PART I:

RESOURCE DESCRIPTION

This part provides a brief description of Northland's land and water resources.

1. NORTHLAND'S LAND AND WATER RESOURCES

This section broadly describes Northland's geology, soils and types of water bodies.

1.1 NORTHLAND'S GEOLOGY AND RESULTING LANDFORMS

Northland consists of a long narrow peninsula, less than 100 km across at its widest point, bounded by the Tasman Sea to the west and the Pacific Ocean to the east. There are no significant mountain ranges and the highest point, Te Raupua in the Waima Range, is only 781 metres above sea level.

Northland's geology is a mixture of basement rock (greywacke), volcanic rock, sedimentary rocks, alluvial material and sands. A generalised map of the geology of Northland is shown in Figure 1.

Uplifted blocks of hard blue-grey sandstone or greywacke extend along the east coast from north of the Bay of Islands as far south as the Brynderwyn range, and inland from Whangarei. To the west of these surface outcrops, greywacke forms a basement deep beneath various sedimentary and volcanic rocks. Old volcanic rock outcrops are among the most dramatic features of the Northland landscape. These outcrops extend down the eastern side of Northland from North Cape to Mount Manaia and Whangarei Heads. On the west coast, similar outcrops are a feature of the landscape from Turiwiri to Tinopai.

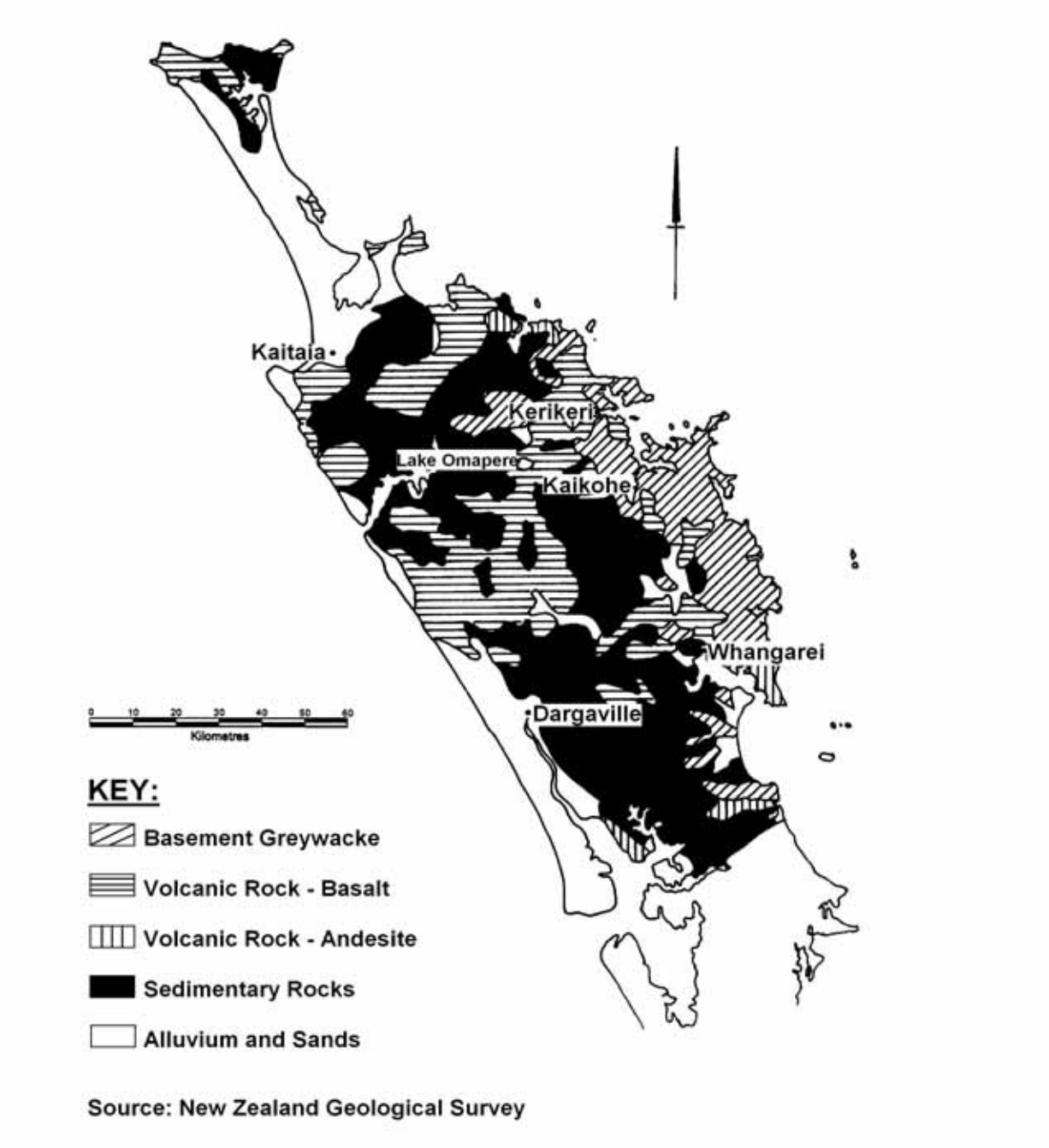
Basalt lava flows over soft sedimentary rocks form the plateau landforms of much of central Northland. The eroded cones of older volcanoes extend along fault lines south of the Brynderwyns, north of Whangarei Harbour, and from Kaikohe to Matauri Bay. Younger scoria cones are features of the landscape around Whangarei and Kaikohe.

The low hill country of the region consists of a complex mix of soft sedimentary sandstone, mudstone, argillite and limestone rocks. This mix also contains large blocks of volcanic rock which form Northland's most prominent ranges. Material eroded from surrounding hills forms the Hikurangi swamp, the Waipu-Ruakaka flats and the Awanui flats. Sediment from Northland's largest river, the Northern Wairoa, forms the most extensive area of flat land in the region, the Northern Wairoa and Ruawai Flats.

Rising sea levels have drowned river valleys to create several harbours which extend well into the interior of the region. As a result, rivers tend to be short, dropping quickly in bouldery streams from higher country, and then meandering sluggishly through mangrove lined channels into harbours and estuaries.

Sand, originally from the Waikato River, has been transported northwards along the west coast to form South Head, Pouto Peninsula and the Kaipara Harbour. In the Far North, sand deposited between the mainland and near-shore islands has created the Aupouri and Karikari peninsulas. Similar sand movement and deposits along the east coast have created numerous examples of sandspits enclosing estuaries and sheltered harbours.

FIGURE 1: MAJOR GEOLOGY TYPES IN NORTHLAND



1.2 NORTHLAND'S SOILS

Northland lies outside New Zealand's belt of vigorous geologic activity and has, for millions of years, remained relatively calm. The low relief, the absence of any deposits from recent ash showers, the warm moist climate and the original vegetation have combined to cover much of Northland in strongly leached, mature, heavy clays. Generally, topsoils are thin and subsoils are of low fertility. The main exceptions are the fertile volcanic soils, young alluvial deposits and the young soils developing on unstable steep slopes.

The composition of the original indigenous forest shows an important relationship to the soil properties. Trees with acid litter, such as kauri, totara, rimu and kahikatea, have produced strongly leached soils, with the kauri producing the well-known gumland soils. By contrast, the broadleaf trees, including puriri, kohekohe, taraire and tawa, have returned nutrients to the soil through rapid decomposition of dead leaves, twigs and bark, giving mellow, fertile top soils.

The soils of Northland can be broken up into seven major groups and are shown in generalised form in Figure 2.

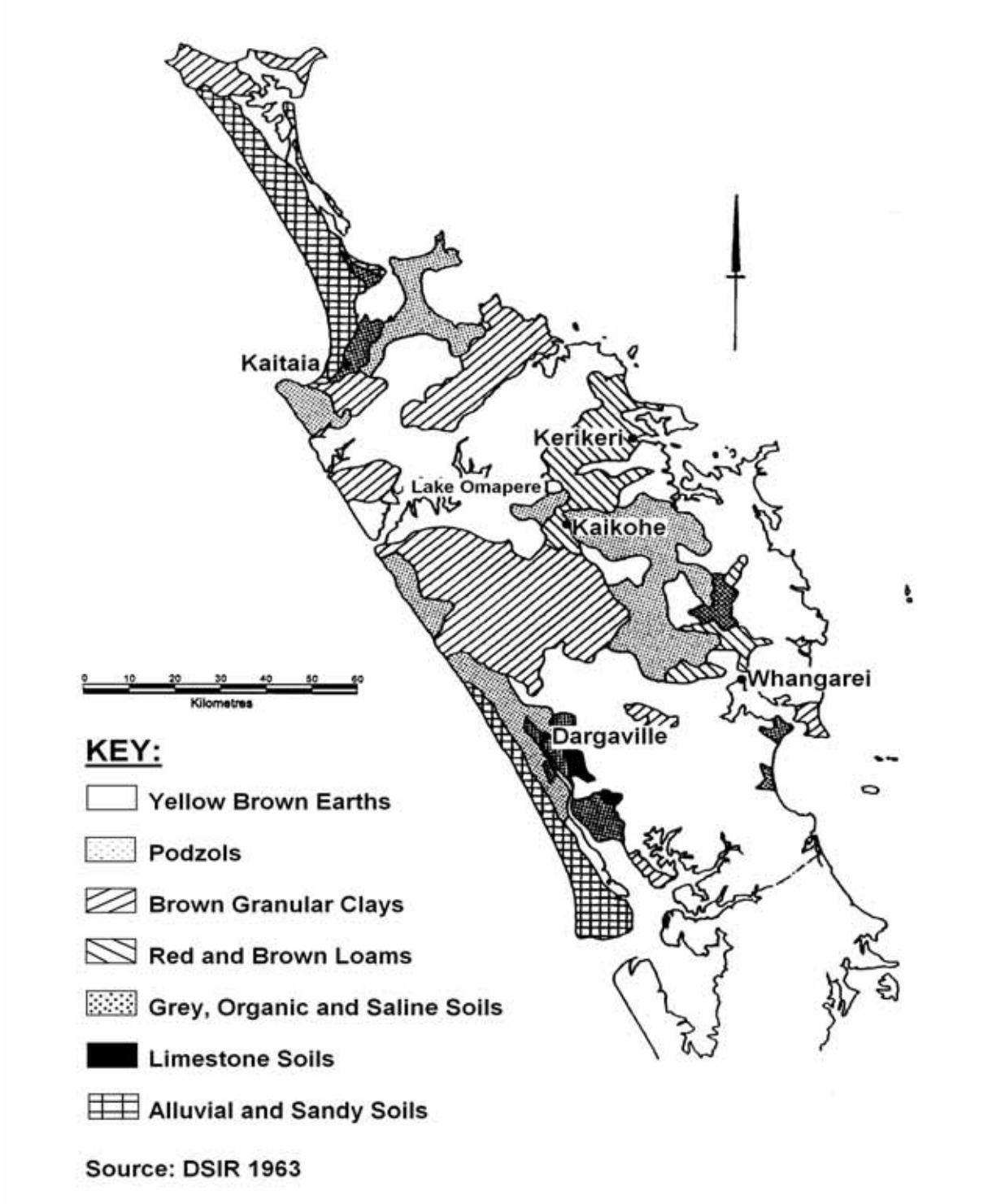
1.2.1 Yellow-Brown Earths

These are soils formed from sand, mudstone, claystone, sandstone, greywacke, dacite and from alluvial deposits from sedimentary rocks. They are by far the most common soil types found in Northland and approximately 90 separate and different yellow brown earth types have been mapped. They have greatly varying levels of fertility, ranging from the fertile Waiotira soils to the podzolised Wharekohe gumland soils of very low natural fertility. This group also includes such diverse soils as the friable Redhill sands and the heavy gleyed soils of the river flats. Yellow brown earths cover most of the low hill country of Northland and include all those referred to as "clay hill" soils. On steeper land, these soil types are prone to slipping, particularly during heavy rain, while on the easier, more deeply weathered soils, gully erosion can be a problem during land development. On some hill country, erosion can expose acid shales which not only contribute sediment to streams but are also very difficult to stabilise or revegetate.

The term 'gumland' refers to the strongly weathered, strongly leached, and usually podzolised yellow brown earths. Where strongly podzolised, a silica pan exists in the subsoil that causes them to become very boggy during wet conditions and very dry during droughts. In their natural state, these soils support only stunted scrub vegetation. However, if heavy topdressing, liming and replacement of trace elements is carried out, together with drainage, they are capable of high production.

Apart from the Northern Wairoa-Ruawai and Awanui Flats, the small areas of alluvial soils in Northland usually have a heavy texture and require extensive subsurface drainage to enable even pastoral production. The more mature soils may not be suited to subsurface drainage.

FIGURE 2: MAJOR SOIL TYPES IN NORTHLAND



1.2.2 Brown Granular Clays (Semi-Volcanic Soils)

Brown granular clays are formed from andesitic rock material and are extensive on rolling to moderately steep land in Northland. They are friable with medium to high fertility in the younger soils. The older soils are more strongly leached with a high clay content. With inadequate fertiliser or overgrazing, these soils are prone to serious sheet erosion. Subsoils are high in aluminium and are very difficult to revegetate when exposed by erosion. When surface runoff carries soil particles into water, the colloidal nature of the particles can result in their remaining in suspension for long periods, and even in low concentrations can cause major discolouration.

1.2.3 Red and Brown Loams (Volcanic Soils)

Red loams are formed from scoriaceous basalt on the sides of volcanic cones. Brown loams are developed from basalt rock and are most extensive on rolling to flattish plateaux. Red and Brown loams have formed over a wide time period, and range from the young free draining Papakauri and Kiripaka soils to the mature Okaihau soils. The mature soils are characterised by the formation of iron nodules (the aggregation of materials including oxides of iron, aluminium and manganese). Under cultivation, all these soils are prone to sheet erosion and rilling, even on easy slopes. The layer of ironstone nodules can impede drainage and ripping is required before tree planting for forestry or horticulture.

1.2.4 Gley Organic and Saline Soils

These are low-lying soils derived from alluvium, peat or marine sediment and are found in small pockets throughout Northland. If drainage is practicable, they can be highly productive. The largest areas are at Awanui and the Ruawai and Northern Wairoa flats. Care must be taken not to overdrain peat soils as they are difficult to re-wet and are susceptible to wind erosion and burning.

1.2.5 Limestone Soils (Rendzinas)

Medium to high fertility soils derived from limestone are found in small patches throughout Northland, with larger areas in the Kaipara District. Although they are heavy, with poor subsoil drainage and are subject to drying out in the summer, they produce high quality pastures.

1.2.6 Sandy Soils

Soils on the dunes and sandy marine deposits along the west coast of Northland and, to a much lesser extent, the east coast, vary in age and soil development from recently stabilised dunes to the mature and podzolised gumland sands. These older soils exhibit the features of Yellow-Brown Earths and have been included in that group. The younger soils are prone to wind erosion and gullying particularly when the thin surface soils are disturbed by overgrazing, insect pests, rabbits, cultivation and tracking. The unconsolidated sand, once exposed, can quickly develop into sand drifts.

1.3 USERS OF THE LAND RESOURCES

Northland's economy is predominantly based on the productive capabilities of the land. Approximately 59% of the land is in pasture, while 10% is planted in production forests and 0.6% in orchards or crops. The remaining area not directly used for productive purposes is generally native forest on steep lands which has important water and soil protection values.

The region has around 125,000 ha of planted production forest. It is estimated that Northland economy currently earns $71 million a year from forestry. This is predicted to increase to over $380 million a year over the next twenty years.

The region has a well developed horticultural industry, centred mainly around the growing of avocados, citrus, kiwifruit, kumara, squash and flowers. Around 2,300 ha are currently planted in fruit crops and 3,500 ha in market gardens. Most fruit crops, particularly citrus and kiwifruit are grown in the Bay of Islands and Whangarei areas. Farming earns around $1 billion a year in total for the region, of which the dairy processing industry contributes some $630 million per annum. The land resource is also important for the continued survival of indigenous flora and habitats of indigenous fauna.

Mining is a significant contributor to the regional economy. High quality ceramic clay operations are based at Matauri Bay and silica sand is taken from the Parengarenga Harbour. Limestone is recovered for agricultural purposes and cement manufacturing. The Portland quarry and associated cement works south of Whangarei is the largest in the country.

1.4 NORTHLAND'S WATER RESOURCES

The fresh water resources in Northland can be found in three broad forms: rivers and streams, lakes and wetlands, and groundwater.

1.4.1 Rivers and Streams

Northland has a dense network of rivers and streams, many of which are relatively short, with small catchments. Most of the major rivers have their outlets into harbours; few discharge directly to the open coast. The Northern Wairoa River is Northland's largest river. It drains a catchment area of some 3650 square kilometres, or 29% of the land area in Northland. Figure 3 shows the major rivers and their catchments.

The flow regimes of Northland's rivers are mainly influenced by climate and geology.

Northland's rainfall distribution pattern results from its narrow shape and its topography. Annual rainfalls range from 900 millimetres in low-lying coastal areas to over 2,900 millimetres in higher altitude areas such as Tutamoe Plateau. Seasonal influences on rainfall are well defined due to the seasonal movement of high pressure belts. Rainfall is highest in winter and lowest in summer, with up to one third of the annual total often falling in the three winter months. Northland also experiences high intensity rainfalls which can result in flash floods.

The marked seasonal rainfall pattern is reflected in the broad seasonal pattern of higher flows during winter months and lower flows during summer months. Most rivers have only 10-20% of the yearly flow in summer flows.

Northland's variable geology also has a major influence on flow regimes. Some types of rock allow water to pass through them much more easily than others. In Northland, the fractured basalt rocks readily absorb rainfall and slowly release it through springs. This slow release sustains the flow during dry periods. Catchments of less pervious geology absorb less rain and therefore have less water available in storage. Flows from these catchments tend to recede quickly during dry summer months, with little sustaining baseflow.

On rolling sand country, rainfall infiltrates quickly into the ground flowing as groundwater rather than streamflow. Many streams on the Aupouri Peninsula have little or no baseflow.

Mean annual low flows for Northland rivers with long periods of flow records are shown in Table 1, along with an estimation of the 1 in 5 year, 7 day low flow. The estimation is relevant only for that period of record shown.

TABLE 1: LONG-TERM RIVER FLOW RECORDER STATIONS IN NORTHLAND

Catchment Name	Recorder Site Name and Number	Catchment Area Above Recorder Site (km^2)	Predominant Geology	Period of Record	Mean Annual Low Flow Based on Daily Average (l/sec)	1 in 5 Year, 7 Day Low Flow (l/sec)
Awanui	School Cut 1316	222	Mixture of mudstones, sandstones and old volcanics	1958-2003	557	460
Mangakahia	Gorge 46618	246	Volcanics (60%), mudstone, sandstone (30%)	1960-2003	1451	1171
Maungaparerua	Tyrees Ford 3506	11.1	Basalt (volcanic)	1967-2003	33	23
Ngunguru	Dugmores 4901	12.5	Greywacke	1969-2004	79	61
Mangere	Kara Weir 46609	12.3	Greywacke	1975-1993	59	48
Manganui	Permanent Station 46651	411	Mudstone, sandstone	1960-2004	276	154
Waipapa	Forest Ranger 46804	122	Greywacke	1978-2003	709	559
Waitangi	Wakelins 3722	302	Basalt, shale	1979-2003	966	552
Waiotu	SH1 46627	125	Greywacke	1987-2000	233	197
Whakapara	Cableway 46632	162	Greywacke	1959-2000	851	653
Waipao	Draffins Road 46641	36.7	Basalt (Volcanics)	1979-2000	239	208
Wairua	Purua 46644	544	Greywacke, alluvium, some volcanics	1961-2000	1850	1450
Mangere	Knights Road 46646	79	Greywacke and sandstone	1983-2000	119	102
Wairua	Wairua Bridge	707	Mixture of greywacke, sandstone and basalt	1961-2000	2250	1780
Mangaharuru	County Weir 46647	20.5	Greywacke	1961-2000	105	78
Kaihu	Gorge 46611	116	Volcanic	1970-1995	718	609

FIGURE 3: MAJOR RIVERS, CATCHMENT AREAS AND LAKES IN NORTHLAND

KEY:

A Awanui River
B Oruru & Oruaiti Rivers
C Whangaroa Hbr / Kaeo River
D Kerikeri River
E Waitangi River
F Kawakawa River
G Whangarei Hbr / Hatea River
H Ruakaka & Waipu Rivers
I Oruawharo & Arapaoa Rivers

Northern Wairoa River
J Manganui River
K Kaihu & Awakino Rivers
L Tangowahine & Kirikopuni Rivers
M Mangakahia River
N Wairau River

O Waipoua River
P Punakitere & Waima Rivers
Q Waihoe & Utakura Rivers
R Mangamuka & Otukere Rivers

1 Aupouri Peninsula Lakes
2 Lake Omapere
3 Kai Iwi Lakes
4 Pouto Dune Lakes

The geology and associated soils also influence the chemistry of the water in streams. Natural water quality is therefore variable from catchment to catchment as geology changes. For example, if the underlying rock and soils have naturally high phosphate levels, then water which drains that land is also likely to have high phosphate levels. Geothermal activity, such as around Ngawha, also strongly influences the chemistry of the water in the catchment.

Rivers and streams provide habitats for a wide range of species of indigenous fauna and flora. Rivers and streams are important to native fish which must migrate between freshwater and the sea in order to complete their life cycle. Natural barriers, such as waterfalls, limit the number of potential habitats for these native fish. Man-made barriers can adversely affect migratory fish. These barriers may be physical (for example a dam in a stream), chemical (discharges which are low in dissolved oxygen or high in ammonia) or biological (a manmade change in the migration route may increase the fish's vulnerability to predators).

The type and quality of rivers and streams as aquatic habitats is determined by many factors. Natural factors such as gradient and the underlying geology have a major influence. Rivers and streams can be broadly described as hard bedded or soft bedded. Hard bedded systems are usually of moderate gradient and have a bed component of bedrock, boulders, cobbles and sands. Such environments generally offer better habitat to aquatic life than do soft bedded environments comprising fine sands and silts. Superimposed on these features are land uses. Native bush catchments enhance instream values. At the other end of the spectrum, open pastoral settings offer different habitats.

The potential for the degradation of water quality in rivers and streams increases as the catchment area increases. The headwaters of streams, or streams in short catchments are generally of a quality suitable for most uses because of the relatively small influence of runoff from adjacent land uses. Further down the catchment where the contributing area is large, the degradation may be such that the potential uses of the water may be limited to stock watering or industrial purposes.

1.4.2 Lakes and Wetlands

Northland has a large number of small and generally shallow lakes and associated wetlands, most of which have been formed between stabilised sand dunes along the west coast. These dune lakes are grouped on the Aupouri, Karikari and Pouto Peninsulas. They vary in size, with the majority being between 5 and 35 hectares in area and generally less than 15 metres deep. Lake Taharoa of the Kai Iwi Group is one of the largest and deepest dune lakes in the country, covering an area of 237 hectares and being 37 metres deep.

The dune lakes in the region generally have little or no continuous surface inflows or outflows, being primarily fed by rainfall directly onto their surfaces and surrounding wetlands. As a result, their levels fluctuate considerably with climatic patterns. As most of the lakes are relatively small and shallow, they have limited capacity to assimilate any contaminants. They are prone to nutrient enrichment from stock and fertiliser, particularly where lakeside vegetation has been grazed or removed, and where there is direct stock access to the lake.

The region also has several inland lakes which were formed through the damming of valleys by lava flows. Two such lakes are Lake Omapere and Lake Owhareiti near Kaikohe. These lakes have special spiritual and cultural significance to the tangata whenua.

Wetlands can make a significant contribution to water quality and natural hazard mitigation. There are many remnant wetlands in Northland, including some relatively large inland wetlands. These include Hikurangi Swamp, the Motatau Wetlands, and other wetlands in the mid catchments of larger rivers such as the Manganui/Tauraroa. Wetlands associated with dune and gumland areas and adjoining the coast are also important; a number of those on the Poutu Peninsula, Kaimaumau and in the Bay of Islands being considered habitats of international significance. The original area of wetlands has been greatly reduced due to drainage and conversion to agricultural uses. In just five years between 1978 and 1983 there was a 14.4% reduction in freshwater wetlands. The remaining wetlands tend to be small and scattered, and continue to be vulnerable to changes in hydrologic regimes and to the effects of stock grazing and further land development.

These lake and wetland ecosystems are important habitats for a wide variety of plant and animal species, some of which are regionally or nationally significant because of their rarity. These include birds such as the brown teal, banded rail, New Zealand dabchick, marsh crake, fern bird and bittern, the aquatic plants *Hydatella inconspicua, Myriophyllum robustum* and native freshwater fish including the giant kokopu, banded kokopu, short jawed kokopu and dwarf inanga.

1.4.3 Groundwater

There are three main types of geological formations associated with groundwater in Northland. These are sands and gravels, volcanic cones and related lava flows and sedimentary rocks such as greywacke and limestone. The main aquifers (rocks which store water) are the Aupouri sands, Kaikohe basalts and Whangarei basalts. There are a number of smaller sand and gravel coastal aquifers such as those at Russell, Matapouri and Taipa. A number of smaller less productive greywacke aquifers are situated throughout the region.

Northland's rainfall distribution pattern also influences groundwater recharge. Groundwater recharge tends to occur in winter months due to the heavier and more consistent rainfall. A reduction in summer rainfall can occur with little impact on groundwater levels but drier than normal conditions during winter months can result in reduced recharge. The critical factor affecting late summer groundwater levels is the length of time since the last significant recharge (rainfall) event.

The water in some aquifers is high in iron which makes it unpalatable, even to stock. Treatment is required before it can be used as a water supply. In areas where the aquifer is unconfined (i.e. rainwater can infiltrate directly into the saturated zone), there is a risk of pollution of the groundwater through discharges of contaminants to land. In general, groundwater quality is high enough to allow the water to be consumed without treatment.