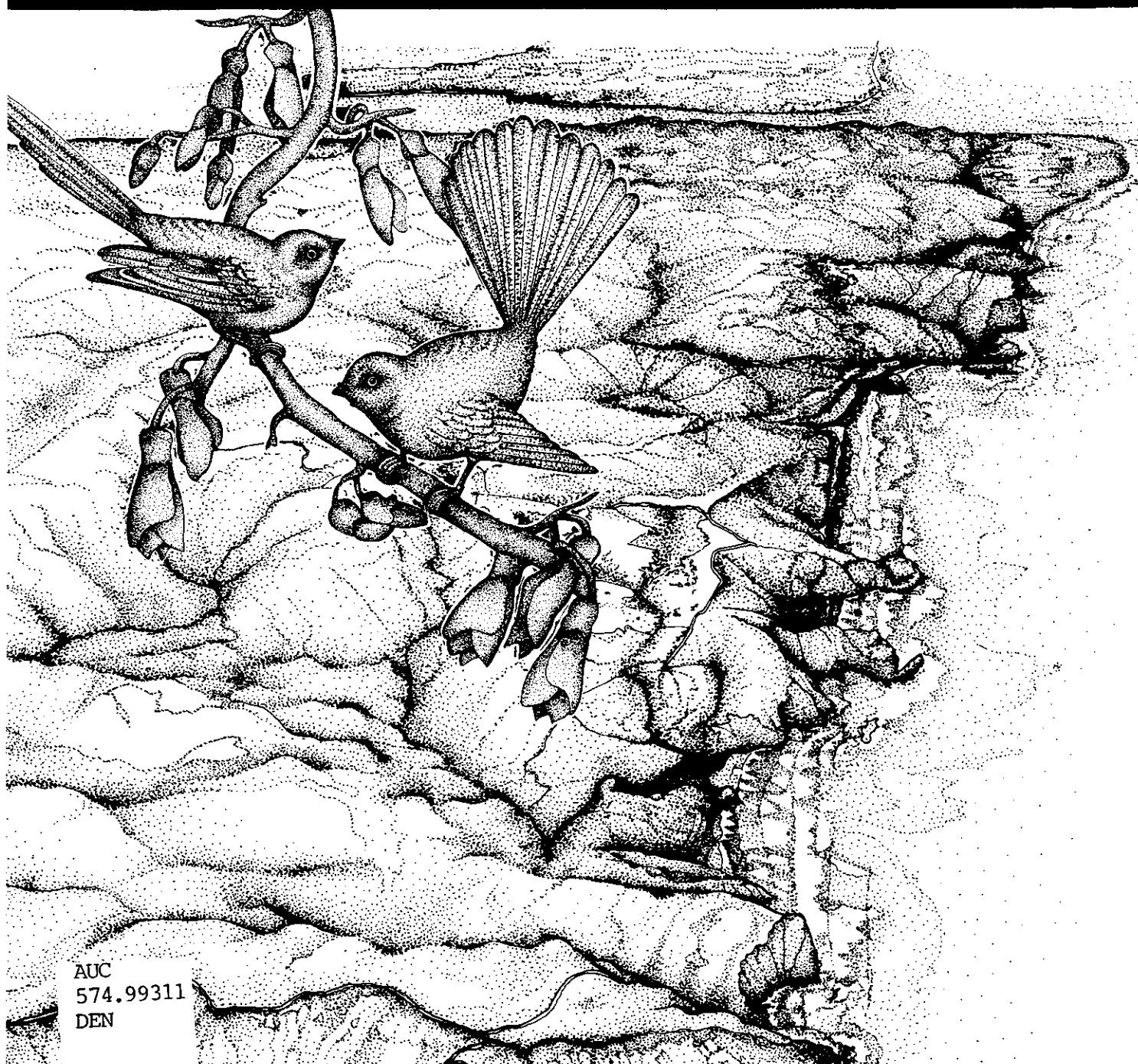


WAITAKERE ECOLOGICAL DISTRICT



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SURVEY REPORT FOR THE PROTECTED NATURAL AREAS PROGRAMME

AUCKLAND REGIONAL COUNCIL

Looking south over the Waitakere Ranges towards the Manukau Harbour and Awhitu Peninsula. Anawhata Beach in the foreground
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WAITAKERE ECOLOGICAL DISTRICT

Survey Report for the Protected Natural Areas Programme

K. Denyer, M. Cutting, G. Campbell, C. Green, M. Hilton

**New Zealand Protected Natural Areas
Programme No. 15
ISSN 0112-9252**

ISBN 0-908938-00-4

**Published by the Auckland Regional Council,
Private Bag 68 912, Newton, Auckland.**

1993

PREFACE

The Protected Natural Areas Programme was pioneered by the New Zealand Biological Resources Centre on behalf of the National Parks and Reserves Authority and is a New Zealand wide Department of Conservation programme.

Fieldwork for the Waitakere Ecological District Protected Natural Areas Programme (PNAP) survey was carried out in the summer of 1988-89. The survey was one of two carried out by the Auckland Regional Council, in conjunction with the Department of Conservation. The survey and this report follows the standards which have been set for the programme. The final report has been formally reviewed and accepted by the Department of Conservation, Head Office.

In addition to meeting the objectives of the PNAP itself, the prime purpose of the survey was to obtain scientific information to enable the ARC to assess its landholdings in the District and develop appropriate management approaches, to ensure the long term protection of the best representative natural areas in its ownership.

The natural character of the Waitakere Ecological District is represented for the most part by a continuous expanse of native vegetation. Despite its continuous nature, most of the vegetation and habitats in the District have been extensively modified. However, the District's ecology is remarkable for its rapid return to a natural state and for its richness and diversity of species and habitat.

The existing reserve network in the District is already extensive and in many instances contains the best examples of the range of the ecological characteristics. Analysis of the existing reserve network however, shows that it is not fully representative of the District's natural character. Under represented or completely missing in the reserve network are many coastal terrestrial vegetation types, sand dune communities, saline wetlands and major freshwater ecosystems.



SUMMARY

This report describes the Protected Natural Areas Programme survey of the Waitakere Ecological District which covers 29,157 ha, in the Auckland Ecological Region. The phases of preparation, field survey, analysis and selection of Recommended Areas for Protection are detailed.

Most of the District was covered in the field survey using the rapid ecological survey methodology of non area plots for all vegetation types except bluffs where descriptions were recorded. Physical areas and priority landform sites for protection were identified primarily from secondary sources, followed by field checking. Selected areas with high faunal values were also surveyed mainly using Sites of Special Wildlife Interest (SSWI) recording methods. The water supply reservoirs were electric fished and a detailed sampling survey for Hochstetter's frog was also carried out in a selected catchment. Noxious animal damage reconnaissance was undertaken in selected vegetation types.

Vegetation canopy cover abundance data for 660 sample sites of terrestrial communities, freshwater and saline wetlands and other coastal vegetation communities were classified using the species indicator computer programme, TWINSpan. Forty three vegetation classes were derived from the analysis. Fourteen physical areas were identified in the District.

The flora of the District is diverse containing 540 indigenous plants. Several rare and endangered species are present, with some being restricted to the District.

Seventy one bird species are known from the District, nineteen of which are birds introduced to New Zealand. Several thousand insect species are recorded from the District, and the District is the type locality for over 200 species. Over 100 species of land snails are known from the District. Eleven freshwater fish, five lizards and Hochstetter's frog are also found in the District.

From the survey results and evaluation, twenty one Recommended Areas for Protection (RAPs) are identified. All are first priorities for protection and in total are equivalent to 12,159 ha or 42% of the District. Many of these RAPs are already in public ownership with varying levels of formal conservation status.

The RAPs are distributed across the District. Three combine to cover a substantial part of the interior of the District. Nine RAPs identify large areas along both coastlines in the District, identifying many diverse habitats that characterise the District's flora and fauna. The RAPs range in size from 10 to over 4,000 ha.

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ACKNOWLEDGEMENTS

The authors of the report wish to thank all those who assisted with the Waitakere Ecological District PNAP survey. In particular we are greatly indebted to the following people.

All the landowners in the District who permitted access onto their land.

The Auckland Regional Council Parks and Water Services Staff. In particular, Bill Beveridge and Ross Sleeman and their staff who provided expert guidance through the remote areas of the District. Also the Regional Parks and Regional Planning staff who helped in the field survey.

The following people who provided their scientific knowledge and advice: Ewen Cameron, Auckland University, Botany Department; Alan Esler and Bruce MacMillan, DSIR; and Anthony Wright, Auckland Institute and Museum. Also to Alastair Jamieson and John Stewart for their contributions to the text revision (landforms).

The many organisations who provided their information and assistance; including the Ornithological Society of New Zealand (Auckland Branch); DSIR, Plant Protection; Entomological Society of New Zealand (Auckland Branch); Herpetological Society of New Zealand (Auckland Branch); Auckland Botanical Society, Royal Forest and Bird Protection Society (West Auckland Branch), and the Auckland Regional Water Board.

The Waitakere City Council Parks Officers, for information on reserves administered by the Council.

The Karekare and Piha Surf Lifesaving Clubs, Andy Pederson and Bob Harvey for accommodation during the survey.

Don Scott Film Productions, in particular Ashley Scott, and the Westpac Rescue Helicopter for providing resources to produce an aerial video of the District. David Kuridza for flying members of the field team over the District during the pre reconnaissance phase of field survey.

Brian McClure for feeding the field team and greatly enhancing morale during the field survey.

Also acknowledged are:-

Department of Conservation, Head Office staff for commenting on and reviewing the report, namely Philip Simpson, Shona Myers, John Gallie and Peter de Lange.

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CHAPTER ONE:

INTRODUCTION

1.1 The Protected Natural Areas Programme

The goal of the Protected Natural Areas Programme is to facilitate by way of the assessment of existing ecological data and targeted field survey, the identification and protection of representative examples of the full range of indigenous biological and landscape features in New Zealand (Park and Kelly, 1986). The programme's goal is derived from the objective expressed in Section 3(1)(b) of the Reserves Act 1977, which states that one of the purposes of reserves is:

"Ensuring as far as possible, the preservation 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."

To achieve this, New Zealand has been divided into 268 ecological districts, grouped in 85 ecological regions (McEwen, 1987). An ecological district is an area of New Zealand which is considered to be an ecologically cohesive unit with respect to geology, topography, climate, biology, and human modification, and forms a distinctive and recognisable entity.

The Auckland Ecological Region is an insular area of eight ecological districts capturing a diverse range of ecosystem types including coastal lowlands, consolidated sands, uplifted and deeply dissected hillcountry, volcanic hills, lowland hills and inner gulf islands. The Region has a long and intricate coastline and a temperate maritime climate which sustains naturally a vigorous complex of species rich forests and varied landscape patterns. Today most of the region is highly modified and is the home of one in four New Zealanders.

The Waitakere Ecological District lies immediately to the west of metropolitan Auckland (Figure 1.1). The District has been greatly affected by the growth and associated pressures of having one of the earliest settled and now largest city in New Zealand at its doorstep. Despite this it retains a natural character of intrinsic value which is uniquely its own.

Within the District, much of the Waitakere Ranges is now owned and managed by the Auckland Regional Council (ARC) on behalf of the people of Auckland. The water supply catchments have been until recently managed by the Water Services Department. They are now managed by the Regional Park Department as are the peripheral catchments which form the Waitakere Ranges Regional Parkland.

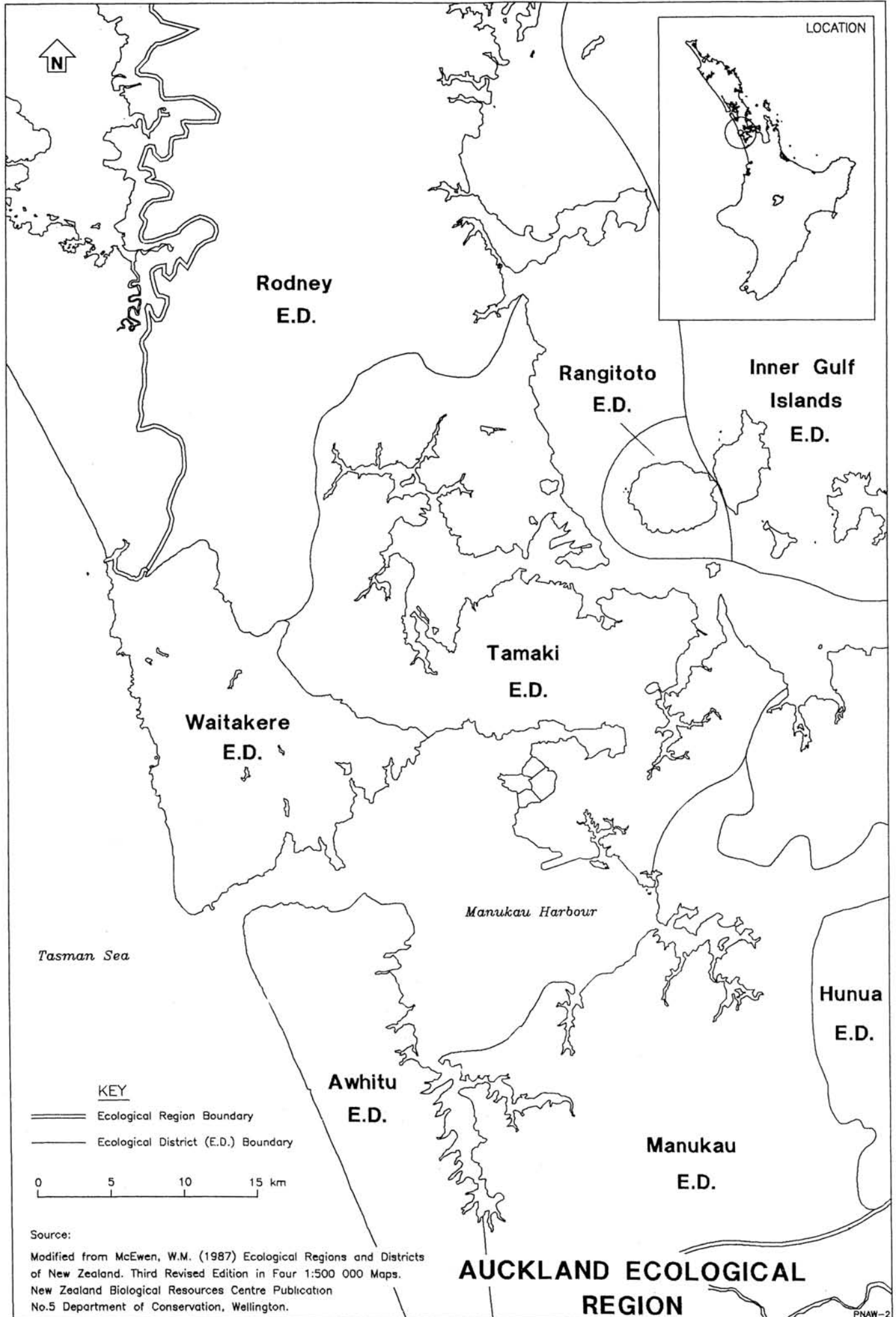
Waitakere Ecological District was not one of the national priority districts for survey in the PNA Programme, because so much land is already in public ownership. However it was evident to the Regional Council that much of that land was not secured in a protective tenure, nor were the priorities for conservation management clearly identified. Furthermore it was evident that the publicly owned land was confined to the hills and coast, and some ecosystem types, e.g. wetlands, were not in protected tenure. The Regional Council accepted that it had a primary lead role in addressing these matters and it commenced this survey with the goal of identifying and protecting the full range of indigenous biological and landscape features in the District.

The objectives of the survey were:

- 1) To assess the full range of ecosystems in the District and identify those places that are the best representative examples of each ecosystem through reconnaissance survey of all natural areas.

Figure 1.1

THE LOCATION OF THE WAITAKERE ECOLOGICAL DISTRICT



- a) To survey vegetation, wildlife and landforms separately, but to integrate the results in a comprehensive assessment of the Ranges.
 - b) To survey coastal areas, to low water mark.
- 2) To advise the ARC on the appropriate management for the long term protection of the best representative natural places in its ownership.
 - 3) That where representative classes of ecosystems are not adequately protected, to develop and implement a programme of action to achieve their effective protection.
 - 4) To establish and maintain a comprehensive information base on the natural character of the Waitakere and Hunua Ranges and to ensure that appropriate information is available to managers and for interpretation for public use.¹

This report describes the results of the survey and outlines the process of evaluation leading to the identification and recommendation for protection of the best representative examples of natural ecosystems found in the Waitakere Ecological District. The report also describes these selected areas, as well as the District's ecology, in terms of vegetation, landform and wildlife values.

1.2 Introduction to the Waitakere Ecological District

Ten million years ago, volcanic activity ceased in what is now the Waitakere District and a stage of uplift occurred. This activity lifted the Waitakere, Hunua, Coromandel and Port Waikato hills. The accompanying down faulting formed the Manukau and Kaipara Harbours and the Firth of Thames. Since that phase of uplifting, the volcanic sediments have been eroded to form the Waitakere Ranges which dominate the landscape of the Waitakere Ecological District.

The District is 29,157 ha in area. Altitude ranges from sea level to 474m. Much of the District is still in native vegetation.

The southern boundary of the District, at the Manukau Harbour, is a steep fault scarp which becomes more subdued towards Auckland City. The inland boundary extends from Muriwai in the north, to Green Bay in the south and includes all of the uplifted Waitakere Ranges and foothills. The Ranges give way abruptly to the lowlands of the Auckland Isthmus to the east. The northern boundary, with Rodney and Kaipara Ecological Districts, follows the Mokoroa catchment boundary which generally accords with the boundary between the volcanic Manukau subgroup rocks and the Kaihu sands. To the west the District is bounded by the Tasman Sea.

The District is significant in the context of broad ecological patterns in the Region. It encompasses one of the two largest blocks of continuous native vegetation left in the Region. As such it contains a high diversity of vegetation and wildlife associations. The District's location with respect to major wildlife habitats is also significant with the Manukau Harbour, on the southern boundary, having a wading bird habitat of international importance (one of three in the Region, including the Kaipara Harbour and Firth of Thames).

1. Based on ARA agendas, August 1987 and July 1988, on project briefs for the survey and the information brochure distributed to the public.

In pre European times the vegetation of the Ranges was dense rainforest (podocarp - broadleaf) with kauri forest on the eastern slopes and ridges (Millener, 1965). After more than a century of intensive modification, the District's vegetation has few areas of pre European forest left. It is now composed of extensive areas of regenerating and successional vegetation providing significant wildlife habitats.

The Waitakere District has a history of human modification and use extending back one thousand years. The coastal fringes of the District were extensively modified in the pre European era. The interior of the District however, was left virtually untouched during this period. In the last century the District has been modified by extractive industries. Timber milling drastically altered the original characteristics of the vegetation and wildlife habitats, by selective species removal or clearfelling. Other industries included flaxmilling, gumdigging, mineral extraction and quarrying (Murdoch, 1991). Farming also resulted in extensive areas being cleared of their original vegetation.

One major ecological modification was ultimately to lead to the opportunity to preserve a large part of the selectively logged but regenerating indigenous forest in the District. This was the development of a water supply headworks system for metropolitan Auckland. Initially large areas of forest were cleared for the reservoir lake beds and dam sites. To ensure the purity of the water supply, the catchments were retired from development and allowed to recover naturally. The closing of the catchments at that time allowed the regeneration of 2,610 ha of forest, which, by the late 1930's, provided the only example of a large area of indigenous forest in the Auckland Region which had some form of protection. This land also provided the focal point for the creation of the Auckland Centennial Memorial Park (Murdoch, 1991).

1.3 Brief Description of the Waitakere Ecological District

Much of the Waitakere Ecological District comprises lava and associated breccias, conglomerates, water-sorted volcanic sands and tuffs resulting from eruptions of andesitic lava from volcanic islands off the west coast of the District (Manukau Breccia Formation). These rocks overlie an earlier sedimentary bed of sandstone and muddy siltstone (Waitemata Formation).

The southern Waitakere Ranges have an extremely rugged, deeply-dissected topography, illustrating the resistant nature of these rocks to erosion. In comparison the north of the Waitakere Ranges is relatively undulating due to the occurrence of fewer lavas, volcanic breccias and andesites, and more volcanic sands and ashes. North of Te Henga Beach, the Ranges are mantled with a veneer of consolidated sands (Kaihu Formation) which forms a subdued topography of low relief.

The western boundary of the District contains all the features characteristic of a bold rocky coastline experiencing rapid marine erosion. The prevailing westerly wind produces prolonged periods of high energy wave conditions which lead to this erosion. Much of the coastal landscape is dominated by cliffs, intertidal platforms, islands, stacks, caves and blowholes. Dune fields are present in the shallow embayments. The District contains the largest contemporary sand accretion in the Region, known as the Whatipu Sands, and significant dune lake ecosystems at Te Henga.

There is a pronounced coastal bioclimatic zone where the exposure to wind and waves has defined distinct and varied coastal communities of plants, animals and landforms. Obvious examples include the Australasian gannets nesting on Motutara stack, and the wind-blown sand deposits of Whatipu. At the latter, dunefields of pingao and spinifex, together with small seasonal wetlands, provide habitats for a range of coastal birds, such as the threatened New Zealand dotterel and variable oystercatcher.

Along most of the coastline the vegetation has been modified, but in some places continuous coastal to inland vegetation sequences still remain. Also remaining, despite modification, are wildlife species now rare in other west coast localities, such as the grey-faced petrels nesting in the Piha - Karekare area. Coastal habitats have probably suffered a smaller loss of faunal species than forested areas. Both New Zealand and international migrant species of wading birds still use the intertidal feeding areas and northern blue penguins still come ashore at night. The four seabird species (grey-faced petrel, sooty shearwater, diving petrel and fleshfooted shearwater) found on Kauwahaia Island may be a vestige of the seabirds which, although now rare on the west coast of the North Island, were once characteristic of the Waitakere western coastline.

The District contains the largest freshwater wetland (Te Henga) in the Auckland Ecological Region, which supports a range of vegetation classes and structural types. Such diversity is also reflected by the high number of wildlife species in the wetland, including threatened species such as Australasian bittern, North Island fernbird, banded rail plus the secretive marsh crake and spotless crake. Threatened plant species such as the native carnivorous bladderwort are also present in the wetland.

The District's terrestrial ecology also has a number of distinctive features. Most obvious is that the District, for the most part, is characterised by a large continuous block of forest and scrub over much of the Waitakere Ranges. The large size of this forest block has, at least in part, aided the survival of several bird species in the District, such as pied tit, New Zealand falcon, New Zealand pigeon, together with migrant North Island kaka and long tailed cuckoo. Other wildlife species (such as Hochstetter's frog and the kauri snail which are found in restricted localities in the Ranges) have survived because of the high quality of habitat present.

The vegetation classes found in the District are complex and typical of northern New Zealand where more than one species can be dominant in the canopy. In many instances the vegetation classes are surprisingly distinctive compared to others in the Region. There remains in the District extensive mature podocarp forests, much less modified than those in the Hunua Ecological District. The mature kauri forests left in Waitakere Ecological District are quite different in structure and associated canopy or mid tier species than those in the Hunua, Rodney and Waipoua forests. In the mature kauri forests in Waitakere, kauri and the occasional podocarp species emerge over a very low mid tier of *Gahnia* species, kauri grass, kiekie and mingimingi whereas in Hunua Ecological District, kauri is associated with hard beech (and in the only relict site surveyed, kauri towered above a mid tier of heketara and kohekohe). In Rodney and Waipoua forests, kauri tends to emerge over a taraire canopy.

A number of other distinctive vegetation classes are closely associated with the physiography of the District. While the District lacks vegetation and habitat associated with climatic extremes (away from coastal influences), there are upland podocarp forests, where species associations reflect an increase in precipitation. In association with the highly dissected nature of the southern ranges in particular, unique vegetation associations occur on bluffs and cliff tops with Waitakere endemic species and a kowhai variety. The District also contains a gumland association at Cornwallis in the south, and on the more subdued topography of the north-western coastal foothills unusual associations of divaricating plants are found. The Whatipu sand accretion forms a unique landform in the Region and provides significant habitat for both wildlife and vegetation communities.

The species of wildlife found in the District generally reflect the past history of habitat modification caused by forest clearance, timber extraction, and predator introduction. This modification has resulted in the loss of several species from the District, including North Island kokako, North Island brown kiwi, North Island weka, whitehead and bellbird. Freshwater habitats have lost brown teal, scaup and New Zealand dabchick. Introduced predators are also likely to have caused the decline in lizard diversity with only five species being found during the survey.

Forest clearance, pastoral farming, and reservoir development have probably resulted in the loss of freshwater and alluvial communities. Apart from Te Henga there are few wetlands in the District and these only make up a small area. Creation of large water reservoirs in both upper and lower catchments of several waterways in the Ranges has reduced the area available for spawning of several freshwater fish species. It is possible that some species such as red finned bully, common bully, long finned eel and possibly even koaro, may also be land-locked due to damming. (Grogan, pers. com.) Other wildlife species have taken advantage of the new habitat, however, such as the black shags nesting on the edge of the Waitakere Reservoir.

During the last century, the close proximity of the Ranges to Auckland City resulted in it becoming a popular collecting area for early entomologists. Because of this at least 200 species of insects have had their type locality recorded from within the District. The mild climate and high diversity of plant species has fostered a high diversity of invertebrates, for example over 700 species of beetles have been identified from a forest area near Te Henga. The District also has a number of endemic insect species. Land snail species recorded from the Ranges number 100, which is equivalent to 20% of the known New Zealand fauna (Slaven, 1989).

1.4 **Conservation Issues**

The Waitakere Ecological District is on the doorstep of New Zealand's largest metropolitan centre, which houses close to one million people. For many people living in Auckland, the District contains accessible recreational resources of forest and sea, and as a consequence, experiences high recreational use. It has been estimated that in 1987, the District was visited by over three quarters of a million people (ARA, 1988). One of the major factors that attracts people into the District is its natural environmental qualities (ARA, 1988). However the numbers of people using the District's recreational resources are putting at risk the very qualities that they value in the area. Further research and monitoring will be needed to establish the 'carrying capacity' of ecosystems in favoured recreational areas of the District. Intensive recreation has had an impact in some areas. Other places need careful control of both people and wild animals to ensure that associated wildlife values remain intact. An accommodation of both recreation and conservation needs, based on an understanding of the ability of particular ecosystems and landforms to survive continued recreation use, must be found if the District's ecosystems are to remain intact and evolve in the future.

- Many people also live in the Waitakere Ecological District. Here more than anywhere else in New Zealand, residential urban development has taken place within a forested landscape. In addition to scattered coastal settlements, the eastern fringe of the District contains "extensive" residential development. People, their pets, and the rodents that are associated with human settlement have reduced wildlife values in these areas. Increasing subdivision and development continues to fragment the vegetation cover in the forest fringes of the District, undermining the ecological qualities of these areas. Increased population pressure has also resulted in an increased demand for infrastructure services such as sewerage systems, and wider community and commercial pressures for refuse landfills, quarries and transmitter towers. The development of all these activities disturbs the natural environment and the density and location of continued urbanisation of the District is a major strategic issue facing Auckland.

The natural processes of succession and invasion dominate the dynamics of the ecological character of the District. The District's warm and moist climate has ensured the rapid success of both native plant regeneration and exotic plant invasion. Natural vegetation has been influenced by a range of alien plants introduced into the District, in some cases as early as the first European settlement over 150 years ago (Esler, 1987). Many of these plants have successfully naturalised, to the point where they are now considered to be problem weeds, and some will alter natural regeneration processes. They are often shade tolerant and now proving difficult to eradicate. The suppression of native regeneration by weeds requires urgent attention in many parts of the District.

The presence and increasing numbers of possums, rats, cats, stoats and other feral animals continues to have an impact on plant regeneration and the breeding success of the District's fauna. Possums have had a dramatic impact on particular forest classes in the District. Of most concern is the impact on the coastal pohutukawa forests. A number of individual forest species including rata, Hall's totara, and kohekohe are also being damaged and destroyed. Possums, if left unchecked, will irrevocably change the forest composition and character of the District, particularly on the pohutukawa fringed coastline. The effect of cats, rats and possums on the District's wildlife and habitats is also a concern. It is imperative that future management of the District's ecosystems deals with these problems.

Another major issue is the human modification which has altered the ecology of the District in many ways, both obvious and subtle. Only a few areas of unmodified forest are thought to remain in the Ranges and even these may have been selectively logged for at least one species.

In the water catchment areas natural regeneration patterns have been influenced by human interference. Records indicate that Auckland City Council waterworks staff, in localised areas, actively spread seed and planted seedlings (Murdoch, pers. com.). How much this would have confounded the regenerating patterns based on the natural seed bank and distribution mechanisms is not known.

The Te Henga wetland has developed as a result of both the construction of the Waitakere dam in 1910 (raised in 1926) and siltation after the removal of forest cover in the catchment in the early 1920's. As such it is a natural swamp primarily formed as a result of a series of human impacts in the catchment.

The distribution and abundance of plant species in the District has been altered by human activities. The massive modification which has occurred in the forest areas of the District may have favoured the light tolerant kiekie to become the major component of the understorey in many places. Taraire, like karaka, seems to be closely associated with pre European Maori settlement and the current localised distribution of taraire in a few isolated catchments may well be an expansion of its range as a result of Maori cultivation practices, rather than resulting from a natural distribution pattern. Many species such as kauri, kahikatea, totara, rimu, matai, tawa, puriri and northern rata were extensively milled (Murdoch, 1991) resulting in forest classes of altered composition and distribution.

From the above conservation issues it is clear that the ecology of the District is still vulnerable to change. In the past these ecosystems have shown their vulnerability to environmental change. However, in spite of this, the Waitakere Ecological District contains a valued natural environment of national significance. "It is a priceless heritage of great intrinsic value to the people of Auckland Region and beyond" (ARA, 1985). As such, the future use of all lands in the District needs to have regard to these values which warrant careful management.

1.5 Survey Methodology

A comprehensive account of the pre-survey work, survey method and analysis is recorded in Appendix 3.

The organisation of the vegetation survey was based on the PNAP methodology for rapid ecological survey. The survey methodology was extended to include saline and freshwater wetlands. Recognising the strength of the PNAP methodology in dealing with vegetation and landform, efforts were made to match this in wildlife survey. The Department of Conservation resurveyed the Sites of Special Wildlife Interest (SSWI) for the Waitakere PNAP survey, a small survey for Hochstetter's frog was carried out and the freshwater fish populations in the Waitakere reservoirs were also surveyed. As part of the study a report (Slaven, 1989) was prepared collating the available information on faunal features of the District. Noxious animal damage was

also surveyed at the same time using methodology devised in the Hunua Ranges (Barton *et al*, 1990).

In this way a balanced ecological statement about the District has been obtained. Information from various disciplines has been integrated in the evaluation and decision making process leading to the selection of recommended areas for protection.

1.6 Field Survey

The vegetation field survey was carried out by six field teams composed of botanists accompanied by Regional Council field staff. Four of the botanists had used PNAP methodology in the Region prior to the Waitakere survey. The wildlife survey and data collection was carried out by staff from the Department of Conservation and Ecology Division, Department of Scientific and Industrial Research (now DSIR Land Resources). A noxious animal damage survey was carried out by ARC Operations staff. The Regional Water Board co-ordinated and implemented freshwater fish surveys, after the main field survey. All components of the field survey ran in the period from December 1988 to April 1989.

1.7 Vegetation Classification

The vegetation was classified using the Cornell programme, TWINSPLAN, which was run on the Auckland University IBM computer. Modification and species richness in canopy has lead to the usual difficulty experienced in sampling and classifying northern New Zealand forest types. Continua between classes and sample sites made classification difficult (See section 2.4.1).

1.8 Data analysis, storage and access

The PNAP survey data were entered and stored on an IBM compatible, Tandon AT personal computer, using dBASE IV software. The computer data are stored as part of the Environment and Planning Division's natural environment information system, within the Environmental Management Department, ARC. The field cards are stored in a fire safe within the Council building and copies of the data printouts are stored in the Parks Department. Accompanying information such as aerial photographs, video, maps and unpublished reports such as that on the history of the District (Murdoch, 1991) which were used in report preparation are stored in the Environmental Management Department's natural environmental information system which includes a computerised natural resource bibliography stored on an Inmagic software system.

The SSWI survey information is stored in the Department of Conservation, Auckland Conservancy and can be accessed from the Department. The Hochstetter's frog, and freshwater fish survey information is presented in an accompanying report to the PNAP survey report (Slaven, 1989). The detailed physical areas report is also a supplementary document to this one (Hilton, 1988). 1:50 000 maps showing the boundary of the District are held by the Auckland Regional Council and the Department of Conservation, Auckland Conservancy.

CHAPTER TWO:

ECOLOGICAL CHARACTER OF THE WAITAKERE ECOLOGICAL DISTRICT

2.1 Introduction to the Physical Geography of the District

Hayward (1979) summarises the understanding of the development of the Waitakere Ranges in the following description. 'During the early Miocene epoch the Auckland Region was under the sea. A deep marine basin, known as the Waitemata Basin extended from Dargaville in the north to Hamilton in the south. To the east it was flanked by a landmass stretching from Whangarei Heads through Great Barrier to Coromandel Peninsula, composed of greywacke rock. In a number of areas volcanoes erupted lava and ash onto the land. Sediments eroded from this landmass collected in the basin, as a sequence of alternating mudstones and sandstones (the Waitemata Formation).

The Waitemata Basin was bordered to the west by a line of volcanic islands, situated 5 to 10 kilometres off the present west coast of Northland. Three major volcanoes were sited offshore from the Waitakere Ranges, Kaipara Heads and Hokianga Harbour. As these volcanoes grew they contributed increasing quantities of volcanic material (pebbles and smaller particles of volcanic rock) to the sediments accumulating in the Waitemata Basin. At times large masses of unconsolidated volcanic debris on the upper slopes of the submarine volcano became unstable and flowed as mudflows or underwater landslides into deeper parts of the basin. These mudflows came to rest on the sea floor as thick layers of volcanic pebbles, grit and mud sitting on the thinly bedded sequence of the Waitemata Sandstones.' The volcanic sediments and intrusions of the Basin were ultimately consolidated and uplifted in the Pliocene, and have been eroded to form the Waitakere Ranges since that time.

The Waitakere Ecological District is therefore essentially an uplifted block of land with a pronounced relief. The nature of the District's origin is now reflected in its remnant volcanic landforms and in its resistance to erosion. In the interior of the District this general relationship is characterised by a series of gorges and waterfalls reflecting changes in the local resistance of rocks to erosion. Such features are unique in the Auckland Ecological Region. The impact of active erosion on a volcanic coastline has resulted in a spectacular landscape. Remnants of volcanic features occur down the length of the west coast, perhaps best exemplified by the pillow lavas at Maori Bay.

The climate of the Waitakere Ecological District generally reflects that of the Auckland Region. It is therefore mild because of its maritime location, lacking in extremes of temperature, rainfall, and wind. There are some significant microclimatic effects however, occurring as a response to the relatively high exposure to prevailing westerly winds and marine processes, along the high energy Tasman sea coast. Rainfall, temperature and wind experienced in the District reflect this exposure in comparison to the east coast of the Region. Rainfall is doubled together with an increase in the number of rainy days. The elevated plateaus of Waitakere and Hunua Ranges experience lower mean annual temperatures than the Region generally, however this overall variation is minor.

2.1.1 Classification of the Physical Environment

One of the key elements of PNAP survey and evaluation is the classification of the physical environment of the District, with respect to its climatic and physiographic features. Thus the District is divided into bioclimatic zones and physical areas which identify areas of a similar nature. As part of this process also, the best representative features of the District's landform assemblages have been chosen as priority landform sites. In the Waitakere instance, these sites are often smaller features within the large physical areas, which are especially reflective of the geological processes that have operated in the District.

2.1.2 Bioclimatic Zones

Two bioclimatic zones are recognised in the Waitakere Ecological District (Figure 2.1) - coastal and lowland. The coastal bioclimatic zone comprises the coastal margin of the District along the Tasman and Manukau coasts. Along the Tasman Sea coast in particular, this zone of land is exposed to frequent high south-west and westerly, on-shore winds. These winds have a pronounced influence on habitats present here. Strong winds and waves during storm periods subject the coastal flora and fauna to frequent wind shear and salt spray stress.

The second bioclimatic zone which comprises the rest of the District is considered to be lowland. While there are species which are restricted to within the coastal bioclimatic zone, the distribution of other "coastal" species such as pohutukawa, can not be rigidly defined by the zone and reflect instead the variable extent of coastal influences. These influences can extend far into coastal catchments, particularly on the western and southern edges of the District. In this respect much of the District can be considered coastal in nature.

2.1.3 Physical Areas

Physical areas are units of the land surface that have a distinctive ecological character, and which reflect the local importance of a geomorphic, climatic, soil-related or hydrological process. The definition of physical areas relies on the identification of natural process(es) that impart specific characteristics on ecosystems. Some physical areas can be defined by a single geomorphic or bioclimatic process. In others the concept is more difficult to apply as no one factor or process may be of fundamental importance in accounting for the ecological character of a physical area.²

Nine physical areas are identified. A summary table of the extent of these physical areas is presented in Table 2.1 with a description of each physical area class below. Figure 2.1 presents a map of the location of each physical area.

2.1.4 Physical Area Descriptions

1. **Unconsolidated Sand**

Unconsolidated (Holocene) coastal dune and beach sands.

This physical area describes those areas formed or influenced by aeolian (wind blown) processes. Two places stand out as particularly significant dune areas - Whatipu and Te Henga. Both are considered to be unusual features in the context of the West Coast. Whatipu is an area of sand accretion and this kind of sand movement is unusual in historical times. In this instance the formation appears to be related to the increased erosion of the Awhitu coast following entrapment and removal of Waikato River sands. The Whatipu physical area extends from Whatipu to Cowan Point, north of the Pararaha stream and is inclusive of saline wetland and ephemeral lake features of the dune sand.

The Te Henga dune area is also unusual because dune formation and landward transgression along the West Coast is not usually confined within an embayment. The dune complex at Te Henga is considered to be a classic example of its type.

2.

"Physical areas" are a refinement of the "land systems" approach used in other PNAP survey reports.

Figure 2.1

PHYSICAL AREAS AND BIOCLIMATIC ZONES OF THE WAITAKERE ECOLOGICAL DISTRICT

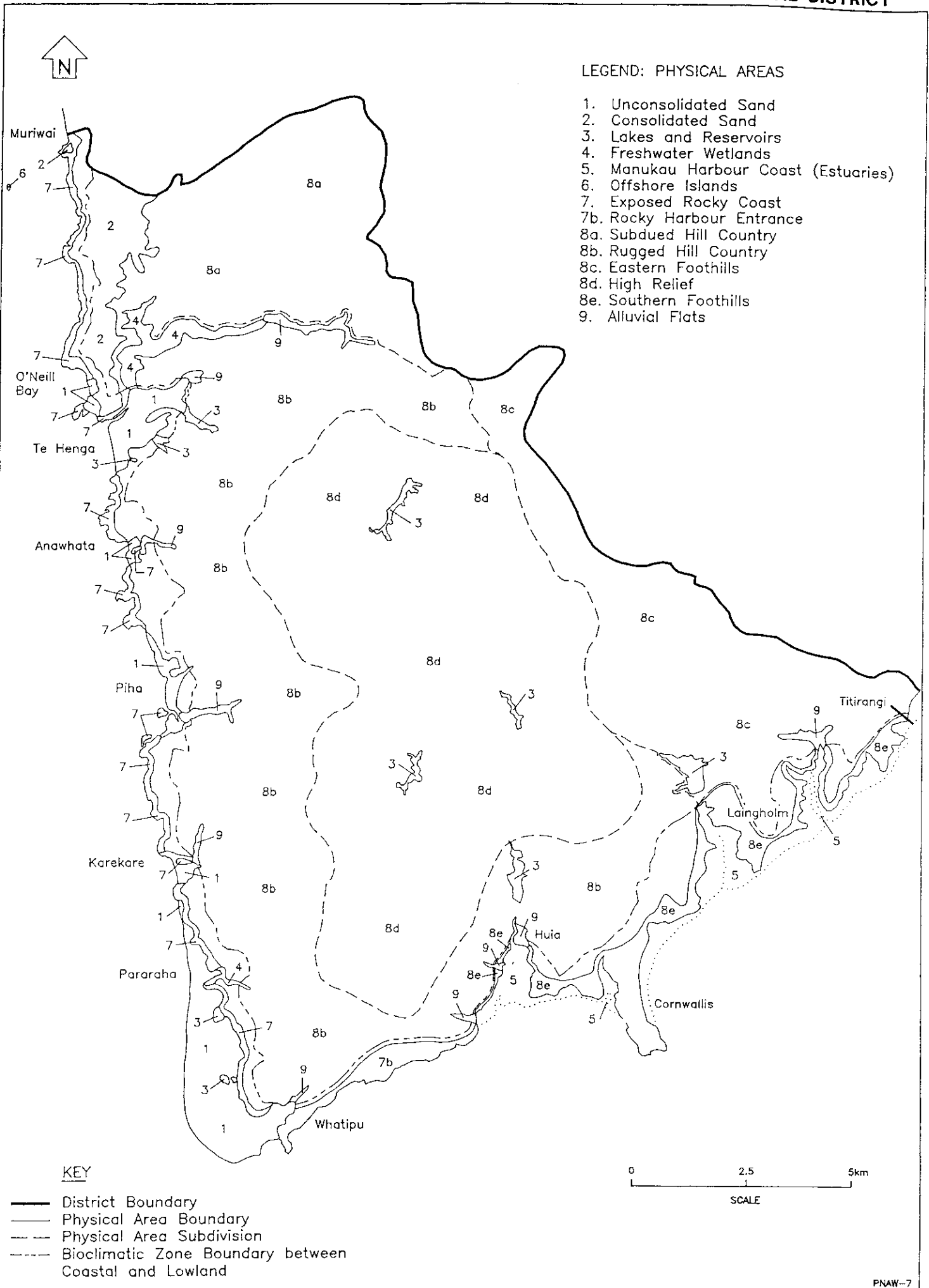


Table 2.1 Extent of Physical Areas in the Waitakere Ecological District

Physical Area (ref Figure 2.1)	Number of Physical Areas	Total (ha)	Percent District
Unconsolidated sand	6	788	2.70
Consolidated sand	1	700	2.40
Lakes and Reservoirs			
Impounded dune	3	25	0.08
Whatipu lakes	3	25	0.04
Reservoirs	6	145	0.50
Total	12	183	0.62
Freshwater wetlands	1	179	0.61
Manukau Harbour Coast (Estuaries)	2	677	-
Offshore Islands and Exposed Rocky Coast	10	424	1.45
Dissected Hillcountry			
Subdued hillcountry	1	2,709	9.28
Rugged hillcountry, High relief and Southern foothills	3	19,900	68.21
Eastern foothills	1	4,118	14.11
Total		26,727	91.60
Alluvial flats	11	174	0.59
Total	37	29,864	100

It has been formed by dune sands moving into a valley, damming several small streams and impounding Lakes Waiataru, Kawaupaka³ and Wainamu.

Much smaller examples of this physical area occur at Karekare, Piha, Whites Beach, Anawhata and O'Neill Bay. In Tables 2.2, 2.4, 2.5, Figure 2.1 and RAP descriptions this physical area is referred to as **unconsolidated sand**.

2. Consolidated Sand

Consolidated marine sands of the Kaihu Formation.

The extent of this physical area corresponds to the area of the Kaihu Formation consolidated marine sands. The most distinguishing characteristic of this area is the subdued nature of the topography. Steeper slopes and cliffs do occur where the surface veneer of consolidated sands has been eroded, exposing the much harder volcanic rocks beneath. Generally the slopes are less than 20 degrees and soil profiles are deep and well developed, with low to moderate podzolisation. The natural fertility of such soils is usually low. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **consolidated sand**.

3. Lakes and Reservoirs

Freshwater lakes and artificial reservoirs.

Three types of lakes comprise this physical area:-

1. Semi permanent and ephemeral lakes of the Whatipu sand area (near Pascoe and Ohaka Points).
2. Dune impounded lakes of Te Henga; Wainamu, Waiataru, Kawaupaka.
3. The water supply reservoirs - Waitakere, Nihotupu, Upper Nihotupu, Huia, Lower Huia.

The lakes of the Whatipu sand area are shallow and most probably ephemeral features that fluctuate in area in response to seasonal variations in rainfall and runoff. For long periods they may be present as wetlands or dry up completely.

The Te Henga lakes are text book examples of impounded dune lakes, of high geomorphic interest and value.

The five artificial reservoirs have been formed by damming valleys for water supply. They are deep, freshwater lakes.

4. Freshwater Wetlands.

The Te Henga swamp is the only sizeable freshwater wetland in the Waitakere Ecological District. This area is dominated by freshwater aquatic processes, but has also been much affected by sedimentation in historic times. The lower area of the swamp was originally a lake similar to Lake Wainamu, but natural and human related processes such as reservoir construction have led to high rates of sedimentation. The swamp is well defined by the enclosing hillslopes, and probably effectively sheltered from westerlies by a narrow ridge of land that separates it from the sea.

3. In the text, the spelling of place names is taken from the NZMS 260 series maps, however the traditional Maori spelling will be indicated in footnotes. In this instance the spelling is Kawaupaku.

Smaller wetlands are also present on the sand country between Pararaha and Whatipu, particularly in the older dunes near the base of the coastal scarp. The margins of the lakes near Whatipu and Te Henga may also be considered wetlands. Elsewhere in the District, wetlands are small and confined, particularly in rugged hill country.

5. **Manukau Harbour Estuarine Coast.**

Compared with the exposed Tasman sea coast the Manukau harbour coastline is a very low energy system. Huia Bay, Little and Big Muddy Creeks are sheltered estuarine embayments with extensive areas of sand and mud flats. Saline wetlands, dominated by mangroves and to a lesser extent saltmarsh, are found at Little Muddy Creek and Big Muddy Creek, east of Huia and are an important component of the ecosystems of the Manukau coast.

The character of this physical area is the result of biological and physical processes of erosion and sedimentation in a tidal flow dominated marine environment (although wave action is locally important). In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **estuaries**.

6 & 7. **Offshore Islands and the Exposed Rocky Coast.**

This area is defined as extending from the top of the sea cliff or coastal scarp to the low tide level. It extends from Muriwai to Whatipu and is characterised by extreme exposure to marine processes of erosion by wind and sea water. Between Karekare and the Manukau entrance the rocky coast is now separated from the sea by the Whatipu sand area, and the features, such as caves and cliffs, could be considered relict. At relatively few locations this physical area is disrupted by the deposition of sands in shallow embayments. However the circumstances that permit extensive and long term deposition seldom occur along the Tasman Sea rocky coast.

Rock platforms, offshore islands, stacks, cliffs, pebble and cobble beaches, caves, natural shafts, headlands, and bays comprise the landforms of this physical area. These are all features characteristic of an actively eroding coast, which nevertheless contains a wide range of habitats for species adapted to high exposure.

7.b. **Rocky Harbour Entrance**

The rocky harbour entrance is the exposed coastal cliffs within the Manukau Harbour entrance from Whatipu to Little Huia. In its character, this steep scarp relates more to the Tasman Sea cliffs, than to the inner harbour subdued coasts of 8.e. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **rocky harbour entrance**.

8. **Dissected Hill Country.**

Over 90 percent of the Waitakere Ecological District comprises hill country with an elevation over 100 metres above sea level. Five subdivisions have been made, but within the physical area, and within each subdivision there is considerable diversity. The ecological significance of each division recognised is at times much less important than local variations, for example, in slope stability, aspect, exposure and water availability. Interactions between species and historical factors is also an important influence on the ecological patterns found.

The subdivisions within this physical area reflect variations in climate, particularly related to altitude, geology, topography, slope stability, drainage, and soil type.

8.a. **Subdued Hill Country**

Subdued topography north of the Waitakere Stream.

North of the Waitakere River the topography is relatively undulating with hill crests around 200 m. Waterfalls are common, but the slopes are generally less steep than the southern Ranges. This

is because andesitic flows and other relatively resistant rocks are rare in this area. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **subdued hillcountry**.

8.b. **Rugged Hill Country**

Rugged topography south of the Waitakere Stream.

The broad area of the District rising above 300 m to 400 m in the south corresponds to this subdivision. It is bounded by the alluvial deposits of the Waitakere valley, and to the east the Waitakere scarp. Slopes are steep and soil development poor. Cliff scarps, dykes, sills, lavas and waterfalls are associated with relatively resistant beds of volcanic rock, and gorges are common. Slope failure and mass movement is rare, despite steep slopes, because of the high mass strength of the rocks. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **rugged hillcountry**.

8.c. **Eastern Foothills**

Subdued topography east of the Waitakere scarp.

This subdivision is east of the Waitakere scarp and comprises the head-waters of the Swanson, Opanuku and Oratia streams. Slopes are again relatively subdued, reflecting a change in the geology to interbedded sandstones and siltstones of the Waitemata formations east of the inferred faultline. Rainfall is less and air temperatures higher. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **eastern foothills**.

8.d. **High Relief**

Bio-climatic subdivision, area over 400 m.

Superimposed over the central and southern Ranges is a physical area subdivision determined primarily on the basis of climate. The climate of this zone is characterised by a much higher and more persistent rainfall (>2000m) and lower temperatures than the rest of the area. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **high relief**.

8.e. **Southern Foothills**

Subdued coastal hillslopes.

At the south of the Waitakere Ranges the volcanic hills fall in a series of broad ridges to the embayments, promontories and peninsulas of the Manukau Harbour. These subdued coastal hillslopes are generally south facing and the soils markedly deficient in phosphates and other minerals, and, significantly podsolised. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **southern foothills**.

9. **Alluvial Flats**

Valley alluvial deposits.

Alluvial valley deposits are rare in the Ecological District, comprising less than one percent of the surface area. These deposits are distinguished on the basis of low slope angles and a well developed, generally fertile soil, derived from fine fluvial and colluvial sediments. The constituent sediments are usually deposited during periods of high river flow when the water levels are higher in the stream channels. Most are small and occur on the coastal margin where stream gradients are substantially reduced. The only significant area of alluvium that occurs in the hinterland is in the upper Waitakere valley. In the tables, Figure 2.1 and RAP descriptions this physical area is referred to as **alluvial flats**.

2.2 **Priority Landform Sites**

The PNAP survey of the Waitakere Ecological District aims to select those natural areas that best represent the ecological character of, and range of ecosystems and landscapes in the District. Part of this selection process is the identification of landform sites of significance.

The identification of the physical areas which constitute the Waitakere Ecological District enables the natural processes and physical nature of the District to be defined. In identifying physical areas emphasis has been placed on identifying the natural processes that impact on an ecosystem creating its particular characteristics. The priority landform sites therefore include single features and assemblages of landforms which best illustrate the processes which have given the District its particular character.

From the physical areas we can identify four main types of process which have had a major influence on the natural character of the District; volcanic, coastal, depositional, fluvial. The majority of the landforms present in the District have originated from one or a combination of these processes. They have had and will continue to have a major influence on the ecology of the District. It is therefore appropriate that these processes form the basis for the selection of priority landform sites.

The four process types are often inter-related and many areas are influenced by more than one process. The District's volcanic origins in particular are a determining factor in much of its geomorphology. Many of the habitats and ecosystems in the District are functionally related to specific landforms which are the result of the geomorphic relationship between the volcanic lithology of the ranges and the action of the other processes. Preserving evidence of the volcanic activity itself is difficult as few of the original volcanic landforms remain. However, eroded remnants of volcanic centres outcrop along the coastline, and the best examples of these (O'Neill Bay, The Watchman) have been selected as priority landform sites. Other sites (Nihotupu Gorge, Lion Rock) have been selected for the important record they provide of past geological events.

The processes operating along the exposed coastline of the District are dominated by the prevailing westerly winds and the high energy wave conditions they create. These climatic and marine conditions are of profound ecological importance in the Waitakere Ecological District, particularly along the coastal margins. The Tasman Coast is primarily a bold coast, and exhibits a form characteristic of a high-energy wave dominated coast, experiencing relatively rapid erosion by various marine processes. Many of the landforms created by these processes are also related to the volcanic history of the District. The coastline consists of volcanic rocks of varying resistance to erosion. Coastal processes erode the softer rocks leaving resistant outcrops behind in the form of headlands and stacks. Erosion also occurs more rapidly in jointed volcanic rocks often leading to the formation of tunnels and caves. Three sites which best represent these coastal processes have been selected as priority landform sites (Muriwai to Tirikohua Point, South Piha Coastline, Mercers Bay). A further area (Elevated Coastal Terraces) has been selected as a priority landform site on the basis of the record of past marine processes which it provides.

It is unusual to find extensive areas of deposition on an eroding coastline but two such areas exist in the Waitakere Ecological District. The coast between Paratutae Island and Cowan Pt consists of an extensive sand plain backed by an historic rocky coastline. The sand deposits are unusual as very few locations have recorded extensive progradation in historic times on the West Coast of New Zealand. The entire area has been selected as a priority landform site. The other area of extensive sand deposition is at Te Henga. Here deposition of sand in the lower Waitakere Valley has resulted in the formation of large mobile sand dunes extending inland. Associated with this deposition has been the restriction of natural drainage and the formation of dune lakes and the Te Henga Wetland. Two separate priority landform sites (Te Henga Wetland, Te Henga Valley) cover the important processes and features of this area.

The combination of varied volcanic lithology and tectonic uplift has created a particular pattern of fluvial and hillslope features in the Waitakere Ecological District. The District is dominated by the major uplifted block of the Ranges, with a broad area of summit heights over 300m rising to over 400m in the south. The result is a relatively high rainfall and rugged deeply dissected topography particularly in the southern half of the ranges. Landforms include bluffs, waterfalls, gorges and steep hillslopes. These features are the result of the particular relationship between fluvial erosion and the volcanic rocks of the District. All the volcanic rock types are relatively hard but not so hard that they cannot be eroded. However, because they are unbedded they are able to form steep slopes without collapsing or rapidly eroding. Where there are variations in resistance to erosion abrupt changes of gradient are likely to occur resulting in waterfalls. Four sites which best represent these processes and features have been selected as priority landform sites (Various Waterfalls, Piha Gorge, Karamatura-Marama Stream Catchments, Pararaha Valley).

The PNA Programme seeks to define representativeness at the District level. Is there a suite of landforms which is unique to the District, or representative of the District? None of the landform features are peculiar to this District, although some such as the Pillow lava (RAP 1) are the best examples of their type in New Zealand and almost all the others listed as priorities are the best examples of their type in the Ecological Region. But it is the landforms that most distinguish this District, and set it apart from the others in the Region. That distinctive character is the aggregate of landforms in distinctive assemblages which do recur throughout the District in recognisable suites - remnant terraces, above exposed rocky sea cliffs, with rock platforms below and stacks and offshore islands beyond; or subdued hills and low gradient streams leading to high falls, deep gorges and incised streams. But it is the juxtaposition of suites that provide the ecological context for the diversity and richness which is a biological feature of the District - rocky headlands and sandy beaches; high sea cliffs and bluffs, and sand dunes; low gradient streams penetrating inland along broad valleys and high waterfalls with gorges.

The priority landforms selected do represent those suite of landforms which distinguish the District in the sense that they are repeated patterns and/or those which most dramatically define changes and juxtaposition of morphologies. Above all, they are representative of the land forming processes operating in the District. They are also representative of the different parent materials.

The table below shows the relative distribution of priority landform sites by physical area and by type of predominant geological / geomorphological processes operating. Not surprisingly those landforms of the hills and coast predominate the representation, while alluvial flats are present, but not typical of the District. The Manukau Coast is represented in RAP 15 but is not a PLS. The table also shows that the main process groupings are also represented well.

[illegible]

Priority Landform Site Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5. Manukau Coast															
6. Islands	x									x					
7. Exposed Rocky Coast	x		x				x	x			x				
8. Hill Country		x						x	x				x	x	
9. Alluvial Flats															
Processes															
Volcanic	x	x					x			x	x				
Coastal	x		x			x						x			
Fluvial								x	x				x	x	
Depositional				x	x										x

The information on priority landform sites has been used in the evaluation of recommended areas for protection. Table 2.2 which follows gives a description of each priority landform site and Figure 2.2 indicates their location.

PRIORITY LANDFORM SITES IN THE WAITAKERE ECOLOGICAL DISTRICT

Notes to the Priority Landform Site Table

1. The Priority Landform Site (PLS) numbering system is consistent with the numbers of the priority sites described and mapped in the Recommended Areas for Protection, for example 13L2 is the Nihotupu Gorge which is contained in RAP 13 - that is '13' for the RAP, 'L' for landform, '2' for the PLS number for the Nihotupu Gorge (see Table 1).
2. Grid references are for NZMS 260 series 1:50,000 R11 and Q11 topographical maps.
3. 'RAP No.' refers to the Recommended Area for Protection within which a given PLS occurs.

KEY TO ABBREVIATIONS

CMP	Auckland Centennial Memorial Park
QEII	Queen Elizabeth II National Trust (open space covenants)
Reg. Park	Regional Park
WCC	Waitakere City Council
WSC	Water Supply Catchment

TABLE 2.2

PRIORITY LANDFORM SITES IN THE WAITAKERE ECOLOGICAL DISTRICT

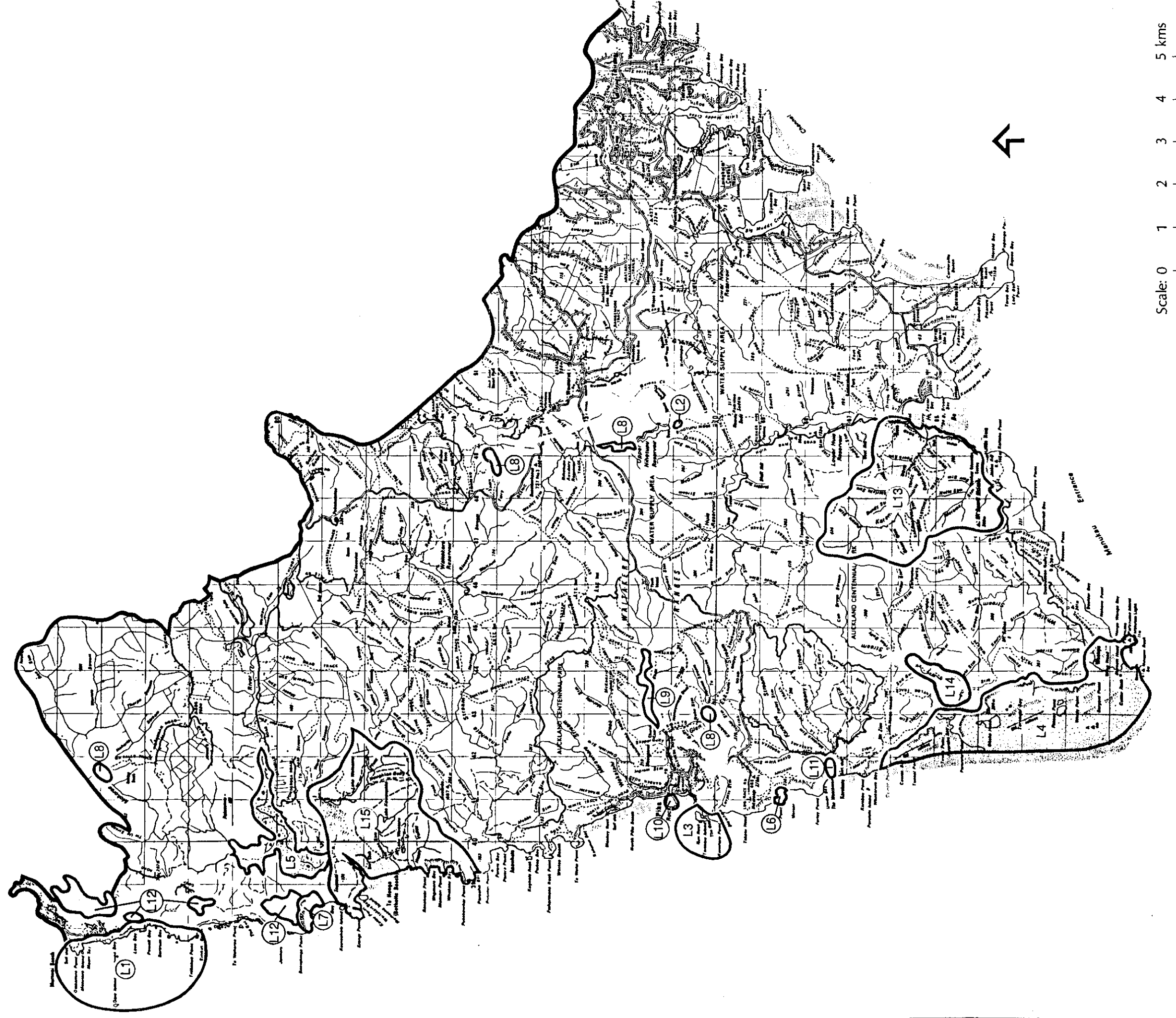
PLS No.	NAME	GRID REFERENCE	DESCRIPTION	SIGNIFICANCE	SITE PRO-TECTED?	TENURE	RAP No
Volcanic Processes							
1	Muriwai to Tirikohua Point	Q11 376844	The site contains several andesitic pillow lavas which were formed as a result of the extrusion of lava over the sea floor. These are deposited amongst beds of sandstone, mudstone, and conglomerate and overlain by volcanic conglomerates, pumiceous and scoriaceous grits and coarse sandstones.	The pillow lavas are regarded as some of the best examples in the world and are of international significance. These features also provide a record of important events in the geological history of the District.	Yes	Part Reg. Park	1
2	Nihotupu Gorge	Q11 497710	The Nihotupu Gorge contains an exposure of a sequence of interfingering volcanoclastic flysch and conglomerate forming a lateral facies boundary between Waitemata Basin flysch and Waitakere volcanics.	The exposure of geological strata is of regional significance for the interpretation of Auckland's regional geology.	No	WSC	13
7	O'Neill Bay	Q11 384794	The bay is the northernmost of a line of eroded volcanic crater complexes which follow the western margin of the Waitakere Ranges. At the bay's northern end a sequence of volcanic strata are exposed which are believed to have resulted from the infilling of a crater by lava flows and subaerial pyroclastics.	Of regional significance for the record it provides of the volcanic history of the District.	No	Private	6
10	Lion Rock	Q11 409710	A 100m high rock mass isolated at the edge of Piha Beach. Its formation is inferred to have been by the infilling of a volcanic neck, followed by intrusion by andesitic and diastrophic dykes.	An excellent example of an isolated rock mass due to the presence of relatively resistant (volcanic) rocks, and provides an important depositional record of the geology of the Waitakere Ranges. Of district significance.	Yes	CMP	9

PLS No.	NAME	GRID REFERENCE	DESCRIPTION	SIGNIFICANCE	SITE PRO-TECTED?	TENURE	RAP No
11	The Watchman	Q11 416674	One of the few Waitakere promontories composed of dacite, the Watchman is part of a large multiple crater and intrusion complex. It consists of the remains of viscous dacite extruded into a former crater, and being of relatively hard rock has resisted erosion.	Of significance at the district level for the record it provides of the geological history of the District.	Yes	CMP	9
<u>Coastal Processes</u>							
1	Muriwai to Tirokohua Point	Q11 376844	A rocky stretch of coastline with features typifying the interaction of high energy marine processes with an exposed coast consisting of highly varied lithology. Landforms include islands, sea cliffs, stacks, headlands, caves, boulder beaches, shore platforms, blowholes, and intertidal and subtidal reefs.	The coastal landforms are excellent examples of the processes and features that characterise the West Coast of the Waitakere Ecological District. The diversity and quality of the features makes them of national significance.	Yes	Part Reg. Park	1
3	South Pina Coastline	Q11 407703	Small section of coastline containing typical Waitakere ocean coast landforms such as a rock stack (Nun Rock), cliffs, blowholes, caves and shore platforms. The site also contains a shallow volcanic intrusion and a well-exposed marine volcaniclastic conglomerate sequence.	The coastal landforms are particularly good examples of the interaction between processes of coastal erosion and the varied volcanic lithology, and are of regional significance. The volcanic intrusion and conglomerate sequence are also of regional significance for the record they provide of important events in the geological history of the District.	No	Private	9
6	Mercers Bay	Q11 409684	Te Ahua Point, the northern headland of Mercer Bay contains a vertical shaft descending about 90m to sea level and varying between 20 and 30m wide. This feature was formed by the preferential erosion of a zone of relatively weak volcanic rocks.	The shaft is an excellent example of both the erosive power of the sea, and the relationship between the volcanic history of the District and the development of closely related landforms. Unique in the District and of regional significance.	Yes	CMP	9

PLS No.	NAME	GRID REFERENCE	DESCRIPTION	SIGNIFICANCE	SITE PRO-TECTED?	TENURE	RAP No
12	Elevated Coastal Terraces	Q11 385796	Between Muriwai Beach and Te Henga are several remnant marine terraces at about 200m above present sealevel. They are comprised of Kaihu Formation weathered sands and clays, in contrast to the adjacent rocky coast.	The coastal terraces are of district significance for the history of past marine conditions and processes that they record.	No	Private	4, 6
<u>Depositional Processes</u>							
4	Cowan Pt to Paratutae Island	Q11 430620	The former rocky coastline is separated from the sea by a broad sand plain resulting from deposition mostly within historic times. The rocky cliffs contain caves and other distinctive features of the Waitakere west coast. The area includes remnants of a line of volcanic intrusions and Paratutae Island contains exceptional examples of dyke swarms and high tide platforms.	Of national significance for its unique association of landforms. The extensive sand deposition is extremely rare as most sandy coasts around New Zealand have tended to erode in historic times. The former rocky coastline contains excellent examples of the features which characterise the Waitakere west coast, the high tide platforms of Paratutae Island being particularly well noted.	No	Uninvestigated Land	10
5	Te Henga Wetland	Q11 396797	Originally a lake, this wetland has developed through infilling by sediments which has continued in historic times. The wetland occupies the lower reaches of the Waitakere River and Mokoroa Stream and is now dominated by freshwater aquatic processes.	Of regional significance as a rare feature of high quality, it is the largest freshwater wetland in the Auckland Ecological Region.	No	Private	5
15	Te Henga Valley	Q11 405780	Deposition of sand in the lower Waitakere Valley has resulted in the formation of large mobile sand dunes, which extend approximately 2 km inland. Associated with this deposition has been the formation of dune lakes (Wainamu, Kawaupaka and Waataru) and the Te Henga Wetland.	This association of landforms is of regional significance as it is unique in the Auckland Region.	Yes/No	OEII / WCC, Private	7

PLS No.	NAME	GRID REFERENCE	DESCRIPTION	SIGNIFICANCE	SITE PRO-TECTED?	TENURE	RAP No
<u>Fluvial Processes</u>							
8	Various Waterfalls	eg Q11 493722	Includes the Nihotupu, Kitekite, Cascade, Fairy, Mokoroa and Waitakere Falls which are some of the best examples of the many waterfalls in the Waitakere Ranges. The varied lithology of the Ranges has provided conditions for many waterfalls to form where hard rock (e.g. volcanic intrusions) has resisted erosion while adjacent softer rock has eroded away.	These waterfalls are of regional significance as they provide clear illustrations of the relationship between the varied volcanic lithology of the Waitakere Ranges and the erosive action of fluvial processes.	Yes/No	CMP / WSC	3, 8, 13, 18
9	Piha Gorge	Q11 440717	A narrow steep-sided gorge characteristic of the southern third of the Waitakere Ranges.	Of regional significance as it illustrates the interaction of fluvial erosion and the massive unbedded rock structures which produces steep slopes resistant to collapse.	Yes	CMP	8
13	Karamatua-Marama Stream Catchments	Q11 474640	This area comprises two stream catchments and contains a range of landforms that are both characteristic and extraordinary examples of their type. These include bluffs, waterfalls, gorges and steep hillslopes. The area also includes Mt Donald McLean, an andesitic exfoliation dome unique in the ranges.	Of regional significance for the range and diversity of landforms within a small area. The features present illustrate the relationship between the varied volcanic lithology of the Waitakere Ranges and the erosive action of fluvial processes.	Yes/No	CMP/WSC	13
14	Pararaha Valley	Q11 435645	This valley is an example of the relatively small dissected catchments of the western Waitakere Ranges. The Pararaha Stream has eroded down through deep unbedded breccias to produce a spectacular steep-sided gorge.	Of regional significance as it illustrates the interaction of fluvial erosion and the massive unbedded rock structures which produces steep slopes resistant to collapse.	Yes	CMP	11
15	Te Henga Valley	Q11 405780	Impounded dune lake	Dune lake of regional significance.	Yes/No	QEII / WCC & Private	7

PRIORITY LANDFORM SITES IN THE WAITAKERE ECOLOGICAL DISTRICT



2.3 Human Modification of the Ecology of the District

According to Murdoch (1990), the Waitakere Ranges have a history of human modification that extends back approximately 1,000 years. The present ecology of the District reflects the extent of the modification of the natural environment, that has taken place throughout this time. The flora, fauna, hydrological systems and to a lesser degree, the landforms of the Waitakere Ranges have been extensively modified.

In the pre European era, this modification was gradual, yet it brought significant ecological change to the coastal environmental fringes of the District (Esler, 1983). However the vast forest covered interior of the District was largely untouched during this period.

The Kawerau a Maki people occupied the Waitakere Ranges from the early 1600's. Maori settlement was concentrated on the coastal fringes and in particular around the mouths of the main valley systems running inland from the coast. It was in this coastal belt that the main modifications of the ecology of the Waitakere Ranges occurred in the pre European era. Throughout the pre European occupation, the Waitakere coastline was treasured for its natural resources. The sea provided an immense food resource, as did the coastline where a wide variety of shellfish was harvested. Eggs and young sea birds were taken from nesting areas on the sea cliffs, headlands and off-shore islands. The coastline also provided ideal sites for the construction of pa (fortifications). The warm frost free stream valleys contained fertile sandy soils which were ideal for the cultivation of kumara. The adjoining waterways and swamp areas provided eels, fish, waterfowl and a wide variety of weaving and building material. A further resource in the north western part of the Waitakere Ranges was provided by the dune impounded freshwater lakes. Where all these resources were found located in one place in the lower Waitakere River Valley, one of the most intensively settled areas in the Auckland region was found.

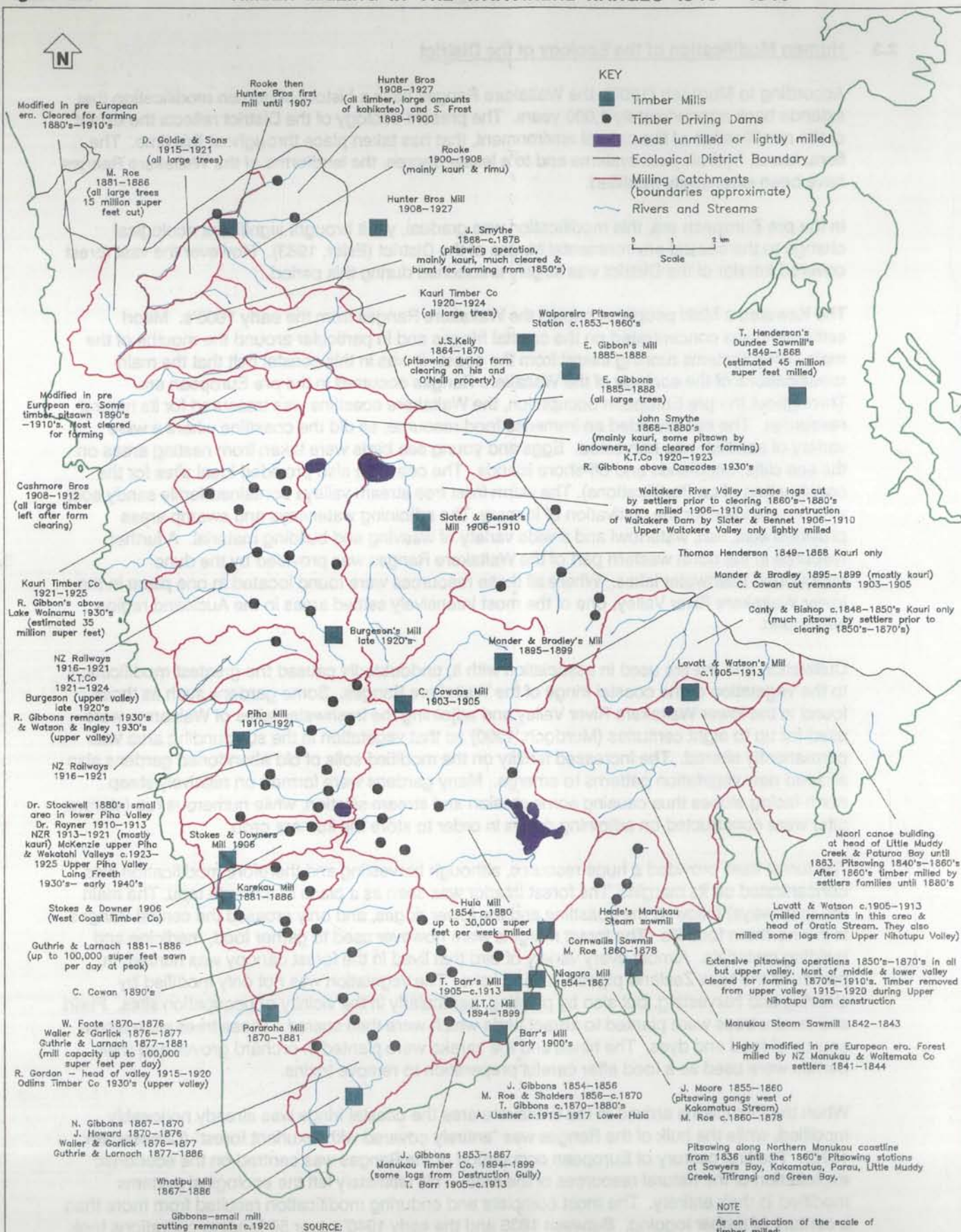
Cultivation and the fire used in association with it, undoubtedly caused the greatest modification to the vegetation of the coastal fringe of the Waitakere Ranges. Some gardens such as those found in the lower Waitakere River Valley and adjoining the freshwater lakes of Wainamu, were used for up to eight centuries (Murdoch, 1990) so that vegetation in the surrounding area was permanently altered. The increased fertility on the modified soils of old abandoned gardens also allowed new vegetation patterns to emerge. Many gardens were formed on relatively steep north facing slopes thus causing some erosion and stream siltation, while numerous rua (storage pits) were constructed on adjoining ridges in order to store the kumara crop.

The forest itself provided a huge resource, although harvesting and therefore modification was concentrated on its margins. The forest interior was seen as a place of extreme tapu. The main ara (pathways) followed the coastline and the lower ridges, and only crossed the central Ranges in the northern foothills. The forest margins were however used to gather food, medicine and building materials. Almost every variety of bird that lived in the forest canopy was hunted, in particular the New Zealand pigeon, tui and kaka. The vegetation was not only modified by clearing and harvesting, but also by planting, particularly in the vicinity of occupation sites. Puriri and taraire trees were planted to attract birds which were then snared. These trees were also a source of food and dyes. The hinau and the karaka were planted in orchard groves and their berries were used as a food after careful preparation to remove toxins.

When the Europeans arrived in the Waitakere area the coastal fringe was already noticeably modified, while the bulk of the Ranges was "entirely covered with luxuriant forest" (Cheeseman, 1872). The first century of European occupation of the Ranges was centred on the economic exploitation of the natural resources of the area. This ultimately left the ecological systems modified in their entirety. The most complete and enduring modification resulted from more than a century of timber logging. Between 1836 and the early 1940's over 50 logging operations took place in every major catchment (see Figure 2.3).

Figure 2.3

TIMBER MILLING IN THE WAITAKERE RANGES 1840 - 1940



SOURCE:

- J.T. Diamond & B.W. Hayward - *Historic Archaeological Sites of the Waitakere Ranges, West Auckland, NZ. ARA 1978*
- J.T. Diamond & B.W. Hayward - *Waitakere Kauri 1980*
- A.G. Flude - *Henderson's Mill 1977*
- N. Laing - *The Settlement of Hula 1985*
- G.J. Murdoch - *unpublished manuscript material*
- D. Scott - *Fire on the Clay 1979*

NOTE

As an indication of the scale of timber milled, 100,000 super feet is roughly equivalent to 5 trees the size of the mature kauri on the Aratiki Nature Trail or one tree the size of Tane Mahuta in the Waipoua Forest. The amounts of timber actually milled is probably of the order of 1/3 the volume of timber felled when the amounts of timber wasted are taken into consideration. Main operations boundaries approximate.

In the nineteenth century logging concentrated on kauri, although in the twentieth century kahikatea, totara, rimu, matai and tawa were also milled. The only mature tree species left standing in any number was the northern rata and many of these were cut in the 1930's and 1940's for firewood.

While these activities impacted on the natural environment, the activity which had the most influence in the ecology of the Waitakere Ranges in the post European era other than timber logging, was agriculture. Agriculture impacted on the ecology of the District in a number of ways. Land clearance involved the removal of large areas of forest which had previously mostly been leased to timber companies for 'cutting rights'. In the clearing process, fires often ran out of control and widespread erosion resulted. At the beginning of the twentieth century, the only areas in the Waitakere Ranges that had not been at least partly cleared for farming were the steep and inaccessible upper parts of the main catchments. Even areas that remained in cut-over forest were often subjected to grazing by cattle where properties were inadequately fenced or where farms had been abandoned. By this time farming had become difficult because of the basic infertility of the soils in the Ranges, poor road access, and the economic depression of the late 1880's and early 1890's. By the 1920's farming had virtually ceased to exist in the central Ranges for the aforementioned reasons and also because many properties had been purchased by the Auckland City Council for 'water supply purposes'.

Further information on the human modification in the District can be obtained from Murdoch, 1991.

2.4 Principal characteristics of the contemporary vegetation in the District.

Contemporary patterns of indigenous vegetation cover within the mainland districts of the Auckland Ecological Region, are now distinguished by ecosystem remnants of various sizes within a pastoral or urban matrix. In contrast, the Waitakere Ecological District is characterised for the most part, by a continuous expanse of native vegetation, primarily rainforest. This expanse of native vegetation is the principal characteristic of the ecology of the District. This situation is unusual within the Auckland Ecological Region, matched only by Rangitoto Island and the Hunua Ranges. However, despite the continuous nature of much of the vegetation, a fragmented pattern of vegetation classes also exists within the District, arising from a similar history of human modification characteristic of the Region.

The second fundamental characteristic of the ecological character of the Waitakere Ecological District is its complex diversity and richness in both habitats and species. This diversity is reflected in part by a range of structural types. It is also evident in the juxtaposition of eight broad and 43 subgroups of vegetation classes surveyed (See Figure 2.4). The varying patterns of vegetation classes across the landscape of the Waitakere District reflect the interrelationship of a number of factors. The broad changes of environment from the coast to inland, lowland to upland, and exposed to sheltered areas, account for some of the differences. The micro scale changes in the landforms determine others such as patterns across gullies, through mid slopes to ridge tops. In addition many of the District's ecosystems show the impact of modification and disturbance by humans and exotic plants and animals. Although examples of primary successions are present, many of the District's vegetation classes are indicative of secondary successional and regenerative processes.

The original vegetation cover of the Waitakere Ecological District was principally forest, the composition of which was thought to be kauri-northern rata-rimu dominated (Esler, 1983). While forest is still the main structural class today, the District's vegetation reflects the impact of extensive modification. This modification is illustrated in part by the scrublands which follow forests as the second main structural class in the District (See Figure 2.5). The scrublands are mostly dominated by manuka or kanuka, with the older stages of these successions common as forest. Other important structural types, while not as extensive, include sandfield communities (most obvious at Whatipu), and the various structural classes of freshwater and saline wetlands

(notably those of Te Henga and Big Muddy Creek respectively). Less obvious, are the rockland and shrubland vegetation communities of the seacliffs, bluffs, and gorges prevalent within the District. These particular ecosystems are significant in adding to the diversity of habitat types for wildlife. It is of interest that they are also principally primary successions, some of quite recent origin. Although not surveyed it is assumed that the marine ecosystem is also rich in species and diverse in habitats.

Some of the structurally diverse (and species rich) plant communities within the District are represented in the Te Henga wetland and the dune impounded lakes also in the Te Henga area. Much of the Te Henga swamp is composed of *Baumea* sedgeland with raupo, tall spike rush and many species of native and exotic herbs. Several islands of manuka scrub with cabbage tree occur in the lower reaches of the swamp. In the middle are areas of open water with extensive mats of floating vegetation. Impounded dunes lakes with complete surrounds of native vegetation are also present at Te Henga. Associated with these dune lakes are vegetation sequences from submerged macrophytes, through emergent littoral raupo reedland, to cabbage tree forest and terrestrial forest.

Although some of the environmental gradients in the District have been modified by human activities, these gradients can still be broadly observed. While small scale ecotonal changes through wetlands (freshwater and saline) to terrestrial ecosystems are present, the most obvious environmental gradients are those associated with the coastal environment. The ecosystems found on the west and southern coastlines of the District illustrate the influence of exposure to salt spray, high wind velocity and conversely shelter. Parts of the broader coast to inland sequence of vegetation change are still obvious, despite the contemporary absence of a continuous sequence of unmodified vegetation.

Within the coastal bioclimatic zone small scale ecotonal sequences, such as those caused by decreasing salt tolerance, are still apparent as a response to the coastal environmental gradient. However on the exposed, high energy Tasman coast, wind shear is the dominant force, the various taller plant communities showing the typical (flattened) growth response. The rocky sea cliffs are sparsely vegetated with small, hardy plants. Common associations are the native ice plant and New Zealand spinach, shore pimpernel, shore lobelia, shore groundsel and the stocky fern, *Asplenium northlandicum*, found higher in the rock crevices. Where there is greater soil presence and stability, coastal shrubs such as tauhinu, karo, flax, and toetoe are found scattered. Pohutukawa forests cling to the rocky slopes and the cliff tops are generally covered with windswept manuka scrub.

In a few places along the Tasman coast, onshore winds, waves and currents have deposited sediments and formed aeolian landforms. This combination of climatic events and resulting landforms have created a range of coastal ecosystems characterised by familiar species associations. Sand dunes occur at the mouth of almost all the major streams in the District that enter the Tasman sea. The most significant area of sand dune on the west coast is the area known as the Whatipu Sands, an extensive area comprising over 650 ha of bare dunes, pingao and spinifex sandfields, herbfields, saline wetlands, and ephemeral freshwater swamps. Over half of the area of the Whatipu Sands consists of shifting, unvegetated, black ironsand.

A more sheltered coastal environment is indicated by the presence of mangrove and salt marsh communities on the Manukau Harbour's coast, the southern boundary separating Waitakere and Manukau Ecological Districts.

Leaving the coastal edges of the District, ecosystems influenced by other environmental gradients are found. Two pertinent causal factors in these environmental gradients are

LAND COVER AND VEGETATION STRUCTURE OF THE WAITAKERE ECOLOGICAL DISTRICT

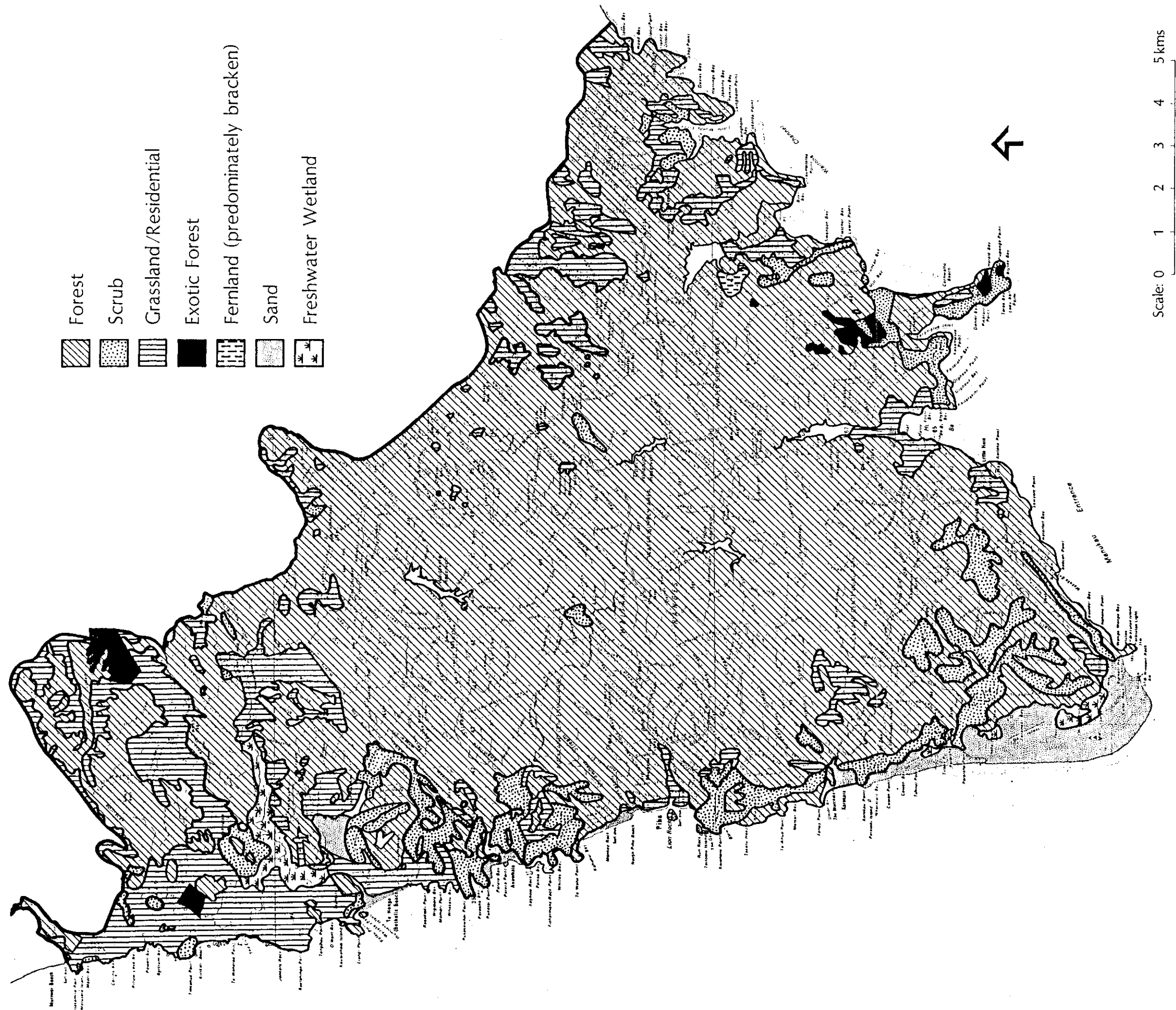


Figure 2.5

altitude and slope. Strictly speaking there is not a montane flora present in the District with the highest point being 474 m. However the increase in elevation within the District is reflected by the occurrence of upland forest in the middle of the Waitakere Ranges. The change in forest type with elevation is also reflected in an increase or occurrence of certain species at higher altitudes, a phenomenon probably related to higher frequency and amount of rainfall. The characteristic species of higher altitudes in the District include tawari (*Ixerba brexioides*), tawheowheo (*Quintinia serrata*), Smith's fern (*Cyathea smithii*), toro (*Myrsine salicina*) and wheki (*Dicksonia squarrosa*). Other species commonly found at such altitudes include heketara, lancewood, rimu, miro, hinau, tawa, maire rauriki and white maire.

Within the District, the slope of the landform varies from extensive flat areas on the plateaus, through to the vertical faces of bluffs. The relationship between slope and the type of vegetation class present can be observed. In this regard, particularly obvious effects of slope can be seen in the consequent drainage, fertility and capability for roothold. Kahikatea, pukatea, and maire tawake swamps have developed in flat areas and depressions, where water collects. Where mature vegetation still occurs on gently rolling slopes of ridges and plateaus, kauri forest or rimu-miro-Hall's totara forest abounds. Most of the broadleaf forest classes occur on the mid slope sites with an average gradient of 15 - 25 degrees. Tawa forest is common on steeper sites (~ 30 degrees), as are secondary broadleaf complexes with heketara, lancewood and lacebark. The steepest sites in the District, close to being vertical, are the dry bluff faces where kowhai, kanuka and monocotyledonous species prevail.

The general pattern of the District's vegetation is one of bands of successional and regenerating forest and scrub. Along the coastline most of the vegetation has been burnt and/or cleared repeatedly in the past. It is now composed of manuka scrub with patches of pohutukawa on exposed sites and puriri forest in the more sheltered gullies. On the inland lower slopes some areas are succeeding from farmland into kanuka forest over a kauri and broadleaf understorey. Other areas were not cleared but were heavily logged and subject to local and tree crown fires. These sites now comprise secondary successional and regenerating broadleaf forest characterised by a paucity or absence of emergent trees. Some parts of the interior Ranges consists of logged, but generally not burnt, forest in which emergent trees are frequent.

Thus the distribution of vegetation classes, confounded by the degree of environmental change, adds to the natural complexity of the ecology in the District. However, one of the major components of the original natural character of the District is still represented by the large central block of upland and podocarp broadleaf forest on the rugged hill country. Other mature forest "remnants" remaining are scattered principally in the central core of the Ranges. Large blocks of unmodified kauri, for example at Cascades Kauri Park, are indicative of the original ecosystems of the Waitakere District.

There appear to be differences in the pattern of vegetation classes between the north and south of the District. The ecosystems in the north have been fragmented by successful pastoral, and to a lesser extent, residential development. The broad vegetation pattern in this area is of remnants of puriri and mamaku forest on the south facing slopes with secondary kauri and kanuka forest on the warmer north facing slopes. Puriri composite forest appears more frequent here. A number of divaricating plant species are common north of Waitakere River, in areas that have been grazed for some time; these species are generally uncommon elsewhere in the District. These species include *Coprosma crassifolia*, *Myrsine divaricata*, *Lophomyrtus obcordata*, *Melicactus micranthus*, *Melicope simplex*, *Pennantia corymbosa*, *Streblus heterophyllus* and *Pseudopanax anomalus*.

Botanists more familiar with other parts of New Zealand are impressed by the distinct morphological appearance of some species in the Waitakere District which are widely distributed elsewhere. Local variation of this sort is a characteristic of the New Zealand flora, generated by former geological isolation and a generally small scale of landscape diversity. The geological history of the Waitakere Ranges appears to indicate a degree of isolation from surrounding land. Although there are few endemic species or varieties, there is plenty of evidence for distinctiveness at a more intraspecific level - tarata, maire rauriki, manuka, prickly mingimingi,

kotukutuku, rewarewa, kohuhu, tawapou, lancewood, hen and chicken fern - these species appeared to be represented by morphological features specific to the district, region or province (pers. com. - P. Simpson, 1992). Such features underscore the importance of using only local material if planting to restore ecosystems.

The final characteristic of the District's vegetation is contained in the relative richness of its flora. The flora of the District is comprised of 542 species of higher plants including 111 species of fern and fern allies. This represents almost 20% of the flowering plant species and 60% of the ferns in New Zealand. There are twenty one rare and endangered plant species recorded in the District including one endangered and five vulnerable species, with several that are rare, local and of indeterminate status. There are also several local endemic species, *Hebe bishopiana*, a prostrate sprawling hebe; *Myostis petiolata* var *pansa* and *Celmisia major* var *major*. A local endemic variety of kowhai is also common along the coastal areas of the District. The type locality for this variety (*Sophora microphylla* var *fulvida*) is at Whites Beach, Piha.

2.4.1 Classification of the Vegetation in the District.

Following field survey, the extensive vegetation dataset was classified using the programme TWINSpan, a clustering technique that provides a mechanism for grouping large datasets based on their species component. For analysis, the coastal and wetland datasets were separated from the terrestrial dataset, to assist in the delineation of vegetation classes. For the terrestrial dataset, 154 canopy species from 625 sample sites were used in the analysis. The TWINSpan classes were refined by hand sorting. The terrestrial dendrogram shown in Figure 2.6 illustrates the relationship between the forest classes of the Waitakere dataset. The dendrogram is a useful tool in discriminating and interpreting forest relationships. Lines in the dendrogram joining and linking each vegetation class depict the biological relationships between each class. The first division of the data set indicated by the cut level 1, separates the most widely disparate samples being classified. By following the links between classes it is possible to surmise how similar the classes are to each other. The further apart the linkage, the less similar the class (Mitchell et al, in press). For example in ecological terms mamaku and ponga forest classes are more closely similar to each other than to the tawa class. The mamaku, ponga and tawa classes are more similar to each other than to the podocarp group.

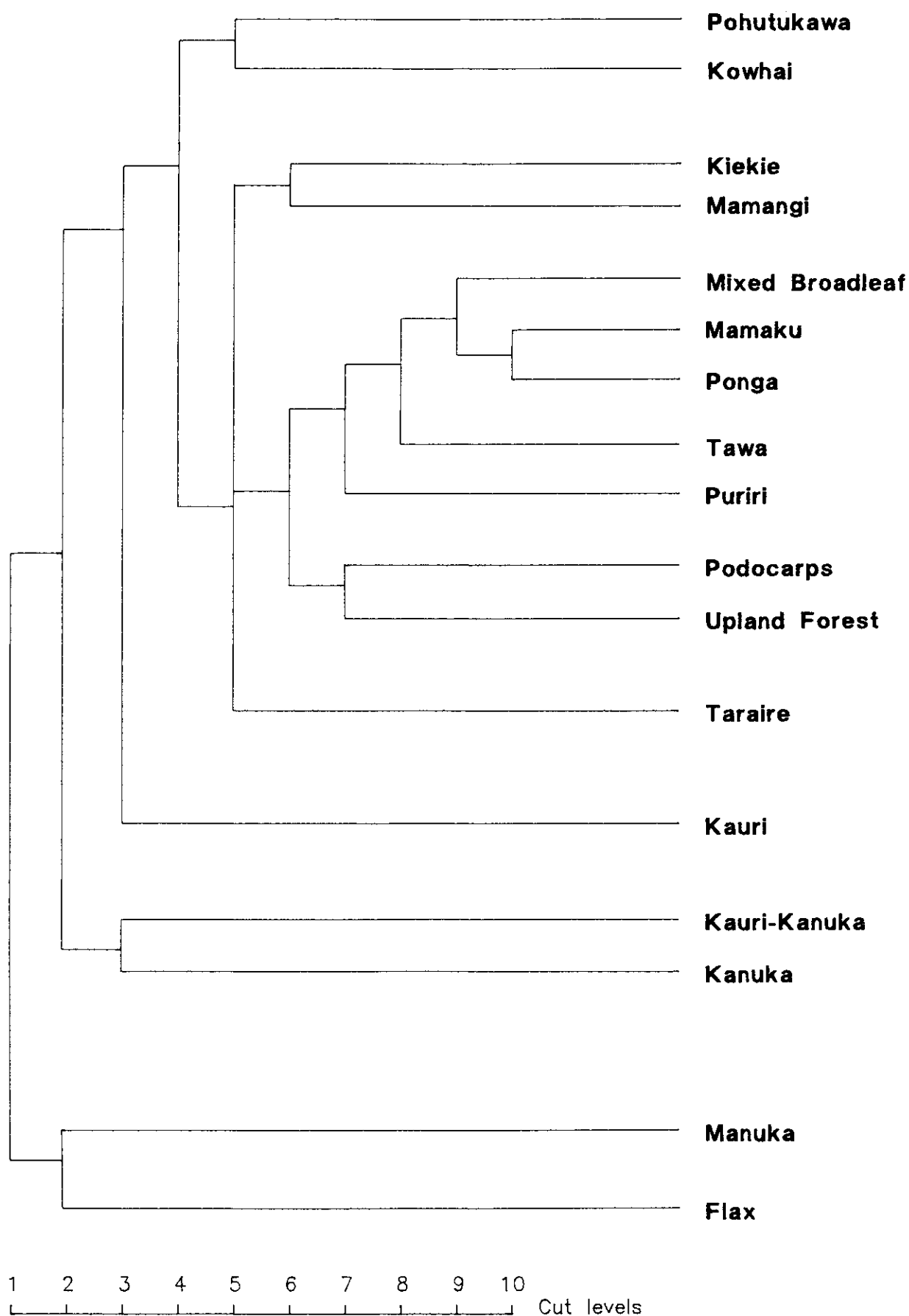
As indicated by the terrestrial dendrogram, the manuka and flax communities, which are principally coastal, are the most distinctly different from the forest classes in the District. This may reflect the more extreme environmental gradients affecting the coastal manuka areas of the District. These areas have also suffered intensive modification and may have resulted in substantially different vegetation and structural types.

The next major distinction is between the kanuka and kauri-kanuka successions and the other forest classes of the District. This distinction could be between the secondary and tertiary successions as compared to those forest types that are original or regenerating. The kauri and kauri-kanuka groups are indicated on the dendrogram as related although distinctive subgroups. This close relationship reflects the successive stages of succession from kanuka through the stages of changes in dominance to kauri forest. The kauri group itself is related more closely to the other forest classes, perhaps reflecting its previous dominance as a common forest species prior to extensive logging.

The next division separates pohutukawa, kowhai and then taraire, kiekie and mamangi from the podocarp broadleaf group. With this division, pohutukawa forest and kowhai, including a minor division between *S. fulvida* and *S. microphylla*, branches off. Clearly separate from pohutukawa and kowhai are taraire, mamangi and kiekie (kiekie was not used as a vegetation class).

DENDROGRAM OF THE TERRESTRIAL VEGETATION CLASSES IN THE WAITAKERE ECOLOGICAL DISTRICT

Figure 2.6



Note: Only the canopy or "top" tier species were used in the TWINSpan analysis represented in this diagram

The vegetation classes of podocarp, mamaku, ponga, mixed broadleaf, tawa and puriri proved the most difficult set of samples to classify. This set of 300 samples was concentrated together after the initial analysis. The podocarp broadleaf groups of upland, secondary and podocarp broadleaf were drawn from this large group and the remainder were re-analysed through a second, separate analysis. Despite the second analysis, much of the final delineation of classes had to be clarified by hand sorting of sites based on field experience. These classes are labelled as mamaku-broadleaf, ponga-broadleaf, mixed broadleaf, tawa, and puriri composite. The groupings are closely related, they appear as a whole to occupy moister sites than the other classes discussed previously. Some of the sites now classified in the podocarp groupings are more akin to the latter broadleaf groups, but because they had podocarps in the vicinity these were hand sorted and classified into the podocarp broadleaf subgroups.

The bluff vegetation sites are scattered throughout the vegetation classes. For ease of classification this set was identified from its landform type, and then sorted by hand. Consequently they do not appear as a separate class in the main analysis. However various examples of them are found at either end of the dendrogram, that is in the pohutukawa and the kowhai groups, and with the flax and general coastal set. Some are in the general mixed broadleaf set and next to the kanuka set. This scattering of samples reflects the varying nature and exposure of the bluff vegetation to various environmental gradients and modification experiences. It also reflects micro scale changes in form and degree of slope and the subsequent variation in vegetation composition and structure. The major species of the bluff associations also form their own distinctive communities outside of bluff landforms, and this may also explain their scattered distribution through the vegetation classes. However on all the bluffs in the District the same vegetation communities tend to occur on similar slope sections.

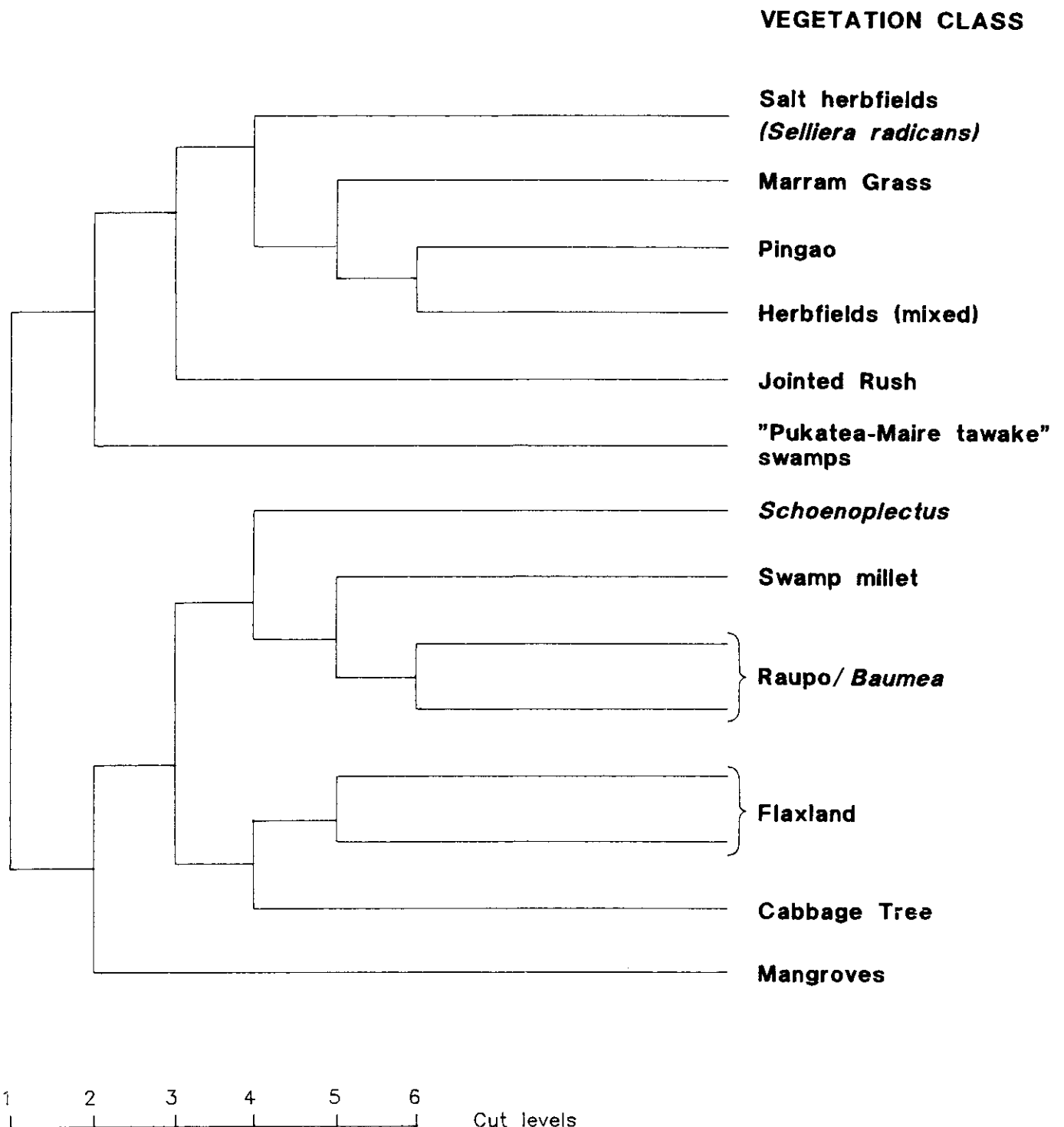
In the coastal and wetland classification, 35 sites were analysed using 93 species. The dendrogram illustrated in Figure 2.7 shows the classification of these sites into 12 vegetation classes. From the dendrogram it would appear that the sand communities such as herbfields, pingao etc are the most distinctively different from the mangrove forest, perhaps reflecting substrate as well as structural distinctions. The dendrogram illustrates the separation of the individual vegetation communities into essentially two disparate groups. The first group includes mangrove forest and the freshwater wetland classes. The second major grouping is of "pukatea-maire tawake" swamps, jointed rush and then the coastal sand communities. The dendrogram may be depicting a general trend of decreasing depth of inundation experienced by these classes. The similarity of the habitat occupied by *Baumea* and raupo is reflected by their close proximity on the dendrogram.

The classes used in this report to define the vegetation of the District are outlined in Table 2.3 and described in greater depth in the next section.

Table 2.3 outlines the broad groupings of the vegetation classes with their subgroups. This table illustrates the relationships between the broader vegetation groups, the classes and leading species. Often although not always, the dendrogram classification is at the level of vegetation group.

DENDROGRAM OF COASTAL AND WETLAND VEGETATION CLASSES IN THE WAITAKERE ECOLOGICAL DISTRICT

Figure 2.7



Note: Only the canopy or "top" tier species were used in the TWINSPLAN analysis represented in this diagram

Table 2.3: Vegetation Groups in the Waitakere Ecological District

Structural Class	Vegetation Group	Vegetation Class	Sub Group or Leading species
Forest	Kauri	mature kauri successional	kauri-tanekaha young kauri kauri-rimu (kauri-hardbeech) (kauri-tawari)
Forest	Podocarp Broadleaf	podocarp broadleaf upland secondary podocarp kahikatea puriri composite tawa mamaku-broadleaf ponga-broadleaf mixed broadleaf	
	<i>Broadleaf</i> <i>Treefern</i> <i>Nikau</i>		
Forest	Broadleaf	mamangi taraire maire tawake	
Forest	Successional	manuka kanuka kauri-kanuka	
Scrub		manuka kanuka	
Rockland Shrub rockland Shrubland	Bluff	monocot kowhai, kanuka, puka kowhai-kanuka	<i>Astelia banksii</i>
Forest	Coastal Edge	pohutukawa karo-houpara toetoe-houpara <i>Coprosma macrocarpa</i> flax-manuka	
Scrub/shrubland			
Scrub			
Sandfields	Coastal Ecosystems	pingao spinifex arrow grass, water milfoil etc <i>Phormium</i> seacliff jointed rush mangrove	<i>Asplenium</i> sp.
Herbfields Flaxland Rockland Sedgeland Forest			
Reedland Sedgeland	Freshwater Wetlands	raupo <i>Baumea</i> <i>Scirpus</i> swamp millet cabbage tree	
Grassland Forest/scrub			

2.4.2 Vegetation Classes of the Waitakere Ecological District.

The following section describes the individual vegetation groups and classes in some depth. In doing so it describes the broad ecosystem diversity of the District. Figure 2.4 locates the vegetation classes in the District.

KAURI FOREST

The Waitakere Ranges were renowned for the great tracts of kauri forest that once covered the hills. For over a century, giant kauri were logged throughout the District. The pattern of kauri forest in the District now consists of small patches of mature kauri forest on ridges in rugged terrain in the centre of the Ranges, with young kauri forest around the periphery and kauri-tanekaha in the lower elevations of the District.

Mature kauri forest: Mature kauri forest remnants of a significant size exist in three places in the District. The typical species association of these original stands is with a heavy dominance of kauri, usually emergent when there is a canopy layer or forming a high broken canopy in the absence of a distinct canopy tier. Occasionally present in the canopy are Hall's totara, rimu, kahikatea, miro or kawaka around the mature kauri trees. The kauri canopy is often up to 35 m in height. Typically within the mid tier are neinei, toropapa, korokio, Kirk's daisy, white maire and ponga. The ground tier is generally very low and composed principally of cutty grass (*Gahnia* species), kauri grass, kiekie and mingimingi together with a wide range of broadleaf shrubs.

Kauri-rimu forest: The kauri-rimu forest class is composed of mostly secondary forests. Rewarewa, lancewood, ponga and kanuka usually accompany kauri in the canopy. The mid tier is normally composed of a range of species; however, the dominance of ponga is noticeable in most sites. The ground tier is more diverse than in the mature kauri stands.

Young kauri forest: Young kauri forests are secondary successions, with an average canopy height of not more than 25 m. Kauri is normally associated in the canopy with small amounts of tanekaha, kanuka, rewarewa, lancewood and rimu. Ponga is often dominant in the mid tier which is usually composed of many species. In some sites the ground tier has a high dominance of *Gahnia lacera* or kauri grass but is normally a mix of ferns or broadleaf species. This forest class is found on ridges and spurs in the lower altitude areas of the District.

Kauri-tanekaha forest: Kauri-tanekaha forest is not common in the District and is found in small patches in the lower altitude periphery of the District. Typical canopy species include kauri, tanekaha and kanuka with a canopy height that does not usually exceed 15 m. There is a tendency for more canopy species to be present than in the previous kauri forest classes. A diverse mid tier is common.

PODOCARP BROADLEAF FOREST

The term 'podocarp broadleaf' is used in this report to describe and unify a set of closely related but distinctive vegetation classes. The most common podocarp species in the District are rimu, miro, Hall's totara, kahikatea, matai and lowland totara. Broadleaf species include the following which are present in the forest canopies in the District; northern rata, puriri, karaka, kohekohe, tawa, taraire. The term has also been used to include a range of other species including mahoe, nikau, lacebark, pigeonwood and mamangi, that are common in the podocarp broadleaf forest classes. Over one third of the vegetation in the Waitakere Ranges consists of podocarp broadleaf forest in which rata, rimu, miro, kahikatea and Hall's totara tower over a relatively low canopy of treefern, nikau, broadleaf trees and shrubs. This low canopy often merges with and becomes indistinguishable from the mid tier vegetation.

Along with the podocarp broadleaf group, the 'broadleaf, nikau and treefern' group covers a large proportion of the District. In this group, podocarps are less frequent or absent.

However the species associations are similar between the *broadleaf*, *treefern*, *nikau* classes and the more obvious podocarp broadleaf forest classes. From this it can be surmised that many sites of broadleaf, treefern forest are the result of modification of the original podocarp broadleaf forest.

Overlap in terms of recurring species arises between the classes listed under this unifying label of *broadleaf*, *nikau* and *treefern* in Table 2.3. Within this group of forest classes there are many ubiquitous species especially ponga, nikau, rewarewa, and mamaku. As well there are several forest species which form their own distinctive communities in some sites and have been classified as such, but in other sites share dominance with other species.

Podocarp broadleaf forest: The bulk of the central region of the Ranges is vegetated with a mixed podocarp broadleaf forest which, despite selective logging, still retains much of the character of the original podocarp broadleaf forest. Rimu, miro, kahikatea and Hall's totara are the most common podocarps in this association. Matai is uncommon and lowland totara and tanekaha are found at lower altitudes. Rata is the most visually dominant broadleaf species, often emerging high above the rest of the broadleaf vegetation. Rewarewa, nikau, mamaku, ponga, heketara, lancewood, pigeonwood and mahoe tend to occur throughout podocarp broadleaf forest. The lower tiers are generally dense with shrubs and treeferns, and thick with a luxuriance of ferns, lianes and epiphytes. This forest class covers extensive areas in the Huia, Upper Nihotupu and Waitakere catchments, occurring predominantly on the mid slope and more occasionally on ridges and gullies.

Upland forest: In the upland areas of the Waitakere Ecological District, generally above 300 m a.s.l., the podocarp broadleaf forest is associated with a characteristic group of species including tawari, tawheowheo, toro, wheki, maire rauriki and *Cyathea smithii*. Rimu and miro are the principal podocarps in this forest. Upland forest occurs mainly in the upper Nihotupu catchment and on the ridges between Huia and Whatipu catchments, and Nihotupu Basin and Waitakere catchment.

Secondary podocarp forest: Several areas of pole stand podocarps have been classified as secondary podocarp forest. Rimu is replacing tea tree forest in the interior upland areas of the Ranges. Rimu seldom forms more than 40% of the canopy with the remainder comprising kanuka and broadleaf trees. Kahikatea pole stands occur on terraces and alluvial sites, which have been cleared in the past. This subclass of podocarp broadleaf forest has been identified to exemplify a step in the regeneration processes occurring in the District.

Kahikatea forest: Kahikatea swamp forest is found as small patches in areas of impeded drainage. Pukatea, putaputaweta, nikau, mamaku, lancewood, rewarewa and ponga are common canopy associates in kahikatea forest. Kahikatea swamp forest occurs on all examples of dissected hillcountry, but was not found within the coastal bioclimatic zone.

Puriri composite forest: In this District, puriri, kohekohe and karaka are commonly associated on warm sites with fertile soils, especially near the coast, on colluvial slopes or at the base of bluff faces. As puriri is the most commonly recurring species and also usually the most dominant, this group of sites has been labelled puriri composite forest. This is despite there being several examples where puriri is of low abundance or even absent. The term composite is used in this class to describe an association of samples where some sites are dominated by either puriri, karaka, or kohekohe. All these species may be present and of varying dominance in any site. Puriri composite forest occurs in a wide range of sites with varying dominance of individual forest species. The sheltered coastal sites and bluff bases are generally dominated by puriri, occasionally with pohutukawa, while karaka prevails on the colluvial slopes. Kohekohe and kowhai reach their greatest abundance in the Titirangi forest remnants and along the Laingholm coastline. Mamaku and tawa tend to be common on hillcountry sites, with pukatea on the few areas with impeded drainage. Nikau is abundant in all areas while ponga, rewarewa

and mahoe are common canopy subdominants. Ponga and nikau strongly dominate the understorey in most examples of puriri composite forest. Although it is restricted to areas below 260 m and does not cover more than 600 ha in total, this forest class covers a greater diversity of physical areas than any other vegetation class. This reflects that this is a broad class, incorporating a number of species with a collective tolerance of a wide range of gradients, landforms, aspects, and substrates.

Tawa forest: Within the tawa forest class, tawa seldom forms more than 40% of the canopy and there are generally several co-dominant species (which vary with location). In the higher altitude areas, such as Nihotupu and Huia catchments, heketara, lacebark, mahoe, rewarewa, karaka, ponga, mamaku, nikau, rata and rimu occur with tawa. In lower altitude areas (such as Karekare Valley, Cascades and Fairy Falls), puriri becomes an important component of the tawa dominated canopy and heketara, lacebark and rimu become less abundant. The ground tier of all these sites consists of parataniwha and kiekie, usually on a mobile rocky slope. Significant areas of tawa occur on the steep slopes in the rugged hillcountry of the District. The gradient of slopes where tawa forest occurs ranges from 20 to 40 degrees.

Mamaku-broadleaf and Ponga-broadleaf forests: These two forest classes cover large areas of the Ranges and comprise a highly diverse canopy in which single species dominance rarely occurs. The classes have been distinguished on the basis of mamaku being more common in some sites while in others, ponga is the more common. Within these two classes the species list is generally similar, the divisions between groups depend upon the dominance, presence or absence of particular species. The commonly recurring species include, mamaku, ponga, nikau, rewarewa, lancewood, heketara, pigeonwood, mahoe and lacebark. Tree ferns and nikau which regenerate quickly after fire (Esler, 1983) are often visually dominant in these sites. The distribution of these two forest classes in the District is not restricted by altitude and they occur on a wide range of aspects and landforms. Mamaku tends to occur in the wetter gully situations with ponga more abundant in the drier areas and steep slopes.

Mixed broadleaf forest. This class is composed of a number of small sites generally dominated by heketara-lancewood-mapou-hinau, or lacebark-pigeonwood-mahoe along with tree ferns, and nikau. This forest type is similar to the species association of tawa and occurs in similar sites. Many sites contain species commonly associated with secondary forest including kanuka, kohuhu and mapou, and are situated in exposed areas where small scale disturbances caused by windthrow probably creates the broken canopy described in these sites. The mid tier is often dense, with thick tangles of kiekie in canopy gaps.

BROADLEAF FOREST

The following broadleaf forests were illustrated by the vegetation analysis as distinct from the former podocarp broadleaf group. Consequently they are discussed as singular forest classes.

Mamangi forest: Mamangi forest tends to be secondary forest that occurs after clearance. This forest type occurs on the warm upper slopes and ridges of lowland rugged hillcountry around the periphery of the Ranges, with large concentrations in the Whatipu catchment. The canopy tends to be of an even height (10 m) with few gaps. It is usually comprised of mamangi with kanuka, rewarewa, lancewood, ponga, kauri, and rimu. The canopy associates of this forest type tend to be kauri and tanekaha on the ridges and broadleaf species on the mid slope. The important broadleaf species are puriri, mahoe, mapou, rata and pigeonwood.

Maire tawake forest: Maire tawake forest is rare in the District. Of the three sites identified, two are in boggy ground at higher altitudes, associated with tawari, tawheowheo, wheki, and *Cyathea smithii*. The third site is on an alluvial flat and is associated with kahikatea and pukatea.

Taraire forest: Taraire forest is largely restricted to the Pararaha and Karekare catchments. Taraire forest consists of an even, dense canopy of mature taraire trees occasionally broken by puriri or emergent rata, over a sparse mid tier dominated by nikau and ponga. Other sites have a more diverse podocarp and broadleaf species composition where taraire only forms about one quarter of the canopy.

SUCCESSIONAL VEGETATION

Extensive areas of the District are covered in tea tree forest and scrub. These are areas where the original forest was completely cleared by fire during the past one hundred years. This group of sites has been divided into manuka, kanuka and kanuka-kauri forest.

Manuka forest and scrub: Manuka forest covers large areas of the District. Manuka forest, rather than kanuka, tends to occur where the climate is influenced by cold southerlies and possibly salt-laden westerlies such as at Nihotupu, Whatipu and Cornwallis. Species associated with manuka forest vary, however lancewood, rewarewa, and mamangi tend to occur with manuka on the lowland dissected hill country. In the higher areas mamangi is replaced with rimu, kohuhu and mapou.

Manuka scrub tends to occur in the more exposed sites. On the coastal slopes, flax, cabbage tree, toetoe and *Coprosma robusta* occur in the dense, low windswept manuka canopy. Inland, lancewood and mamangi are common canopy associates, with the mid tier usually more diverse than in coastal sites. At higher altitudes wheki, heketara and toru become the canopy co-dominants.

Kanuka forest and scrub: Kanuka forest has a range of species occurring within it, depending upon the location. Puriri-karaka and pohutukawa-kowhai, are commonly found with and beneath the kanuka dominated canopy in the coastal areas. On the ridges of dissected hill country, podocarps and kauri are significant. Kowhai and cabbage tree are common on the mid slope in lowland hill country areas.

Kanuka scrub is found in exposed coastal areas. These sites are usually composed of a low dense canopy of kanuka with a mid tier of broadleaf species including hangehange, mahoe, mingimingi, mapou, *Coprosma macrocarpa*, *C.rhamnoides*, *C. crassifolia*, *C.robusta*, flax and *Gahnia lacera*. Ferns such as *Doodia media*, shield fern (*Polystichum richardii*), shining spleenwort and bracken, with native and exotic grasses form the ground tier.

Kauri-kanuka forest: Kauri-kanuka forest appears to be a stage of the regeneration cycle of kanuka through to mature kauri forest. This class describes sites where some of the kauri trees have emerged through a senescing canopy of kanuka while most of the kauri are beneath the canopy. The species association is similar to that of young kauri forest.

BLUFF VEGETATION

Within the resistant beds of volcanic rock in the Ranges, bluffs, gorges and waterfalls are common. The steep rocky faces that these geological features present create a special habitat which is uncommon in the Auckland Ecological Region. Characteristic vegetation associations recur on the bluff systems throughout the District. The fall faces are colonised by monocot rocklands on the steepest slopes and by kowhai-kanuka dominated scrub and shrublands on less precipitous faces. The vegetation on the tops of the bluffs varies with location and degree of disturbance. The bluff bases are characterised by fertile soils due to the accumulation of debris from the bluff face. Puriri composite forest is common in such sites. The bluff vegetation communities are described in more detail in Appendix 6.

Monocot rockland: Rocklands supporting predominantly monocotyledonous species cover most of the bluff faces. The association of *Astelia banksii*, *Phormium tenax*, *P.cookianum*, *Arthropodium cirratum*, *Gahnia* spp., *Machaerina sinclairii* and the exotic

purple pampas grass recurs on all of the steep rocky faces. Vegetation tends to cover 20 % of the rock surface.

Shrub rockland: In shrub rockland sites the vegetation cover is up to 40 %. The shrubs found include kowhai, kanuka, puka, akeake and akepiro, with occasional rewarewa and karaka on ledges. The monocotyledonous species discussed previously are in the ground tier.

Kowhai-kanuka shrubland: Kowhai-kanuka scrub and/or shrubland is common on the less steep parts of the bluff faces and occurs on nearly all of the bluffs. Kowhai and kanuka are the dominant species and usually occur with the rockland monocotyledonous species in the District. Other shrubs less frequently found are akepiro, akeake, puka, mahoe and mapou. Vegetation cover always exceeds that of bare rock. The structure of these sites varies from scrub, and shrubland to forest. Two kowhai varieties are found. *Sophora microphylla* var *fulvida*, endemic to the District, is the more common of the two on the inland bluffs and along the west coast, while *S. microphylla* var *microphylla* occurs along the hillslopes of the inner Manukau Harbour.

COASTAL EDGE VEGETATION

Pohutukawa forest: Pohutukawa forest has been greatly reduced from its former extent in the District. However it is still common along the cliff tops, faces and bases of the west coast and Manukau Harbour hillslopes. The characteristic canopy species is pohutukawa, with scattered kowhai, karaka, puriri and nikau. To a lesser extent karo and houpara are also common. Found occasionally with pohutukawa are wharangi, ngaio, whau, and tawapou. The mid tier is usually composed of kawakawa, ponga, mahoe, flax, coastal astelia and *Coprosma* species and in some sites dominated by nikau. The ground tier varies between sites with a variety of grasses, herbs and shrubs. Ground ferns are very common in these sites, especially *Asplenium oblongifolium*, *Polystichum richardii*, *Adiantum cunninghamii*, *Doodia media*, *Phymatosorus diversifolius* and various species from the genus *Pteris*.

Karo-houpara forest: Karo and houpara are found on the coastal sites. This is a vegetation type found on two small offshore islands at Te Henga Beach. Its successional status is unclear as the islands were occupied for many centuries. Flax, hangehange, kawakawa, *Coprosma crassifolia* and mingimingi are also found here.

Coastal scrub/shrubland: Two sites of this vegetation group have been identified in the District. One site is a shrubland dominated by toetoe (*Cortaderia splendens*) and houpara and found on an island at Piha. The second is coastal scrub, dominated by *Coprosma macrocarpa* at the base of the cliffs at Maori Bay. The species composition of this single tiered vegetation is similar to the midtier of pohutukawa forest on the same landform.

Flax-manuka scrub: Low dense scrub equally dominated by manuka and flax (predominantly *P. tenax*) occurs on the coastal cliff tops and hillslopes.

COASTAL VEGETATION

Sandfield: In the Whatipu area pingao covers the most seaward sand dunes while spinifex covers the dunes behind. North of the Pararaha valley pingao is uncommon. Here spinifex and marram grass dominate the dunes. Because pingao and spinifex tend to form separate colonies, they have been separated into two vegetation classes.

Herbfield: Herbfields are common on the Whatipu sand plains where the elevation is low and seasonal ponding occurs. The most common species in these low, single-tiered herb gardens are arrow grass (*Triglochin striata*), water milfoil (*Myriophyllum votschii*), and the small dicotyledonous herbs, *Lilaeopsis novae-zelandiae* and *Limosella lineata*. In the

northern extent of the Whatipu sands, sedges such as *Carex pumila* and *Isolepis cernua*, are more common. Other herbs, including *Lobelia anceps* and *Selliera radicans* are locally present.

Flaxland: Several small flaxlands occur at the base of the sand impounded cliffs along Whatipu Beach. Here flax (*P. tenax*), *Baumea juncea*, *Isolepis nodosa*, and spinifex are the dominant species. Pohutukawa and cabbage tree are occasionally present. North of the Whatipu dunes, flax tends to be associated with dense manuka.

Seacliff rockland: Rocky coastal cliffs occur along the length of the west coast. In many places the vegetation cover is sparse and low in stature. The small stocky fern *Asplenium northlandicum* is common in the crevices of the rocks. Flax, native cutty grass, *Hebe obtusata*, iceplant, New Zealand spinach, shore pimpernel, shore lobelia, shore groundsel and pohutukawa seedlings survive here.

Jointed rush sedgeland: Jointed rush (*Leptocarpus similis*) is associated with small amounts of *Juncus maritimus*, *J. planifolius*, *Carex pumila*, arrow grass, purple pampas grass, water milfoil, manuka seedlings, "*Blechnum capense*" and *Glossostigma elatinoides*. This vegetation class occurs in a small saline wetland on the Whatipu sandflats.

Mangrove forest: Mangrove forest covers the intertidal mudflats of Big and Little Muddy Creeks. In these forests, mangroves are the only tree species, unlike other saline wetlands in the Region. Saltmarsh dominated by jointed rush and glasswort fringe the landward side of these forests.

FRESHWATER WETLAND VEGETATION

Raupo reedland: Raupo dominated wetlands are found at Pararaha valley, Ohaka Head lake, Lake Kawaupaka, Lake Wainamu and in small swamps on the coastal cliffs between Muriwai and Te Henga. Raupo occurs through the Te Henga swamp but is not the dominant species. Usually raupo is concentrated in the middle of the wetland with *Baumea* and *Eleocharis* species found in the fringe.

Baumea sedgeland: *Baumea* sedgeland is only found in the Te Henga swamp where it is the dominant vegetation class. Two species of *Baumea* predominate, in the drier part of the swamp, *B. rubiginosa* dominates, while the wetter area at the head of the swamp is composed of *B. articulata*. Raupo, swamp millet, native and exotic herbs occur throughout. Within the *B. articulata* sedgelands are areas of open water with floating herbs and patches of swamp millet grassland. Several "islands" of manuka-cabbage tree scrub are scattered throughout the drier parts of the swamp.

Swamp millet grassland: Floating mats of swamp millet (*Isachne globosa*) dominated grassland occur in the Te Henga swamp. The swamp millet is dense and reaches 1.6 m in height. Within the grassland are assorted reeds including spike rush, raupo, *Baumea rubiginosa*, *Carex secta* and *Schoenoplectus validus*, with native and exotic herbs among their bases.

Cabbage tree forest: Two areas of cabbage tree forest occur in the Te Henga swamp. Cabbage trees over a flax dominated lower tier occur in the boggy area at the head of the swamp. The second area is more diverse, in an area of impeded drainage, and contains putaputaweta, titoki and kahikatea.

Schoenoplectus sedgeland: A band of *Schoenoplectus validus* traces the shallows of the Ohaka Head lake, the only permanent freshwater lake on the Whatipu dunes. The spike rush *Eleocharis acuta* is present in small amounts along the lake margin.

2.4.3 Representative vegetation associations and classes in the District.

Vegetation classes which are now representative of the ecosystems in the District reflect but no longer mirror the original extent and composition of the District's ecological character. The following discussion is concerned with what are now representative vegetation classes in the District and indicates which of these were part of the original natural character.

Inland podocarp broadleaf forest dominates the central portion of the Waitakere Ranges (3033 ha, see RAP 13). This forest group is characteristic of the original vegetation of the District and covers the most extensive area of all the vegetation classes in the District. This forest class is closely followed in extent by manuka scrub and forest within both the coastal and inland bioclimatic zones (2693 ha) and inland mamaku broadleaf forest on all dissected hill country physical areas (2730 ha). Inland and coastal kanuka scrub and forest also covers extensive areas across the District (3164 ha, see RAP 8). The next major forest class is upland forest on the high relief of the Ranges proper. This forest type is restricted to the higher altitude, central part of the District (1184 ha, RAP 21).

While still covering large areas of the District, the following vegetation classes are an order of magnitude less frequent than those discussed above. Coastal and inland kauri-kanuka covers both subdued and rugged hillcountry (685 ha). Inland puriri composite forest, on subdued and rugged hillcountry, is scattered throughout the District.

Many other vegetation classes, while not as extensive as the former, are representative and characteristic of the physical areas that they develop on. These are also significant vegetation types that reflect the diversity of the natural character of the District. For example pohutukawa forest on exposed rocky cliffs, pingao and spinifex communities on sand dunes, and *Baumea* sedgeland which dominates the vegetation in the largest freshwater swamp in the District (RAP 10 & 5).

Mature kauri forest situated on dissected hill country, while representative, is no longer a common vegetation class, now only occurring in limited and scattered areas in the District such as Cascades Kauri Park. Some of the rare vegetation types such as kauri-hard beech and kauri-tawari forest, are subgroups within these broad and more frequent classes. Such vegetation classes were probably not common in the District (RAP 13). Much more mature kauri forest on the rugged hillcountry probably existed in pre European times, however these areas were extensively modified.

Many other vegetation classes are found in the District and both the check-list for priority vegetation sites in this chapter and the check-list of ecological units in Appendix 1 indicate the range of vegetation and landform associations that occur in the District.

2.5 Priority Vegetation Sites

The table of priority vegetation sites (Table 2.4) which follows records part of the decision making process which leads to recommended areas for protection. This table lists what are considered to be the best examples of individual vegetation classes on each physical area (ecological units) where they are found to occur. The tables of priority landform, wildlife, and vegetation sites are the primary building blocks which lead to the initial RAP selection. Figure 2.8 shows the location of the priority vegetation sites.

PRIORITY VEGETATION SITES IN THE WAITAKERE ECOLOGICAL DISTRICT

Notes to the Priority Vegetation Site Table:

1. The Priority Vegetation Site (PVS) numbering system is consistent with the numbers of the priority sites described and mapped in the Recommended Areas for Protection, for example 8V1 is lowland mature kauri forest on rugged hillcountry which is captured within RAP 8 - that is '8' for the RAP, 'V' for vegetation, '1' for the PVS number.
2. Vegetation sites are *ordered* according to Vegetation Class firstly, Community Class secondly, Bioclimatic Zone thirdly, and Physical Area lastly. Note however that the columns in the PVS list are *placed* in the order in which the ecological units are named (ie Bioclimatic Zone, Vegetation Class, Community Class, Physical Area).
3. Definitions of Bioclimatic Zones and Physical Areas are provided in Chapter 2.
4. Community Classes follow the definitions provided in the glossary (definitions taken from NZ Biological Resources Centre Publication No 6 1987).
5. 'Number Surveyed' relates to the number of sample sites surveyed (i.e. the number of field cards completed) for each ecological unit. Some ecological units are so large that several sample sites were surveyed to adequately describe them.
6. 'Total Area' is an estimate of the total area (in hectares) of each ecological unit surveyed. The area given is an estimate as not every example of a given ecological unit is likely to have been surveyed. The area values are probably more accurate for smaller sites or for areas with easily discernable boundaries, such as kanuka forest.
7. Priority Vegetation Sites are individual sites identified by the grid reference (NZMS 260, 1:50,000 R11 and Q11) of their central point. In some cases only one priority site per ecological unit has been chosen, however there are often cases where two or three sites were chosen. More than one site was chosen if the particular vegetation class is rare/uncommon (eg maire tawake forest), or reduced from former extent (eg wetland vegetation, mature kauri forest), or a class of high diversity which could easily be subdivided into several vegetation classes (eg puriri composite forest), or a class which covers a large proportion of the District and requires several sites to capture at least 10% of the total amount present (eg kanuka forest).
8. 'Site area' is the area of each individual PVS.
9. Tenure of each PVS is listed. Key to abbreviations is provided below.
10. Under the heading 'Ecol Unit Protected?' an indication of the adequacy of protection of that particular vegetation/landform system as a whole (not just of the PVS) is given. If the area is in some form of reserve the name of the reserve is provided. Abbreviations are listed below. Question marks indicate sites where the degree of protection is uncertain. This occurs at the Whatipu Sands where the land is currently untitled, but is managed by the Regional Parks Department. Where a value with hectares is given this is an indication that only a small amount of that class is in protection and that this small amount may not be enough to protect this vegetation class in perpetuity, i.e., the area protected may be too small to be viable and therefore thought should be given to protecting a further amount of this class.

11. 'RAP No' refers to the Recommended Area for Protection within which a given PVS occurs.

KEY TO ABBREVIATIONS:

ARC	Auckland Regional Council
Auck. Uni.	Auckland University (Botany Department)
Bdlf	Broadleaf
CMP	Auckland Centennial Memorial Park
DOC	Department of Conservation
Entr	Entrance
Espl	Esplanade
pt	part (only part of the total area is kanuka forest)
QEII	Queen Elizabeth II National Trust (open space covenants)
RDC	Rodney District Council
Reg. Park	ARC Regional Parkland
RFBPS	Royal Forest and Bird Protection Society
SR	Scenic Reserve
Uninvest	Uninvestigated Land (Untitled) - Whatipu sands
WCC	Waitakere City Council
WSC	Water Supply Catchment (ARC)

TABLE 2.4

PRIORITY VEGETATION SITES IN THE WAITAKERE ECOLOGICAL DISTRICT

PVS No	BIOCL-MATIC ZONE	VEGETATION CLASS	COMMUNITY CLASS	PHYSICAL AREA	NUMBER SURVEYED	TOTAL AREA ha	PRIORITY VEG SITE	SITE AREA ha	TENURE	ECOL UNIT PROTECTED?	RAP
							Grid Ref				No
1	Lowland	Mature Kauri	Forest	Rugged Hillcountry	6	17	Q 426706	3	CMP	Yes CMP	8
2				Eastern Foothills	2	4	Q 492777	3	CMP	Yes CMP	18
3				High Relief	15	117	Q 496688	28	ARC WSC	Yes CMP	13
							Q 458779	25	CMP		
							Q 481711	10	ARC WSC		13
4	Lowland	Kauri-Rimu	Forest	Subdued Hillcountry	1	17	Q 443848	17	Private	No	3
5				Rugged Hillcountry	4	50	Q 472786	12	CMP	Yes CMP	
6				Eastern Foothills	3	8	R 500762	5	CMP	Yes CMP	18
7				High Relief	2	6	Q 453673	5	ARC WSC	Yes, 1ha CMP	13
8	Lowland	Kauri-Tawari	Forest	High Relief	1	1	Q 465675	1	ARC WSC	No	13
9	Lowland	Kauri-Beech	Forest	Rugged Hillcountry	1	0.5	Q 457639	0.5	CMP	Yes CMP	13
10	Coastal	Young Kauri	Forest	Rocky Harbour Entr	1	19	Q 456623	19	CMP	Yes CMP	12
11	Lowland	Young Kauri	Forest	Consolidated Sand	1	7	Q 395833	7	DOC SR	Yes Motutara SR	3
12				Subdued Hillcountry	8	80	Q 419834	40	DOC SR	Yes Mokoroa SR	3
							Q 418805	3	RFBPS		5
13				Rugged Hillcountry	14	100	Q 453628	30	CMP	Yes CMP	13
14				Eastern Foothills	2	10	R 532747	9	Auck Uni.	Yes CMP	17
15				High Relief	3	7	Q 458784	5	CMP	Yes CMP	
16	Coastal	Kauri-Tarekaha	Forest	Southern Foothills	1	8	R 562700	8	Private	No	

PVS No	BIOCL-MATIC ZONE	VEGETATION CLASS	COMMUNITY CLASS	PHYSICAL AREA	NUMBER SURVEYED	TOTAL AREA ha	PRIORITY VEG SITE	SITE AREA ha	TENURE	ECOL UNIT PROTECTED?	RAP No
							Grid Ref				
17	Lowland	Kauri-Tanekaha	Forest	Subdued Hillcountry	1	14	Q 419807	14	RFBPS	Yes RFBPS	5
18				Rugged Hillcountry	6	11	Q 421721	4	CMP	Yes CMP	8
							Q 418752	5	CMP		
19	Coastal	Kauri-Kanuka	Forest	Rocky Harbour Entr	1	12	Q 470631	12	CMP	Yes CMP	12
20				Southern Foothills	3	79	R 545697	42	Private	Yes ARC Parkland	15
21	Lowland	Kauri-Kanuka	Forest	Subdued Hillcountry	2	200	Q 419809	196	Private	Yes, 2ha RFBPS	5
22				Rugged Hillcountry	16	316	Q 435707	150	CMP	Yes CMP	8
							Q 410768	42	Private		7
23				Eastern Foothills	1	2.5	R 580714	2.5	CMP	Yes, 2ha CMP	16
24				High Relief	3	10	Q 493692	4	ARC WSC	Yes, 3ha CMP	13
25	Coastal	Kanuka	Forest	Rocky Harbour Entr	4	46	Q 465628	30	CMP	Yes CMP	12
26				Rugged Hillcountry	3	25	Q 404774	15	Private	Yes CMP	7
27				Southern Foothills	2	180	R 548696	175	Private	Yes ARC Parkland	15
28	Lowland	Kanuka	Forest	Consolidated Sand	1	22	Q 385834	22	Private	No	4
29				Subdued Hillcountry	5	156	Q 402826	87	DOC	Yes DOC SR	3
							Q 404821	16	Private		3
30				Rugged Hillcountry	24	571	Q 442706	pt 150	CMP	Yes CMP	8
							Q 438698	20	CMP		8
31				Eastern Foothills	4	150	R 538708	115	ARC WSC	Yes, 7ha CMP	7
32				High Relief	19	336	Q 442728	50	CMP	Yes CMP	8
							Q 473661	30	ARC WSC		13
33	Coastal	Kanuka	Scrub	Unconsolidated Sand	2	34	Q 404782	34	Private	No	7
34				Consolidated Sand	2	27	Q 389781	20	Private	Yes, 7ha Reg. Park	6
35				Rugged Hillcountry	3	50	Q 414682	3	CMP	Yes CMP	9
36	Lowland	Kanuka	Scrub	Rugged Hillcountry	2	25	Q 415766	22	Private	Yes, 3ha CMP	7
37	Coastal	Manuka	Scrub	Rocky Harbour Entr	2	26	Q 465624	14	CMP	Yes CMP	12
38				Rugged Hillcountry	9	237	Q 406734	80	CMP	Yes CMP	8
39				Southern Foothills	4	50	R 509648	16	CMP	Yes ARC Parkland	14

PVS No	BIOCL- MATIC ZONE	VEGETATION CLASS	COMMUNITY CLASS	PHYSICAL AREA	NUMBER SURVEYED	TOTAL AREA ha	PRIORITY VEG SITE Grid Ref	SITE AREA ha	TENURE	ECOL UNIT PROTECTED?	RAP No
40	Lowland	Manuka	Scrub	Consolidated Sand	1	4	Q 391827	20	Private	No	4
41				Subdued Hillcountry	4	90	Q 405807	48	Private	Yes WCC Res.	5
42				Rugged Hillcountry	10	330	R 510676	60	ARC WSC	Yes CMP	13
43				Eastern Foothills	1	10	Q 425667	16	Private/CMP	Yes CMP	11
44				High Relief	4	90	R 534717	10	CMP	Yes CMP	13
							Q 473643	24	CMP		
45	Lowland	Manuka	Forest	Subdued Hillcountry	1	103	Q 441815	103	Private	No	5
46				Rugged Hillcountry	7	730	Q 459639	106	CMP	Yes CMP	13
47				Eastern Foothills	2	26	R 528713	11	ARC WSC	Yes CMP	18
							Q 493770	15	CMP		13
48				High Relief	8	526	Q 467646	85	CMP	Yes CMP	
49	Coastal	Mamangi	Forest	Rocky Harbour Entr	2	7	Q 457620	5	CMP	Yes CMP	12
50	Lowland	Mamangi	Forest	Subdued Hillcountry	2	17	Q 405826	12	RFBPS	Yes, 2ha RFBPS	3
							Q 405823	5	RFBPS		3
51				Rugged Hillcountry	13	219	Q 494672	69	ARC WSC	Yes CMP	13
							Q 423717	33	CMP		8
52				High Relief	3	6	R 505706	4	ARC WSC	No	13
							Q 463773	2	ARC WSC		
53	Lowland	Taraire	Forest	Rugged Hillcountry	12	70	Q 427658	20	CMP	Yes CMP	11
							Q 442863	7	CMP		11
							Q 432647	6	CMP		11
54				High Relief	1	5	Q 489691	5	ARC WSC	No	13
55	Coastal	Puriri Composite	Forest	Exposed Rocky Coast	1	6	Q 434632	6	CMP	Yes, 6ha CMP	10
56				Rocky Harbour Entr	4	38	Q 457618	13	CMP	Yes CMP	12
57				Rugged Hillcountry	3	24	Q 405777	7	Private	No	7
58				Southern Foothills	5	17	R 561688	6	Private	No	15
							R 544678	5	Private		
							R 553687	3	Private		15

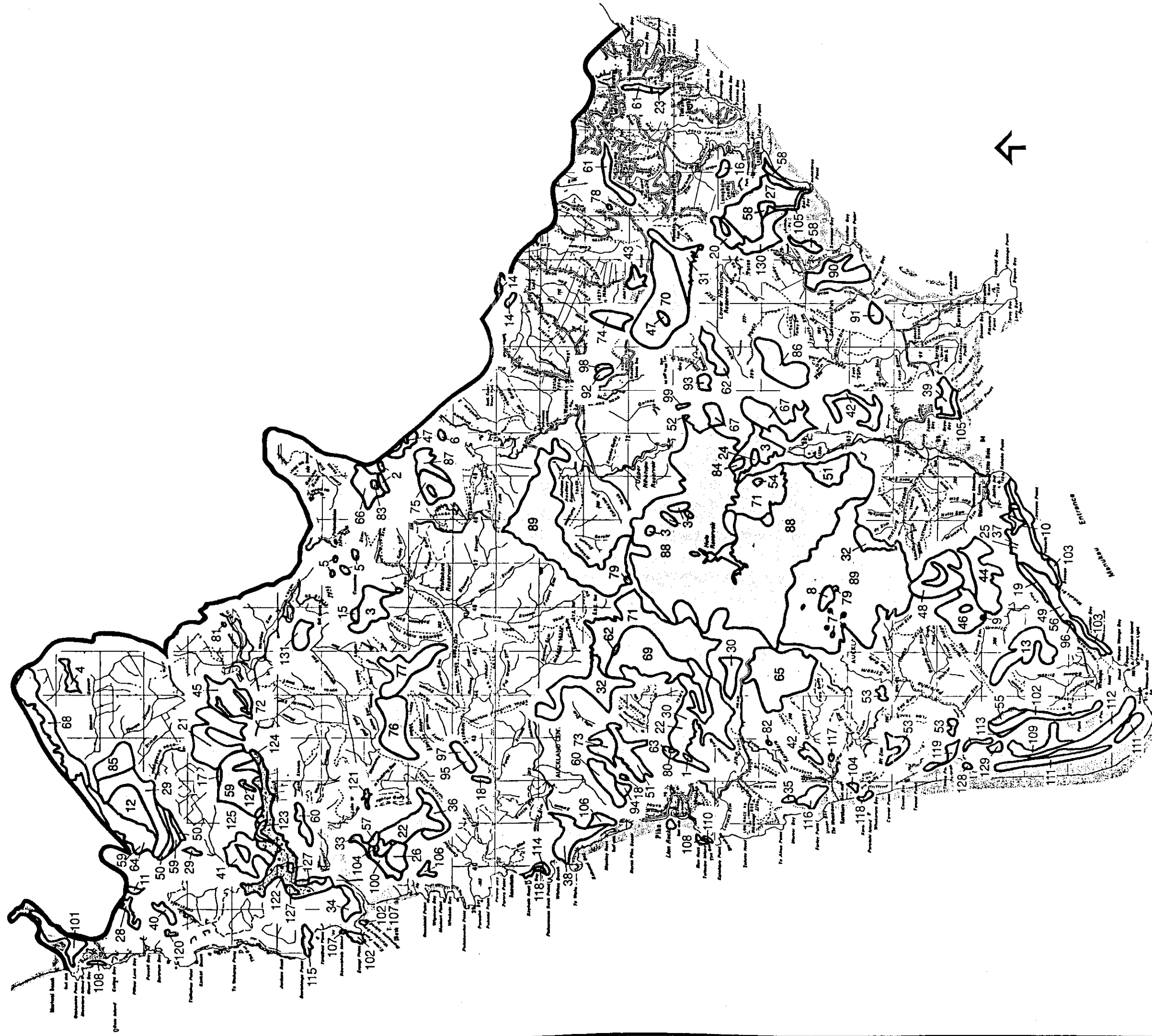
PVS No	BIOCLIMATIC ZONE	VEGETATION CLASS	COMMUNITY CLASS	PHYSICAL AREA	NUMBER SURVEYED	TOTAL AREA ha	PRIORITY VEG SITE	SITE AREA ha	TENURE	ECOL UNIT PROTECTED?	RAP
							Grid Ref				No
59	Lowland	Puriri Composite	Forest	Subdued Hillcountry	8	172	Q 405824	18	Reserve	Yes RFBPS	3
							Q 413839	19	Private		3
							Q 416805	97	RFBPS		5
60				Rugged Hillcountry	24	218	Q 417723	22	CMP	Yes CMP	8
							Q 407792	33	Private		5
61				Eastern Foothills	8	38	R 556722	17	CMP	Yes CMP	16
							R 581717	5	CMP		16
62				High Relief	4	26	R 513700	16	ARC WSC	Yes, 3ha CMP	
							Q 451723	3	CMP		8
63				Alluvial Flat	1	2.5	Q 427709	2.5	CMP	Yes, 2.5ha CMP	8
64	Lowland	Tawa	Forest	Subdued Hillcountry	1	46	Q 411837	46	Private	No	3
65				Rugged Hillcountry	12	159	Q 445687	80	CMP	Yes CMP	
66				Eastern Foothills	2	52	Q 485778	40	CMP	Yes CMP	18
67				High Relief	18	482	R 506690	90	ARC WSC	Yes CMP	13
							R 506701	10	ARC WSC		13
68	Lowland	Mamaku Broadleaf	Forest	Subdued Hillcountry	2	160	Q 432852	82	Private	No	3
69				Rugged Hillcountry	13	277	Q 444710	120	CMP	Yes CMP	8
70				Eastern Foothills	5	62	R 538714	43	ARC WSC	Yes CMP	
71				High Relief	19	397	Q 492686	120	ARC WSC	Yes CMP	13
							Q 453726	40	CMP		8
72	Lowland	Ponga Broadleaf	Forest	Subdued Hillcountry	2	18	Q 441814	3	Private	No	5
73				Rugged Hillcountry	10	101	C 128724	30	CMP	Yes CMP	8
74				Eastern Foothills	1	16	R 527723	16	CMP	Yes CMP	
75				High Relief	6	46	Q 489765	12	CMP	Yes CMP	18
76	Lowland	Mixed Broadleaf	Forest	Rugged Hillcountry	7	113	Q 435775	64	CMP	Yes CMP	
77				High Relief	2	75	Q 447775	59	CMP	Yes CMP	
78	Lowland	Maire tawake	Forest	Eastern Foothills	1	1?	Unsurveyed	1?	Private	No	
79				High Relief	2	3.5	Q 465719	2	ARC WSC	No	21
							Q 464672	1	ARC WSC		13
80				Alluvial Flat	1	0.5	Q 427710	0.5	CMP	Yes, 0.5ha CMP	8

PVS No	BIOCL-MATIC ZONE	VEGETATION CLASS	COMMUNITY CLASS	PHYSICAL AREA	NUMBER SURVEYED	TOTAL AREA ha	PRIORITY VEG SITE	SITE AREA ha	TENURE	ECOL UNIT PROTECTED?	RAP
							Grid Ref				No
81	Lowland	Kahikatea Swamp	Forest	Subdued Hillcountry	1	1	Q 453812	1	WCC Reserve	Yes, 1ha WCC/RFBPS	5
82				Rugged Hillcountry	1	1	Q 429688	1	Private	No	
83				Eastern Foothills	3	3	Q 488778	2	CMP	Yes, 2ha CMP	18
84				High Relief	5	16	Q 493697	6	ARC WSC	No	13
85	Lowland	Podocarp Bdlf	Forest	Subdued Hillcountry	4	50	Q 423837	26	Private	Yes RFBPS/WCC	3
86				Rugged Hillcountry	6	228	R 513684	60	ARC Parkland	Yes ARC Parkland	
87				Eastern Foothills	8	85	Q 492767	15	CMP	Yes CMP	18
88				High Relief	71	1871	Q 480700	507	ARC WSC	Yes CMP	13
89	Lowland	Upland Podocarp	Forest	High Relief	33	1184	Q 475737	340	ARC WSC	Yes CMP	21
							Q 470670	300	ARC WSC/CMP		13
90	Coastal	Secondary Podocarp	Forest	Southern Foothills	1	44	R 537674	44	ARC Parkland	Yes ARC Parkland	
91	Lowland	Secondary Podocarp	Forest	Rugged Hillcountry	2	6	R 528665	6	ARC Parkland	Yes, 6ha ARC Parkland	
92				Eastern Foothills	4	20	R 514727	4	CMP	Yes CMP	20
93				High Relief	4	35	R 514704	7	ARC WSC	Yes, 8ha CMP	13
94	Lowland	Monocot	Rockland	Rugged Hillcountry	5	3.5	Q 418722	1.5	CMP	Yes, 3.5ha CMP	8
95	Lowland	Shrub	Rockland	Rugged Hillcountry	7	11	Q 427758	0.5	CMP	Yes, 11ha CMP	
							Q 410747	2	CMP		
96	Coastal	Kowhai-Kanuka	"Scrub"	Rocky Harbour Entr	1	12	Q 456618	12	CMP	Yes CMP	12
97	Lowland	Kowhai-Kanuka	"Scrub"	Rugged Hillcountry	14	16	Q 423756	1.5	CMP	Yes CMP	
							Q 428759	2	CMP		
							Q 418721	0.5	CMP		8
98				Eastern Foothills	2	2	R 515727	2	CMP	Yes, 2ha CMP	20
99				High Relief	2	6	R 507709	5	ARC WSC	No	13
100	Coastal	Pohutukawa	Forest	Unconsolidated Sand	6	25	Q 402778	3	Private	Yes, 4ha CMP	7
							Q 403775	6	Private		7

PVS No	BIOCL-MATIC ZONE	VEGETATION CLASS	COMMUNITY CLASS	PHYSICAL AREA	NUMBER SURVEYED	TOTAL AREA ha	PRIORITY VEG SITE	SITE AREA ha	TENURE	ECOL UNIT PROTECTED?	RAP No
							Grid Ref				
101				Consolidated Sand	4	30	Q 381847	27	ARC Reg. Park	Yes CMP	2
102				Exposed Rocky Coast	13	70	Q 433634	30	CMP	Yes CMP	10
							Q 383781	5	Private		6
103				Rocky Harbour Entr	5	44	Q 452613	18	CMP	Yes CMP	12
							Q 481628	26	CMP		
104				Rugged Hillcountry	5	20	Q 404778	6	Private	Yes CMP	7
							Q 421671	5	CMP		9
105				Southern Foothills	5	23	R 506645	5	CMP	Yes CMP	14
							R 553685	5	Espl Reserve		15
106	Lowland	Pohutukawa	Forest	Rugged Hillcountry	2	6	Q 412725	3	CMP	Yes, 3ha CMP	8
							Q 400766	3	Private		7
107	Coastal	Karo-Houpara	Forest	Exposed Rocky Coast	2	2.5	Q 385785	1	Private	No	6
							Q 387781	1.5	Private		6
108	Coastal	Coastal Shrub	"Scrub"	Exposed Rocky Coast	2	5.5	Q 406703	2.5	Private	No	9
							Q 377843	3	ARC Reg. Park	Yes Reg. Park	1
109	Coastal	Coastal Herb	Herbfield	Unconsolidated Sand	4	40	Q 426628	40	Uninvest. Land	No?	10
110				Exposed Rocky Coast	1	0.5	Q 407699	0.5	Private?	No	9
111	Coastal	Pingao	Sandfield	Unconsolidated Sand	3	84	Q 425628	84	Uninvest. Land	No?	10
112	Coastal	Spinifex	Sandfield	Unconsolidated Sand	1	68	Q 426628	68	Uninvest. Land	No?	10
113	Coastal	Phormium	Flaxland	Unconsolidated Sand	3	2	Q 417664	1	CMP	Yes, 1ha CMP	10
114				Exposed Rocky Coast	2	15	Q 402738	6	CMP	Yes CMP	9
115	Coastal	Flax-Manuka	Scrub	Exposed Rocky Coast	1	11	Q 387786	11	Private	No	6
116				Rugged Hillcountry	2	28	Q 415678	25	CMP	Yes CMP	9
117	Lowland	Flax-Manuka	Scrub	Rugged Hillcountry	2	3	Q 424673	2	CMP	Yes, 3ha CMP	11

PVS No	BIOCL-MATIC ZONE	VEGETATION CLASS	COMMUNITY CLASS	PHYSICAL AREA	NUMBER SURVEYED	TOTAL AREA ha	PRIORITY VEG SITE	SITE AREA ha	TENURE	ECOL UNIT PROTECTED?	RAP No
Grid Ref											
118	Coastal	Sea-Cliff	Rockland	Exposed Rocky Coast	2	20	Q 398745 Q 416665	10 10	CMP	Yes CMP	9 9
119	Coastal	Raupo	Reedland	Freshwater Wetland	2	3.5	Q 427646	3.5	Uninvest. Land	No?	10
120	Lowland	Raupo	Reedland	Consolidated Sand	1	2	Q 384825	2	Private	No	4
121				Dune Impounded Lake	2	3	Q 406773 Q 417779	1 2	Private SR	Yes SR	7 7
122	Lowland	Baumea	Sedgeland	Freshwater Wetland	3	80	Q 405800	80	Private	No	5
123	Lowland	Swamp Millet	Grassland	Freshwater Wetland	1	6	Q 416803	6	Private	No	5
124	Lowland	Cabbage Tree	Forest	Freshwater Wetland	1	7	Q 425804	7	Private	No	5
125				Subdued Hillcountry	1	1.5	Q 412805	1.5	RFBPS	Yes, 1.5ha RFBPS	5
126				Dune Impounded Lake	1	1	Q 406773	1	Private	No	7
127	Lowland	Manuka-cabbage	Scrub	Freshwater Wetland	1	3	Q 400797	3	Private	No	5
128	Coastal	Leptocarpus	Sedgeland	Saline Wetland(sand)	1	4	Q 424643	4	Uninvest. Land	No?	10
129	Coastal	Schoenoplectus	Sedgeland	Freshwater Wetland	1	6	Q 428636	6	Uninvest. Land	No?	10
130	Coastal	Mangrove	Forest	Estuary	1	43	R 545688	43	Crown	No	15

PRIORITY VEGETATION SITES IN THE WAITAKERE ECOLOGICAL DISTRICT



Scale: 0 1 2 3 4 5 kms

Figure 2.8

2.6 Wildlife of the Waitakere Ecological District

Introduction

The Waitakere Ecological District has a diverse range of both endemic and introduced wildlife species. At the time of surveying 71 species of birds were recorded, one marine mammal, five lizards, three frogs, 11 freshwater fish and two freshwater crustacea. In addition nine species of introduced noxious animals were found. Recent studies have shown that large numbers of invertebrates are also present in the District, including over 100 species of land snail (Slaven, 1989). The Waitakere Ecological District also has the type localities for over 200 species of insects (Dugdale et al, 1989). Ongoing detailed studies have shown that over 800 species of insects occur at the 80 ha RFBPS Matuku Reserve at Te Henga (Auckland Branch of the Entomological Society - unpublished information) which is mostly forest with some freshwater swamp.

All of these wildlife species depend on other flora or fauna species in the District in some way for their survival. Although most of these species also occur outside the District, it is the combination and interaction between them which makes Waitakere Ecological District unique.

The three broad wildlife habitat types, namely:

- forest - shrublands,
- freshwater wetlands, and
- coastal - estuarine,

are all represented in the District, with forest habitat still dominant.

A complete list of the fauna species found in Waitakere Ecological District appears in Appendix 7.

2.6.1 Forest - Shrubland Habitat

Significant species

The Waitakere Ranges is the second largest contiguous forest block, after the Hunua Ranges, remaining in the Auckland Ecological Region. As such it is an important refugia for many wildlife species now threatened through past forest habitat destruction. Birds such as the North Island (NI) kaka (listed as "threatened" in Bell, 1986) and long tailed cuckoo ("rare", *ibid*) which pass through the District without stopping to breed. Several NZ falcon ("threatened", *ibid*) have been reported from Karekare and other areas, which may be breeding, and also in the Karekare area, the NZ long tailed bat ("threatened", *ibid*) has recently been sighted. Colonies of the kauri snail *Paryphanta busbyi* ("threatened", *ibid*) still survive in several areas of the Waitakere Ranges.

The District also supports one of the few wild colonies in New Zealand of the introduced Australian sulphur-crested cockatoo, which has established in the Cascades area.

Insects which are uncommon but still survive in the Ranges include the spectacular forest ringlet butterfly which feeds on *Gahnia* spp., the large giraffe weevil, and the two large longhorn beetles *Blosyropus* sp. and *Nesoptychia* sp. There are three endemic beetle species in the Ranges, including the minute rove beetle, *Paratorchus insuetus* in forest litter in Destruction Gully (McColl, 1982), the longhorn *Hybolasius optatus* (Dugdale, 1989) and an undescribed scarab *Sericospilus* sp. which has an adult flight period of just one to two weeks each year (Green, unpublished information).

Fauna now thought to be extinct from the forests of the District include the NI weka and NI brown kiwi, despite attempts to re-introduce both species (MacMillan, 1990), NI kokako (Slaven, 1989), whitehead (Robertson, 1985), bellbird (Falla et al, 1982) and stitchbird (Angehr, 1985).

Native parakeets, both red-crowned and yellow-crowned, are occasionally recorded in the Ranges but are most likely to be escaped aviary birds which are rarely seen for long at the same locality.

All these bird species appear to have suffered severely from introduced predators, such as the cat and ship rat in particular, which are still present in the Waitakere Ranges today.

Fauna Relationships

The present forest - shrublands in the District provide suitable habitat for a range of forest bird species. Many utilize a wide range of plant and insect species as food at different times of the year. New Zealand pigeons are frequently seen in the forested areas feeding on the large seeds or drupes of miro, puriri, tawa, taraire, totara and kahikatea. Because these drupes are generally too large to be eaten by other birds, the New Zealand pigeon plays an important role in distributing these species to new areas, both within the Waitakere Ecological District and to neighbouring districts.

Many of the plants in the subcanopy and shrub tiers of the forest, such as mahoe, mapou, hangehange, and *Coprosma* species, provide smaller fruit and berries for a range of smaller birds, such as silvereye, tui, and several introduced finch species.

Foliage feeding insects are found throughout the forest but mostly in the subcanopy and shrub tiers and include many species of caterpillars, beetles and plant sucking bugs including cicadas. These insects in turn support a range of parasitic and predacious insects, and spiders. Insectivorous birds including shining cuckoo, kingfisher, grey warbler, silvereye, tui, and fantail, utilize most of this complex of species.

Also present to feed on the invertebrates in the shrub tier are several lizard species such as the forest, pacific and green geckos. The latter is found on regenerating kanuka stands at the northern end of the District.

Plants in the ground tier tend not to be used as much by berry-eating birds but do have many species of insects feeding on foliage, such as a variety of weevils on the many fern species found in the District. Nocturnal insects, together with some native snail species often hide during the day either on the ground, under litter, or in perched litter caught up in plants. Several bird species, such as tomtit, fantail, introduced blackbird spend much time on or near the ground searching for invertebrates.

The forest floor also supports a large variety of insect species feeding on plant roots, dead foliage, logs and branches in all stages of decay. They include fly and beetle larvae, cicada nymphs, collembola or springtails, and some caterpillars. Several lizards including the ornate skink and copper skink, are found on the ground in forest or shrubland areas to take advantage of the adult forms of many of these insects. The Ranges also have a healthy population of the largest insect carnivore found in New Zealand, the carabid beetle *Mecodema spinifer*, which ranges over the forest floor in search of invertebrate prey.

The large, carnivorous kauri snail, *P. busbyi*, emerges late on damp nights from its diurnal hiding place in search of worms and other invertebrates in the leaf litter.

In areas where the forest has been cleared and introduced pasture, shrub or tree species have been planted new niches have been created. These have largely been occupied by introduced fauna species rather than natives which tend to be completely displaced and suffer a consequent decline in numbers. As in other areas in the Ecological Region introduced birds such as greenfinch, goldfinch, yellowhammer, redpoll, dunnoek, pheasant and Californian quail do well in the broken, shrubland areas and forest margins, while starling, myna and white-backed magpie thrive on farmland. Recently these pasture species have been joined by the spur-winged plover which has spread into the District. The eastern rosella, introduced from Australia, is common in open tree-land areas, often associated with introduced tree species on forest margins.

Only a few introduced bird species have adapted to native forest habitat in the District, notably blackbird and chaffinch. Thus with the local extinction of those species listed above the niches may have been largely left unoccupied. Introduced mammals found in the forest - shrubland areas in the District, include ship rat, Norwegian rat, mouse, possum, pig, goat, feral cat and stoat. These species generally would be regarded as occupying new niches with only minor overlap with some of the lost natives.

2.6.2 Freshwater - Wetland Habitat

Significant Species

Several freshwater wetland bird species found in the District are listed by Bell (1986) as "threatened", including Australasian bittern and banded rail, while North Island fernbird is listed as "regionally threatened". In addition the District has the only known record of the secretive marsh crake in the Auckland Region.

Wetland birds now thought to be extinct from the District include brown teal, NZ scaup and NZ dabchick (Slaven, 1989).

All these bird species have been prone to predation, especially from introduced cats and stoats, which have contributed significantly to their present status in the District.

Of the 11 freshwater fish species present the koaro is considered rare and has been found in only a few localities in the Auckland Ecological Region.

One endemic NZ frog species, Hochstetter's frog, is known from several streams in the Waitakere Ranges and is listed by Bell (1986) as "regionally threatened". This status does apply to Hochstetter's frog in the Region because of habitat loss through the destruction of riparian forest vegetation.

Fauna Relationships

The District has a variety of freshwater wetland habitat from dune lakes, swamps, streams to large man-made reservoirs. There are two large swamp areas, one at Te Henga which is permanent and an area of the Whatipu dunelands which increases significantly during the wetter months of the year. It is in these two areas that many of the "threatened" species are found, including Australasian bittern, and NI fernbird which are common to both and the banded rail and marsh crake recorded from Te Henga. The secretive spotless crake and more common pukeko were found in these and several other areas of swamp dominated by raupo.

The secretive NI fernbird, marsh and spotless crake feed on a variety of freshwater insects, including various small dipterian flies, damselflies, moths and hemipteran bugs. Many of these swamp inhabiting insects have an aquatic or semi-aquatic larval stage in their life history with adults generally found amongst wetland vegetation such as rushes, sedges and herbs.

Two species of shag utilize trees overhanging lakes or reservoirs as nesting sites. One arm of the Waitakere Reservoir has a colony of black shag nesting while a colony of little shag has been recorded for many years nesting above Lake Kawaupaka on pohutukawa trees.

A variety of other native and introduced freshwater birds were recorded during the survey on the lakes, reservoirs and open water of swamps. These included black swan, New Zealand shoveller, paradise shelduck, grey teal, grey duck and mallard.

The reservoirs behind the five dams built to collect a supply of water for metropolitan Auckland are used by waterfowl during the moulting season. These reservoirs offer secluded areas with some exposed banks during late summer when mallard and grey duck are unable to fly while growing their new flight feathers.

Lake Wainamu and Lake Kawaupaka are both deep water dune lakes that have been little modified as wildlife habitat. Lake Wainamu is one of the few west coast dune lakes in the Auckland Region apparently still free of exotic coarse fish species such as rudd, perch and tench. All three species were found elsewhere in the District with rudd located in seven lakes and reservoirs (Slaven, 1989).

There were 13 native freshwater fish and crustacean species recorded, including the freshwater crayfish or koura, which was relatively abundant in most streams. Of lesser abundance but still widely distributed in the District were banded kokopu, short finned and long finned eels, the common bully, red finned bully and koaro.

Many streams in the central Waitakere Ranges have yielded high numbers of some freshwater stream insects such as mayflies and caddisflies which reflect the high water quality present (Auckland Regional Water Board, 1989). These insects, together with those which have accidentally fallen into the stream, form an important food source for the native fish present.

Native fish such as koaro, banded kokopu and bullies have suffered through the removal of riparian vegetation in areas developed into farmland. Such riparian vegetation is also essential for the survival of the only native frog found in the District. Hochstetter's frog occurred in high numbers in some streams (Slaven, 1989) and preliminary genetic research has indicated that the Waitakere population may be unique (Green in Slaven, 1989). Hochstetter's frog is the most aquatic of New Zealand's native frogs and requires specialised habitat. In particular small streams with generally moderate flow rate, high water quality and clean bottom and banks with little clay or mud deposits. Such habitat is common in the upper catchments of the Waitakere Ranges.

A variety of dragonflies have been recorded from the District (Rowe, 1987) including New Zealand's largest species, the bush giant dragonfly. The male of this species flies widely from its streamside larval habitat to catch other insects, such as bees, wasps and cicadas on the wing. Predators of the dragonfly include kingfisher, harrier and even tui. As with many large bodied invertebrates introduced rats, mice, mustelids and cats also take their toll, particularly on newly emerged adults as they prepare for their first flights.

2.6.3 Coastal - Estuarine Habitat

Significant Species

Of the coastal birds found in the District, several are significant because they have a high conservation status while others represent small vestigial populations of what are still common species in other areas of the Ecological Region. Coastal species listed as "threatened" by Bell (1986) include New Zealand dotterel, banded dotterel, banded rail and Caspian tern, while the variable oystercatcher is listed as "rare". Several sea bird species including grey faced petrel, flesh-footed shearwater, sooty shearwater and diving petrel are still common on islands off the east coast in the Hauraki Gulf but have declined on the western Waitakere coastline.

Breeding colonies of both the Australasian gannet near Muriwai, and spotted shag near Bethells Beach are unusual because they are on the mainland. Both species appear to have been increasingly restricted to islands for breeding. The gannet colony has been steadily increasing in size on the headlands adjacent to Motutara Island since fences were erected to protect nesting birds from disturbance and predation. This has allowed it to become only the second mainland colony apart from that at Cape Kidnappers.

The most outlying island in the District, Oaia Island, has a colony of New Zealand fur seal. This is significant not only because of its expanding size but also the possibility that the species could begin to breed on the island. At present fur seals breed on New Zealand southern islands as far north as Cook Strait.

Fauna Relationships

The steep rugged uplifted nature of the western Waitakere Ranges coastline has provided good habitat for a number of coastal species. The friable soils on the cliff tops have allowed sea birds to dig their nesting burrows. Apart from Kauwahaia and Ihumoana Islands grey-faced petrel and sooty shearwater were found to be still active in the Karekare-Piha-Anawhata area. These sea birds are very prone to predation from cats, mustelids and rats and may have only a low breeding success on these mainland areas.

Kauwahaia Island is unusual for a west coast island in having all four burrow nesting sea bird species found in the District. Such species diversity may well have been present along much of the Waitakere coastline. These petrel and shearwater species tend to range widely out to sea and feed on various squid species. Other cliff top nesters including gannet, spotted shag and white-fronted tern feed mostly on small fish closer to the coastline.

Another sea bird which comes ashore along much of the coastline is the blue penguin. Although still common, the species suffers from predation by dogs near built-up areas such as Piha.

The exposed, high energy coastline is relatively less attractive to coastal wading birds when compared to protected harbour habitats. While part of the District borders onto the Manukau Harbour which, as a single habitat, has very high numbers of waders, they are generally concentrated in the more sandy, southern and eastern parts of the harbour. The northern shores feature greater concentrations of soft muddy sediments which are less attractive to waders. For example, the few species seen in Huia Bay area were generally the common South Island pied oystercatcher, pied stilt and white-faced heron.

Other wader species including New Zealand dotterel, variable oystercatcher and banded dotterel were found in the estuarine area of the Pararaha Stream mouth. The first two species were reported to have regularly nested in this area over many years but have suffered through disturbance from dogs and predators such as stoats. Occasionally international migratory species of waders, such as eastern bar-tailed godwit and lesser knot, appear on sandy areas of the western coastline but only in small numbers. Again this is due to the relatively small amount of sheltered estuarine habitat on sandy substrate present in the District.

The muddy estuarine habitat of the northern Manukau Harbour features areas of mangrove trees abutting other coastal vegetation. Such areas are good habitat for the "threatened" banded rail. This secretive species feeds at the waters edge on a range of invertebrates which inhabit estuarine mudflats. Banded rail are rarely seen in the open and have suffered through clearance of coastal vegetation close to the high tide mark.

2.7 Priority Wildlife Sites

The information on priority wildlife sites has been used in the evaluation of recommended areas for protection. Table 2.5, which follows, describes each priority wildlife site, with Figure 2.9 indicating their location in the District.

PRIORITY WILDLIFE SITES IN THE WAITAKERE ECOLOGICAL DISTRICT

Notes to the Priority Wildlife Site Table

1. The Priority Wildlife Site (PWS) numbering system is consistent with the numbers of the priority sites described and mapped in the Recommended Areas for Protection, for example, 2W1 is the Houghton's Bush habitat captured within RAP2 - that is '2' for the RAP, 'W' for Wildlife, '1' for the PWS number.
2. Grid Reference to NZMS 260 series 1:50,000 Q11 and R11 topographical maps.
3. RAP No. refers to the Recommended Area for Protection within which a given PWS occurs.
4. This list of Priority Wildlife Sites is a complete list of the registered Sites of Special Wildlife Interest (SSWI) in the District (as surveyed initially by the Wildlife Service (Department of Internal Affairs) resurveyed for the PNAP survey. Sites ranked Moderate, Moderate-High, High and Outstanding were selected as Priority Wildlife Sites. The sites ranked Potential are not PWS, however, they have been included in this list for the sake of a complete inventory of significant wildlife habitats within the Waitakere Ecological District.
5. The names in brackets are those used in the SSWI system.
6. Appendix 3A2 lists criteria used for ranking the SSWI.

KEY TO ABBREVIATIONS:

CMP	Auckland Centennial Memorial Park
PPL	Protected Private Land
QEII	Queen Elizabeth II National Trust (open space covenants)
Reg. Park	ARC Regional Parkland
RFBPS	Royal Forest and Bird Protection Society
RR	Recreation Reserve
SR	Scenic Reserve
Uninvest.	Uninvestigated Land (Untitled)
WCC	Waitakere City Council
WSC	Water Supply Catchment

TABLE 2.5

PRIORITY WILDLIFE SITES IN THE WAITAKERE ECOLOGICAL DISTRICT

PWS No	NAME	AREA (ha)	GRID REFERENCE	SITE PROTECTED?	FEATURES	RAP SITE
FOREST HABITATS RANKED OUTSTANDING						
15	Waitakere Ranges	20,000	Q11 460720	Part CMP Part Private	Large area of diverse forest types including mature and secondary kauri-podocarp-broadleaf forest. Much of the area milled at various times with varying degrees of regeneration, often with kanuka-manuka associations. Hochstetter's frog, paryphantia snails, grey-faced petrel colonies, kaka frequently reported, pied tit widespread, NZ pigeon and good numbers of other common forest birds. NZ falcon reported. Diverse insect and snail fauna with many endemic species.	Falls within many RAPS: 5, 7-21
FOREST HABITATS RANKED MODERATE-HIGH						
1	Houghtons Bush (Okaihau Bush)	130	Q11 386853	Part Reg. Park Part Private	Good example of coastal forest. Adjoins an area of hardwood forest with regenerating kauri. Part of hardwood forest fenced off. Good range of typical forest bird species.	2
FOREST HABITATS RANKED MODERATE						
6	Jonker Bush	650	Q11 430817	Part RFBPS QEII	Regenerating bush with kauri, puriri and cabbage tree associations. Logged until 1920s. Kiwis have been released in this bush but survival is doubtful. Good diversity of native bird species. Goat and possum control undertaken in part of this area.	5
4	Mokoroa Stream Bush	800	Q11 420-835	Part DOC SR	Secondary kauri, hardwood, kanuka and mamaku forest. Large area with potential to improve as wildlife habitat. Usual forest bird species.	3
FRESHWATER WETLAND HABITATS RANKED HIGH						
7	Te Henga Wetland (Puketotara Swamp)	140	Q11 405800	Part RFBPS QEII	Largest freshwater swamp in Auckland Ecological Region. High diversity of vegetation types and wildlife species. Bittern, fernbird, spotless crane with banded rail, marsh crane reported. Large numbers of waterfowl at times.	5

PWS No	NAME	AREA (ha)	GRID REFERENCE	SITE PROTECTED?	FEATURES	RAP SITE

FRESHWATER WETLAND HABITATS RANKED MODERATE-HIGH

8	Lake Wainamu	15	Q11 415780	Part Private Part SR	Deep dune lake, 95% open water, narrow vegetated margin of raupo and spike rush. Mostly forest catchment with pasture and mobile dune backing onto the lake. Good diversity of wildlife, including waterfowl, little black shag, with bittern, spotless crane and fernbird reported. Banded kokopu reported from the lake.	7
23	Ohaka Head Lake	8	Q11 428637	No Uninvest. Land	Permanent dune lake which greatly enlarges during the wetter periods. 30-50% open water with large rush and sedge areas around margin. Bittern, fernbird, waterfowl, black shag and Caspian tern.	10

FRESHWATER WETLAND HABITATS RANKED MODERATE

3	Constable Road Swamp	1.5	Q11 384825	No Private	Long thin strip of raupo dominant swamp, under 5% flax and cabbage trees. Rush and sedge margin backing into manuka. Small catchment 75% pasture, 25% shrubland or reverting pasture. Spotless crane and fernbird. Reduced amount of such habitat remaining in the Ecological District.	4
9	Lake Kawaupaka	12	Q11 404775	No Private	Deep lake, 95% open water, forest catchment and completely enclosing lake. Narrow margin of raupo, flax, rushes and sedges. Little shag colony and waterfowl present with spotless crane and black shag reported.	7
22	Pataraha Swamp	12	Q11 427647	No Uninvest. Land	Relatively large area of raupo, flax, rush and sedge mixture including 5% deep open water with dense <i>Eleocharis sphacelata</i> margin behind high mobile dune. Located in a stream valley between coastal cliffs and also running along base of cliffs. Large forest catchment. Bittern, fernbird, pukeko and likely spotless crane.	10
21	Piha Stream Swamp	2.5	Q11 423712	Part CMP	Diverse vegetation dominated by raupo 90% with cabbage tree, flax, rushes and sedges. Backs onto completely forested catchment. Narrow stream channel is the only open water. Pukeko and likely spotless crane, fernbird.	8
24	Taranaki Bay Swamp	0.2	Q11 432633	No Uninvest. Land	Small area of raupo, flax, rushes and cabbage tree backing onto dense manuka. Part of back-dune lake system at the foot of bush clad coastal cliffs. 5% open water. Permanent swamp in large area of seasonal swampland. Fernbird, pukeko, likely spotless crane.	10

PWS No	NAME	AREA (ha)	GRID REFERENCE	SITE PROTECTED?	FEATURES	RAP SITE

FRESHWATER WETLAND HABITATS RANKED POTENTIAL

	Anawhata Wetland	3	Q11 420750	Part CMP Part DOC	Small area of stream and associated vegetation sheltered from coast. Occasional tidal influence. Flax and totara dominant with raupo sedges and grasses. Possible fernbird habitat.	
	Goldies Bush Swamp	0.2	Q11 401828	No Private	Small raupo swamp with karuka and farmland margins. Catchment mostly in regenerating kauri-tanekaha-podocarp forest. Spotless crane habitat.	3
	Huia Reservoir	21.4	Q11 472698	No WSC	Deep clear water for reticulation. Catchment is continuous mixed podocarp-hardwood forest down to water's edge. Good loafing area for waterfowl. Fluctuating water-levels make the margins less suitable for swamp birds. Banded kokopu reported.	13
	Lower Huia Reservoir	55.7	Q11 498674	No WSC	Deep clear water for reticulation. Continuous forest catchment. Good loafing and moulting area for waterfowl, particularly at northern end. Banded kokopu reported.	13
	Lower Nihotupu Reservoir	71.5	R11 539703	No WSC	Deep clear water for reticulation. Forest and shrub catchment, some rush and sedge swamp on margins with pukeko. Good loafing and moulting area for waterfowl. Banded kokopu reported.	
	Upper Nihotupu Reservoir	14.5	Q11 495715	No WSC	Deep clear water for reticulation. Catchment of cutover podocarp-hardwood forest down to water's edge. Good loafing area for waterfowl. Fluctuating water-level. Banded kokopu reported.	
	Waitakere Reservoir	27.8	Q11 463765	No WSC	Deep clear water for reticulation. Catchment of secondary regenerating podocarp-hardwood forest to water's edge. Areas of <i>Baumera</i> stretching out into the reservoir. Black shag colony and good loafing and moulting area for waterfowl. Banded kokopu and koaro reported.	

COASTAL/ESTUARINE HABITATS RANKED HIGH

12	Erangi Point	5	Q11 383783	No Private	Small peninsula with steep rocky face to the sea. Forest on top consisting of pohutukawa, karo, karaka, kowhai and flax. Breeding and roosting area for spotted shag colony in cavities of the cliffs.	6
11	Kauwaha Island	0.7	Q11 384785	No Private	Small rock island with steep sides. Covered in karo, houpara, tussock grass and small coastal herbs and succulents. Grey-faced petrel, sooty shearwater and diving petrel colonies plus possible fleshfooted shearwater breeding. Rats eradicated.	6

PWS No	NAME	AREA (ha)	GRID REFERENCE	SITE PROTECTED?	FEATURES	RAP SITE

2	Muriwai Gannet Colony					
	- Oata Island	)	Q11 362837	Yes Reg. Park	Four areas with breeding Australasian gannet. The colony spread from the small rocky Oata Is. to the rock stack of Motutara Is in 1975, then to two headlands by 1982. White fronted terns breed on the sides of Motutara Is. Very little vegetation on the islands. Fur seal colony on Oata Is.	1
	- Motutara Island	) 1	Q11 374844			
	- Otakamiro Point	)	Q11 374845			
	- Headland	)	Q11 375844			
25	Whaitapu Dunes	800	Q11 427623	No Uninvest. Land	Large area consisting of unvegetated foredunes leading into <i>spinifex</i> and pingao covered dunes and extensive vegetated backdunes up to pohukukawa-puriri forest on coastal cliffs. Cabbage tree, flax, lupin, kawakawa and <i>Muehlenbeckia</i> cover backdunes, with large flat areas between covered in sedges, rushes and herbs. Low areas are seasonal wetlands. High diversity of coastal birds, including breeding NZ dotterel and variable oystercatcher, banded dotterel, Caspian tern, white fronted tern. Swamp birds including bittern, ternbird and pukeko. Little blue penguin nesting reported. Stoats present.	10

COASTAL/ESTUARINE HABITATS RANKED MODERATE-HIGH

10	Ihumoana Island	1.7	Q11 387780	No Private	Rock island with steep sides. Covered in pohutukawa, karo, houpara, kawakawa, flax, grasses and coastal herbs. Grey-faced petrel colony. Rat and possum control undertaken.	6

COASTAL/ESTUARINE HABITATS RANKED POTENTIAL

	Piha Inlet Stream	3	Q11 412710	Part WCC RR	Total stream mouth with flax, rush and sedge margins. Borders grassed domain with small residential development in an otherwise forested catchment. High recreation pressure in summer. Paradise shelduck, mallard and pied sill breeding, gulls and other common seabirds at mouth.	8

PRIORITY WILDLIFE SITES IN THE WAITAKERE ECOLOGICAL DISTRICT

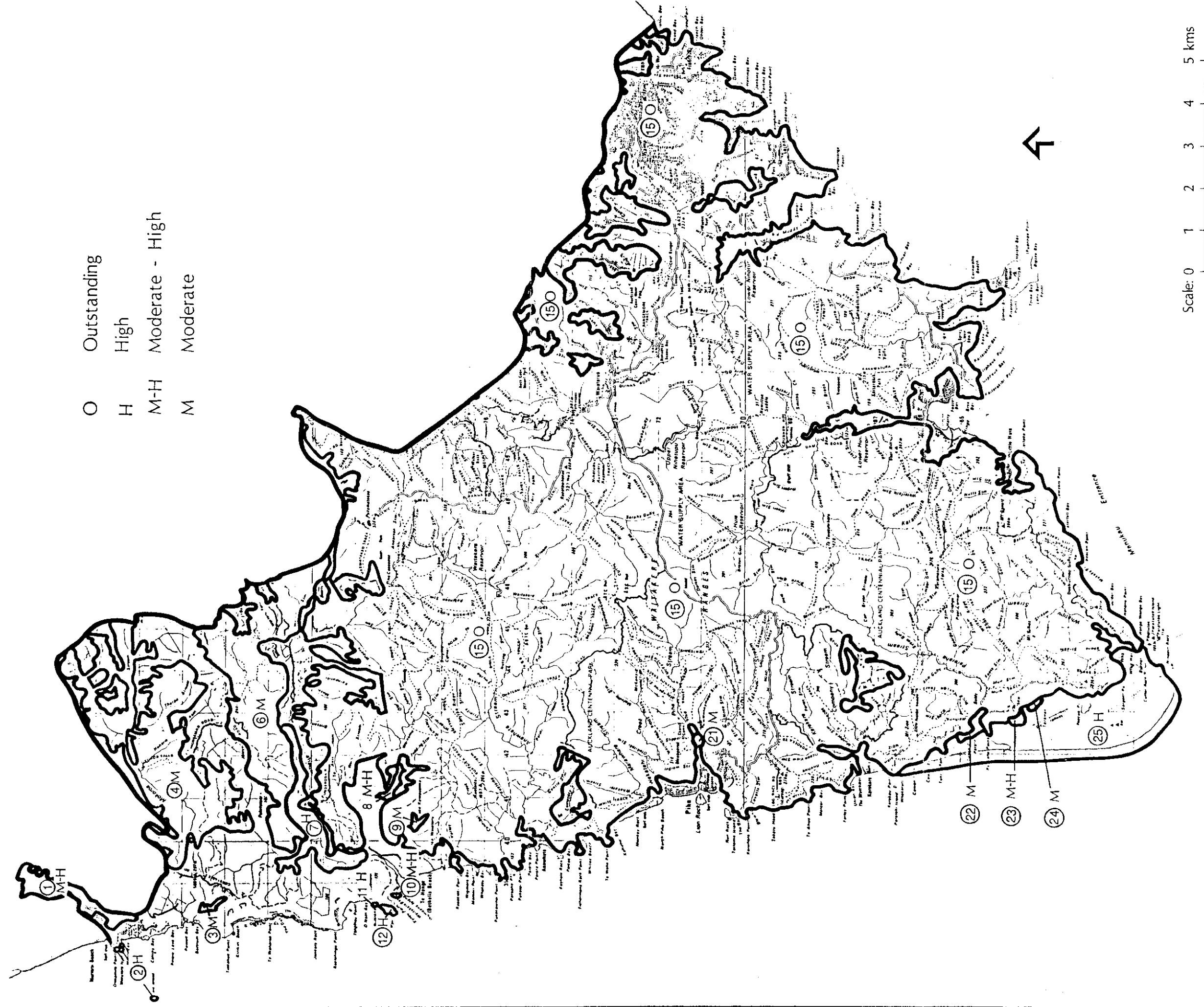


Figure 2.9

CHAPTER THREE:

EXISTING PROTECTED NATURAL AREAS

3.1 Introduction

The Waitakere Ecological District, totalling 29,175 hectares, has 8,882 ha, or 30%, in some form of protection (Figure 3.1). While this may appear to be an adequate area of natural features protected, the degree of protection is variable, some vegetation classes are well represented in the reserve system while others are not, and a number of significant vegetation and wildlife communities and landform sites are unprotected in the District. Within the District there are also large areas of public land which have conservation values. These areas are indicated by Figure 3.2. The following paragraphs examine the nature of protection and the representativeness of the protected natural areas and canvass protection issues of the publicly owned land within the Waitakere Ecological District. Appendix 2 lists all the protected natural areas known in the District.

3.2 Protection Mechanisms

The areas which have the highest degree of protection for ecological values in the District are those protected under the Reserves Act 1977 as Scenic Reserves, Protected Private Land and under the Queen Elizabeth the Second National Trust Act 1977 as Open Space Covenants. The Auckland Centennial Memorial Park (CMP) and the Regional Parklands are also considered to have a high level of protection. These particular protected areas are discussed in more detail later as they are unique to this District and region. A number of reserves in the District have other classifications. These include recreation, local purpose and esplanade reserves. While these areas may protect natural areas, this is not the primary purpose of these reserves. These reserves are considered to offer moderate protection to natural values.

The water supply catchments are owned by the ARC and designated in the district scheme for bulk water supply purposes. These lands are in freehold tenure and there is no legal impediment to their sale and alienation from public ownership. They have been managed to protect the quality of water supplied to metropolitan Auckland. Fortuitously this has protected many of the biological values in these places. The management of this area has recently been transferred to the Regional Parks Department, however unless the tenure of these lands are changed to reserves, the protection of the natural values will remain relatively insecure. These lands are considered to have moderate protection, although they are not considered to be legally protected natural areas.

Much of the residential and freehold land in the District is zoned in various landscape protection zones or in non urban residential zones. Land in the north of the District is in a variety of rural zones. The landscape protection and non urban residential zonings provide some protection for the aesthetic natural character, when enforced, but do not ensure the long term ecological viability of natural areas particularly where residential dwellings are predominant.

3.3 Adequacy of the Existing Protected Natural Areas Network

The following is a discussion of the types of ecosystems safeguarded under the various levels of protection in the District. Following this is a discussion on the ecological character representative of the District which is not protected.

LEGALLY PROTECTED NATURAL AREAS IN THE WAITAKERE ECOLOGICAL DISTRICT

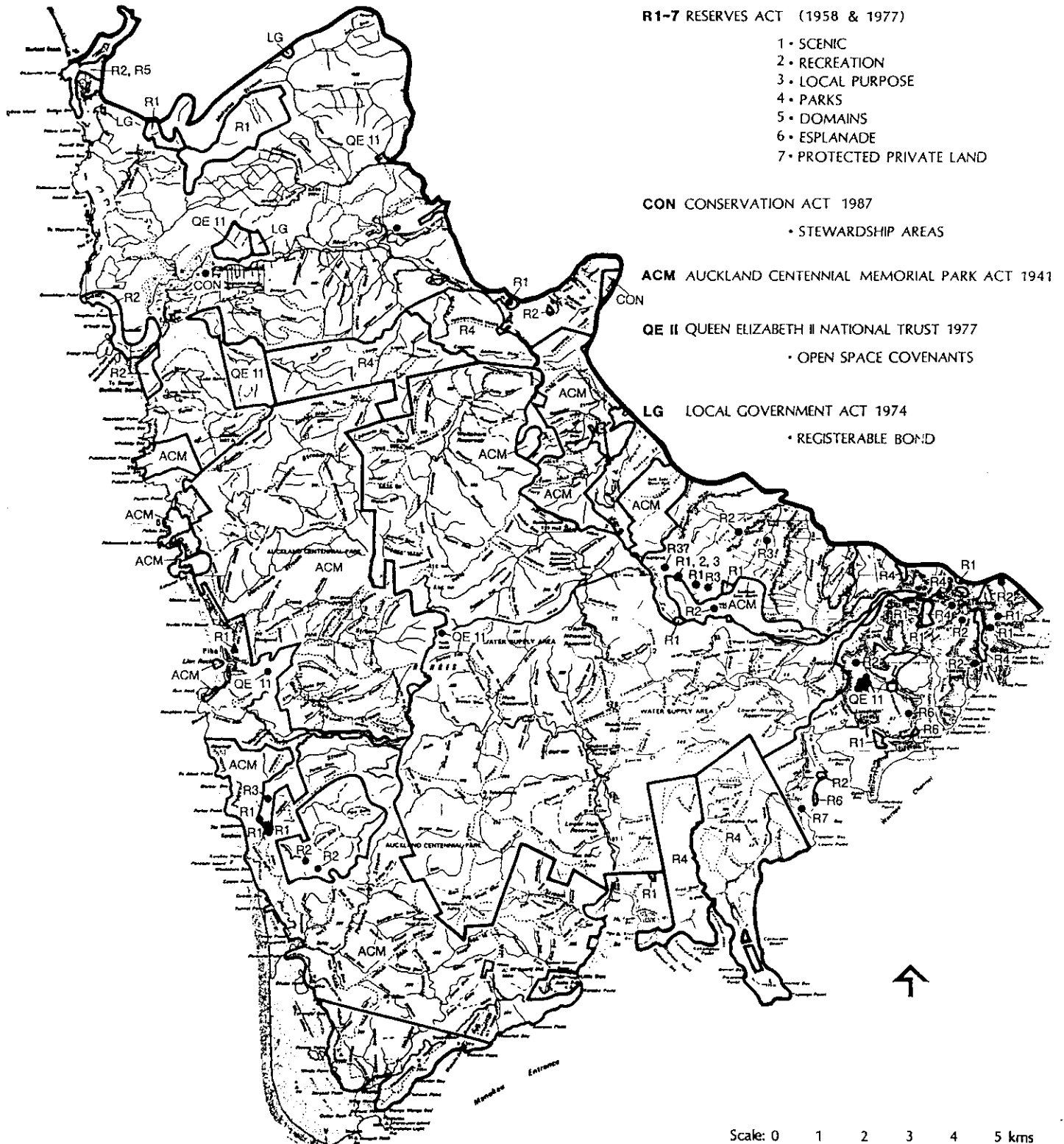


Figure 3.1

MANAGEMENT OF PUBLICLY OWNED LAND IN THE WAITAKERE ECOLOGICAL DISTRICT

ARC AUCKLAND REGIONAL COUNCIL

DOC DEPARTMENT OF CONSERVATION

LA LOCAL AUTHORITIES



Figure 3.2

3.3.1 Protected Ecosystems in Regional Council Stewardship

Within the Waitakere Ecological District, the Auckland Centennial Memorial Parkland covers 6,498 ha. This represents 22% of the District. Most of this land is situated in a wide 4 km belt extending from Whatipu in the south to Smythe Ridge in the Anawhata Catchment to the north. It also includes a narrow strip along the eastern side of Scenic Drive. Most of the vegetation within the Auckland CMP is modified. Large tracts of tea tree forest and scrub now exist where the land has previously been completely cleared. Mature kauri, podocarp and broadleaf forests exist in the upper Piha Catchment and in the Fairy Falls area in the north-east. Several stretches of coastline are included within the Auckland CMP areas. The longest area of coastline within the Park is the stretch of cliffs extending from Little Huia on the Manukau Harbour, around Paratutae Island, along the length of the Whatipu sands, and northwards as far as Takatu Head north of Mercer Bay. A smaller section of coastline from Piha to Anawhata is also included. The nationally significant Whatipu sands are not legally protected however the Regional Council "takes a close interest in the area and acts as de facto manager" (Waitakere Ranges Regional Parkland Management Plan, 1985). In the Mt Donald Maclean to Whatipu area, an area of former Auckland Harbour Board endowment land, which was leased on a long term basis to the ARC, is to be resumed by the Crown and classified as a scenic reserve. The Department of Conservation intends to vest the area in the ARC, to be managed subject to that classification and the Auckland CMP Act.

The Waitakere Ranges regional parkland surrounding the Auckland CMP includes Cornwallis, Kaitarakihi, Cascade and Kauri Parks as well as Atkinson Reserve, and the sum of these totals approximately 1,655 ha. These parks add to the diversity of the Auckland CMP and are particularly significant for containing the best example of mature kauri forest in protection (in Cascades Park) and the only example of gumland scrub (Kaitarakihi Park). Muriwai Beach Regional Park straddles the boundary of the District. The park area within the District protects the Australasian gannet colony, the landforms of the headland and priority vegetation sites (see RAPs 1 and 2).

3.3.2 Scenic Reserves

Within the District there are 19 scenic reserves covering almost 420 ha of land. Reserve administration rests with either the Department of Conservation, Auckland Regional Council or the local authorities. The reserves range in size from 0.1 ha to 200 ha. While most of the reserves are under 5 ha in size, these smaller reserves are important particularly in the residential areas for a number of reasons. Some of them capture the original character of areas that are now highly modified. They also provide an aesthetic character highly valued by the local residents. While the scenic reserves are legally well protected, many are currently poorly managed, with weeds being a problem in the smaller reserves in close proximity to residential areas.

3.3.3 Protected Private Land

Within the District are 9 QEII open space covenants. Many of these covenanted areas protect small 1-5 ha patches of forest at Piha, Wairere Rd and Laingholm. A larger open space covenant protects Royal Forest and Bird Protection Society (RFBPS) land known as Matuku Reserve. This covenant protects part of the Te Henga swamp and a larger area of forest adjacent to the swamp.

A small area of protected private land protects an area of coastal forest adjacent to Big Muddy Creek.

Three small areas of forest on private land have recently been protected by a memorandum of encumbrance (which is a registerable bond under Section 291 of the Local Government Act 1974), resulting from Rodney District Council's bush lot subdivision ordinance in the district scheme.

3.3.4 Local Authority Reserves

Within the District there are 13 recreation reserves with native vegetation. In some instances the vegetation is not highly natural, such as the recreation reserve at the car park at Karekare Beach where there are several large pohutukawa trees over a grassy picnic area. However some recreation reserves are entirely covered with native forest, eg Ruru Reserve. A number of esplanade reserves exist within the District, administered by the local authorities. Two of the longest reserves are situated in the south of the District in the Laingholm area and border the Manukau Harbour. They include Taumatarea Reserve which is a strip of coastal cliffs supporting pohutukawa forest. Many strips of coastline in the Laingholm area are currently proposed as public reserves. The local purpose reserves containing native vegetation have been listed in Appendix 2 but they are not generally considered to have a high protected status. Many of them are small in area.

3.4 Ecosystems Unrepresented in Protected Natural Areas

Most of the vegetation and habitats protected in the District are forest and scrub. The ecosystems absent from the reserve system are those which are a major component of the structural character and habitat diversity of the District. These areas include the major saline and freshwater wetlands, and dune systems in the District.

Twenty seven percent of the vegetation classes found in the District are not represented in the reserve system. A further 29 % are inadequately represented in the reserve network.⁴ The location of these vegetation classes can be found in Figure 2.4. Table 3.1 illustrates the unprotected vegetation classes and Table 3.2 the under-represented vegetation classes in the reserve system.

The vegetation classes not represented include the wetland types found in the Te Henga marsh, the mangroves of the southern coast on the boundary of the District, and the saline wetlands and sandfield vegetation classes of the Whatipu sands area. Coastal vegetation classes on a range of physical areas are also absent. These include several vegetation types on the exposed rocky coastline of the western edge of the District, the subdued coastal hill country to the north, and the rugged hillcountry and consolidated sands within the coastal bioclimatic zone.

Of the 15 landforms or landform assemblages identified as priorities for protection in the District, only a few are within protected areas in their entirety. Six of the priority landform assemblages are unprotected. These are the southern Piha coastline, the Whatipu sands, the Te Henga wetland, Nihotupu Gorge and O'Neil Bay and the elevated terraces north of Te Henga Beach. Many of these landforms are ones that can be relatively easily damaged by human development or environmental change.

Seventeen wildlife habitats have been recommended for protection. Only one of these sites is fully protected in the reserve network, that of the Muriwai Australasian gannet colony. Ten of the wildlife sites are unprotected, and six are protected in part of their extent. The largest priority wildlife site, which identifies the Waitakere Ranges as an outstanding habitat, is protected in much of its extent by the Auckland CMP.

4. Under-representation in the reserve network can be estimated with regard to the degree to which the natural diversity is captured in the reserve network, compared to its extent in the original or present landscape. While it is difficult to put numerical values on this, the minimum guide-lines used have been 10% of the original, natural extent of a particular ecosystem. It is recognised that such estimates should be used with caution and each ecosystem evaluated individually (O'Connor et al, 1990).

Table 3.1 Unprotected Vegetation Classes in the Waitakere Ecological District

Vegetation Class	Physical Area	Total area (ha)	Tenure
Kauri-tawari forest	High relief	1.0	WSC
Kanuka forest	Consol. sand	22.0	Pvt
Kanuka scrub	Unc. sand	34.0	Pvt
Manuka scrub	Consol. sand	4.0	Pvt
Manuka forest	Subdued hillcountry	103.0	Pvt
Taraire forest	High relief	5.0	WSC
Puriri composite forest	Rugged hillcountry	24.0	Pvt
Puriri composite forest	Southern foothills	17.0	Pvt
Maire tawake forest	High relief	3.0	WSC
Kahikatea swamp forest	Rugged hills	1.0	Pvt
Kahikatea swamp forest	High relief	16.0	WSC
Kowhai-kanuka scrub	High relief	6.0	WSC
Karo-houpara forest	Exposed rocky coast	2.4	Pvt
Coastal scrub	Exposed rocky coast	2.5	Pvt
Coastal herbfield	Unc. sand	40.0	Uninvest. Lnd
Coastal herbfield	Exposed rocky coast	0.5	Pvt
Pingao sandfield	Unc. sand	84.0	Uninvest. Lnd
Spinifex sandfield	Unc. sand	68.0	Uninvest. Lnd
Flax-manuka scrub	Exposed rocky coast	11.0	Pvt
Raupo reedland	Freshwater wetland	3.5	Uninvest. Lnd
Raupo reedland	Consol. sand	2.0	Pvt
Swamp millet grassland	Freshwater wetland	6.0	Pvt
Baumea sedgeland	Freshwater wetland	80.0	Pvt
Cabbage tree forest	Freshwater wetland	7.0	Pvt
Cabbage tree forest	Dune lakes	1.0	Pvt
Manuka-cabbage tree scrub	Freshwater wetland	3.0	Pvt
Letptocarpus sedgeland	Saline wetland	6.0	Uninvest. Lnd
Schoenoplectus sedgeland	Freshwater wetland	6.0	Uninvest. Lnd
Mangrove forest	Estuary	43.0	Crown

Table 3.2 Under Represented Vegetation Classes in the Waitakere Ecological District

Vegetation Class	Physical Area	Area		
		Total ha	Area protected ha	%
Kauri-kanuka forest	Subdued hillcountry	200	2	(1%)
Kanuka forest	Eastern foothills	150	7	(5%)
Mamangi forest	Subdued hillcountry	17	2	(12%)
Pohutukawa forest	Unc.sand	25	4	(16%)
Kahikatea swamp forest	Eastern foothills	3	2	(66%)
Kanuka scrub	Rugged hillcountry	25	3	(12%)
Kanuka scrub	Consol. sand	27	7	(26%)
Kauri-kanuka forest	High relief	10	3	(30%)
Flaxland	Unc. sand	2	1	(50%)
Tawa forest	Subdued hillcountry	46	5	(11%)
Puriri composite forest	High relief	26	3	(12%)
Kauri-rimu forest	High relief	6	1	(17%)
Secondary podocarp forest	High relief	35	8	(23%)

Note, abbreviations - consol. means consolidated and unc. refers to unconsolidated.

However this wildlife habitat includes the water catchment land which requires a formal protective status. All the forest habitats identified as priority wildlife habitats are protected in part. Five of the six coastal habitats, have no formal legal protection. Within the eight wetland wildlife sites, one, Lake Wainamu, and a portion of a second, Te Henga, are within protected areas. The Te Henga wetland and Mokoroa Stream forest are protected by district scheme controls.

3.5 Implications for Management for Auckland Regional Council Land

3.5.1 Auckland Centennial Memorial Parkland

A large portion of the Waitakere Ecological District is administered by the Auckland Regional Council under the Auckland Centennial Memorial Parks Act 1941. The land within Auckland Centennial Memorial Park cannot be sold without an Act of Parliament. Under the Auckland Centennial Memorial Park Act 1941 and the consequential Auckland Regional Authority Act 1963 and its amendments (which gave the Authority the power to take up the CMP Board powers and responsibilities), the Council has the right to hold, manage, maintain and develop the land as a scenic park. It does not specifically under this act have the power to sell the land or to manage for any other purpose than a scenic park. Therefore developments within the park cannot be allowed if they detract from the values of a scenic park. However the Act gives little guidance on the appropriate balance between recreational use and the protection of ecological values. The Act does not specify the relationship or priorities between these values.

In the past the management priorities have been to develop the recreational potential of the Auckland CMP. There has been less priority and emphasis placed upon the need for general and specific management requirements to ensure the preservation in perpetuity of the biological values in the Auckland CMP.⁵ To some extent the lack of detailed knowledge and understanding of the nature and significance of the ecological values in the Ranges has prevented a comprehensive and integrated approach to conservation management of the Auckland CMP. This study was initiated to fill those gaps in knowledge and to provide information and recommendations that could be directly incorporated into catchment management plans, so that the objectives and policies in the Parkland management plan can be fully achieved.

The potential conflict between sensitive ecosystems, landforms and recreational activities will be the key issue to be addressed in future management plans. With careful management, recreation activities need not compromise preservation requirements. The current (1985) management plan acknowledges the possible conflicts that can arise between recreation and preservation, and observes that it "must contain policies which will restrict the use people make

5. Waitakere Ranges Regional Parkland Management Plan (1985). General Objectives are to:-

"Develop and manage, in association with the Bulk Water Supply Department, scenic parks in both the Waitakere and Hunua Ranges, in a manner which will both protect the natural features of the districts and provide for public access in defined walking tracks so as to promote appropriate recreation uses of the parks."

Policies include:-

"- give priority to recreational uses which are based on the natural resources of the area and which will not threaten the natural features or character of the Ranges.

- conserve the indigenous vegetation, hydrologic systems and wildlife habitats.
- control and eradicate noxious animals and undesirable plants, and
- preserve, and where appropriate, to enhance the landscape and character of the Ranges".

of the park in order to ensure the long term survival of the physical environment which attracts them to the Ranges."

3.5.2 Waitakere Ranges Regional Parkland

In addition to the Auckland Centennial Memorial Park, the ARC also administers large blocks of land as regional parkland. In the Waitakere District, many of these areas are reserves or parks under the Reserves Act 1977 some of which were formerly vested in the Auckland City Council and were transferred to the ARC in 1982 under an empowering act.⁶ Due to their underlying reserve status these areas are considered to have a high protected status unlike regional parkland purchased by the ARC. These areas are currently managed as Auckland CMP and are intended to be made part of Auckland CMP (ARA, 1985).

Muriwai Beach Regional Park totals approximately 183 ha, of which 30 ha is in the District. The Park includes the Muriwai Beach Domain recreation reserve and gifts of land by the local community. The Park is managed in accordance with the Reserves Act 1977.

3.5.3 Water Supply Catchments

The water supply catchments are freehold land owned by the ARC. As such they do not have any formal legal protection for conservation purposes. These catchments have some of the best examples of a range of wildlife, vegetation and landform sites in the District. It is imperative that the tenure of these catchments reflect their important status in conservation terms with an appropriate level of protection.

3.5.4 Future Protective Status for the ARC Lands

As indicated by the previous discussion, the tenure and administration of the ARC lands in the District is complex.

It is now fifty years since the enactment of the Auckland CMP Act and it would be appropriate to review this legislation to update the conservation and recreation philosophy it contains. Such a review could also provide for the accommodation of catchment lands within the Auckland CMP framework. Alternatively the land could be classified as a reserve to achieve conservation as a primary purpose.

The national significance of the Waitakere protected area network would also be recognised by an umbrella status such as a national reserve.

6. Auckland City Council (Reserves Disposal) Empowering Act 1982.

CHAPTER FOUR:

RECOMMENDED AREAS FOR PROTECTION

4.1 Introduction

Twenty one areas are recommended for protection in the Waitakere Ecological District (see Figure 4.1). These Recommended Areas for Protection (RAP) total approximately 12,159 hectares, or 42% of the District. The RAPs range in size between 10 and 4,000 ha. Two thirds of the RAPs are over 100 ha in size. Substantial parts of the upland area of the District have been identified as RAPs, as have large areas of the coastline and coastal ecosystems.

The following chapter describes the natural characteristics of each RAP, detailing why each has been selected as a priority for protection. In most instances a RAP is a composite of priority landform, vegetation, and wildlife sites. Occasionally a RAP just identifies a priority vegetation site. Thus the places identified as recommended areas for protection contain the best examples of the range of natural features which capture the ecological character and diversity of the District. Every individual RAP is equally ranked and mutually exclusive, so the protection of only one will not ensure the protection of a representative reserve system.

The boundaries to recommended areas for protection were drawn to a consistent rationale. A number of factors influenced the extent of the boundaries for each area. In some instances RAP boundaries are defined by the extent of the priority landform site, which is often a distinct physical area or place. In RAPs such as these (e.g. 1, 7, 10) areas of farmland are often included within the RAP, where there is no intention of seeking changes to existing land uses or to seek the formal protection of land not identified as having particular values. However in these RAPs, the boundary may be useful in identifying areas where a consistent level of management may be appropriate such as for pest and weed control, or monitoring requirements.

More common in the Waitakere RAPs however are areas defined by the priority wildlife sites. In RAPs such as these, all the habitat / vegetation contained within the RAP is considered to require formal conservation attention. Examples of RAPs defined by PWS include 2, 3 and 15.

The smaller RAPs tend to be composed primarily of priority vegetation sites, occasionally associated with small landform sites. Often the RAPs defined only by vegetation values are a disparate collection of separate priority vegetation sites. They have not been combined within a single RAP as there were not considered to be sufficient unity or unifying features between them, such as high wildlife values or even the same vegetation class. Often there is a distinctive change in land use activity as well. These RAP sites are clusters of individual sites, linked on the maps by a solid black line. Often these clusters of sites have the same vegetation class or are in adjoining catchments.

Not all RAPs can be defined by the above boundary criteria. For example boundaries are often defined by other features such as the boundary of another RAP, a catchment, or the District boundary. The exception to this is in Rap 6 where a distinctive landform feature (although not a PLS) has defined the boundary. The second anomaly is in Rap 5 where a priority vegetation site close to the area or RAP has been linked due to its proximity.

RECOMMENDED AREAS FOR PROTECTION IN THE WAITAKERE ECOLOGICAL DISTRICT

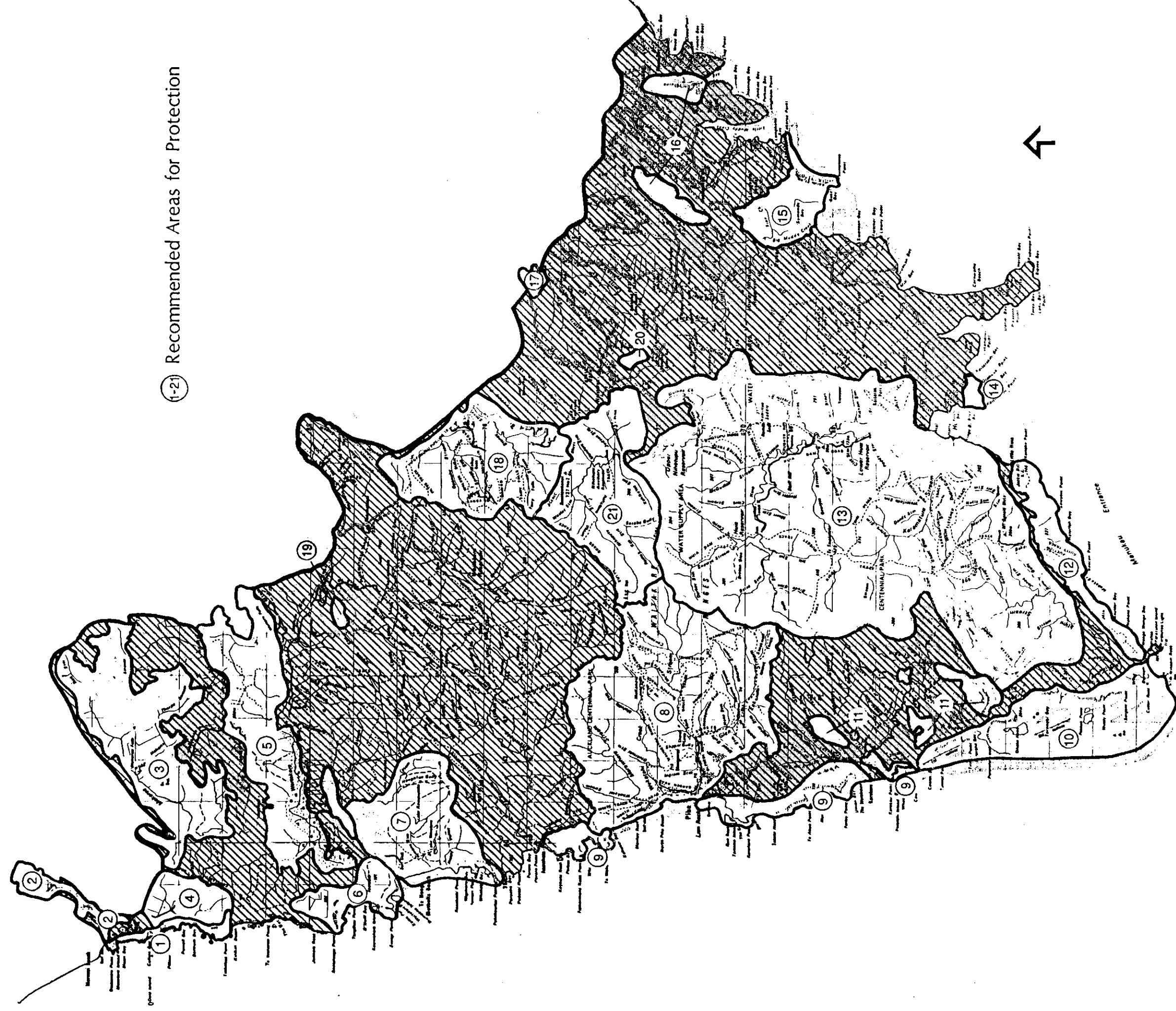


Figure 4.1

4.2 Notes to RAP Descriptions

These notes follow the format in which the descriptions are written. To understand the RAP descriptions which follow read these notes in conjunction with RAP #1. The examples are in bold text and the explanations are in roman type.

WAITAKERE RAP #1: MURIWAI TO TIRIKOHUA POINT COASTLINE

Number and Name of RAP:

The number relates to RAP numbers listed in Priority Landform, Vegetation and Wildlife Site checklists (Tables 2.2, 2.4, 2.5), and on the RAP maps which follow each RAP description. The RAPs are numbered in a geographical sequence - not in any implied order of priority.

The name is a convenient label which aims to identify the RAP's location (often using a locally known name), and the type of habitat (eg coastline, forest, sands).

Exposed rocky coastline with sparsely vegetated cliffs.

etc.

A brief description of the major landform and habitat features of the RAP are listed here to enable the reader to obtain a picture of the landscape of the area.

The important features of the RAP including Priority Landform, Vegetation and Wildlife Sites and their significance, important sequences, and uncommon associations are listed next.

A description of the RAP, its boundaries, broad habitat descriptions and physical character is included. This may be one or several paragraphs.

Note: On the RAP location map accompanying each RAP description the RAP boundary is outlined in black ink.

LANDFORMS:

1L1 Number	Maori Bay Pillow Lava Site Name and/or Type	International Significance

Priority Landform Sites (PLS's) are tabulated in numerical order - the numbering system, it begins with the RAP number, is followed by a letter to indicate type of Priority Site (ie L for Landform) and concludes with the number of the Priority Site (which relates to the number in Table 2.2). The type of site and its significance is also provided in the table. A description of each PLS within the RAP follows.

Note: On the RAP location map accompanying each RAP description the Priority Landform Sites are outlined and numbered in blue ink.

VEGETATION:

1V108	Coastal scrub on exposed rocky coast	Best and Only
Number	Ecological Unit	Significance

Priority Vegetation Sites (PVS's) are listed in numerical order as for PLS's (see also Table 2.4). The type of vegetation for each PVS and its significance in the District are listed in the second and third columns respectively.

A full description of each Ecological Unit follows the summary table (with the number corresponding to those in the table). The bioclimatic zone, vegetation class, and physical area combinations are given, followed by the size of the unit, its tenure, a description of the main canopy species and the landform on which it tends to occur.

Other vegetation: a note on the other (non-PVS) vegetation within a RAP is given here.

Note: On the RAP location map accompanying each RAP description the Priority Vegetation Sites are outlined and numbered in green ink.

Definitions Of Vegetation Site Significance Statements:

Best in District	the site listed is considered to be the best example of that ecological unit (ie vegetation class on bioclimatic zone/ physical area/ hydrologic class combination). This decision is based on naturalness, health, viability, buffering, size, diversity, representativeness, significance as part of an ecological sequence, presence of rare species etc. There are other sites of this ecological unit within the District. There may, in some cases, be two PVS sites of one ecological unit within a RAP. If one is the best in the District both are considered to have this value and are coded 'Best in District' within the table.
Best and Only	the site listed is the only example of that ecological unit within the District, in most cases it is known that there are no other examples.
Best and Only*	the site listed is the only example of that ecological unit surveyed within the District however there are likely to be other examples in the District.
Best and Only Two	there are only two examples of this ecological unit known in the District and both examples have been selected as PVS's.
Best and Only Two*	the two sites listed are the only examples of that ecological unit surveyed within the District however there are likely to be other examples in the District.
One of the Best	this site is one of two or three sites chosen as a PVS for a particular ecological unit. There may be a site considered to be better (if this is the case the better site will be listed above this site in Table 2.4 and will have 'Best in District' listed beside it within its own RAP description). Alternatively the

	best two or three sites may be considered to be of equal quality and there is, therefore, no 'Best in District' site.
Two of the Best	there are two PVS's in this RAP which are of the same ecological unit. They are described together, and to emphasise that these are two sites of which there is likely to be a better PVS elsewhere they are described as Two of the Best sites.
Where two priority sites of the same ecological unit are included within one RAP the two sites are described in aggregate and only listed once in the PVS summary table in the RAP description.	
Two priority sites of the same vegetation class are listed in the PVS table when they are on separate physical areas or bioclimatic zones (ie they are different ecological units).	

WILDLIFE:

1W2 Number	Muriwai Gannet Colony Site Name	High Value

As for PLS and PVS the Priority Wildlife Sites (PWS) within the RAP are tabulated, using the same numbering system, followed by the name of the Wildlife Site (usually the name of the habitat) and the value within New Zealand.

A description of each PWS follows.

Note: On the RAP location map accompanying each RAP description the Priority Wildlife Sites are outlined and numbered in red ink.

VISUAL LANDSCAPE:

A comment on the significance of the visual landscape within the RAP is quoted from a report produced for the ARA by Steven Brown (1984).

CONSERVATION SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
1L1	Low (in part)	Protect stabilising vegetation

Above is an example of the Conservation Summary. It is a matrix to identify the order in which sites should be prioritised for protection with a note on the management requirements necessary to conserve the significant natural values. The Priority Sites within the District are listed in the first column. The second column lists the degree of protection afforded each Priority Site based on the tenure of the land. Those sites with a Low Protection Status are the highest priority for legal protection. The third column lists some of the action(s)

required to protect each site from known or potential threats. This is action required over and above securing legal protection.

TENURE:

Ownership of the land - in several cases there is more than one owner due to the large size of the RAP, eg some parts privately owned, some parts Scenic Reserve etc.

EXISTING PROTECTION:

List of tenure which give legal protection to part or all of the RAP.

RAP Maps

Accompanying each RAP description is a location map which defines the boundary of the RAP and outlines each priority site. The colour codes of the overlay lines and numbers are as described above (black for RAP boundary, blue for PLS, green for PVS, red for PWS). The following information appears at the bottom of each map.

GRID REFERENCE:

Grid Reference on the 1:50,000 NZMS 260 series - two maps involved (Q11 and R11).

AREA OF RAP:

The area (ha) of land included within the RAP boundary is given. Note that in many cases this exceeds the area of land required to be protected formally because the RAP often encompasses non-priority land.

SCALE:

A line scale is provided for each RAP map. Note that RAP maps are produced at different scales to enable an A4 (or A3) format to be maintained.

RECOMMENDED AREAS FOR PROTECTION

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WAITAKERE RAP # 1: MURIWAI TO TIRIKOHUA POINT COASTLINE

Exposed rocky coastline with sparsely vegetated cliffs.

Priority Landform Site of International Significance for pillow lava formations, also of National Significance for exposed volcanic rocky coastline.

Priority Vegetation Site for coastal scrub.

Priority Wildlife Site ranked High for the Australasian gannet colony on two islands and two headlands.

This RAP consists of several kilometres of coastline, from Otakamiro to Tirikohua Point, characterised by pillow lava, and by landforms which typify an actively eroding rocky coast. This area is principally significant for its landform values, although an important wildlife site and a priority vegetation site are also contained within the RAP. The coastline is generally rocky with high cliffs rising from the sea. Sheer headlands with rocky wave-cut platforms at their bases are separated by sandy and cobblestone beaches. Most of the area is in grasses, bare rock, or scrubby vegetation as a result of the impact of fire and grazing since the early 1900's.

LANDFORMS:

1L1	Maori Bay Pillow Lava International Significance Muriwai Rocky Coast National Significance
- 1L1 The geological characteristics of the outcrops between Otakamiro Point and Tirikohua Point are of international significance. This area contains some of the best examples of pillow lavas in the world. They formed as a result of the extrusion of lava over a sea floor during the early Miocene, when the Muriwai area lay on the submarine lower slopes of a volcano. The rocks of the cliffs south of Motutara Island record much of the geological history of the Waitakere Volcanics from the early Miocene. The pillow lavas of the Nihotupu Formation are overlain by the younger Tirikohua Formation which in turn is overlain by Quaternary sediments of the Kaihu Formation.
- The landforms between Otakamiro and Tirikohua Points are excellent examples of the features that typify actively eroding rocky coasts, comprising sea cliffs, stacks (Motutara Island), islands (Oaia), caves, headlands, cobble and boulder beaches (Collins Bay), pocket sand and gravel beaches, shore platforms, gulls, blow holes and intertidal and subtidal reefs (Otakamiro Point). These features reflect the interaction of marine processes along an exposed, eroding, high energy coast, and the diversity of the local geology. While generally characteristic of the exposed West Coast these landforms are not replicated elsewhere, either in terms of the great diversity of features present within a relatively small area, or their superlative quality. This stretch of coast is of national significance.

VEGETATION:

1V108	Coastal scrub on exposed rocky coast Best and Only
- 1V108 Coastal scrub on exposed rocky coast. 3 ha. ARC, Regional Parkland. This scrub occurs on the gentle slope at the base of the cliff in Maori Bay. The dense, low

canopy consists of *Coprosma macrocarpa* shrubs with karo, kawakawa, hangehange, and flax.

Other vegetation: Pohutukawa-karaka forest on the cliff faces at Maori and Powell Bays, flax-manuka scrub, raupo swamps, and flaxlands on the cliff tops and slopes along the coastline, iceplant herbfields on the rocky cliff faces.

WILDLIFE:

1W2	Muriwai gannet colony	High
1W2	The Muriwai gannet colony is the northern-most mainland breeding colony of Australasian gannets and as such has national significance. The long established colony on Oaia Island spread to the rock stack of Motutara Island in 1975, then to two adjoining headlands by 1982. A large colony of white-fronted terns which existed on Motutara Island prior to 1975 have been largely displaced by the gannets. They now exist only as a small colony nesting on narrow shelves on the steep sides of the island. New Zealand fur seals have been recorded in variable numbers on Oaia Island for many years. Breeding would appear to be unlikely so far to the north although pups have been recorded. Oaia Island also has a colony of spotted shags. Southern black-backed gulls breed on the steep, eroding, seaward slopes just to the north of Tirikohua Point.	

VISUAL
LANDSCAPE:

Extremely sensitive and valuable (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
1L1	Low (in part)	Protect stabilising vegetation Limit disturbance to lava
1V108	High	Weed control
1W2	High	Maintain habitat quality

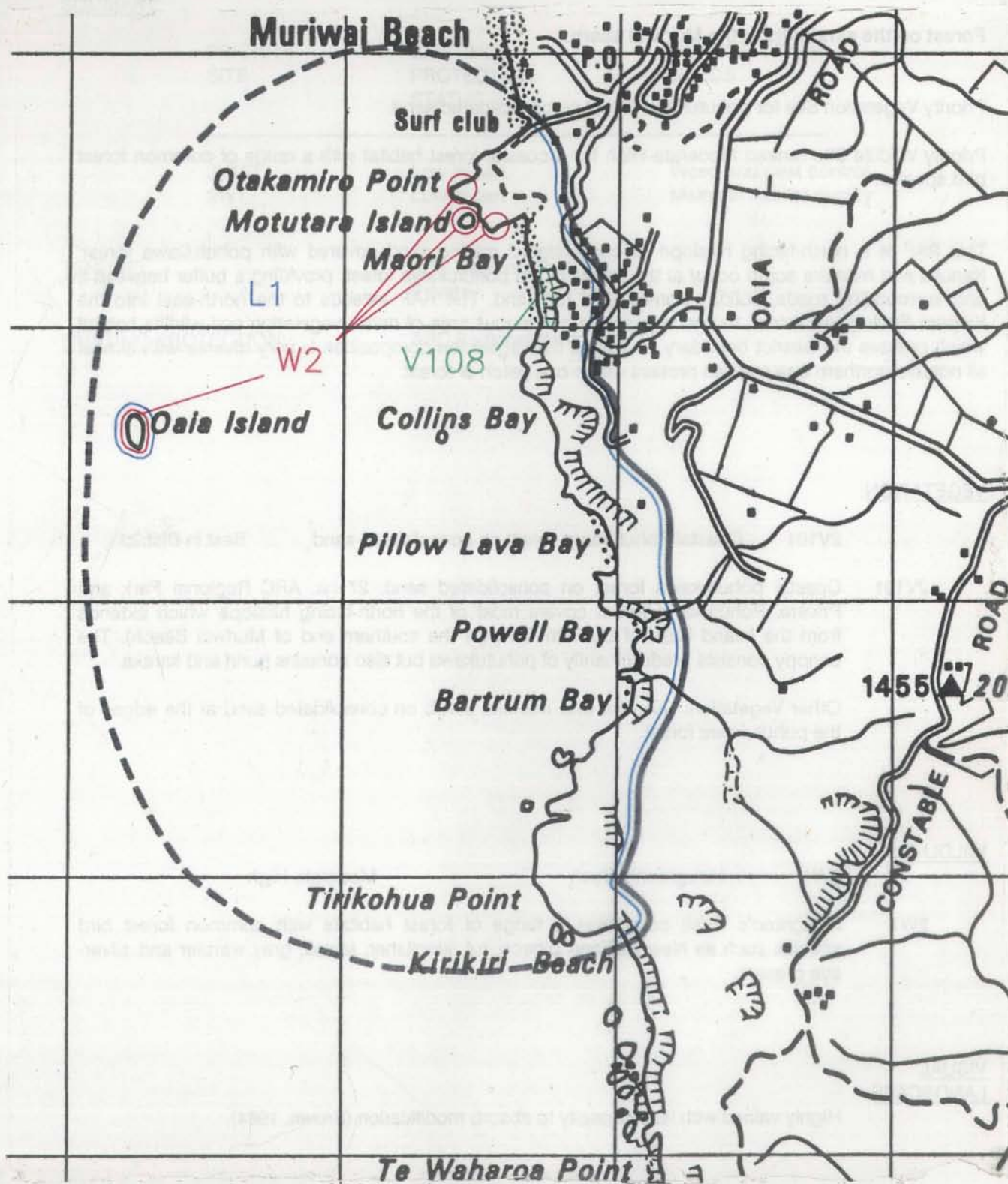
TENURE:

ARC Regional Park
Private

EXISTING PROTECTION:

Part ARC Regional Park

RECOMMENDED AREA FOR PROTECTION # 1: MURIWAI TO TIRIKOHUA POINT COASTLINE



GRID REFERENCE

NZMS 260 Q11 380830

AREA OF RAP

65ha

SCALE:

0 0.5 1 km

WAITAKERE RAP # 2: MURIWAI FOREST

Forest on the sand hills of the Muriwai scarp.

Priority Vegetation Site for pohutukawa forest on consolidated sand.

Priority Wildlife Site ranked Moderate-High for a coastal forest habitat with a range of common forest bird species.

This RAP is a north-facing hillslope of consolidated marine sand covered with pohutukawa forest. Kanuka and manuka scrub occur at the edges of the pohutukawa forest, providing a buffer between it and surrounding roads, holiday homes, and farmland. The RAP extends to the north-east into the Kaipara Ecological District, to encompass the continuous area of native vegetation and wildlife habitat which crosses the District boundary. In places the vegetation composition is very diverse with almost all notable northern tree species present within one patch of forest.

VEGETATION:

2V101	Coastal Pohutukawa forest on consolidated sand	Best in District
2V101	Coastal pohutukawa forest on consolidated sand. 27 ha. ARC Regional Park and Private. Pohutukawa forest covers most of the north-facing hillslope which extends from the inland base of Otakamiro Pt (at the southern end of Muriwai Beach). The canopy consists predominantly of pohutukawa but also contains puriri and karaka.	
	Other Vegetation: Kanuka and manuka scrub on consolidated sand at the edges of the pohutukawa forest.	

WILDLIFE:

2W1	Houghton's Bush	Moderate-High
2W1	Houghton's Bush comprises a range of forest habitats with common forest bird species such as New Zealand pigeon, tui, kingfisher, fantail, grey warbler and silver-eye present.	

VISUAL LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
2V101	Low in part	Weed and pest control
2W1	Low in part	Maintain habitat quality

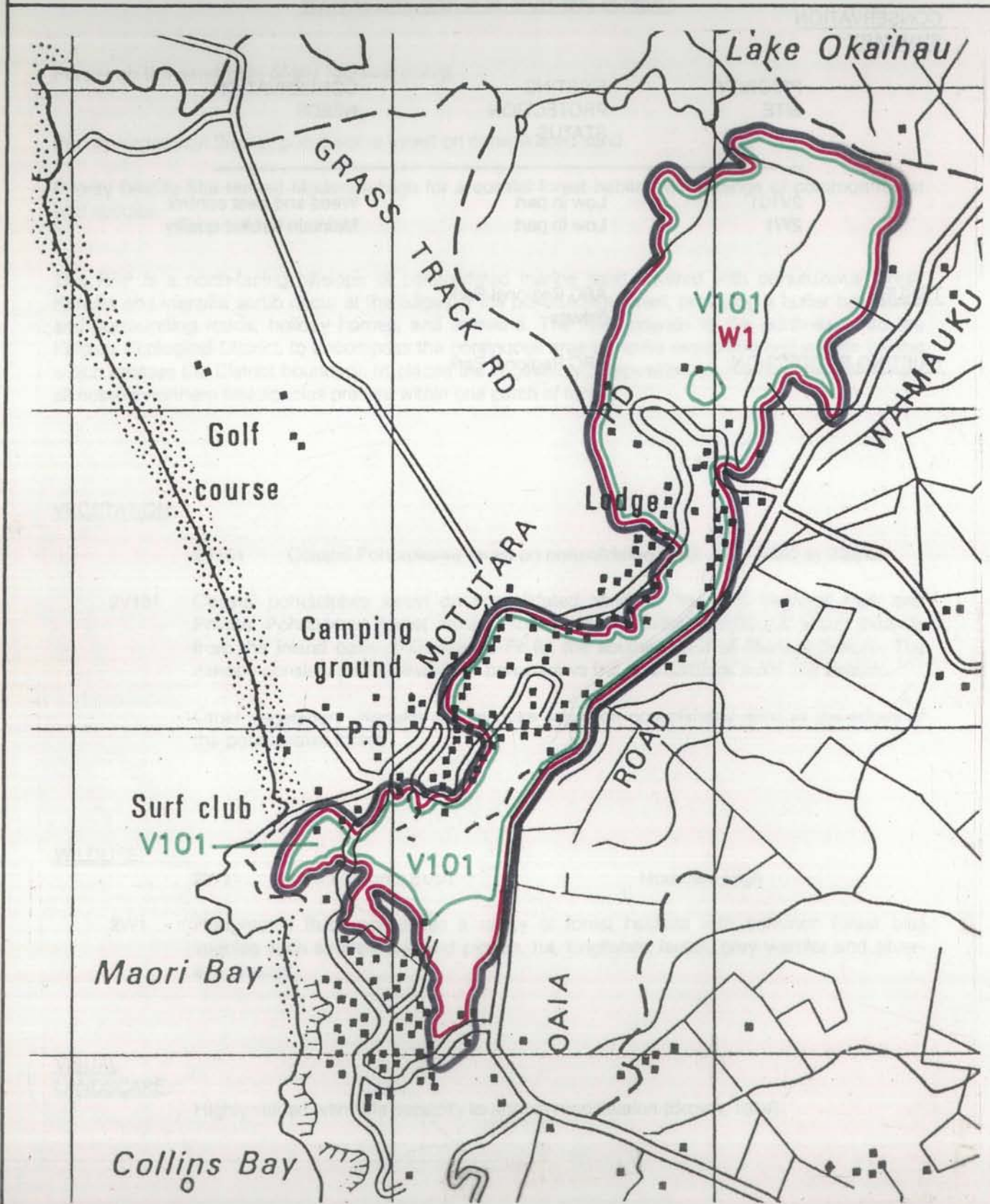
TENURE:

ARC Regional Park
Private

EXISTING PROTECTION:

ARC Regional Park

RECOMMENDED AREA FOR PROTECTION # 2: MURIWAI FOREST



GRID REFERENCE

NZMS 260 Q11 385850

AREA OF RAP

97ha

SCALE: 0 5 1 km

WAITAKERE RAP # 3: MOKOROA STREAM FOREST

Large forest remnant on subdued hillslopes.

Priority Landform Site of Local Significance for a waterfall.

Priority Vegetation Site for mamangi forest, puriri composite forest, tawa forest, kanuka forest, mamaku-mixed broadleaf forest, podocarp-broadleaf forest, young kauri forest and kauri-rimu forest on subdued hillcountry, and for young kauri forest on consolidated sand.

Priority Wildlife Site ranked Moderate for a large area of secondary regenerating forest habitat with a range of common forest bird species.

This RAP comprises a large block of forest covering the hillslopes on both sides of the Mokoroa Stream. The north-facing slopes are covered with secondary kauri and kanuka forest whilst puriri-tawa-mamaku forest covers the south-facing slopes. The RAP is surrounded by pasture. Adjoining the main block of vegetation are several tongues of forest in the gullies of streams which feed into the Mokoroa Stream.

LANDFORMS:

	3L8	Mokoroa Waterfall	Regional Significance
3L8	Waterfalls are a feature of the catchments of the river valleys of the Waitakere Ranges, and are of regional significance. This waterfall provides one of the better examples. The prevalence of waterfalls in the Ranges is related to the diversity of rock types of markedly differing resistance to erosion. Waterfalls are commonly associated with intrusive volcanic rocks, which tend to be harder and more resistant to erosion. A stream will tend to erode the softer rocks below and downstream from these outcrops more readily, creating an abrupt change of gradient.		

VEGETATION:

3V4	Lowland	Kauri-rimu forest on subdued hillcountry	Best and Only
3V11	Lowland	Young kauri forest on consolidated sand	Best and Only
3V12	Lowland	Young kauri forest on subdued hillcountry	Best in District
3V29	Lowland	Kanuka forest on subdued hillcountry	Best in District
3V50	Lowland	Mamangi forest on subdued hillcountry	Best and Only Two*
3V59	Lowland	Puriri composite forest on subdued hillcountry	Best in District
3V64	Lowland	Tawa forest on subdued hillcountry	Best and Only
3V68	Lowland	Mamaku-broadleaf forest on subdued hillcountry	Best in District
3V85	Lowland	Podocarp-broadleaf forest on subdued hillcountry	Best in District
3V4	Lowland kauri-rimu forest on subdued hillcountry. 17 ha. Private. The north-facing slope above the head of the Roe Stream is covered with young conifer forest dominated by kauri and rimu with rewarewa, lancewood, heketara and mapou.		

- 3V11 Lowland young kauri forest on consolidated sand. 7 ha. DOC. This area of kauri forest is situated within a small remnant surrounded by farmland. The canopy species include kauri, tanekaha, rimu, kanuka, miro and white maire.
- 3V12 Lowland young kauri forest on subdued hillcountry. 40 ha. DOC. This site consists of many pockets of kauri ricker on ridges and spurs within a larger area of kanuka forest. Rimu, rewarewa, tanekaha and kahikatea are also present.
- 3V29 Lowland kanuka forest on subdued hillcountry. 103 ha DOC and 16 ha Private. Within this large area of kanuka dominated forest is considerable variation of the minor canopy associates. On mid and upper slopes and ridges kauri, tanekaha, totara, and rimu are associated with the kanuka canopy whilst kowhai, kahikatea and rimu are more abundant on the lower slopes. One small (16 ha) patch of kanuka forest on the alluvial flat of a southern tributary to the Mokoroa Stream has been included within this site as it provides an example of the uncommon occurrence of kanuka forest on an alluvial site.
- 3V50 Lowland mamangi forest on subdued hillcountry. 12 ha and 5 ha. DOC. This site consists of two elongate strips of mamangi forest covering ridges separated by a gully filled with puriri composite forest. Kauri, rimu, puriri and kanuka occur with the mamangi on the ridge tops whilst kowhai, mapou, lancewood, mahoe and mamaku are present on the side slopes.
- 3V59 Lowland puriri composite forest on subdued hillcountry. 18 ha and 19 ha. DOC and Private. Puriri, karaka, nikau, rewarewa, mamaku, rata, totara, kahikatea, pukatea, tawa and mamangi are present in the canopy of the smaller site which is located in a gully between two mamangi ridges. The larger site, on the northern side of the Mokoroa Stream, contains puriri, mapou, nikau, rewarewa, ponga, mahoe and scattered emergent podocarps.
- 3V64 Lowland tawa forest on subdued hillcountry. 46 ha. Private. Tawa and puriri forest merge together on the northern slopes of the Mokoroa Stream. These forest types are very diverse with no clearly dominant species. Mahoe, tawa, puriri, mamaku, kowhai, nikau and rewarewa are abundant in the forest canopy on this relatively steep, south facing hillslope. Tawa forest is rare in the northern section of the Ecological District due to the paucity of steep slopes on which this forest class generally occurs.
- 3V68 Lowland mamaku-broadleaf forest on subdued hillcountry. 82 ha. Private. A very diverse treefern-broadleaf forest complex covers the northern slopes of Roe Stream, a tributary of Mokoroa Stream. There are no obviously dominant species in this forest type although the most commonly recurring are mamaku, mahoe, pigeonwood, nikau, rewarewa, mapou, tawa and ponga. Emergent podocarps are scattered sparsely throughout.
- 3V85 Lowland podocarp-broadleaf forest on subdued hillcountry. 26 ha. Private. The subdued slopes between the Thorpe and Hoheria Streams support an area of dense podocarp-broadleaf forest. Kahikatea dominates the canopy with lesser amounts of rimu, miro, kauri, rewarewa, cabbage tree and kanuka. Rimu and kauri tend to occur as pockets within this area.

Other vegetation: Manuka scrub at the north-western end of the RAP.

WILDLIFE:

3W4 Mokoroa Stream Bush Moderate

3W4 This is a large area of native forest with common forest bird species including New Zealand pigeon, tui, kingfisher, fantail, grey warbler and silver-eye. The forest has the potential to improve as a wildlife habitat as regeneration continues towards a mature forest sequence. The kanuka and manuka scrub on the northern boundary of the RAP provide a particularly good habitat for the Auckland green gecko and forest gecko.

VISUAL
LANDSCAPE:

Above average quality, restricted in suitability for development (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
3L8	High	Leave unmodified
3V4	Low	Fence
3V11	High	Check fencing, monitor weeds
3V12	High	Check fencing
3V29	High	Check fencing
3V50	High	Check fencing
3V59	High	Check fencing
3V64	Low	Check fencing
3V68	Low	Check fencing
3V85	Low	Check fencing
3W4	High	Maintain habitat quality

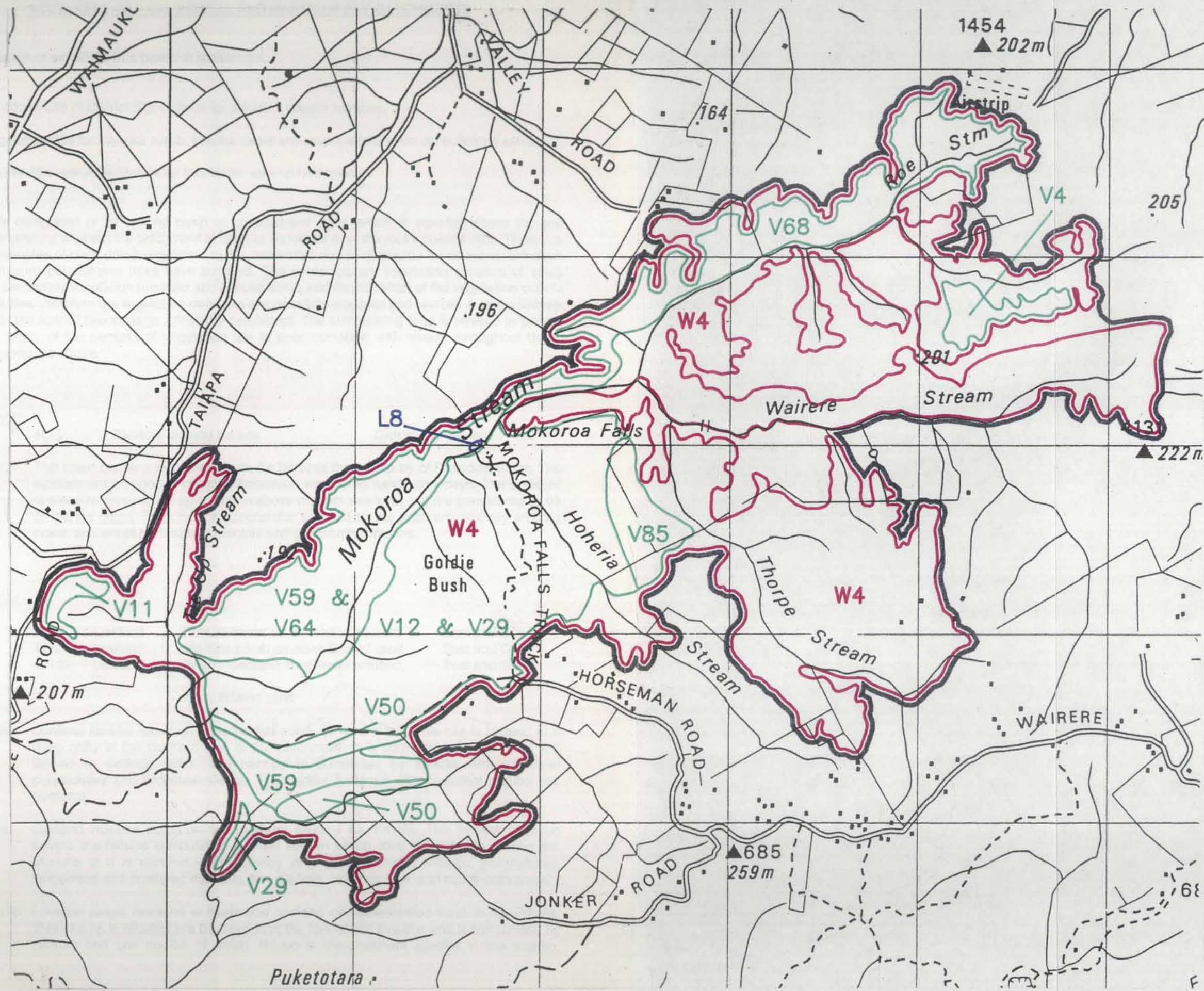
TENURE:

Private
DoC (Goldies and Mokoroa SR)

EXISTING PROTECTION:

DoC Scenic Reserves
District Scheme control

RECOMMENDED AREA FOR PROTECTION # 3: MOKOROA STREAM FOREST



GRID REFERENCE

NZMS 260 Q11 420830

AREA OF RAP

885ha

SCALE: 0 0.5 1 1.5 km

WAITAKERE RAP #4: POWELL AND BARTRUM BAY CATCHMENTS**Elevated basin of sandhills in a pastoral landscape.**

Priority Landform Site of District Significance for elevated coastal terraces.

Priority Vegetation Site for manuka scrub, kanuka forest and raupo reedland on consolidated sand.

Priority Wildlife Site ranked Moderate for freshwater swamp bird species.

This RAP is comprised of an eroded basin of consolidated sand, which is elevated above the sea causing the streams draining the catchment to drop as waterfalls over the rocky coastal cliffs. There are no intact examples of unmodified vegetation in this catchment due to clearance for farmland, although scattered mature pohutukawa trees have survived. The contemporary vegetation consists of small pockets of secondary vegetation (manuka and kanuka scrub and forest). Most of the vegetation occurs in stream gullies, therefore the vegetation remnants are generally elongate and narrow. A raupo swamp is present in the fork of two streams within the catchment. The surrounding land is pasture in private ownership. Many of the pockets of vegetation are in poor condition with weeds throughout them, especially along the edges.

LANDFORMS:

4L12	Elevated coastal terrace	District Significance
4L12	This coast contains examples of marine terraces thought to be of Pleistocene age. The terraces are composed of Kaihu Formation weathered sands and clays. The surfaces of these terraces occur up to 200 m above modern sea level, yet are considered to be of marine origin. They form a spectacular contrast to the adjacent, actively eroding coast, and are of particular geological and geomorphic interest.	

VEGETATION:

4V28	Lowland	Kanuka forest on consolidated sand	Best and Only*
4V40	Lowland	Manuka scrub on consolidated sand	Best and Only*
4V120	Lowland	Raupo reedland, freshwater wetland, consolidated sand	Best and Only*
4V28	Lowland kanuka forest on consolidated sand. 22 ha. Private. This site is located in a deep gully in the northern end of the catchment. It is surrounded by farmland but fenced to exclude stock. The canopy is dominated by kanuka with scattered pohutukawa and broadleaf shrubs. The midtier is dense with broadleaf shrubs and treeferns.		
4V40	Lowland manuka scrub on consolidated sand. 4 ha. Private. This pocket of scrub covers the hillside surrounding a small stream which runs through the catchment. Manuka at 4 m dominates the canopy which also includes akepiro, pohutukawa, lancewood and scattered mamaku, flax, <i>Gahnia</i> , cabbage tree, and native cuttygrass.		
4V120	Lowland raupo reedland in freshwater wetland on consolidated sand. 2 ha. Private. This swamp is situated in a depression at the fork of two streams and is surrounded by pasture and one pocket of scrub. Raupo is the dominant species in the swamp.		

Cabbage tree, *Baumea*, *Cyperus* and *Eleocharis* species are present around the periphery.

Other Vegetation: Pockets of kanuka and manuka forest and scrub, treefern-broadleaf vegetation in the bottom of deep gullies.

WILDLIFE:

4W3 Constable Raupo Swamp Moderate

4W3 Constable Road Swamp is a raupo habitat for secretive bird species including spotless crake and the regionally threatened North Island fernbird. There are relatively few areas of this habitat type in the Ecological District.

VISUAL
LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
4L12	Low	Leave unmodified, prevent erosion
4V28	Low	Monitor weeds
4V40	Low	Fence, weed control
4V120	Low	Fence
4W3	Low	Control feral cats

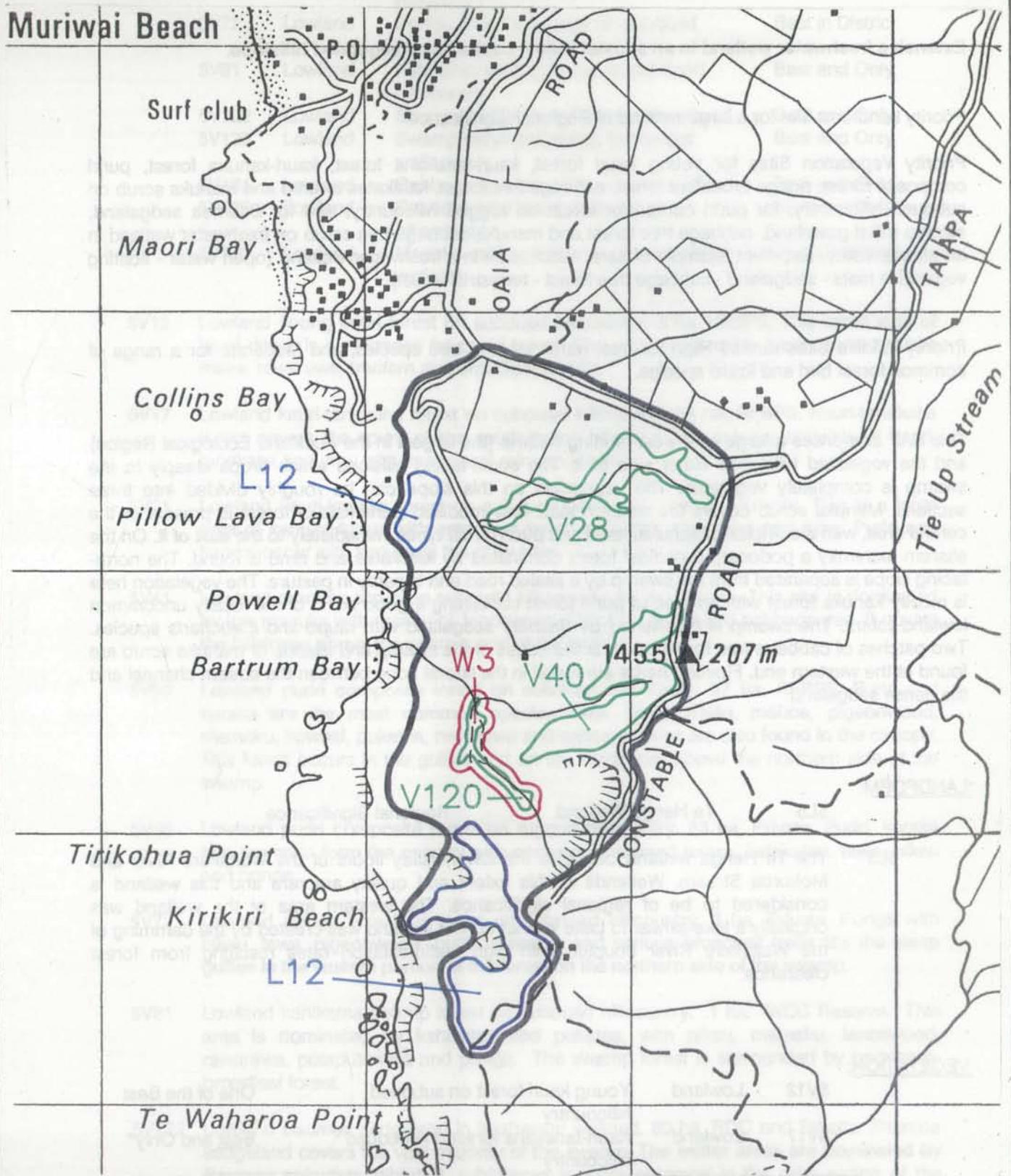
TENURE:

Private

EXISTING PROTECTION:

Nil

RECOMMENDED AREA FOR PROTECTION # 4: POWELL AND BARTRUM BAY CATCHMENTS



GRID REFERENCE

NZMS 260 Q11 385830

AREA OF RAP

180ha

SCALE:

0 5 1 km

WAITAKERE RAP #5: TE HENGA VALLEY

Extensive freshwater wetland in an alluvial valley, backed by a vegetated hillslope.

Priority Landform Site for a large wetland of Regional Significance.

Priority Vegetation Sites for young kauri forest, kauri-tanekaha forest, kauri-kanuka forest, puriri composite forest, ponga-broadleaf forest, cabbage tree forest, kahikatea swamp and manuka scrub on subdued hillcountry, for puriri composite forest on rugged hillcountry, and for *Baumea* sedgeland, swamp millet grassland, cabbage tree forest and manuka-cabbage tree scrub on freshwater wetland in an alluvial valley. Excellent example of seral succession in a freshwater wetland (open water - floating vegetative mats - sedgeland - cabbage tree forest - terrestrial forest).

Priority Wildlife Sites ranked High for freshwater wetland bird species, and Moderate for a range of common forest bird and lizard species.

This RAP comprises a large east-west tending swamp (the largest in the Auckland Ecological Region) and the vegetated hillslopes either side of it. The south-facing hillslope which drops steeply to the swamp is completely vegetated. The vegetation on this slope can be roughly divided into three sections. Manuka scrub covers the western side, less modified puriri-karaka forest is present in the central area, with a complex of kanuka, kauri and puriri forest types immediately to the east of it. On the eastern extremity a podocarp-broadleaf forest dominated by kahikatea and rimu is found. The north-facing slope is separated from the swamp by a sealed road and is partly in pasture. The vegetation here is mostly kanuka forest with an area of puriri forest containing a good stand of the locally uncommon lowland totara. The swamp is dominated by *Baumea* sedgeland with raupo and *Eleocharis* species. Two patches of cabbage tree forest occur at the edges of the swamp and islands of manuka scrub are found at the western end. Floating herbs are found in the littoral zone between the stream channel and the dense sedgeland.

LANDFORM:

5L5	Te Henga Wetland	Regional Significance
5L5	The Te Henga wetland occupies the lower valley floors of the Waitakere River and Mokoroa Stream. Wetlands of this extent and quality are rare and this wetland is considered to be of regional significance. The western area of the wetland was originally a lake similar to Lake Wainamu. The wetland was created by the damming of the Waitakere River coupled with high sedimentation rates resulting from forest clearance.	

VEGETATION:

5V12	Lowland	Young kauri forest on subdued hillcountry	One of the Best
5V17	Lowland	Kauri-tanekaha forest on subdued hillcountry	Best and Only*
5V21	Lowland	Kauri-kanuka forest on subdued hillcountry	Best in District
5V41	Lowland	Manuka scrub on subdued hillcountry	Best in District
5V59	Lowland	Puriri composite forest on subdued hillcountry	One of the Best

5V60	Lowland	Puriri composite forest on rugged hillcountry	One of the Best
5V72	Lowland	Ponga-broadleaf forest on subdued hillcountry	Best in District
5V81	Lowland	Kahikatea swamp forest on subdued hillcountry	Best and Only
5V122	Lowland	<i>Baumea</i> sedgeland, freshwater wetland	Best and Only
5V123	Lowland	Swamp millet grassland, freshwater wetland	Best and Only
5V124	Lowland	Cabbage tree forest, freshwater wetland	Best and Only
5V125	Lowland	Cabbage tree forest on subdued hillcountry	Best and Only
5V127	Lowland	Manuka-cabbage tree scrub, freshwater wetland	Best and Only
5V12	Lowland young kauri forest on subdued hillcountry. 3 ha. RFBPS. This small area of kauri ricker is surrounded by puriri forest. The canopy contains kauri, karaka, white maire, rewarewa, treefern and broadleaf shrubs.		
5V17	Lowland kauri-tanekaha forest on subdued hillcountry. 14 ha. RFBPS. Kauri-tanekaha forest covers the spurs of the south-facing hillslope. The canopy consists of kauri, tanekaha and rimu with occasional miro and toatoa.		
5V21	Lowland kauri-kanuka forest on subdued hillcountry. 196 ha. Private. This is a large area of kanuka forest with emergent kauri, tanekaha, rewarewa and miro. Puriri and karaka occur with kanuka in the gully sites.		
5V41	Lowland manuka scrub on subdued hillcountry. 48 ha. Private. This site is dominated by low manuka with mamangi, lancewood, kanuka, kowhai and cabbage tree. It covers the hillslopes above the western end of the swamp.		
5V59	Lowland puriri composite forest on subdued hillcountry. 97 ha. RFBPS. Puriri and karaka are the most common species here. Tawa, nikau, mahoe, pigeonwood, mamaku, kowhai, pukatea, rewarewa and cabbage trees are also found in the canopy. This forest occurs in the gullies and on the midslopes above the northern side of the swamp.		
5V60	Lowland puriri composite forest on rugged hillcountry. 33 ha. Private. Puriri, karaka and mamaku form the canopy with occasional lowland totara, kahikatea, tawa, nikau and ponga.		
5V72	Lowland ponga broadleaf forest on subdued hillcountry. 3 ha. Private. Ponga with nikau, tawa, pigeonwood, puriri, mamaku and various broadleaf trees fills the steep gullies in the eastern portion of the forest on the northern side of the swamp.		
5V81	Lowland kahikatea swamp forest on subdued hillcountry. 1 ha. WCC Reserve. This area is dominated by kahikatea and pukatea, with nikau, mamaku, lancewood, rewarewa, putaputaweta and ponga. The swamp forest is surrounded by podocarp-broadleaf forest.		
5V122	Lowland <i>Baumea</i> sedgeland in freshwater wetland. 80 ha. RDC and Private. <i>Baumea</i> sedgeland covers the vast majority of the swamp. The wetter areas are dominated by <i>Baumea articulata</i> , whilst <i>B. rubiginosa</i> is more common in the drier region of the lower half of the swamp. Raupo and swamp millet are common throughout the <i>Baumea</i> sedgeland.		

- 5V123 Lowland swamp millet grassland in freshwater wetland. 6ha. RDC. Swamp millet (*Isachne globosa*) forms floating mats of native grassland vegetation within the swamp. *Eleocharis sphacelata*, *Baumea rubiginosa*, raupo, *Carex secta* and *Scirpus lacustris* are also present in these mats. At the ground level, among the bases of the grasses and sedges, exotic and native wetland herbs are found.
- 5V124 Lowland cabbage tree forest in freshwater wetland. 7 ha. Private. In this site cabbage trees form a continuous canopy over a shrub layer dominated by flax with occasional mahoe, nikau, hangehange and other shrubs.
- 5V125 Lowland cabbage tree forest on subdued hillcountry. 1.5 ha. RFBPS. Cabbage tree is the dominant canopy species here. Putaputaweta, titoki, kanuka, karaka and kahikatea are also present. This site is situated at the base of the south-facing hillslope between the swamp and the puriri-karaka forest.
- 5V127 Lowland manuka-cabbage tree scrub in freshwater wetland. 3 ha. Private. This site comprises several islands of low scrub within the *Baumea* sedgeland. Manuka forms an almost continuous canopy with scattered *Coprosma robusta* and emergent cabbage trees. The midtier consists of sedges, flax and shrubs.

Other Vegetation: Lowland kanuka forest on subdued hillcountry.

WILDLIFE:

5W6	Jonkers Bush	Moderate
5W7	Puketotara Swamp	High

5W6 Jonkers Bush contains a good diversity of native and introduced forest bird species. A wide range of insect species has been identified from Matuku Reserve which is owned by the Royal Forest and Bird Protection Society. Three species of lizard occur in this forest; the Auckland green gecko, the forest gecko and the copper skink.

5W7 Te Henga Swamp is the largest freshwater wetland in the Auckland Ecological Region. It is of national importance for wildlife species with a high diversity of freshwater wetland bird species including the threatened Australasian bittern and banded rail, and the regionally threatened North Island fernbird. Spotless crane, pukeko and marsh crane are also present. Large numbers of waterfowl use the swamp at times.

VISUAL LANDSCAPE:

Forest - Highly valued with little capacity to absorb modification (Brown, 1984)

Swamp - Above average quality, restricted in suitability for development (Brown, 1984)

**CONSERVATION
SUMMARY:**

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
5L5	Low	Control clearance and sedimentation from catchment
5V12	High	Fencing
5V17	High	Fencing
5V21	High	Fencing
5V41	Low	Fencing
5V59	High	Fencing
5V60	Low	Weed and pest control
5V72	Low	Monitor for pests and weeds
5V81	High	Monitor for weeds and pests
5V122	Low	Monitor weeds, prevent drainage, pollutants and sedimentation
5V123	Low	as for 5V122
5V124	Low	Weed control and as for 5V122
5V125	Low	as for 5V122
5V127	Low	as for 5V122
5W6	Low	Maintain habitat quality
5W7	Low	Maintain habitat quality

TENURE:

Private
Royal Forest and Bird Protection Society
Waitakere City Council

EXISTING PROTECTION:

RDC Rural Conservation 1 (Nature Conservation), WCC Landscape
Protection 1 zone.
RFBPS Protected Private Land - swamp and forest
WCC and RFPBS Reserve - Waitoru Reserve (podocarp-broadleaf
forest)

RECOMMENDED AREA FOR PROTECTION # 5: TE HENGA VALLEY



NZMS 260 Q11 410800

GRID REFERENCE

975ha

AREA OF RAP

SCALE: 0 0.5 1 1.5 2 km

WAITAKERE RAP # 6: NORTHERN TE HENGA COASTLINE

Exposed rocky coastline and islands, backed by forested hillslopes and pasture covered terraces.

Priority Landform Sites for volcanic formation of Regional Significance and for elevated coastal terrace of District Significance.

Priority Vegetation Sites for kanuka scrub on consolidated sand, pohutukawa forest, karo-houpara forest and flax-manuka scrub on the exposed rocky coast.

Priority Wildlife Sites ranked High and Moderate-High for colonies of sea bird species.

This RAP consists of a stretch of rocky and sandy coastline incorporating two vegetated islands (both accessible at low tide), a headland, and a vegetated hillslope of consolidated marine sand. The two islands and the headland are covered with a recent succession composed of pohutukawa, karo, houpara, tawapou and kowhai. Pasture and scrub covers most of the coastal hill country backing the beach, and separates the coastline from the Te Henga swamp which is included in RAP #5.

LANDFORM:

6L7	O'Neill Bay	Regional Significance
6L12	Elevated coastal terrace	District Significance
6L7	The northern end of O'Neill Bay contains sections of particular geological significance. O'Neill Bay is the northern-most of a string of eight volcanic crater complexes (much eroded) that extend along the western margin of the Waitakere Ranges. The exposed strata are comprised of an almost horizontal sequence (some 100 m thick) of andesitic flows and other volcanic rocks. It is believed the sequence of rocks resulted from the subsidence and infilling of a crater by lava flows and subaerial pyroclastics.	
6L12	This coast contains examples of marine terraces thought to be of Pleistocene age. (See RAP #4 for detailed description of this priority landform site).	

VEGETATION:

6V34	Coastal	Kanuka scrub on consolidated sand	Best in District
6V102	Coastal	Pohutukawa forest, exposed rocky coast	One of the Best
6V107	Coastal	Karo-houpara forest, exposed rocky coast	Best and Only Two
6V115	Coastal	Flax-manuka scrub, exposed rocky coast	Best and Only*
6V34	Coastal kanuka scrub on consolidated sand. 20 ha. Private. Kanuka scrub with manuka and <i>Coprosma rhamnoides</i> covers the sides of Taumaiti, ⁷ a large hill at the northern end of Te Henga Beach.		
6V102	Coastal pohutukawa forest on exposed rocky coast. 5 ha. Private. Pohutukawa forest occurs on Erangi Point and Ihumoana Island (the high headland and the privately owned island at the northern end of Te Henga Beach). Kowhai, houpara and karo are		

7. Traditional spelling is Taumaihi.

also present in the canopy. This site also contains a small amount of tawapou forest with pohutukawa, ngaio, kowhai and karo.

- 6V107 Coastal karo-houpara forest on exposed rocky coast. 2.5 ha. Private. Karo and houpara are coastal plants which, in the Waitakere Ecological District, are only present in significant amounts on the two islands at the northern end of Te Henga Beach (Kauwahaia with karo and Ihumoana Island with houpara dominant). Here they form a dense canopy over sparse mid and ground tiers.
- 6V115 Coastal flax-manuka scrub on exposed rocky coast. 11 ha. Private. This large area of low dense scrub dominated by flax and manuka with tauhinu and bracken, covers the steep cliff faces at the northern end of O'Neill Bay. Seedlings of pohutukawa and kawakawa were found under the manuka shrubs.

Other Vegetation: Pohutukawa forest and kanuka forest cover the hillslopes below the Taumaiti trig.

WILDLIFE:

6W10	Ihumoana Island	Moderate-High
6W11	Kauwahaia Island	High
6W12	Erangi Point	High

- 6W10 Ihumoana Island is a small rock island with a remnant grey-faced petrel colony. Although a common petrel species on North Island east coast islands it is now rare on the west coast of the Auckland Ecological Region.
- 6W11 Kauwahaia Island is a small rock island of national significance owing to a high diversity of sea bird species on a west coast island. Bird species breeding on the island include grey-faced petrel, sooty shearwater, diving petrel and possibly flesh-footed shearwater.
- 6W12 Erangi Point is a small peninsula with breeding and roosting areas for the endemic spotted shag in cavities on the steep coastal cliffs. Blue penguin may also nest on the point after coming ashore on the sandy beaches either side of the headland.

VISUAL

LANDSCAPE:

Extremely sensitive and valuable (Brown, 1984)

CONSERVATION

SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
6L7	Low	Leave unmodified, prevent erosion
6L12	Low	Leave unmodified
6V34	Low	Weed control
6V102	Low	Pest and weed control
6V107	Low	Weed control

6V115	Low	Monitor weeds and pests
6W10	Low	Maintain habitat quality
6W11	Low	Maintain habitat quality
6W12	Low	Maintain habitat quality

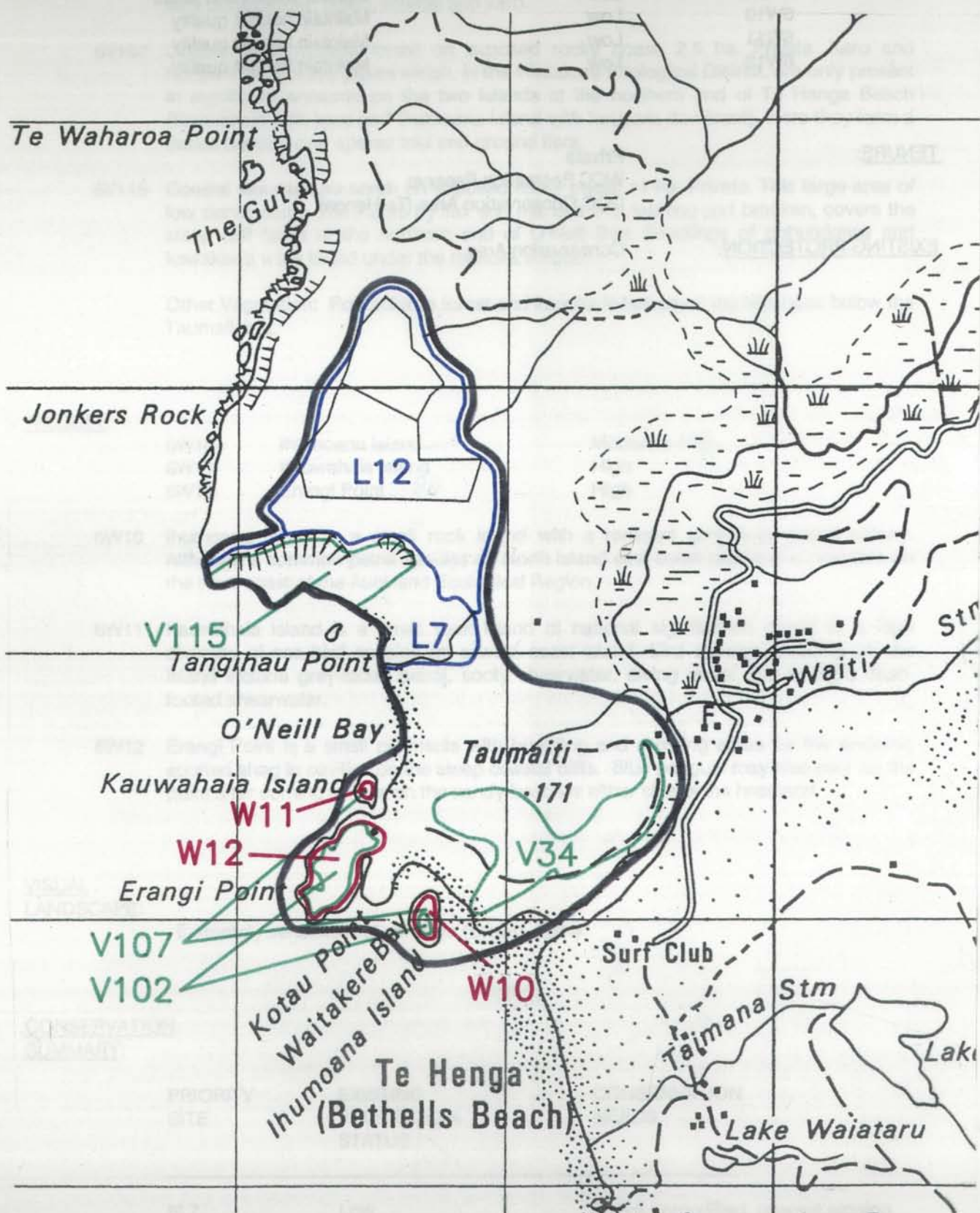
TENURE:

Private
WCC Recreation Reserve
DOC Conservation Area (Te Henga)

EXISTING PROTECTION:

Conservation Area

RECOMMENDED AREA FOR PROTECTION # 6: NORTHERN TE HENGA COASTLINE



GRID REFERENCE

NZMS 260 Q11 410800

AREA OF RAP

185ha

SCALE: 0 5 1 km

WAITAKERE RAP #7: TE HENGA DUNES AND LAKES

Large area of sand dunes surrounded by vegetated lowland hillcountry. Contains several dune impounded lakes.

Priority Landform Site of Regional Significance for vegetated and mobile dunes and for dune impounded freshwater lakes.

Priority Vegetation Sites for kanuka scrub and pohutukawa forest on unconsolidated sand, for pohutukawa forest, kanuka forest and puriri composite forest on rugged hillcountry, and for raupo reedland and cabbage tree forest within a dune impounded lake system. Sequences: raupo reedland in lake margin - cabbage tree forest at lake edge - terrestrial forest (young kauri) on hillslopes above lake.

Priority Wildlife Sites ranked Moderate-High and Moderate for freshwater species.

This RAP is situated within a larger area containing a complex array of landforms, including a large freshwater swamp, an exposed sandy beach, a rocky cliff coastline, dune sands, dune impounded lakes and rugged hillcountry covered in native forest and scrub. The freshwater swamp, the beach and cliffs are located in RAPs 5 and 6. The dune lakes, their catchments and the dunes impounding the lakes are the focus of this RAP. One of the two major lakes in the RAP (L. Kawaupaka⁸) is one of the few examples in the Region of a dune lake completely surrounded by native forest. The larger lake (L. Wainamu) is surrounded by native vegetation along most of its margin. The shallows of these lakes are marked by a littoral zone with raupo and sedge vegetation. The stream which drains from L. Wainamu divides a large area of mobile dunes from an equally large area of vegetated dunes in pasture which does not fall in this RAP. Much of the catchment of these lakes is comprised of secondary vegetation on hillslopes - manuka scrub on exposed ridges, kanuka forest with young kauri on upper slopes and inland ridges. To the north and west of L. Kawaupaka are examples of the pre European vegetation of this area - pohutukawa forest and puriri-karaka forest - but even here the presence of kanuka indicates disturbance in the past.

LANDFORM:

7L15 Te Henga Valley Regional Significance

7L15 Extensive areas of sand dune development are rare along the Waitakere Coast. In fact Te Henga is the only example of its type, given that deposition at Whatipu is probably greatly influenced by the adjacent mouth of the Manukau Harbour. Deposition of sand in the lower Waitakere Valley has resulted in the formation of large mobile sand dunes which extend approximately two kilometres inland. Associated with this deposition has been the restriction of natural drainage and the formation of several dune lakes (Wainamu, Kawaupaka and Waataru) and the Te Henga wetland. This association of landforms creates a dramatic landscape which has no parallel in the Auckland Region. At the same time the processes of sand deposition, sand dune and lake development is typical of the West Coast of the North Island of New Zealand.

8. Traditional spelling is Kawaupaku.

VEGETATION:

7V22	Lowland	Kauri-kanuka forest on rugged hillcountry	One of the Best
7V26	Coastal	Kanuka forest on rugged hillcountry	Best in District
7V33	Coastal	Kanuka scrub on unconsolidated sand	Best and Only
7V36	Lowland	Kanuka scrub on rugged hillcountry	Best in District
7V57	Coastal	Puriri composite forest on rugged hillcountry	Best in District
7V100	Coastal	Pohutukawa forest on unconsolidated sand	Best in District
7V104	Coastal	Pohutukawa forest on rugged hillcountry	Best in District
7V106	Lowland	Pohutukawa forest on rugged hillcountry	One of the Best
7V121	Lowland	Raupo reedland on dune impounded lake	Best and Only Two
7V126	Lowland	Cabbage tree forest on dune impounded lake	Best and Only

7V22 Lowland kauri-kanuka forest on rugged hillcountry. 42 ha. Private. This forest covers the southern slopes of Lake Kawaukapa linking this area with the vegetation of the Waitakere Ranges. Kauri and kanuka dominate the canopy of this forest which also includes rimu, rewarewa, lancewood, mamangi, mamaku and tanekaha.

7V26 Coastal kanuka forest on rugged hillcountry. 15 ha. Private. Kanuka forest with rewarewa, kowhai, mahoe and rimu covers the mid slopes between Lake Kawaupaka and Lake Waitatu.

7V33 Coastal kanuka scrub on unconsolidated sand. 34 ha. Private. This is an area of patchy kanuka scrub, with cabbage tree, mapou, and mangeao scattered through it, situated to the north of the lakes. The area has many large open patches filled with exotic plants including pampas and pine trees.

7V36 Lowland kanuka scrub on rugged hillcountry. 22 ha. Private. Kanuka scrub with manuka and occasionally akepiro. Both the mid and ground tiers contain a diverse array of species.

7V57 Coastal puriri composite forest on rugged hillcountry. 7ha. Private. Forest with a canopy of puriri, karaka, nikau, kowhai, rewarewa, ponga and cabbage tree occurs on the eastern slopes of L. Kawaupaka.

7V100 Coastal pohutukawa forest on unconsolidated sand. 19 ha. Private. Pohutukawa forest with karaka, nikau, kowhai, whau and rewarewa extends in a band from the tip of L. Kawaupaka towards the coast. The trees here are very large however the presence of kanuka indicates some modification.

7V104 Coastal pohutukawa forest on rugged hillcountry. 6 ha. Private. This patch of pohutukawa forest covers the northern slopes of L. Kawaupaka. Karaka, puriri, kanuka, tawapou, rewarewa, kowhai and nikau are present in the canopy.

7V106 Lowland pohutukawa forest on rugged hillcountry. 3 ha. Private. Pohutukawa forest fills the Happy Valley gully which is surrounded by a large area of teatree scrub to the south of the lakes. The canopy is dominated by pohutukawa and puriri with karaka, nikau and occasional tawapou and kowhai. Kanuka covers the upper slopes of the gully.

7V121 Lowland raupo reedland on dune impounded lake. 3ha. Private and scenic reserve. Raupo dominated vegetation with *Eleocharis*, *Cyperus* and *Carex* species, occurs at the tip of the southern-most arm of L. Kawaupaka and around the shallows of L. Wainamu.

7V126 Lowland cabbage tree forest on dune impounded lake (edge). 1ha. Private. Cabbage tree with nikau, puriri and manuka lies between the raupo in L. Kawaupaka and the forest on the slopes above the lake. Within the lower tiers of this forest is a sequence

from sedge and fern dominated vegetation at the lake edge to shrub species further towards the hillslopes.

Other Vegetation: Puriri-totara-rewarewa forest, puriri-karaka-tawa forest, kanuka forest, kauri-kanuka forest, kauri-puriri forest and manuka scrub.

WILDLIFE:

7W8	Lake Wainamu	Moderate-High
7W9	Lake Kawaupaka	High

7W8 Lake Wainamu is a deep dune lake with 95% open water and a good diversity of freshwater wetland bird species. The threatened Australasian bittern and regionally threatened North Island fernbird have been reported on the lake margins. Black shag, little black shag, and various waterfowl species use the lake regularly. Banded kokopu, an endemic freshwater fish, has also been reported from Lake Wainamu.

7W9 Lake Kawaupaka is also a deep dune lake with 95% open water used by various waterfowl. A colony of little shags is found on the lake margin and spotless crane have been reported from raupo margins.

Other wildlife sites: The shrubland areas on the margin of Lake Wainamu and on the northern boundary of the RAP represent good habitat for lizard species including Auckland green gecko and the forest gecko.

VISUAL LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
7L15	Low	No planting, no vehicles
7V22	Low	Monitor weeds, pests
7V26	Low	Monitor weeds, pests
7V33	Low	Weed control
7V36	Low	Monitor weeds
7V57	Low	Pest control
7V100	Low	Urgent pest control, weed control
7V104	Low	Urgent pest control, weed control
7V106	Low	Urgent pest control, weed control
7V121	High	Control recreational impact
7V126	Low	Limit public access
7W8	Low	Maintain habitat quality
7W9	Low	Maintain habitat quality

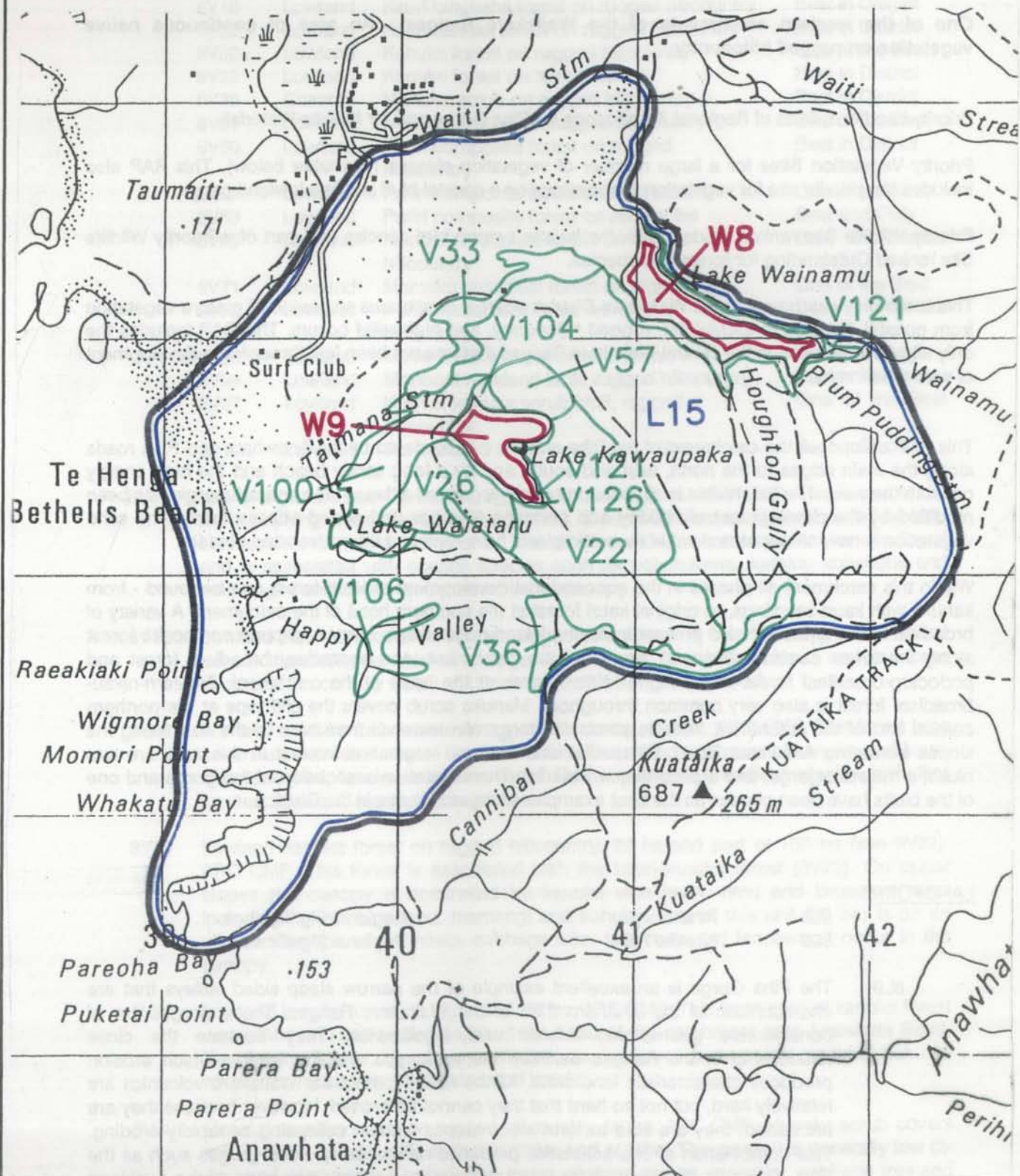
TENURE:

Private
Scenic Reserve administered by QEII Trust

EXISTING PROTECTION:

Scenic reserve protects Lake Wainamu, its surrounding hillslopes, and the unvegetated dunes to the north of the lake.

RECOMMENDED AREA FOR PROTECTION # 7: TE HENGA DUNES AND LAKES



GRID REFERENCE

NZMS 260 Q11 405775

AREA OF RAP

540ha

SCALE:

0 5 1 km

WAITAKERE RAP #8: PIHA CATCHMENT

One of the western catchments of the Waitakere Ranges. An area of continuous native vegetation on rugged hillcountry.

Priority Landform Sites of Regional Significance for Piha Gorge and for Kitekite Waterfall.

Priority Vegetation Sites for a large number of vegetation classes (see table below). This RAP also includes the priority site for vegetation associations on a coastal bluff and in a lowland gorge.

Priority Wildlife Site ranked Moderate for freshwater swamp bird species and part of a Priority Wildlife Site ranked Outstanding for forest bird species.

This is the only catchment in the Waitakere District where a continuous sequence of mature vegetation from coastal, through to alluvial flat, rugged hillcountry, and high relief occurs. This RAP includes the only alluvial vegetation in the central Waitakere Ranges that has not been lost through the development of water reservoirs.

This RAP comprises the catchment of the Piha stream. It is bordered by the Anawhata and Piha roads along the main ridges to the north, east and south, and by a long sandy beach and the high energy coast to the west. The catchment is almost completely vegetated although the coastal margin has been modified by the development of holiday and permanent homes and sealed access roads. The sand vegetation is now of low natural value as exotic plants have replaced the native sand-binders.

Within this catchment all phases in the successional development of kauri forest can be found - from kanuka with kauri seedlings, to original kauri forest at the southern head of the catchment. A variety of broadleaf forest types are also present including inland pohutukawa forest and puriri composite forest along the lower coastal influenced slopes of the catchment, and secondary broadleaf forest and podocarp-broadleaf forest in the higher altitude area at the head of the catchment. Treefern-nikau-broadleaf forest is also very common throughout. Manuka scrub covers the cliff tops at the northern coastal end of the catchment. Teatree scrub and forest also extends from here to the east along the slopes bordering Anawhata Road. Of special landform and vegetation interest in this area are two bluffs, a majestic gorge, and a picturesque waterfall. The vegetation association of the gorge and one of the bluffs have been chosen as the best examples of these features in the District.

LANDFORM:

8L9	Piha Gorge	Regional Significance
8L8	Kitekite Falls	Regional Significance
8L9	The Piha Gorge is an excellent example of the narrow steep sided valleys that are characteristic of the southern third of the Waitakere Ranges. These gorges are of considerable geomorphic interest and significance. They illustrate the close relationship in the Ranges between the rock type and the way in which erosion produces characteristic landforms. All the rock types of the Waitakere volcanics are relatively hard, but not so hard that they cannot be eroded. However because they are unbedded, they are able to form steep slopes without collapsing or rapidly eroding. This combination of characteristics produces narrow steep-sided gorges such as the Piha, Pararaha and Huia. Such features are not found in other parts of the Auckland Region, and are therefore of regional significance.	
8L8	Waterfalls are a feature of the catchments of the river valleys of the Waitakere Ranges, and are of regional significance. The Kitekite Falls are among the better examples. See RAP #3 for the detailed description of this priority landform site.	

VEGETATION:

8V1	Lowland	Mature kauri forest on rugged hillcountry	Best in District
8V18	Lowland	Kauri-tanekaha forest on rugged hillcountry	Best in District
8V22	Lowland	Kauri-kanuka forest on rugged hillcountry	Best in District
8V30	Lowland	Kanuka forest on rugged hillcountry	One of the Best
8V32	Lowland	Kanuka forest on high relief	Best in District
8V38	Coastal	Manuka scrub on rugged hillcountry	Best in District
8V51	Lowland	Mamangi forest on rugged hillcountry	One of the Best
8V60	Lowland	Puriri composite forest on rugged hillcountry	Best in District
8V62	Lowland	Puriri composite forest on high relief	One of the Best
8V63	Lowland	Puriri composite forest on alluvial flat	Best and Only
8V69	Lowland	Mamaku broadleaf forest on rugged hillcountry	Best in District
8V71	Lowland	Mamaku broadleaf forest on high relief	One of the Best
8V73	Lowland	Ponga broadleaf forest on rugged hillcountry	Best in District
8V80	Lowland	Maire tawake forest on alluvial flat	Best and Only
8V94	Lowland	Monocot rockland bluff, rugged hillcountry	Best in District
8V97	Lowland	Kowhai-kanuka scrub bluff, rugged hillcountry	One of the Best
8V106	Lowland	Pohutukawa forest on rugged hillcountry	Best in District
8V1	Lowland mature kauri forest on rugged hillcountry. 3 ha. ARC CMP. This is one of the few remaining areas of original kauri forest. It survived because it was located on land inaccessible to milling operations. It is situated within secondary kauri-kanuka forest and is associated with coastal species such as pohutukawa, karaka, kohekohe and mamangi. Tanekaha is also present in the canopy.		
8V18	Lowland kauri-tanekaha forest on rugged hillcountry. 4 ha. ARC CMP. This forest covers the sheltered side of a ridge in the lower Piha Valley. Kauri and tanekaha dominate the canopy which also includes kanuka and lancewood.		
8V22	Lowland kauri-kanuka forest on rugged hillcountry. 150 ha. ARC CMP. This forest type covers an extensive area of the Piha Valley. The canopy consists of kanuka and kauri, with rewarewa, tanekaha and mamangi. On lower slopes broadleaf species, including kowhai, tawa and lacebark, are present.		
8V30	Lowland kanuka forest on rugged hillcountry. 20 ha and part of 150 ha (see 8V22). ARC CMP. This forest is associated with the kauri-kanuka forest (8V22). On upper slopes the canopy is dominated by kanuka with kauri, rimu and broadleaf trees including heketara, mapou, mamangi and kohuhu. Part of this unit (20 ha) is on an alluvial toeslope where nikau, cabbage tree, rewarewa and lancewood occur in the canopy.		
8V32	Lowland kanuka forest on high relief. 50 ha. ARC CMP. This large area of kanuka forest covers the mid and upper slopes at the head of the catchment near Anawhata Road. Kanuka dominates the canopy with mapou, lancewood, mamaku, manuka, kohuhu, rewarewa, hinau, rimu, kahikatea and kauri.		
8V38	Coastal manuka scrub on rugged hillcountry. 80 ha. ARC CMP. Manuka scrub covers much of the coastal cliffs at the northern end of Piha. The canopy is generally low (3-4m) and windswept. Kowhai, flax, ngaio, akepiro, ponga, mamaku, cabbage tree and native toetoe (<i>Cortaderia</i> sp.) are also present in the canopy.		
8V51	Lowland mamangi forest on rugged hillcountry. 33 ha. ARC CMP. This forest covers the Maungaroa ridge in the lower Piha valley. It is associated with kauri forest.		

Mamangi, kauri, kanuka and scattered rewarewa, tanekaha and rimu are the main canopy species here.

- 8V60 Lowland puriri composite forest on rugged hillcountry. 22 ha. ARC CMP. This forest covers the hillslopes above the Wekatahi Stream in the centre of the catchment. It is part of a coastal to inland vegetation sequence. The canopy species include puriri, pohutukawa, nikau, karaka, rewarewa, ponga and hinau. Away from the coast the pohutukawa trees are replaced by northern rata trees often with a transitional patch of pohutukawa-rata hybrid.
- 8V62 Lowland puriri composite forest on high relief. 3 ha. ARC CMP. This forest covers the lower slopes of a hillside in the upper part of the catchment. The canopy species include puriri, pukatea, karaka, nikau, mahoe, ponga, rewarewa, rata and tawa.
- 8V63 Lowland puriri composite forest on alluvial flat. 2.5 ha. ARC CMP. This small patch of forest surrounds a maire tawake and kahikatea swamp on the alluvial flat at the confluence of the Glen Esk and Piha Streams. Puriri and nikau are the dominant canopy species. Kanuka, pohutukawa-rata hybrid, rata, karaka, maire-tawake, cabbage tree, kahikatea, kowhai and mamaku are also present.
- 8V69 Lowland mamaku broadleaf forest on rugged hillcountry. 120 ha. ARC CMP. A large portion of the head of the Piha catchment consists of mixed treefern-broadleaf forest. Here mahoe, ponga, puriri, mamaku, lacebark, hangehange, rewarewa, mapou and nikau form much of the canopy layer of the vegetation covering the gullies and side slopes.
- 8V71 Lowland mamaku broadleaf forest on high relief. 40 ha. ARC CMP. This forest is continuous with the forest in 8V69 where it makes a transition from lowland to upland vegetation. Again the species composition is variable and diverse. The recurring canopy species are similar in both sites although heketara and lancewood become more abundant in the higher elevation and upland forest species such as toru and wheki appear.
- 8V73 Lowland ponga broadleaf forest on rugged hillcountry. 30 ha. ARC CMP. The northern slopes of the Wekatahi Stream are covered by a forest dominated by ponga with nikau, rata, mamaku, rewarewa, scattered puriri, tawa, mamangi and occasional podocarps. This forest is part of a coast to upland sequence of mixed broadleaf forest.
- 8V80 Lowland maire tawake forest on alluvial flat. 0.5 ha. ARC CMP. This swamp vegetation is surrounded by and contiguous with the puriri composite forest (8V63). This site exhibits a small vegetation sequence. Kiekie vineland fills the centre of the swamp with a dense patch of maire-tawake forming a narrow band around the kiekie. Kahikatea and pukatea merge with the maire at the forest edge of the swamp and become more abundant as this forest merges with the surrounding puriri forest.
- 8V94 Lowland monocot rockland on a bluff face in rugged hillcountry. 1.5 ha. ARC CMP. This rockland is situated on the lee side of the Wekatahi bluff in the lower northern half of the catchment. The Wekatahi bluff has one of the best coastal bluff vegetation associations in the rugged hill country of the District. Coastal astelia (*Astelia banksii*) dominates the vegetation here. Rengarenga rock lily, *Macherina sinclairii*, kowhai, akeake and puka are also present.
- 8V97 Lowland kowhai-kanuka scrub on bluff face in rugged hillcountry. 0.5 ha. ARC CMP. This scrub covers the less steep parts of the rock face on the lee side of the Wekatahi bluff. The species present here include kowhai, kanuka, pohutukawa, karaka, flax, puka, coastal astelia and rengarenga rock lily.

- 8V106 Lowland pohutukawa forest on rugged hillcountry. 3 ha. ARC CMP. Inland pohutukawa forest is now an uncommon forest type in the Waitakere Ecological District due to extensive fires in the past. This site, which covers the hillslopes of the lower Marawhara valley, is dominated by pohutukawa with puriri, karaka, kowhai, nikau, and occasional kanuka, cabbage tree and mahoe.

Other Vegetation: Mature kauri and podocarp-broadleaf forest on high relief. Young kauri forest on rugged hillcountry. Pohutukawa forest on exposed rocky coast. Bluff vegetation in the Piha Gorge and on several bluff faces.

WILDLIFE:

8W15	Waitakere Ranges	Outstanding
8W21	Piha Stream Swamp	Moderate

- 8W15 The Piha Valley forms part of the large Waitakere Ranges PWS. Wildlife species identified within the RAP include the pied tit which has a limited distribution in the Auckland Ecological Region. Blue penguin nest along the coast and a pair of the threatened New Zealand falcon have recently been reported in the Piha area. Common native and introduced forest bird species are also well represented. The forest habitat is continuous with that of RAP's #13 and #21 which increases the value to wide ranging wildlife species in all three RAP's.

- 8W21 The Piha Stream Swamp is a raupo swamp habitat for secretive bird species including spotless crane and the regionally threatened North Island fernbird. Half of the swamp margin is continuous with forest habitat, increasing its value to these bird species. There are relatively few areas of this habitat type remaining in the Ecological District.

VISUAL LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
8L8	High	Leave unmodified
8L9	High	Leave unmodified
8V1	High	Control recreational impact
8V18	High	Control recreational impact
8V22	High	Control recreational impact
8V30	High	Control recreational impact
8V32	High	Monitor weeds
8V38	High	Monitor weeds
8V51	High	Monitor weeds
8V60	High	Control pests
8V62	High	Monitor pest numbers
8V63	High	Control recreational impact
		Urgent pest control
8V69	High	Weed control

8V71	High	Pest control
8V73	High	Pest control
8V80	High	Control recreational impact
		Urgent pest control
8V94	High	Control recreation impact
		Limit further development
8V97	High	As for 8V94
8V106	High	Urgent pest control
8W15	High	Maintain habitat quality
8W21	High	Maintain habitat quality

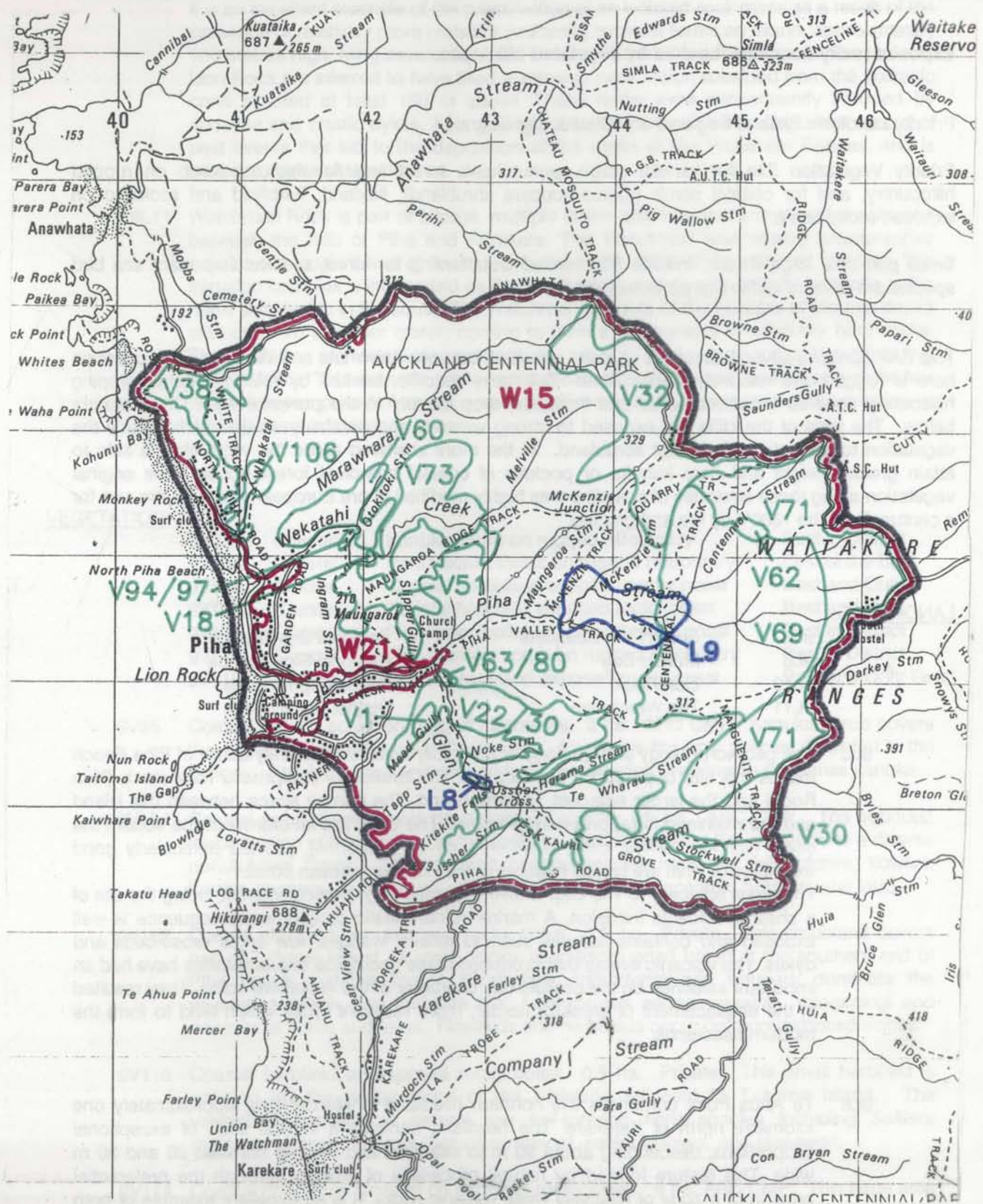
TENURE:

ARC CMP
Private

EXISTING PROTECTION:

Most of the RAP is ARC CMP

RECOMMENDED AREA FOR PROTECTION # 8: PIHA CATCHMENT



GRID REFERENCE

NZMS 260 Q11 430720

AREA OF RAP

1935ha

SCALE:

0 1 2 3 km

WAITAKERE RAP #9: ANAWHATA TO KAREKARE ROCKY COASTLINE

Exposed rocky coastline, backed by vegetated hillslopes.

Priority Landform Sites of Regional and District Significance.

Priority Vegetation Site for kanuka scrub, pohutukawa forest and flax-manuka scrub on rugged hillcountry, and for coastal scrub (toetoe-houpara shrubland), flaxland, herbfield and rockland on exposed rocky coast.

Small part of a large Priority Wildlife Site ranked Outstanding for forest species. Important sea bird species are present within this portion of the PWS.

This RAP contains several stretches of rocky coastline between Anawhata and Whatipu. The coastline here is rugged and relatively inaccessible. Tall rocky seacliffs, backed by relatively gently sloping hillcountry covered in teatree scrub and flaxlands, drop steeply to the powerful West Coast waters below. The tops of the cliffs are exposed to strong westerly and southerly winds which reduce the vegetation to a stunted windswept scrubland. In the more sheltered areas the vegetation is able to attain greater height and here kanuka or pockets of coastal broadleaf forest occur. The original vegetation along these stretches of coastline was highly modified in pre European times by fire and for a century from the 1860's by fire and grazing.

LANDFORMS:

9L3	South Piha Coastline	Regional Significance
9L6	Mercer Bay	Regional Significance
9L10	Lion Rock	District Significance
9L11	The Watchman	District Significance

- 9L3 The geomorphology and geology of the rocky coast immediately south of Piha Beach makes this site of particular significance. The landforms comprise a rock stack (Nun Rock) and the larger adjacent Taitomo Island. The narrow space between this island and the mainland is (appropriately) termed The Gap. The landforms of the south Piha coast (stacks, islands, cliffs, blowholes, caves, platforms), provide particularly good examples of what are typical features of the Waitakere ocean coast.

The coast adjacent to The Gap is also of particular geological interest, being the site of a shallow volcanic intrusion. A marine volcanoclastic conglomerate sequence is well exposed and contains features such as lenses, wedges, low angle cross-beds and dykes. The volcanic events that produced these geological characteristics have had an important influence on the present day character of the Waitakere coast. They resulted in the emplacement of areas of harder, more resistant rocks which tend to form the modern headlands.

- 9L6 Te Ahua Point comprises the northern headland of Mercer Bay, approximately one kilometre north of Karekare. The headland contains a vertical shaft of exceptional proportions, descending about 90 m to sea level and varying between 20 and 30 m wide. This feature formed by natural processes of erosion, through the preferential erosion of a zone of relatively weak volcanic rocks. It is an excellent example of both the erosive power of the sea and the relationship between the volcanic history of the Waitakere Ranges and the development of closely related landforms. It is of regional significance there being no similar features in the Auckland Region.

- 9L10 Lion Rock is a feature of particular geological and geomorphic interest. As a landform it is an excellent example of the preservation of an isolated rock mass as a result of the presence of relatively more resistant (volcanic) rocks. It forms an island, approximately 100 metres high, lying several hundred metres offshore from Piha Beach. The rocks of Lion Rock are inferred to have filled a volcanic neck which subsided from the volcanic cone situated at least 150 m above. These rocks were subsequently intruded by andesite and clastic dykes. As a geological feature it provides an important record of past events that led to the deposition of the rocks of the Waitakere Ranges, and is hence of regional significance.
- 9L11 Watchman Rock is part of a large, multiple crater and intrusion complex that outcrops between the hills of Piha and Karekare. The Watchman and nearby promontories consist of a single dome of dacite within the rubbly mass of the volcanic complex. The intrusion complex is interpreted as the product of several vents, mostly andesitic in the north and dacitic in the south. The Watchman consists of the remains of viscous dacite extruded into a former crater, cooling to form a promontory of relatively hard rocks. These rocks are relatively resistant to erosion and have formed outstanding promontories. This example, while not atypical of the Waitakere coast, is one of the few headlands comprised of dacite, and of significance in the explanation of the creation of the Waitakere landscape.

VEGETATION:

9V35	Coastal	Kanuka scrub on rugged hillcountry	Best in District
9V104	Coastal	Pohutukawa forest on rugged hillcountry	One of the Best
9V108	Coastal	Coastal shrubland exposed rocky coast	Best and Only
9V110	Coastal	Coastal herbfield exposed rocky coast	Best and Only
9V114	Coastal	<i>Phormium</i> flaxland exposed rocky coast	Best in District
9V116	Coastal	Flax-manuka scrub on rugged hillcountry	Best in District
9V118	Coastal	Sea-cliff rockland exposed rocky coast	Best and Only Two*
- 9V35 Coastal kanuka scrub on rugged hillcountry. 3 ha. ARC CMP. Kanuka scrub covers the slopes on the cliff above Cowan Bay. Kanuka is the only species recorded in the canopy. Shrubs, ponga and ground ferns are growing underneath the dense kanuka.
- 9V104 Coastal pohutukawa forest on rugged hillcountry. 5 ha. ARC CMP. The subdued lower section of the hillslope at the southern end of Karekare Beach supports a diverse pohutukawa forest. The common canopy species here are pohutukawa, kowhai, karaka, tawapou, ngaio, puriri with occasional kanuka, lacebark, houpara and karo.
- 9V108 Coastal shrubland on exposed rocky coast. 2.5 ha. Private. This shrubland covers part of Taitomo Island - a small, rocky, sand-impounded island at the southern end of Piha beach. Native toetoe (*Cortaderia splendens*) and houpara dominate the vegetation which also includes flax, *Leptocarpus* sedge, cassinia, mingimingi and occasional herbs and ferns. Flaxfields and herbfields occur on more exposed slopes.
- 9V110 Coastal herbfield on exposed rocky coast. 0.5 ha. Private. This small herbfield is growing on the gentle slope of the mainland adjacent to Taitomo Island. The vegetation consists of several low turf-forming herb species including *Selliera radicans*, shore pimpernel (*Samolus repens*), native iceplant, and glasswort.
- 9V114 Coastal *Phormium* flaxland on exposed rocky coast. 6 ha. ARC CMP. This large area of flax dominated vegetation covers the lower slopes of the cliffs at Whites Beach. Hangehange, kawakawa, *Astelia banksii*, pohutukawa, *Cortaderia splendens*, karo, cabbage tree, ground ferns and houpara are also present in this site.

- 9V116 Coastal flax-manuka scrub on rugged hillcountry. 25 ha. ARC CMP. Windswept manuka scrub with flax covers the hillslopes between Karekare Beach and Mercer Bay to the north. Mixed with the dense flax and manuka are mahoe, *Coprosma macrocarpa*, houpara, and occasional mamaku, cabbage tree and pohutukawa.
- 9V118 Coastal sea-cliff rockland on exposed rocky coast. 20 ha. ARC CMP. Two sites of coastal rockland were surveyed, one at Anawhata Beach, the second at the southern end of Karekare Beach. The steeper rock faces are sparsely vegetated with small herbs growing in crevices or hugging the rock face, as can be seen at the Karekare site. The vegetation is often unilayered and includes small herbs such as *Lobelia anceps*, iceplant, NZ spinach, a hardy fern (*Asplenium northlandicum*), pohutukawa seedlings, and small tufty grasses such as *Deyeuxia billardierei*. Taller plants such as flax, cutty grass and small coastal shrubs, cover the more subdued rock faces at Anawhata.

Other Vegetation: Pohutukawa forest and pohutukawa treeland on exposed rocky coast; coastal kanuka forest, kanuka scrub, and manuka scrub on rugged hillcountry.

WILDLIFE:

9W15 Waitakere Ranges Outstanding

The exposed rocky coastline and cliff tops of the West Coast of the Waitakere Ranges represent part of the large Waitakere Ranges Priority Wildlife Site. Important wildlife species identified within the RAP include grey-faced petrel with nesting burrows on the cliff-tops south of Piha and above Union Bay at Karekare. Blue penguin also nest along the coastline within the RAP. There is also a colony of white-fronted terns on Paratahi Island just south of Karekare.

VISUAL LANDSCAPE:

Extremely sensitive and valuable (Brown, 1984)

CONSERVATION SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
9L3	Low	Leave unmodified
9L6	High	Protect stabilising vegetation
9L10	High	Control recreational impact
9L11	High	Control recreational impact
9V35	High	Monitor weeds, pests
9V104	High	Pest and weed control
9V108	Low	Control weeds
9V110	Low	Urgent weed control
9V114	High	Control weeds
9V116	High	Control weeds

9V118
9W15

High
High

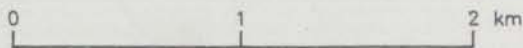
Monitor weeds
Maintain habitat quality

TENURE:

ARC CMP
Private

EXISTING PROTECTION:

ARC CMP



WAITAKERE RAP # 10: WHATIPU SANDS AND CLIFFS

Extensive area of vegetated sand flats, containing freshwater and saline wetlands, impounding a stretch of cliffs.

Priority Landform Site of National Significance for unconsolidated coastal dune and beach sands, for coastal freshwater and saline wetlands, and for landforms of the rocky coast.

Priority Vegetation Sites for pohutukawa and puriri forests on exposed rocky coast, raupo swamp on freshwater wetland, *Leptocarpus* sedgeland, pingao sandfield, spinifex sandfield, mixed herbfield and *Phormium* flaxland on unconsolidated sand, and for *Schoenoplectus* sedgeland on coastal freshwater wetland. Important vegetation sequences: excellent example of seral succession on dunes (pingao on mobile dunes, weeds on fixed dunes, herbfields and ephemeral wetlands on low-lying sand flats, flaxlands on sand hills at cliff base, pohutukawa and puriri on cliff face).

Priority Wildlife Sites ranked High, Moderate-High and Moderate for coastal and freshwater bird species.

This RAP is a remote wilderness area comprising an extensive sand plain. Native sand binders colonise the mobile foredunes with low-lying basins behind supporting native herbfields. Further landward is a series of dunes stabilised by exotic grasses and shrubs, with patches of native shrubland (manuka, cabbage tree, flax, kawakawa). Ephemeral wetlands are common on the low sand plain behind the fixed dunes. Backing this is a stretch of tall sand impounded cliffs with flaxlands at their base. These dunes have a well documented history of rapid progradation and recession with a net increment of 567 ha of sand since 1940 (Esler, 1974). The progressive increase in area of the sand dunes has been followed by a seral succession of vegetation communities which is reflected in the present distribution of plant associations.

LANDFORM:

	10L4	Whatipu Sands	National Significance
10L4	The coast between Paratutae⁹ and Cowan Point is of exceptional geomorphic and geological significance. It contains a unique association of landforms that distinguish it from other parts of the New Zealand coast, and is of national significance. The rocky coast is separated from the sea by a broad sand plain deposited largely in historic times. Such deposition is exceptional, most sandy coasts around New Zealand have tended to erode. The former (rocky) coast contains excellent examples of those features, including the Whatipu caves, that are the quintessence of the exposed West Coast. The rock platforms on Paratutae Island are exceptional examples of high tide platforms, and are of international importance. The landforms of this coast are closely related to the volcanic history of the western margin of the Waitakere Ranges. Volcanic rocks of the Pararaha, Taranaki Bay and Whatipu cliffs comprise remnants of a line of volcanic intrusions and complexes that extend from O'Neill Beach to Paratutae Island. The cliff sections at Whatipu and Paratutae are exceptional for the presence of dyke swarms.		

9. Traditional spelling is Paratutai.

The sand plain that extends a maximum of about two kilometres from the old sea cliff contains a sparse cover of vegetation.

VEGETATION:

10V55	Coastal	Puriri composite forest on exposed rocky coast	Best and Only
10V102	Coastal	Pohutukawa forest on exposed rocky coast	Best in District
10V109	Coastal	Coastal herbfield on unconsolidated sand	Best and Only*
10V111	Coastal	Pingao sandfield on unconsolidated sand	Best and Only*
10V112	Coastal	Spinifex sandfield on unconsolidated sand	Best and Only*
10V113	Coastal	<i>Phormium</i> flaxland on unconsolidated sand	Best in District
10V119	Coastal	Raupo reedland in freshwater wetland	Best and Only Two
10V128	Coastal	<i>Leptocarpus</i> sedgeland saline wetland, on unconsolidated sand	Best and Only
10V129	Coastal	<i>Schoenoplectus</i> sedgeland, freshwater wetland, on unconsolidated sand	Best and Only
10V55	Coastal puriri composite forest on exposed rocky coast. 6 ha. ARC CMP. This site occurs as pockets of puriri-dominated forest within the pohutukawa site (10V102). Other canopy species include nikau, karaka, pohutukawa and cabbage trees.		
10V102	Coastal pohutukawa forest on exposed rocky coast. 30 ha. ARC CMP. Pohutukawa trees cover the rocky faces and sandy bases of the cliffs along most of the length of Whatipu Beach. Ngaio, cabbage tree, nikau, puriri, kowhai, karaka and whau are scattered throughout the pohutukawa dominated canopy.		
10V109	Coastal herbfield on unconsolidated sand. 40 ha. Uninvestigated land. ¹⁰ Herbfields dominated by arrow grass, water milfoil, <i>Lilaeopsis novae-zelandiae</i> and <i>Limosella lineata</i> , occur on the unstable low-lying sand plains between the mobile sand dunes and the ephemeral wetlands (and tend to intergrade with both). Other species present in the herbfields include <i>Carex pumila</i> , <i>Isolepis cernua</i> , <i>Deyeuxia billardierei</i> , <i>Lobelia anceps</i> and <i>Selliera radicans</i> .		
10V111	Coastal pingao sandfield on unconsolidated sand. 84 ha. Uninvestigated land. Pingao covers the unstable mobile dunes along the seaward side of the vegetated parts of the Whatipu sands. In the last 20 years pingao has expanded from a small patch near Cutter Rock (Cameron, 1989) and now extends along the length of the beach as far as Pararaha Stream.		
10V112	Coastal spinifex sandfield on unconsolidated sand. 68 ha. Uninvestigated land. Spinifex tends to colonise the dunes immediately behind the pingao dominated stretches. Spinifex is more abundant than pingao in the northern section of the beach.		
10V113	Coastal <i>Phormium</i> flaxland on unconsolidated sand. 1 ha. Uninvestigated land. Flax dominated vegetation occurs as scattered clumps at the base of the cliffs		

10.

As the Whatipu Sands are a recent sand accretion, it is uninvestigated land which has not been legally surveyed and therefore is land without title.

along the length of the Whatipu sands. Sedges (*Baumea juncea* and *Isolepis nodosa*) and occasional cabbage trees, shrubs and pohutukawa are associated with these flaxlands.

- 10V119 Coastal raupo reedland in freshwater wetland. 3.5 ha. Uninvestigated land. Two patches of raupo-dominated wetland are separated by the Pararaha Stream and a strip of cabbage tree, manuka and flax. Sedges, especially *Baumea articulata* and *Eleocharis sphacelata*, form monotypic patches between the raupo. This association also occurs within the small permanent ponds scattered through a large region of ephemeral wetlands on the Whatipu Dunes.
- 10V128 Coastal *Leptocarpus* sedgeland in saline wetland on unconsolidated sand. 4 ha. Uninvestigated land. This sedgeland is virtually completely dominated by *Leptocarpus similis* on the flat sand where the Pararaha Stream crosses the dunes. Other species present include *Juncus maritimus*, *Cortaderia splendens* and coastal herbs. The substrate here is muddy and this site is probably influenced by springtides.
- 10V129 Coastal *Schoenoplectus* sedgeland in freshwater wetland on unconsolidated sand. 6 ha. Uninvestigated land. *Schoenoplectus validus* covers the shallows and littoral edges of the lake below Ohaka Head (probably the only permanent lake on the dunes). Small amounts of the spike rush *Eleocharis acuta* occur within the *Schoenoplectus* dominated vegetation.

Other Vegetation: Exotic vegetation dominated by kikuyu, boxthorn, pampas, marram, fireweed and various exotic grass species extends from the south-eastern end of the beach to the Pararaha Point.

WILDLIFE:

10W22	Pararaha Valley	Moderate
10W23	Ohaka Head Lake	Moderate-High
10W24	Taranaki Bay Swamp	Moderate
10W25	Whatipu Sands	High
- 10W22 In the mouth of the Pararaha Valley is a relatively large area (12 ha) of freshwater swamp. It comprises an area of raupo, rushes and sedges in the Pararaha Stream bed and an associated flax area on the margin adjoining a side arm dominated by giant spike rush. The threatened Australasian bittern, the regionally threatened North Island fernbird, and pukeko have been recorded in this swamp. The raupo area is a suitable spotless crane habitat while little black shag feed in the small area of open water in the side arm.
- 10W23 The lake below Ohaka Head is a permanent shallow dune lake, the size of which varies seasonally with winter flooding. Australasian bittern and North Island fernbird occur in the large areas of rushes and sedges around the lake margin. Black shag, Caspian tern and various species of waterfowl feed in the open water of the lake.
- 10W24 The Taranaki Bay wetland is a small area of permanent water with raupo, flax and rushes associated with cabbage tree and dense manuka at the foot of forest clad coastal cliffs. North Island fernbird and pukeko are present, with spotless crane also likely.
- 10W25 The Whatipu dunes consist of a large area of unvegetated foredunes leading into spinifex and pingao covered dunes and extensive vegetated backdunes up to the

coastal cliffs. Large low-lying areas are seasonal wetlands which attract swamp birds including the Australasian bittern, North Island fernbird and pukeko. The dunes support a high diversity of coastal birds including waders such as the threatened New Zealand dotterel and rare variable oystercatcher, both of which nest in the Pararaha Stream delta. Banded dotterel, Caspian tern and white-fronted tern also use the dune area for feeding and roosting. This diverse habitat also includes a wide variety of common native and introduced shrubland and forest margin bird species.

VISUAL
LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEED
10L4	Low	Protect stabilising vegetation
10V55	High	Pest control
10V102	High	Pest control
10V109	Low	Control recreational impact
10V111	Low	Monitor weeds, pests
10V112	Low	Weed control
10V113	Low	Monitor for weeds
10V119	Low	Monitor weeds, pests
10V128	Low	Control recreational impact
10V129	Low	Weed control
10W22	Low	Maintain restrictions on dogs
10W23	Low	Maintain restrictions on dogs
10W24	Low	Maintain restrictions on dogs
10W25	Low	Maintain restrictions on dogs

TENURE:

Uninvestigated land¹¹.
ARC CMP

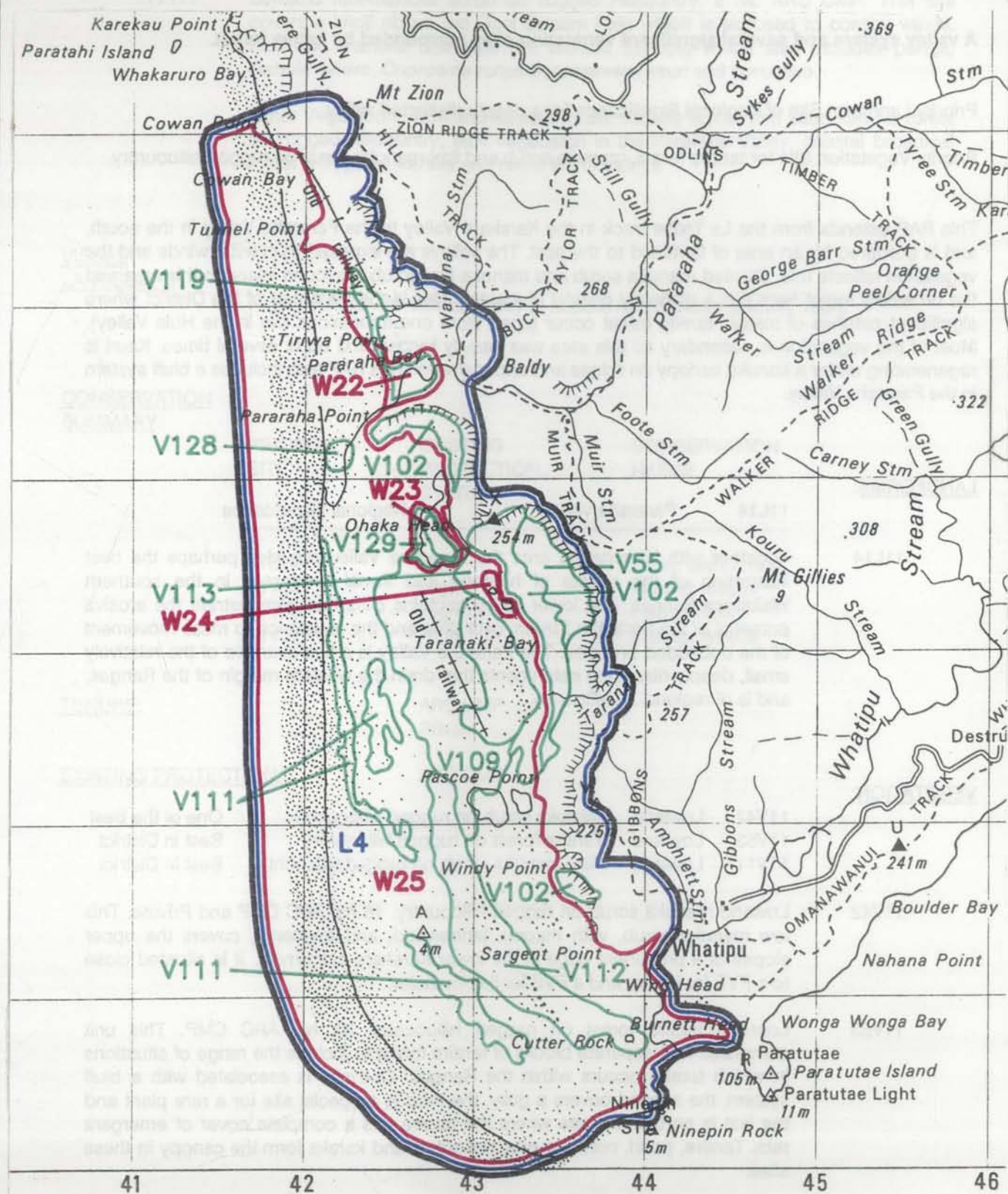
EXISTING PROTECTION:

ARC CMP - cliffs

11.

As the Whatipu Sands are a recent sand accretion, it is uninvestigated land which has not been legally surveyed and therefore is land without title.

RECOMMENDED AREA FOR PROTECTION # 10: WHATIPU SANDS AND CLIFFS



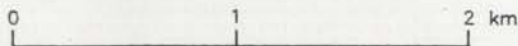
GRID REFERENCE

NZMS 260 Q11 430620

AREA OF RAP

777ha

SCALE:



WAITAKERE RAP # 11: PARARAH AND KAREKARE VALLEYS

A valley system and several significant vegetation sites surrounded by native forest.

Priority Landform Site of Regional Significance for a deeply dissected valley.

Priority Vegetation Site for taraire forest, manuka scrub and flax-manuka scrub on rugged hillcountry.

This RAP extends from the La Trobe track in the Karekare Valley to the Pararaha Valley in the south, and is bordered by an area of farmland to the east. The valleys are exposed to coastal winds and the vegetation reflects this. Stunted manuka scrub and manuka-flax scrub are found inland in this area and the broadleaf forest here has a distinctly coastal character. This is the main part of the District where significant patches of mature taraire forest occur (apart from one anomalous site in the Huia Valley). Most of the vegetation is secondary as this area was heavily logged and burnt several times. Kauri is regenerating under a kanuka canopy on ridges and upper slopes. This RAP also includes a bluff system in the Pararaha Valley.

LANDFORMS:

	11L14	Pararaha Valley	Regional Significance
11L14	Together with Karamatura area the Pararaha Valley provides perhaps the best illustration of the effects of hillslope and fluvial processes in the southern Waitakere Ranges. The lower valley contains cliffs that demonstrate the erosive potential of the Pararaha Stream over time and the resistance to mass movement of the unbedded breccias. The Pararaha Valley is a fine example of the relatively small, deeply dissected catchments that drain the western margin of the Ranges, and is of regional significance.		

VEGETATION:

	11V42	Lowland	Manuka scrub on rugged hillcountry	One of the Best
	11V53	Lowland	Taraire forest on rugged hillcountry	Best in District
	11V117	Lowland	Flax-manuka scrub on rugged hillcountry	Best in District
11V42	Lowland manuka scrub on rugged hillcountry. 16 ha. ARC CMP and Private. This low manuka scrub, with mapou, lancewood, and mamangi, covers the upper slopes of a prominent ridge in the lower Karekare catchment. It is situated close to a PVS for taraire and a PVS for flax-manuka.			
11V53	Lowland taraire forest on rugged hillcountry. 33 ha. ARC CMP. This unit comprises four separate blocks of taraire forest to include the range of situations in which taraire occurs within the Ranges. One site is associated with a bluff system, the second covers a gully, the third is a special site for a rare plant and the last is an unusual site where the taraire has a complete cover of emergent rata. Taraire, puriri, northern rata, rewarewa and karaka form the canopy in these sites.			

11V117 Lowland flax-manuka scrub on rugged hillcountry. 2 ha. ARC CMP. This site covers a knoll above the Opal Stream Falls which is exposed to coastal winds. Flax and manuka dominate the stunted canopy, which also includes ponga, *Gahnia lacera*, *Coprosma robusta*, rewarewa, kauri and koromiko.

Other Vegetation: Lowland kanuka forest, kanuka scrub, and kauri-kanuka forest on rugged hillcountry, bluff vegetation in the Pararaha Valley, coastal broadleaf forest with puriri, karaka and nikau in the valleys.

VISUAL
LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
11L14	High	Leave unmodified
11V42	High	Monitor weeds
11V53	High	Pest control
11V117	High	Monitor weeds

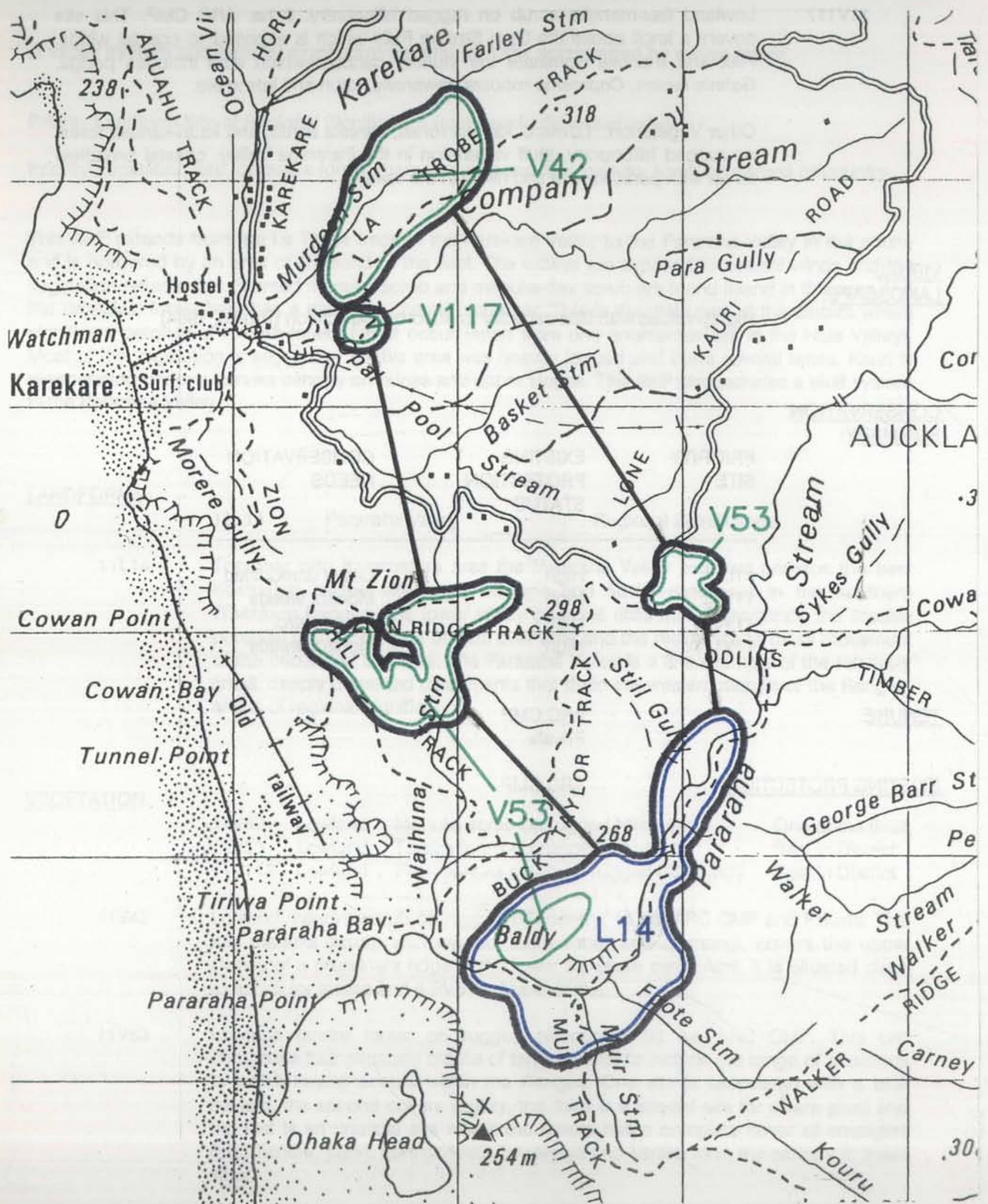
TENURE:

ARC CMP
Private

EXISTING PROTECTION:

ARC CMP

RECOMMENDED AREA FOR PROTECTION # 11: PARARAH AND KAREKARE VALLEYS



GRID REFERENCE

NZMS 260 Q11 435660

AREA OF RAP

75ha

SCALE:



WAITAKERE RAP # 12: OMANAWANUI FOREST

The vegetated rocky cliffs of the northern Manukau Harbour Entrance.

Priority Vegetation Site for young kauri forest, kauri-kanuka forest, kanuka forest, manuka scrub, mamangi forest, pohutukawa forest, puriri composite forest and kowhai-kanuka forest, all on rocky harbour entrance.

Small part of a Priority Wildlife Site ranked Outstanding for forest bird species.

This RAP consists of steep vegetated hillslopes that rise approximately 200 metres above the northern Manukau Harbour. The hillslopes extend along the length of the Manukau Harbour Entrance from Paratutae¹² Island to Little Huia. This coastline differs from the West Coast in that it is exposed to strong lateral currents rather than the high energy onshore waves which have created the distinctive gulls and caves found on the rocky West Coast shoreline. Salt spray would be less here as rough waves are not as frequent as they are on the West Coast.

The vegetation consists of secondary teatree and kauri forest types along the main ridge and on spurs, merging with mamangi and puriri composite forest on the slopes. These forest classes intergrade and are difficult to map at the 1:50,000 scale. The coastal edge is fringed with pohutukawa forest.

VEGETATION:

12V10	Coastal	Young kauri forest, rocky harbour entrance	Best and Only*
12V19	Coastal	Kauri-kanuka forest, rocky harbour entrance	Best and Only*
12V25	Coastal	Kanuka forest, rocky harbour entrance	Best in District
12V37	Coastal	Manuka scrub, rocky harbour entrance	Best in District
12V49	Coastal	Mamangi forest, rocky harbour entrance	Best in District
12V56	Coastal	Puriri composite forest, rocky harbour entrance	Best in District
12V96	Coastal	Kowhai-kanuka scrub, rocky harbour entrance	Best and Only
12V103	Coastal	Pohutukawa forest, rocky harbour entrance	Best and Only
12V10	Coastal young kauri forest on rocky harbour entrance. 19 ha. ARC CMP. This vegetation consists of small pockets on upper slopes and ridges of these hillslopes. Mamangi, kanuka, tanekaha, lancewood and rewarewa are associated with the kauri dominated canopy.		
12V19	Coastal kauri-kanuka forest on rocky harbour entrance. 12 ha. ARC CMP. A strip of kauri-kanuka forest lies parallel to Whatipu Road which runs along the ridge top. Kanuka and kauri are the dominant species in the canopy which also includes rimu, tanekaha, rewarewa, lancewood and mamangi.		
12V25	Coastal kanuka forest on rocky harbour entrance. 30 ha. ARC CMP. Kanuka forest with puriri, nikau, rata and pohutukawa grades into the puriri forest on the lower slopes of these hills.		

12. Traditional spelling is Paratutai.

- 12V37 Coastal manuka scrub on rocky harbour entrance. 14 ha. ARC CMP. Manuka scrub with ponga, nikau, cabbage tree, rewarewa and karamu covers the tops of some of the spurs near Destruction Gully.
- 12V49 Coastal mamangi forest on rocky harbour entrance. 5 ha. ARC CMP. Mamangi forest covers the steep midslopes of this area along most of its length. Mamangi, nikau and ponga dominate the canopy layer with occasional lancewood, mahoe, pigeonwood, heketara, rewarewa and tawa.
- 12V56 Coastal puriri composite forest on rocky harbour entrance. 13 ha. ARC CMP. Patches of puriri forest occur on the steep hillslopes south of the Omanawanui walking track. Puriri, karaka, tawa, rata, nikau, kohekohe and ponga are common canopy species in these sites. Surrounding the patches of puriri forest are areas of disturbed forest indicated by the presence of kanuka, lancewood and mamangi.
- 12V96 Coastal kowhai-kanuka scrub on rocky harbour entrance. 12 ha. ARC CMP. The steep cliff face below the trig point on the Omanawanui Track supports kowhai-kanuka scrub with korokio, akepiro and lancewood over a well developed understorey in which regeneration of kowhai is occurring. The kowhai variant here is *Sophora microphylla* var *microphylla* which is more common than the usual bluff associate (*S. microphylla* var *fulvida*) along the southern slopes of the Ranges.
- 12V103 Coastal pohutukawa forest on rocky harbour entrance. 44 ha. ARC CMP. Two long strips of pohutukawa forest hug the cliffs along the northern Harbour Entrance. The dominant canopy trees are pohutukawa, karaka, nikau, puriri, kowhai, tawapou, houpara, mamangi and rewarewa.

WILDLIFE:

- 12W15 Waitakere Ranges Outstanding
- 12W15 The habitats within this RAP are a small part of the large Waitakere Ranges Priority Wildlife Site (PWS 15). The range of forest habitats present contain common forest bird species such as NZ pigeon, tui, kingfisher, fantail, grey warbler and silvereye. The regionally threatened Hochstetter's frog has been found in the neighbouring catchments and may also occur in this RAP.

VISUAL
LANDSCAPE:

Extremely sensitive and valuable (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
12V10	High	Monitor weeds, pests
12V19	High	Monitor weeds, pests

12V25	High	Pest control
12V37	High	Monitor weeds, pests
12V49	High	Pest control and monitoring
12V56	High	Pest control
12V96	High	Monitor weeds, pests
12V103	High	Pest control
12W15	High	Maintain habitat quality

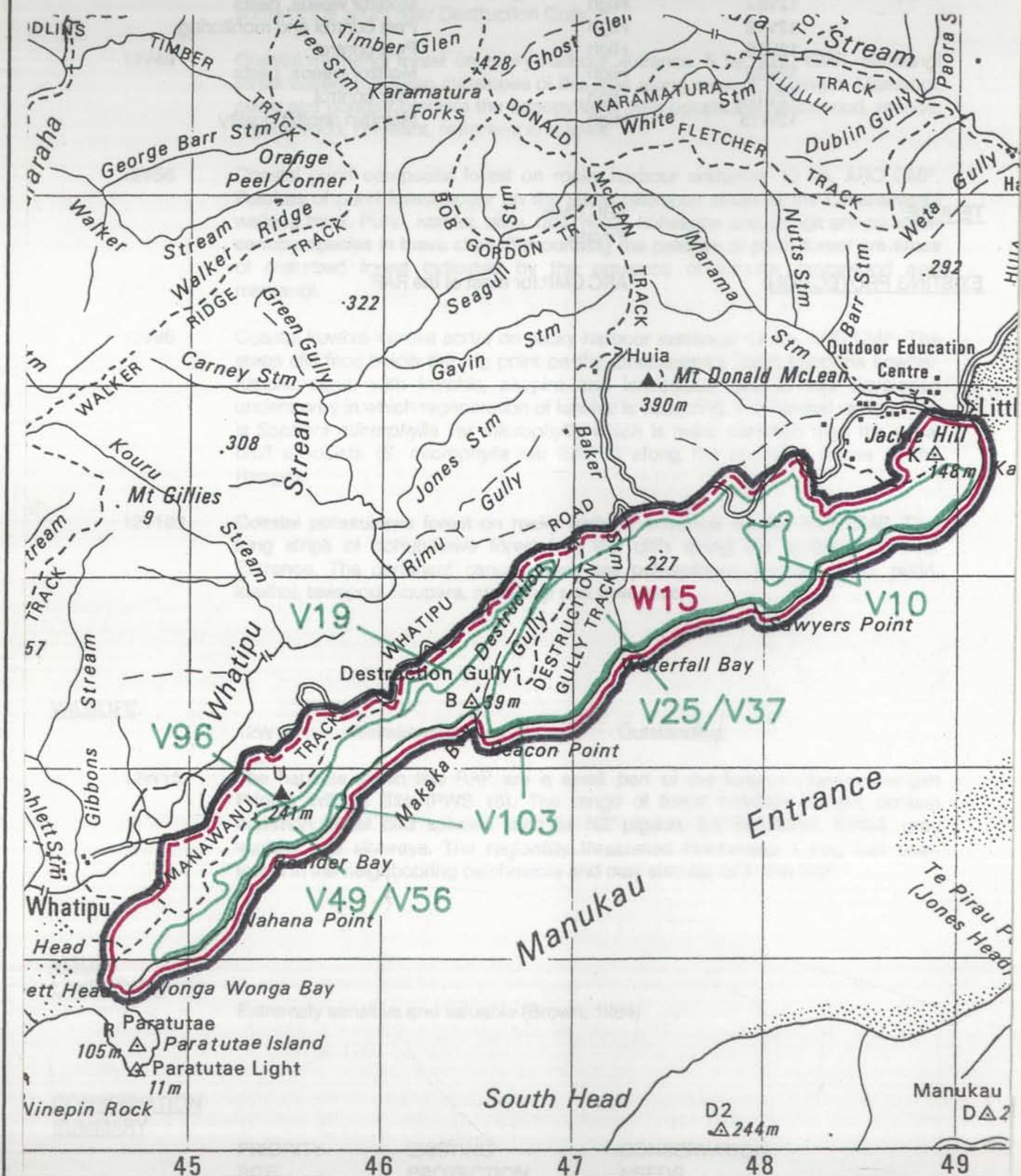
TENURE:

ARC CMP
Private

EXISTING PROTECTION:

ARC CMP for most of the RAP

RECOMMENDED AREA FOR PROTECTION # 12: OMANAWANUI FOREST



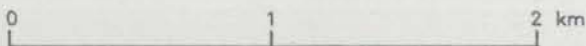
GRID REFERENCE

NZMS 260 Q11 470630

AREA OF RAP

242ha

SCALE:



WAITAKERE RAP # 13: SOUTHERN WAITAKERE RANGES

Several large, vegetated catchments.

Priority Landform Sites of Regional Significance for the Nihotupu Gorge, the Nihotupu Falls and for an example of dissected hill country.

Priority Vegetation Site for a large number of vegetation classes (see table below). Also the best bluff vegetation association on high relief.

Priority Wildlife Site ranked Outstanding for forest bird, frog and snail species.

This RAP is comprised of several catchments, the focus being on the Huia Catchment, a large watershed which drains through two water supply reservoirs to the Manukau Harbour. From the Huia watershed the RAP extends eastwards across a main ridge into the adjacent Nihotupu Catchment in order to include the Nihotupu Gorge, a priority landform site with several priority vegetation sites. The vegetation of this extension is continuous with the podocarp-broadleaf forest in the Huia Catchment. Both catchments are used for bulk water supply and are not accessible to the public. To the west the RAP includes the Karamatura Catchment and follows the Walker Ridge Track down towards the Whatipu Stream mouth to include an important wildlife habitat and also Mt Donald McLean.

The upper reaches of the Huia catchment are rugged and comparatively inaccessible, and although this area was selectively logged for kauri, most of the vegetation is relatively unmodified. Knolls and ridges support small pockets of mature kauri forest whilst the narrow spurs and ridges are covered with rimu, miro, Hall's totara and broadleaf forest. Rata, rimu and kahikatea, emergent over rewarewa, lancewood, heketara, pigeonwood, ponga, lacebark, mahoe and nikau, cover the side slopes. In the narrow gullies rewarewa and rata overhang dense tangles of supplejack, parataniwha and kiekie. In the higher elevations an association of upland species becomes evident within the podocarp-broadleaf forest. Towards the mouth of the catchment coastally influenced vegetation replaces the podocarp-broadleaf forest. Mamangi covers the slopes on the western side of the lower reservoir whilst young teatree forest and scrub prevails on the eastern side. The wide, triangular Nihotupu Gorge is situated within a high altitude plateau covered with cut-over podocarp-broadleaf forest. The sides of the gorge are steep and rocky in parts and support kowhai dominated scrub and shrubland with areas of monocot rockland. The vegetation in the Whatipu catchment has been heavily modified and is now reverting to forest through manuka scrub.

LANDFORM:

13L2	Nihotupu Gorge	Regional Significance
13L8	Nihotupu Falls	Regional Significance
13L13	Karamatura Catchment	Regional Significance
13L2	The Nihotupu Gorge, immediately below the Nihotupu Dam, contains exposures of geological strata of significance in the interpretation of the regional geology of Auckland. The site consists of a sequence of interfingering volcanic rocks and conglomerate forming a lateral facies boundary between the Waitemata basin sedimentary rocks and the Waitakere volcanics.	
13L8	Waterfalls are a feature of the catchments of the river valleys of the Waitakere Ranges, and are of regional significance. These falls are some of the better examples. For a detailed description of this priority landform of significance refer to RAP #3.	

- 13L13 This area contains the Karamatura and Marama Stream catchments, including Mt Donald McLean. It contains a range of landforms that are both characteristic and extraordinary examples of their type. These include bluffs, waterfalls, gorges and steep hillslopes. Mt Donald McLean is the only example of an exfoliated dome in the Ranges. This area is of regional significance.

VEGETATION:

13V3	Lowland	Mature kauri forest on high relief	Two of the Best
13V7	Lowland	Kauri-rimu forest on high relief	Best in District
13V8	Lowland	Kauri-tawari forest on high relief	Best and Only
13V9	Lowland	Kauri-hard beech forest on rugged hillcountry	Best and Only
13V13	Lowland	Young kauri forest on rugged hillcountry	Best in District
13V24	Lowland	Kauri-kanuka forest on high relief	Best in District
13V32	Lowland	Kanuka forest on high relief	One of the Best
13V42	Lowland	Manuka scrub on rugged hillcountry	Best in District
13V44	Lowland	Manuka scrub on high relief	Best in District
13V46	Lowland	Manuka forest on rugged hillcountry	Best in District
13V48	Lowland	Manuka forest on high relief	Best in District
13V51	Lowland	Mamangi forest on rugged hillcountry	Best in District
13V52	Lowland	Mamangi forest on high relief	Best in District
13V54	Lowland	Taraire forest on high relief	Best and Only
13V67	Lowland	Tawa forest on high relief	Best in District
13V71	Lowland	Mamaku broadleaf forest on high relief	Best in District
13V79	Lowland	Maire tawake forest on high relief	One of the Best
13V84	Lowland	Kahikatea forest on high relief	Best in District
13V88	Lowland	Podocarp broadleaf forest on high relief	Best in District
13V89	Lowland	Upland forest on high relief	One of the Best
13V93	Lowland	Secondary podocarp forest on high relief	Best in District
13V99	Lowland	Kowhai-kanuka scrub on high relief	Best in District
- 13V3 Lowland mature kauri forest on high relief. 28 and 10 ha. ARC WSC. Two sites of kauri forest in this catchment have been chosen as priority vegetation sites. The larger site is bisected by metal roads but remains in a healthy condition. The smaller site is in a remote area in rugged country. Tall, mature kauri trees dominate the canopy in these sites. Rimu, Hall's totara, miro and rata are also present.
- 13V7 Lowland kauri-rimu forest on high relief. 5 ha (minimum). ARC WSC. Small pockets of forest, with kauri and rimu as co-dominants in the canopy, occur on many ridges and spurs throughout the catchment.
- 13V8 Lowland kauri-tawari forest on high relief. 1 ha. ARC WSC. This vegetation class is less common in the Auckland ecological region, than in Northland. Tawari, young kauri, rimu and tawheowheo are the dominant canopy species in this site. The understorey of this site is similar to that of kauri forest elsewhere in the District.
- 13V9 Lowland kauri-hard beech forest on rugged hillcountry. 0.5 ha. ARC CMP. This small site is an anomaly in the Waitakere Ecological District as hard beech has only been found in two locations. Here it is located next to the Whatipu Stream and comprised of hard beech, kauri and rewarewa emergent over kanuka and tawa. Saplings and seedlings of beech and kauri were noted.
- 13V13 Lowland young kauri forest on rugged hillcountry. 30 ha. ARC CMP. Young kauri forest occurs as small (1-4 ha) pockets on ridges, knolls and spurs throughout much of the peripheral areas of the Ranges. In this site (30 ha) kauri pockets are

abundant within a larger area of teatree forest and scrub. The general area therefore, has been chosen as an example of the distribution of kauri rickers. In the site sampled, kauri dominates the canopy. Rewarewa, tanekaha and toru are present in small amounts.

- 13V24 Lowland kauri-kanuka forest on high relief. 4 ha. ARC WSC. Kanuka with emergent kauri trees, and occasional rimu and tanekaha, form the canopy in this site. It covers a spur adjacent to the priority site for mature kauri beside the Crusher Pipeline Track.
- 13V32 Lowland kanuka forest on high relief. 30 ha. ARC WSC. This large area of kanuka dominated vegetation covers a hillslope near the head of the Karamatura Stream. Manuka, rewarewa and toru were also noted in the canopy.
- 13V42 Lowland manuka scrub on rugged hillcountry. 60 ha. ARC WSC. Manuka scrub covers the exposed ridges and slopes of the eastern side of the lower Huia Reservoir. Rewarewa, lancewood and kanuka are also present in the dense canopy which shades a diverse midtier. Pockets of kanuka and kauri-tanekaha forest occur with the manuka scrub.
- 13V44 Lowland manuka scrub on high relief. 24 ha. ARC CMP. This provides a good example of the manuka scrub that covers many of the exposed ridges in the Whatipu catchment. The canopy consists of dense 6 m high manuka, with lancewood, heketara, mamangi, toatoa, mapou and Hall's totara.
- 13V46 Lowland manuka forest on rugged hillcountry. 106 ha. ARC CMP. Whilst manuka scrub covers the exposed ridge tops in the Whatipu catchment, manuka forest is common on the more sheltered upper slopes. Emergent trees of kauri, tanekaha, rewarewa and totara can be seen above the dense canopy of manuka trees in this site. Lancewood, mamangi and kanuka are also present in the canopy.
- 13V48 Lowland manuka forest on high relief. 85 ha. ARC CMP. This forest is continuous with the priority site for manuka forest on rugged hillcountry. The species association is similar although at the higher altitude tanekaha probably becomes less abundant.
- 13V51 Lowland mamangi forest on rugged hillcountry. 69 ha. ARC WSC. The western side of the lower Huia Reservoir is covered with mamangi forest. Kanuka, rewarewa, ponga, rimu and kauri are associated with the mamangi canopy on the mid to upper slopes.
- 13V52 Lowland mamangi forest on high relief. 4 ha. ARC WSC. This small piece of mamangi forest is one of only three that were identified in the high relief. Mamangi forms most of the canopy, which also includes kauri, rata and rimu emergents, with ponga and broadleaf shrubs at canopy height.
- 13V54 Lowland taraire forest on high relief. 5 ha. ARC WSC. This patch of taraire forest is an anomaly as it is isolated from the main concentration of taraire forest (in the Pararaha area) by a prominent ridge and a large area of both original and secondary forest. Taraire forms 40% of the canopy, the remainder consisting of tawa, rewarewa, pigeonwood, white maire, rimu, nikau and ponga. Miro, kahikatea, treeferns and broadleaf trees are minor components of the canopy.
- 13V67 Lowland tawa forest on high relief. 103 ha. ARC WSC. Two general areas of tawa forest were identified as priority sites, one site covers the north-eastern slopes of the lower Huia Dam, the second is located in a basin south of the Nihotupu Gorge. Tawa, nikau, mamaku, mahoe and lacebark are the most common

species on the steep slopes which this forest type covers. Parataniwha and kiekie are very abundant on the ground.

- 13V71 Lowland mamaku broadleaf forest on high relief. 120 ha. ARC WSC. Two contiguous areas of forest form this site. They are located on the slopes surrounding the road between the two Huia dams. Nikau, mamaku, ponga, mahoe, lacebark, rewarewa, pigeonwood and heketara are common components of the diverse forest in this area.
- 13V79 Lowland maire tawake forest on high relief. 1 ha. ARC WSC. In this small patch of forest, maire tawake, wheki, *Cyathea smithii*, heketara, pigeonwood, mamaku, lancewood, and hinau form the canopy. The ground here is very boggy and devoid of vegetation.
- 13V84 Lowland kahikatea forest on high relief. 6 ha. ARC WSC. This is one of the larger areas of kahikatea forest on boggy ground in the District. Pukatea, nikau, rewarewa and other broadleaf species are associated with the tall kahikatea which dominate this site. Kiekie and parataniwha are very dense on the ground.
- 13V88 Lowland podocarp broadleaf forest on high relief. 507 ha. ARC WSC and ARC CMP. This area of podocarp broadleaf forest covers a large area of the upper Huia catchment. Rimu, miro, kahikatea and Hall's totara are the most common podocarps in this forest. They emerge, along with rata, high over a broken broadleaf-treefern canopy of predominantly rewarewa, mamaku, ponga, heketara, nikau, lancewood, pigeonwood, kiekie and mahoe. This forest covers a range of landforms, from gully sites to ridge tops. With change in landform, subtle differences in vegetation are discernable, particularly in the lower tiers.
- 13V89 Lowland, upland forest on high relief. 300 ha. ARC WSC. This forest type is distinguished by a characteristic association of species which are generally found above 300 m altitude in the Ranges. Tawheowheo, tawari, toro, maire rauriki, wheki and *Cyathea smithii* seldom occur below this altitude but are common in high altitude plateaus. Rimu, miro, kahikatea, Hall's totara, heketara, lancewood, hinau, rewarewa and tawa are also common canopy species here.
- 13V93 Lowland secondary podocarp forest on high relief. 7 ha. ARC WSC. This is an area of young kahikatea forest on a hillside terrace. The kahikatea in the canopy is co-dominant with ponga, mamangi, rewarewa, lancewood and nikau. Nikau and ponga dominate the midtier in this site.
- 13V99 Lowland kowhai-kanuka scrub on high relief ha. 5 ha. ARC WSC. This is a common vegetation type on steep rocky faces, where the percentage of bare rock exceeds that of vegetation cover. Here kowhai dominates the upper layer of the vegetation. Tarata, lacebark, mahoe, wharangi, manuka, puka, and kohuhu were also noted.

Other Vegetation: Young kauri forest on high relief. Lowland kanuka forest on rugged hillcountry.

WILDLIFE:

13W15	Waitakere Ranges	Outstanding
- 13W15 The extensive area within this RAP forms part of the larger Waitakere Ranges PWS. Many of the wildlife values which led to the outstanding ranking of the PWS are also found in this RAP. In particular the regionally threatened Hochstetter's frog occurs in the streams of several catchments. The threatened kauri snail

Paryphanta busbyi survives in several areas and pied tit, a bird with a limited distribution in the Auckland Ecological Region, occurs in many areas within the RAP. Kaka, a threatened species, pass through the RAP, although none are known to be resident in the District. This RAP is also an important site for NZ pigeon because it contains the largest area of relatively unmodified podocarp-broadleaf forest in the District. Common forest bird species are present throughout this RAP. The forest habitat is continuous with that of RAPs 8 and 21 which increases the value of the habitat to wide ranging wildlife species in all three RAPs.

VISUAL
LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

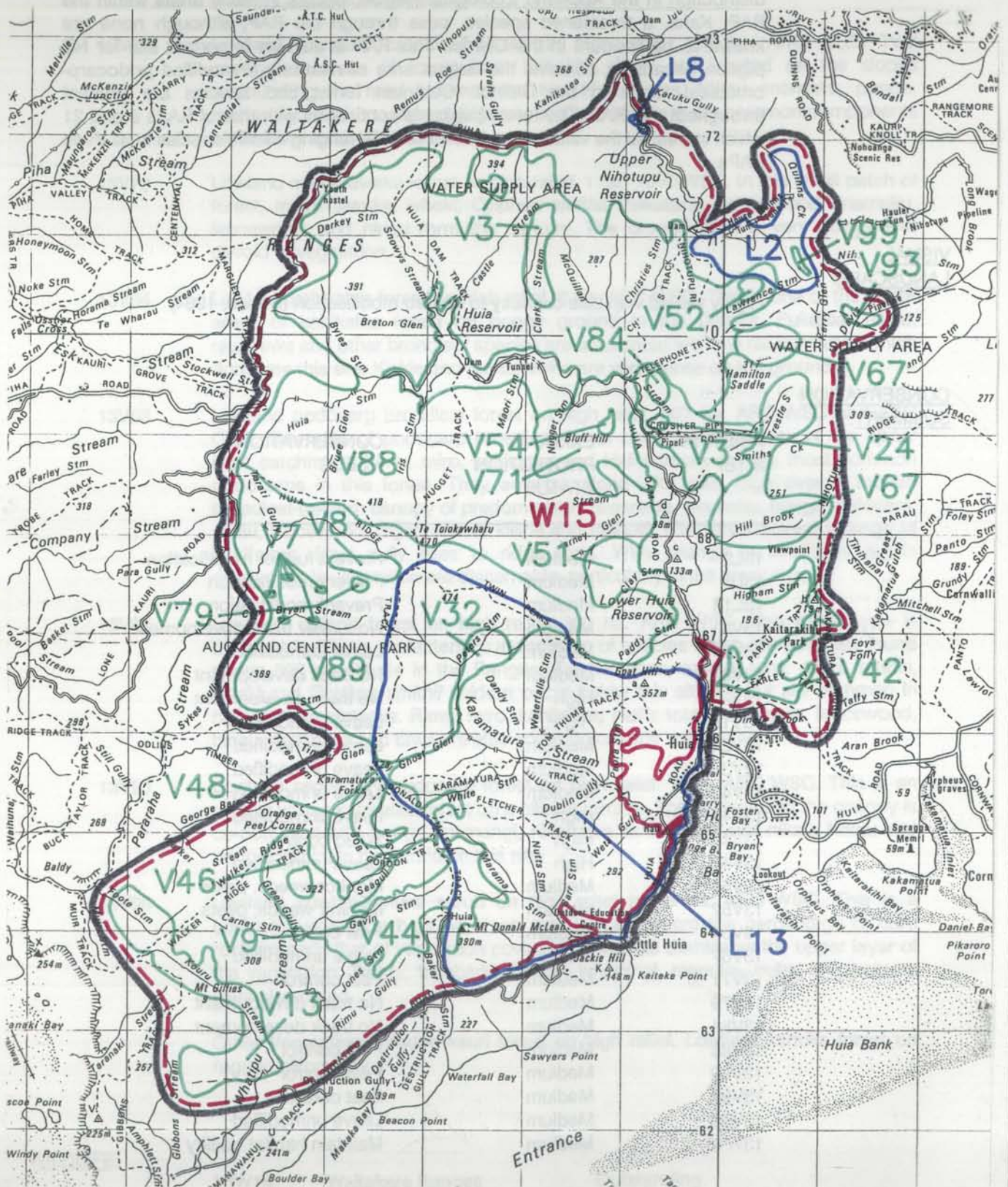
PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
13L2	Medium	Prevent further modification
13L8	Medium	Prevent modification
13L13	Medium	Prevent modification
13V3	Medium	No further track development
13V7	Medium	Leave unmodified
13V8	Medium	No track development
13V9	High	No track development
13V13	High	Leave unmodified
13V24	Medium	Leave unmodified
13V32	Medium	Leave unmodified
13V42	Medium	Leave unmodified
13V44	High	Leave unmodified
13V46	High	Weed control
13V48	High	Leave unmodified
13V51	Medium	Monitor weeds, pests
13V52	Medium	Monitor weeds, pests
13V54	Medium	Pest control
13V67	Medium	Leave unmodified
13V71	Medium	Pest control
13V79	Medium	No track development
13V84	Medium	No track development
13V88	Medium	Pest control
13V89	Medium	Pest control
13V93	Medium	Pest control
13V99	Medium	Leave unmodified
13W15	Medium	Maintain habitat quality

TENURE:

ARC WSC
ARC CMP

The western part of the RAP is in ARC CMP

RECOMMENDED AREA FOR PROTECTION # 13: SOUTHERN WAITAKERE RANGERS



GRID REFERENCE

NZMS 260 Q11 480690

AREA OF RAP

4017ha

SCALE:

0 1 2 3 km

WAITAKERE RAP # 14: KAITARAKIHI GUMLANDS**Scrub covered subdued hillslopes adjoining the northern shores of the Manukau Harbour.**

Priority Vegetation Sites for pohutukawa forest and manuka scrub on subdued hillslopes of the southern foothills.

This RAP comprises a stretch of subdued coastline hillslopes between a large bay and a prominent peninsula along the northern shores of the Manukau Harbour. A remnant of pohutukawa forest covers the coastal cliffs at the western end of the RAP. The rest of the area is recovering from repeated fires which resulted in complete clearance. The soil is impoverished here and the secondary vegetation is similar to the gumland scrub found in North Auckland. Typical gumland species found here include neinei, toro, akepiro, mingimingi, club mosses, umbrella ferns, sundews and ground orchids.

VEGETATION:

14V39	Coastal	Manuka scrub on southern foothills	Best in District
14V105	Coastal	Pohutukawa forest on southern foothills	Best in District
14V39	Coastal manuka scrub on southern foothills. 16 ha. ARC Parkland. Gumland manuka scrub, with kanuka, kauri, tanekaha, mamangi, rewarewa, treeferns and broadleaf shrubs, occurs throughout the area. This is the only area in the District where a gumland association occurs.		
14V105	Coastal pohutukawa forest on cliffs on the southern foothills. 5 ha. ARC CMP. Pohutukawa trees with kowhai and karaka cover the coastal cliff face at Kaitarakihi Point.		
	Other Vegetation: Kowhai forest with manuka, mapou, tanekaha and pohutukawa on the cliffs at the eastern point of the RAP. Kanuka forest with puriri, kowhai, ngaio and mahoe in gullies, and kanuka forest with kauri and tanekaha on the ridges of the hillslopes.		

**VISUAL
LANDSCAPE:**

Highly valued with little capacity to absorb modification (Brown 1984)

**CONSERVATION
SUMMARY:**

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
14V39	High	Vegetation management
14V105	High	Pest control

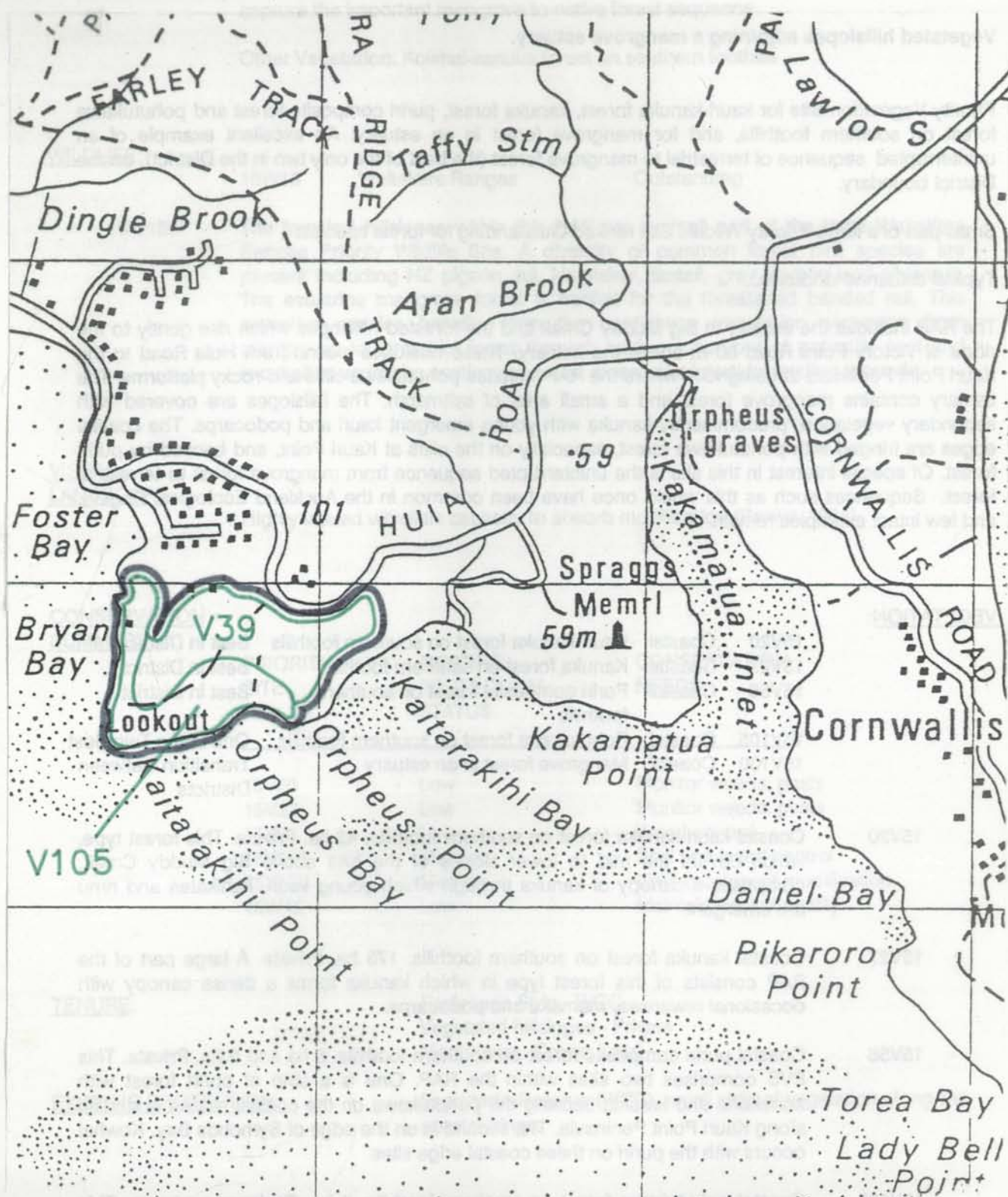
TENURE:

ARC Parkland and CMP
Private
WCC Esplanade Reserve

EXISTING PROTECTION:

ARC Parkland and CMP for most of the RAP.

RECOMMENDED AREA FOR PROTECTION # 14: KAITARAKIHI GUMLANDS



GRID REFERENCE

NZMS 260 R11 515650

AREA OF RAP

32ha

SCALE:

0 .5 1 km

WAITAKERE RAP # 15: BIG MUDDY CREEK FOREST

Vegetated hillslopes adjoining a mangrove estuary.

Priority Vegetation Site for kauri-kanuka forest, kanuka forest, puriri composite forest and pohutukawa forest on southern foothills, and for mangrove forest in an estuary. An excellent example of an uninterrupted sequence of terrestrial to mangrove forest (the best of the only two in the District), on the District boundary.

Small part of a large Priority Wildlife Site ranked Outstanding for forest species.

Typical estuarine landform.

The RAP includes the estuary in Big Muddy Creek and the forested hillslopes which rise gently to the ridge of Victory Point Road 80 m above the estuary. These hillslopes extend from Huia Road to the Kauri Point Peninsula at Laingholm where the RAP includes pohutukawa cliffs and rocky platforms. The estuary contains mangrove forest and a small area of saltmarsh. The hillslopes are covered with secondary vegetation, predominantly kanuka with young emergent kauri and podocarps. The coastal edges are fringed with pohutukawa forest, especially on the cliffs at Kauri Point, and backed by puriri forest. Of special interest in this site is the uninterrupted sequence from mangrove forest to terrestrial forest. Sequences such as this would once have been common in the Auckland Ecological Region, and few intact examples remain.

VEGETATION:

15V20	Coastal	Kauri-kanuka forest on southern foothills	Best in District
15V27	Coastal	Kanuka forest on southern foothills	Best in District
15V58	Coastal	Puriri composite forest on southern foothills	Best in District
15V105	Coastal	Pohutukawa forest on southern foothills	One of the Two Best
15V130	Coastal	Mangrove forest in an estuary	Transition between Districts
15V20	Coastal kauri-kanuka forest on southern foothills. 42 ha. Private. This forest type, which covers the mid to lower slopes of the hills above Big Muddy Creek, comprises a canopy of kanuka through which young kauri, kahikatea and rimu are emergent.		
15V27	Coastal kanuka forest on southern foothills. 175 ha. Private. A large part of the RAP consists of this forest type in which kanuka forms a dense canopy with occasional rewarewa, mamaku and podocarps.		
15V58	Coastal puriri composite forest on southern foothills. 6 ha and 5 ha. Private. This PVS comprises two sites within the RAP. One is a strip of puriri forest with kohekohe and karaka, backing the pohutukawa on the coastal slopes and cliffs along Kauri Point Peninsula. The second is on the edge of Symonds Bay. Kowhai occurs with the puriri on these coastal edge sites.		
15V105	Coastal pohutukawa forest on southern foothills. 5 ha. Esplanade reserve. This strip of pohutukawa forest hugs the coastal fringe of the south-western end of the Kauri Point Peninsula. The canopy is comprised of pohutukawa and kowhai with occasional karaka and puriri. Ferns are very abundant here.		
15V130	Coastal mangrove forest in an estuary. 43 ha. Crown. This is an extensive area of mangrove forest which covers the upper estuary as far as Armour Point. It is a		

monotypic community with the mangroves reaching 3 m in height. This site is within the Manukau Ecological District but has been included within this RAP to capture the important mangrove to native forest sequence.

Other Vegetation: Kowhai-kanuka forest on southern foothills

WILDLIFE:

15W15 Waitakere Ranges Outstanding

15W15: The forested hillslopes within this RAP are a small part of the large Waitakere Ranges Priority Wildlife Site. A diversity of common forest bird species are present including NZ pigeon, tui, kingfisher, fantail, grey warbler and silvereye. The estuarine mangrove forest is habitat for the threatened banded rail. This secretive species benefits from the continuous vegetation sequence from mangroves to terrestrial forest through having a number of potential nest and roost sites under the continuous cover, close to its intertidal feeding grounds.

VISUAL
LANDSCAPE:

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

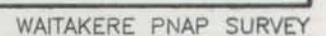
PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
15V20	Low	Monitor weeds, pests
15V27	Low	Monitor weeds, pests
15V62	Low	Weed control
15V106	Medium	Pest and weed control
15V130	Medium	Limit catchment modification
15W15	Low	Maintain habitat quality

TENURE:

Esplanade Strip - WCC
Vegetated hillslopes - Private
Mangroves - Crown Land

EXISTING PROTECTION:

Esplanade Reserve (WCC), small strip of vegetation along the coastal fringe.



WAITAKERE RAP # 16: TITIRANGI FOREST REMNANTS

Gully vegetation in a forested area with low density residential housing.

Priority Vegetation Site for puriri composite forest and kauri-kanuka forest on eastern foothills.

A small part of a Priority Wildlife Site ranked Outstanding for forest bird species.

This RAP consists of two blocks of vegetation in the Titirangi area. The vegetation in this area is threatened by urban development, possum damage, and heavy weed infestation. It is important, therefore, that examples of forest that occur on the edges of the Ranges are conserved and protected from these threats. The indigenous forest cover is still a dominant feature of the landscape in this area with roads and residences breaking its continuity. Most of the blocks of vegetation are in gullies with houses and roads on the ridges. The forest around Titirangi differs slightly from that of most of the Ranges because of the absence of podocarp-broadleaf and steepland vegetation, and the greater amount of kohekohe, puriri and nikau forest types. The general forest pattern is one of puriri, kohekohe and nikau-treefern forest in the damp, dark, cool gullies, and kanuka with kauri rickers and scattered podocarps on the undeveloped ridges.

VEGETATION:

16V23	Lowland	Kauri-kanuka forest on eastern foothills	Best and Only*
16V61	Lowland	Puriri composite forest on eastern foothills	Best in District

16V23 Lowland kauri-kanuka forest on eastern foothills. 2.5 ha. ARC CMP. This forest covers the lower slopes of Paturua Gully where kauri is emerging through a layer of kanuka. Rewarewa, rimu, kahikatea, lancewood, tawa and mamangi were also recorded in the canopy.

16V61 Lowland puriri composite forest on eastern foothills. 17 ha and 5 ha. ARC CMP. This site consists of two blocks of forest separated by roads, houses and other forest types. One block is in Paturua Gully where the canopy of the forest on the eastern slope contains puriri, kowhai, nikau, mamaku, ponga, kohekohe, tawa and rewarewa. The other site is located on the slope between Scenic Drive and Exhibition Drive. Here the canopy species include puriri, nikau, kohekohe, tawa, mamaku, ponga and mahoe. This site is the larger and less modified of the two.

Other Vegetation: Kanuka forest around Waima, kauri rickers on spurs, kohekohe dominated puriri composite forest on the slopes around Exhibition Drive, young kahikatea throughout.

WILDLIFE:

16W15	Waitakere Ranges	Outstanding

16W15 The two forested areas within this RAP are a small part of the large Waitakere Ranges PWS. A diversity of common forest bird species are present, including NZ pigeon, tui, kingfisher, fantail, grey warbler and silvereye. The threatened kauri snail (*Paryphanta busbyi*) is present in the Exhibition Drive area while the Atkinson Park - Paturua Gully area has a high species diversity of land snails with 56 species reported by Goulstone (1982).

VISUAL
LANDSCAPE:

Above average quality. (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
16V23	High	Possum, weed, litter control
16V61	High	Possum, weed, litter control
16W15	High	Maintain habitat quality

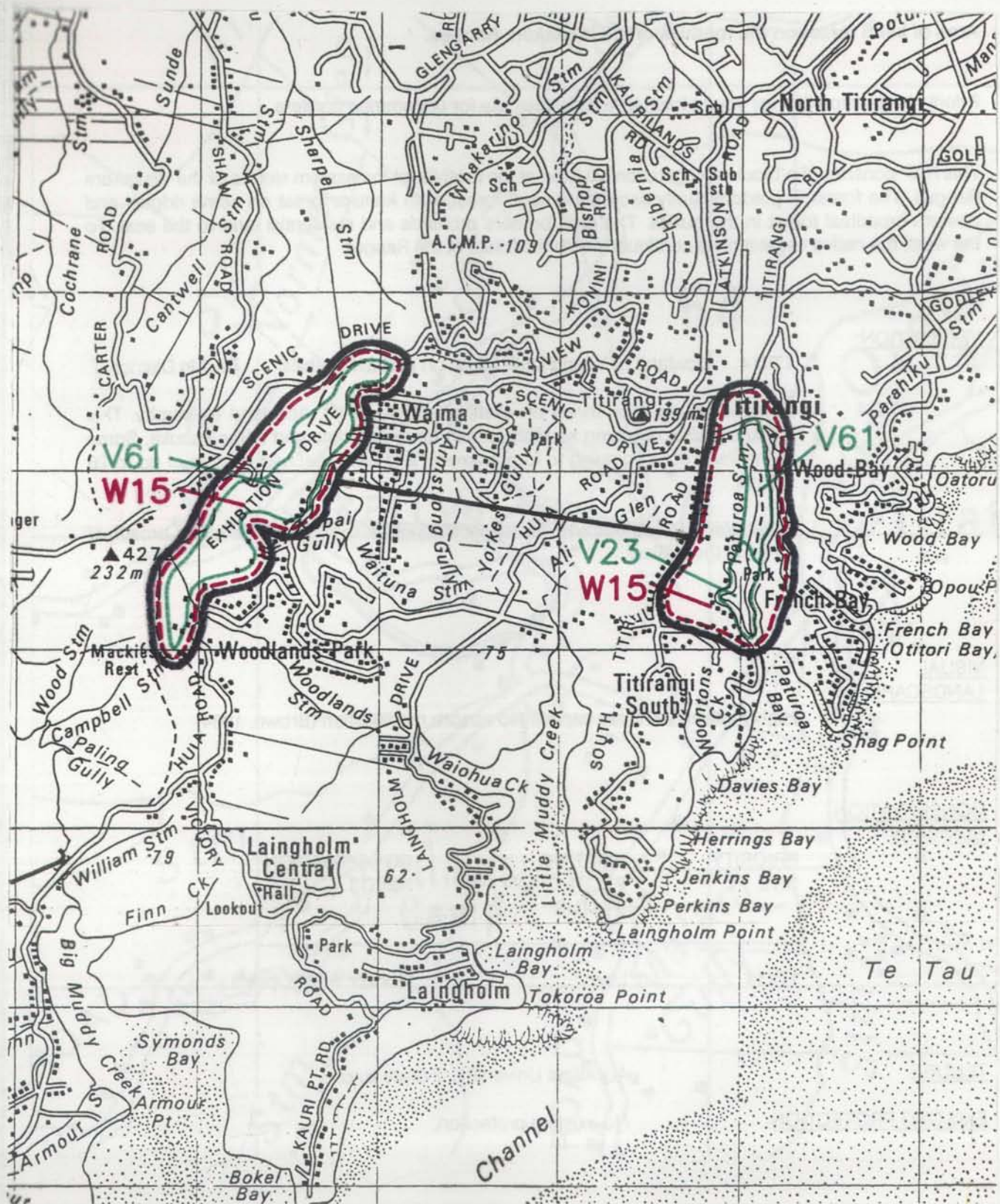
TENURE:

ARC CMP
Private

EXISTING PROTECTION:

Paturoa Gully and hillslopes around Exhibition Drive are part of ARC CMP.

RECOMMENDED AREA FOR PROTECTION # 16: TITIRANGI FOREST REMNANTS



GRID REFERENCE

NZMS 260 R11 580715

AREA OF RAP

115ha

SCALE:

0 1 2 km

WAITAKERE RAP # 17: UNIVERSITY FOREST - ORATIA**Area of kauri forest on the foothills of the Waitakere Ranges.**

Priority Vegetation Site for young kauri forest. Special site for uncommon conifers.

This RAP consists of a block of vegetation situated at the foothills of the eastern slopes of the Waitakere Ranges. The forest is predominantly secondary kauri forest, with kanuka forest on some ridges, and treefern-broadleaf forest in the gullies. The area borders orchards and residential land to the east. To the west, the native vegetation is continuous with the forest of the Ranges.

VEGETATION:

17V14 Lowland Young kauri forest on eastern foothills Best in District

17V14 Lowland young kauri forest on eastern foothills. 9 ha. Auckland University. This forest consists of young kauri trees with tanekaha, rimu and some kanuka. Some of the kauri are beginning to form a crown and have reached heights of up to 26 metres.

Other Vegetation: Kanuka forest on the ridges to the west, treefern-broadleaf forest in the gullies.

**VISUAL
LANDSCAPE:**

Highly valued with little capacity to absorb modification (Brown, 1984)

**CONSERVATION
SUMMARY:**

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
17V14	Low	Monitor weeds, pests

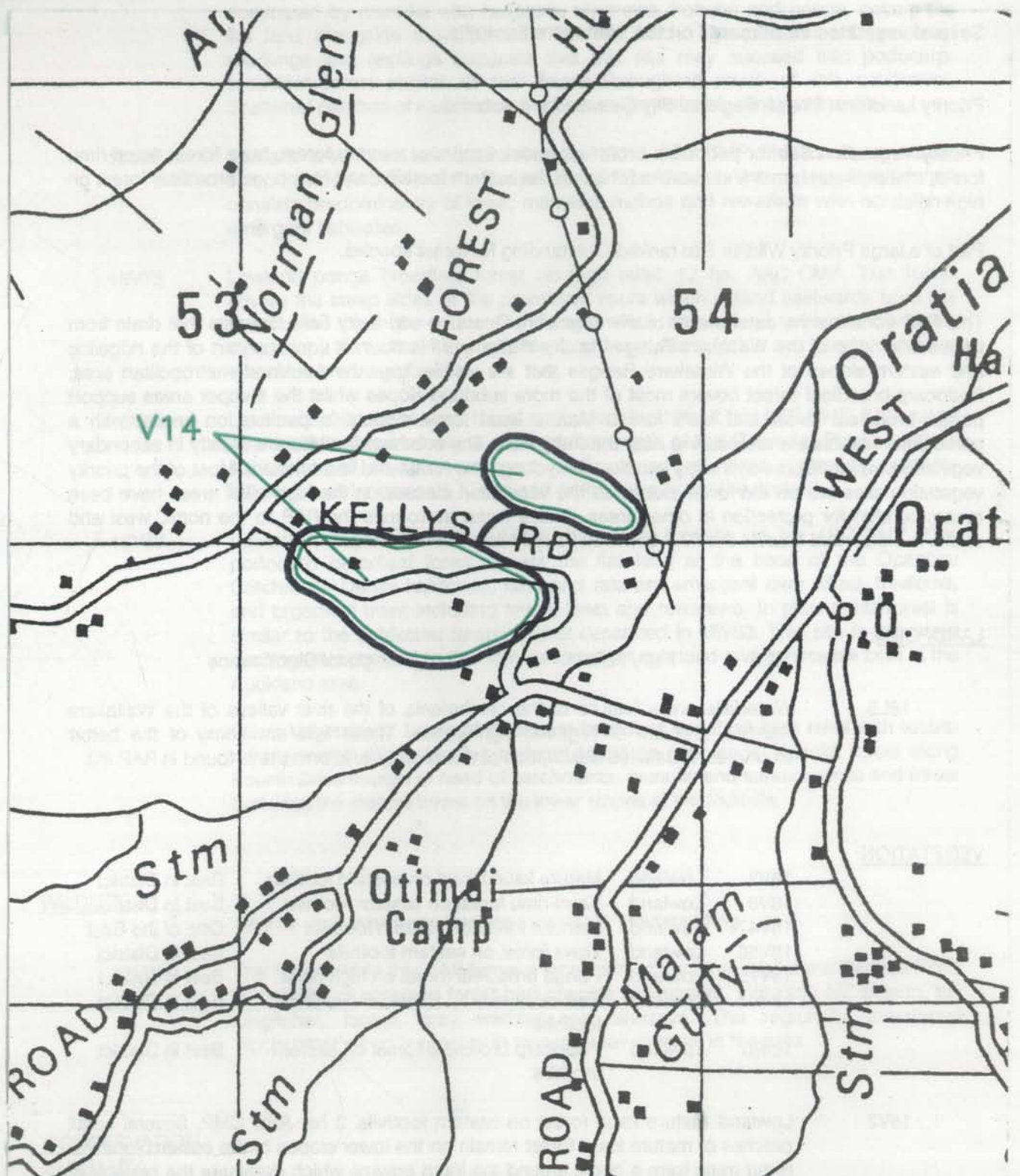
TENURE:

Auckland University. Private land.

EXISTING PROTECTION:

No existing protection.

RECOMMENDED AREA FOR PROTECTION # 17: UNIVERSITY FOREST - ORATIA



GRID REFERENCE

NZMS 260 R11 535750

AREA OF RAP

15ha

SCALE: 0 .25 .5 .75 km

WAITAKERE RAP # 18: OPANUKU - FAIRY FALLS FOREST

Several vegetated catchments on the Waitakere Foothills.

Priority Landform Site of Regional Significance for a waterfall.

Priority Vegetation Site for podocarp broadleaf forest, kahikatea swamp forest, tawa forest, kauri-rimu forest, mature kauri forest and manuka forest on the eastern foothills, and for ponga broadleaf forest on high relief.

Part of a large Priority Wildlife Site ranked Outstanding for forest species.

This RAP contains the catchments of the Swanson, Opanuku and Fairy Falls Streams that drain from the central ridge of the Waitakere Ranges to the Waitemata Harbour. It contains part of the ridgeline and eastern slopes of the Waitakere Ranges that are visible from the Auckland metropolitan area. Podocarp-broadleaf forest covers most of the more subdued slopes whilst the steeper areas support ponga broadleaf forest and tawa forest. Mature kauri forest occurs in pockets on knolls, with a particularly notable stand occurring near the Fairy Falls. The subdued foothills are mostly in secondary vegetation, which is predominantly kanuka with young rimu forest and kauri rickers. Most of the priority vegetation sites are on the lower slopes as the vegetation classes on the high relief areas have been recommended for protection in other areas. Native forest surrounds the RAP to the north, west and south. A metal road bisects the RAP between Fairy Falls and Walker Bush.

LANDFORM:

	18L8	Fairy Falls	Regional Significance
18L8	Waterfalls are a feature of the catchments of the river valleys of the Waitakere Ranges, and are of regional significance. These falls are some of the better examples. A detailed description of this priority landform site is found in RAP #3.		

VEGETATION:

	18V2	Lowland	Mature kauri forest on eastern foothills	Best in District
	18V6	Lowland	Kauri-rimu forest on eastern foothills	Best in District
	18V47	Lowland	Manuka forest on eastern foothills	One of the Best
	18V66	Lowland	Tawa forest on eastern foothills	Best in District
	18V75	Lowland	Ponga broadleaf forest on high relief	Best in District
	18V83	Lowland	Kahikatea swamp forest on eastern foothills	Best in District
	18V87	Lowland	Podocarp broadleaf forest on eastern foothills	Best in District
18V2	Lowland mature kauri forest on eastern foothills. 3 ha. ARC CMP. Several small patches of mature kauri forest remain on the lower slopes of the eastern foothills. Rimu trees form a circle around the kauri crowns which dominate the canopy of this site. Saplings of rimu, kauri and tanekaha were noted in the midtier.			
18V6	Lowland kauri-rimu forest on eastern foothills. 5 ha. ARC CMP. Young kauri and rimu with miro, rewarewa and occasional kahikatea form the canopy in this ridge site on the Sharp Bush Track. Occasional mature kauri and rimu are also present. The lower tiers are dense with a mixture of treeferns, conifer saplings and hardwood shrubs.			

- 18V47 Lowland manuka forest on eastern foothills. 15 ha. ARC CMP. Secondary forest, dominated by manuka with heketara, rewarewa, kohuhu and ponga, covers the flat land alongside the Opanuku Pipeline Track. The presence of podocarp seedlings and saplings suggests that this site may succeed into podocarp-broadleaf forest similar to that found throughout much of this catchment. Scattered patches of kauri ricker break through the even canopy of teatree.
- 18V66 Lowland tawa forest on eastern foothills. 40 ha. ARC CMP. This forest covers the steep hillslopes between the Peripatus and Filter Tracks. The canopy of this forest consists predominantly of tawa, mamaku, mahoe and rewarewa with occasional emergent kahikatea.
- 18V75 Lowland ponga broadleaf forest on high relief. 12 ha. ARC CMP. This forest covers the steep sides of the prominent spurs which extend eastwards from the head of the Opanuku catchment. Ponga, nikau, mahoe and rewarewa dominate the canopy here. As with most steepland forest sites, kiekie and parataniwha are abundant on the ground.
- 18V83 Lowland kahikatea swamp forest on eastern foothills. 2 ha. ARC CMP. This patch of kahikatea forest covers a small terrace north of the Opanuku Pipeline Track. Kahikatea and rimu are emergent over a canopy of nikau, rewarewa, pukatea, heketara and lancewood. Kiekie and paritaniwha cover the ground.
- 18V87 Lowland podocarp broadleaf forest on eastern foothills. 15 ha. ARC CMP. This podocarp broadleaf forest covers the flat land at the base of the Opanuku Catchment. Dense kahikatea, rimu and rata are emergent over nikau, treeferns, and broadleaf trees including hinau, tawa and rewarewa. In places this forest is similar to the kahikatea swamp forest described in 18V83. This site is important because it is unusual to find mature forest on subdued and accessible land in the Auckland area.

Other Vegetation: Lowland podocarp broadleaf forest on high relief with totaramiro covered ridges leading to kauri forest on spur ends. Kanuka forest along Scenic Drive margin at head of catchments, manuka and kanuka scrub and forest buffering the mature forest on the lower slopes at the foothills.

WILDLIFE:

18W15	Waitakere Ranges	Outstanding
- The forest within this RAP forms a small part of the large Waitakere Ranges PWS. A diversity of common forest bird species are present, including NZ pigeon, tui, kingfisher, fantail, grey warbler and silvereye. The regionally threatened Hochstetter's frog is present in several small streams in the area.

CONSERVATION SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
18L8	High	Leave unmodified
18V2	High	Monitor weeds, pests

18V6	High	Monitor weeds, pests
18V47	High	Monitor weeds, pests
18V66	High	Pest and weed control
18V75	High	Pest and weed control
18V83	High	Pest control
18V87	High	Pest control
18W15	High	Maintain habitat quality

TENURE:

ARC CMP
Private

EXISTING PROTECTION:

ARC CMP for most of the RAP



WAITAKERE RAP # 19: UPPER WAITAKERE RIVER VALLEY ALLUVIAL FOREST**Kahikatea forest on undulating land in the northern Waitakere foothills.**

Special Site for lowland kahikatea forest on subdued hillcountry (lowland kahikatea has been greatly reduced from its former extent in New Zealand).

This RAP is consists of a stand of young kahikatea forest on the rolling hillcountry adjacent to the Cascades Golf Course. To the south this forest is an extension of the vegetation of the Waitakere Ranges. Farmland with forest remnants forms the western border. It is probable that this kahikatea forest is a remnant of what was a more extensive forest stand covering the expanse of undulating topography which now forms the golf course.

VEGETATION:

19V131 Lowland Kahikatea forest on subdued hillcountry Special Site

19V131 Lowland kahikatea forest on subdued hillcountry. 25 ha. Private. This forest was placed in the podocarp broadleaf category and was not chosen as a PVS. However, this site has been chosen as a special site, as an example of a nationally rare forest type. In places the substrate is boggy and here the forest includes pole kahikatea, maire tawake, pukatea, cabbage tree, putaputaweta, kiekie and sedges. On drier ground the kahikatea is mixed with manuka, rewarewa, mahoe, mamangi, lancewood, treeferns and occasional rimu. Some lowland totara trees also occur in the forest surrounding the golf course.

Other Vegetation: Kanuka forms a buffer zone between the kahikatea forest and the farmland to the west. Young kauri forest covers the ridge to the north, manuka scrub follows the stream at the southern boundary of kahikatea forest.

**VISUAL
LANDSCAPE:**

Highly valued with little capacity to absorb modification (Brown 1984)

**CONSERVATION
SUMMARY:**

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
19V131	Low	Leave unmodified

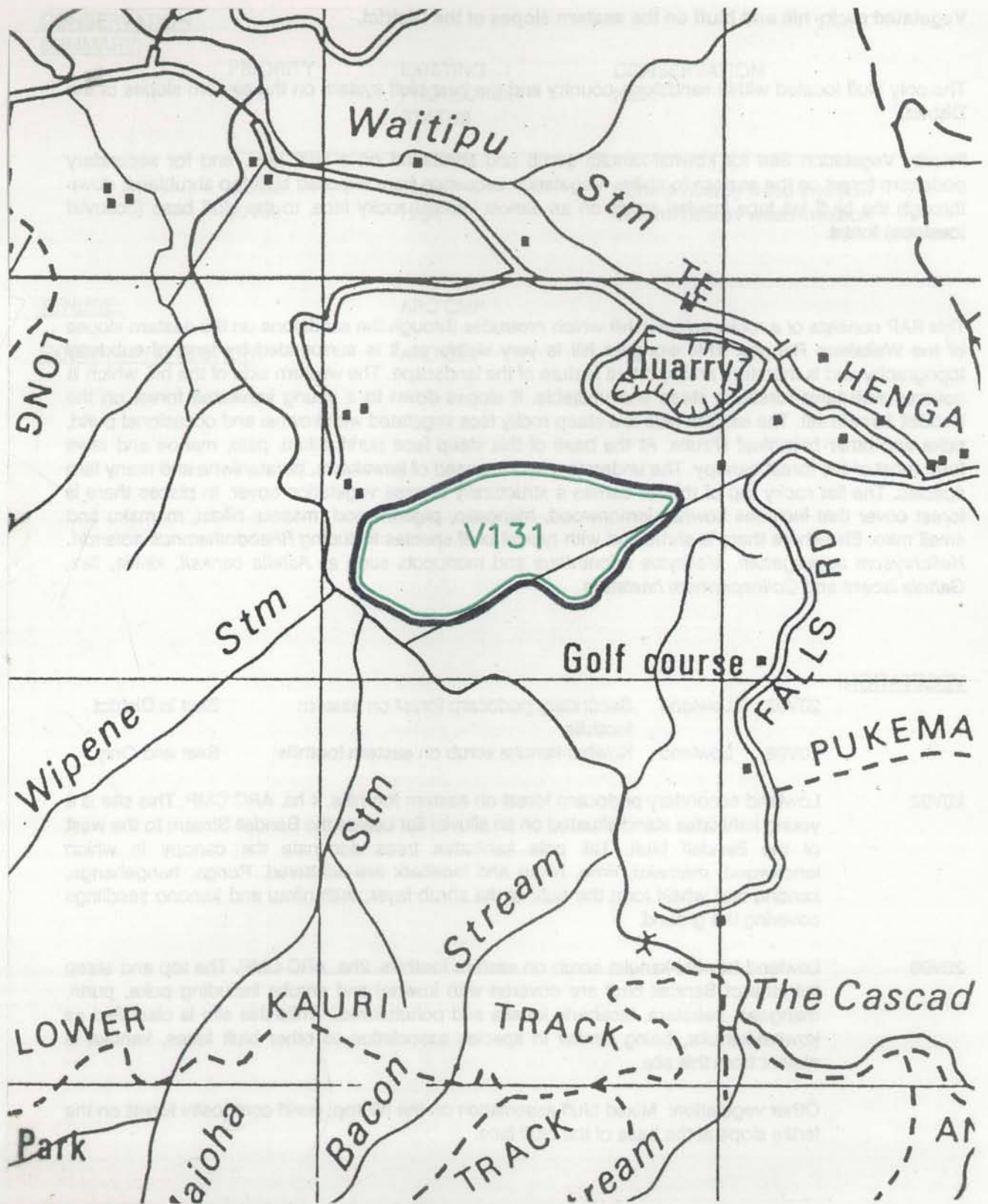
TENURE:

Private

EXISTING PROTECTION:

No existing protection

RECOMMENDED AREA FOR PROTECTION # 19: UPPER WAITAKERE RIVER VALLEY ALLUVIAL FOREST



GRID REFERENCE

NZMS 260 Q11 455795

AREA OF RAP

25ha

SCALE:

0 .5 1 km

WAITAKERE RAP # 20: BENDALL BLUFF**Vegetated rocky hill and bluff on the eastern slopes of the District.**

The only bluff located within sandstone country and the best bluff system on the eastern slopes of the District.

Priority Vegetation Site for kowhai-kanuka scrub and shrubland on a bluff face, and for secondary podocarp forest on the eastern foothills. Vegetation sequence from exposed bluff top shrubland, down through the bluff fall face kowhai scrub on an almost vertical rocky face, to the bluff base (colluvial toeslope) forest.

This RAP consists of a rocky volcanic hill which protrudes through the sandstone on the eastern slopes of the Waitakere Ranges. This elongate hill is very visible as it is surrounded by land of subdued topography and is therefore an important feature of the landscape. The western side of the hill, which is covered with tawa forest, is steep and unstable. It slopes down to a young kahikatea forest on the Bendall Stream flat. The eastern side is a steep rocky face vegetated with kowhai and occasional puriri, puka and other broadleaf shrubs. At the base of this steep face puriri, nikau, pate, mahoe and tawa form most of the forest canopy. The understory is composed of kawakawa, parataniwha and many fern species. The flat rocky top of the hill carries a structurally diverse vegetation cover. In places there is forest cover that includes kowhai, lemonwood, mangeao, pigeonwood, mapou, nikau, mamaku and small miro. Elsewhere there is shrubland with typical bluff species including *Rhabdothamnus solandri*, *Helichrysum aggregatum*, *Melicytus micranthus* and monocots such as *Astelia banksii*, kiekie, flax, *Gahnia lacera* and *Collospermum hastatum*.

VEGETATION:

20V92	Lowland	Secondary podocarp forest on eastern foothills	Best in District
20V98	Lowland	Kowhai-kanuka scrub on eastern foothills	Best and Only
20V92	Lowland secondary podocarp forest on eastern foothills. 4 ha. ARC CMP. This site is a young kahikatea stand situated on an alluvial flat beside the Bendall Stream to the west of the Bendall Bluff. Tall pole kahikatea trees dominate the canopy in which lancewood, mamaku, rimu, nikau and lacebark are scattered. Ponga, hangehange, kanono and wheki form the bulk of the shrub layer, with nikau and kanono seedlings covering the ground.		
20V98	Lowland kowhai-kanuka scrub on eastern foothills. 2ha. ARC CMP. The top and steep fall face of Bendall bluff are covered with kowhai and shrubs including puka, puriri, mangeao, heketara, lacebark, karaka and pohutukawa. While this site is classified as kowhai-kanuka, being similar in species association to other bluff faces, kanuka is absent from this site.		
Other vegetation: Mixed bluff association on the hill top, puriri composite forest on the fertile slope at the base of the bluff face.			

**VISUAL
LANDSCAPE:**

Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEED
20V92	High	Control nearby weed invasion
20V98	High	Control nearby weed invasion

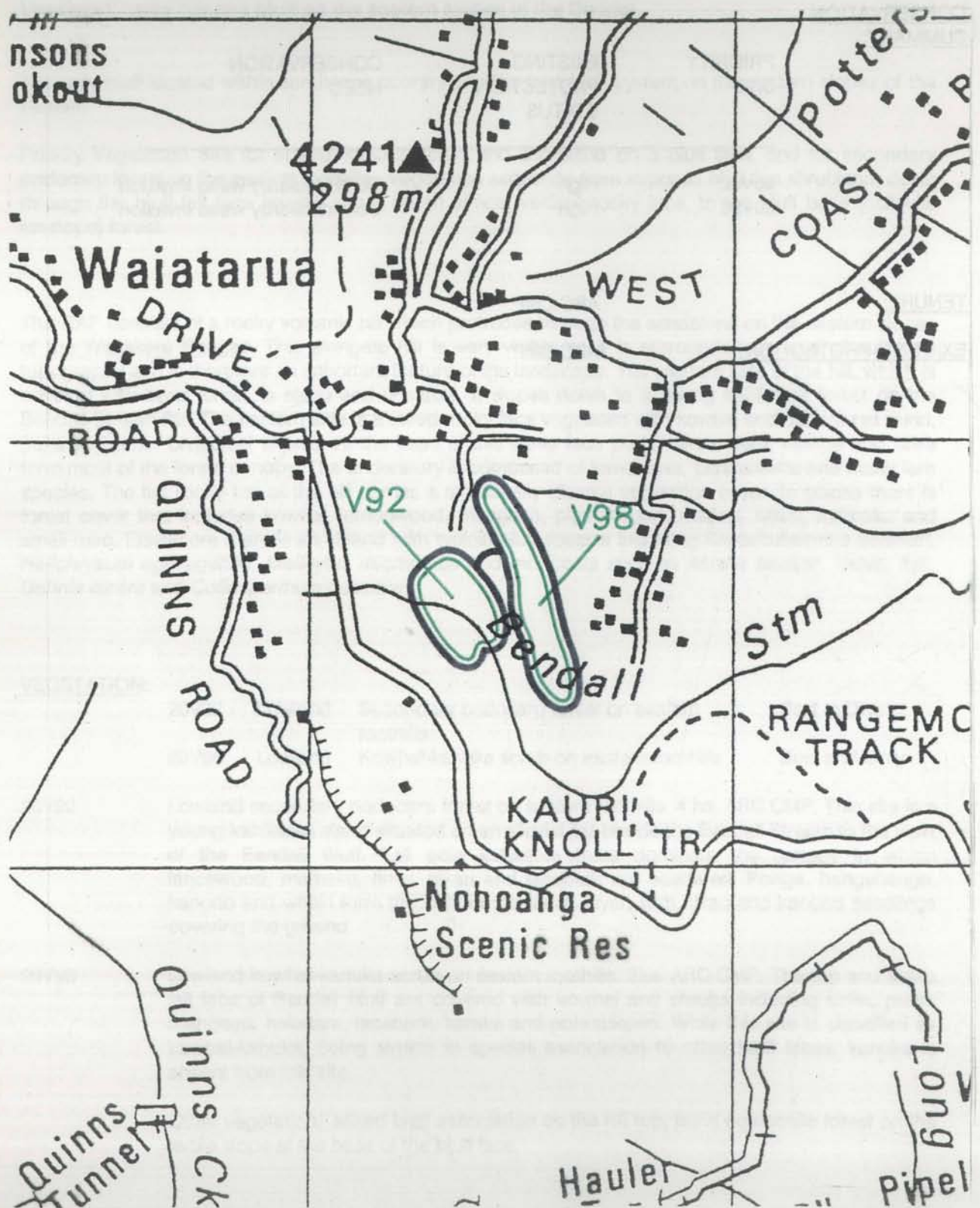
TENURE:

ARC CMP

EXISTING PROTECTION:

ARC CMP

RECOMMENDED AREA FOR PROTECTION # 20: BENDALL BLUFF



GRID REFERENCE

NZMS 260 R11 515725

AREA OF RAP

10ha

SCALE:

0 0.5 1 km

WAITAKERE RAP # 21: NIHOTUPU BASIN**Vegetated high altitude basin.**

Priority Vegetation Site for maire tawake forest and for upland forest on high relief.

Part of a large Priority Wildlife Site ranked Outstanding for forest species.

This RAP consists of a large, high altitude basin with gently undulating topography - the only landform of its type in the Ranges. The basin is bordered by relatively subdued slopes on the northern and eastern sides which are covered with the upland forest characteristic of the high altitude parts of the District. On the western and southern sides the basin slopes drop into the Huia and Nihotupu catchments. The basin streams pass through a depression, which is the now empty Nihotupu Auxillary Reservoir, and drain into the Upper Nihotupu Reservoir.

This RAP has a complex history of modification. It was milled in the period between 1890 and 1910 at which time a severe fire swept through this area, destroying what remained of the forest cover. Following this an extensive area was cleared for the construction of a proposed water reservoir. Ultimately only a small portion of the area was inundated to form the Nihotupu Auxillary Reservoir and the remaining area was allowed to revert. Today the vegetation covering the rolling basin flats is secondary teatree forest and scrub with young regenerating podocarp forest. With a complete surround of mature native forest there is an excellent seed source and the number of podocarp seedlings and saplings seen in this area is impressive. Extensive kahikatea stands are now becoming prominent in the basin. While these may have been artifically induced by planting, the landform is not inconsistent with the presence of kahikatea forest. Within this RAP are many pockets of young kauri forest, scattered throughout the kanuka and manuka nurse crops.

Due to its accessibility to a main road, this site with its rapid regeneration of podocarp species provides a good opportunity to study regeneration processes of podocarp and kauri forests. In addition several uncommon plant species have been identified in this site, with three of them not known to occur in any other place in the District.

VEGETATION:

21V79	Lowland	Maire tawake forest on high relief	Best in District
21V89	Lowland	Upland forest on high relief	One of the Two Best
21V79	Lowland maire tawake forest on high relief. 2 ha. ARC WSC. This small pocket of maire tawake swamp forest occurs in the south-western corner of the basin on flat land at the head of the Remus Roe Stream. Maire tawake (<i>Syzygium maire</i>) and tawheowheo (<i>Quintinia serrata</i>) dominate the canopy of this forest which also contains heketara, toru, wheki, tawari, miro, pukatea, rewarewa, <i>Cyathea smithii</i>, Hall's totara, mangeao, maire rauriki, tawa, rimu and lancewood.		
21V89	Lowland, upland forest on high relief. 585 ha. ARC WSC. This extensive area of upland forest covers the sides of the basin. The canopy consists of mature podocarps, predominantly rimu, miro and kahikatea with occasional rata and pukatea. These trees tower over a more intact canopy of tawheowheo, toru, tawari, heketara, hinau, lancewood, tawa, wheki and <i>Cyathea smithii</i>.		
Other Vegetation: Manuka forest, manuka scrub, kanuka forest, young pole kahikatea forest, and young kauri forest on high relief.			

WILDLIFE:

21W15 Waitakere Ranges Outstanding

21W15 The Nihotupu Basin forms part of the large Waitakere Ranges PWS. Bird species identified within the RAP include the pied tit which has a limited distribution in the Auckland Ecological Region. Also present are a diversity of common forest bird species including NZ pigeon, tui, kingfisher, fantail, grey warbler and silvereye. The forest habitat within the RAP is part of the continuous forest block of the Waitakere Ranges, which increases its value to wide ranging wildlife species. Visiting kaka, for example, have been reported from several locations near the eastern boundary of this RAP.

VISUAL:LANDSCAPE:

Drained lakebed - Extremely sensitive and valuable (Brown, 1984)

Forest - Highly valued with little capacity to absorb modification (Brown, 1984)

CONSERVATION
SUMMARY:

PRIORITY SITE	EXISTING PROTECTION STATUS	CONSERVATION NEEDS
21V79	Medium	Prevent dumping of spoil or change in road alignment
21V89	Medium	Control pests
21W15	Medium	Reconsider 4W drive access Maintain habitat quality

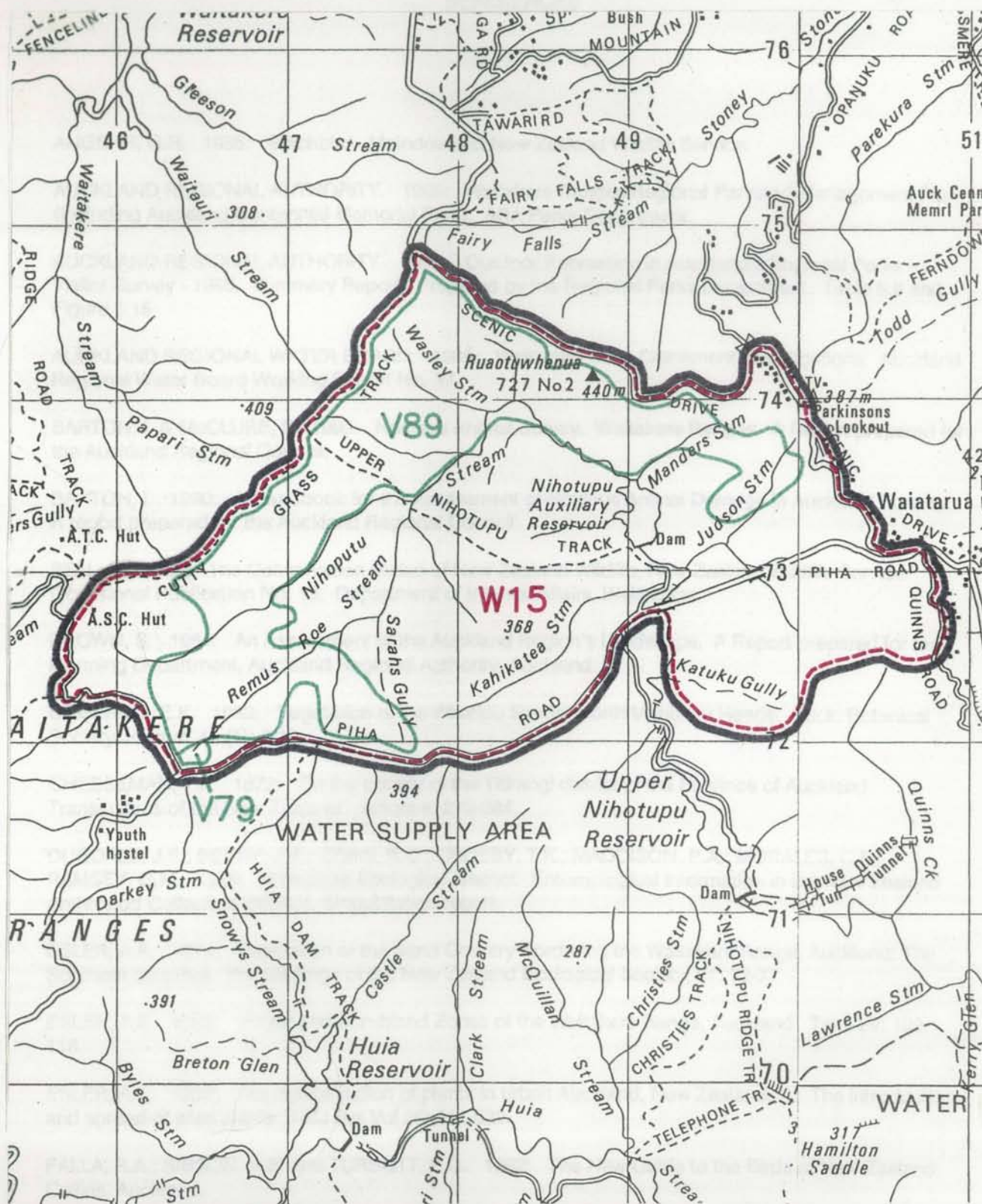
TENURE:

ARC WSC

EXISTING PROTECTION:

Nil.

RECOMMENDED AREA FOR PROTECTION # 21: NIHOTUPU BASIN



GRID REFERENCE

NZMS 260 Q11 480730

AREA OF RAP

830ha

SCALE:

0 1 2 km

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Note:

A comprehensive bibliography for Waitakere Ecological District can be found in Appendix 8.

LIST OF APPENDICES

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APPENDIX 1

EXPLANATORY NOTES TO CHECKLIST OF ECOLOGICAL UNITS

I. Checklist of the Ecological Units in the District

The following table lists the ecological units recorded in the Waitakere Ecological District during the PNAP Survey. The ecological units are listed within each physical area category. The approximate area of each Physical Area is provided in brackets.

II. Protection Status Codes

The following codes indicate the degree of legal protection for each ecological unit. Note that adequate protection does not ensure the viability of any ecological unit - active management may be required to protect the unit from degradation or destruction (e.g. by possum damage, overuse of recreational areas etc).

1. This ecological unit is not represented in the existing protected natural area (EPNA) network. For a list of EPNA's see Appendix 2.
2. There are inadequate amounts of this ecological unit in the EPNA system to ensure its viability (generally based on sites for which there is less than 10 ha in EPNA).
3. There are inadequate amounts of this ecological unit in the EPNA system to ensure the preservation of the character of the District (less than 10% of the original extent of the ecological unit occurs in the EPNA system - in many cases this was based on subjective decisions which involved comparing the present extent of original vegetation classes with the extent of the landforms they naturally occur on). Ecological units containing secondary vegetation classes are included in this category if less than 10% of the current extent is represented within the EPNA system.
4. Adequately protected within the EPNA system (units that don't fall within categories 1-3 and for which there is 10-100 ha in EPNA).
5. Well represented within the EPNA (units that don't fall within categories 1-3 and for which there is over 100 ha in EPNA).
- * This denotes ecological units which are inadequately protected but for which there are no other known examples in the District - i.e. there is no more that can be added to the EPNA system.

III. Conservation Values

Various features related to the conservation value of the ecological units are listed in three columns, with comments provided where necessary. These features are: Ecological unit:-

- A. Currently significant within the District (measured subjectively in terms of area coverage within each Physical Area).
- B. A major part of the original natural landscape (measured on a subjective basis comparing the current original vegetation classes with the extent of the landforms each typically occurs on). The original natural landscape was considered to be unmodified (by human occupation) and secondary forest types were assumed to

be insignificant in such a landscape (although it is likely that they were present as a result of local disturbance - fires, slips, earthquake damage, volcanic eruption etc).

- C. Greatly reduced from former extent in the original natural landscape (measured again subjectively. Areas coded 'Yes' are those which were formerly a major part of the landscape and which are not currently significant within the District or are thought to be less significant than they originally were. Conversely, 'No' means not greatly reduced from the former extent.)

NOTE:

This table does not include ecological units which were formerly, but now, no longer present. Such units may re-establish given a suitable seed source and time for development to occur. An example is mature kauri forest on subdued hillcountry. The seed source is present in the Ranges nearby and with time the young kauri forest and kauri-kanuka forest areas will develop into an ecological unit not currently described. It is important not to dismiss the significance of an ecological unit because it is not listed in this table.

It is also important not to dismiss the significance of secondary vegetation types merely because they were not present in the original landscape and because they have not been reduced in area. These secondary vegetation types are the step to replacing the ecological units which have been lost or greatly reduced, for example many areas of kanuka forest may be nurturing puriri composite forest which has been greatly reduced in some physical areas. In addition ecological units comprising secondary vegetation are a significant addition to the diversity of the natural areas within the District. The preservation of natural diversity is the fundamental aim of nature conservation. Diversity can be measured in terms of the number of species (species richness), the number of ecosystems, communities, habitats, landforms etc, and the change in species composition or communities along environmental gradients, i.e. ecological patterns.

Note:

Reference to Figure 2.4 (Vegetation Classes) will assist in locating these ecological units.

CHECKLIST OF THE ECOLOGICAL UNITS IN THE WAITAKERE ECOLOGICAL DISTRICT

BIOCLIMATIC ZONE	HYDROLOGIC CLASS	PHYSICAL AREA	VEGETATION STRUCTURE	VEGETATION CLASS	PROTECTION STATUS	CONSERVATION VALUE		
						A	B	C
COASTAL	Terrestrial	Unconsolidated sand (788 ha)	Forest	Pohutukawa	2	No	No	No
			Scrub	Kanuka	1	No	No	No
			Sandfield	Pingao	1	Yes	Yes	No
				Spinifex	1	Yes	Yes	Yes
			Herbfield	Coastal herbs	1	Yes	No	No
			Flaxland	Phormium	2	No	Yes	Yes
COASTAL	Terrestrial	Consolidated sand (210 ha)	Forest	Pohutukawa	4	Yes	Yes	Yes
			Scrub	Kanuka	2	Yes	No	No
COASTAL	Terrestrial	Exposed rocky coast (224 ha)	Forest	Puriri composite	2*	No	No	No
				Pohutukawa	3?	Yes	Yes	Yes
				Karo-houpara	1	No	No?	Yes?
			Scrub	Coastal shrubs	1	No	No?	No?
				Flax-manuka	1	Yes	No	No
			Herbfield	Coastal herbs	1	No	No	No
			Flaxland	Phormium	4	No	Yes?	Yes?
			Rockland	Sea cliff	5	Yes	Yes	No

BIOCLIMATIC ZONE	HYDROLOGIC CLASS	PHYSICAL AREA	VEGETATION STRUCTURE	VEGETATION CLASS	PROTECTION STATUS	CONSERVATION VALUE		
						A	B	C
COASTAL	Terrestrial	Rocky harbour entrance (200 ha)	Forest	Young kauri	4	Yes?	No	No
				Kauri-kanuka	4	Yes?	No	No
				Kanuka	5	Yes	No	No
				Mamangi	4	No	No	No
				Puriri composite	4	Yes	Yes	Yes
				Pohutukawa	4	Yes	Yes	No
			Scrub	Manuka	4	Yes	No	No
				Kowhai-kanuka	4	Yes	Yes	No
				Kauri-tanekaha	1	No	No	No
				Kauri-kanuka	4	Yes	No	No
COASTAL	Terrestrial	Southern foothills (550 ha)	Forest	Kanuka	3	Yes	No	No
				Puriri composite	1	Yes	Yes	Yes
				Secondary podocarp	5	No	No	No
				Pohutukawa	3?	Yes	Yes	Yes?
			Scrub	Manuka	5	Yes	No	No
				Kanuka	4	NIN	No	No
				Puriri composite	1	No	Yes?	Yes?
				Pohutukawa	3	No	Yes	Yes
				Kanuka	4	No	No	No
				Manuka	4-5	Yes	No	No
COASTAL	Terrestrial	Rugged hillcountry (500 ha)	Forest	Flax-manuka		No	No?	No?
				Manuka		Yes	No	No
				Kanuka		NIN	No	No
				Puriri composite		No	Yes?	Yes?
				Pohutukawa		No	Yes	Yes
				Kanuka		No	No	No
				Manuka		Yes	No	No
				Flax-manuka		No	No?	No?
				Manuka		Yes	No	No
				Flax-manuka		No	No?	No?
COASTAL	Estuarine	Estuary	Forest	Mangrove	1	Yes	No	No
COASTAL	Palustrine	Saline wetland	Sedgeland	Leptocarpus	1	No	No	No
COASTAL	Palustrine	Freshwater wetland (13 ha)	Sedgeland	Scirpus	1	Yes?	Yes?	Yes?
			Reedland	Raupo	1	Yes?	Yes?	Yes?

BIOCLIMATIC ZONE	HYDROLOGIC CLASS	PHYSICAL AREA	VEGETATION STRUCTURE	VEGETATION CLASS	PROTECTION STATUS	CONSERVATION VALUE		
						A	B	C
LOWLAND	Terrestrial	Rugged hillcountry (10,700 ha)	Scrub	Secondary podocarp	4	No	No	No
				Manuka	4	No	No	No
				Kowhai-kanuka	2*	No	No	No
			Forest	Mature kauri	3*	No	Yes	Yes
				Kauri-rimu	4	No	No	No
				Kauri-hard beech	2*	No	No	No
				Young kauri	4	Yes	No	No
				Kauri-tanekaha	4	No	No	No
				Kauri-kanuka	5	Yes	No	No
				Kanuka	5	Yes	No	No
				Manuka	5	Yes	No	No
				Mamangi	4	Yes?	No	No
				Taraire	4	No	No?	Yes
				Puriri composite	4	Yes?	Yes	Yes
				Tawa	5	No	No	No
				Mamaku broadleaf	5	Yes	No?	No?
				Ponga broadleaf	4	No	No?	No?
				Mixed broadleaf	4	No	No?	No?
				Podocarp broadleaf	4	Yes	Yes	Yes
				Secondary podocarp	2*	No	No	No
				Pohutukawa	2*	No	No	No
			Scrub	Kanuka	2	No	No	No
				Manuka	4	Yes	No	No
				Kowhai-kanuka	4	No?	No?	No
				Flax-manuka	2*	No	No	No
			Rockland	Mixed monocotyledons	2*	No?	No?	No
				Mixed shrubs	4	No	No	No

BIOTIC ZONE	HYDROLOGIC CLASS	PHYSICAL AREA	VEGETATION STRUCTURE	VEGETATION CLASS	PROTECTION STATUS	CONSERVATION VALUE		
						A	B	C
LOWLAND	Terrestrial	High relief (8190 ha)	Forest	Mature kauri	3	No	Yes	Yes
				Kauri-rimu	2	No	No	No
				Kauri-tawari	1	No	No	No
				Young kauri	2*	No	No	No
				Kauri-kanuka	2*	No	No	No
				Kanuka	4	Yes	No	No
				Manuka	4	Yes	No	No
				Mamangi	1	No	No	No
				Taraire	1	No	No	No
				Puriri composite	2	No	No	No
				Tawa	5	Yes	Yes	Yes?
				Mamaku broadleaf	4	Yes	Yes?	No
				Ponga broadleaf	4	No	No	No
				Mixed broadleaf	4	No	No	No
				Podocarp broadleaf	5	Yes	Yes	No
				Upland podocarp	3	Yes	Yes	Yes?
				Secondary podocarp	2	No	No	No
	Scrub			Manuka	4	No	No	No
				Kowhai-kanuka	1	No	No	No
LOWLAND	Palustrine	Consolidated sand	Reedland	Raupo	1	No	No	No
	Palustrine	Dune impounded lake (25 ha)	Forest	Cabbage tree	1	No	No	No
LOWLAND	Palustrine		Reedland	Raupo	2*	Yes	No	No

BIOCLIMATIC ZONE	HYDROLOGIC CLASS	PHYSICAL AREA	VEGETATION STRUCTURE	VEGETATION CLASS	PROTECTION STATUS	CONSERVATION VALUE		
						A	B	C
LOWLAND	Palustrine	Freshwater wetland (170 ha)	Forest	Cabbage tree	1?	No	No	No
			Scrub	Manuka-cabbage tree	1	No	No	No
			Sedgeland	Baumea	1?	Yes	No	No
			Grassland	Swamp millet	1?	No?	No	No
LOWLAND	Palustrine	Alluvial flat	Forest	Maire tawake	2*	No	No	Yes
LOWLAND	Palustrine	Subdued hillcountry (2700 ha)	Forest	Kahikatea	2*	No	No	Yes
				Cabbage tree	2*	No	No	No
LOWLAND	Palustrine	Eastern foothills (4120 ha)	Forest	Maire tawake	1	No	No	Yes
				Kahikatea	2	No	No	Yes
LOWLAND	Palustrine	Rugged hillcountry (10700 ha)	Forest	Kahikatea	1	No	No	No
LOWLAND	Palustrine	High relief (8190 ha)	Forest	Maire tawake	1	No	No	No
				Kahikatea	1	No	No	No

Appendix 2

EXISTING PROTECTED NATURAL AREAS IN THE WAITAKERE ECOLOGICAL DISTRICT

NAME	TYPE	ADMINISTRAT- ING BODY	GRID REF NZMS 260	AREA ha	DESCRIPTION	REFERENCE
Auckland CMP	CMP	ARC	Q11 435735	6498.6	Coastal manuka scrub on rugged hillcountry and southern foothills; sandfield and rockland vegetation on exposed rocky coast, pohutukawa forest on exposed rocky coast and rocky harbour entrance; puriri composite forest on rugged hillcountry and southern foothills. Lowland manuka scrub on rugged hillcountry, eastern foothills and high relief; bluff vegetation on rugged hillcountry; young kauri forest on rugged hillcountry and high relief; mamangi on rugged hillcountry; kanuka forest on rugged hillcountry and high relief; mixed broadleaf forest on rugged hillcountry and high relief; taraire forest on rugged hillcountry; puriri composite forest on rugged hillcountry, eastern foothills and high relief; mamaku broadleaf forest on rugged hillcountry and high relief; tawa forest on high relief; kauri-kanuka forest on rugged hillcountry; podocarp broadleaf on rugged hillcountry; ponga broadleaf on rugged hillcountry and eastern foothills; kauri-rimu forest on rugged hillcountry; secondary podocarp forest on rugged hillcountry and kahikatea swamp forest on eastern foothills.	PNA Survey
Armour Res.	RR	WCC	R11 545685	11.6	Coastal puriri composite forest on southern foothills (small patches)	WCC
Beverly Hills	SR	ARC	R11 568721	1.0	Lowland regenerating forest - puriri-kohekohe-podocarps on eastern foothills	L&S 1981

NAME	TYPE	ADMINISTRATING BODY	GRID REF NZMS 260	AREA ha	DESCRIPTION	REFERENCE
Bishop Park	SR	WCC	R11 576726	3.3	Lowland kanuka scrub, puriri and mixed broadleaf forest on eastern foothills	L&S 1981
Bush Road Res.	LPR	WCC	R11 519728	0.8	Lowland mixed broadleaf forest on eastern foothills	WCC
Cascade Res.	LPR/SR/RR	WCC	R11 514729	6.9	Lowland puriri composite forest and bluff vegetation on high relief	WCC
Daffodil Park	SR	WCC	R11 576729	0.7	Mostly native bush	WCC
Douglas Res.	SR	WCC	R11 523727	4.8	Lowland mamaku-mixed broadleaf forest on eastern foothills	PNA Survey
Fawcett OSC	OSC	QEII	R11 556706	4.0	Lowland kauri-tanekaha-rimu-totara-rewarewa on eastern foothills	QEII file
Fell OSC	OSC	QEII	Q11 447825	4.6	Lowland rimu-kahikatea-puriri-rewarewa on subdued hillcountry	QEII file
Flower OSC	OSC	QEII	Q11 448825	2.3	Lowland rimu-kahikatea-puriri-rewarewa on subdued hillcountry	QEII file
Goldies Bush	SR	DOC	Q11 415830	192.2	Lowland young kauri, puriri composite, secondary podocarp, mamangi and kanuka forest on subdued hillcountry	PNA Survey
Heller	PPL	Private	R11 541677	3.49	Coastal manuka scrub	DOC Land Inventory
Huia SR	SR	WCC	R11 507662	3.2	Lowland kanuka forest on rugged hillcountry	WCC
Ijsseldijk	OSC	QEII	R11 555706	4.0	Lowland kauri-tanekaha-podocarp-rewarewa on eastern foothills	QEII file
John Bishop Memorial	SR	ARC	R11 569722	1.4	Lowland regenerating kauri-rimu-totara-kahikatea-puriri-kohekohe on eastern foothills	L&S 1981

NAME	TYPE	ADMINISTRATING BODY	GRID REF NZMS 260	AREA ha	DESCRIPTION	REFERENCE
Karekare Plantation	LPR	WCC	Q11 422678	0.1	Lowland kanuka forest on rugged hillcountry	WCC
Karekare Res.	RR	WCC	Q11 423674	0.3	Pohutukawa trees and carpark	WCC
Karekare SR	SR	WCC	Q11 421673	0.8	Lowland kanuka scrub on rugged hillcountry	WCC
Karekare Valley	SR	WCC	Q11 420674	0.1	Coastal/lowland manuka scrub on rugged hillcountry	WCC
Kauri Plantation	LPR	WCC	R11 532738	2.6	Lowland mixed broadleaf forest on eastern foothills	WCC
Kauri Res.	RR	WCC	R11 527740	2.0	Lowland kanuka forest on eastern foothills	WCC
Kitewaho Res.	RR	WCC	Q11 484790	2.0	Native bush, minimal track development	WCC
Laingholm Res.	SR	WCC	R11 558693	6.9	Coastal secondary manuka with kauri-totara-puriri on southern foothills	PNA Register
Laingholm Drive	LPR Espl	WCC	R11 566697	2.6	Coastal kauri-kanuka forest on southern foothills	WCC
Lake Wainamu	SR	QEII	Q11 416774	155.0	Sand dunes, lake, raupo reedland, lowland kauri-kanuka and puriri composite forest on rugged hillcountry	PNA Survey
Lawrence OSC	OSC	QEII	R11 555705	4.8	Lowland kauri-tanekaha-podocarp-karaka-rewarewa on eastern foothills	QEII
Lone Kauri Glade	RR	WCC	Q11 433664	0.5	Lowland kanuka forest on rugged hillcountry	WCC
Lone Kauri	RR	WCC	Q11 429665	0.9	Lowland kanuka forest on rugged hillcountry	WCC
Matuku	OSC	RFB	Q11 416805	80.8	Lowland young kauri, kauri-tanekaha, puriri composite forest on subdued hillcountry	PNA Survey
Matuku-Waitakere Stream	ME	Private	Q11 419804	3.5	Lowland puriri composite forest on subdued hillcountry	RDC

NAME	TYPE	ADMINISTRATING BODY	GRID REF NZMS 260	AREA ha	DESCRIPTION	REFERENCE
Miller OSC	OSC	QEII	Q11 461716	2.8	Native bush - kauri, rimu, kahikatea	QEII file
Minehaha Res.	RR	WCC	R11 554710	0.9	Lowland kauri-kanuka forest on eastern foothills	WCC
Motutara Settlement	SR	DOC	Q11 397832	12.5	Lowland manuka scrub on subdued hillcountry with young kauri and puriri forest on consolidated sand and subdued hillcountry	PNA Survey
Mt Atkinson Park		ARC	R11 575723	2.6		
Muriwai Beach Regional Park	RR, Gifts to Crown	ARC	Q11 381847	29.0 (in WED)	Coastal pohutukawa forest, kanuka scrub, coastal scrub on exposed rocky coast and consolidated sand	PNA Survey
Muriwai Valley Rd	ME	Private	Q11 425850	3.01	Lowland kauri-kanuka and broadleaf forest on subdued hillcountry	RDC
Nohoanga SR	SR	ARC	R11 514720	1.2	Lowland secondary kanuka/taraire-puriri-totara-rimu on eastern foothills and high relief	PNA Register
Oaia Rd	ME	Private	Q11 386835	1.0	Lowland kanuka scrub on subdued hillcountry	RDC
Otitori Res.	SR	DOC	R11 583718	0.1	Lowland kauri forest on eastern foothills (access way)	DOC Land Inventory
Piha SR	SR	WCC	Q11 413713	2.3	Coastal manuka forest on rugged hillcountry	L&S 1981
Puketotara	SA	DOC	Q11 407799	0.004	Lowland Baumea sedgeland on freshwater wetland	DOC Land Inventory

NAME	TYPE	ADMINISTRATING BODY	GRID REF NZMS 260	AREA ha	DESCRIPTION	REFERENCE
Rahui Kahika	RR	WCC	R11 585728	10.7	Secondary native bush, some cleared areas	WCC
Ruru Res.	RR	WCC	R11 523723	3.7	Native bush	WCC
Sth Titirangi	RR	WCC	R11 576719	1.7	Steep bush covered slopes	WCC
Swanson	SA	DOC	Q11 498796	20.4	Lowland kanuka scrub on eastern foothills	DOC Land Inventory
Takahe Res.	SR	WCC	R11 585720	1.6	Native bush	WCC
Taumata Res.	SR	DOC	R11 523727	0.4	Lowland treefern-nikau-kahikatea-tawa forest on eastern foothills (steep rock face)	PNA Register
Tavinor & Johnston	OSC	QEII	Q11 445925	2.3	Lowland rimu-kahikatea-puriri-rewarewa forest on subdued hillcountry	QEII file.
Te Henga	RR	DOC	Q11 390780	83.5	Cliff top; coastal pohutukawa forest on exposed rocky coast; kanuka scrub, flaxfield, and pohutukawa forest on consolidated sand and grass	DOC Land Inventory
Tinopai Res.	RR/LP	WCC	R11 579710	0.6	Native bush	WCC
Waatarua Res.	?	WCC	R11 511732	3.5	Lowland tawa forest on high relief, some buildings	WCC
Waitakere Domain	SR	WCC	Q11 476792	15.0	Lowland kahikatea forest, broadleaf-podocarp regeneration on rugged hillcountry	PNA Register
Waitakere Regional Parklands						
Cornwallis	Park	ARC	R11 526674	750.9	Coastal manuka scrub, pohutukawa forest, puriri composite, kanuka forest on southern foothills; secondary podocarp broadleaf, kauri-kanuka, kauri-tanekaha, mixed broadleaf on rugged hillcountry; lowland mixed broadleaf, ponga-broadleaf, kanuka and manuka forest on rugged hillcountry	

NAME	TYPE	ADMINISTRAT- ING BODY	GRID REF NZMS 260	AREA ha	DESCRIPTION	REFERENCE
Kaiterakihi Park		ARC	R11 518652	307.7	Coastal kauri-kanuka forest on southern foothills and rugged hillcountry; pohutukawa forest on southern foothills; manuka forest on rugged hillcountry; manuka scrub on rugged hillcountry and southern foothills; lowland mixed broadleaf, kauri-kanuka forest, tawa, ponga-broadleaf and podocarp broadleaf forest on rugged hillcountry	
Titirangi & Atkinson Parks		ARC	R11 579718	29.4	Lowland puriri composite, kauri-kanuka and kanuka forest on eastern foothills (Atkinson Park only)	
Cascades/Kauri Park Cascades Park		ARC	Q11 445778	567.08	Lowland mamaku broadleaf, kauri-kanuka, kauri-rimu, podocarp broadleaf, mixed broadleaf, mature kauri, young kauri kanuka forests and manuka scrub on rugged hillcountry; lowland podocarp broadleaf, mature kauri and kanuka forest on high relief	
Kauri Park		ARC	Q11 472784		Lowland puriri composite, kanuka, podocarp broadleaf, young kauri, mature kauri, tawa, ponga broadleaf forests, manuka scrub on rugged hillcountry	
Waitoru	SR	WCC	Q11 450810	15.3	Lowland regenerating podocarp forest (rimu-kahikatea dominant) on subdued hillcountry	Slaven
Warner Park Espl	Espl	WCC	R11 566694	2.4	Pohutukawa treeland	WCC
Whiteoak OSC	OSC	QEII	R11 555706	4.7	Lowland kauri-tanekaha-rimu-kahikatea-rewarewa on eastern foothills	QEII
Total				8,882.1		

KEY TO ABBREVIATIONS:

<u>Designation</u>	
CMP	Centennial Memorial Park
Esp/	Esplanade Reserve
LPR	Local Purpose Reserve
ME	Memorandum of Encumbrance (with Rodney District)
OSC	Open Space Covenant
PPL	Private Protected Land
RR	Recreation Reserve
SA	Stewardship Area
SR	Scenic Reserve

Administering Body

ARC	Auckland Regional Council
DOC	Department of Conservation
QEII	Queen Elizabeth II National Trust
RFB	Royal Forest and Bird Protection Society
RP	Regional Parkland
WCC	Waitakere City Council

References

WCC	unpublished data provided by Waitakere City Council in 1989
PNA Survey	results of 1989 survey
L&S 1981	published report by the Department of Lands and Survey (see references)
QEII	unpublished data provided by Queen Elizabeth II National Trust 1989
PNA Register	Protected Natural Areas Register published 1984
DOC Land Inventory	Inventory of DOC Estate (in press) - held at Auckland Conservancy
Slaven	Slaven, D (1986)
RDC	Rodney District Council files

APPENDIX 3

WAITAKERE SURVEY METHODOLOGY

A3:1.0 Broad Survey Focus

The Waitakere Ecological District 1988/89 vegetation survey was based on the methodology outlined in the Protected Natural Area Programme Guidebook. (Myers et al, 1987)

In conjunction with the PNAP survey component, a number of other specialised surveys were also undertaken. These surveys include a re-survey of the Sites of Special Wildlife Interest (see Section A3:3.8) within the Ecological District. Some smaller scale wildlife surveys were also carried out. The Auckland Regional Water Board electric fished the reservoirs to ascertain the freshwater fish populations. A detailed herpetological survey for *Leiopelma hochstetteri* in a particular stream was also carried out. The results of these surveys are reported in an accompanying technical report (Slaven, 1989).

A noxious animal damage survey was also carried out concurrent with the vegetation survey (Barton et al, 1990)

As with the Hunua PNAP survey a decision was made to survey the coastline using essentially PNAP methodology.

A3:2.0 Pre Survey Work

A3:2.1 Assembly and analysis of existing information

This period of work involved the collation of known published and unpublished information on the District ecology initially based on the then Regional Planning Department's natural environment bibliography. Important contacts were made with Auckland University, the Auckland Institute and Museum, and DSIR scientists who provided much information and advice.

An invitation was extended through the Environment Auckland Region network, to people who had an interest in the natural history, flora and fauna of the Waitakere District to share their knowledge with the field team. From this meeting contact was established with many people who had valuable information and this proved to be productive.

During this pre survey time the physical areas of the District were derived and mapped, and the general geology, physiography and climate of the District and sites of particular geological interest were described (Hilton, 1988).

Maps showing significant Maori place names related to the ecology of the District were produced.¹⁴ A map of rare plant distributions was also compiled.

From this data collection, the draft landform report, and the field scientific adviser's (S. King) knowledge, an ecological zone map was produced for the District.¹⁵ This map broadly defined the

14. Unpublished map. Graeme Murdoch, Historian, Resource Management Division, ARC. This map is located in the Land Resources Section, Environmental Management Department, Environment and Planning Division, ARC.

District's ecological patterns and diversity, and was used as a first basis for structuring the priority survey areas.

A3:2.2 Survey Aids

Survey aids included an aerial video shot from a helicopter which was used in staff training and familiarisation of the general ecological pattern of the District. Both the vegetation team leader and the field scientific adviser flew over the District prior to field survey commencement. Black and white aerial photos were used in the field by the surveyors.

A colour aerial photo run, which was flown during the survey, was used extensively in the selection of Priority Vegetation Sites, and Recommended Areas for Protection, as well as for vegetation identification and mapping of un-surveyed or poorly covered survey areas.

A3:2.3 Rationale for the selection of priority survey areas

The rationale to determine priority survey areas was devised by the team leader and field scientific adviser. Pragmatic factors structured the division of the District into broad "study areas" to be surveyed in the initial sense.

A fixed time constraint had been determined by the managers of the survey, so this along with the number of field teams available made the initial division into ten working week survey blocks, plus the coastal and wetland areas which were surveyed as a separate block.

The working week blocks for the terrestrial teams were generally bordered by catchment boundaries. Within each working week block, further divisions were made based on the number of field teams available (normally 4-5) to formulate study areas. The study areas were based on natural boundaries especially obvious boundaries between vegetation types. Specialist sites within these areas (eg the bluffs) were treated as one study area. The division of working week blocks for study areas was done evenly with some allowance for the ease of access and complexity of vegetation types to be surveyed. Sometimes a team had several study areas to survey in a week, each composed of particular ecological characteristics.

Preceding each field team, the survey leader and field scientific adviser would conduct a pre reconnaissance of the working week block to determine study areas and to assess the ecological patterns and units in order to brief the teams for the following week. Pre reconnaissance involved aerial photo analysis and subsequent field investigation particularly from vantage points. Supplementary information was provided by the field leader to each team on known features about the botany of the area including information on past modification.

Within study areas, each team used the rapid ecological survey technique to choose typical areas within ecological units to sample. (Myers et al, 1987)

A3:3.0 Field Survey

A3:3.1 Field Instruction

Prior to survey, a day's field test of the new sample site card design was carried out by both seasoned PNAP and inexperienced surveyors to ensure that the design and format was clearly interpretable. The Park rangers and water catchment staff who were involved in the survey as guides, were also briefed

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15. In this survey ecological zone is used to denote a division slightly broader than ecological class, the difference resulting from the absence of vegetation structure information. This map is also located in the Land Resource Section, ARC.

on survey technique before the survey started, although it was not their responsibility to complete survey cards.

A day's office training in survey philosophy and methodology was followed by a period of intensive field training. During the course of field work the scientific leaders also visited the field camp to assist and answer queries raised as a result of technique, methodology and landform classification. The field scientific adviser visited the field camp most nights for the duration of the survey. A guide to the methodological requirements for the Waitakere vegetation survey was also assembled and distributed to the field team during the course of survey. (See Appendix 3A1)

A3:3.2 Logistics

The botanical field team was composed of six team members and a field team leader. Four of the surveyors were experienced in that they had previously used PNAP methodology in the Hunua survey.

Each team member was partnered in the field by ARC parks and water catchment staff who work in the Ranges and whose responsibility was to guide the team in and out of the field safely. The ARC staff also provided logistical assistance and information from their knowledge on the history, disturbance and modification of areas.

The field team leader surveyed and accompanied team members for ongoing training and to check the field teams' work. Vegetation survey commenced in February 1989 and continued until the end of April 1989.

The SSWI survey was completed prior to the start of the vegetation survey in November to be in the spring bird calling season. The wildlife team consisted of two people working together and acted independently from the vegetation survey. Field survey was based on SSWI sites with the exploration of new areas as appropriate.

The noxious animal damage survey was carried out concurrently with the vegetation survey by one person and was based on plots selected in a random way with the selection of plots based on vegetation types. Plots (0.1 ha in size) were quantified and a larger radius outside the plot examined to determine the "typicalness" of damage recorded. (Barton, 1990)

A3:3.3 PNAP survey methodology

The survey technique used in the Waitakere survey was principally based on the PNAP Guidebook, with some minor alterations that were made in context with the District ecology.

A decision was made to survey the coastline vegetation (down to mean high spring) using essentially PNAP methodology. This entailed walking and in places boating along the coastline in a systematic manner. The types of vegetation found on the coastline created some changes in sampling technique particularly as "ecological units" were frequently much smaller than a 50 x 20 m plot. Transitions between ecological units varied between being abrupt or very gradual. Such transitions occurred more frequently, within smaller areas, than would be found in forest situations. Choosing a typical area to represent an ecological unit faithfully required a measure of experience.

In terms of survey technique for terrestrial ecosystems a number of changes were made. These changes principally involve quantitative measures of canopy cover and tier structure.

A decision was made to change the recording of cover estimates from a range of cover classes to single percentages. Cover classes were therefore assigned to the nearest 5 % when the cover was under 25 % and to the nearest 10 % when the cover was over 25 %. This was done in the hope of recording better estimates on cover class and reducing the range of "error" possible in cover classes recommended in the Guidebook.

The changes made to vegetation structure involve the assessment of what is the canopy tier. A decision was made to move away from the definition of canopy as being any part of the plant layer that

the sun touches. It was considered that in the Waitakeres where the canopy has in many places been selectively logged and the canopy tier is variable in terms of height and cover, the use of this definition would lead to misleading vegetation descriptions. Tiers were determined on more of a structural layer basis. Consequential to this decision some ecological units did not fit well within the structural classes that are in the Guidebook, and a sub-class code was used to indicate situations where the cover of the canopy layer is less than 80%, (sub-class 1b).

Limitations to field survey using the rapid ecological survey technique were encountered for many of the bluff and coastal cliff systems where access was dangerous and the ability to sample a 50 x 20 m plot impossible. In these areas descriptions of sites were made, often with binoculars, and tier information on the sample site cards was not formally completed. Surveyors also made descriptions of ecological units when they did not have sufficient time to sample properly, or where the site was small, and for atypical but interesting sites. While all this information proved valuable it was not possible to formally classify all of these sites using Twinspan although many were classified by hand.

A3:3.4 Card design

The card set used in the Waitakere survey consisted of study area cards, unchanged from the guidebook, new ecological unit (sample site) cards for both terrestrial and wetland ecosystems, species list cards, and 100 point cards.

Ecological unit card design was changed radically. This change in card design had been an evolving process stemming from changes in the Hunua PNAP survey ecological unit cards and based on the problems experienced in that survey with technique and interpretation in the field. The changes were made in the hope that interpretation problems could be minimised between surveyors. Related to card design were decisions about the type and nature of information collected with some expansion of the latter. These are discussed in more detail in section 3.5.2.

Unlike the Hunua PNAP survey a separate coastal card was not used, with information for coastal sites recorded on the ecological unit and wetland unit cards developed for the surveys.

The field recording card set used in the Waitakere PNAP survey included the following; the study area card (unchanged from the Guidebook), separate ecological unit cards for terrestrial and wetland ecosystems (with the terrestrial card being substantially redesigned from the Guidebook and the wetland card being new altogether) a species list card (from a concept designed in the Hunua PNAP survey and usefully restructured for Waitakere). A 100 point count card was designed as a field check for the surveyors. This was used as a running personal check for surveyors to keep an audit on the accuracy of their estimates of cover class during the course of survey.

A3:3.5 Detailed card design reformat

The ecological unit card (terrestrial) was redesigned both in terms of content and structure. (refer to examples of cards and computer printout found in Appendix 3A1, Figures 1 & 2)

The first structural change was to integrate the required landform and vegetation information required on the ecological unit card.

The check-list box on modifying factors was rewritten as a series of questions and became the first set of questions asked about the condition of the ecosystem being surveyed. The answers to these questions then lead the surveyor into answering the question about naturalness. The surveyor continues to answer the questions on forest dynamics and physiognomic characteristics followed by an assessment of management requirements.

Other major structural changes included, as in the Hunua PNAP survey, creating more space to record dominant species in all tiers, and the creation of a column to record clearly whether canopy species were emergent or not. Provision was also made for comments on each tier and more space for general comments.

The result of restructuring the questions on the card was the need to move to a bigger card. The redesigned ecological unit card became an A3 data sheet folded to A4 for ease of use in the field. It had the advantage of reducing the number of loose field card sheets that had to be taken into the field. By moving to A3, space became available to allow greater opportunity to comment on issues in a more structured form, resulting in much greater clarity in using the appropriate fields for data entry. The opportunity to draw sketch maps was an added bonus.

A corresponding bonus was also gained in data entry clarity when data is written into the appropriate fields. As the data entry programme is similar to the card structure, checking printouts was simplified. The ability to extract a greater range of data from specific fields has also made the PNAP database more accessible as a research tool.

A3:3.5.1 Change in emphasis

A number of changes were made to the questions asked of surveyors on the field card. The condition and dynamics questions have been rephrased to obtain more information from the surveyor and hopefully less assumption. The first question in the forest dynamics section now reads as follows "Is the sample site composed of original or secondary vegetation?" and is followed by, "If secondary is the stand a secondary succession or is it regenerating?" These questions are now followed by, "Is there information available on the historical modification of this site? State modification, time period and source" (of knowledge).

Directly after this set of questions the surveyor is required to answer questions on the physiognomic characteristics of the sample site. These questions are 'and / or' options and reads, "Is this stand a mixture of size and age classes with predominantly mature trees in the canopy?" If the answer is yes, the surveyor is requested to record whether all tiers are present, if just the top tier is intact, if the top and mid tiers are intact, or if the top and ground tiers are intact.

The 'or' question reads, "Is this stand predominantly of an even age with respect to its physiognomic dominants?" The same intact structural options are offered to the surveyor. During the course of survey a fifth option was needed for both questions on the options for intactness. This was "mid and ground tiers intact" - the obvious one if selective logging has happened in the past!

Surveyors were also asked to code the predominant slope position that the ecological unit occurred on using the Dalrymple landform model (see Appendix 3A1, Figure 3).

A3:3.5.2 New information on cards

Additional information was requested of the surveyors on the field card. Some of these follow on from the changes made in the Hunua PNAP survey. A 'notable lianes, ferns and epiphytes' category was added for each tier as well as a 'dead tree' section and an expanded (from Hunua) litter category.

Some minor additions were made to record plot size and the ecological district prefix on the site number code on the ecological unit card.

A3:3.6 New Cards

A wetland / lake ecological unit card was developed in the Hunua PNAP survey and remodelled slightly for the Waitakere survey. This card has been described in more detail in the Hunua PNAP report (Tyrrell et al, in press). The significant changes on the card between the two surveys lie in the physiognomic questions. An example of this card is in Appendix 3A1, Figure 4.

An example of the species list card is found in Figure 5 (Appendix 3A1). This card is essentially a listing of the predominant species likely to be found in the field. Surveyors can indicate in which tier species were observed by marking the appropriate column.

A3:3.7 Survey Coverage

Despite stringent time limits the vast majority of the District was intensively surveyed with much of the area seen and described from vantage points and most of the large ecological units sampled using the rapid survey technique. Bluffs were particularly well visited although the nature of the terrain limited the information able to be gathered to predominantly the canopy coverage. It was felt that the bluffs should be well covered during the survey firstly because they are relatively rare in other districts within the Auckland Ecological Region, and secondly because (due to their inaccessibility) there was very little information about them in the available literature.

Areas poorly surveyed include the Cornwallis Parkland area for which previous studies provided information on the vegetation of the area including detailed vegetation maps. Due to illness of one of the field surveyors, the stretch of east facing slopes from Titirangi to Waiaatarua, and the Titirangi-Laingholm areas were also undersurveyed.

Small areas of secondary growth forest in the Anawhata, north Cascades and part of the Piha catchments were not surveyed as it was felt that this forest type had been well covered in similar physical areas in other parts of the District.

For the production of a vegetation map of the District, aerial photographs were used to identify vegetation types where field surveys were inadequate. For this process known vegetation types in easily identified areas were pin-pointed on aerial photographs enabling other areas of the same vegetation types to be identified from the structure and colour of the vegetation shown on the photographs.

A3:3.8 Wildlife Survey

The wildlife component of the Waitakere Ecological District PNAP Survey was essentially a comprehensive resurvey of all the registered Sites of Special Wildlife Interest (SSWI) in the Ecological District. These SSWI were first surveyed by the Wildlife Service (Department of Internal Affairs) in September 1981 during a nationwide survey of all significant wildlife habitats. During the resurvey, conducted over December 1988 and January 1989, the methods used were similar to those employed by the Wildlife Service. Each habitat type is utilised by different fauna species and thus slightly different methods were used for each of the three types. Note that these surveys were conducted during daylight hours only.

1. Forest-Shrubland Habitats

A walking transect line was undertaken and five minute bird counts were compiled every 250 m. During each count, the number and identity of all bird species was recorded. Additional bird species seen or heard between counts were also noted. Some species of birds and many other fauna may have been present at other times of the year and missed during the survey. Additional notes were taken of other species previously recorded from the habitat, either from local residents or previous studies.

During the field survey, brief searches for other native fauna such as frogs, lizards and snails were also undertaken.

2. Freshwater-Wetland Habitats

These consisted of swamps, lakes, ponds and associated wetland vegetation. All bird species associated with the wetland habitat were recorded but no five minute bird counts were undertaken. Where appropriate, particularly in vegetative swamps, tape recorded calls of secretive swamp bird species were played to determine their presence.

3. Coastal Estuarine Habitats

Unlike the other habitat types, the wide open spaces of the coastal-estuarine habitat made it possible to identify all the species present at the time of surveying and count the total numbers of each. Other species not seen during the survey but recorded by others, notably the Ornithological Society of New Zealand or local residents, were also noted. Brief searches for other coastal fauna groups, such as lizards, were also carried out.

The boundary of coastal-estuarine habitats encompassed the total area used by the wildlife species present, which included from low tide level up to spring high tide, as well as the high tide roost sites and breeding areas used by coastal birds.

For all SSWI recorded, the habitat itself was described, including vegetation type and predominant species, diversity of habitat, degree of modification, presence of stock or noxious animals, fencing status, proximity to other SSWI, shape and size as well as the significance of the habitat on a local, regional or national level.

For each habitat, particular attention was paid to the presence of breeding populations of species and presence of rare, threatened or endangered species as listed by Bell (1986).

The SSWI were ranked as Outstanding, High, Moderate-High, Moderate or Potential. The criteria used in ranking are listed in Appendix 3A2.

A3:4.0 Data Handling and Management

A3:4.1 Data Entry

Data was entered and stored on an IBM compatible Tandon AT personal computer, initially using dBase III+ software. At a later stage the data storage system was upgraded to dBase IV. A programme was designed so that the format of the survey cards was repeated on the screen, making data entry a relatively simple process and easy to check.

A data entry person was employed two weeks after field survey commenced to enter the field cards in to a computer database. Cards were completed in the field office with all the required information, checked by the field leader and returned to town for data entry. Printouts of the cards were then passed back to the field surveyors for checking. As a result there was only a small backlog (two weeks) of unfinished or unchecked cards from most of the field team after the completion of survey. A greater data input accuracy was ensured by having access to a data entry person for the length of the survey period and the analysis process occurred quickly after field survey completion.

A3:4.2 Access to data

The computer on which the data is stored is part of the Land Resources section's natural environment information system in the Environmental Management Department, Auckland Regional Council. The field cards themselves will be stored in a fire safe in ARC, and copies of the data printouts will be stored in the Parks Department. Accompanying information used in report preparation is stored in the Environmental Management Department natural environment information system, which includes the computerised natural resource bibliography stored on an Inmagic software system.

A3:4.3 Numbering system for the study areas

The number sequence 0902 which precedes each unique study area number is the national number for the Waitakere Ecological District (McEwen, 1987). The second paired number, such as 01, is the working week number and is followed by the study area number eg 02. The last paired number is the ecological unit number which identifies the position of the field card eg 03.

So

0902 01 02 03 breaks down to

0902	01	02	03
Ecological District	Working week block	Study area	Ecological unit

A3:5.0 Data Analysis and RAP Derivation

A3:5.1 Vegetation Classification

The vegetation was classified independently by two techniques. The data was run through a Twinspan analysis (Hill, 1979) and was also classified manually from field knowledge of vegetation patterns. The two analyses were compared and card by card decisions were made in assigning a vegetation class.

The vegetation classification derived from Twinspan was run on the Auckland University IBM by Dr Neil Mitchell, Botany Department, Auckland University. Terrestrial and wetland systems were analysed separately. In the terrestrial vegetation set a second Twinspan run was required for a large division (100+ samples) which remained after the first run. It was felt this set could be better defined by analysing separately.

Some sites were determined to be non classifiable, namely those that were described sites, where the species tier information was not completed for the samples.

A3:5.2 Selecting Priority Sites and Recommended Areas for Protection

As discussed in the PNAP Guidebook, the principal objective of the PNAP Programme is 'the preservation of representative samples of all classes of natural ecosystems and landscapes' (Reserves Act 1977).

To achieve this objective the PNAP survey of the Waitakere Ecological District was structured around the identification of the remaining natural areas in the Ecological District and the selection of those natural areas that best represent the ecological character of, and range of ecosystems and landscapes in the District. This selection of the 'best areas' was undertaken on a two step level. The first step is the selection of 'Priority Sites' for vegetation, landform and wildlife. The second is selecting aggregates of Priority Sites to be proposed as 'Recommended Areas for Protection'.

A3:5.2.1. Selection of Priority Vegetation Sites

A3:5.2.1.1 Selection Criteria:

To select Priority Vegetation Sites (PVS's) the examples of each ecological unit (henceforth referred to as 'sites') were ordered, manually, on the basis of seven criteria as stated in the Guidebook.

"The intrinsic functions of natural systems gives rise to the following seven criteria which are appropriate for use in the PNAP Programme for evaluation of natural areas and defining priorities for protection:

- i representativeness
- ii diversity and pattern
- iii rarity and special features
- iv naturalness
- v long-term viability
- vi size and shape
- vii buffering and surrounding landscape"

Definitions of these criteria and their significance can be found on pages 58-65 of "A Guidebook for the Rapid Ecological Survey of Natural Areas" (Myers et al, 1987). Following the Guidebook's recommendation (page 53) that a numerical ranking system of ecological units for each criteria is "not recommended for Districts with extensive tracts of vegetation", each ecological unit was rated a grading of High, Medium, or Low for each criterion. It was felt that a numerical ranking system (eg 1-5) was not appropriate to compare the values of each site because, as an example, a '2' for diversity is not necessarily twice as good as a '4' for buffering etc. In other words the criteria are not numerically comparable nor are they equally important for every site. Subjective decisions, rather than the imposition of a mathematical system, were therefore necessary to compare the value of each site.

The importance of each of these criteria in choosing the PVS's varied with ecological unit and location. For example species diversity is typically low in manuka scrub so high species diversity was not a criterion for the PVS selection of manuka scrub. In other words, species diversity was only considered if a given vegetation class typically has a high species richness.

Many of the selection criteria are positively correlated. For instance sites of large size are likely to be self-buffered, have a higher *diversity* of vegetation and landform features, and have larger populations producing more propagules (seeds) with a consequentially higher potential for regeneration and therefore a greater *long-term viability*. These correlations do not hold for every situation of course as, for instance, an unfenced ten hectare site located on farmland may have a lower viability in the long term than a five hectare site of the same vegetation class located in a remote area surrounded by a native vegetation buffer.

A3:5.2.1.2 The Selection Process:

Each ecological unit was evaluated independently of other ecological units unless several ecological units were perceived as having a profound effect on each other, or are part of an ecosystem (for instance as seres in a wetland). All examples of a given ecological unit were assembled and scrutinised for their representativeness. Sites not considered to be representative were discarded from the selection process.¹⁶

The next step in the process was to group the sites according to naturalness (each was assessed with regard to possible observer bias, taking into account the comments about each site, the extent of modification within the site and the size of the site). Naturalness and viability have some bearing on each other as the sites of higher naturalness are those with fewer modifications and current threats, and threats are among the factors which lower viability. Those sites with a perceivably higher viability and subsequently lower degree of management input are preferred sites for protection.

Within the Ranges the vegetation is largely continuous and therefore most ecological units are buffered by other forest types or by extensive areas of the same unit. The concept of buffering therefore was not an important determinant between these sites. It was, however, important in choosing between remote sites and peripheral sites (where external influences may have a profound affect on the vegetation). It was also an important consideration in the remnants north of the Waitakere River (often the 'buffer' in this situation is stock-proof fencing).

16. Sites considered to be unrepresentative included those with a high proportion of exotic species and those considered to be of an unnatural structure due to the absence of vegetation tiers that are normally present within a given vegetation type (e.g. treeland) or those thought to be of artificial derivation (e.g. parkland plantings). Unrepresentative sites also included those sites that did not meet the typical situation for a given vegetation class (e.g. tawa forest is typically found on steep slopes so the few sites on subdued slopes were considered to be unrepresentative examples of tawa forest in the Waitakere Ecological District). Factors considered to be typical and characteristic varied with vegetation class (e.g. steep slope typical of tawa forest, high species richness typical of mixed broadleaf forest types, certain species typically associated with puriri composite forest, sparse emergents typical of kauri forest, etc.)

As it was assumed for most ecological units that diversity and viability are directly related to size, the size of a site became the next major determinant in the sifting process. If several sites were of the same naturalness code and size, factors such as buffering, shape, physical diversity, patterns, regeneration potential, and the surrounding landscape were used to complete the ordering process.^{17.}

Rare species and special features were not included in the determination of PVS's because it was felt that rarity could compromise representativeness. However rarity was considered to be an important feature when protecting the diversity of species within an ecological district. Sites with rare species or special features were identified as 'sites of special significance' which were treated as PVS's during the selection of RAPs.

A3:5.2.1.3 Selecting more than one PVS:

Although the objective in selecting Priority Vegetation Sites is to choose the best example of each ecological unit, in some situations up to three sites may be recommended as PVS's of a given unit. The decision to choose more than one site to represent an ecological unit can be based on one of several factors which include;

- the need to protect proportionately more of an ecosystem which has been greatly reduced from its former extent;
- the need to protect several examples, as back-ups, of ecosystems that are fragile and/or unable to be replaced if destroyed;
- the need to capture the range of situations in which a highly diverse vegetation class may exist; and
- the need to capture the representative proportions of an ecosystem that covers a large percentage of the District.

A3:5.2.2. Selection of Priority Wildlife Sites

The Priority Wildlife Sites in the District are all the Sites of Special Wildlife Interest with a ranking of Moderate, Moderate-High, High or Outstanding. The criteria used in ranking are listed in Appendix 3A2.

A3:5.2.3. Selection of Priority Landform Sites

Priority Landform Sites are physical features of particular paleontological, landform, geological, aesthetic or scientific interest; as well as sites or areas that are characteristic of the physical nature of the Ecological District. The first step in the evaluation of the Priority Landform Sites was the compilation

17. These features are defined and explained in the Guidebook (Myers, S. et al, 1987) however the following comments are provided as they are significant in the context of this discussion.

Buffering relates to inaccessibility to humans, weeds and noxious animals.

Physical diversity relates to small-scale diversity of physical parameters, e.g. landform (ridge to gully sequences), altitude, and aspect.

Patterns include ecological sequences and gradients.

Regeneration potential is identified by the presence of seedlings.

With regard to the surrounding landscape it was recognised that rural, urban and natural surroundings all have different effects on native habitats. In the Waitakere Ecological District the surrounding landscape for much of the area is native vegetation and as this condition was relatively constant for most of the Ranges this criterion was not considered to be an important selection criterion. Where the surrounding landscape is farmland (to the north of the Waitakere Stream) this criterion became more of a consideration.

of a bibliography on the geology, geomorphology, pedology and physiography of the Waitakere Ecological District.

From this information it was possible to prepare a provisional list of Priority Landform Sites.

This provisional list was distributed to individuals and organisations with lay or professional experience of the District (including University academics, Auckland Centennial Memorial Park Rangers, staff from the NZ Geological Survey and the Department of Scientific and Industrial Research, local residents and special interest groups, such as the Waitakere Ranges Protection Society). Comment from these individuals and organisations were invited.

The features listed in the provisional list were examined in the field to assess current quality and to obtain or check descriptions of the features. On the basis of field checking and comment from interested parties the provisional list was re-assessed. Each site was evaluated on the basis of district, regional and national significance, and representative value.

Once the list of sites of particular interest was finalised the characteristics of each Priority Landform Site was documented including the following information:

- the physical nature of the PLS
- the exceptional or commonplace values of the site (including scientific, educational, recreational and aesthetic values)
- the representative value of the site
- the existing tenure
- the conservation requirements
- the protection recommendations

A3:5.2.4. Selection of Recommended Areas for Protection

The areas chosen as RAPs are those places where aggregates of Priority Vegetation, Wildlife and Landform Sites indicate a natural area of high ecological significance. As it was considered that RAPs should have ecological continuity, the RAP boundaries were extended to overlay natural boundaries such as catchment ridges, vegetation transitions and major changes in landform.

RAPs were selected to capture the maximum diversity of natural features. They include examples from the four main ecosystems - the coastline, the wetlands, the bush remnants and the large forested area of the Ranges. Within these four broad ecological divisions, diversity was further ensured by choosing areas with a large concentration of PVS's to maintain diversity of vegetation and habitat and to capture the character of the District. Although the objective of the PNAP Survey is the identification of sites requiring protection to ensure the existing reserve network is representative, the RAPs in this survey include areas which are already protected to ensure adequate management of those areas considered to be paramount in preserving the character of the Waitakere Ecological District.

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APPENDIX 3A1

Figure 1

NZ PROTECTED NATURAL AREAS PROGRAMME
WAITAKERE ECOLOGICAL DISTRICT SAMPLE SITE CARD

ECOLOGICAL UNIT

Study Area Name: _____

Date: _____ Site No.: 0 9 0 2 _____

Observers: _____ Map No.: _____ Grid Ref: _____

Tenure: _____ Area (ha) _____ Plot Size: _____

Vegetation Description _____ Ecological Class ☐

Vegetation Name: _____ Vegetation Structure ☐

Sample Site Relationship Rest of Ecological Unit: _____

Forest (1)
 Treeland (2)
 Scrub (4)
 Shrubland (5)

Hydrologic class: (1) Estuarine (2) Lacustrine (3) Riverine ☐
 (4) Palustrine (5) Marine (6) Terrestrial

Physical Area ☐ Soil ☐ Geology ☐ Land- ☐ ☐ Bioclimatic ☐
 form ☐ Zone

Condition of Sample Site/Ecological Unit

1. Indicate if there is evidence of human activity in this site, e.g. milling, ☐
 farm activities etc? Code Yes (Y); No (N)
 State activity and code degree of impact. High (H), Medium (M), Low (L) ☐

Indicate the extent of impact, i.e. sample site only or common for
 ecological unit. _____

2. Indicate whether introduced plants are modifying this site e.g. pampas, ☐
 wandering jew. Code Y/N.
 Code degree of impact (H/M/L) ☐
 Specify species: _____
 Describe extent of impact: _____

3. Indicate whether introduced animals are altering the species composition ☐
 through selective browsing. Yes/No
 Code degree of impact (H, M, L) ☐
 Specify plant and animal species involved: _____

4. Are there any physical conditions or events which are modifying the ☐
 vegetation in this sample stand e.g. erosion, climatic events.
 Code Yes/No. Specify event, nature and extent of impact: _____

Naturalness Code: Don't Know (D), Low (L), Medium (M), High (H) ☐

If you code 'Don't Know', please indicate the reasons for your uncertainty:

Forest Dynamics

Is this sample site composed of original or secondary vegetation?
Original (O), Secondary (S) ☐

If secondary is the stand a secondary succession or is it regenerating?
Succession (S), Regenerating (R) ☐

Is there information available on the historical modification of this site? State modification, time period and source.

Physiognomic Characteristics of Sample Site

1. Is this stand a mixture of size and age classes with predominantly mature trees in the canopy? Yes/No (Y/N) If No go to question 2 ☐

- Are: a) all tiers present
b) top tier intact
c) top and mid tier intact ☐
d) top and ground tier intact

2. Is this stand predominantly of an even age with respect to its physiognomic dominants? Yes/No (Y/N) ☐

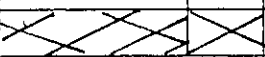
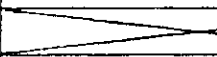
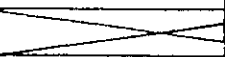
- Are: a) all tiers present
b) top tiers intact only ☐
c) top and mid tiers intact
d) top and ground tiers intact

Management Requirements

What management needs would be required to maintain this vegetation in, or enable it to return to, its probable 'original' state, as part of a representative protected natural area network? Specify and comment:
Consider animal control, fencing, weed control, time, planting buffers, etc.

Degree of Effort Required. (L, M, H, D) ☐

Altitude (m) Aspect Slope

	Canopy Tier				Middle Tier			Ground Tier	
Mean Height (m)									
Height Range									
Cover %									
	Species	E/ C	%c	reg	Species	%c	reg	Species	%c
Species 1:									
2:									
3:									
4:									
5:									
6:									
7:									
8:									
9:									
10:									
11:									
12:									
13:									
14:									
15:									
16:									
17:									
Gaps									
Notable lianes, ferns epiphytes & lichens/ bryophytes									
	Species		%c		Species	%c		Species	%c
Species 1:									
2:									
3:									
4:									
5:									
6:									
7:									
8:									
9:									
10:									
11:									
12:									
13:									

Use code P for present, otherwise assign % cover values to the nearest 5 %
when under 25 % and 10 % when over 25 %.

	Canopy			Mid		Ground	
Dead Trees	Species	E/C	#	Species	#	Species	#
Species 1:							
2:							
3:							
4:							
Bare Ground							
Litter	Species	%c Litter	Depth cm	<u>Dead Trees</u> Young Old Both Trunks Stumps Both Standing Fallen Both			
Species 1:							
2:							

Comments

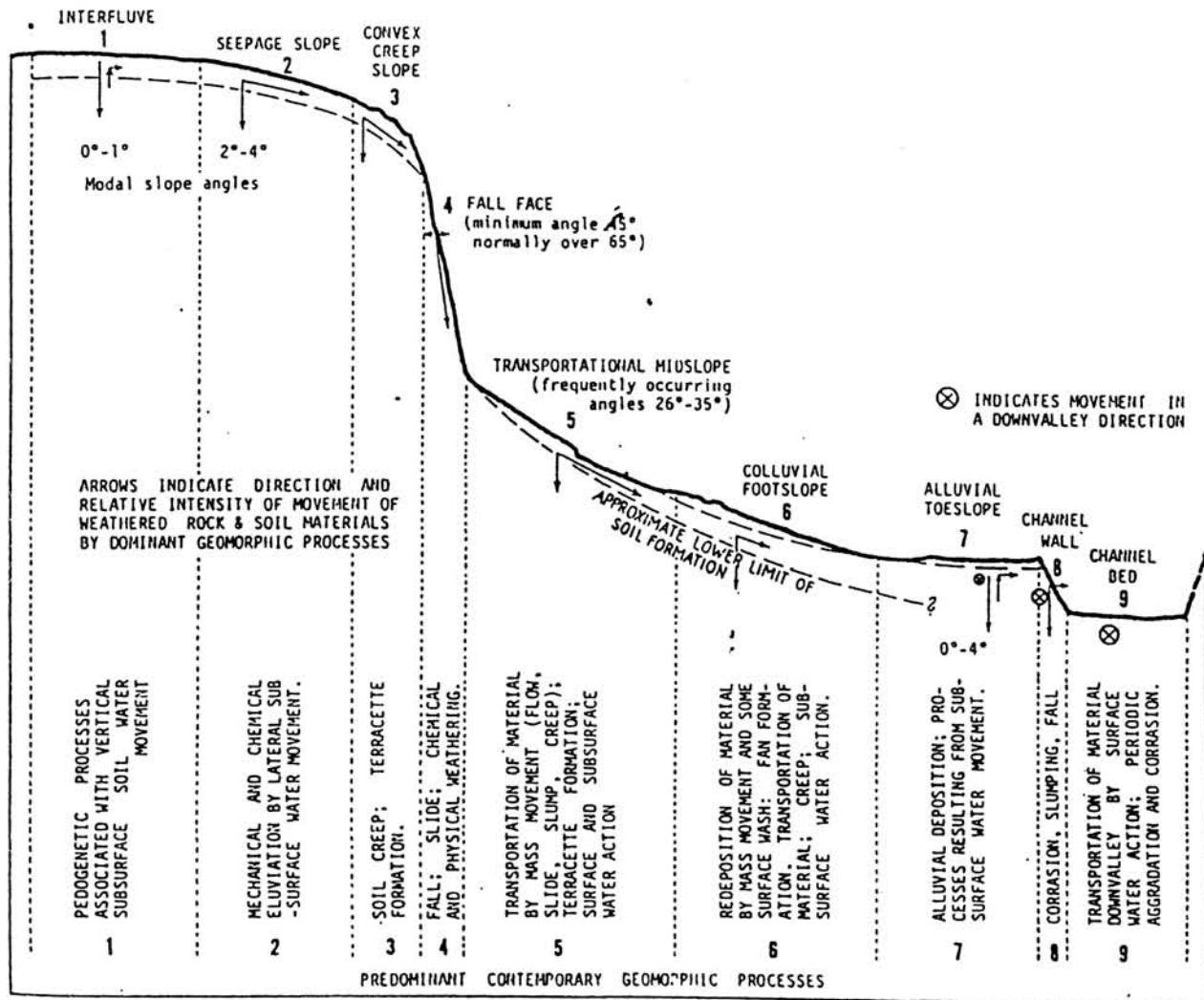
Canopy Tier: _____

Mid Tier: _____

Ground Tier: _____

General Notes and Sketch Map

Figure 3



Ref: Dalrymple, J. Blang, R. & Conacher, A. (1968) A hypothetical nine unit landsurface model. Z. Geomorphology. 12, 60-76.

NZ PROTECTED NATURAL AREAS PROGRAMME
WAITAKERE ECOLOGICAL DISTRICT - SAMPLE SITE CARD - WETLANDS/LAKES

Study Area Name: _____

Date: _____ Site No.: _____

Observer: _____ Map No.: _____ Grid Ref: _____

Tenure: _____ Area (ha): _____ Plot Size: _____

Vegetation Description _____ Ecological Class ☐

Vegetation Name: _____ Vegetation Structures

_____ ☐ + ☐

Sample Site Relationship to Rest of Ecological Unit: _____

Hydrologic Class: (1) Estuarine; (2) Lacustrine; (3) Riverine; ☐
 (4) Palustrine; (5) Marine; (6) Terrestrial

Physical Area ☐ Soil ☐ Geology ☐ Land-form ☐ Bioclimatic Zone ☐

Condition of Sample Site/Ecological Unit

1. Is there evidence of human activity? Yes (Y)/No (N) ☐

- Please state activity and degree of impact: High (H), Medium (M), Low (L) ☐

- Indicate extent of impact, i.e. sample site only or common for entire ecological unit. Code S/E. Comment if impact differs in degree for the ecological unit. ☐

2. Are introduced plants modifying this sample site? Code Y/N. Indicate degree of impact: H, M, L. ☐

Specify species: _____ ☐

Indicate extent of impact: _____

3. Are introduced animals altering the species composition through selective browsing? Y/N. Indicate plant and animal species involved: ☐

Code degree of impact: H, M, L. ☐

4. Are there any natural/physical conditions which are modifying the vegetation in this sample stand/or ecological unit? For example climatic events. Code impact: H, M, L. ☐

Please specify: _____

Naturalness

Code: Don't Know (D); Low (L); Medium (M); High (H) ☐

Dynamics

Indicate whether the vegetation is native (N), exotic (E) or mixed (M). ☐

Is there information available on the historical modification of this site?
State modification, time period and source. _____

Physiognomic Characteristics of Sample Site

1. Is this stand of vegetation a mixture of different dominant structural types? Y/N. If yes, describe the pattern and density of structural types. If no, go to question 2. ☐
- _____
- _____
- _____

2. Is this stand of vegetation a mixture of the same dominant structural types, but of different vegetation communities? Y/N. Describe: ☐
- _____
- _____
- _____
- _____
- _____

Management Requirements

What management effort is needed to maintain this vegetation in, or enable it to return to, its probable original state, as part of a representative system of protected natural areas? Consider animal control, fencing, weed control, time, planting, buffers, etc.

Degree of Effort Required: (L, M, H, D) ☐

COMPOSITION: MAJOR SPECIES IN STRUCTURAL TIERS
WETLANDS/LAKES

	SUBMERGED	FLOATING	LITTORAL	TOP	MID	GROUND
Mean Height cm/m						
Height Range cm/m						
Total Cover %c						
	Species %c	Species %c	Species %c	Species %c	Species %c	Species %c
Species 1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
Water Depth (m)		Wetland Type				
Water Clarity High-Med-Low		% Open Water				

Comments: _____

Observer: _____

Date: _____

Site No: _____

Grid: Q/R

C M G

C M G

C M G

C M G

Trees and
Shrubs

AGA AUS			
ALE EXC			
ALS MAC			
ARI SER			
Δ ASC LUC			
BEI TAR			
BEI TAW			
BRA KIR			
BRA REP			
CAR ARB			
CAR SER			
COP ARB			
COP ARE			
COP CRA			
COP GRA			
COP LUC			
COP MAC			
COP PRO			
COP RHA			
COP ROB			
COP SPA			
COR AUS			
COR BAN			
COR PUM			
COR ARB			
COR BUD			
COR COT			
COR LAE			
CYA JUN			
DAC CUP			
DAC DAC			
DOD VIS			
DRA LAT			
DRA SIN			
DYS SPE			
ELA DEN			
ELA HOO			
ENT ARB			
EPA PAU			
GAU ANT			
FUC EXC			
GEN RUP			
GRI LUC			
+ HAL KIR			
HEB BIS			
HEB MAC			
HEB STR			
HED ARB			
HEL AGG			
HOH POP			
IXE BRE			
KNI EXC			
+ KOR SAL			
KUN ERI			
LAG COL			

LAU NOV			
LEP SCO			
LEU FAS			
LEU FRA			
+ LIB PLU			
LIT CAL			
LOP BUL			
LOP OBC			
MAC EXC			
MEL SIM			
MEL TER			
+ MEL LAN			
MEL MAC			
MEL MIC			
MEL RAM			
MET EXC			
MET ROB			
MID SAL			
MYO LAE			
MYR AUS			
MYR DIV			
MYR SAL			
NES CUN			
NES LAN			
NES MON			
NOT TRU			
Δ+ OLE ALB			
OLE FUR			
OLE RAN			
+ PEN COR			
PER TET			
+ Δ PHE NUD			
PHY GLA			
PHY TRI			
PIM LON			
PIM TOM			
PIT COR			
PIT CRA			
Δ PIT ELL			
PIT EUG			
Δ PIT KIR			
PIT TEN			
Δ PLA COS			
POD HAL			
POD TOT			
POM KUM			
POM ERI			
PSE ANO			
PSE ARB			
PSE CRA			
PSE EDG			
PSE LES			
+ PSE AXI			
PRU FER			
PRU TAX			
QUI SER			
RHA SOL			
RHO SAP			

SCH DIG			
SOL AVI			
SOP MIC			
STR BAN			
STR HET			
SYZ MAI			
TOR TOR			
TUP ANT			
VIT LUC			
+ WEI SIL			

Ferns and
allies

ADI AET			
ADI CUN			
ADI DIA			
ADI FUL			
ADI HIS			
ADI VIR			
ANA LAN			
ART TEN			
ASP BUL			
ASP FLAB			
ASP FLAC			
ASP GRA			
Δ+ ASP HOO			
ASP LAM			
ASP OBL			
ASP POL			
BLE CHA			
Δ BLE COL			
BLE DIS			
BLE FIL			
BLE FLU			
BLE FRA			
BLE MEM			
BLE MIN			
BLE NIG			
BLE PRO			
+ BLE VUL			
BLE BLA			
BLE MOU			
BLE			
BOT AUS			
CHE DIS			
CHE SIE			
CTE HET			
+ CYA CUN			
CYA DEA			
CYA MED			
CYA SMI			
DEP PET			
Δ DIC FIB			
DIC LAN			
DIC SQU			
DIP AUS			
DOO MED			

Δ DOO MOL			
GLE DIC			
GLE MIC			
GRA BIL			
GRA CIL			
GRA PSE			
HIS INC			
HYM ARM			
HYM DEM			
HYM DIL			
HYM FER			
HYM FLA			
+ HYM FLE			
HYM LYA			
HYM MUL			
HYM RAR			
HYM REV			
HYM SAN			
HYM SCA			
HYM			
HYP AMB			
HYP DIC			
HYP LAC			
HYP RUF			
LAS GLA			
LAS HIS			
LAS MIC			
LAS BEL			
LEP NOV			
LEP HYM			
LIN LIN			
LIN TRI			
* LIN VIR			
LYC CER			
LYC DEU			
LYC LAT			
LYC SCA			
LYC VAR			
LYC VOL			
LYG ART			
* MAR SAL			
OPH COR			
+ OPH PET			
PAE SCA			
PEL ROT			
PHY DIV			
PHY SCA			
PNE PEN			
POL RIC			
PTE ESC			
PTE MAC			
PTE PEN			
PTE TRE			
PTE COM			
PYR ELA			
RUM ADI			
SCH BIF			
SCH DIC			

+ HYP DIS

Δ Restricted in Northland but not nationally rare.

+ Low numbers recorded for Waitakere ED

* Rare plant

C M G

C M G

C M G

C M G

SCH FIS			
STI CUN			
* STI FLA			
TME ELO			
TME LAN			
TME SIG			
TME TAN			
TRI ELO			
TRI END			
TRI REN			
TRI STR			
TRI VEN			

Climbers and Lianes

CAL SEP			
CAL TUR			
+ CLE FOR			
CLE PAN			
FRE BAU			
* MET CAR			
MET DIF			
MET FUL			
MET PER			
MUE AUS			
MUE COM			
+ PAR CAP			
PAR HET			
PAS TET			
RIP SCA			
RUB AUS			
RUB CIS			
Δ+ RUB SQU			

Orchids

ACI SIN			
BUL PYG			
* BUL TUB			
CAL CAT			
CAL IRI			
CAL MIN			
CHI COR			
COR ACU			
COR CHE			
COR MAC			
COR OBL			
COR RIV			
COR TRI			
CYR OBL			
DEN CUN			
DRY ADV			
EAR AUT			
EAR MUC			
GAS MIN			
GAS SES			
MIC UNI			

ORT STR			
PRT VOR			
PRA NUD			
* PRA PUM			
PTE ALO			
PTE BAN			
PTE BRU			
PTE GRA			
* PTE PLU			
PTE TRU			
PTE RUB			
THE AEM			
THE CAR			
THE FOR			
THE INT			
THE LON			
THE PAU			
THE IXI			
* YOA AUS			

Other Monocots

AST BAN			
AST GRA			
Δ AST NER			
AST SOL			
AST TRI			
BAU HUT			
BAU JUN			
BAU TEN			
BAU TER			
CAR BRE			
CAR DIS			
CAR FLA			
CAR INV			
CAR LAM			
CAR LES			
CAR MAO			
CAR OCH			
CAR SOL			
CAR SPI			
CAR TES			
COL HAS			
COR FUL			
CYP UST			
DEY TAI			
DIA NIG			
DIC CRI			
DIC INA			
DIC MIC			
ECH OVA			
ELY MUL			
GAH LAC			
GAH PAU			
GAH SET			
GAH XAN			
ISO INU			
ISO NOD			

ISO RET			
JUN AUG			
JUN GRE			
JUN PAL			
JUN PAU			
JUN SAR			
LAC FIL			
LEP AUS			
LEP LAT			
LIB GRA			
LIB IXI			
LIB PUL			
LUZ BAN			
LUZ PIC			
MAC SIN			
MIC AVE			
+ MIC POL			
MIC STI			
MOR AFF			
OPL IMB			
PHO COO			
PHO TEN			
POA ANC			
POA PUS			
RYT BIA			
RYT CLA			
RYT GRA			
RYT SET			
RYT UNA			
SCH BRE			
SCH MAS			
SCH TEN			
TET CAP			
UNC BAN			
UNC FER			
UNC LAX			
UNC LEP			
UNC UNC			
UNC ZOT			

Dicot Herbs

ACA ANS			
ACA NOV			
ANA KER			
Δ CEL GRA			
CEN UNI			
CEN ORB			
COT COR			
Δ DAU GLO			
DIC REP			
ELA RUG			
EPI BIL			
EPI NER			
EPI NUM			
EPI PUB			
EPI ROT			
GAL PRO			

GER POT			
GER RET			
GNA DEL			
GNA GYM			
GON INC			
GON MIC			
HAL ERE			
HYD DIS			
HYD ELO			
HYD MOS			
HYD NOV			
HYD PTE			
HYP JAP			
LAG PUM			
MEN CUN			
MYO PET			
NER DEP			
NER DIC			
NER SET			
PEP URB			
PLA RAO			
PRA ANG			
RAN REF			
SCA ROS			
SEN GLO			
SEN HIS			
SEN MIN			
SEN QUA			
SON KIR			
VIO FIL			
WAH GRA			
WAH NAU			

APPENDIX 3A2**CRITERIA FOR RANKING WILDLIFE HABITATS AS SITES OF SPECIAL WILDLIFE SIGNIFICANCE (SSWI)****1. Outstanding**

- (a) Presence of a breeding population of a highly endangered or rare endemic species.
- (b) A population of an endemic species of very restricted distribution and which could become endangered.
- (c) Areas essential to species from (a) and (b) for purposes other than breeding.
- (d) Areas of vital importance to internationally uncommon species (breeding and/or migratory).
- (e) Areas of vital importance to internally migratory species with very limited distribution or abundance.
- (f) Largely unmodified ecosystem or example of original habitat type not represented elsewhere in the country, of large size and containing viable populations of all or almost all species which are typical of the ecosystem or habitat type.

2. High

- (a) Habitat containing an indigenous species which has declined significantly through man's influence.
- (b) One of few or the only breeding area for a non-endemic indigenous species of limited abundance.
- (c) Habitat of an uncommon, discontinuously distributed species not adequately represented in a particular ecological region.
- (d) Example of a largely unmodified habitat which is not represented to the same extent elsewhere in the ecological region and is used by most species which are typical of that habitat type for the region.
- (e) Presence of a species of an endemic family which is of limited abundance throughout the country although adequately represented in one ecological region but whose habitat is at some risk.

3. Moderate-High

- (a) Presence of a species which is still quite widely distributed but whose habitat has been and still is being significantly reduced or modified through man's influence.
- (b) Areas containing high numbers of breeding or moulting birds, or where breeding or moulting areas are of inter-regional significance to wildlife.
- (c) A large and fairly unmodified habitat or ecosystem which is represented elsewhere in the ecological region and contains all or almost all species typical of that habitat type for a particular region.

- (d) An area where any particular species is exceptional in terms of say, abundance or behaviour but which is otherwise widespread.

4. **Moderate**

All habitats supporting good numbers of species which are typical of that particular habitat within an ecological region and which is otherwise widespread.

5. **Potential**

All areas of some wildlife significance which are limited by size, heavy modification or other reasons, but are of potential wildlife value if left to regenerate or are managed or developed for wildlife. (May include habitat which functions as a corridor or is sub-optimal habitat which is necessary for maintaining genetic diversity).

APPENDIX 4**SPECIES LIST OF NATIVE HIGHER PLANTS IN THE WAITAKERE ECOLOGICAL DISTRICT**

E	Endangered
V	Vulnerable
R	Rare
I	Indeterminate
L	Local
UR	Uncommon throughout their range
UW	Uncommon in the Waitakere Ecological District

GYMNOSPERM TREES AND SHRUBS

<i>Agathis australis</i>		kauri
<i>Dacrycarpus dacrydioides</i>		kahikatea
<i>Dacrydium cupressinum</i>		rimu
<i>Halocarpus kirkii</i>	UW	Kirk's pine, monoao
<i>Lagarostrobos colensoi</i>	UW	silver pine
<i>Libocedrus plumosa</i>		kawaka
<i>Phyllocladus glaucus</i>		toatoa
<i>Phyllocladus trichomanoides</i>		tanekaha
<i>Podocarpus hallii</i>		Hall's totara
<i>Podocarpus totara</i>		lowland totara
<i>Prumnopitys ferruginea</i>		miro
<i>Prumnopitys taxifolia</i>		matal

MONOCOTYLEDONOUS TREES AND SHRUBS

<i>Cordyline australis</i>		cabbage tree
<i>Cordyline banksii</i>		forest cabbage tree
<i>Cordyline pumilio</i>		dwarf cabbage tree
<i>Rhopalostylis sapida</i>		nikau

DICOTYLEDONOUS TREES AND SHRUBS

<i>Alectryon excelsus</i>		titoki
<i>Alseuosmia macrophylla</i>		toropapa
<i>Aristotelia serrata</i>		wineberry
<i>Ascarina lucida</i>	UW	hutu
<i>Avicennia marina</i>		mangrove
<i>Beilschmiedia tarairi</i>		taraire
<i>Beilschmiedia tawa</i>		tawa
<i>Brachyglottis kirkii</i> var. <i>angustior</i>	UR	Kirk's daisy
<i>Brachyglottis kirkii</i> var. <i>kirkii</i>	UR	Kirk's daisy
<i>Brachyglottis repanda</i>		rangiora
<i>Carmichaelia arborea</i>		broom
<i>Carpodetus serratus</i>		putaputaweta
<i>Cassinia leptophylla</i> (incl. <i>C. aligera</i>)		tauhinu

<i>Coprosma acerosa</i>	UW	sand coprosma
<i>Coprosma arborea</i>		mamangi
<i>Coprosma areolata</i>		thin-leaved coprosma
<i>Coprosma crassifolia</i>		stiff-stemmed coprosma
<i>Coprosma grandifolia</i>		kanono
<i>Coprosma lucida</i>		karamu
<i>Coprosma macrocarpa</i>		karamu
<i>Coprosma propinqua</i>		mingimingi
<i>Coprosma repens</i>		taupata
<i>Coprosma rhamnoides</i>		
<i>Coprosma robusta</i>		karamu
<i>Coprosma spathulata</i>		
<i>Coprosma tenuicaulis</i>		swamp coprosma
<i>Coriaria arborea</i>		tutu
<i>Corokia buddleioides</i>		korokio
<i>Corokia cotoneaster</i>		mountain korokio
<i>Corynocarpus laevigatus</i>		karaka
<i>Cyathodes juniperina</i>		prickly mingimingi
<i>Dodonaea viscosa</i>		akeake
<i>Dracophyllum latifolium</i>		neinei
<i>Dracophyllum sinclairii</i>		
<i>Dysoxylum spectabile</i>		kohekohe
<i>Elaeocarpus dentatus</i>		hinau
<i>Elaeocarpus hookerianus</i>	UW	pokaka
<i>Entelea arborescens</i>		whau
<i>Epacris pauciflora</i>		tamingi
<i>Fuchsia excorticata</i>		kotukutuku
<i>Fuchsia procumbens</i>		
<i>Gaultheria antipoda</i>		bush snowberry
<i>Geniostoma rupestre</i>		hangehange
<i>Griselinia lucida</i>		puka
<i>Hebe macrocarpa</i>		koromiko
<i>Hebe obtusata</i>		hebe
<i>Hebe pubescens</i>		koromiko
<i>Hebe stricta</i>		koromiko
" <i>Hebe bishopiana</i> "	R	hebe
<i>Hedycarya arborea</i>		pigeonwood
<i>Helichrysum lanceolatum</i> (incl. <i>H. aggregatum</i>)		niniao
<i>Hoheria populnea</i>		lacebark
<i>Ileostylus micranthus</i>		mistletoe (historical record)
<i>Ixerba brexioides</i>		tawari
<i>Knightia excelsa</i>		rewarewa
<i>Korthalsella salicornioides</i>	UW	
<i>Kunzea ericoides</i>		kanuka
<i>Laurelia novae-zelandiae</i>		pukatea
<i>Leptospermum scoparium</i>		manuka
<i>Leptospermum sinclairii</i>		Sinclair's tea tree
<i>Leucopogon fasciculatus</i>		mingimingi
<i>Leucopogon fraseri</i>		patotara
<i>Litsea calicaris</i>		mangeao
<i>Lophomyrtus bullata</i>		ramarama
<i>Lophomyrtus obcordata</i>	UW	rohutu
<i>Macropiper excelsum</i>		kawakawa
<i>Melicope simplex</i>		poataniwha
<i>Melicope ternata</i>		wharangi
<i>Melicytus lanceolata</i>	UW	narrow-leaved mahoe
<i>Melicytus macrophyllus</i>		large-leaved mahoe
<i>Melicytus micranthus</i>		manakura
<i>Melicytus ramiflorus</i>		mahoe

<i>Metrosideros excelsa</i>		pohutukawa
<i>Metrosideros robusta</i>		northern rata
<i>Mida salicifolia</i>		maire taiki
<i>Myoporum laetum</i>		ngaio
<i>Myrsine australis</i>		mapou
<i>Myrsine divaricata</i>	UW	
<i>Myrsine salicina</i>		toro
<i>Nestegis cunninghamii</i>	UW	black maire
<i>Nestegis lanceolata</i>		white maire
<i>Nestegis montana</i>		maire rauriki
<i>Nothofagus truncata</i>	UW	hard beech
<i>Olearia albida</i>	UW	tree daisy
<i>Olearia furfuracea</i>		akepiro
<i>Olearia rani</i>		heketara
<i>Olearia solandri</i>		tree daisy
<i>Pennantia corymbosa</i>	UW	kaikomako
<i>Peraxilla tetrapetala</i>		red mistletoe (historical record)
<i>Phebalium nudum</i>		mairehau
<i>Pimelea arenaria</i>	I	sand pimelea
<i>Pimelea longifolia</i>		long-leaved pimelea
<i>Pimelea prostrata</i>		Strathmore weed
<i>Pimelea tomentosa</i>	I (V)	tomentose pimelea
<i>Pittosporum cornifolium</i>		tawhirikaro
<i>Pittosporum crassifolium</i>		karo
<i>Pittosporum ellipticum</i>		
<i>Pittosporum eugenioides</i>		tarata/lemonwood
<i>Pittosporum kirkii</i>		Kirk's pittosporum
<i>Pittosporum tenuifolium</i>		kohuhu
<i>Plagianthus divaricatus</i>		marsh ribbonwood
<i>Planchonella costata</i>		tawapou
<i>Pomaderris kumerahou</i>		kumarahou
<i>Pomaderris phylicifolia</i>		tauhinu
<i>Pseudopanax anomalus</i>		
<i>Pseudopanax arboreus</i>		five finger/whauwhaupaku
<i>Pseudopanax crassifolius</i>		lancewood
<i>Pseudopanax edgerleyi</i>		raukawa
<i>Pseudopanax lessonii</i>		houpara
<i>Pseudowintera axillaris</i>	UW	horopito
<i>Quintinia serrata</i>		tawheowheo
<i>Rhabdothamnus solandri</i>		taurepo
<i>Schefflera digitata</i>		pate
<i>Solanum aviculare</i>		poroporo
<i>Sophora microphylla</i> var. <i>microphylla</i>		kowhai
<i>Sophora microphylla</i> var. <i>fulvida</i>		kowhai
<i>Streblus banksii</i>	UW	coast milk tree
<i>Streblus heterophyllus</i>		turepo
<i>Syzygium maire</i>		maire tawake
<i>Toronia toru</i>		toru
<i>Tupeia antarctica</i>	L	mistletoe
<i>Vitex lucens</i>		puriri
<i>Weinmannia silvicola</i>	UW	towai

MONOCOTYLEDONOUS LIANES

<i>Freycinetia baueriana</i>	kiekie
<i>Ripogonum scandens</i>	supplejack

DICOTYLEDONOUS LIANES AND RELATED TRAILING PLANTS

<i>Calystegia sepium</i>	bindweed
<i>Calystegia soldanella</i>	shore bindweed
<i>Calystegia tuguriorum</i>	convolvulus
<i>Clematis forsteri</i>	clematis
<i>Clematis paniculata</i>	clematis
<i>Metrosideros carminea</i>	carmine rata
<i>Metrosideros diffusa</i>	white climbing rata
<i>Metrosideros fulgens</i>	rata vine
<i>Metrosideros perforata</i>	small white rata
<i>Muehlenbeckia australis</i>	pohuehue
<i>Muehlenbeckia complexa</i>	pohuehue
<i>Parsonsia capsularis</i>	pink jasmine
<i>Parsonsia heterophylla</i>	NZ jasmine
<i>Passiflora tetrandra</i>	NZ passionfruit
<i>Rubus australis</i>	bush lawyer
<i>Rubus cissoides</i>	bush lawyer
<i>Rubus squarrosus</i>	bush lawyer

PSILOPSIDS, LYCOPODS, AND QUILLWORTS

<i>Lycopodium cernuum</i>	creeping club-moss
<i>Lycopodium deuterodensum</i>	tree club-moss
<i>Lycopodium laterale</i>	bog club-moss
<i>Lycopodium scariosum</i>	mountain club-moss
<i>Lycopodium varium</i> (incl. <i>L. billarderei</i>)	nodding club-moss
<i>Lycopodium volubile</i>	climbing club-moss
<i>Tmesipteris elongata</i>	
<i>Tmesipteris lanceolata</i>	
<i>Tmesipteris sigmatifolia</i>	
<i>Tmesipteris tannensis</i> ssp. <i>robusta</i>	
<i>Tmesipteris tannensis</i> ssp. <i>tannensis</i>	

FERNS

<i>Adiantum aethiopicum</i>	true maidenhair
<i>Adiantum cunninghamii</i>	common maidenhair
<i>Adiantum diaphanum</i>	small maidenhair
<i>Adiantum fulvum</i>	maidenhair
<i>Adiantum hispidulum</i>	rosy maidenhair
<i>Adiantum viridescens</i>	
<i>Anarthropteris lanceolata</i>	
<i>Arthropteris tenella</i>	
<i>Asplenium bulbiferum</i>	hen & chicken fern
<i>Asplenium flabellifolium</i> agg.	
<i>Asplenium flaccidum</i>	hanging spleenwort
<i>Asplenium gracillimum</i>	
<i>Asplenium hookerianum</i>	UW
<i>Asplenium lamprophyllum</i>	
<i>Asplenium oblongifolium</i>	shining spleenwort
<i>Asplenium northlandicum</i>	UW

<i>Asplenium polyodon</i>		sickle spleenwort
<i>Asplenium terrestre</i> subsp. <i>maritimum</i>	UW	
<i>Azolla filiculoides</i>		floating fern
<i>Blechnum banksii</i>	UW	
<i>Blechnum chambersii</i>		rereti
<i>Blechnum colensoi</i>	UW	peretao
<i>Blechnum discolor</i>		crowii fern
<i>Blechnum filiforme</i>		thread fern
<i>Blechnum fluviatile</i> agg.		kiwikiwi
<i>Blechnum fraseri</i>		hardfern
<i>Blechnum membranaceum</i>		
<i>Blechnum minus</i>		
<i>Blechnum nigrum</i>	UW	
<i>Blechnum procerum</i>		
<i>Blechnum vulcanicum</i>	UW	
" <i>Blechnum</i> blackspot lowland"		kiokio
" <i>Blechnum</i> mountain"		kiokio
" <i>Blechnum</i> Green Bay cliff"		kiokio
<i>Botrychium australe</i>		parsley fern
<i>Cheilanthes distans</i>		
<i>Cheilanthes sieberi</i>		rock fern
<i>Ctenopteris heterophylla</i>		
<i>Cyathea cunninghamii</i>	UW	gully fern (local in District)
<i>Cyathea dealbata</i>		ponga, silver treefern
<i>Cyathea medullaris</i>		mamaku, black treefern
<i>Cyathea smithii</i>		soft treefern
<i>Deparia petersenii</i>		
<i>Dicksonia fibrosa</i>	UW	weki-ponga
<i>Dicksonia lanata</i>		stemless treefern
<i>Dicksonia squarrosa</i>		weki
<i>Diplazium australe</i>		
<i>Doodia media</i>		pukupuku
<i>Doodia mollis</i>	UR	mokimoki
<i>Gleichenia dicarpa</i>		swamp umbrella fern
<i>Gleichenia microphylla</i>		waewaekaka
<i>Grammitis billardierei</i>		
<i>Grammitis ciliata</i>		
<i>Grammitis pseudociliata</i>		
<i>Histiopteris incisa</i>		water fern
<i>Hymenophyllum armstrongii</i>		filmy fern
<i>Hymenophyllum demissum</i>		filmy fern
<i>Hymenophyllum dilatatum</i>		filmy fern
<i>Hymenophyllum ferrugineum</i>		filmy fren
<i>Hymenophyllum flabellatum</i>		filmy fern
<i>Hymenophyllum flexuosum</i>		filmy fern
<i>Hymenophyllum lyallii</i>		filmy fern
<i>Hymenophyllum multifidum</i>		filmy fern
<i>Hymenophyllum rarum</i>		filmy fern
<i>Hymenophyllum revolutum</i>		filmy fern
<i>Hymenophyllum sanguinolentum</i> agg.		filmy fern
<i>Hymenophyllum scabrum</i>		filmy fern
<i>Hypolepis ambigua</i>		
<i>Hypolepis dicksonioides</i>		
<i>Hypolepis distans</i>	UW	(rare in District)
<i>Hypolepis rufo-barbata</i>		
<i>Lastreopsis glabella</i>		
<i>Lastreopsis hispida</i>		
<i>Lastreopsis microsora</i>		
<i>Lastreopsis velutina</i>	UW	

<i>Leptolepia novae-zelandiae</i>	UW	
<i>Leptopteris hymenophylloides</i>		crepe fern
<i>Lindsaea linearis</i>		
<i>Lindsaea trichomanoides</i>		
<i>Lindsaea viridis</i>	UR	
<i>Loxoma cunninghamii</i>	L	(historical record)
<i>Lygodium articulatum</i>		mangemange
<i>Marattia salicina</i>	R	king fern
<i>Ophioglossum coriaceum</i> agg.	UR	adder's tongue
<i>Ophioglossum petiolatum</i>	V	
<i>Paesia scaberula</i>		ring fern
<i>Pellaea falcata</i>		
<i>Pellaea rotundifolia</i>		
<i>Phymatosorus diversifolius</i>		hounds tongue fern
<i>Phymatosorus scandens</i>		fragrant fern
<i>Pneumatopteris pennigera</i>		paakau
<i>Polystichum richardii</i>		shield fern
<i>Pteridium esculentum</i>		bracken
<i>Pteris macilenta</i>		
<i>Pteris pendula</i>		
<i>Pteris tremula</i>		
" <i>Pteris comans</i> NZ"		
<i>Pyrrosia eleagnifolia</i>		leather-leaf fern
<i>Rumohra adiantiformis</i>		
<i>Schizaea bifida</i>		
<i>Schizaea dichotoma</i>		fan fern
<i>Schizaea fistulosa</i>		comb fern
<i>Sticherus cunninghamii</i>		umbrella fern
<i>Sticherus flabellatus</i>	UW	
<i>Todea barbara</i>		
<i>Trichomanes elongatum</i>		bristle fern
<i>Trichomanes endlicherianum</i>		
<i>Trichomanes reniforme</i>		kidney fern
<i>Trichomanes strictum</i>		
<i>Trichomanes venosum</i>		veined bristle-fern

ORCHIDS

<i>Acianthus sinclairii</i>		giant orchid
<i>Bulbophyllum pygmaeum</i>		bulb-leaf orchid
<i>Bulbophyllum tuberculatum</i>	L	bulb-leaf orchid
<i>Caladenia catenata</i>		
<i>Caladenia iridescens</i>		
<i>Caladenia minor</i>		
<i>Chiloglottis cornuta</i>		
<i>Corybas acuminatus</i>		spider orchid
<i>Corybas cheesemanii</i>		spider orchid
<i>Corybas macranthus</i>		spider orchid
<i>Corybas oblongus</i>		spider orchid
<i>Corybas rivularis</i>		spider orchid
<i>Corybas trilobus</i>		spider orchid
<i>Cyrtostylis oblonga</i>		
<i>Dendrobium cunninghamii</i>		
<i>Drymoanthus adversus</i>		
<i>Earina autumnalis</i>		easter orchid
<i>Earina mucronata</i>		spring orchid

Gastrodia minor		
Gastrodia sesamoides		
Microtis unifolia		malkaika
Orthoceras strictum		horned orchid
"Orthoceras viride"		(colour variant)
Prasophyllum nudum		
Prasophyllum pumilum		
Pterostylis alobula		
Pterostylis banksii		hooded orchid
Pterostylis brumalis		
Pterostylis cardiostigma		
Pterostylis graminea		
Pterostylis plumosa		
Pterostylis trullifolia		
"Pterostylis rubricaulis"		
Thelymitra aemula		sun orchid
Thelymitra carnea		sun orchid
Thelymitra formosa		sun orchid
Thelymitra intermedia		sun orchid
Thelymitra longifolia		white sun orchid
Thelymitra cf. pauciflora		sun orchid
Thelymitra pulchella		blue sun orchid
Thelymitra tholyformis	R	
"Thelymitra aff. ixioides"		sun orchid
"Thelymitra ixioides"		sun orchid
Yoania australis	L	

GRASSES

Cortaderia fulvida		toetoe
Cortaderia splendens		coastal toetoe
Deyeuxia billardierei		sand wind grass
Deyeuxia quadriseta		spiked bent grass
Dichelachne crinita		long-hair plume-grass
Dichelachne inaequiglumis		short-hair plume-grass
Dichelachne micrantha		purple plume-grass
Echinopogon ovatus		hedgehog grass
Elymus multiflorus		wheat grass
Elymus rectisetus		blue wheat grass
Isachne globosa		swamp millet
Lachnagrostis filiformis var. filiformis		NZ wind grass
Lachnagrostis filiformis var. littoralis		
Microlaena avenacea		forest rice grass
Microlaena polynoda		native bamboo
Microlaena stipoides		meadow rice grass
Oplismenus imbecillis		slender panic grass
Poa anceps		plumed tussock
Poa pusilla		slender tussock
Rytidosperma biannulare		danthonia
Rytidosperma clavatum		danthonia
Rytidosperma gracile		danthonia
Rytidosperma setifolium		danthonia
Rytidosperma unarede		danthonia
Spinifex sericeus		silvery sand grass
Stipa stipoides		wind grass
Trisetum antarcticum	UW	shining oat grass

Zoysia pauciflora
Zoysia planifolius

SEDGES

<i>Baumea articulata</i>		jointed twig rush
<i>Baumea complanata</i>	E	(historical record)
<i>Baumea huttonii</i>		sedge tussock
<i>Baumea juncea</i>		sedge tussock
<i>Baumea rubiginosa</i>		sedge tussock
<i>Baumea tenax</i>		sedge tussock
<i>Baumea teretifolia</i>		pakihi rush
<i>Bulboschoenus medianus</i>		purua grass
<i>Bulboschoenus fluviatilis</i>		purua grass
<i>Carex breviculmis</i>		grassland sedge
<i>Carex dissita</i>		flat leaved sedge
<i>Carex flagellifera</i>		Glen Murray tussock
<i>Carex inversa</i>		creeping lawn sedge
<i>Carex lambertiana</i>		
<i>Carex lessoniana</i>		rautahi
<i>Carex maorica</i>		cyperus sedge
<i>Carex ochrosaccus</i>		
<i>Carex pumila</i>		sand sedge
<i>Carex secta</i>		niggerhead
<i>Carex solandri</i>		Solander's sedge
<i>Carex spinirostris</i>		
<i>Carex testacea</i>		speckled sedge
<i>Carex virgata</i>		small swamp sedge
<i>Cyperus ustulatus</i>		giant umbrella sedge
<i>Desmoschoenus spiralis</i>	L	pingao
<i>Eleocharis acuta</i>		spike rush
<i>Eleocharis gracilis</i>		spike rush
<i>Eleocharis neozelandica</i>	V	spike rush
<i>Eleocharis sphacelata</i>		tall spike rush
<i>Gahnia lacera</i>		cutty grass
<i>Gahnia pauciflora</i>		cutty grass
<i>Gahnia setifolia</i>		cutty grass
<i>Gahnia xanthocarpa</i>		cutty grass
<i>Isolepis cernua</i>		drooping club rush
<i>Isolepis distigmatica</i>		(presence doubted)
<i>Isolepis inundata</i>		swamp club rush
<i>Isolepis nodosa</i>		club rush
<i>Isolepis prolifer</i>		
<i>Isolepis reticularis</i>		
<i>Lepidosperma australe</i>		square-stemmed sedge
<i>Lepidosperma laterale</i>		sword sedge
<i>Machaerina sinclairii</i>		tuhara
<i>Morelotia affinis</i>		cutty grass
<i>Schoenoplectus pungens</i>		club rush
<i>Schoenoplectus validus</i>		club rush
<i>Schoenus apogon</i>		bog rush
<i>Schoenus brevifolius</i>		bog rush
<i>Schoenus maschalinus</i>		bog rush
<i>Schoenus tendo</i>		wiiwii
<i>Tetraria capillaris</i>		twig rush
<i>Uncinia banksii</i>		leafy hook sedge

<i>Uncinia ferruginea</i>		hook sedge
<i>Uncinia laxiflora</i>		hook sedge
<i>Uncinia leptostachya</i>		tall hook sedge
<i>Uncinia uncinata</i>		hook sedge
<i>Uncinia zotovii</i>		hook sedge

RUSHES AND ALLIED PLANTS

<i>Juncus australis</i>		rush
<i>Juncus caespiticius</i>		rush
<i>Juncus gregiflorus</i>		rush
<i>Juncus holoschoenus</i>	I	rush
<i>Juncus maritimus</i>		wiwi
<i>Juncus pallidus</i>		giant rush
<i>Juncus pauciflorus</i>		leafless rush
<i>Juncus planifolius</i>		grass-leaved rush
<i>Juncus prismatocarpus</i>		rush
<i>Juncus sarophorus</i>		wiwi
<i>Leptocarpus similis</i>		coastal jointed rush
<i>Luzula banksiana</i>		wood rush
<i>Luzula picta</i>		wood rush

MONOCOTYLEDONOUS HERBS OTHER THAN GRASSES, SEDGES, RUSHES AND ALLIED PLANTS

<i>Arthropodium cirratum</i>		rengarenga rock lily
<i>Astelia banksii</i>		coastal astelia
<i>Astelia fragrans</i>	UW	(presence doubted)
<i>Astelia grandis</i>		giant astelia
<i>Astelia nervosa</i>	UW	bush lily
<i>Astelia solandri</i>		perching lily
<i>Astelia trinervia</i>		kauri grass
<i>Collospermum hastatum</i>		kahakaha
<i>Dianella nigra</i>		turutu (NZ blueberry)
" <i>Lemna minor</i> NZ"		duckweed
<i>Libertia grandiflora</i>		large flowered iris
<i>Libertia ixioides</i>		native iris
<i>Libertia peregrinans</i>	I	(historical record)
<i>Libertia pulchella</i>	UW	forest iris
<i>Phormium cookianum</i>		mountain flax
<i>Phormium tenax</i>		flax
<i>Potamogeton cheesemanii</i>		red pondweed
<i>Potamogeton ochreatus</i>		pondweed
<i>Ruppia polycarpa</i>		tassel pondweed
<i>Sparganium subglobosum</i>	UW	burr reed
<i>Triglochin striata</i>		arrow grass
<i>Typha orientalis</i>		bulrush/raupo
<i>Zostera capricorni</i>		eel grass

DICOTYLEDONOUS HERBS : COMPOSITES

Anaphalis keriensis		
Celmisia gracilentia		cotton grass
Celmisia major var major		
Centipeda orbicularis		
Cotula coronopifolia		Bachelor's button
Gnaphalium audax		
Gnaphalium delicatum		cudweed
Gnaphalium gymnocephalum		cudweed
Lagenifera pumila		native daisy
Leptinella rotundata	V	shore cotula (historical record)
Leptinella squalida		
Leptinella tenella		
Senecio glomeratus		woolly fireweed
Senecio hispidulus		scabrid fireweed
Senecio lautus		shore groundsel
Senecio minimus		common fireweed
Senecio quadridentatus		cotton fireweed
Senecio rufiglandulosus		/
Sonchus kirkii		sow thistle

DICOTYLEDONOUS HERBS OTHER THAN COMPOSITES

Acaena anserinifolia		bidibid
Acaena novae-zelandiae		red burr
Apium prostratum		shore celery
Callitriche muelleri		water starwort
Centella uniflora		marsh pennywort
Chenopodium glaucum		glaucus goosefoot
Crassula sieberiana		stonecrop
Dactylanthus taylorii		wooden rose (historical record)
Daucus glochidiatus	UW	NZ wild carrot
Dichondra repens		creeping dichondra
Disphyma australe		NZ ice plant
Drosera binata		sundew
Drosera peltata		sundew
Einadia trigonos		berry salt bush
Elatostema rugosum		parataniwha
Epilobium billardioreanum		red-stemmed willow herb
Epilobium brunnescens		
Epilobium chionathum		pale-leaved willow herb
Epilobium hirtigerum		
Epilobium nerteroides		wrinkled willow herb
Epilobium nummulariifolium		creeping willow herb
Epilobium pallidiflorum		swamp willow herb
Epilobium pubens		soft leaved willow herb
Epilobium rotundifolium		round leaved willow herb
Galium propinquum		bed straw
Geranium potentilloides		Crane's bill
Geranium retrosorum		Crane's bill
Glossostigma elatinoides		
Gonocarpus incanus		piripiri
Gonocarpus micranthus		sand gunnera
Gunnera dentata		solitary gunnera
Gunnera monoica		

<i>Haloragis erecta</i>		toatoa
<i>Hydrocotyle dissecta</i>		marsh pennywort
<i>Hydrocotyle elongata</i>		long stemmed marsh p.wort
<i>Hydrocotyle moschata</i>		sharp-toothed marsh pennywort
<i>Hydrocotyle novae-zeelandiae</i>		NZ marsh pennywort
<i>Hydrocotyle pterocarpa</i>	UW	
<i>Hypericum japonicum</i>		swamp hypericum
<i>Lepidium flexicaule</i>	V	(historical record)
<i>Lepidium obtusatum</i>		(historical record)
<i>Lepidium oleraceum</i>	V	(historical record)
<i>Lilaeopsis novae-zelandiae</i>		
<i>Limosella lineata</i>		
<i>Linum monogynum</i>		native flax
<i>Lobelia anceps</i>		shore lobelia
<i>Mentha cunninghamii</i>		native mint
<i>Myosotis forsteri</i>		forget-me-not
<i>Myosotis petiolata</i> var. <i>pansa</i>	L	forget-me-not
<i>Myosotis pygmaea</i>		small flowered forget-me-not
<i>Myriophyllum propinquum</i>		water milfoil
<i>Myriophyllum triphyllum</i>		water milfoil
<i>Myriophyllum votschii</i>		small water milfoil
<i>Nertera depressa</i>		duckweed
<i>Nertera dichondrifolia</i>		nertera
<i>Nertera setulosa</i>		nertera
<i>Oxalis magellanica</i>		white wood-sorrel
<i>Oxalis rubens</i>		wood-sorrel
<i>Parietaria debilis</i>		pellitory
<i>Peperomia urvilleana</i>		
<i>Plantago raoulii</i>		kopakopa
<i>Polygonum salicifolium</i>		swamp willow weed
<i>Pratia angulata</i>		panakenake
<i>Ranunculus acaulis</i>		shore buttercup
<i>Ranunculus amphitrichus</i>		water buttercup
<i>Ranunculus reflexus</i>		
<i>Ranunculus urvilleanus</i>	R	hairy buttercup
<i>Samolus repens</i>		shore pimpernel
<i>Sarcocornia quinqueflora</i>		glasswort
" <i>Scandia rosifolia</i> "	UW	aniseed
<i>Scleranthus biflorus</i>	UW	kohukohu
<i>Selliera radicans</i>		remuremu
<i>Solanum americanum</i>		
<i>Spergularia media</i>		salt marsh sand-spurry
<i>Stellaria decipiens</i>		chickweed
<i>Suaeda novae-zelandiae</i>		sea blight
<i>Tetragonia trigyna</i>		iceplant/NZ spinach
<i>Utricularia australis</i>	I	bladderwort
<i>Viola filicaulis</i>		slender violet
<i>Wahlenbergia gracilis</i>		harebell
" <i>Wahlenbergia</i> N. Auckland"		harebell

This list is based on Gardner (1982) with recent additions from the PNAP field survey, and from information provided by Auckland Botanical Society members (particularly Sandra Jones and Ewan Cameron) and Auckland Botanical Society literature (including Gardner's own additions).

Nomenclature based on Druce (1989).

Common names taken from Healy (1984) where present, and from common knowledge. Maori names taken from Beever (1987).

Varieties provided by Ewen Cameron, Herbarium Curator, Botany Department, University of Auckland (Note: varieties are only provided for species in which two or more varieties are present in the District).

Information on status of threatened species provided by David Given, DSIR, Christchurch.

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APPENDIX 5

WEEDS IN THE WAITAKERE ECOLOGICAL DISTRICT

Some weeds have reached such proportions in some areas of New Zealand that they are virtually impossible to eradicate. In the Waitakere Ranges most of the threatening weeds are at a stage where they are controllable. It is vital that the threatening plants are identified and controlled **now** before they become unmanageable.

1. Aim to remove, confine or reduce threatening plants such as ginger, selaginella and mist flower. Where control is very difficult or expensive it may be necessary to concentrate on a few areas to keep some examples of natural habitats eg keep a few streams free of mist flower instead of trying unsuccessfully to control the weed in every stream.
2. Leave transitory plants such as gorse and prickly hakea to act as nursery plants for shade tolerant native seedlings. The weeds will be overwhelmed by the native plants in the succession to forest. Removal of transitory weeds may increase erosion or fire risk and may actually facilitate the increase of weed species by perpetuating the conditions which favour them.
3. Educate the public about the threats of dumping garden refuse and where possible encourage them to remove threatening weeds (particularly those such as wild ginger which will not be confused with native species), or report infestations to the appropriate authorities.

The following weeds have been listed by Esler (1988) as being among the thirteen primary threatening weeds of urban Auckland;

Asparagus asparagoides - smilax, introduced as an ornamental. Bird-dispersed seeds, twine around other plants, occupy subcanopy position (cf most other vines which are canopy dwellers), obstructive and suppressive (shades native plants). Few smilax plants were found in the Waitakere Ranges during the PNAP survey, but there is a high potential for it to spread.

Asparagus scandens - climbing asparagus, introduced as an ornamental. Windborne seed, subcanopy position, kills natives by strangulation (tightly encircling asparagus vine ringbarks the trunk of the supporting tree). More common than smilax in the Waitakeres, and potentially much more troublesome. Found around Titirangi and Cornwallis at present.

Cortaderia jubata - purple pampas grass. Windborne seeds travel for many kilometres, infest disturbed areas and cliff faces. Obstructive and suppressive to native vegetation but is relatively shortlived and may be overtopped by native plants where the stands are not too dense. Greatest threat is fire hazard. Very abundant in the Waitakere Ranges on cliff faces, open coastal areas and disturbed sites such as slips and sites that have been destroyed by fire.

Cortaderia selloana - pampas grass. Windborne seeds. Obstructive and suppressive to native plants, more so than purple pampas because this forms larger clumps, lives longer and is more slowly replaced by native vegetation. Appears to be less abundant than purple pampas grass in the Waitakere Ranges.

Elaeagnus x reflexa - Elaeagnus. Introduced for stock shelter on farms. Bird-dispersed seeds, infests secondary forest and wasteland, can establish in moderate shade and grows quickly. Obstructs and suppresses native vegetation. Occurs around the Waitatarua area and on the hill above Muriwai Regional Park. There is also a large infestation along Piha Road.

Hedychium gardnerianum - wild ginger, also known as kahili ginger. Spread by bird-dispersed seeds and creeping rhizomes and by the dumping of garden refuse (uprooted plants can readily resprout if left lying on the ground). Will infest forest edges and can form extensive colonies in the shade but will

not set seed if the light is too subdued. Suppresses smaller plants and seedlings. Can impede water flow of open streams. Very abundant in the Waitakere Ranges especially around residential areas such as Titirangi. Has invaded the bush and is increasing (many seedlings were found during the PNAP survey).

Ligustrum lucidum - tree privet. Introduced for shelter. Bird-dispersed, can establish in the shade but will not readily invade intact native vegetation. Can become dominant in open forest obstructing and suppressing native species. Very little recorded in the Waitakere Ranges. Was noted along Kelly Road, Oratia, near the University reserve.

Lonicera japonica - Japanese honeysuckle. Bird-dispersed, can establish in moderate shade. Envelopes supporting plants strangling and shading them. Was found in a few areas of the Waitakere Ranges, near the Karekare turnoff and the upper Nihotupu Dam.

Pennisetum clandestinum - kikuyu grass. Introduced for testing as pasture species. Spread by underground runners, stolons and seeds. Suppresses seedlings of native plants, poses a considerable fire risk as dead stolons accumulate beneath new growth and are inflammable when dry. There are extensive areas of kikuyu grass at Karekare, Piha and other West Coast beaches.

Tradescantia fluminensis - wandering Jew. A creeping plant which can form extensive dense patches in damp shaded places such as forest remnants. Spread by resilient stem fragments in garden refuse and via streams. Suppresses native seedlings and small plants.

Wandering Jew was not found in the intact native forest of the Ranges but was found near residential properties in Titirangi, Karekare and Piha, a controllable patch was seen at Cascade-Kauri Park. There is a high potential for this plant to invade the native bush wherever gardens and roads are nearby.

Other weeds in the Waitakere Ranges.

Ageratina riparia - mist flower. Has infected many of the streams in the Waitakere Ranges in significant proportions. Suppresses native species and impedes water flow.

Hedychium flavescens - wild ginger, also known as yellow ginger. Spreads by rhizomes, has no seeds. Its spread is mainly facilitated by the dumping of garden refuse. Like the other ginger species it suppresses native species and can spread rapidly through forest edges by vegetative progress.

Selaginella kraussiana - a lycopod which forms low mats along track and streamsides. It does not look out of place and most people would assume it is native. The mats suppress small plants and seedlings. The free dispersal of spores may put every part of the Waitakere Ranges within its distribution range.

Ulex europaeus - gorse. Although rated as a Noxious B plant gorse is not a harmful plant to native vegetation communities around Auckland. Gorse will establish on recently disturbed areas such as slips or fire sites. It will help to control erosion via its substantial root system, and improve soil fertility by adding nitrogen to it. As gorse nears the end of its cycle the canopy will break down providing an ideal habitat for native plants. The gorse will succumb to the developing native community as it becomes shaded out. Gorse was found in many areas in the Waitakere Ranges during the survey but the most prevalent areas were the recently reverted pasture in the Anawhata and lower Nihotupu catchments.

Leycesteria formosa Himalayan honeysuckle. Has established in various places in streamsides, tracks and roads. Seen beside the Waitakere Stream at the Cascades, and along Scenic Drive.

Lycium ferocissimum boxthorn. Boxthorn is becoming a dominant plant on the slopes around the fishing lodge at Whatipu.

Hakea sericea - spiny hakea was found to be most abundant in the areas that were previously cleared for pasture, ie in the Anawhata and Nihotupu catchments.

Hakea salicifolia - willow leaf hakea was found on the slopes above the Lower Huia dam in young tanekaha forest. It is the most threatening of the *Hakea* species because of its longevity, height and dense shading.

Pinus radiata - pine trees were found throughout the ranges. The most noticeable groves are at Cornwallis and Nihotupu, Karekare, Anderson Track and Anawhata.

Salix spp - willow trees are causing problems in the Te Henga swamp by suppressing native plants and increasing sedimentation.

Arundo donax - giant reed. Well established in open water at Cascades and Lake Kawaupaka. Has formed large impenetrable communities at Lake Kawaupaka. Impedes waterflow. Could get into the Te Henga Swamp.

Alternanthera philoxeroides - alligator weed. An aquatic herb which is plentiful in streams and lakes on the Whatipu coastline, and also in the Marawhara and Wekatahi streams at Piha.

Utricularia biflora - bladderwort. A significant weed in the Te Henga Swamp where it competes with the native species. It also occurs in the Whatipu dune lakes.

Egeria densa - well established in many streams.

Albizia lophantha - brush wattle. Plentiful on some bush margins. Most will probably disappear but the trees on steep rocky slopes near the Waitakere Dam will persist.

Clematis vitalba - Old Man's beard. A few plants have been found on private property along Scenic Drive. In other parts of the country this vine has become the most devastating weed known in forest margin situations.

Nymphaea alba - water lily. Blocking waterflow and competing with native plants at Te Henga Swamp.

Myriophyllum aquaticum - Parrot's feather. An invasive and aggressive weed which is displacing native species at the Te Henga Swamp. Can form monospecific communities.

Ludwigia peploides - Primrose willow. Can restrict water flow.

Salvinia molesta - a floating aquatic fern which is very invasive and aggressive. Class A noxious weed. A small patch was found in the Te Henga Swamp and was hand-cleared in 1987-88.

Ammophylla arenaria - marram grass. A sand binder which competes with pingao (on less mobile sites) and spinifex for habitat sites.

Lupinus arboreus - tree lupin. Previously occurred in significant proportions along the entire West Coast but has succumbed to the fungal infections which have afflicted lupins nationally recently. May re-establish.

Reference:

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APPENDIX 6

VEGETATION OF THE BLUFFS, GORGES AND WATERFALLS IN THE WAITAKERE ECOLOGICAL DISTRICT

The Waitakere Ranges consists of an elevated, dissected plateau comprised of Manukau Breccia, a resistant volcanic andesite-breccia formation, overlying a bed of sandstone and mudstone of the Waitemata Formation. This consolidation of sedimentary and volcanic sediments was uplifted from the sea in the Pliocene and has since been eroded into the dissected hillslopes which comprise the Waitakere Ranges. The rocks of the southern half of the Ranges are very resistant to erosion but the short vigorous streams which originate in the high rainfall regions in the southern central portion have carved through these volcanic rocks resulting in rugged topography characterised by bluffs, steep narrow gorges and waterfalls (Hilton, 1988).

These geomorphic features (bluffs and gorges of volcanic sediments) are unique to the Waitakere District within the Auckland Ecological Region. The vegetation associations which typically occur on bluff and waterfall faces are therefore also unique to this District. Indeed all of the plant species which are endemic to the Waitakere Ranges are associated with bluffs and cliffs (*Sophora microphylla* var. *fulvida*, *Celmisia major* var. *major*, *Myosotis petiolata* var. *pansa*, *Hebe obtusata* and *Hebe bishopiana*).

During the PNAP survey of the Waitakere Ranges, bluffs, cliffs, gorges and waterfalls were specifically surveyed for their vegetation associations. Most of the bluff faces were surveyed through binoculars, due to difficulty of access, and therefore only the canopy layer was recorded. In most cases only one layer of vegetation was present so the binocular method of survey was considered to be sufficient for obtaining a picture of the vegetation patterns present, however information regarding regeneration and identification of small herbs was not possible to obtain.

The vegetation of five waterfalls, Con Bryon, Company Stream, Kitekite Falls, Fairy Falls and the fall face of the overspill below the Upper Nihotupu Reservoir, was described. The bluff faces, tops and bases of Bendall Bluff, the Nihotupu Gorge, Karamatura Bluffs, the Whatipu Stream bluffs, the Pararaha Gorge, the Piha Gorge, Marawhara Bluff, Wekatahi Bluff, Gentle Stream Bluffs, and Anawhata-Trinity Stream Gorge were also surveyed. These sites include representative examples of bluffs, gorges and waterfalls within both the coastal and lowland bioclimatic zones, and in the rugged hill country and high relief physical areas.

Bluff tops:

The vegetation associations of the fall faces tends to be similar regardless of the location of the bluff. The vegetation at the bases of the bluff faces also tends to be repetitive. However the vegetation on the top of the bluffs differs with degree of disturbance and proximity to the coast. The vegetation on the bluff tops of the least disturbed areas, such as the Karamatura and Nihotupu bluffs, is mature kauri and/or podocarp-broadleaf forest whilst the accessible areas, such as the Kitekite Falls and the Pararaha Gorge which were milled and/or burnt, consist of secondary kanuka forest with regenerating kauri. In those sites closer to the coast manuka is more abundant than kanuka. This is well demonstrated on the Marawhara Bluff which is a rocky spur running parallel to the coast. On the side exposed to the coast manuka is the dominant shrub whilst on the inland facing slope kanuka is more abundant.

Bluff fall faces:

The bluff fall faces are generally very steep (close to if not vertical) and vegetation cover is often less than 50%. Monocotyledenous species are very common in such situations and include *Astelia banksii*, flax, rengarenga rock lily, *Macherina sinclarii*, and native and exotic species of cuttygrass and pampas (*Gahnia* and *Cortaderia* species). On less precipitous slopes and on ledges shrubs can find a foothold. Shrubs typically found on fall faces include kanuka, kowhai and gorse. *Helichrysum aggregatum*, *Phebalium nudum* and *Rhabdothamnus solandrii* are generally regarded as uncommon species in the Waitakere Ranges but this is probably because they are restricted to bluff areas which have not been surveyed in depth by botanists. These species were found to occur frequently in these inaccessible areas. Lianas and vines such as *Metrosideros perforata* (white rata), *Clematis forsteri* and kiekie are also associated with bluff faces.

Bluff bases:

The bluff bases are areas where debris from the face above accumulates. This debris includes dead vegetation and minerals leached from eroding rock, and therefore tends to be more fertile than the soil of other landforms. Often streams run along the bluff bases and further accumulation of fertile sediments occurs via alluvial deposition. These areas then are characterised by fertile soils and the vegetation associations which occur here are usually determined by this parameter. Puriri, karaka, nikau, kawakawa and *Asplenium* ferns are very common on these sites. In disturbed areas kanuka is also part of the species assemblage. Where coastal winds have an effect on the vegetation pohutukawa occurs. In the Pararaha catchment taraire trees are also part of the bluff base vegetation. In the inland regions of the Karamatura and Nihotupu bluffs rata, mahoe, pigeonwood and other broadleaf shrubs form the forest on the colluvial slopes.

Waterfalls:

Five waterfalls were described during the survey. Detailed descriptions were not made and an attempt to choose the best waterfall vegetation was not possible due to the informal way in which these areas were examined, and because a representative sample of waterfalls was not surveyed.

Two coastal falls, the Kitekite and the Company Stream Falls, one set of falls on the eastern side of the ranges and two falls in the interior of the ranges were surveyed. One of the falls in the interior, the Nihotupu overspill is not in a natural situation because the water level of the falls is controlled by the reservoir water levels.

The Kitekite and the Company Stream Falls differ in aspect and surrounding vegetation, but the vegetation on the rock faces either side of the waterfalls is similar. The Kitekite Falls face to the north and are surrounded by tawa-rewarewa forest. The Company Stream Falls face the sea and are surrounded by taraire-puriri forest. The rock faces of both are covered with kiekie and flax in the moister regions and kowhai-kanuka where it is drier. In the coastal Company Stream Falls manuka is present and in places is more abundant than kanuka.

This pattern is not repeated on the rock faces of the more inland waterfalls such as the Con Bryon or the Fairy Falls. The rock faces of these falls is generally covered with mosses and small herb species such as *Gnaphalium keriensis*, *Pratia angulata* and the willow herb, *Epilobium* sp. As these waterfalls were surveyed by different field workers it is possible that herbs also grow in the wetter regions of the coastal falls but were not recorded.

The overspill of the Upper Nihotupu Reservoir has been modified by the construction of the dam and the reduced water levels since the dam has been in operation. With the increase in bare rock available since a lowering of the water flow over the falls many species of weed have quickly invaded where native species would otherwise have settled. These weeds include pampas, wandering jew, mistflower,

Lotus major, exotic grasses and exotic daisies. Obviously any further attempts to alter the flow of waterfalls in native bush should be accompanied by careful management to reduce the chance of weed infestation. Flow level over waterfalls below man-made dams should be restored to as close to the former level as possible.

Reference:

Hilton, M.J. (1988) A report on the Physical Areas of the Waitakere Ecological District. Unpublished Report prepared for the ARA.

APPENDIX 7SPECIES LIST OF WILDLIFE IN THE WAITAKERE ECOLOGICAL DISTRICT

The following is a list of those vertebrate wildlife species found in the Ecological District. There are a large number of invertebrate species recorded from the District including over 100 snail species (Slaven, 1989) and several thousand insect species. There are over 200 insect species which were first discovered and reported in the Waitakere Ecological District.

BIRDS - Forest and Shrubland Species:

<i>Acridotheres tristis</i>	Myna*
<i>Alauda arvensis</i>	Skylark*
<i>Anthus novaeseelandiae novaeseelandiae</i>	New Zealand Pipit
<i>Cacatua galerita</i>	Sulphur Crested Cockatoo*
<i>Callipepla californica brunnescens</i>	Californian Quail*
<i>Carduelis carduelis</i>	Goldfinch*
<i>Carduelis chloris</i>	Greenfinch*
<i>Carduelis flammea</i>	Redpoll*
<i>Chrysococcyx lucidus lucidus</i>	Shining Cuckoo
<i>Circus approximans</i>	Harrier
<i>Columba livia</i>	Rock Pigeon*
<i>Emberiza citrinella</i>	Yellowhammer*
<i>Eudynamis taitensis</i>	Long Tailed Cuckoo
<i>Falco novaeseelandiae</i>	New Zealand Falcon
<i>Fringilla coelebs</i>	Chaffinch*
<i>Gerygone igata</i>	Grey Warbler
<i>Gymnorhina tibicen</i>	White Backed Magpie*
<i>Halcyon sancta vagans</i>	New Zealand Kingfisher
<i>Hemiphaga novaeseelandiae novaeseelandiae</i>	New Zealand Pigeon
<i>Hirundo tahitica neoxena</i>	Welcome Swallow
<i>Nestor meridionalis septentrionalis</i>	North Island Kaka
<i>Ninox novaeseelandiae novaeseelandiae</i>	Morepork
<i>Passer domesticus</i>	House Sparrow*
<i>Petroica macrocephala toitoi</i>	Pied Tit
<i>Phasianus colchicus</i>	Pheasant*
<i>Platycercus eximius</i>	Eastern Rosella*
<i>Prosthemadera novaeseelandiae novaeseelandiae</i>	Tui
<i>Prunella modularis</i>	Dunnock*
<i>Rhipidura fuliginosa placabilis</i>	Fantail
<i>Sturnus vulgaris</i>	Starling*
<i>Synoicus ypsilophorus</i>	Brown Quail*
<i>Turdus merula</i>	Blackbird*
<i>Turdus philomelos</i>	Song Thrush*
<i>Zoetroops lateralis lateralis</i>	Silvereye

*

Species introduced to New Zealand by human agents.

BIRDS - Freshwater and Coastal Species:

<i>Anas gracilis</i>	Grey Teal
<i>Anas platyrhynchos platyrhynchos</i>	Mallard*
<i>Anas rhynchotis variegata</i>	New Zealand Shoveler
<i>Anas superciliosa superciliosa</i>	Grey Duck
<i>Anser sp.</i>	Feral Goose*
<i>Ardea novaehollandiae novaehollandiae</i>	White Faced Heron
<i>Botaurus poiciloptilus</i>	Australasian Bittern
<i>Bowdleria punctata vealeae</i>	North Island Fernbird
<i>Calidris canutus canutus</i>	Lesser Knot
<i>Charadrius bicinctus bicinctus</i>	Banded Dotterel
<i>Charadrius obscurus</i>	New Zealand Dotterel
<i>Cygnus atratus</i>	Black Swan*
<i>Eudiptula minor</i>	Blue Penguin
<i>Haematopus ostralegus finschi</i>	South Island Pied Oystercatcher
<i>Haematopus unicolor</i>	Variable Oystercatcher
<i>Himantopus himantopus leucocephalus</i>	Pied Stilt
<i>Larus dominicanus dominicanus</i>	Southern Black Backed Gull
<i>Larus novaehollandiae scopulinus</i>	Red Billed Gull
<i>Limosa lapponica baueri</i>	Eastern Bar-tailed Godwit
<i>Morus serrator</i>	Australasian Gannet
<i>Pelecanoides urinatrix urinatrix</i>	Diving Petrel
<i>Phalacrocorax carbo novaehollandiae</i>	Black Shag
<i>Phalacrocorax melanoleucos brevirostris</i>	Little Shag
<i>Phalacrocorax sulcirostris</i>	Little Black Shag
<i>Phalacrocorax varius varius</i>	Pied Shag
<i>Porphyrio porphyrio melanotus</i>	Pukeko
<i>Porzana pusilla affinis</i>	Marsh Crake
<i>Porzana tabuensis plumbea</i>	Spotless Crake
<i>Pterodroma macroptera gouldi</i>	Grey Faced Petrel
<i>Puffinus carneipes</i>	Flesh Footed Shearwater
<i>Puffinus griseus</i>	Sooty Shearwater
<i>Rallus philippensis assimilis</i>	Banded Rail
<i>Sterna caspia</i>	Caspian Tern
<i>Sterna striata</i>	White Fronted Tern
<i>Stictocarbo punctatus punctatus</i>	Spotted Shag
<i>Tadorna variegata</i>	Paradise Shelduck
<i>Vanellus miles novaehollandiae</i>	Spur Winged Plover

TERRESTRIAL MAMMALS:

<i>Chalinolobus tuberculatus</i>	Long-tailed Bat

MARINE MAMMALS:

<i>Arctocephalus forsteri</i>	New Zealand Fur Seal

* Species introduced to New Zealand by human agents.

INTRODUCED NOXIOUS ANIMALS:

Capra hircus
Mus domesticus
Mustela erminea
Oryctolagus cuniculus
Rattus norvegicus
Rattus rattus
Sus scrofa
Trichosurus vulpecula

Goat
 Mouse
 Stoat
 Rabbit
 Norwegian Rat
 Ship Rat
 Pig
 Opossum

LIZARDS:

Cyclodina aenea
Cyclodina ornata
Hoplodactylus granulatus
Hoplodactylus pacificus
Naultinus elegans elegans

Copper Skink
 Ornate Skink
 Forest Gecko
 Pacific Grey Gecko
 Auckland Green Gecko

AMPHIBIANS:

Leiopelma hochstetteri
Litoria aurea
Litoria raniformis

Hochstetters Frog
 Golden Bell Frog*
 Green Frog*

LARGE LAND SNAILS:

Paryphanta busbyi busbyi
Rhytida greenwoodi
Rhytida dunni

Kauri Snail

FRESHWATER FISH:

Anguilla dieffenbachii
Anguilla australis
Gobiomorphus cotidianus
Gobiomorphus basalis
Gobiomorphus huttoni
Retropinna retropinna
Galaxias fasciatus
Galaxias brevipinnis
Galaxias maculatus
Geotria australis
Mugil cephalus

Long-finned Eel
 Short-finned Eel
 Common Bully
 Cran's Bully
 Red-finned Bully
 Common Smelt
 Banded Kokopu
 Koaro
 Inanga
 Lamprey
 Grey Mullet

*

Species introduced to New Zealand by human agents.

FRESHWATER CRUSTACEA:

Paranephrops planifrons
Paratya curvirostris

Koura
Freshwater Shrimp

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APPENDIX 9**LIST OF SURVEY SAMPLE SITES IN THE WAITAKERE ECOLOGICAL DISTRICT**

Study Area Card # ¹	Eco Unit	Grid Ref ²	Veg Class ³	Phys Area ⁴	Bioc Zone ⁵	Area (ha)
09020101	01	481657	Hpu	8D	2	6.0
09020101	02	484660	U	8D	2	10.0
09020101	03	481662	Pb	8D	2	11.0
09020101	04	483660	Hmk	8B	2	0.5
09020101	05	483656	Bsr	8B	2	3.0
09020102	01	463636	Hpu	8B	2	4.0
09020102	02	457637	Hpu	8B	2	2.0
09020103	01	432647	Hta	8B	2	6.0
09020103	02	436648	Ky	8B	2	1.0
09020103	03	435645	Sks	8B	2	3.0
09020103	05	438648	Hpu	8B	2	2.0
09020103	07	435647	Bkk	8B	2	0.2
09020103	08	435648	Hta	8B	2	2.0
09020103	09	437647	Bmr	8B	2	1.0
09020103	10	439647	Bkk	8B	2	1.0
09020103	4A	437645	Hpu	8B	2	1.0
09020103	4B	438646	Hpu	8B	2	2.0
09020103	6A	430647	Bkk	8B	2	0.2
09020103	6B	430647	Bkk	8B	2	<0.1
09020107	01	466670	Pu	8D	2	10.0
09020107	02	464675	Pu	8D	2	41.0
09020107	03	463678	Pu	8D	2	26.0
09020107	04	470675	Pu	8D	2	9.0
09020107	05	472674	Pu	8D	2	10.0
09020107	06	465675	Ki	8D	2	1.0
09020107	07	464672	Hmt	8D	2	1.0
09020107	08	447685	Hmk	8D	2	13.0
09020107	09	464684	Pu	8D	2	3.0
09020107	10	464657	Pu	8D	2	1.0
09020107	11	482673	Pu	8D	2	13.0
09020110	02	453673	Kr	8D	2	5.0
09020110	04	450674	Hta	8B	2	20.0
09020110	05	455671	U	8D	2	1.0
09020110	1A	458681	Pb	8D	2	130.0
09020110	1B	452673	Hta	8B	2	-
09020110	1C	453677	Pb	8B	2	-
09020110	1D	454664	Pb	8D	2	-
09020110	1E	459671	Pb	8D	2	-
09020110	1F	457672	Pb	8D	2	-
09020110	3A	459657	Pu	8D	2	120.0
09020110	3B	455663	Pb	8D	2	-
09020110	6A	452672	Skf	8D	2	10.0
09020110	6B	454662	Ps	8B	2	-
09020111	02	473661	Skf	8D	2	30.0
09020111	03	472661	Km	8D	2	2.0
09020111	1A	482667	Pu	8D	2	146.0
09020111	1B	479672	Pu	8D	2	-
09020111	1C	471664	Pu	8D	2	-

09020111	1D	471660	Pu	8D	2	-
09020111	1E	467660	Pu	8D	2	-
09020111	1F	468658	Pu	8D	2	-
09020112	01	494661	Htw	8B	2	15.0
09020112	02	490664	Pb	8B	2	25.0
09020112	03	495659	Hma	8B	2	5.0
09020112	04	490660	Skf	8B	2	10.0
09020112	05	495659	U	8B	2	1.0
09020113	01	473643	Sms	8D	2	24.0
09020113	02	474654	Skf	8D	2	7.0
09020113	03	476652	Smf	8D	2	15.0
09020113	04	475649	Kk	8D	2	3.0
09020113	05	473643	Pb	8D	2	2.0
09020113	06	479646	Hmk	8B	2	29.0
09020113	07	481645	Kt	8D	2	1.0
09020113	08	481640	Hmi	8B	2	8.0
09020113	09	477637	Kt	8B	2	1.0
09020113	10	488645	Htw	8B	2	4.0
09020114	01	459639	Smf	8B	2	106.0
09020114	02	457639	Kb	8B	2	0.5
09020114	03	452623	Skf	8B	2	30.0
09020114	04	467646	Smf	8D	2	85.0
09020114	05	454630	Htw	8B	2	0.5
09020114	06	446619	Smf	8B	2	464.0
09020114	07	472644	Pb	8D	2	18.0
09020114	08	443621	Hma	8B	2	25.0
09020114	09	443626	Km	8B	2	5.0
09020114	10	453628	Ky	8B	2	28.0
09020114	11	442616	Skf	8B	1	127.0
09020114	12	469643	Sms	8D	2	50.0
09020114	13	465652	Hmk	8D	2	6.0
09020116	01	452645	Smf	8B	2	28.0
09020116	02	448649	Ky	8B	2	2.0
09020116	03	445644	Skf	8B	2	6.0
09020116	04	445641	Ky	8B	2	6.0
09020116	05	444641	Pb	8B	2	6.0
09020117	01	428661	Hmi	8B	2	6.0
09020117	03	425658	Kk	8B	2	8.0
09020117	04	435658	Smf	8B	2	25.0
09020117	05	437657	Skf	8B	2	6.0
09020117	06	449667	Hmi	8B	2	5.0
09020117	07	433652	Hta	8B	2	7.0
09020117	08	441655	Hta	8B	2	7.0
09020117	09	443657	Skf	8B	2	65.0
09020117	10	439662	Hta	8B	2	1.0
09020117	2A	427658	Hta	8B	2	20.0
09020117	2B	442663	Hta	8B	2	7.0
09020201	01	427677	Km	8B	2	1.0
09020201	02	424678	Hta	8B	2	6.0
09020201	03	425677	Sms	8B	2	16.0
09020201	04	424673	Cfm	8B	2	2.0
09020201	05	423674	Cfm	8B	2	1.0
09020202	01	437664	Hta	8B	2	2.0
09020202	02	432663	Ky	8B	2	1.0
09020202	03	429663	Hta	8B	2	4.0
09020202	04	427669	Kk	8B	2	8.0
09020202	05	433667	Hta	8B	2	6.0
09020202	06	426665	Hta	8B	2	5.0

09020202	07	433663	Hta	8B	2	4.0
09020202	08	422621	Hta	8B	2	2.0
09020202	09	431668	Ky	8B	2	7.0
09020202	10	425666	Ky	8B	2	1.0
09020202	11	425664	Ky	8B	2	1.0
09020203	02	443693	Ky	8B	2	2.0
09020203	1A	445687	Htw	8B	2	113.0
09020203	1B	448683	Hmk	8D	2	-
09020204	01	426684	Hpu	8B	2	2.0
09020204	02	427685	Kk	8B	2	3.0
09020204	03	429688	Pk	8B	2	1.0
09020204	04	431689	Hpu	8B	2	0.2
09020204	05	431687	Hpu	8B	2	7.0
09020204	06	435687	Ky	8B	2	1.0
09020204	07	433685	Hta	8B	2	5.0
09020204	08	429684	Hta	8B	2	1.0
09020204	09	427688	Hta	8B	2	1.0
09020204	10	424686	Hpu	8B	2	4.0
09020204	11	445687	Htw	8B	2	80.0
09020205	01	423691	Skf	8B	2	30.0
09020205	02	416685	Htw	8B	2	12.0
09020205	03	416681	Skf	8B	2	25.0
09020205	04	423689	Kr	8B	2	0.5
09020301	01	430701	Skf	8B	2	1.5
09020301	02	428702	Htw	8B	2	1.0
09020301	03	429702	Bsr	8B	2	2.0
09020301	4A	430702	Bkv	8B	2	0.2
09020301	4B	430701	Bkv	8B	2	0.2
09020302	01	417720	Bkk	8B	2	1.5
09020302	02	417723	Hpu	8B	2	4.0
09020302	03	418722	Bmr	8B	2	1.0
09020302	04	418721	Bkk	8B	2	0.3
09020302	05	418722	Bmr	8B	2	0.5
09020303	01	414726	Bkk	8B	1	1.0
09020303	02	415726	U	8B	2	3.0
09020304	01	440716	Htw	8B	2	1.5
09020304	02	443717	Sms	8B	2	1.0
09020304	03	441716	Ky	8B	2	2.0
09020304	04	443716	Bmr	8B	2	0.5
09020304	05	440717	Bsr	8B	2	3.0
09020304	06	439717	Bkv	8B	2	1.5
09020304	07	439717	Brr	8B	2	1.5
09020306	02	426706	Km	8B	2	3.0
09020306	03	426704	Km	8B	2	1.0
09020306	04	432711	Hma	8B	2	7.0
09020306	1A	435707	Kk	8B	2	150.0
09020306	1B	442706	Skf	8B	2	-
09020306	1C	435706	Kk	8B	2	-
09020306	1D	434704	Kk	8B	2	-
09020306	1E	428712	Kk	8B	2	-
09020306	1F	432707	Kk	8B	2	-
09020306	1G	427708	Kk	8B	2	-
09020306	5A	429704	Hmk	8B	2	25.0
09020306	5B	428710	Hmk	8B	2	-
09020306	6A	423717	Hma	8B	2	33.0
09020306	6B	427722	Hma	8B	2	-
09020307	01	451697	Pb			

09020308	01	434722	Hmk	8B	2	7.0
09020308	02	424714	Skf	8B	2	3.0
09020308	03	426715	Hpu	8B	2	6.0
09020308	04	423714	Bkk	8B	2	4.0
09020308	05	422714	Hma	8B	2	6.0
09020308	06	424713	Hpo	8B	2	2.0
09020308	07	421712	Hpo	8B	2	6.0
09020308	08	417715	Hma	8B	2	5.5
09020308	09	419715	Skf	8B	2	2.0
09020308	10	439713	Htw	8B	2	2.0
09020308	11	439711	Hmi	8B	2	2.0
09020308	12	431720	Hmi	8B	2	3.0
09020308	13	439712	U	8B	2	2.0
09020308	14	439712	U	8B	2	2.0
09020309	01	441696	Hmi	8B	2	25.0
09020309	02	438698	Skf	8B	2	20.0
09020309	03	447698	Skf	8B	2	12.0
09020310	01	439721	Htw	8B	2	3.0
09020310	02	442728	Skf	8D	2	50.0
09020310	03	442733	Hmk	8D	2	35.0
09020310	04	434736	Smf	8D	2	50.0
09020310	05	438738	Pb	8D	2	9.0
09020311	01	447716	Hpo	8B	2	3.0
09020311	02	451720	Pb	8B	2	10.0
09020311	03	451717	Htw	8B	2	4.0
09020311	04	456715	Htw	8D	2	10.0
09020311	05	452714	Hmk	8B	2	1.0
09020311	06	451723	Hpu	8D	2	3.0
09020311	07	449720	Km	8B	2	5.0
09020311	08	455725	Htw	8D	2	1.5
09020311	09	446720	Km	8B	2	6.5
09020311	10	444717	Hpu	8B	2	3.0
09020311	11	457722	Htw	8D	2	2.0
09020311	12	444710	Hmk	8B	2	65.0
09020311	13	445713	Kk	8B	2	7.0
09020311	14	453726	Hmk	8D	2	40.0
09020312	01	428724	Hpo	8B	2	30.0
09020312	03	424723	Hpu	8B	2	0.5
09020312	04	417723	Hpu	8B	2	22.0
09020312	05	421721	Kt	8B	2	4.0
09020312	2A	429728	Hma	8B	2	3.0
09020312	2B	429727	U	8B	2	-
09020313	01	413736	Hmk	8B	2	15.0
09020313	02	415736	Sms	8B	2	7.0
09020313	03	416735	Smf	8B	2	27.0
09020401	01	414754	Kr	8B	2	3.0
09020401	02	411749	Skf	8B	2	0.5
09020401	04	411749	Bbr	8B	2	0.1
09020401	3A	411753	Hmk	8B	2	3.0
09020401	3B	411753	Bkk	8B	2	-
09020401	3C	411753	Bkk	8B	2	-
09020401	3D	411753	Bsr	8B	2	-
09020401	5A	410747	Bsr	8B	2	1.0
09020401	5B	410747	Bkk	8B	2	1.0
09020401	5C	410747	Bsr	8B	2	1.0
09020401	5D	410747	Hpu	8B	2	1.0
09020401	5E	410747	Bkk	8B	2	1.0
09020401	5F	410747	Hpu	8B	2	1.0

09020402	01	425757	Hpu	8B	2	0.2
09020402	02	427758	Hmk	8B	2	2.0
09020402	03	423756	Bkk	8B	2	1.3
09020402	05	428759	Bkk	8B	2	2.0
09020402	4A	428758	Bmr	8B	2	0.5
09020402	4B	427758	Bsr	8B	2	0.7
09020403	01	439758	Hpu	8D	2	1.5
09020403	02	444757	Hmk	8D	2	0.5
09020404	01	415753	Hpo	8B	2	8.0
09020404	02	415751	Skf	8B	2	4.0
09020404	03	423753	Kk	8B	2	1.0
09020404	04	428754	Ky	8D	2	1.0
09020404	05	418752	Kt	8B	2	5.0
09020404	06	418754	Hma	8B	2	8.0
09020404	07	418754	Ky	8B	2	4.0
09020404	08	414745	Sms	8B	2	24.0
09020404	09	422749	U	8B	2	2.0
09020404	10	422745	U	8B	2	36.0
09020404	11	433756	Hmk	8D	2	20.0
09020404	12	405750	Skf	8B	2	32.0
09020404	13	431752	U	8D	2	14.0
09020404	14	743437	Skf	8D	2	9.0
09020405	01	413759	Skf	8B	2	20.0
09020405	02	416760	Skf	8B	2	2.0
09020405	03	415766	Sks	8B	2	22.0
09020405	04	416765	Htw	8B	2	16.0
09020405	05	415765	Skf	8B	2	4.0
09020406	02	446737	Hmk	8D	2	12.0
09020406	03	453748	Hmk	8D	2	5.0
09020406	04	438753	Htw	8D	2	2.0
09020406	06	445759	Hmk	8D	2	7.0
09020406	07	437759	Hmk	8D	2	27.0
09020406	08	441768	Hmk	8D	2	10.0
09020406	1A	454736	Skf	8D	2	14.0
09020406	1B	449762	Smf	8D	2	57.0
09020406	5A	438745	Pb	8D	2	30.0
09020406	5B	436750	Pb	8D	2	30.0
09020501	02	478733	Skf	8D	2	10.0
09020501	03	497733	Ps	8D	2	5.0
09020501	04	484737	Pu	8D	2	15.0
09020501	05	482725	Pu	8D	2	15.0
09020501	06	484722	Skf	8D	2	30.0
09020501	1A	482732	Smf	8D	2	270.0
09020501	1B	489733	Smf	8D	2	-
09020502	02	465719	Hmt	8D	2	2.0
09020502	1A	477735	Pu	8D	2	325.0
09020502	1B	467732	Pu	8D	2	-
09020502	1C	495734	Hpo	8D	2	-
09020502	1D	483740	Pu	8D	2	-
09020601	02	457755	Pk	8D	2	2.0
09020601	04	468768	Km	8D	2	10.0
09020601	05	469740	Pu	8D	2	10.0
09020601	1A	463751	Pb	8D	2	550.0
09020601	1B	473757	Pb	8D	2	-
09020601	1C	469748	Pu	8D	2	-
09020601	1D	462750	Pb	8D	2	-
09020601	1E	467747	Pb	8D	2	-
09020601	3A	475758	Skf	8D	2	50.0

09020601	3B	473758	Skf	8D	2	-
09020603	01	466779	Pb	8D	2	5.0
09020603	02	467779	Skf	8D	2	2.0
09020604	01	466774	Htw	8D	2	5.0
09020604	02	463773	Hma	8D	2	2.0
09020604	03	464773	Pb	8D	2	6.0
09020604	04	466773	Htw	8D	2	
09020605	01	457755	Pk	8D	2	7.0
09020605	02	459760	Skf	8D	2	7.0
09020605	03	455752	Skf	8D	2	33.0
09020605	04	456767	Pb	8D	2	27.0
09020605	05	463766	Pb	8D	2	6.0
09020607	01	458779	Km	8D	2	25.0
09020607	02	458784	Ky	8D	2	5.0
09020607	03	455773	Smf	8D	2	44.0
09020607	04	454769	Skf	8D	2	1.0
09020607	05	461767	Pb	8D	2	250.0
09020607	06	447775	Hmi	8D	2	59.0
09020611	02	472786	Kr	8B	2	12.0
09020611	04	467485	Hpu	8B	2	9.0
09020611	05	480778	Pb	8D	2	4.0
09020611	07	481779	Hmi	8D	2	15.0
09020611	6A	465785	Pb	8B	2	71.0
09020611	6B	472784	Hpo	8B	2	71.0
09020611	6C	473778	Hmk	8B	2	71.0
09020611	6D	474777	Htw	8B	2	71.0
09020701	01	495744	Pb	8D	2	2.0
09020701	02	529685	Pb	8D	2	70.0
09020701	03	489752	U	8D	2	1.0
09020701	04	493742	Pb	8D	2	0.0
09020701	05	492753	Ky	8D	2	1.0
09020701	06	488756	U	8D	2	0.5
09020701	07	485747	Pb	8D	2	
09020701	08	488749	Pu	8D	2	5.0
09020701	09		Kr	8D	2	1.0
09020701	10	492752	Htw	8D	2	20.0
09020701	11	492750	Htw	8D	2	0.1
09020701	12	491749	Htw	8D	2	1.0
09020701	13	494748	Htw	8D	2	1.0
09020702	02	493770	Smf	8C	2	15.0
09020702	03	494773	Ps	8C	2	5.0
09020702	04	492777	Km	8C	2	3.0
09020702	1A	492772	Pb	8C	2	82.0
09020702	1B	487775	Pb	8C	2	-
09020702	1C	485773	Pb	8C	2	-
09020702	1D	485774	Hmk	8C	2	-
09020703	01	497766	Ps	8C	2	9.0
09020703	02	494767	Pb	8C	2	3.5
09020703	04	492768	Pb	8C	2	14.0
09020703	05	500762	Kr	8C	2	5.0
09020703	3A	494759	Hmk	8D	2	85.0
09020703	3B	491760	Pb	8D	2	85.0
09020704	01	479761	Pu	8D	2	20.0
09020704	02	478758	Skf	8D	2	3.0
09020705	01	489765	Hpo	8D	2	12.0
09020705	02	490763	Hmk	8D	2	8.0
09020706	01	483774	Ps	8D	2	8.0
09020706	02	485775	Pb	8D	2	5.0

09020706	03	488778	Pk	8C	2	2.0
09020706	04	485778	Htw	8B	2	50.0
09020801	01	485688	Skf	8D	2	2.0
09020801	02	489691	Hta	8D	2	5.0
09020801	03	491695	Skf	8D	2	42.0
09020801	04	475697	Pb	8D	2	12.0
09020801	05	496688	Km	8D	2	28.0
09020801	06	493697	Pk	8D	2	6.0
09020801	07	498695	Pb	8D	2	13.0
09020801	08	493692	Kk	8D	2	4.0
09020801	09	492686	Hmk	8D	2	75.0
09020801	10	479689	Km	8D	2	2.5
09020802	03	486682	Km	8D	2	10.0
09020802	05	488678	Hmk	8D	2	45.0
09020802	1A	475685	Pb	8D	2	265.0
09020802	1B	483672	Htw	8D	2	-
09020802	2A	477683	Pb	8D	2	-
09020802	2B	485666	Pb	8D	2	-
09020802	4A	494672	Hma	8B	2	69.0
09020802	4B	492668	Hma	8B	2	-
09020802	4C	493668	Hma	8B	2	-
09020803	01	474715	Skf	8D	2	18.0
09020803	03	472704	Smf	8D	2	5.0
09020803	04	481711	Km	8D	2	10.0
09020803	05	458709	Pu	8D	2	15.0
09020803	06	481706	Km	8D	2	3.0
09020803	2A	485705	Hpo	8D	2	400.0
09020803	2B	484704	Pb	8D	2	0.0
09020803	2C	476716	Pb	8D	2	0.0
09020803	2D	481701	Pb	8D	2	0.0
09020803	2E	488698	Pb	8D	2	0.0
09020803	2F	481713	Pb	8D	2	0.0
09020803	2G	470698	Pb	8D	2	0.0
09020803	2H	472713	Pb	8D	2	0.0
09020803	2I	470719	Pb	8D	2	0.0
09020803	2J	477707	Pb	8D	2	0.0
09020804	01	468693	Pb	8D	2	0.5
09020804	02	470691	Hpo	8D	2	4.0
09020804	03	471693	Pb	8D	2	5.0
09020804	05	456693	Skf	8D	2	20.0
09020804	07	455696	Pu	8D	2	3.0
09020804	08	456696	Pb	8D	2	1.5
09020804	10	470698	Pb	8D	2	50.0
09020804	11	468693	Km	8D	2	5.0
09020804	12	459701	Pu	8D	2	15.0
09020804	4A	455691	Pb	8D	2	100.0
09020804	4B	470683	Pb	8D	2	0.0
09020804	6A	456694	Pb	8D	2	12.0
09020804	6B	460701	Pb	8D	2	12.0
09020804	9A	469701	Pb	8D	2	8.0
09020804	9B	470700	Pb	8D	2	0.0
09020805	01	506690	Htw	8D +	2	70.0
09020805	02	489686	Pb	8D	2	5.0
09020805	03	509682	U	8D +	2	25.0
09020805	05	510675	Kt	8B	2	0.5
09020805	06	510676	Sms	8B	2	60.0
09020805	07	501671	Skf	8B	2	0.0
09020805	08	501671	Kt	8B	2	0.2

09020805	4A	507680	Hpo	8B	2	15.0
09020805	4B	508681	Pk	8B	2	0.2
09020901	01	506724	Pu	8D	2	5.0
09020901	03	497728	Sms	8D	2	12.0
09020901	04	484717	Pu	8D	2	47.0
09020901	05	490722	Km	8D	2	0.5
09020901	06	494726	Ps	8D	2	15.0
09020901	2A	506729	Pu	8D	2	330.0
09020901	2B	507720	Pu	8D	2	330.0
09020901	2C	491721	Pu	8D	2	330.0
09020901	2D	494713	Pu	8D	2	330.0
09020902	02	505706	Hma	8D	2	4.0
09020902	03	504706	Pk	8D	2	1.0
09020902	05	507709	Bkk	8D	2	5.0
09020902	06	504708	Km	8D	2	4.0
09020902	1A	505714	Htw	8D	2	155.0
09020902	1B	499710	Hmk	8D	2	-
09020902	1C	503708	Pb	8D	2	-
09020902	1D	504713	Hmk	8D	2	-
09020902	1E	506703	Htw	8D	2	-
09020902	1F	507720	Pb	8D	2	-
09020902	4A	508715	U	8D	2	1.0
09020902	4B	507706	U	8D	2	1.0
09020902	4C	497711	U	8D	2	1.0
09020902	7A	506708	U	8D	2	3.0
09020902	7B	498710	U	8D	2	-
09020903	01	511702	Bkk	8D	2	1.0
09020903	02	510702	Htw	8D	2	3.0
09020903	03	508702	Km	8D	2	3.0
09020903	04	507703	Hma	8D	2	0.1
09020903	05	506701	Htw	8D	2	10.0
09020903	06	502698	Hpo	8D	2	6.0
09020903	08	500707	Km	8D	2	0.3
09020903	09	502707	Pb	8D	2	4.0
09020903	10	500703	Pb	8D	2	16.0
09020903	11	514704	Ps	8D	2	7.0
09020903	7A	497701	U	8D	2	45.0
09020903	7B	495704	Pb	8D	2	-
09020903	7C	495705	Pk	8D	2	-
09020904	01	517699	Pb	8D	2	9.0
09020904	02	513700	Hpu	8D	2	16.0
09020904	03	513697	Pb	8D	2	4.0
09020904	04	515692	Km	8D	2	4.0
09020904	05	513690	Pb	8D	2	12.0
09020904	06	522698	Hmk	8D	2	8.0
09020904	07	522693	U	8D	2	3.0
09020905	01	513715	Htw	8D	2	10.0
09020905	04	512709	Pb	8D	2	8.0
09020905	2A	518708	Skf	8D	2	5.0
09020905	2B	516708	Kk	8D	2	6.0
09020905	3A	517709	Hpo	8D	2	3.0
09020905	3B	517708	Pb	8D	2	3.0
09020906	01	538708	Skf	8C	2	115.0
09020906	02	548709	Kr	8C	2	1.0
09020906	03	533716	Hmk	8C	2	0.5
09020906	04	528713	Smf	8C	2	11.0
09020906	05	526707	Pb	8C	2	16.0
09020906	06	538714	Hmk	8C	2	43.0

09020906	07	530686	Hmk	8B	2	108.0
09020906	08	534689	Sms	8B	2	6.0
09020906	09	535711	Pb	8C	2	5.0
09020906	10	532684	Skf	8B	2	4.0
09020906	11	532686	Kt	8B	2	0.5
09020906	12	525704	Ps	8C	2	2.0
09020906	13	534716	Hpu	8C	2	1.5
09020906	14	531690	Hpo	8B	2	3.0
09021001	01	532684	Kk	8B	2	2.0
09021001	02	521685	Hpo	8B	2	80.0
09021001	03	513684	Pb	8B	2	20.0
09021001	04	528680	Smf	8B	2	24.0
09021001	05	529678	Hmk	8B	2	18.0
09021001	06	528665	Ps	8B	2	6.0
09021001	07	530668	Skf	8B	1	60.0
09021101	01	530721	Km	8C	2	1.0
09021101	02	531721	Pb	8C	2	6.0
09021101	03	534717	Sms	8C	2	0.5
09021102	01	527723	Hpo	8C	2	16.0
09021102	02	526722	Ky	8C	2	1.0
09021103	01	518722	Pk	8C	2	0.1
09021103	02	519722	Pb	8C	2	40.0
09021103	03	518720	Pb	8C	2	0.1
09021103	04	517720	Pk	8C	2	0.1
09021104	01	513726	Skf	8C	2	7.0
09021104	02	514727	Ps	8C	2	4.0
09021104	03	515727	Htw	8C	2	2.5
09021104	04	515728	Bkk	8C	2	0.1
09021104	05	515727	Bkk	8C	2	2.0
09021104	06	517727	Hpu	8C	2	3.0
09021105	01	532747	Ky	8C	2	9.0
09021105	02	528735	Hpu	8C	2	6.0
09021105	03	563732	Skf	8C	2	5.0
09021105	04	525729	Hmk	8C	2	4.0
09021201	01	552718	Hmk	8C	2	14.0
09021201	02	556722	Hpu	8C	2	12.0
09021201	03	563726	Hpu	8C	2	5.0
09021201	04	562723	Kr	8C	2	3.0
09021201	05	568722	Hpu	8C	2	5.0
09021201	06	570722	Skf	8C	2	23.0
09021203	01	581719	Hpu	8C	2	1.0
09021203	02	581717	Hpu	8C	2	4.0
09021203	03	580714	Kk	8C	2	2.5
09021500	00	462803	Hpo	8A	2	
09029901	01	424649	Wr	4	1	1.0
09029901	02	426647	Cpf	1	1	0.5
09029901	03	427646	Wr	4	1	2.5
09029901	04	433615	Cps	1	1	36.0
09029901	05	431613	Chf	1	1	18.0
09029901	06	428615	Cps	1	1	30.0
09029901	07	425628	Cps	1	1	18.0
09029901	08	426628	Css	1	1	68.0
09029901	09	426628	Chf	1	1	16.0
09029901	10	424643	Wl	5	1	4.0
09029901	11	428636	Ws	3A	1	6.0
09029901	12	428642	U	1	1	0.7
09029901	13	427629	Cpf	1	1	92.0
09029901	14	437609	Exo	1	1	8.0

09029901	15	423643	Chf	1	1	4.0
09029901	16	434632	Hpu	7	1	6.0
09029901	17	433634	Cpo	7	1	16.0
09029901	18	435626	Cpo	7	1	1.0
09029901	19	423654	Cpo	7	1	6.0
09029901	20	417664	Cpf	1	1	1.0
09029901	21	417664	Cpo	7	1	1.0
09029901	22	420659	Cpo	1	1	2.0
09029901	23	438614	Cpo	7	1	8.0
09029901	24	418660	Chf	1	1	0.1
09029902	01	459622	Hpu	8B	1	7.0
09029902	02	457620	Hma	8B	1	5.0
09029902	03	457618	Hpu	8B	1	6.0
09029902	04	453615	Cpo	8B	1	9.0
09029902	05	456618	Bkk	8B	1	12.0
09029902	06	455618	Sms	8B	1	18.0
09029902	07	454617	Skf	7B	1	7.0
09029902	08	451613	Hpu	8B	1	25.0
09029902	09	452614	Sms	8B	1	12.0
09029902	10	452613	Cpo	8B	1	9.0
09029902	11	450612	Skf	8B	1	2.0
09029902	12	491637	Cpo	8B	1	4.0
09029902	13	490637	Skf	7B	1	7.0
09029902	14	487633	Cpo	8B	1	12.0
09029902	15	481628	Cpo	8B	1	10.0
09029902	16	476628	Cfm	8B	1	3.0
09029902	17	472624	Hpu	8B	1	0.5
09029902	18	465624	Sms	8B	1	14.0
09029902	19	469628	Skf	8B	1	30.0
09029902	20	470631	Kk	8B	1	12.0
09029902	21	471630	Hma	8B	1	2.0
09029902	22	449615	Skf	8B	2	25.0
09029902	23	456623	Ky	8B	2	19.0
09029903	01	416665	Ccr	7	1	
09029903	02	416675	Cpo	7	1	4.0
09029903	03	415678	Cfm	8B	1	25.0
09029903	04	413678	Cpo	8B	1	3.0
09029903	05	414682	Sks	8B	1	3.0
09029903	06	414688	Sms	8B	1	32.0
09029903	07	412679	Cpo	7	1	5.0
09029903	08	414685	Cpo	7	1	3.0
09029903	09	418676	Cpo	1	1	1.0
09029903	10	421671	Cpo	8B	1	5.0
09029903	11	418667	Sks	8B	1	41.0
09029903	12	409692	Sms	8B	1	15.0
09029903	13	411695	Hpu	8B	1	10.0
09029903	14	410695	Sks	8B	1	103.0
09029904	01	413725	Cpo	8B	1	4.0
09029904	02	412725	Cpo	8B	2	3.0
09029904	03	409725	Sms	8B	1	4.0
09029904	04	409728	Sms	8B	2	32.0
09029904	05	406734	Sms	8B	1	43.0
09029904	06	402738	Cpf	7	1	6.0
09029904	07	399732	Cpo	7	1	7.0
09029904	08	406728	Cpo	7	1	13.0
09029904	09	406703	Ccs	7	1	2.5
09029904	10	407699	Chf	7	1	0.5
09029905	01	404774	Skf	8B	1	5.0

09029905	02	403775	Cpo	1B	1	6.0
09029905	03	402777	Cpo	1B	1	10.0
09029905	04	406773	Wr	3B	2	1.0
09029905	05	406773	Wct	3B	2	1.0
09029905	06	406778	Hpo	8B	1	5.0
09029905	07	405777	Hpu	8B	1	7.0
09029905	08	404778	Cpo	8B	1	6.0
09029905	09	417779	Wr	3B	2	2.0
09029905	10	417777	Hpu	8B	2	13.0
09029905	11	410778	Hpu	8B	2	22.0
09029905	12	409782	Skf	8B	2	127.0
09029905	13	407792	Hpu	8B	2	33.0
09029905	14	404782	Sks	1B	1	33.0
09029905	15	403783	Sks	1B	1	1.0
09029905	16	410768	Kk	8B	2	42.0
09029905	17	422769	Sms	8B	2	36.0
09029905	18	434770	Kr	8B	2	35.0
09029905	19	435775	Hmi	8B	2	64.0
09029905	20	433775	Ky	8B	2	27.0
09029905	21	427776	Kk	8B	2	8.0
09029905	22	415765	Kk	8B	2	30.0
09029905	23	414766	Sms	8B	2	48.0
09029905	24	435780	Pb	8B	2	112.0
09029905	25	426784	Hma	8B	2	58.0
09029905	26	431790	Kk	8B	2	57.0
09029905	27	428788	Hpu	8B	2	51.0
09029905	28	415797	Skf	8B	2	35.0
09029905	29	414796	Hpu	8B	2	20.0
09029905	30	408796	Smf	8B	2	56.0
09029905	31	417796	Ky	8B	2	18.0
09029905	32	402771	Skf	8B	2	15.0
09029905	33	402778	Cpo	1B	1	3.0
09029906	01	398765	Sms	8B	1+	30.0
09029906	02	400766	Cpo	8B	2	3.0
09029906	03	396768	Cpf	1A	1	0.3
09029906	04	404771	Skf	8B	2	51.0
09029906	05	405765	Sms	8B	2	53.0
09029906	06	398745	Ccr	7	1	0.0
09029906	07	402753	Cpo	8B	1	2.0
09029906	08	398753	Cpf	7	1	9.0
09029906	09	401744	Sms	8B	1	53.0
09029906	10	403743	Sms	8B	1	10.0
09029906	11	403770	Hpu	8B	2	8.0
09029907	01	419809	Kk	8A	2	196.0
09029907	02	419807	Kt	8A	2	14.0
09029907	03	417806	Hpu	8A	2	27.0
09029907	04	418805	Ky	8A	2	3.0
09029907	05	416805	Hpu	8A	2	70.0
09029907	06	412805	Wct	8A	2	1.5
09029907	07	412807	Skf	8A	2	31.0
09029907	08	444809	Sms	8A	2	14.0
09029907	09	441815	Smf	8A	2	103.0
09029907	10	438814	Pb	8A	2	9.0
09029907	11	441814	Hpo	8A	2	3.0
09029907	12	449811	Ky	8A	2	7.0
09029907	13	453809	Sms	8A	2	7.0
09029907	14	454812	Pb	8A	2	9.0
09029907	15	453812	Pk	8A	2	1.0

09029907	16	405807	Sms	8A	2	48.0
09029907	17	402809	Ky	8A	2	8.0
09029907	18	403812	Hpu	8A	2	8.0
09029907	19	414803	Exo	4	2	
09029907	20	416803	Wsm	4	2	6.0
09029907	21	416803	Wb	4	2	6.0
09029907	22	419804	Wb	4	2	6.0
09029907	23	400797	Wmc	4	2	3.0
09029907	24	400796	Wb	4	2	96.0
09029907	25	425804	Wct	4	2	7.0
09029908	01	406822	Skf	8A	2	12.0
09029908	02	405823	Hma	8A	2	5.0
09029908	03	405824	Hpu	8A	2	18.0
09029908	04	403825	Ky	8A	2	3.0
09029908	05	404821	Skf	8A	2	16.0
09029908	06	395833	Ky	2	2	21.0
09029908	07	396832	Hpu	8A	2	9.0
09029908	08	402826	Skf	8A	2	87.0
09029908	09	405826	Hma	8A	2	12.0
09029908	10	419834	Ky	8A	2	40.0
09029908	11	413839	Hpu	8A	2	19.0
09029908	12	411837	Htw	8A	2	46.0
09029908	13	400830	Sms	8A	2	13.0
09029908	14	432853	Ky	8A	2	6.0
09029908	15	432852	Hmk	8A	2	82.0
09029908	16	443848	Kr	8A	2	17.0
09029908	17	444844	Pb	8A	2	6.0
09029908	18	443843	Hmk	8A	2	78.0
09029908	19	429846	Kk	8A	2	4.0
09029908	20	429845	Ky	8A	2	4.0
09029908	21	437831	Skf	8A	2	63.0
09029908	22	424836	Hpu	8A	2	14.0
09029908	23	423837	Pb	8A	2	26.0
09029908	24	395817	Ky	8A	2	9.0
09029908	25	394815	Hpu	8A	2	7.0
09029908	26	393815	Skf	8A	2	10.0
09029909	01	381847	Cpo	2	1	27.0
09029909	02	382847	Sks	2	1	7.0
09029909	03	375844	Cpo	2	1	1.0
09029909	04	377843	Ccs	7	1	3.0
09029909	05	377847	Cpo	2	1	1.5
09029909	06	384825	Wr	2	2	2.0
09029909	07	391827	Sms	2	2	4.0
09029909	08	385834	Skf	2	2	22.0
09029910	01	515647	Sms	8E	1	2.0
09029910	02	514648	Skf	8E	1	5.0
09029910	03	509648	Sms	8E	1	14.0
09029910	04	518648	Sms	8E	1	19.0
09029910	05	517651	Kk	8E	1	22.0
09029910	06	521648	Cpo	8E	1	3.0
09029910	07	543679	Hpu	8E	1	2.0
09029910	08	544678	Hpu	8E	1	3.0
09029910	09	537674	Ps	8E	1	44.0
09029910	10	540671	Kk	8E	1	15.0
09029910	11	542680	Sms	8E	1	15.0
09029910	12	553685	Cpo	8E	1	5.0
09029910	13	553687	Hpu	8E	1	3.0
09029910	14	545697	Kk	8E	1	42.0

09029910	15	548698	Hpu	8E	1	3.0
09029910	16	548696	Skf	8E	1	175.0
09029910	17	561688	Hpu	8E	1	6.0
09029910	18	562688	Cpo	8E	1	2.0
09029910	19	506645	Cpo	8E	1	5.0
09029910	20	562700	Kt	8E	1	8.0
09029910	21	545688	Wm	5A	1	43.0
09029910	22	571700	Cpo	8E	1	8.0
09029911	01	389783	Cpo	2	1	0.5
09029911	02	387786	Cfm	7	1	11.0
09029911	03	387781	Ckh	7A	1	1.5
09029911	04	386780	Cpo	7A	1	0.5
09029911	05	383781	Cpo	2+7	1	4.0
09029911	06	384782	Cpo	2+7	1	2.0
09029911	07	385785	Ckh	7A	1	1.0
09029911	08	388782	Cpo	1	1	3.0
09029911	09	389781	Sks	2	1	20.0
09029912	01	427709	Hpu	9	2	2.5
09029912	02	427710	Hmt	9	2	0.5

Notes to table

1. Study area and ecological unit numbers are the reference number to access the sample cards taken in field survey. The first four numbers are the national reference numbers for Waitakere Ecological District. The next four find the study area card and the last two are the reference for individual ecological unit sample plots.
2. The map sheets involved are Q11 and R11. Easting grid references between 350 and 500 are in Q11; while those between 500 and 600 are in R11.
3. Vegetation Class Codes are as follows:-

Km	Mature kauri forest	Kr	Kauri-rimu forest
Ki	Kauri-tawari forest	Kb	Kauri-hard beech forest
Ky	Young kauri forest	Kt	Kauri-tanekaha forest
Kk	Kauri-kanuka forest		
Pk	Kahikatea forest	Pb	Podocarp broadleaf forest
Pu	Upland forest	Ps	Secondary podocarp forest
Hta	Taraire forest	Hpu	Puriri composite forest
Htw	Tawa forest	Htw	Mamaku broadleaf forest
Hpo	Ponga broadleaf forest	Hmt	Maire tawake forest
Hma	Mamangi forest		
Skf	Kanuka forest	Sks	Kanuka scrub
Smf	Manuka forest	Sms	Manuka scrub
Cpo	Pohutukawa forest	Ckh	Karo-houpara forest
Ccs	Coastal scrub	Chf	Mixed herbfield
Cps	Pingao sandfield	Css	Spinifex sandfield
Cpf	Phormium flaxland	Cfm	Flax-manuka scrub
Ccr	Coastal cliff rockland		
Bmr	Monocot rockland	Bsr	Shrub rockland
Bkk	Kowhai-kanuka scrub	Bkv	Kiekie vineland

Bbr	Moss rockland	Brr	Rata rockland
Wr	Raupo reedland	Wb	<i>Baumea</i> sedgeland
Wsm	Swamp millet grassland	Wct	Cabbage tree forest
Wmc	Manuka-cabbage tree scrub	Wl	<i>Leptocarpus</i> sedgeland
Ws	<i>Schoenoplectus</i> sedgeland	Wm	Mangrove
U	Unclassifiable		
Exo	Exotic species dominated		

4. Physical Area Code

1. Unconsolidated (Holocene) coastal dune sands
2. Consolidated marine sands of Kaihu formation
3. Freshwater lakes and artificial reservoirs
4. Freshwater (non coastal) wetlands
5. Saline wetlands
6. Offshore islands
7. Exposed rocky coast
 - 7a. Tasman sea coast
 - 7b. Rocky harbour entrance (Manukau Harbour coast)
8. Dissected hill country
 - 8a. Subdued hillcountry
 - 8b. Rugged hillcountry
 - 8c. Eastern foothills
 - 8d. High relief
 - 8e. Southern foothills
9. Alluvial flats

5. Bioclimatic Zone

1. Coastal
2. Lowland

APPENDIX 10**GLOSSARY OF TERMS USED IN THE REPORT**

Andesite	A dark-coloured, fine-grained igneous (volcanic) rock with a silica content of 54-65%.
Basalt	A dark-coloured, fine-grained generally extrusive, igneous rock composed predominantly of minerals with a high iron and magnesium content.
Breccia	A coarse-grained rock composed of angular fragments that are derived from pre-existing rocks which have been transported mechanically to their place of deposition.
Bioclimatic Zone	One of the categories used in classifying natural ecosystems in the PNA Programme. It refers to the broad distribution of vegetation zones along altitudinal gradients where a particular climatic regime dictates the character of the natural ecosystem. There are two classes of bioclimatic zone identified in the Waitakere Ecological District - coastal and lowland.
Broadleaf	A term used in this report to indicate trees and shrubs of angiosperm species.
Buffering	Protection of an area (or a particular community) from outside modifying influences, given by natural features (catchment boundaries, rock barriers, surrounding vegetation) or, in some cases, fences or other artificial structures. 'Buffering and surrounding landscape' is one of the seven criteria used in the evaluation and selection of Recommended Areas for Protection.
Canopy	The layer or layers formed by the uppermost crown or their parts. The concept is applicable to any kind of vegetation. In forests, it includes lianes and epiphytes.
Communities	A collection of populations of animals and plants that occur naturally together in a common environment of any size.
Composite	A term used to describe a group of related vegetation classes combined within one vegetation class. Such classes were combined to avoid splitting up a closely associated group of species in which the dominance of several species changes subtly from site to site, with no constantly dominant species. Used in this report to link the forest classes in which puriri is common but not always present.
Conglomerate	Similar rock to breccia except that the fragments comprising conglomerate are rounded whilst the breccia fragments are angular.
Dacite	A fine-grained extrusive igneous rock with a silica content of 54-65%.
Distal	Describes geological materials transported farthest from the source area (cf proximal).
Divaricating	Small leaved shrubs with inter-laced, wide-angled branches. (Lovell et al, 1991)

Dominant species	The species which comprise the obvious majority of the canopy foliage (percent cover) in a given vegetation class. There may be 4-5 dominant species in a composite forest class.
Dyke	An igneous intrusion that cuts across the bedding or layers of the host rock.
Ecological Character	The distinguishing features of a particular place, definable in terms of biotic composition, climatic, edaphic and topographical information.
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 bioclimatic communities. New Zealand has been subdivided into 268 such districts. It represents the level for assessing the representativeness of major ecosystems types in the national network of Protected Natural Areas.
Ecological Region	A group of adjacent ecological districts with very closely related ecological characteristics, or, in some cases, a single very distinctive ecological district. New Zealand has been subdivided into 85 such regions.
Ecological Unit	Any combination of vegetation classes (or suite of interrelated classes), plus the bioclimatic zone and physical area it occurs on e.g. coastal pohutukawa forest on exposed rocky cliffs. It is used to determine the biological and physical composition of a district and to identify the best or most representative examples of the ecological diversity of a district.
Ecological Zone	A division of the Waitakere Ecological District into broad working zones for the purpose of vegetation survey. They were used to structure study areas on the basis of natural divisions (geological, geographical, aspect etc).
Ecosystem	Any interrelated and functioning assemblage of plants, animals and substrates (including air, water, soil) on any scale, including the processes of energy flow and productivity.
Emergent	Describes a plant, usually a tree, whose upper canopy or crown is well above the general canopy layer of the vegetation around it.
Endangered	Natural features, usually species, in danger of extinction and whose survival is unlikely if the causal factors continue operating. For example, those species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. This is interpreted to include species with populations so low that a breeding collapse due to a lack of genetic diversity becomes a possibility, whether or not they are threatened by humans.
Endemic	The situation of organisms being restricted to a particular region such as a mountain, island, or country. <i>cf</i> Indigenous
Ephemeral	Of lakes - short-lived or temporary in nature.
Estuarine	One of six hydrological classes. An environment of salt or brackish water, partially enclosed but permanently open to the sea, with diurnal or less frequent inundation.

Exotic	Introduced plants whether wild, (self-seeded) or planted. Many species in the Waitakere Ecological District have spread from garden refuse dumped on roadsides or by spreading naturally from gardens.
Extrusive	Said of an igneous rock that has been erupted onto the surface of the earth.
Fernland	Vegetation in which the cover of ferns in the canopy is 20-100% and in which the fern cover exceeds that of any other growth form or bare ground. Tree ferns > 10 cm dbh are included as trees (<i>cf</i> Forest).
Flaxland	Vegetation in which the cover of flax in the canopy is 20-100% and in which the flax cover exceeds that of any other growth form or bare ground. Flax includes species of <i>Phormium</i> .
Flysch	A marine sedimentary rock type.
Forest	Woody vegetation in which the cover of trees exceeds that of shrubs. Trees are woody plants > 10 cm dbh. Trees ferns > 10 cm dbh are treated as trees. ¹
Grassland	Vegetation in which the cover of grass in the canopy is 20-100% and in which the grass cover exceeds that of any other growth form or bare ground. Tussock-grasses are excluded from the grass growth-form.
Greywacke	A dark grey, indurated, coarse-grained sandstone with grains of quartz, feldspar, dark rock and mineral fragments in a compact clayey matrix.
Ground Tier	The structural layer of any type of vegetation that is defined by its proximity to the soil surface. The ground tier is always <u>beneath</u> a covering tier, or layer, i.e. canopy, except beneath canopy gaps. In low vegetation consisting of only one structural layer, the term canopy replaces ground tier, which may be discontinuous or non-existent. In forest habitats the ground tier is characterised by shade-tolerant plants, usually ferns, bryophytes and herbs. It also includes the litter layer as well as stones, rocks, etc. Although ground tier plants are usually considered to be those less than 30 cm in height, this tier should not be treated as a layer with an absolute fixed upper height limit. In this survey a visual distinction was used to determine ground and mid tiers.
Habitat	The part of the environment in which a plant or animal lives. An organism usually has adaptations which allow it to live in that particular part of the environment, and it may be more or less restricted to that habitat.
Herbfield	Vegetation in which the cover of herbs in the canopy is 20-100% and in which the herb cover exceeds that of any other growth form or bare ground. Herbs include all herbaceous and low-growing semi-woody plants that are not separated as ferns, tussocks, grasses, sedges, rushes, reeds, cushion plants, mosses or lichens.

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The definition of forest has been changed from that of the Guidebook as the many areas with scattered emergents would, according to the original definition, be classified as treeland rather than forest.

Hydrologic Class	A category used in classifying the influence of water on the character of the biotic elements. If water is not a significant influence, a site is considered terrestrial. On sites where water is a major feature the characteristics of the soils and biota will be strongly influenced by the <u>nature</u> of the water body (e.g. palustrine, lacustrine, riverine, estaurine, marine).
Indeterminate	Species known to be Endangered, Vulnerable or Rare but about which there is insufficient information.
Indigenous	Native to, and occurring naturally in New Zealand. All those features which in the aggregate, originally gave New Zealand its own distinctive character. It is important at the regional, district and species level. <i>cf</i> Endemic
Indurated	Used to describe rocks hardened under pressure.
Intrusion	The process of emplacement of magma in pre-existing rock.
Lacustrine	One of six hydrological classes. A lake community/environment lacking persistent emergent vegetation. <i>cf</i> Palustrine
Landform	All the physical, recognisable, naturally formed features of land, having a characteristic shape, e.g. hill, valley or alluvial fan. In the PNA programme, classification of a landform emphasises its ecological significance rather than its geomorphological or geological significance.
Marine	One of six hydrologic classes. Wetlands formed as a result of marine deposition or changes in sea-level such as the post-glacial rise.
Mid-tier	The layer of vegetation spatially arranged between the canopy and the ground tier. This layer may be several metres deep and the percentage cover of all the species combined within this layer may exceed 100% because each species is analysed separately and different species often form separate layers.
Mosaic	Two or more classes of vegetation and/or soil displaying a repetitive, inter-related pattern and treated as a whole for the purposes of description or mapping. <i>cf</i> Pattern
Mossfield	Vegetation in which the cover of mosses in the canopy is 20-100% and in which the moss cover exceeds that of any other growth form or bare ground.
Naturalness	An estimate of how closely vegetation approaches the state expected for this vegetation class in the absence of impact by humans and introduced animals and plants. In practice, most sites have been modified to a greater or lesser degree. It is important to note that secondary communities or other disturbed stands can be highly natural, so a high naturalness rating may not be equal to the popular notion of "virgin".
Natural Diversity	Natural diversity refers to the range of the natural physical and biotic components in the landscape including species, plant and animal communities, ecosystems, landforms, soil sequences and dynamic systems and processes. 'Diversity and pattern' is one of seven criteria used to evaluate and select Recommended Areas for Protection.

Natural Vegetation	The plants indigenous to, or characteristic of a particular place. This excludes exotic or adventive plants.
Original Native Vegetation	Original vegetation which is substantially unchanged from the supposed primitive state e.g. mature podocarp forest, fern-clad rock faces, or vegetation growing anew as it has always done e.g. riverbed herbs.
Orogeny	The process of forming mountains.
Palustrine <i>cf</i> Lacustrine	One of 6 hydrologic classes. A wetland community/ environment characterised by emergent vegetation which may, or may not, have free standing water present.
Pattern	An ecological term describing the arrangement of species, communities and habitats according to spatial and environmental gradients.
Pelean	A type of volcanic eruption characterised by gaseous clouds and/or the development of volcanic domes.
Peneplain	A low, nearly featureless and gently undulating or almost plane land surface which presumably has been reduced almost to base level via erosion processes.
Pillow lava	A pillow-shaped form of igneous rock considered to be the result of extrusion under water, usually of deep-sea origin.
Physical Area	A unit of land surface which has a distinctive ecological character that reflects the local importance of a geomorphic, climatic, soil-related or hydrologic process. In the Waitakere PNA survey they were used as part of the ecological unit matrix to capture the diversity of natural features within the District.
Physiognomic Dominant	A visually obvious species - usually visually obvious due to structure eg height, girth, foliage spread etc. The actual percentage cover of this species in the tier may be relatively low.
Podocarp	Denotes a species or group of species in the Podocarpaceae family which includes miro, matai, kahikatea, totara and rimu. Although tanekaha is also in this taxonomic group it is not associated with the other podocarps in the WED forests and is therefore not included in the use of the word 'podocarp' in this report.
Priority Site	A place identified as the best example or one of the best examples of a vegetation class, a wildlife site or a landform within an ecological district. Aggregations of Priority Sites of vegetation, landform and wildlife form the basis for selecting Recommended Areas for Protection.
Protected Natural Area	A legally protected area, characterised by indigenous species or ecosystems, in which the principal purpose of management is retention of the indigenous state.
Proximal	Consisting of geological materials nearest the point of source. <i>cf</i> distal.
Pyroclastic	Pertaining to rocks made of fragments of pre-existing rocks, formed by volcanic explosion or aerial expulsion from a volcanic vent.

RAP	Recommended Area for Protection. A place identified as priority for protection because it contains the best example or examples of its type of natural ecosystem and/or landscape in an ecological district. A RAP is intended to be the basis for a proposal for a new protected natural area that would supplement the existing system of protected natural areas to make it more fully representative of New Zealand's ecological diversity.
Rare	Natural features, usually species with small world populations that are not at present Endangered or Vulnerable but are at risk. These species are usually localised within restricted geographical areas or habitats, or are thinly scattered over a more extensive range.
Rarity	Rarity is a measure of the paucity of numbers or occurrences of elements of natural diversity (e.g. species, communities). It is one of seven selection criteria used to select Recommended Areas for Protection in the PNA Programme.
Reedland	Vegetation in which the cover of reeds in the canopy is 20-100% and in which the reed cover exceeds that of any other growth form or open water. Reeds are herbaceous plants growing in standing or slowly-running water that have tall, slender, erect, unbranched leaves or culms that are either hollow or have a very spongy pith. Examples include <i>Typha</i> .
Regenerating	The extent to which a vegetation class is replacing itself or another class within an area which has been disturbed. It is measured in terms of the presence of seedlings and saplings of a given vegetation class.
Remnant	A block of vegetation which has been obviously diminished from its former size into an area with few or no natural boundaries through the influence of man. Although arguably all native vegetation areas have been diminished from the former continuous cover over NZ, the areas referred to as remnants generally have a natural area-modified area boundary visible when looking at the outside of the area from a vantage point. Generally refers to original vegetation.
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. They are named from the leading plant species when plant cover > 1% e.g. koromiko rockland.
Rushland	Vegetation in which the cover of sedges in the canopy is 20-100% and in which the rush cover exceeds that of any other growth form or bare ground. Included in the rush growth form are some species of <i>Juncus</i> and all species of <i>Leptocarpus</i> .
Representative	The extent to which an area represents or exemplifies the components of the natural diversity of a larger reference area e.g. representation in reserves of the current natural diversity of an ecological district, or representation of the original natural landscape. The identification and evaluation of the key representative natural areas in all Ecological Districts is the principal objective of the PNA Programme. It is one of the seven criteria used to evaluate natural areas and select Recommended Areas for Protection.
Riverine	One of six hydrologic classes. A system of flowing freshwater.

Sandfield	Land in which the area of bare sand (0.02-2 mm diam) exceeds the area covered by any one class of plant growth-form. Dune vegetation often includes sandfields which are named from the leading plant species when plant cover > 1%.
Scarp	A line of cliffs formed by faulting or erosion.
Scrub	Woody vegetation in which the cover of shrubs and trees in the canopy is > 80% and in which shrub cover exceeds that of trees (<i>cf</i> Forest). Shrubs are woody plants < 10 cm dbh.
Secondary Regenerating Native Vegetation	Regrowth after destruction or disturbance, but which is essentially similar to the previous vegetation.
Secondary Successional Native Vegetation	Vegetation which establishes after destruction or disturbance of the previous cover, and which may dominate for many decades, but is essentially different from the original vegetation e.g. kanuka forest.
Sedgeland	Vegetation in which the cover of sedges in the canopy is 20-100% and in which the sedge cover exceeds that of any other growth form or bare ground. Included in the sedge growth form are some species of <i>Carex</i> , <i>Uncinia</i> , <i>Scirpus</i> and <i>Baumea</i> .
Seral Stage	A group of plant species which are regularly recognisably associated at any particular point during the course of succession.
Sere	Succession built up from a regular repeatable set of seral stages. Commonly used to describe the process of encroachment of vegetation into a wetland by the visible spatial patterns of plant associations.
Shrubland	Vegetation in which the cover of shrubs in the canopy is 20-80% and in which the shrub cover exceeds that of any other growth form or bare ground.
Site	An area of land surface for which a specific statement can be made of aspect, slope, exposure, ground water, underlying geological material and vegetation. The size of a site may vary quite widely depending on the degree of uniformity required for sampling.
Succession	The process of a sequential change in the appearance, composition and structure of a community, usually over a number of years. Change may be due to biotic factors, or state factors, or both.
Study Area	A tract of land with indigenous vegetation delineated as suitable for survey in rapid field inventory in order to identify the ecological patterns and the natural diversity of an ecological district. It is an arbitrary unit, defined as appropriate to circumstances - it may be defined by the boundary of a remnant forest stand; a catchment; a legal title; or in largely undifferentiated environments by grid squares or other manageable, arbitrarily bound areas.
Terrestrial	One of six hydrological classes. Free water has an insignificant role in the ecological character of these areas.
Threat	The risk of adverse change to an area's (or community's) naturalness or "ecological quality".

Tuff	A general term for all consolidated pyroclastic rocks.
Vegetation Class	An association of species which is recognisable, describable and mappable at 1:50,000 scale. In this survey they have been identified by computer analysis and named by the leading dominant or dominants and the community structure, eg podocarp-broadleaf forest, pingao sandfield.
Viability	The ability of an area's plant communities (or in some cases a particular species) to maintain themselves in the long term, in the absence of any <u>special</u> effort to perpetuate them. Regeneration and vigour of a particular species and the size and stability of communities are important factors for evaluation. 'Long term viability' is one of seven criteria used in the evaluation and selection of Recommended Areas for Protection.
Vineland	Vegetation in which the cover of unsupported (or artificially supported) woody vines in the canopy is 20-100% and in which the cover of these vines exceeds that of any other growth form or bare ground. Vegetation containing woody vines that are supported by trees or shrubs is classified as forest, scrub or shrubland.
Volcaniclastic	Pertaining to a rock composed of broken fragments of pre-existing rock, containing volcanic material in any proportion and without regard to its origin or environment.
Vulnerable	Species believed likely to move into the Endangered category in the near future if the causal factors continue operating. For example, species whose populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbances.

The authors would like to acknowledge the use of descriptions of many of these terms from the Protected Natural Areas Guidebook (Myers et al, 1987). Some of the descriptions have been slightly altered from the state in which they appear in the Guidebook.

Other definitions are derived from the following:

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APPENDIX 11**ABBREVIATIONS USED THROUGHOUT THE REPORT**

AER	Auckland Ecological Region
ARC	Auckland Regional Council
a.s.l.	above sea level
coast.	coastline
Consol. sand	Consolidated sand
CMP	Auckland Centennial Memorial Park
DOC	Department of Conservation
ED	Ecological District
ER	Ecological Region
ha	hectares
HR	Historic Reserve
m	metres
pers. com.	personal communication
PLS	Priority Landform Site
PNA	Protected Natural Areas
PVS	Priority Vegetation Site
Pvt	Private
PWS	Priority Wildlife Site
QEII	Queen Elizabeth II Trust
RAP	Recommended Area for Protection
Reg. Park	Regional Park
RDC	Rodney District Council
RFBPS	Royal Forest and Bird Protection Society
RR	Recreational Reserve
sp.	species singular
spp.	species plural
SR	Scenic Reserve
Unc. sand	Unconsolidated sand
Uninvest.	Uninvestigated
var	variety (taxonomic term)
WED	Waitakere Ecological District
wet.	wetland
WSC	Water Supply Catchment

