ABSTRACT

The lower Wairarapa Valley was an estuary as late as 6 500 years ago. Since then sediments from the Ruamahanga and Tauherenikau Rivers have deposited large loads of sediment into the area, prograding the eastern shore and changing the system from an estuary into lakes and rivers.

The aims of this study were to investigate the late Quaternary deposits and soils of the eastern shore of Lake Wairarapa, using the information gained to look at the way in which infilling has taken place.

The surface geology and soils of the study area were mapped. The mapping units were described and defined. Some chemical tests were carried out on selected soil samples.

The order and method of infilling of the deposits are discussed.

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CHAPTER ONE: INTRODUCTION.

1.1.0 Aims and scope of study.

The primary aim of the study was to map the late Quaternary deposits on the eastern shore of Lake Wairarapa. Specifically to:

(a) Examine the history of infilling of the study area by fluvial and fluvio-lacustrine sediments, i.e. the development of deltas into the lake.

(b) Examine the chronosequence of sand dunes around the lake margin.

(c) Produce a soil map and detail land resources of the area.

Late Quaternary deposits, physiographic units and soils of the study area were mapped at a scale of 1:25 000.

When describing properties of the landscape and in particular soils, morphology, rather than detailed chemical and physical tests was used as a basis for interpretation. A few chemical analyses were carried out on soil samples however, to reveal broad trends in soil chemical properties. These were:

(1) pH in H_2O, KCl and $CaCl_2$,

(2) C%,

(3) N%,

(4) C/N ratio,

(5) inorganic, organic and total P.

1.2.0 Location and setting of the study area.

1.2.1 Location and extent of study area.

The study area lies on the eastern shore of Lake Wairarapa in southern Wairarapa Valley. Its boundaries are the lake margin in the north-west, the former Ruamahanga River channel in the south-west, Kahutara Road in the south-east and Mangatete Stream in the north-east (figure 1). These boundaries enclose an area of just over 4 100 hectares (approximately 10 150 acres).

An additional area outside the above boundaries, is the large north-east to south-west trending dune line lying just east of the study area. It was studied to complete the chronosequence of dune soils (figure 1).

1.2.2 Setting of the study area.

Wairarapa Valley is a structural depression 77km long and up to 20km wide that plunges south to Palliser Bay (Kamp and Vucetich 1982). It is bounded to the west by the Rimutaka and Tararua Ranges, and to the east by the Eastern Hills and Aorangi Mountains (figure 2). The southern end of the valley is flat and low lying (Heine 1975).

Lake Wairarapa sits at the head of a riverine and lacustrine complex which ends at Lake Onoke (Wairarapa Catchment Board A). Water discharges from Lake Onoke into Palliser Bay through an outlet in the shingle bar which separates Lake Onoke from the sea (figures 1, 2 and plate 1). When the outlet is open Lake Onoke is estuarine, tidal fluctuations to a height of 0.5m affecting up to 25km of the Ruamahanga River. At times this regular backflow carries salt water into Lake Wairarapa as evidenced by the presence of salt water dependent plants in places around the lake (Wairarapa Catchment Board 1985).

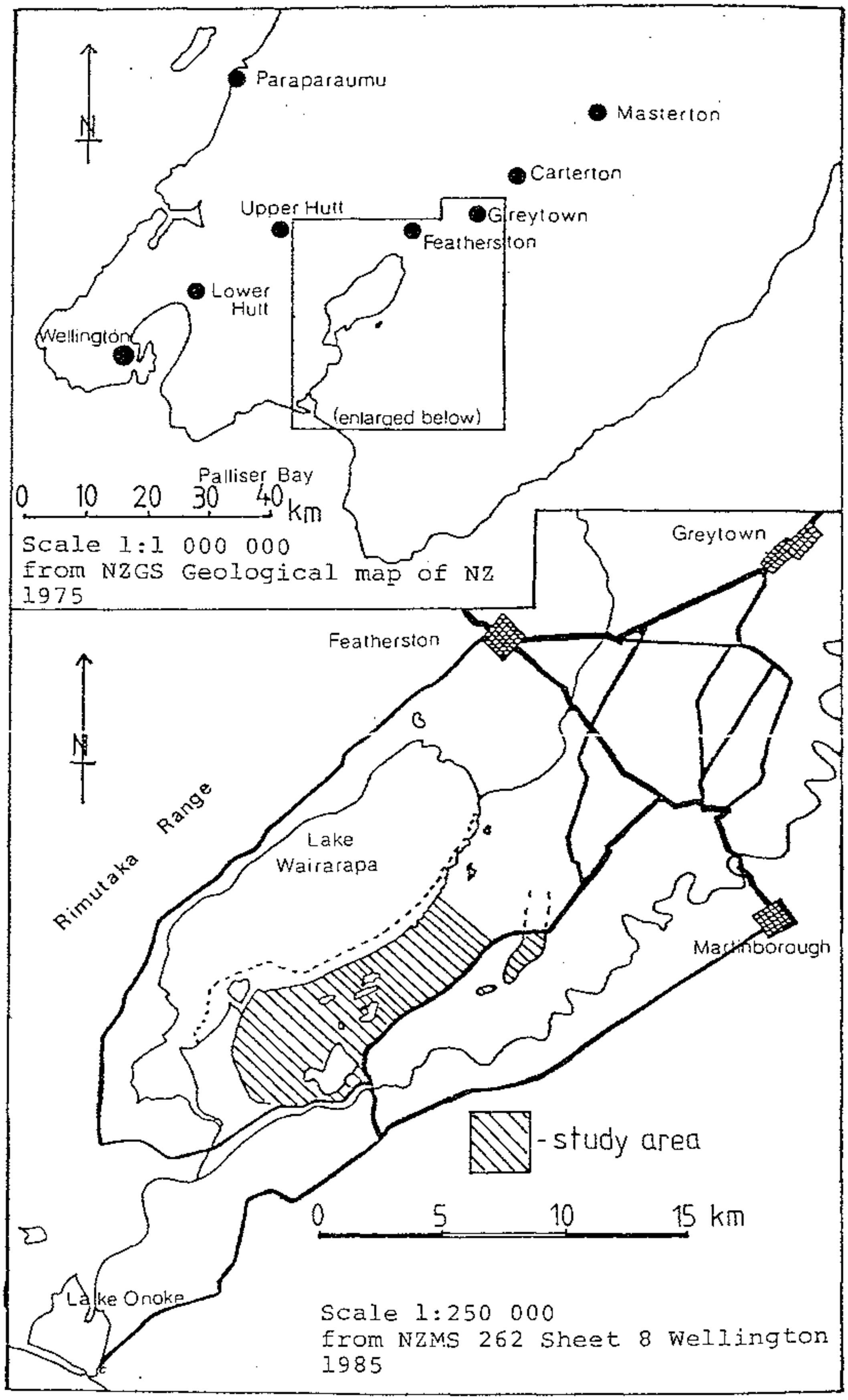

Figure 1 Location of the study area.

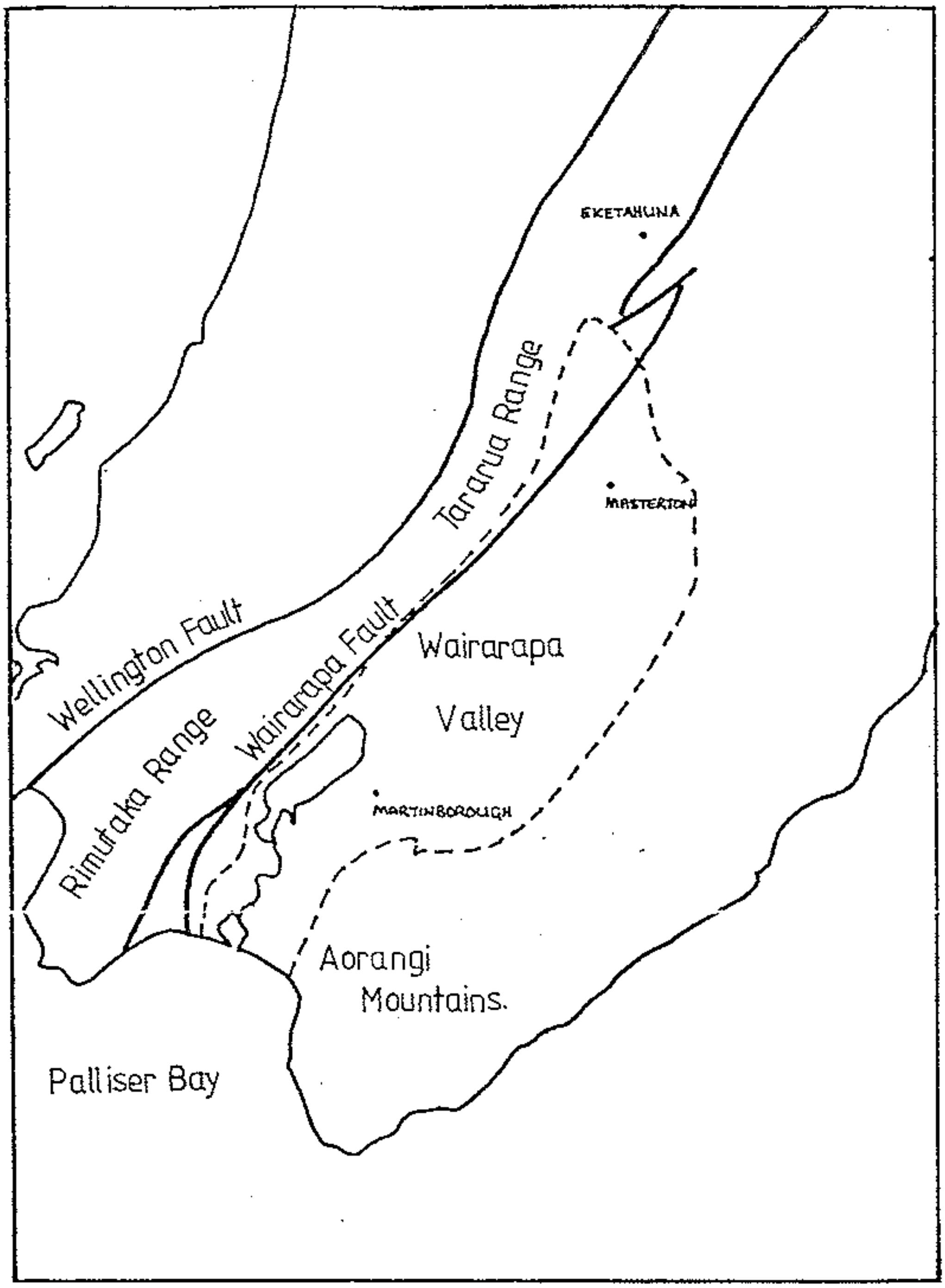

Figure 2 Extent of the Wairarapa Valley

Wairarapa valley (the area within the dashed line) is 77 km long and up to 20 km wide. The Western boundary is marked by the steep eastern face of the Rimutaka and Tararua Ranges, and the eastern boundary by the Aorangi mountains.

Plate 1 Lake Wairarapa and the Onoke bar

Lake Wairarapa (top right) heads a riverine and lacustrine complex which ends at Lake Onoke (middle left) when water enters Palliser Bay via an outlet in the shingle bar. At the top right of the photo can be seen the diversion channel which prevents normal flow from entering Lake Wairarapa.

LAKE WAIRARAPA.

Lake Wairarapa is a large shallow lake with a length of approximately 18km and a width of about 6km, its length-wise axis striking north-east almost parallel to the Rimutaka Range (Wairarapa Catchment Board 1985). At normal levels it has an area of 7 800 ha (similar to Wellington Harbour), a maximum depth of approximately 2.6m and an average depth of only 1.37m (Voice 1982, Wairarapa Catchment Board A).

Reduction of lake level in summer exposes extensive areas of flats, particularly on the eastern side where the Tauherenikau and Ruamahanga Rivers have formed large deltas where they enter the lake. The Tauherenikau delta contains coarse sand and gravel while the Ruamahanga River delivers large quantities of sand and finer material (Voice 1982, Palmer 1982).

The shallowness of the lake means that strong persistent winds create wave action stirring up sand and silt from the bottom, large quantities of suspended sediments giving the lake a brown turbid appearance. In calm conditions these suspended sediments, along with sediment carried into the lake by tributaries, settle out onto the lake bottom or on the mud and sand flats of the eastern shore (Wairarapa Catchment Board 1985, Voice 1982).

The strong winds also cause 'set up' to occur across the lake, prevailing westerly winds pushing water in front of them, tilting the water surface and lifting levels on the eastern side (figure 3). A difference of 1.2m in level has been measured from west to east across the barrage at the southern end of the lake. The nodal point (i.e. zero water level change) is closer to the western shore leading to the set up on the eastern shore being approximately fifty percent greater than the set down on the western side. The winds create steep, breaking waves, up to 1m in height, these winnow silt and clay from the sediments along the eastern shore, leaving the sand fraction behind. Waves of more than 45cm occur less than one percent of the time (Pickrill and Irwin 1978, Wairarapa Catchment Board 1985, Voice 1982).

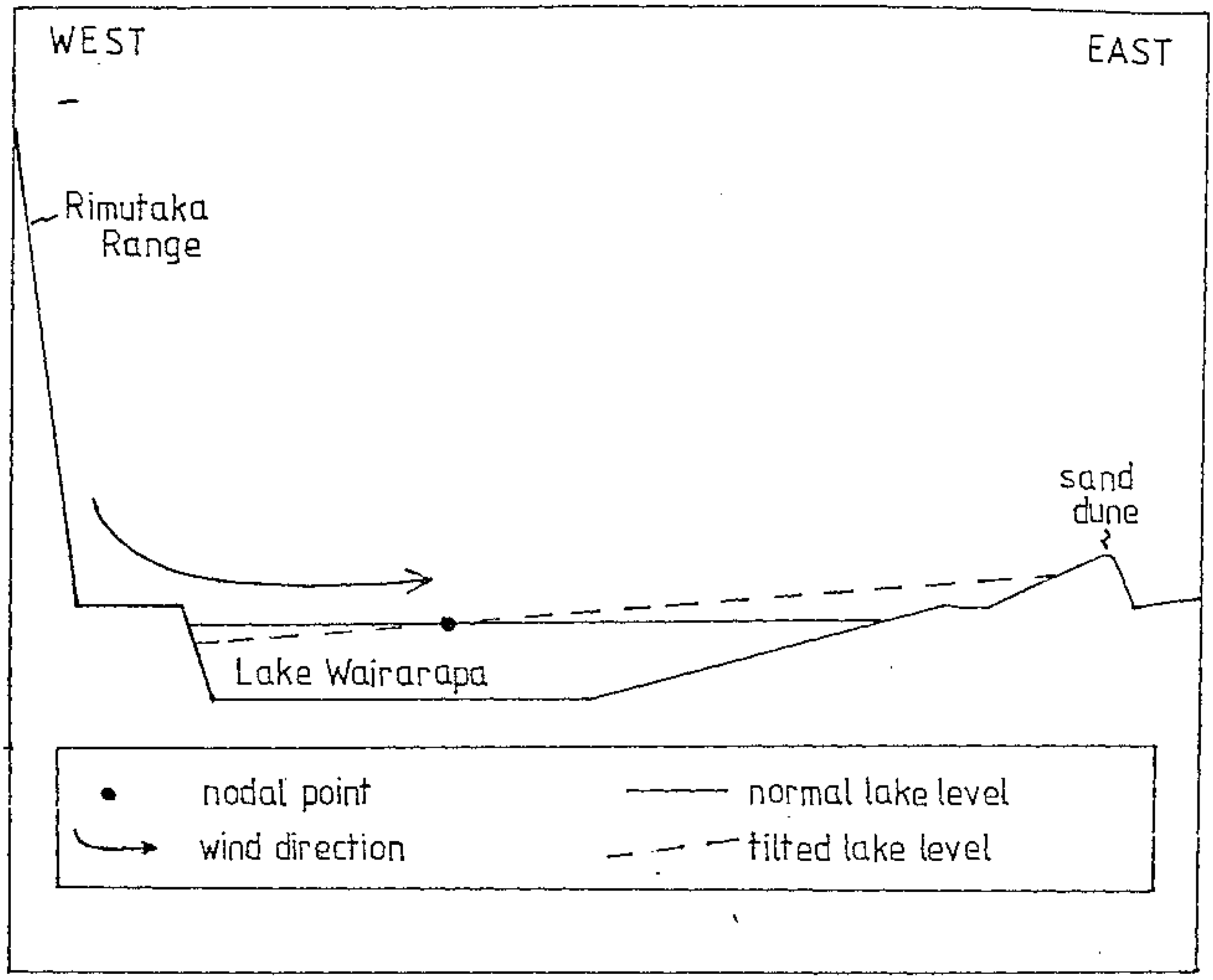

Figure 3 Illustration of set up.

The block diagram above (not to scale) illustrates the phenomenon of set up. This occurs when strong winds push up water in front of them, tilting the lake surface. The nodal point is the point of zero change of water level. As it is closest to the western shore the amount of fall in lake level on the western side is less than the rise in lake level on the eastern side.

HIGHEST HOLOCENE SHORELINE AND MARINE CUT TERRACES.
Around Lake Wairarapa are found beach ridges, sand dunes and cliffs cut into older surfaces (Palmer 1982, Heath 1979). Their distribution, and the discovery of *in situ* shell beds composed of typically estuarine species buried beneath lake and river sediments, show that the area was recently occupied by an estuary (Leach and Anderson 1974). The outermost features represent the furthest incursion of the post-glacial sea level, and therefore mark the highest Holocene shoreline (HHS) (figure 4), (Heath 1979).

Within the study area are a series of dune lines, parallel to the eastern shore of Lake Wairarapa. The oldest outermost dune sits above a cliff cut by the HHS. The succession of dune lines is associated with the receding shoreline of the estuary/lake since the dune formed (Heath 1979, Palmer 1982).

The Holocene incursion is not the first to occur in the Wairarapa Valley. Terraces found on both sides of the valley were formed by previous marine incursions. These marine terraces or marine benches were created by the landward cutting of a marine cliff, and have been preserved from subsequent high sea-levels by regional tectonic uplift (Ghani 1978, Palmer 1982).

1.3.0 Climate of southern wairarapa.

The weather of the Wairarapa region is controlled to a large extent by the presence of the Rimutaka and Tararua Ranges (Figure 2). These ranges exert a strong influence on the distribution of rainfall in the valley, as well as modifying wind directions (Thompson, 1982).

WIND
The Wairarapa region is windy, particularly in spring and summer. Cook Strait and Manawatu Gorge tend to funnel westerly winds, producing south-westerly and north-westerly winds respectively.

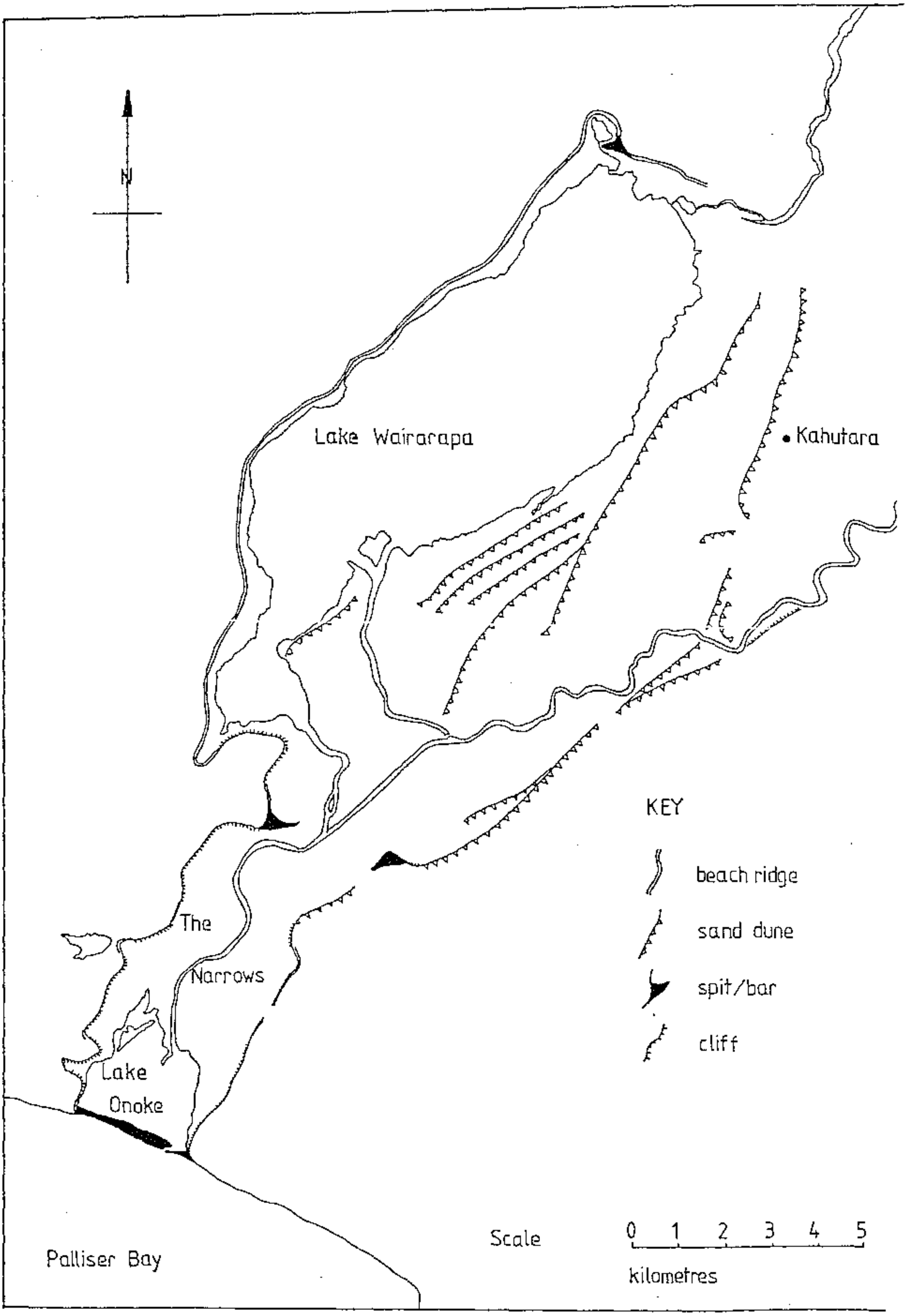

Figure 4 Extent of the highest shoreline (from Heath 1979)

Lake Wairarapa is a windy location with prevailing winds from the north-west (23%), south-west (17%), and north (19%). Wind from the north-east (13%), and south (12%), are the next frequent, with calms (< 3 knots) only occurring 3% of the time (Thompson 1982). Figure 5 shows the direction and speeds of winds recorded at the Barrage, south of Lake Wairarapa. The westerly winds are important to the soils of the study area, as they are responsible for the formation of the sand dunes on which many of the soils have developed.
Mean monthly wind speeds from Lake Wairarapa, Waiorongomai and Papatahi stations on the north, south-west, and southern sides of Lake Wairarapa respectively, range from a low of 8 knots to a high of 16 knots. Mean annual averages from the three stations total 12, 13 and 9 knots. Strong winds (i.e. those over 30 knots) blew for 4.3% of the time at Lake Wairarapa station (Thompson, 1982).

There is not a great deal of variation in wind speed throughout the year, although there is a strong diurnal variation. Wind is generally at a minimum at night as radiational cooling increases the stability of the atmosphere, and at a maximum in the afternoon when lower layers of the atmosphere are least stable due to surface heating.

RAIN

Rainfall has a winter maximum and a summer minimum. Strong frequent westerlies during summer months produce a foehn wind effect, often leading to dry spells and droughts away from the ranges. This is because the ranges shelter the lowlands during prevailing westerly winds, most rain falling in the ranges themselves, with showers on land adjacent to the hills, and dry winds on the plains. Rainfall can be as high as 3000 - 6000mm annually in the ranges, decreasing rapidly from approximately 1500mm to 800mm from west to east across the plains (Thompson 1982, Heine 1975).

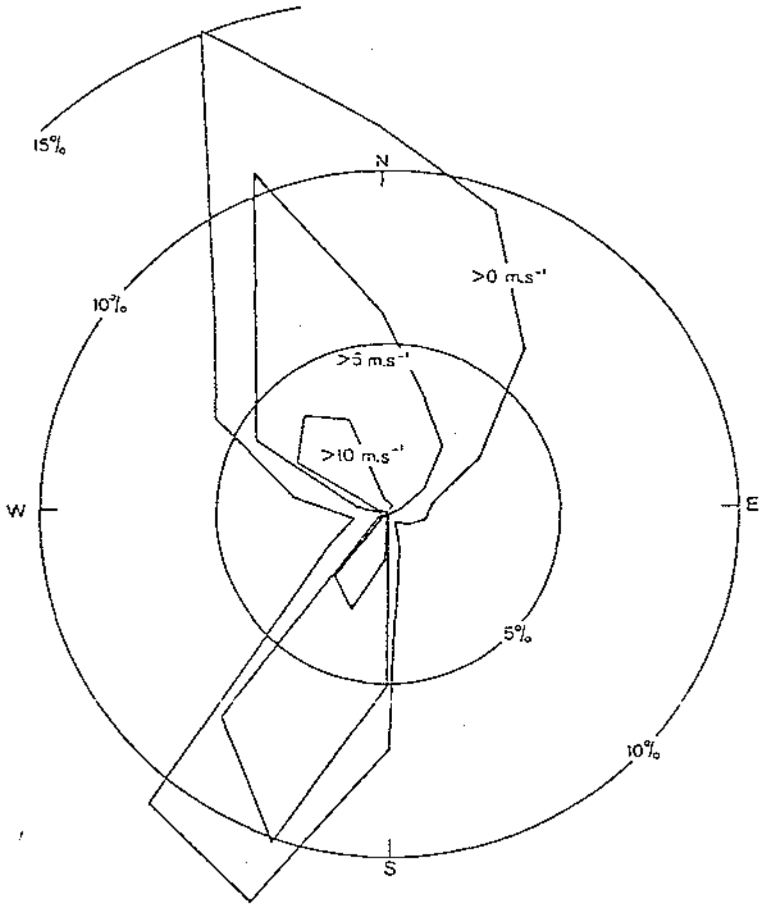

Figure 5 Windrose

Frequency and speeds of winds from different directions at the Barrage meterological logical station, Ruamahanga River, 1973-75 (from Pickrill and Irwin 1978)

As rainfall totals decrease away from the ranges, the distribution of the rain becomes increasingly seasonal leading to frequent summer droughts in the east.

Rainfall in the study area follows the usual Wairarapa trend of a winter maximum and a summer minimum, with 32% of the total falling in the winter months of June - August, and 20% in the summer months of December - February, with 23% and 26% in spring and autumn respectively (Thompson, 1982).

Isohyets from Thompson (1982) show that the area receives an annual average of between 1000 - 1200mm of rain. Rainfall totals around Lake Wairarapa decrease from west to east with annual averages from Featherston and Waiorongomai being higher than those at Martinborough and Pirinoa.

FLOODS

The headwaters of the Ruamahanga River rise in the Tararua range near Mt. Dundas, and many of its tributaries also drain the Tararua range. Consequently heavy or persistent rain in the Tararua range causes river levels to increase and may lead to serious flooding in the lower plains. Heavy rain in the Tararuas can be caused by moist easterlies being forced to ascend the steep sided ranges, or, by north westerlies which although producing a rain shadow effect in the Wairarapa valley, leads to rain in the hills (Thompson, 1982). Heavy rain from the south can also cause flooding in the central and lowland plains (Heine, 1975).

TEMPERATURE

The Wairarapa region experiences sharp and sudden changes in temperature and has a larger daily temperature range than is found in most coastal districts.

At Waiorongomai, the mean annual temperature is 12.3°C. Mean monthly temperatures range from 7.6°C in July to 16.8°C in February, with extreme temperatures recorded being a minimum of -3.1°C, and a maximum of 32.5°C (Thompson, 1982).

The soil temperature is very sensitive to site conditions, but is generally at a maximum in January to February and a minimum in July. At Waoiorongomai the mean annual 9am soil temperature at a depth of 30cm is 13.5°C (Thompson, 1982).

The study area receives approximately 1850 hours of sunshine a year, about 45% of the total possible. There are generally 35 to 55 days per year with no sunshine (Thompson, 1982).

FROST

The study area has on average 29 days of frost a year, compared with 102 days at Masterton, showing the ameliorating effect of the lake. Two thirds of these frosts occur between March and September (Heine, 1975).

FOG AND HAIL

Low lying areas near the lake have a mean annual total of 18 days of fog per year. These are mostly radiation type fogs which occur on calm nights at any time of year (Thompson, 1982).

Hail, thunder and snow are all infrequent phenomenon.