FOXTON ECOLOGICAL DISTRICT

SURVEY REPORT FOR THE

PROTECTED NATURAL AREAS PROGRAMME

D A RAVINE

Published by
Department of Conservation
Wanganui
New Zealand 1992

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This report is one of the Protected Natural Areas (PNA) Programme series of reports which describe recommended areas for protection (RAPs) within ecological regions and districts. It has been prepared by staff of the Wanganui Conservancy of the Department of Conservation. Field survey was carried out during 1989-90.

Few Ecological Districts in New Zealand have been as modified by human activities as Foxton Ecological District. PNA survey of the district was given a high priority by the Department because of the on-going losses and modification of the few natural areas remaining.

Foxton Ecological District is readily defined as the strip of western North Island sand country between Paekakariki in the south and Mokoia near Hawera, in the north. Dominated by sand dunes of varying shapes and ages, the district also has dune-related landforms such as dune lakes and swamps, damp dune flats, coastal sand spits and tidal streams and rivers. Unfortunately, there is little in the district which remains in a truly natural state. Roading and urban areas, agricultural and exotic foresty, recreational activities such as use of off-road vehicles, and the spread of introduced wild animals and weeds have all reduced the areal extent and quality of the natural character of the dune country. More local in their effects, some other activities have been equally devastating, such as rubbish dumping, construction of pipelines and communication networks, land reclamations, and attempts to "protect" the dunes from their inherent, dynamic, geological processes.

Although these changes are still happening, sometimes rapidly, there are still remnants of native vegetation in Foxton Ecological District. The main purposes of the PNA survey were to locate the remaining areas, to assess their quality and extent, and to select the best representative areas of each kind of dune community.

The chief product of this report is the description of the set of RAPs which are intended to represent the range of natural ecological diversity of the Foxton Ecological District that is not already protected. They are the starting point for the implementation phase of the PNA Programme. This will involve discussion and consultation, particularly with the landholders involved. The Department of Conservation has a strong commitment to pursue the objectives of the PNA Programme.

A Recommended Area for Protection is as much a recommendation to the Department of Conservation as from it. Changes in recommendations may occur following the consultation process, or after consideration of other values that the RAP and its surroundings may possess. The Department will then endeavour to negotiate the proposals resulting from this process with the landholders concerned, to achieve the appropriate form of protection for each area.

This survey report contains a great deal of information on the ecological values of the Foxton Ecological District. It is a substantial reference work as well as a guide to conservation priorities. It will be of wide interest to landholders, conservation managers from the Department of Conservation and other agencies, iwi, scientists, conservation groups and the general public.

Bill Carlin
Regional Conservator
Wanganui Conservancy
Department of Conservation

30 June 1992

SUMMARY

The Foxton Ecological District was surveyed as part of the New Zealand Protected Natural Areas Programme during 1989 and 1990.

The Foxton Ecological District contains the largest sand dune system in New Zealand. It is part of the Manawatu Ecological Region, along with the Manawatu Plains Ecological Distict and is situated on the west coast of the North Island. It has had a history of major modification and now contains mostly farmland, exotic pine plantations and urban areas. Several natural areas remain, mostly in coastal dunes or associated with lakes. Weeds and drainage are major threats to remaining natural values.

There are 29 protected natural areas in the district, totalling 2,470ha or 2.2% of the area of the district. Of these, four are recreation reserve, with approximately 1,080 ha leased for grazing. Thus only 1.3% of the district is effectively protected.

Sixty areas have been recommended for protection, totally 1,750 ha or 1.6% of the area of the district. These areas comprise 46 priority one areas (1,435 ha) and 14 priority two areas (315 ha). These areas, together with the existing protected natural area network, represent the full range of ecological diversity remaining in the ecological district, much of which has already been lost.

ACKNOWLEDGEMENTS

The following people have contributed their time and effort to make this project successful. I would like to thank them all:

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I would especially like to thank many landowners who allowed me on their properties in order to carry out the survey. Their helpful attitude augurs well for the eventual success of the PNA Programme in the Foxton Ecological District.

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CHAPTER 1

1. INTRODUCTION

1.1 THE PROTECTED NATURAL AREAS PROGRAMME

The goals of the Protected Natural Areas (PNA) Programme are to identify and to protect examples of the full range of indigenous biological and landscape features in New Zealand, and thereby maintain the distinctive character of the country (Technical Advisory Group 1986). The programme was set up in 1983 in response to the objective expressed in Section 3 (1) (b) of the Reserves Act 1977 which identified the need for

"... the preservation of representative samples of all classes of natural ecosystems and landscapes which in their aggregate gave New Zealand its own recognisable character".

An ecological district is a local part of New Zealand where the features of geology, topography, climate and biology, plus the broad cultural pattern, interrelate to produce a characteristic landscape and range of biological communities (Technical Advisory Group 1986; Myers et al. 1987).

New Zealand has been divided into 268 ecological districts, which are grouped into 85 ecological regions (McEwen 1987).

PNA surveys are based on ecological districts. The purpose of these surveys is to identify ecological features which are inadequately protected in the existing protected natural area network and recommend areas for protection which, if protected, would compensate for these inadequacies.

The PNA Programme seeks to protect representative biological and landscape features that are common or extensive within an ecological district, as well as the district's unique or special features.

1.2 FOXTON ECOLOGICAL DISTRICT

1.2.1 Location and Criteria

The Foxton Ecological District occupies the full length of the western (coastal) side of the Manawatu Ecological Region (Fig 1). The Manawatu Ecological Region runs from the Tangahoe River, near Hawera, in the north, south to Paekakariki, extending inland as far as Kimbolton in the east, an area of a 3,500 km^2. It is bounded in the west by the Tasman Sea, in the south-east by the Tararua Ecological Region, in the east by the Manawatu Gorge Ecological Region, in the north by the Rangitikei Ecological Region and in the north-west by the Taranaki and Egmont Ecological Regions. It includes the low altitude plains and terraces of the Manawatu Plains Ecological District (2,400km^2) and the sand country of the Foxton Ecological District (1,100 km^2).

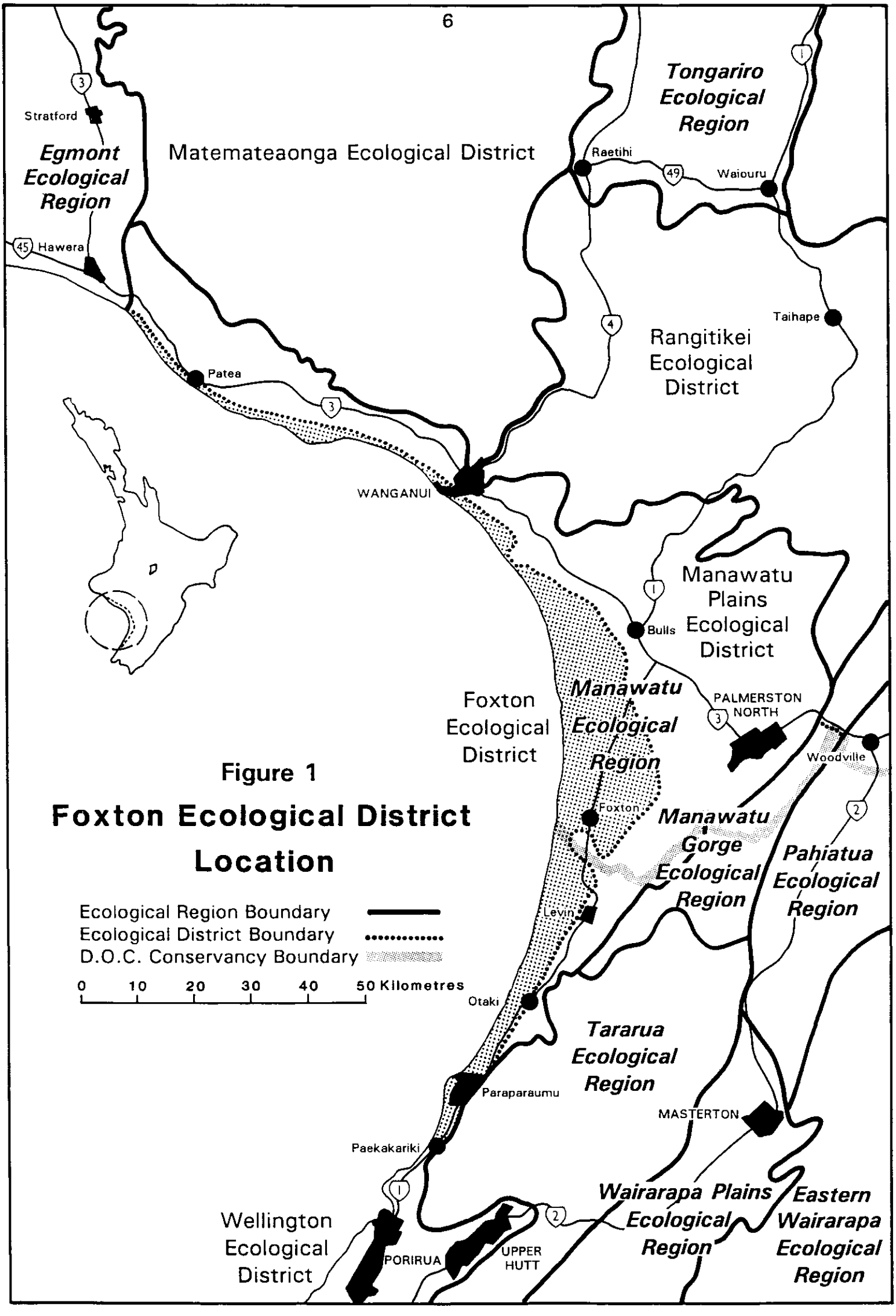


Figure 1

Foxton Ecological District Location

The principal criteria which define the Foxton Ecological District are its dune topography and associated vegetation. The long strip of Holocene sand dune country with its several associated wetlands, lagoons and several estuaries form the most extensive sand dune system in New Zealand (McEwen, 1987).

The ecological district boundary used for this survey differs from that in McEwen (1987) (see section 2.1.1).

1.2.2 Climate

The climate of Foxton Ecological District is mild, with warm summers and moderate winters. Average temperatures are slightly higher in the north of the ecological district than in the south and range between an average yearly minimum of -4.0°C to an average yearly maximum of 28.7°C (Holland 1985). Average yearly rainfall is lowest in the Himatangi-Foxton area (averaging 858mm annually at Foxton) increasing south and north to an average 1054 mm annually at Paraparaumu airport. The rain is fairly evenly distributed over the whole year, with February being the driest month and July the wettest (Duguid 1990).

The dominating feature of the climate is the wind. West-north westerly winds predominate, often reaching gale force (gusts exceeding 34 knots occur on an average 82-85 days each year in Paraparaumu and 76.3 days each year in Wanganui). These strong winds, evenly spread throughout the year, have had a major effect on the physical shape of the ecological district.

1.2.3 Landform and Geology

The physiographic character of the Foxton Ecological District is based on a dynamic sand dune system. This is described in some detail here because an appreciation of dune processes and landforms is necessary to understand the recommendations of this report. In fact, there is really only one extensive land system in the Foxton Ecological District, namely sand country. The only exceptions are small areas of alluvial plain near the Manawatu, Ohau and Rangitikei Rivers, and some downland in the Waikanae-Otaki and Waverley areas, generally associated with dune lakes.

There are three main sources of sand in the district. They are greywacke from the Ruahine ranges, volcanic sediment from the Egmont and Central Volcanic Plateau areas and sediment from the Wanganui Basin (Holland 1985). These sediments are carried to the coast by rivers and then tend to move east and southwards along the coast, though occasionally this trend is temporarily reversed. The prevailing wind has blown this sand inland, forming an extensive network of dunes which are aligned in a west-northwest to east-southeast direction.

Cowie (1963) identified four phases of dune building in the Manawatu part of the ecological district (Whangaehu River to Levin). The oldest (and furthest inland) phase is the Koputaroa Phase, which dunes are 10,000 to 20,000 years old. These dunes are limited in extent and many have arisen from "braided courses of rivers draining periglacial areas". There is a higher degree of soil development than on dunes of the other phases.

Dunes of the Foxton Phase are 2,000 to 4,000 years old and are thought to have arisen from volcanic eruptions in the Taupo, Tongariro and Taranaki districts. These dunes have a well developed topsoil, and form a near - continuous belt up to 7 km wide from west of Bulls to near Levin which is broken only by major rivers.

The Motuiti Phase has been attributed by Cowie to destabilisation of existing dunes following vegetation destruction by early Maori (up to 1,000 years ago). These dunes contain pumice from the Taupo (and other) eruptions and overtop sands of the Foxton Phase. Forest growing on both phases can be seen in Himatangi Bush Scientific Reserve (Esler, Greenwood and Atkinson, 1979).

The most recent dune-building phase is the Waitarere Phase. These dunes are less than 120 years old and have resulted from erosion of coastal dunes following European settlement and farming. More sand has been added through increased sediment loads in rivers, the result of forest clearance further inland.

South of Otaki and north of the Whangaehu river the dunes do not readily fit the pattern of these phases. North of the Whangaehu River the land is being uplifted and dunes are found above cliffs which are up to 45 metres high. Stock and fire over the last 100 years destablished these dunes forming several dune complexes and lakes (Fleming 1953). There is still some active sand aggradation and dune building at Patea, the Whenuakura Estuary, Waipipi Point, north of the Waitotara River, Nukumaru Beach and at the base of the cliffs in several places south, as well as Castlecliff Beach.

The moving sand, being driven in one direction by a prevailing wind has formed regular patterns, making landform descriptions relatively straight-forward. As sand is deposited on the beach, a foredune forms over driftwood. This may happen several times, resulting in swales and relict foredunes inland of the foreshore, which all run parallel to the coast (M Shepherd pers. comm.). This phenomenon is clearly seen now only to the south of Pekapeka Beach.

Following disturbance, a blowout may occur in one of these dunes. As it increases in size it forms a parabolic dune with a dune hollow behind it. These are a regular feature of the ecological district. Where two parabolic dunes have merged, a sand basin forms behind them.

Several adjacent parabolic dunes joining together form a dune with parabolic lobes and trailing sand ridges. As dry sand is blown more easily than wet sand, the surface sand tends to be blown away down to the water table. Consequently, sand basins and sand plains are flat, often containing ephemeral wetlands. In several places along the coast this dynamic process is still occurring, leaving a range of landforms over a small dune area. Often during the survey it was hard to clearly distinguish a landform as either sandbasin or sandplain, or a sandridge or parabolic dune, but generally the pattern is consistent (west of Lake Alice there are larger, stabilised barchan-type dunes, though none are now covered in indigenous vegetation).

When one or more parabolic dunes moves across an older sandplain, it can restrict water runoff from that sandplain, and form a dune lake. Sometimes a chain of lakes results, the most obvious example being where Waitarere Phase dunes meet Motuiti Phase sand country between the Rangitikei and Manawatu Rivers. These basin lakes are shallow and not "fixed" in position, moving inland with sand movement in the face of prevailing winds. For Pukepuke Lagoon and Lake Koputara, this is well documented (DOC files).

The other type of dune lake (the valley type) occurs where Foxton Phase dunes (or undifferentiated dunes further north and south) dam gullies in downland of the Manawatu Plains Ecological District. These lakes are steeper sided, deeper and more permanent than basin lakes. Though the lake edge vegetation and landform more closely fit the criteria for the Manawatu Plains Ecological District these lakes are included in the Foxton Ecological District because they are formed as a result of windblown sand action. Examples include Lakes Kopureherehere, Alice and Wiritoa.

Major drainage works carried out over the last 100 years have had a drastic effect on these lakes, particularly the basin type. Even where a lake has not been drained directly, its level may have been lowered as a result of drainage of lakes or swamps nearby. Whereas 100 years ago much of the ecological district consisted of dune lakes and peat swamps, these now account for only a small part of the area and it was sometimes difficult during the survey to decide if a natural area was on a dune lake or sandplain. Lake levels vary considerably (up to 1.5m) from season to season and from year to year.

There are several estuaries in the Foxton Ecological District, ranging from simple tidal stream mouths to the large (200ha) Manawatu Estuary. The positions of the mouths of major rivers are constantly changing, moving south (over 100m annually in the case of the Turakina River) and forming spits as sediment is carried down the coast, and then breaking through further north following floods. Groynes at the mouth of the Wanganui River have caused erosion south of the river mouth and accretion north of the river mouth. Inland of the mouths, there are often quite extensive tidal flats (up to 100ha).

Most rivers are slow near the coast, meandering round sand dunes and carrying a silt load. The major exception is the Otaki River, a fast river with a straight path to the sea which carries gravel from the Tararua Range. This has led to a stony beach between the Otaki River and Te Horo Stream. After heavy floods the Rangitikei River has been known to carry gravel to the coast, forming storm beach ridges (M. Shepherd pers. comm.). Evidence of this can be seen among in dune hollows south of the present river mouth.

The combined catchment of the rivers which form these estuaries is very large, including the western half of the Tararua ranges, much of southern Hawkes Bay and northern Wairarapa, the southern Kaimanawa Ranges, much of Mt Ruapehu and the King Country, the Matemateaonga Ecological District, much of South Taranaki, and the entire Manawatu Ecological Region.

The most recent uplifted marine terraces (Rapanui Terrace) north of the Whangaehu River provide a different range of landforms. These have eroded at times to "mesa-like hillocks" (Fleming 1953) in the Harakeke Block and low, irregular promontories east of the Waitotara River. More commonly, landforms associated with the uplifting are confined to the cliff edge, and the dunes above have the same general pattern as those further south. Cliff substrates are of Quaternary age mudstone, gravels, sands, shelly limestone, or andesitic tephras.

The cliffs are undergoing a continual process of erosion. Consequently, landforms present include slump ledges and talus slopes. These cliffs range in height from 3-45m. They are broken by gorges and valleys where streams exit, and by dune complexes at Waipipi Point, on either side of the Waitotara River and over much of the coast between the Wanganui and Whangaehu Rivers. At Patea, between Snapper Rock (near Wai-inu) and the Kaiiwi Stream and at Castlecliff, dune systems are forming at the base of the cliffs.

More detailed information on the landform and geology of the Foxton Ecological District can be found in Cowie (1963); Cowie, Fitzgerald and Owers (1967); and Fleming (1953).

1.2.4 Vegetation

Because of its easy accessability, mild climate and gentle contours the Foxton Ecological District has been greatly modified for mainly agricultural uses. Less than 5% of the surface area now has predominantly indigenous vegetation.

Few observations on vegetation were recorded by the earliest European settlers. Esler (1978) and Duguid (1990) indicate what the early vegetation may have been like in the Manawatu and Horowhenua parts of the ecological district, and Bussell (1988) has taken pollen samples from the Waverley area which also gives some insight into original vegetation.

Present day vegetation in existing natural areas gives some indication of pre-European vegetation, though a century of modifying influences, such as fires, drainage, selective logging and selective browsing by introduced herbivores has lowered the true representativeness of many areas.

On foredunes, spinifex was probably always common, especially on the seaward-facing side. Pingao would have been nearly as common. On the rear of the foredunes and on relict foredunes, shrubs such as tauhinu and sand coprosma (and possibly matagouri) would also have been numerous, with some sand daphne and club sedge. Before the arrival of Europeans, when the coast was more stable, the coastal dune complexes such as those found at Waipipi Point and Himatangi would have been less extensive than now. Younger dune hollows and sand plains in these areas would have had several low stature sedges and herbs with older areas being covered in jointed wire-rush, toetoe, cabbage trees and flax.

Further inland, on deeper soils there would have been many shrubs and trees. The present extensive areas of kanuka around Foxton and Hokio are probably a successional stage following clearance by burning. There are few remnants left of original dune and sandridge vegetation and those are being modified to at least a moderate extent giving only a poor indication of the original vegetation. Forest would have existed within a kilometre of the sea. Common species here would have included akeake, rewarewa, titoki, ngaio and mahoe, with kohekohe and wharangi in the south, and at least some totara, matai and shrubs including coprosmas, poataniwha and broom. Karaka was also common in pre-European times, though probably spread by early Maori. Further inland still there would have been a greater diversity, with species such as tawa, turepo, hinau, kaikomako and even northern rata and kamahi.

A great part of the ecological district would have had swamp forest, dominated by kahikatea and pukatea with plentiful rimu and, from Foxton southwards, swamp maire. Sadly, these great forests are now reduced to several small remnants. There is some evidence that these forests were reduced greatly in extent even before European times by Maori burnoffs (Cowie, Fitzgerald and Owers, 1967).

Less fertile sandplain areas would have been covered in scrub. The most common shrubs were probably Coprosma propinqua, C. rigida, Olearia solandri, O. virgata and manuka, with emergent cabbage trees and tree ferns (particularly mamaku and wheki). There would also have been extensive flax swamps and flax shrublands.

Bands of Schoenoplectus validus and bamboo spike sedge would have been more common. Carex secta would have been common round the edge of the open water. Most lakes would have been surrounded by toetoe, flax and cabbage trees, giving way to scrub or swamp forest.

The estuaries would have had similar vegetation to that which is found now (though without the weeds) as estuarine conditions have discouraged agriculture and urbanisation. Small herbs such as glasswort, shore primrose and halfstar were early colonisers, followed by sedges, particularly three-square and Bolboschoenus caldwellii. Tidal flats which developed a sand cover were usually covered in sea rush or jointed wire-rush, with occasionally some saltmarsh ribbonwood.

In the northern part of the ecological district, on cliff faces, many herbaceous species, common in estuaries and young sandplains, occurred including glasswort, shore primrose and halfstar. Cliff epilobium and taupata were also common, as was New Zealand iceplant in more exposed situations. Harsh conditions and poor access for people and introduced mammals have ensured that some of these faces are still relatively unchanged. Where some soil clung to the cliff face were areas of flax or kiokio (Blechnum capense "Green Bay form"). It is unclear exactly what grew on the tops of the cliffs. It is probable that mats of Zoysia minima were more extensive than now. Probably low stature forest with taupata, mahoe and ngaio grew close to the cliff edge but, if so, there is little evidence now. There would at least have been areas of jointed wire-rush. Further inland the vegetation would have been similar to that in the southern part of the ecological district.

Ever since humans arrived in the Foxton Ecological District the vegetation has undergone extensive modification. As long as 1,000 years ago, Maori lit fires to encourage growth of bracken, to flush birds or for access and strategic reasons. It is probably that fires often got out of hand and by the time Europeans arrived in the early 19th century much of the forest had already gone, to be replaced by bracken and kanuka. These early Europeans further reduced the extent of these forest, removing many trees for timber and firewood, and clearing the land for agriculture. Most of the few forest remnants left have either been logged and regenerated or have been selectively logged (such as when kahikatea were removed from Round Bush). Drainage of adjacent farmland has altered the composition of many of the regenerating remnants. Ironically, thousands of hectares of the sand country have been replanted in pine forests.

The effects of urbanisation have also modified the vegetation. Patea, Wanganui, Levin, Otaki, Waikanae, Paraparaumu and several smaller beach settlements, together with a network of roads, cover a surface area at least as great as that of remaining natural areas. Towns have generally been built on flat but dry areas which adds to the present disproportionate representation of original vegetation.

Even where areas were not deliberately cleared for farming stock made major changes to indigenous vegetation. Loss of plant cover from foredunes created massive destablisiation of the dunes and greatly reduced the extent of spinifex and pingao (spinifex has recovered well on the sea side of foredunes. Few bush remnants were fenced and their understories were badly damaged by stock. In estuaries, cattle especially have aided the spread of weeds. Rabbits, even now, cause damage to pingao and small herbs and sedges and may have been partially responsible for the reduction of many species. The likely impacts of sambar deer on coastal vegetation are not well-understood.

Recreational activities have had an adverse impact on vegetation. Off-road vehicles do serious damage, particularly to very vulnerable communities on foredunes, in ephemeral wetlands behind them and in estuaries. Even though duckshooters have been instrumental in saving some wetlands, they have also deliberately modified swamps by digging ponds, altering water tables and introducing exotic species of plant.

Sand stabilisation schemes have had massive impact on dune communities. Marram planting, often followed by lupin and then pines, still continues. Even in the last 15 years hundreds of hectares of indigenous vegetation cover have been lost in this way, removing habitat for regionally scarce wildlife such as fernbirds.

Few natural areas remaining in the ecological district are free from weeds. Some were deliberately planted and then spread unassisted, while others are accidental introductions, garden escapes or pasture species, often spread by stock. Only a few are discussed here. As already stated, marram grass is a serious weed of foredunes, having been planted or spread along most of the coast. Pampas is spreading at a truly alarming rate over wet sandplains, particularly at Tangimoana and Himatangi. Jointed rush occurs round lake and stream edges and in wet dune hollows particularly where stock have had access. It is particularly aggressive in the Waitotara area. Few estuaries are free of tall fescue, which has also invaded many rushlands. Another serious weed found in the Ohau, Manawatu, Whenuakura and Patea estuaries is Spartina anglica, which colonises mudflats, thus occupying the feeding habitat of wading birds.

Taller vegetation (forest, shrub, flaxland) has suffered less from weeds but many still occur. Pasture species (and pasture weeds such as thistles and ragwort) are found throughout many of these areas. Gorse, blackberry and willows affect swamp areas. In at least two places alders are spreading rapidly. Old man's beard has become established in the district and poses a serious threat to two areas already. Manchurian wild rice is established near Waikanae. This species has proved very hard to eradicate in Northland (Lambrechtsen, 1979). Near Turakina pyp grass, a rhizomatous relative of common veld grass, is spreading alarmingly from an original planting, smothering indigenous and exotic species indiscriminately. Most areas recommended for protection in this report have several weeds, sometimes serious ones. However, these areas are the least modified of what remains.

Of the remaining natural areas in the ecological district, the largest are coastal dunes such as those south of Himatangi and at Harakeke. These are also the areas with the worst weed and recreational vehicles problems. Most of the estuaries still retain intact natural vegetation; that of the Manawatu River also has high ornithological value. Several lakes and swamps also have good indigenous vegetation round their edges, extending in area up to 80 ha. Many of these areas are already protected while others are kept in reasonable condition by owners who see benefits for their stock or for duckshooting. The least modified, and so most natural, areas in the Foxton Ecological District are those associated with some lakes.

As commented earlier, most of the original forest has either been removed or is secondary growth forest following disturbance. There are no large (over 50ha) forest areas left, the most extensive (and in best condition) being at Lake Papaitonga Scenic Reserve and Round Bush Scenic Reserve. In the Waikanae area and also south of Bainesse there are several remnants within a relatively small area. There are also several small (1-10 ha) swamp forest remnants around Lake Horowhenua north to the Manawatu River. Most of these remaining remnants are on wet sand plains or lake edges. Very few remain on dry dunes and most of those are recommended for protection in this report. Indigenous forest in the ecological district is all but non-existent north of the Turakina River.

The only other type of natural area still covered mainly by indigenous vegetation is the cliff edges and faces in the northern part of the ecological district. Nearly everywhere there is pasture right to the cliff edge but at Waverley Beach, Patea and Kakaramea there are still Zoysia minima mats and small herbfields. The cliff faces have many weeds (tall fescue and boxthorn are prominent) but are mostly still natural, especially north of Patea where there are several kilometres with taupata, glasswort and New Zealand iceplant as the dominant plants.

1.2.5 Threatened Plants

Eleven species listed by Given (1990) are found in the ecological district.

Endangered:

Sebaea ovata: On wet sand flats at Harakeke, Hawken's Lagoon and Waipipi (previously recorded also at Hokio, Foxton and Turakina Beaches [Ogle 1989]).

Vulnerable:

Eleocharis neozelandica: On bare wet sand flats at Tangimoana, Hawken's Lagoon and Waipipi.

Leptinella dioica subsp. monoica: Otaihanga oxbow (Waikanae River mouth).

Mazus nozaezeelandiae: On damp sand at Waimahora Swamp and Harakeke (previousl recorded also at Turakina Beach).

Ophioglossum petiolatum: On a lake edge south of Hokio Beach.

Amphibromus fluitans: ephemeral wetland in Queen Elizabeth II Park, Paekakariki (Ogle 1987).

Rare:

Crassula manaia: On cliff edges at Waverley Beach and Patea.

Leptinella dispersa subsp. rupestris: On cliff faces at several locations between Castlecliff and Hawera.

Indeterminate:

Libertia peregrinans: On sandplains at Harakeke and Hawken's Lagoon (previously near a lake south of Hokio).

Pimelea arenaria: On coastal dunes at Hokio, Himatangi, Tangimoana, Harakeke and Waipipi.

Local:

Desmoschoenus spiralis: On coastal dunes at a number of locations throughout the ecological district.

1.2.6 Indigenous Fauna

Because of its mild climate and large range of habitats, the Foxton Ecological District would once have supported a very diverse indigenous fauna. The impacts of 1000 years of people and introduced animals will have caused many changes to this fauna, though, sadly, there is little information on what species have been lost.

The most conspicuous elements of the native fauna which remain are the birds. The New Zealand Wildlife Service National Habitat Register (now known as Sites of Special Wildlife Interest) covered much of the district and the survey cards provide good base data on the avifauna. These are supplemented by records of the Ornithological Society of New Zealand (OSNZ).

Many species of migratory birds, some in large number, have been recorded from estuaries in the Foxton Ecological District, particularly the Manawatu, Ohau and Waikanae estuaries. These include rarely seen migrants, such as the great knot, wandering tattler, Terek sandpiper, and red-kneed dotterel, as well as more regularly seen species such as the least golden plover, bar-tailed godwit and lesser knot. Species which breed in other parts of New Zealand use the estuaries seasonally. Again, these include rarer birds, such as black stilt, wrybill, and royal spoonbill, as well as a host of more common species including South Island pied oystercatcher, pied stilt, black-backed gull, white-faced heron, and white-fronted tern. Between 1958 and 1987 members of the OSNZ recorded 58 species of bird from the Manawatu Estuary alone (OSNZ, 1987).

Dune lakes often support large populations of waterbirds. Some of these areas are managed as wildlife refuges or wildlife management reserves in order to enhance the habitat value of these areas. Several others are managed privately for duck hunting and such habitat management can be beneficial for protected species also. Indigenous species seen at these lakes during this survey include brown teal, grey teal, paradise shelduck, shoveler, white heron, white-faced heron, black shag, litte shag, Australasian bittern, pukeko, Australian coot, dabchick and spotless crake. Two particularly common exotic water fowl are mallard duck and black swan.

Several wet areas with shrubs and rushes support populations of fernbirds, though most probably contain only a very few birds. At the Manawatu estuary, however, the population could number into the hundreds (pers. obs.). An apparent decline of fernbird numbers is probably the result habitat deterioration through drainage, stock damage and weed invasion as much as predation by cats, rats or mustelids.

Drier dune areas, particularly those with scattered shrubs (often this includes areas of predominantly exotic vegetation, such as boxthorn or lupin and introduced grasses) support very high number of birds. Falla (1957) stated that "for absolute density of numbers irrespective of species composition, semi-cultivated sand-dune country probably gives a higher figure than any other kind of terrain in New Zealand". Most of these, however, are exotic - in Falla's list of 32 species found in these areas, only 13 are indigenous. Falla also stated that "The most noticeable characteristic in this assemblage is the high proportion of naturalised passerine birds, especially finches". These high numbers even persist in winter. This species composition is largely a feature of a modified habitat. Only the harrier and the NZ pipit, among the indigenous species, seem to have benefited.

Though forest remnants account for only a small proportion of the total area of the Foxton Ecological District, there is still a variety of indigenous birds associated with these remnants, particularly in the Waikanae area (pers. obs.). Fantail, grey warbler, tui and bellbird were the species seen most often during the survey. These relatively high numbers are probably, at least in part, the result of the proximity of the remnants to large forest areas a few kilometres away in the Tararua Ecological District.

Occasionally, NZ fur seals are reported from the beaches of the Foxton Ecological District. These are usually sick or resting - seals do not breed in the district. Whales have stranded on these beaches, but this is a very rare occurrence and usually the whales are dead (DOC files).

Among the exotic mammals which are naturalised in the Foxton Ecological District, the best known, perhaps, is the sambar deer. Sambar deer were released near the Rangitikei River in 1875 and have spread south to around Hokio and north to near Waitotara. This herd is protected under the Wild Animal Control Act 1977 and managed by the Department of Conservation. During the course of this survey, damage to native vegetation attributable to sambar deer was seen in some places, such as near Lake Koputara and the Forest Road wetlands (though in some places cattle are also involved) which suggests such protection is inappropriate.

Rabbits were seen in very high numbers in the south of the ecological district but were found everywhere. Between the Manawatu and Rangitikei Rivers they had severely grazed pingao, as well as digging up small herbs and sedges on damp sand flats. Hedgehogs also occur in high numbers in the sand country (Brockie, 1957). Ferrets are common in places and have been the subject of several studies (eg. Lavers, 1973). Cats and European rats occur throughout the ecological district and together with hedgehogs and mustelids (ferret, stoat, weasel) must have had an adverse impact on indigenous birds, reptiles and invertebrates.

For an area with a large invertebrate population, mild climate and plenty of cover there have been surprisingly few records of lizards from the Foxton Ecological District. Gold-stripe gecko are known from just north and south of the ecological district and so presumably once occurred within it also. This suggests that the herpetofauna of the Foxton Ecological District may have contained more species than are now present. The amphibian and reptile distribution scheme of New Zeland lists the following reptiles from within the district: northern grey gecko, common skink and leathery turtle (the last from Waitarere Beach, 1954). Two introduced frogs (the golden bell frog and whistling tree frog) are common over much of the ecological district.

Several stream and river mouths along the coast are popular for whitebaiting. Whitebait are still reasonably common, though drainage of wetlands and stock damage to spawning areas has reduced numbers over the last century. As well as inanga, giant kokopu and other galaxids occur in the ecological district, as do brown mudfish and species of bully. Several dune lakes contain (often large) populations of both long-finned and short-finned eels. The estuaries have black flounder, kahawai, mullet, brown trout and occasionally quinnat salmon.

As suggested previously, the Foxton Ecological District contains a large invertebrate fauna. However, this fauna has not been comprehensively studied and available information is patchy. Brockie (1957) summarised the invertebrate fauna of the sand dunes. Of the insects, moths are the most common, followed by flies and then beetles. During the survey, locusts and dragonflies were also conspicuous. Some of these insects are very rare. For example, the moth Ericodesma aerodana, caterpillars of which feed on sand daphne, was found at Harakeke recently, the first North Island sighting for 111 years (Ogle and Patrick, 1991). It is possible that some of the insects and spiders in the ecological district are still undescribed. One of New Zealand's most infamous invertebrates, the katipo spider, is common along the foreshore area. Slaters, sandhoppers, millipedes, slugs, snails and other spiders are also common. Meads, Walker and Elliott (1984) recorded Powelliphanta traversi landsnails from Lake Papaitonga and rare forms of this species occur in other forest remnants within a few kilometres of the Foxton Ecological District.

1.2.7 Existing Protected Natural Areas

There are 29 natural areas, totalling 1,390ha, in the Foxton Ecological District with some level of protection. These area listed below under their appropriate protected classes. Twenty three areas, or 1,308ha are crown land and a further six areas, totalling 82ha, are on privately owned land.

SCENIC RESERVES

Lake Papaitonga Scenic Reserve

GR Centre: S25 985600
Area: 111 ha

Ecological Units:

- kahikatea - pukatea - tawa forest on gully
- pukatea - tawa - swamp maire forest on gully
- titoki - kohekohe - tawa forest on terrace
- tawa - titoki - (karaka) forest on terrace
- tawa - titoki/mahoe-kawakawa forest on terrace
- tawa - titoki/exotic grasses forest on terrace
- mahoe forest on terrace
- karaka - ngaio - cabbage tree forest on dune lake island
- manuka shrubland on footslope
- Coprosma propinqua - flax/ shrubland on dune lake
- flax - koromiko - mixed shrubs shrubland on dune lake
- flax - raupo flaxland on dune lake
- Carex secta sedgeland on dune lake

Comment: Administered by the Department of Conservation.

Round Bush Scenic Reserve

GR Centre: S24 038825
Area: 51 ha

Ecological Units:
- pukatea forest on sand basin
- mixed podocarp - broadleaf forest on sand basin
- mixed broadleaf forest on sand basin
- Coprosma propinqua shrubland on sand basin
- (cabbage tree)-flax flaxland on sand basin
- raupo reedland on sand basin

Comment: Administered by the Department of Conservation.

Barber's Bush Scenic Reserve

GR Centre: S24 122832
Area: 6.3 ha

Ecological Unit:
- pukatea treeland on sand plain

Comment: Vested in Manawatu District Council

SCIENTIFIC RESERVES

Waikanae Estuary Scientific Reserve

GR Centre: R26 790350
Area: 27.3 ha

Ecological Units:

- raupo reedland on sand plain
- sea rush - jointed wire-rush rushland on tidal flat
- marram - spinifex grassland on foredune
- Isolepis cernua/shore primrose - bachelors button herbfield on tidal flat

Comment: Administered by the Department of Conservation.

Himatangi Bush Scentific Reserve

GR Centre: S24 177833
Area: 18.7621 ha

Ecological Units:

- pukatea/tawa-mahoe forest on sand plain
- pigeonwood forest on parabolic dune
- kanuka scrub on parabolic dune
- mixed shrub/bracken-exotic grasses grassland on parabolic dune
- bracken fernland on parabolic dune

Comment: Administered by the Department of Conservation.

Harakeke Dunes

GR Centre: S23 890280
Area: 250 ha

Ecological Units:

- ngaio - boxthorn/club sedge treeland on marine terrace remnant
- club sedge - jointed wire-rush/Schoenus nitens sedgeland on sand plain
- marram - spinifex - (pingao) grassland on fore dune
- sand gunnera - halfstar herbfield on sand plain
- (cabbage tree)/Coprosma propinqua - (manuka)-(toetoe)/jointed wire-rush shrubland on sandplain.

Comment: Administered by the Department of Conservation.

WILDLIFE MANAGEMENT RESERVES

McKay's Crossing Wildlife Management Reserve

GR Centre: R26 764240
Area: 15 ha

Ecological Units:

- raupo reedland on sand plain

Comment: Administered by the Department of Conservation.

Lake Koitiata Widlife Management Reserve

GR Centre: S23 973186
Area: 41.4650 ha

Ecological Units:

- raupo reedland on dune lake
- raupo/Schoenoplectus validus reedland on dune lake

Lake Kohata Wildlife Management Reserve

GR Centre: R22 877350
Area: 14 ha

Ecological Units:

- raupo reedland on dune lake

Lake Waiau Wildlife Management Reserve

GR Centre: R22 538555
Area: 60 ha

Ecological Units:

- mahoe forest on dune lake island
- flax flaxland on dune lake

Ihupuku Swamp Wildlife Management Reserve

GR Centre: Q22 498561
Area: 80 ha

Ecological Units:

- flax/Coprosma tenuicaulis flaxland on gully

RECREATION RESERVES

Queen Elizabeth Park Domain

GR Centre: R26 755245
Area: 638.4372ha total
150ha (approximate natural area)

Ecological Units:

- mahoe-taupata forest on relict foredune
- mahoe-taupata forest on swale
- kahikatea -(pukatea) - (kohekohe) treeland on sand basin
- Muehlenbeckia complexa vineland on relict foredune
- (taupata) -(flax)/bracken Muehlenbeckia complexa vineland on foredune
- (taupata) -(flax)/bracken Muehlenbeckia complexa vineland on relict foredune
- (taupata) -(flax)/bracken Muehlenbeckia complexa vineland on swale
- flax flaxland on relict fore dune
- bracken fernland on relict fore dune

Comment: vested in Kapiti Coast District Council. Most leased for grazing.

Waimeha Lagoon

GR Centre: R25 802357
Area: 5 ha

Ecological Units:

- Coprosma propinqua -(C. propinqua x C. robusta)-taupata shrubland on dune lake
- raupo reedland on dune lake
- Carex secta sedgeland on dune lake

Comment: managed by Waimeha Domain Board

Koitiata Domain

GR Centre: S23 930227
Area: 70 ha

Ecological Units:

- (flax) -(Olearia solandri)/jointed wire-rush rushland on sand plain
- (three-square)/glasswort herbfield on tidal flat
- bachelor's button herbfield on tidal flat

Comment: vested in Rangitikei District Council

Nukumaru Domain

GR Centre: R22 553490
Area: 725.261 ha
133 ha natural
Ecological Units:

- tauhinu shrubland on swale
- tauhinu shrubland on relict foredune
- spinifex grassland on foredune
- NZ iceplant - glasswort herbfield on marine terrace remnant

Comment: Administered by the South Taranaki District Council, acting as Nukumaru Domain Board. Most leased for grazing.

STEWARDSHIP LAND

Pukepuke Lagoon

GR Centre: S24 025935
Area: 90 ha

Ecological Units:

- cabbage tree treeland on dune lake
- flax/Carex secta flaxland on dune lake
- raupo reedland on dune lake
- Potamogeton spp. - Chara spp. (submerged in) dune lake

Comment: Administered by the Department of Conservation as a Wildlife Management Area.

Waimahora Swamp (Santoft Forest)

GR Centre: S23 977157
Area: 30 ha

Ecological Units:

- flax flaxland on sand plain
- raupo reedland on sand plain

Comment: Administered by the Department of Conservation for conservation purposes though unallocated at time of writing.

Hawken's Lagoon

GR Centre: R22 538501
Area: 150 ha

Ecological Units:

- Carex pumila/sand gunnera sedgeland on sandplain
- Schoenoplectus validus - three-square/mercer grass - sharp spike-sedge sedgeland on dune lake
- marram - (spinifex) - (pingao) grassland on fore dune
- sand gunnera - Myriophyllum votschii - Schoenus nitens herbfield on sand plain
- water milfoil - Lilaeopsis novae-zelandiae herbfield on dune lake

Victoria Conservation Area

GR Centre: Q22 353595
Area: 11.9130 ha

Ecological Units:

- marram grassland on cliff edge.
- Zoysia minima - halfstar herbfield on cliff edge.

Comment: Only a small part (less than 1ha) of the cliff edge contains indigenous plant communities.

Kaikura Stewardship Area

GR Centre: Q21 304662
Area: 2.3269 ha

Ecological Units:

- raupo reedland on dune lake.

TIMBERLANDS ECOLOGICAL COVENANTS

Blind Lakes

GR Centre: S23 980165
Area: 20 ha

Ecological Units:

- Coprosma propinqua - C. propinqua x C. robusta shrubland on dune lake
- raupo reedland on dune lake
- three-square sedgeland on dune lake

Tunnel Hill

GR Centre: S23 967212
Area: 30 ha

Ecological Units:

- Coprosma propinqua shrubland on sand plain
- raupo reedland on dune lake

LANDCORP COVENANT

Waitotara River Mouth Swamp

GR Centre: R22 553503
Area: 3 ha

Ecological Units:

- (cabbage tree)/karamu - flax treeland on sand basin

QUEEN ELIZABETH II TRUST - OPEN SPACE COVENANTS

Lion Downs Bush

GR Centre: R26 812343
Area: 2 ha

Ecological Units:

- kahikatea - (pukatea) - (nikau palm) forest on sand plain

White's Bush

GR Centre: S24 070790
Area: 3 ha

Ecological Units:

- kahikatea - tawa - pukatea forest on sand plain

Lake Koputara

GR Centre: S24 021873
Area: 40 ha

Ecological Units:

- cabbage trees/flax-toetoe flaxland on dune lake
- raupo reedland on dune lake

Moore's Bush

GR Centre: S23 057098
Area: 1.6 ha

Ecological Units:

- mixed podocarp-broadleaf forest on dune hollow

PRIVATE TRUST

Nga Manu Sanctuary

GR Centre: R26 837363
Area: 10 ha

Ecological Units:

- kahikatea - pukatea - swamp maire forest on sand plain
- pukatea - swamp maire forest on sand plain
- swamp maire - pukatea forest on sand plain
- tawa - kohekohe forest on parabolic dune
- mahoe - ngaio forest on parabolic dune
- manuka shrubland on parabolic dune
- manuka/bracken shrubland on parabolic dune
- flax - Carex virgata flax land on sand plain
- flax - raupo flax land on dune lake island
- raupo reedland on sand plain
- Cyperus ustulatus sedgeland on sand plain
- Carex geminata sedgeland on sand plain
- Isolepis prolifer sedgeland on dune lake

Comment: Nga Manu Sanctuary is administered by the Peter McKenzie Trust which protects it in perpetuity.

PROTECTED PRIVATE LAND

Lake Omanu

GR Centre: S24 010817
Area: 25 ha

Ecological Units:

- raupo reedland on dune lake

Comment: owned by Fish and Game Council and managed for waterfowl. Though not formally protected, the land would not be sold without a covenant (Peter Taylor, pers. comm.).

CHAPTER 2

2. SURVEY METHOD

2.1 PREPARATION

2.1.1 Initial Preparation

PNA reconnaisance information (Phases I-III of PNAP methodology in Myers et al. 1987) for the entire Manawatu Ecological Region had already been compiled (J Skipworth 1988).

After reading available literature on the ecological district, a familiarisation tour of parts of the ecological district was made in the company of Colin Ogle, Conservancy Advisory Scientist for the survey, during which common plant communities and landform features were discussed. A small herbarium was established to aid plant identification during the survey.

To save confusion over whether a natural area lay in the Foxton Ecological District or the adjacent Manawatu Plains Ecological District a working ecological district boundary was drawn up (see Fig 2) which is more detailed that that found on the "Ecological Regions and Districts of NZ" map (McEwen, 1987). This boundary was derived from information on topographical maps, soil maps and aerial photographs. The boundary was modified during field work whenever it was deemed necessary. A copy of this boundary is now included with reconnaisance data for the Manawatu Plains ensuring no areas will be missed by both surveys.

Reconnaisance information had been gathered from several sources each using a different method for vegetation and landform description and therefore ecological unit descriptions were inconsistant. It was also necessary to standardise the description of ecological units. The object of the PNA programme is to ensure protection for areas based on representative ecological units so an effort was made to describe these based on the guidelines in Myers et al. (1987). Vegetation descriptions used were as outlined by Atkinson (1985) with the following differences:

- brackets were used to describe prominent spp (under 20% cover) even when they did not overtop the canopy.
- NZ flax - dominated communities were placed in the vegetational structural class flaxland, rather than tussockland. No "tussock" communities were recorded.

A standardised description of sand country land forms, which proved to be simple to use and effective in later data analysis was provided by Dr Mike Shepherd, Department of Geography, Massey University (pers. comm.). A description of cliff landforms was provided by Colin Ogle and Chris Ward (pers. comm.) of the Department of Conservation.

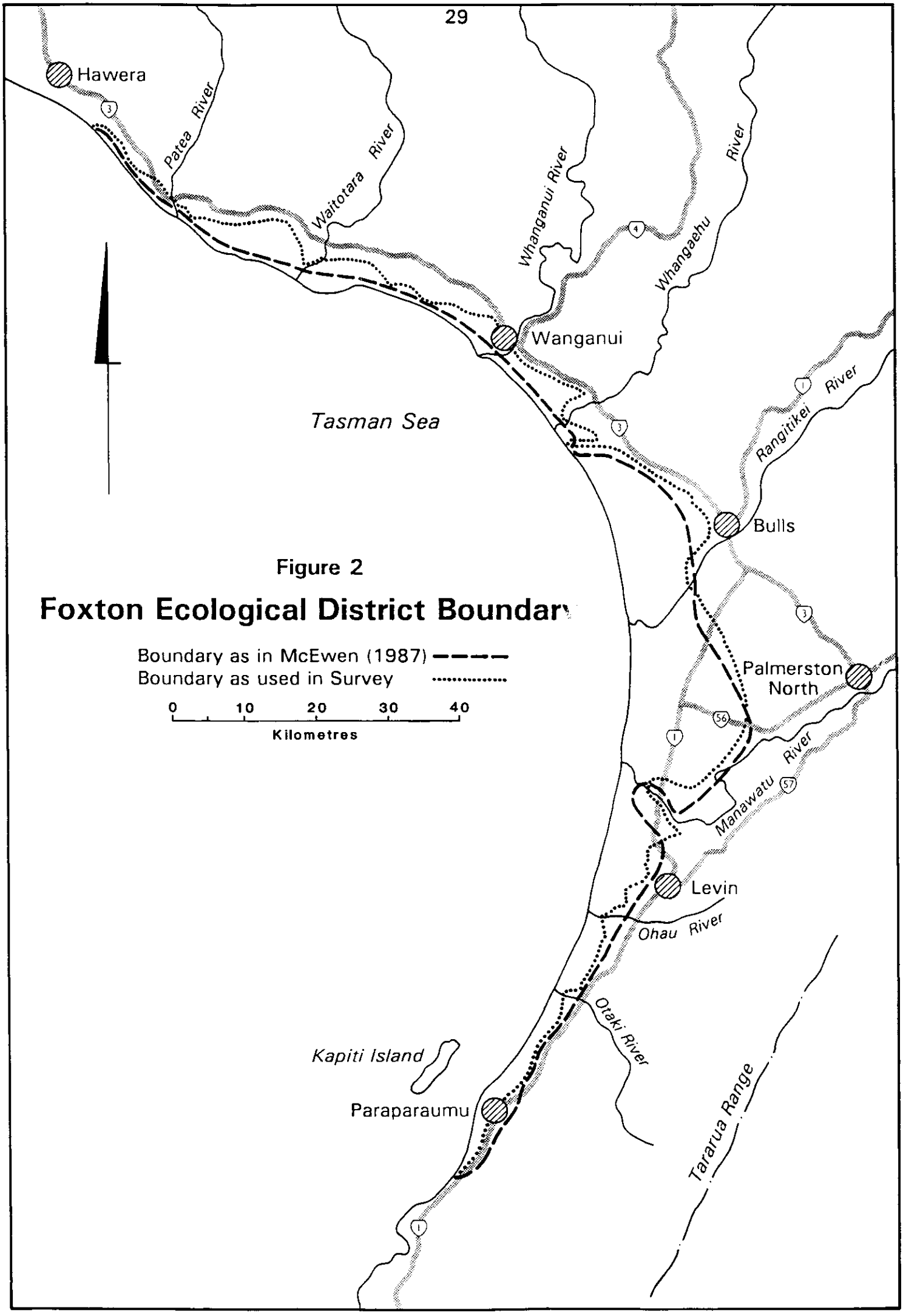


Figure 2

Foxton Ecological District Boundary

2.1.2 Study Area Selection

A list of natural areas in the ecological district was compiled using information from the following sources:

- PNAP Reconnaisance information for the Manawatu Ecological Region (information on Foxton Ecological District areas had to be separated from those in the Manawatu Plains Ecological District).

- places not included in Reconnaisance information but known to myself or other Department of Conservation staff.

- aerial photographs of the ecological district.

- other places noticed during the course of the survey.

These places were then numbered according to the source of information for survey purposes. A flight over the southern third of the ecological district in April 1991 showed that a good coverage was achieved, though it is possible that small natural areas have been missed.

Priority areas for survey were selected from the list on two main criteria:

- areas known to contain ecological units which were unprotected or inadequately protected.

- areas in a good natural condition but in which there was insufficient information to assess what ecological units were present.

In several cases, when information on an area was poor, it was assessed briefly from the nearest road or high point with binoculars, notes made in a field book, and the decision to survey or not made subjectively. If information available on an area suggested a high degree of modification or low natural values it was rejected for survey. In a few cases where the type of protection afforded a protected natural area did not adequately protect natural values (as in some recreation reserves vested in local bodies) the area was treated as unprotected and surveyed accordingly.

2.2 FIELD SURVEY

2.2.1 Sample Site Selection

Before sample sites were chosen in a study area an attempt was made to get an overview of the whole area, either on foot, by four-wheel drive vehicles or motorcycle or occasionally with binoculars from high ground. The actual selection of sample sites depended on an area's size and complexity as well as practical considerations such as access.

Areas with little ecological variation were generally surveyed only at one sample site considered representative of the whole area (sometimes this was the whole area, as in small forest remnants). Larger areas with more ecological variation were surveyed at several sample sites, chosen subjectively to indicate the overall ecological pattern of the whole area.

Small areas with high diversity (such as cliff edges and damp sand flats) were covered in one sample site which covered all the variation, for practical reasons. Sample site size varied according to how much area needed sampling to give a true picture of an area's ecological pattern. With rare exceptions, sample sites were confined to one landform.

2.2.2 Data Recording

For each area surveyed, one or more vegetation cards were filled out. A full species list was not attempted, but most indigenous vascular plants present were noted. Where a plant was common in an area but could not be identified in the field, a sample was taken for identification later. Exotic plants were often clumped together under "pasture spp" or "exotic grasses". Where access was a problem (such as through dense flax) vegetation was identified through binoculars and around the area's edges. In these cases even common smaller plants may not have been seen.

On the vegetation cards each species was assigned a cover class based on estimate of its cover in the height class where it was found. No quantitative sampling was done - usually this caused few problems but may have resulted in incorrect floristic naming of the vegetation type where two species had similar cover and, in the case of foredune vegetation, estimates of cover were higher than measurement would have shown (however, estimates were consistent over the whole survey). From this information, the vegetation component of the ecological unit in the sample site was named.

Also on the vegetation cards, information on stock disturbance, human disturbance, weeds, drainage, fencing and other factors likely to affect the indigenous vegetation of the sample site was recorded.

A landform card was filled for each sample site. This card contains a landform description as well as information on erosion, drainage and other features likely to affect the landform. Features such as altitude, slope and aspect were also recorded.

Finally, information from all vegetation and landform cards was summarised on a study area card. This card contains a list of ecological units for an area, as well as a map, a description of ecological pattern, buffering, surrounding landscape and other conservation values. Information on altitude, aspect, slope and tenure was also summarised on the study area card.

2.3 DATA ANALYSIS

A standardised ecological unit checklist for the ecological district was made (Appendix One) following the completion of field work. It was based on information collected during the field work (survey cards and field book notes) in the case of unprotected areas and on ecological units derived from existing information on protected areas.

The checklist was organised on a landform basis (all vegetation types listed under each land form type as this allowed the simplest data manipulation). The ecological units were further organised by structural class from forest down to sandfield allowing easy comparison across different landforms. This checklist was produced in two columns, one for unprotected areas and one for protected areas, which allowed rapid assessment of what proportion of an ecological unit (if any) remaining in the ecological district was protected. In some cases ecological units are not identical but similar enough to be clumped (such as occurs when weeds or stock have modified the vegetation pattern). This checklist allowed such "clumping" to be done as objectively as possible.

Areas were recommended for protection based on information contained in the checklist and using selection criteria as set down by Myers et al. (1987). Initially, areas were each assessed individually on their own merits and given tentative classification ("Recommended Area for Protection [RAP], Priority One" "RAP, Priority Two", "uncertain") or rejected. Because of the great diversity of ecological units in the ecological district, it was rarely necessary to consider secondary criteria to sort out priorities between two similar areas though this information was noted for all areas surveyed.

Following this initial classification, the ecological unit checklist was checked for gaps and inconsistencies (such as ecological units which were unprotected and not in a tentative RAP). Some gaps occurred where a natural area is so modified that it has become unrealistic to attempt to protect it. In the remaining cases areas were reclassified to ensure that the full ecological diversity of the ecological district is covered by existing PNAs or by RAPs. Areas were then confirmed as Priority One or Priority Two RAPs, following the guidelines set by Myers et al. (1987) (Section 3.1).

CHAPTER 3

3. RESULTS

3.1 RECOMMENDED AREAS FOR PROTECTION

Priority One

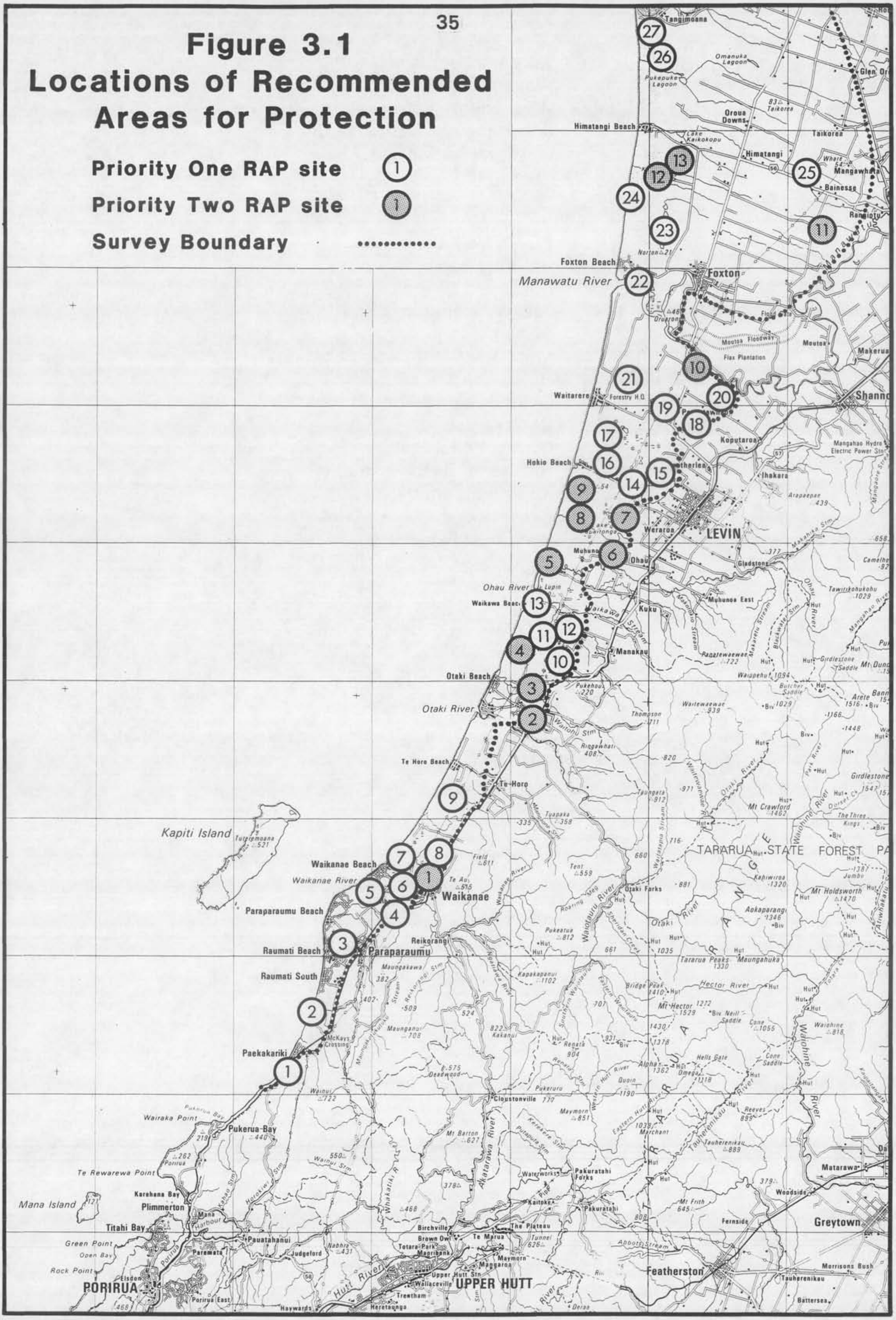
RAP 1	Fisherman's Table Dune
RAP 2	Queen Elizabeth Park (part of)
RAP 3	Andrew's Pond
RAP 4	Tini Bush
RAP 5	Waikanae Estuary Saltmarsh
RAP 6	Turf Farm Dune Forest
RAP 7	Te Harakiki Swamp
RAP 8	Ngarara Bush
RAP 9	Te Hapua Road Swamp
RAP 10	Lake Kopureherehere
RAP 11	Lake Huritini
RAP 12	Waikawa Beach Road Forest
RAP 13	Waikawa Estuary
RAP 14	Lake Horowhenua West Bush
RAP 15	Whitiki Bush and Swamp
RAP 16	Pakipaki Dune Forest
RAP 17	Moutere Lake No. 2
RAP 18	Te Whanga Bush
RAP 19	Poroutawhao Bush
RAP 20	Manawakaikiekie Bush
RAP 21	Oturoa Lake No. 3
RAP 22	Manawatu Estuary
RAP 23	Oruakaitawa Swamp
RAP 24	Foxtangi Dunes
RAP 25	Legg Estate Bush
RAP 26	Tangimoana Fernbird Area
RAP 27	Tangimoana Dump Dunes
RAP 28	Forest Road Wetlands
RAP 29	Mt Amon
RAP 30	Lake Herbert
RAP 31	Lake Alice
RAP 32	Sarah Pond
RAP 33	Plains Farm Shrubland
RAP 34	Lakes Vipan and Karamu
RAP 35	Koitiata Recreation Reserve
RAP 36	Turakina Estuary Spit
RAP 37	Whangaehu-Turakina Swamp
RAP 38	Whangaehu Estuary
RAP 39	Kaiiwi-Waiinu Cliffs
RAP 40	Nukumaru Beach
RAP 41	Waverley Beach
RAP 42	Lake Waikato Island
RAP 43	Waipipi Dunes
RAP 44	Whenuakura Estuary

RAP 42	Lake Waikato Island
RAP 43	Waipipi Dunes
RAP 44	Whenuakura Estuary
RAP 45	Kakaramea Powerhouse Cliffs
RAP 46	Manawapou Clifftop

Priority Two

RAP (2) 1	Waikanae Park
RAP (2) 2	Haruatai Park
RAP (2) 3	Ngatotara Lagoon
RAP (2) 4	Lake Wairongomai
RAP (2) 5	Ohau Estuary
RAP (2) 6	Muhunoa West Road Remnants
RAP (2) 7	Hokio Sand Road Remnants
RAP (2) 8	Levin Sewage Plant Scrub
RAP (2) 9	Okotore Lagoon
RAP (2) 10	Oturoa Road Bush
RAP (2) 11	Himatangi Bush Remnants
RAP (2) 12	Koputara Sandflats
RAP (2) 13	Pirie Pond
RAP (2) 14	Rangitikei Estuary

Figure 3.1
Locations of Recommended Areas for Protection



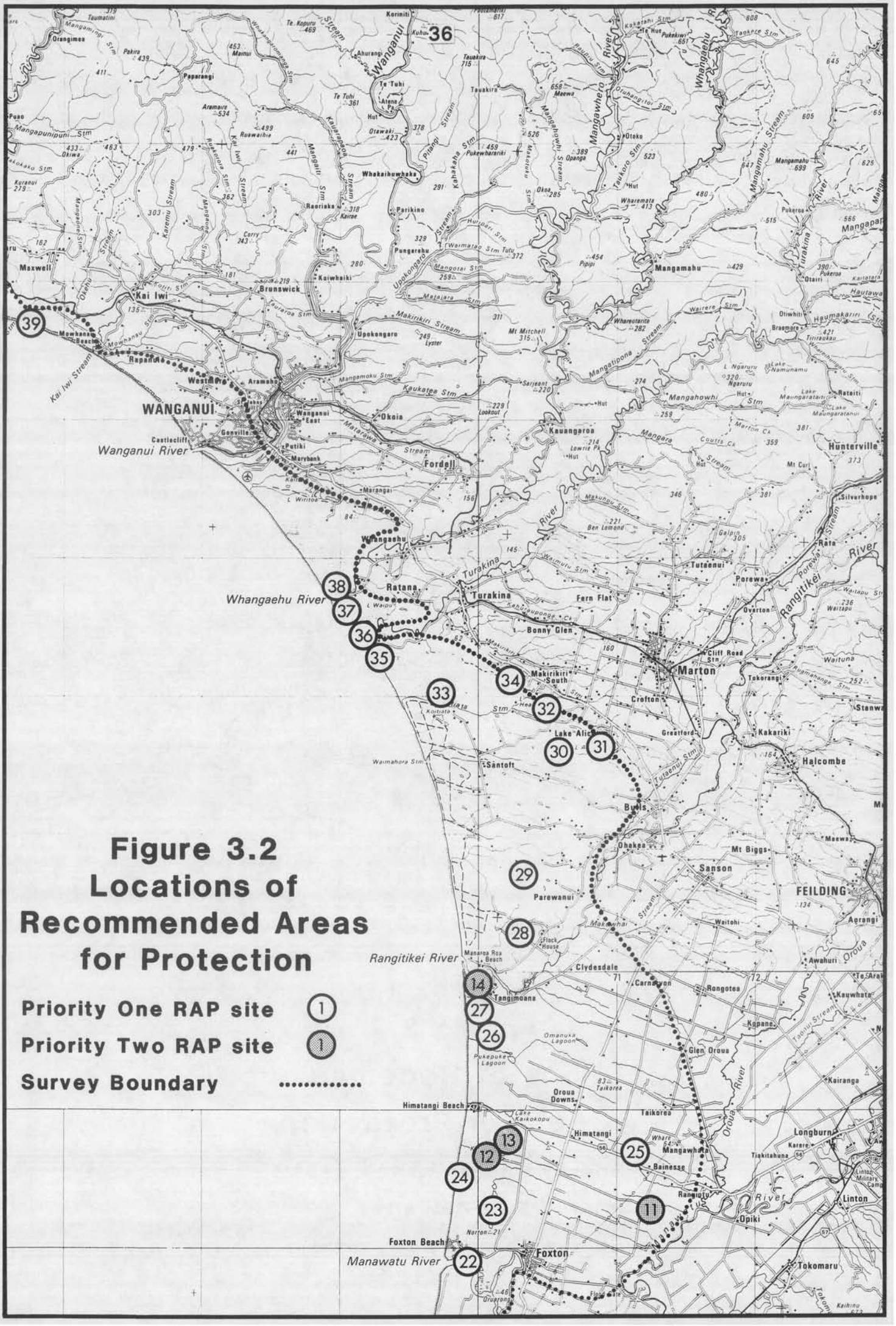


Figure 3.2
Locations of
Recommended Areas
for Protection
Priority One RAP site 1
Priority Two RAP site 1
Survey Boundary
WANGANUI
Wanganui River
Whangaehu River
Rangitikei River
Manawatu River
Marton
FEILDING
Foxton
Foxton Beach
Himatangi Beach
Hunterville
Halcombe
Kakariki
Sanson
Mangamahu
Turakina
Bulls
Opiki
Linton
Tokomaru
Longburn
Awahuri
Clydesdale
Tangimoana
Parewanui
Santoft
Lake Alice
Crofton
Bonny Glen
Fern Flat
Ratana
Fordell
Kai Iwi
Maxwell
Brunswick
Mowhanau Beach
Castlecliff
Gonville
Westmere
Aramoho
Putiki
Marybank
Wanganui East
Okoia
Kauangaroa
Mangaweka
Taihape
Koriniti
Pipiriki
Raetihi
Ohakea
Mt Biggs
Sanson
Rongotea
Kairanga
Glen Oroua
Oroua Downs
Taikorea
Himatangi
Mangawhata
Bainesse
Tiakitahuna
Karere
Rangiotu
Linton Military Camp
Tokomaru
Kopane
Kauwhata
Awahuri
Agrangi
Waitohi
Flock House
Manakau Road Beach
Omanuka Lagoon
Pukepuke Lagoon
Lake Kaikokopu
Norton
Oruarangi
Waimahora Stm
Mangaweka
Mangawhero River
Whangaehu River
Rangitikei River
Turakina River
Oroua River
Manawatu River
Porewa Stream
Mangamahu Stream
Mangaweka
Taihape
Koriniti
Pipiriki
Raetihi
Ohakea
Mt Biggs
Sanson
Rongotea
Kairanga
Glen Oroua
Oroua Downs
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Mangaweka
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Whangaehu River
Rangitikei River
Turakina River
Oroua River
Manawatu River
Porewa Stream
Mangamahu Stream

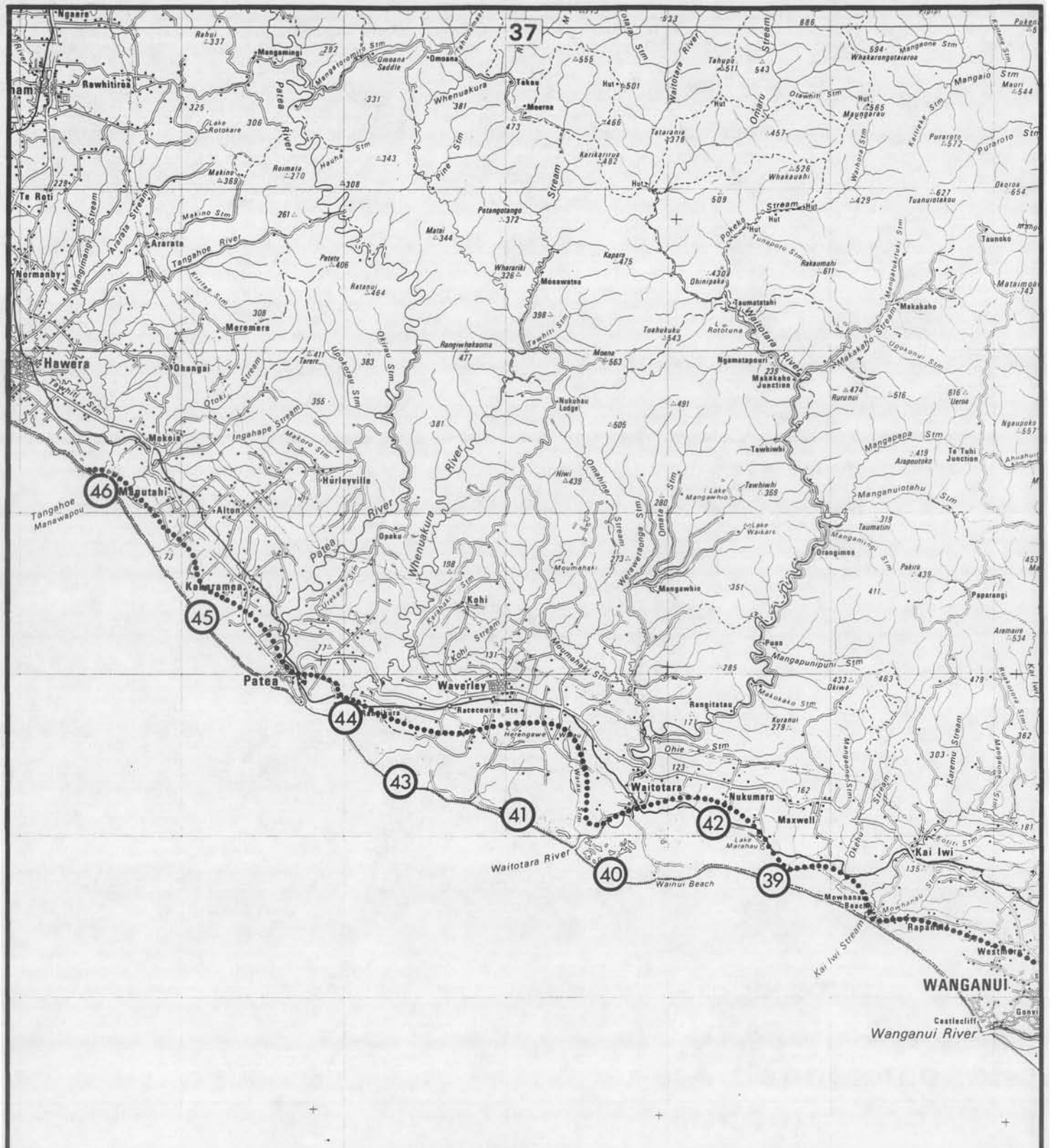


Figure 3.3
Locations of Recommended Areas for Protection

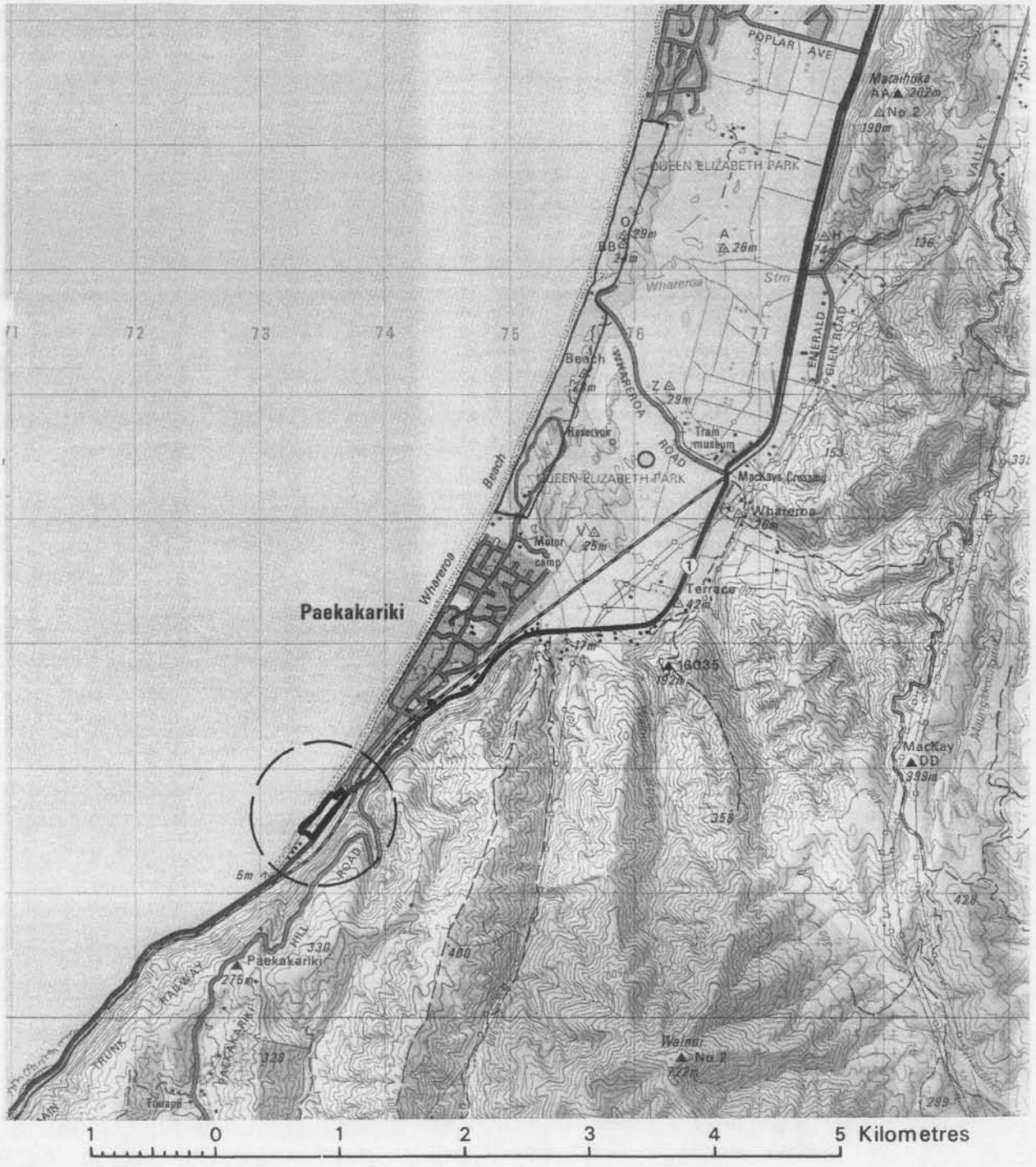
Priority One RAP site (1)

Priority Two RAP site (1)

Survey Boundary ••••••••••••

3.2 PRIORITY ONE RECOMMENDED AREAS FOR PROTECTION

RAP 1 Fisherman's Table Dune



Study Area:	1A
GR Centre:	R26 734216
Area:	5 ha
Survey Date:	17/12/90

RAP1 FISHERMAN'S TABLE DUNE

Ecological Unit

mahoe - kohekohe treeland on foredune

Landform

Geology: windblown sand
Soils: recent yellow-brown sands

This is a high, eroding dune on the sea edge. The dune is called a foredune in the ecological unit because of its location but originally would have been part of a parabolic dune which, through a continual process of coastal erosion (Gibbard 1972), is now in a foredune situation. The inland edge has been trimmed by road works during construction of State Highway One. The southern tip has recently been bulldozed for residential purposes. Beyond the northern boundary of the RAP this dune becomes the southern end of Paekakariki township. This dune is notable because it clearly defines the southern limit of the Foxton Ecological District.

Vegetation

Only part of this dune (that part recommended for protection) is covered in representative, indigenous vegetation. This is dominated by mahoe and kohekohe 3-6.5m in height, but also includes plentiful taupata and occasional ngaio and kawakawa. There is no subcanopy as such - the main canopy plants being taller where they are denser. Several open areas break the treeland up and these are either covered in dense bracken or rank, exotic grasses. Surrounding areas include steep eroding faces with mainly exotic grasses on the sea edge, pohutukawa plantings to the north and east, a wattle grove to the north-east also and a mown grass area along the northern boundary.

This is the only place in the ecological district where a mahoe-kohekohe community was noted during this survey. Five-finger is rare in the Foxton Ecological District.

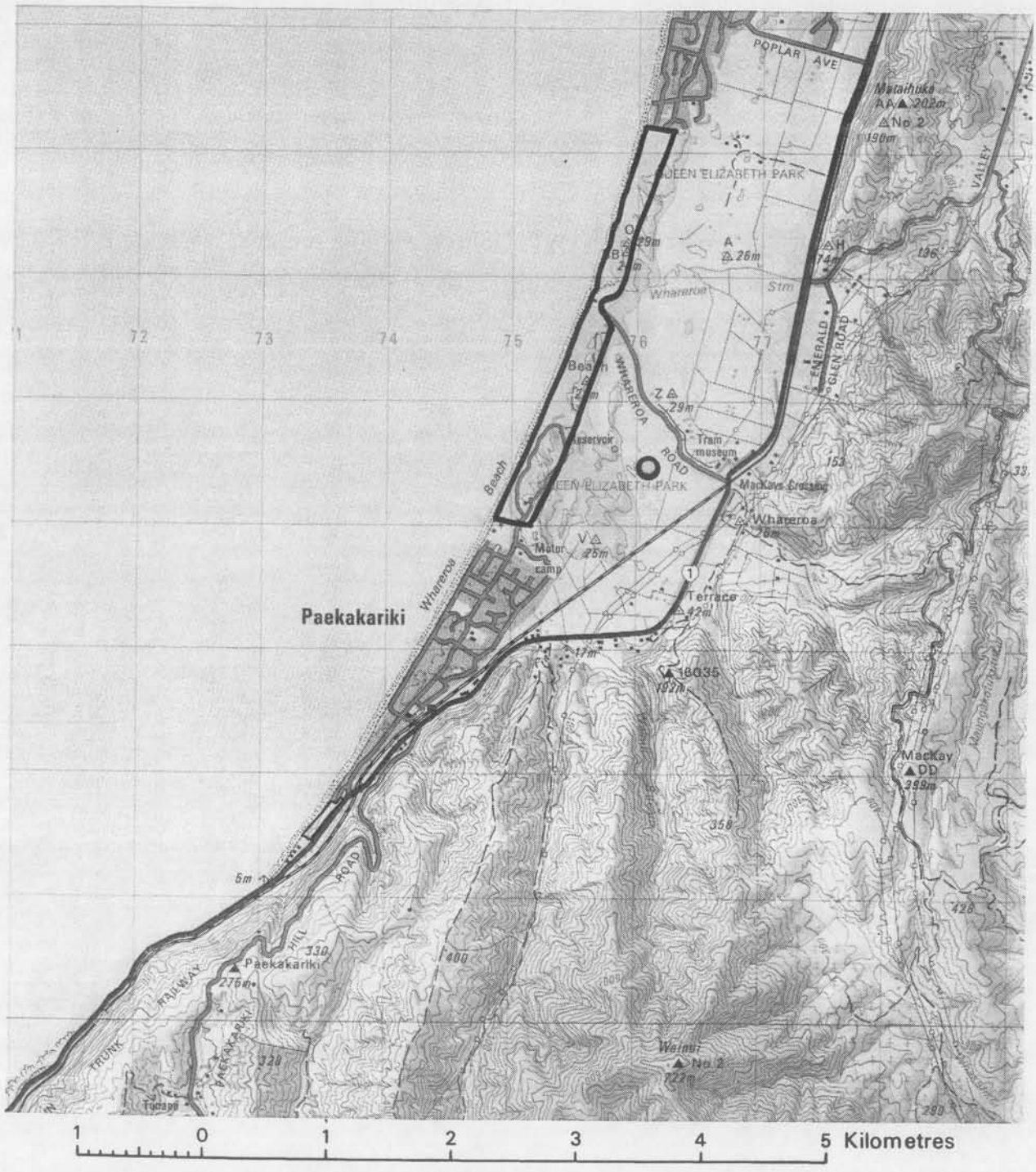
Special Features

Though only covering a small area, this RAP has special landscape values, resulting from its location (alongside a major highway and at the boundary of three ecological districts) and visual impact (including nearby pohutukawa plantings) (Gay 1990). Only in this southern end of the ecological district are indigenous trees found naturally occurring within 100m of the sea and the best occurrence of this is found in this RAP.

Selection Criteria

Representativeness:	H	Though modified, only example of a forest type which would have covered much of the Paekakariki area.
Diversity:	L	Other than treeland and bracken areas diversity is due to exotic plants and artificial works.
Special Features:	H	Unique ecological unit. Treeland/forest so close to sea rare in ecological district. Defines southern boundary of the ecological district.
Naturalness:	M	Patchy, some parts very natural.
Viability:	M	Small but not under threat.
Size and Shape:	M	Small area, shape dictated by physical boundaries.
Buffering:	H	Protected from stock. Close to seed sources.
Other:		Very little weed control or other management required. High landscape value.

RAP 2 Queen Elizabeth Park (part of)



Study Area:	2 and D10A
GR Centre:	R26 757253
Area:	150ha
Survey Date:	7/9/89 and 15/3/90

RAP2 QUEEN ELIZABETH PARK (PART OF)

Ecological Units

1. mahoe-taupata forest on relict foredune
2. mahoe-taupata forest on swale
3. kahikatea - (pukatea)-(kohekohe) treeland on sand basin
4. Muehlenbeckia complexa vineland on relict fore dune
5. (taupata) - (flax)/bracken - Muehlenbeckia complexa vineland on foredune
6. (taupata) - (flax)/bracken - Muehlenbeckia complexa vineland on relict foredune
7. (taupata) -(flax)/bracken - Muehlenbeckia complexa vineland on swale
8. flax flaxland on relict foredune
9. bracken fernland on relict foredune

Landform:

Geology: windblown sand; unconsolidated windblown sand
Soils: yellow-brown sands; little soil development

Queen Elizabeth Park consists of a foredune - swale - relict fore dune complex of about 200ha on the sea edge, backing onto a sandplain of about 400ha with several parabolic dunes. It is bounded by Raumati Beach and Paekakariki townships, the Tasman Sea and State Highway One. Those parts of the park recommended for protection include the entire foredune - swale - relict fore dune complex and a sand basin of about 3 ha several hundred metres inland. Both areas have been modified by horse-riding and walking tracks and the foredune complex also has a small amount of roading. Parts of the park have been destabilised by stock pressure but this has yet to affect the RAPs. There is some wave erosion on the coast, especially south of Raumati Beach.

Vegetation

Queen Elizabeth Park has a history of disturbance of vegetation which has resulted in several natural areas being lost or badly damaged, even within the last 10 years. However, the two parts of the park shown on the map as recommended for protection still contain predominantly indigenous vegetation. An area of ephemeral wetland further inland was identified in the Park's management plan (1981) and was discussed by Ogle (1991) as the habitat of the threatened species Amphibromus fluitans. It is now so modified by grazing and adventive plants that it is not identified here as an RAP. There is an unusually high diversity in vegetation types on the foredune and relict foredune areas compared to other areas in the ecological district. The swale areas mirror this diversity but some of these have been cleared for picnic and recreation use.

Muehlenbeckia complexa vineland, containing much native spinach, is the most common vegetation type in the foredune area. There are also areas dominated by bracken or flax, totalling many tens of hectares. These communities are not discrete, but blend into each other. In the more sheltered areas mahoe and taupata become dominant. Just south of Raumati, these small trees form a low forest (about 3m high) covering some 20ha in three main blocks.

As much as a third of this foredune area has been cleared and is now mown grass, walking track or pasture. There are several weeds present in large amounts, notably boneseed, pampas, blackberry, gorse, boxthorn and marram.

The vegetation does not show an obvious successional sequence going inland, as is the case in other fore dune areas in the ecological district. This may indicate that this part of the coast is comparatively stable or eroding slowly and, consequently, the dunes are considerably older than otherwise similar areas further north. The range of communities present is likely to reflect the effects of fires or grazing. This range of foredune communities is unique in the ecological district.

The separate sand basin recommended for protection contains a remnant stand of ex-forest (now treeland) dominated by kahikatea. Slightly drier parts contain mature kohekohe trees and tall kanuka. There are also several pukatea and swamp maire. Both canopy and understory are in a modified condition (the understorey is very poor) and attempts have been made to replant the area. However, species used are not all appropriate, eg. karo is outside its natural distribution here). The association of kahikatea with significant amounts of pukatea and kohekohe is unique in the ecological district.

Special Features

With a background featuring Kapiti Island, the ocean or the Tararua Ranges and a foreground dominated by diverse, indigenous vegetation, the foredune area has particularly high landscape values which are easily seen by the public. This RAP contains several ecological units now unique within the Ecological District.

Selection Criteria

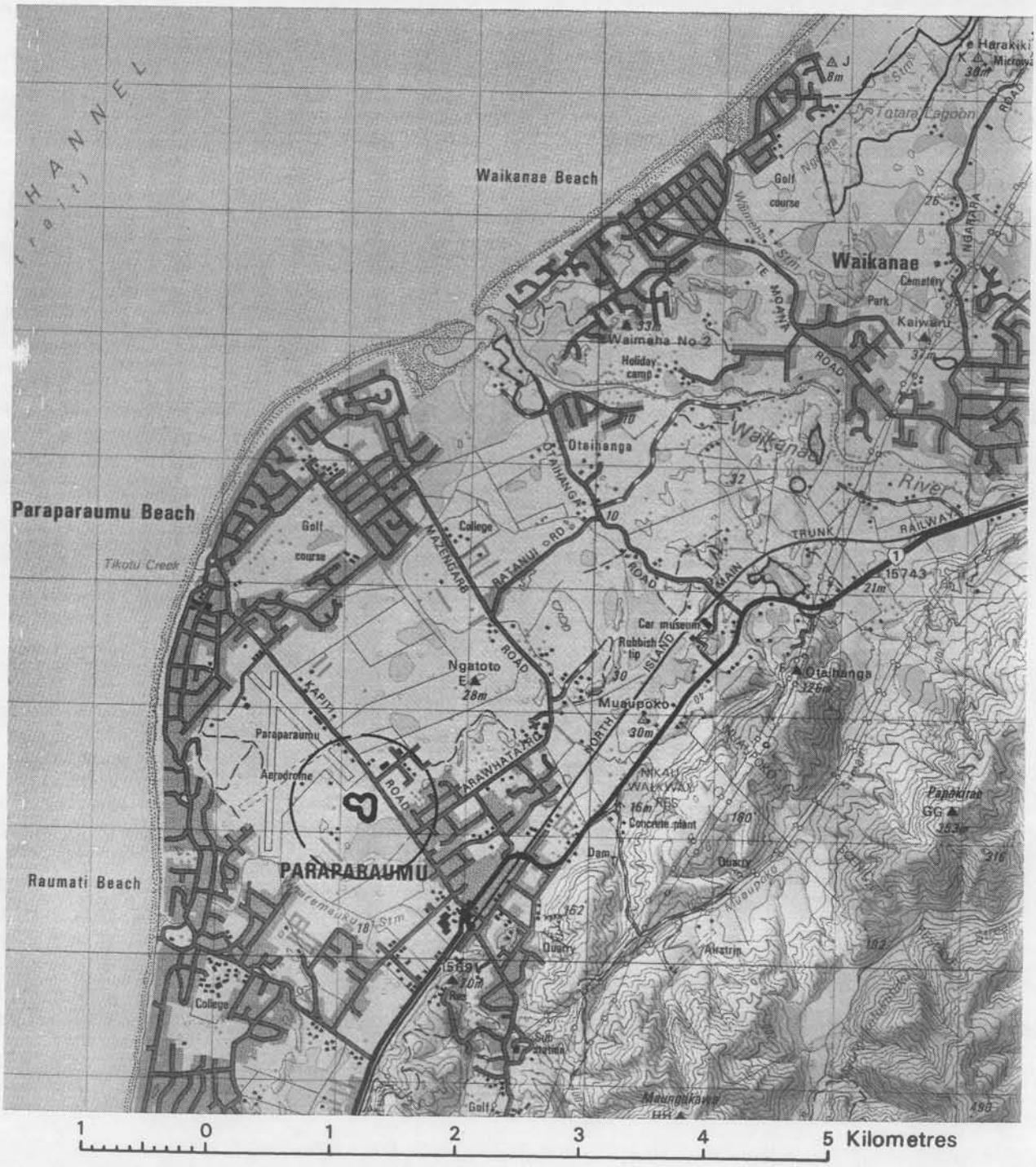
Representativeness:	M	Despite modification this area still indicates the original ecological character of this part of the coast.

Diversity:	H	Foredune areas show high diversity of communities.
Special Features:	H	Communities (and consequently ecological units) unique in the ecological district
Naturalness:	M	Spoiled by exotics, track work and insentive plantings.
Viability:	M	Good prospects with improved management.
Size and Shape:	H	Foredune area very large, though relatively long and thin. Sand basin smaller than ideal.
Buffering:	H	Both parts fully fenced. Fore dune area has sufficient seed source to recover from current, disturbed state. Sand basin sheltered from wind by plantings of macrocarpas.
Other:		High scenic value.

Comment

Queen Elizabeth Park is a recreation reserve vested in Kapiti Coast District Council. The areas recommended for protection are among the areas designated in the management plan (1981) as being managed for protection purposes. However, management practices have not followed the intentions of this plan and many of the conservation values have been greatly compromised. Thus it is necessary to recommend these areas for a higher and more binding degree of legal protection.

RAP 3 Andrew's Pond



Study Area:	R1A
GR Centre:	R26 782 313
Area:	1.5 ha
Survey Date:	25/10/91

RAP 3 ANDREW'S POND

Ecological Units:

- manuka/Isolepis prolifer/sphagnum moss shrubland on dune lake.

Landform:

Geology: peat; windblown sand
Soils: organic soils; recent yellow-brown sands

Andrew's Pond is a small dune lake set in two dune hollows connected by a narrow bottleneck. There is no obvious inlet or outlet, yet the water level is some 3m higher than in ponds in surrounding sandplains. Parabolic dunes surrounding the pond rise some 6m above the water surface.

The surrounding dunes have been tracked by cattle which have also caused extensive pugging around most of the pond edges.

The landform is slightly unusual in that dune lakes within dune hollows are rare in the ecological district, other than ephemeral wetlands found nearer the coast.

Vegetation:

The vegetation of the RAP is in two main parts. One part is dominated by manuka, which appears to have been depleted by fire, some harvesting (presumably for firewood) and cattle but nevertheless retains a reasonably closed canopy over nearly half of the area. The most common plant in the ground cover is sphagnum moss, though this has been taken over in places by Isolepis prolifer and also some Baumea teretifolia. Some Carex secta present has been badly damaged by cattle browsing. Few other native plants were noted.

The other part of the RAP is dominated by exotic floating sweetgrass with some bachelor's button and duckweed. Though not in a natural condition it is important to include this area in the RAP as the rest of the area relies on the maintenance of high water levels and low fertility.

Gorse and blackberry have begun invading the area and need control. Stock damage is not confined to browsing and pugging. Much of the vegetation is indicative of a low fertility site, yet cattle droppings over many years have clearly increased fertility to the point where other plants (such as floating sweetgrass and Isolepis prolifer) have become well-established).

Special Features:

There are only two places in the ecological district where sphagnum moss is plentiful (under manuka in both cases). In the other area (north of Te Hapua road, near Otaki) drainage, weeds and heavy stock pressure for many years have modified the area to a point where restoration is not realistic. Thus this small, damaged shrubland is the best that remains in the ecological district of an ecological unit susceptible to destruction by farming practices.

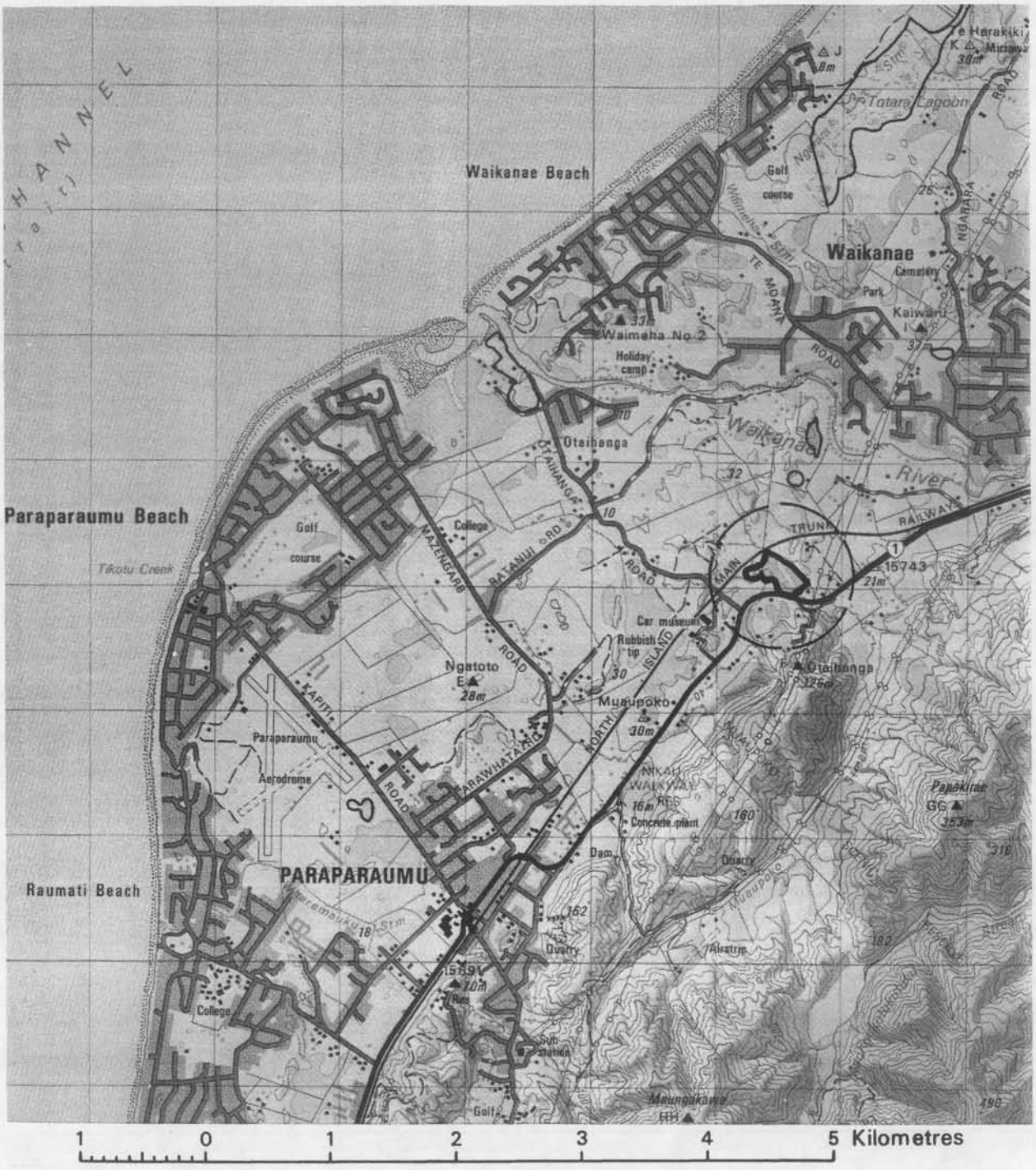
Selection Criteria

Representativeness:	H	One of only two remaining examples of an ecological unit which could be expected to once have been much more extensive.
Diversity:	L	Low diversity is one of the special features of the area.
Special Features:	M	Contains a plant community which is very rare in the ecological district.
Naturalness:	M	Low in some parts, moderate in others.
Size and Shape:	M	Two round areas with a bottleneck. Small size.
Buffering:	M	Part fenced. High water levels restrict stock slightly and inhibit weed establishment.

Comment

This area is zoned residential. When the surrounding area is developed expert advice should be sought on effects of construction, stormwater discharge etc on water levels and fertility.

RAP 4 Tini Bush



Study Area:	7
GR Centre:	R26 815332
Area:	20 ha
Survey Date:	27/3/90

RAP 4 TINI BUSH

Ecological Units

1. pukatea - kohekohe forest on sand plain
2. kohekohe forest on sand ridge
3. kohekohe forest on footslope

Landform

Geology: windblown dune sand
Soils: yellow-brown sands; thin sands

Tini Bush is found at the inland edge of the Foxton Ecological District at a point where the sand country meets downland. As a result the sand dunes are shaped by the contours of the land they have migrated over and no longer have the clear parabolic patterns found elsewhere in the ED.

Associated with these dunes is about 5ha of sand plain which is very wet. This area has been artificially bounded by construction of a railway line to the north-west.

The Muaupoko Stream runs through the RAP, mostly along the northern edge. A drain runs from swampy pasture on the south-east of the RAP down to the stream but does not appear to have an adverse effect on natural values.

Approximately 2ha of forest in the RAP is on downland. Otherwise the RAP is in sand country.

Vegetation

Tini Bush is composed of four forest remnants totalling about 15ha, separated by about 5ha of pasture and a vehicle track. The blocks are mostly, but not completely, fenced. There are two predominant forest types which merge quite sharply. On the drier sand ridges, kohekohe (of about 10m height) dominates, with little else present on the higher parts. Lower down, there are notable quantities of tawa and occasional rewarewa and titoki.

Pukatea (rising to 15m) dominates the wet forest on the sand plain though there is over a hectare in which nikau palms dominate. On the higher side the forest merges with tawa and kohekohe. Towards the railway there is an abrupt change to wet pasture with a thin band of cabbage trees, toetoe, Cyperus ustulatus, Carex sp. and Juncus gregiflorus. Because nearby stands contain much kahikatea (a large tree was noted in the sample site) it is likely that this forest may once have been selectively logged. This possibility is supported by the presence of young totara (20-50 years) but no mature examples.

Tini Bush contains a good diversity of species for its size. As well as those species named, swamp maire and pokaka reach the canopy. There are several epiphytes and climbers; kiekie, puka, climbing rata (Metrosideros diffusa and M. colensoi) and supplejack being most common. There is little understorey beneath kohekohe compared to similar areas in the ecological district. In wetter areas the understorey contains dense young nikau palms, or kawakawa, hangehange and several seedlings of the canopy trees and totara.

Weeds are mainly confined to the edges and pasture areas. Only blackberry, arum lilies and buddleja are present in any quantity, though willows have potential to spread.

Kohekohe forest is very rare in the ecological district (only about 8 ha is now kohekohe dominant). The vegetation is this RAP shows the full diversity of swamp forest to dry sandridge forest and is still in good condition, also a rare feature in the Foxton Ecological District.

Special Features

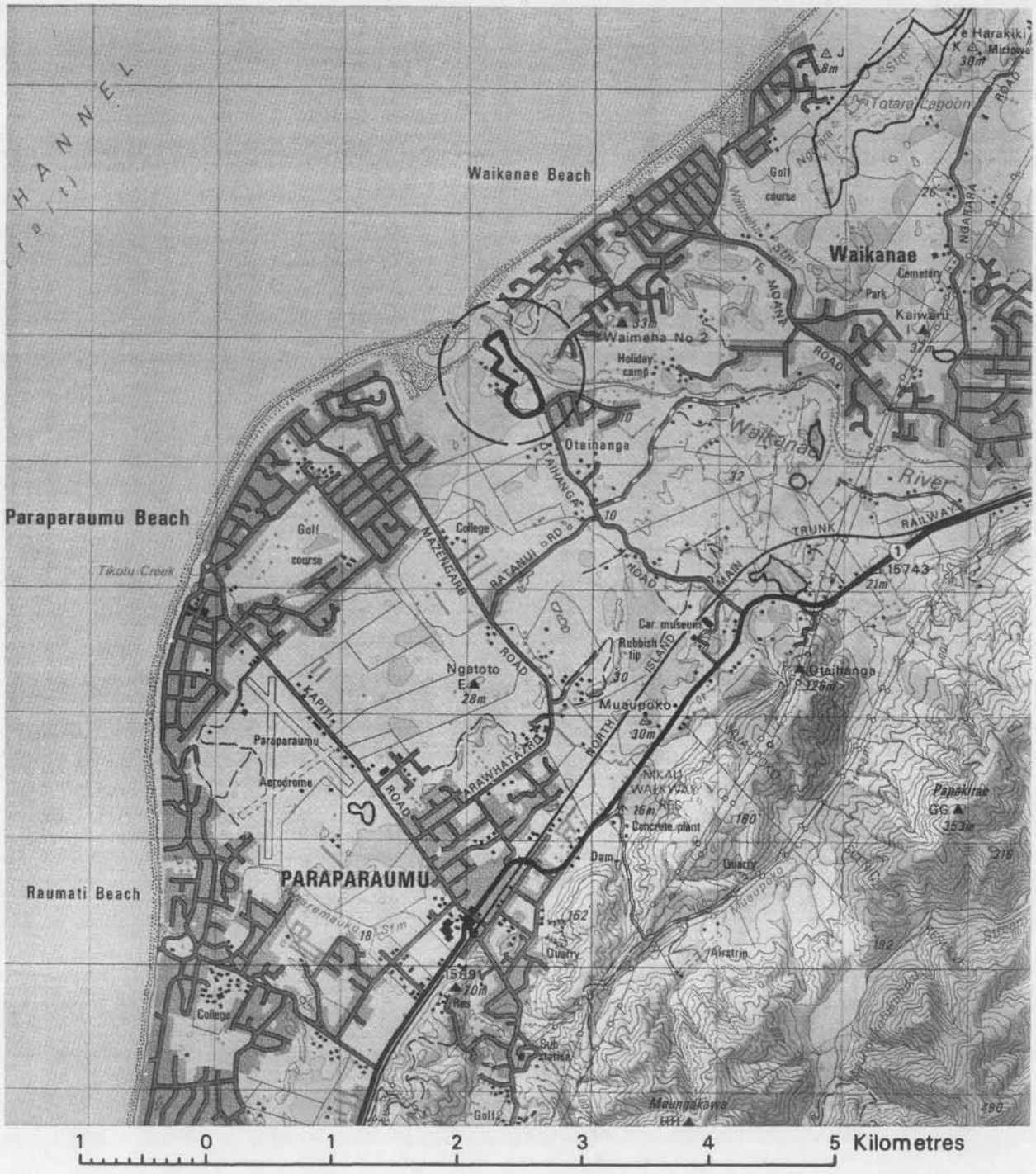
Due to its good condition and its location along State Highway One and the main trunk railway Tini Bush has particularly high scenic value.

Selection Criteria

Representatives:	H	Indicative of much of the forest diversity which once would have existed over the ecological district from Paraparaumu to Waikanae.
Diversity:	H	High species diversity. Shows wet to dry forest patterns.
Special features:	M	The only pukatea - kohekohe forest recorded in ecological district. Kohekohe forest now rare.
Naturalness:	H	Only a little stock damage and few weeds. There may have been some selective logging once.
Viability:	H	This could be improved by completing fencing and weeding.
Size and Shape:	M	Fragmented and only a moderate size.
Buffering:	M	Much is fenced. Good seed sources nearby (though not in the ED).

Other: High bird numbers (part of a series of remnants which together provide plentiful and diverse habitat).

RAP 5 Waikanae Estuary Saltmarsh



Study Area: 9A
GR Centre: R26 793348
Area: 7ha
Survey Date: 25/10/90

RAP 5 WAIKANAE ESTUARY SALTMARSH

Ecological Unit

- saltmarsh ribbonwood/jointed wire-rush-sea rush rushland on tidal flat

- bachelor's button - Triglochin striatum herbfield on tidal flat.

Landform

Geology: estuarine muds and silts
Soils: saline soils

The area recommended for protection is a saltmarsh on the south bank of the Waikanae River, a few hundred metres upstream from the river mouth and east of the Waikanae Estuary Scientific Reserve. It is flat except where a low (2m) sandridge has covered some of the western side.

The saltmarsh is submerged during spring high tides and possible also during periods of flood. The few tidal channels which cut across the west side of the area are only 0.5m deep though there is a major (5m across) channel which defines the eastern side of the RAP. This latter channel is known as the Otaihanga Oxbow.

The saltmarsh appears very stable, with no erosion or sand deposition noted. The only major modification is a vehicle track which marks the western boundary.

Vegetation

Nearly all the RAP is covered by jointed wire rush and sea rush, with salt-marsh ribbonwood growing over the rushes over much of the area. Occasional flax was also seen. Open area of up to several hundred square metres contain a dense sward of halfstar, with a very few plants of shore primrose and Isolepis cernua.

The Otaihanga Oxbow is dominated by bachelor's button, with much Triglochin striatum and Isolepis prolifer in places. Though edged by jointed wire-rush and sea rush with some half-star, most of the land within the loop is covered by tall fescue, gorse and blackberry, with just a few plants of flax and Olearia solandri indicating what the original cover may have been. Leptinella dioica subsp. monoica, a herb with a nationally vulnerable status, has been recorded from the oxbow (C. Ogle, pers. comm.).

On the sandridge in the west the rushes continue and there is also a few tauhinu shrubs and some gorse, lupin and a sole macrocarpa tree about 7 m tall. The latter, exotic, species are still uncommon within the RAP, though there is plenty of gorse 100m to the south.

Special Features

Though several estuaries in the ecological district contain a community of saltmarsh ribbonwood growing amongst sea-rush and jointed wire-rush, this is the only such place where weeds are virtually absent and no stock have access. Leptinella dioica subsp. monoica has been recorded here.

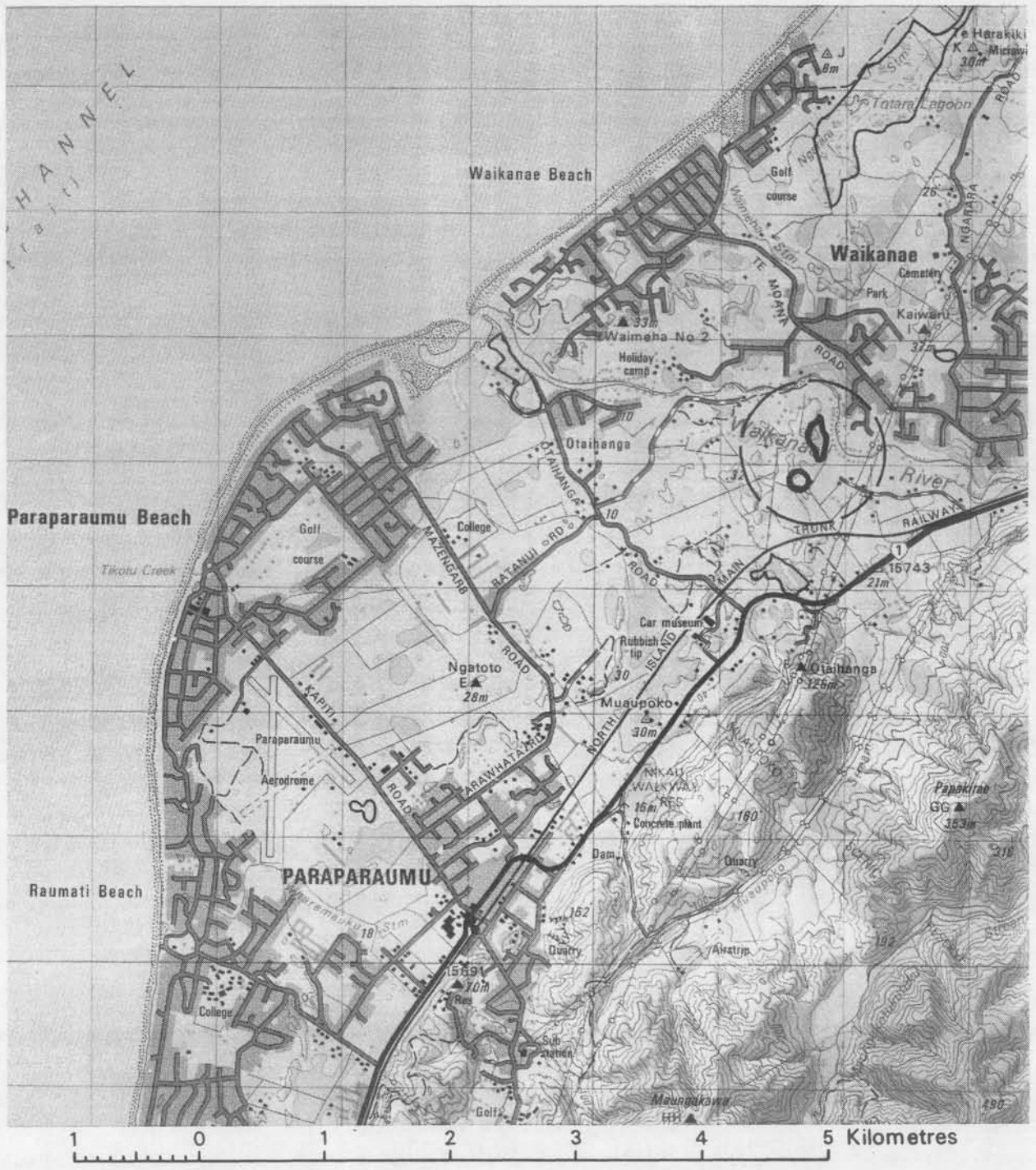
Selection Criteria

Representativeness:	H	An excellent example of an estuarine shrub-rushland.
Diversity:	L	A relatively homogenous area.
Special Features:	H	An absence of stock or weeds has allowed much of this area to retain a high quality. Presence of nationally vulnerable herb (Leptinella dioica subsp monoica).
Naturalness:	H	Virtually unmodified.
Size and Shape:	H	Though small and narrow the RAP is adjacent to the Waikanae Estuary Scientific Reserve.
Buffering:	H	Wetness and salinity buffer from weeds. Density of vegetation restricts access by people.

Comment

Though smaller than other, similar area the possiblity of adding this area to an existing natural area makes it particularly valuable. It should be noted that, while the rushland continues well into the reserve, the saltmarsh ribbonwood area barely extends beyond the RAP boundary and this shrub is rare in the reserve. Though the area bounded by the oxbow is in poor condition, its inclusion in a protected area would allow better protection of the oxbow.

RAP 6 Turf Farm Dune Forest



Study Area:	7A
GR Centre:	R26 817342
Area:	3 ha
Survey Date:	23/3/90

RAP 6 TURF FARM DUNE FOREST

Ecological Units

1. kohekohe - (titoki) forest on parabolic dune

Landform

Geology: windblown dune sand
Soils: yellow-brown sand, thin sands

The RAP is located mainly on the south-east (inland) face of a parabolic dune. The dune slopes down to the edge of the Waikanae River and an associated alluvial plain, and is part of a series of dunes marking the inland boundary of the sand country. It rises 16m above the plain. Within and near the RAP four-wheel-drive tracks have been formed. A straight drain runs along the base of the dune to the Waikanae River. A very small (100m x 10m) stand of trees is on alluvial plain beside the drain and is included in the RAP.

Vegetation

The forest is mostly in one triangular block with a few scattered trees at the edges, including one stand at the base of the dune. The canopy of the main block consists of approximately 80% kohekohe and 10% titoki. Rewarewa, tawa, lancewood, pokaka, towai and mahoe all reach the canopy, which is mostly at about 10m but ranges from 5m to 14m. Horses have grazed this remnant for many years. As a result, there is virtually no understorey, though blackberry in the northern corner protects a few kawakawa and some young mahoe and kohekohe. About a quarter of the ground area is covered by wandering Jew. There are also a few elderberry plants and patches of pasture grasses.

The stand of trees at the base of the dune includes a few immature kahikatea, pukatea, cabbage trees, wharangi, and single specimens of lancewood and ramarama. Towai and wharangi were not recorded elsewhere in the survey, though wharangi has been recorded at Papaitonga and Forest Lakes (Duguid 1990). Ramarama was only recorded here and at Whitiki Bush (RAP13) during the survey.

Selection Criteria

Representativeness:	H	Lowered by lack of understorey but does indicate former canopy diversity of dune forest in the Waikanae area.

Diversity:	M	Shows a hint of wet plain to dry dune succession.
Special Features:	M	Unique ecological unit. Contains three plants rare in the ecological district.
Naturalness:	M	Would be high but for lack of understorey.
Viability:	L	Would be high if fenced and weeded.
Size and Shape:	M	Main body of forest poses no problems but isolated stand is very small and narrow.
Buffering:	L	Unfenced. Some shelter from wind provided by dune. Some seed sources within 1 km. Surrounded by pasture.

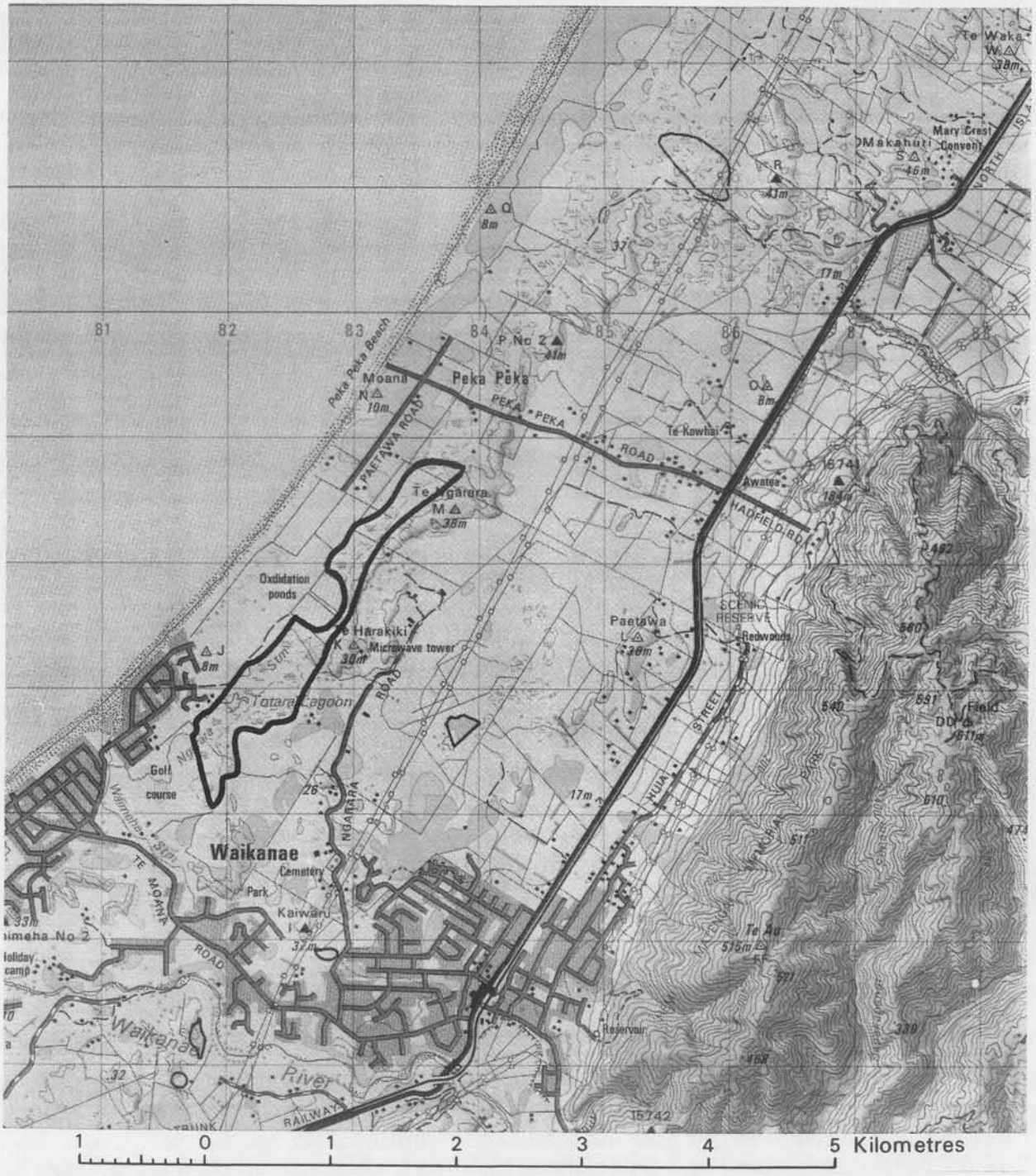
Comment

This remnant is part of a subdivision proposal which would turn the surrounding area from farm to urban. This would provide an opportunity for legal protection, but could lead to increased recreational use.

Some 200 m to the south is a small stand of mature kahikatea, also on alluvial plain at the base of a dune. Though not physically connected it should be considered for protection with the dune forest (both are on the same property).

References: F C Duguid, 1990

RAP 7 Te Harakiki Swamp



Study Area:	13
GR Centre:	R26 826374
Area:	120 ha
Survey Date:	5/9/90

RAP 7 TE HARAKIKI SWAMP

Ecological Units

1. kanuka forest on parabolic dune
2. kahikatea - pukatea tree land on dune hollow
3. flax - toetoe - (Coprosma propinqua) grassland on swale

Landform

Geology: peat; sand; recent alluvium
Soils: organic soils.

Te Harakiki Swamp, which includes Totara Lagoon, occupies some of the swale running north-east for 3km from Waikanae golf course. This is part of the most clearly-defined foredune-swale-relict foredune-swale complex occurring in the ecological district. The main body of a swamp extends 300m across the swale. In the south-east the swamp also extends into an area behind the relict foredune. On the southern end, the swale becomes fragmented by a series of parabolic dunes. The kahikatea-pukatea treeland occurs on a dune hollow bounded by one of these dunes. The northern end of the swale rises more gradually, ending in the parabolic dune on which the kanuka forest is found.

Te Harakiki Swamp is completely bisected by the Waikanae sewage treatment plant, which contains two effluent ponds and a runoff drain which runs south west along the swale area. At the time of survey this drain did not appear to be having any adverse effect on water tables in either the swamp or the lagoon. A drain running from the dune hollow to the swamp proper has dried the dune hollow considerably. The northern section of the swamp has at least one artificial pond and a causeway cutting directly across it.

A blowout in the relict foredune has exposed an archaic midden site containing shells and oven stones.

Vegetation

Te Harakiki Swamp is important because it shows two types of vegetation sequences on wet sand country, both from open water to trees. In the southern half, the sequence is as follows: Open water (with some Pacific azolla) is invaded by raupo. Where it is slightly drier, toetoe becomes plentiful, with some flax. The flax becomes dominant and its association with toetoe gets replaced by an association with small shrubs (3 m high) particularly Coprosma propinqua. In the south and east the flax in turn gets replaced by trees (up to 6 m high) mostly mahoe but also ngaio and a few small stature kahikatea and rimu.

Though only a small remnant, the kahikatea - pukatea association in the dune hollow (reaching 14m) with scattered ngaio, tawa, karaka and pokaka) gives an indication of mature forest in this sequence. This sequence is "wet", from open water to swamp forest. In the northern half the sequence is similar, from open water through to dominance of Coprosma propinqua. However, in this case Coprosma propinqua gives way to manuka which is replaced abruptly at the swamp edge by kanuka, which is up to 8 m tall and has trunks up to 700mm thick. This different sequence not only represents drier conditions but may have resulted from fire or other modification.

Over most of the swamp there is only a gradual merging, rather than discrete units. There is a large range of species, and as well as those mentioned, cabbage trees, tree ferns (wheki and mamaku), Olearia solandri, hangehange, Muehlenbeckia complexa, bamboo spike sedge, Cyperus ustulatus and Isolepis prolifer are common.

The quality of the vegetation varies. It is high in denser, wetter parts, especially in the south, but the edges show severe stock damage as do the understories of the kanuka and kahikatea-pukatea remnant. There are several weeds round the edges. A potentially serious problem is posed by Manchurian wild rice, found near the sewage ponds and the associated drain. A serious weed in parts of Northland, it has proved hard to eradicate (Lambrechtsen, 1979). As well as many common pasture species where stock have invaded, notable weeds include blackberry, gorse, crack willow, pussy willow, inkweed and jointed rush. On the east of the swamp are pines, wattles and macrocarpas.

Special Features

This area provides diverse and plentiful habitat for birdlife. Despite modification it remains one of the largest and most diverse wetlands in the ecological district.

Selection Criteria

Representativeness:	H	Once covering thousands of hectares, most areas like this have now been drained for farming.
Diversity:	H	Open water to swamp forest and kanuka forest with a large range of species and associations.
Special Features:	M	Good bird habitat.

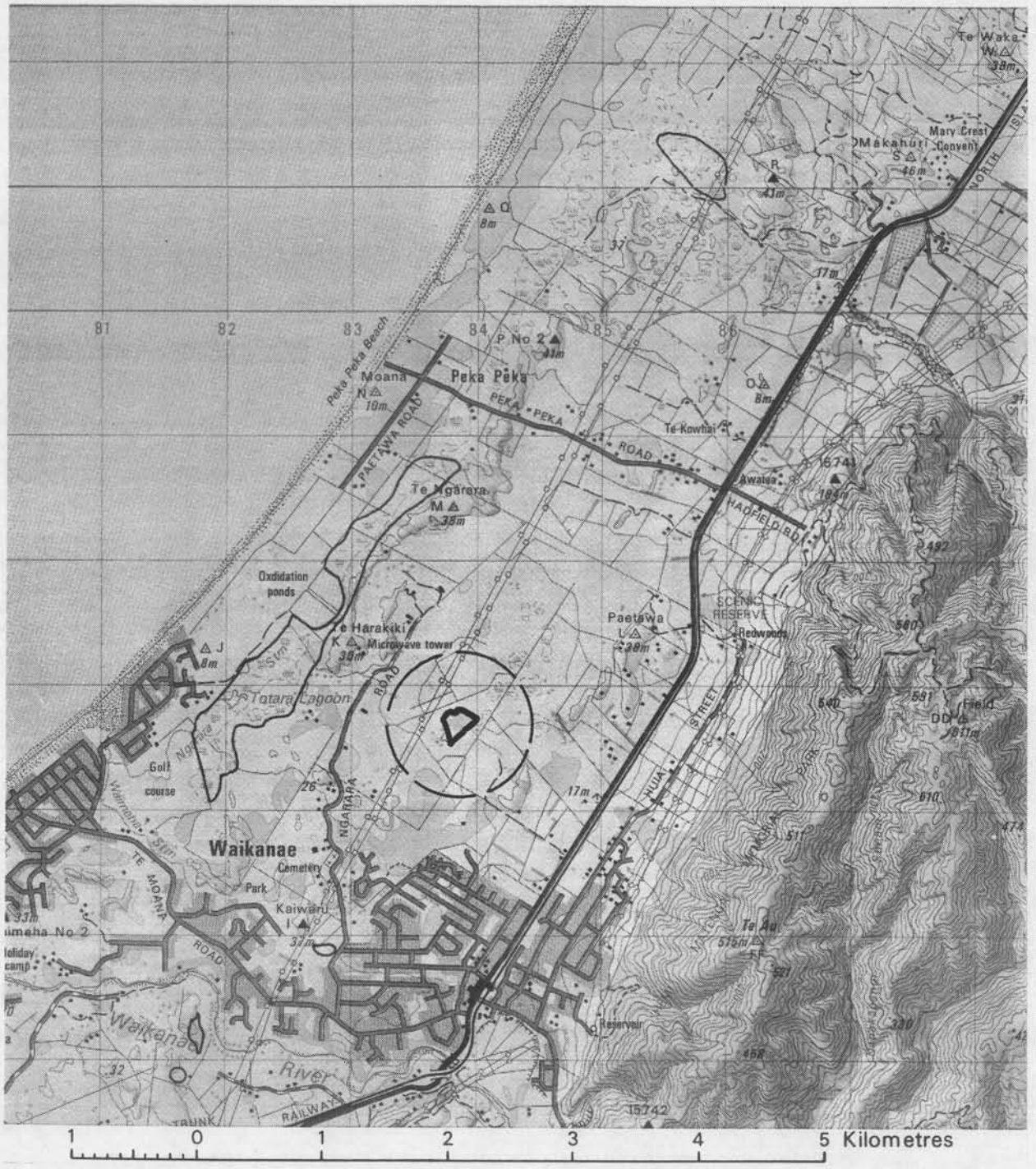
Naturalness:	M	Lower at edges. Spoiled by sewage ponds.
Viability:	H	Excluding stock would improve viability, especially northern part.
Size and Shape:	H	One of the largest such areas, though long and narrow.
Buffering:	M	Only buffered by size, wetness, dense vegetation.
Other:		High aesthetic value. Whitebait spawning habitat.

Comment

Te Harakiki Swamp is part of a larger parcel of land which is in the process of being sold to Kapiti Coast District Council. Tentative plans are to use the swamp for extending the sewage plant, a landfill site and an extension to the golf course. This conflicts with its outstanding natural values and means protection of this RAP is a priority.

References: 1. NZWSNHR
2. Lambrechtsen (1979)

RAP 8 Ngarara Bush



Study Area: R30
GR Centre: R26 838367
Area: 5 ha
Survey Date: 30/5/90

RAP 8 NGARARA BUSH

Ecological Units

1. kohekohe forest on parabolic dune
2. pukatea-kahikatea treeland on dune hollow

Landform

Geology: windblown dune sand; peat
Soils: yellow-brown sands; recent yellow-brown sands; organic soils

Two-thirds of this remnant lies on the crest and slopes of a parabolic dune. The remainder is in a dune hollow between this and the next dune south. There are no obvious drains but the dune hollow was much drier at the time of survey than the vegetation suggests. The western side of the study area is now defined by a private road.

Vegetation

The dune hollow contains a remnant of pukatea-kahikatea forest. Though the trees are mature trees of around 20 m there are many gaps, either through previous selective logging or, more probably, deaths caused by exposure or drought following clearance of surrounding forest into pasture. These gaps are full of inkweed, blackberry and bracken (stock have only recently been removed from this part of the remnant). Mamaku in a belt on the north side of the hollow are now mostly dead. Notable in this area is a large (20 m) mature rimu tree. Rimu are now very rare in the ecological district. The south side of this hollow, once cleared, has now been replanted. Unfortunately, some species are incompatible with the natural character such as tarata, akeake and rhododendrons.

As the dune rises out of the hollow, pukatea is replaced by tawa of 10-15m, with one or two titoki and rewarewa. This merges over a narrow band to a canopy of nearly pure kohekohe (with two mature karaka and a few nikau palms) which blankets the dune. There is a high species diversity in the understorey which is dominated by kawakawa and seedling of kohekohe and karaka. Scattered through the area are some mahoe, mapou, poroporo and poataniwha. There are no notable weeds in this part of the study area.

The dune part of the study area has been fenced for many years. Two years ago the whole area was fenced (except where it adjoins the owner's garden). It is only 0.5km from Nga Manu Wildlife Sanctuary which provides an excellent seed source, especially considering the large numbers of birds which fly between both forests.

Special Features

Large numbers of birds (such as tui, NZ pigeon, fantail and grey warbler) were heard or seen during the survey. This is probably because the forest is so close to Nga Manu Wildlife Sanctuary.

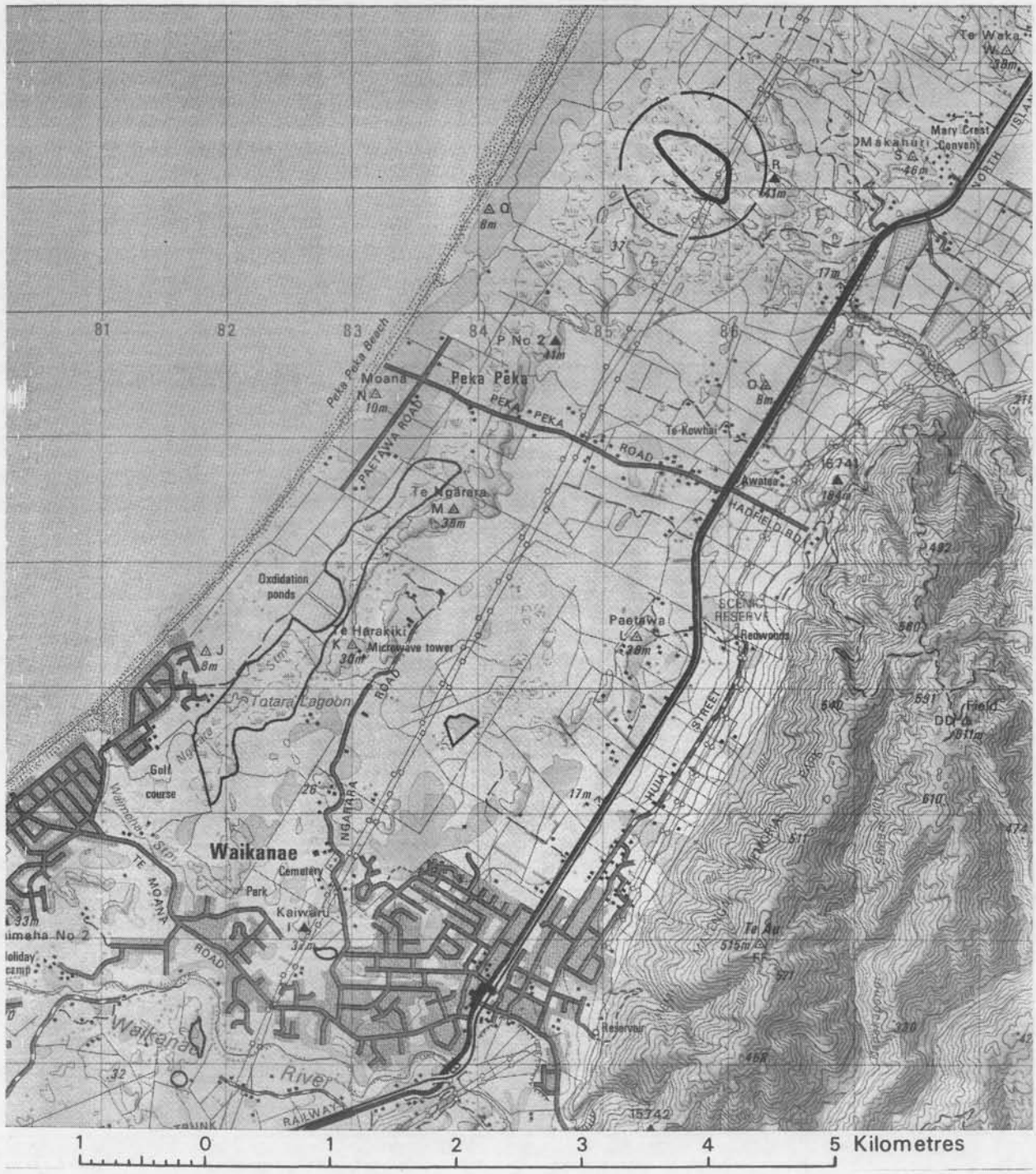
Selection Criteria

Representativeness:	H	Kohekohe forest was once common in the ecological district but is now rare. This is one of the best examples left.
Diversity:	H	High for small area.
Special Features:	M	Rimu rare in ecological district. High bird numbers.
Naturalness:	H	High overall, spoiled by gaps in swamp forest.
Viability:	H	Fenced, no serious weeds, nearby seed source.
Size and Shape:	M	Moderate size. Roughly in two overlapping squares.
Buffering:	H	Fully fenced, near seed source. Younger trees now provide some wind protection.

Comment:

At the time of writing Department of Conservation is negotiating a covenant over this forest with the owners.

RAP 9 Te Hapua Road Swamp



Study Area:	16
GR Centre:	S25 857403
Area:	15 ha
Survey Date:	28/6/90

RAP9 TE HAPUA ROAD SWAMP

Ecological Units

1. flax - Coprosma propinqua flaxland on sand plain
2. flax - toetoe (Coprosma propinqua) flaxland on sand plain

Landform

Geology: peat; windblown sand
Soils: organic soils; recent yellow-brown sands

Originally most of that part of the Foxton Ecological District bounded in the south by Pekapeka road, the west by the foredune and the north by Te Horo Beach, and extending inland half way to State Highway One (some 500-600 ha) was a giant swamp complex consisting of a series of parabolic dunes and sandridges damming a sand plain to produce an interconnected series of swamps. Most of these swamps have now been drained and converted to farmland. Parts of this complex remain as swamp and the RAP covers the three discrete remnants in the east (and slightly north) of this part of the ecological district. These are separated by two low sandridges and a parabolic dune.

Although there is no direct drainage the owner reports a steadily lowering water table (probably due to drainage of surrounding areas). The largest swamp area has an artificial duck pond. A similar area to the east (Pateke Lagoon) has been extensively modified by artificial duck ponds.

Vegetation

Flax, up to 3m tall, is the dominant plant in the wetland areas making up this RAP. The largest wetland also has about 30% cover of toetoe though there is less than 10% cover of toetoe in the other two areas. All three wetlands have a large but varying amount of Coprosma propinqua. Nothing else is plentiful, though moderate quantities of Carex secta, Muehlenbeckia complexa, Cyperus ustulatus, Baumea rubiginosa and Juncus sp. are found and occasional cabbage trees rise up to 7 m.

Cattle have had free access, resulting in pasture plants, particularly the ubiquitious tall fescue, becoming established, mostly round the edges.

Charred totara stumps found in the more eastern swamp area indicate that at least some of this general area was once forest, though burning off could have occurred before European times. Nevertheless, the vegetation in the RAP is the best representative example left of what would have occurred in this once extensive swamp.

Special Features

The property has been purchased by its current owner for its value as waterfowl habitat.

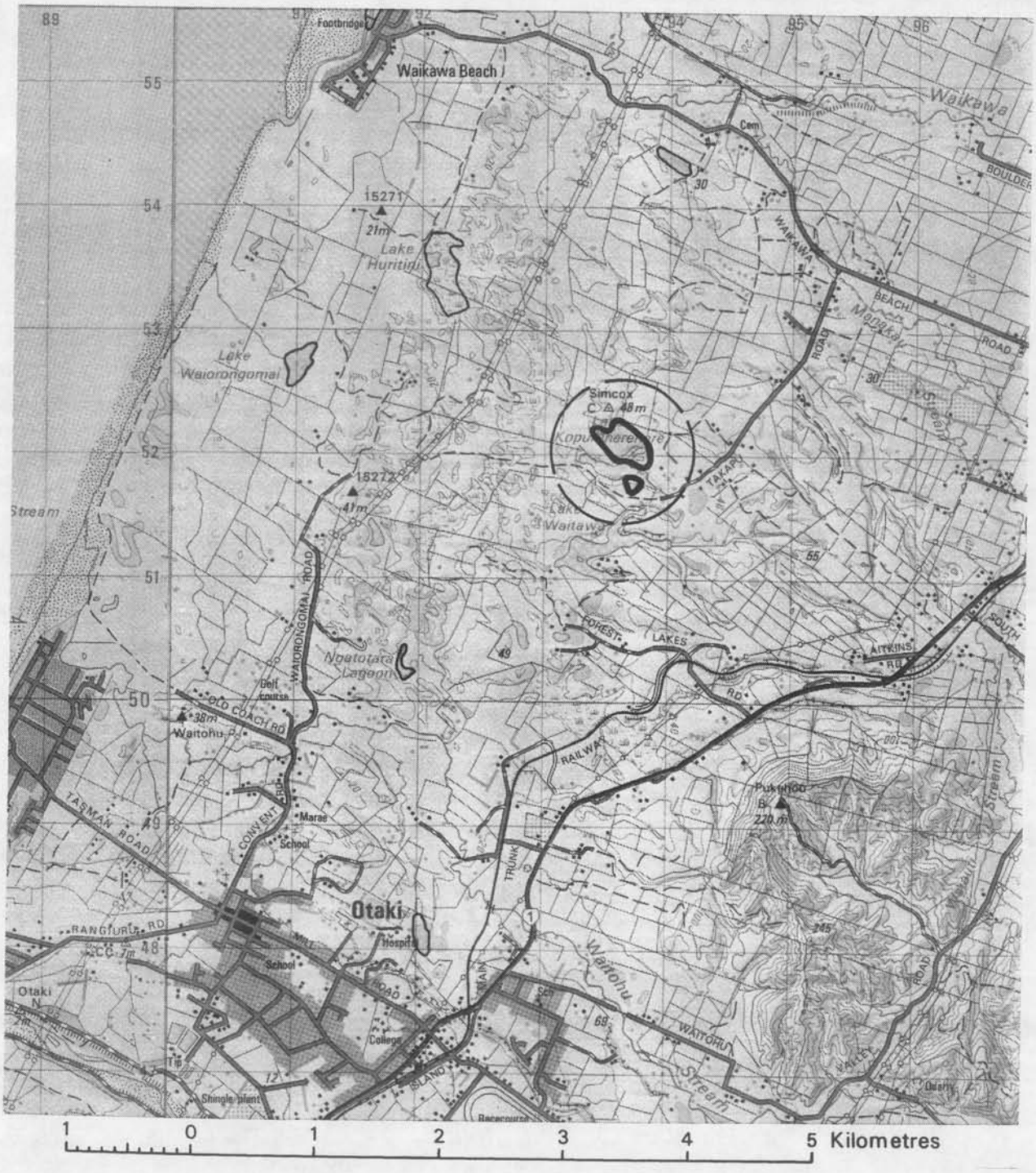
Selection Criteria

Representativeness:	H	Best example of once extensive wetland communities.
Diversity:	L	Very uniform except for relative abundance of toetoe.
Special Features:	M	Good waterfowl habitat (though artificial).
Naturalness:	H	Only low at edges.
Viability:	M	Will deteriorate slowly unless watertable restored.
Size and Shape:	M	Moderate sized fragments. Would be better to include intervening (grassed) dunes in the RAP.
Buffering:	M	Partially fenced. Buffered by wetness and density.

Comment

The management of this area has recently changed from farming to waterfowl protection. However, this may not fully protect vegetation or landform values, hence its inclusion as an RAP.

RAP 10 Kopureherehere



Study Area:	49
GR Centre:	S25 937521
Area:	15 ha
Survey Date:	28/6/90

RAP 10 LAKE KOPUREHEREHERE

Ecological Units

1. rimu-tawa treeland on footslope
2. kahikatea forest on footslope

Landform

Geology: loess on terrace deposits; windblown dune sand.
Soils: yellow-brown loams, yellow-brown earths; yellow-brown sands.

The RAP covers the eastern part of Lake Kopureherehere and three associated forest remnants. Lake Kopureherehere was formed by sand dunes damming a gully in downland on the edge of the Manawatu Plains ecological district. Two of the forest remnants are on gently sloping (5°) spurs forming "fingers" extending into the lake. A quarter of the third remnant is on the foot of a parabolic dune and the rest is on a footslope, also about 5°, at the lake edge. This remnant is poorly drained, while the other two were quite dry at the time of survey.

The eastern end of this valley-type lake is deeper than in basin-type dune lakes of the sand country. The western end is shallower and eutrophying.

Vegetation

Between the forest remnants and the lake is a thin band (5-10m) of raupo and flax, which ends abruptly at tall forest right at the lake edge and is fenced off from stock. The southern and eastern forest remnants appear very similar though only the eastern one was surveyed. In this remnant, rimu dominates, with some kahikatea from the lake edge inland for about 50m. These trees are around 20m tall and further inland are replaced in the canopy by tawa of about 15m with scattered titoki. About 100-150m from the lake shore the forest becomes very open though it is regenerating well and includes some planted specimens (totara, wineberry, matai, pohutukawa, tree lucerne, sheoaks and magnolias). This remnant has been fully fenced for several years and has a dense understorey containing mahoe, mapou, karamu, lancewood, kawakawa, ponga, poataniwha, pigeonwood and hangehange, ranging from 2-8m. Kiekie and supplejack are thick in places. The ground cover consists of ferns, Oplismenus imbecillis and exotic grasses in more open areas.

The northern remnant repeats this pattern along its eastern fringe, but to the west becomes almost pure kahikatea up to 20m high. Though fenced, this area is still grazed and has a poor understorey.

Both remnants surveyed have some elderberry but no other potential problem weeds were noted.

Special Features

Lake Kopureherehere carries large number of waterfowl. The forest remnants also provide good bird habitat. This is the only rimu dominant forest in the Foxton Ecological District.

Selection Criteria

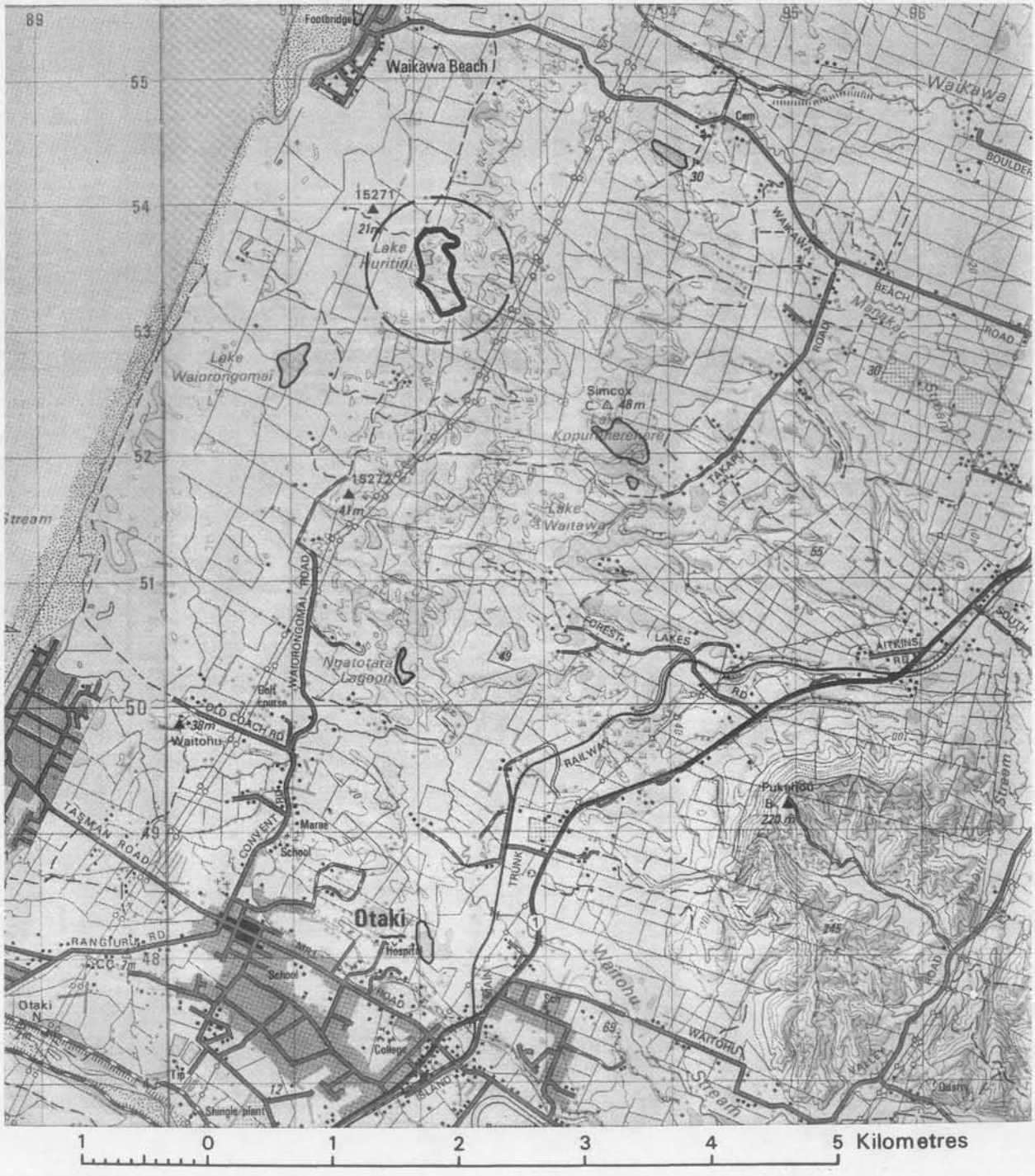
Represenativeness:	H	While not all the lake edge vegetation remains, what there is represents the original vegetation communities once found right across the eastern end of the Otaki Lakes area.
Diversity:	H	Despite small area shows an open water to dry forest sequence. High species diversity.
Special Features:	H	No other rimu-dominant forest in ecological district. High wildlife value.
Naturalness:	H	Some parts spoiled by stock and exotic plantings.
Viability:	H	Even better if fencing improved in northern remnant.
Size and Shape:	M	Remnants too small to maintain current high diversity (three small remnants). Remnants have good "round" shape.
Buffering:	H	Protected by lake and fences. Good seed sources nearby in Manawatu Plains ecological district. Planted recreation area on edge.

Other: High recreational value (has picnic area and shooting and boating facilities).

Comment

While the ecological units are unique in the Foxton Ecological District they may be more common in the Manawatu Plains Ecological District. However, for the purposes of this survey, Lake Kopureherehere is considered to be in the Foxton Ecological District because the lake was formed by the action of wind blown sand.

RAP 11 Lake Huritini



Study Area:	55
GR Centre:	S25 922535
Area:	20 ha
Survey Date:	3/7/90

RAP 11 LAKE HURITINI

Ecological Units

1. raupo reedland on dune lake
2. raupo-toetoe reedland on dune lake
3. cabbage tree/(Coprosma propinqua) shrubland on dune lake
4. bamboo spike sedge sedgeland on dune lake
5. flax flaxland on dune lake

Landform

Geology: windblown dune sand
Soils: recent yellow-brown sands

Lake Huritini is a shallow (up to 3 m) dune lake formed by two parabolic dunes damming runoff from a sandplain, which in turn is bounded by two other parabolic dunes and associated sand ridges, forming a lake with very convoluted edges. The lake is deepest in the west, getting gradually shallower to the east. The lake's surface area may vary seasonally quite markedly, with only several centimetres change in lake depth.

Much of this area is swamp rather than open water. A deep, wide drain in the north has been blocked and the lake level was obviously higher at the time of survey than it has been in the past. Though the lake is shallow, the dunes rise abruptly on the south-east to about 15 m, allowing excellent views over the whole lake area.

Vegetation

Several factors contribute to the diversity of plant communities at Lake Huritini, namely overall depth of water coupled with variations in water levels, the influence of stock and weeds.

Most open water is in the north and west. There is pasture to the edge - in fact several hundred square metres of pasture were submerged at the time of survey. The only indigenous vegetation on dry land comprises Juncus sp., Cyperus ustulatus and club sedge. There is about 2ha of raupo with some toetoe in the north and a long thin band (about 200 x 10m) of bamboo spike sedge weaving south-west to north-east 10-30m offshore. Nearer the shore there is also some sharp spike sedge and Isolepis prolifer.

Parts of the eastern shore (2-3ha) are fenced from stock. Because it was too wet to walk into, this area was surveyed with binoculars. Here raupo on the lake edge gives way to a community of cabbage trees over Coprosma propinqua. Similar vegetation covers 0.5ha in the south also.

In the rest of the south part of the lake, raupo gives way to flax with patches of toetoe and cabbage trees. Vegetation in this area (about 5 ha) is very dense and the ground was also wet at the time of survey. These factors limit the adverse effects of stock, which have severely damaged the vegetation at the edge.

Where stock pressure has been high, tall fescue is plentiful. There are also several hectares of gorse on the south-east sides of the lake, though these had been sprayed. In three places on the north and west edges there have been plantings of pines and eucalyptus trees. Some of these had just been felled. Near these areas are a few crack willows.

Selection Criteria

Representativeness:	H	Many of these shallow lakes have been drained so the vegetation communities found here were probably once more common in the ecological district.
Diversity:	H	High diversity of emergent communities, especially for a relatively small area.
Special features:	M	Good waterfowl habitat. Large areas of bamboo spike sedge now uncommon in the ecological district.
Naturalness:	M	Spoiled over much of the lake by clearing and stock pressure.
Viability:	H	High if current high water level maintained, though fencing still needs improving.
Size and Shape:	M	Reasonable area but convoluted edges.
Buffering:	P	Only well buffered where wet or dense.

RAP 12 Waikawa Beach Road Forest

Study Area:	56
GR Centre:	S25 940544
Area:	1.2 ha
Survey Date:	15/12/89

RAP 12 WAIKAWA BEACH ROAD FOREST

Ecological Unit

kahikatea-tawa forest on sand plain.

Landform

Geology: windblown dune sand.
Soils: foxton-Pinaki yellow-brown sands.

This forest remnant lies on the south edge of a sand plain, along the base of a sandridge, for about 250m. It varies in width from 20-80m. The surrounding farm land has been drained but the remnant still retains a high water table, because of its location. A vehicle track runs across the sand ridge, just behind the remnant.

Vegetation

There is a surprising diversity of species for such a small forest remnant. Up to 40% of the canopy consists of mature kahikatea, with scattered pukatea, reaching 15m. Another 30% is tawa, apparently younger and mostly 8-12m. Other trees over 5m include totara, matai, cabbage tree, kohuhu, mapou and turepo. About 20% of this remnant contains lower stature forest. This is very diverse and consists of some of the trees named above, plus young lancewood and rewarewa, wheki, mahoe, poataniwha, tree fuchsia, marbleleaf, pate, ribbonwood, karamu, Coprosma rigida and C. areolata.

In 1980 the understorey was described as "sparse" (Newsome, 1980). Though fenced now, occassional cattle still get into the area. The understorey is now thick and healthy and there are many seedlings and ferns. Sedges and Cortaderia fulvida are found on the sandridge side. The bush is thick with climbers. Those noted were pohuehue, supplejack, climbing ratas (Metrosideros colensoi and M. diffusa) and Parsonsia heterophylla.

A Japanese honeysuckle and some willows may spread and become a problem if not removed. Other weeds included blackberries and a few pasture species which persist at the edges.

Only 3ha of kahikatea-tawa forest remains on the sandplains in the ecological district. The remnant is surrounded by pasture except for pine plantings on the sand ridge.

Selection Criteria

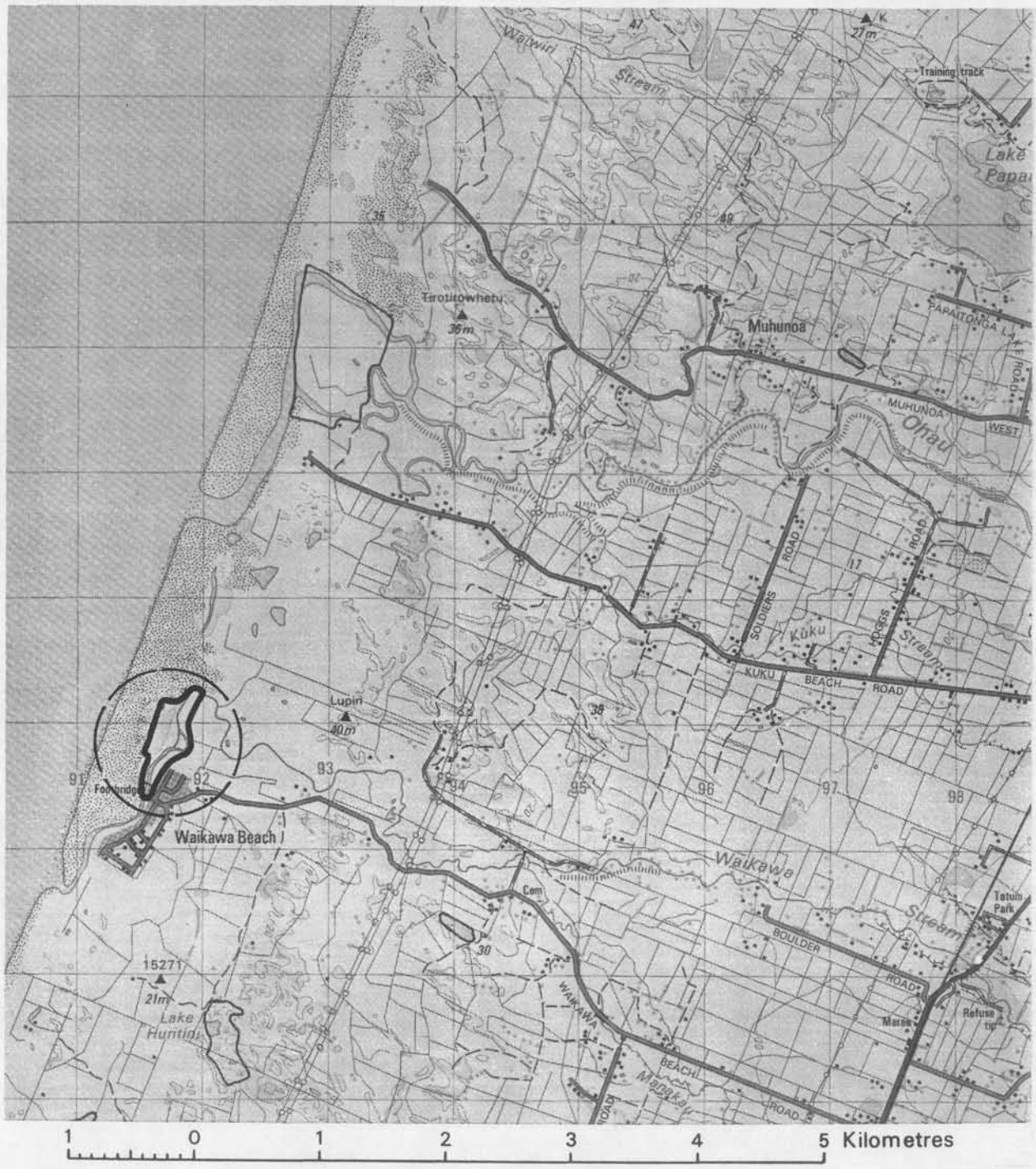
Represenativeness:	H	Now rare, this forest type would once have covered hundreds of hectares.
Diversity:	M	Very high species diversity, but little variation in forest type.
Special features:	M	Value for bird habitat.
Naturalness:	H	High proportion of tawa may be result of lowered water table.
Viability:	H	Excellent if stock kept out.
Size and Shape:	L	Small, thin. Species diversity likely to reduce over time.
Buffering:	H	Fenced. Protected from wind by pines.

Comment

The pines behind the native trees should be protected to prevent the possibility of wind damage to this valuable block.

References: P J Newsome (1980).

RAP 13 Waikawa Estuary



Study Area:	58
GR Centre:	S25 916558
Area:	20 ha
Survey Date:	15/12/89

RAP 13 WAIKAWA ESTUARY

Ecological Units

1. saltmarsh ribbonwood/jointed wire-rush - tall fescue rushland on tidal flat.
2. jointed wire-rush - three-square/(half star) rushland on tidal flat.
3. three-square sedgeland on tidal flat.
4. flax/tall fescue - saltmarsh ribbonwood grassland on tidal flat.

Landform

Geology: unconsolidated windblown sand; estuarine muds
Soils: no soil development; recent soils related to yellow-brown sand; saline soils.

Until the 1870s the Waikawa Stream shared a common estuary with the Ohau River (Duguid 1990). When the Ohau River broke away to the north an alluvial plain some 3km across was formed. Since then most of this plain has been covered by drifting sand and the Waikawa Stream now meanders around the resultant dunes. It is tidal for more than 3km.

The RAP covers mud flats and drier, sand covered flats along the banks of the Waikawa Stream from Waikawa Beach township upstream for about 1 km. By the township only tidal muddy areas on the streamedges are included (about 30m across) as houses on the east and pines on the west cover all the permanently dry ground. Further north the stream and former stream channels with associated tidal flats widen out to about 200m.

Dunes rise steeply from these flats on the west but are not included in the RAP. The area is historically unstable in that the course of the stream is likely to change, either during floods or as a result of sand drift.

Vegetation

Indigenous vegetation covers patches on both banks, rather than a single, discrete area. Dominant vegetation in these patches depends on relative water level and salinity and the influence of weeds, but a similar pattern is shown throughout the RAP. On the parts of the stream edges which are regularly submerged with each tide there are small patches of batchelor's button, giving way to Bolboschoenus caldwellii and three-square (which cover several ha in total). On drier ground jointed wire-rush and sea rush grow over half-star, glasswort and shore primrose. Further from the stream is a strip of saltmarsh ribbonwood, merging in turn into toetoe and then flax.

In these latter areas tall fescue is now the dominant plant. There is a also some gorse and pampas, though these are still in low numbers. There is a weed problem behind the housing area, where mowing and planting has introduced garden plants into a natural area. Taller plants planted include cacti, eucalypts and karo.

Special Features

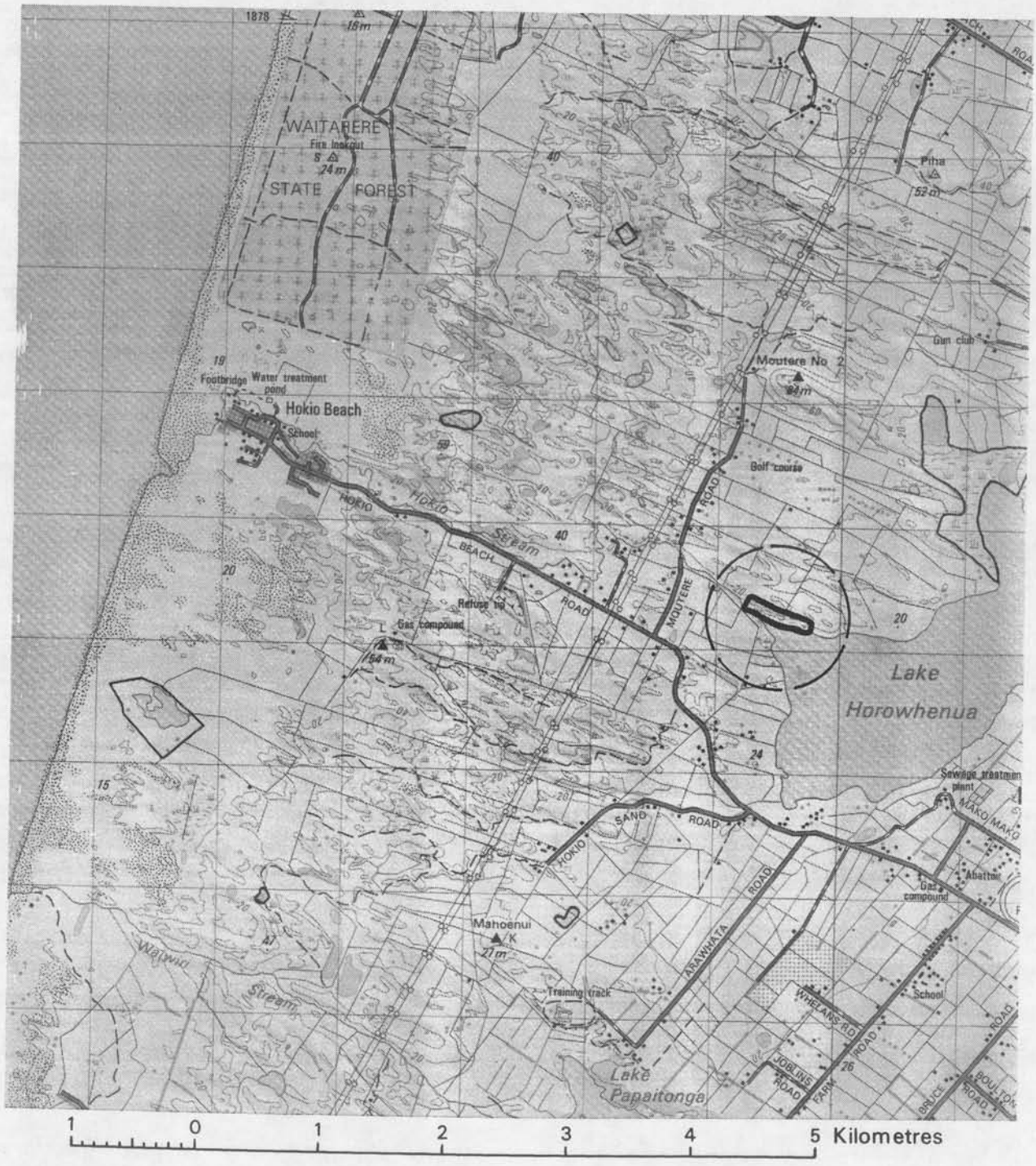
This RAP provides some habitat for waterfowl and could provide good fernbird habitat. This is an excellent area for whitebait spawning. The area has high recreational value being used for shooting, whitebaiting, horseriding, walking and also by recreational vehicles.

Selection Criteria

Representativeness:	M	Though many species are now missing the estuary still gives a good indication of original estuarine communities.
Diversity:	H	Shows a range of estuarine communities.
Special Features:	H	Whitebait spawning area.
Naturalness:	M	Spoiled by tall fescue but still very high in places.
Viability:	M	Subject to alteration in stream course, otherwide could last indefinitely.
Size and Shape:	M	Necessarily long and thin. One of the smaller estuaries in the south of the ecological district but still an adequate size for an RAP.
Buffering:	H	Partially fenced. Buffered by wetness and salinity.
Other:		High landscape value and recreational value.

References: F C Duguid (1990).

RAP 14 Lake Horowhenua West Bush



Study Area:	R18
GR Centre:	S25 994643
Area:	2 ha
Survey Date:	11/7/90

RAP 14 LAKE HOROWHENUA WEST BUSH

Ecological Unit

kahikatea forest on sandplain.

Landform

Geology: windblown dune sand.
Soils: recent yellow-brown sands

This remnant is situated between Lake Horowhenua and the base of a parabolic dune, running some 300m along the lake edge and is mostly 50-100m wide. All the forest is on flat ground, the dune having been cleared down to a vehicle track at its base. The forest is one of the few swamp forest remnants in the Foxton Ecological District which still is wet enough for successful kahikatea regeneration. This is due to a weir which controls the level of Lake Horowhenua. This weir is immediately west of the remnant.

Vegetation

On the very edge of the lake is a fringe of raupo, bordered by a band (only a few metres wide) of flax, with patches of kiokio or sharp spike sedge. Between these and the main forest is a band, again only a few metres wide, of trees and shrubs, mostly 2-5m tall. This band contains cabbage trees, manuka, kohuhu, karamu, Coprosma tenuicaulis, C. propinqua, mahoe and several kahikatea saplings.

The forest proper is in two blocks, the smaller one to the west being separated from the main block by 10m of rough ex-pasture, though all the forest has been fenced as one block (though fully fenced some stock may get past, as the fence is only low and consists of three strands of barbed wire). This forest is dominated by kahikatea up to 13m tall. Of other common species, only pukatea reaches the same height, but cabbage trees, karaka and mahoe are also found in the 5-12m height range. There is a subcanopy in places of under 5m, including species already named (especially mahoe) and also mapou, mamaku, karamu, titoki, tawa, hangehange and Coprosma areolata. Kiekie and hounds tongue fern are common.

In the north-east of the forest there is a dense area of bush lawyer and nearby a climbing rata (Metrosideros diffusa) reaches over 10 m.

Despite the poor fence, stock pressure is low. There are a few gorse plants in the western end and also some inkweed and pasture, mainly Yorkshire fog in open places but no serious weed problems.

Special Features

Though several small stands of kahikatea forest exist in the Foxton Ecological District only those on the shores of Lake Horowhenua (RAP 12 and RAP 13) have not suffered seriously from drainage and are likely to successfully regenerate in kahikatea.

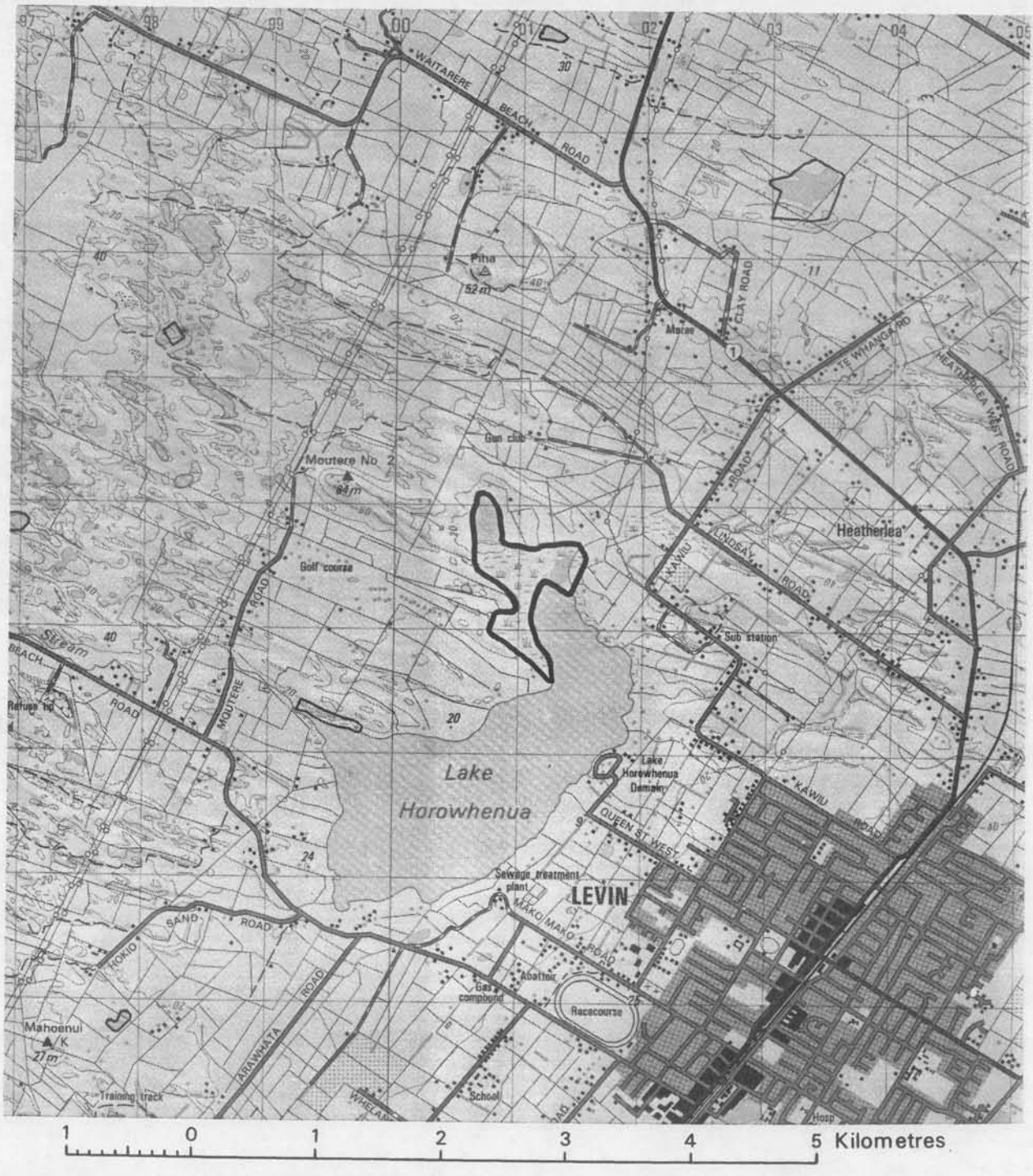
Selection Criteria

Represenativeness:	H	A forest type which once would have covered thousands of hectares and is now confined to a scattered few remnants.
Diversity:	H	High in species. Also has open water to forest community range.
Special Features:	H	Extremely rare forest in good condition.
Naturalness:	H	Very little recent disturbance.
Viability:	H	Would be even better if fence upgraded.
Size and Shape:	M	Small and thin, but few remnants larger in the vicinity.
Buffering:	M	One side buffered by lake. Fenced, but poorly. Dune reduces risk of wind damage.
Other:		Moderately high aesthetic value.

Comment

Ideally, because the remnant is so small, a larger area than that currently fenced should be protected, to allow the forest to expand in time and maintain its relatively high diversity.

RAP 15 Whitiki Bush and Swamp



Study Area:	R19 and R20
GR Centre:	S25 010653
Area:	50 ha
Survey Date:	6/7/90

RAP 15 WHITIKI BUSH AND SWAMP

Ecological Units

1. kahikatea-pukatea forest on sand plain
2. kahikatea-pukatea forest on dune lake
3. Coprosma propinqua - flax shrubland on dune lake
4. Coprosma propinqua - flax shrubland on sand plain

Landform

Geology: peat; windblown sands.
Soil: recent yellow-brown sands; organic soils.

This RAP is located along the north-west edges of Lake Horowhenua. In this area the lake is very shallow and gradually merges on to sandplain, between and around three parabolic dunes, rather than having a clearly defined edge. One of these dunes, rising to about 12m, separates the larger forest remnant (see below) from the other natural areas but only by about 10m.

Lake Horowhenua has its depth regulated by a weir on its western side. This means that not only are these natural areas wet but also that it would not be possible to drain them. The high water level also meant that the survey was mainly confined to the inland edges of the RAP.

Vegetation

Some 25ha of this RAP is covered by a shrub and flax swamp which has the biggest diversity of shrubs noted in a swamp during the survey (though the swamp at Lake Papaitonga is similarly diverse). It was only possible to survey the inland edges though the whole swamp could be seen with binoculars from the adjacent dune. Coprosma propinqua, flax, toetoe or raupo all are dominant in different parts of the swamp, though these areas merge gradually from one to another. Most of this vegetation is 2.5-4m high, though occasional cabbage trees reach 6m and kahikatea and lancewood to the north reach 5m. Other shrubs, trees and tree ferns noted were manuka, mamaku, karamu, Coprosma propinqua x C. robusta, C. tenuicaulis, mapou, kohuhu, koromiko and Olearia virgata. There are also several vines and ferns.

Weeds mostly are confined to the edges where cattle have invaded, though none appear serious. However, in the east, several hectares of willows pose a serious threat and need controlling.

The shrub-flax swamp merges in the north to a kahikatea-pukatea forest remnant of about 2ha, the bases of which were submerged by 0.5m of water at the time of survey. The dune mentioned above separates this remnant from a larger (10 ha) one to the west. Both are unfenced, but are protected to a degree from stock by the wetness of the ground.

In these remnants, kahikatea, pukatea, some rewarewa and two rimu reach 16m. There are also several tall tawa and titoki trees on raised ground within the larger remnants. There is a good diversity of smaller (3-10 m) trees, the most common being cabbage trees, lancewood, mahoe, mapou, kaikomako, Coprosma propinqua and C. tenuicaulis. There was little understorey where surveyed because of stock pressure, but less accessible parts appeared better with several ferns and seedlings seen. Some large epiphytic puka were also seen.

Though only a few mapou, rewarewa and kaikomako occur on the intervening dune, this should be included in the RAP as it would allow the high diversity of species to be maintained. Few weeds were noted in the forest areas, but the whole RAP is surrounded by pasture.

Special Features

Remnants of kahikatea (or kahikatea-pukatea) forest which are still wet enough to regenerate as kahikatea forest are now extremely rare in the ecological district and this is now the largest wet remnant. The high species diversity of the swamp area is also very unusual now in the ecological district.

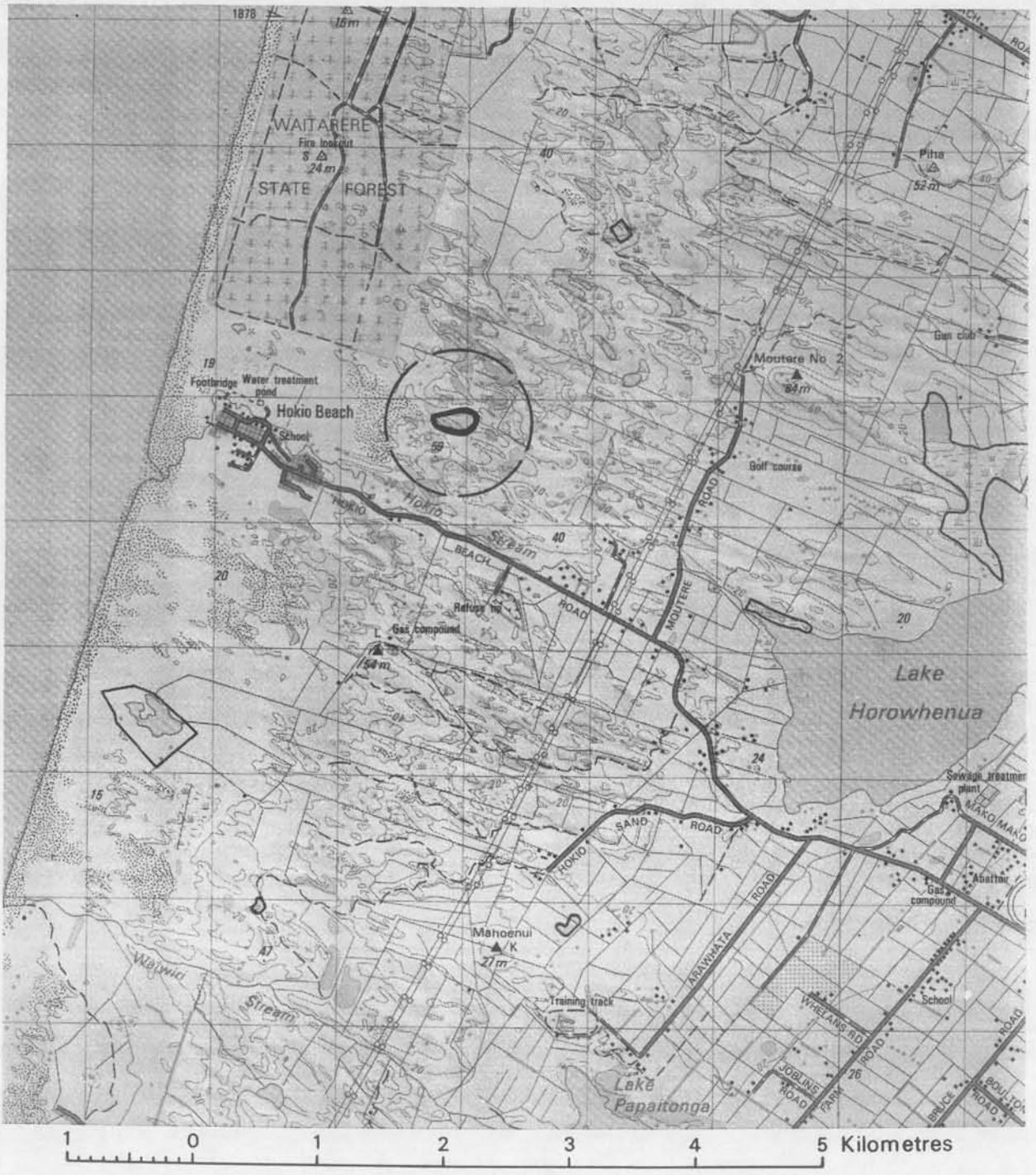
Selection Criteria

Representativeness:	H	One of the best remnants of plant communities which once covered thousands of ha of the ecological district
Diversity:	H	High in species and communities.
Special Features:	H	Rare forest and unusually diverse swamp.
Naturalness:	H	Spoiled in parts by stock damage to forest.
Viability:	H	Fencing would further improve viability.
Size and Shape:	H	Biggest such areas left (though forest remnants still smaller than ideal).
Buffering:	M	Mainly wetness. Not fenced.

Comment

At the time of writing negotiations for protection are proceeding between the Department of Conservation and the owners.

RAP 16 Pakipaki Dune Forest



Study Area:	90
GR Centre:	S25 969658
Area:	10 ha
Survey Date:	21/12/89

RAP 16 PAKIPAKI DUNE FOREST

Ecological Units

1. mixed broadleaf forest on parabolic dune
2. kanuka forest on parabolic dune

Landform

Geology: windblown dune sand.
Soils: recent soils related to yellow-brown sands.

Pakipaki dune forest is located on one of a series of steep sided, tall (20m) dunes between Lake Horowhenua and Waitarere Forest. Though this dune was formed during the Foxton dune-building phase, mobile sand of the Waitarere phase is encroaching on its trailing ridges in the west. The RAP runs from this bare sand area eastward for about 400m and includes part of a sand basin at the southern base of the dune, rising over the crest of the dune and including the top of the northern slope. A gully with very steep sides (45°) rises from south-west to north-east across the middle of the dune. Several tracks have been formed on the east face and along the centre of the dune. Some of these are now well overgrown.

Vegetation

Pakipaki dune forest vegetation differs in composition from that of the few other dune or sand ridge forests in the ecological district. This is probably the result of its more coastal location and lower rainfall. The surrounding area has kanuka forest on dunes and ridges and pasture in dune hollow and sand basin areas. There are scattered patches of mahoe and akeake in the kanuka but Pakipaki dune forest is the only true forest remnant in this area, though it is also surrounded by kanuka. This suggests that it has escaped fire or other severe disturbance in the past. Although unfenced it remains in a highly natural state, though in several places on the fringes there are open areas with pasture plants.

At the base of the dune, scattered across the pasture are several plants of Corokia cotoneaster and Coprosma rhamnoides, with one narrow-leaved maire and a few kaikomako. Just above this area, on the footslope of the dune, is a band of tall (15m) forest, dominated by matai in the west and rewarewa in the east. Though akeake of 5-10m dominates the crest of the dune, except for a stand of mahoe on the east, the rest of the dune slope is very diverse, with no dominant species. Species noted include matai, rewarewa, lancewood, kanuka, cabbage tree, kaikomako, mahoe, rohutu, Olearia paniculata, kawakawa, totara, Coprosma rhamnoides, C. areolata, C. crassifolia, hangehange, marbleleaf, mapou and broom (Carmichaelia arborea var. = C. flagellifera) as well as several climbers and ferns. None are found in great numbers yet together they form a dense cover of 1.5-10m.

In direct contrast the gully contains a stand of tall (15m) titoki covering about a hectare.

Despite the lack of fencing stock pressure had obviously been low for several years before the time of survey and seedlings abounded. There is evidence the forest is deteriorating (I. Cooksley pers. comm.). The tracks in the area may have been associated with totara removal. Though there are some gorse, lupin and pasture weeds at the edge of the forest no weeds are likely to cause any problems in the forseeable future.

Special Features

This forest remnant has long been recognised as an area of special botanical interest (Allan 1945).

Selection Criteria

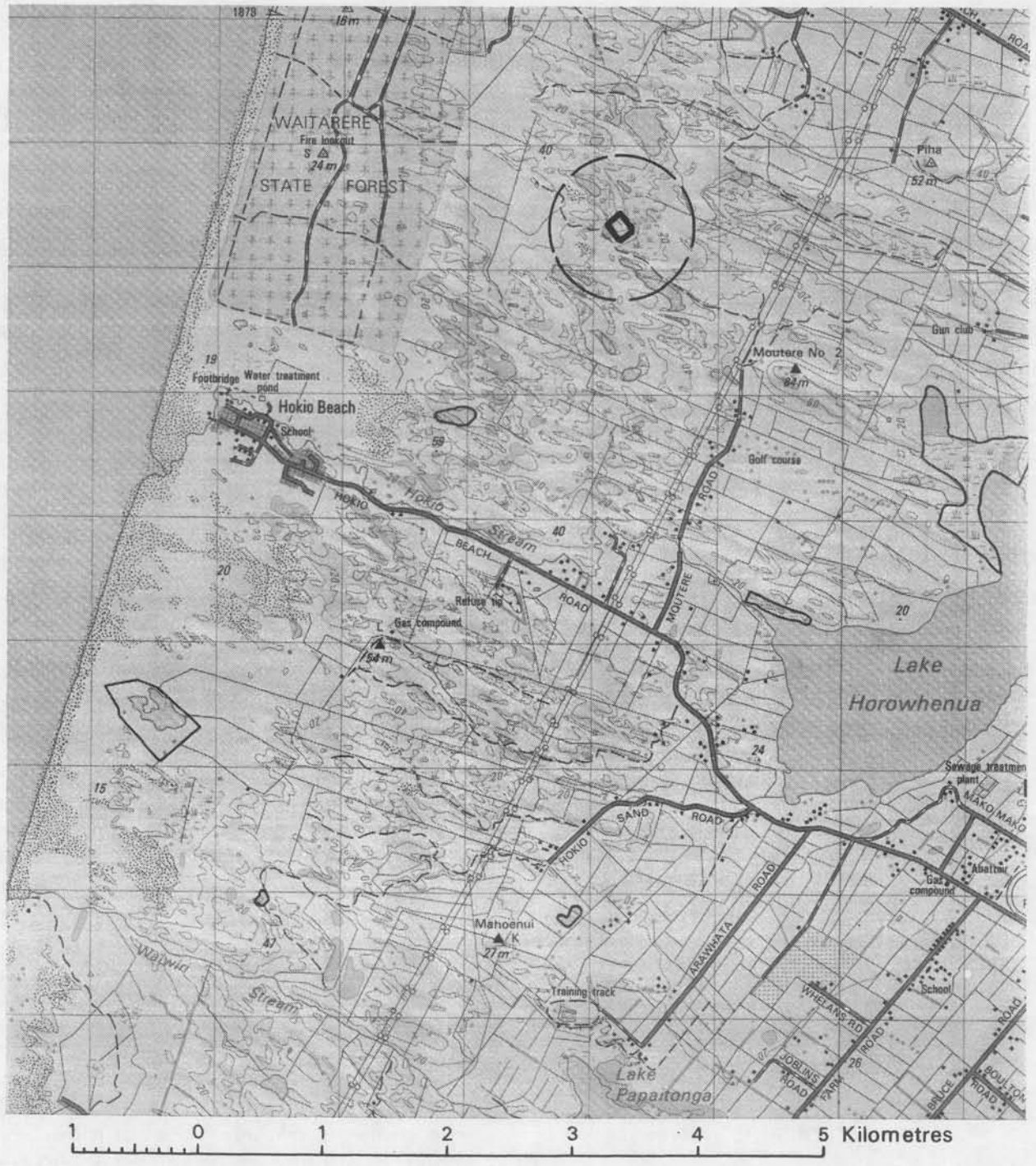
Representativeness:	H	Very rare remnant with vegetation communities which would have covered much of this part of the ecological district.
Diversity:	H	Diversity of species and vegetation pattern.
Special Features:	H	High botanical value.
Naturalness:	H	Only lower round the edges and along tracks.
Viability:	M	Slowly deteriorating. Needs fencing.
Buffering:	M	Not fenced. Protected by steepness and surrounding kanuka.
Other:		No good nearby seed sources.

Comment

As much of the surrounding kanuka forest as possible should be included in a PNA.

References: F C Duguid, 1985 and 1990
H H Allan, 1945

RAP 17 Moutere Lake No. 2



Study Area: 102
GR Centre: S25 982673
Area: 1 ha
Survey Date: 10/8/90

RAP 17 MOUTERE LAKE NO. 2

Ecological Unit

Coprosma propinqua - Olearia virgata shrubland on sandplain.

Landform

Geology: peat; windblown sand.
Soils: organic soils; recent soils related to yellow-brown sands; yellow-brown sands.

The RAP covers an area which once would have been at the tip of the south-eastern arm of Moutere Lake number two. Now the lake level is very low, through drainage, and the study area was dry underfoot at the time of survey, despite recent rain. Plant species present indicate that the lake would have reached to the study area some years before. The RAP is more or less bounded by sandridges to the north-east and south and separated from a parabolic dune to the west by a vehicle track. Damp areas near this track have been pugged by cattle.

Vegetation

This shrubland is unique in the Foxton Ecological District in that it is composed chiefly of an association of Coprosma propinqua and Olearia virgata. Though found together elsewhere in the ecological district, this is the only place where they form the dominant plant cover. The shrubland reaches 2-4.5m, though one cabbage tree reaches 6 m. As well as these species, other shrubs are manuka and other Coprosma species (C. tenuicaulis, C. propinqua x C. robusta).

Carex secta and bracken (some growing on C. secta) reach 3m and climbers noted were pohuehue, Muehlenbeckia complexa and Parsonsia capsularis. Very few other indigenous plants were found, though in the north and in the south are bands of Cyperus ustulatus and Juncus sp.. Otherwise the area is completely grazed out, with a ground cover of thistles and pasture grasses.

Selection Criteria

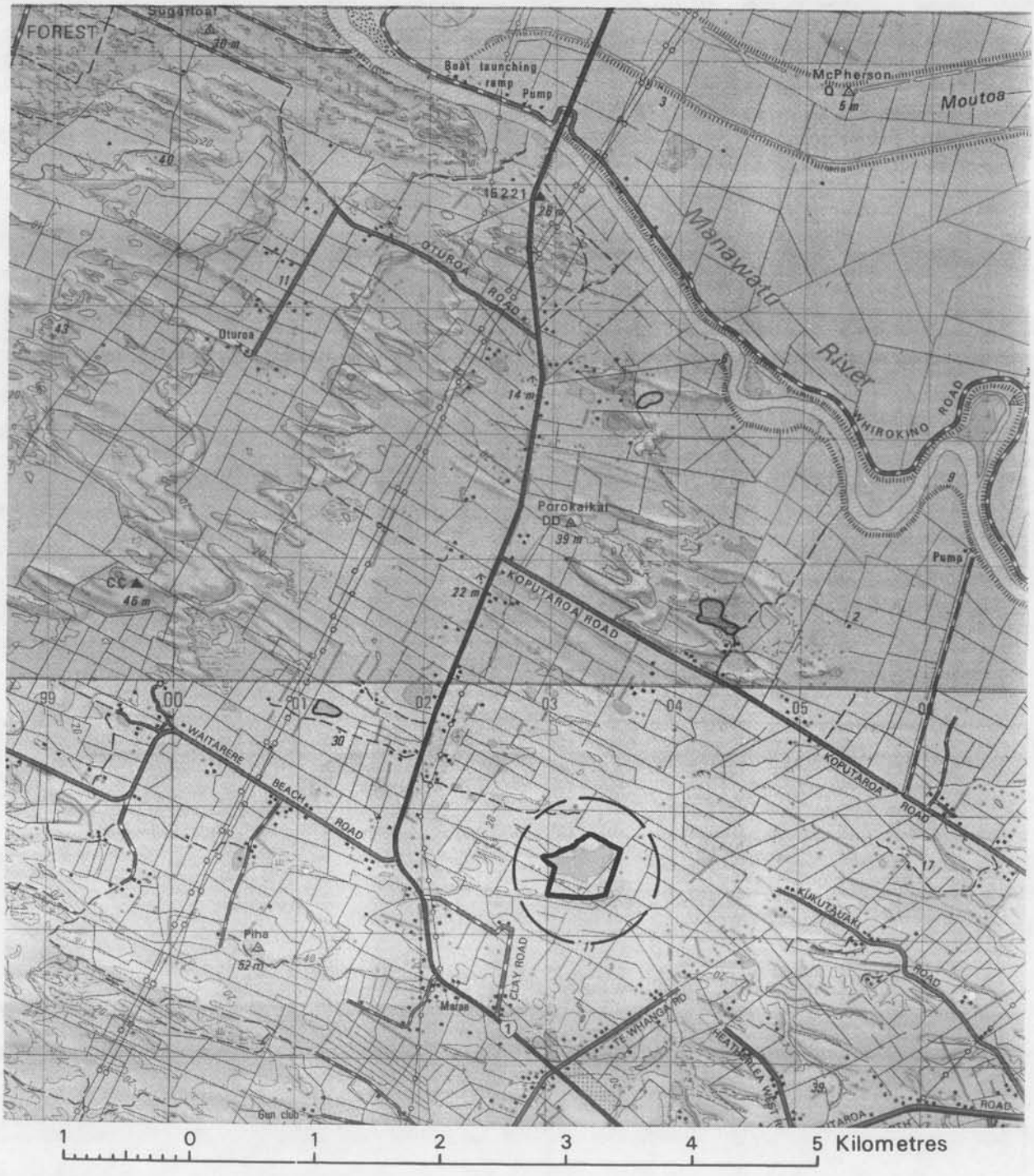
Representativeness:	H	The only example of a community which may have covered up to 100 ha of lake shore in the local area before clearance for farming.
Diversity:	L	Little diversity.

Special Features:	L	
Naturalness:	M	Good canopy, otherwise very poor.
Viability:	L	May not regenerate without fencing and restoration of previous water table.
Size and Shape:	M	Small, but round.
Buffering:	L	None.

Comment

Though in poor condition this area has been recommended for protection because it is the only remaining example of an ecological unit which could have covered up to 100 ha of the ecological district. The apparently great age of the shrubs indicate this is a genuine remnant and not an induced community. It may be impossible to restore the water table but it would be a very easy area to fence.

RAP 18 Te Whanga Bush



Study Area: 110
GR Centre: S25 033686
Area: 15 ha
Survey Date: 20/8/90

RAP 18 TE WHANGA BUSH

Ecological Units

1. pukatea - (tawa) - (kahikatea) forest on sandplain.
2. kanuka - poataniwha shrubland on sandridge.

Landform

Geology: windblown dune sand.
Soils: recent yellow-brown sands.

Te Whanga Bush is in a fenced off square. Most of it is sand plain, but a 5m sandridge runs along the southern boundary. There is also a lower (2-3m) sandridge running east-west across the middle of the block. In the south-east corner of the block a cutting has been made across the larger sandridge, presumably for vehicle access.

The surrounding farmland has been extensively drained, with drains running just beyond the northern and eastern boundaries of the bush area. Yet much of Te Whanga Bush remains wet, with surface water amongst pukatea roots at the time of survey. This is due to the damming effect of the sandridges, coupled with limited effectiveness of the drains. In contrast, the sand ridge areas are very dry.

Vegetation

Only two thirds of the area fenced off as Te Whanga Bush is in indigenous vegetation. The rest is in rank pasture, mainly in the north-west, with planted pines and macrocarpas in the south-west. The owner stated that the area had been fenced for five years and has not been grazed since. The sandridge on the south is mainly kanuka (around 6m) over poataniwha for half a hectare, though going further east there is a higher proportion of other trees including rewarewa and matai (up to 12m) and kohuhu, mapou and kaikomako. The ground cover is still mainly exotic grasses. This vegetation continues outside the fenced area to the west but is very sparse there.

There is also a scattering of kahikatea and pukatea (over 0.5ha) on the wet sand plain to the west of the fenced area, but again this is in poorer condition than similar patches within the fenced-off area, where the dominant species is pukatea, with several fine specimens rising up to 25m. Several gaps in this canopy (with corresponding open areas at ground level) suggest that kahikatea (and possible totara and matai) may have once been selectively logged. Pole kahikatea abound and in the north-west, which is particularly thick and wet, there are several mature kahikatea. Slightly drier fringes of these areas are dominated by tawa.

Several other trees were noted, including cabbage trees, mahoe, rimu, turepo, pokaka, white maire, pigeonwood, lancewood, titoki, wheki-ponga, hangehange, karamu and Coprosma areolata. Climbers noted include pohuehue, supplejack, climbing fuchsia and native passionfruit. Epiphytes are common, especially kiekie and Collospermum hastatum. Several fern species were noted, both ground-dwelling and epiphytic species.

Past disturbance has resulted in and many open areas and there are many weeds, though only Jerusalem cherry and old man's beard are likely to cause problems. The old man's beard appears to be spreading rapidly and could become serious. Though the area is fully fenced, cattle have occasional access. Because there is a large seed source handy, the grassy areas can be expected ultimately to regenerate and there is evidence of this starting to happen already. Pines and macrocarpas in the south-west are valuable as windbreaks - a section on the west without these trees contains several wind-damaged pukatea.

Selection Criteria

Representativeness:	M	Only about 2ha truly represent original sand plain swamp forest but the rest is regenerating.
Diversity:	H	Species diversity and community diversity.
Special Features:	M	Some of the best pukatea in the ecological district.
Naturalness:	M	High in places, low in others, improving overal.
Viability:	H	Could be even better if old man's beard is removed.
Size and Shape:	H	Relatively large, square block.
Buffering:	H	Fenced, still has several wet areas, good seed sources both within and near the area.

Other: High bird numbers seen. Some landscape value.

RAP 19 Poroutawhao Bush

Study Area: 113
GR Centre: S25 012698
Area: 4 ha
Survey Date: 20/8/90

RAP 19 POROUTAWHAO BUSH

Ecological Units

kahikatea/(titoki)-(ngaio) forest on sand plain.

Landform

Geology: windblown dune sand.
Soils: recent yellow-brown sands.

Poroutawhao Bush is located centrally on a sand plain of about 50ha. It is a fully fenced area, square in shape. A cattle race runs along the north-east side, with a drain to the east of that. Another drain runs along the south-east side of the bush. There drains clearly have an adverse effect on the water table and though the soil was slighly moister in the east than the west the whole area was quite dry at the time of survey.

Vegetation

This RAP is a remnant of kahikatea-dominant swamp forest, though only a few mature kahikatea (of about 18m) stand out above a 15m canopy of younger kahikatea. In the western corner, titoki is dominant and is separated from the main kahikatea area by a band of ngaio. There are a few pines in the south corner and rank grass along the south-west side. The bush is dense but there is a small (5m x 5m) clearing in the middle with a few native brooms (Carmichaelia arborea).

Other canopy trees are rimu, rewarewa and white maire. A sub-canopy covers parts of the area, of around 6-8m. Common species here are cabbage trees, mahoe, kaikomako and Coprosma areolata. Though several climbers were noted, only native passionfruit is common. There is a healthy ground cover with many low shrubs and seedlings and plentiful Blechnum filiforme among other ferns.

There are few serious weeds, though there is some gorse on the edges and Jerusalem cherry in the north. There is no evidence of recent stock damage, despite a gate in the northern corner.

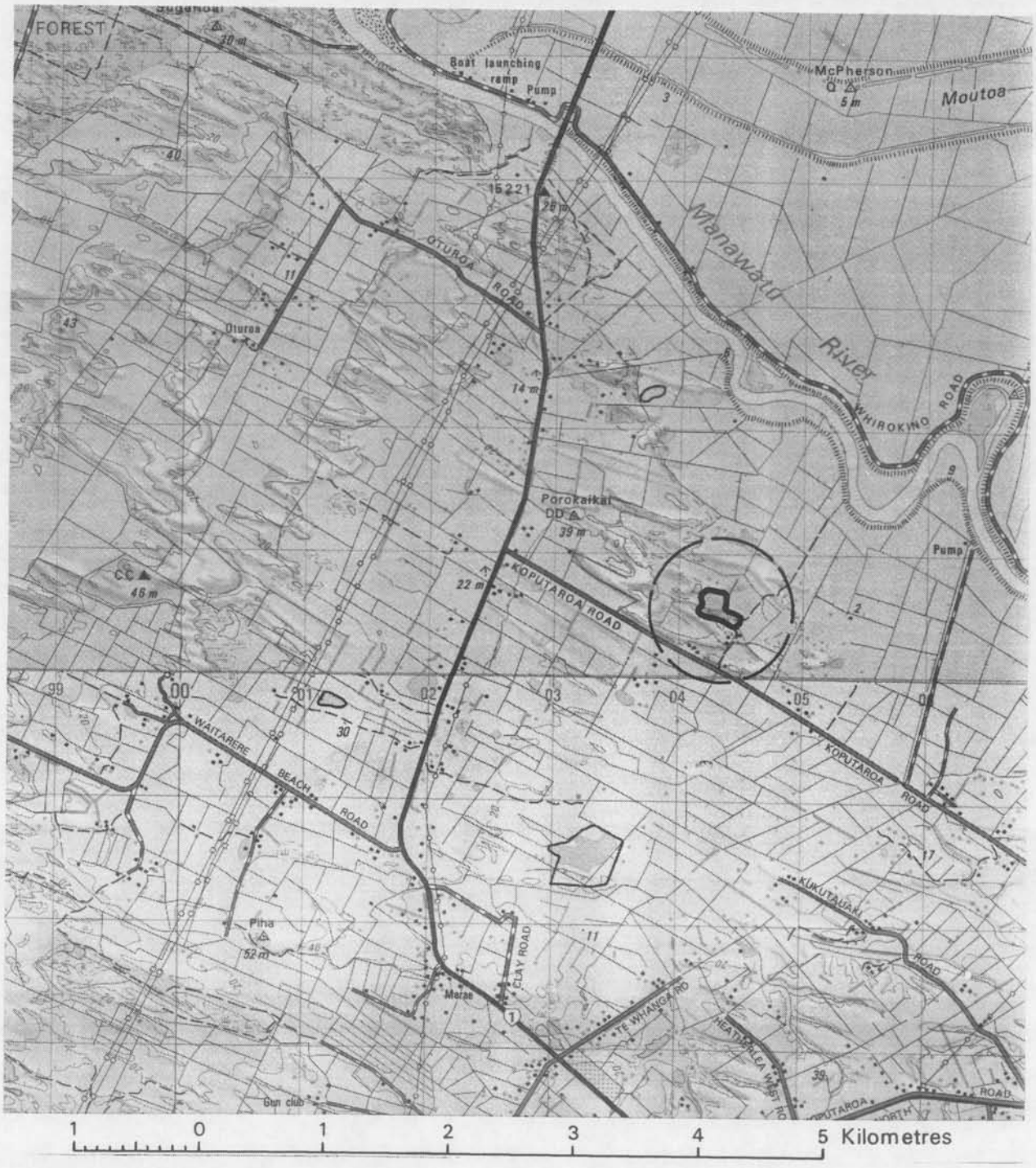
The forest composition can now be considered in part to be induced by the effects of several years of drainage. However, it is likely to represent a pattern which once would have occurred naturally over slightly drier parts of the sand plains.

These drier, fringe areas would have been converted to farm land very early on and consequently only Poroutawhao Bush is left to indicate what those areas were once like.

Selection Criteria

Representativeness:	M	See text above.
Diversity:	M	Small variation in composition. Good species diversity.
Special Features:	H	Rare association in the ecological district.
Naturalness:	H	Few weeds, some logging but has regenerated.
Viability:	M	Fenced, some local seed sources but lowered water table means that species composition will change.
Size and Shape:	M	Small, but good square shape.
Buffering:	M	Fenced, protected from prevailing wind by large pines to the west.

RAP 20 Manawakaikiekie Bush



Study Area: R24
GR Centre: S24 046705
Area: 2 ha
Survey Date: 11/7/90

RAP 20 MANAWAKAIKIEKIE BUSH

Ecological Unit

kahikatea-tawa forest on sand plain.

Landform

Geology: windblown dune sand.
Soil: recent yellow-brown sands.

Located to the south of a much larger sand plain, Wamakaikiekie Bush is in a more or less "L" shape, following the base of a parabolic dune which rises 10-15m above the forest. The forest is entirely on the plain and is surrounded by heavily drained farmland. The vegetation indicates the bush area was once quite wet but now, though damp areas exist in the south, it is fairly dry as a result of this drainage.

Vegetation

This forest remnant is in two adjoining parts, with only the eastern half being fenced. As a result, the western part has no understorey though it has several large (18m) kahikatea in a canopy which appears similar to that of the eastern block. The eastern block is dominant in kahikatea but there is some variation. In the south-east the canopy is lower (6-10m) and contains mainly mahoe. In the north-west the kahikatea grows with pukatea and, in the south-west of the fenced part, there are mainy kaikomako and tawa on slighly higher ground. There is also a band of tawa across the centre of this block and a concentration of titoki in the north-west. Cabbage trees and mapou are also common. Areas where canopy trees are thin (near the edges, mainly) have Cortaderia fulvida, mahoe, Coprosma areolata, mamaku, karamu, poataniwha and climbing fuchsia. There is a dense ground cover of seedlings and ferns.

A number of poplars should be removed but otherwise there is no weed problem. The fenced portion has clearly been well fenced for many years.

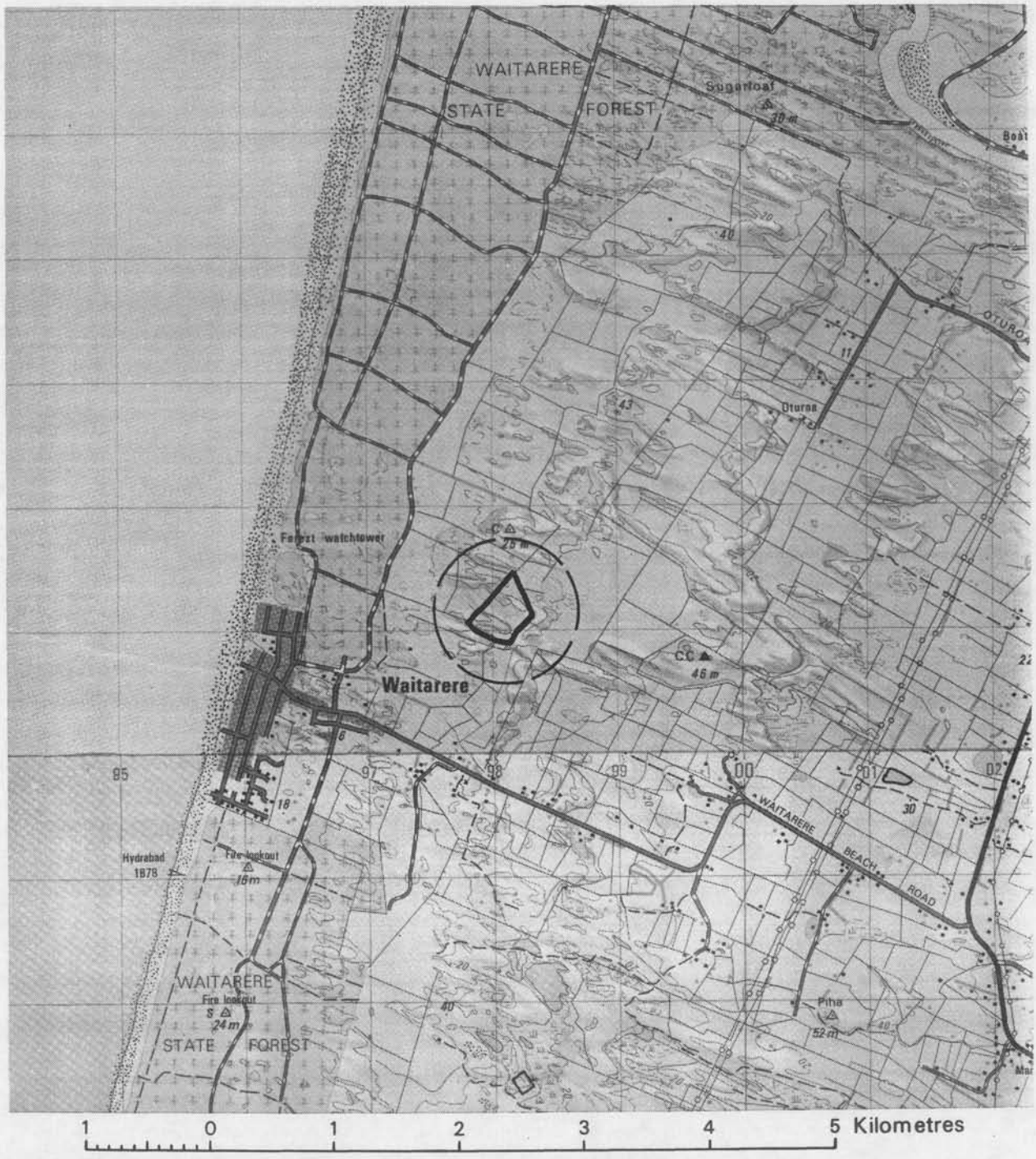
Selection Criteria

Representativeness:	H	Good example of a once-common forest type.
Diversity:	M	Slight canopy variations. Good species diversity.
Special Features:	M	Birds plentiful. Climbing fuchsia uncommon in the ecological district.
Naturalness:	H	Fenced half in excellent condition.
Viability:	M	Though fenced, species composition will change due to drainage effects.
Size and Shape:	M	Small, but relatively broad.

Comment

Though only the fenced part meets the criteria for an RAP the area would have considerably more conservation value if the unfenced part is included as part of a protected natural area.

RAP 21 Oturoa Lake No. 3



Study Area: 122
GR Centre: S24 981712
Area: 20 ha
Survey Date: 13/7/90

RAP 21 OTUROA LAKE NO. 3

Ecological Unit

flax-raupo/(Coprosma propinqua)-(Carex secta) flaxland on dune lake.

Landform

Geology: peat; windblown dune sands
Soils: organic soils; recent soils related to yellow-brown sands.

There are really two lakes in this RAP. They were formed by the damming effect of three parabolic dunes on water run-off from a sand plain and are separated by the central dune, which rises to a maximum of 10m but is so low in the east that the lakes practically join. The dune to the north rises to about 20m and affords a spectacular view over the lake area. Though shallow, the lake edges are clearly defined at the base of the dunes (in the west), but to the south and east get progressively shallower and consequently the lake area would vary considerably with water level changes.

At the time of survey, less than 20% of the lake area was open water, the rest being covered in emergent vegetation. The owner reports that two drains allowed the lake to dry out completely each summer. In 1989, he blocked the outlets and now there is permanent open water. At the time of survey water levels were very high, which restricted the survey to the edges, plus binocular survey from the dune crests.

Moderate pugging was noticed, particularly in the south and west.

Vegetation

Tree stumps (not positively identified but thought to be swamp maire) around the lake edges suggest there was once forest to the lake edge. Now there is just pasture, with a few rushes (Juncus sp.) and some Cyperus ustulatus. However, dense, indigenous vegetation covers over 80% of the lake area. Most of this is flax, with some Coprosma propinqua though there are also large areas of raupo. In the east, toetoe dominates and around patches of open water are areas of Carex secta. The vegetation is very dense but only a few species were noted (the high water levels meant sampling could only be done round the edges). The only other species which are at all common are bamboo spike sedge, bracken and swamp kiokio.

Stock are intruding in the south and consequently there is quite a bit of tall fescue in that part of the area (which has been drier for several years). The northern part of the lake is fenced, and though stock are allowed in, stock pressure is much lighter there. Where the south-western outlet has been blocked there are pines round the edges of the lake. There is also a pine plantation to the west of the lake which comes within 10m of the lake edge in places and provides good wind protection. Tree lupin and blackberries were noted but are confined to the grassed dunes.

Selection Criteria

Representativeness:	H	Only 10 years ago a chain of these lakes stretched from Waitarere to the Manawatu River. Now only this one remains in a natural condition.
Diversity:	M	Pattern of open water to flax and shrubs. Few species noted.
Special Features:	H	Very high number of water birds, including spotless crake and bittern.
Naturalness:	H	Very high in lake, poor round edges.
Viability:	H	Excellent, if stock controlled and water level maintained.
Size and Shape:	H	Relatively large, more or less round area.
Buffering:	M	Mainly density and wetness. Partly fenced. Pines provide shelter from wind.
Other:		This may be the southern limit of distribution of Australian Coot in the ecological district.

Comment

This lake is particularly important because hundreds of hectares of similar lakes have been drained in the vicinity in the last 10 years and this is the only one left in a more or less natural condition. It also has very high wildlife values, no doubt aided by its inaccessability.

RAP 22 Manawatu Estuary

Study Area:	137
GR Centre:	S24 005774
Area:	200 ha
Survey Date:	27/7/89, 3/8/89, 7/12/90

RAP 22 MANAWATU ESTUARY

Ecological Units

1. saltmarsh ribbonwood/jointed wire-rush - sea rush rushland on tidal flat.
2. flax-raupo/sharp rush/jointed wire-rush rushland on tidal flat.
3. half star - (shore primrose) - (glasswort) herbfield on tidal flat.
4. bachelor's button herbfield on tidal flat.

Landform

Geology: estuarine muds, silts and clays
Soils: saline soils

The RAP covers the area from the western side of the Foxton Loop to the sea and includes an S-bend of the Manawatu River and associated, tidal mudflats, a 100ha saltmarsh on the north bank along the loop edge, and two smaller salt marshes totalling about 40ha on the south bank of the river.

The river's path has been modified by the Whirokino cut to the east of the study area. There is a continual process of erosion and accretion on the curves of the river. Stopbanks define the north of the RAP east of Foxton Beach township. To the south-east, Waitarere forest is on eroding dunes which rise 5m from the river.

A dune area is forming a small spit on the north side of the river mouth, though this area has not been included in the RAP.

The large salt marsh on the northern bank has had three ponds dug in it which are used for duck shooting purposes. These ponds have had boardwalks contructed to them.

Vegetation

The vegetation of the Manawatu Estuary can be divided into four main groups. The easiest seen are extensive mudflats covered largely by the exotic cordgrass (Spartina anglica) or bachelor's button. Despite competition with Spartina the largest areas of bachelor's button in the ecological district are found in the Manawatu Estuary (tens of hectares).

Where sand has covered the mud flats and there is less tidal influence, particularly on the south bank, there are tens of hectares of herbfields, with halfstar, shore primrose and glasswort. Though much of this area is highly natural, invasion by Spartina, sharp rush and tall fescue is occurring at an alarming rate (noticeable over 18 months during this survey).

Over half of the large salt marsh on the northern bank is covered by a community of saltmarsh ribbonwood emergent over jointed wire-rush and sea rush. This is the largest such area in the ecological district. The three ponds dug in this area for duck-shooting purposes have raupo and flax around their edges for up to 30m.

Around the riverside edges of these salt marshes are bands 5-100m wide, of rushes. Originally native sea rush was the dominant plant but over much of its range it appears to be outcompeted by the introduced sharp rush, which forms a dense, exclusive cover. Cattle around this area are slowly reducing natural values and allowing invasion of creeping bent and tall fescue.

Despite the adverse influence of major problem weeds at least half of the Manawatu Estuary remains highly natural, with a good range of indigenous species occupying a diversity of niches bought about by the effects of salinity, tidal influences, fertility and sand cover. While elements of this diversity are mirrored in other estuaries, nowhere else in the ecological district is there the sheer area and high natural quality found here.

Special Features

The Manawatu Estuary has long been regarded as being nationally important as a feeding and breeding area for a large number of bird species including international migratory species. It also contains the southernmost and biggest population of fernbirds in the ecological district.

The estuary receives high recreational use and has high landscape value.

Selection Criteria

Representativeness:	H	Still largely in original condition.
Diversity:	H	Good range of estuarine habitats and species.
Special Features:	H	Outstanding ornithological value.
Naturalness:	M	Major weed problems but very high over much of the estuary.
Viability:	M	Gradually deteriorating through weeds and stock though much of this could be, or is being, controlled.
Size and Shape:	H	One of the largest remaining natural areas in the ecological district.

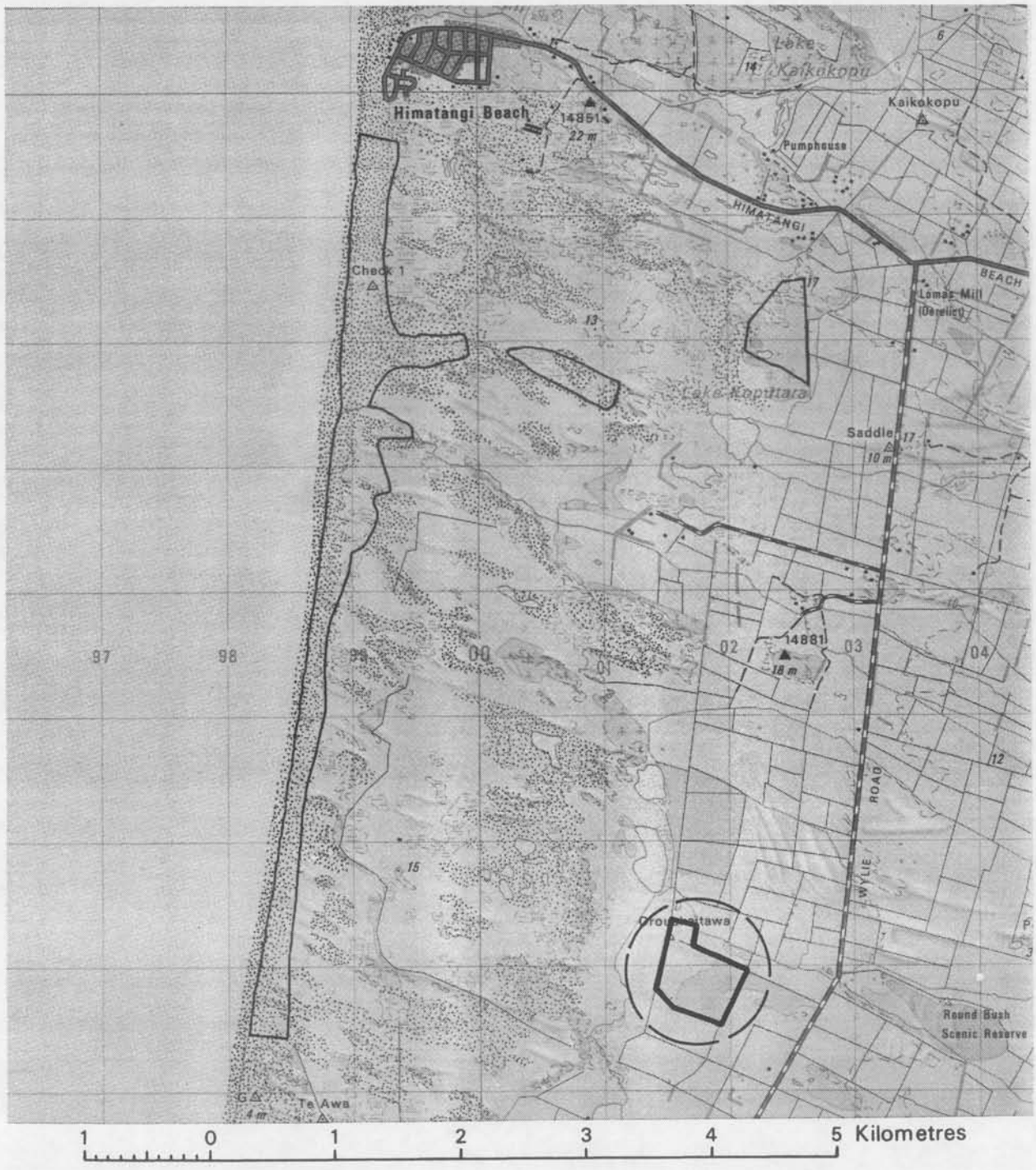
Buffering:	H	Protected by river, stopbanks, fences, salinity and size of the RAP.

Comment

Though the spit area at the river mouth does not meet the criteria for an RAP it would add to the value of a protected estuary if it was included as part of a larger protected natural area.

References: 1. OSNZ, 1987
2. Johnson, 1991

RAP 23 Oruakaitawa Swamp



Study Area: 146
GR Centre: S24 017828
Area: 20 ha
Survey Date: 16/2/89

RAP 23 ORUAKAITAWA SWAMP

Ecological Units

1. Coprosma propinqua scrub on sand plain.
2. Coprosma propinqua shrubland on sand ridge.

Landform

Geology: windblown sand
Soils: yellow-brown sands

Oruakaitawa swamp is on wet ground which resulted from a series of low (3-5m) sand ridges blocking drainage from a sand plain to the east. It was originally a shallow dune lake but as a result of drainage and eutrophication there are now only a few square metres of open water and over half the area was dry underfoot at the time of survey. A drain runs across the swamp from north to south. It could easily be blocked with no adverse effect on surrounding farm land.

Part of the RAP includes the sand ridge which forms the northern boundary of the swamp. A peak at the western corner is about 6-7m above water level and it lowers gradually to the east. Heavy stock pressure on this sand ridge has led to a severe blowout on the north-west.

Vegetation

Coprosma propinqua is the dominant plant both in the swamp proper and on the sand ridge but the vegetation is considerably richer than this implies. On the sand ridge there is a fenced area (1ha) on the west which also has Coprosma rigida, C. propinqua x C. robusta, Olearia solandri, O. virgata and manuka mostly at about 3m with emergent cabbage trees reaching 4-5m. This area is still lightly grazed though appeared to be recovering at the time of survey. Climbers abound, including Muehlenbeckia complexa and bush lawyer. Open areas have rank pasture with some bittersweet in places, though there are a few square metres of jointed wire-rush and some bracken. To the east of the fence, the ridge is grazed from the top down to the north face, though Leucopogon fraseri, bracken and rushes (Juncus sp.) persist. The south side is fenced and has Coprosma propinqua and Olearia solandri heavily covered in Muehlenbeckia complexa, Parsonsia heterophylla and bush lawyer.

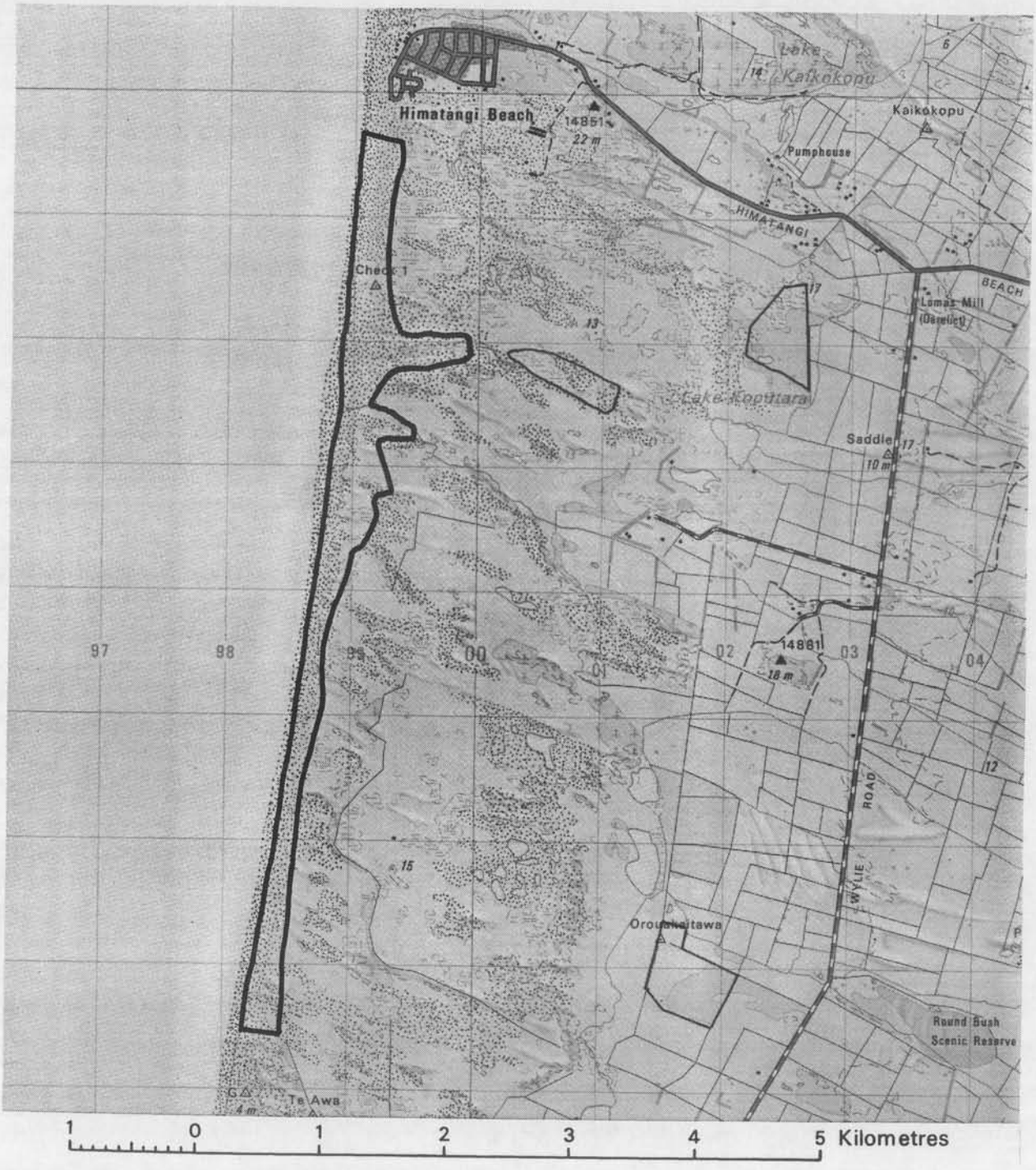
The scrub on the sand plain is fringed to the west by Olearia solandri, but Coprosma propinqua is far more common over the rest of this area. Other plants which reach the 3m canopy are Olearia virgata, Coprosma rigida, C. tenuicaulis, C. propinqua x C. robusta and manuka. Around the scrub and near the open water are smaller areas containing Carex secta, raupo, toetoe, flax or cabbage trees. Disturbed sites have Cyperus ustulatus or jointed rush. There are also patches of gorse and occasional fingers of sand, only 1m above swamp level with rushes, sedges and stunted shrubs but mostly covered by pasture spp. Overall there is an intricate network of small communities round the edges of the main scrub, based on differences in water level and stock pressure. This whole area is fenced but stock are still allowed access occasionally.

Selection Criteria

Representativeness:	H	Excellent example of lower fertility wet sand plain communities which are now much reduced in area.
Diversity:	H	Though mostly scrub, there is a range of communities from open water to dry sand ridge ones.
Special Features:	M	Spotless crake and bittern recorded here. Unusual to find "wet" shrubs growing on dry sand ridge.
Naturalness:	M	Very low on edges, high in parts. Varies considerably.
Viability:	M	Would be high if drain blocked and stock excluded.
Size and Shape:	H	Relatively large for the ecological district, square shape.
Buffering:	H	Fully fenced. Part of a chain of wetland areas providing a good seed source.

References: NZWSNHR

RAP 24 Foxtangi Dunes



Study Area:	D3
GR Centre:	S24 988862
Area:	280 ha
Survey Date:	31/1/89 and 1/2/89

RAP 24 FOXTANGI DUNES

Ecological Units

1. pampas grass/jointed wire-rush/Schoenus nitens rushland on sandplain.
2. jointed wire-rush rushland on sandplain.
3. (tauhinu) - (sand coprosma)/spinnifex grassland on parabolic dune.
4. spinifex grassland on foredune.
5. (pingao)/sand convolvulus herbfield on foredune.
6. Carex pumila/halfstar herbfield on sandplain.
7. Carex pumila/halfstar herbfield on sand basin.
8. Lilaeopsis novae-zelandiae - Limosella lineata herbfield on sandplain.
9. mixed (grass)-(herb) sandfield on sand plain.

Landform

Geology: windblown sand
Soils: yellow-brown; recent soils

This RAP covers part of the sand dune system between Himatangi Beach and Foxton Beach. It includes the entire foredune from Himatangi Beach to 2 km north of Foxton Beach plus a series of ephemeral wetlands on sandplains, separated by sandridges, from a point 600m south of three Mile Creek northwards. The inland boundary of this part of the RAP is defined by plantings of exotic pines, though the sandplain found between 500m and 1km south of Himatangi Beach township is also included in the RAP despite recent pine planting.

This area has a high wind run and the lowest rainfall in the ecological district. There is a history of disturbance by cattle and recreational vehicles. These factors, together with the presence of many steep, marram-covered dunes, mean that the area is very dynamic, with a considerable amount of sand movement (there was probably some prior to European occupation also). Consequently the wetlands "move" across the sand plain, and over a period of years some disappear and new ones are formed. This effect occurred several kilometres inland in the past but an intensive programme of pine planting has confined most of the movement to that area within the RAP.

The foredune consists mostly of a series of low (up to 6m) shallow-sloping, spinifex dunes. Many of these dunes are parabolic and consequently this is not a "true" foredune such as is found between Paekakariki and Hokio. These dunes run west south-west at an angle to the coast, but together form the equivalent of a foredune. They accreted rapidly over the two years of the survey.

There is no swale or relict fore dune. The sand plain behind the fore dune covers up to 250ha and is divided by long (up to 0.5km), low (less than 5m) sandridges, trailing parabolic lobes on the eastern edges, into areas between 2 and 30ha. There is no artificial drainage of the ephemeral wetlands, but in places pines have been planted in ditches 300mm deep. Only some of the western parts of the plains remain in a natural enough condition to be included in the RAP.

Vegetation

Even as recently as 10 or 15 years ago this was an area with a rich indigenous flora and few weeds Esler (1969 a). Much of this richness still remains though pine plantings, encroachment of pampas and sowing of pasture species has considerably reduced the extent and quality of the natural areas.

Indigenous vegetation is still dominant on the foredune. Over most of the length of the RAP, from the beach to the crest, the foredune is almost purely in spinifex with just a few hectares of marram in places and occasional patches of pingao, especially towards the south. To the rear of the foredune there is more marram and pingao with indigenous shrubs. Tauhinu is the most common of these, though sand coprosma is also widespread and there are scattered populations of sand daphne. Other common plants are sand convolvulus (which may become locally dominant) sand bent, exotic flat weeds (around and under shrubs) and Senecio elegans.

On the sandplains where sand is mobile, there are many damp areas where Carex pumila and halfstar are the most common plants, though there may also be Triglochin striatum, Isolepis cernua and near Three Mile Creek, Limosella lineata and Lilaeopsis novae-zelandiae. More stable areas (which tend to be much larger) were mostly covered by an association of jointed wire-rush over Schoenus nitens, with occasional toetoe and, on slightly drier parts club sedge or marram. In the last few years most of these areas have been planted in pine trees (though only a small percentage of these have survived) and pampas is becoming a serious problem, especially on the northern plains. Some areas have also been oversown in pasture grasses and legumes while to the south of the RAP there is established pine forest.

Many wet sand-growing species are found on these ephemeral wetlands, including some rare or threatened plants. The best remaining such area is the one described above near Himatangi Beach. This was rapidly being covered by pampas, most of which was killed after the initial survey, when pines were planted. It would be highly desirable to remove the pines and pampas from at least the western half of this area.

The following plants, listed by Given (1990) have been recorded from this area:

Eleocharis neozelandica - vulnerable (Esler, 1969 a)
Pimelea arenaria (sand daphne) - indeterminate
Desmoschoenus spiralis (pingao) - local

There is also an undescribed form of Pimelea found on the edges of the jointed wire-rush areas, which may be part of the P. urvilleana complex and is called P. "Himatangi" for the purposes of this report. A hundred or so plants exist in this RAP but it is not known in any other area at the time of writing, though it has been recorded at Turakina Beach (A P Druce, b). Some plants recorded by Esler (1969) have not been recorded from this area since, including Eleocharis neozelandica and Isolepis basilaris.

Special Features

Several rare or endangered plants have been identified in this RAP (see above). The foredune area is the most natural remaining in the ecological district.

Selection Criteria

Representativeness:	H	The foredune area especially has high representativeness. This and the sand plain part of the RAP is the best remaining example of a vegetation and landform pattern which once extended over most of the coast between the Manawatu and Rangitikei Rivers.
Diversity:	H	Large range of communities, habitats and species
Special Features:	H	Populations of rare plants.
Naturalness:	M	Foredune high, sandplain modified by weeds, foresty and farming.
Viability:	M	High on foredune, poor on flats without major management effort.
Size and Shape:	H	Large RAP, sufficient width allows for dynamics associated with sand movement.

Buffering: M Foredune well buffered by water and sand movement. Jointed wire-rush flats are poorly buffered.

Other: Used by Massey University and Manawatu Polytechnic for educational purposes. Has a range of recreational uses. High landscape value.

References
1. Esler, A E, (1969, 1978)
2. Ogle, C C (pers. comm.)
3. Shepherd, M (pers. comm.)

RAP 25 Legg Estate Bush

Study Area: 148B
GR Centre: S24 120873
Area: 1 ha
Survey Date: 15/5/90

RAP 25 LEGG ESTATE BUSH

Ecological Unit

titoki-rewarewa -(pukatea) forest on sandridge.

Landform

Geology: windblown sand
Soils: recent soils; yellow-brown sands

The entire RAP is on the south face of a sandridge which runs in east-north-east to west-south-west direction. It extends from the edge of a sand basin at the base of the ridge to just below the crest of the ridge, which is about 10m above the sand basin and has a slope of about 25°. The sand ridge has been modified by road construction just east of the RAP and a farm track near the western edge.

Vegetation

Despite the small size of the RAP there is a vegetation sequence shown. At the base of the sand ridge where the ground is damp are several mature pukatea, up to 12m, with a few kahikatea and cabbage trees. Further up the sandridge, titoki (8-10 m tall) is dominant but at the higher levels of the RAP titoki is replaced by rewarewa as the dominant tree species. The understorey is mainly composed of mahoe and kawakawa. Other common trees and shrubs are mapou, kaikomako, Coprosma areolatea and C. rhamnoides with manuka, poroporo and some ngaio in the north-east of the area. There are a few plants of kiekie and climbing rata (Metrosideros diffusa) and a small area of supplejack. There were few seedlings and little ground cover when surveyed (the area had only recently been fenced).

Two weeds present in small quanitities could spread and become a problem if not controlled soon. They are wandering Jew and elderberry. The RAP is bounded to the north by a pine plantation and to the south by pasture. To the west and more so across the road to the east are scattered indigenous trees over pasture. These areas are probably now too modified to be included in the RAP but still have value as seed sources.

Selection Criteria

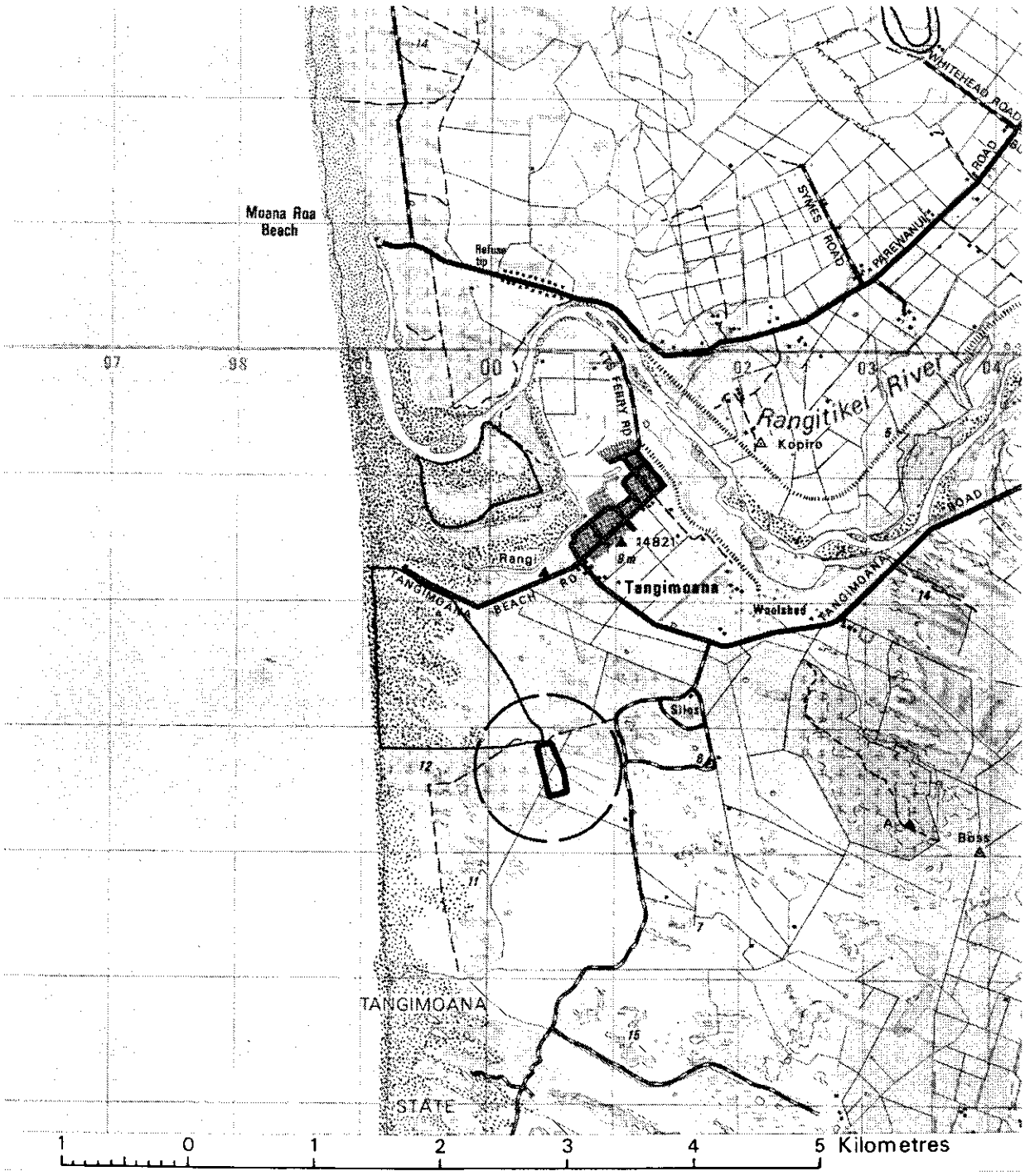
Representativeness:	H	Dune forests are now very rare ined and this is the only example left with this forest type.
Diversity:	M	Does show a vegetation sequence but otherwise little diversity.

Special features:	L	
Naturalness:	M	Spoiled a little by disturbance and weeds.
Viability:	H	Would be even better without elderberry and wandering Jew.
Size and Shape:	M	Small but rectangular shape is good.
Buffering:	H	Fully fenced, local seed source, pines provide protection from wind.

Comment

It would be desirable to include some of the adjacent pine block in a PNA to ensure continued shelter from the wind.

RAP 26 Tangimoana Fernbird Area



Study Area: 175A
GR Centre: S24 004966
Area: 5 ha
Survey Date: 26/6/90

RAP 26 TANGIMOANA FERNBIRD AREA

Ecological Unit

Coprosma propinqua/jointed wire-rush rushland on sand plain.

Landform

Geology: windblown sand
Soil: recent soils; yellow-brown sands

This RAP is located on the western edge of a large (over 50 ha) sand plain. Its north-eastern and south-western edges are defined by low (1-2m) sandridges, the north-west side by a vehicle track and the south-east by fences. The area is bisected by a 1m deep drain which drains nearby pasture. This drain may have serious consequences for the area (originally "wetland" but quite dry when surveyed despite recent heavy rain) but could be blocked or rediverted relatively easily, being in soft sand country.

Vegetation

The vegetation is very uniform, the whole area being covered by a community of Coprosma propinqua over-topping jointed wire-rush. There is also some manuka, Coprosma propinqua x C. robusta (which have further hybridised and show a range from near C. propinqua to near C. robusta) and Muehlenbeckia complexa. The shrubs reach only 1.5m in the north but rise to 2.5m in the south. There are scattered clumps of cabbage trees and toetoe and occasional flax. Near the edges there are also some Juncus pallidus and Cyperus ustulatus.

The whole area is infested by tall fescue and there is some blackberry and several pampas plants on the edges. Some Corsican pines have been planted in the north-east. Despite being fenced, the area has been grazed by cattle for many years and consequently there are pasture weeds throughout. However, it is still in a predominantly natural condition.

Selection Criteria

Representativeness:	M	It is hard to gauge the former extent of this ecological unit, which is now confined to this area.
Diversity:	L	Very little diversity shown.
Special Features:	M	A population of fernbirds occupies the area.

Naturalness:	M	Spoiled by drainage and grazing.
Viability:	L	Would be high if drain blocked and cattle kept out.
Size and Shape:	H	Moderate size, good, square shape.
Buffering:	M	Fenced (though needs upgrading). Pines provide wind protection.

Comment

Despite modification and the need for management this area is recommended for protection because it contains a unique ecological unit.

RAP 27 Tangimoana Dump Dunes

Study Area:	D2
GR Centre:	S24 993977
Area:	159 ha
Survey Date:	30/1/89, 23/6/89, 30/6/89

RAP 27 TANGIMOANA DUMP DUNES

Ecological Units

1. tauhinu/marram shrubland on fore dune
2. Carex pumila sedgeland on sand basin
3. Carex pumila/(halfstar) sedgeland on sand plain
4. jointed wire-rush/Schoenus nitens rushland on sand plain
5. toetoe-flax/jointed wire-rush grassland on dune hollow
6. spinifex-marram-(pingao) grassland on foredune
7. club sedge/halfstar herbfield on sand basin
8. (tauhinu)/(spinifex) stonefield on sand basin

Landform

Geology: windblown sand
Soils: recent soils; yellow-brown sands

The Tangimoana Dump Dunes are the least stabilised and most mobile coastal dunes remaining in the ecological district. The foredunes are mostly the spinifex type which are smooth in outline, low (less than 6m) and rise gently. In the north and south of the RAP there are also some of the marram-type, steeper, taller dunes. Many of these have blown out, leaving gaps in the fore dune. Inland from the fore dune, dunes have moved (and are still moving) inland for up to 800 m, resulting in a complex series of parabolic dunes, sandridges, dune hollows, sand basins and small (10ha) sand plains with associated wetlands. The inland side of the RAP is part of an older, stable sand plain extending 2-3 km inland but is rapidly being covered by bare sand dunes, up to 10m high and up to 10 ha in extent. In the south, sand movement has exposed stone fields - remnants of storm beach ridges caused by flooding of the Rangitikei River.

This area is very popular for use of recreational vehicles. It is likely that this activity is contributing to destablisation of these dunes. A landfill site in the north of this RAP is further modifying the land form.

Vegetation

Indigenous vegetation covers most of this RAP but, despite not having a history of deliberate modification, there have been some major weed invasions. However, the combined effects of strong winds, sand, salt and fluctuating water tables means that these weeds tend to be localised and most of the area can still be regarded as natural.

The foredune is mostly covered in spinifex with patches of marram which becomes locally dominant and pingao scattered throughout. To the rear of the foredune and on dunes up to 100m inland are clumps of indigenous shrubs. Only tauhinu and sand coprosma were noted in this survey but sand daphne was noted in a survey in 1989 by Kingett Mitchell and Associates Ltd. There is also some spinifex, pingao, club sedge and sand bent present. Some of these places have many weeds, especially marram, hare's tail and hawkbit.

There are several ephemeral wetlands thoughout the area, associated with dune hollows, sand basins and sand plains. In places where sand is very mobile and the water table high (often up to 30cm of surface water) the most successful plant is Carex pumila, though there may also be large amounts of half-star and other herbs, as well as Triglochin striatum and Isolepis cernua. At least three of these wetlands contain populations of the vulnerable sedge Eleocharis neozelandica. These areas sometimes have a fringe of Pseudognaphalium luteoalbum.

On the inland side of the dunes, the sand plain vegetation is quite different again (this area is rarely wet). In one sample site, toetoe and flax, over jointed wire rush, were dominant, with a few cabbage trees reaching 4.5m. There were also some shrubs (manuka and Olearia solandri) and Muehlenbeckia complexa. However, there was also gorse, tall fescue, blackberry and pasture plants, and over the rest of this area adventive species have largely taken over to the extent that this side of the RAP can no longer be considered "natural" or representative.

As well as the weeds already mentioned, pampas, boxthorn, climbing dock and lupin are becoming serious problems. There is also some rabbit damage, notably grazing on pingao and also on damp sand flats where several small herbs and sedges have been dug up. Recreational vehicles have also caused localised vegetation damage.

Special Features

This area contains at least three populations of the vulnerable sedge, Eleocharis neozelandica.

Selection Criteria

Representativeness:	M	High in places but spoiled by weedy area.
Diveristy:	H	Large range of ecosystems from beach to inland sand plain.
Special Features:	H	Contains vulnerable Eleocharis neozelandica and good populations of pingao.

Naturalness:	M	High variation, poor to excellent.
Viability:	M	Some naturalness will remain, but overall deteriorating. Would improve with management.
Size and Shape:	H	Large, triangular shape. Extensive enough to allow natural, dynamic processes to continue indefinitely.
Buffering:	M	Buffered by natural coastal processes. Fully fenced from stock.
Other:		High recreational value; some educational value resulting from easy access and diversity of natural communities.

Comment

Some of this area is being used by the Paneke Training and Development Trust for pingao propagation trials. The area is ideal for a range of dune research topics.

References: Kingett Mitchell and Associates (1989).

RAP 28 Forest Road Wetlands

Study Area:	D7
GR Centre:	S23 025030
Area:	80 ha
Survey Date:	8/2/89

RAP 28 FOREST ROAD WETLANDS

Ecological Unit

karamu/flax flaxland on remnant river channel.

Landform

Geology: undifferentiated floodplain alluvium
Soils: gley recent soils; gley soils

The Forest Road wetlands follow the course of a former channel of the Rangitikei River, north of its present channel, for approximately 5km. This channel is dammed by sand dunes to the west and much of it is under water to a depth of 1-2m. The channel meanders around stable dunes in a series of loops and is 30-150m wide.

This area is 1.5km from the present river channel. It is the only example of a major river channel completely separated from its parent river in the ecological district.

Vegetation

The vegetation is more or less uniform over the whole RAP except where it has been influenced by stock damage or weed invasion. It consists of karamu over-topping flax and some toetoe. The karamu is very common and reaches 4-5m in the west but becomes smaller (2m) and more scattered further east. Occasional cabbage trees reach 5m. There is also occasional Coprosma propinqua and Calystegia sepium and Cyperus ustulatus at the edges. Where the water is deeper (over 0.5m at time of survey) raupo is dominant.

Much of the area is fenced or inaccessible to stock. Where cattle and sambar deer have ready access there is some browsing damage. These areas also have pasture weeds and jointed rush. There is some gorse on adjacent farmland which has spread into the wetland in one or two places. The western edge is bounded by pine forest and a few pine trees have established in the wetland.

Because of the high water levels and density of the vegetation only the edges were surveyed and it is very likely that species diversity is higher than what was recorded.

Selection Criteria

Representativeness:	H	Representative not only of river channel vegetation but also of a wet sand plain vegetation type which may have once been locally common.
Diversity:	L	Very uniform. May have moderate species diversity.
Special Features:	H	Unique landform.
Naturalness:	H	High overall. Some parts modified by stock and weeds.
Viability:	H	Would be even better if managed for its natural values.
Size and Shape:	M	Large, but long and thin shape not ideal.
Buffering:	M	Some fencing, some wind shelter from pines in west.

RAP 29 Mt Amon

Study Area:	184
GR Centre:	S23 031071
Area:	8 ha
Survey Date:	17/2/89

RAP 29 MT AMON

Ecological Units

1. flax flaxland on sand plain.
2. flax-raupo flaxland on dune lake.

Landform

Geology: windblown sand
Soils: gley soils; yellow-brown sands; recent soils

Mt Amon is a parabolic dune, rising to 39m above sea level in the east, with associated sand ridges to the west. It has dammed a sand plain, resulting in one dune lake and two swamp areas about 20m below the crest of the dune. The RAP includes the dune lake (in the east) and a flax swamp in the north and west but ideally would also include a "corridor" linking the two sections round the north-east of Mt Amon.

A 1m deep drain runs along the north edge of the RAP. This has not affected the lake but has lowered the water level over most of the flax swamp. It would be a straight-forward task to block or divert this drain.

Vegetation

The swamp area in the north is covered in dense flax standing up to 3m high, with occasional cabbage trees reaching up to 8m. Toetoe is scattered over the whole area and becomes dominant in the centre. Raupo and native convolvulus are also common. The flax ends abruptly on the north side at the drain edge, beyond which is pasture. On the dune side flax gives way to Cyperus ustulatus, club sedge and pasture. The north is fenced but stock have access from the south.

Another flax swamp 100m to the south (but not included in the RAP) has been drained and open to stock for many years and is now very open, though it still has some buffering value.

The dune is covered in rough pasture, with much marram and club sedge and some Cyperus ustulatus. It separates the natural vegetation of the swamp and lake. The lake has abut 0.25ha of open water, fringed by Carex secta with a band of raupo. This in turn, is surrounded by a broader (10-30m) band of flax, with a few cabbage trees. Toetoe was not recorded here though it might have been expected. At the base of the dune are areas of bracken and some Juncus pallidus. Though there is little stock damage, where cattle have had access there are small areas (a few m^2) of jointed rush.

Though surrounded by pasture there are no weeds likely to cause problems in the natural areas, other than a few gorse plants in the flax swamp. Dead tree lupin on the dune may have come away again since the time of survey (as has occurred elsewhere in the the ecological district) though this is unlikely to affect the wetlands.

Selection Criteria

Representativeness:	H	Only small remnants of ecological units which would originally have covered several hundred ha.
Diversity:	M	Two very different areas but each with little diversity.
Special Features:	M	Good waterfowl habitat.
Naturalness:	H	High only in lake and flax swamp.
Viability:	M	Needs stock and drainage control.
Size and Shape:	M	Neither area very large but both have a good, approximately round shape.
Buffering:	M	Whole area fenced, but stock allowed access. Adjoining areas of lower naturalness, could allow increase in size of natural areas.

Comment:

It is the "flaxland on sandplain" ecological unit which is underepresented in the existing PNA network. However, the value of the RAP is greatly increased by addition of the dune lake and a surrounding buffer area.

RAP 30 Lake Herbert

Study Area:	195A
GR Centre:	S23 063162
Area:	15 ha
Survey Date:	25/2/91

RAP 30 LAKE HERBERT

Ecological Unit

cabbage tree/flax flaxland on dune lake

Landform

Geology: windblown sand
Soils: recent soils; yellow-brown sands

Lake Herbert occupies a drowned sand basin between two sandridges, which run in a WNW-ESE direction. It is up to 200m across. The open water area is about 600m long, with emergent vegetation for a further 700m to the east. The sandridges rise up to 20m above the lake surface level.

The landform has been called "dune lake" as surface water extended into the vegetated area. However, the owner stated that the water level was unusually high in which case it would become more correct to call the landform a sand basin in the flax area. The owner stated he had attempted to drain "surplus" water. This had failed, because surrounding areas also had a high water level.

There is a lot of cattle pugging round the "usual" lake edges and also some pugging at the edges of the higher level.

Vegetation

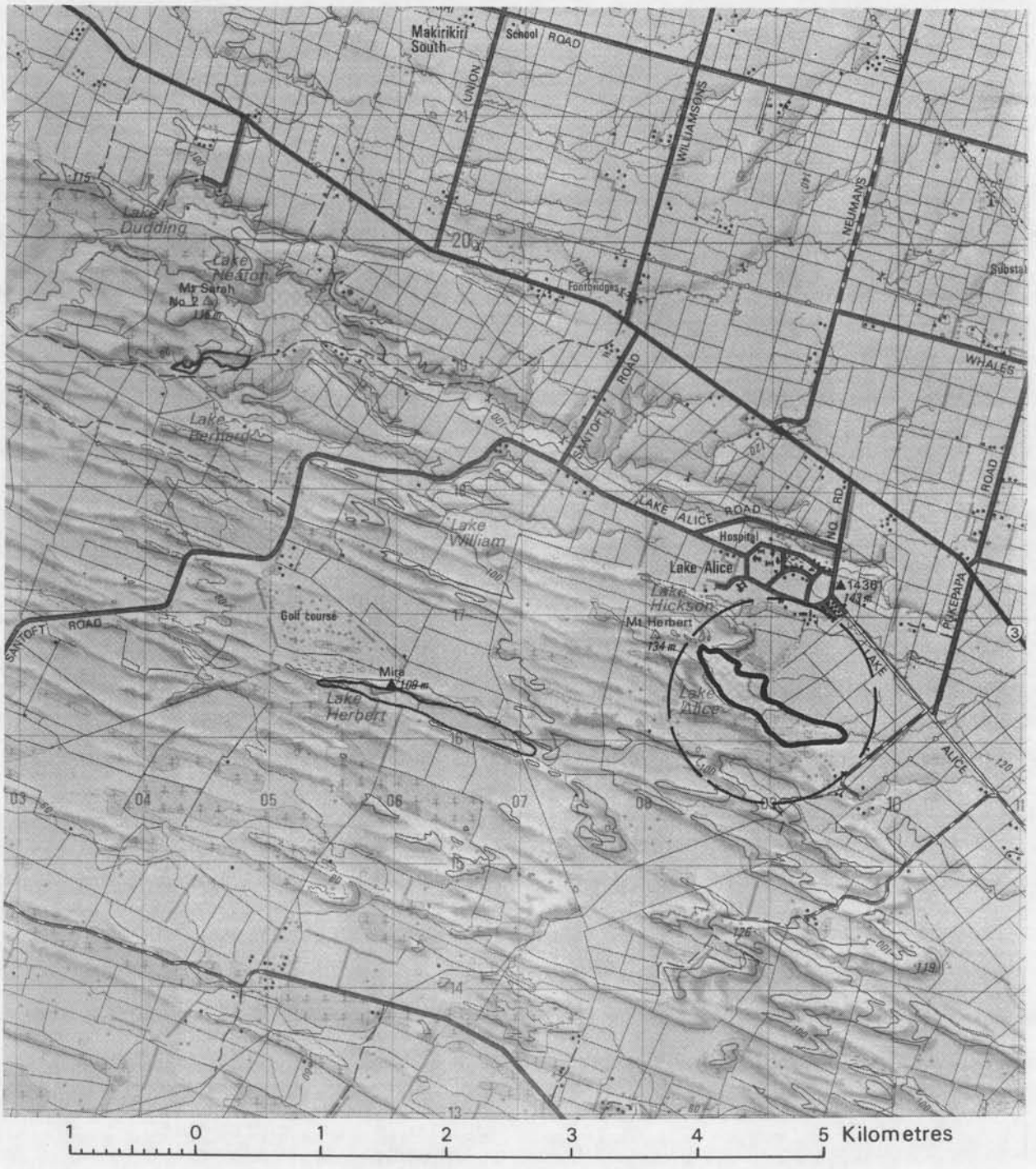
The north-east, northern and western edges of Lake Herbert have pasture to the edges. Emerging from the open water, several metres from the edges are sparse bands, identified through binoculars as Schoenoplectus validus, and also a few crack willow trees. Where the lake edges have been heavily pugged is a band of weeds, mainly jointed rush, with some sharp spike sedge. In the east, however, the vegetation is considerably more natural and less modified. About two thirds of this area is dominated by flax of 2-3m and the other third (further from the lake) is dominated by cabbage trees, mostly at 6m but some reaching 10m. There are small (up to 100m^2), localised areas where raupo is dominant. Toetoe is common across most of the area and the rushes, Juncus gregiflorus and J. pallidus are common in places at the edges. Small trees (up to 3m), seen from the edges with binoculars, were thought to be karamu. A few isolated mahoe and pigeonwood were noted at the base of the northern sand ridge.

Though stock have damaged some vegetation at the edges, and there are a few herbaceous weeds, away from the edges the vegetation is less modified and in good condition. A few crack willows have the potential to spread but could easily be controlled. Recently pines have been planted on the sand ridge. These plantations have been fenced and as a result three quarters of the vegetated area is now protected from stock.

Selection Criteria

Representativeness:	H	Flax swamps of this type would once have covered several hundred ha.
Diversity:	M	Sequence shown of open water to cabbage trees, though mostly cabbage tree over flax.
Special Features:	M	Some value for water fowl habitat.
Naturalness:	H	Only poor at edges.
Viability:	H	Would be further improved with more fencing and willow control.
Size and Shape:	H	Long and relatively thin but shape dictated by land form. Large area.
Buffering:	H	Water levels and denseness provide stock protection and resistance to weeds. Partially fenced.

RAP 31 Lake Alice



Study Area: 195
GR Centre: S23 090163
Area: 25 ha
Survey Date: 15/2/89

RAP 31 LAKE ALICE

Ecological Unit

flax flaxland on dune lake.

Landform

Geology: windblown sand; loess; colluvium
Soils: recent soils; yellow-brown sands; yellow-grey earths

Lake Alice was formed by parabolic dunes in the west damming runoff from downland in the east. The dunes continue along the south of the lake, forming a long, curving lake. Over half of the lake is open water while the rest is in swamp, 1ha in the north-east and 10ha in the south-west.

Cattle have free access to the lake edges and pugging is severe round the swamp edges. No artificial drainage was evident. An outfall from Lake Alice Psychiatric Unit sewage treatment plant in the east may have an effect on fertility of the lake.

Vegetation

Most of Lake Alice has pasture right to the edge though there are several cabbage trees in these paddocks. The swamp areas are dominated by flax. Toetoe and karamu are also plentiful with cabbage trees commonly reaching 5m. Though it was only possible to walk round the edges, several small trees and shrubs were noted, including Coprosma tenuicaulis, C. propinqua x C. robusta, manuka, lancewood, mapou and mahoe.

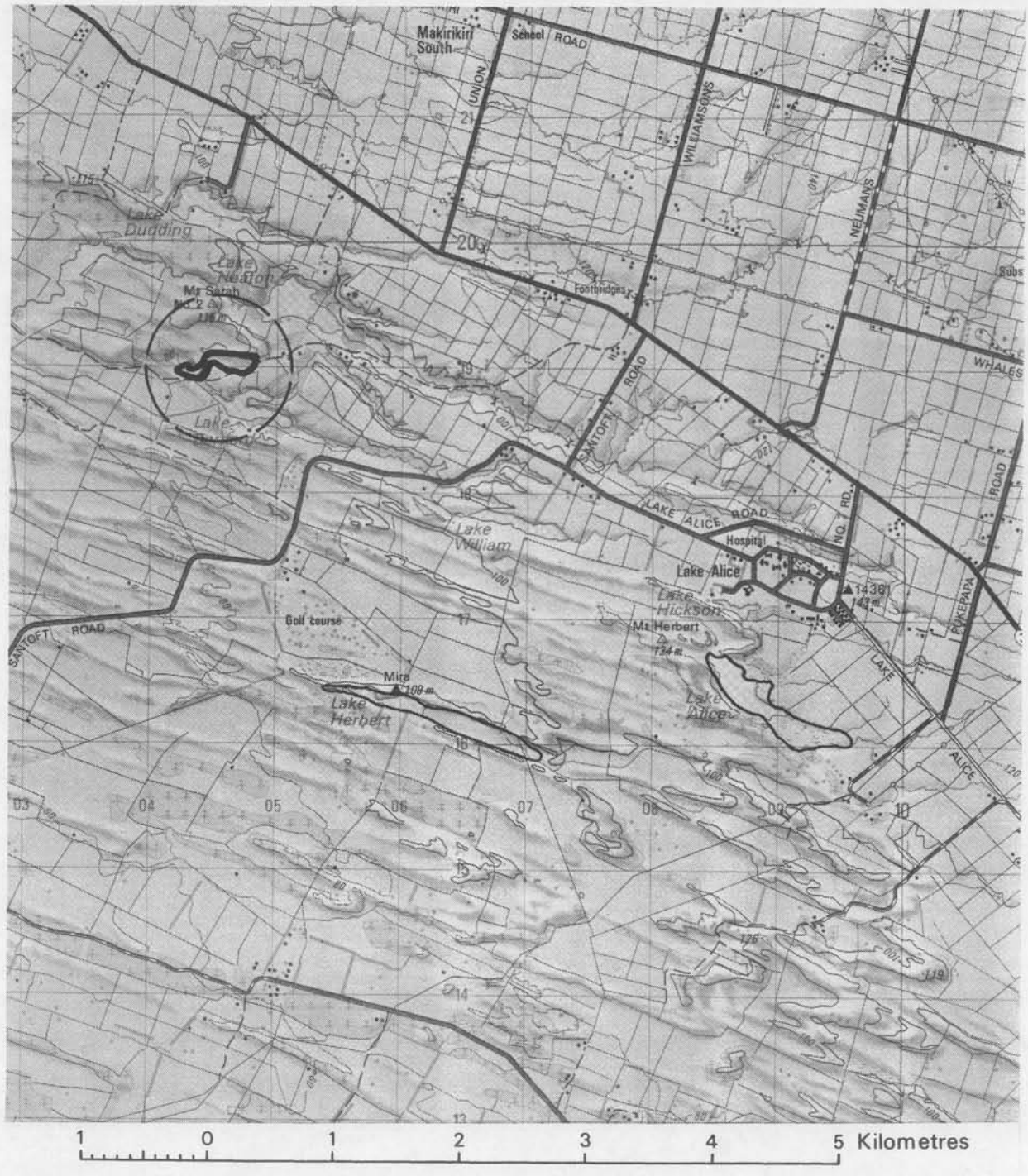
The edges of the swamp are weedy where cattle have access and few lower stature indigenous plants were seen, though it is probable the situation would be better away from the edges. Of the weeds noted, only crack willows are likely to become a problem and there were only half a dozen or so seen at the south end. Cattle have done considerable damage, browsing the flax at the edges.

Selection Criteria

Representativeness:	H	Swamp areas are good representative examples of eutrophying dune lake vegetation.
Diversity:	M	Only open water and flax swamp but high species diveristy.

Special Features:	L	
Naturalness:	M	High in swamp areas away from edges, lower elsewhere.
Viability:	M	Slowly deteriorating but would improve markedly with fencing.
Size and Shape:	H	Large area and broad.
Buffering:	M	Only protected by high water level and density of vegetation.
Other:	Large numbers of waterfowl observed.	

RAP 32 Sarah Pond



Study Area:	207
GR Centre:	S23 045190
Area:	15 ha
Survey Date:	13/2/89

RAP 32 SARAH POND

Ecological Units

1. mixed broadleaf forest on sandridge.
2. flax-raupo flaxland on dune lake.

Landform

Geology: windblown sand
Soil: recent soils; yellow-brown sands

The RAP runs from the crest of a sandridge down its southern slope (a vertical distance of 25-30m) to a dune lake at its base. The eastern side of the RAP is artificially defined by a vehicle track going diagonally up the ridge, the west by a pine plantation. The natural area stops abruptly on its south-east edge at the base of a parabolic dune which separates Sarah Pond from Lake Bernard. To the south-west a low sand ridge (complete with tree stumps) has been bulldozed up to the edge of the lake - this may have resulted in raised water levels.

The slope of the sand ridge has three temporary streams running down it. At the base cattle pugging has turned these into bogs. Cattle tracking along the ridge has caused slight erosion.

Vegetation

Few areas in the ecological district still contain a full range of vegetation communities from dune lake communities to dry sand ridge ones and this RAP is one of the best examples. The dune lake has about 1ha of open water, with scattered Carex secta and areas of raupo. The western end is dominated by flax, with some toetoe and occasional cabbage trees reaching up to 6m. On drier ground on the south side are ngaio and mahoe with pohuehue and some bracken but also many weeds (thistles, grasses, gorse, inkweed and boxthorn).

On the north-east edges of the lake, at the base of the sand ridge, are a few kahikatea and pukatea. Below these, and in the boggy areas around the temporary streams are nikau palm, cabbage tree, Carex secta and dense colonies of Collospermum hastatum. The rest of the forested area is very diverse. On the lower part of the slope, titoki and karaka are the most common trees. Further up, tawa is more common, while near the top there are several rewarewa, and also some northern rata and kamahi. Mahoe occurs throughout. The tallest trees (kahikatea, rewarewa and kamahi) reach 12-15m but there is a great deal of variation in the canopy height, which ranges from 3m to 12m. Other common species are lancewood, ngaio, kaikomako, kohuhu, kawakawa, pate, Coprosma areolata, C. rhamnoides, hangehange, pohuehue, supplejack, Parsonsia heterophylla, wheki and mamaku. Northern rata, kamahi and the lawyer, Rubus squarrosus all found here, are rare in the ecological district.

There is evidence of occasional browsing by cattle, despite the area being fenced on three sides and awkward access at the unfenced top side. There are few weeds, other than gorse, which forms a protective band 5-20m wide along the top of the sand ridge. The pine plantation to the west provides shelter from the prevailing wind and so may create problems when the pines are eventually felled.

East of the RAP, on farmland, are several indigenous trees of the same species as found in the RAP, covering around 5ha. Two hundred metres to the south are trees of titoki, karaka and other indigenous species, though these are being overgrown by alders.

Selection Criteria

Representativeness:	H	Contains rare example of a whole range of communities which once covered much of the ecological district between Bulls and Turakina.
Diversity:	H	Excellent range of species and habitats.
Special Features:	H	Contains plant species rare in Ecological District. A range of bird habitats present.
Naturalness:	M	Low at edges but high through most of area. Some cattle damage to understorey of forest.
Viability:	H	Excellent if managed and top fenced. Slow deterioration otherwise. (Possum control vital for northern rata and kamahi).

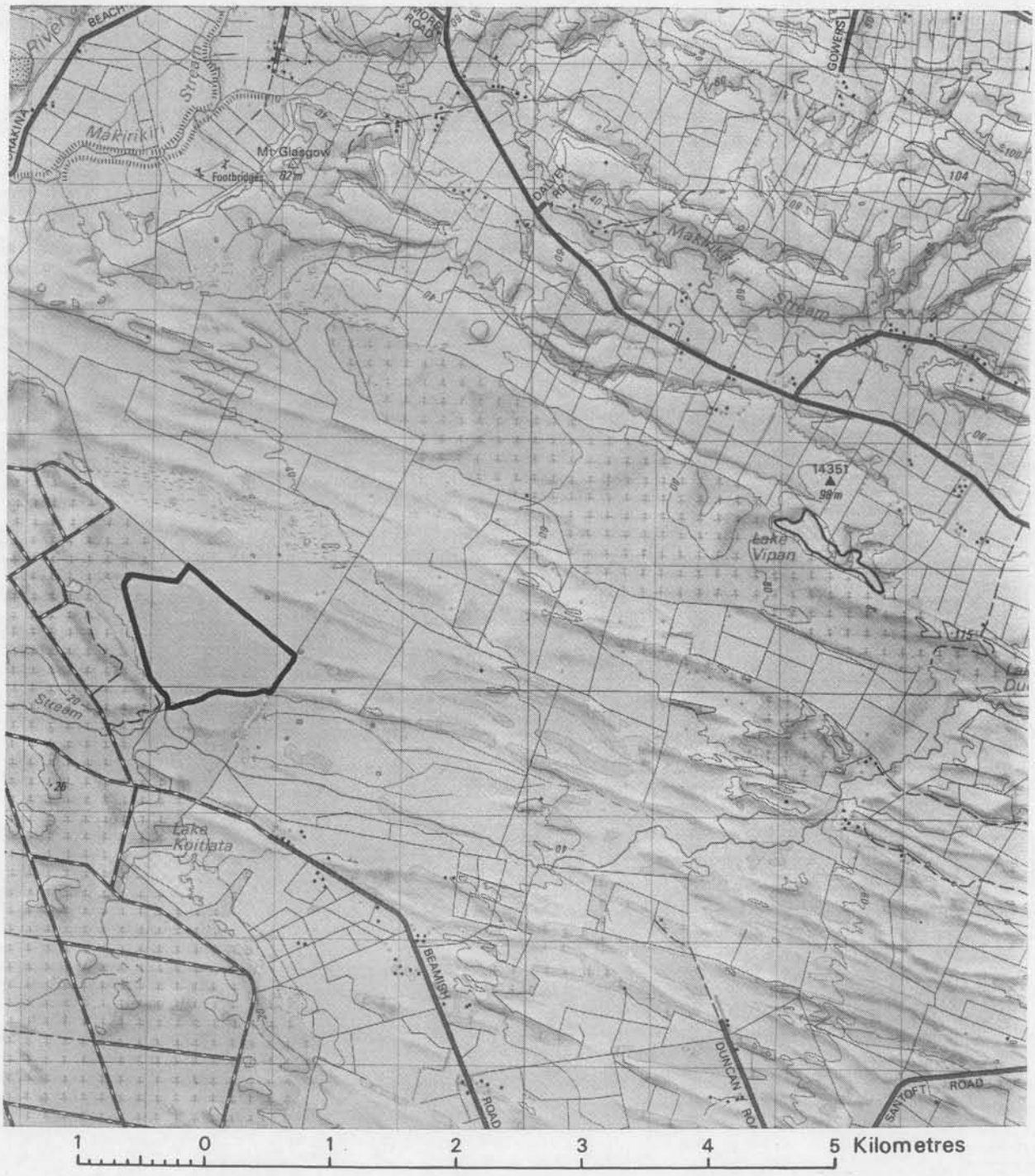
Size and Shape:	M	Roundish shape but may be too small to maintain present diversity.
Buffering:	H	Fencing, bulldozing and water depth protects lake. Gorse and fence provide some protection for forest. Pines provide wind shelter. Seed sources present nearby.

Comment

Though it would require a major fencing and replanting exercise there is potential to include the treeland area to the east of the RAP and so double the size of a protected natural area and considerably increase the long-term viability of the area.

Over half of the rata and kamahi trees were dead at the time of survey, most probably as a result of possum damage. Possum control must be a priority for this area.

RAP 33 Plains Farm Shrubland



Study Area: 208B
GR Centre: S23 973202
Area: 80ha
Survey Date: 19/11/91

RAP 33 PLAINS FARM SHRUBLAND

Ecological Unit

Coprosma propinqua - manuka shrubland on sandplain.

Landform

Geology: windblown sand
Soils: yellow-brown sands

The area covered by this RAP is on the western side of a sandplain which covers several hundred hectares. The sandplain is broken up by several low (up to 3m) sandridges, some of which extend into the RAP.

There are three small lakes in the west of the sandplain where it has been dammed by a line of parabolic dunes up to 10m high. Though none of these lakes is in the RAP, much of it is wet underfoot. Three streams (which feed into the Koitiaka Stream) drain Plains Farm shrubland and both of these has been opened up to increase drainage.

Cattle have pugged some of the shrubland edges and forced tracks through. Two sambar deer wallows were also noted.

Vegetation

Indigenous shrubs cover about three quarters of the RAP. Of these, Coprosma propinqua, mostly 2-3m high, is by far the most common, though manuka accounts for around 20% of the vegetative cover. Other common shrubs are Olearia solandri and O. virgata, while Coprosma rigida has also been recorded here (C Ogle 1987-1991). A single kahikatea of about 8m and several scattered cabbage trees of similar height overtop the shrubs. Cabbage trees are considerably more numerous amongst pasture west of the RAP. Under the shrubs, at least away from the edges are several sedges, including Baumea juncea, B. rubiginosa, Carex flagellifera, C. lessoniana, C. maorica and C. virgata, while C. secta and Cyperus ustulatus are common near the edges. Ferns, particularly swamp kiokio are also common. More open areas have some toetoe and flax.

The sandridges are mostly in pasture, though several young manuka, Olearia solandri and Coprosma propinqua plants were noted and there would be at least some regeneration in the absence of stock.

Stock and sambar deer have done considerable damage to the vegetation (particularly the few flax plants). However, if stock are removed gorse (which is already plentiful) and blackberry (which is still sparse) would spread more rapidly, meaning active management is necessary.

Special Features

Parts of this area may provide fernbird habitat. Several inanga were seen in the streams.

Selection Criteria

Representativeness:	H	Represents an ecological unit which once would have extended over several hundred hectares in this part of the ecological district.
Diversity:	H	Only moderate diversity, especially for a relatively large area.
Special Features:	M	Inanga habitat. May contain fernbirds.
Naturalness:	M	Some parts very natural but most disturbed by introduced mammals or invaded by weeds or pasture.
Viability:	M	Slow deterioration could be stemmed with active management.
Size and Shape:	H	Relatively large, with a broad oval shape.
Buffering:	L	Poor, only buffered by density of vegetation, including gorse fringes.

Comment

If protected, this RAP would greatly increase the value of the nearby Tunnel Hill Timberlands Covenant.

RAP 34 Lakes Vipan and Karamu

Study Area:	204 and 206
GR Centre:	S23 025211
Area:	15 ha
Survey Date:	15/2/89

RAP 34 LAKES VIPAN AND KARAMU

Ecological Units

1. flax-raupo-Coprosma tenuicaulis flaxland on dune lake.
2. raupo reedland on dune lake.

Landform

Geology: windblown sand; loess
Soils: recent soils; yellow-brown sands; yellow-grey earths

Though Lake Vipan (to the west) and Lake Karamu (to the east) appear on a map or aerial photos as two separate bodies of water they are really one lake divided by a band of raupo. The lake has been formed by a sand ridge along the south-west damming downland on the north-east, forming a long, narrow (1km by 30-200m) lake with three shallow arms on its eastern side which total about 4ha. The lake is almost pinched in two in the middle by a spur which is separated from the sand ridge by only 30m. Here the water is shallow and has emergent vegetation, giving the appearance of two lakes.

The landform on the downland side has been modified by ploughing and on the sand ridge side by pine foresty and associated tracking. There is no evidence of artificial drainage. There are localised areas which have been pugged by stock.

Vegetation

Lake Vipan has little indigenous vegetation on its edges, with pasture, cropping land and pine forestry reaching to the lake edge over half its perimeter. In the west are two small patches of raupo and on the north some scattered rushes (Juncus sp.). It is where Lake Vipan meets Lake Karamu and in the arms of Lake Karamu that the areas of high naturalness are found.

The vegetation emerging from the shallow (0.5m) water where the two lakes meet is mostly raupo, reaching about 3m above the lake surface. Occasional cabbage trees reach up to 8-10m. There is also some flax and Juncus pallidus is common at the edges. Other indigenous plants noted were Carex secta, Coprosma rigida, C. tenuicaulis and bracken, with duckweed and Pacific azolla on the water surface. Many weeds were recorded in the sample site, but these were on the dry edges where stock have had access in the past.

The arms of Lake Karamu have a vegetation type which is rare in the ecological district. Flax and raupo are dominant, with Coprosma tenuicaulis being nearly as common. These plants are mostly 2-3m tall though the few cabbage trees present rise to 5 m. Toetoe and Carex secta are common and some Coprosma propinqua x C. robusta, pohuehue, sharp spike sedge, bracken and swamp kiokio are also present. There are a few weeds, mainly confined to the edges (beggar's ticks, redroot, forget-me-not, celery-leaved buttercup and jointed rush), though bittersweet scrambles well into the indigenous vegetation. There are also stands of crack willow in both lakes which, though not numerous, are clearly spreading.

The quality of vegetation varies considerably depending on stock pressure. Some parts are fenced but stock have access at several points. Nowhere have they penetrated far, because the high water level and dense vegetation act as a natural barrier.

Special Features

This RAP provides habitat for large numbers waterfowl.

Selection Criteria

Representativeness:	H	Good example of wetland associated with a chain of lakes which are now mostly highly modified.
Diversity:	M	Good diversity of wetland vegetation communities but no "dry" vegetation present.
Special Features:	H	Rare ecological unit present. Excellent bird habitat.
Naturalness:	M	High where protected from stock. Low elsewhere.
Viability:	H	Better still if willows controlled.
Size and Shape:	M	Good size but "fingers" not an ideal shape.
Buffering:	M	Partially fenced. Protected by wetness and density. No close seed sources.

RAP 35 Koitiata Recreation Reserve

Study Area:	210
GR Centre:	S23 928230
Area:	70 ha
Survey Date:	29/11/89

RAP 35 KOITIATA RECREATION RESERVE

Ecological Units

1. (flax)-(Olearia solandri)/jointed wire-rush rushland on sand plain.
2. (three-square)/glasswort herbfield on tidal flat.
3. bachelor's button herbfield on tidal flat.

Landform

Geology: windblown sand
Soils: yellow-brown sands; recent soils

Koitiata Recreation Reserve extends approximately 1.5km south-east from Koitiata township, by the Turakina River and is about 400m across. The RAP also includes 10ha of tidal flat on the north-west which is outside the recreation reserve.

Study of aerial photos shows that the river mouth is moving south along the coast at a rate of hundreds of metres per year. As it does so, it is eroding a foredune which was once the seaward side of the recreation reserve (the river now extends along the entire south-west boundary) and a sand spit is extending along the true right bank of the river.

The foredunes are low (6m) and rounded in shape and extend inland for 50-100m. A sandplain behind extends inland to the boundary of the RAP (defined artificially in the north-east and south-east by pine forestry). In the north-west there is no foredune for 500m. In this area tidal flats bound the sand plain.

Deep (1-2m) drains run along the centre of the sand plain. The plain is very dry (even the drains were dry at the time of survey). The vegetation present suggests this would once have been a much wetter area but it is hard to tell if the current dry state is the result of the drains or natural processes (such as erosion of the foredune). Vehicle tracks exist in the area but have not led to any serious erosion.

Vegetation

Koitiata Recreation Reserve is an area with varying degrees of naturalness over different parts, mainly due to the distribution of weeds, but it nevertheless retains a good diversity of representative coastal and estuarine vegetation.

There are two distinct vegetation communities on the tidal flats. Muddy areas which are regularly submerged have populations of bachelor's button and some Limosella lineata. Higher, drier and sandier areas which would only be submerged at spring tides or floods are fringed with three-square and contain mainly glasswort, with some shore primrose and halfstar. These areas are separated by low (less than 1m) sand mounds covered mainly in marram and flat weeds.

The fore dune area is dominated by spinifex on the river side and spinifex and marram on the inland side. Pingao is very common (the area has been recommended as a pingao reserve by the Paneke Conservation Team (1989)) and the inland side also has plentiful club sedge and tauhinu.

Jointed wire-rush is the most common plant on the sandplain. In the southern 15ha is also much flax and Olearia solandri (under 1.5m), with few cabbage trees, scattered manuka and club sedge, a community which is not found elsewhere in the ecological district though it may well have covered much of what is now Santoft Forest. Further north there are fewer shrubs, more marram and much tall fescue. Toetoe is never plentiful, but occurs over most of the sandplain.

Druce (unpublished, b) recorded the endangered herb Sebaea ovata here in 1967, though no areas remain where it is still likely to occur. He also recorded the unusual form of Pimelea (dubbed P. "Himatangi for this report) which now only occurs in the Foxtangi dunes.

This RAP contains several weeds, as well as those already mentioned. In the middle of the sand plain is 2ha of silver poplars and boxthorn occurs in several places. Boneseed occurs throughout and appears to be spreading (pers. obs. 1989-1991). Another plant which appear to be spreading rapidly and may have serious consequences is pyp grass. This aggressive plant has formed a dense mat over around 1ha of the dune area (there is also another, larger population 1km away in Santoft Forest) and is smothering not only indigenous species but also marram and boxthorn (up to 2 m!). It has not been recorded elsewhere in New Zealand.

Selection Criteria

Representativeness:	M	Good example of a range of once common communities but value lowered by weed influence.
Diversity:	H	Good range of communities present.

Special Features:	H	High value for birds (fernbirds and waders). The endangered plant, Sebaea ovata was found here in 1967 (A P Druce, unpublished, b).
Naturalness:	M	Highly variable - poor to excellent. Weeds a problem.
Viability:	M	Slowly deteriorating but would improve with weed control.
Size and Shape:	H	Relatively narrow but large, with simple boundaries.
Buffering:	H	Forest, river and urban boundaries protect from stock. Sufficient area to maintain diversity even with weed invasions.
Other:		High scenic and recreational value.

Comment

As the name implies, Koitiata Recreation Reserve is already a legally protected area (vested in the Rangitikei District Council). However, management has not been to maintain or enhance natural values so this area (and the adjoining tidal flats) have been recommended for protection in order that a re-emphasis of management goals may occur.

References: C C Ogle (1989)
Paneke Conservation Team (1989)
A P Druce (b)

RAP 36 Turakina Estuary Spit

Study Area: D4
GR Centre: S23 924230
Area: 8 ha
Survey Date: 2/2/89

RAP 36 TURAKINA ESTUARY SPIT

Ecological Unit

(pingao)-(spinifex) sandfield on incipient foredune.

Landform

Geology: windblown sand
Soils: little soil development

The spit follows the true right bank of the Turakina River from opposite Koitiata township south-east for approximately 2km. It averages 40m across. The spit is covered in driftwood, which has caused small incipient foredunes to form. The north-west third of the spit is vegetated, and here the incipient foredunes rise to a height of 1.5m and are smooth in outline, though there is still driftwood present. The south-west side is bounded by ocean beach and the north-west side by tidal flat and river channel.

Vegetation

Less than 10% of the area has live vegetation. Pingao is the most numerous species occurring over small areas of up to 100m^2. There are also slightly smaller amounts of spinifex and some marram, though the marram could be controlled with very little effort. The estuarine edges have a few plants of bachelor's button.

On the very north-west edge of the spit pingao is grazed by cattle.

Selection Criteria

Representativeness:	H	Never common but this ecological unit would have occurred temporarily at several estuaries in the ED.
Diversity:	L	One vegetation/land form pattern. Four plant species.
Special Features:	H	Pingao dominant vegetation now very rare in ED.
Naturalness:	H	Only spoiled by small amount of marram.
Viability:	H	High, but much could disappear in a flood.

Size and Shape:	M	Long thin, moderate size. Shape dictated by physical processes.
Buffering:	H	Location and coastal processes ensure natural state will remain.

RAP 37 Whangaehu-Turakina Swamp

Study Area: D4 ii
GR Centre: S23 907258
Area: 100 ha
Survey Date: 2/2/89

RAP 37 WHANGAEHU-TURAKINA SWAMP

Ecological Unit

jointed wire-rush rushland on sandplain.

Landform

Geology: windblown sand
Soils: yellow-brown sands; recent soils

This RAP is a long (up to 2km) wetland which covers a sandplain behind the foredune over most of the coast between the Whangaehu and Turakina Rivers. It extends inland for about 0.5km, ending at some low parabolic dunes and running in a north-west to south-east direction.

The area was surveyed in mid-summer and was mostly dry, with some mud but little open water though it appeared (from stains on fence posts, etc) that it would be considerably wetter over much of the year. There was no sign of artificial drainage.

A raised vehicle track bisects the wetland, running in a north-east to south-west direction. Near this track is some heavy cattle pugging but this affects only a very small part of the total area.

Vegetation

Jointed wire-rush, mostly around 1m tall, is dominant over the whole RAP. Toetoe, manuka and Muehlenbeckia complexa also occur over the whole area. The tallest plants are the very occasional cabbage trees, which only reached 4m in the sample site (in the centre of the RAP). Flax occurs in localised areas as does three-square. Sea rush is present on the seaward side and sand coprosma occurs on low sand hummocks near the fore dune. The only low stature (less than 30cm) plants recorded in any number were Schoenus nitens and bidibidi.

Unlike many other areas in the ecological district dominated by jointed wire-rush there is still very little tall fescue present. Round the edges and where cattle have access there are flatweeds and several legumes such as lotus and black medick with jointed rush where pugging has been heavy.

In the north-west the vegetation gives way to marram and boxthorn with bare sand areas. The south-west is similar but there is less boxthorn and more bare sand. The inland edge borders pine forest and pasture and the fore dune side has much bare sand with some spinifex, marram and Carex pumila. The area is mostly fenced but this appears to be used to keep stock in, rather than to exclude them.

Special Features

Fernbirds are present in this area. The only known population of a New Zealand fathen relative, Chenopodium glaucum, in the ecological district is found here (Colin Ogle, pers. comm.).

Selection Criteria

Representativeness:	H	Though several similar areas exist in the ecological district this area best represents the original condition.
Diversity:	L	Unusually uniform for such a large area.
Special Features:	M	Contains populations of fernbirds and Chenopodium glaucum.
Naturalness:	H	Poor near edges and track but high elsewhere.
Viability:	M	Deteriorating, but stock control could reverse this.
Size and Shape:	H	Very large, rectangular area.
Buffering:	M	Some fencing. Buffered best by sheer size.

References DOC Files (fernbird report).

RAP 38 Whangaehu Estuary

Study Area:	D4 v and vi
GR Centre:	S23 893275
Area:	5 ha
Survey Date:	2/2/89

RAP 38 WHANGAEHU ESTUARY

Ecological Units

1. three-square sedgeland on tidal flat
2. Triglochin striatum - Lilaeopsis novae-zelandiae herbfield on tidal flat.

Landform

Geology: windblown sand; estuarine muds, silts and clays
Soils: yellow-brown sands; recent soils; saline soils

The mouth of the Whangaehu river has been pinched into a narrow channel by a spit on the southern side. Behind this spit the river widens to 300m, most of which is tidal flat on the southern (true left) bank which extends upstream for about 600m. At low tide there is deep, soft mud nearer the river which changes to harder sand in the south of the RAP. Receding tides have cut channels up to 1m wide and 50cm deep through the east of the flats.

A small amount of stock pugging was noted. Recreational vehicles use the area but, despite many tracks, they have not damaged the landform. A formed road follows the southern edge of the RAP.

Vegetation

Over three quarters of the estuary is bare sand or mud. Only in the east was indigenous vegetation noted, though with sand movement and floods, conditions would allow the vegetation to spread or cause it to recede over time.

By the road there is a band of raupo, a few metres wide, which gives way to a hectare or so of three-square (mostly over 1m tall). Also common here are Schoenoplectus validus, Bolboschoenus caldwellii, sea rush and Triglochin striatum. Sharp spike sedge, Leptinella dioica subsp. dioica, Baumea rubiginosa and bachelor's button were also noted.

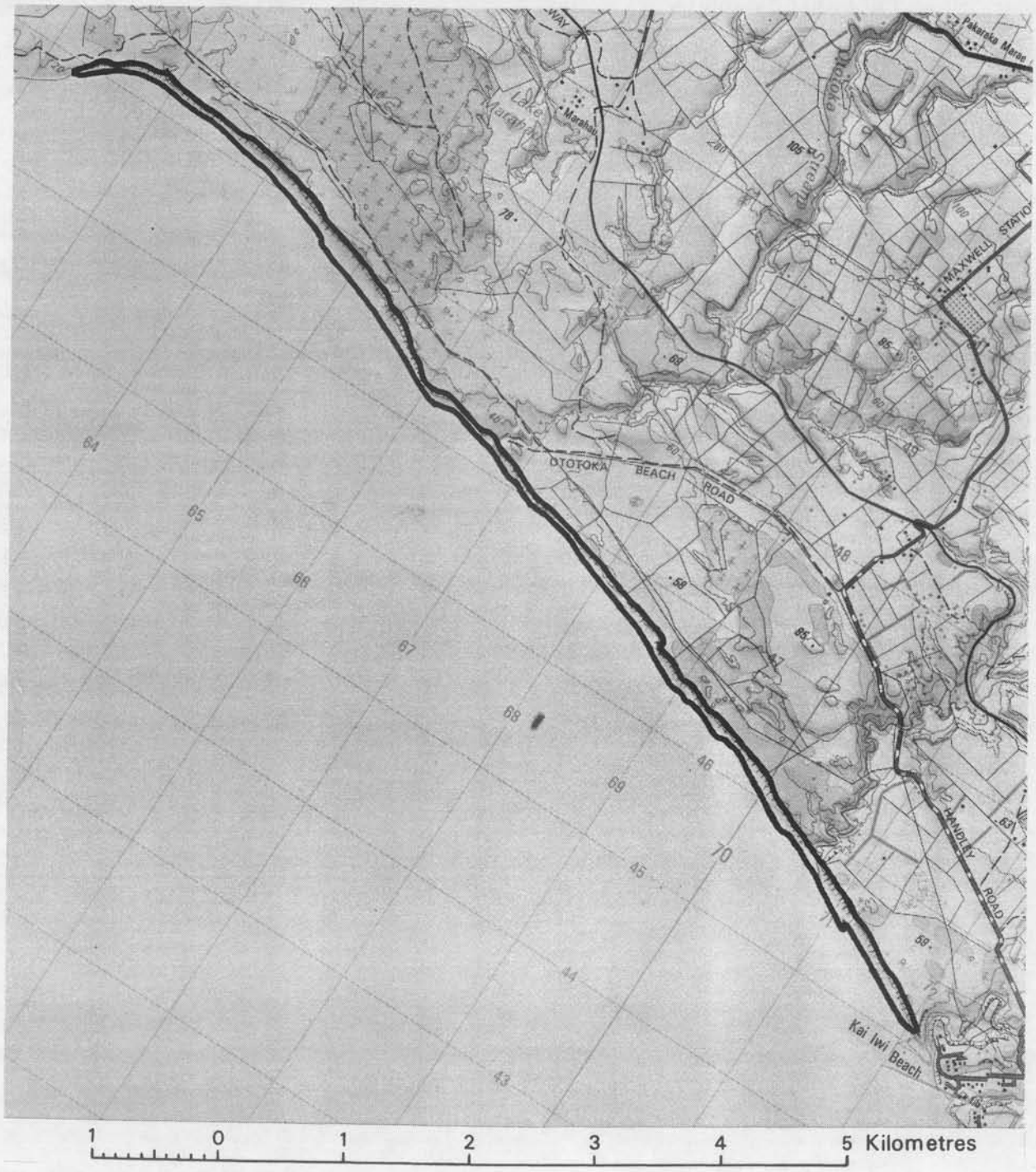
Further from the road, the three-square is lower (< 1m) and sparser and there are more herbs. Most common of these are Triglochin striatum and Lilaeopsis novae-zelandiae (under 10cm and 3cm respectively) though Isolepis cernua and Leptinella dioica subsp. dioica are also common. Bachelor's button and Limosella lineata were also recorded.

Few weeds were recorded and these were exotic grasses only at the edges, near the road. Some trampling and grazing by sheep and rabbits was noted, as was slight damage by recreational vehicles but neither problem appears serious.

Selection Criteria

Representativeness:	H	Would be very close to original condition, though always very restricted in area.
Diversity:	M	Slight variation in composition related to water salinity and time spent submerged each tide.
Special Features:	H	Some value as wading bird habitat.
Naturalness:	H	Only modified at edges.
Viability:	H	Could last indefinitely, though the river course could change.
Size and Shape:	M	Moderate size, semi-circular but only 1ha or so in vegetation.
Buffering:	M	Naturally buffered by tides, salinity and wind-blown sand. Fenced, though sheep still gain access.

RAP 39 Kaiiwi-Waiinu Cliffs



Study Area:	W12
GR Centre:	R22 660473
Area:	100 ha
Survey Date:	3/10/90 and 27/1/91

RAP 39 KAIIWI-WAIINU CLIFFS

Ecological Unit

1. flax flaxland on cliff face.
2. raupo reedland on cliff face.
3. raup reedland on swale.
4. (toetoe)-(raupo)/Cyperus ustulatus sedgeland on slump ledge.
5. half-star-(Lobelia anceps) herbfield on cliff face.
6. glasswort - NZ iceplant herbfield on cliff edge.

Landform

Geology: massive sandstone, mudstone or siltstone
Soils: steepland soils related to yellow-brown earths; bare rock

The RAP includes a series of 30-50m high, coastal cliffs of the Rapanui Terrace running from eroding dunes 3km east of Waiinu Beach south-east to the Kaiiwi Estuary from where the cliffs continue again beyond the RAP to Castlecliff. These cliffs are broken by the narrow gorges of the Ototoka and Okehu Stream mouths and the wider valleys of the Kaiiwi and Mowhanau streams to the south-east of the RAP. Otherwise they are continuous. Several seepages form small wetland habitats on the near vertical faces. Occasional slumps have occurred, most only a few square metres, but one is up to 0.25ha. The surfaces of these are very boggy.

The coast is prograding at the base of the cliffs and has formed a low (less than 3m) foredune with a series of swamps in the swale behind. This mini-dune system is not continuous and reaches out up to 15m from the cliff base.

These cliffs are rich in fossils, particularly around the Okehu Stream mouth.

Vegetation

As much as half of this RAP is covered by exotic vegetation, mainly grasses, which have become established where there is sufficient soil, particularly nearer the tops of the cliffs. However there are several communities present which are primarily indigenous.

The most visually striking of these is the flaxland growing on the cliff face. These areas are steep and virtually inaccessible so were not surveyed in detail but they total several ha. They also contain large populations of kiokio which are dominant over small areas (up to 100 m^2).

Most of the swale area, where it exists, is covered by exotics such as marram and boxthorn, but there are places where raupo is plentiful, along with low trees of mahoe and karamu and some sand coprosma. North of Ototoka, the raupo continues up the cliffs, forming the unusual ecological unit of raupo reedland on cliff face!

Raupo also occurs on the slumps, which trap seeping water from the cliff faces and consequently are very wet. One kilometre north of the Okehu Stream mouth is the large slump mentioned before. The most common species here is Cyperus ustulatus, with toetoe and raupo on the wetter parts. The few drier areas have a cover mainly of Muehlenbeckia complexa.

The least-modified communities in this cliff area occur on the wet, near-vertical seepages where there is no talus material, and around the stream mouths. Some plants here are similar to those found in sandy estuaries, with shore primrose, glasswort and halfstar being most common. Cliff epilobium is also common. Other plants noted here include native puha, Epilobium nerteroides, Lagenifera pumila, Plantago raoulii, Lachnagrostis filiformis, Limosella lineata and the rare cotula, Leptinella dispersa subsp. rupestris (of which at least three populations occur in the RAP). The Okehu stream mouth also has the only known population of Gnaphalium polylepis in the ecological district.

At Snapper Rock, in the west of the RAP, indigenous herbs occupy sandy shelves in the limestone (shell-rock) cliff faces. The most common plants are glasswort and NZ iceplant. Also common are shore primrose, sea celery, Lobelia anceps, halfstar and Schoenus nitens.

Where the cliffs end in the west the dunes have rough pasture with much marram and club sedge on top, but some natural areas of spinifex and sand convolvulus on the seaward face.

Special Features

This area is part of NZ's most complete sequence of uplifted marine terraces and is rated in the New Zealand Geopreservation Inventory as of international importance.

This RAP contains at least three populations of the rare button daisy, Leptinella dispersa subsp. rupestris. It also has the only known population of the minute cudweed, Gnaphalium polylepis in the ecological district (only two lowland populations of this plant are known in the North Island).

Selection Criteria

Representativeness:	H	Despite moderate naturalness there is a good representative range of original cliff communities.
Diversity:	H	Large range of communities and habitats.
Special Features:	H	Presence of rare plants. Geologically important.
Naturalness:	M	Locally high but much has low naturalness.
Viability:	H	Natural values should continue indefinitely.
Size and Shape:	M	Large area, but very narrow. Length of area important.
Buffering:	H	Steepness precludes stock damage. Continual process of erosion, coupled with seepage and salt air provide conditions which buffer well against weeds over much of the area.
Other:		High aesthetic and landscape value.

Comment

Parts of this RAP are presently recreation reserve. However, this does not necessarily protect natural values.

References C A Fleming (1953)

RAP 40 Nukumaru Beach

Study Area:	245 (part of)
GR Centre:	R22 565475
Area:	133 ha
Survey Date:	11/10/90

RAP 40 NUKUMARU BEACH

Ecological Units

1. tauhinu shrubland on swale.
2. tauhinu shrubland on relict foredune.
3. pingao sedgeland on foredune.
4. spinifex grassland on foredune.
5. NZ iceplant - glasswort herbfield on marine terrace remnant.

Landform

Geology: windblown sand
Soils: recent soil

Fleming (1953), identifies a low promontory south-east of the Waitotara River as shell-limestone. This "has been subjected to severe wind deflation and stripped of its former cover of Rapanui beds". This process has resulted in a number of outcrops, remnants of this promontory, along the coast between the Waitotara River mouth and Waiinu Beach, with reefs running out to the sea from them and sandy bays in between.

The area contains a very dynamic dune system, with areas of bare sand covering up to a hectare and smaller areas of lag gravel. Immediately south-east of the Waitotara River the sand is aggrading but relatively stable. The immediate foredune is formed of low (4-5m), rounded spinifex-type dunes, backed by steeper, higher (5-10m) marram-type dunes. Further to the south-east, between the outcrops, low (3-4m) pingao-type dunes cover the 20-50m nearer the beach, rising to a complex of highly eroded, steep marram-type dunes and mobile bare sand dunes rising up to 10m. These dunes are backed by ephemeral wetland areas on sand plains with occasional, older, stabilised dunes, some of which are eroding through stock damage. Nearer Waiinu there is a rocky beach with low (3 m), eroding dunes on the sea edge backed by older, stablised dunes.

This area is famous for its ventifact beds and part of it is reserved for their protection. Most have now been disturbed by fossickers, stock and recreational vehicles. Stock pressure may also have added to the instability of the sand dunes in other parts of the RAP, as stock have had free access over much of this coast. There are recreational vehicle tracks for the whole length of the RAP, but these are mostly restricted to an access path and appear to have contributed little to the instability.

Vegetation

There are two distinct vegetation types in this RAP, one associated with the dunes and one with the outcrops. Consequently the plant communities alternate along the coast.

The foredune near the Waitotara River is covered almost entirely in spinifex. Behind this foredune, in a swale and on relict fore dunes, is a tauhinu shrubland. Though the tauhinu is plentiful and tall (reaching 1.5m), the ground cover is entirely exotic (marram with some flatweeds). Further inland, the vegetation further deteriorates to gorse and rank pasture.

A kilometre to the south-east, the vegetation changes. The crest of the foredune is marram-covered, though blow-outs are numerous. The area from the beach to the crest of the foredune contains the largest and least damaged population of pingao in the ecological district. (The Nukumaru Recreation Reserve Draft Management Plan (1986) identifies the best areas of pingao as being near the Waitotara River and 2 km inland from where it is now most numerous. This highlights the need to include as large an area as possible in PNAs with active dunes and their associated communities).

About half way to Waiinu, spinifex and pingao together cover a more stable foredune and marram is only common further inland. The foredune here also has some sand convolvulus in places. Further east, near Waiinu and beyond the RAP, marram becomes dominant over the entire foredune, with some club sedge and many exotic pasture species almost to the beach.

The vegetation on the outcrops is completely different and it is this contrast, along with the striking pingao areas, which gives the area such a high scenic value. The only common plants on these outcrops are NZ iceplant and glasswort, both under 10cm in height and covering about 50% of the substrate. The only other plants noted were some very prostrate boxthorn (under 20cm) and hawkbit though a prostrate form of sand coprosma (which retains this form under cultivation) has also been found here (Colin Ogle, pers. comm.). The zone between rocky outcrops and sand dunes has spinifex, pingao, marram and some evening primrose.

Inland from the foredune area, 0.5-2km from the Waitotara River, the wetland areas have a large component of jointed wire-rush but are now dominated by exotics, mainly hare's tail and King Island melilot in the drier places and jointed rush where it is wetter. Sandy areas of up to 0.25ha have Carex pumila over Limosella lineata. Some other small stature sedges and herbs occur but natural values overall are very low. Only part of these wetlands are in the RAP and their main value is a buffer area.

Selection Criteria

Representativeness:	H	One of the best representative examples of pingao-dominated foredunes (few left in the ecological district).
Diversity:	M	Low for size of RAP but there are different foredune communities and the promontory community.
Special Features:	H	Ventifacts, excellent pingao population.
Naturalness:	M	Varies from poor to very high.
Viability:	H	Could be improved further with weed and stock control.
Size and Shape:	H	A large natural area for the ecological district. Relatively long and narrow but shape is dictated by nature of the area.
Buffering:	M	Well buffered by natural coastal processes, but there is little protection inland from stock and weeds.
Other:		Very high scenic value, high recreational value.

Comment

This RAP is section 98 of Nukumaru Recreation Reserve and therefore a protected natural area already. However, it is managed primarily for recreational, rather than conservation, purposes and so has been included as an RAP.

References C A Fleming (1953).
Nukumaru Recreation Reserve Draft Management Plan (1986).

RAP 41 Waverley Beach

Study Area: W6
GR Centre: R22 505511
Area: 10 ha
Survey Date: 15/11/90

RAP 41 WAVERLEY BEACH

Ecological Units

1. Zoysia minima grassland on cliff edge.
2. Zoysia minima - halfstar grassland on cliff edge.
3. glasswort - NZ iceplant herbfield on cliff edge.
4. Lilaeopsis novae-zelandiae - Triglochin striatum - halfstar herbfield on cliff edge.
5. shore primrose - Isolepis cernua herbfield on cliff edge.
6. glasswort herbfield on cliff edge.

NOTE: each "unit" may only cover a few m^2 and is too small to map. The units have been separated to allow better comparison with similar areas.

Landform

Geology: windblown sand; massive sandstone, mudstone or siltstone
Soils: recent soils; bare rock

The RAP covers the tops and faces of a cliff, 13m high, above Waverley Beach and extending 1km east along the coast. This cliff is described by Fleming (1953): "the cliff is cut in sand, silt and shellbeds of the Whenuakura Group, unconformably overlain by beds on the Pouakai Group". Wave erosion has carved a series of caverns and gulches in this cliff leaving 11 small peninsulas projecting 5-15m into the sea (at high tide) and an "island" at Waverley Beach, accessable at low tide. Two slumps, a few metres inland from the cliff edges, have formed tunnels which open right down to the sea.

Erosion at the edges of the cliffs has formed a number of small platforms from 5-100 square metres in extent. Some are bare rock, others covered in sand. Some of these are quite wet because of several seepages. Only occasionally does topsoil persist to the cliff edge. The high winds and proximity of the sea mean that the cliff edges are often subjected to salt spray.

Sheep have access to the cliff edges and have formed tracks in places. Otherwise they contribute little erosion. The area is continually being eroded by wind and wave action.

Vegetation

Considering that the land above the cliffs is farmed and stock graze to the cliff edge, the vegetation is surprisingly natural. There are large, local variations in vegetation composition, depending on wetness, substrate and fertility.

Bare, dry areas, mainly on the tops, are covered in the minute mat-forming grass, Zoysia minima with some Colobanthus muelleri. Damper patches also have plentiful halfstar. These Zoysia mats are the most extensive in the ecological district. They contain a thriving population of the rare succulent, Crassula manaia, at the southern limit of its known range.

Faces exposed to the full blast of salt spray (most of the RAP, in fact) have a dominant cover of glasswort and often also NZ iceplant. These areas frequently also have taupata, growing to less than a metre, and may also contain halfstar and Isolepis cernua. Ledges among these areas, particularly where there are seepages, are covered with shore primrose and Isolepis cernua.

Very wet seepages, particularly where there is some shelter from salt spray, have dense populations of Lilaeopsis novae-zelandiae, up to 12cm tall with Triglochin striatum being plentiful. There is usually some half star, shore primrose and Isolepis cernua, and Schoenus nitens may also be present.

There are other plant communities present though these are less extensive. In the east of the RAP is a few square metres of jointed wire-rush. Flax grows in at least three places. Amongst the pasture at the top of the cliff are Cyperus ustulatus, Juncus pallidus and Juncus australis. Dry sandy areas are scattered throughout the higher parts and have marram and club sedge.

One patch of Leptinella squalida (a rare plant in the ecological district) is known, and L. dispersa subsp. rupestris (a nationally threatened taxon) occurs in sand on wet cliff ledges.

There are few problem weeds in the RAP. A few boxthorn plants have established but are unlikely to spread further. Clover, along with some Yorkshire fog, occur on the inland edges of the Zoysia mats and may have already reduced the extent of these mats. Sheep have done a limited amount of damage by trampling some of the Zoysia.

Special Features

This RAP contains the largest population of the rare succulent Crassula manaia in the ecological district.

Selection Criteria

Representativeness:	H	Excellent example of cliff communities.
Diversity:	H	Large range of species and communities.

Special Features:	H	Best population of Crassula manaia in the ED.
Naturalness:	H	Very high except on top edges.
Viability:	H	Better if tops fenced from stock.
Size and Shape:	M	Shape dictated by cliffs. Moderate size.
Buffering:	M	Well-buffered by effect of wind, waves and salt air on adventive species but needs a fence at the top.
Other:		Waverley Beach is used for swimming and fishing. High scenic value.

References: C A Fleming (1953).

RAP 42 Lake Waikato Island

Study Area:	250
GR Centre:	R22 629514
Area:	0.25 ha
Survey Date:	9/10/90

RAP 42 LAKE WAIKATO ISLAND

Ecological Unit

karaka forest on island.

Landform

Geology: tephra formations in Taranaki loess
Soils: yellow-brown loams; granular loams

Lake Waikato was formed by parabolic dunes damming runoff from downland on the northern boundary of the ED. The main body of water is 500m long, lying north-northeast to south-southwest. Just north of the mid-point there is a shallower arm extending 250 m to the east. The island is situated at the junction of this arm and the main body of the lake, where a shallow spur is submerged and only part of the crest emerges.

Lake levels appeared particularly high at the time of survey. However, it is unlikely that the island would be connected to the shore even at times of low water levels. There is 50m of water between the island and the shore on the north and south sides.

The island is slightly oval, lying in a north-south direction. The west rises more steeply than the east (20° opposed to 10°) and the island is flat topped and rounded at the edges. The highest point was estimated at 4-5m above the lake surface level.

Vegetation

Most of Lake Waikato is open water, with pasture to the edges (pine forest in the south-east) and consequently has little natural value. There is an unusual vegetation type of bamboo spike sedge (indigenous) over water lily (exotic) covering over one hectare of the shallow arm, with some sharp spike sedge and raupo, though cattle graze this heavily round the lake edges.

In contrast, the vegetation on the island appears very natural, though it was only surveyed from the lake edges using binoculars. The island is covered by dense forest about 5-7m high. 80% of this forest cover was estimated to be in karaka. Other indigenous species noted were ngaio, cabbage trees, karamu, kawakawa and rangiora. The only exotic plants noted were a grove of willows (probably crack willows), on the north-east side. These have the potential to spread around the circumference of the island, if not controlled.

Ground cover and species away from the edges were not surveyed. The inaccessability which caused this is the main reason for the apparent high quality of the vegetation. Stock cannot gain access, and other than willows there did not appear to be any problem weeds.

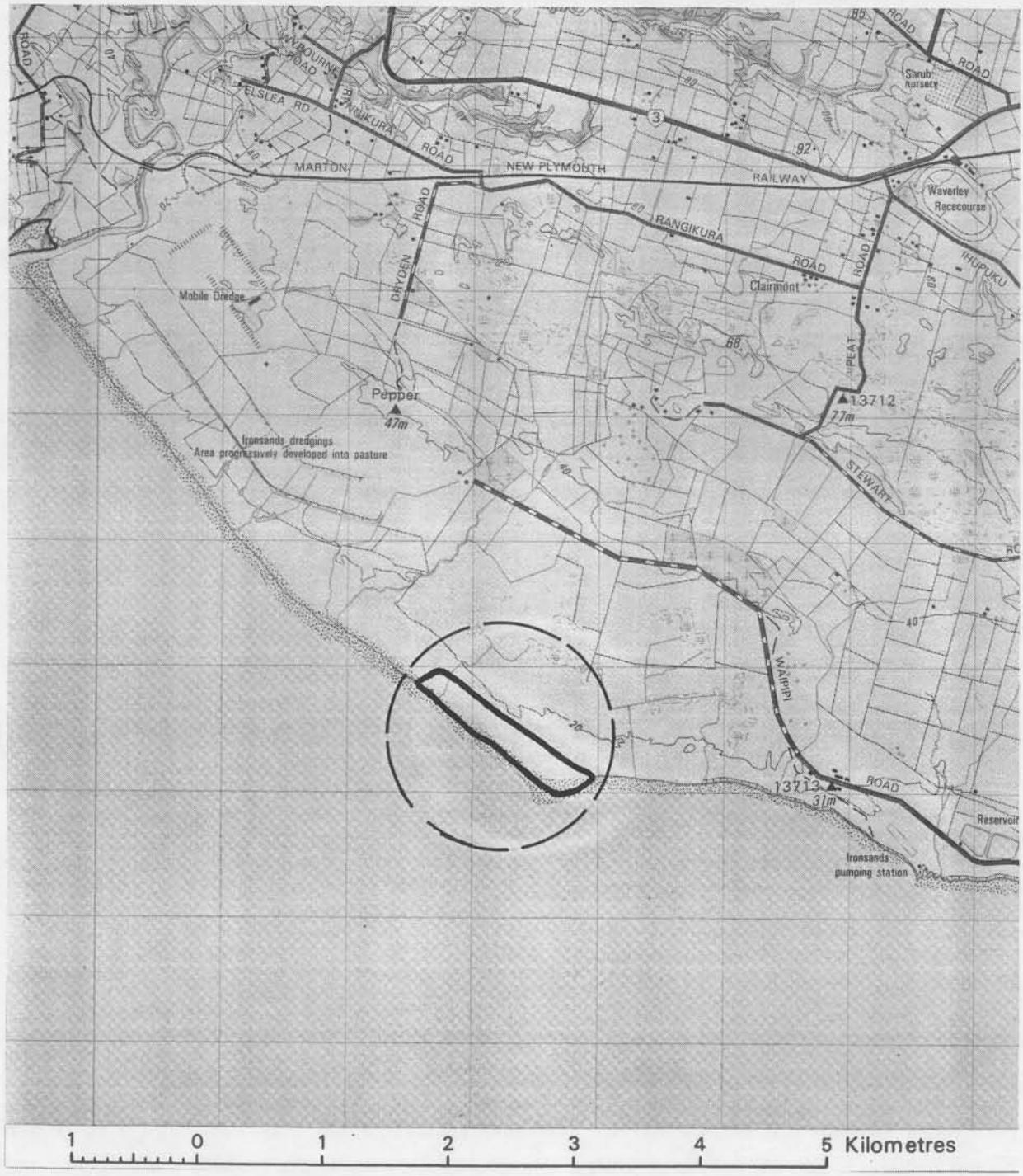
Selection Criteria

Representativeness:	H	See comment below.
Diversity:	L	Mostly in one species (karaka).
Special Features:	M	Very few dune lake islands exist in the ecological district.
Naturalness:	H	High on island, but low in surrounding lake.
Viability:	H	Lowered slightly by willows.
Buffering:	H	Well buffered by "moat" effect.
Other:		Lake has recreational value (duck hunting, boating).

Comment

It is possible that karaka were originally planted on the island in pre-European times by Maori. Such karaka groves are part of the New Zealand heritage and are now rare in the ecological district hence the inclusion of an "artificial" area as an RAP.

RAP 43 Waipipi Dunes



Study Area:	Y14
GR Centre:	Q22 434533
Area:	40 ha
Survey Date:	14/11/90

RAP 43 WAIPIPI DUNES

Ecological Units

1. pingao sedgeland on foredune.
2. Carex pumila/Lilaeopsis novae-zelandiae herbfield on swale.

Landform

Geology: windblown sand
Soils: recent soils

Waipipi dunes comprise a highly dynamic complex of low (less than 4m) dunes and small, wet sand flats and depressions running 1.5km north-west from Waipipi Point and extending inland 200-300km to taller (15m), more stable relict foredunes. Though it is an intricate complex, there is an overall pattern, with most of the dunes being concentrated in the strip from the coast inland for 50-100m, together forming the equivalent of a fore dune, while the series of connected sand flats together form a swale area.

Unlike otherwise similar dune areas elsewhere in the ecological district, water flows (albeit slowly) across these wetlands, in a north-west to south-east direction. As a result, the sand flats and depressions form a series of steps, averaging around 5 x 10m. There are low hummocks and occasional dunes partly separating these wet areas so that the overall water course is very meandering. In places, water was over 0.5m deep at the time of survey which suggests some places have permanent water.

Most of the water flows out to the sea at Waipipi Point, where it appears that temporary, shallow lagoons form periodically on the beach. In the west of the RAP water breaks through the foredune as a small stream only 1-2m across. There are several patches of quicksand by this stream, particularly on the south-west bank.

It is likely that this unusual drainage pattern is a consequence of the Waipipi Ironsands mining operation which used to operate inland of the RAP. This effectively flattened all the dunes and water courses and may have led to a seepage over that length of coast, rather than the series of streams found elsewhere.

In a depression in the foredune at Waipipi Point is a stonefield measuring 10 x 8m. These stones re-appear as a reef out to sea. There is another, similar, reef 500m to the west.

Waipipi Dunes are the only sizeable dune area in the ecological district which have no stock or recreational vehicles tracks or other form of artificially induced erosion. This is due to the difficult access and low impact farming on adjacent land.

Vegetation

Only four plant species were recorded on the foredune. The dominant plant is pingao, mostly growing to 40-80cm, with a much smaller amount of marram and some spinifex. There are also isolated areas covered in sand convolvulus. Bare sand accounts for nearly half the area.

The vegetation of the swale area is much more diverse. The plant which formed the greatest cover by far in the sample site (half the area) was Lilaeopsis novae-zelandiae which grows wherever the sand is flat with a few centimetres of water cover. In slightly drier areas halfstar is dominant (but only in patches of a few square metres). The boundaries of these areas are dominated by Carex pumila. Club sedge and marram cover the small hummocks, on the edges of which are sand gunnera and Myriophyllum votschii. On the small dunes in this swale area, the club sedge and marram continues and there is also sand coprosma, tauhinu and sand daphne. This swale area contains a large range of indigenous herbs and sedges, including the endangered herb Sebaea ovata and the vulnerable sedge, Eleocharis neozelandica.

The inland edges of the RAP merge into rank pasture which appears to have been grazed very infrequently in recent years. Some clovers, chickweed and hare's tail are found on the fringe of the RAP. Moving sand and water means these weeds are unlikely to spread much through the RAP. The only potentially serious weed is jointed rush. This plant is very aggressive near the Waitotara River mouth and though still very local in the RAP it could spread rapidly.

Special Features

The waterflow pattern and layout of dunes gives this area a landform unique in the RAP. This area contains an endangered plant, Sebaea ovata, a vulnerable plant, Eleocharis neozelandica, and one species of indeterminate threat status, sand daphne (Given, 1990).

Selection Criteria

Representativeness:	H	One of the best examples of early foredune/swale colonising vegetation in the ED.
Diversity:	H	A good range of dune communities.
Special Features:	H	Unusual landform and presence of threatened plants.
Naturalness:	H	Few weeds and no other modification.

Viability:	H	May deteriorate if jointed rush not controlled.
Size and Shape:	M	Necessarily long and narrow. Average size.
Buffering:	H	Not immediately fenced but well buffered by sand, wind, salt air and water table.

Comment

Because this area is dynamic and aggrading the boundaries of a PNA must allow for geographic movement of areas with higher natural values.

RAP 44 Whenuakura Estuary

Study Area:	W9
GR Centre:	Q22 395574
Area:	10 ha
Survey Date:	1/11/90

RAP 44 WHENUAKURA ESTUARY

Ecological Unit

shore primrose - (Triglochin striatum) herbfield on tidal flat.

Landform

Geology: undifferentiated floodplain alluvium
Soils: gley recent soils; gley soils

This RAP is located on the north-west bank of the Whenuakura River. It is a dynamic area subject to major changes following floods and storms.

At the time of survey, the Whenuakura Estuary consisted of two shallow (1-2m) lagoons separated by a sand bar, rising up to 3m, an "island" (10m high), connected to the mainland at high tide by the sand bar, and a tidal flat. The south-west sandy lagoon (2ha) is of recent origin (as evidenced by the lack of vegetation) and only separated from the river and the sea by unvegetated sand dunes about 1-1.5m high formed over driftwood. The sand bar runs along the north-west of this lagoon. The second lagoon (1ha) is older and well vegetated. It gets progressively shallower to the north-east, eventually turning into a tidal flat, so in effect the lagoon is also tidal. This lagoon and tidal flat have mud under recent sand. The tidal flat curves away to the east to meet the main channel of the river. It is drained by three shallow channels.

The "island" is an eroded remnant of marine terrace which is now mostly covered by sand. Though not a true island at the time of the survey (even at high tide there is a connection to shore) in the past the river has flowed on either side of the structure and occasionally isolated it from the shore.

A cliff on the north-west edge of the RAP rises 20m above the estuary. It reduces gradually in height till it disappears under sand dunes (up to 8m high) in the south-west. The northern boundary is a wet basin between this cliff and a lower one (up to 15m) in the north and north-east. The rest of the area is bounded by the river and the sea.

A protected natural area based on the Whenuakura estuary would need to cover sufficient area to allow for fluctuations in the river channel.

Vegetation

Over half the area recommended for protection is unvegetated, being either bare sand or open water as a result of the dynamic nature of the area. The dunes which led to the formation of the south-west lagoon are completely bare, though some spinifex occurs to the west of the RAP. The only vegetation noted in this lagoon is a fringe of three-square at the western edge. In contrast the island is well covered in plants, but following a fire in about 1986 has regenerated in exotics, mainly marram with some boxthorn and pasture species, a pattern which continues across the sand bar.

The tidal flat and inner lagoon have a good indigenous plant cover which differs in composition from that found in other estuaries in the ecological district. Though there are scattered clumps of searush and club sedge the indigenous vegetation is otherwise under 15cm tall. The area is covered by shore primrose with some halfstar, interspersed by patches, a few metres in diameter, of Triglochin striatum, of which both erect and sprawling forms occur. Bachelor's button, glasswort and Isolepis cernua are also common, while three-square, Carex pumila, sea celery, Ranunculus acaulis and Lialaeopsis novae-zelandiae were also noted.

On the edges of the tidal flat, at the base of the cliff, are raupo and three-square, with flax, Cyperus ustulatus and Cortaderia fulvida on talus above them, though much gorse and tall fescue spoil the natural value of this part of the RAP.

One serious weed on the tidal flat and in the north-east lagoon is Spartina anglica. This plant has covered many hectares in the nearby Patea estuary and the Manawatu estuary. It covers less than 1ha of the Whenuakura estuary and so could still be controlled relatively easily. Sheep tracks were noted but no grazing or trampling was apparent. The estuary is electric fenced from pasture in the north.

Special Features

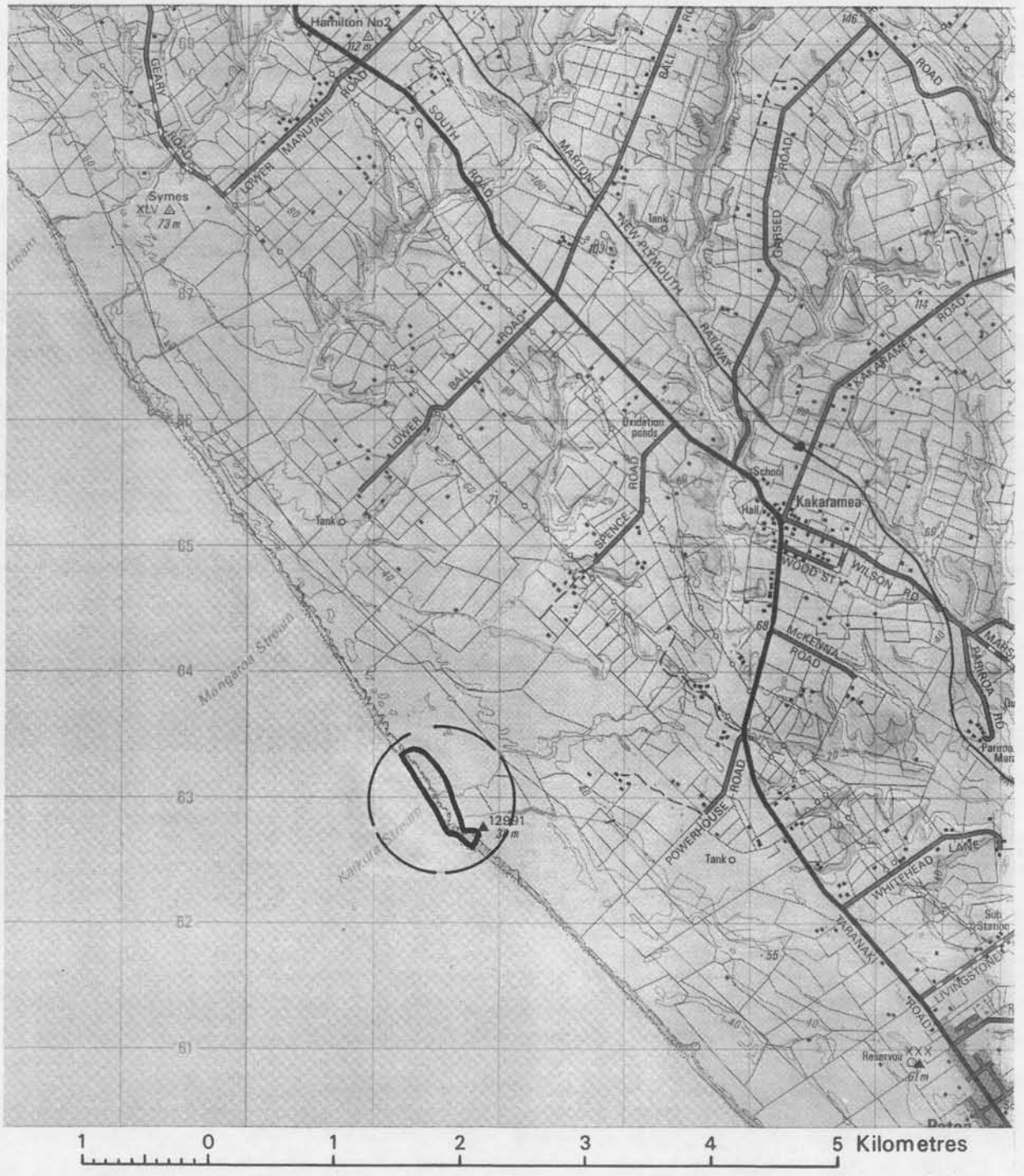
Oystercatchers breed in this area. A white heron was also seen here.

Selection Criteria

Representativeness:	H	The only example of this ecological unit remaining in the ecological district.
Diversity:	M	High diversity of landform but little vegetation diversity.
Special Features:	M	Rare ecological unit. Wildlife values.
Naturalness:	M	Much very high, island low.

Viability:	M	Needs spartina control.
Size and Shape:	M	Square-rectangular shape with moderate size.
Buffering:	H	Protected by sea, river and cliffs. Fenced from stock.
Others:		Useful whitebait spawning area on northern edge.

RAP 45 Kakaramea Powerhouse Cliffs



Study Area: W10
GR Centre: Q21 315631
Area: 10 ha
Survey Date: 7/11/90

RAP 45 KAKARAMEA POWERHOUSE CLIFFS

Ecological Units

1. Zoysia minima grassland on cliff edge.
2. taupata/shore primrose herbfield on colluvial ledge.
3. Limosella herbfield on sandplain.
4. (NZ iceplant) gravelfield on cliff edge.

Landform

Geology: windblown sand; massive mudstone, sandstone or siltsone

Soils: recent soils; steepland soils related to yellow-brown earths; bare rock

The Kakaramea Powerhouse Cliffs are part of a cliff, 25m high, which extends from Patea Beach to the Manawapou river. In the area recommended for protection the cliffs extend out to sea in a series of fingers about 50m long and 10-15m across, with bays in between.

The Kakaramea hydro-electric power station used to operate in the south-east of the RAP, using the Oroua Stream as an energy source. Tunnels were drilled down through the cliffs to the beach below as part of the power station complex. Most of the structures associated with the power station have now deteriorated badly and overall there is little modification to the landform. One bonus of the construction is that it allows ready access to the cliff face, which is inaccessible elsewhere.

The Oroua Stream now passes north of the power station site, meandering across a sandplain and cascading down to the sea north of the "fingers". This sandplain runs from near the cliff edge inland to parabolic dunes, about 50m away and continues north-west for about 400m. There are only a few square metres of open water away from the stream but the sand is damp and the water table is near the surface. Despite being 25m above the beach the area is active and there appeared to be fresh sand deposition.

North of the sandplain is a hard, mudstone terrace which is 2m higher than the sandplain. The surface is red-brown and stony. This terrace extends north-west a further 300m or so before giving way to dunes which reach to the eroding cliff edge.

The RAP north-west from the Oroua Stream has been fenced. However, round the powerhouse area sheep have formed tracks which have led to slight erosion in places. Because access is difficult, there is no erosion or deterioration of the landform resulting from adverse human activity.

Vegetation

The area north of the Kakaramea Powerhouse is the only sizeable clifftop area in the ecological district which has been fenced off from stock and does not have pasture right to the cliff edge, instead having good, representative plant communities. The powerhouse area is one of only two places where access to the cliff face was safe and easy, allowing close study of the vegetation (though similar vegetation can be expected over the whole distance from Patea to the Manawapou River).

Part of the powerhouse structure allowed access onto a colluvial ledge. Here, only a fifth of the surface area is bare rock. Taupata, all under 60m tall, accounts for another fifth of the cover, growing out of drier parts of the cliff faces. The rest of the area, mostly wet with seepage water, is covered in herbaceous plants up to 20 cm tall. The most common of these is shore primrose, followed by glasswort, Triglochin striatum and halfstar. Senecio lautus, NZ iceplant, Isolepis cernua and Lilaeopsis novae-zelandiae are also common. The only weed in the sample site was occasional marram, though gorse was seen elsewhere on these faces.

On the flat-topped fingers of cliff near the powerhouse, where the surface is dry, are mats of the tiny grass, Zoysia minima. Where moisture levels are higher this gives way to halfstar. It was estimated that there was over 100m^2 of Zoysia scattered over this area. Other indigenous plants noted were Carex pumila, tiny plants of club sedge (under 10cm) and Colobanthus muelleri. Some pearlwort was also noted and inland edges are flanked by marram and boxthorn. Sheep tracking has badly eroded the edges of some of the Zoysia mats. Fortunately about half of this area is fenced from stock.

A third of the sand plain north of the Zoysia mats is bare sand. Half the remaining area is covered by sheets of an unnamed species of Limosella[1] each covering hundreds of square metres. Other common plants noted on the sand plain were Carex pumila, two forms of halfstar and Triglochin striatum. Nearer the cliff edge are also some NZ iceplant and shore primrose. Near the stream, sand buttercup and some Leptinella tenella were found, the only record of L. tenella in the current survey though it was recorded at Hokio in 1968 (Duguid, 1990). Between the plain and the cliff edge is a belt, 10m wide, of marram and other exotic grasses. The dunes inland of the sandplain have bare sand, giving way to boxthorn, marram and then rank pasture.

The mudstone terrace is mostly bare, though in places NZ iceplant occurs, varying in cover from a few plants per square metre to about 50% cover. The only other plants noted were Limosella (unnamed species) in the south-east and a few plants of Cape daisy. The plain, stark vegetation and colour contrast with the rock, coupled with the backdrop of the sea and Mt Egmont make this area visually stunning.

1. A P Druce (pers. comm. 1991) advises that this Limosella, currently known only from sea cliffs between Kakaramea and Manutahi, is distinct from both L. lineata and another unnamed Limosella species known only from Opunake to the west of Foxton Ecological District.

Stock damage to the vegetation in this RAP is limited to a small part of the area and could be easily prevented with 100m of fence. Boxthorn and marram are limited in their distribution and there are no other potentially serious weeds present.

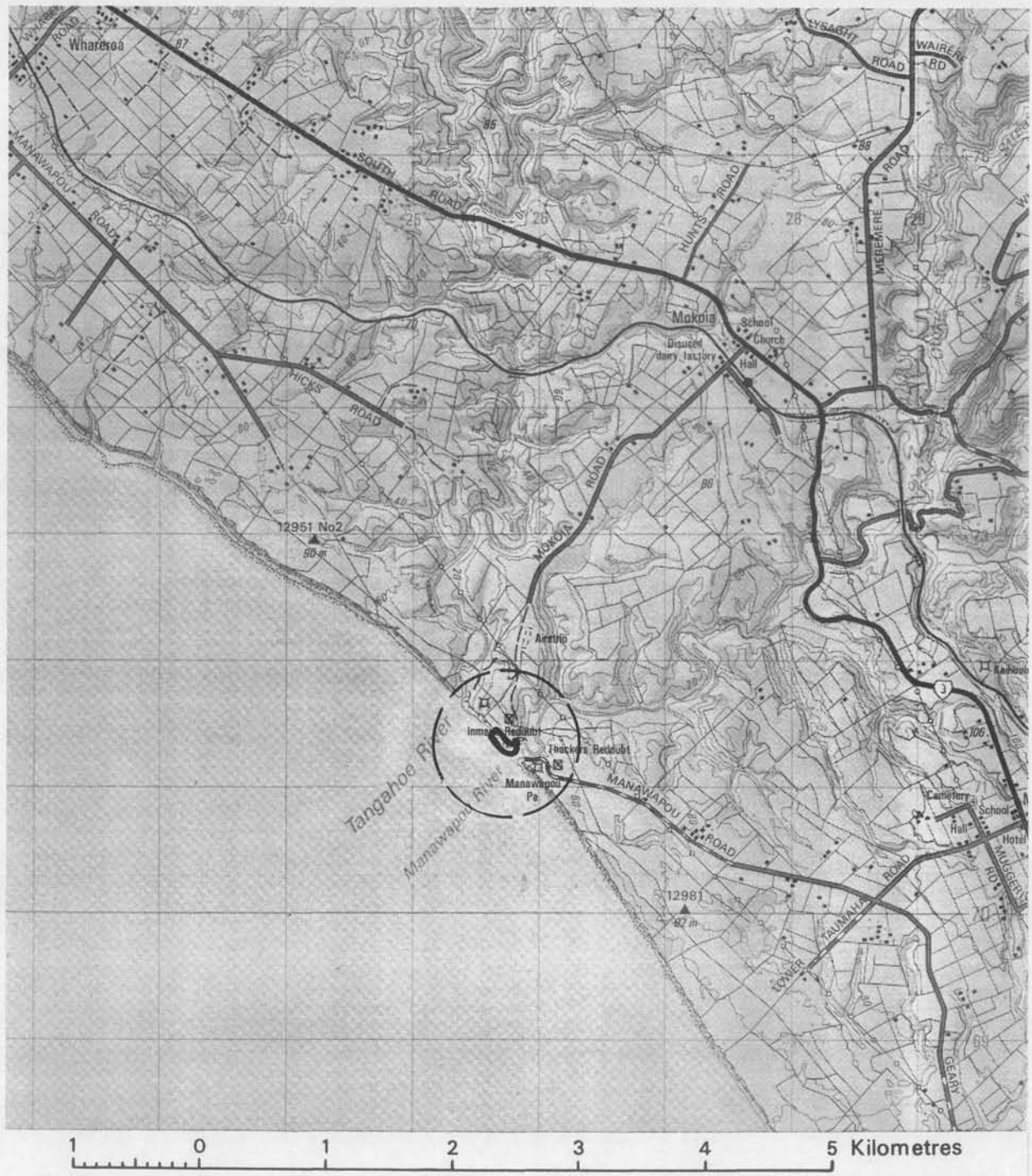
Selection Criteria

Representativeness:	H	Best representative area of original cliff edge vegetation in the ecological district.
Diversity:	H	A large range of landform and substrates and associated vegetation communities.
Special Features:	H	Only sizeable natural sandplain on cliff edge north of Wanganui.
Naturalness:	H	Weeds/stock only at edges.
Viability:	H	Would improve further with 100 m of fencing.
Size and Shape:	M	Largest such area left but long and narrow.
Buffering:	H	Sand and salt laden wind, good fencing overall.
Other:	High scenic value.	

References

F C Duguid (1990).

RAP 46 Manawapou Clifftops



Study Area:	W11
GR Centre:	Q21 257713
Area:	0.2 ha
Survey Date:	31/10/90

RAP 46 MANAWAPOU CLIFFTOP

Ecological Unit

halfstar - Leptinella squalida herbfield on cliff edge.

Landform

Geology: tephra formations in Taranaki over massive sandstone or siltstone.
Soils: yellow-brown loams

The area recommended for protection is on a sandy shelf at the edge of the cliff north of the Manawapou River mouth. The shelf is about 25m above sea level. Behind it is steep hill country, sloping straight up from the shelf edge. The cliff edge is eroding, as evidenced by the remains of a vehicle track passing across the RAP which ends abruptly at the cliff edge, and so the life of this natural area is limited. Two seepages run across the shelf.

Vegetation

Though too small to treat as separate ecological units, there are two main plant communities on the cliff edge. The one which defines the ecological unit as unique in the ecological district is a dense sward of Leptinella squalida, with some Cape daisy and Isolepis cernua being the only other plants present. Elsewhere, halfstar is most common, with good quantities of Isolepis cernua and Triglochin striatum and some shore primrose and sand buttercup. On one seepage are a few plants of Asplenium terrestre subsp. maritimum, Blechnum banksii and Luzula banksiana.

Yorkshire fog and pearlwort were found over much of the area but not in large quantities. An electric fence keeps cattle off the area though hoofprints indicate the fence is recent or only partially effective. The vehicle track previously mentioned is unused and has been completely recolonised.

It was not possible to safely survey the vegetation on the cliff faces below the shelf. Flax, jointed wire-rush, glasswort and NZ iceplant are all present in various combinations, though exotic grasses, thought to be tall fescue and Yorkshire fog, are well-established. Inland from the RAP is pasture.

Selection Criteria

Representativeness:	H	Elsewhere the cliffs are grazed to the edge.
Diversity:	M	Cliff faces differ from edge but otherwise little variety.

Special Features:	L	Unique ecological unit in the ecological district.
Naturalness:	H	High where surveyed, slightly weedy below.
Viability:	M	Well protected but slowly eroding away.
Size and Shape:	L	Small and narrow.
Buffering:	M	Fenced. Steepness protects one side. Buffered from weeds by salt air.

Comment

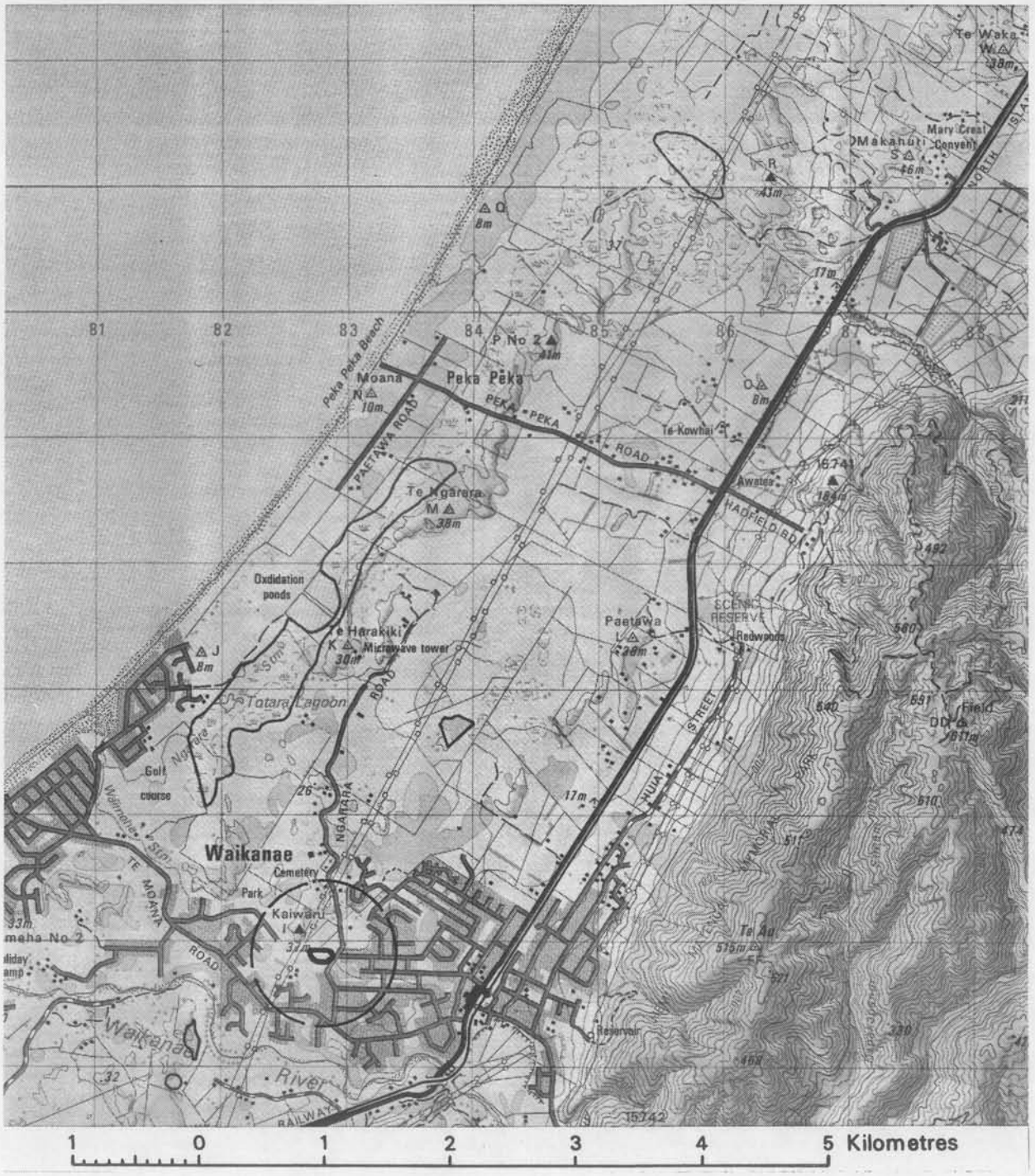
This RAP is probably more correctly included in the Egmont Ecological District. It has been recommended for protection as it is unique in the Foxton Ecological District but the recommendation is justified also as the ecological unit is unprotected in the Egmont Ecological District and not recommended for protection in the PNA survey report for that district (Bayfield and Benson, 1986).

References

M A Bayfield and M A Benson (1986).

3.3 PRIORITY TWO RECOMMENDED AREAS FOR PROTECTION

RAP (2)1 Waikanae Park Remnant



Study Area:	8A
GR Centre:	R26 828349
Area:	0.25 ha
Survey Date:	23/5/90

RAP2 1 WAIKANAE PARK REMNANT

Ecological Unit

kohekohe forest on sandridge.

Alternative to: RAP4 and RAP6.

Landform

Geology: windblown dune sand
Soils: recent yellow-brown sands

Situated in an urban area and modified at its eastern end by a sealed road, this area is on the crest and southern slope of a low (up to 4m) sandridge.

Vegetation

This is an area of kohekohe forest with two mature karaka trees. A ngaio and a tawa were also noted. There is some kawakawa in the understorey, but the remnant is completely open and used for walking and playing, allowing little regeneration.

Selection Criteria

Representativeness:	M	Though small this area represents a once-common forest type in the Waikanae area.
Diversity:	L	Only one forest type with little species diversity.
Special Features:	L	Forest type now quite rare in sand country.
Naturalness:	M	Spoiled by poor understorey.
Viability:	M	Not under threat but poor regeneration.
Size and Shape:	L	Small and narrow.
Buffering:	M	Little buffering, though no stock have access and there are local seed sources.

Comment

There is neither the diversity and size of RAP4 nor the titoki component of RAP6, so it is a poor alternative to either.

RAP(2) 2 Haruatai Park

Study Area:	39
GR Centre:	S25 922481
Area:	2 ha
Survey Date:	29/5/90

RAP(2) 2 HARUATAI PARK

Ecological Unit

kahikatea-pukatea forest on sand plain.

Alternative to: RAP12, RAP14, RAP15, RAP20

Landform

Geology: windblown dune sand
Soils: yellow-brown sands

The forest remnant at Haruatai Park is situated on the wet north-west edge of a sandplain at the top of a parabolic dune. A drain, 0.5m deep, cuts across the area, draining to the south. Though part of the remnant was still muddy when surveyed, it does dry out in summer. An adjoining remnant to the east has heavy cattle pugging but there was none noted in the RAP.

Vegetation

The RAP covers the western half of a larger forest remnant. The eastern half has been selectively logged, leaving scattered, mature pukatea in pasture - fencing, replanting and weed control would make it an expensive addition to the PNA. The part recommended for protection is a kahikatea-pukatea forest remnant, with mature trees rising to 15m. Tawa and mahoe are common and totara and rewarewa reach the canopy. There are several canopy gaps where climbers and epiphytes abound. The area has only recently been fenced and so has a poor understorey, dominated by Coprosma areolata, though seedlings are plentiful and diverse.

Several weeds are noted, including the potentially serious smothering climber, old man's beard, as well as blackberry, elderberry and Jerusalem cherry. The fencing is poor and it is likely that stock trespass may still occur.

Selection Criteria

Representativenes:	H	Though in poor condition, the RAP represents a swamp forest type which once would have covered many hundreds of hectares.
Diversity:	M	Only one basic forest type but high species diversity.

Special Features:	M	Forest type now uncommon in the ecological district.
Naturalness:	M	Many weeds present.
Viability:	M	Needs some weed control, especially old man's beard.
Size and Shape:	M	Good shape but small.
Buffering:	M	Fenced, though not well. Nearby pukatea help shelter from wind, some seed source.
Other:		High aesthetic, recreational and educational value in an urban situation.

Comment

Of the several swamp forest remnants surveyed in the ecological district this is among the smallest and most weedy, so has not been given priority one status. However, in the event of protection being unattainable for one of the other areas named above it would be a good alternative.

Reference J Rolfe (1989)

RAP(2) 3 Ngatotara Lagoon

Study Area:	41
GR Centre:	S25 918503
Area:	6 ha
Survey Date:	22/6/90

RAP(2) 3 Ngatotara Lagoon

Ecological Units

1. raupo/Schoenoplectus validus reedland on dune lake.
2. raupo-flax reedland on dune lake.

Alternative to: RAP29, RAP32, (Lake Papaitonga Scenic Reserve and Lake Koitiata Wildlife Management Reserve also contain similar ecological units).

Landform

Geology: windblown dune sand
Soils: recent yellow-brown sands

Ngatotara Lagoon is a dune lake formed where three parabolic lobes from the west have over-run an older dune system, forming an approximately W-shaped lake. The lake is now well eutrophied, with only about 40% in open water. There is no artificial drainage. Some cattle pugging was observed.

Vegetation

The vegetation shows a sequence from emergent to dry-edge dune lake vegetation. Areas of open water are fringed by Schoenoplectus validus, giving way to raupo. Raupo is then replaced by flax, with toetoe common in this intermediate zone. The edges of the lake have small shrubs (manuka, Coprosma propinqua) and cabbage trees are scattered through the flax and shrub areas. Unusually, two lancewoods persist on the dune above the west of the lake, an indication that the area was cleared later than much of the ecological district.

Two groves of crack willow in the south-west have the potential to spread. There is also some scattered gorse and where stock have access (the area is only partly fenced), jointed rush and pasture species proliferate. Some cattle browsing was noted but this was restricted to accessible areas.

Selection Criteria

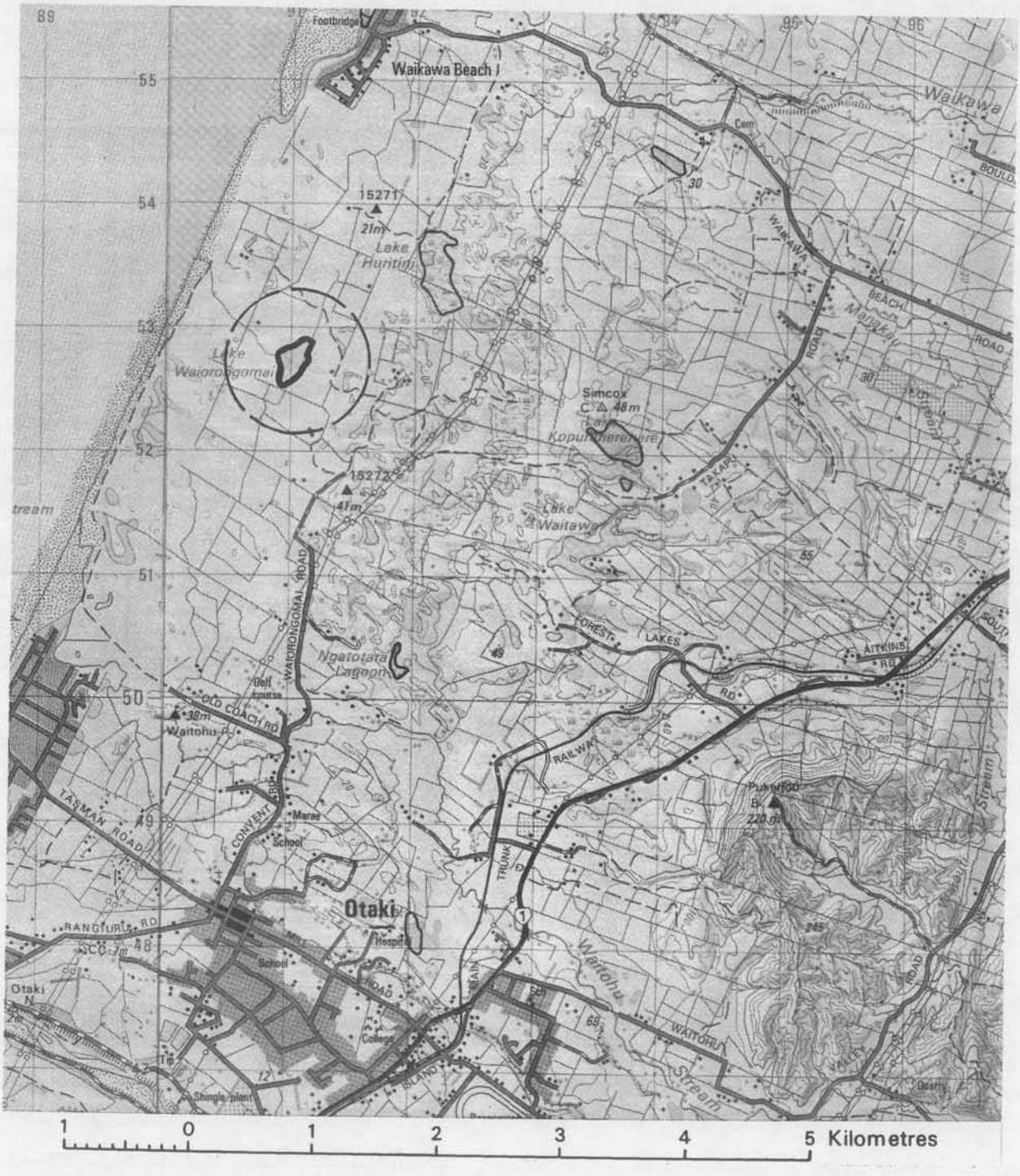
Representativeness:	H	Good example of a eutrophying dune lake.
Diversity:	H	Shows a wet to dry vegetation sequence.
Special Features:	M	Unusual landform.
Naturalness:	M	Weedy edges but high elsewhere.

Viability:	H	Would be even better with improved fencing and willow control.
Size and Shape:	M	Reasonable size. Convoluted shape.
Buffering:	M	Part fenced. Wetness and density protect from stock.
Other:		Good waterfowl habitat.

Comment:

The vegetation sequence shown here is also found in already protected areas or other areas considered of higher quality. However, this is a good wetland area which would well compensate for RAP29 or part of RAP32 if either could not be protected.

RAP(2) 4 Lake Wairongomai



Study Area:	51
GR Centre:	S25 910527
Area:	15 ha
Survey Date:	21/6/90

RAP(2) 4 LAKE WAIRONGOMAI

Ecological Units

flax-toetoe-(raupo) flaxland on dune lake.

Alternative to: RAP9, RAP30, (Lake Koputara (protected) has a similar ecological unit).

Landform

Geology: windblown dune sand.
Soils: recent yellow-brown sands.

Lake Wairongomai is on the western edge of a sand plain where two parabolic dunes have dammed runoff, forming a shallow, roughly D-shaped lake. There is a natural outlet between the dunes in the north-west but no artificial draining of the area is apparent. The lake and surrounding vegetation are only fenced to the north, so cattle have free access and the edges are heavily pugged. There is a vehicle track right to the lake edge on the eastern side.

Vegetation

Despite modification by stock, Lake Wairongomai shows a vegetation sequence from wet, emergent vegetation to drier, lake-edge vegetation. In open water in the east there is a band of Schoenoplectus validus only a few metres wide and 50m long. The lake is fringed in places by raupo, which gives way to toetoe and then flax. There is a shallower part of the lake in the east of a few square metres which has a flax-manuka association. Round much of the lake the raupo and toetoe have been replaced by jointed rush.

Much of the flax is open and grazed, with pasture species, gorse and blackberry invading and just a few shrubs of Coprosma propinqua and C. propinqua x C. robusta. Stock browsing damage is severe. Though the vegetation could still recover is fenced and weeded it is now in poor condition overall.

Selection Criteria

Representativeness:	M	Despite modification, still represents original dune lake edge vegetation.
Diversity:	M	Shows successional pattern. Low species diversity.

Special Features:	M	Useful waterfowl habitat.
Naturalness:	M	Spoiled by years of cattle damage.
Viability:	M	Could be high if fenced and weeds controlled.
Size and Shape:	H	Relatively large, round area.
Buffering:	M	Denseness of flax and wetness provide some protection.
Other:		Potential for adult whitebait habitat. Recreational use (duck shooting).

Comment

Though a viable alternative to RAP9 and RAP30 the major effort needed to restore this area make it considerably less desirable.

RAP(2) 5 Ohau Estuary

Study Area:	69
GR Centre:	S25 930590
Area:	100 ha
Survey Date:	7/6/90

RAP(2) 5 OHAU ESTUARY

Ecological Units

1. saltmarsh ribbonwood/searush shrubland on tidal flat.
2. sea rush - jointed wire-rush rushland on tidal flat.
3. sea rush/halfstar rushland on tidal flat.
4. jointed wire-rush/halfstar rushland on tidal flat.
5. halfstar herbfield on tidal flat.
6. glasswort - halfstar - (Triglochin striatum) herbfield on tidal flat.

Alternative to: RAP22

Landform

Geology: unconsolidated windblown sand; windblown sand; peat
Soils: no soil development; recent yellow-brown sands; yellow-brown sands; thin sands; organic soils.

The mouth of the Ohau River has reached the sea in a number of places over 3km of coastline in the last 120 years, at one time sharing a common mouth with the Waikawa Stream (Duguid, 1990). The river mouth still moves 100m or more each year. There is now 100ha of scattered, unstable, low dunes bounded by disused river channels as well as the present, more northerly channel. The only stable areas in this system are on the inland edges and on a 50ha tidal flat in the north-east (which is the part of the area which is recommended for protection). The tidal flat is dissected by a branching channel on its south side. Ten hectares on the east of this flat have been ploughed and partly cultivated and drains dug but the exercise appears futile as the area would be submerged during very high tides. There are numerous trailbike tracks in mud south of the tidal flat despite the whole area being fenced.

Vegetation

Two-thirds of the RAP is covered by a community of sea rush over halfstar. A band, covering 10ha and running north-south across the centre of the area, is dominated by saltmarsh ribbonwood. In the west, partly covered by sand, jointed wire-rush is common. A muddy area of several hundred square metres, covered in halfstar has been badly damaged by trailbikes.

Other locally common species are three-square, bachelor's button, shore primrose, Triglochin striatum, glasswort and Schoenus nitens. The cultivated area is being recolonised by Isolepis cernua, bachelor's button and shore primrose. The only common weeds are gorse on the inland edges and tall fescue on drier ground on the south bank of the river. Spartina grass and Juncus acutus grows nearby and threaten the area. No stock damage was observed.

On the north bank of the river some flax, jointed wire-rush and halfstar persist against the influence of vehicles, pasture weeds and river erosion.

Special Features — The Ohau Estuary is a known South Island pied oystercatcher breeding area and is used by migratory waders (Hugh Robertson, pers. comm).

Selection Criteria

Representativeness:	H	Good examples of estuarine communities.
Diversity:	M	Moderate diversity for a large area.
Special Features:	M	Some wildlife value.
Naturalness:	M	High except on edges and where cultivated.
Viability:	H	Would be even better with light weed control and if trail bikes were restricted.
Size and Shape:	H	Relatively large and square.
Buffering:	H	Fenced. Protected by salinity and tidal influence from weeds.

Comment

This RAP is very similar to part of the Manawatu estuary, except it is smaller and less diverse.

References

F C Duguid (1990).

RAP(2) 6 Muhunoa West Road Remnant

Study Area:	70A
GR Centre:	S25 972589
Area:	1 ha
Survey Date:	6/12/89

RAP(2) 6 MUHUNOA WEST ROAD REMNANT

Ecological Unit

titoki-pukatea treeland on sand ridge.

Alternative to: RAP16, RAP25, RAP32.

Landform

Geology: windblown dune sand
Soils: recent yellow-brown sands

This remnant is situated on the footslope of a sandridge, on its southern face. The ridge slopes up from an alluvial plain of the Ohau River and the remnant extends partly on to the edge of that plain. The plain is now well-drained though the species present indicate it was once swamp. The remnant only extends about half way up the sand ridge. A farm track has been cut up the dune along the eastern edge of this remnant.

Vegetation

Despite the small size of the remnant there is a sequence shown from wet plain forest to dry sand ridge vegetation. On the plain there are scattered cabbage trees, with several pukatea (15m tall) and a few kahikatea at the base of the sand ridge. Just above the pukatea are few tawa and the rest of the slope is mostly covered in titoki around 13m tall, the most common tree in the remnant.

Other than Coprosma areolata, there is little in the way of understorey due to years of heavy cattle browsing. The eastern half is now fenced but wandering Jew has become well established. Elderberry also occurs throughout this area. The west side is still grazed and there is no sign of any regeneration.

Selection Criteria

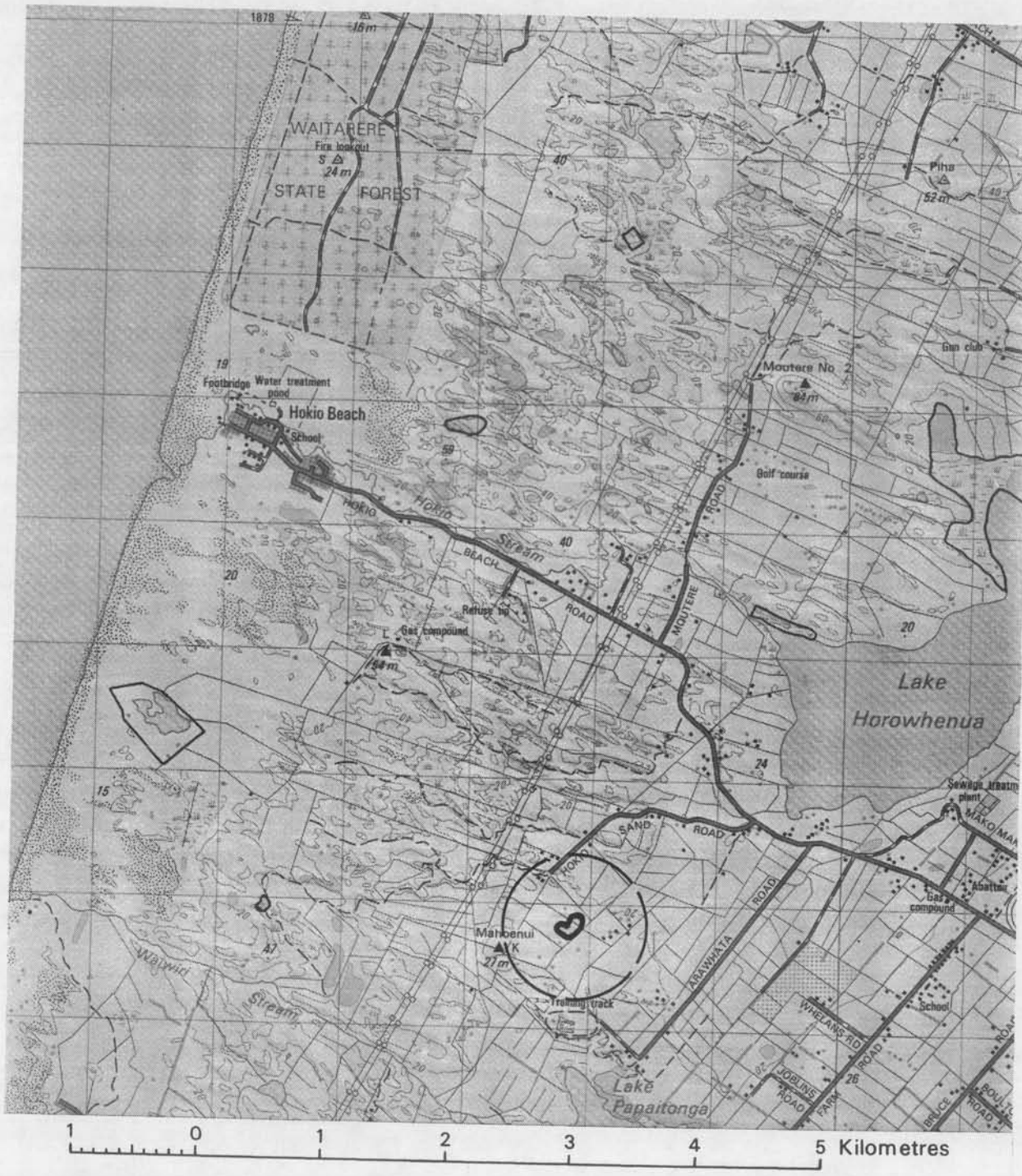
Representativeness:	M	May have been partly logged, but does indicate an original vegetation type where the sand dunes meet the alluvial plains.
Diversity:	M	Little species diversity but shows a vegetation sequence.
Special Features:	M	Sandridge forest rare in the ecological district.

Naturalness:	M	Reasonable canopy, poor understorey.
Viability:	M	Needs better fencing and weed control.
Size and Shape:	L	Small, long and thin.
Buffering:	M	Part fenced. Dune provides some wind protection.

Comment

The titoki component is much better represented at Pakipaki Dune Forest (RAP16). Legg Estate Bush (RAP25) is very similar but in much better condition. Sarah Pond Forest (RAP32) is much more diverse and much larger. None of these have the small alluvial plain component but this is poor and more comparable to areas in the Manawatu Plains Ecological District.

RAP(2) 7 Hokio Sand Road Remnants



Study Area:	78/79
GR Centre:	S25 978618
Area:	4 ha
Survey Date:	19/9/89

RAP(2) 7 HOKIO SAND ROAD REMNANTS

Ecological Unit

mixed broadleaf (podocarp) forest on sandridge.

Alternative to: RAP16, RAP25, RAP32

Landform

Geology: windblown dune sand
Soils: recent yellow-brown sands

This RAP is in two parts associated with a 10m high sandridge, running in a north-west to south-east direction. The larger, south-west remnant is oval-shaped and runs from a sandplain at the base of the sandridge up to just below its crest. The smaller part is long and narrow and runs down the north-east face of the landridge from just below the crest to the base.

A fence runs between the two parts (which are on two, adjacent properties) though neither is completely fenced off. There are stock tracks but no other stock-induced erosion. The sandplain which was once swampy has been drained and was dry at the time of survey.

Vegetation

The vegetation of these remnants shows a pattern, only in that the few pukatea, kahikatea (both reaching 15m) and cabbage trees present are confined to the sand plain. The forest on the sandridge is more variable, with a canopy ranging from 5-15m and no species being dominant. Species which reach the canopy are titoki, tawa, mahoe, matai, karaka, lancewood, kanuka, pigeonwood, ngaio and kaikomako. Other than Coprosma areolata, which is found throughout, there is little understorey.

Both remnants are secondary forest and very open. They are surrounded by and separated by pasture and have been browsed for many years. Recent subdivision for rural-residential purposes may lead to a reduction in stock pressure. There is some wind damage on the western flank which may ultimately impede regeneration.

Selection Criteria

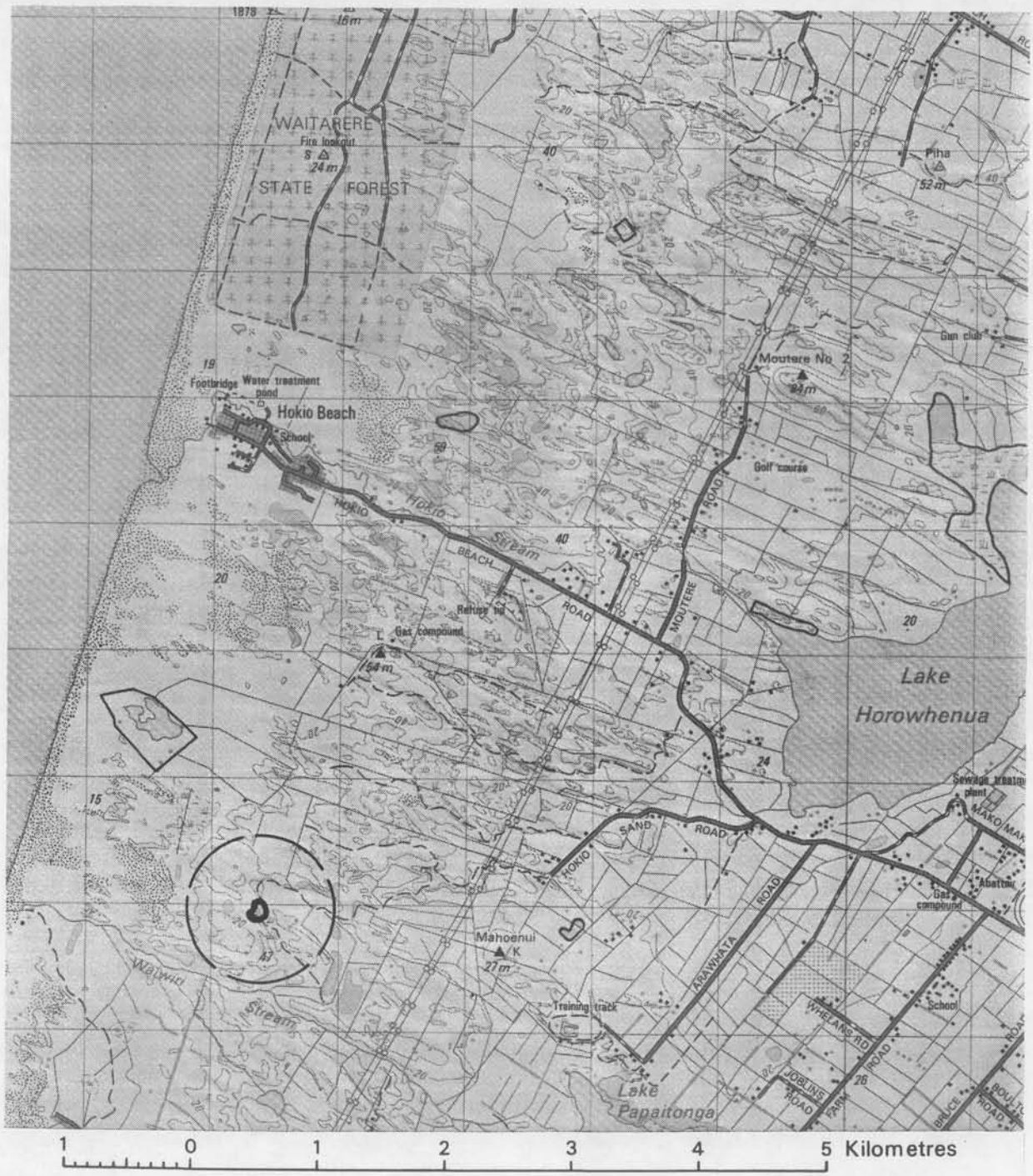
Representativeness:	M	Secondary, but species present represent a vegetation type once common over a large part of the ecological district.
Diversity:	M	Diverse canopy for a small area but otherwise poor.

Special Features:	M	Sandridge forest rare in the ecological district.
Naturalness:	M	Secondary and poor understorey.
Viability:	L	Needs fencing and wind protection.
Size and Shape:	M	Moderate overall size. Good round shape.
Buffering:	L	Poorly buffered.

Comment

RAP16 and RAP32 are more diverse and larger. RAP25 is similar but has much better buffering.

RAP(2) 8 Levin Sewage Plant Scrub



Study Area: 81A
GR Centre: S25 958622
Area: 10ha
Survey Date: 12/10/89

RAP(2) 8 LEVIN SEWAGE PLANT SCRUB

Ecological Unit

kanuka scrub on sandridge.

Alternative to: RAP16

Landform

Geology: windblown dune sand
Soils: recent soils related to yellow-brown sands.

The RAP is part of a much larger area used for land-based disposal of treated sewage. It is mostly on the south-west slope of a high (20-25 m) sandridge, though the scrub does continue over the crest and down the north-east slope. Although some scrub on the north-east slope, is sprayed with treated effluent which will eventually affect the soil composition, most of the area recommended for protection is not used for effluent disposal.

The south-west base of the sandridge has been partly covered by an artificial lake. The crest has a road running along it. A rough vehicle track cut down the south-west face is overgrown but one in the north-east is still used.

Vegetation

The canopy of this RAP is almost entirely kanuka, mostly around 4m tall but reaching 6.5m. The only other species which was seen in the canopy was Parsonsia sp. (probably P. capsularis). The canopy is broken only where there are roads. The kanuka is thinner stemmed, denser and presumable younger than in other areas surveyed. There are few plants under the canopy, other than some Muehlenbeckia complexa, Coprosma propinqua, C. rotundifolia, C. areolata, bracken, gorse and lupin. The edges have rank grass and bracken, with some club sedge and inkweed.

A young plant of old man's beard was found which is potentially serious as this species spreads rapidly. The RAP is not fenced but stock are excluded from the entire sewage disposal block. Much of the surrounding area has been planted in pines.

Selection Criteria

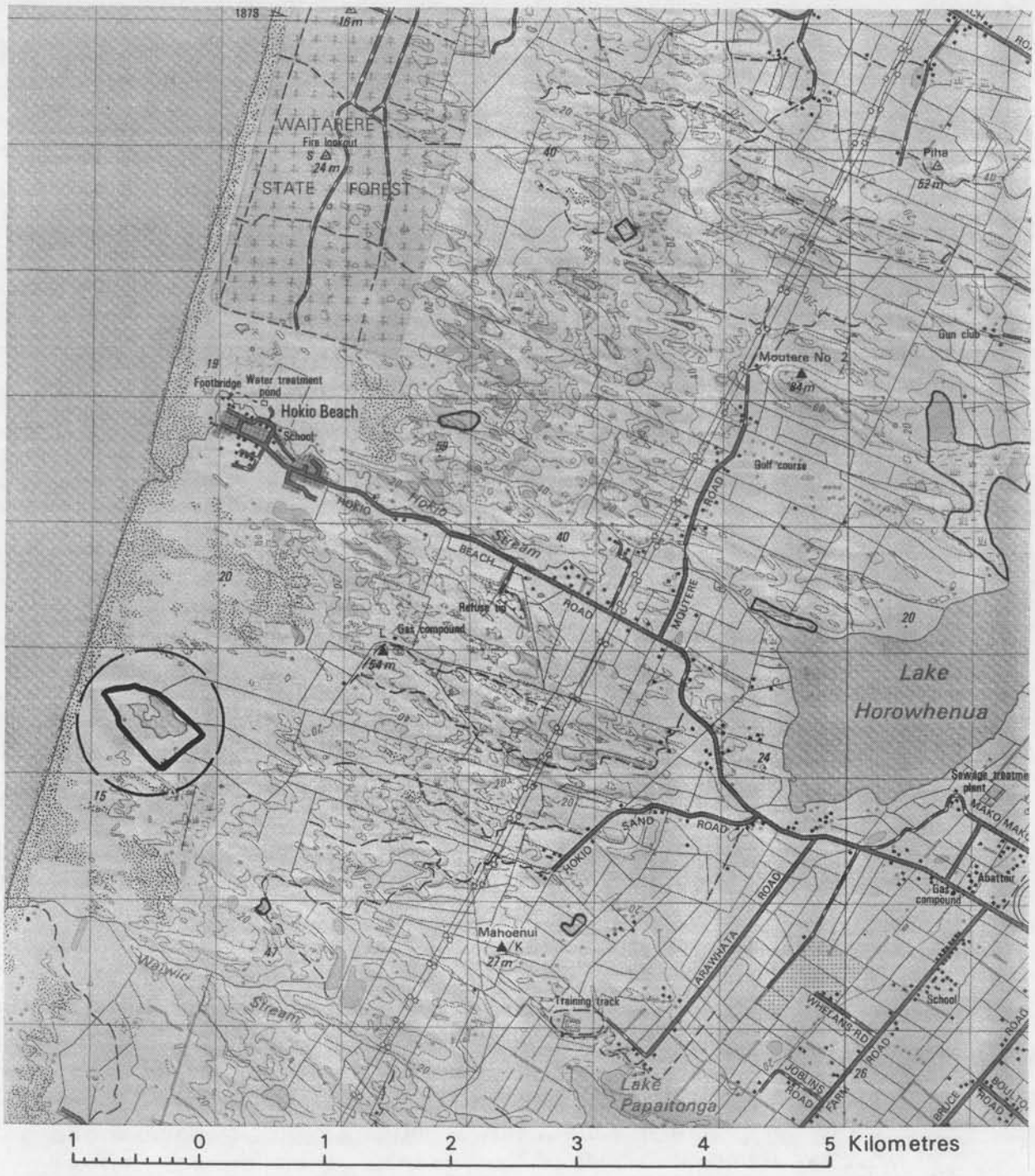
Representativeness:	M	Secondary, but represents a successional stage following disturbance.
Diversity:	L	Little diversity.

Special Features:	L	
Naturalness:	M	Induced indigenous community.
Viability:	H	Excellent if old man's beard controlled.
Size and Shape:	H	Reasonably large, square area.
Buffering:	M	Protected from stock. Seed sources nearby.

Comment

Because of the low diversity this area makes a poorer choice for protection of kanuka than RAP16. Given time it could improve as it is reasonably large and undisturbed. The land is owned by Horowhenua District Council and should be relatively easy to protect.

RAP(2) 9 Okotore Lagoon



Study Area:	81
GR Centre:	S25 946634
Area:	20 ha
Survey Date:	12/12/89

RAP(2) 9 OKOTORE LAGOON

Ecological Units

flax flaxland on dune lake.
raupo reedland on dune lake.

Alternative to: RAP9, RAP11, RAP29, RAP34

Landform

Geology:	peat; windblown dune sand; windblown sand
Soils:	organic soils; recent soils related to yellow-brown sands; recent yellow-brown sands.

Okotore Lagoon is a basin type dune lake formed by parabolic dunes in the west damming runoff from an older sandplain. Two blowouts in the north-west have created sand ridges which have formed spits running south-west into the lake.

From the late 1970s till the late 1980s the lake level dropped markedly. Following commissioning of Levin's landbased sewage disposal system nearby, the lake level has started to rise. There is an artificial drain running from farmland into the west of the lake which is unlikely to have a long-term effect on water levels.

Parts of the lake edge, especially in the east, have had moderate cattle pugging. The blowouts in the north-west are now stable. A vehicle track skirts the south-west of the lake but has had little effect on landform.

Vegetation

Only about 3ha of the 10ha in the RAP was open water at the time of survey. A history of varying lake levels and the influence of stock has had an effect on the vegetation composition as it has allowed some areas to become very weedy. Nevertheless, much of the vegetation is still natural. Raupo is the dominant plant, covering up to half of the area, especially around the edges of the open water. Flax is dominant away from the open water, with Cyperus ustulatus blending into rough pasture round the edges of the flax area. Other common indigenous species were cabbage trees, Carex secta, bracken, sharp spike-sedge and Coprosma propinqua. One notable plant reported from this lake (but not recorded during this survey) is the vulnerable fern, Ophioglossum petiolatum (Brownsey, 1985).

There is a high diversity and large numbers of exotic species present, ranging from jointed rush at 15cm to pines 9m tall. Only jointed rush, gorse and blackberry are likely to further threaten natural values and these are still not very widespread. Stock no longer have access to the lake, except some of the eastern edge which is unfenced. The lake is surrouneded to the east and south by pasture and to the north and west by rough dune country with club sedge, marram and boxthorn.

Special Features

The lake has high numbers and good diversity of bird life (including white heron and >15 dabchicks at times) and insects. It is important as it contains one of only a very few populations in NZ of the vulnerable fern Ophioglossum petiolatum.

Selection Criteria

Representativeness:	H	Despite weeds remain a good example of a coastal dune lake (most now dry on this part of the coast).
Diversity:	M	Open water to raupo to flax communities.
Special Features:	H	Contains vulnerable Ophioglossum petiolatum. Large numbers of waterfowl, dabchicks.
Naturalness:	M	Spoiled by weeds.
Viability:	M	Would be high with weed control.
Size and Shape:	H	Moderate size, square shape.
Buffering:	H	Part of a larger, fenced-off area. Increasing water levels will reduce effect of weeds.
Other:		Used for eeling, duck shooting and pheasant shooting.

Comment

Several flax and raupo areas in better condition have been recommended for protection or are protected. The owners maintain this area for recreational use, which has ensured its short-term protection.

References P J Brownsey (1985)

RAP(2) 10 Oturoa Road Bush

Study Area: 125
GR Centre: S24 038723
Area: 1.5 ha
Survey Date: 16/5/90

RAP(2) 10 OTUROA ROAD BUSH

Ecological Unit

kahikatea-pukatea-titoki forest on sand plain.

Alternative to: RAP12, RAP14, RAP15, RAP19, RAP20

Landform

Geology: recent alluvium; peat; windblown sand.
Soils: recent gleyed and organic soils; organic soils; recent yellow-brown sands.

Oturoa Road Bush is situated on a sand plain south of the Manawatu River. A parabolic dune reaches within 20m of the south-west edge and a sand ridge skirts to the south. Two parallel drains, running south-west to north-west drain the sand plain on either side of the remnant. Consequently the ground was very dry when visited.

The Manawatu River is only about 200m to the north-west. Before the river was stopbanked flood water may have reached the bush, making the plain at least partly alluvial, though the soil is sandy.

Vegetation

Though this remnant is too small to separate into discrete ecological units, there is a noticeable variation in the canopy. The south-western end is almost pure kahikatea (up to 13m tall). Further north, tawa increases but never becomes dominant. Moving north-east there is a smaller area with titoki (up to 10m tall) dominant. The northern tip is dominated by pukatea. On the east side are two areas of bracken, each about 20m across. Despite the small size of the block there is a large diversity of species, though the only other common ones are mahoe and poroporo.

The remnant is completely unfenced and is grazed out. Because of drainage, what regeneration there is has been tawa and titoki, rather than kahikatea and pukatea. The remnant is surrounded to the north, east and south by pasture and to the west by up to 0.2 ha of gorse (which may help regeneration). No other serious weeds were noted. There are some windthrown trees. Several similar, but even more disturbed, remnants occur in the vicinity.

Selection Criteria

Representativeness:	M	Represents a once-common forest type but dry condition and poor understorey not representative.

Diversity:	M	Slight canopy variation and good species diversity.
Special Features:	L	
Naturalness:	M	Spoiled by poor understorey. Mostly secondary.
Viability:	M	Slowly deteriorating but easily salvageable by fencing and blocking drains.
Size and Shape:	M	Small, roundish shape.
Buffering:	M	Some protection by gorse, nearby seed sources.

Comment

Several other swamp forest remnants have been recommended for protection in this report. All are either larger, more diverse or in better condition. However, with fencing and work on the drains this remnant could improve and if a priority one area cannot be protected would be a practicable alternative.

RAP(2) 11 Himatangi Bush Remnants

Study Area:	145
GR Centre:	S24 127823
Area:	10 ha
Survey Date:	8/12/89

RAP(2) 11 HIMATANGI BUSH REMNANTS

Ecological Units

1. kahikatea-pukatea-titoki treeland on sand basin.
2. poataniwha tree land on sand ridge.

Alternative to: RAP18

Landform

Geology: windblown sand
Soils: gley soils; yellow-brown sands

The main part of this RAP is mostly in a sand basin lying between two sandridges, 150m apart, which run in a north-west to south-east direction. The southern ridge is about 5m high while the northern ridge only reaches up to 2-3m. A low (6m) parabolic dune joins the southern sandridge at the north-west end. The northern ridge begins 50m east of this point. To the east of the RAP the basin opens onto a larger sandplain.

A drain runs right through the forest remnant though it would be a simple task to re-route it around the edge of the remnant. Though stock have access, there was no serious pugging or stock induced erosion noted.

A second, smaller (2ha) remnant lies on a sand plain 100m north of the larger area. A drain runs along the southern edge though it is still wet in the west. Across a fence to the north is a metalled farm track, and to the west Himatangi Block Road. Cattle pugging is moderate in this area.

Vegetation

Only the larger remnant was surveyed (the smaller one is similar but in poorer condition). It is highly variable in canopy condition. In the west there is mainly dense, pole kahikatea (at 10-12m tall). A grassed area separates this stand from a mature stand with titoki (up to 13m tall), kahikatea and pukatea (both up to 15m). Further to the south-east is an open, grassed area, with a fence running north to south across it. Beyond the fence the pasture continues with several scattered small trees and shrubs (mapou, kaikomako, pigeonwood and Coprosma areolata). Along the north-east of this area are several mature pukatea and kahikatea (again 15m tall). Along the southern sand ridge, particularly to the west, are several shrubs and small trees, dominated by poataniwha. Though this sandridge is open with only secondary vegetation it is worth including in the RAP because it greatly increases the range of species. Overall, in fact, despite the disturbed nature of the remnant, there is a surprising range of tree and shrub species present, including lacebark, matai, kowhai and marbleleaf, none of which are common in the ecological district.

Though partly fenced, the remnant is open to stock and heavily browsed. There is virtually no understorey but large numbers of seedlings were noted amongst the roots of pukatea.

Several windthrown trees have resulted from the open nature of the remnant. Though pasture weeds are common (and may impede regeneration) only gorse is likely to have a major impact. This weed is plentiful, especially west of the remnant but if it spreads would be more likely to help regeneration than to hinder it.

Selection Criteria

Representativeness:	M	Too modified to be truly representative but does contain species likely to have been present over a larger part of the ecological district in the past.
Diversity:	M	High species diversity though little canopy diversity.
Special Features:	M	Contains species rare in the ecological district.
Naturalness:	M	Partly logged, several open areas.
Viability:	L	With fencing and drainage control would improve over several decades.
Size and Shape:	M	Two longer, narrower remnants.
Buffering:	L	Inadequately fenced. Several nearby seed sources.

Comment

This area is smaller to RAP18 but in considerably poorer condition. It also has similarities to Himatangi Bush Scientific Reserve and Barber's Bush Scenic Reserve nearby. Though its lower representativeness and naturalness do not meet the criteria for a priority one RAP, an opportunity exists to have a chain of protected forest remnants all within a kilometre of each other in this vicinity, which would be beneficial for plant species diversity and bird life.

RAP(2) 12 Koputara Sandflats

Study Area:	D9
GR Centre:	S24 005878
Area:	50 ha
Survey Date:	13/7/89

RAP(2) 12 KOPUTARA SAND FLATS

Ecological Units

1. Carex pumila sedgeland on sandplain.
2. jointed wire-rush rushland on dune hollow.
3. half-star herbfield on sandplain.

Alternative to: RAP24, RAP27, RAP43

Landform

Geology: windblown sand
Soils: recent soils; yellow-brown sands

Koputara sand flats are part of the more recent Waitarere dune-building phase (see introduction, page 8). Partly because of the action of cattle (some of which were seen during the survey) much of the area has become destabilised and a feature of the area is a massive dune, several hectares in extent and up to 12m high which is still active in the east (it was seen to be covering mature cabbage trees).

West of this dune, the area consists of a sandplain bounded north and south by sandridges and also a dune hollow in the north-west between two adjacent sandridges. There are also two lower (6m), eroded, parabolic dunes north of the centre of the area.

Much of the sandplain consists of ephemeral wetlands. In the east, in the lee of the recent dune, some of these may be permanent.

A hundred years ago Lake Koputara was in this area. Sand, moving in a west-south-west direction before the prevailing winds, has moved the lake completely off the land it used to occupy. (Lake Koputara is now protected by a QEII Trust Open Space Covenant).

Vegetation

There are two broad groups of indigenous vegetation communities preset - those on stable areas in the north-west and those associated with moving sand in the south-east.

The dune hollow in the north-west, which covers less than 1ha has the most advanced stage of indigenous vegetation in the RAP. More than half the cover is jointed wire-rush. Flax, toetoe and Baumea juncea area also common, and occasional cabbage trees grow to 4m. Shrubs scattered through the area include manuka, Olearia solandri, Coprosma propinqua and C. acerosa. Tall fescue and Yorkshire fog grow throughout and pampas is also present. The western edge of this area is being covered by windblown sand.

Much of the rest of the RAP is also covered by jointed wire-rush though greater amounts of tall fescue, Yorkshire fog and jointed rush have lowered natural values considerably. A long, ephemeral wetland bounds the northern edge of this plain, at the base of a sandridge. The vegetation here is a herbfield, dominated by halfstar. Unusually in the ecological district, over 5% of the cover is sand buttercup. Other common indigenous plants are Schoenus nitens and Isolepis cernua. Isolepis basilaris, rare in the ecological district, is also present Isolated clumps of club sedge reach 60cm in height. Pampas is spreading rapidly over part of this area and needs urgent control.

The dominant plant by far in the more recent and dynamic sand plain areas to the south-west is Carex pumila, swards of which cover several hectares. Among them are sheets of Limosella lineata. Of the several other indigenous plants growing here, only club sedge is very common, growing on low sand ridges. This part of the RAP contains the largest population of Isolepis basilaris found in the survey. Some jointed rush, pampas and marram are present but the only common weed is strawberry clover.

The rest of the RAP is either bare sand or covered in boxthorn, marram, tall fescue and other weeds. However, the dynamic nature of this RAP means a large area needs to be protected to adequately preserve the natural features in the longer term. Cattle trampling is causing some damage (the area is fenced but poorly). Evidence was also seen of sambar deer browsing cabbage tree foliage.

Selection Criteria

Representativeness:	M	Now very modified but does indicate what vegetation occurred over much of the ecological district.
Diversity:	H	A good range of wet sandplain communities.
Special Features:	M	The largest population of Isolepis basilaris seen in the survey.
Naturalness:	M	Mostly low but locally very high.
Viability:	M	Poor over much of the area unless pampas and stock controlled. High in more dynamic areas.
Size and Shape:	H	Large, broad area.
Buffering:	M	Buffered mainly by its own size.

Comment

The more dynamic areas are very similar to those in other dune areas. Priority one areas all have either more diversity or are less modified than the rest of the Koputara Sandflats. However, the species diversity and large area makes this a viable alternative, though it would not be a cheap option to protect.

Koputara sand flats adjoin Lake Koputara (a covenanted area) which gives an opportunity for a large, more diverse protected natural area than that provided by the lake alone.

RAP(2) 13 Pirie Pond

Study Area: 163
GR Centre: S24 023879
Area: 20 ha
Survey Date: 28/8/90

RAP(2) 13 PIRIE POND

Ecological Units

1. Coprosma propinqua - flax shrubland on sandplain
2. raupo reedland on dune lake

Alternative to: RAP15, RAP34

Landform

Geology: peat; windblown sand
Soils: organic soils; recent soils; yellow-brown sands

Pirie Pond is a mostly eutrophied basin type dune lake formed by parabolic dunes in the west damming runoff from a sandplain. The south and west edges have been planted with pines which are now mature but the dunes are still active and have covered some of these. Sand has pushed round the north of these trees, forming a spit into the lake. On the southern edge a 20m causeway has been built, with a maimai and jetty on the end. There is no longer any open water near this jetty, indicating eutrophication has been rapid, perhaps as a result of fertiliser runoff from neighbouring farmland. At the time of survey there were only a few square metres of open water left.

There was no sign of artificial drainage, and surface water lay over most of the area at the time of survey. North of the sandblow, cattle have access and as a result there is some pugging.

Vegetation

The western third of Pirie Pond is covered by dense raupo which has spread rapidly over recent years (as shown by aerial photos). The only other plants found in any numbers are Carex secta and Pacific azolla, though the south-west corner also has Olearia solandri, Coprosma propinqua, C. propinqua x C. robusta, manuka and Muehlenbeckia complexa.

The eastern two thirds is a much more diverse shrubland, which has older plants and more diversity than many other swamp shrublands in the ecological district. Around half the cover is Coprosma propinqua (around 3m tall) with flax providing a further quarter of the cover. Occasional cabbage trees reach 6m. Other shrubs and small trees include karamu, Coprosma propinqua x C. robusta, Olearia virgata, manuka and rangiora. A feature of this area is the high numbers of fern species present (17 spp. were recorded during the survey). Several sedges and rushed were also found.

Several weeds are present though none are serious (the vegetation is too dense for pampas to spread rapidly) and most are confined to the edges. Some exotic species have been planted including Tasmanian ngaio and arum lilies. Most of the shrubland is effectively protected from stock by fencing in the south and east and high water levels in the north and west, though there is heavy browsing along the north-western edge.

Selection Criteria

Representativeness:	H	High raupo content not representative of original condition but shrubland good example of a once common ecological unit.
Diversity:	M	High species diversity but little overall variation.
Special Features:	M	High diversity of ferns.
Naturalness:	M	High in places, Edges spoiled by cattle and weeds. High raupo content induced.
Viability:	M	Excellent with improved fencing and some weed and raupo control.
Size and Shape:	H	Relatively large. Broad rectangle.
Buffering:	M	Part fenced. Protected by water level and density of vegetation. Nearby seed sources.

Comment

Raupo reedland is already well protected in the ecological district. The shrubland component of this area is of a similar quality to that in RAP15 and better than that in RAP34, but both other areas are overall larger and more diverse. Pirie Pond is an excellent alternative to the shrubland parts of those areas.

RAP(2) 14 Rangitikei Estuary Saltmarsh

Study Area:	175
GR Centre:	S24 000988
Area:	50 ha
Survey Date:	8/2/89, 18/6/90

RAP(2) 14 RANGITIKEI ESTUARY SALTMARSH

Ecological Units

1. sea rush rushland on tidal flat
2. sea rush - (exotic grasses)/sand gunnera - halfstar herbfield on tidal flat.

Alternative to: RAP13, RAP22

Landform

Geology: windblown sands; estuarine muds, silts and clays
Soils: recent soils; saline soils

This salt marsh is situated south of the main channel of the Rangitikei River. An oxbow of the river forms tidal channels to the east, south and west of the saltmarsh almost forming an island at high tide. The saltmarsh is smooth, flat and sand covered and only partly dissected by small channels on its southern side. The edges are quite muddy, but across the channels on the south and west are sandy areas with low dunes.

Stock have access to this area from the west and have created some tracks and cause a little pugging in muddier parts. Though sandy part of the estuary have received high recreational vehicle use, the saltmarsh has escaped this due to the difficult access.

Vegetation

Much of the saltmarsh is covered by sea rush, 80cm tall. In places there is also jointed wire rush. Below these rushes the ground is covered in low herbs, the most common being sand gunnera, halfstar, shore primrose and Apium filiforme. In the centre of the saltmarsh are a few plants of saltmarsh ribbonwood. On dry, sandy patches, also near the centre, are good populations of Carex litorosa, a plant which is uncommon in the ecological district.

Unfortunately, weeds are spreading rapidly through the saltmarsh (this was even apparent over 16 months during this survey). The most obvious are grasses such as tall fescue and creeping bent. Buck's horn plantain is replacing the small, indigenous herbs. There is quite severe cattle damage (trampling and browsing) to the vegetation. Cattle are probably responsible for the rapid spread of weeds.

Selection Criteria

Representativeness:	H	Despite weeds still gives a good indication of original condition.
Diversity:	L	Fairly uniform, especially considering size of area.
Special Features:	M	Good populations of Carex litorosa (rare in the ecological district).
Naturalness:	M	Spoiled by stock and weeds.
Viability:	L	Deteriorating. Needs stock and weed control.
Size and Shape:	H	Large, round area.
Buffering:	M	Theoretically protected by poor access and salinity, yet weeds and stock still problems.

Comment

This saltmarsh is less diverse and more modified than those in other estuaries in the ecological district. The large areas and moderate naturalness mean it could be worth protecting but it is a lower priority than these other estuaries.

CHAPTER 4

DISCUSSION

Ever since people first arrived in the Foxton ecological district, natural areas have been modified or destroyed. Unfortunately, these areas are still deteriorating. Several hundred hectares between Tangimoana and Himatangi, for example, were the subject of important sand country vegetation studies by Alan Esler of DSIR (eg. Esler 1969 (a), 1970 (b)). Even in 1980 there were still healthy, indigenous communities (pers. obs.), but these areas are now mostly planted in pines. This survey has come too late to save these areas. It is hoped that implementation of the recommendations in this report will be in time to protect the best of what remains.

In many cases, the "best of what remains" is not truly representative of the original condition, even in existing protected natural areas. Much of the districts original ecological diversity has already been lost. What has been recommended for protection in this report is the closest to that original condition and gives the best cover of what remains of the ecological district's original ecological diversity. For example "dry" forest remnants (as found on sandridges and parabolic dunes) are all small and modified and few remain. All coastal dune areas (except at Waipipi Point) have major weed problems. At least if the better areas are protected restoration work can be contemplated.

Not surprisingly, the existing protected natural area network is biased to forest and wildlife (waterfowl) habitat. Another deficiency in the existing protected natural areas network is that some areas have inadequate status. Stewardship land vested in the Department of Conservation at least now is managed for conseration purposes, but recreation reserves vested in local authorities, though not deliberately destroyed, are often not managed primarily for natural values. It is hoped, therefore, that implementation of this report's recommendations will not only add new areas to the protected natural areas network but degrade the level of protection of some of those existing areas.

During the course of this survey, the rapid assessment used (Myers et al. 1987) meant some decisions were made subjectively. This has led to the possibility of two descrepencies. It is possible a valuable natural areas was not surveyed at all due to subjective assessment of preliminary information. Usually if there was doubt the area in question was at least visited before a decision was made but the possibility remains that an area has been missed (aerial photos are a great help in this respect). The other area where subjective assessment has allowed possible discrepancies is in estimating plant cover. In some cases (especially foredune communities) species will have been estimated at higher covers than if they had been measured (once this was realised the same method of estimation was still employed to maintain consistency). Usually there was no problem with subjective cover estimates but it sometimes could affect description of ecological units (how different is a pukatea-kahikatea forest compared to an apparently similar kahikatea-pukatea forest?). The use of defined plots as used in the Umbrella PNAP survey (KJM Dickinson, 1986) would have reduced error and made survey results more valuable.

Initially the idea of using plots or other forms of measured quantitative assessment was rejected on the grounds it would increase survey time and be difficult for a single person to do. As most PNAP surveys are done by teams and much time is spent in travel and sampling already (little extra time would be involved in sampling plots) these arguments are perhaps not fully justified. I would recommend future PNAP survey people strongly consider the use of sample plots.

Because an attempt was made during the survey to record all relatively common indigenous plants, the survey cards are a potentially useful resource in themselves. There is a wealth of information already on the vegetation of the Foxton Ecological District (see Appendix III) but this survey has filled many gaps in the coverage of the district.

No attempt was made to survey the fauna of the ecological district (though if fauna considerations added to the value of an area they were noted). This was mainly a result of the emphasis on ecological units (which are based on vegetation and land form) and also because of time and cost considerations. Information on the avifauna is summarised in SSWI (Sites of Specific Wildlife Interest) cards held by the Department of Conservation and there is some published information on other fauna (see Appendix III). It would be true to say that indigenous fauna of the ecological district has been insufficiently studied.

Despite its history of disturbance and modification, the Foxton Ecological District remains an ecologically fascinating area. It contains the largest sand dune system in New Zealand, a truly diverse range of vegetation communities from fields of herbs less than 1cm high to tall forests, rare and threatened plants and scenery which is unique in New Zealand. I hope this survey report will ultimately lead to protection of these features for the benefit, not only of all future human generations, but also the plants and animal species which thrived in the area thousands of years before people arrived.

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APPENDIX ONE

CHECKLIST OF ECOLOGICAL UNITS IN THE FOXTON ECOLOGICAL DISTRICT

Notes:

1. An ecological unit is "any combination of vegetation types, plus the landform it occurs on" (Myers et al. 1987). It is the basis for deciding that all the types of natural ecosystem in the ecological district have been identified. The following table uses the terminology for landforms which was discussed in Section 1.2.3 of this report, and for vegetation in Section 1.2.4.

2. Where a "protected" natural area has been recommended for protection (as with some recreation reserves) its ecological units are listed in the "unprotected" column.

SANDPLAIN

UNPROTECTED

Vegetation Composition	Structure	Ha.	Study Area
kahikatea-tawa	forest	2.2	RAP12, RAP20
kahikatea-pukatea	forest	1.2	RAP(2)2, RAP15
kahikatea-pukatea-titoki	forest	12	RAP(2) 10
kahikatea	forest	7	RAP14, 84, 85, 86,R25
kahikatea/(titoki)-(ngaio)	forest	4	RAP19
pukatea-kohekohe	forest	10	RAP4
pukatea-(tawa)-(kahikatea)	treeland	10	RAP18
Coprosma propinqua	scrub	10	RAP23, 149
Coprosma propinqua - flax	shrubland	25	RAP15, RAP(2)13
Coprosma propinqua-Olearia virgata	shrubland	1	RAP17
manuka	shrubland	10	50
manuka-toetoe	shrubland	1	89A
flax	flaxland	28	RAP9, RAP29
flax-(toetoe)/gorse	flaxland	20	251
flax-Coprosma propinqua	flaxland	3	RAP9
flax-toetoe(Coprosma propinqua)	flaxland	5	RAP9
cabbage tree/flax	flaxland	2	RAP11
Carex pumila	sedgeland	3	RAP(2)12
Carex pumila/halfstar	sedgeland	3	RAP27
jointed wire-rush	rushland	150	RAP24, RAP37
jointed wire-rush/Schoenus			

PROTECTED

Vegetation Composition	Structure	Ha.	Study Area
kahikatea-tawa-pukatea	forest	3	138
kahikatea-pukatea-swamp maire	forest	0.5	12
pukatea-(kahikatea)-(titoki)-(tawa)	forest	2	R17
pukatea/tawa-mahoe	forest	?	148
pukatea-swamp maire	forest	0.5	12
swamp maire-pukatea	forest	0.6	12
pukatea	treeland	7	148
Coprosma propinqua	shrubland	20	208
flax	flaxland	7	193
flax/Carex virgata	flaxland	0.5	12
(Swamp maire)/raupo	reedland	1	12
raupo	reedland	35	1, 9, 12, 193
Carex pumila - sand gunnera	sedgeland	20	248
club sedge - jointed wire-rush	sedgeland	100	D1
Cyperus ustulatus	sedgeland	0.25	12
Carex germinata	sedgeland	0.12	12

UNPROTECTED

Vegetation Composition	Structure	Ha.	Study Area
nitens	rushland	50	RAP27
Coprosma propinqua/jointed wire-rush	rushland	5	RAP26
toetoe/Coprosma propinqua) -(manuka)/jointed wire-rush	rushland	30	D11
pampas grass/jointed wire-rush	rushland	50	RAP24
jointed wire-rush-club sedge-exotic grasses	grassland	3	RAP(2)12
Limosella sp (unnamed)	herbfield	2	RAP45
mixed herb-grass	sandfield	1	RAP24
DUNE LAKE			
kahikatea-pukatea	forest	2	RAP15
cabbage tree/Coprosma propinqua	shrubland	0.5	RAP11
Coprosma propinqua - flax	shrubland	10	RAP15
flax	flaxland	12	RAP(2)9, RAP31,61
flax-raupo	flaxland	5	RAP29, RAP32
flax-raupo-Coprosma tenuicaulis	flaxland	2	RAP31
flax-raupo-(toetoe)	flaxland	0.1	232
flax-raupo/(Coprosma propinqua)/ Carex secta	flaxland	20	RAP21
flax-toetoe-(raupo)	flaxland	5	RAP(2)4
cabbage tree/flax	flaxland	10	RAP30

PROTECTED

Vegetation Composition	Structure	Ha.	Study Area
(flax)(Olearia solandri)/jointed wire-rush	rushland	15	210
sand gunnera - halfstar	herbfield	1	D1
Carex pumila/Limosella lineata	herbfield	0.25	245
Cabbage tree	treeland	5	169
Coprosma propinqua-C. propinqua x robusta	shrubland	2	194
Coprosma propinqua - (C. propinqua x robusta) - taupata	shrubland	1	11
Corprosma propinqua-flax/ Carex secta	shrubland	5	71
flax-koromiko - mixed shrubs	shrubland	3	71
flax	flaxland	12	262
flax-raupo	flaxland	5	71
flax/Carex secta	flaxland	?	169

UNPROTECTED

Vegetation Composition	Structure	Ha.	Study Area
raupo	reedland	24	RAP11, RAP34, RAP(2)9, RAP(2)15, 61, 98, 170, 238
raupo-flax	reedland	2	RAP(2)3
raupo/(koromiko)/Carex secta	reedland	1	281
raupo/(flax)/Carex secta	reedland	0.5	252
raupo/(Carex secta)	reedland	0.1	42
raupo/(Cyperus ustulatus)-(Carex secta)	reedland	10	102, 103
raupo/Schoenoplectus validus	reedland	2	RAP(2)3
raupo-bamboo spike-sedge	reedland	0.25	96
raupo-toetoe	reedland	1	RAP11
bamboo spike-sedge	sedgeland	1	RAP11
bamboo spike - sedge/waterlily	sedgeland	2	250
Isolepis fluviatilis - Cyperus ustulatus - Juncus sp.	sedgeland	5	238
Myriophyllum propinquum - Potamogeton sp.	dune lake	10	238

FOREDUNE

mahoe-kohekohe	treeland	5	RAP1
tauhinu/marram	shrubland	1.5	RAP27, RAP40
(taupata)-(flax)/Muehlenbeckia complexa - bracken	vineland	10	RAP2
pingao	sedgeland	25	RAP40, RAP43
spinifex	grassland	230	RAP24, RAP40, 37B, 89A, D4, Y5
spinifex-marram	grassland	100	D10
spinifex-marram-(pingao)	grassland	20	RAP27

PROTECTED

Vegetation Composition	Structure	Ha.	Study Area
raupo	reedland	62	cabbage tree/flax-toetoe flaxland161, 11, 64, 142, 161, 169, 194, 198, 208, 235, 242, 703 83
raupo/Schoenoplectus validus	reedland	2	198
Carex secta	sedgeland	2.5	11, 71
three-square	sedgeland	1	194
Isolepis prolifer	sedgeland	0.02	12
Potamogeton spp. - Chara sp.	dunelake	1.5	169
pingao	sedgeland	5	D1A

UNPROTECTED				PROTECTED			
Vegetation Composition	Structure	Ha.	Study Area	Vegetation Composition	Structure	Ha.	Study Area
sand coprosma-tauhinu/marram-spinifex	grassland	20	137				
				marram-spinifex	grassland	50	9, D1
				marram-spinifex-(pingao)	grassland	20	248
marram-(mixed shrubs)-(pingao)	grassland	10	D11				
pingao/sand convolvulus	herbfield	0.5	RAP24				
RELICT FOREDUNE							
mahoe-taupata	forest	20	RAP2				
Muehlenbeckia complexa	vineland	10	RAP2				
(taupata)-(flax)/Muehlenbeckia complexa-bracken	vineland	10	RAP2				
flax	flaxland	10	RAP2				
bracken	fernland	10	RAP2				
INCIPIENT FOREDUNE							
pingao-spinifex	sandfield	3	RAP36				
(spinifex)-(marram)-(pingao)	sandfield	40	D5				
TIDAL FLAT							
saltmarsh ribbonwood-searush	shrubland	10	RAP(2)5				
three-square	sedgeland	1	RAP13, RAP38				
raupo/three-square	sedgeland	1	89				
Bolboschoenus caldwellii	sedgeland	0.2	W2				
sea rush	rushland	30	RAP(2)14				
sea rush/halfstar	rushland	35	RAP(2)5				
sea rush - jointed wire-rush	rushland	1	RAP(2)5	sea rush - jointed wire-rush	sedgeland	1	9
saltmarsh ribbonwood/jointed wire-rush - sea rush	rushland	20	RAP22				

UNPROTECTED

Vegetation Composition	Structure	Ha.	Study Area
saltmarsh ribbonwood/jointed wire-rush - tall fescue	rushland	5	RAP13
jointed wire-rush/halfstar	rushland	0.25	RAP(2)5
jointed wire-rush-three square/halfstar	rushland	1	RAP13
flax-raupo/jointed wire-rush - Juncus acutus	rushland	10	RAP22
flax/saltmarsh ribbonwood/tall fescue	grassland	4	RAP13
halfstar	herbfield	5	RAP(2)5
halfstar - shore primrose-(glasswort)	herbfield	10	RAP22
glasswort-halfstar - (Triglochin striatum	herbfield	0.5	RAP(2)5
(three-square)/glasswort	herbfield	1	RAP35
glasswort - shore primrose	herbfield	5	RAP22
shore primrose (Triglochin striatum)	herbfield	10	RAP44
bachelor's button	herbfield	5	RAP22, RAP35, W2
bachelor's button/Triglochin striatum	herbfield	1	9A
Triglochin striatum - Lilaeopsis novae-zelandiae	herbfield	1	RAP38
sea rush - (pasture spp.)/sand gunnera - halfstar	herbfield	5	RAP(2)14

DUNE HOLLOW

kahikatea	forest	0.5	RAP6
pukatea-kahikatea	treeland	2	RAP8
flax	flaxland	0.25	Y16
jointed wire-rush	rushland	6	RAP(2)12, 89A
toetoe-flax/jointed wire-rush	grassland	0.5	RAP27

PROTECTED

Vegetation Composition	Structure	Ha.	Study Area
three square/shore primrose - bachelor's button	herbfield	1	9
mixed podocarp-broadleaf	forest	1.6	184B

UNPROTECTED

Vegetation Composition	Structure	Ha.	Study Area
SAND BASIN			
kahikatea-(pukatea)-(kohekohe)	treeland	3	RAP2
kahikatea-pukatea-titoki	treeland	10	RAP(2)11
manuka-raupo-(mixed shrubs)-(mixed sedges)	shrubland	3	R3
raupo	reedland	4	15
Carex pumila	sedgeland	0.25	RAP27
club sedge/halfstar	herbfield	0.04	RAP27
PARABOLIC DUNE			
kohekohe	forest	4	RAP8
kohekohe-(titoki)	forest	2	RAP6
mixed broadleaf	forest	10	RAP16
kanuka	forest	20	RAP16
tawa-kohekoke	treeland	1	43
kanuka-(mahoe)	treeland	20	88
(tauhinu)-(sand coprosma)/spinifex	grassland	2	RAP24

PROTECTED

Vegetation Composition	Structure	Ha.	Study Area
kahikatea-(pukatea)-(nikau)	forest	2	C01
mixed podocarp-broadleaf	forest	?	144
pukatea	forest	5	144
mixed broadleaf	forest	10	144
karamu-flax	treeland	3	A23
Coprosma propinqua	shrubland	3	144
raupo	reedland	2	144
tawa-kohekohe	forest	1	12
mahoe-ngaio	forest	0.14	12
pigeonwood	forest	?	148
kanuka	scrub	?	148
mahoe	scrub	0.2	12
manuka	shrubland	0.2	12
manuka/bracken	shrubland	0.08	12
mixed shrub/bracken-exotic grasses	grassland	?	148
bracken	fernland	?	148

UNPROTECTED				PROTECTED			
Vegetation Composition	Structure	Ha.	Study Area	Vegetation Composition	Structure	Ha.	Study Area
SANDRIDGE							
mixed broadleaf	forest	30	RAP32				
mixed broadleaf-(podocarp)	forest	4	RAP(2)7				
kohekohe	forest	2	RAP4,RAP(2)1				
titoki-rewarewa-(pukatea)	forest	2	RAP25				
(pohutukawa)/mahoe	forest	3	281				
titoki-pukatea	treeland	1	RAP(2)6				
poataniwha	treeland	1	RAP(2)11				
kanuka	scrub	20	RAP(2)8				
kanuka-poataniwha	shrubland	0.5	RAP18				
Coprosma propinqua	shrubland	2	RAP23				
SWALE							
mahoe-taupata	forest	10	RAP2				
tauhinu	shrubland	0.5	RAP40				
(taupata)-(flax)/Muehlenbeckia complexa-bracken	vineland	10	RAP2				
flax-toetoe	flaxland	5	W3				
flax-toetoe-(Coprosma propinqua)	grassland	40	RAP5				
Lilaeopsis novae-zelandiae-Carex pumila	herbfield	10	RAP43				
MARINE TERRACE REMNANT							
				ngaio-boxthorn/club sedge	treeland	1	D1
NZ iceplant-glasswort	herbfield	1	RAP40				
CLIFF EDGE							
Zoysia minima	grassland	1	RAP43, RAP45				

UNPROTECTED

Vegetation Composition	Structure	Ha.	Study Area
Zoysia minima - halfstar	grassland	<1	RAP41
halfstar	herbfield	<1	RAP45
glasswort	herbfield	<1	RAP41
glasswort-NZ iceplant	herbfield	1	RAP41, RAP39
shore primrose - Isolepis cernua	herbfield	<1	RAP41
shore primrose - Leptinella squalida	herbfield	0.2	RAP46
Lilaeopsis novae-zelandiae - Triglochin striatum - halfstar	herbfield	<1	RAP41
NZ iceplant	gravelfield	2	RAP45
CLIFF FACE			
ngaio-mahoe-karamu	treeland	0.1	Y6
flax	flaxland	2	RAP39
raupo	reedland	1	RAP39
(ngaio)/(kawakawa)-(Cortaderia fulvida)/tall fescue	grassland	0.5	W2
halfstar - (Lobelia anceps)	herbfield	0.01	RAP39
TALLUS SLOPE			
(ngaio)/(kawakawa)-(Cortaderia fulvida)/tall fescue	grassland	0.5	W2
COLLUVIAL LEDGE			
taupata/shore primrose	herbfield	0.01	RAP45

PROTECTED

Vegetation Composition	Structure	Ha.	Study Area
halfstar - Zoysia minima	herbfield	0.01	Y17

UNPROTECTED				PROTECTED			
Vegetation Composition	Structure	Ha.	Study Area	Vegetation Composition	Structure	Ha.	Study Area
SLUMP LEDGE							
(toetoe)-(raupo)/Cyperus ustulatus	sedgeland	1	RAP39				
FOOTSLOPE							
kahikatea	forest	5	RAP10				
mahoe-(cabbage tree)/(flax)	forest	3	281				
kohekohe	forest	2	RAP4				
rimu-tawa	treeland	1.5	RAP10				
				manuka	shrubland	?	71
TERRACE							
				tawa-titoki-(karaka)	forest	10	71
				tawa-titoki/mahoe-kawakawa	forest	<5	71
				tawa-titoki/(exotic grasses)	forest	2	71
				titoki-kohekohe-tawa	forest	<5	71
				mahoe	forest	<5	71
GULLY							
				kahikatea-pukatea-tawa	forest	<5	71
				pukatea-tawa-swamp maire	forest	<5	71
				flax-Coprosma tenuicaulis	flaxland	80	266
DUNE LAKE ISLAND							
karaka	forest	0.25	RAP42				
				karaka-ngaio-cabbage tree	forest	<1	71
				mahoe	forest	0.5	262
				flax-raupo	flaxland	0.06	12

UNPROTECTED

Vegetation Composition	Structure	Ha.	Study Area
FORMER RIVER CHANNEL			
karamu/flax	flaxland	5	RAP28
ALLUVIAL PLAIN			
kahikatea	treeland	0.25	RAP6

PROTECTED

Vegetation Composition	Structure	Ha.	Study Area

KEY TO PROTECTED NATURAL AREAS

Study Area	Name
1	McKay's Crossing Wildlife Management Reserve
9	Waikanae Estuary Scientific Reserve
11	Waimeha Lagoon Recreation Reserve
12	Nga Manu Sanctuary
71	Lake Papaitonga Scenic Reserve
138	White's Bush Open Space Covenant
142	Lake Omanu Wildlife Refuge
144	Round Bush Scenic Reserve
148	Himatangi Bush Scientific Reserve
161	Lake Koputara Open Space Covenant
169	Pukepuke Lagoon Stewardship Area
184B	Moore's Bush Open Space Covenant
193	Waimahora Swamp Stewardship Land
194	Blind Lakes Timberlands Covenant
198	Lake Koitiata Wildlife Management Reserve
208	Tunnel Hill Timberlands Covenant
210	Koitiata Domain Recreation Reserve
235	Lake Kohata Wildlife Management Reserve
245	Nukumaru Domain Recreation Reserve
248	Hawken's Lagoon Stewardship Area
262	Lake Waiau Wildlife Management Reserve
266	Ihupuku Swamp Wildlife Management Reserve
A23	Waitotara River Mouth Swamp Landcorp Covenant
C01	Lion Downs Bush Open Space Covenant
D1/D1A	Harakeke Dunes Scientific Reserve
Y17	Victoria Stewardship Area
70383	Kaikura Stewardship Area

APPENDIX TWO

COMMON AND FORMAL PLANT NAMES AS USED IN THE TEXT

Indigenous species (species marked * are growing outside of their natural range)

Common	Botanical
akeake	Dodonaea viscosa
bachelor's button	Cotula coronopifolia
bamboo spike sedge	Eleocharis sphacelata
bidibidi	Acaena novae-zelandiae/A. anserinifolia
bracken	Pteridium esculentum
broom	Carmichaelia arborea var.
bush lawyer	Rubus cissoides
cabbage tree	Cordyline australis
cliff epilobium	Epilobium komarovianum
climbing fuchsia	Fuchsia perscandens
club sedge	Isolepis nodosa
coprosma	Coprosma spp.
duckweed	Lemna sp.
five-finger	Pseudopanax arboreus
flax	Phormium tenax
glasswort	Sarcocornia quinqueflora
halfstar	Selliera radicans
hangehange	Geniostoma rupestre var. ligustrifolium
hinau	Elaeocarpus dentatus
hound's tongue fern	Phymatosorus diversifolius
jointed wire-rush	Leptocarpus similis
kahikatea	Dacrycarpus dacrydioides
kaikomako	Pennantia corymbosa
kamahi	Weinmannia racemosa
kanuka	Kunzea ericoides
karaka	Corynocarpus laevigatus
karamu	Coprosma robusta
karo	Pittosporum crassifolium
kawakawa	Macropiper excelsum
kiekie	Freycinetia baueriana var. banskii
kiokio	Blechnum sp. (unnamed, B. capense agg. "black spot")
kohekohe	Dysoxylum spectabile
kohuhu	Pittosporum tenuifolium
koromiko	Hebe stricta var.[1]
kowhai	Sophora microphylla
lacebark	Hoheria populnea var. [= H. sextylosa]
lancewood	Pseudopanax crassifolius
mahoe	Melicytus ramiflorus
mamaku	Cyathea medullaris
manuka	Leptospermum scoparium
mapou	Myrsine australis
marbleleaf	Carpodetus serratus
matagouri	Discaria toumatou
matai	Prumnopitys taxifolia
narrow-leaved maire	Nestegis montana
native convolvulus	Calystegia sepium
native passionfruit	Passiflora tetrandra
native puha	Sonchus kirkii
native spinach	Tetragonia trigyna
NZ iceplant	Disphyma australe
ngaio	Myoporum laetum
niggerhead	Carex secta
nikau	Rhopalostylis sapida
northern rata	Metrosideros robusta
Pacific azolla	Azolla filiculoides var. rubra
pate	Schefflera digitata
pigeonwood	Hedycarya arborea

pingao	Desmoschoenus spiralis
poataniwha	Melicope simplex
pohuehue	Muehlenbeckia australis
pohutukawa	Metrosideros excelsa
pokaka	Elaeocarpus hookerianus
ponga	Cyathea dealbata
poroporo	Solanum aviculare/S. laciniatum
puka	Griselinia lucida
pukatea	Laurelia novae-zelandiae
ramarama	Lophomyrtus bullata
rangiora	Brachyglottis repanda
raupo	Typha orientalis
rewarewa	Knightia excelsa
ribbonwood	Plagianthus regius
rimu	Dacrydium cupressinum
rohutu	Lophomyrtus obcordata
saltmarsh ribbonwood	Plagianthus divaricatus
sand bent	Deyeuxia billardierei
sand buttercup	Ranunculus acaulis
sand convolvulus	Calystegia soldanella
sand coprosma	Coprosma acerosa
sand daphne	Pimelea arenaria
sand gunnera	Gunnera arenaria (G. dentata var.)
sea celery	Apium prostratum subsp. australe
sea-rush	Juncus maritimus var. australiensis
sharp spike-sedge	Eleocharis acuta
shore primrose	Samolus repens
sphagnum moss	Sphagnum sp.
spinifex	Spinifex sericeus
supplejack	Ripogonum scandens
swamp kiokio	Blechnum minus
swamp maire	Syzygium maire
tarata	Pittosporum eugenioides
tauhinu	Cassinia leptophylla
taupata	Coprosma repens
tawa	Beilschmiedia tawa
three-square	Schoenoplectus pungens
titoki	Alectryon excelsus
toetoe	Cortaderia toetoe
totara	Podocarpus totara
towai	Streblus banksii
tree fuchsia	Fuchsia excorticata
turepo	Streblus heterophyllus
water milfoil	Myriophyllum propinquum
wharangi	Melicope ternata
wheki	Dicksonia squarrosa
wheki-ponga	Dicksonia fibrosa
white maire	Nestegis lanceolata
wineberry	Aristotelia serrata

Adventive Species

alder	Alnus glutinosa
arum lily	Zantedeschia aethiopica
beggar's ticks	Bidens frondosa
bitter-sweet	Solanum dulcamara
black medick	Medicago lupulina
blackberry	Rubus fruticosa agg.
boneseed	Chrysanthemoides monilifera
boxthorn	Lycium ferocissimum
buck's horn plantain	Plantago coronopus
Canadian fleabane	Conyza spp.
Cape daisy	Arctotheca calendula
celery-leaved buttercup	Ranunculus sceleratus
chickweed	Stellaria media

climbing dock	Rumex sagittatus
clover	Trifolium spp.
cocksfoot	Dactylis glomerata
Corsican pine	Pinus nigra
crack willow	Salix fragilis
creeping bent	Agrostis stolonifera
elderberry	Sambucus nigra
eucalyptus	Eucalyptus spp.
evening primrose	Oenothera stricta
floating sweetgrass	Glyceria fluitans
forget-me-not	Myostis laxa
gorse	Ulex europaeus
hare's tail	Lagurus ovata
hawkbit	Leontodon taraxacoides
honesuckle, Japanese	Lonicera japonica
inkweed	Phytolacca octandra
Jerusalem cherry	Solanum pseudocapsicum
jointed rush	Juncus articulatus
King Island melilot	Melilotus indica
lotus	Lotus pedunculatus
lupin	Lupinus arboreus
macrocarpa	Cupressus macrocarpa
magnolia	Magnolia sp.
Manchurian wild rice	Zizania latifolia
marram	Ammophila arenaria
Mercer grass	Paspalum distichum
old man's beard	Clematis vitalba
pampas	Cortaderia selloana
pearlwort	Sagina procumbens
pine	Pinus radiata
poplar	Populus spp.
pussy willow	Salix cinerea [mostly]
pyp grass	Ehrharta villosa
ragwort	Senecio jacobaea
redroot	Amaranthus spp.
rhododendron	Rhododendron spp.
ripgut brome	Bromus diandrus
sheoak	Casuarina japonica
sharp rush	Juncus acutus
strawberry clover	Trifolium fragiferum
tall fescue	Festuca arundinacea
Tasmanian ngaio	Myoporum insulare
thistle	several genera/species
veld grass	Ehrharta erecta
wandering Jew	Tradescantia fluminensis
water lily	Nymphaea spp.
wattle	Acacia longifolia var. (A. sophorae mostly)
willow	Salix spp. (S. fragilis mostly)
Yorkshire fog	Holcus lanatus