breeding and feeding grounds for many indigenous water bird and wader species including three threatened tern species (New Zealand fairy tern, Caspian tern, and white-fronted tern), the threatened northern New Zealand dotterel and reef heron, and many international migrant wader species. The Whangarei Harbour coast and small areas within the river estuaries along Bream Bay have saltmarsh and mangrove communities that provide important breeding and feeding habitat for banded rail, fernbird, herons, and shag species.

Seabirds formerly nested over large areas of mainland New Zealand. The former extent of seabird colonies in Waipu ED is not known but many elevated areas such as the Brynderwyn Hills, Bream Tail, Mareretu Forest, and Takahiwai Forest probably supported colonies. Seabirds play a critical role in nutrient cycling, raising fertility of soils through the deposition of guano and fish deposits, and creating soil turnover through burrow excavation. The extinction of colonies therefore results in long-term effects on ecosystem function. A suite of species (such as coastal cresses – *Lepidium* spp., invertebrates living in burrows, and others) are reliant on seabird colonies for habitat, and the decline of these species is closely linked with the decline of seabird colonies (Bellingham *et al.* 2006). Within Waipu ED, seabirds that nest on land, such as shags and possibly grey-faced petrel, are now confined to coastal forest (Ray Pierce pers. comm.).

Natural freshwater wetlands occur throughout Waipu ED but are often highly modified and drastically reduced in extent. Most wetlands within Waipu ED are associated with streams or rivers, although small but important wetland habitats occur within the coastal dune system. Constructed lakes and ponds now function as important wetland habitat and are likely to provide habitat linkages between the remaining natural freshwater wetlands. Constructed water bodies provide almost all of the open water habitat for indigenous water birds such as grey duck, grey teal, Australasian little grebe, and New Zealand dabchick. The larger, less modified wetlands, and some of the smaller wetlands if larger wetlands are nearby, are habitat for threatened species such as spotless crake and Australasian bittern. Bitterns, in particular, feed in a variety of natural and artificial water bodies within their home range. Common indigenous bird species associated with wetlands in Waipu ED include pukeko, paradise shelduck, welcome swallow, and New Zealand kingfisher. The Waipu River catchment supported a significant pateke (brown teal) population until the 1960s (Bell 1959; McKenzie 1971; Parrish & Williams 2001).

Indigenous birds of forests, shrublands, and grasslands which are common within Waipu ED include tui, grey warbler, welcome swallow, shining cuckoo, Australasian harrier, New Zealand kingfisher, North Island fantail, paradise shelduck, pukeko, spur-winged plover, black-backed gull, morepork, and silvereye.

Within the last 30 years, terrestrial reptile species recorded from Waipu ED are copper skink, shore skink, forest gecko, and Auckland green gecko. The only remaining endemic frog species is Hochstetter's frog. The former diversity of herpetofauna in Waipu ED is indicated by deposits in caves; for example, in the Waipu Caves area bones of a further three skink species (robust skink *Cyclodina alani*, ornate skink *C. ornata*, and *C. northlandi*), one gecko species (pacific gecko, *Hoplodactylus pacificus*), and three frog species (Archey's frog *Leiopelma archeyii*, *L. markhamii*, and *L. waitomoensis*) were found between 1986 and 1991 (DOC 2007). However, it is likely that ornate skink and pacific gecko still occur in Waipu ED as they occur in neighbouring EDs (Richard Parrish pers. comm.).

Four of the seven species of marine reptiles that reach New Zealand waters have been found on the coast of Waipu ED. These species are regarded as visitors or vagrants to New Zealand and are sometimes dead or in poor condition (Gill & Whitaker 1996). The yellow-bellied sea snake is a 'relatively regular visitor to northern New Zealand' with more than 35 records since 1930 (Gill & Whitaker 1996). At Waipu Cove a dead sea snake was found in January 1931, and a live one was found in January 1965. The green turtle is found throughout the tropics and is an occasional visitor to northern New Zealand, with more than 12 records since 1980 (Gill & Whitaker 1996). Two dead specimens have been found on the coast of Waipu ED, at Ruakaka Beach in February 1985 and May 2002. The loggerhead turtle is found throughout the tropics but also regularly visits temperate areas (Gill & Whitaker 1996). One live specimen was found on Ruakaka Beach in July 1973. The hawksbill turtle is also an occasional visitor to New Zealand waters and one was found dead at One Tree Point in May 2004. Although all sea turtles worldwide are considered threatened (IUCN 2006), New Zealand does not list them in the threat classification lists for indigenous species (Hitchmough *et al.* 2007).

Eleven species of indigenous freshwater fish, and four introduced species, have been recorded from Waipu ED. With the exception of shortjaw kokopu, they are not threatened, however banded kokopu and giant bully are considered to be regionally significant. Some marine fish species such as grey mullet, yelloweyed mullet, and kahawai are likely to visit the lower reaches of the larger streams and rivers. The Ahuroa River and North River catchments support a small, self-sustaining rainbow trout fishery, and the water supply dam on the upper Waiwarawara Stream is stocked by the Northland Fish and Game Council with brown trout (Andrew Venmore pers. comm. 2006).

Several species of threatened endemic land snail occur in Waipu ED, and some of these have localised distributions. The kauri snail is relatively widespread, occurring in forest and shrubland habitats.

There are few records of invertebrates within Waipu ED. No extensive invertebrate surveys have been undertaken, and most of the records are incidental observations made during ecological surveys, often without full identification. *Peripatus* sp. (Range Restricted) was found in the Waipu Gorge Forest Remnants (Q08/222) in 1992.

The following sections (3.4.2 to 3.2.11) are brief notes on nationally and regionally threatened species in Waipu ED (as per Hitchmough *et al.* 2007 which uses the threat classification system of Molloy *et al.* 2002; see Appendix

8.3) or DOC, in prep., Wendy Holland pers. comm.). A checklist of fauna recorded in Waipu ED is presented in Appendix 8.7. Nomenclature follows Hitchmough *et al.* (2007) for indigenous threatened species, and the following for all other species: Heather & Robertson (1996) for birds, Gill & Whitaker (1996) for amphibians, McDowall (2000) for fish, and King (2005) for mammals.

3.4.2 Threatened bird species

Waipu ED has a high number of threatened bird species: ten species are acutely threatened, eight species are chronically threatened, and eight species are classed as being at risk (Range Restricted or Sparse). Seventeen migrant species and four vagrant species have been recorded.

ACUTELY THREATENED

New Zealand fairy tern *Sterna nereis davisae* (Nationally Critical)
Endemic subspecies

The New Zealand subspecies of fairy tern has an estimated total population of 35-40 individuals, with only 11 breeding pairs. The Waipu Wildlife Refuge is one of only four breeding locations, and four pairs nested there in 2005-06. Nesting success at Waipu is threatened by predation, storm-related events, and direct disturbance of nesting and feeding areas, such as quad bikes on the beach, jet-skis on the water, and other potentially disruptive recreational use by people (Hansen 2005; Williams 2006; Richard Parrish pers. comm.). This species formerly bred at Ruakaka River Estuary (Q07/130), with the last breeding record from 1985 (Parrish and Honnor 1997).

White heron *Egretta alba modesta* (Nationally Critical)
Indigenous

White heron inhabits freshwater wetlands and estuaries, and breeds only at Okarito, on the west coast of the South Island (Heather & Robertson 1996). There are occasional individual white heron records from the Waipu River Estuary (Q08/228) (one in 1990 – CSN *Notornis* 39; one in 1993 – CSN *Notornis* 41; one in 1995 – Burtt *et al.* 1995; and another in 1995 CSN *Notornis* 43) and from the Ruakaka River Estuary (Q07/130) (one in 1995 – CSN *Notornis* 43).

Australasian bittern *Botaurus poiciloptilus* (Nationally Critical)
Indigenous

Australasian bitterns mainly inhabit freshwater wetlands, but may utilise estuarine wetlands in autumn and winter (Heather & Robertson 1996). Within Waipu ED, all records of this species are from the freshwater and estuarine wetlands on the north-east coast between Waipu and Whangarei Harbour. Australasian bitterns are recorded regularly from Doctor's Hill Road Wetland (Q07/127), McEwan Road Wetland (Q07/131), Northland Port Corporation Ponds (Q07/164), Semenoff sand supply ponds within the Ruakaka Dunelands (Q07/128), Ruakaka Racecourse Dune Lake (Q07/129), Ruakaka River Estuary (Q07/130), and Blacksmith's Creek Estuary (Q07/144), and were first recorded at Sime Road Wetland (Q07/141) during this survey. They are likely to breed only in the larger freshwater wetlands in Waipu ED, and utilise a wider range of wetlands for feeding.

New Zealand shore plover *Thinornis novaeseelandiae* (Nationally Critical)
Endemic

New Zealand shore plover is a rare wader species which became extinct on mainland New Zealand in the late 1700s/early 1800s with the arrival of Norway rats and feral cats, surviving only on two predator-free islands in the Chathams. Since 1994 it has been twice released on Motuora Island (Hauraki Gulf), and several individuals have appeared on the east coast of Northland. There was one record (possibly two) from Waipu River Estuary (Q08/228) by Lorna Simpkin of OSNZ in the late 1990s (Richard Parrish pers. comm.).

North Island kaka *Nestor meridionalis septentrionalis* (Nationally Endangered)
Endemic

North Island kaka have been recorded as occasional visitors to the Brynderwyn Hills (Q08/225e) in 1989, from forest remnants on Bream Tail Coastal Headland (R08/001) in 1993, in the Flyger Road area (near Q07/125) in 1994, near Ruakaka Forest (Q07/121) in the early 2000s, and in recent years in the Marunui Queen Elizabeth II Open Space Covenant in the southeastern Brynderwyn Hills (Q08/225h). This species is resident on larger offshore islands off the eastern coast of Northland and Auckland, and birds often wander to mainland areas (Heather & Robertson 1996).

Reef heron *Egretta sacra sacra* (Nationally Vulnerable)
Indigenous

This species occurs in very low numbers in Waipu ED, probably because of limited habitat. The nearest substantial concentration, of at least 20 birds, is along the rocky, northern shores of Whangarei Harbour. Reef herons have been recorded in ones and twos from the Ruakaka and Waipu River Estuaries (Q07/130, Q08/228), and there are recent unconfirmed reports of breeding at or near the Ruakaka River Estuary (Q07/130) (Margaret Hick pers. comm.). Confirmed nesting pairs are present on three Whangarei Harbour islands very near to Waipu ED ("McDonald's" Island (one pair), Motukaroro Island (three or possibly four pairs) and Calliope Island (possibly up to three pairs) (Richard Parrish pers. comm., Wildland Consultants 2005).

Bush falcon *Falco novaeseelandiae* (Nationally Vulnerable)
Endemic

The nearest breeding population of bush falcon to Waipu ED is in the Coromandel Range. Juveniles disperse widely in the autumn and winter (Heather & Robertson 1996) and these young birds may account for sightings of this species in Northland. Within Waipu ED, there is an unconfirmed report of bush falcon from the Brynderwyn Hills Forest Complex - Part G (Q08/225g).

Caspian tern *Sterna caspia* (Nationally Vulnerable)
Indigenous

Knight Point, on the southern shores of Whangarei Harbour, to the north of Waipu ED, and Mangawhai Harbour to the south of Waipu ED, are important breeding sites for this species. Caspian terns have been recorded from the

coastal sites in Waipu ED including the Ruakaka River Estuary (Q07/130) (a maximum of 12 birds in 2002, CSN *Notornis* 50), the Waipu River Estuary (Q08/228) (a maximum of 13 birds in 2001, CSN *Notornis* 49), and the coastline between Bream Tail Coastal Headland (R08/001) and Whangarei Harbour.

Wrybill *Anarhynchus frontalis* (Nationally Vulnerable)
Endemic

This species nests on South Island braided rivers but migrates to feeding grounds in northern New Zealand during for the autumn and winter months (Dowding and Moore 2006). Within Waipu ED, wrybills have been recorded from the Ruakaka River Estuary (Q07/130) (a maximum of two birds in 1999, CSN *Notornis* 47) and the Waipu River Estuary (Q08/228) (a maximum of 12 birds in 1999, CSN *Notornis* 47). The Takahiwai tidal flats, adjacent to the northern boundary of Waipu ED are a key feeding area for wrybill that overwinter in the Whangarei Harbour area (Pierce 2005). The Whangarei Harbour supports a wintering population of up to 150 birds each year (3% of the national population) (Parrish 1984, Richard Parrish pers. comm.).

Northern New Zealand dotterel *Charadrius obscurus aquilonius* (Nationally Vulnerable)
Endemic

This species has an estimated population of 1700 birds, 48% of which are in Northland (Dowding & Moore 2006). Sandy beaches, sandspits, shellbanks, sand bars, and low dunes are favoured breeding sites (Heather & Robertson 1996), and the Waipu River Estuary and Sandspit (Q08/228) is a key breeding site for the species with 14–17 pairs (Dowding & Moore 2006; CSN *Notornis* 41). An average of six pairs of northern New Zealand dotterel currently breed at the Ruakaka River Estuary (Q07/130) (Richard Parrish pers. comm.), and the species formerly bred on the margins of the Semenoff Sand Supplies ponds within the Ruakaka Dunelands (Q07/128). Breeding no longer occurs at these ponds, presumably due to recent vegetation clearance and disturbance (John Kendrick pers. comm.). Both Ruakaka and Waipu River Estuaries are major post-breeding and wintering sites for this species, with up to 51 birds present at Waipu River Estuary. Whangarei Harbour to the north and Mangawhai Harbour to the south are also very important breeding and feeding areas for this species, with the four areas holding in excess of 10% of the national population (Richard Parrish pers. comm.).

CHRONICALLY THREATENED

Grey duck *Anas superciliosa superciliosa* (Serious Decline)
Indigenous

This species was recorded from lakes, ponds, estuaries, and slow-flowing rivers throughout Waipu ED in the 1970s and early 1980s (Q07/115, Q07/126, Q07/127, Q07/129, Q08/220, Q08/228). Sites with recent records are relatively few: Ruakaka River Estuary (Q08/130) in 1991, Ruakaka River Forest Remnants (Q07/119) in 1993, Piroa Stream in the southern Brynderwyn Hills (Q08/225a) in 2006, and Ruakaka Racecourse Dune Lake (Q07/129) in 2007. Grey ducks have not been recently recorded at several of the sites where they were formerly present, for example Waipu River Estuary (Q08/228), Mountfield Road

Wetland (Q07/126) and Doctor's Hill Road Wetland (Q07/127). Introgressive hybridisation and competition with the introduced mallard, along with habitat loss, are key reasons for the decline of this species (Heather & Robertson 1996).

North Island brown kiwi *Apteryx mantelli* (Serious Decline)
Endemic

Prior to the late 1970s, brown kiwi were widespread throughout the larger forest remnants of Waipu ED, including the Brynderwyn Hills,* Mareretu Forest (Q08/220), and Ruakaka Forest (Q07/121) (Miller & Pierce 1995), and North River Forest (Q07/117) (SSBI Q07/R07/H059). An assessment of North Island brown kiwi distribution and abundance in 1992 detected no kiwi in southeastern Northland, and kiwi are now probably locally extinct in Waipu ED, with now only occasional unconfirmed records of birds being heard. Local extinction can be attributed to habitat loss, and particularly to uncontrolled predation by introduced mammalian predators. During the 1970s and early 1980s there was large-scale land clearance throughout Northland (encouraged by government-subsidised rural bank land clearance loans), which, combined with intense dog predation and the release of ferrets into the wild after the 'fitch' farming industry failed in the 1980s, may have contributed to the dramatic decline of kiwi during that period (Peter Anderson, DOC, pers. comm.).

Banded dotterel *Charadrius bicinctus bicinctus* (Gradual Decline)
Endemic

The total population of banded dotterels has been recently estimated at 50,000 birds (Dowding & Moore 2006). Whangarei Harbour, on the northern edge of Waipu ED, is an important wintering site nationally for banded dotterels, most of which originate from breeding grounds in Marlborough and the southern and central North Island (Pierce 1999). The Takahiwai tidal flats, adjacent to the northern boundary of Waipu ED, are estimated to support 65% of the wintering banded dotterel population in Whangarei Harbour (Wildland Consultants 2005). Within Waipu ED, banded dotterels are regularly present in the Ruakaka River Estuary (Q07/130) (a maximum of 27 birds in 1990, CSN *Notornis* 38) and the Waipu River Estuary (Q08/228) (a maximum of 35 birds in 1997, Audrey Williams and Richard Parrish pers. comm.).

Long-tailed cuckoo *Eudynamys taitensis* (Gradual Decline)
Breeding endemic

This species has been recorded once within Waipu ED, flying over the Brynderwyn Hills Forest Complex – Part G (Q08/225g) in 1992. Long-tailed cuckoo breed only in New Zealand, and in the North Island they parasitise the nests of whiteheads (*Mohoua albicilla*). Whiteheads are now absent from Northland, therefore records in this area are likely to be of birds migrating to their wintering grounds in the tropical Pacific (Heather & Robertson 1996). Long-tailed cuckoo typically pass north through Northland in February-early

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* The last known brown kiwi in the Brynderwyn Hills was killed by a pig dog in 1966 (Peter Anderson, DOC, pers. comm.)

March (Ray Pierce pers. comm.). The decline of this species follows the decline of its host species, and is possibly further contributed to by the loss of its rainforest habitat on tropical Pacific islands (Heather & Robertson 1996).

Northern little blue penguin *Eudyptula minor iredalei* (Gradual Decline)
Endemic

The nearest significant breeding colonies of this species to Waipu ED are on islands off the eastern coast of Northland and in the Hauraki Gulf. Small numbers of northern little blue penguins still breed on Motukaroro Island and probably elsewhere in Whangarei Harbour to the north of Waipu ED. In addition, birds (particularly young of the year) frequently wash up on Bream Bay beaches following severe storms when many are left exhausted and starving (Richard Parrish pers. comm.). Northern little blue penguins were seen on beaches in the southern Waipu ED in the 1990s, including Bream Tail and Waipu Cove, and some residents still report them in the Lang's Beach area (Ray Pierce pers. comm.). This species nests in burrows or natural cavities and is prone to predation by introduced mammalian predators such as dogs, cats, and mustelids. Extreme fluctuations in numbers can also occur, and have been attributed to food shortages or biotoxins (Heather & Robertson 1996).

Kukupa *Hemiphaga novaeseelandiae* (Gradual Decline)
Endemic

Kukupa are threatened by illegal hunting of adult birds, competition for fruit from possums, and the predation of eggs and chicks by rats, stoats, and possums (Heather & Robertson 1996). This species occurs in small numbers throughout Waipu ED and individuals will usually travel between several forest remnants to utilise seasonally available food resources. Kukupa are generally resident in larger indigenous forest tracts that include areas of mixed podocarp–broadleaf forest, but have also been recorded in many small forest remnants.

Red-billed gull *Larus novaehollandiae scopulinus* (Gradual Decline)
Endemic subspecies

Red-billed gull is listed as chronically threatened (Gradual Decline) because of a decline in numbers at its three largest colonies. This species appears to be common and widespread on the coast of Waipu ED with records from the Ruakaka and Waipu River Estuaries (Q07/130, Q08/228), Ruakaka Racecourse Dune Lake (Q07/129), Lang's Beach (Q08/230) and the coast of Bream Tail (R08/001). It breeds every year at Whangarei Harbour (up to 1000 pairs), and in most years at Mangawhai Harbour (up to 100 pairs) (Richard Parrish pers. comm.).

White-fronted tern *Sterna striata striata* (Gradual Decline)
Indigenous

White-fronted terns breed on islands in Whangarei Harbour and a total of 1,200 birds were seen during a survey of the harbour in 2005 (Wildland Consultants 2005). Major breeding concentrations can occur at Mangawhai Harbour to the south (a maximum of 1,098 nests recorded in 2000/2001 (CSN *Notornis* 49). Within Waipu ED, this species frequents the Ruakaka River Estuary (Q08/130)

and breeds occasionally on the Waipu River Estuary and Sandspit (Q08/228), e.g. *c.*30 pairs recorded in 2002/2003 (CSN *Notornis* 50).

AT RISK

North Island fernbird *Bowdleria punctata vealeae* (Sparse)
Endemic subspecies

Fernbirds were present in mangrove and saltmarsh habitat in the Takahiwai Stream Estuary (Q07/143) in 1979/1980 (Parrish 1984) and in the Ruakaka River Estuary (Q07/130) in 1991 (SSBI Q07/H051), although the latter population disappeared following a fire that destroyed fernbird habitat in the early 1990s (Peter Anderson, DOC, pers. comm.). There are no recent records from the Ruakaka River Estuary (Wildland Consultants 2004a; Richard Parrish pers. comm.), but birds have been reported recently from Takahiwai, and it is likely that mangroves in the Takahiwai-Mangapai River area are used as a dispersal corridor (Wildland Consultants 2005).

Brown skua *Catharacta antarctica lonnbergi* (Sparse)
Indigenous

The brown skua is a subantarctic and Antarctic breeder, nesting from the Stewart Island region and Chatham Islands south. This species is an occasional winter visitor to the entrance of Whangarei Harbour (Ray Pierce pers. comm.).

Banded rail *Gallirallus philippensis assimilis* (Sparse)
Indigenous

Banded rails are still widespread within Whangarei Harbour, on the northern boundary of Waipu ED (Parrish 1984, Pierce 2005), and have a preference for areas of mangrove that grade into saltmarsh. Estuarine vegetation in the Takahiwai area, including the Takahiwai Stream Estuary (Q07/143), has an important banded rail population, and banded rails are also known to occur in the Blacksmith's Creek Estuary area (Q07/144) (Parrish 1984). Further south, banded rails may breed in the Ruakaka River Estuary (Q07/130) (Wildland Consultants 2004a), although their numbers have greatly declined since a 1979/1980 survey of the estuary (Richard Parrish pers. comm.). In the Waipu River Estuary (Q08/228) only two individuals have been recorded since 1992 (CSN *Notornis* 41; CSN *Notornis* 47). Banded rails were formerly present at the Waipu Caves Road Wetland (Q07/123) in 1978, but are now likely to be absent or very rare in freshwater wetlands in Waipu ED.

Black shag *Phalacrocorax carbo novaehollandiae* (Sparse)
Indigenous

Black shags have been recorded at only five sites in Waipu ED. The species was seen at the Northland Port Corporation Ponds (Q07/164) and the Ruakaka Racecourse Dune Lake (Q07/129) during the current survey, and has previously been recorded at the Ruakaka River and Waipu River Estuaries (Q07/130, Q08/228) and the Ruakaka River Forest Remnants (Q07/119).

New Zealand dabchick *Poliocephalus rufopectus* (Sparse)
Endemic

New Zealand dabchick is well distributed on lakes and ponds in the North Island, and was formerly present in the South Island, but died out there in the

nineteenth century due to unknown causes (Heather & Robertson 1996). There are three recent records of New Zealand dabchick in Waipu ED, both from constructed water bodies (Semenoff Sand Supplies Ltd ponds in 2004 and 2007 (Ray Pierce pers. comm.), and recently on a farm dam beside Ormiston Road (in Q07/120) (John Kendrick pers. comm.)).

Spotless crake *Porzana tabuensis plumbea* (Sparse)
Indigenous

Spotless crakes have been recorded at five wetlands in Waipu ED, but are probably now absent from some of these sites. A spotless crake was confirmed present at Ruakaka Racecourse Dune Lake (Q07/129) in 2007 (Ray Pierce pers. comm.), and there is also a recent record from the Ruakaka River Estuary (Q07/130) nearby (Wildland Consultants 2004a). One bird was recorded in reed sweetgrass and raupo at Doctor's Hill Road Wetland (Q07/127) during the current survey. The species was present in Mountfield Road Wetland (Q07/123) and Waipu Caves Road Wetland (Q07/126) in 1978, however a tape of spotless crake was played at these sites several times during the current survey with no response. These wetlands appear to have been severely reduced in extent and this may explain why spotless crakes were not detected.

Little black shag *Phalacrocorax sulcirostris* (Range Restricted)
Indigenous

Little black shag breeds mainly in freshwater wetlands at selected sites throughout the North Island, with many birds moving to coastal areas in Northland and Auckland in the autumn (Heather & Robertson 1996). Small groups of little black shag are often seen feeding in the Waipu River (Ray Pierce pers. comm.; CSN *Notornis* 38). Flocks are present in Whangarei Harbour every winter and can number in excess of 100 birds (Richard Parrish pers. comm.).

Red-tailed tropicbird *Phaethon rubricuda* (Range Restricted)
Indigenous

The red-tailed tropicbird is widely distributed in the Indian and Pacific Oceans, but, within the New Zealand region, breeds only on the Kermadec Islands. Birds are most often seen in summer off the coast of Northland and in the Hauraki Gulf, or are found beach-wrecked on the coast of northern and western North Island. One live bird was collected, cared for and released in Bream Bay in 1989 (Richard Parrish pers. comm.). A dead red-tailed tropicbird was found on Uretiti Beach in September 2006 (John Kendrick pers. comm.).

NON-RESIDENT NATIVE

Turnstone *Arenaria interpres* (Migrant)
Indigenous

Turnstone is a transequatorial migrant wader species with approximately 5000–7000 individuals arriving in New Zealand each year (Dowding and Moore 2006). This species was recorded at the Ruakaka River Estuary (Q07/130) in 1978, and is a regular visitor in low numbers to the Waipu River Estuary and Sandspit Q08/228) (Katrina Hansen pers. comm. 2005). A maximum of 49 birds were recorded there in 1992 (CSN *Notornis* 41).

Cattle egret *Bubulcus ibis* (Migrant)
Indigenous

Cattle egrets were first recorded in New Zealand in 1963, and since then have been an increasingly common winter visitor. Birds arrive in April-May, probably from Australia, and return in October-November. Some juveniles remain for the summer months (Heather & Robertson 1996). Cattle egrets favour farmland and open habitats, often accompanying livestock (Heather & Robertson 1996). Within Waipu ED, birds have frequently been seen on paddocks adjacent to the Waipu River (CSN *Notornis* 45; CSN *Notornis* 49; Richard Parrish pers. comm.) and four birds were seen feeding alongside cattle near Oakleigh in the western part of Waipu ED in July 2005 (John Kendrick pers. comm.).

Sharp-tailed sandpiper *Calidrus acuminata* (Migrant)
Indigenous

Sharp-tailed sandpipers breed in northeastern Siberia and 50-200 birds visit New Zealand each summer (Heather & Robertson 1996), being occasional visitors to Waipu River Estuary and Sandspit (Q08/228) (Katrina Hansen pers. comm. 2005).

Lesser knot *Calidris canutus* (Migrant)
Indigenous

Lesser knot is the second most common transequatorial migrant wader species that reaches New Zealand with approximately 50 000–70 000 birds arriving each year (Dowding & Moore 2006). The intertidal areas of Whangarei Harbour are important feeding grounds (with up to *c.* 6500 birds in 1993, CSN *Notornis* 42), and this species also uses the Ruakaka River Estuary (Q07/130) (the usual number of birds in summer is *c.* 200–300 but will on occasions reach 500, Richard Parrish pers. comm.) and the Waipu River Estuary (Q08/228) with up to 260 birds recorded in 1989 (CSN *Notornis* 38).

Curlew sandpiper *Calidris ferruginea* (Migrant)
Indigenous

The curlew sandpiper is an Arctic-breeding wader species which winters in Africa, southern Asia, and Australasia, with flocks of up 10–50 birds recorded in various New Zealand harbours (Heather & Robertson 1996). Two birds were seen at Waipu River Estuary (Q08/228) in 1994 (CSN *Notornis* 43).

Pectoral sandpiper *Calidris melanotos* (Migrant)
Indigenous

The pectoral sandpiper is an Arctic-breeding wader species which mainly winters in South America, but a few birds also migrate to southeastern Asia, small islands in the Pacific, Australia, and New Zealand (Heather & Robertson 1996). One pectoral sandpiper was seen at Waipu River Estuary (Q08/228) in 1992 (CSN *Notornis* 41).

Red-necked stint *Calidrus ruficollis* (Migrant)
Indigenous

Red-necked stint is a transequatorial migrant wader species with approximately 150–200 birds arriving in New Zealand each year (Dowding & Moore 2006). It is infrequently recorded at the Waipu River Estuary and Sandspit (Q08/228) and

has been seen once at Ruakaka River Estuary (Q08/130) in 1980 (Richard Parrish pers. comm.).

White-winged black tern *Chlidonias leucopterus* (Migrant)
Indigenous

The white-winged black tern breeds in the northern hemisphere and migrates to winter in tropical Africa, southeastern Asia, and Australasia, with usually fewer than ten reaching New Zealand each year (Heather & Robertson 1996). One bird was seen at Ruakaka River Estuary (Q07/130) in 1998/1999 (CSN *Notornis* 47).

Hudsonian godwit *Limosa haemastica* (Migrant)
Indigenous

The Hudsonian godwit breeds in North America and overwinters in South America but a few birds are recorded on New Zealand estuaries and lagoons each year (Heather & Robertson 1996). Hudsonian godwit is an occasional visitor to the Waipu River Estuary and Sandspit (Q08/228) (Katrina Hansen pers. comm. 2005), and there is one 1999 record from Ruakaka River Estuary (Q07/130) (CSN *Notornis* 47).

Bar-tailed godwit *Limosa lapponica* (Migrant)
Indigenous

Bar-tailed godwit is the most common transequatorial migrant wader species that reaches New Zealand, with approximately 85 000–105 000 arriving each year (Dowding & Moore 2006). Within Waipu ED, this species is frequently recorded from the Ruakaka River Estuary (Q07/130) where around 150 individuals feed and roost most summers (Richard Parrish pers. comm.). Up to *c.* 3000 birds were recorded in the Ruakaka estuary in March 2001 (CSN *Notornis* 49), although this high number has been attributed to birds from Whangarei Harbour which left there after nests were inundated by king tides. Waipu River Estuary (Q08/228) is also a wintering site for this species with 1–150 birds present every summer (Richard Parrish pers. comm.), and a recorded maximum of 153 birds in 1989 (CSN *Notornis* 38).

Eastern curlew *Numenius madagascariensis* (Migrant)
Indigenous

Eastern curlew breeds in northeastern Asia and 20–50 birds visit New Zealand each year (Heather & Robertson 1996). Single birds are occasionally recorded at Ruakaka River Estuary (Q07/130) and at Waipu River Estuary (Q08/228) (Katrina Hansen pers. comm.; Richard Parrish pers. comm.).

Whimbrel *Numenius phaeopus* (Migrant)
Indigenous

The whimbrel is a transequatorial migrant wader that breeds in the lower Arctic and overwinters in tropical regions and the temperate Southern Hemisphere. Most of the 100–200 birds that arrive each year are the Asiatic subspecies (*Numenius phaeopus variegata*). Small flocks of 10–30 birds regularly visit larger harbours such as Whangarei Harbour, on the northern boundary of Waipu ED, and smaller groups have been recorded from estuaries throughout New Zealand (Heather & Robertson 1996). Within Waipu ED, whimbrels were recorded once in the Waipu River Estuary (Q08/228) in the 1990s (Ray Pierce pers. comm.).

Pacific golden plover *Pluvialis fulva* (Migrant)
Indigenous

Pacific golden plover is a transequatorial migrant wader species with approximately 600–1200 birds visiting New Zealand annually (Dowding and Moore 2006). This species is an occasional visitor to the Waipu River Estuary and Sandspit (Q08/228) (Katrina Hansen pers. comm. 2005). It is a regular visitor to the intertidal flats at Takahiwai, Whangarei Harbour (north of Waipu ED boundary), with a maximum of 100 birds arriving per year (Richard Parrish pers. comm.).

Arctic skua *Stercorarius parasiticus* (Migrant)
Indigenous

Arctic skua is an occasional visitor to Waipu ED, and has been recorded from the Waipu River Estuary and Sandspit (Q08/228) (Katrina Hansen pers. comm. 2005). It is frequently seen within the entrance to Whangarei Harbour, just to the north of Waipu ED (Richard Parrish pers. comm.). This species visits New Zealand waters on the way from its breeding grounds in the Arctic and sub-Arctic to its wintering grounds in the southern hemisphere (Heather & Robertson 1996).

Pomarine skua *Stercorarius pomarinus* (Migrant)
Indigenous

Pomarine skua is an occasional visitor to Waipu ED, and has been recorded from the Waipu River Estuary and Sandspit (Q08/228) (Katrina Hansen pers. comm. 2005). This species is an uncommon but regular visitor to New Zealand waters on the way from its breeding grounds in the Arctic and sub-Arctic to its wintering grounds in the southern hemisphere (Heather & Robertson 1996).

Little tern *Sterna albifrons* (Migrant)
Indigenous

Little tern breeds worldwide, but about 150–200 birds of the Asian subspecies (*Sterna albifrons sinensis*), which breeds in Australia, China, Japan, Korea, and southeastern Asia, migrate to New Zealand during the northern winter (Heather & Robertson 1996). One bird was seen at Waipu River Estuary (Q08/228) in 2001 (CSN *Notornis* 49). Their foods and feeding behaviour are similar to the New Zealand fairy tern (which breeds at Waipu River Estuary), except little terns chatter while hovering to feed (Heather & Robertson 1996).

Terek sandpiper *Tringa flavipes* (Migrant)
Indigenous

Terek sandpipers breed in northern Europe and Asia and are a 'scarce but annual visitor to New Zealand' (Heather & Robertson 1996). One bird was seen feeding at low tide at the Waipu River Estuary and Sandspit (Q08/228) in March 2005 (John Kendrick pers. comm.).

Common sandpiper *Tringa hypoleucos* (Vagrant)
Vagrant

Common sandpipers breed in the northern hemisphere and overwinter in the southern hemisphere from Africa to Australasia, occasionally straying to New Zealand. There have been fewer than 20 sightings since they were first recorded

in 1964 (Heather & Robertson 1996). One common sandpiper was seen at Ruakaka in 1980 (Richard Parrish pers. comm.).

Greenshank *Tringa nebularia* (Vagrant)
Vagrant

Greenshanks breed in the northern hemisphere and overwinter in the southern hemisphere from Africa to Australasia, occasionally straying to New Zealand, with singles or parties of up to four reported (Heather & Robertson 1996). One greenshank was seen at Waipu River Estuary (Q08/228) in 2001 during a banded dotterel census (Richard Parrish pers. comm.).

Western sandpiper *Calidris mauri**
Vagrant

Western sandpipers breed in Siberia and Alaska, and overwinter in coastal California, Mexico, Central America, and northern South America, rarely appearing in New Zealand (five records at publication of Heather & Robertson (1996)). One western sandpiper was seen at Waipu River Estuary (Q08/228) in 1999 (CSN *Notornis* 47).

White-tailed tropicbird *Phaethon lepterus**
Vagrant

The white-tailed tropicbird breeds on tropical islands in the Atlantic, Indian, and western Pacific Oceans, but otherwise remains at sea when not breeding. They are rare vagrants to New Zealand waters, possibly blown south by cyclones, and usually beach-wrecked on Northland coasts (Heather & Robertson 1996). One bird was brought in to DOC from Bream Bay in the late 1990s/early 2000s and was cared for and released (Richard Parrish pers. comm.).

3.4.3 Regionally significant bird species

The following species are included in a draft list of regionally significant species prepared by the Northland Conservancy (DOC, in prep.).

Grey teal *Anas gracilis*
Indigenous

Grey teal are found on lowland lakes and estuaries throughout North and South Island (Heather & Robertson 1996). This species has been recorded within Waipu ED in low numbers in wetlands around the Ruakaka River Estuary (Q07/130) and in flocks of up to 68 birds on the Northland Port Corporation Ponds (Q07/164) (Beauchamp & Parrish 1999).

Australasian shoveler *Anas rhynchotis*
Indigenous

This species has two subspecies, one of which breeds in Australia (*Anas rhynchotis rhynchotis*) and the other which breeds in New Zealand (*Anas rhynchotis variegata*, also known as New Zealand shoveler). They occur throughout New Zealand, preferring lakes, shallow wetlands and ponds, usually

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* A vagrant not classified by Hitchmough *et al.* (2007).

away from cities (Heather & Robertson 1996). Habitat loss has lead to a decline in abundance in Northland, hence they are regarded as regionally significant (Wendy Holland pers. comm.). Within Waipu ED Australasian shoveler has been recorded at Waipu River Estuary and Sandspit (Q08/228) in 1997, and from Ruakaka Racecourse Dune Lake (Q07/129) in 2007.

Bellbird *Anthornis melanura melanura*
Endemic

Within Waipu ED, bellbirds are occasionally seen in the southern Brynderwyn Hills (Q08/225h). Bellbirds were formerly widespread throughout New Zealand but became locally extinct on the mainland north of the Waikato in the 1860s (Heather & Robertson 1996). Previously it was thought that females were unable to reach the mainland in sufficient numbers from offshore islands, e.g. Hen and Chicken Islands (Heather & Robertson 1996). However, pest control at Bream Head (Manaia ED) in recent times has resulted in successful breeding there and increased bellbird sightings away from the control site (Ray Pierce pers. comm.).

New Zealand scaup *Aythya novaeseelandiae*
Endemic

NZ scaup are widespread in New Zealand, but have a patchy distribution. In Northland they mostly occur on dune lakes (Heather & Robertson 1996), and they are uncommon due to loss of habitat (Wendy Holland pers. comm.). Within Waipu ED one was observed at the Ruakaka Racecourse Dune Lake (Q07/129) in March 2007 (Ray Pierce pers. comm.).

Red-crowned kakariki *Cyanoramphus novaezelandiae novaezelandiae*
Endemic

Red-crowned kakariki have secure and thriving populations on predator-free islands, but are rare on the mainland. This species visits the eastern coast of Northland from nearby islands (Heather & Robertson 1996). Red-crowned kakariki were seen in the forest remnants of Bream Tail Coastal Headland (R08/001) in 1993, and are occasional visitors to forest remnants on the southern side of the Brynderwyn Hills (Q08/225h).

Variable oystercatcher *Haematopus unicolor*
Endemic

Variable oystercatcher is a coastal species with its stronghold in the northern North Island. The total population is currently estimated at *c.* 4500 birds, and the Waipu and Ruakaka River Estuaries (Q07/130, Q08/228) are wintering and breeding sites of considerable importance, with up to 25 pairs breeding at Ruakaka and 39 pairs breeding at Waipu. Post-breeding flocks can number 200 birds or more on each estuary (Richard Parrish pers. comm.). The species is currently increasing in numbers, and appears to be benefiting from predator control carried out to protect fairy tern and northern NZ dotterel (Beauchamp & Parrish in press; Dowding & Moore 2006). Current management of variable oystercatcher nesting areas on the coast of Waipu ED includes fencing of nests to reduce human disturbance, and control of mustelids, cats, rats, and hedgehogs (Hansen 2005).

North Island tomtit *Petroica macrocephala toitoi*
Endemic

North Island tomtit declined throughout New Zealand after lowland forest clearance and the introduction of predatory mammals, but was able to adapt to these changes in many parts of the country and persisted in forest remnants (Heather & Robertson 2000). Within Waipu ED, tomtits are most frequently seen in the Brynderwyn Hills Forest Complex (Q08/225) to the east of State Highway 1, where indigenous forest cover is more extensive. Birds are reportedly resident and increasing in numbers in the Marunui Queen Elizabeth II Open Space Covenant within the south-eastern Brynderwyn Hills (Q08/225h). Further north in the ED, tomtits have been reported from Mareretu Forest (Q08/220) in 2001, Ruakaka Forest (Q07/121) in 1992, and Takahiwai Forest (Q07/124) in 1978.

Grey-faced petrel *Pterodroma macroptera*
Endemic

Grey-faced petrel is the most common petrel species breeding in the New Zealand region (Heather & Robertson 1996). The main grey-faced petrel breeding colonies are on offshore islands off the upper North Island (with one colony on Taranga Island, just outside Waipu ED), and the few remaining mainland colonies are restricted to headlands and clifftops, due to declines inflicted by rats, cats, dogs, mustelids, and humans (Heather & Robertson 1996). Within Waipu ED, the steep coastal face of Bream Tail Coastal Headland (R08/001) is a probable nesting area (Andrea Booth pers. comm. 2006). However it is not known how many birds nest here, or if the colony is still present. A grey-faced petrel breeding colony is present on Sentinel Rock, Mangawhai, immediately south of Waipu ED (Cameron & Taylor 1997).

Australasian little grebe *Tachybaptus novaehollandiae novaehollandiae*
Indigenous

Australasian little grebe self-introduced from Australia in the 1960s and 1970s and inhabits ponds and lakes in the northern North Island. The total New Zealand population was *c.* 50 birds in 1995 (Heather & Robertson 1996) and may now be as high as 100–200 birds (Ray Pierce pers. comm.). In Waipu ED, Australasian little grebes were first recorded at the Semenoff Sand Supplies ponds (Q07/128) in the late 1990s (Richard Parrish pers. comm.), and in 2006 they were recorded at the Ruakaka Racecourse Dune Lake (Q07/129) (Peter Anderson, DOC, pers. comm.), and a farm dam beside Ormiston Road (Q07/120) (John Kendrick pers. comm.).

3.4.4 Threatened mammal species

There have been recent, unconfirmed reports of bats from the southeastern Brynderwyn Hills (Q08/225h), but there are no confirmed records of either of New Zealand's endemic bat genera in Waipu ED. If the animals were correctly identified as bats, they were most likely to be the North Island long-tailed bat (*Chalinolobus tuberculata*, Nationally Vulnerable). This species has been recently recorded from the adjacent Rodney ED, and occurs throughout larger

forested areas of North Island. The northern short-tailed bat (*Mystacina tuberculata aupourica*, Nationally Endangered) is now only known from Puketi/Omahuta, Warawara, and Little Barrier Island. Both of these bats would have been present in Waipu ED before mammalian predators became abundant and major human-mediated habitat loss occurred (Molloy 1995).

ACUTELY THREATENED

Southern elephant seal *Mirounga leonina* (Nationally Critical)
Indigenous

Southern elephant seals are circumpolar in distribution, and haul out to breed near the southern tip of South America and on subantarctic islands of the Atlantic, Indian, and Pacific Oceans. Within New Zealand their main breeding colonies are on Antipodes Island and Campbell Island, where there have been huge population reductions (Taylor & Taylor 1989). Southern elephant seals occasionally haul out on sand or gravel beaches to moult and rest (King (ed.) 1990). An elephant seal hauled out on the beach at Waipu Cove in January 1996 during the national beach volleyball championship (Richard Parrish pers. comm.).

NON-RESIDENT NATIVE

Leopard seal *Hydrurga leptonyx* (Migrant)
Indigenous

The leopard seal also has a circumpolar distribution, being present throughout the pack ice and southwards to the Antarctic continent. Those seen in Northland are vagrant individuals (King 1990). A leopard seal was seen at Marsden Spit, Whangarei Harbour, in early 1990s. It had been snagged by a net and was resting (Richard Parrish pers. comm.).

3.4.5 Threatened land snail species

Several threatened species of land snail occur in remnants of indigenous vegetation throughout Waipu ED. The larger, least modified forest remnants appear to support the greatest diversity, but smaller forest and shrubland remnants can provide important habitat.

ACUTELY THREATENED

Punctidae sp. 64 (Nationally Endangered)
Endemic

This species is endemic to eastern Northland, where it is present in areas of indigenous forest on limestone karst. Four populations are known, one of which, at the Waipu Caves Forest (Q07/118), is within Waipu ED. The historical decline of this species is attributed to forest clearance and habitat modification, and the area now occupied by this species is probably less than 10 ha. Current threats to the Waipu Caves population include predation by rodents and the cellar glass snail, and trampling and browsing by cattle (Brook 2002).

CHRONICALLY THREATENED

Schizoglossa worthyae (Gradual Decline)
Endemic

This species occurs sparsely in conifer-broadleaved forest in the northern North Island and its decline has been attributed to habitat loss, predation by rodents, possums, pigs, and hedgehogs, and trampling and browsing by livestock, as for other land snail species (Brook 2002). In Waipu ED this species has been recorded from the Mareretu Forest (Q08/220) and Waipu Gorge Forest Remnants (Q08/222).

Amborhytida dunniae (Gradual Decline)
Endemic

This land snail is endemic to Auckland and Northland with a sporadic distribution resulting from extensive habitat destruction. The main threats to the species are predation by mammalian predators and loss or degradation of habitat, especially through browsing and trampling by livestock or land clearance (Brook 2002). Within Waipu ED this species has been recorded at nine sites, including Takahiwai Forest (Q07/124) in 1993, and Brynderwyn Hills Forest Complex - Part G (Q08/225g) in 1992.

Kauri snail _Paryphanta busbyi_ (Gradual Decline)
Endemic

The kauri snail is endemic to Northland and north Auckland with a fragmented distribution resulting from the extensive destruction of indigenous vegetation. Predation by pigs, rats, possums, and possibly hedgehogs, and continued loss of habitat are the main threats to the species (Brook 2002). Kauri snails have been recorded from eight areas of forest or shrubland in Waipu ED between 1978 and 2006.

3.4.6 Threatened frog species

Recent records confirm the presence of only one endemic species of frog in Waipu ED. At least three other endemic species of frog are now either extinct or locally extinct within Waipu ED.

AT RISK

Hochstetter's frog _Leiopelma hochstetteri_ (Sparse)
Endemic

Hochstetter's frog is the most widely distributed endemic frog and is currently found from central Northland to the central North Island. This species is semi-aquatic and is found in or near small, forested streams (Gill & Whitaker 1996). The northernmost limit of Hochstetter's frog is the forest remnants of the central Waipu ED. Hochstetter's frog has been recorded from many of the larger forest remnants between North River and the Brynderwyn Hills but appears to be most abundant in Waipu Gorge Forest Remnants (Q08/222) and the Brynderwyn Hills Forest Complex (Q08/225a, Q08/225b, Q08/225e, Q08/225c), which are considered to be its northern stronghold (Avi Holzapfel pers. comm.). Recent surveys for Hochstetter's frog have raised concerns regarding the effects of cattle, pigs, and goats on frog populations in North River Scenic

Reserve (Q07/117), Mareretu Forest (Q08/220), and in the Brynderwyn Hills Forest Complex – Part A area (Q08/225a) (Parrish 1993a and 1993b).

3.4.7 Threatened lizard species

CHRONICALLY THREATENED

Auckland green gecko *Naultinus elegans elegans* (Gradual Decline)
Endemic

Auckland green gecko is an arboreal species endemic to Auckland and Northland (north to approximately Hokianga Harbour). It has been reported from four sites in eastern and southern Waipu ED. Auckland green geckoes were seen in the Ruakaka Dunelands (Q07/128) in 1992, and were recently found by road-workers clearing vegetation in Waipu Gorge Forest Remnants (Q08/222). The third and fourth records are unconfirmed; a resident near Robert Hastie Memorial Scenic Reserve in the Brynderwyn Hills Forest Compex (Q08/225j) recently reported to DOC that he had seen green lizards climbing through vegetation on his property (Desmond Hetherington pers. comm.), and there are also unconfirmed reports of this species in the vicinity of the Brynderwyn Hills Forest Complex – Part C (Q08/225c).

3.4.8 Threatened fish species

CHRONICALLY THREATENED

Longfin eel *Anguilla dieffenbachii* (Gradual Decline)
Indigenous

Longfin eels have been recorded from many rivers and streams throughout Waipu ED (NIWA 2007). Longfin eels occur throughout New Zealand, but are threatened by over-harvesting (especially of large females) and habitat modification.

AT RISK

Shortjaw kokopu *Galaxias postvectis* (Sparse)
Endemic

Shortjaw kokopu are very uncommon in Waipu ED, with records from two forested tributaries of the Ruakaka River in the 1980s (Q07/121, Q07/124), although DOC now believes that these may have been misidentified (Peter Anderson, DOC, pers. comm.) Shortjaw kokopu are usually found in small streams flowing through unmodified indigenous forest, and extensive forest clearance is likely to have contributed to its current rarity (McDowall 1990). Until recently the distribution of shortjaw kokopu in Northland was poorly understood, however they have recently been recorded from several parts of Northland, with the most recent record (2005) being the Pikiwahine Stream in Tangihua Forest (Tangihua ED) (NIWA 2007).

3.4.9 Regionally significant fish species

Banded kokopu *Galaxias fasciatus*
Endemic

Within Waipu ED, banded kokopu have been recorded from many streams that flow through forested catchments, which is their preferred habitat (McDowall

1990). The young of banded kokopu have considerable climbing ability, and this species can be present considerable distances inland, including above tall waterfalls (McDowall 1990).

Giant bully *Gobiomorphus gobioides*
Endemic

Northland appears to be the stronghold for this species, which has an intermittent distribution throughout New Zealand (McDowall 1990). The species may be more common than records indicate, due to the difficulty of sampling in estuaries, and the lower reaches of rivers and streams, which are its preferred habitats (McDowall 1990). Within Waipu ED, giant bully has been recently recorded from the small streams that enter the southern end of Lang's Beach and Waipu Cove from the Brynderwyn Hills Forest Complex – Part G (Q08/225g).

3.4.10 Threatened arachnid species

CHRONICALLY THREATENED

Black katipo *Latrodectus atratus*
Endemic

The black katipo is a small spider in the world-wide widow spider genus *Latrodectus*. It occurs along the west coast of the North Island down to Oakura (Taranaki), and on the east coast down to Te Kaha (Bay of Plenty), amongst grasses, sedges, herbs, driftwood, and flotsam on sandy beaches (Griffiths 2001). Females are approximately eight times larger than males, and have a poisonous bite (Griffiths 2001). Black katipo females are all black and differ from the closely related red katipo (which does not occur in Northland) only in that they do not have a red stripe bordered in white down the top of the abdomen (both species have a red or brown hour-glass shape underneath the abdomen) (Sutton *et al.* 2006). Mature males are predominantly white with a series of red-orange diamonds running from the thorax to the spinnerets that are bordered by irregular black lines (Sutton *et al.* 2006). There is a dense population of black katipo within the Ruakaka Dunelands site (Q07/128), which is one of the top three populations for this species on the east coast of Northland in terms of density (Griffiths 2000). Populations of black katipo on the east coast are fragmented and sometimes separated by distances in excess of 100 km, therefore this site is highly significant to the species in Northland (Griffiths 2000; Peter Anderson, DOC, pers. comm.). The introduction of exotic sand-binding plants such as marram grass and lupin, and others, along with the reclamation of dune systems for agriculture, forestry and recreational use, deprive katipo of the conditions they need to prosper (Patrick 2002).

3.4.11 Threatened and regionally significant fauna species not recorded recently in the Waipu Ecological District

ACUTELY THREATENED

Pateke/brown teal *Anas chlorotis* (Nationally Endangered)
Endemic

Pateke or brown teal were formerly present in the Waipu River catchment until the 1950s and 1960s and this area retained significant numbers of birds for

much longer than many other areas around Whangarei Harbour and to the south of Waipu township. One count was made in the July 1958 breeding season of 19 birds over *c.* 8 km of the Waihoihoi Stream and another 58 birds over 100 km of other creeks in the Waipu area (Bell 1959, McKenzie 1971; Parrish & Williams 2001). Introduced mammalian predators have been identified as the current main agents of decline (O'Connor *et al.* 2007). A more recent report of pateke on the Otaika River in 2003 could not be confirmed when visited by DOC staff (Richard Parrish pers. comm.).

North Island weka *Gallirallus australis greyi* (Serious Decline)
Endemic

North Island weka were widespread until the 1920s and 1930s, but mainland populations are now restricted to the east of Opotiki (Bay of Plenty) and the Bay of Islands (where it was reintroduced) (Heather & Robertson 1996). Within Waipu ED there is an old, undated record from the Brynderwyn Hills (Q08/225e). A record of weka in the Brynderwyn Hills (Bull *et al.* 1985), made between September 1969 and December 1979, may be the same sighting. The latest unconfirmed report of weka from the Brynderwyn Hills was in 1986 (Peter Anderson, DOC, pers. comm.). Weka were released into the dunelands of Ruakaka and Waipu during the 1970s, and there were several sightings of birds on sand dunes near Tip Road, Uretiti, until about the early to mid 1980s (Richard Parrish pers. comm.; Peter Anderson, DOC, pers. comm.). There is an unsubstantiated report from *c.* 2000 of two adults and chicks at Uretiti (Tony Beauchamp pers. comm.).

AT RISK

Marsh crake *Porzana pusilla affinis* (Sparse)
Indigenous

Marsh crakes are possibly now locally extinct in Waipu ED, with one record from the Waipu Caves Road Wetland (Q07/123) in 1978. This wetland has been severely reduced in extent and marsh crake are unlikely to still be present, but this requires confirmation.

3.5 THREATS

There are several ongoing and potential threats to the natural areas of Waipu ED. Most of these threats are shared with all of lowland New Zealand.

Invasive plants

Saltmarshes, freshwater wetlands, dunelands, and shrublands are the worst affected habitat types in terms of weed infestation. Saltwater paspalum forms a component of many saltmarsh, mangrove, and mudflat communities in Waipu ED, and is a serious threat to indigenous estuarine vegetation, in particular through the displacement of indigenous salt meadow species such as arrow grass. Saltwater paspalum also excludes burrowing fauna, reduces access to feeding and roosting sites of shore birds, alters fish spawning and feeding grounds, and changes estuarine hydrology by accumulating sediment (Graeme & Kendal 2001; Shaw & Allen 2003).

The dunelands of Waipu ED are prone to weed invasion due to the low stature and frequent disturbance of the vegetation, mild winter temperatures, and close proximity to residential gardens. Pampas and gorse are dominant over large areas of the dunes at Ruakaka (Q07/128), and in places the duneland vegetation has been replaced by a canopy of maritime pine, radiata pine, Chinese privet, or tree privet. Marram grass, a South African species widely planted for dune stabilisation but now recognized as a threat to coastal dune systems, is of localised distribution within Waipu ED. Other weeds found throughout the dune systems include harestail, South African iceplant, dimorphotheca, lupin, purple groundsel, smilax, and gazania.

Few freshwater wetlands remain in Waipu ED, and most have been heavily modified by weed invasion. Small riparian wetlands alongside streams and rivers are often dominated by crack willow. Dense swards of reed sweetgrass are present in at least two natural wetlands, and this species covers approximately 45% of the Doctor's Hill Road Wetland site (Q07/127). Drier parts throughout wetlands, or wetland margins, are often dominated by pampas or gorse.

There are several relatively common invasive tree species which attain forest canopy height (e.g. radiata pine, maritime pine, crack willow, black wattle, and tree privet), however the main weed threat in forests is in the understorey. Dense growth of exotic species inhibits the growth of indigenous seedlings, and can prevent forest regeneration even when stock are excluded. Smothering weeds (e.g. tradescantia) are particularly prevalent in riparian forest remnants, because periodic flooding and greater light intensities at the edges of the remnant provide suitable habitat (Standish 2002). Flooding also spreads weeds by dispersing plant fragments and seeds.

Shrublands are more readily invaded by invasive plants than forests due to relatively higher light levels reaching the ground. In some shrublands, the indigenous cover and their associated weeds may have established at the same time following the clearance of former vegetation. On inland hills, gorse and black wattle are often present. In coastal areas, invasive plants of shrubland areas include gorse, brush wattle, maritime pine, radiata pine, woolly nightshade (tobacco weed), and pampas. As most of these areas are likely to be gorse shrubland reverting to indigenous shrubland, rather than gorse invading indigenous shrubland, the future vegetation of many exotic-dominant shrublands on hill country is likely to be indigenous or mixed indigenous-exotic forest.

Pest animals

Several mammalian pest animals are present in Waipu ED (Appendix 8.7). Pest control appears to be restricted to high value conservation sites, or is undertaken over relatively small areas by private landowners.

Mustelids, cats, rats, and hedgehogs prey on indigenous birds, lizards and invertebrates, and are a major cause of decline for threatened seabirds. The threat posed by these species is particularly evident on coastal sand dunes and estuary margins on the coast of Waipu ED, which are nationally important breeding sites for threatened seabird species. Management of the acutely threatened New Zealand fairy tern and other threatened seabirds in Waipu ED is focused on control of mustelids, cats, rats, and hedgehogs, and reducing human

disturbance of nests (Hansen 2005). Hedgehogs are particularly abundant in sand dune areas of the Northland coast, due to the abundance of introduced brown snails, an important food source, and few winter frosts (Jones & Sanders 2005). Stoats, ferrets, and weasels are all present in Waipu ED (King 2005), although ferrets only colonized this area in the last 20–40 years (Miller & Pierce 1995). Ferrets had only spread as far north as the eastern Kaipara by the 1960s, but had reached high densities in southern Northland by the early 1990s. Ferrets were likely to have increased in numbers when the ferret or 'fitch' farming industry failed in the 1980s and animals were released into the wild by careless owners in the hope that they could be caught again should the industry be revived (Peter Anderson, DOC, pers. comm.). Ferrets were probably the cause, or at least a significant contribution to, the severe decline and probable extinction of kiwi in Waipu ED (Miller & Pierce 1995).

Possums are 'opportunistic herbivores' but also eat meat including birds, eggs, and land snails. Within each region they have distinct preferences, and this often results in canopy dieback and loss for some plant species (Cowan 2005). The full effects of possum browse on the biota of Waipu ED are yet to be realised; possums were released in the Auckland region in the 1860s and 1870s, and by 1963 had spread as far north as the Bay of Islands and Hokianga Harbour (Cowan 2005). Thus, in the majority of forest remnants the current canopy comprises tree species that established prior to or at the time of the arrival of brushtail possum. Brushtail possums have been well implicated in the decline of highly palatable species such as northern rata, pohutukawa, tree fuchsia, kohekohe, and titoki, and the establishment of possums in Waipu ED is certainly a key factor in the decline of these species. Highly palatable plant species are now scarce and comprise a minor proportion of possum diet in Waipu ED Less palatable species are now frequently browsed and these species are predicted to decline. Until relatively recently, the importance role of possums as predators was underestimated; recent research by Innes *et al.* (2004) has clearly demonstrated predation of threatened species such as kukupa by possums, and this decline is further exacerbated by competition for food resources between possums and indigenous species .

Feral goats are not widespread in Waipu ED, with records from North River Forest (Q07/117), Ormiston Road Forest and Shrubland (Q07/135), and Brynderwyn Hills Forest Complex – Part E (Q08/225e). Goats inhibit forest regeneration, particularly where they coexist with stock, and cause the decline or localised extinction of highly palatable species such as mida and tree fuchsia.

Feral pigs browse and uproot vegetation, consume seeds and root material, and prey on large invertebrates such as land snails and earthworms. Pigs probably occur throughout the larger forest remnants of Waipu ED, with recent records from Ruakaka Forest (Q07/121) and the Brynderwyn Hills, where there are extensive plantation forests contiguous with indigenous forest. Populations may be supplemented by illegal releases for hunting purposes, as occurs in other parts of Northland.

Effects of agriculture on natural areas

Grazing and trampling by livestock in natural areas limits regeneration of most indigenous plant species, causes soil compaction, and reduces habitat quality

for indigenous animals. In the long-term, grazing leads to the loss of forest areas by halting forest regeneration. The effects of grazing can be clearly seen throughout Waipu ED; many grazed remnants are characterised by a sparse, species-poor understorey, and are degrading on their edges into indigenous treeland with a groundcover of exotic pasture species. In addition, run-off from pugging and high volumes of urine and faeces from livestock adversely affect water quality, causing eutrophication of waterways, which degrades habitat for indigenous fish and sensitive aquatic macroinvertebrate species (e.g. stoneflies, caddisflies, and mayflies), and has negative downstream effects on estuaries.

Effects of residential dwelling on natural areas

The main threats from residential areas in contact with natural areas are weed invasion through 'garden escapes' (horticultural plants which naturalise), dumping of refuse, increased direct disturbance by humans (e.g. trampling of plants and birds' nests on dunes), and predation by domestic pets (e.g. dogs and cats) on indigenous fauna. Waipu ED is currently undergoing some of the most extensive coastal subdivision and residential development in New Zealand, which intensifies the above-mentioned effects.

Sullivan *et al.* (2005) recently demonstrated a clear link between the number of exotic plant species in remnants and proximity to gardens in coastal Northland. The recent increase in residential developments, particularly in the south-eastern coastal areas of Waipu ED, will see further weed invasion and degradation of remaining indigenous habitats.

Domestic pets, as well as feral animals, can be important factors in the decline of indigenous species. Domestic cats prey on a wide range of indigenous fauna, including birds, lizards, invertebrates, and occasionally frogs (Gillies & Fitzgerald 2005). As residential development increases, particularly in the coastal areas of Waipu ED, the effects of agriculture may lessen, but the types of threats listed here are likely to increase.

Ongoing effects of former land clearance

Former land clearance has lead to severe habitat fragmentation throughout Waipu ED. Smaller habitats have a greater ratio of edge to area, and are therefore more vulnerable to a wide range of threats; these processes are often referred to as 'edge effects'. Edge effects include: (a) increased penetration by invasive weeds and pest animals, (b) more light entering the understorey from the sides, which changes conditions for plant growth and hence vegetation composition, and (c) increased wind in the understorey and consequent drying effects. Some forest remnants are so small and exposed that the edge effects render them ecologically dysfunctional; they are in effect tree museums. They no longer contain palatable species and regeneration is limited by the combined impacts of stock grazing, trampling and infestation by pest animals and plants. In addition, the further away they are from other habitats and seed sources, the less likely it is that regeneration can occur. If regeneration does not occur then trees will not be replaced in the landscape after they mature and die.

Present-day land clearance

In an assessment of recent loss of indigenous cover, Walker *et al.* (2005) ranked the majority of Waipu ED as 'at risk' (based on percent cover of lost habitat and protected areas as of May 2005), and mapped the ED as having a 0.25–1% loss of indigenous cover for the five-year period 1996/97 to 2001/02. While this rate of loss may appear to be low, Walker *et al.* (2005) concluded that Northland, including Waipu ED, is losing indigenous habitats at a higher rate than most of the country, and recent clearance appears to be concentrated in coastal areas, or on marginal hill country. Any amount of further clearance could be considered ecologically damaging. For example, residential subdivision developments near or within natural areas can lead to small-scale clearances for house sites or gardens that may appear to be of little consequence when considered individually, but may collectively contribute to a high level of loss or degradation of habitat.

Intensification of land use can also cause increased isolation of habitat remnants. Whilst clearance of gorse-dominated scrub is an agricultural activity with an assumption of few negative impacts on indigenous biodiversity, the linkages that these habitats can in some instances provide may assist the movement of indigenous fauna across pastoral landscapes. Indigenous forest remnants have recently become isolated by the clearance of gorse in the Helmsdale Road/North River area of Waipu ED. Similarly, pine plantations can act as functional yet temporary linkages between forest remnants, and can support considerable indigenous biodiversity themselves, depending on management. Plantation forest cover can be subject to rapid change in response to economic fluctuations, e.g. grazing of plantations, and the current trend of conversion of plantations to agriculture.

Poaching of kukupa

Kukupa occur sparsely in Waipu ED and are chronically threatened at a national level. It is an offence to kill or harm kukupa, but illegal poaching is likely to occur in Waipu ED from time to time.

Legal protection versus conservation management action

Although several large areas in Waipu ED have some legal protection status and are managed by the Department of Conservation, the Whangarei District Council or the QEII National Trust, these areas will continue to lose indigenous biodiversity without active conservation management. Furthermore, all of the larger protected areas are on steeper topography and many ecological units (particularly those of coastal areas, wetlands, and forest on alluvium) are absent from or under-represented in protected areas. As a bare minimum, the following actions need to be undertaken to protect the immediate and long-term viability of the natural areas:

- Fencing to exclude livestock from remnants of indigenous habitat.
- Reducing the impact of invasive plants through targeted control programmes.
- Regular control of mammalian pests.

- Education of local residents regarding the negative impacts caused by residential developments and how to reduce these impacts, particularly in areas relatively remote from the main urban centres.

A lack of active conservation management, in the face of all the pressures discussed above, is probably the greatest threat to the future viability of the natural areas of Waipu ED. Priority areas for protection are described in Section 5.2 (page 262).

4. Site descriptions

Midpoint grid references are given for all sites. Where more than one remnant exists in a site, the number of remnants is given in brackets after the grid reference.

Vegetation types within ecological units are defined by 'abundant' (species which form > 50% of the canopy) and 'common' (species which form 20–50% of the canopy) species. If there is more than one canopy species, these are listed in descending order of abundance. The percentage cover of ecological units has been included in the site descriptions, however individual ecological units within sites are not mapped. Broad habitat types, (e.g. 'forest', 'shrubland', 'freshwater wetland', 'estuarine wetland' and 'duneland', 'rockland') have been mapped according to Section 2.3.

Records of threatened plants and fauna have been sourced from herbaria and other databases and information systems mentioned in Section 2.1, or were direct observations during the course of this survey. The status of all records was checked prior to inclusion in this report. The fauna section of each site description lists incidental indigenous fauna observations (exotic fauna are not recorded here) and identifies significant fauna with their current New Zealand conservation status in capitals (e.g. Gradual Decline) which is derived from Hitchmough *et al.* (2007). See Appendix 8.7 for a list of fauna present in Waipu Ecological District.

'Not surveyed' is stated in the fauna section of the site description if, at the time of publication, the Department of Conservation, Northland Conservancy, did not have any information on indigenous fauna species from that natural area.

4.1 LEVEL 1 SITES

The following were assessed to be Level 1 sites. These are listed in Table B, and described and mapped in the following sections.

5. Summary and conclusions

5.1 ANALYSIS OF EXISTING PROTECTED AREAS

5.1.1 Overview

Waipu Ecological District covers a total extent of 49,413 ha, of which natural areas cover 14,045 ha (28.4% of the ecological district). The natural areas comprise 12,699 ha forest, 708 ha shrubland, 116 ha freshwater wetland, 257 ha estuary, 239 ha duneland, and 26 ha rockland.

Approximately 31.4% (4,407 ha) of the natural areas are formally protected, which is equivalent to about 8.9% of the total extent of Waipu ED. The extent (ha) and type of protection status within each site is identified in Table 1.

A list of ecological units recorded in Waipu Ecological District and their current protection status is set out in Table 2 (page 266) and a summary of the site evaluations is given in Table 3 (page 298).

5.1.2 Ecological units protected

Approximately 31.4% of the identified natural areas is protected. A summary of the vegetation/habitat types with formal protection (as per Table 1) is presented in Table 1A. The following general patterns are evident:

Forest

Of the 12,699 ha of forest and treeland, 3,591 ha (28.3%) is protected.

Larger areas of forest and treeland at higher altitudes (i.e. above 100 m asl) are better protected than forest and treeland at lower altitudes. The largest protected area of forest is in Mareretu Forest (Q08/220), and the other protected areas of indigenous forest over 100 ha are Ruakaka Forest (Q07/121), Brynderwyn Hills Forest Complex (Q08/225), Waipu Gorge Forest Remnants (Q08/222), and North River Forest (Q07/117).

Forest on alluvial plains is extremely limited in extent and very little of what remains is formally protected. Eight alluvial forest or treeland units have some protection, although four of these are smaller than 1 ha.

Coastal forest is not well represented in protected natural areas. The only sites where coastal forest is protected are Bream Tail Coastal Headland (R08/001) in which four forest types are protected, Takahiwai Forest (Q08/124) in which two forest types are protected, and Lang's Beach Coastal Forest and Shrubland (Q08/226) in which three forest types are protected. Pohutukawa forest and treeland contiguous with the Ruakaka and Waipu River Estuaries is not protected. Only parts of the sequence of mixed broadleaf forest and treeland on Bream Tail Coastal Headland (R08/001) are protected.

TABLE 1. PROTECTED NATURAL AREAS NETWORK IN THE WAIPU ECOLOGICAL DISTRICT (AREAS IN ha).

Site	Survey no.	Private	Department of Conservation					
		QEII*	MS	SL	SB	GP	RR	SR	WR
Mangapai Caves Road Forest and Shrubland	Q07/116							23.2	
North River Forest	Q07/117	32.5						167.0	
Waipu Caves Forest	Q07/118							70.5	
Ruakaka River Forest Remnants	Q07/119		2.4						
Ruakaka Forest	Q07/121	6.5		294.3				442.0	
Takahiwai Forest	Q07/124							65.0	
Doctor's Hill Road Wetland	Q07/127			0.2					0.1
Ruakaka Dunelands	Q07/128		17.3	411.6	0.3	73.4	62.3		13.6
Ruakaka Racecourse Dune Lake	Q07/129			2.8					
Ruakaka River Estuary	Q07/130		0.2	22.8			0.5		50.1
Hewlett QEII Covenant	Q07/136	1.7							
Sandford Road Forest Remnant	Q07/142								
Takahiwai Stream Estuary	Q07/143				2.3				
Blacksmith's Creek Estuary	Q07/144				17.8	1.3			
Mangapai Riparian Forest Remnants	Q07/161						0.4		
Pohuenui River Forest Remnants	Q07/163								
Mill Brook Forest Remnants	Q07/165								
Mareretu Forest	Q08/220		0.8	1321.3					
Waipu Gorge	Q08/222	12.8	1.2	145.2				85.7	
Brynderwyn Hills Forest Complex - Part A	Q08/225a								
Brynderwyn Hills Forest Complex - Part B	Q08/225b	10.7						61.9	
Brynderwyn Hills Forest Complex - Part C	Q08/225c								
Brynderwyn Hills Forest Complex - Part D	Q08/225d	39.1							
Brynderwyn Hills Forest Complex - Part E	Q08/225e		1.8						
Brynderwyn Hills Forest Complex - Part G	Q08/225g	17.4						14.6	
Brynderwyn Hills Forest Complex - Part H	Q08/225h	222.9						236.8	
Brynderwyn Hills Forest Complex - Part I	Q08/225i							67.9	
Brynderwyn Hills Forest Complex - Part J	Q08/225j							28.4	
Lang's Beach Coastal Forest and Shrubland	Q08/226	9.9							
Waipu River Estuary and Sandspit	Q08/228		0.2			115.9	3.3		30.3
Ahuroa River Forest Remnants	Q08/235								
Bream Tail Coastal Headland	R08/001	24.1							
Grand total (ha)		377.6	23.8	2198.2	20.4	190.6	66.5	1263.0	94.1

* QEII = Queen Elizabeth II National Trust Open Space Covenant; RR = Recreation Reserve; SL = Stewardship Land; SR = Scenic Reserve; SB = Seabed; GP = Government Purpose Reserve; MS = Marginal Strip; WR = Wildlife Refuge; ER = Esplanade Reserve; LP = Local Purpose Reserve.

TABLE 1 (*continued*).

Site	Survey no.	Whangarei District Council RR	SR	ER	LP	WR	Total area protected	Total site area
Mangapai Caves Road Forest and Shrubland	Q07/116						23.2	271.3
North River Forest	Q07/117						199.5	973.4
Waipu Caves Forest	Q07/118		3.2				73.7	370.8
Ruakaka River Forest Remnants	Q07/119	0.1			0.2		2.6	104.3
Ruakaka Forest	Q07/121				135.9		878.7	1699.3
Takahiwai Forest	Q07/124						65.0	641.2
Doctor's Hill Road Wetland	Q07/127						0.3	23.2
Ruakaka Dunelands	Q07/128			0.4			578.9	725.7
Ruakaka Racecourse Dune Lake	Q07/129						2.8	4.0
Ruakaka River Estuary	Q07/130			0.2		0.9	74.7	87.2
Hewlett QEII Covenant	Q07/136						1.7	2.1
Sandford Road Forest Remnant	Q07/142			1.4			1.4	2.8
Takahiwai Stream Estuary	Q07/143						2.3	11.1
Blacksmith's Creek Estuary	Q07/144						19.0	22.0
Mangapai Riparian Forest Remnants	Q07/161			0.3			0.7	7.7
Pohuenui River Forest Remnants	Q07/163			0.5			0.5	49.1
Mill Brook Forest Remnants	Q07/165			0.2			0.2	27.1
Mareretu Forest	Q08/220						1322.1	2820.3
Waipu Gorge	Q08/222				0.0		244.9	543.7
Brynderwyn Hills Forest Complex - Part A	Q08/225a				0.2		0.2	236.0
Brynderwyn Hills Forest Complex - Part B	Q08/225b						72.6	189.1
Brynderwyn Hills Forest Complex - Part C	Q08/225c				0.7		0.7	481.9
Brynderwyn Hills Forest Complex - Part D	Q08/225d						39.1	56.5
Brynderwyn Hills Forest Complex - Part E	Q08/225e		21.8				23.6	813.0
Brynderwyn Hills Forest Complex - Part G	Q08/225g	2.4			0.4		34.8	796.4
Brynderwyn Hills Forest Complex - Part H	Q08/225h						459.7	73.5
Brynderwyn Hills Forest Complex - Part I	Q08/225i						67.9	973.4
Brynderwyn Hills Forest Complex - Part J	Q08/225j						28.4	370.8
Lang's Beach Coastal Forest and Shrubland	Q08/226	0.3					10.2	109.9
Waipu River Estuary and Sandspit	Q08/228			2.2			152.0	220.5
Ahuroa River Forest Remnants	Q08/235			1.0			1.0	53.8
Bream Tail Coastal Headland	R08/001						24.1	260.7
Grand total (ha)		2.8	25.0	6.2	137.4	0.9	4406.6	13021.8

Shrubland

Of the 708 ha of shrubland within natural areas, 415 ha (58.6%) are protected.

Shrublands are protected at seven of the 30 sites where they occur.

The protected shrublands are either within large hill country forests or in the coastal dunelands (where they are dominated by exotic species).

Shrublands on low hills or on alluvial plains are not represented in protected areas.

Freshwater wetland

The total area of freshwater wetlands identified was 116 ha, of which 42 ha (36.6%) is protected. However, of the total, only 45 ha were considered to be 'natural' or 'semi-natural' wetlands (the remainder is constructed lakes, dams or ponds). Only 2 ha (4.4%) of the natural or semi-natural wetlands are protected.

Protected ecological units within natural or semi-natural wetlands include the following: 0.3 ha of reed sweetgrass grassland (exotic) at Doctor's Hill Road Wetland (Q07/127); very small areas of marsh clubrush sedgeland at the estuarine margins of Blacksmith's Creek Estuary (Q08/144) and Waipu River Estuary and Sandspit (Q08/228), and about half the lake and wetland habitat at the Ruakaka Racecourse Dune Lake site (Q07/129) (1.6 ha).

A 40 ha dam recently created for the purpose of town water supply (Wilson's Dam in Ruakaka Forest Q07/121) is fully protected as a local purpose reserve.

Estuarine

Of 257 ha of estuarine habitats, 175 ha (68.2%) are protected.

While the full range of estuarine habitats is under some form of legal protection, although very little of the indigenous vegetation adjacent to estuaries is formally protected.

Duneland

Of the 239 ha of duneland habitat identified (this includes all vegetation types on duneland except shrubland and forest on dunes), 185 ha (77.5%) is protected.

Every duneland ecological unit is represented in a protected area.

Rockland

There are two examples of significant rockland habitat in Waipu ED (0.5 ha of sandstone cliff on Waipu Caves Road Sandstone Knoll Q07/132 and 25.5 ha of coastal cliffs and rocky outcrops at Bream Tail Coastal Headland R08/001). 0.72 ha of coastal cliffs in the latter site are within a Queen Elizabeth II Open Space Covenant.

TABLE 1A: LIST OF VEGETATION/HABITAT TYPES WITHIN PROTECTED AREAS IN WAIPU ECOLOGICAL DISTRICT.

SITE	SURVEY NO.	VEGETATION/HABITAT TYPES WITHIN PROTECTED LAND STATUS
Mangapai Caves Road Forest and Shrubland	Q07/116	Kanuka forest, towai forest, kanuka-totara forest
North River Forest	Q07/117	Kanuka-rimu-tanekaha-kauri forest, kanuka-mamaku forest, taraire forest, tanekaha-kanuka forest, kanuka forest, puriri forest, kauri-kanuka forest, kanuka-rewarewa forest, totara forest, totara-taraire forest, rimu-tanekaha forest
Waipu Caves Forest	Q07/118	Totara forest, totara-taraire forest, kanuka forest, totara-mamaku forest, totara treeland, totara-hawthorn forest, kauri-kanuka forest
Ruakaka River Forest Remnants	Q07/119	Totara-kahikatea forest (alluvial)
Ruakaka Forest	Q07/121	Kanuka-rimu-tanekaha forest, kauri forest, totara forest, kanuka forest, towai forest, totara-mamaku forest, open water (constructed dam), taraire forest, tanekaha-kanuka forest, kanuka-mamaku forest, kahikatea-totara forest, kauri-rimu forest, nikau-ponga forest, kanuka shrubland, mahoe-kanuka shrubland, pate-ti kouka shrubland
Takahiwai Forest	Q07/124	Kanuka forest, kanuka-kauri forest
Doctor's Hill Road Wetland	Q07/127	Reed sweetgrass grassland
Ruakaka Dunelands	Q07/128	Gorse-pampas scrub, sandfield habitat, pohuehue shrubland, sweet vernal-harestail grassland, *Kunzea ericoides* var. *linearis* forest, maritime pine treeland, brush wattle-Chinese privet-mapou scrub, radiata pine forest, spinifex grassland, pingao sedgeland, tree privet-Chinese privet scrub, pohuehue-*Coprosma acerosa* shrubland, pampas-ginger scrub, sweet vernal grassland, knobby clubrush-pohuehue sedgeland, harestail-gazania-marram grassland, harakeke-gorse flaxland, glasswort herbfield
Ruakaka Racecourse Dune Lake	Q07/129	Open water (dune lake), gorse scrub, raupo-alligator weed reedland, ti kouka treeland, raupo reedland, lake clubrush-alligator weed reedland
Ruakaka River Estuary	Q07/130	Mudflat and sandflat, estuarine open water, mangrove shrubland and forest, oioi rushland, oioi-sea rush rushland, *Austrostipa stipoides* tussockland, glasswort-mangrove sandfield, glasswort herbfield, saltmarsh ribbonwood shrubland, manuka shrubland, gorse scrub
Hewlett QEII Covenant	Q07/136	Kahikatea treeland (alluvial)
Sandford Road Forest Remnant	Q07/142	Totara treeland (alluvial)
Takahiwai Stream Estuary	Q07/143	Mangrove shrubland
Blacksmith's Creek Estuary	Q07/144	Mangrove shrubland, searush-oioi rushland, glasswort herbfield, marsh clubrush sedgeland
Mangapai Riparian Forest Remnants	Q07/161	Totara forest (alluvial)
Pohuenui River Forest Remnants	Q07/163	Totara treeland (alluvial)
Mill Brook Forest Remnants	Q07/165	Totara forest (alluvial)
Mareretu Forest	Q08/220	Kanuka forest, rimu forest, taraire-mamaku-rimu-rewarewa-totara forest, kauri-kanuka forest, mamaku-mahoe shrubland, taraire forest, tanekaha forest, mapou-mingimingi-ponga shrubland, manuka shrubland, totara forest, taraire-totara forest, towai forest, mapou-manuka shrubland
Waipu Gorge	Q08/222	Kanuka-mamaku forest, taraire forest, mamaku-mapou forest, kanuka-rimu forest, totara forest, kauri-tanekaha forest, mahoe-mamaku forest, kanuka-tanekaha forest, kanuka-tanekaha-rewarewa forest, kauri forest, manuka shrubland, nikau forest (alluvial)
Brynderwyn Hills Forest Complex - Part A	Q08/225a	Taraire-tawa forest? (tiny area)
Brynderwyn Hills Forest Complex - Part B	Q08/225b	Unknown gully forest types, kanuka forest, kauri forest, kauri-tanekaha-rimu-kanuka forest, taraire-nikau forest, tanekaha forest
Brynderwyn Hills Forest Complex - Part C	Q08/225c	Tawa-taraire forest? (tiny area)
Brynderwyn Hills Forest Complex - Part D	Q08/225d	Kanuka forest, kauri forest, kauri-rimu forest, kanuka-rimu-tanekaha forest, taraire-puriri forest

SITE	SURVEY NO.	VEGETATION/HABITAT TYPES WITHIN PROTECTED LAND STATUS
Brynderwyn Hills Forest Complex – Part E	Q08/225e	Kanuka forest
Brynderwyn Hills Forest Complex – Part G	Q08/225g	Kanuka forest, kanuka–mamaku forest
Brynderwyn Hills Forest Complex – Part H	Q08/225h	Kanuka forest, taraire–puriri forest, puriri–taraire–rewarewa–totara–nikau–mamaku forest, puriri forest, totara–tanekaha–rewarewa forest, mamaku forest, tanekaha–kanuka forest, kauri–kanuka forest, kauri–tanekaha forest, tawa–rewarewa–mamaku–ponga–nikau–kohekohe forest
Brynderwyn Hills Forest Complex – Part I	Q08/225i	Kanuka forest, taraire–puriri forest
Brynderwyn Hills Forest Complex – Part J	Q08/225j	Kanuka–tanekaha–kauri forest, manuka–kanuka
Lang's Beach Coastal Forest and Shrubland	Q08/226	Pohutukawa–rimu forest, pohutukawa forest, pohutukawa treeland
Waipu River Estuary and Sandspit	Q08/228	Mudflat and sandflat, sandfield habitat, estuarine open water, spinifex grassland, purple groundsel–South African iceplant herbfield, sea rush rushland, sea rush–*Austrostipa stipoides* rushland, oioi rushland, knobby clubrush–tall fescue sedgeland, mangrove shrubland and forest, saltwater paspalum grassland, sea primrose–remuremu herbfield, sea grass grassland, marsh clubrush sedgeland, buffalo grass–South African iceplant grassland, buffalo grass–pohuehue–knobby clubrush shrubland, South African iceplant–harestail–shore bindweed herbfield, pingao sedgeland, *Carex pumila* sandfield
Ahuroa River Forest Remnants	Q08/235	Totara forest (alluvial)
Bream Tail Coastal Headland	R08/001	Kanuka–tawa forest, kanuka forest, puriri forest, taraire forest, rocky outcrop and cliff habitat

5.2 PRIORITY NATURAL AREAS FOR PROTECTION IN WAIPU ECOLOGICAL DISTRICT

The purpose of this section is to identify the unprotected natural areas documented in this report that best supplement the existing protected natural areas network, to make it more fully representative of Waipu Ecological District's ecological diversity and character.

The natural areas of Waipu ED comprise reasonably large areas of secondary forest in the upper hill country areas, a paucity of indigenous habitats on lower hills and lowland alluvial plains, and an extensive but highly modified coastal dune system. There is also one major coastal headland and a few freshwater wetlands (including a single remaining dune lake). In terms of legal protection, the upper inland hill country and dunelands have a relatively high level of protection compared with other parts of Waipu ED. Therefore the priorities for protection currently in the ED are:

1. Indigenous vegetation and habitats on alluvial plains.
2. Freshwater wetland vegetation and habitat, especially those sites supporting natural or semi-natural wetland. The full protection of Ruakaka Racecourse Dune Lake (Q07/129) (last remaining dune lake in the whole Eastern Northland Ecological Region) is a particularly high priority.
3. Level 1 forest and shrubland remnants below 100 m altitude, which provide linkages between upland indigenous forest and lowland alluvial forest remnants.
4. Forest and treeland adjacent to estuaries, especially pohutukawa forest and treeland on coastal scarps next to Ruakaka River Estuary (Q07/130) and Waipu River Estuary and Sandspit (Q08/228).
5. Coastal indigenous forest, treeland, shrubland, and rockland on Bream Tail Coastal Headland (R08/001).

An effective strategy to create an integrated protected areas network in Waipu ED would need to consider protection of priority natural areas and ecological restoration of wetlands, ecological corridors, linkages, and buffers to promote better connectivity between inland hill country, alluvial plains and the coastal dune system.

TABLE 2. ECOLOGICAL UNITS RECORDED IN WAIPU ECOLOGICAL DISTRICT AND PROTECTION STATUS.

Key: * = Level 2 site; bold pna numbers = representative ecological units; pt = site is partially protected, but not known if ecological unit falls within the protected area; QEII = Queen Elizabeth II National Trust Open Space Covenant; RR = Recreation Reserve; SL = Stewardship Land; SR = Scenic Reserve; SB = Seabed; GP = Government Purpose Reserve; MS = Marginal Strip; WR = Wildlife Refuge; ER = Esplanade Reserve; LP = Local Purpose Reserve.

GEOL. GROUP:†	A	B	C	D	E	F	G	H
Coastal Freshwater Wetland Vegetation and Habitats								
Azolla filiculoides herbfield		**Q07/131**						
Azolla filiculoides-burr reed herbfield		**Q07/131**						
Baumea articulata reedland		**Q07/127** (ptSL,WR) **Q07/141**						
Baumea sp. and *Juncus* sp. reedland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Baumea teretifolia sedgeland		**Q07/141**						
Bracken fernland		**Q07/127** (ptSL,WR)						
Carex ovalis sedgeland		Q07/141						
Cyperus ustulatus tussockland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Eleocharis acuta-Azolla filiculoides sedgeland		**Q07/131**						
Eleocharis sphacelata reedland		**Q07/131** **Q07/141**						
Juncus pallidus rushland								
Lake clubrush reedland								
Lake clubrush-alligator weed reedland		**Q07/129** (ptSL)						
Manuka shrubland		**Q07/131**						
Manuka-harakeke-ti kouka shrubland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Marsh clubrush sedgeland	**Q07/144** (ptSB,GP) Q08/228 (ptMS,GP, RR,WR)							
Open water (constructed pond)								
Open water (dune lake)		**Q07/129** (ptSL)						

† A: Holocene estuarine sediments
B: Holocene coastal dunefields
C: Holocene alluvium
D: Late Pleistocene (last interglacial) alluvial and/or estuarine deposits
E: Pleistocene consolidated dune sand
F: Miocene dacite intrusions (Waitakere Group)
G: Miocene bluff-forming sandstone (Waitemata Group)
H: Miocene sandstone and mudstone/sandy mudstone (Waitemata Group)

GEOL. GROUP:†	I	J	K	L	M	N	O	P
Coastal Freshwater Wetland Vegetation and Habitats								
Azolla filiculoides herbfield								
Azolla filiculoides–burr reed herbfield								
Baumea articulata reedland								
Baumea sp. and *Juncus* sp. reedland						**R08/001** (ptQEII)		
Baumea teretifolia sedgeland								
Bracken fernland								
Carex ovalis sedgeland								
Cyperus ustulatus tussockland						**R08/001** (ptQEII)		
Eleocharis acuta–Azolla filiculoides sedgeland								
Eleocharis sphacelata reedland								
Juncus pallidus rushland								Q07/164
Lake clubrush reedland								**Q07/164**
Lake clubrush–alligator weed reedland								
Manuka shrubland								
Manuka–harakeke–ti kouka shrubland						**R08/001** (ptQEII)		
Marsh clubrush sedgeland							Q08/230	
Open water (constructed pond)								Q07/122* Q07/128 (ptMS,SL, SB,GP,RR, WR, ER) Q07/164
Open water (dune lake)								

† I: Oligocene muddy limestone (Mahurangi Limestone, Motatau Complex)
J: *?Non-calcareous mudstone (?Mangakahia Complex)*
K: Melange (undifferentiated Mangakahia and Motatau Complex lithologies)
L: Oligocene flaggy limestone (Whangarei Limestone, Te Kuiti Group)
M: Eocene glauconitic sandstone (Ruatangata Sandstone, Te Kuiti Group)
N: Mesozoic greywacke (Waipapa Terrane)
O: Holocene beach sands
P: Human-made

GEOL. GROUP:	A	B	C	D	E	F	G	H
Coastal Freshwater Wetland Vegetation and Habitats (continued)								
Open water in gully	**Q07/127** (ptSL,WR)							
Raupo reedland		**Q07/127** (ptSL,WR) **Q07/129** (ptSL) Q07/141				**R08/001** (ptQEII)		**R08/001** (ptQEII)
Reed sweetgrass grassland		Q07/127 (ptSL,WR)						
Soft rush–*Azolla filiculoides* rushland		Q07/131						
Ti kouka treeland		**Q07/129** (ptSL)						
Watercress–*Polygonum* sp.–bachelor's button–*Baumea articulata* herbfield	Q07/144 (ptSB,GP)							
Yorkshire fog grassland		Q07/131						
Inland Freshwater Wetland Vegetation and Habitats								
Carex geminata–kahikatea sedgeland			**Q08/222** (ptQEII, MS, SL, SR,LP)					
Crack willow treeland								Q07/115
Harakeke flaxland			**Q07/138**					Q07/115
Kahikatea–harakeke treeland			**Q07/138**					
Open water (constructed dam)								
Open water (constructed lake)								
Open water (constructed pond)			Q07/126	Q07/126				
Raupo reedland		**Q07/126**	Q07/123 Q07/154* **Q08/223** Q08/244	**Q07/126**				Q07/115 Q07/140* Q07/154* **Q08/220** (ptMS,SL) Q08/221
Reed sweetgrass grassland			Q07/138					
Willow weed herbfield			Q07/126	Q07/126				
Estuarine Vegetation and Habitats								
Austrostipa stipoides tussockland	**Q07/130** (ptMS,SL, RR,WR)							
Estuarine open water	**Q07/130** (ptMS,SL, RR,WR) **Q08/228** (ptMS,GP, RR,WR)							

GEOL. GROUP:	I	J	K	L	M	N	O	P
Coastal Freshwater Wetland Vegetation and Habitats (continued)								
Open water in gully								
Raupo reedland						Q07/122* Q07/124 (ptSR) **R08/001** (ptQEII)		
Reed sweetgrass grassland								
Soft rush–*Azolla filiculoides* rushland								
Ti kouka treeland								
Watercress–*Polygonum* sp.–bachelor's button–*Baumea articulata* herbfield								
Yorkshire fog grassland								
Inland Freshwater Wetland Vegetation and Habitats								
Carex geminata–kahikatea sedgeland								
Crack willow treeland								
Harakeke flaxland								
Kahikatea–harakeke treeland								
Open water (constructed dam)								Q07/121 (ptQEII,SL, SR,LP)
Open water (constructed lake)								Q07/121 (ptQEII,SL, SR,LP) Q07/124 (ptSR)
Open water (constructed pond)								Q08/223 Q07/120 Q07/140*
Raupo reedland		**Q07/150**			**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL) Q08/221		
Reed sweetgrass grassland								
Willow weed herbfield								
Estuarine Vegetation and Habitats								
Austrostipa stipoides tussockland								
Estuarine open water								

GEOL. GROUP:	A	B	C	D	E	F	G	H
Estuarine Vegetation and Habitats (continued)								
Glasswort herbfield	**Q07/130** (ptMS,SL, RR,WR) **Q07/144** (ptSB,GP) Q07/167*	**Q07/128** (ptMS,SL, SB,GP, RR, WR, ER)						
Glasswort-mangrove sandfield	**Q07/130** (ptMS,SL, RR,WR)							
Gorse scrub	Q07/130 (ptMS,SL, RR,WR)							
Knobby clubrush-tall fescue sedgeland	**Q08/228** (ptMS,GP, RR,WR)							
Mangrove shrubland	**Q07/143** (ptSB) Q07/144 (ptSB,GP) Q07/167*							
Mangrove shrubland and forest	**Q07/130** (ptMS,SL, RR,WR) **Q08/228** (ptMS,GP, RR,WR)							
Manuka shrubland	**Q07/130** (ptMS,SL, RR,WR)							
Mudflat and sandflat	**Q08/228** (ptMS,GP, RR,WR) **Q07/130** (ptMS,SL, RR,WR) Q07/167*							
Oioi rushland	**Q08/228** (ptMS,GP, RR,WR) **Q07/130** (ptMS,SL, RR,WR)							
Oioi-sea rush rushland	**Q07/130** (ptMS,SL, RR,WR)							
Saltmarsh ribbonwood shrubland	**Q07/130** (ptMS,SL, RR,WR) Q07/167*							
Saltwater paspalum grassland	Q08/228 (ptMS,GP, RR,WR)							
Sea grass grassland	**Q08/228** (ptMS,GP, RR,WR)							

GEOL. GROUP:	I	J	K	L	M	N	O	P
Estuarine Vegetation and Habitats (continued)								
Glasswort herbfield								
Glasswort-mangrove sandfield								
Gorse scrub								
Knobby clubrush-tall fescue sedgeland								
Mangrove shrubland								
Mangrove shrubland and forest								
Manuka shrubland								
Mudflat and sandflat								
Oioi rushland								
Oioi-sea rush rushland								
Saltmarsh ribbonwood shrubland								
Saltwater paspalum grassland								
Sea grass grassland								

GEOL. GROUP:	A	B	C	D	E	F	G	H
Estuarine Vegetation and Habitats (continued)								
Sea primrose-remuremu herbfield	**Q08/228** (ptMS,GP, RR,WR)							
Sea rush rushland	**Q08/228** (ptMS,GP, RR,WR) Q07/167*							
Sea rush-*Austrostipa stipoides* rushland	**Q08/228** (ptMS,GP, RR,WR)							
Sea rush-oioi rushland	**Q07/143** (ptSB) Q07/144 (ptSB,GP)							
Duneland Vegetation and Habitats								
Brush wattle-Chinese privet-mapou scrub		Q07/128 (ptMS,SL, SB,GP, RR, WR, ER)						
Gorse scrub		Q07/129 (ptSL)						
Gorse-pampas scrub		Q07/128 (ptMS,SL, SB,GP, RR, WR, ER)						
Harakeke-gorse flaxland		**Q07/128** (ptMS,SL, SB,GP, RR, WR, ER)						
Pampas-ginger scrub		Q07/128 (ptMS,SL, SB,GP, RR, WR, ER)						
Tree-privet-Chinese privet scrub		Q07/128 (ptMS,SL, SB,GP, RR, WR, ER)						
Kunzea ericoides var. *linearis* forest		**Q07/128** (ptMS,SL, SB,GP, RR, WR, ER) Q07/141						
Maritime pine treeland		Q07/128 (ptMS,SL, SB,GP, RR, WR, ER)						
Radiata pine forest		Q07/128 (ptMS,SL, SB,GP, RR, WR, ER)						
Buffalo grass-pohuehue-knobby clubrush shrubland		Q08/228 (ptMS,GP, RR,WR)						
Buffalo grass-South African iceplant grassland		Q08/228 (ptMS,GP, RR,WR)						

GEOL. GROUP:	I	J	K	L	M	N	O	P
Estuarine Vegetation and Habitats (continued)								
Sea primrose-remuremu herbfield								
Sea rush rushland								
Sea rush-*Austrostipa stipoides* rushland								
Sea rush-oioi rushland								
Duneland Vegetation and Habitats								
Brush wattle-Chinese privet-mapou scrub								
Gorse scrub								
Gorse-pampas scrub								
Harakeke-gorse flaxland								
Pampas-ginger scrub								
Tree-privet-Chinese privet scrub								
Kunzea ericoides var. *linearis* forest								
Maritime pine treeland								
Radiata pine forest								
Buffalo grass-pohuehue-knobby clubrush shrubland								
Buffalo grass-South African iceplant grassland								

GEOL. GROUP:	A	B	C	D	E	F	G	H
Duneland Vegetation and Habitats (continued)								
Carex pumila sandfield								
Harestail-gazania-marram grassland		Q07/128 (ptMS,SL, SB,GP,RR, WR, ER)						
Harestail-spinifex grassland								
Knobby clubrush-pohuehue sedgeland		**Q07/128** (ptMS,SL, SB,GP, RR, WR, ER)						
Pingao sedgeland		**Q07/128** (ptMS,SL, SB,GP,RR, WR, ER) **Q08/228** (ptMS,GP, RR,WR)						
Pohuehue shrubland		**Q07/128** (ptMS,SL, SB,GP,RR, WR, ER)						
Pohuehue-buffalo grass shrubland								
Pohuehue-*Coprosma acerosa* shrubland		**Q07/128** (ptMS,SL, SB,GP,RR, WR, ER)						
Purple groundsel-South African iceplant herbfield		Q08/228 (ptMS,GP, RR,WR)						
Sandfield habitat		**Q07/128** (ptMS,SL, SB,GP,RR, WR, ER) **Q08/228** (ptMS,GP, RR,WR)						
Sickle grass grassland								
South African iceplant-harestail-shore bindweed herbfield		Q08/228 (ptMS,GP, RR,WR)						
Spinifex grassland		**Q07/128** (ptMS,SL, SB,GP,RR, WR, ER) **Q08/228** (ptMS,GP, RR,WR)						

GEOL. GROUP:	I	J	K	L	M	N	O	P
Duneland Vegetation and Habitats (continued)								
Carex pumila sandfield							**Q08/228** (ptMS,GP, RR,WR) Q08/230	
Harestail-gazania-marram grassland								
Harestail-spinifex grassland							Q08/230	
Knobby clubrush-pohuehue sedgeland								
Pingao sedgeland							Q08/230	
Pohuehue shrubland								
Pohuehue-buffalo grass shrubland						R08/001 (ptQEII)		
Pohuehue-*Coprosma acerosa* shrubland								
Purple groundsel-South African iceplant herbfield								
Sandfield habitat							**Q07/128** (ptMS,SL, SB,GP,RR, WR,ER) **Q08/228** (ptMS,GP, RR,WR) Q08/230 R08/001 (ptQEII)	
Sickle grass grassland							Q08/230	
South African iceplant-harestail-shore bindweed herbfield								
Spinifex grassland							**Q07/128** (ptMS,SL, SB,GP,RR, WR,ER) Q08/228 (ptMS,GP, RR,WR)	

GEOL. GROUP:	A	B	C	D	E	F	G	H
Duneland Vegetation and Habitats (continued)								
Sweet vernal grassland		Q07/128 (ptMS,SL, SB,GP,RR, WR,ER)						
Sweet vernal-harestail grassland		Q07/128 (ptMS,SL, SB,GP,RR, WR,ER)						
Coastal Alluvial Vegetation								
Brush wattle-manuka shrubland				Q07/167*				
Kanuka shrubland	**Q07/144** (ptSB,GP) **Q07/143** (ptSB)							
Manuka-harakeke shrubland	**Q07/144** (ptSB,GP)							
Inland Alluvial Vegetation								
Manuka shrubland			**Q08/244**					
Kahikatea forest			Q07/145 **Q07/152** Q08/220 (ptMS,SL) Q08 225 Q08/247	**Q07/125** Q08/224 Q08/233 Q08/234* Q08/247				
Kahikatea treeland				Q07/136 (ptQEII)				
Kahikatea-nikau forest			**Q07/113**					
Kahikatea-puriri treeland				Q08/233				
Kahikatea-totara forest			Q07/152 **Q08/235** (ptER)	**Q08/235** (ptER)				
Kahikatea-totara treeland			Q07/142* (ptER)	Q07/142* (ptER)				
Kanuka-kahikatea forest				**Q08/233**				
Kauri forest			**Q07/148**					
Kowhai-kahikatea forest			**Q07/117** (ptQEII,SR)					
Nikau forest			**Q08/222** (ptQEII, MS, SL, SR,LP)					
Puriri-totara treeland			Q07/163 (ptER)	Q07/163 (ptER)				
Taraire forest			**Q08/225a** (ptLP) **Q08/231** **Q08/235** (ptER)	**Q08/231** **Q08/235** (ptER)				
Titoki-kowhai-totara forest			**Q07/145**					
Titoki-totara forest			**Q07/145**					

GEOL. GROUP:	I	J	K	L	M	N	O	P
Duneland Vegetation and Habitats (continued)								
Sweet vernal grassland								
Sweet vernal-harestail grassland								
Coastal Alluvial Vegetation								
Brush wattle-manuka shrubland								
Kanuka shrubland								
Manuka-harakeke shrubland								
Inland Alluvial Vegetation								
Manuka shrubland								
Kahikatea forest		Q07/147						
Kahikatea treeland								
Kahikatea-nikau forest								
Kahikatea-puriri treeland								
Kahikatea-totara forest								
Kahikatea-totara treeland								
Kanuka-kahikatea forest								
Kauri forest								
Kowhai-kahikatea forest								
Nikau forest								
Puriri-totara treeland								
Taraire forest								
Titoki-kowhai-totara forest								
Titoki-totara forest								

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Alluvial Vegetation (continued)								
Totara forest			Q07/145 Q07/148 Q07/152 Q07/161* (ptRR,ER) Q07/165* (ptER) **Q08/235** (ptER) Q08/242*	Q07/165* (ptER) **Q08/235** (ptER) Q08/242* Q08/246				
Totara treeland			**Q07/119** (ptMS, RR,LP) Q07/142* (ptER) Q07/163 (ptER) Q08/232	**Q07/119** (ptMS, RR,LP) Q07/142* (ptER) Q07/163 (ptER) Q08/232				
Totara-kahikatea forest			**Q07/119** (ptMS, RR,LP) Q07/145 Q07/148	Q07/119 (ptMS, RR,LP)				
Totara-kanuka forest			**Q07/163** (ptER) Q08/232 **Q08/231**	**Q07/163** (ptER) Q08/232 **Q08/231**				
Totara-taraire-kanuka treeland			Q07/163 (ptER)	Q07/163 (ptER)				
Coastal Hill Vegetation								
Bracken-kikuyu-tall fescue-Yorkshire fog grassland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Hangehange-harakeke shrubland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Harakeke-kawakawa flaxland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Harakeke-pampas flaxland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Kanuka shrubland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Manuka shrubland								**R08/002**
Rocky outcrop and cliff habitat						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Kahikatea forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Kanuka forest						**R08/001** (ptQEII)		**R08/001** (ptQEII) Q08/225i (ptSR) Q08/225g (ptQEII,SR, RR,LP)

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Alluvial Vegetation (continued)								
Totara forest								
Totara treeland								
Totara-kahikatea forest								
Totara-kanuka forest								
Totara-taraire-kanuka treeland								
Coastal Hill Vegetation								
Bracken-kikuyu-tall fescue-Yorkshire fog grassland						**R08/001** (ptQEII)		
Hangehange-harakeke shrubland						**R08/001** (ptQEII)		
Harakeke-kawakawa flaxland						**R08/001** (ptQEII)		
Harakeke-pampas flaxland						**R08/001** (ptQEII)		
Kanuka shrubland						**Q08/226** (ptQEII, RR,LP) **R08/001** (ptQEII)		
Manuka shrubland						**Q07/124** (ptSR)		
Rocky outcrop and cliff habitat						**R08/001** (ptQEII)		
Kahikatea forest						**R08/001** (ptQEII)		
Kanuka forest						Q07/122* **Q07/124** (ptSR) **R08/001** (ptQEII) Q08/225i (ptSR)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Coastal Hill Vegetation (continued)								
Kanuka forest (*continued*)								
Kanuka treeland								
Kanuka-puriri treeland								
Kanuka-puriri-pohutukawa forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Kanuka-tanekaha forest								**R08/002**
Kanuka-tawa forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Kanuka-totara forest						R08/001 (ptQEII)		R08/001 (ptQEII)
Kanuka-totara treeland						R08/001 (ptQEII)		R08/001 (ptQEII)
Karaka-nikau-kanuka forest								
Kauri-kanuka forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Nikau forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Nikau-karaka-pohutukawa-mahoe treeland						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Pohutukawa forest					**Q07/130** (ptMS,SL, RR,WR)	**R08/001** (ptQEII)		**R08/001** (ptQEII)
Pohutukawa treeland					**Q08/228** (ptMS,GP, RR,WR)			
Pohutukawa-rimu forest								
Puriri forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Puriri-rewarewa-pohutukawa forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Taraire forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Taraire-puriri forest								**Q08/225i** (ptSR)
Taraire-totara-puriri forest						**R08/001** (ptQEII)		**R08/001** (ptQEII)
Totara forest								
Totara treeland								

GEOL. GROUP:	I	J	K	L	M	N	O	P
Coastal Hill Vegetation (continued)								
Kanuka forest (*continued*)						Q08/225g (ptQEII, SR,RR,LP) Q08/226 (ptQEII, RR, LP)		
Kanuka treeland						Q07/122*		
Kanuka-puriri treeland						**Q07/124** (ptSR)		
Kanuka-puriri-pohutukawa forest						**R08/001** (ptQEII)		
Kanuka-tanekaha forest								
Kanuka-tawa forest						**R08/001** (ptQEII)		
Kanuka-totara forest						R08/001 (ptQEII)		
Kanuka-totara treeland						R08/001 (ptQEII)		
Karaka-nikau-kanuka forest						**Q07/124** (ptSR)		
Kauri-kanuka forest						**Q07/124** (ptSR) **R08/001** (ptQEII)		
Nikau forest						**R08/001** (ptQEII)		
Nikau-karaka-pohutukawa-mahoe treeland						**R08/001** (ptQEII)		
Pohutukawa forest				**Q08/226** (ptQEII, RR, LP)		**Q08/226** (ptQEII, RR,LP) **R08/001** (ptQEII)		
Pohutukawa treeland				**Q08/226** (ptQEII, RR,LP)		**Q08/226** (ptQEII, RR,LP)		
Pohutukawa-rimu forest						**Q08/226** (ptQEII, RR,LP)		
Puriri forest						**R08/001** (ptQEII)		
Puriri-rewarewa-pohutukawa forest						**R08/001** (ptQEII)		
Taraire forest						**R08/001** (ptQEII)		
Taraire-puriri forest								
Taraire-totara-puriri forest						**R08/001** (ptQEII)		
Totara forest						**Q07/124** (ptSR) Q07/127 (ptSL,WR)		
Totara treeland						Q07/127 (ptSL,WR)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Coastal Hill Vegetation (continued)								
Totara-pohutukawa forest					Q07/130 (ptMS,SL, RR,WR)			
Totara-puriri forest								
Inland Hill Vegetation								
Bracken-tangle fern fernland								**Q07/137**
Kanuka shrubland								Q07/117 (ptQEII,SR) **Q07/121** (ptQEII,SL, SR,LP) Q08/239
Kanuka-manuka shrubland								**Q08/220** (ptMS,SL) Q08/237
Mahoe-kanuka shrubland								**Q07/121** (ptQEII,SL, SR,LP)
Mahoe-totara-kohuhu shrubland								**Q07/112**
Mamaku-kanuka-gorse shrubland								
Mamaku-mahoe shrubland								**Q08/220** (ptMS,SL)
Mamaku-mahoe-kanuka-hangehange shrubland								
Mamaku-pate shrubland								
Mamaku-ponga shrubland								**Q08/225e** (ptMS,SR)
Manuka shrubland								Q07/116 (ptSR) Q07/160* **Q08/220** (ptMS,SL) Q08/221 Q08/222 (ptQEII,MS, SL,SR,LP)
Manuka-gorse-kanuka shrubland								
Manuka-kanuka shrubland							Q07/135	Q07/135 Q08/224
Manuka-kanuka-ponga shrubland								**Q07/158**
Manuka-ponga shrubland								
Mapou-manuka shrubland								**Q08/220** (ptMS,SL)
Mapou-mingimingi-ponga shrubland								**Q08/220** (ptMS,SL)
Pate-mamaku shrubland								

GEOL. GROUP:	I	J	K	L	M	N	O	P
Coastal Hill Vegetation (continued)								
Totara-pohutukawa forest								
Totara-puriri forest						**Q07/124** (ptSR)		
Inland Hill Vegetation								
Bracken-tangle fern fernland								
Kanuka shrubland				Q07/117 (ptQEII,SR) Q08/239		Q07/117 (ptQEII,SR) **Q07/121** (ptQEII,SL, SR,LP) Q07/139		
Kanuka-manuka shrubland					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL) Q08/225a (ptLP) Q08/237		
Mahoe-kanuka shrubland						**Q07/121** (ptQEII,SL, SR,LP)		
Mahoe-totara-kohuhu shrubland								
Mamaku-kanuka-gorse shrubland						Q08/225a (ptLP)		
Mamaku-mahoe shrubland					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL)		
Mamaku-mahoe-kanuka-hangehange shrubland						**Q08/225h** (ptQEII,SR)		
Mamaku-pate shrubland						**Q08/225c** (ptLP)		
Mamaku-ponga shrubland						**Q08/225e** (ptMS,SR)		
Manuka shrubland		Q07/147 **Q07/150**			**Q08/220** (ptMS,SL)	Q07/116 (ptSR) **Q08/220** (ptMS,SL) Q08/221 Q08/222 (ptQEII,MS, SL,SR,LP)		
Manuka-gorse-kanuka shrubland						Q07/139		
Manuka-kanuka shrubland						Q07/135 Q08/224 **Q08/225j** (ptSR)		
Manuka-kanuka-ponga shrubland								
Manuka-ponga shrubland		Q07/147						
Mapou-manuka shrubland					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL)		
Mapou-mingimingi-ponga shrubland					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL)		
Pate-mamaku shrubland						**Q08/225a** (ptLP)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Hill Vegetation (continued)								
Pate-ti kouka shrubland								**Q07/121** (ptQEII,SL, SR,LP)
Totara-kanuka shrubland								
Rockland							**Q07/132**	
Kahikatea forest							**Q07/113** Q07/120	**Q07/112** **Q07/113** Q07/120 Q07/160* Q08/240
Kahikatea treeland								
Kahikatea-pukatea forest								**Q07/112**
Kahikatea-puriri forest								Q08/225d (ptQEII)
Kahikatea-rimu-totara forest								
Kahikatea-rimu-totara treeland								Q08/227*
Kahikatea-totara forest							**Q07/148**	**Q07/121** (ptQEII,SL, SR,LP) Q07/148 Q07/153*
Kahikatea-totara treeland								
Kanuka forest							Q07/120	Q07/137 Q07/116 (ptSR) **Q07/117** (ptQEII,SR) Q07/118 (ptSR) Q07/120 **Q07/121** (ptQEII,SL, SR,LP) Q07/158 **Q08/220** (ptMS,SL) Q08/221 Q08/223 Q08/224 Q08/229* Q08/225e (ptMS,SR) **Q08/225g** (ptQEII,SR, RR,LP) Q08/227* Q08/237 **Q08/239**
Kanuka-kahikatea forest								**Q07/114**
Kanuka-kauri forest								Q08/225g (ptQEII,SR, RR,LP)

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Hill Vegetation (continued)								
Pate-ti kouka shrubland						**Q07/121** (ptQEII,SL, SR,LP)		
Totara-kanuka shrubland						**Q07/139**		
Rockland								
Kahikatea forest		Q07/147		Q07/120		Q07/120	**Q07/113** **Q08/225a** (ptLP)	
Kahikatea treeland						Q07/127 (ptSL,WR)		
Kahikatea-pukatea forest								
Kahikatea-puriri forest						Q08/225d (ptQEII)		
Kahikatea-rimu-totara forest		Q07/150						
Kahikatea-rimu-totara treeland								
Kahikatea-totara forest	**Q07/149**		**Q07/148**			Q07/121 (ptQEII,SL, SR,LP) Q07/153*		
Kahikatea-totara treeland		Q07/150						
Kanuka forest		**Q07/150** Q07/147		**Q07/117** (ptQEII,SR) Q07/118 (ptSR) Q07/120 **Q08/225g** (ptQEII,SR, RR,LP) **Q08/239**	**Q08/220** (ptMS,SL)	Q07/166* Q07/116 (ptSR) **Q07/117** (ptQEII,SR) Q07/118 (ptSR) Q07/120 **Q07/121** (ptQEII,SL, SR,LP) **Q08/220** (ptMS,SL) Q08/221 Q08/224 Q08/225a (ptLP) Q08/225b (ptQEII,SR) Q08/225e (ptMS,SR) Q08/225f Q08/225h (ptQEII,SR) **Q08/225g** (ptQEII,SR, RR,LP) Q08/225c (ptLP) Q08/237		
Kanuka-kahikatea forest						**Q07/114**		
Kanuka-kauri forest				Q08/225g (ptQEII,SR, RR,LP)		Q08/225g (ptQEII,SR, RR,LP)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Hill Vegetation (continued)								
Kanuka-mamaku forest								**Q07/117** (ptQEII,SR) **Q07/121** (ptQEII,SL, SR,LP) **Q08/222** (ptQEII,MS, SL,SR,LP) Q08/225e (ptMS,SR) Q08/225g (ptQEII,SR, RR,LP) Q08/239 Q08/241
Kanuka-mamaku-puriri forest								Q08/225e (ptMS,SR)
Kanuka-rewarewa forest								**Q07/117** (ptQEII,SR)
Kanuka-rimu forest								Q08/221 **Q08/222** (ptQEII,MS, SL,SR,LP) Q08/225g (ptQEII,SR, RR,LP)
Kanuka-rimu-tanekaha forest								**Q07/121** (ptQEII,SL, SR,LP) Q08/225d (ptQEII) Q08/225g (ptQEII,SR, RR,LP)
Kanuka-rimu-tanekaha-kauri forest								**Q07/117** (ptQEII,SR)
Kanuka-tanekaha forest								**Q08/222** (ptQEII,MS, SL,SR,LP) Q08/224
Kanuka-tanekaha-kauri forest								
Kanuka-tanekaha-rewarewa forest								**Q08/222** (ptQEII,MS, SL,SR,LP)
Kanuka-totara forest								Q07/114 **Q07/116** (ptSR) Q08/225e (ptMS,SR)
Kanuka-totara treeland								Q08/223
Kanuka-totara-mamaku forest							Q07/113	Q07/113
Kanuka-towai forest								**Q07/116** (ptSR)

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Hill Vegetation (continued)								
Kanuka-mamaku forest				**Q07/117** (ptQEII,SR) Q08/225g (ptQEII,SR, RR,LP) Q08/239		**Q07/117** (ptQEII,SR) **Q07/121** (ptQEII,SL, SR,LP) Q07/166* **Q08/222** (ptQEII,MS, SL,SR,LP) **Q08/225e** (ptMS,SR) **Q08/225g** (ptQEII,SR, RR,LP)		
Kanuka-mamaku-puriri forest						Q08/225e (ptMS,SR)		
Kanuka-rewarewa forest				**Q07/117** (ptQEII,SR)		**Q07/117** (ptQEII,SR)		
Kanuka-rimu forest				Q08/225g (ptQEII,SR, RR,LP)		Q08/221 **Q08/222** (ptQEII,MS, SL, SR,LP) Q08/225g (ptQEII,SR, RR,LP)		
Kanuka-rimu-tanekaha forest				Q08/225g (ptQEII,SR, RR,LP)		**Q07/121** (ptQEII,SL, SR,LP) Q08/225d (ptQEII)		
Kanuka-rimu-tanekaha-kauri forest				**Q07/117** (ptQEII,SR)		**Q07/117** (ptQEII,SR)		
Kanuka-tanekaha forest						**Q08/222** (ptQEII,MS, SL,SR,LP) Q08/224		
Kanuka-tanekaha-kauri forest						**Q08/225j** (ptSR)		
Kanuka-tanekaha-rewarewa forest						**Q08/222** (ptQEII,MS, SL, SR,LP)		
Kanuka-totara forest		Q07/147 **Q07/150**				Q07/114 **Q07/116** (ptSR) Q08/225e (ptMS,SR)		
Kanuka-totara treeland								
Kanuka-totara-mamaku forest						Q07/113		
Kanuka-towai forest						**Q07/116** (ptSR)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Hill Vegetation (continued)								
Kauri forest								Q07/116 (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q07/162 Q08/222 (ptQEII,MS, SL,SR,LP) Q08/225d (ptQEII) Q08/225e (ptMS,SR)
Kauri-kanuka forest								**Q07/117** (ptQEII,SR) Q07/118 (ptSR) **Q08/220** (ptMS,SL)
Kauri-kanuka-rimu forest								Q08/243*
Kauri-rimu forest							Q07/120 **Q07/135**	Q07/120 **Q07/121** (ptQEII,SL, SR,LP) **Q07/135** Q08/225d (ptQEII)
Kauri-tanekaha forest								**Q08/222** (ptQEII,MS, SL,SR,LP)
Kauri-tanekaha-rimu-kanuka forest								
Kohekohe forest								**Q08/224**
Kohuhu forest								
Mahoe-mamaku forest								**Q08/222** (ptQEII,MS, SL,SR,LP)
Mamaku forest								**Q08/220** (ptMS,SL) **Q08/221** Q08/238
Mamaku-mahoe forest								**Q07/114**
Mamaku-mapou forest								**Q08/222** (ptQEII,MS, SL,SR,LP)

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Hill Vegetation (continued)								
Kauri forest		**Q07/150**				Q07/116 (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q08/222 (ptQEII,MS, SL,SR,LP) **Q08/225b** (ptQEII,SR) Q08/225e (ptMS,SR)		
Kauri-kanuka forest				**Q07/117** (ptQEII,SR) Q07/118 (ptSR)	**Q08/220** (ptMS,SL)	**Q07/117** (ptQEII,SR) Q07/118 (ptSR) **Q08/220** (ptMS,SL) Q08/225h (ptQEII,SR)		
Kauri-kanuka-rimu forest								
Kauri-rimu forest				Q07/120		Q07/120 **Q07/121** (ptQEII,SL, SR,LP) **Q07/135** Q08/225d (ptQEII) Q08/225c (ptLP)		
Kauri-tanekaha forest						**Q08/222** (ptQEII,MS, SL,SR,LP) Q08/225h (ptQEII,SR)		
Kauri-tanekaha-rimu-kanuka forest						**Q08/225b** (ptQEII,SR)		
Kohekohe forest						**Q08/224** **Q08/225c** (ptLP)		
Kohuhu forest						**Q08/225c** (ptLP)		
Mahoe-mamaku forest						**Q08/222** (ptQEII,MS, SL,SR,LP)		
Mamaku forest					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL) **Q08/221** Q08/225a (ptLP) Q08/225h (ptQEII,SR)		
Mamaku-mahoe forest						**Q07/114**		
Mamaku-mapou forest						**Q08/222** (ptQEII,MS, SL,SR,LP)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Hill Vegetation (continued)								
Mamaku-rewarewa forest								**Q08/240**
Mapou-mamaku forest								
Mapou-ponga-mamaku forest								
Miro-tawa-rewarewa forest								
Nikau forest							**Q07/120**	**Q07/120**
Nikau-mamaku forest								
Nikau-ponga forest								**Q07/121** (ptQEII,SL, SR,LP)
Nikau-rewarewa forest								
Ponga-nikau forest								Q07/153*
Ponga-nikau treeland								Q07/153*
Pukatea-kahikatea-totara forest								Q07/153*
Puriri forest								**Q07/117** (ptQEII,SR)
Puriri-nikau forest								**Q08/225e** (ptMS,SR)
Puriri-taraire-rewarewa-totara-nikau-mamaku forest								
Rewarewa-mamaku-tarata forest								
Rewarewa-tanekaha forest								
Rimu forest								**Q08/220** (ptMS,SL) Q08/245* Q08/227*
Rimu-kanuka forest								**Q08/237**
Rimu-kauri-kanuka forest								**Q08/239**
Rimu-rewarewa-tanekaha forest								
Rimu-tanekaha forest							Q07/120	**Q07/117** (ptQEII,SR) Q07/120
Rimu-totara-kanuka forest								
Tanekaha forest								**Q08/220** (ptMS,SL) **Q08/224** Q08/241
Tanekaha-kanuka forest								**Q07/117** (ptQEII,SR) **Q07/121** (ptQEII,SL, SR,LP)

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Hill Vegetation (continued)								
Mamaku-rewarewa forest								
Mapou-mamaku forest						**Q08/225a** (ptLP)		
Mapou-ponga-mamaku forest						**Q08/225a** (ptLP)		
Miro-tawa-rewarewa forest						**Q08/225c** (ptLP)		
Nikau forest				**Q07/120**		**Q07/120**		
Nikau-mamaku forest						**Q08/225c** (ptLP)		
Nikau-ponga forest						**Q07/121** (ptQEII,SL, SR,LP)		
Nikau-rewarewa forest						**Q08/225f**		
Ponga-nikau forest						Q07/153*		
Ponga-nikau treeland						Q07/153*		
Pukatea-kahikatea-totara forest						Q07/153*		
Puriri forest				**Q07/117** (ptQEII,SR)		**Q07/117** (ptQEII,SR) Q08/225h (ptQEII,SR)		
Puriri-nikau forest						**Q08/225e** (ptMS,SR)		
Puriri-taraire-rewarewa-totara-nikau-mamaku forest						**Q08/225h** (ptQEII,SR)		
Rewarewa-mamaku-tarata forest						**Q08/225c** (ptLP)		
Rewarewa-tanekaha forest						**Q08/225f**		
Rimu forest					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL) **Q08/225b** (ptQEII,SR)		
Rimu-kanuka forest						**Q08/225f** **Q08/237**		
Rimu-kauri-kanuka forest				**Q08/239**				
Rimu-rewarewa-tanekaha forest						**Q08/225a** (ptLP)		
Rimu-tanekaha forest				**Q07/117** (ptQEII,SR) Q07/120		**Q07/117** (ptQEII,SR) Q07/120		
Rimu-totara-kanuka forest						**Q08/225c** (ptLP)		
Tanekaha forest					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL) Q08/224 Q08/225b (ptQEII,SR)		
Tanekaha-kanuka forest				**Q07/117** (ptQEII,SR)		**Q07/117** (ptQEII,SR) **Q07/121** (ptQEII,SL, SR,LP)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Hill Vegetation (continued)								
Tanekaha-kanuka forest (*continued*)								
Tanekaha-rewarewa forest								**Q08/225e** (ptMS,SR) **Q08/236**
Tanekaha-rewarewa-kanuka forest								
Taraire forest							Q07/120 Q07/132	**Q07/112** Q07/114 **Q07/117** (ptQEII,SR) Q07/120 **Q07/121** (ptQEII,SL, SR,LP) **Q08/220** (ptMS,SL) Q08/222 (ptQEII,MS, SL,SR,LP) Q08/224 Q08/236 Q08/237
Taraire-kahikatea forest								**Q07/112** Q07/156*
Taraire-kanuka forest								
Taraire-mamaku-rimu-rewarewa-totara forest								**Q08/220** (ptMS,SL)
Taraire-nikau forest								
Taraire-puriri forest								Q08/225d (ptQEII) **Q08/225g** (ptQEII,SR, RR,LP)
Taraire-tawa forest								
Taraire-tawa-rewarewa-mamaku forest								
Taraire-totara forest								**Q07/121** (ptQEII,SL, SR,LP) **Q08/220** (ptMS,SL)
Taraire-totara-rimu forest								
Tawa-nikau forest								
Tawa-rewarewa-mamaku-ponga-nikau-kohekohe forest								

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Hill Vegetation (continued)								
Tanekaha-kanuka forest (*continued*)					Q08/225h (ptQEII,SR)	Q08/225a (ptLP)		
Tanekaha-rewarewa forest						**Q08/225e** (ptMS,SR)		
Tanekaha-rewarewa-kanuka forest						**Q08/225a** (ptLP)		
Taraire forest				**Q07/117** (ptQEII,SR) Q07/120	**Q08/220** (ptMS,SL)	Q07/114 **Q07/117** (ptQEII,SR) Q07/120 **Q07/121** (ptQEII,SL, SR,LP) **Q08/220** (ptMS,SL) Q08/222 (ptQEII,MS, SL,SR,LP) Q08/224 Q08/225c (ptLP) Q08/237		
Taraire-kahikatea forest								
Taraire-kanuka forest						**Q08/225a** (ptLP)		
Taraire-mamaku-rimu-rewarewa-totara forest					**Q08/220** (ptMS,SL)	**Q08/220** (ptMS,SL)		
Taraire-nikau forest						**Q08/225b** (ptQEII,SR)		
Taraire-puriri forest				**Q08/225g** (ptQEII,SR, RR,LP)		Q08/225d (ptQEII) **Q08/225h** (ptQEII,SR) **Q08/225g** (ptQEII,SR, RR,LP)		
Taraire-tawa forest						**Q08/225a** (ptLP)		
Taraire-tawa-rewarewa-mamaku forest						**Q08/225a** (ptLP)		
Taraire-totara forest					**Q08/220** (ptMS,SL)	**Q07/121** (ptQEII,SL, SR,LP) **Q08/220** (ptMS,SL)		
Taraire-totara-rimu forest						**Q08/225b** (ptQEII,SR)		
Tawa-nikau forest						**Q08/225c** (ptLP)		
Tawa-rewarewa-mamaku-ponga-nikau-kohekohe forest						**Q08/225h** (ptQEII,SR)		

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Hill Vegetation (continued)								
Tawa-taraire forest								
Ti kouka-putaputaweta-manuka shrubland								**Q08/221**
Totara forest							Q07/113 Q07/135	Q07/112 Q07/113 Q07/115 Q07/117 (ptQEII,SR) **Q07/118** (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q07/135 Q07/140* Q07/153* Q07/156* Q07/157* Q07/160* **Q08/220** (ptMS,SL) Q08/222 (ptQEII,MS, SL,SR,LP) Q08/225g (ptQEII,SR, RR,LP) Q08/245*
Totara treeland							Q07/113 Q07/135	Q07/113 Q07/118 (ptSR) Q07/118 (ptSR) Q07/135 Q08/245*
Totara-hawthorn forest								Q07/118 (ptSR)
Totara-kahikatea forest								Q07/112 Q07/134 Q07/155 Q07/159* **Q08/221** Q08/231
Totara-kahikatea-kanuka forest								**Q07/114**
Totara-kahikatea-taraire forest								Q07/112
Totara-kanuka forest							Q07/120 Q07/135	Q07/120 Q07/135 Q07/155 Q07/162 Q08/225g (ptQEII,SR, RR,LP)
Totara-kanuka treeland							Q07/120	Q07/120
Totara-kanuka-kahikatea forest								
Totara-kanuka-mamaku forest								Q07/157*

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Hill Vegetation (continued)								
Tawa-taraire forest						**Q08/225c** (ptLP)		
Ti kouka-putaputaweta-manuka shrubland						**Q08/221**		
Totara forest		Q07/147 **Q07/150** Q07/151*	Q07/133* Q07/146*	Q07/117 (ptQEII,SR) **Q07/118** (ptSR) Q08/225g (ptQEII,SR, RR,LP)	**Q08/220** (ptMS,SL)	Q07/113 Q07/117 (ptQEII,SR) **Q07/118** (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q07/135 Q07/139 Q07/153* Q07/166* **Q08/220** (ptMS,SL) Q08/222 (ptQEII,MS, SL,SR,LP) Q08/225b (ptQEII,SR) Q08/225g (ptQEII,SR, RR,LP) Q08/225c (ptLP)		
Totara treeland				Q07/118 (ptSR)		Q07/113 Q07/118 (ptSR) Q07/135		
Totara-hawthorn forest				Q07/118 (ptSR)		Q07/118 (ptSR)		
Totara-kahikatea forest						**Q08/221**		
Totara-kahikatea-kanuka forest						**Q07/114**		
Totara-kahikatea-taraire forest						**Q07/139**		
Totara-kanuka forest		Q07/147		Q07/120 Q08/225g (ptQEII,SR, RR,LP)		Q07/120 Q07/135 Q08/225g (ptQEII,SR, RR,LP)		
Totara-kanuka treeland				Q07/120		Q07/120		
Totara-kanuka-kahikatea forest		**Q07/150**						
Totara-kanuka-mamaku forest								

GEOL. GROUP:	A	B	C	D	E	F	G	H
Inland Hill Vegetation (continued)								
Totara-kauri-kanuka forest								
Totara-mamaku forest								Q07/118 (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q07/160* Q08/221
Totara-mamaku-puriri forest								
Totara-puriri-kanuka forest								
Totara-radiata pine forest								Q07/153*
Totara-rewarewa forest								**Q07/121** (ptQEII,SL, SR,LP)
Totara-rewarewa-taraire forest								**Q08/240**
Totara-rimu forest								
Totara-tanekaha-rewarewa forest								
Totara-taraire forest								**Q07/117** (ptQEII,SR) **Q07/118** (ptSR) Q07/156* **Q08/241**
Totara-taraire-kanuka forest								**Q07/162**
Towai forest								**Q07/116** (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q07/153 **Q08/220** (ptMS,SL)
Towai-mamaku forest								**Q08/240**
Unknown forest type								
Unknown forest type								
Unknown forest type								**Q08/241**

GEOL. GROUP:	I	J	K	L	M	N	O	P
Inland Hill Vegetation (continued)								
Totara-kauri-kanuka forest						Q08/225c (ptLP)		
Totara-mamaku forest				Q07/118 (ptSR)		Q07/118 (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q08/221		
Totara-mamaku-puriri forest						Q08/225c (ptLP)		
Totara-puriri-kanuka forest			Q08/232					
Totara-radiata pine forest						Q07/153*		
Totara-rewarewa forest						**Q07/121** (ptQEII,SL, SR,LP)		
Totara-rewarewa-taraire forest								
Totara-rimu forest	**Q07/149**							
Totara-tanekaha-rewarewa forest						**Q08/225h** (ptQEII,SR)		
Totara-taraire forest				Q07/117 (ptQEII,SR) **Q07/118** (ptSR)		**Q07/117** (ptQEII,SR) **Q07/118** (ptSR)		
Totara-taraire-kanuka forest								
Towai forest					**Q08/220** (ptMS,SL)	**Q07/116** (ptSR) **Q07/121** (ptQEII,SL, SR,LP) Q07/153 **Q08/220** (ptMS,SL)		
Towai-mamaku forest								
Unknown forest type						**Q08/225b** (ptQEII,SR)		
Unknown forest type						**Q08/225f**		
Unknown forest type								

TABLE 3: SUMMARY OF SITE EVALUATIONS.

e.u.= ecological unit, reg.sig.= regionally significant

LEVEL 1 SITES Survey no.	REPRESENT-ATIVENESS*	RARITY†/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Ruarangi Road Forest Remnants 1 Q07/112	Rep.site for 5 e.u.s	Fauna: 2 threatened	9 e.u.s	Diverse, healthy canopy; established understorey in remnants that are fenced; mature, emergent podocarps; minimal weed infestation	Riparian protection	58.8 ha, 15 small remnants
Takatearea Stream Forest Q07/113	Rep.site for 2 e.u.s	Forest on alluvium	5 e.u.s	Highly disturbed and grazed; several weed infestations; broken into many separate remnants, therefore strong edge effects	Partial catchment protection	105.5 ha, 17 small remnants with convoluted edges
Pokapu Hill Forest Remnants Q07/114	Rep.site for 3 e.u.s	Flora: 1 threatened Fauna: 2 threatened	5 e.u.s	Diverse, healthy canopy; established understorey in parts that are fenced; minimal weed infestation	Riparian protection	82.8 ha, 1 large and 5 small remnants
Mangapai Caves Rd Forest and Shrubland Q07/116	Rep.site for 2 e.u.s	Flora: 1 threatened Fauna: 2 threatened	7 e.u.s	Diverse, healthy canopy; established understorey in parts that are fenced; minimal weed infestation	Catchment protection	271.3 ha, 2 large and 2 small remnants
North River Forest Q07/117	Rep.site for 9 e.u.s	Limestone geology; Flora: 4 threatened, 5 reg.sig. Fauna: 5 threatened, 2 reg.sig.	13 e.u.s	Large, continuous secondary forest area with diverse, healthy canopy; domestic stock and feral goat impacts in understorey; moderate recreational use; piecemeal clearance near summit and around edges	Near Q07/120 and Q08/239; catchment and riparian protection	960.3 ha, 2 large remnants divided by a track and 7 small remnants
Waipu Caves Forest Q07/118	Rep.site for 2 e.u.s	Limestone geology; Flora: 1 threatened, 2 reg.sig. Fauna: 4 threatened	7 e.u.s	Large, continuous forest area; diverse, healthy canopy; some ancient emergent podocarps; severe stock impacts in understorey around limestone areas	Near Q07/120 and Q07/117; catchment and riparian protection	370.8 ha, 2 large remnants divided by a road and 3 small remnants
Ruakaka River Forest Remnants Q07/119	Rep.site for 2 e.u.s	Forest on alluvium; Flora: 1 reg.sig. Fauna: 4 threatened	2 e.u.s	Highly fragmented, disturbed and weed-infested lowland floodplain forest remnants spread over a wide area in a catchment largely cleared of original vegetation	Ecological linkage between Q07/124, Q07/121 and Q07/116	104.3 ha, 39 small, narrow remnants, sometimes widely separated
Caves Road Forest Q07/120	Rep.site for 1 e.u.	Limestone geology; northernmost Hochstetter's frogs; Flora: 1 reg.sig. Fauna 3 threatened, 1 reg.sig.	9 e.u.s	Highly disturbed and grazed forest remnants, though species and habitat diversity is moderate to high; weed infestations from contiguous residential areas; planting of non-ecosourced indigenous plant species	Near Q07/117, Q07/135 and Q07/118; riparian protection	171.9 ha, 1 major tract in west and 8 smaller remnants

* Note that most sites have more than one ecological unit present. This column indicates whether or not the site has been selected as being a representative site for one or more ecological units.

† The rapid quantitative method used in this survey did not cover survey for rare species; in most cases species information in this column has been collated from other databases. It is likely that specific species surveys for all sites would reveal additional data on threatened and rare species, and in the case of Level 2 sites, a change in ranking.

LEVEL 1 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Ruakaka Forest Q07/121	Rep.site for 17 e.u.s	Flora: 4 reg.sig. Fauna: 5 threatened, 2 reg.sig.	18 e.u.s	Very large (for the ED) and diverse secondary forest area; disturbance on edges; browsers, pigs and livestock all have negative impacts	Catchment protection, especially for Ruakaka River (Q07/119)	1699.3 ha, 2 major remnants and 17 smaller peripheral remnants
Takahiwai Forest Q07/124	Rep.site for 7 e.u.s	Flora: 5 reg.sig. Fauna: 3 threatened, 2 reg.sig.	9 e.u.s	Large, compact area of secondary forest; older broadleaf forest in gullies; some edges grazed with sparse canopy	Riparian protection	641.2 ha, 1 major and 10 smaller peripheral remnants
Tauroa Floodplain Forest Remnants Q07/125	Rep.site for 1 e.u.	Forest on alluvium	1 e.u.	One remnant fenced and in good condition; other remnant unfenced, sparse treeland, grazed, lacking regeneration	Near Q07/119; part of corridor along Ruakaka River	4.8 ha, 2 remnants 1 km apart
Mountfield Rd Wetlands Q07/126	Rep.site for 1 e.u.	Fauna: 2 threatened	3 e.u.s	Two constructed ponds and two semi-natural gully wetlands with fringing indigenous vegetation; grazing and weed infestations; threatened birds not recorded for 19 years	Near a large forested site, Ruakaka Forest Q07/121	2.3 ha, 4 remnants
Doctor's Hill Rd Wetland Q07/127	Rep.site for 4 e.u.s	Fauna: 4 threatened	8 e.u.s	Largest natural wetland remaining in ED; fragmented, modified, extensively weed-infested, but provides habitat for threatened bird species	Near Q07/121 and contiguous with Q07/128 and Q07/130	23.2 ha, 8 relatively narrow remnants
Ruakaka Dunelands Q07/128	Rep.site for 8 e.u.s	Flora: 3 threatened, 1 reg.sig. Fauna: 5 threatened, 2 reg.sig.	19 e.u.s	Largest duneland site in Waipu ED (includes all undeveloped duneland north of Waipu River); mostly exotic vegetation, but a high diversity of indigenous species is included; high human, animal pest and vehicle disturbance	Buffer between sea and land; international migrant wader site; near to or linked with several coastal wetlands, e.g. Q07/131, Q07/141,Q07/127, Q07/130; contiguous with Q08/228; relatively isolated from large forested areas	723.3 ha, 2 major continuous stretches varying from 800 m to 30 m wide plus 4 smaller remnants
Ruakaka Racecourse Dune Lake Q07/129	Rep.site for 5 e.u.s	Only dune lake in ED. Flora: 1 reg.sig. Fauna: 7 threatened, 3 reg.sig.	6 e.u.s	Dune lake surrounded by gorse scrub and rank pasture; horse grazing and earth-moving disturbance down to margins; probably infilling of northern area in recent times; weed infestation (alligator weed) and apparent poor water quality	Near Q07/128 and Q07/130	4.0 ha, 2 remnants
Ruakaka River Estuary Q07/130	Rep.site for 11 e.u.s	Flora: 2 threatened, 1 reg.sig. Fauna: 16 threatened, 2 reg.sig.	13 e.u.s	Estuarine margins, raised islands and coastal scarp have multiple weed infestations but fully inundated habitats in better condition; high human and animal pest disturbance	Contiguous with Q07/128	83.5 ha, major area is estuary (77.6 ha) with 4 small peripheral forest remnants
McEwan Road Wetland Q07/131	Rep.site for 5 e.u.s	Flora: 2 reg.sig. Fauna: 1 threatened	7 e.u.s	Very small natural dune slack wetland surrounded by pasture and roads; weed infestations on margins mainly	Relatively isolated, but part of wetland bird habitat network including Q07/131, Q07/141, Q07/127, Q07/129, Q07/130 and Q07/164	0.7 ha compact area

LEVEL 1 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Waipu Caves Road Sandstone Knoll Q07/132	Rep.site for 1 e.u.	Flora: 2 reg.sig. Fauna not surveyed	2 e.u.s	Very small knoll and adjoining cliff face; grazed and trampled by stock	Isolated	2.4 ha forest remnant with narrow extension of sandstone cliff adjacent
Ormiston Road Forest and Shrubland Q07/135	Rep.site for 1 e.u.	Fauna: 1 threatened	5 e.u.s	Medium-sized, mostly un-fenced secondary forest remnants; possums regularly poisoned in one remnant, but feral cats, weasels, cattle, and goats present throughout	Links Q07/121, Q07/118 and Q07/120	31.6 ha, 3 remnants
McDonnell Road Forest and Shrubland Q07/137	Rep.site for 1 e.u.	Fauna: 2 threatened	2 e.u.s	Fenced and regenerating; minimal weed infestation	Riparian protection; near Q07/116 and Q07/162	3.4 ha, 2 remnants
Upper Mangawai River Wetlands Q07/138	Rep.site for 2 e.u.s	Flora: 1 reg.sig.	3 e.u.s	Two wetland patches dominated by harakeke and kahikatea; second largest natural freshwater wetland in ED; several weed infestations; not fully fenced	Isolated	6.8 ha, 2 remnants
Eastern Mangawai Catchment Q07/139	Rep.site for 2 e.u.s		5 e.u.s	Mosaic of regenerating forest and shrubland with a lot of surrounding gorse; appears grazed	Catchment protection; near Q07/117 and Q08/245; probably contribute to habitat network for mobile spp	117.6 ha, 1 large and 4 smaller remnants
Sime Road Wetland Q07/141	Rep.site for 3 e.u.s	Fauna: 1 threatened	6 e.u.s	Very small natural dune slack wetland surrounded by pasture and roads; some invasive weeds, but these are not dominant	Near Q07/128	0.7 ha
Takahiwai Stream Estuary Q07/143	Rep.site for 3 e.u.s	Fauna: 2 threatened	3 e.u.s	Contains complete transition from terrestrial to estuarine vegetation; no grazing; some weed infestation	Protective buffer to coastal fringe; contiguous with extensive Takahiwai tidal flats	11.1 ha, 1 larger central part and 2 smaller peripheral remnants
Blacksmith's Creek Estuary Q07/144	Rep.site for 4 e.u.s	Flora: 1 reg.sig. Fauna: 2 threatened	3 e.u.s	Diverse mosaic of estuarine and terrestrial vegetation; weed invasion on margins; increasingly urbanised surrounds; dumping of garden refuse; disturbance by dogs	Protective buffer to coastal fringe; contiguous with Marsden Bay tidal flats	22.0 ha, 2 remnants (one very tiny and peripheral)
Tauraroa River Forest Remnants Q07/145	Rep.site for 2 e.u.s	Forest on alluvium; Flora: 1 reg.sig.	5 e.u.s	Heavily grazed with no understorey, or fenced with understorey of harakeke	Isolated	1.2 ha, 5 remnants
Waiotira Stream Forest Remnants Q07/148	Rep.site for 2 e.u.s	Forest on alluvium; Fauna not surveyed	4 e.u.s	Grazed and disturbed; strong edge effects	Riparian protection	24.7 ha, 19 remnants, small and narrow
Russek Road Natural Area 1 Q07/149	Rep.site for 2 e.u.s	Limestone geology; Fauna not surveyed	2 e.u.s	Sparse understorey; possibly recently fenced		1.9 ha, 1 compact remnant
Russek Road Natural Area 2 Q07/150	Rep.site for 8 e.u.s		10 e.u.s	Diverse canopy; grazed; localised patches with established understorey	Riparian protection	30.3 ha, 14 remnants

LEVEL 1 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Paparoa Road Riparian Forest Remnants Q07/152	Rep.site for 1 e.u.	Forest on alluvium; Flora: 1 reg.sig.	3 e.u.s	Grazed and disturbed; localised weed infestation; strong edge effects	Riparian protection; near Q07/112	5.5 ha, 8 remnants, small and narrow
Ngatoka Forest and Shrubland Q07/158	Rep.site for 1 e.u.	Fauna not surveyed	2 e.u.s	Dense young forest and shrubland; gorse on edges and occasional pines	Riparian protection; each remnant contiguous with pine plantation	30.1 ha, 2 compact remnants
Parry Road Forest Remnants Q07/162		Fauna: 1 threatened	3 e.u.s	Diverse, healthy canopy; weed infestation (tradescantia); understorey present where browsing pressure is light	Riparian protection; provides linkage between Q07/114 and Q07/116	30.9 ha, 8 remnants, long and narrow
Pohuenui River Forest Remnants Q07/163	Rep.site for 1 e.u.	Forest on alluvium; Flora: 1 reg.sig. Fauna not surveyed	4 e.u.s	Grazed and disturbed; strong edge effects; understorey sparse or absent; weed infestation	Riparian protection	49.1, 21 remnants, long and narrow
Northland Port Corporation Ponds Q07/164	Rep.site for 1 e.u.	Fauna: 2 threatened, 1 reg.sig.	3 e.u.s	Recently constructed wetland; dominated by indigenous species; extreme water level fluctuations	Water bird habitat; near Q07/144	3.8 ha
Mareretu Forest Q08/220	Rep.site for 13 e.u.s	Forest on alluvium; Flora: 3 threatened, 5 reg.sig. Fauna: 7 threatened, 2 reg.sig.	14 e.u.s	Large, continuous area of forest; diverse, healthy canopy; areas of mature, emergent podocarps; catchment protection; edges disturbed and grazed	Links many smaller remnants on its periphery; linked by forestry to North River and Smales Road Forest Remnants	2820.3 ha, 1 large continuous remnant and 9 smaller peripheral remnants
Brooks Road Forest and Shrubland Q08/221	Rep.site for 3 e.u.s		6 e.u.s	Mostly grazed; localised weed infestation (gorse)	Riparian protection	168.8 ha, 18 remnants (1 large)
Waipu Gorge Forest Remnants Q08/222	Rep.site for 9 e.u.s	Forest on alluvium; Flora: 3 threatened, 8 reg.sig. Fauna: 7 threatened, 1 reg.sig.	12 e.u.s	Diverse, healthy canopy; emergent podocarps and northern rata; localised weed infestation; some edges grazed and disturbed	Catchment protection; near Q08/237 and Q08/225	544.4 ha, 15 remnants (2 main remnants divided by road and 13 peripheral remnants)
Glenmohr Road Wetland Q08/223	Rep.site for 1 e.u.		4 e.u.s	Long stretches of raupo reedland in stream gully; probably grazed to edges; some damming	Near Q08/225d, but otherwise relatively isolated	9.3 ha, 6 remnants, very long and narrow
Ahuroa Road Forest Remnants Q08/224	Rep.site for 2 e.u.s	Forest on alluvium; Flora: 1 reg.sig.	4 e.u.s	Mostly grazed and disturbed; established understorey on roadsides; localised weed infestation (pampas, gorse, tradescantia, pines)	Riparian protection; contiguous with Q08/220; near Q08/235	198.9 ha, 2 large remnants divided by track and 6 smaller ones on edges
Brynderwyn Hills Forest Complex – Part A Q08/225a	Rep.site for 9 e.u.s	Forest on alluvium; Flora: 2 threatened, 3 reg.sig. Fauna: 4 threatened	16 e.u.s	Very diverse forest and shrubland remnants separated by roads, pine plantations, quarrying and farming operations	Part of a complex mosaic of indigenous forest and pine plantations; catchment protection; near Q08/222	235.5 ha, 7 remnants

LEVEL 1 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Brynderwyn Hills Forest Complex – Part B Q08/225b	Rep.site for 5 e.u.s	Fauna: 2 threatened, 1 reg.sig.	9 e.u.s	Very diverse forest remnants, surrounded by pasture and plantation forest; pigs present	Part of a complex mosaic of indigenous forest and pine plantations; catchment protection	189.1 ha, 1 major and 1 minor remnant
Brynderwyn Hills Forest Complex – Part C Q08/225c	Rep.site for 9 e.u.s	Flora: 2 threatened, 3 reg.sig. Fauna: 4 threatened, 2 reg.sig.	15 e.u.s	Diverse, apparently healthy and relatively remote forested area with some mature forest types	Part of a complex mosaic of indigenous forest and pine plantations; catchment protection	481.9 ha, 1 major central remnant, 3 smaller remnants
Brynderwyn Hills Forest Complex – Part D Q08/225d		Flora: 2 threatened, 4 reg.sig. Fauna: 1 threatened	6 e.u.s	Small, moderately diverse forest remnants surrounded by pasture; formerly trampled by cattle, hence some damage to streams (Hochstetter's frog habitat)	Part of a complex mosaic of indigenous forest and pine plantations; extends into lowlands; catchment protection	56.5 ha, 1 large and 5 small remnants
Brynderwyn Hills Forest Complex – Part E Q08/225e	Rep.site for 3 e.u.s	Flora: 1 threatened, 2 reg.sig. Fauna: 3 threatened, 1 reg.sig.	8 e.u.s	Large area of diverse indigenous forest remnants set in mosaic of pine plantations; some damage from new roads, forest clearance and earthworks; pigs, goats, cattle present	Part of a complex mosaic of indigenous forest and pine plantations	481.3 ha, 12 remnants of various sizes and shapes, some compact, some narrow
Brynderwyn Hills Forest Complex – Part F Q08/225f	Rep.site for 3 e.u.s	Flora: 1 reg.sig. Fauna: 1 threatened, 1 reg.sig.	5 e.u.s	Diverse older secondary forest site contiguous with younger forested sites; probably not grazed	Part of a complex mosaic of indigenous forest and pine plantations	55.3 ha, 2 remnants of equal size divided by narrow road
Brynderwyn Hills Forest Complex – Part G Q08/225g	Rep.site for 2 e.u.s	Flora: 1 threatened, 1 reg.sig. Fauna: 6 threatened, 3 reg.sig.	8 e.u.s	Diverse forest site; many parts younger regeneration than surrounding sites; highly fragmented in lower catchment, with a lot of pasture edge; probably grazed in parts; domestic animals	Part of a complex mosaic of indigenous forest and pine plantations; extends towards coast near Q08/226; catchment protection	837.9 ha, 13 remnants of various sizes spread across catchment
Brynderwyn Hills Forest Complex – Part H Q08/225h	Rep.site for 4 e.u.s	Flora: 2 threatened, 2 reg.sig. Fauna: 4 threatened, 3 reg.sig.	11 e.u.s	Large, diverse, relatively healthy forest and shrub-land mosaic; large-scale pest management in western part over past 4 years; some tall emergent trees; development disturbance in eastern part	Part of a complex mosaic of indigenous forest and pine plantations; catchment protection	796.4 ha, 1 large continuous tract with 3 small peripheral remnants; eastern side penetrated by roads and housing
Brynderwyn Hills Forest Complex – Part I Q08/225i	Rep.site for 1 e.u.	Flora: 2 reg.sig. Fauna: 1 threatened	2 e.u.s	Diverse, high-quality forest remnant with dense under-storey; mostly protected therefore probably not grazed	Part of a complex mosaic of indigenous forest and pine plantations; near R08/001	73.5 ha, 2 remnants on either side of road
Brynderwyn Hills Forest Complex – Part J Q08/225j	Rep.site for 2 e.u.s	Flora: 3 reg.sig. Fauna: 3 threatened, 1 reg.sig.	2 e.u.s	Diverse, high-quality forest and shrubland; some older secondary forest; probably not grazed	Part of a complex mosaic of indigenous forest and pine plantations; near R08/001	95.0 ha, 3 remnants divided by road and farm track

LEVEL 1 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Lang's Beach Coastal Forest and Shrubland Q08/226	Rep.site for 3 e.u.s	Limestone geology	5 e.u.s	Small, diverse, coastal forest and shrubland remnants with some fenced, regenerating areas and some weed-infested and grazed areas; missing many palatable species	Buffer to Lang's Beach coastline, and linkage to Q08/225	29.7 ha, 9 small remnants
Waipu River Estuary and Sandspit Q08/228	Rep.site for 15 e.u.s	Flora: 1 threatened, 2 reg.sig. Fauna: 14 threatened, 2 reg.sig.	20 e.u.s	Most natural duneland vegetation in ED; largest estuary in ED; shorebird protection programme (pest control, fencing, patrolling by rangers); human disturbance along estuary margin, but spit relatively isolated from disturbance	Buffer between sea and land; contiguous with Q07/128; international migrant wader site; relatively isolated from large forested areas	194.6 ha, 5 km-long sandspit next to 5 km-long estuary
Lang's Beach Q08/230		Flora: 1 threatened Fauna: 2 threatened	6 e.u.s	Small, naturally formed beach with high recreational use; invasive plants present; abutted by residential housing	Contiguous with Q08/225g	7.9 ha, narrow elongated area
Waihoihoi River Forest Remnants Q08/231	Rep.site for 2 e.u.s	Forest on alluvium; Flora: 1 reg.sig.	3 e.u.s	Diverse, healthy canopy; mostly grazed and disturbed; weed infestation (tradescantia, Chinese privet)	Riparian protection; near Q08/229	19.3 ha, 2 remnants
Waionehu Stream Forest Remnants Q08/232		Forest on alluvium; Flora: 1 reg.sig.	3 e.u.s	Heavily weed-infested remnants of alluvial forest and treeland; mostly unfenced	Relatively isolated, but may act as wildlife corridor from Brynderwyn Hills to Waipu River estuary	19.7 ha, 17 small remnants
SH1 Forest Remnants Q08/233	Rep.site for 1 e.u.	Forest on alluvium; Flora: 1 reg.sig.	3 e.u.s	Healthy canopy; mostly grazed; severe weed infestation	Near Q08/224 and Q08/235	7.4 ha, 8 remnants in 2 groups 1.5 km apart (2 to SW and 6 to NE)
Ahuroa River Forest Remnants Q08/235	Rep.site for 2 e.u.s	Forest on alluvium; Flora: 1 reg.sig. Fauna: 1 threatened	3 e.u.s	Mostly grazed with understorey sparse or absent; weed infestation (crack willow, tradescantia)	Riparian protection	53.8 ha, 18 small remnants scattered along river banks
Dodd Road Forest Remnant Q08/236	Rep.site for 1 e.u.	Fauna not surveyed	2 e.u.s	Diverse, healthy canopy; grazed by cattle	Contiguous with pine plantation	4.5 ha compact area
Durham Road Forest and Shrubland Q08/237	Rep.site for 1 e.u.	Flora: 1 threatened	4 e.u.s	Diverse, healthy canopy; established understorey in fenced areas; minimal weed infestation	Riparian protection; near Q08/222	41.7 ha, 11 remnants
Maxwell Creek Forest Remnant	Q08/238	Fauna: 1 threatened	1 e.u.	Disturbed; probably grazed on western edge	Riparian protection; surrounds and is contiguous with pine plantation; contiguous with Q08/222	31.5 ha in one piece, though divided by plantation forest
Helmsdale Road Forest and Shrubland Q08/239	Rep.site for 3 e.u.s	Limestone geology; Flora: 1 threatened Fauna: 1 threatened	5 e.u.s	Healthy canopy; kauri up to *c.* 70 cm diameter; established understorey in older, fenced remnants	Riparian protection, provides some linkage between Q07/117 and Q08/220	87.9 ha, 21 remnants widely scattered

LEVEL 1 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Kaikowhiti Stream Forest Remnants Q08/240	Rep.site for 3 e.u.s		4 e.u.s	Disturbed and grazed; localised dieback; severe possum browse; understorey absent except for steepest slopes	Riparian protection; linked by forestry to Q08/220 and Q08/241	24.8 ha, 7 remnants
Smales Road Forest Remnants Q08/241		Flora: 1 reg.sig.	4 e.u.s	Diverse, healthy canopy; partly grazed; occasional emergent northern rata	Riparian protection; linked by forestry to Q08/220 and Q08/240	126.1 ha, 14 remnants widely scattered
Brooks Road Wetland Q08/244	Rep.site for 1 e.u.	Fauna not surveyed	2 e.u.s	Disturbed and grazed; weed infestation (gorse)	Riparian protection; near Q08/243	0.7 ha
Shoemaker Road Forest Remnant 2 Q08/247		Forest on alluvium; Flora: 1 reg.sig. Fauna not surveyed	1 e.u.	Diverse canopy, including kahikatea developing rounded-crowns; possibly grazed; weed infestation on edges (gorse)	Isolated	1.1 ha
Bream Tail Coastal Headland R08/001	Rep.site for 20 e.u.s	Flora: 6 threatened, 5 reg.sig. Fauna: 6 threatened, 4 reg.sig.	26 e.u.s	Extremely diverse but fragmented site; covers forest, shrubland, wetland, rockland and duneland habitats; variable condition, but apparently improving overall through fencing to exclude stock; non-ecosourced indigenous plants	Contiguous with Q08/225i and near Q08/225j; probable seabird nesting	260.7 ha, 18 remnants of varying sizes
Cove Road Shrubland and Forest R08/002	Rep.site for 2 e.u.s	Flora: 1 reg.sig.	2 e.u.s	Dense, healthy gumland shrubland with small area of forest	Near Q08/225g	20.2 ha, 2 remnants divided by road
Total Level 1 sites (57 sites)						**13,675.6 ha**

LEVEL 2 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Ngatoka Wetland Catchment Q07/115		Fauna: 1 threatened	5 e.u.s	Wetland areas grazed and weed-infested (willows) or fenced and planted in harakeke	Riparian protection	8.5 ha, 7 remnants
Pakauhokio Knoll Forest Q07/122		Pa sites	3 e.u.s	Highly disturbed and grazed; weed infested (pines); low diversity; constructed wetland	Riparian protection; contiguous with Q07/124	65.69 ha, 1 large and 5 smaller remnants
Waipu Caves Road Wetland Q07/123		Fauna: 3 threatened	1 e.u.	Small, grazed remnants of a formerly larger wetland	Near Q07/117; Riparian protection	0.4 ha, 2 remnants
Crutcher Road Forest Remnants Q07/133		Fauna not surveyed	1 e.u.	Small, unfenced forest remnants	Isolated, but probably contribute to habitat network for mobile species	7.2 ha, 2 remnants
Reid Road Forest Remnants Q07/134		Flora: 1 reg.sig.	1 e.u.	Small, unfenced forest remnants	Isolated, but probably contribute to habitat network for mobile species	11.3 ha, 2 remnants
Hewlett QEII Covenant Q07/136		Forest on alluvium	1 e.u.	Very small remnant, sparse understorey, but recently fenced		2.1 ha
Mangapai Caves Road Wetland Q07/140		Fauna not surveyed	3 e.u.s	Small, isolated; weed-infested; partially fenced	Riparian protection	3.6 ha, 4 remnants
Sandford Road Forest Remnants Q07/142		Forest on alluvium	2 e.u.s	Very small alluvial forest remnants, lacking under-storey; trampled and grazed by stock; domesticated geese present	Isolated, but may provide ecological linkage between coast and larger forests further inland (e.g. Q07/121)	2.8 ha, 2 remnants
Hayward Road Forest Remnant Q07/146		Fauna not surveyed	1 e.u.	Low canopy diversity; possibly grazed	Isolated	1.9 ha
Moewhare Forest and Shrubland Q07/147			8 e.u.s	Grazed; sparse understorey; localised weed infestation	Riparian protection	33.6 ha, 13 remnants
Paparoa Road Dam Forest Remnants Q07/151		Fauna not surveyed	1 e.u.	Possibly grazed	Near Q07/147 and Q07/112	5.8 ha, 3 compact remnants
Ruarangi Road Forest Remnants 3 Q07/153			7 e.u.s	Grazed and disturbed; emergent pines; strong edge effects	Riparian protection	7.9 ha, 8 remnants, narrow
Ruarangi Road Wetland Q07/154		Fauna not surveyed	1 e.u.	Small, isolated; weed-infested (pampas, gorse); partially fenced	Riparian protection	0.5 ha, 2 remnants, small and narrow
Ruarangi Mangapai Forest Remnants Q07/155		Fauna: 1 threatened	2 e.u.s	Possibly grazed	Riparian protection; near Q07/112, Q07/114, and Q07/161; linked by crack willow to Q07/157	7.3 ha, 4 remnants, all linked by exotic/ indigenous vegetation
Ruarangi Road Forest Remnants 2 Q07/156		Fauna not surveyed; emergent podocarps	3 e.u.s	Some emergent podocarps; mostly grazed with sparse understorey; some dieback on edges	Contiguous with Q07/157	6.4 ha, 5 remnants

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Graham Road Riparian Forest Remnants Q07/157			2 e.u.s	Grazed and disturbed; weed infestation	Riparian protection; linked by crack willow to Q07/114 and Q07/155	16.3 ha, 6 remnants, long and narrow
Graham Road Forest Remnant Q07/159			1 e.u.	Grazed and disturbed; sparse understorey	Near Q07/157 and Q07/160	8.8 ha, 4 remnants
Graham Road Forest and Shrubland Q07/160		Fauna not surveyed	4 e.u.s	Probably grazed; emergent pines	Riparian protection; contiguous with pine plantation	19.7 ha, 4 remnants (1 large compact, 3 smaller)
Mangapai Riparian Forest Remnants Q07/161		Forest on alluvium	1 e.u.	Mostly grazed; weed infestation; strong edge effects	Riparian protection; linked by crack willow to remnants upstream (Q07/114, Q07/155)	7.7 ha, 4 remnants, long and narrow
Mill Brook Forest Remnants Q07/165		Forest on alluvium	1 e.u.	Grazed and disturbed; strong edge effects; under-storey sparse or absent; weed infestation	Riparian protection; near Q08/220 and Q08/224	27.1 ha, long and narrow
McLeod Road Forest Remnants Q07/166		Fauna not surveyed	3 e.u.s	Moderately sized area of secondary forest; reasonably fragmented with one larger central area; little information gathered (not surveyed)	Near Q07/121	34.6 ha, 1 main, 4 smaller remnants
Takahiwai Saltmarsh and Shrubland Q07/167			6 e.u.s	Small estuarine site with adjacent terrestrial shrubland; weed infestations; drains dug in mudflats	Contiguous with large areas of mangrove, saltmarsh, and mud-flats in Whangarei Harbour	4.3 ha
Northern Brynderwyn Hills Remnants Q08/227		Fauna not surveyed	3 e.u.s	Grazed and disturbed; sparse understorey	Between Q08/222, Q08/242 and Q08/225b	3.1 ha, 3 remnants
Braigh Forest Remnants Q08/229		Fauna not surveyed	1 e.u.	Possibly grazed	Near Q08/231	22.7 ha, 1 major , 1 minor remnant over river to east
Argyll Street Forest Remnant Q08/234		Forest on alluvium; Fauna not surveyed	1 e.u.	Possibly recently fenced; weed infestation (tree privet, Chinese privet)	Isolated	1.2 ha, 2 remnants
Finlayson's Brook Forest Remnants Q08/242		Forest on alluvium; Fauna not surveyed	1 e.u.	Disturbed and grazed; sparse understorey; weed infestation (crack willow, tradescantia, woolly nightshade)	Riparian protection; linked by treeland to Q08/220	6.0 ha, 5 small remnants spread along waterway
Brooks Road Forest Remnants Q08/243		Fauna not surveyed	1 e.u.	Probably grazed	Near Q08/242 and Q08/220	7.9 ha, 2 remnants
Millbrook Dam and Forest Remnants Q08/245			4 e.u.s	Large constructed dam with two contiguous forest remnants; probably grazed; little information	Isolated	26.6 ha, long narrow area

LEVEL 2 SITES Survey no.	REPRESENT-ATIVENESS	RARITY/SPECIAL FEATURES	DIVERSITY AND PATTERN	NATURALNESS	BUFFER/ LINKAGE/ CORRIDOR	SIZE AND SHAPE
Shoemaker Road Forest Remnant 1 Q08/246		Forest on alluvium; Fauna: 1 threatened	1 e.u.	Understorey either mown lawns or exotic gardens; hydrology altered by drainage	Isolated	1.1 ha, 2 remnants divided by small track
Total Level 2 sites (29 sites)						**369.2 ha**

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* Aerial orthophotography was provided courtesy of Northland Regional Council and Whangarei District Council. Copyright reserved.
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8. Appendices

8.1 FIELD SURVEY FORM

PROTECTED NATURAL AREAS PROGRAMME
WAIPU ECOLOGICAL DISTRICT

Department of Conservation
Te Papa Atawhai

NATURAL AREA NAME:	PNA NO.:
RECORDER:	SURVEY DATE:
GRID REF.:	SSBI NO.:
HABITAT TYPE(S):	
GEOMORPHOLOGICAL TYPE(S):	

ECOLOGICAL UNIT(S):

Habitat Class	Vegetation/ Habitat Structure	Landform	% of Total Area	% Percentage Canopy Cover			
				Abundant (50-100)	Common (20-50)	Frequent (5-20)	Occasional (0-5)

NATURAL AREA NAME:						PNA NO.:	
Habitat Class	Vegetation/ Habitat Structure	Landform	% of Total Area	% Percentage Canopy Cover			
				Abundant (50-100)	Common (20-50)	Frequent (5-20)	Occasional (0-5)

COMMENTS:

Department of Conservation
Te Papa Atawhai

25 August 2006

Dear Landowner

I would like to advise you that Wildland Consultants Ltd under contract with the Department of Conservation will soon be undertaking an updated survey of natural features such as forest, wetlands, gumlands and dunelands within the Takahiwai, Ruakaka and Waipu area of the Whangarei District. The natural features have been identified from recent aerial photography and are viewed from roadsides or (with the permission of landowners) from other viewpoints, recording information on their vegetation type and general condition. This survey is a continuation of work first undertaken by the Department in 1994.

In some cases, if these areas are not visible from the road, you may be contacted for permission to enter your land to enable a quick survey of the natural feature to gain information on the vegetation type and key plant species present.

Why are we doing this survey? Northland's natural features make a significant contribution to the character and quality of the region. Many of these areas are habitat for some of our increasingly rare plants and animals. The Department of Conservation and Kaipara District Council have existing information on many of the natural features in the District. However some of this information is now out of date, and therefore may no longer be accurate. This survey enables us to update our information and is an important reference point for assessing habitat changes over time and to assist landowners with management of their natural features.

The information gathered in this survey will be made available to anyone interested in natural features such as landowners, iwi, environmental groups, local bodies, and professionals.

The Kaipara District Council will be provided with the results of the survey upon completion.

With an increasing awareness in the value of natural features many residents and future residents to the District will have updated information describing the native plants and animals in the District. Information collected during this survey may be used to support cases made by private landowners to increase protection of forest or wetland on their land. These cases can be made to the Governments Biodiversity Condition and Advice Fund and the Northland Regional Council's Environment Fund. The Funds were set up to support landowners for the management and protection of natural areas, the information provided in this survey is an important tool in achieving these aims.

If you have any questions about the survey, please contact the Department of Conservation, (attention Peter Anderson or Wendy Holland) at Northland Conservancy Office in Whangarei, telephone (09) 430 2470; fax 09 430 2479 or email panderson@doc.govt.nz or wholland@doc.govt.nz.

Thank you for your assistance

Chris Jenkins
CONSERVATOR NORTHLAND
Department of Conservation

Waipu ecology goes under the microscope

THE WAIPU Ecological area is under scrutiny.

The Conservation Department has contracted Wildland Consultants to identify important natural features in the area, that include Takahiwai, Ruakaka, Waipu, Brynderwyns and Bream Tail.

Aerial photographs were used to identify the features, which will be viewed from roadsides and other viewpoints, with the permission of landowners.

NOTING NATURE: Tim Martin, Sarah Beadel and Jenny Lux from Wildland Consultants survey Langs Beach as part of a project to collect information on natural features in the Waipu Ecological area.

Information about the vegetation type and general condition will be recorded.

The survey is a Northland-wide project that aims to make information on the natural features, including forest, wetlands, gumlands and dunelands, in the region available to anyone interested.

The information will benefit landowners, iwi, environmental groups, local bodies and professionals.

It has been ongoing since 1994 and is nearing completion.

Wildland Consultants has started work in the Waipu area and expects to finish in early 2007.

DoC commissions a survey of Bream Bay's natural areas

The Department of Conservation has commissioned a report on important natural habitats within the *Waipu Ecological District*. The *Waipu Ecological Distric*t includes the areas of Takahiwai, Ruakaka, Waipu, Brynderwyns and Bream Tail.

A team from Wildland Consultants have started working on this project, which is expected to be finished in early 2007.

The survey team will be using recent aerial photographs to identify natural features such as: forests, wetlands, dune lands and gumlands and will visit to take a closer look either from the roadside or, with the landowners permission, from a vantage point on private land, to identify the vegetation type and key plant species present.

The last such survey was undertaken in 1994 and is likely to be out of date.

Information obtained will be made available to anyone interested - such as landowners, iwi, environmental groups, local bodies and professionals.

(Bream Bay News, 23 November 2006)

8.3 CATEGORIES OF THREAT

In this report the categories of threat are taken from the New Zealand Threat Classification developed by Molloy et al. (2002). This new system replaces Molloy & Davis (1994), the prioritising system used previously for threatened species work by the Department of Conservation.

Below are Sections 3 and 7, which have been taken from Molloy et al. (2002) to explain the new species classification system.

3. Classification structure and categories

... This section describes each of the categories (shown in Fig. 1).

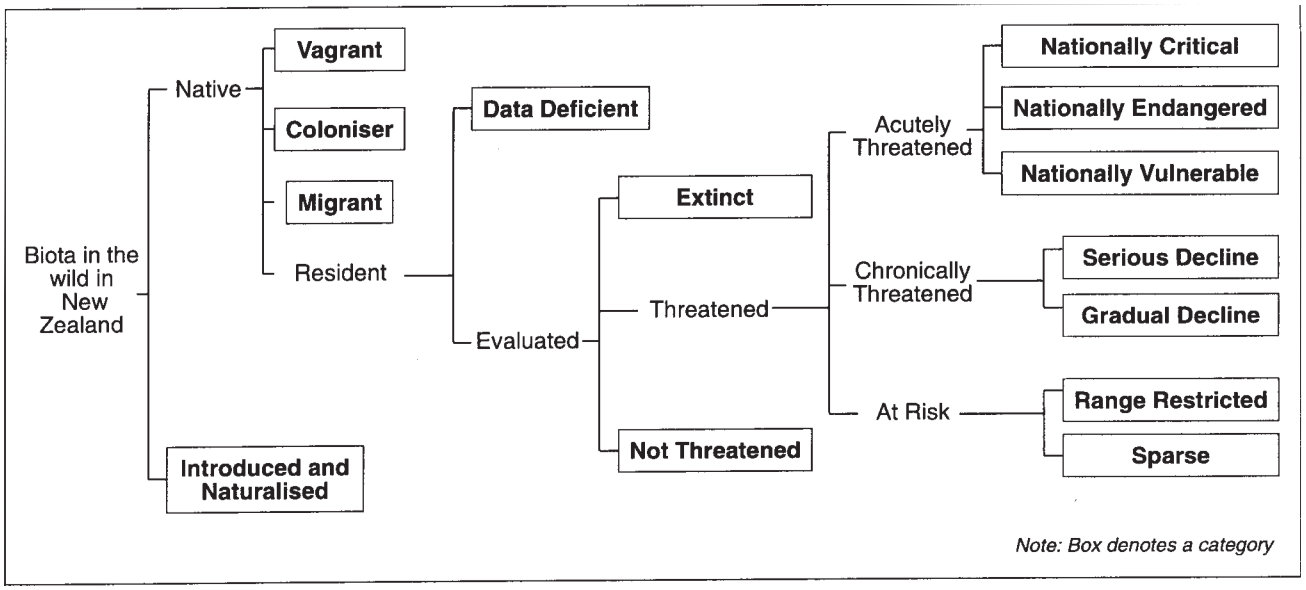

Figure 1. Structure of the New Zealand Threat Clasification System.

INTRODUCED AND NATURALISED

Introduced and Naturalised taxa are those that have become naturalised in the wild after being deliberately or accidentally introduced to New Zealand by human agency.

If an Introduced and Naturalised taxon has an IUCN Red Listing in its country (or countries) of origin, the IUCN category and source of the listing are shown after the taxon's name in the New Zealand list. Current examples of this include the cress *Lepidium hyssopifolium* and the southern bell frog (*Litoria raniformis*), both of which are listed as Endangered in Australia; and the parma wallaby (*Macropus parma*), listed as Lower risk/Near threatened.

VAGRANT

For the purposes of this document, vagrants are taxa that are found unexpectedly and rarely in New Zealand, and whose presence in our region is naturally transitory. These are taxa that do not establish themselves beyond their point of arrival because of reproductive failure or for specific ecological reasons (see de Lange & Norton 1998).

Examples include the red-kneed dotterel (*Erythrogonys cinctus*) and the blue moon butterfly (*Hypolimnas bolina nerina*), both from Australia, and the spotted sawtail (*Prionurus maculatus*) from the tropical south-west Pacific Ocean.

If a taxon in the Vagrant category has been listed in an IUCN Red List in its country of origin, the IUCN category and source of the listing are shown beside the taxon's name in the New Zealand list.

COLONISER

Colonisers are taxa that have arrived in New Zealand without direct or indirect help from humans and have been successfully reproducing in the wild for less than 50 years. Three examples are the Nankeen night heron (*Nycticorax caledonicus*), the scoliid wasp *Radumeris tasmaniensis* and the orchid *Cryptostylis subulata*.

The IUCN Red List category and source of the listing is included where this exists.

MIGRANT

Taxa that predictably and cyclically visit New Zealand as part of their normal life cycle, but do not breed here are included in the category Migrant. Examples include the Arctic skua (*Stercorarius parasiticus*) and striped marlin (*Tetrapturus audax*).

In contrast, taxa that either breed here and migrate beyond New Zealand during their life cycle, e.g. Chatham Island albatross (*Thalassarche eremita*), or taxa that are resident in New Zealand for most of their lives, such as longfinned eels (*Anguilla dieffenbachii*), are not included in this category.

The IUCN Red List category and source of the listing is included where this exists.

DATA DEFICIENT

The amount of information available for assessing the threat of extinction is highly variable between taxa and groups of taxa. At one extreme there are taxa such as kakapo, *Gunnera hamiltonii* and *Tecomanthe speciosa* where every wild individual is known, while at the other extreme there are taxa whose ecology and biology is virtually unknown (e.g. *Koeleria riguorum*, a recently described grass).

Certain criteria and/or definitions must be met for a taxon to be listed in a category. Where information is so lacking that an assessment is not possible, the taxon is assigned to the Data Deficient category. If a taxon is listed in a category other than Data Deficient but confidence in the listing is low due to poor quality data, then the listing can be qualified with the letters DP (Data Poor) to indicate this ...

EXTINCT

A taxon is listed as Extinct when there is no reasonable doubt, after repeated surveys in known or expected habitats at appropriate times (diurnal, seasonal and annual) and throughout the taxon's historic range, that the last individual has died. Examples include huia (*Heteralocha acutirostris*) and Adams's mistletoe (*Trilepidea adamsii*). Only taxa that have become extinct since 1840 are included in the list. Taxa that are extinct in the wild but occur in captivity or cultivation are not listed in this category. These are listed as Critically Endangered and are qualified with the letters EW (Extinct in the Wild).

THREATENED

The threatened categories are grouped into three major divisions: 'Acutely Threatened', 'Chronically Threatened' and 'At Risk'.

Acutely Threatened

The categories in the 'Acutely Threatened' division—Nationally Critical, Nationally Endangered and Nationally Vulnerable—equate with the IUCN categories of Critically Endangered, Endangered and Vulnerable. Taxa in these three categories are facing a very high risk of extinction in the wild, as defined by criteria that quantify:

- Total population size
- Area of occupancy
- Fragmentation of populations
- Declines in total population
- Declines in habitat area
- Predicted declines due to existing threats

Although the criteria (described in Section 6) measure similar population features as those in the IUCN Red List criteria, numerical limits and timeframes are tailored to suit New Zealand circumstances. These were set through a process of testing and refinement by the project team and as a result of feedback from New Zealand species experts. Criteria that attempt to predict declines due to possible future threats are not included because of the highly speculative nature of this type of assessment.

Chronically Threatened

Taxa listed in either of the two categories in the 'Chronically Threatened' grouping (Serious Decline and Gradual Decline) also face extinction, but are buffered slightly by either a large total population, or a slow decline rate (see Section 6).

At Risk

Taxa that do not meet the criteria for Acutely Threatened or Chronically Threatened, but have either restricted ranges or small scattered sub-populations, are listed in one of two categories (Range Restricted and Sparse) that fall under the division 'At Risk'. Although these taxa are not currently in decline, their population characteristics mean a new threat could rapidly deplete their population(s). Range Restricted taxa either occur in a small geographic area (e.g. Three Kings Islands), are restricted to a particular habitat (e.g. geothermal areas), or require very specific substrates (e.g. ultramafic rock), and for colonial breeders, have fewer than 10 subpopulations. Taxa that have naturally restricted ranges and taxa that have become restricted as a result of human activities are both included in this category. This is because both would face the same risk of extinction in the face of a new threat. The two groups are differentiated by the use of a qualifier (see Section 4).

Sparse taxa have very small, widely scattered populations, e.g. New Zealand spinach (*Tetragonia tetragonoides*). As with the Range Restricted category, taxa that are either naturally sparse or have become sparse as a result of human activities are included in this category.

NOT THREATENED

Taxa that are assessed and do not fit any of the Threatened categories are listed in the Not Threatened category.

7. Criteria for the Acutely Threatened and Chronically Threatened categories

... a taxon must meet specific criteria to be listed in one of the Acutely Threatened or Chronically Threatened categories. The criteria for each category are set out below ...

NATIONALLY CRITICAL

Very small population *or* a very high predicted decline

A taxon is Nationally Critical when available scientific evidence indicates that it meets any of the following three criteria:

1. The total population size is ≤ 250 mature individuals.
2. Human influences have resulted in ≤ 2 sub-populations *and either*:
   a. ≤ 200 mature individuals in the largest sub-population, *or*
   b. the total area of occupancy is ≤ 1 ha (0.01 km^2).
3. There is a predicted decline of ≥ 80% in the total population in the next 10 years due to existing threats.

NATIONALLY ENDANGERED

A: Small population *and* moderate to high recent or predicted decline

A taxon is Nationally Endangered when available scientific evidence indicates that it fits at least one Status criterion *and* one Trend criterion as follows:

Status criteria

1. The total population size is 250–1000 mature individuals.
2. There are ≤ 5 sub-populations *and either*:
   a. ≤ 300 mature individuals in the largest sub-population, *or*
   b. the total area of occupancy is ≤ 10 ha (0. 1 km^2).

Trend criteria

1. There has been a decline of ≥ 30% in the total population or habitat area in the last 100 years.
2. There is a predicted decline of ≥ 30% in the total population in the next 10 years due to existing threats.

B: Small to moderate population *and* high recent or predicted decline

A taxon is Nationally Endangered when available scientific evidence indicates that it fits at least one Status criterion *and* one Trend criterion:

Status criteria

1. The total population size is 1000–5000 mature individuals.
2. There are ≤ 15 sub-populations *and either*:
   a. 300–500 mature individuals in the largest sub-population, *or*
   b. the total area of occupancy is 10–100 ha (0.1–1 km^2).

Trend criteria

1. There has been a decline of ≥ 60% in the total population or habitat area in the last 100 years.

2. There is a predicted decline of ≥ 60% in the total population in the next 10 years due to existing threats.

NATIONALLY VULNERABLE

Small to moderate population *and* moderate recent or predicted decline

A taxon is Nationally Vulnerable when scientific evidence indicates that it fits at least one Status criterion *and* one Trend criterion:

Status criteria

1. The total population size is 1000–5000 mature individuals.
2. There are ≤ 15 sub-populations *and either*:

   a. 300–500 mature individuals in the largest sub-population, *or*

   b. the total area of occupancy is 10–100 ha (0.1–1 km^2).

Trend criteria

1. There has been a decline of 30–60% in the total population or habitat area in the last 100 years and the total population or habitat area is still in decline.
2. There is a predicted decline of 30–60% in the total population in the next 10 years due to existing threats.

SERIOUS DECLINE

A. Moderate to large population *and* moderate to large predicted decline

A taxon is listed in Serious Decline when scientific evidence indicates that it fits at least one Status criterion *and* the Trend criterion:

Status criteria

1. The total population size is ≥ 5000 mature individuals.
2. There are ≥ 15 sub-populations *and either*:

   a. ≥ 500 mature individuals in the largest sub-population, *or*

   b. the total area of occupancy is ≥ 100 ha (1 km^2).

Trend criterion

1. There is a predicted decline of ≥ 30% in the total population in the next 10 years due to existing threats.

B. Small to moderate population *and* small to moderate predicted decline

A taxon is listed in Serious Decline when available scientific evidence indicates that it fits at least one Status criterion *and* the Trend criterion:

Status criteria

1. The total population size is ≤ 5000 mature individuals.
2. There are ≤ 15 sub-populations *and either*:

   a. ≤ 500 mature individuals in the largest sub-population, *or*

   b. the total area of occupancy is ≤ 100 ha (1 km^2).

Trend criterion

1. There is a predicted decline of 5–30% in the total population in the next 10 years due to existing threats.

GRADUAL DECLINE

Moderate to large population *and* small to moderate decline

A taxon is fisted in Gradual Decline when available scientific evidence indicates that it fits at least one Status criterion *and* the Trend criterion:

Status criteria

1. The total population size is > 5000 mature individuals.
2. There are > 15 sub-populations *and either*:

   a. > 500 mature individuals in the largest sub-population, *or*

   b. the total area of occupancy is > 100 ha (1 km^2).

Trend criterion

1. There is a predicted decline of 5–30% in the total population in the next 10 years due to existing threats, and *the decline is predicted to continue beyond 10 years*.

8.4 CATEGORIES OF IMPORTANCE FOR GEOLOGICAL AND SOIL SITES

Geological sites

Ranking criteria for important geological sites and landforms in the Northland Region follow Kenny & Hayward (1996).

Sites are listed under three levels of importance:

(a) International – site of international scientific importance.

(b) National – site of national scientific, educational or aesthetic importance.

(c) Regional – site of regional scientific, educational or aesthetic importance.

Soil sites

Ranking criteria for New Zealand soil sites of international, national, and regional significance, from Arand *et al.* (1993).

Soil sites are listed under three levels of importance:

(a) International

- Contains the best example of a soil (generally a soil group) or soil–vegetation or soil–landform association that is unique to New Zealand (or these latitudes)
- Contains a soil that is naturally uncommon or greatly reduced in extent in other parts of the world
- Contains a wide range of extensive soils with a relatively unmodified vegetation cover
- Has been studied in detail and is known internationally.

(b) National

- Contains the best or a 'classic' example of a soil (either a soil group or a mapping unit) or a soil–vegetation or a soil–landform association in New Zealand
- Contains a soil or soil–vegetation or a soil–landform association that is nationally uncommon or reduced in extent
- Contains a moderate range of extensive soils with a relatively unmodified vegetation cover
- Has been studied in detail and is known nationally.

(c) Regional

- Contains the best regional example of a soil (generally a mapping unit) or a soil or soil–vegetation or a soil–landform association
- Contains a limited range of soils under vegetation that is relatively unmodified.

8.5 CHECKLIST OF PLANT SPECIES IN WAIPU ECOLOGICAL DISTRICT

This species list was compiled by the authors during a reconnaissance survey in the late spring/early summer of 2006. It includes all vascular plant species known to be native to or wild and naturalised in Waipu Ecological District. Other records, including those from Department of Conservation Sites of Specific Biological Interest (SSBI) database and Auckland Museum Herbarium (AK), have been referenced following the Latin species name. AK herbarium records from the current study are also referenced.

1. INDIGENOUS SPECIES

Gymnosperms	
Agathis australis	kauri
Dacrycarpus dacrydioides	kahikatea
Dacrydium cupressinum	rimu
Halocarpus kirkii (AK 295324)	monoao
Libocedrus plumosa	kawaka
Phyllocladus trichomanoides	tanekaha
Podocarpus hallii (SSBI Q08/H021; Jones 1991)	Hall's totara
Podocarpus totara	totara
Prumnopitys taxifolia	matai
Prumnopitys ferruginea	miro
Monocot. trees and shrubs	
Cordyline australis	ti kouka, cabbage tree
Cordyline banksii cabbage tree	ti ngahere, forest
Phormium cookianum (Forester *et al.* 2001)	wharariki, mountain flax
Phormium tenax	harakeke, flax
Rhopalostylis sapida	nikau
Dicot. trees and shrubs	
Ackama rosifolia	makamaka
Alectryon excelsus subsp. *excelsus*	titoki
Alseuosmia banksii var. *banksii* (DOC internal files – Waipu Gorge; SSBI Q07/H047; Landcare)	
Alseuosmia banksii var. *linariifolia* (Kendrick and Young 2006)	
Alseuosmia macrophylla (DOC internal files – Waipu Gorge; SSBI Q07/H047)	toropapa
Alseuosmia quercifolia (DOC internal files – Waipu Gorge; Jones 1991; SSBI Q07/H047)	
Aristotelia serrata	makomako, wineberry
Avicennia marina subsp. *australasica*	manawa, mangrove
Beilschmiedia tarairi	taraire
Beilschmiedia tawa	tawa
Brachyglottis kirkii var. *angustior*	komingiroa
Brachyglottis repanda	rangiora
Carmichaelia australis	makaka, maukoro, NZ broom
Carpodetus serratus	putaputaweta
Corokia buddleioides (Boffa Miskell 2003)	korokio
Coprosma acerosa	
Coprosma arborea	mamangi, tree coprosma
Coprosma areolata	
Coprosma grandifolia	kanono, raurekau
Coprosma lucida	shining karamu
Coprosma macrocarpa	
Coprosma parviflora	
Coprosma propinqua var. *propinqua*	
Coprosma propinqua var. *propinqua* × *C. robusta*	
Coprosma repens	taupata
Coprosma rhamnoides	
Coprosma rigida (AK 297990; AK 298333, current survey)	
Coprosma robusta	karamu
Coprosma spathulata subsp. *spathulata*	
Coriaria arborea var. *arborea*	tutu
Corynocarpus laevigatus	karaka
Dracophyllum latifolium (incl. *D. mathewsii*)	neinei
Dracophyllum lessonianum	
Dysoxylum spectabile	kohekohe
Elaeocarpus dentatus (incl. *E. d.* var. *obovatus*)	hinau
Epacris pauciflora var. *pauciflora* (AK 295325)	
Fuchsia excorticata (AK 298336, current survey)	kotukutuku, tree fuchsia
Gaultheria antipoda	tawiniwini
Geniostoma rupestre var. *ligustrifolium*	hangehange
Griselinia lucida	puka
Hebe macrocarpa var. *macrocarpa* (AK 298337; AK 298338, current survey)	kokomuka
Hebe stricta var. *stricta*	koromiko
Hedycarya arborea	pigeonwood, porokaiwhiri
Hoheria populnea	houhere, lacebark
Knightia excelsa	rewarewa
Kunzea ericoides	kanuka
Kunzea ericoides var. *linearis*	
Laurelia novae-zelandiae	pukatea
Leptospermum scoparium	manuka

Leptecophylla juniperina (Boffa Miskell 2003)	prickly mingimingi
Leucopogon fasciculatus	mingimingi
Leucopogon fraseri	patotara
Litsea calicaris (Forester *et al.* 2001)	mangeao
Lophomyrtus bullata (Jones 1991)	ramarama
Macropiper excelsum subsp. *excelsum*	kawakawa
Melicope simplex (Kendrick and Young 2006)	
Melicope ternata	wharangi
Melicytus macrophyllus	large-leaved mahoe
Melicytus micranthus	
Melicytus ramiflorus subsp. *ramiflorus*	mahoe
Metrosideros excelsa	pohutukawa
Metrosideros robusta	northern rata
Mida salicifolia (incl. *M. s.* var. *myrtifolia*)	mida, sandalwood
Myoporum laetum	ngaio
Myrsine australis	mapou
Myrsine salicina	toro
Nestegis apetala (Forester *et al.* 2001)	coastal maire
Nestegis cunninghamii	black maire
Nestegis lanceolata	white maire
Nestegis montana (DOC internal files – Waipu Gorge)	oro-oro
Nothofagus truncata (Forester *et al.* 2001)	hard beech, tawhai raunui
Olearia furfuracea	akepiro
Olearia rani	heketara
Ozothamnus leptophyllus	tauhinu
Pennantia corymbosa	kaikomako
Pimelea prostrata	pinatoro
Pisonia brunoniana (DOC Bioweb database)	parapara
Pittosporum cornifolium	tawhirikao
Pittosporum crassifolium	karo
Pittosporum eugenioides	tarata, lemonwood
Pittosporum tenuifolium subsp. *tenuifolium*	kohuhu
Plagianthus divaricatus	saltmarsh ribbonwood, makaka
Plagianthus regius (AK 298005, current survey)	manatu, ribbonwood
Pomaderris kumerahou	kumarahou
Pomaderris aff. *phylicifolia*	
Pouteria costata (Forester *et al.* 2001)	tawapou
Pseudopanax arboreus	five finger, whauwhaupaku
Pseudopanax crassifolius	lancewood, horoeka
Pseudopanax crassifolius × *P. lessonii*	
Pseudopanax lessonii	houpara
Quintinia serrata	tawheowheo
Raukaua anomalus	
Rhabdothamnus solandri	taurepo
Schefflera digitata	pate
Solanum aviculare f. *aviculare* (Jones 1991)	poroporo
Sophora chathamica	kowhai
Streblus heterophyllus	small-leaved milktree
Streblus heterophyllus × *S.* ?*banksii* (AK 298332, current survey)	small-/large-leaved milktree hybrid
Syzygium maire (SSBI Q07/H047)	maire tawake, swamp maire
Toronia toru	toru
Vitex lucens	puriri
Weinmannia silvicola	towa

Monocot. lianes

Freycinetia banksii	kiekie
Ripogonum scandens	supplejack, kareao

Dicot. lianes

Calystegia sepium (Jones 1991; SSBI Q07/H047)	pohue
Calystegia soldanella	shore bindweed, panahi
Clematis cunninghamii	ngakau-kiore
Clematis paniculata	puawananga
Metrosideros carminea (AK 297995, current survey)	carmine rata, akakura
Metrosideros diffusa	rata
Metrosideros fulgens	rata
Metrosideros perforata	aka
Muehlenbeckia australis	
Muehlenbeckia complexa	pohuehue
Parsonsia capsularis	akakiore
Parsonsia heterophylla (Jones 1991)	NZ jasmine, akakaikiore
Passiflora tetrandra	kohia
Rubus australis	bush lawyer, tataramoa
Rubus cissoides	bush lawyer, tataramoa
Rubus schmidelioides	bush lawyer, akatataramoa
Tetragonia implexicoma	
Tetragonia tetragonioides	kokihi

Lycopods and psilopsids

Huperzia varia	Whiri-o-Raukatauri
Lycopodiella cernua	maatukutuku
Lycopodium deuterodensum	puakarimu
Lycopodium volubile	waewaekoukou
Tmesipteris elongata (Jones 1991)	
Tmesipteris lanceolata (Jones 1991)	
Tmesipteris sigmatifolia (Jones 1991)	
Tmesipteris tannensis (Jones 1991)	

Ferns

Adiantum cunninghamii	huruhuru tapairu, common maidenhair fern
Adiantum diaphanum (Jones 1991; Forester *et al.* 2001)	huruhuru tapairu
Adiantum fulvum	huruhuru tapairu
Adiantum hispidulum	rosy maidenhair fern

Adiantum viridescens (SSBI Q07/H059; Forester *et al.* 2001)	huruhuru tapairu
Arthropteris tenella	
Asplenium bulbiferum	hen and chicken fern, mouku
Asplenium flaccidum	hanging spleenwort, makawe
Asplenium lamprophyllum (Boffa Miskell 2003)	
Asplenium oblongifolium	shining spleenwort, huruhuruwhenua
Asplenium polyodon	sickle spleenwort, petako
Asplenium haurakiense	
Azolla filiculoides	retoretore
Blechnum chambersii	rereti
Blechnum discolor	petipeti, crown fern
Blechnum filiforme	panako, thread fern
Blechnum fluviatile agg. (Jones 1991)	kiwikiwi
Blechnum fraseri (Jones 1991)	
Blechnum membranaceum	
Blechnum novae-zelandiae	kiokio
Blechnum minus	swamp kiokio
Blechnum minus × *B. novae-zelandiae*	
Cyathea cunninghamii (SSBI Q08/H021)	gully tree fern, punui
Cyathea dealbata	ponga, silver tree fern
Cyathea medullaris	mamaku
Cyathea smithii (SSBI Q08/H021)	katote, soft tree fern
Deparia petersenii subsp. *congrua*	
Dicksonia squarrosa	wheki
Diplazium australe	
Doodia australis	rasp fern, pukupuku
Doodia mollis (AK 298335, current survey)	
Doodia squarrosa (SSBI Q07/H059)	
Gleichenia dicarpa (SSBI Q08/H021)	tangle fern
Gleichenia microphylla	waewaekaka
Grammitis ciliata (Kendrick & Young 2006)	
Histiopteris incisa	matata
Hymenophyllum demissum	irirangi
Hymenophyllum dilatatum (Jones 1991)	matua mauku
Hymenophyllum ferrugineum (SSBI Q08/H021)	mauku
Hymenophyllum flabellatum	mauku
Hymenophyllum flexuosum (SSBI Q07/H059)	mauku
Hymenophyllum multifidum	mauku
Hymenophyllum rarum (Kendrick & Young 2006; SSBI Q07/H059)	mauku
Hymenophyllum revolutum (Kendrick & Young 2006)	mauku
Hymenophyllum sanguinolentum (Kendrick & Young 2006)	piripiri
Hymenophyllum scabrum (SSBI Q07/H059)	mauku
Hypolepis ambigua	
Hypolepis distans	
Lastreopsis glabella	
Lastreopsis hispida	
Lastreopsis velutina (Forester *et al.* 2001)	
Lastreopsis microsora subsp. *pentangularis*	
Leptopteris hymenophylloides	heruheru
Lindsaea trichomanoides (Jones 1991; SSBI Q08/H021)	
Loxogramme dictyopteris (Jones 1991; SSBI Q07/H047)	
Loxsoma cunninghamii (AK 176354)	
Lygodium articulatum (Jones 1991; SSBI Q07/H059; SSBI Q07/H054)	mangemange
Microsorum pustulatum	kowaowao, hound's tongue fern
Microsorum scandens	fragrant fern, mokimoki
Paesia scaberula	matata
Pellaea rotundifolia	tarawera, button fern
Pneumatopteris pennigera	pakau, gully fern
Polystichum sp. (recorded as *P. richardii* in Forester *et al.* 2001)	
Pteridium esculentum	bracken, rarahu
Pteris comans	coastal brake
Pteris macilenta (Jones 1991)	
Pteris saxatilis (Forester *et al.* 2001)	
Pteris tremula	turawera, shaking brake
Pyrrosia eleagnifolia	leather-leaf fern
Rumohra adiantiformis (DOC internal files – Waipu Gorge; SSBI Q07/H059)	
Schizaea dichotoma (SSBI Q07/H047)	
Trichomanes elongatum (Kendrick & Young 2006; SSBI Q07/H059)	
Trichomanes endlicherianum (Jones 1991; SSBI Q07/H047; SSBI Q07/H047)	
Trichomanes reniforme (Landcare; Jones 1991)	
Trichomanes venosum (SSBI Q08/H021; SSBI Q07/H047; SSBI Q07/H059)	

Orchids

Acianthus sinclairii	
Anzybas rotundifolius (Jones 1991)	
Corybas cheesemanii (Jones 1991)	spider orchid
Cyrtostylis oblonga (Kendrick & Young 2006; SSBI Q07/H047)	
Diplodium alobulum (Jones 1991)	
Diplodium brumalum (DOC internal files – Waipu Gorge; SSBI Q07/H059)	
Diplodium trullifolium (Kendrick & Young 2006; SSBI Q07/H059)	
Drymoanthus adversus (Kendrick & Young 2006)	
Earina autumnalis (Jones 1991)	Easter orchid
Earina mucronata	bamboo orchid
Ichthyostomum pygmaeum (Kendrick & Young 2006)	
Microtis unifolia agg.	onion orchid
Nematoceras rivulare (SSBI Q07/H059)	
Nematoceras triloba (Jones 1991; SSBI Q07/H059)	
Orthoceras novae-zeelandiae	
Petalochilus chlorostylus (SSBI Q07/H059)	
Prasophyllum colensoi (SSBI Q07/H059)	
Pterostylis agathicola (Kendrick & Young 2006)	

Pterostylis banksii	green hood orchid
Pterostylis graminea agg. (SSBI Q07/H047)	
Simpliglottis cornuta (SSBI Q07/H059)	
Stegostyla sp.	
Thelymitra longifolia agg.	
Thelymitra pauciflora agg.	
Winika cunninghamii (DOC internal files – Waipu Gorge; SSBI Q08/H001)	winika

Grasses

Austrofestuca littoralis	
Austrostipa stipoides	
Chionochloa bromoides	
Cortaderia splendens	toetoe
Dichelachne crinita	patiti
Isachne globosa	swamp millet
Lachnagrostis billardierei	sand wind grass
Lachnagrostis filiformis (AK 297993, current survey)	wind grass
Microlaena avenacea (SSBI Q07/H047)	bush rice grass
Microlaena stipoides	patiti
Oplismenus hirtellus subsp. *imbecillis*	
Rytidosperma biannulare (Forester *et al.* 2001)	
Rytidosperma gracile	
Spinifex sericeus	spinifex, kowhangatara

Sedges

Baumea arthrophylla	
Baumea articulata	
Baumea juncea	
Baumea rubiginosa	
Baumea teretifolia	
Bolboschoenus fluviatilis	marsh clubrush, ririwaka
Carex dissita	
Carex flagellifera	manaia
Carex geminata (AK 297985, current survey)	
Carex lambertiana	
Carex lessoniana	
Carex maorica	
Carex ochrosaccus	
Carex pumila	
Carex secta	purei
Carex solandri	
Carex testacea	
Carex virgata	purei
Cyperus ustulatus	toetoe upokotangata, giant umbrella sedge
Desmoschoenus spiralis	pingao
Eleocharis acuta	sharp spike sedge
Eleocharis gracilis	slender spike sedge
Eleocharis sphacelata	kuta, tall spike sedge
Ficinia nodosa	wiwi, knobby clubrush
Gahnia lacera	tarangarara
Gahnia pauciflora (Kendrick and Young 2006; SSBI Q07/H047; SSBI Q07/H051)	takahikahi
Gahnia setifolia	mapere
Gahnia xanthocarpa	tupari-maunga
Isolepis cernua	
Isolepis inundata (Jones 1991)	
Isolepis reticularis (SSBI Q08/H021)	
Lepidosperma australe	
Lepidosperma laterale	
Morelotia affinis	
Schoenoplectus tabernaemontani	lake clubrush, kapungawha
Schoenus maschalinus	
Schoenus apogon	
Schoenus tendo	wiwi
Uncinia banksii	matau, hook sedge
Uncinia uncinata	kamu, matau a Maui, hook sedge
Uncinia zotovii	matau, hook sedge

Rushes

Juncus edgariae	wi
Juncus kraussii subsp. *australiensis*	sea rush, wi
Juncus pallidus	wi
Juncus planifolius	
Juncus sarophorus	wi
Luzula picta var. *picta*	

Monocot. herbs (other than orchids, grasses, sedges and rushes)

Apodasmia similis	oioi
Arthropodium cirratum	rengarenga
Astelia banksii	kakaha
Astelia solandri	kowharawhara, perching lily
Astelia trinervia (Kendrick & Young 2006)	kauri grass, mauri
Collospermum hastatum	kahakaha, perching lily
Cordyline pumilio (Kendrick & Young 2006; Wilcox 2006)	ti rauriki
Dianella nigra	turutu
Lemna minor	karearea
Sparganium subglobosum (AK 297989, current survey)	maru, burr reed
Triglochin striata (AK 298334, current survey)	arrow grass
Typha orientalis	raupo
Zostera sp.	sea grass

Composite herbs

Cotula coronopifolia	bachelor's button
Euchiton audax	
Euchiton collinus	
Euchiton sphaericus (Forester *et al.* 2001)	
Lagenifera pumila	papataniwhaniwha
Pseudognaphalium luteoalbum	pukatea
Senecio hispidulus (Jones 1991; Forester *et al.* 2001)	

Senecio minimus (Jones 1991)
Senecio glomeratus (SSBI Q08/H021)
Senecio lautus

Dicot. herbs (other than composites)

Acaena anserinifolia	piripiri
Apium prostratum	native celery
Callitriche muelleri	
Centella uniflora	
Dichondra repens	Mercury Bay weed
Disphyma australe	horokaka
Drosera auriculata	
Elatostema rugosum	parataniwha
Epilobium nerteroides	
Epilobium nummulariifolium	
Epilobium pedunculare (SSBI Q07/H047)	
Epilobium rotundifolium (AK 297986, current survey)	
Galium propinquum	mawe
Geranium solanderi	
Geranium homeanum (Jones 1991)	
Gonocarpus aggregatus	
Gonocarpus incanus	piripiri
Haloragis erecta subsp. *erecta*	toatoa
Hydrocotyle elongata (SSBI Q08/H021)	
Hydrocotyle heteromeria	
Hydrocotyle microphylla	
Hydrocotyle moschata	
Hydrocotyle novae-zeelandiae (Jones 1991)	
Hydrocotyle tripartita	
Leptostigma setulosa	
Lobelia anceps	punakuru
Myriophyllum propinquum	
Nertera depressa	
Nertera dichondrifolia	
Oxalis exilis	
Oxalis magellanica (AK 297992, current survey)	
Oxalis rubens	
Parietaria debilis	
Pelargonium inodorum (DOC Bioweb 2007)	kopata
Peperomia urvilleana	
Persicaria decipiens	
Pratia angulata	panakenake
Ranunculus reflexus	maruru
Samolus repens	sea primrose
Sarcocornia quinqueflora	glasswort
Selliera radicans	remuremu
Solanum americanum (Landcare; SSBI Q08/H021)	small-leaved nightshade
Spergularia media	
Suaeda novae-zelandiae (AK 297982, current survey)	
Wahlenbergia gracilis (SSBI Q07/H059)	

Doubtful records

Myrsine divaricata (SSBI Q08/H052)

2. ADVENTIVE SPECIES

Gymnosperms

Pinus pinaster	maritime pine
Pinus radiata	radiata pine

Dicot. trees and shrubs

Acacia longifolia	Sydney golden wattle
Acacia mearnsii	black wattle
Acacia melanoxylon	Tasmanian blackwood
Acacia paradoxa (AK 297987)	
Acacia sophorae	
Acacia verticillata	prickly Moses
Banksia integrifolia (AK 297994)	coastal banksia
Brugmansia candida	angel's trumpet
Cotoneaster glaucophyllus	cotoneaster
Crataegus monogyna	hawthorn
Elaeagnus × *reflexa*	elaeagnus
Eriobotrya japonica	loquat
Erythrina × *sykesii*	coral tree
Euonymus japonicus	Japanese spindle tree
Hakea salicifolia	willow-leaved hakea
Hakea sericea	prickly hakea
Hydrangea macrophylla	hydrangea
Hypericum androsaemum	tutsan
Impatiens sodenii	shrub balsam
Juglans sp.	walnut
Leycesteria formosa	Himalayan honeysuckle
Ligustrum lucidum	tree privet
Ligustrum sinense	Chinese privet
Lupinus arboreus	lupin
Paraserianthes lophantha	brush wattle
Polygala myrtifolia (SSBI Q07/H051)	sweet pea shrub
Prunus persica	peach tree, nectarine
Psoralea pinnata	dally pine
Rhaphiolepis umbellata (AK 297984)	Sexton's bride
Rubus sp. (*R. fruticosus* agg.)	blackberry
Salix fragilis	crack willow
Senecio angulatus	Cape ivy
Senecio petasitis	velvet groundsel
Solanum mauritianum	woolly nightshade
Solanum pseudocapsicum	Jerusalem cherry
Syzgium smithii	lillypilly, monkey apple
Ulex europaeus	gorse

Dicot. lianes

Anredera cordifolia	madeira vine
Araujia sericifera	moth plant
Calystegia silvatica	
Hedera helix	ivy
Jasminum polyanthum	jasmine
Jasminum sp.	jasmine
Lonicera japonica	Japanese honeysuckle
Passiflora edulis	black passionfruit

Passiflora mollissima var. *tripartita*	banana passionfruit
Rosa sp.	rose vine
Rumex sagitattus	climbing dock
Senecio angulatus	cape ivy
Senecio mikanioides	German ivy
Vinca major	periwinkle
Vitis vinifera	grape
Wisteria sinensis	wisteria

Ferns

Azolla pinnata (AK 297991)	
Nephrolepis cordifolia	tuber ladder fern

Monocot trees and shrubs

Phoenix canariensis	Phoenix palm

Grasses

Agrostis capillaris	browntop
Agrostis stolonifera	creeping bent
Aira caryophyllea	silvery hairy grass
Ammophila arenaria	marram
*Anemanthele lessoniana**	gossamer grass
Anthoxanthum odoratum	sweet vernal
Arundo donax	giant reed
Avena barbata	slender oat
Axonopus fissifolius (SSBI Q08/H021)	narrow-leaved carpet grass
Briza maxima	large quaking grass
Briza minor	shivery grass
Bromus diandrus	ripgut brome
Bromus hordeaceus (AK 297983, current survey)	soft brome
Bromus willdenowii	prairie brome
Cortaderia selloana	pampas
Dactylis glomerata	cocksfoot
Digitaria sanguinalis	summer grass
Ehrharta erecta	veld grass
Elytrigia repens	couch
Glyceria maxima	reed sweetgrass
Holcus lanatus	Yorkshire fog
Lagurus ovatus	harestail
Lolium perenne	rye grass
Parapholis incurva	sickle grass
Paspalum dilatatum	paspalum
Paspalum distichum	Mercer grass
Paspalum urvillei	
Paspalum vaginatum	saltwater paspalum
Pennisetum clandestinum	kikuyu grass
Phleum pratense	timothy
Poa annua	annual poa
Poa trivialis (SSBI Q07/H059)	rough stalked meadow grass
Schedonorus phoenix	tall fescue
Setaria palmifolia	palm grass
Sporobolus africanus	ratstail
Stenotaphrum secundatum	buffalo grass
Vulpia myuros	vulpia hair grass
Zizania latifolia (SSBI Q07/H056)	Manchurian wild rice
Unidentified bamboo species	running bamboo

* Indigenous grass species naturalised from plantings in the Ruakaka Dunelands site (Q07/128).

Sedges

Carex divulsa
Carex ovalis
Cyperus eragrostis
Cyperus tenellus
Isolepis sepulcralis

Rushes

Juncus acuminatus	sharp-fruited rush
Juncus articulatus	
Juncus bulbosus	
Juncus effusus	soft rush
Juncus tenuis	track rush

Monocot. herbs (other than orchids, grasses, sedges and rushes)

Agapanthus praecox	agapanthus
Agave sp.	
Aloe sp.	aloe
Allium triquetrum	three-cornered garlic
Asparagus asparagoides	smilax
Asparagus scandens	climbing asparagus
Canna indica	canna lily
Crocosmia × *crocosmiiflora*	montbretia
Hedychium flavescens	ginger
Hedychium gardnerianum	kahili ginger
Kniphofia uvaria	red hot poker
Spirodella punctata	purple-backed duckweed
Tradescantia fluminensis	tradescantia
Watsonia bulbillifera	watsonia
Yucca sp.	yucca
Zantedeschia aethiopica	arum lily

Composite herbs

Arctotis sp.	arctotis
Aster subulatus (SSBI Q07/H051)	sea aster
Bellis perennis	daisy
Bidens frondosa	beggars' ticks
Cirsium arvense	California thistle
Cirsium vulgare	Scotch thistle
Conyza albida	fleabane
Conyza bilbaoana (SSBI Q07/H051)	fleabane
Crepis capillaris	hawksbeard
Erigeron karvinskianus	Mexican daisy
Gamochaeta purpurea (SSBI Q08/H021; SSBI Q07/H047)	purple cudweed
Gamochaeta simplicicaulis (SSBI Q08/H021; SSBI Q07/H047)	cudweed
Gamochaeta spicata	cudweed
Gazania linearis	gazania

Gazania rigens (SSBI Q07/H051)	
Hypochoeris radicata	catsear
Lapsana communis	nipplewort
Leontodon taraxacoides	hawkbit
Leucanthemum vulgare	oxeye daisy
Osteospermum fruticosum	rain daisy/ dimorphotheca
Picris echioides	oxtongue
Senecio bipinnatisectus	Australian fireweed
Senecio elegans	purple groundsel
Senecio sylvaticus	wood groundsel
Senecio vulgaris	groundsel
Sonchus oleraceus	puha
Taraxacum officinale	dandelion

Dicot. herbs (other than composites)

Acanthus mollis	acanthus
Acetosa acetosella	sheep's sorrel
Ageratina adenophora	Mexican devil
Ageratina riparia	mist flower
Alisma plantago-aquatica	water plantain
Alternanthera philoxeroides	alligator weed
Alternanthera aff. *sessilis*	
Anagallis arvensis	scarlet pimpernel
Blackstonia perfoliata (Forester *et al.* 2001)	
Cakile edentula	sea rocket
Cakile maritima	sea rocket
Callitriche stagnalis	starwort
Cardamine sp.	
Carpobrotus edulis	South African ice plant
Cerastium fontanum	mouse-ear chickweed
Chenopodium album	fathen
Chenopodium ambrosioides (SSBI Q07/H051)	Mexican tea
Conium maculatum	hemlock
Coronopus didymus	twin cress
Crassula multicava	fairy crassula
Datura stramonium	thorn apple
Daucus carota	wild carrot
Digitalis purpurea	foxglove
Duchesnea indica	Indian strawberry
Euphorbia peplus	milkweed
Fragaria vesca	wild strawberry
Foeniculum vulgare	fennel
Fumaria capreolata	fumitory
Fumaria muralis	scrambling fumitory
Galium aparine	cleavers
Galium divaricatum	
Geranium robertianum	herb Robert
Geranium sp.	geranium
Hypericum perforatum	St John's wort
Impatiens walleriana	busy lizzie
Linum bienne (SSBI Q07/H047)	
Linum trigynum	
Linum catharticum	
Lotus pedunculatus	lotus
Lotus suaveolens	hairy birdsfoot trefoil
Ludwigia palustris	water purslane
Ludwigia peploides	primrose willow
Malva sp.	mallow
Medicago nigra	bur medick
Melilotus indicus	King Island melilot
Mentha × *piperita*	peppermint
Modiola caroliniana	creeping mallow
Myosotis laxa var. *caespitosa*	forget-me-not
Myosotis sp.	forget-me-not
Nasturtium officinale	watercress
Oenanthe pimpinellioides	parsley dropwort
Orobanche minor	broomrape
Parentucellia viscosa	tarweed
Physalis peruviana	cape gooseberry
Plantago australis (SSBI Q07/H047)	swamp plantain
Plantago coronopus (SSBI Q07/H051)	buck's-horn plantain
Plantago lanceolata	narrow-leaved plantain
Plantago major (SSBI Q08/H021)	broad-leaved plantain
Polycarpon tetraphyllum	allseed
Polygonum hydropiper	water pepper
Polygonum persicaria	native willow weed
Polygonum strigosum	
Prunella vulgaris	selfheal
Ranunculus repens	creeping buttercup
Rumex obtusifolius	dock
Sagina procumbens	pearlwort
Sigesbeckia orientalis	
Silene gallica	catchfly
Solanum chenopodioides	velvety nightshade
Solanum linnaeanum	apple of Sodom
Solanum nigrum	black nightshade
Solanum pseudocapsicum	Jerusaleum cherry
Spergularia rubra	sand spurrey
Stachys sylvatica (AK 297988)	hedge woundwort
Trifolium pratense	red clover
Trifolium repens	white clover
Tropaeolum majus	garden nasturtium
Urtica urens (SSBI Q07/H059)	nettle
Verbena bonariensis	purple-top
Veronica anagallis-aquatica	water speedwell
Veronica arvensis	field speedwell
Veronica plebeia (SSBI Q08/H021; SSBI Q07/H059)	
Veronica serpyllifolia	turf speedwell
Vicia sativa	vetch
Vicia tetrasperma	
Vinca major	periwinkle

8.6 COMMON PLANT NAMES USED IN TEXT

Introduced/exotic species are indicated by an asterisk.

*	agapanthus	*Agapanthus praecox*
	akepiro	*Olearia furfuracea*
*	alligator weed	*Alternanthera philoxeroides*
*	allseed	*Polycarpon tetraphyllum*
*	annual poa	*Poa annua*
*	arctotis	*Arctotis* sp.
*	aristea	*Aristea ecklonii*
	arrow grass	*Triglochin striata*
*	arum lily	*Zantedeschia aethiopica*
	bachelor's button	*Cotula coronopifolia*
*	banana passionfruit	*Passiflora mollissima* var. *tripartita*
*	black wattle	*Acacia mearnsii*
	bracken	*Pteridium esculentum*
*	Brazilian plume	*Justicia carnea*
*	broomrape	*Orobanche minor*
*	brush wattle	*Paraserianthes lophantha*
*	buffalo grass	*Stenotaphrum secundatum*
*	bur medick	*Medicago nigra*
	carmine rata	*Metrosideros carminea*
*	catchfly	*Silene gallica*
*	catsear	*Hypochoeris radicata*
*	Chinese privet	*Ligustrum sinense*
*	cleavers	*Galium aparine*
*	climbing asparagus	*Asparagus scandens*
*	clivia	*Clivia miniata*
	coastal banksia	*Banksia integrifolia*
	coastal maire	*Nestegis apetala*
*	coral tree	*Erythrina xsykesii*
*	cotoneaster	*Cotoneaster glaucophyllus*
*	crack willow	*Salix fragilis*
*	creeping buttercup	*Ranunculus repens*
*	dally pine	*Psoralea pinnata*
*	dimorphotheca	*Osteospermum fruticosum*
*	dock	*Rumex* sp.
	duckweed	*Lemna minor*
*	elaeagnus	*Elaeagnus* x *reflexa*
*	eucalyptus	*Eucalyptus* sp.
*	fairy crassula	*Crassula multicava*
*	fathen	*Chenopodium album*
*	fishtail palm	*Caryota aequatorialis*
	five finger	*Pseudopanax arboreus*
*	foxglove	*Digitalis purpurea*
	fragrant fern	*Microsorum scandens*
*	garden nasturtium	*Tropaeolum majus*
*	gazania	*Gazania linearis*
*	ginger	*Hedychium gardnerianum* or *H. flavescens*
	glasswort	*Sarcocornia quinqueflora*
*	gorse	*Ulex europaeus*
	gully fern	*Pneumatopteris pennigera*
	gully tree fern	*Cyathea cunninghamii*
*	hairy birdsfoot trefoil	*Lotus suaveolens*
	Hall's totara	*Podocarpus halli*
	hangehange	*Geniostoma ligustrifolium* var. *ligustrifolium*
	hanging spleenwort	*Asplenium flaccidum*
	harakeke	*Phormium tenax*
	hard beech	*Nothofagus truncata*
*	harestail	*Lagurus ovatus*
*	hawkbit	*Leontodon taraxacoides*
*	hawthorn	*Crataegus monogyna*
	heketara	*Olearia rani*
*	hemlock	*Conium maculatum*
	heruheru	*Leptopteris hymenophylloides*
	hen and chicken fern	*Asplenium bulbiferum*
	hinau	*Elaeocarpus dentatus*
	houhere	*Hoheria populnea*
	hound's tongue fern	*Microsorum pustulatum*
	houpara	*Pseudopanax lessonii*
*	hydrangea	*Hydrangea macrophylla*
*	Japanese honeysuckle	*Lonicera japonica*
*	Japanese spindle tree	*Euonymus japonicus*
*	jasmine	*Jasminum polyanthum*
*	Jerusalem cherry	*Solanum pseudocapsicum*
	kahakaha	*Collospermum hastatum*
	kahikatea	*Dacrycarpus dacrydioides*
	kaikomako	*Pennantia corymbosa*
	kanono	*Coprosma grandifolia*
	kanuka	*Kunzea ericoides*
	karaka	*Corynocarpus laevigatus*
	karamu	*Coprosma robusta*
	karo	*Pittosporum crassifolium*
	kauri	*Agathis australis*
	kawaka	*Libocedrus plumosa*
	kawakawa	*Macropiper excelsum* subsp. *excelsum* f. *excelsum*
	kiekie	*Freycinetia banksii*
*	kikuyu grass	*Pennisetum clandestinum*
	king fern	*Marattia salicina*
*	King Island melilot	*Melilotus indicus*
	kiokio	*Blechnum novae-zelandiae*
*	knobby clubrush	*Ficinia nodosa*
	kohekohe	*Dysoxylum spectabile*
	kohuhu	*Pittosporum tenuifolium*
	koromiko	*Hebe stricta* var. *stricta*
	kowhai	*Sophora chathamica* or *S. microphylla*
	kumarahou	*Pomaderris kumerahou*
	lake clubrush	*Schoenoplectus tabernaemontani*
	lancewood	*Pseudopanax crassifolius*
*	large quaking grass	*Briza maxima*
	large-leaved mahoe	*Melicytus macrophyllus*
	large-leaved milk tree	*Streblus banksii*
	leather-leaf fern	*Pyrrosia eleagnifolia*
*	lotus	*Lotus pedunculatus*
*	macrocarpa	*Cupressus macrocarpa*
*	madeira vine	*Anredera cordifolia*
	mahoe	*Melicytus ramiflorus* subsp. *ramiflorus*
	maire tawake	*Syzygium maire*
	mamaku	*Cyathea medullaris*
	mamangi	*Coprosma arborea*
	manatu	*Plagianthus regius*
*	Manchurian wild rice	*Zizania latifolia*
	mangrove	*Avicennia marina* subsp. *australasica*
	manuka	*Leptospermum scoparium*
	mapou	*Myrsine australis*
*	maritime pine	*Pinus pinaster*

*	marram	*Ammophila arenaria*
	marsh clubrush	*Bolboschoenus fluviatilis*
	matai	*Prumnopitys taxifolia*
*	Mexican daisy	*Erigeron karvinskianus*
*	Mexican devil	*Ageratina adenophora*
	mida	*Mida salicifolia*
*	milkweed	*Euphorbia peplus*
	mingimingi	*Leucopogon fasciculatus*
	miro	*Prumnopitys ferruginea*
*	mist flower	*Ageratina riparia*
*	montbretia	*Crocosmia* x *crocosmiiflora*
	native celery	*Apium prostratum*
	native iceplant	*Disphyma australe*
	ngaio	*Myoporum laetum*
	nikau	*Rhopalostylis sapida*
	northern rata	*Metrosideros robusta*
	oioi	*Apodasmia similis*
*	palm grass	*Setaria palmifolia*
*	pampas	*Cortaderia selloana*
	parapara	*Pisonia brunoniana*
*	paspalum	*Paspalum dilatatum*
	pate	*Schefflera digitata*
	patotara	*Leucopogon fraseri*
*	periwinkle	*Vinca major*
	pigeonwood	*Hedycarya arborea*
	pingao	*Desmoschoenus spiralis*
	pink bindweed	*Calystegia sepium*
	pohuehue	*Muehlenbeckia complexa*
	pohutukawa	*Metrosideros excelsa*
	ponga	*Cyathea dealbata*
	Poor Knights lily	*Xeronema callistemon*
*	poplar	*Populus* sp.
*	prairie brome	*Bromus willdenowii*
*	prickly hakea	*Hakea sericea*
*	puha	*Sonchus oleraceus*
	puka	*Griselinia lucida*
	pukatea	*Laurelia novae-zelandiae*
	puriri	*Vitex lucens*
*	purple groundsel	*Senecio elegans*
*	purple-top	*Verbena bonariensis*
	putaputaweta	*Carpodetus serratus*
*	radiata pine	*Pinus radiata*
	rangiora	*Brachyglottis repanda*
	rasp fern	*Doodia australis*
*	ratstail	*Sporobolus africanus*
	raupo	*Typha orientalis*
*	reed sweetgrass	*Glyceria maxima*
	remuremu	*Selliera radicans*
	rengarenga	*Arthropodium cirratum*
	rewarewa	*Knightia excelsa*
	rimu	*Dacrydium cupressinum*
*	ripgut brome	*Bromus diandrus*
*	rye grass	*Lolium perenne*
	saltmarsh ribbonwood	*Plagianthus divaricatus*
*	saltwater paspalum	*Paspalum vaginatum*
	sea grass	*Zostera* sp.
	sea primrose	*Samolus repens*
*	sea rocket	*Cakile edentula* or *C. maritima*
	sea rush	*Juncus kraussii* subsp. *australiensis*
	shining karamu	*Coprosma lucida*
*	shivery grass	*Briza minor*
	shore bindweed	*Calystegia soldanella*
	shore spurge	*Euphorbia glauca*
*	sickle grass	*Parapholis incurva*
*	soft rush	*Juncus effusus*
*	South African iceplant	*Carpobrotus edulis*
	spinifex	*Spinifex sericeus*
*	starwort	*Callitriche stagnalis*
	supplejack	*Ripogonum scandens*
*	sweet vernal	*Anthoxanthum odoratum*
*	tall fescue	*Schedonorus phoenix*
	tanekaha	*Phyllocladus trichomanoides* var. *trichomanoides*
	tangle fern	*Gleichenia dicarpa*
	taraire	*Beilschmiedia tarairi*
	tarata	*Pittosporum eugenioides*
*	tarweed	*Parentucellia viscosa*
	taupata	*Coprosma repens*
	taurepo	*Rhabdothamnus solandri*
	tawa	*Beilschmiedia tawa*
	tawapou	*Pouteria costata*
	tawheowheo	*Quintinia serrata*
	thread fern	*Blechnum filiforme*
	ti kouka	*Cordyline australis*
	ti ngahere	*Cordyline banksii*
	titoki	*Alectryon excelsus* var. *excelsus*
	toro	*Myrsine salicina*
	totara	*Podocarpus totara* or *P. hallii*
	towai	*Weinmannia silvicola*
*	track rush	*Juncus tenuis*
*	tradescantia	*Tradescantia fluminensis*
	tree fuchsia	*Fuchsia excorticata*
*	tree privet	*Ligustrum lucidum*
*	tuber ladder fern	*Nephrolepis cordifolia*
	turepo	*Streblus heterophyllus*
	turutu	*Dianella nigra*
	tutu	*Coriaria arborea* var. *arborea*
*	veld grass	*Ehrharta erecta*
*	velvet groundsel	*Senecio petasitis*
*	vulpia hair grass	*Vulpia myuros*
*	walnut	*Juglans* sp.
*	watsonia	*Watsonia bulbillifera*
	whahariki	*Phormium cookianum*
	wheki	*Dicksonia squarrosa*
*	white clover	*Trifolium repens*
	white maire	*Nestegis lanceolata*
*	wild carrot	*Daucus carota*
*	willow-leaved hakea	*Hakea salicifolia*
*	willow weed	*Polygonum* sp.
*	windmill palm	*Trachycarpus fortunei*
*	woolly nightshade	*Solanum mauritianum*
*	Yorkshire fog	*Holcus lanatus*

8.7 CHECKLIST OF FAUNA SPECIES IN WAIPU ECOLOGICAL DISTRICT

Compiled by authors, Ray Pierce and Richard Parrish. Nomenclature follows Hitchmough *et al.* (2007) for indigenous species. Nomenclature for exotic species is as follows: Heather & Robertson (1996) for birds, Gill and Whitaker (1996) for amphibians, McDowall (2000) for fish, and King (2005) for mammals.

PL = present in large numbers (>100 present in study area at one time in last 15 years).

P = present in small numbers (<100 present in study area at one time in last 15 years).

R = recorded (<10 present in study area at one time in last 15 years).

E = not recorded in last 15 years, though previous records exist; presumed locally extinct.

U = unconfirmed record.

MAMMALS		
Indigenous		
Chalinolobus tuberculata	long-tailed bat; pekapeka	U
Hydrurga leptonyx	leopard seal	R
Mirounga leonina	southern elephant seal	R
Introduced (feral)		
Bos taurus	feral cattle	R
Capra hircus	feral goat	P
Erinaceus europaeus	European hedgehog	PL
Felis catus	cat	PL
Lepus europaeus	brown hare	PL
Mus musculus	house mouse; kiore-iti	PL
Mustela erminea	stoat	PL
Mustela furo	ferret	P
Mustela nivalis	weasel	P
Oryctolagus cuniculus	European rabbit	PL
Rattus norvegicus	Norway rat; pouhawaiki	PL
Rattus rattus	ship rat	PL
Sus scrofa	feral pig	PL
Trichosurus vulpecula	brushtail possum	PL
BIRDS		
Indigenous		
Anarhynchus frontalis	wrybill; ngutuparore	P
Anas chlorotis "North Island"	pateke, brown teal	E
Anas gracilis	tete; grey teal	P
Anas rhynchotis	Australasian shoveler; kuruwhengi	R
Anas superciliosa superciliosa	grey duck; parera	R
Anthornis melanura melanura	bellbird; korimako; makomako	R
Anthus novaeseelandiae novaeseelandiae	New Zealand pipit; pihoihoi	P
*Apteryx mantelli**	North Island brown kiwi	E?
Ardea novaehollandiae	white-faced heron	P

* Not confirmed present since 1970s.

Arenaria interpres	turnstone	P
Botaurus poiciloptilus	Australasian bittern; matuku	R
Bowdleria punctata vealeae	North Island fernbird; matata	P
Bubulcus ibis	cattle egret	R
Calidris acuminata	sharp-tailed sandpiper	R
Calidris alba	sanderling	R
Calidris canutus	huahou, lesser knot	P
Calidris ferruginea	curlew sandpiper	R
Calidris mauri	western sandpiper	R
Calidris melanotos	pectoral sandpiper	R
Calidris ruficollis	red-necked stint	R
Catharacta antartica lonnbergi	brown skua; hakoakoa	R
Charadrius bicinctus bicinctus	banded dotterel; tuturiwhatu	P
Charadrius obscurus aquilonius	northern New Zealand dotterel; tuturiwhatu	P
Chlidonias leucopterus	white-winged black tern	R
Chrysococcyx lucidus lucidus	shining cuckoo; pipiwharauroa	PL
Circus approximans	Australasian harrier; kahu	PL
Cyanorhamhus novaezelandiae novaezelandiae	red-crowned kakariki; kakariki	R
Egretta alba modesta	white heron; kotuku	R
Egretta sacra sacra	reef heron; matuku-moana	P
Eudynamys taitensis	long-tailed cuckoo; koekoea	R
Eudyptula minor iredalei	northern little blue penguin; korora	R
Falco novaeseelandiae "bush"	bush falcon	U
*Gallirallus australis greyi**	weka	E
Gallirallus philippensis assimilis	banded rail; moho-pereru	P
Gerygone igata	grey warbler; riroriro	PL
Haematopus finschi	New Zealand pied oystercatcher; torea	P
Haematopus unicolor	variable oystercatcher; torea, toreapango	PL
Hemiphaga novaeseelandiae	kukupa; kereru; New Zealand pigeon	PL
Himantopus himantopus leucocephalus	poaka; pied stilt	P
Hirundo tahitica neoxena	welcome swallow	PL
Larus dominicanus dominicanus	southern black-backed gull; karoro	PL
Larus novaehollandiae scopulinus	red-billed gull; tarapunga	PL
Limosa haemastica	Hudsonian godwit	R
Limosa lapponica	bar-tailed godwit	P
Morus serrator	Australasian gannet; takapu	P
Nestor meridionalis septentrionalis	North Island kaka	R
Ninox novaeseelandiae novaeseelandiae	morepork; ruru	PL
Numenius madagascariensis	eastern curlew	R
Numenius phaeopus	whimbrel	R
Petroica macrocephala toitoi	tomtit; miromiro; pied tit	P
Phaethon lepterus	white-tailed tropicbird	R
Phaethon rubricauda	red-tailed tropicbird; amokura	R
Phalacrocorax carbo novaehollandiae	black shag; kawau	P
Phalacrocorax melanoleucos brevirostris	little shag; kawaupaka	P
Phalacrocorax sulcirostris	little black shag	P
Phalacrocorax varius varius	pied shag; karuhiruhi	P
Platalea regia	royal spoonbill; kotuku-ngutupapa	R
Pluvialis fulva	Pacific golden plover	R
Poliocephalus rufopectus	New Zealand dabchick; weweia	R
Porphyrio melanotus	pukeko	PL
Porzana pusilla affinis†	marsh crake; koitareke	E?

* Last unconfirmed report in 1986.

† Not confirmed present since 1970s.

Porzana tabuensis plumbea	spotless crake; puweto	P
Prosthemadera novaeseelandiae novaeseelandiae	tui	PL
Pterodroma macroptera gouldi	grey-faced petrel; oi	U
Rhipidura fuliginosa placabilis	North Island fantail; piwakawaka	PL
Stercorarius parasiticus	Arctic skua	R
Stercorarius pomarinus	pomarine skua	R
Sterna albifrons	little tern	R
Sterna caspia	Caspian tern; taranui	P
Sterna nereis davisae	New Zealand fairy tern	R
Sterna striata striata	white-fronted tern; tara	P
Tachybaptus novaehollandiae	Australian little grebe	R
Tadorna variegata	paradise shelduck; putangitangi; pari	PL
Thinornis novaeseelandiae	New Zealand shore plover; tuturuatu	R
Todiramphus sanctus	New Zealand kingfisher; kotare	PL
Tringa hypoleucos	common sandpiper	R
Tringa nebularia	greenshank	R
Tringa terek	terek sandpiper	R
Vanellus miles	spur-winged plover	PL
Zosterops lateralis	silvereye; tauhou	PL

Introduced

Acridotheres tristis	myna	PL
Alauda arvensis	skylark	PL
Anas platyrhynchos	mallard	PL
Callipepla californica	California quail	PL
Carduelis carduelis	goldfinch	PL
Carduelis chloris	greenfinch	PL
Carduelis flammea	redpoll	P
Cygnus atratus	black swan	P
Emberiza citrinella	yellowhammer	PL
Fringilla coelebs	chaffinch	PL
Gymnorhina tibicen hypoleuca	Australian magpie (white-backed subspecies)	PL
Gymnorhina tibicen tibicen	Australian magpie (black-backed subspecies)	P
Meleagris gallopavo	wild turkey	P
Passer domesticus	house sparrow	PL
Pavo cristatus	peafowl	P
Phasianus colchicus	pheasant	PL
Platycercus eximius	eastern rosella	PL
Prunella modularis	dunnock; hedge sparrow	P
Streptopelia roseogrisea	barbary dove	R
Sturnus vulgaris	starling	PL
Synoicus ypsilophorus	brown quail	PL
Turdus merula	blackbird	PL
Turdus philomelos	song thrush	PL

REPTILES

Indigenous*

Caretta caretta	loggerhead turtle	R
Chelonia mydas	green turtle	R
Cyclodina aenea	copper skink	P
Eretmochelys imbricata	hawksbill turtle	R

* Including vagrant marine turtles and sea snakes.

Hoplodactylus granulatus	forest gecko	R
Naultinus elegans elegans	Auckland green gecko	R
Oligosoma smithii	shore skink	R
Pelamis platurus	yellow-bellied sea snake	R
Introduced		
*Lampropholis delicata**	rainbow skink	P
FISH		
Indigenous		
Aldrichetta forsterii	yelloweyed mullet	PL
Anguilla dieffenbachii	longfin eel	PL
Anguilla australis	shortfin eel	PL
Arripis trutta	kahawai	PL
Cheimarrichthys fosteri	torrentfish	P
Galaxias fasciatus	banded kokopu	PL
Galaxias maculatus	inanga	PL
Galaxias postvectis	shortjaw kokopu	R
Gobiomorphus basalis	Cran's bully	PL
Gobiomorphus cotidianus	common bully	PL
Gobiomorphus gobioides	giant bully	P
Gobiomorphus huttoni	redfin bully	PL
Mugil cephalus	grey mullet	PL
Retropinna retropinna	common smelt	PL
Introduced		
Cyprinus carpio	European (koi) carp	R
Gambusia affinis	mosquitofish	PL
Oncorhynchus mykiss	rainbow trout	PL
Salmo trutta	brown trout	PL
FROGS		
Indigenous		
Leiopelma hochstetteri	Hochstetter's frog	PL
Introduced		
Litoria aurea	green and golden bell frog	PL
INDIGENOUS LAND SNAILS†		
Amborhytida dunniae		R
Cytora cytora		R
Cytora torquilla		R
Dosinea subrosea		R
Liarea turriculata		*R*
Paryphanta busbyi busbyi	kauri snail	PL

- Recently discovered at Lang's Beach (6 March 2007) (David Chapple, Victoria University, pers. comm.).

† These lists probably only represent a small proportion of the total number of species present. Systematic surveys of the ED would increase the diversity of these lists.

Phenacohelix giveni		R
Punctidae sp. 64		R
Punctidae sp. 164		R
Schizoglossa worthyae		R
Therasiella sp. (*celinde* or *tamora*)		R

OTHER MOLLUSCS*

Indigenous		
Amphibola crenata	mudsnail	PL
Austrovenus stutchburyi	cockle	PL
Cellana sp.	limpet	PL
Cominella glandiformis	mud whelks	PL
Cyclomactra ovata		PL
Macomona liliana		PL
Nucula hartvigiana	nutshell	PL
Paphies australe	pipi	PL
Paphies subtriangulata	tuatua	PL
Potamopyrgus antipodarum		PL
Saccostrea cucullata	New Zealand rock oyster	PL
Turbo smaragdus	catseye	PL
Zeacumantus lutulentus		PL
Zediloma subrostrata	mudflat topshell	PL
Introduced		
Crassostrea gigas	Pacific oyster	PL
Cantareus aspersa	garden snail	PL
Oxychilus alliarius	garlic glass snail	PL
Oxychilus cellarius	cellar glass snail	PL

INDIGENOUS CRUSTACEANS*

Elminius modestus	common barnacle	PL
Helice crassa	mud crab	PL
Hemigrapsus crenulatus		PL
Parenephrops planifrons	koura; freshwater crayfish; kewai	PL
Talorchestia sp.	sandhopper	PL
	shrimp species	PL
	polychaete worm species	PL

OTHER INVERTEBRATES*

Indigenous		
Cambridgea sp.	spider	R
Danaus plexippus	Monarch butterfly	P
Peripatus sp.		R
Olinga feredayi	caddisfly	R
Uloma tenebrioides		R
Zizina otis	common blue butterfly	R

* These lists probably only represent a small proportion of the total number of species present. Systematic surveys of the ED would increase the diversity of these lists.

Introduced		
Apis mellifera	bee	PL
Bombus spp.	bumble bee	PL
Vespula germanica	German wasp	PL
Pieris rapae	white cabbage butterfly	P

8.8 GLOSSARY OF TERMS

Biodiversity
The variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Buffer
A zone surrounding a natural area which reduces the effects of external influences on the natural area. For example, shrubland or exotic plantations surrounding an indigenous remnant provide physical protection to it by reducing changes in wind and light, reducing the chance of weed infestation and providing a corridor for the movement of wildlife into and out of it, so that it is less isolated. Vegetation is often considered a buffer to waterways—riparian vegetation and wetlands protect both water quality and habitat from influences arising on the surrounding land.

Community
An association of populations of plants and animals which occur naturally together in a common environment.

Diversity and Pattern
Diversity is the variety and range of species of biological communities, ecosystems and landforms. Pattern refers to changes in species composition, communities and ecosystems along environmental gradients.

Ecological District
A local part of New Zealand where geological, topographical, climatic and biological features and processes, including the broad cultural pattern, interrelate to produce a characteristic landscape and range of biological communities.

Ecological Region
A group of adjacent Ecological Districts which have diverse but closely related characteristics, or in some cases a single very distinctive Ecological District.

Ecological unit
Vegetation type occurring on a particular landform or soil or rock type.

Ecosystem
Any inter-related and functioning assemblage of plants, animals and substrates (including air, water and soil) on any scale including the processes of energy flow and productivity (Myers *et al.* 1987).

Endemic
Occurring naturally in, and restricted to, a particular country, region or locality.

Exotic
Introduced to New Zealand; not indigenous.

Forest
Woody vegetation in which the cover of trees and shrubs in the canopy is >80% and in which tree cover exceeds that of shrubs. Trees are woody plants > 10 cm diameter at breast height (dbh) and shrubs are woody plants < 10 cm dbh. Tree ferns > 10 cm dbh are treated as trees (Atkinson 1985).

Habitat
The part of the environment where a plant or animal lives. It includes both the living and non-living features of the area.

Indigenous
Native to New Zealand. This includes species which occur naturally in New Zealand *and* other places (e.g. migratory bar-tailed godwits which return to New Zealand from Siberia every summer). Species which only occur in New Zealand are 'endemic'.

Landform
Descriptor of the distinctive naturally formed physical characteristics of the land, e.g. hillslope, gully, ridge top, etc.

Linkages/Corridors
An area of habitat which links two or more other areas of habitat. Depending on the habitat type, the linkage or corridor can comprise indigenous vegetation (e.g. forest, shrubland), exotic vegetation (e.g. pine forest), aquatic habitat (e.g. a farm pond) or any other feature which assists the movement of indigenous species between habitat patches. Where a linkage exists between habitats the opportunities for genetic exchange within a species are greater, which enhances the viability of that population. For many species, in particular mobile fauna such as birds, a corridor does not have to be continuous to be effective. Small remnants can act as stepping stones between two larger habitats.

Natural area
A tract of land which supports natural landforms and predominantly native vegetation or provides habitat for indigenous species; identified as a unit for evaluation of ecological quality and representativeness and has potential to be ecologically significant.

Naturalness
The degree to which a habitat is modified and disturbed by human activity or introduced plants and animals and what natural values are retained despite these factors.

Rarity
This is a measure of commonness and may apply to entire ecosystems through to single species. It may refer to the conservation status of a species (see Appendix 8.3) or habitat type in any one of the following ways: formerly common but now rare; confined to a limited geographic area; at the limit of its range; or with a contracting or fragmented range.

For example, old growth alluvial swamp forests are an extremely rare ecosystem type in Northland, and indeed nationally, even though they contain no species which are regarded as rare in themselves.

Reedland
Reedlands comprise 20–100% cover of reeds, which are tall erect herbs emergent from shallow water, having branched leaves or stems that are either hollow or have very spongy pith, e.g. raupo, *Baumea articulata* and lake clubrush (Johnson & Gerbeaux 2004, adapted from Atkinson 1985).

Regionally significant
Assessed by the Department of Conservation (Northland Conservancy) to be either rare or threatened within the Northland Region.

Representativeness
The extent to which an area represents or exemplifies the components of the natural diversity of a larger reference area. This implies consideration of the full range of natural ecosystems and landscapes that were originally found in the reference area and how well they are represented in the environment today. The reference period for 'original' land cover used for this study was the immediate pre-human era (late Holocene). The identification and evaluation of the key representative natural areas in all Ecological Districts is the principal objective of the PNA Programme (Myers *et al.* 1987). In this survey the concept of representativeness was applied at the level of ecological units.

Riparian protection
Riparian vegetation performs important protective functions to streams such as shading, sediment control, primary production and provision of habitat linkages/ corridors. Without riparian protection water temperature can rise depleting the available oxygen and leading to the death of aquatic life. Leaf litter and woody debris enters into the nutrient cycle of the stream providing food for the first consumer in the food web e.g. mayflies, caddisflies and stonefly. Riparian vegetation acts as a filter for non-point source water discharges.

Rockland
Land in which the area of residual bare rock exceeds the area covered by any one class of plant growth-form. Cliff vegetation often includes rocklands.

Rushland
Rushlands comprise 20–100% cover of rushes, which are *Juncus* spp., that have stiff, erect stems or similarly non-flattened leaves (Johnson and Gerbeaux 2004, adapted from Atkinson 1985).

Scrub*
Refers to early successional communities dominated by or with a > 50% component of exotic species such as gorse, woolly nightshade, hakea, wilding pine etc. This definition differs from Atkinson (1985), in which scrub is structurally defined rather than compositionally defined. In this study, scrub refers to vegetation dominated by exotic species. Low woody vegetation in which the indigenous component is > 50% is termed 'shrubland'.

Secondary vegetation
Indigenous vegetation established after destruction or disturbance of the previous vegetation and which is essentially different from the original vegetation.

Shrubland*
Indigenous vegetation in which the cover of shrubs and trees in the canopy is > 80% and in which shrub cover exceeds that of trees. Trees are woody plants > 10 cm diameter at breast height (dbh) and shrubs are woody plants < 10 cm dbh. Tree ferns > 10 cm dbh are treated as trees. This definition combines both indigenous 'scrub' and 'shrubland' cf. Atkinson (1985). These two classes had to be amalgamated as 'scrub' adopts another meaning in this study.

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* This term was adopted by earlier PNAP surveys in Northland to refer to vegetation types, as defined below. This definition has been retained for this study to provide consistency in interpretation of the Northland Region DOC PNAP reports.

Site
An area of habitat or habitats identified during the field survey phase of the PNAP. Some small habitats occurring in close geographical proximity, with similar characteristics and functions, have been grouped and addressed as one site e.g. forest remnants and wetlands within the same catchment.

Succession
Succession is the dynamic process whereby one plant community changes into another, involving the immigration and local extinction of species, coupled with changes in the relative abundance of different plant species (Crawley 1997). Change may be due to natural or human-induced factors, or both. Primary succession refers to the colonisation of a bare surface by vegetation (e.g. the greening of new volcano after it erupts out of the sea). Secondary succession refers to the process of colonisation and change after original vegetation has been destroyed, e.g. by fire, human-induced land clearance, etc.

Survey no.
A sequential number given to each site (e.g. Q08/220). The first letter and two figures refer to the NZMS 260 topographical map sheet on which the site is shown.

Sustainability
The long-term ecological viability of a natural area. This is related to the size and shape of the area as well as to threats from introduced pests.

Treeland
Vegetation in which the cover of trees in the canopy is 20–80%, with tree cover exceeding that of any other growth form, and in which the trees form a discontinous upper canopy above either a lower canopy of predominantly non-woody vegetation or bare ground (Atkinson 1985), e.g. 'totara treeland' refers to a common type in Waipu Ecological District in which sparse totara trees are emergent over an understorey of mainly exotic grasses and herbs. Treeland is mainly induced by grazing.

Vegetation type
The most detailed vegetation descriptive name employed in this study, defined by the composition of dominant canopy species, in order of abundance (e.g. taraire–puriri–kahikatea) and the structure of the vegetation, e.g forest, treeland, shrubland, reedland, etc.

Viability
The ability of natural communities in the site to maintain themselves in the long-term in the absence of particular management efforts to achieve this. Regeneration and vigour of species within these communities and stability of communities and processes contribute to viability.

Wetland
An area of land that is permanently or intermittently waterlogged and supports flora and fauna adapted to wet conditions. Wetland is used as a broad definition for several types of aquatic systems, e.g. ponds, lakes, swamps, bogs, ephemeral wetlands, saltmarshes, mangroves, etc.

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