

THE LANDFORMS OF THE CHRISTCHURCH LOWLAND

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by

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**THE LANDFORMS
OF THE
CHRISTCHURCH LOWLAND**

FORMATION AND TRANSFORMATION

PREFACE

Every landform has some special character of its own and the study of every landform must start with a study of the geological history behind it.¹

Long before European occupation, the main landforms of the Christchurch lowland were coastal sandhills, swamps, river fans and terraces. These landforms were all part of a broad flood plain formed by the Waimakariri as the flow of this river to the sea was blocked by the volcanic island that now forms Banks Peninsula. In this flat swampy lowland the English settlers chose to build their new town.

This study is about those landforms and their subsequent modification. When I started looking at the landforms of Christchurch I realised that the lowland in which it lies has a very special foundation. In order to explain many of the present day topographical features, we have to go back to its geological past.

Chapter one gives a brief overview of this geological past and how it was responsible for the formation of the plains and the lowland of Christchurch. Chapter two is a description of the specific landforms, their formation and natural state. Most of these landforms are interdependent, both in formation and evolution. However, for ease of study these landforms are discussed in separate sections. Chapter three relates the story of human occupation, the first impressions of these settlers, the problems they encountered and the factors which determined where they settled. Chapter four describes how the landforms were used, managed and what modifications were made. The main sections in this chapter discuss the drainage of swamps, by individual effort and public authorities, the modification and management of rivers, estuary, the Waimakariri, sandhills, and roading. Chapter five discusses the landforms that remain, their present state and possible future.

GEOLOGICAL TIME

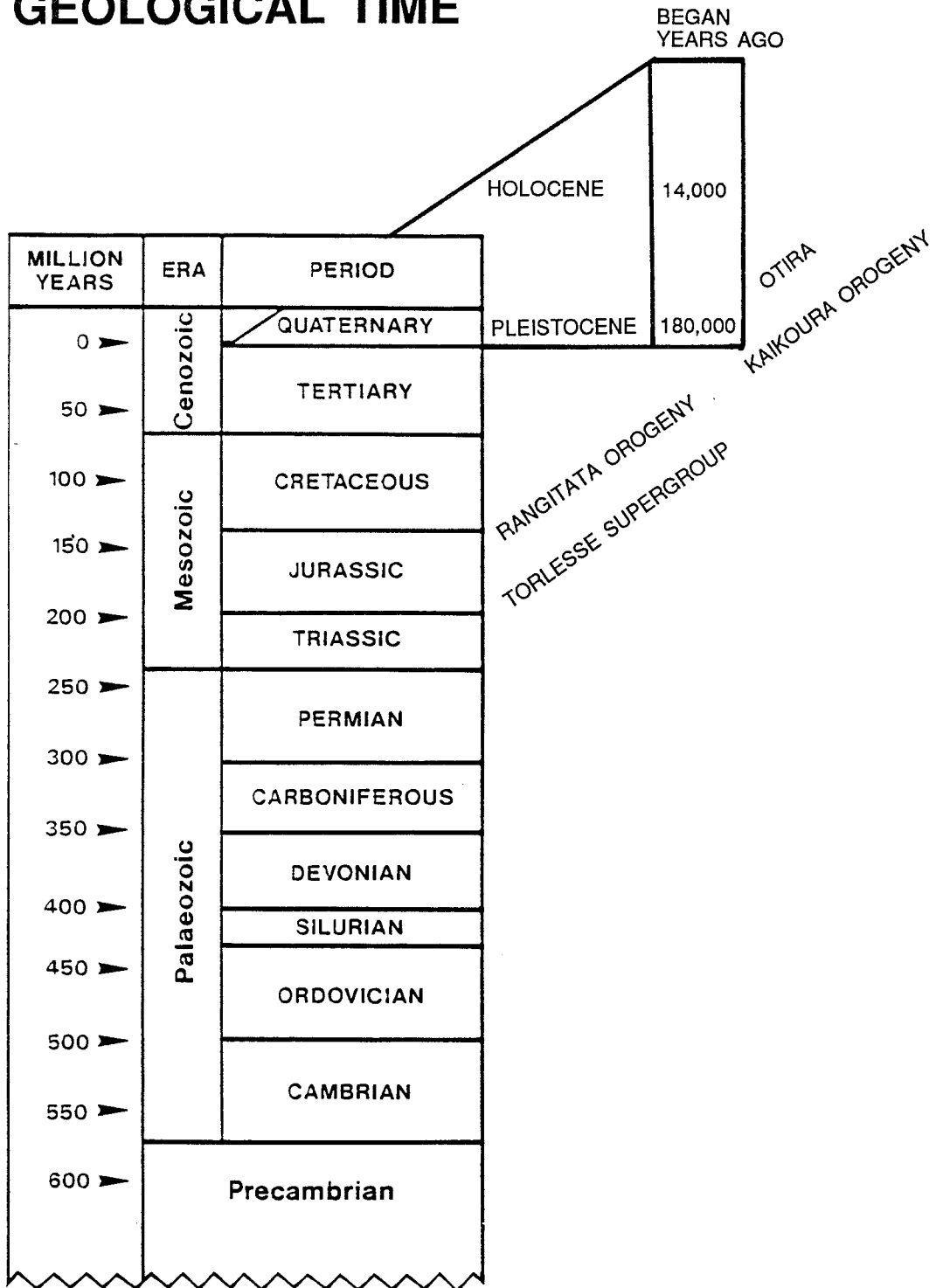


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CHAPTER ONE

GEOLOGICAL FORMATION

GONDWANALAND.

About 200 million years ago, the huge super-continent, called Gondwanaland started to break up forming the continents we now know as Africa, South America, Antarctica, India, Madagascar and Australia. Enormous and prolonged tectonic processes, uplift, faulting, volcanism and seafloor-spreading, accompanied the breakup of this super-continent.

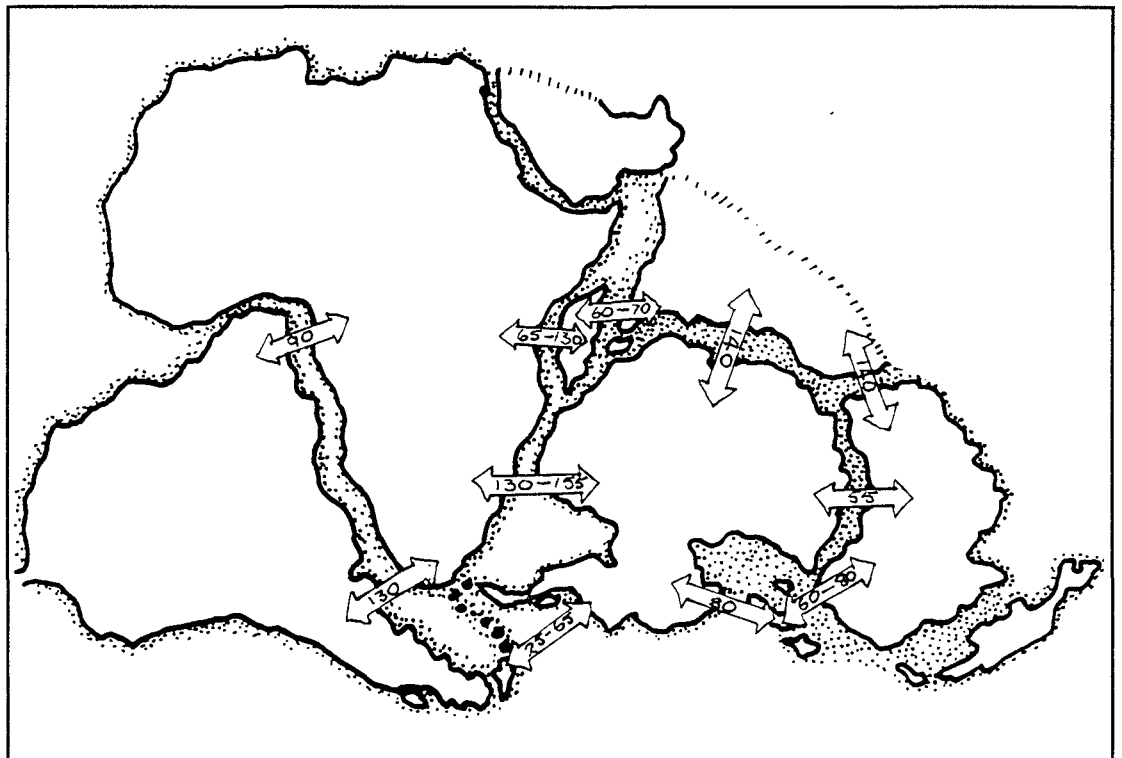


Figure 1.1.
Gondwanaland. Numbers indicate in millions of years, the separation of the continents.
Source: Stevens, New Zealand Adrift.

THE NEW ZEALAND GEOSYNCLINE.

During the approximately 100 million years spanning the early mesozoic era, sands, clays and gravels eroded from the mountainous lands to the west and east of the area where New Zealand was formed. This detritus accumulated together with matter from submarine volcanoes, in a deep depression formed by the down-warping of the submerged continental shelf which was part of the ancient Gondwanaland. This trough, part of which was named the New Zealand Geosyncline, ran along the east of the Indo-Australian plate and was almost completely under water. "Thicknesses in the order of tens of thousands of feet had been attained before the end of the Triassic Period by which time the lowest part of the accumulation already would have been hardened into greywacke and argillite merely as a result of deep burial".¹ These accumulations formed the Torlesse Supergroup, the basement rocks of the present Southern Alps and Canterbury Plains.

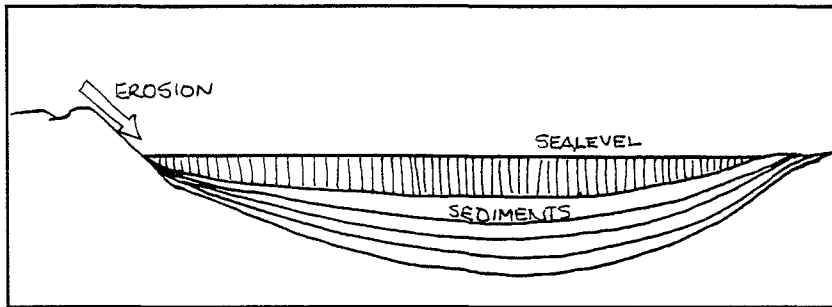


Figure 1.2.

New Zealand Geosyncline. 230-130 Million years ago.
Deposition of sediments. Source: The Christchurch Artesian Aquifers.

RANGITATA OROGENY.

During the mid-Jurassic and early Cretaceous periods, some 150 million years ago, the New Zealand Geosyncline became narrower, sediments were compressed, folded, faulted and crushed while being upheaved to form new land.

These movements, known as the Rangitata Orogeny, were the first of two major upheavals of the earth's crust to affect the shape of New Zealand. Volcanoes were active, islands appeared as mountain ranges were uplifted and most of New Zealand, including the area where Canterbury was later formed, became land. It is not certain whether dry land extended continuously across the Tasman Sea. However, the absence of large marine reptiles, snakes and mammals suggest that it was probably cut off from the land to the west. To the east land extended beyond the present coastline, possibly as far as the Chatham Islands. Plants flourished, especially the Gymnosperms, Cycads, Ginkgo and ferns. The litter of these plants accumulated in swampy depressions to later form the Westland coal deposits.

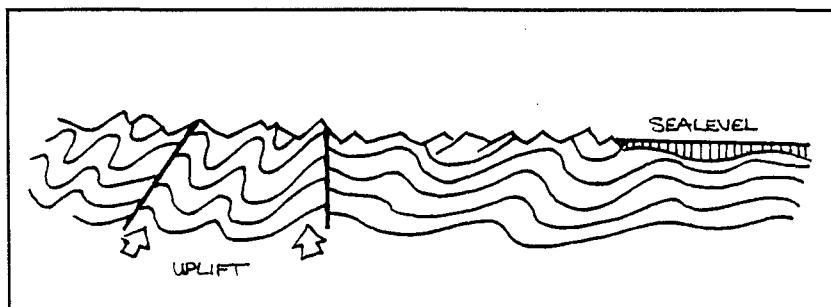


Figure 1.3.

RANGITATA OROGENY. Severe folding and faulting of Triassic-Jurassic sediments.

PENEPLANATION.

Following this vigorous time of upheaval came a long period of erosion during the late Cretaceous periods. By about 90 million years ago the mountains built by the Rangitata Orogeny, had been worn down and reduced to a land surface with low relief. The landscape was undulating and mantled with a layer of deep soil which was eroded from the Torlesse Supergroup. This peneplain extended far beyond the eastern coast of the present Canterbury shoreline.

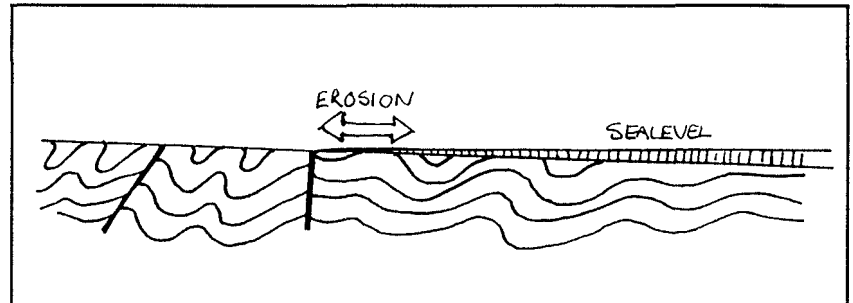


Figure 1.4.
PENEPLANATION. 70-65 Million years ago a peneplain developed over most of New Zealand and sea was encroaching over the levelled-off land along the east coast.

MARINE DEPOSITION.

The Mid-Tertiary period some 38 - 26 million years ago saw the land progressively being submerged as the sea migrated from the south and east. The extent of dry land was limited causing very little erosion and it was generally a period of uniformity with a slow rate of accumulation.

A sub-tropical climate during this time caused vegetation to flourish and plant species changed from Gymnosperms to predominantly Angiosperms. Podocarps were gradually giving way to the ancient form of the Rimu and Southern Beeches became part of the succession. In the low lying swampy areas, the vegetation formed peat which was later converted to coal as the layers were compressed by the deposition of marine sediments by an encroaching ocean. Limestone at Hamner and Mount Summers and the coal deposits of Otago, Southland and Murcheson date from this period. Sub-marine basaltic volcanoes spread north from Eastern Otago into Westland and Canterbury.

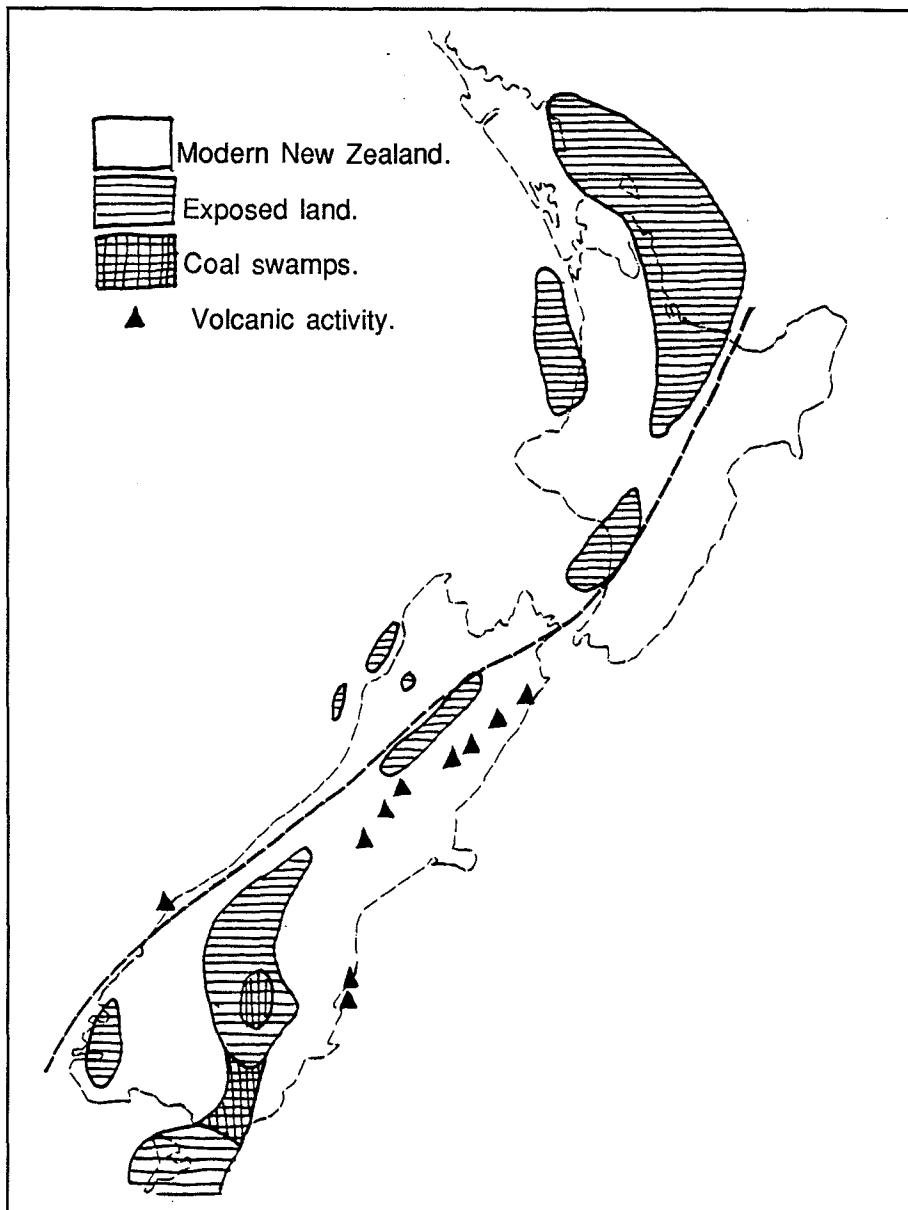


Figure 1.5.
37-25 million years ago. Two thirds of modern New Zealand was covered by sea.
 Source: Stevens, New Zealand Adrift.

KAIKOURA OROGENY.

The late Tertiary, 12-5 million years ago, saw the beginning of a second major period of crustal movements and uplift to affect the Canterbury area. The start of this period corresponds to the splitting of the area about 12-5 million years ago along a major crustal margin forming a new boundary between the Pacific and Indo-Australian plates.

An accelerated period of uplift, folding and faulting caused vigorous mountain building as the two plates moved away from the Antarctic plate at different speeds. Locally known as the Alpine fault, this major fault line is accompanied by minor areas of faulting which are either submerging or sinking. This prolonged period of general uplift caused the re-emergence of land particularly those areas known today as the Southern Alps and the Kaikouras. Vigorous erosion of the uplifting ridges was taking place providing coarse debris from the displaced basement rocks, the Torlesse Supergroup. It has been estimated that 18 kilometres of uplift took place, matched by erosion of similar proportions. This process of erosion is continuing to the present day at a rate of 10 mm. per year.

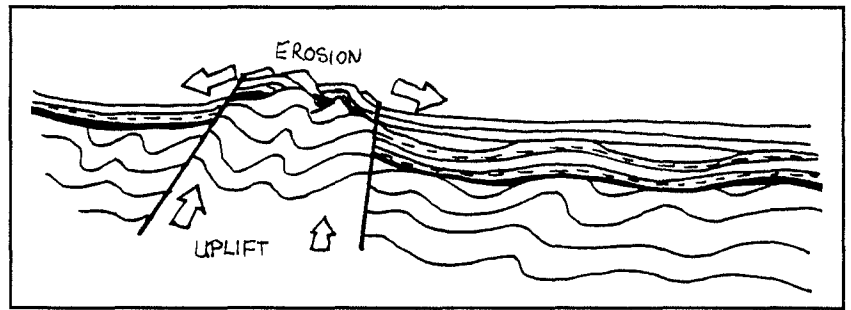


Figure 1.6.
Kaikoura Orogeny. Newly uplifted mountains provided coarse debris which filled depressions.

The Kaikoura Movements which were responsible for the major recognisable landforms of the New Zealand landscape are undoubtedly still active and, "where an orogeny is probably continuing at much the same rate as it has for the past few million years, and where relief and climate combine to produce intense erosion over wide areas, the transition from geological history to the geomorphical study of the development of landform is subtle and may not even be detectable".²

Landforms and rocks formed during the Rangitata were being eroded and reworked so that the new landforms became a geomorphic "mixture" of the two major tectonic movements. Coal and marine sediments laid down during the period of peneplanation were mostly eroded away by the rivers exposing the underlying greywacke. Any remaining sediment was slowly being covered up by the reworked older debris as it gradually formed large alluvial fans over them.

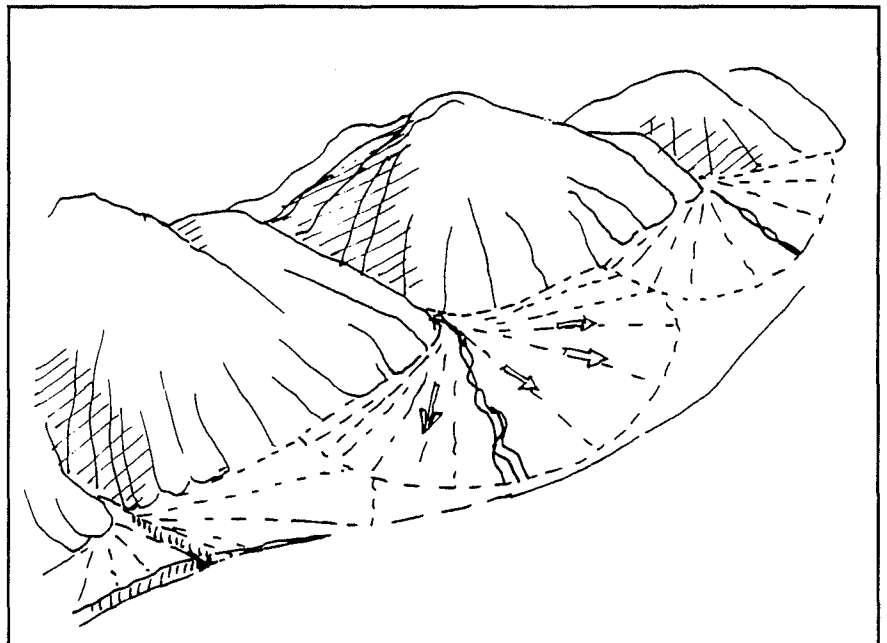


Figure 1.7.
The outbuilding of alluvial fans over the Canterbury Plains.
 Source; Cotton, Geomorphology.

As the land was being uplifted, the ocean gradually retreated towards the east exposing and modelling the Canterbury Plains so setting the scene for the formation of our present landforms.

Here we have to digress briefly to explain a phenomena which stood in the way of the advancing alluvial fans and which was to have an impact on the ultimate form of those plains.

BANKS VOLCANICS.

Between the Rangitata and Kaikoura Movements, there were several periods of volcanic activity further inland, leaving evidence in the Harper hills, Burnt Hill and to the north-west of Oxford. During this period volcanic action also took place in the Banks peninsula area in the form of andesitic and basaltic eruptions near Gebbies Pass and McQueens Valley. It was however not until the Kaikoura Orogeny that the Banks Volcanoes began to grow to an appreciable height.

Starting about 12 million years ago, the Lyttelton volcano took 2 million years to form and eventually shaped a dome estimated to have been 1500 metres high.³ About 9.7 million years ago, volcanics ceased in this area and moved to Akaroa with it's centre at the Onawe peninsula. Akaroa lavas buried parts of the southern slopes of the Lyttelton Volcano and capped Mount Bradley and Mount Herbert (which at present is the highest point on Banks Peninsula at 918 meters). Akaroa had been active for about 1.2 million years when eruptions started in a vent near Mount Herbert. This new eruption formed the Diamond Harbour group dated at 5.8 million years and represent the youngest of the Banks volcanics. Lavas from these eruptions spilled over into the extinct Lyttelton caldera to form the very distinctive landform at the foot of which Diamond Harbour is situated.

When activity ceased in the Lyttelton volcano, erosion caused a pattern of radial drainage channels to become established on the rim of the collapsed volcanic caldera. One such channel on the eastern side became dominant and as it wore down and the sea levels rose, the crater was partially drowned. A similar pattern of erosion occurred on the Akaroa volcano with a dominant channel forming to the southern side creating the present harbour opening.

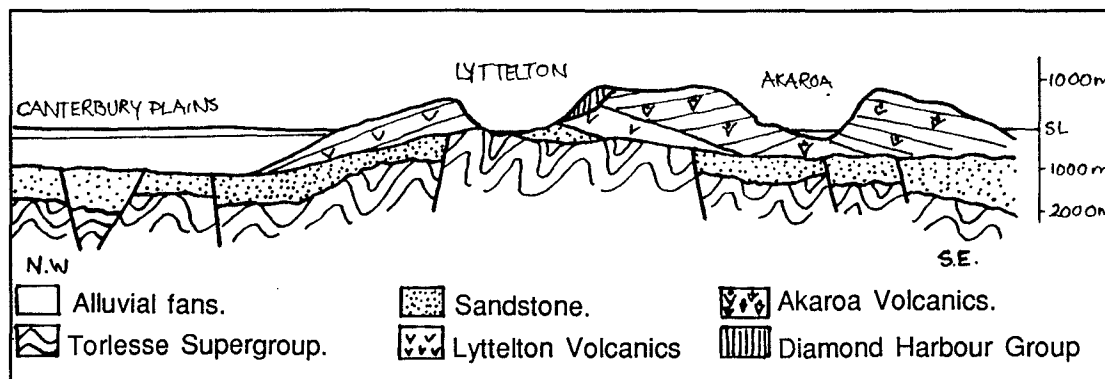


Figure 1.8.
Diagrammatic cross section of Banks Peninsula.

The Banks volcanoes were built from and on the same basement rocks that form much of the Southern Alps and the Kaikouras. Torlesse rocks that are found at 1068 metres below sealevel in the Leeston area, rise to over 300 metres above sealevel in the Gebbies Pass area.

The island that was formed by these volcanics, was to play an important role in the channelling of the major rivers that were gradually forming the alluvial fans towards this area. In this way the volcanic island was partly responsible for the present form of the Canterbury Plains and, more specifically, the Christchurch area.

THE PLEISTOCENE EPOCH.

In contrast to areas such as Africa, where the landscape has elements which can be identified as being as much as 200 million years old, the New Zealand landscape has a history which is for the most part 2 million years old.⁴

This Epoch which saw the development and evolution of the human-ape into homosapiens and the extinction of large mammals like the woolly mammoth, started about 1.8 million years ago.

Climatically it was characterized by fluctuating warm and cold conditions throughout the world as well as recognizable sea-level changes. In New Zealand four major glaciations and periods of interglaciation can be distinguished over the last 2 million years and these contributed much to the erosion and shape of the newly uplifted landforms of the Kaikoura Movements.

The eroded debris brought down by the rivers consists mainly of two major groups of rock. Firstly there are the greywackes and argillite of the Torlesse Supergroup which were laid down during the Mesozoic Era and are extremely hard and durable. Fragments can survive repeated episodes of transportation and deposition and when eroded the rock mass they are derived from form steep rugged country. The second group of rocks are the younger Tertiary rocks which break down rapidly and tend to form softly rounded hills and ridges, in many places with pronounced escarpments forming the characteristic dip-slope topography. These rocks form the basis for most of our soils.

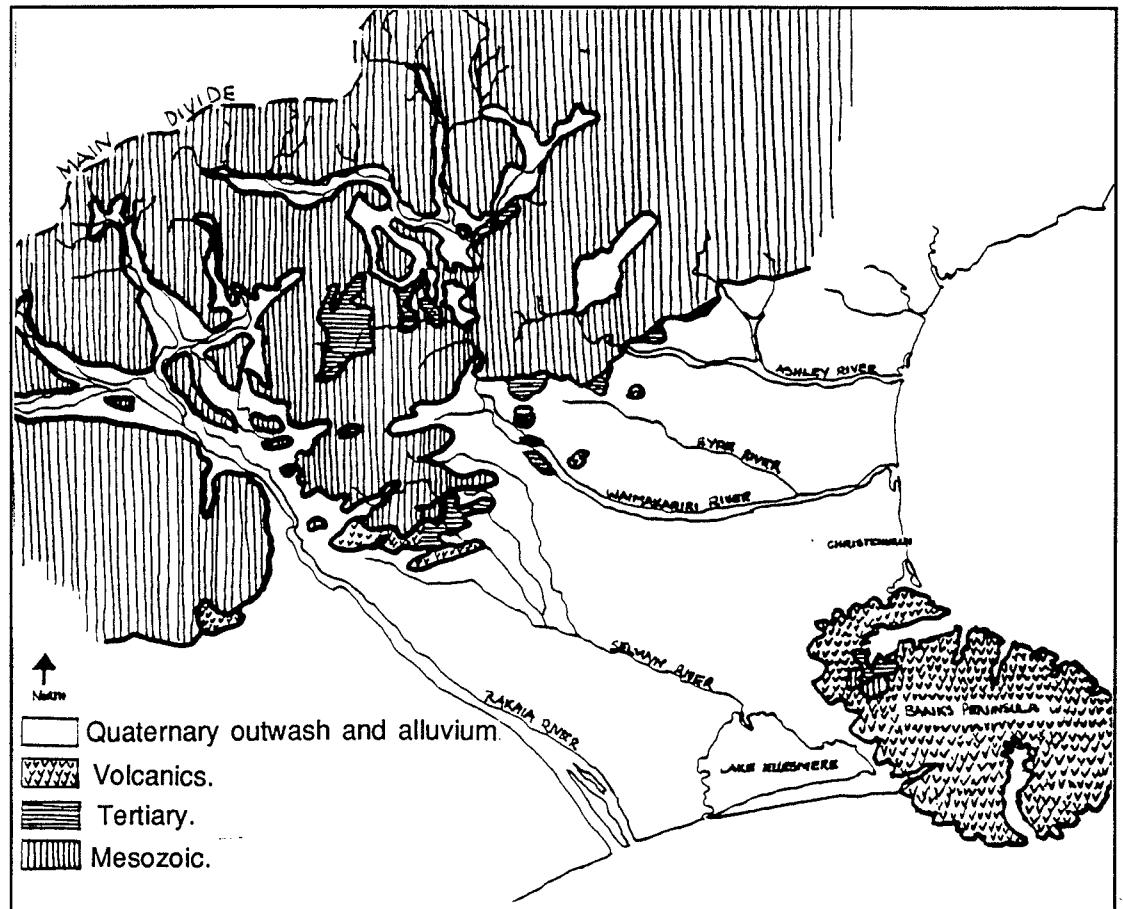


Figure 1.9.
Source rocks for the Quaternary deposits.
 Source; The Christchurch Artesian Aquifers.

GLACIATIONS.

During the glaciations there was a cooling of the earth. Temperatures were generally from 4 to 6 C degrees lower than today. "Formation of an ice body involves removal of water from the normal hydrological cycle, and its storage as ice on the land for a long period. The growth of the pleistocene ice sheets and glaciers was thus accompanied by a drop in the level of the world's oceans."⁵ As the sea-levels dropped by approximately 120 metres, it is estimated that the shoreline along the Canterbury coast retreated 95 kilometres eastward [p.46 in aquifer book] to approximately where the continental shelf now ends.⁶

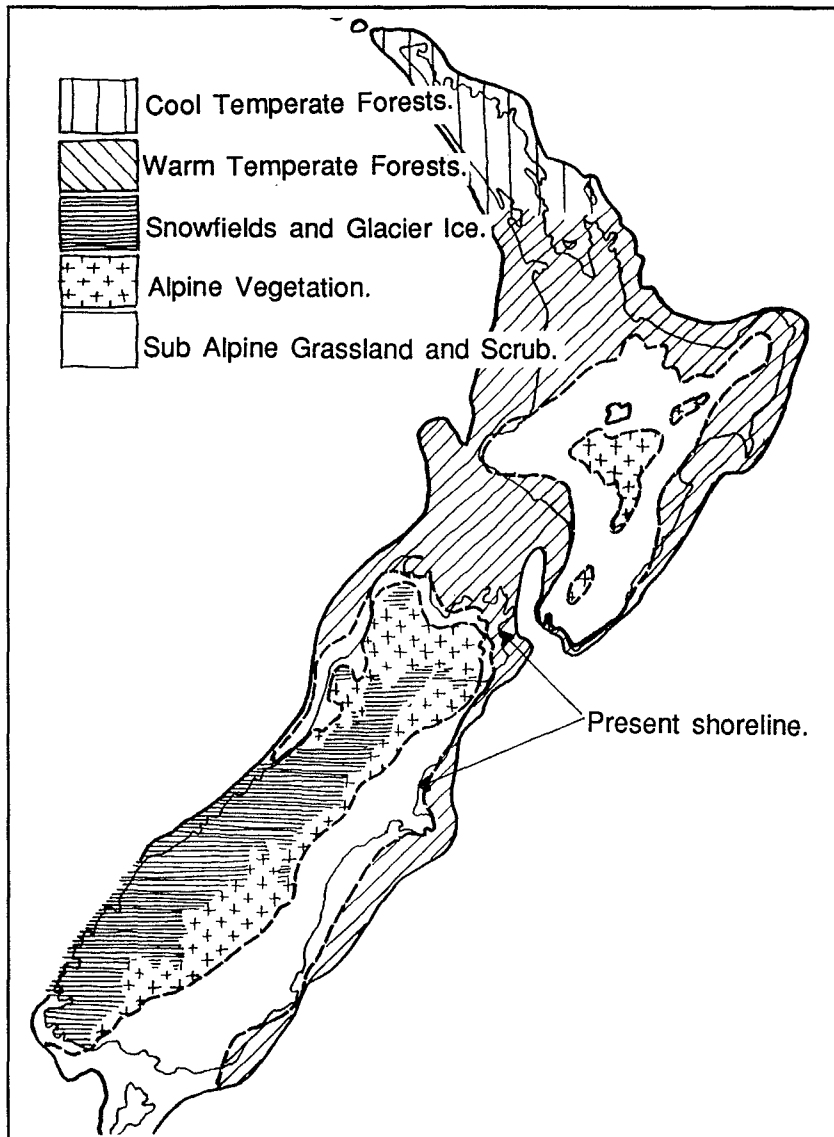


Figure 1.10.
Vegetation 20 000-18 000 years ago.
 Source; Stevens, New Zealand Adrift.

Reduced temperatures coincided with increased rainfall, storms, windiness and frosts which caused accelerated weathering, erosion and deposition of the debris. The glaciers themselves caused a general reworking of interglacial deposits as they advanced. The retreating shoreline not only reworked its own marine deposits but caused an increase in the slope of the rivers making it easier for them to disperse their load. Gravel, clay/silty and sandy gravel deposits were laid down in the Christchurch area during the different glaciations of the Pleistocene, forming large wedge-shaped fans. In the case of the Wainoni gravel, the deposit was 18 metres thick in places, the Burwood gravels, 12 metres and the Linwood gravels up to 41m.

INTERGLACIATIONS.

Botanical evidence suggests that interglacial temperatures may have been higher than at present causing a reduction in the global ice sheet cover. Consequently sea-levels were the same or even slightly higher than those of today.⁷

As the earth warmed between glaciations, glaciers retreated eroding and reworking the inland outwash detritus and redepositing the material downstream. Newly formed rivers cut trenches into the inland fans as they to maintained sufficient runoff slope. The coastline transgressed westward over the continental shelf, where it had been stationed during the glacial period,

depositing fine sands of marine and estuarine origin in the Christchurch area. These deposits were laid down over the peat beds which formed when vegetation decayed as it was swamped in the raised waterlevels. Three different inter-glaciations during the Pleistocene were responsible for deposits in the Christchurch area. These form the Shirley Formation (23 metres thick), the Heathcote Formation (18 meters) and the Bromley Formation (18 metres).⁸ The significance of the glacial and interglacial deposits will be discussed in the section on Aquifers.

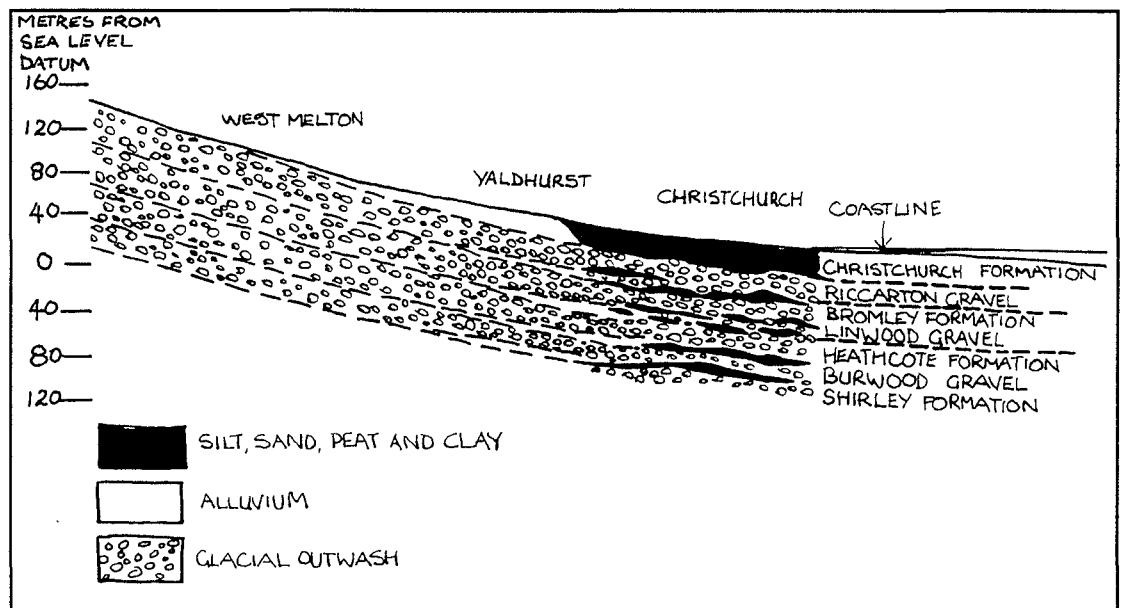


Figure 1.11..
Cross section showing Formations and Gravel Deposits under the Christchurch area.
 Source; The Christchurch Artesian Aquifers.

OTIRA, THE LAST GLACIAL OF THE PLEISTOCENE ICE AGE.

This glacial period which lasted from 70,000 to 14,000 years ago, is characterised by minor climatic fluctuations which caused glaciers to generally advance but at varying speeds as they sometimes halted or even receded along their paths down the Waimakariri Valley. According to Suggate: "The plains of Canterbury are largely made up of the last glaciation, and evidence of earlier comparable surfaces are left only as remnants, mostly at the margins, the glacier-fed rivers had ample erosive power to destroy the earlier deposits."⁹

The importance of the Otiran Glaciation for the Christchurch area was the deposition of the Riccarton Gravels (Halkett Surface). These are in places up to 25 metres thick although in many areas some of this surface was removed by erosion prior to the deposition of the Christchurch formation during post-Otiran inter-glaciation. During the Otiran glaciation, glacial outwash gravels finally filled in the shallow seaway which lay between the eroded volcanic island and the Alps. The island was about 50 kilometres away from the Alps at the beginning of the Pleistocene. The presence of the peninsula drastically altered the shape of the Plains. Successive terrestrial, marine and estuarine deposits were wedged out against the mass of Banks Peninsula. In general it formed a barrier to the southward aggregation of the Waimakariri fan and the northward degradation of the southern currents.

AQUIFERS.

An important resource, formed during the glacial and interglacial periods, are the aquifers underlying the Christchurch area. These are subterranean permeable water-bearing formations in which water is temporarily stored as it slowly moves from inland areas through to the

ocean. Four hydrologically distinct aquifers have been recognised in the Christchurch area and these correspond to the periods of gravel deposition during the glacial periods.

Aquifers are separated by aquitards which are alternating beds of peat, marine sands and estuarine silts forming relatively impermeable confining wedges that were laid down by the interglacial seas and estuaries. Although "water is present at depth under most of the plains, it is only where the confining beds of post and interglacial origin are present that a water resource of truly artesian character is found".¹⁰ Aquitards or confining layers were thus only able to be formed in this area because it had become an entrenched floodplain between the plains and Banks Peninsula.

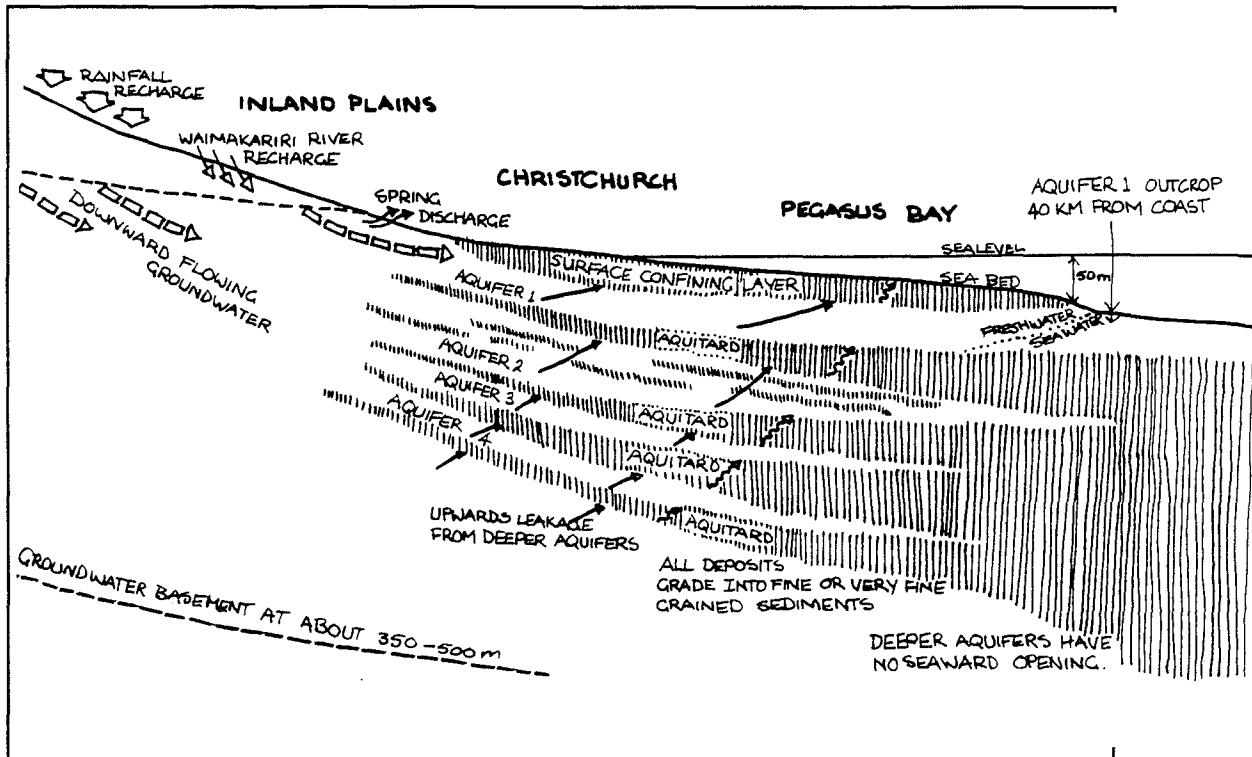


Figure 1.12.
Diagrammatic cross section of the Christchurch groundwater system.
Source; The Christchurch Artesian Aquifers.

The source of water for the aquifers is mainly rainfall in upland areas of the plains as well as the Waimakariri which loses vast amounts of water underground along its southern banks. This water loss is thought to recharge the aquifers in the Christchurch area. It takes about one year for water to reach the aquifers. Once it reaches the aquifer it slows down considerably and it is estimated that the water in the fourth lowest aquifer is about 50 years old. A further source of water for the surface aquifers is slow leakage from deeper aquifers upwards through the aquitards. The water coming into the aquifers continues to flow eastward. At this point, the material forming the aquifer grades into fine or very fine sediments acting as a trap enabling the water to only slowly discharge about 40 kilometers from the coast. Aquifers, then, form vast storage reservoirs and, "any changes in storage, indicated by changes in waterlevels, would be a result of either less or more than average recharge".¹¹

Slight variations always occur from summer to winter but these may also occur over long periods due to severe and extended drought periods, "longterm, however, the change in storage would be nil, and ground water levels would fluctuate about a longterm average".¹² This of course is the natural state without artificial abstraction.

Although much is known about the top four aquifers up to a depth of 160 metres, the total depth of the ground water basement is 500 metres and can be thousands of years old. Little is known about these deeper aquifers.¹³ The North Canterbury Catchment Board is at present boring in the Bexley area in an effort to learn more about the deeper strata.

AEOLIAN DEPOSITS.

An important feature of glacial periods is the accumulation of Loess. These are wind generated dust particles forming "silt deposits which provide a yellowish silty subsoil over extensive areas of the foothills, the higher parts of the plains and the flanks of Banks Peninsula".¹⁴

Vegetation during interglaciations would have been similar to today's although the distribution of the species would have been different. During glaciations, however, the vegetation cover was low and sparse and erosion activity was high. Braided rivers beds also contributed to the abundant supply of glacially worn greywacke rockflour which was blown by strong winds across the plains and deposited on relatively higher landforms. With the predominant winds being northwesterly, the tendency was for deposits to be thicker on the southern banks and terraces of the rivers. Loess deposits are widely distributed and can be up to six metres thick and six layers of loess can be distinguished in the Christchurch area. Three of these have been attributed to the Otiran glaciation.¹⁵ Loess deposits have important economic value today as it serves as parent material for the Grey Earths that form a large area of our agricultural activity.

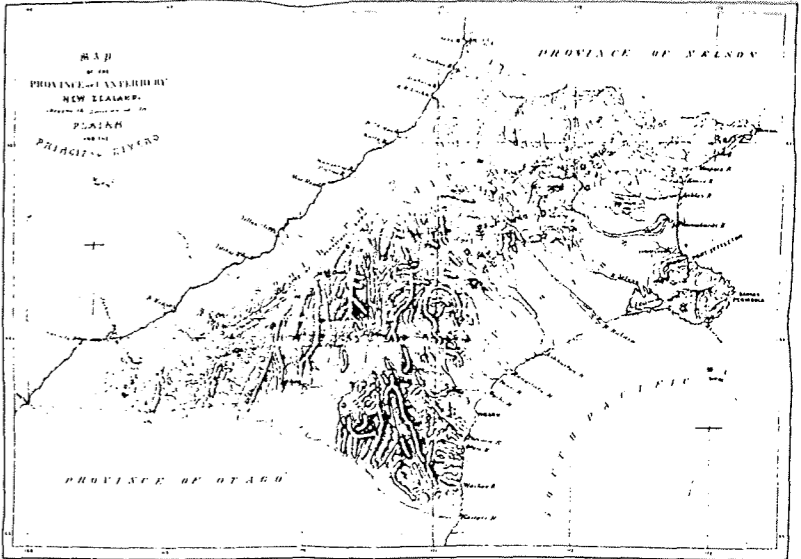
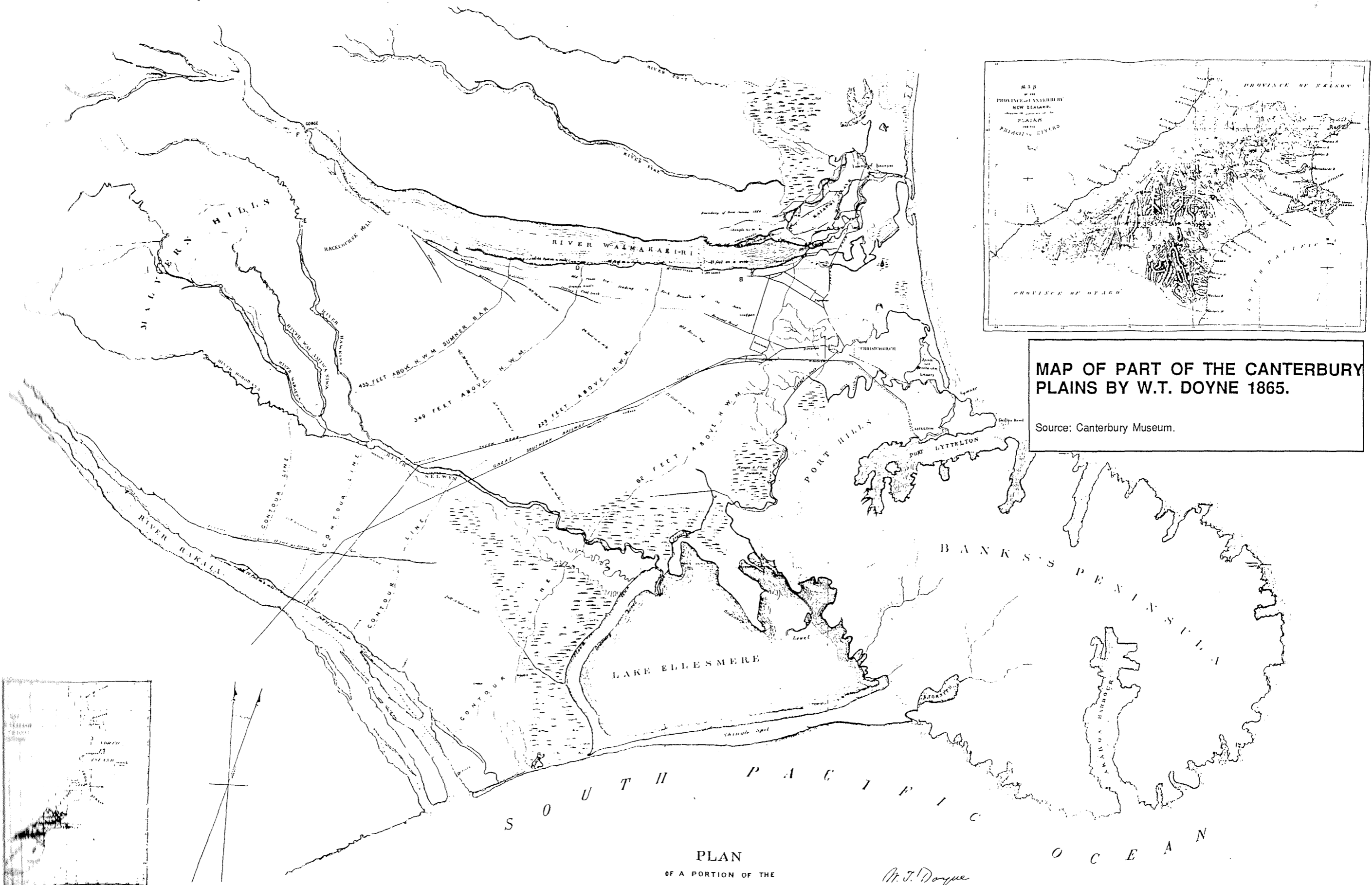
SUBSIDENCE OF CHRISTCHURCH AREA.

To account for peat and shells more than 200 m below the surface of Christchurch, Spreight postulated progressive sinking of the coastal area relative to the inland margins of the plains.¹⁶ Evidence, according to Suggate, indicates that a broad regional downwarping of at least 70 metres has taken place since the early part of the last glaciation due to the accumulation of gravel. The samples of deposits found, indicate a sea-level of about 210 metres below present if there had been no tectonic depression.¹⁷ The fact that there is little trace of raised beaches on Banks Peninsula seems to support this theory.

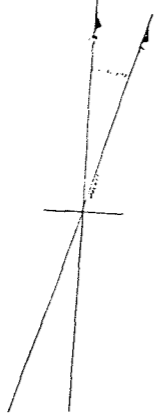
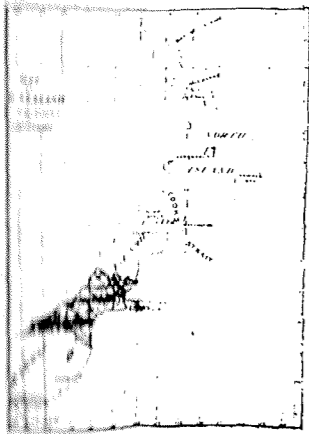
The reason for this subsidence was partially due to the cooling of the volcanoes and subsequent compaction of the rocks, as well as the weight of the accumulated debris of the alluvial fans. Springs on Banks Peninsula and at Ferrymead could be left over from a cooling down of the ancient volcanoes but a recent theory seems to suggest that they may be the result of some ongoing tectonic movements.¹⁸

The geological and geomorphological history reviewed here resulted in the formation of the lowland on which Christchurch is situated. These processes produced a complex web of alluvial fans, rivers, swamps, lagoons and sandhills which we will discuss in chapter two.

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- 3.From lecture notes University of Canterbury extension studies 1986.
- 4.Soons, J.M and Selby, M.J. in Landforms of New Zealand, Preface.
- 5.Pillans et al. p.17
- 6.The Christchurch Artesian Aquifers. p.7.
- 7.Ibid.p26
- 8.The Christchurch Artesian Aquifers. p.42.
- 9.Suggate, R.P in Landforms of New Zealand.p.9
- 10.Fitzharris, Mansergh and Soons, in Landsforms of New Zealand. p.350
- 11.The Christchurch Artesian Aquifers. p.143
- 12.Ibid.
- 13.Ibid.
- 14.Gage in Natural History of Canterbury. p.38
- 15.Suggate, 1958, p.110.
- 16.Ibid., p.104-5.
- 17.Suggate p.118-9
- 18.McSaveney, M. Personal conversation.



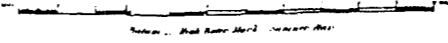
MAP OF PART OF THE CANTERBURY PLAINS BY W.T. DOYNE 1865.
 Source: Canterbury Museum.



PLAN
 OF A PORTION OF THE
PLAINS OF CANTERBURY.

To illustrate Mr Doynes Report of the 26th Nov 1865

Scale 1 Mile to 1 Inch



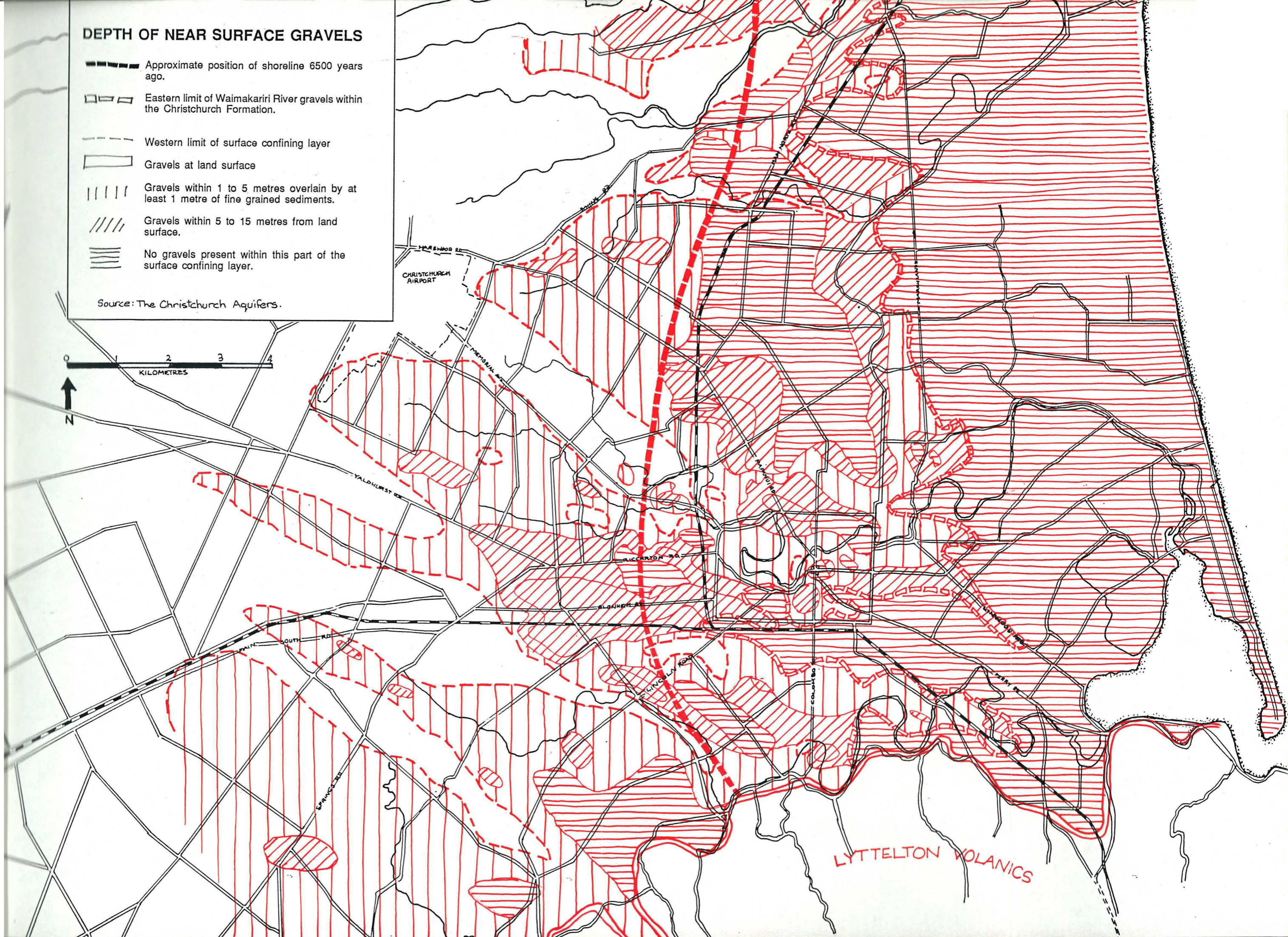
W. T. Doyne
 Christchurch
 November 30 - 1865

DEPTH OF NEAR SURFACE GRAVELS

- Approximate position of shoreline 6500 years ago.
- Eastern limit of Waimakariri River gravels within the Christchurch Formation.
- Western limit of surface confining layer
- Gravels at land surface
- Gravels within 1 to 5 metres overlain by at least 1 metre of fine grained sediments.
- Gravels within 5 to 15 metres from land surface.
- No gravels present within this part of the surface confining layer.

Source: The Christchurch Aquifers.

0 1 2 3 4
KILOMETRES



CHAPTER TWO

THE SHAPING OF OUR PRESENT LANDFORMS

THE POST OTIRAN INTERGLACIAL.

About 18 000 years ago the earth began to gradually warm again. This heralded our present period of interglaciation which was responsible for the formation of the landforms in the lowland Christchurch area.

Intense erosion and deposition followed the retreat of the glaciers. Again the plains and lowland at the base of Banks Peninsula were covered by alluvium. This time the Waimakariri laid down the Springston formation, depositing gravels up to 20 kilometres from the coast. Sediments deposited by the transgressing ocean as well as silts and clays washed down by rivers were reworked to form the Christchurch foundation. Wedge shaped, it is 40 metres thick near the coast and gradually thins inland.

During maximum sealevels, between 14 000 and 6 000 years ago, the coast advanced 12 kilometres to the west of its present position depositing a gravel beach along its shoreline before retreating slightly eastward as sealevels stabilized. This shoreline extended as far inland as Belfast, Papanui, Riccarton and Spreydon. Banks Peninsula was connected to the mainland by a 10 kilometre neck, mainly lowland, extending from Spreydon to Taitapu. Most of this lowland was covered by swamp and swamp forest.

Temperatures after this period dropped, the shore line retreated leaving behind marine sediments. The drop in sealevels and the subsequent period of stability about 2000 years ago, has allowed the Waimakariri to prograde the coastline eastward leaving behind a series of sandhills, dunes and interdunal swamps. As the tempo of erosion eventually reduced under a vegetation cover, soils indicative of stable environmental conditions developed on previously active sites.

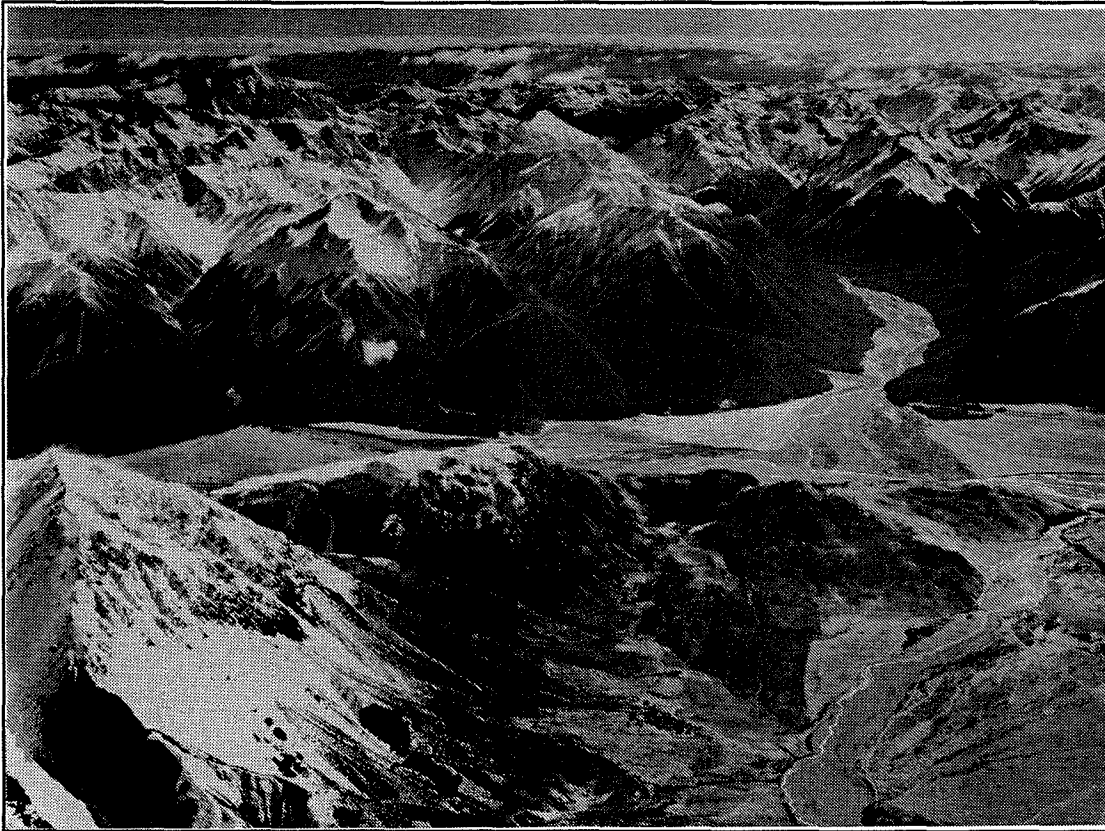


Figure 2.1. The Waimakariri. Erosion of the Southern Alps.
Photo: V.C. Browne and Son.

THE WAIMAKARIRI.

The braided rivers of the Canterbury plains are the prime sculptors of the landscape they traverse. The uplifted mountains supply the materials from which the rivers shape their landscape. With this material the Waimakariri was able to build and greatly influence the Christchurch area.

The Waimakariri emerges from the steep upland areas, where the slope is sufficient for the river to degrade the valleys, into wide flat lands where "the slope is so gentle that the streams are compelled to aggrade".¹ The river has to accumulate debris in order to build channels that are sufficiently steep to give them the needed velocity to deposit their load. These deposits eventually fill the channels which carry them to a level higher than the surrounding area making the course unstable. The river will in due course overflow its banks into the lower lying area adjacent. It will then either take a completely new course or divide into two or more distributaries to unite again further downstream. This network of channels is typical of aggrading or braided rivers of which the Waimakariri is an excellent example.

Where the Waimakariri emerges from the mountains the banks are deeply cut down but as it nears the coast where the land levels out, the incisement or cutting down, is reduced until it reaches a point where the depth of incision is zero. Over time, the river will repeatedly break its banks and form new courses thereby spreading its load evenly to form a wedge shaped fan. The point of zero incisement or entrenchment "has advanced progressively downstream which means that the amount of waste load provided by the weathering processes has recently increased or the flow of the rivers have decreased, with an implication in either case of a slight climatic change within the last few centuries".²

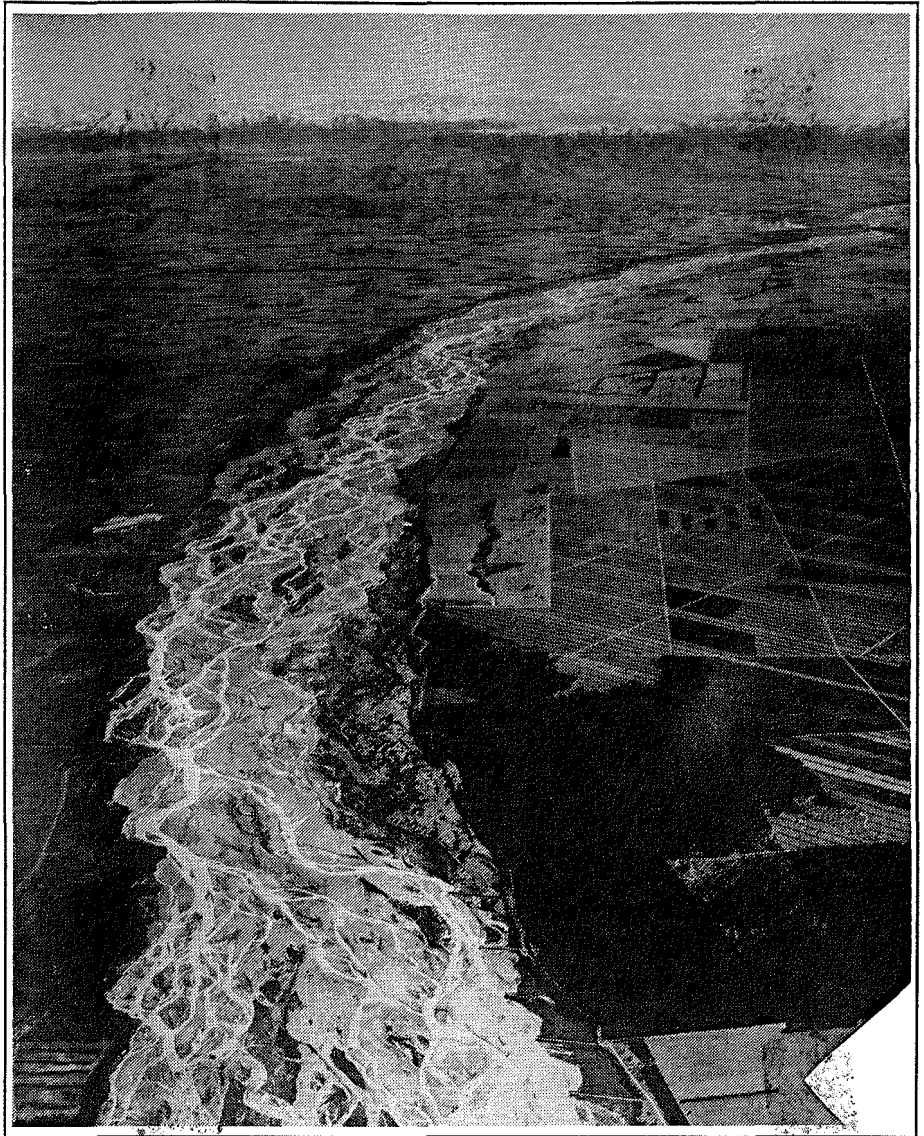


Figure 2.2. **The Waimakariri.** A typical braided river.
Photo: V.C.Browne and Son.

Some of the recently abandoned courses and accompanying lines of terraces of an erratically meandering Waimakariri can easily be traced. "Old river banks and bare stony lands of characteristically recent river bed type indicate that at no very distant date, the Waimakariri flowed to Lake Ellesmere by a course only a little west of Christchurchand that the Rakaia too, reached this Lake at its northern end at a time when the Lake itself extended somewhat further inland".³ Gravel deposits indicate that the Waimakariri was at the foot of the Cashmere hills in the Heathcote Valley 2420 years ago.⁴

In times of flood the Waimakariri fills its whole riverbed up to 2 kilometres wide. As recently as 130 years ago, the river broke its banks and found its way into the Christchurch area along an old river channel. This particular channel may have been one of the river's main channels only 500 years ago. However over the last few hundred years the Waimakariri gradually made its way northwards until it found an outlet in the Brooklands lagoon. According to Suggate it has ceased to develop the whole width of its fan and attributes this to a minor drop in sealevel.⁵ Man has however also intervened.



Figure 2.3. **The Waimakariri.** Emerging from the foothills.
Photo: John Weeber.

BEACHES ALONG PEGASUS BAY.

Most of the Canterbury coastline has been formed by rivers pushing out huge shingle fans from the Southern Alps. The beaches along this shoreline are characteristic of the way in which sand or shingle have been deposited and the effect of wave-action on the detritus brought down by the rivers. Beaches on either side of Banks Peninsula differ quite markedly.

Wave-action along the southern coast is actively eroding the alluvial fans which form coastal cliffs between the Rangitata and Rakaia rivers. This material is being moved northwards by the predominantly southerly storm-induced waves and added to the gravel beaches of Kaitorete spit which contains Lake Ellesmere. Banks Peninsula prevents the longshore drift of this material north. "Without these Volcanoes the 'waist' of the South island would be much narrower".⁶ This landmass also protects the northern part of the Canterbury coast from the southerly winds and the erosive action of the currents induced by these winds.



Figure 2.4. **The Waimakariri Gorge.**
Photo: John Weeber.



Figure 2.5. **The Waimakariri Mouth.** Sand and silt being deposited.
Photo: John Weeber.

The easterly and north easterly winds are the main elements which modify the waves in Pegasus Bay and consequently these beaches are vastly different. These are modified by an interaction of the winds and the waves they produce on a shallow continental shelf which causes the southward transportation of material. In the northern part of the bay the Waipara, Kowhai and Ashley rivers which have comparatively short courses, deposit silt, sand and shingle into the sea. To the north of Amberly the silt and sands are washed further to sea, but the shingle is deposited closer to the beaches. A gradual change from coarse shingle in the north to finer material in the south is caused by the southerly movement of the currents sorting and redepositing these sands back onto the beaches.

The Waimakariri on the other hand, has lost its power to carry its gravel load to the sea probably as a result of a rise in sealevel and drops this load before it reaches its mouth and deposits mainly sand and silt in the sea. The waves then transport these to the beaches further south. All these sediments are composed principally of quartz and feldspar derived from the greywacke rocks of the Southern Alps. Alison Brown in her study of two sites on the Pegasus Bay shore found that, "due to the greater distance from the major sediment source of Waimakariri, the sand at Beatty street is slightly finer and better sorted than at Spencer Park".⁷

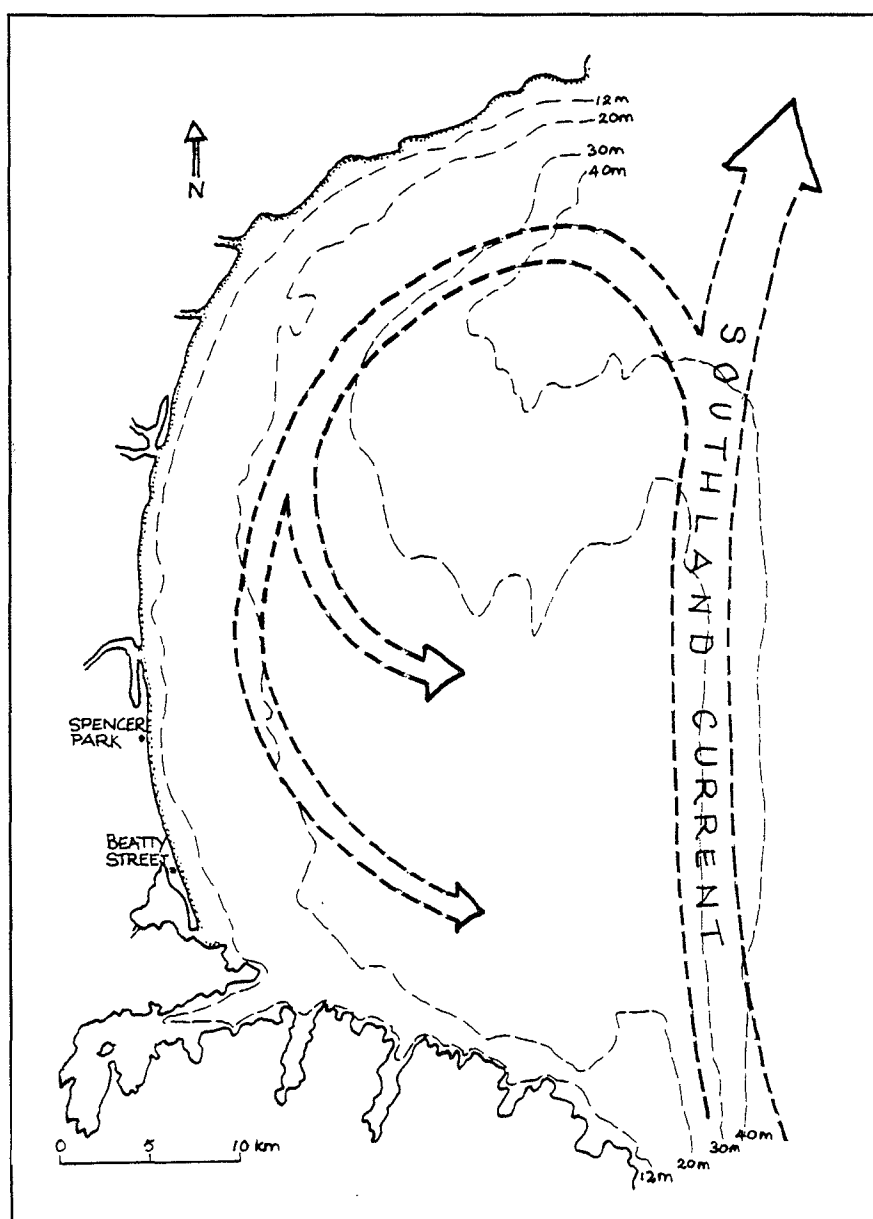


Figure 2.6. Ocean Currents in Pegasus Bay.

Source: A. Brown.

THE SANDDUNES.

Where the sea interacts with the unconsolidated sands of the beach "the waves, wind and currents move the detritus material and mound it into various 'constructional' coastal landforms".⁸

Between the beach and inland areas of the Christchurch lowland are the foredunes which are still actively developing as the dry sand is piled up in a continuous ridge which follows the contour of the shoreline. The predominantly easterly wind and particular wave-action associated with it has caused the gradient of the offshore slope to decrease and the height of the foredunes to increase as one follows the coastline further south. Brown has measured the dunes at Spencer Park as being 4 metres and at Beatty street at 6 metres in height.⁹

In the words of Cockayne, "a well-shaped and plant-fixed foredune is a landform of the greatest importance, since it not only cuts off in part the sand-supply of the shore from the land, but it forms a natural protection against the inroads of the sea thus safeguarding the coast".¹⁰ However these sandy dunes are unstable and dynamic, constantly shifting and changing as the wind builds and destroys them at the same time. Again Cockayne; "On the dunes of East Canterbury I have measured a lee slope 10 ft. high, which moved horizontally 2 ft. in ten hours with a very powerful east wind".¹¹



Figure 2.7. Foredunes along Pegasus Bay.

Sands are blown from the foredune inland where they form interior dune ridges or build on more established older dunes. These interior dune ridges are more irregular as they have been cut into and denuded by wind or river action. The further inland, the lower and more rounded these dunes become as they get fixed by vegetation and develop a fragile loam layer. Swamps of varying sizes developed between these ridges as a result of water being trapped. A dune complex, "is usually a bewildering maze, especially where winds blow from several quarters, the actual origin of which could be traced only with the greatest difficulty and uncertainty".¹²

As we have seen, during episodes of glaciation the coastline extended further east to approximately the edge of the continental shelf, probably forming sanddunes. As sealevels rose again these dunes were drowned and redeposited inland. A higher sealevel formed beach-ridges further inland and left a series of these as it dropped slightly to stabilize at its present level. This allowed a gradual progradation of the coastline by the addition of erosional debris deposited by wave-action. Biggs recognised three phases of progradational dune-building in the present dune-complex. The first of these was during maximum sealevels 6000 years ago when the coastline was at the foot of the youngest alluvial fan. Where it was actively eroding this fan, it left a dune-ridge still distinguishable in Linwood and Richmond. Further east, a second series of beach ridges were built and by 2000 years ago, was well established from Bromley through Burwood up to Spencerville.¹³ At present this series of sand ridges is 5-6 kilometres inland.

In the last 2000 years, a third phase of progradation allowed the building of the present foredunes and the New Brighton spit. A shallow bay at the foot of Banks Peninsula was being supplied with tons of sand and silt from the Waimakariri which was still discharging in the area. A spit may have been present, but depending on the sea currents at the time it could have been either smaller or larger and may even have been attached at the base of the peninsula stretching northwards. The present spit probably formed first as a submerged sand bar. As the Waimakariri moved northwards removing its destructive influence, the bar gradually built up becoming continuous with the beach to the north and became crowned with dunes as more debris became available. At the head of the spit the mouth of the estuary remains open as an outlet for the discharge of the less powerful rivers of the lowland. No doubt sands blowing from these newly formed foredunes helped to fill in the once more extensive water body contained behind the spit.

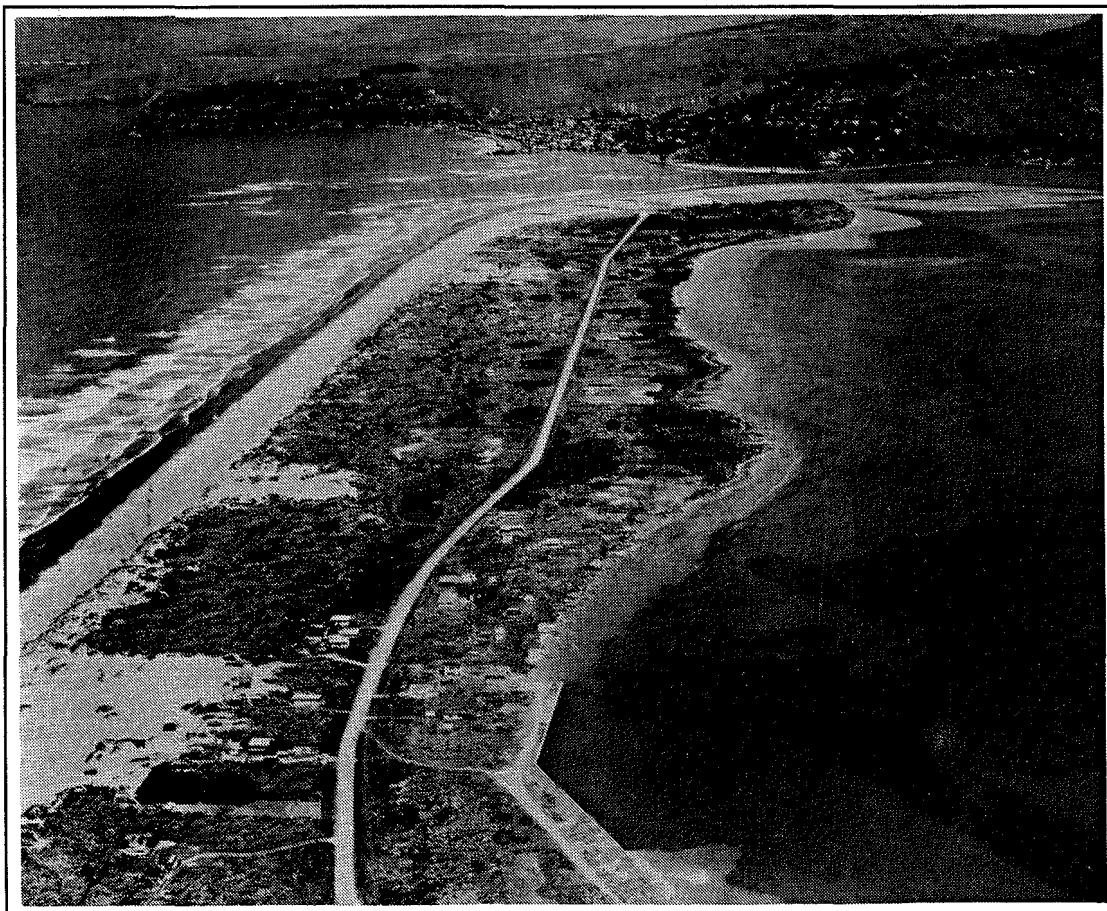


Figure 2.8. The New Brighton Spit.
Photo: V.C.Browne and Son. 1954.

Analysis of the dune and ridge sequences, changes in river patterns and the infilling of lagoons and estuaries, led Blake to conclude that "the present coastline had prograded in the past, and would continue to do so, although at a decelerating rate".¹⁴ This rate is estimated at about 2 metres per year. Campbell, however suggests that the area may be in a state of equilibrium.¹⁵ The shape of Pegasus Bay, which has a long smooth arcuate shoreline developed from the smoothing out of the margins of the shingle fans, is typical of a prograding shoreline.

The present coastal dune area along the bay is triangular extending 53 kilometres from the Waipara in the north to the mouth of the Avon-Heathcote estuary in the south. The maximum width near New Brighton is up to 3 kilometres wide.

OTHER SANDHILLS.

In addition to the sanddunes formed by the ocean, there is also another type of sandhill in the Christchurch area, these are the terraces formed by the Waimakariri and lowland rivers.

During its erratic wandering over the plains, the Waimakariri laid bare barren surfaces as it denuded the area by frequent floods. It left recognizable river channels and terraces which gave the countryside a subtle undulating appearance. These areas, as well as its own wide river bed, supplied vast amounts of loess to slightly elevated areas such as the terraces of discarded river channels. These "had a linear arrangement, extending southward into Papanui and upper Fendalton and through parts of Paparua county",¹⁶ into Riccarton and Sydenham.



Figure 2.9. **Halkett Area.**
The undulating surface of a Waimakariri River Terrace.

RIVERS IN THE CHRISTCHURCH AREA.

The alluvial fans, reached Banks Island either before or during the Otiran glaciation. It would not however have been "attached" to the same degree at all times as fluctuating sealevels and erosion would have changed its status many times before finally forming a peninsula. Once it did, however, a large lowland flood plain was created between the extinct volcanic island and the plains.

As we have seen the Waimakariri discharged into this floodplain until fairly recently before it moved north, but it left traces in the form of old river channels. It also left a surface of loose, exceptionally porous gravel. Excess groundwater as well as rainwater flow under this surface and come to the surface as springs where the end of the fan and old riverbeds meet the less permeable marine clay and silt deposits.¹⁷

The urban streams (e.g. Avon, Styx, Heathcote) originate near the inland boundary of the discharge zone. Baseflow in the streams is derived from shallow eastward flowing groundwater, mainly near the confluence of the unconfined and confined aquifer region where the overlying surface confining layer is relatively thin. The deeper confined aquifers do not discharge into the urban streams. Many springs have been identified along the stream beds, and surface flows increase downstream.¹⁸

These springs became the tributaries of the Styx, Avon, Heathcote and Halswell rivers. Doing their job of draining the surface and near-surface water, these rivers dissect the deposit layers of the Waimakariri and the Christchurch foundation as their meanders locally incise the land to depths of 3-4 metres.

These rivers, however, were comparatively small streams with many even smaller tributaries flowing through beach ridges and huge swamps which acted as catchment areas for the excess water of the plains. Some of the old meanders of these rivers are still discernable today. Horseshoe Lake was probably a meander of the Avon which was cut off to form an oxbow lake when the main current of the river found a more direct line of fall. 940 year-old wood samples from Bowendale Road in Beckenham "together with its associated peat is certainly from a young meander fill".¹⁹

THE SWAMPS.

At the mouth of most of the rivers of Canterbury, wetlands in the form of swamps, lagoons or estuaries exist due to the inability of the rivers to maintain unobstructed outlets for their load against the wave-action of the sea. This situation was probably much enhanced when sea levels were higher about 6000 to 5000 years ago. Until recently the Waimakariri also discharged by means of the Brooklands lagoon.

The formation and distribution of the swamps which covered the Christchurch lowland area since the Pleistocene are as complex as the dune system responsible for their confinement. Ever since the Banks Volcanoes became attached to the mainland, conditions in this lowland area were subjected to repeated inundation by either the ocean, rivers or gravel as well as a gradual regional down-warping of the area. During high sea-levels the neck attaching Banks Peninsula was narrowed by the much larger Lake Ellesmere to the south and the more extensive lagoon or bay to its north. As sealevels dropped, small lakes or wet areas were left in the depressions between shingle lobes and in front of the Waimakariri fan. As this area was built out as a result of the accumulation of beach deposits, water-filled hollows formed between the ridges through the seepage and confinement of water. Swamps, bogs and coastal wet-lands formed in the hollows as vegetation became established. As drainage was impeded in some of these areas, natural eutrophication set in probably assisted by wind blown sand and shifting sanddunes until only patches of swamp or peat beds remained throughout the future Christchurch area.



Figure 2.10. **Travis Swamp.**
A modified remnant of the Christchurch swamps.

Swamps are base-rich, fertile wetlands often with areas of open water and where the plant communities are 50cm or taller.

Swamps and eutrophic lakes have a high biological productivity. Plants - suspended algae and floating or bottom rooted larger plants - grow rapidly with a large turnover of organic material and mineral nutrients each year. Many species are annuals, or, as with raupo, die back to a perennating root or rhizome system each winter. Such conditions encourage large populations of aquatic invertebrates such as insects (including their larvae), water-snails, crustaceans and worms, and also vertebrates such as fish and frogs. Spiders and insects are seasonally abundant in and around emergent vegetation.²⁰

With the 'right' conditions, a swamp will follow a natural succession towards becoming a swamp forest. This happens when raupo and other aquatic plants which are usually present in the deeper water die and reduce the depth of water through the accumulation of their own debris. Sedges, flax and toetoe will start to invade the edges of the swamp trapping wind blown silts, further lowering the water level. The first trees to appear in this succession are cabbage trees, mahoe, kanuka. Eventually the dominant species of a true swamp forest, the kahikatea, makes its appearance.

However, when water circulation in the swamp becomes impeded through a diminished inflow or the accumulation of peat, the area soon loses nutrition and becomes infertile and acidic. This type of wetland is usually called a bog and has its own specialised type of vegetation, less diverse in fauna and flora than the true swamp. Spagnum moss and manuka are the dominant species.

Acland describes the land when humans arrived: "The heavy land along the seacoast and lake Ellesmere was originally deep swamp or in places heavy fern or what was called 'dry swamp - that is rather wet with fern, flax, toetoe, rushes and cutty grass growing on it, and with boggy creeks running through it - just sound enough to ride over if you were careful".²¹

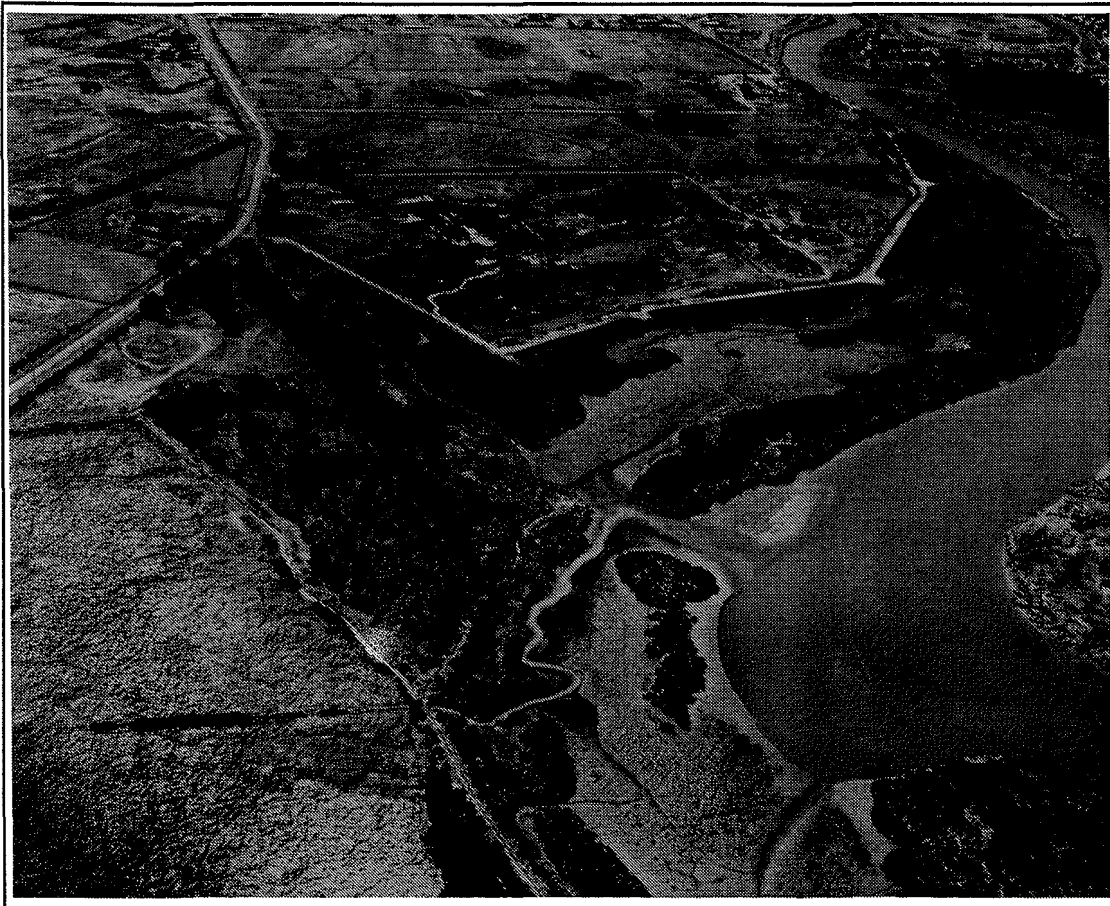


Figure 2.11. Wetland conditions at the mouth of the Avon River.

Photo: V.C.Browne and Son.

THE ESTUARY.

Many samples of marine and estuarine origin found under the Christchurch area indicate that the Avon-Heathcote Estuary was at one time much larger and is like Lake Ellesmere, "a residual fragment of the sea that once separated the Banks Island from the mountains".²²

An estuary is, "a semi-enclosed coastal body of water with a free connection to the sea and is strongly affected by tidal water and within it seawater is mixed with fresh water from land drainage".²³ Circulation and salinity patterns are therefore the most distinctive characteristics of an estuary and these patterns determine the type of flora and fauna found in this particular habitat. Water circulation transports nutrients, flushes away plant and animal wastes, shifts sediments around and controls salinity by mixing the waters while tidal currents scour out and keep channels open. The salinity of the estuary fluctuates depending on the tides and distance from the mouth of rivers or the opening to the ocean.

Like estuarine water, the sediments are also complex and range from mud to sand. In addition they are continually being modified by burrowing invertebrates and the deposition of organic matter. These micro-organisms, together with the wetland plants, form part of a long food chain operative in the estuarine system, providing the basic food for the primary consumers such as amphipods, crabs, cockles, mudflat snails, worm and fishes. These in turn attract the aquatic birds like ducks, gulls and waders. The estuary is also a valuable breeding ground and acts as a nursery for fish and crustacea.

The most significant characteristic of the true estuarine environment is the instability of the system and it is this that determines the main biological features. The complex environment undergoes constant change with the concentration and dilution of chemicals; deposition and erosion of sediments, and the coming and going of animals. This meeting place of land and sea is probably the most dynamic area of earth: the catchword is *change*.²⁴

THE FORESTS.

With the help of bore sample analysis it is possible to get a glimpse of vegetation patterns over the past few million years. These patterns changed as many times as the climatic conditions changed. Coal deposits of Westland and Otago have shown that vegetation existed ever since 'New Zealand' rose from the Geosyncline during the Mesozoic. The oldest identified sample on the plains is that of a wood fragment found in a bore done for the exploration of petroleum near Brookside. This Podocarp sample was found at a depth of 585 metres from near the base of volcanic debris deposited by the Diamond Harbour volcanics which was dated at 7 million years old.²⁵ Wood and pollen samples found in more recent deposits indicate that there has been forests from the mountains to the low-lying areas between the fans and near the coasts since the pleistocene.²⁶

While these forests flourished in favourable climatic and soil conditions, the Waimakariri was still wandering over the plains moulding its particular landscape. In the process it was also destroying much of the vegetation by inundation. A 6500 year old buried forest found in the Sockburn area at a depth of 10 metres is an excellent example. The Totara stumps were found with their roots still in the growing position, their bases snapped off and subsequently buried by sediment as the river destroyed the forest.²⁷ Many examples of trees destroyed in this manner have been found in the Christchurch area and can still cause problems of settlement under new foundations. Occasionally huge logs are found in the Avon which are remnants, not of the present docile river but of the time when the Avon was the Waimakariri.

Although these destructive phases were devastating, they did recreate conditions favouring the establishment of new plant communities.



Figure 2.12. **Riccarton Bush.**
A remnant of the lowland swamp forests.

During this period, known as the 'climatic optimum' these forests reached their maximum extent, occurred about 5000 thousand years ago and probably lasted for a period of 3000 to 4000 years.

Matai, Kahikatea, Kanuka and the true totara are the main species identified from former coastal swamp and semi-swamp areas that stretched discontinuously from north of Christchurch almost to Timaru. By contrast, in the extensive, excessively drained, shallow soil of the plainland Kanuka charcoal are the sole remain of a former low forest.²⁸

Although the Waimakariri destroyed many of the forests and vegetation on the plains, it was not the only destructive element at work. A deterioration in climate after the climatic optimum may have been a contributing factor.²⁹ Frosts and storms, but especially fires aided by strong winds were also responsible for the alteration of the vegetation cover of the plains from a forest domination to grassland. Charcoal fragments suggest climatic variations long before man arrived.

By the time the 'Moahunters' camped on the shores of the estuary near Redcliffs approximately 600 years ago, the only extensive forests in the area were on Banks Peninsula, Riccarton, Papanui and Kaiapoi. These were mainly swamp forests but there were also many areas of sporadic manuka stands on high ground between swampy areas.

SOILS.

Although extremely modified by temperature, winds, water and vegetation: "the initial structure of the Plains supplies the key to the distribution of the soil types... variation from porous stony surfaces of the upper fans with their thin veneer of silts precariously retained, to those immeasurable richer silt and swamp deposits lying within the junctions of the fans."³⁰

There are four main soil groups in the Christchurch area. They reflect their mode of formation and the complex distribution patterns give us an idea of pre-human vegetation patterns. The soils have been mapped and described by Raesdale and Rennie in the New Zealand Soil Bureau Report 16, 1974, but in many instances give only a general indication of a more complex distribution. The natural distribution has been extensively modified by later human occupation.

The Waimakariri Fan Soils are composed mainly of stony greywacke alluvium with a thin veneer of loess. These soils are very free draining and the watertable is low. Towards the east, these soils "merge gradually, without a well marked break, into the fine textured and poorly drained alluvium of the lowland".³¹

Soils of the Lowland and Drained Swamp Land, were formed in the lowland between the Port Hills and the Waimakariri fan. In their natural state, the water table was high, but these have now been drained. "Substantial differences in the age of the sediments are marked by only small differences in relief and soils on sediments of late Pleistocene age (e.g., Temuka soils) merge with soils on late Post-glacial sediments (e.g., Taitapu soils)".³² These soils can be classified according to the nature of the parent material from which they were formed. Parent materials recognised are late Pleistocene loess, post-glacial alluvium, saline post-glacial alluvium and organic matter.

Soils of the Coastal Sand Dunes are divided into two groups. The moving or recently stabilised sand dunes, are made up of Kairaki sand and the older established dunes which have a distinct topsoil layer, are referred to as Waikuku loamy sand.³³

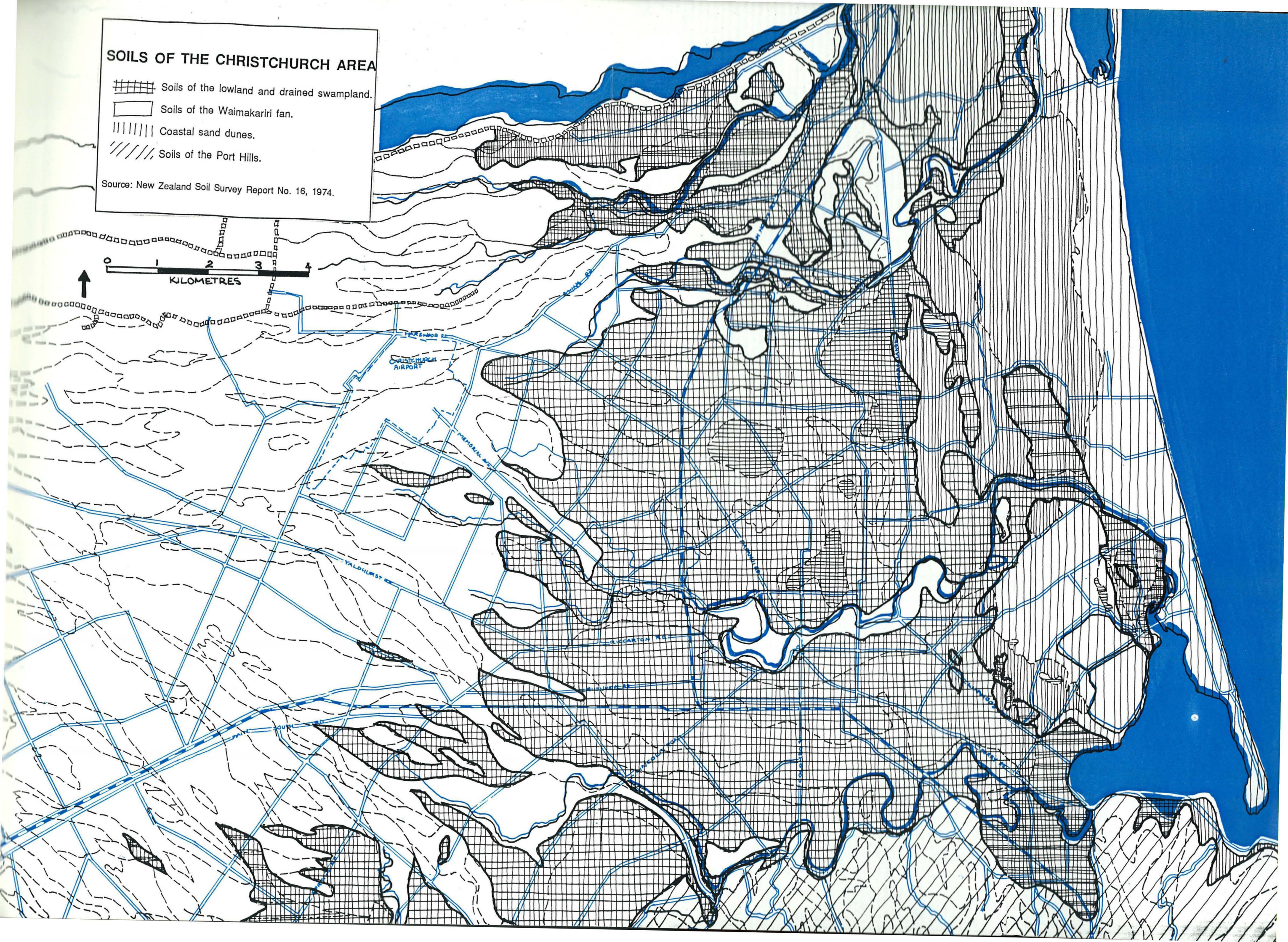
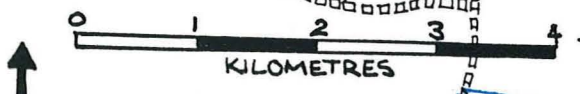
Soils of the Port Hills are composed of volcanic rocks. The northern slopes "are mantled with several layers of loess derived from the greywackes of the Southern Alps and deposited in Pleistocene and Recent times".³⁴

We have looked at the formation of the plains and have given a brief description of the landforms in the Christchurch lowland area as they occurred in their natural state. The natural formation and evolution of these landforms would have continued, were it not for the intervention of humans. In the following chapters we will look at the arrival of humans and the changes they made to the land.

SOILS OF THE CHRISTCHURCH AREA

- ▣ Soils of the lowland and drained swampland.
- Soils of the Waimakariri fan.
- ▨ Coastal sand dunes.
- ▧ Soils of the Port Hills.

Source: New Zealand Soil Survey Report No. 16, 1974.

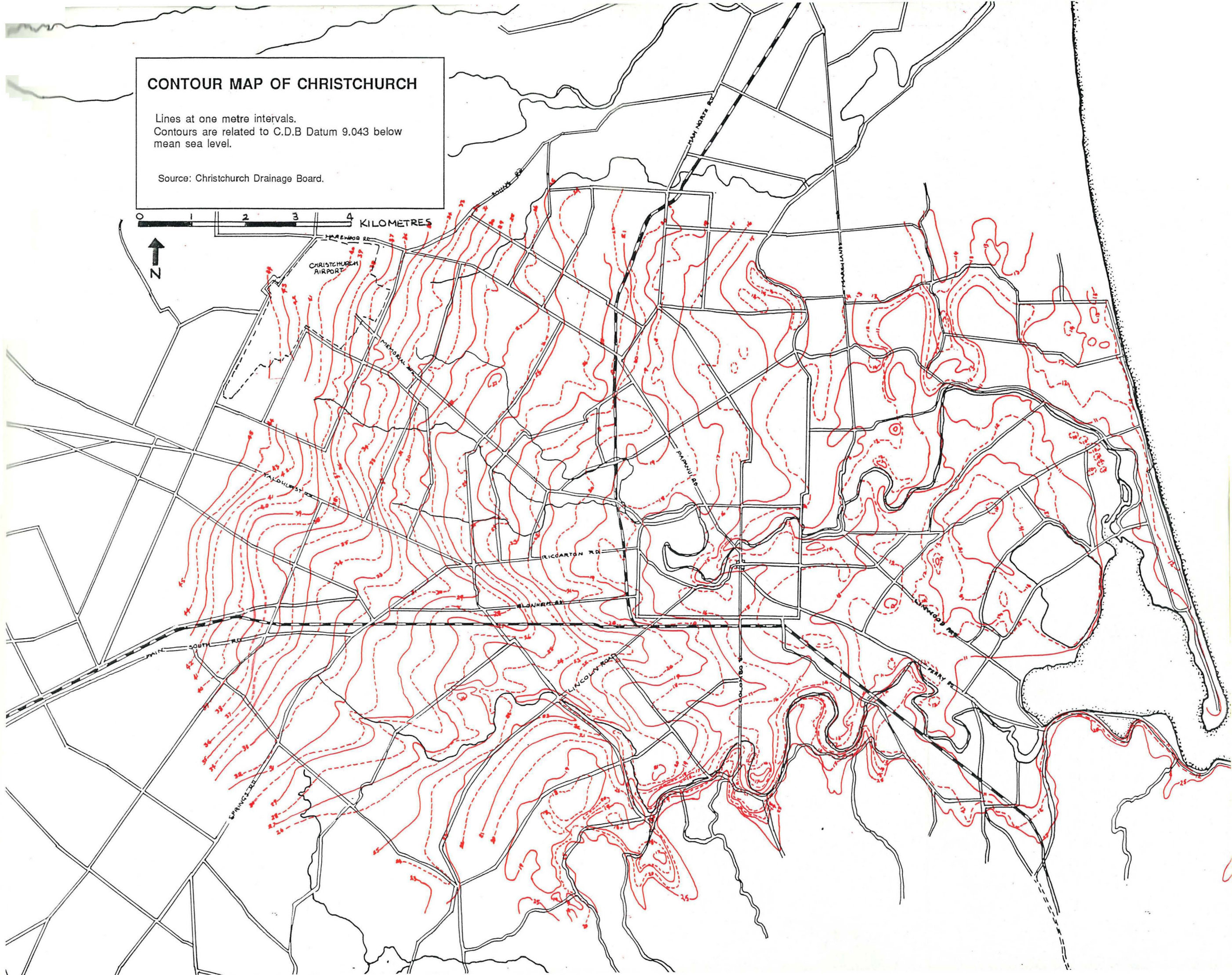


CONTOUR MAP OF CHRISTCHURCH

Lines at one metre intervals.
Contours are related to C.D.B Datum 9.043 below
mean sea level.

Source: Christchurch Drainage Board.

0 1 2 3 4 KILOMETRES



- 1.Cotton, p.197.
- 2.Gage, in Natural History of Canterbury, 1969. p.40.
- 3.Jobberns, in Speight et al., Natural History of Canterbury, 1927. p.90.
- 4.Suggate, 1958. p.115.
- 5.Ibid.
- 6.Suggate in Soons et al. p.6.
- 7.Brown, p.6.
- 8.Healy and Kirk, in Soons et.al., p.81.
- 9.Brown, p.6.
- 10.Cockayne, 1911, p.10.
- 11.Ibid., p.12.
- 12.Ibid., p.10.
- 13.Biggs, p.13.
- 14.Quoted in Brown, p7.
- 15.Brown, p.9.
- 16.Jobberns in Speight et al., p.75.
- 17.Cotton, p.197.
- 18.The Christchurch Artesian Aquifers, p.91.
- 19.Suggate, p.114.
- 20.Smale, p.30.
- 21.Acland, 1975, p.25.
- 22.Morgans in Knox (ed.) 1969, p.553.
- 23.Quoted in Knox, 1980. p.13.
- 24.Ibid., p.14.
- 25.Weeber, personal conversation.
- 26.Pillans, Pullar, Selby and Soons, in Soons et al. p.29.
- 27.Penny, p,50.
- 28.Molloy, in Knox 1969. p.344.
- 29.Holloway, in Knox(ed.) p.218
- 30.Jobberns, in Spreight. p.92.
- 31.Raesdale and Rennie, p.20.
- 32.Ibid., p.29.
- 33.Ibid., p.38.
- 34.Ibid., p.31.

"... here and there the blue line of a stream may be caught as it flows through the plain to the ocean. But the eye in vain seeks a prominent object to rest on. All is vast, open and bare. Suppose this plain was covered with towns, villages, cultivated fields and gentleman's parks, it would present a view perhaps unequalled in the world....but it now presents a striking example of how much the works of man add to the beauties of nature...It is like an unfinished picture by a great master...a great deal remains to be done; they should rather rejoice that so much is left to their skill.."

UNKNOWN INDIAN ARMY OFFICER.

CHAPTER THREE

THE ARRIVAL OF HUMANS.

Up to this point, the natural formation of the Christchurch area has been discussed, but with the arrival of humans, these processes were halted and drastically modified.

THE MOAHUNTERS.

About 950 there arrived in New Zealand a group of eastern Polynesians, "who as far as we know, did not practice agriculture".¹ They mainly fished and hunted. The so-called Moahunters seemed to have settled principally along the eastern shores of the South Island and had the first major human impact on the landscape. Not only did they "kill the last Moa" but caused major fires "largely accidental and only in part deliberate"², in their attempts to procure their prey.

When the first Polynesians arrived in New Zealand, the world was experiencing the final stages of a warm phase known as the "post-glacial climatic optimum". However, the climate steadily deteriorated and after A.D.1200 colder temperatures became the norm.³ Enhanced by the climatic conditions, the fires accounted for the decimation of inland forests and grassland over the major parts of the plains. Denuded in this fashion the plains were subject to severe and widescale erosion and although the grasslands recovered and regenerated comparatively easily after fires, it caused the disappearance of many inland forests.

THE MAORI

It is estimated that the Maori population around the Banks Peninsula area in 1750 was between 3000 and 4000. "It is not clear what relation existed between the Moa hunters and the Maori of the late 18th century - whether they represent two distinct phases of settlement or whether the classical Maori culture evolved from that of the Moa-hunter".⁴ However the later Maori culture was significantly different from that of their predecessors and there were many fewer in the same coastal areas.

In the more temperate area north of the peninsula they grew kumera and kept pigs. The swamplands around the peninsula were of special importance to the Maori because of the availability of food resources. The abundance of fish and bird life in the estuary, rivers and swamps, made the area an important hunting ground and a pattern of planned settlements evolved in these areas. The Maori name for the Avon is Otakaro which means 'place of game'.

The Ngai Tahu, had their headquarters just north of present Kaiapoi at Kaiapohia. Here excellent use was made of the existing landform in that they built their Pa on a 'defensive promontory' of dry land amidst coastal swamps and flax. A well established settlement of about 1000 people lived at this Pa and traded and occasionally made war on the tribes living at Rapaki, Akaroa, Ripapa, Wairewa and other settlements on Banks Peninsula.

There is also evidence that small groups lived amongst the swamps in the Christchurch area and were nicknamed 'O-rata-repo'(swampdwellers) by other tribes. "Tautahi, one of the Ngai Tahu chiefs 300 years ago, built his pa on the banks of the Avon near its junction with Frees Creek... At the east end, Bowrons creek crossed Bealey Avenue to reach the Avon at Bassets reach where there was a Maori village".⁵ Artifacts have been found on the river terrace along Cambridge Terrace where the police station now stands as well as where Colombo Street crosses the Avon River. Maori middens have also been found at Jellicoe Park. Horseshoe Lake was the site of an unfortified pa. This area was called Te Oranga meaning health or food or livelihood and was the base for seasonal food gathering activities.⁶

According to Rakiihia Tau, the Christchurch area was divided into areas with defined boundaries and "the appropriate people skills were appointed to these suburbs".

Within the Heathcote estuary underground caverns extended to various land based sites known by only a few of our Ngai Tuahuriri people. The opening to land in near Queen Elizabeth Park a kaianga nohonga of old known as Oruapaeroa and within the wakawaka or suburb known as Putaringamutu. The importance of this site was that it provided our ancestors at certain times of the year to catch sea run shark from this site. Fresh water was on the upper level, salt water underneath. By dropping a fishing line down this opening sea shark were caught. There are two other sites in the South Island similar to this site. These underground waterways extend from the Heathcote estuary to the Kaiapoi Maori Reserve to the Cam River as well to the Ashley River.⁷

According to McSaveney such caverns could not have existed⁸ but these may have been channels dug through the swamps to serve as waterways. The remains of similar waterways

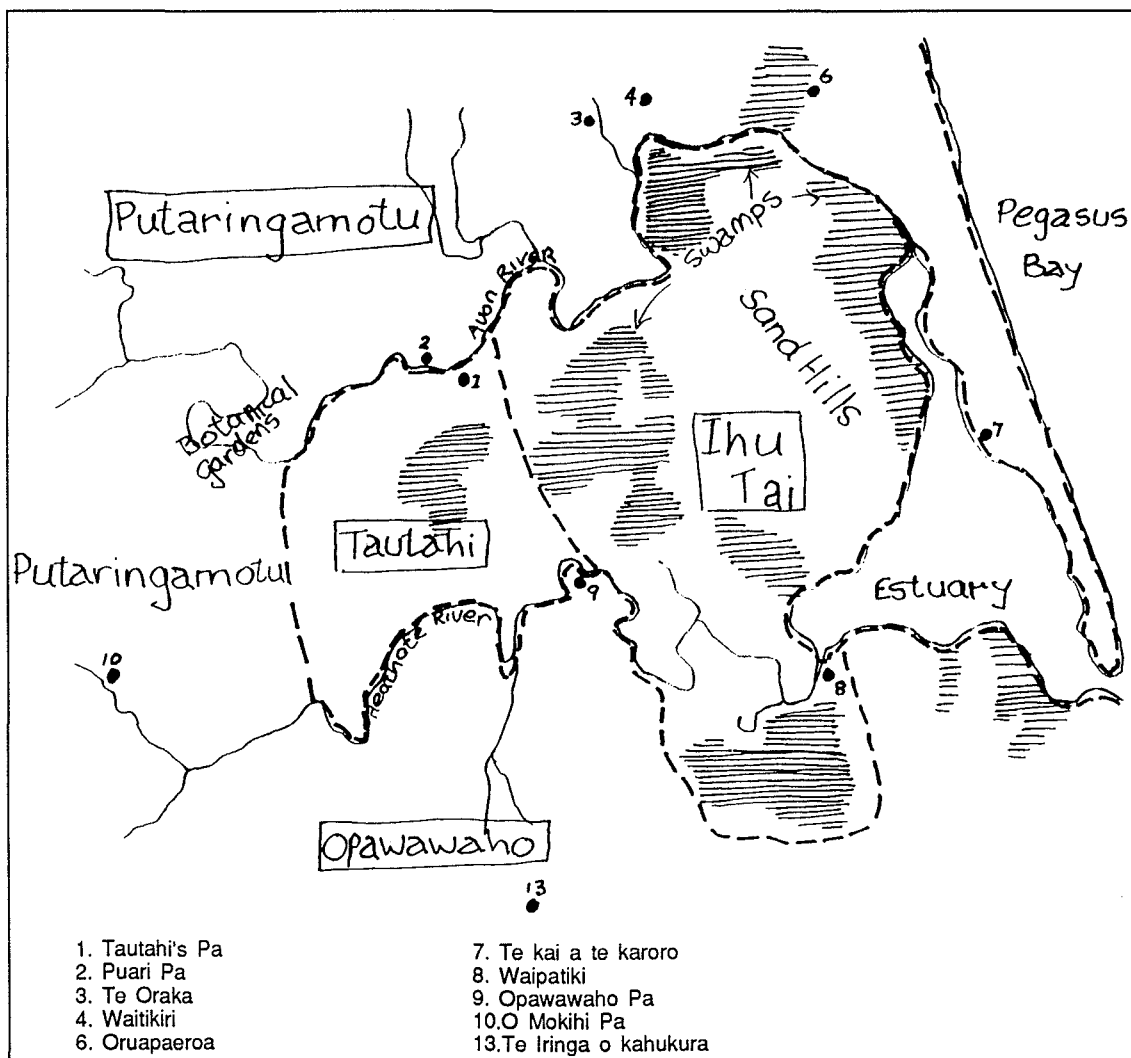


Figure 3.1. Maori Settlements and Boundaries.

Source: Redrawn from sketch map by Rakiihia Tau.

still exist in swamps near Blenheim. If there had been such channels in the Christchurch area, they would long since have been obliterated by the Waimakariri. Besides the waterways, the Maori also used to follow the high sandy ridges that separated the swamps and which linked the peninsula with the plains.⁹

"Although the Maori ranged widely in Canterbury, his modification of the natural environment was marked only in localized areas of concentration where he exploited the forest for building materials and where he carried on garden activities".¹⁰ Fires did occur during Maori occupation. However, these were more likely to have been accidental as they "acted", as Johnston suggests, "more like conservationists, not disturbing the habitat unnecessarily."¹¹ It can be argued that they evolved and were forced to become 'conservationists' when the climate deteriorated during the 14th century and their traditional way of life was no longer sustainable.

THE FIRST EUROPEANS.

Although changes to the environment were caused by these early human arrivals, they were almost negligible compared to the modification the Europeans were to make in their zeal to 'tame' the land.

On 16 February 1770 James Cook's ship, 'The Endeavour' passed some distance to the east of the extinct volcanoes that make up the peninsula. As he could not see the lowland adjacent, he concluded that it was an island and named it Banks Island after Joseph Banks, a young naturalist on board. The island was mapped as being 15 miles away from the hills to the west. "That the hills were joined to the mainland was discovered forty years later by Captain S. Chase of the sealing ship Pegasus".¹² After this and until the decimation of the whales in the 1830's, many sealers and whalers traversed the seas in and around Banks Peninsula. The Captain of one such ship, 'The Elizabeth', representing the Sydney based trading company of Cooper and Levy, named two bays after the firm. Port Cooper was later to become the entry port for the Canterbury settlers.¹³

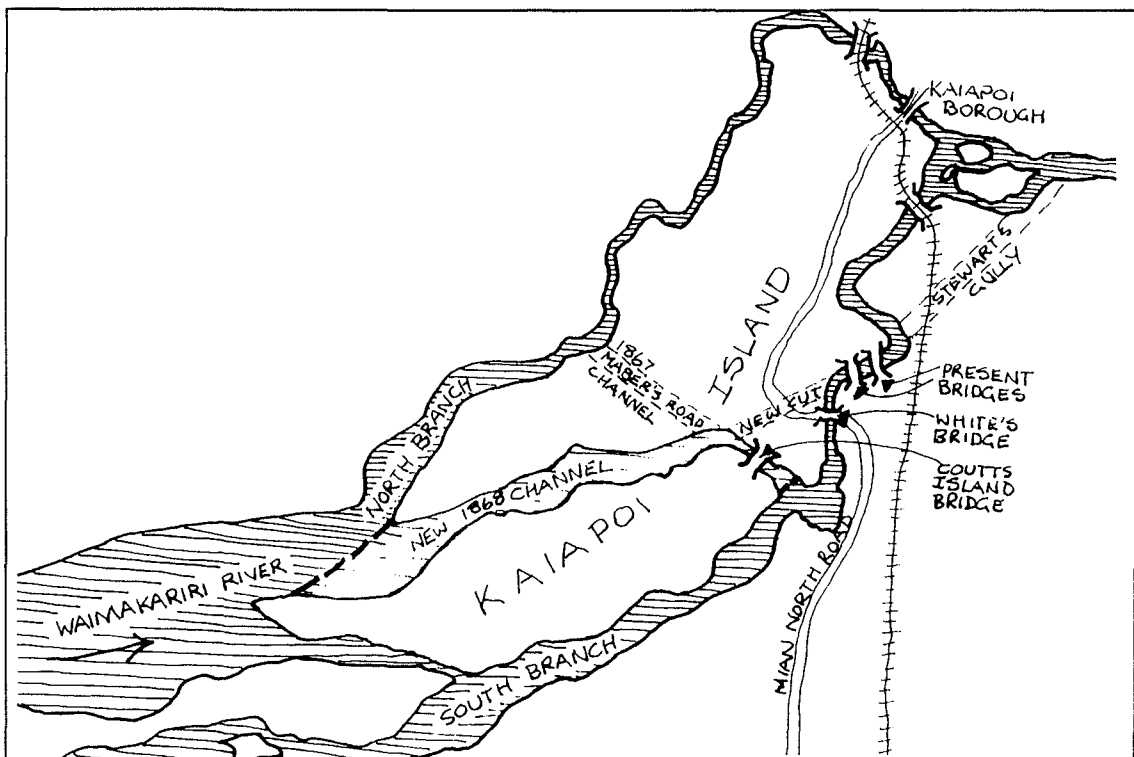


Figure 3.2. Kaiapoi Island.

Source: Redrawn from Logan.

Many of the ships brought traders who would climb the hills behind the harbour and cross the Christchurch lowland area to Kaiapohia to trade guns, rum and blankets for pigsmeat and flax. Maori guides took the men to the Pa via the Rapaki track and through the swamps to the Waimakariri which they crossed by canoe. The Waimakariri had to be crossed in two

places as in 1831 it was reported as flowing in two distinctly different channels, which were on either side of the then much larger Kaiapoi island.

The early exchange of guns were to a great extent responsible for the massacre of the Maori at Kaiapohia in December 1831. Te Rauparahu laid siege to the Pa in order to avenge the deaths of a friend and other notable chiefs at the hands of the Ngai Tahu. The heavy palisading was ransacked and destroyed and although some escaped through the swamp and flax that defended the pa on three sides, the population was reduced from 1000 to 200. Survivors later settled at Te Tuahiwi at Kaiapoi or moved to Banks Peninsula and eventually became labourers for traders and early settlers. The first census of Maori in Canterbury in 1848-9, estimated numbers between 400 and 500.

The whalers and traders were followed by an early group of settlers experimenting with agriculture on Banks Peninsula. Some of these were traders and explorers who had decided to settle on the peninsula. There was also a small French Settlement at Akaroa. By 1840 the European population on Banks Peninsula was 100. These early Europeans exploited not only the seas but also the forests on Banks Peninsula starting the phase of land exploitation and modification which was later to completely alter the face of Canterbury.

The first historic cultivation of the Christchurch area took place near Riccarton Bush when two pastoral squatter families put the soil under the plough. The venture was however short-lived as rats ate the first crops and the group left shortly after a fire started by a Maori on the banks of Lake Ellesmere got out of hand and destroyed the farm "...and this loss, together with the fear of the Sumner bar, discouraged these pioneers, and they abandoned the place after eight months' occupation, leaving a stack of straw behind them".¹⁴

THE DEANS BROTHERS.

In 1840, soon after the McKinnon and Shaw families left the place called Putaringamuto, William and John Deans arrived and rented the area from the Maoris. They had first tried to settle in Wellington and Nelson but were dissatisfied with conditions there and later exchanged their land for the Riccarton area.

In a letter to his father in January 1844, John Deans wrote of their new home;

This is certainly by far the best place I have seen in new Zealand... there is a wood about 200 acres in extent at the back of our houses, and a river of water clearer than crystal (indeed the finest water I ever saw) running close past the front.¹⁵

In the absence of labour and materials they made good use of the existing landform, the river divides into several different branches near to our houses, and it is between them that our cattle feed; they serve as fences.¹⁶

He goes on to describe the district,

near to the beach on both sides the land is very swampy but inland two or three miles it is mostly quite dry land; The banks are generally about ten feet high and the rivers very deep but narrow having no level channel banks like most of the rivers at home; these sorts of rivers are fed by large springs and are always clear, neither rising very much with the rains in winter nor falling low with the droughts of summer.¹⁷

John Deans was somewhat of an optimist! The swamps were far more extensive and the 200 acres of bush behind their houses were at the time of their settlement closer to 50.

The rivers, and notably the Otakaro or Avon as it was renamed by the Deanses, served them well as navigation channels to bring provisions from Port Cooper. This was done by whale boat around Godley Head, over the bar at Sumner into the estuary then up the Avon as far as present day Barbados Street. From here "by canoe to a large pool at the gully west of the present hospital"¹⁸ and from there they towed lighter loads close to home up a stream later called Washbourne Creek.

The Deans home at Riccarton became an important visiting stop for explorers and Banks Peninsula settlers. This set up the first rudimentary communication links with Port Cooper, Kaiapoi and the pioneer settlers on the Canterbury Plains. Their successful farming venture and enthusiasm, fired by a certain amount of self-interest undoubtedly influenced the eventual siting of Christchurch as the surveyors sent out by The Canterbury Association were also frequent visitors.

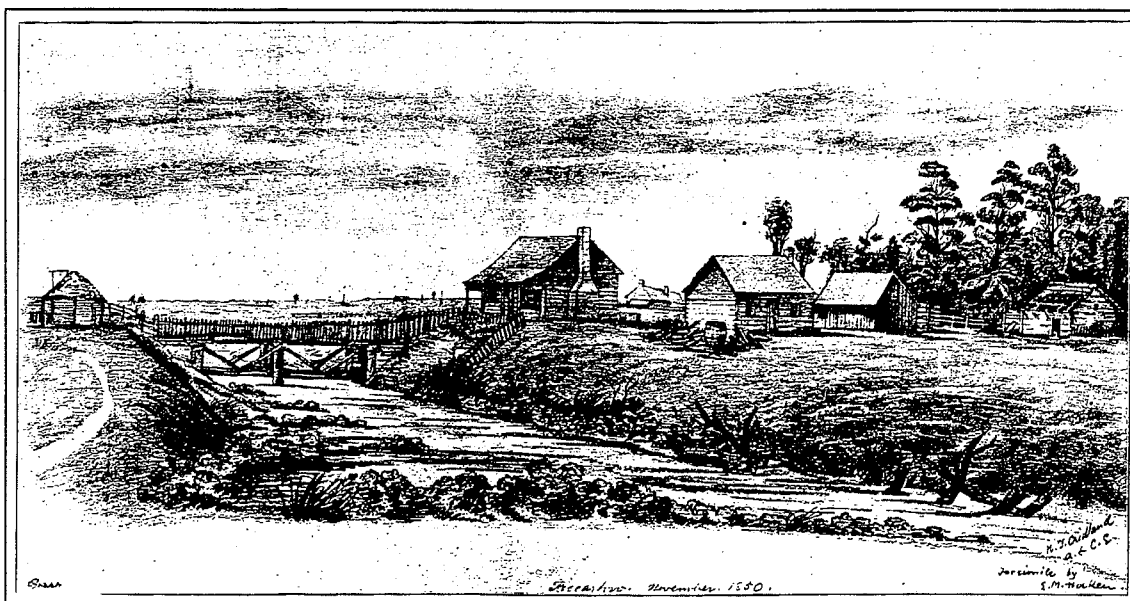


Figure 3.3. The Deans Settlement 1850. From a sketch by H.J. Gridland.
Source: The Press Jubilee Number.

SELECTION OF THE SITE FOR THE NEW SETTLEMENT.

In 1841 scouts rejected the Plains as a site for the Nelson settlers as did Tuckett and Davidson, agents for the establishment of a New Edinburgh or Scottish Settlement in 1844. Wigram quotes from the diary of Dr. Munro;

The travellers had in fact been most unfortunate in their choice of a route to the Messrs. Deans brothers homestead. Starting... from the head of the Bay, they probably descended to the plains by Gebbie's Valley. The country was flooded at the time, and they found themselves entangled in a network of creeks, with which the swamp at the foot of the hills was intersected. In attempting to cross one of them, Mr. Tuckett made use of a Maori raft made of mokihi. The native method of propulsion was to sit astraddle and propel the frail craft with bare feet, but Mr. Tuckett's more civilized methods ended in disaster, and the two prospectors spent a damp and uncomfortable night in the swamp, and did not reach the Deans' hospitable homestead till the following day.¹⁹

The area the men crossed must have been in the vicinity of the Halswell river which at that time was much wider and in places up to 2 metres deep. According to Penney "when a whaling crew about 1820 explored the waterways round the site of Christchurch a boat could be rowed through to Lake Ellesmere".²⁰ Wigram adds to this; "Probably their misadventure had something to do with prejudicing Mr. Tuckett against the Port Cooper Plains".²¹ However, at this time, the Church of England was also looking for a site for the founding of a Canterbury Settlement, on the principles of the Wakefield school. In 1847 Capt. Thomas was directed to find a suitable site. He came out as chief surveyor with a party of surveyors which included two assistants, Thomas Cass and Charles Torlesse as well as the Association agent Godley and William Fox as assistant agent.

"Originally Thomas had intended to explore the country south of Otago before reaching a final decision, but twice storms frustrated his attempts, and in the end he decided to cancel the trip.²² On reading the letters of Torlesse it would seem that Thomas decided fairly easily on the area for the new settlement. In a letter to his friend E.W. Stafford dated the third of February 1849, Torlesse wrote;

After thoroughly examining the district of level land adjoining to Peninsula, of about a million acres, Captain Thomas has come to the decision that this is the place for Canterbury. If he is able, he will leave us here and merely go to Port Nicholson to send despatches home, get the Governor and Bishop's sanction, and buy all the paraphernalia for our future operations. If he is compelled to go up to examine the Wairarapa, as to which he will be informed by Mr. Fox from Wellington, I believe he will do it merely to satisfy people, not that he has the notion of pitting one place against another.²³

Torlesse goes on to give a description of the plains;

The harbour is decidedly a good one...Ridiculously easy of ingress or egress...The rivers - 3 in number, the Waimakariri navigable for boats some 5 miles up and allowing of the entrance of small schooner(20 tons or thereabouts) or a steamer over the bar..The streams are plentiful - 2 first-rate leading from the beach near the NW. end Peninsula westerly - one to Deans' station and both navigable for large boats for 7 miles....Soil - Speaking generally of the whole plain there is no part of it unfit for some purpose or other...Bush - enough in Port Cooper for some time to come...will furnish almost unlimited wood for the settlement...The Scenery - Peninsula wild and beautiful, the lower plain flat but within range of pretty scenery, the middle plain monotonous in the extreme. The upper or western side of the plain very pretty and views from the snowy mountains most romantic.

I believe that this place will not only *do* for the site of Canterbury, but considering its harbour and extensive grazing country (for the whole country from North of Otago to the Kaikouras looks to this as its shipping port) is the best district in New Zealand.....Tuckett must have been blind to pass over this place...Providence interfered with him and saved this for Canterbury.²⁴

Torlesse was not the only enthusiast, H.J.Cridland another early surveyor also stressed the immense tract of level country available "well covered with grass and watered with abundant beautiful streams, within six miles of the Port and easy of access by several routes".²⁵ He went on to say that the soil was free from inundation or other danger, and there would be no struggle with dense forest as in other parts of New Zealand.

Thomas thought the Avon "a prospectively valuable asset as a means of direct communication between the fertile plains and the sea",²⁶ and no doubt influenced by favourable reports from these two surveyors and the contact he had with the Deans brothers, he could in April 1849 report his reasons for the choice of the site to the Association. In a letter to Grey he wrote;

The principle points to which the Association directed my attention in selecting a site were; First, a good commodious harbour. Second, a block of a million of acres; third, a district so removed from natives and other settlements that it may be formed into a separate province with its own institutions. These objects would be obtained by placing the settlement in the Port Cooper District.²⁷

THE SPECIFIC SITE FOR THE NEW TOWN.

Early maps show that the head of Lyttelton Harbour as well as the present site of Oxford were considered as possible sites for the new town and Sumner as a harbour but these were later rejected.

In October 1849, Cass was instructed to survey and map the area from Papanui Bush to the Port Hills. Torlesse had the job of surveying the northern area up to Oxford. Scroggs was to mark the swamps and other natural features to assist the selection of the final site.

Thomas' brief was to find a town site limited to 1000 acres, surrounded by no more than 1000 acres of suburban land. In this Hercus condemns Wakefield and the Association as being blinded by their ideals of artificially restricting the growth of the new town.²⁸ Thomas would have had this size restriction in mind when choosing the site. The proximity of the harbour and the Avon and Heathcote as a means of direct communication with that harbour were important. The Avon also served as an immediate source of fresh water. The Deans brothers requested that the new town not be laid out too close to their farm.²⁹ The bush at Riccarton and Papanui as well as those of Rangiora and Oxford would have been seen as sufficient source of timber for a small population.

The site that was eventually chosen was slightly higher and drier than the surrounding area, but it was nevertheless sited between very swampy areas. Hercus has probably been the strongest critic of the selection of the specific site:

Yet when everything that can be said in favour of the site chosen for Christchurch has been said, it still stands condemned. To a future generation, Thomas's lamentable lack of insight into the problems he was creating in attempting to build a city upon a flat site, a large part of which was nothing but swamp, must ever be deplored.³⁰

Other critics were also to have their say from time to time;

A much less swampy site could have been found by going seven or eight miles further west - and - further in land - but difficulties of transport, already bad enough, would have been immeasurably increased by siting the town far beyond the limits of boat navigation.(Hight and Straubel)³¹

It would be idle to speculate how many headaches the Drainage Board and its staff would have avoided had the age of the motor vehicle been foreseen and Christchurch established out Rolleston way on a good shingle foundation.(Scott)³²

Much of the district was an almost impenetrable tract of unhealthy swamp and bog, while drier lands between the sea and proposed town were too sandy for cultivation.³³

If the selectors of the site for the Canterbury capital had wished to choose a drier area and one that would have caused infinitely less trouble in draining they could have chosen an area north of Papanui. Here land is sixty feet above sealevel, compared with fourteen feet in the centre of the city at Cathedral square. But the northern district is poor shingle country. Christchurch certainly would not have had the beautiful gardens it possesses to-day had it been built on that area.(Morrison)³⁴

It would be interesting to speculate, knowing what we do today and with the technology we have, whether we would site the town where it is?

JOLLIE'S MAP.

The use of the gridiron was fairly typical and "fashionable" for towns that were deliberately planned during this period and reflected much of the ideals of the founding fathers of Christchurch. "The gridiron plan and the central square were being used all over the world in the 18th and 19th centuries in search for order in a fast changing world".³⁵

Some of their 'socialist' ideals come through in the orders received from the Association: "Surveyors had been instructed to see that, though sections for these colonists could not be of regular size and figure, no one should monopolize the advantages of road and river frontage".³⁶

Thomas's personal preference as a military man would have made him appreciate the advantages of a gridiron plan as it was ordered, simple and easy to lay out. With few staff and the imminent arrival of the settlers it was ideal in that it could be done quickly and was fairly adaptable.

This is what Jolly had to say on the matter:

I soon had my proposed plan ready for Thomas's inspection, who approved of it, except one or two parts in which I had indulged in a little ornamentation, such as crescents and which Thomas pronounced 'gingerbread', and for my part I was not sorry to give them up for something more practical; but he made one change I have always regretted. I proposed that some of the streets, should be wider than a chain for two reasons, one being that they might be planted with trees and the other that it might be the means of saving the whole town from being burnt by confining fire to one block. He however would not agree to it at the time, but afterwards, when the survey was nearly completed, he gave me leave to widen one or two of the principal streets if it could be done without much delaying the completion of the survey, but it was then impossible. I had however managed to have two good wide streets on each side of the Avon which would act as lungs to the city and also prevent private drainage from being run into the river. On March 18th 1850, I finished the map of Christchurch, and it was sent home to the Association and on the 16th of March I completed the survey.³⁷

Jollie had some later admirers:

The green presence of Oxford and Cambridge terraces proves how wise this reservation was, and we can be thankful to Jollie for this beauty curve that partially breaks up the regularity of Christchurch. (Anderson)³⁸

Any observer today cannot help but be impressed by Jollie's far sighted concepts of town-planning.(Retter)³⁹

It required imagination and an eye of faith to place the quadrangle of streets diagonally across the course of the river.(Carrington)⁴⁰

There were also of course the critics:

The city of Christchurch suffers from the absence of any main thoroughfare.⁴¹

Cathedral Square is the hub of Christchurch, the Cathedral stands in the square and Christchurch hangs around the square. To the stranger it seems laid out on cartwheel principles, and made up of nerves and spokes - I generally found myself travelling up the wrong spoke. There is a dead same levelness about the streets that is somewhat puzzling". 'A Tramp, Esquire'. ("A Tramp, Esquire")⁴²

Perhaps homesick for the winding, organic, unplanned towns of the old country, an early resident wrote:

You will not find one curve, one bend, one undulation, mound or hillock - the effect is dismal in the extreme viewed in summer or winter.⁴³

According to Anderson, it was only after the main communication patterns became clear, that Ferry Road (High street) and Whately road (Victoria Street) were added to the original town plan by J.S.Browning.⁴⁴

WHAT IT WAS LIKE WHEN THE SETTLERS ARRIVED.

Reading some of the literature on early settlement it becomes clear that the Christchurch the settlers came to was vastly different from the city we know today. In 1948 Agnes Hercus wrote; It was far from beautiful. The unrelieved flatness of the country, the wilderness of high fern, flax, cabbage trees and raupo, tutu and nigger heads, cannot have presented a very prepossessing picture.⁴⁵

Life for the early explorers and surveyors could not have been easy and we read in Jollie's 'Reminiscences' that they lived mainly in tents and sometimes in excavations made in the riverbanks. He tells the story of two men named Dashwood and Mitchell who arrived at the door of the Deanses in a dreadful state after falling into a springhole between the Waimakariri and Riccarton.⁴⁶ This could have been one of the many springs that formed the source of the Styx or Avon Rivers.

Looking at a few extracts from the diary of Charles Torlesse we get some insight into the life of one of our first surveyors;

"22 November 1849 - Driven to the sandhills by mosquitoes - very much bitten there. (north of Kaiapoi)

23 November 1849 - Slept in cart, wetted and awfully bitten by mosquitoes. [p.114]

6 December 1849 - early in the morning White arrived saying that Cream (horse) was found last night in a swamp with only his head out. Boys immediately rode out with Fitch and Tom Bryant to see what could be done to save him, but he died before they reached him.⁴⁷

13 December 1849 - I put in 23 and 22 (pegs) - great swamp hopping (near Ashley river)".⁴⁸

Torlesse was not the only person to loose livestock in swamps or bogs. In 1936 a sewage ditch dug in the area of the old Deans farm, revealed the skeleton of one of their cattle which had sunk to six feet in boggy ground.

However it was not all hardship:

The survey of Christchurch was pleasant, easy work. I lived in Scrogg's grass house at "The Bricks" and the six men who were with me were in a weather-board house of one room about 40 yards off. I worked very hard all day, and in the evening went eel-fishing, pig-hunting or quail shooting in the neighbourhood; quails were very plentiful at that time, and I shot many on what is now the site of Christchurch.⁴⁹

After the surveyors came the settlers. Dr. Barker was one of the very early residents of the new town and we are indebted to him for an excellent photographic record of early Christchurch. He had this to say on his arrival:

I ascended the top of mount Pleasant and had rather an unpromising view of the promised land, as from that spot you look over the worst of the swamps that lie between the sea beach and the grassy plains.⁵⁰

And;

At this time the mosquitoes were so intolerable inside the hut at night that I slept on the bank of the river wrapped in a blanket.....I frequently walked over to Sumner, and twice lost my way in the swamps, and it was for hours wading through them above my knees in water with the dense bush waving over my head and leaving me nothing but the sun to steer by.⁵¹

George Hart was a young boy when he arrived with his parents in 1852:

The only road communication was by means of the Bridle Path...over which the Pilgrim Fathers and mothers too...had to carry on their backs the lighter articles of furniture...The heavier portions had to be sent by sea from Lyttleton by small sailing vessels, over the Sumner bar and thence up the Avon river to the Bricks wharf...Wading through swamps and lagoons we at last came out at the Ferry Road, which was in the course of construction, and had reached...somewhere about the spot on which the Lancaster Park Hotel now is. Between here and our destination, was a raupo swamp, in which afterwards I had many a summer swim. This extended from the junction of the East Town Belt and the Ferry Road to nearly the Caversham Hotel corner. It was no use trying to go round it, for that would have entailed a longer walk than one would have felt able for, so we perforce went through it. It was almost knee deep, and some of us youngsters had a pretty rough time of it, laden as we were. However, we struggled on, and shortly before sunset we reached our home on the plains...All around, except the cleared space in front of the tent, was high fern and tutu, stretching away as far as could be seen. At the back where the Oddfellows' Hall is, and the range of merchants' warehouses in Lichfield Street now stand, was a large raupo swamp, which was a rare resort for wild ducks and pukaki...Tracks here and there had been roughly cut through the fern and tutu by the survey parties of the Association...It was my daily duty...to fetch the meat required for the Hotel...from the whare of Mr. Turner...on Oxford Terrace. Streets, of course, did not exist till a later date; and besides the difficulty of making a bee line through the tall fern which grew considerably over my head, a deep wide gully, full of water, intersected my line of route. This gully, which more resembled a river in the winter time, ran from where St. Michaels Church now is, on the one side, to the river near where the Manchester Street Bridge is now... To cross this gully...entailed a walk very nearly to where it emptied itself into the river, near the Manchester Bridge, as it was too deep and wide to wade through any where else en route.⁵²

In 1860 this oft quoted stanza by Raven, called "**Growl in a Sou'-wester**" appeared:

Land where men with brains of fog
Built a city in a bog!
Land of rain, and storm, and flood!
Land of water, wind, and mud!
Where six days a week the gale,
Laden thick with rain or hail,
First from sou'-west blows a piercer,
Then veers nor'-west and blows fiercer!
This is what I think of thee,
Eden of the Southern Sea.⁵³

Even by 1903, when most of the swamps had been drained, some areas in Riccarton (Burdale street) were still wet and swampy and one resident complained that; "our friends can't come and see me because they'd be over their boot tops in mud".⁵⁴

According to Morrison,

The first impression of the majority was one of deep disillusionment as to this land of their dreams. They remained because they could not return...⁵⁵

CHOOSING SECTIONS.

Early pilgrims were allowed a quarter acre section in town and a further fifty acres of rural land. Although the Pilgrim Fathers wanted them to have a look around before making their choice on sections, the settlers were eager to get on with the business of settling and the first selections took place soon after they arrived.

Various factors seemed to have affected the choice of those first sections and were to have an effect on settlement patterns in Christchurch. Firstly there was the convenience of centrality and transportation access along the river and main roads. A second reason for a particular choice was investment value. The third factor was topography or landform.

ACCESSIBILITY.

The Avon and Heathcote rivers played an important part in the development of Christchurch and although longterm navigation was not viable, these rivers served the early settlers well as a communication routes when there were few alternative forms of transport available. For this reason development around the rivers began right from the start. Heavy furniture and luggage came down the Avon in boats and was offloaded at the Bricks where a small wharf had been built. This was the site beyond which navigation for larger vessels became difficult. It was here that many of the first sections were chosen possibly because at that time as there was no transport available to take their goods much further, but also in anticipation of future development of water traffic.

The area around the Land Office and Market Square, as well as other river frontages were popular early selections. This meant that the early development of the commercial area centred around these sites long before Cathedral Square became the focus for business activities. The square was more or less 'wasteland' and did not become a centre until 1877.

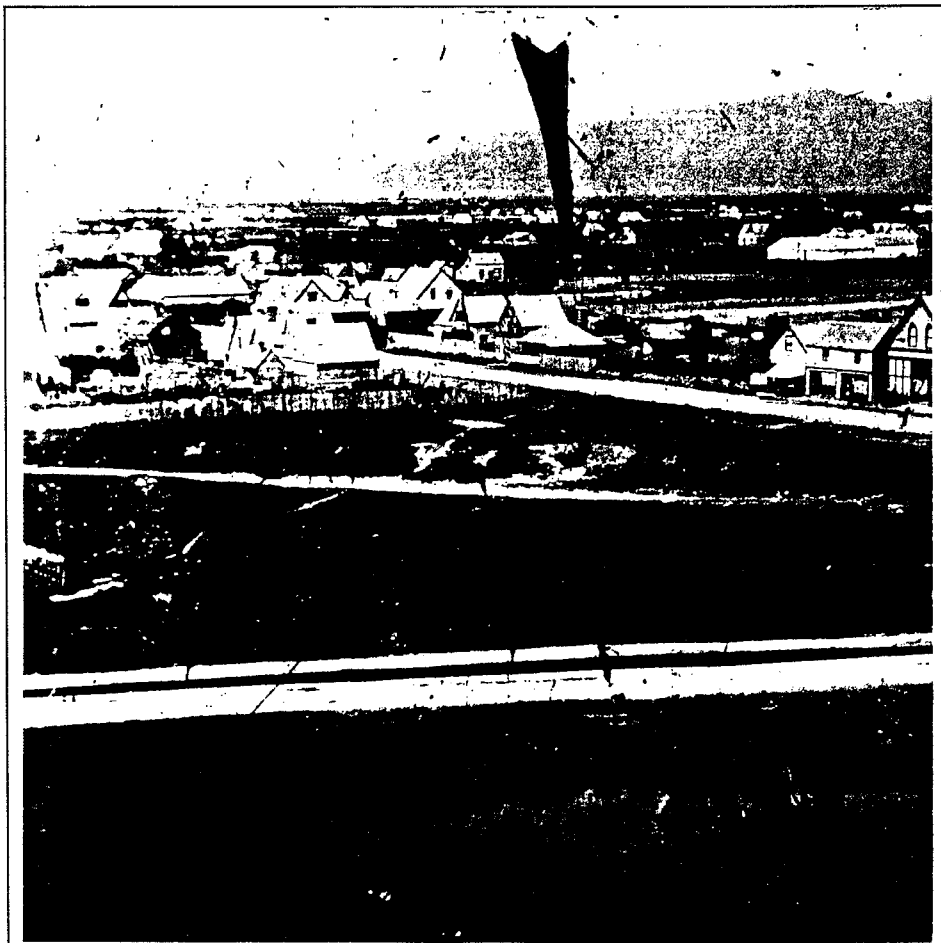


Figure 3.4. **Cathedral Square, 1860.** Oxford Tce. in the foreground and Gloucester Street in the middle ground.
Source: Canterbury Museum.

The streets had been very roughly laid out in the centre of the town up to the town belts were the reserves started. The reserves were laid out surrounding the town with the purpose of artificially restricting the growth to the centre of the town. In 1855 the Provincial Government sold off the reserves and it was only then that development took place in these areas.

The spread of the city outside the city boundaries was not envisaged by the Association. "No plan of streets, however was thought of for the surrounding rural district"⁵⁶ and development took place in a fairly practical way around main communication routes.

Very significant are the main lines of communication which connect the site of the capital city with the port, the surrounding districts, and with the sources of the supply of water, timber, shingle and clay, and other necessities of urban expansion. The deviation from the original plans for Christchurch city, so far as settlement was concerned, began almost immediately. Little settlements sprang up wherever there was an important route leading to or from the town. Wherever traffic was heavy and business was likely to be brisk, there people found their work and built their homes.⁵⁷

Settlements developed around the base of the Bridle path over which the early settlers walked to get to the new town and also at the mouth of estuary and Heathcote river. Not only was the soil fertile but it was a convenient place to catch the tired settlers for a rest and refreshment and a ferry could be used to cross the river.

Ferry Road was the first to be developed as an obvious communication link between the harbour and Christchurch. Riccarton Road was important because it was along this road that the first residents walked to get fresh produce from the Deans brothers and later to get timber for fuel and the building of their homes. The Deanses had given half of their bush to new settlers and the road led through Hagley Park along the river through swamp and undulating land.



Figure 3.5. View West from Provincial Buildings, 1860. Riccarton Bush on the horizon.
Source: Barker photo, Canterbury Museum.

Papanui and Lincoln roads developed in order to obtain resources. Papanui Bush was an important timber resource and by 1853, H. Sewell could write of Papanui; "This is a little village sprung up near the wood, consisting of a number of small tenements and of a little wooden church".⁵⁸ Lincoln Road led to timber on the hills above Hoon Hay and Halswell, later

to the stone on the same hills. This road also led to the Peninsula and Lake Ellesmere. The route could not be taken in a straight line but "a circuitous route had to be taken to cross the mile-wide swamp"⁵⁹ at the foot of the hills.

Many tracks towards the Hinterland soon made their way out of Christchurch to Kaiapoi and Oxford in the north and westward to the farms on the plains and in the foothills. Church Corner became an important settlement where this track and the road to Otago diverged. Upper Riccarton, according to Morrison developed long before Lower Riccarton, "solely because of the race-course established there in 1856".⁶⁰ These roads however, became important as links with the gold fields of Otago and the West Coast. When New Brighton became popular as a seaside resort, a road was formed and settlement sprang up around it.

A major factor in residential settlement patterns as well as the spread of industry in Christchurch was the development of the railway system. In 1863 the first railway line in Christchurch (and New Zealand) was opened connecting the town with Ferrymead and, four years later, in 1867, the Lyttleton tunnel was opened linking the town with its port. The building of this tunnel was a considerable engineering feat as, "It was the first time a complete section of an extinct volcano had been cut".⁶¹ It is also remarkable in that a town that could boast of having one of the longest tunnels in the world at the time, still had to wait a further 8 years before legislation enabled it to get an adequate drainage system. The railway was responsible for the development of Sydenham, Addington, and Woolston as well as Riccarton. "The advent of the railways was the first step to changing part of Riccarton from a farming to an industrial area".⁶² In 1873 the Canterbury Saleyards was moved to the junction of the north and south branches of the railway system.

The tramways which developed, first as horsedrawn in the late 1870's and by 1905 powered by electricity, determined residential development. Later with the advent of the motorcar the areas which remained undeveloped between the 'spokes' of the main tramroutes, were filled in. It was at this time that the Port Hills became a popular area.

INVESTMENT.

If Wakefield was zealous for a theory, many of his backers were keener on cash, for them colonisation was a chance to raise profit through land speculation....Options on sections of land were sold in the main to men who had no intention of emigrating".⁶³

Although Oliver was referring mainly to the settlements of Wellington, Nelson and New Plymouth, this statement was equally true for Christchurch. The investors in this case were mainly "Church of England adherents intent on making a success of the venture, but remaining in Britain".⁶⁴ The Church locked up vast areas of Christchurch and for many years development took place around these areas. North Linwood is an example of an area held by the Church of England, where, "early settlements were made along the boundaries of a triangular-shaped section of 300 acres,...which was not subdivided until 1893".⁶⁵ Another area south of this affected the route of New Brighton tramway. "Once these sections were subdivided and sold, settlement was not long delayed despite the sandy nature of the ground. The district was dry and on the high ground and houses built there had a sunny outlook".⁶⁶

In St Albans; "the Church held onto its rural sections until much of the land around had been developed. The slow subdividing of these Church lands in St. Albans, it is believed, greatly impeded the growth of the district for many years".⁶⁷ Also in the south-west the Church holdings impeded development; "As we study the area down the Lincoln road (now Halswell road) we cannot help but notice the large amount of land held by Absentee owners, by church authorities or by the Lord Lyttelton Trust. Gradually land was offered for sale or for lease".⁶⁸

Part of the settlement conditions were that settlers were allowed a quarter acre section in town and a further fifty acre rural section.

While some of the original owners of these and other rural sections were prepared to settle down on their land, other wanted to speculate and there was a great rush to get the blocks surveyed and subdivided...There is no doubt that most of the original owners of the rural sections in St. Albans bought their land in the hope of making money as, indeed, most of them did.⁶⁹

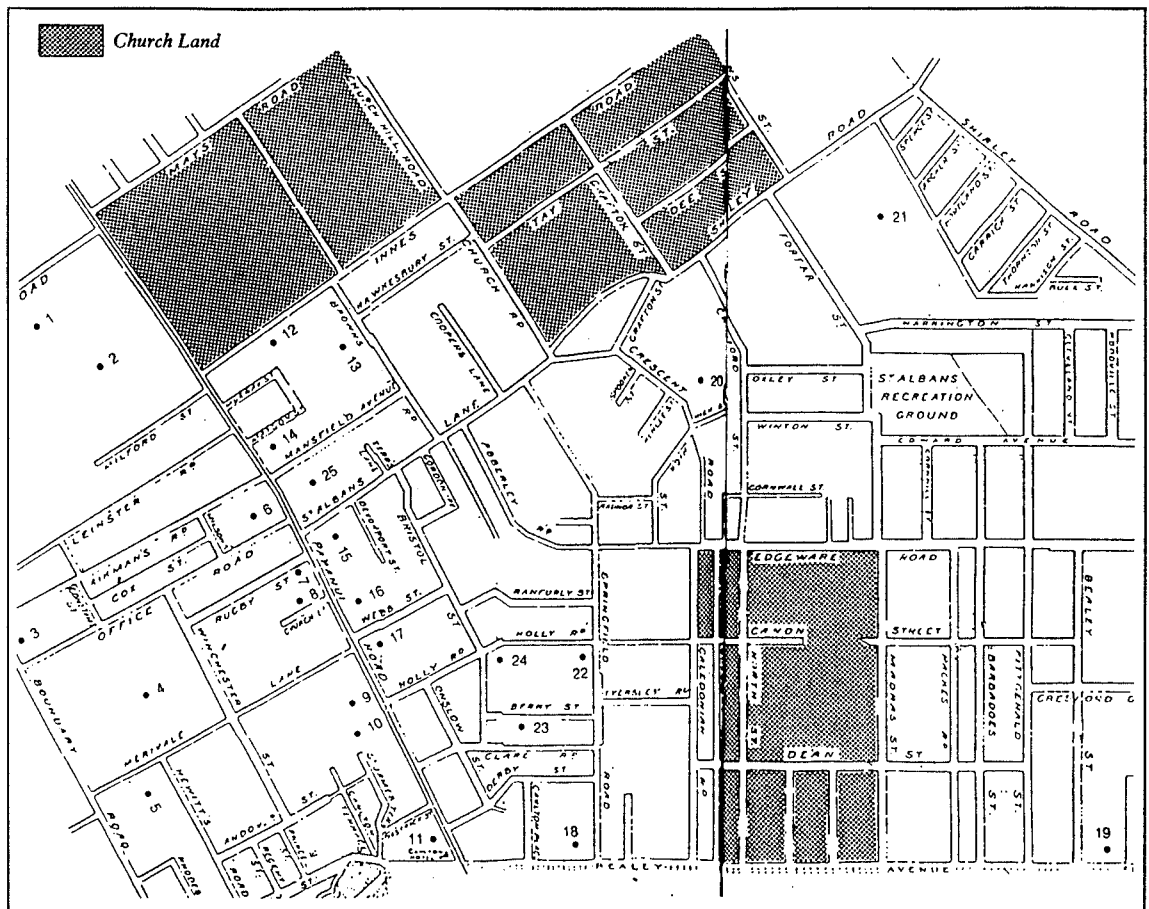


Figure 3.6. St. Albans Map, 1903. Showing the extent of Church land.
Source: St. Albans, Federation of University Women.

The planners had seen Christchurch as a "Little Amsterdam" or a "Little Venice" with canals as waterways linking the Avon, Styx and Heathcote rivers. In anticipation of this development, property was bought around Linwood Avenue, Marshlands Road, and the Halswell River which had been set aside as reserves. This extensive canal scheme was knocked on the head when the railway tunnel was cut through the Port Hills. Dr. A.C. Barker and C.C. Bowen, examples of early speculators, claimed land near Halswell and as these gentlemen lived in town, it can only be presumed that this land was chosen as investment because of the possibility of a canal being build along the Halswell River.

Development towards the north-west was fairly slow, not only as a result of the swampiness of the ground because St Albans, which was also a swampy area was developing rapidly. but A further factor was probably a result of; "the physical and psychological barrier that Hagley Park provided. The late date at which the Borough of Lower Riccarton came into being (1913) compared with the dates at which Sydenham, St. Albans, Linwood, and Woolston boroughs were created, helps to show how slowly settlement proceeded in the north-westerly direction from the town".⁷⁰

TOPOGRAPHY.

The natural landforms to a great extent influenced the direction of settlement. It was not until the swamps were drained and the ground-water levels lowered that the topography became a less important factor in determining settlement patterns.

The city had certainly been planned - on paper - and there were tracks cut to indicate the lines of some of the streets; apart from this, the land was a waste of sand, fern and scrub, crossed by a waterlogged gully. He would have been a prophet indeed who could have foretold where the main channels of commerce would be established.⁷¹

Cathedral Square which was supposed to be the centre of the town, did not attract selection until later. The father of George Hart bought land in Lichfield street only two blocks away from Cathedral Square and,

As giving an idea of want of faith on the part of the earlier Christchurch citizens in the ultimate importance of their City, it may be said that the section upon which the White Hart Hotel is now built was considered by many in those days quite outside the probable extent of the City...every one of his friends thought he was paying a most extravagant price for land so far away from the centre of the City.⁷²

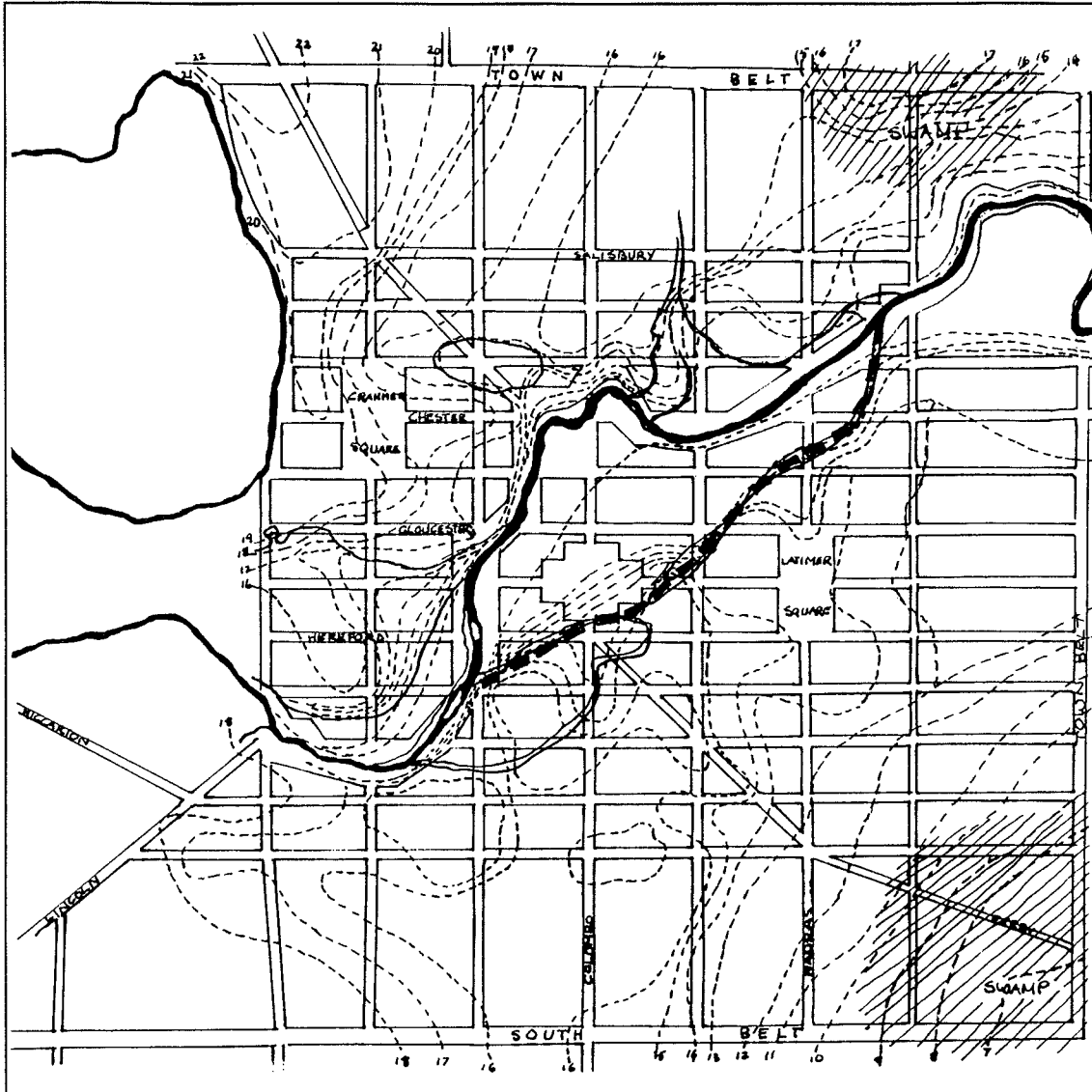


Figure 3.7. The Gully.

Compiled from Dobson drainage Map and Plot of Christchurch 1850.

This area was near where there "was a large raupo swamp". There was also the 'gully', which for many years retarded the early growth of this area. This gully was probably an old river bed of the Avon and in times of heavy rain caused enough trouble to warrant a ferryman according to an advertisement in 1864. "When Ruddenklau built the pie shop a deep gully from Cashel street ran through the section, and the backs of the buildings were on piles".⁷³ The development of J. Coker's Gardens on the western side of Manchester Street, between Worcester and Gloucester Streets, "involved the filling in of an old watercourse which ran from St Michael's Church across Cashel Street to the Gardens. Unfortunately, during the flood in 1868 the watercourse assumed the proportions of a small river and Coker's Gardens were extensively damaged".⁷⁴ One can imagine that before being filled in, the gully effectively cut the town in half during the winter months. Perhaps it is not surprising that in those days when technology was comparatively undeveloped, that the eastern side of town would have been seen as "outside the probable extent of the city".



Figure 3.8. **St. Michaels Church.**
The only evidence remaining of 'the gully'.

"The region bordering the river Avon was undulating, small patches of highland appearing above the levels and swamps. Houses were first built on the driest areas within the town belts, and then on the swamp-land, first just on the edge and in the drier low-lying districts".⁷⁵

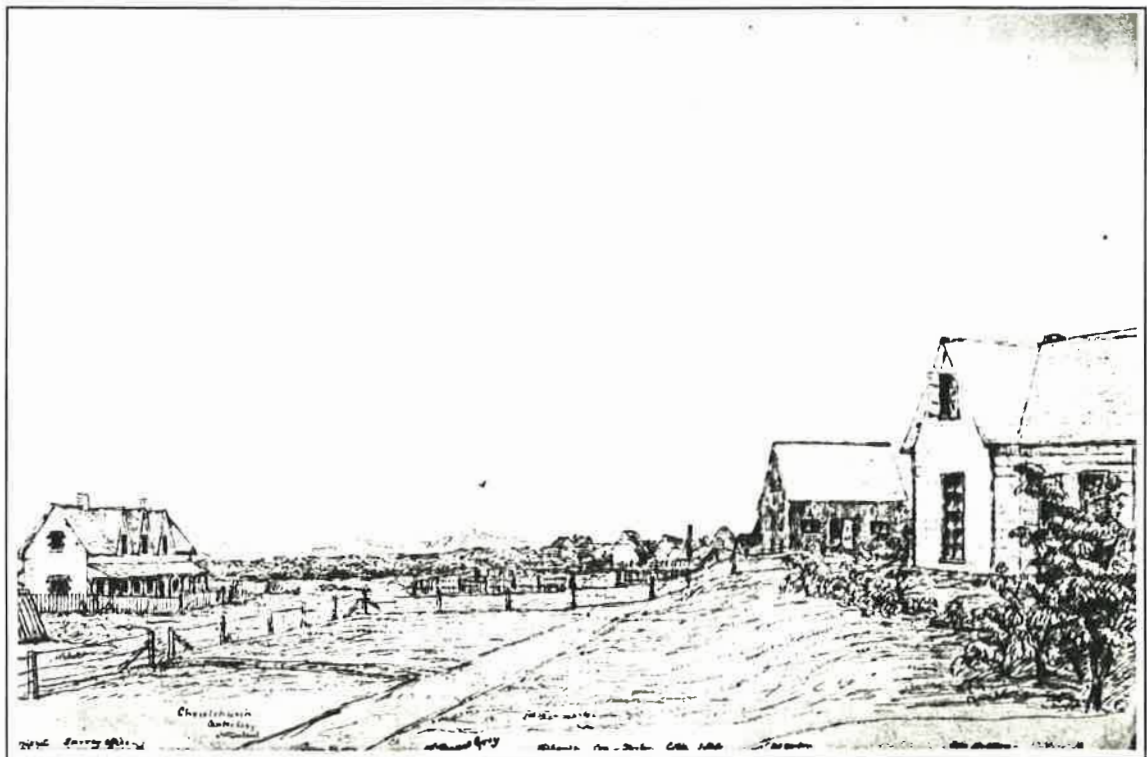


Figure 3.9. **The first houses built on higher, dryer areas.**
Source: Canterbury Museum. Pen and ink sketch by A.C.Barker.

Swampy land in parts of St. Albans were also at first avoided;

The settlers knew that one of the first roads to be formed would be the one bringing timber from Papanui Bush - once these sections had been purchased, buyers turned their attention to the land along the North Belt and then to the land beyond in St. Albans. There, acres of swamp were bounded by sandy ridges with flax, raupo, toi-toi, fern and manuka growing ten to twenty four feet high. It was not an attractive area, but because of its closeness to the city, it could be looked at once the drier areas had been taken up.⁷⁶

It was not until swamps in the Papanui area were drained that development took place in these areas. "Swamps hindered settlement in many places. To the west the land was considered too light and stony; in the south and north-west swamps were encountered. For these reasons the easier settlement directly to the north was favoured".⁷⁷ Also in Lower Riccarton, the settlement patterns skirted the swampy land which lay between two shingle lobes.

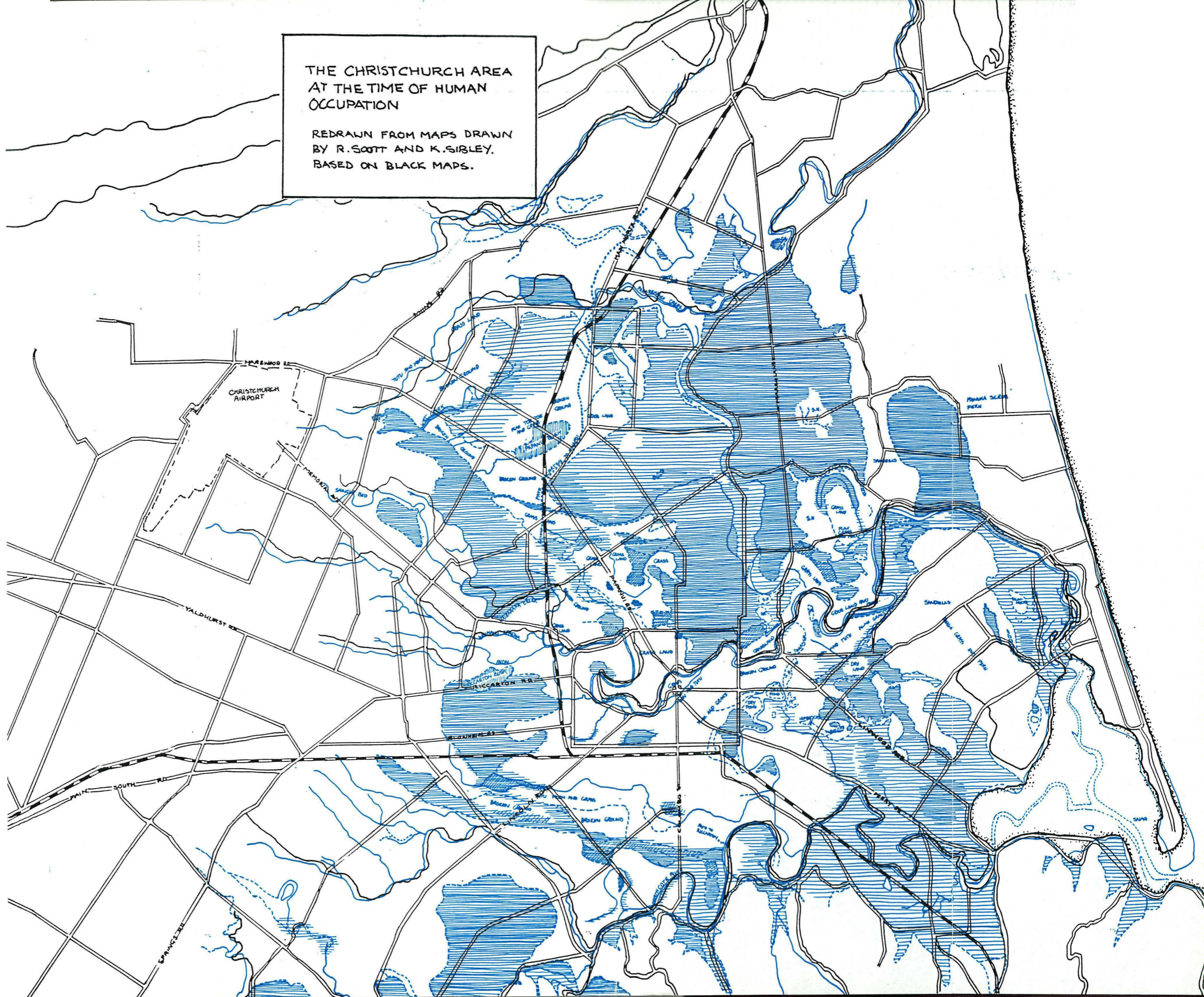
For many years those familiar with the Christchurch landforms avoided the areas that used to be swampland. Webster found that in 1879 the range of physical features stressed in real estate advertisement, included such attributes as 'high land', 'good drainage', 'river location'- being close to either the Avon or Heathcote, 'a healthy location' and 'good soils'.⁷⁸

Interest in physical features showed a decline at the turn of the century, possibly because of the tremendous impact of new household amenities and technological innovations... High, dry land received a mention, but river frontages were almost totally ignored. The latter may partly be due to the transitional location of the high status area, extending from the central area north into St. Albans, Papanui and Merivale, which were all isolated from the main river networks. Hillside location was first mentioned in 1920 with emphasis on the excellent view, and quiet, sunny and sheltered location. However there was little mention of either river location or high dry land. River locations were once again of interest in 1930. Other attributes, such as high land, sunny aspect, sheltered position, and a good view also appeared, but an added incentive was offered - that of privacy. Most of these features were repeated during the following decades, with the hillside benefits dominating. However, reference to physical attributes played a relatively minor role in the overall attributes stressed in advertisements.⁷⁹

It must be mentioned here that Webster's study was done of "high status areas" and one must assume that it was only those who could afford to live in these areas, who would be able to avoid the less desirable wetter areas. Today people are still aware of low-lying areas when buying their homes and these can still be swampy during winter and rainy periods.

THE CHRISTCHURCH AREA
AT THE TIME OF HUMAN
OCCUPATION

REDRAWN FROM MAPS DRAWN
BY R. SCOTT AND K. SIBLEY,
BASED ON BLACK MAPS.



AREA	COLUMN	GAZETTE & PURPOSE	PROCL.
0.1.00	1.5	Yes (1852) N.M. 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000	177268

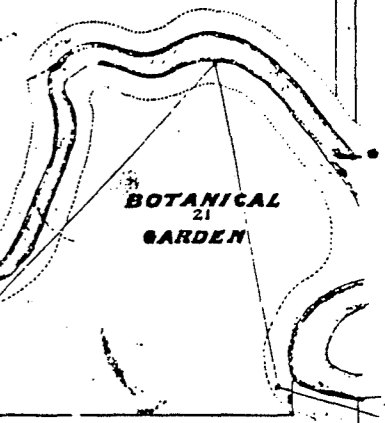
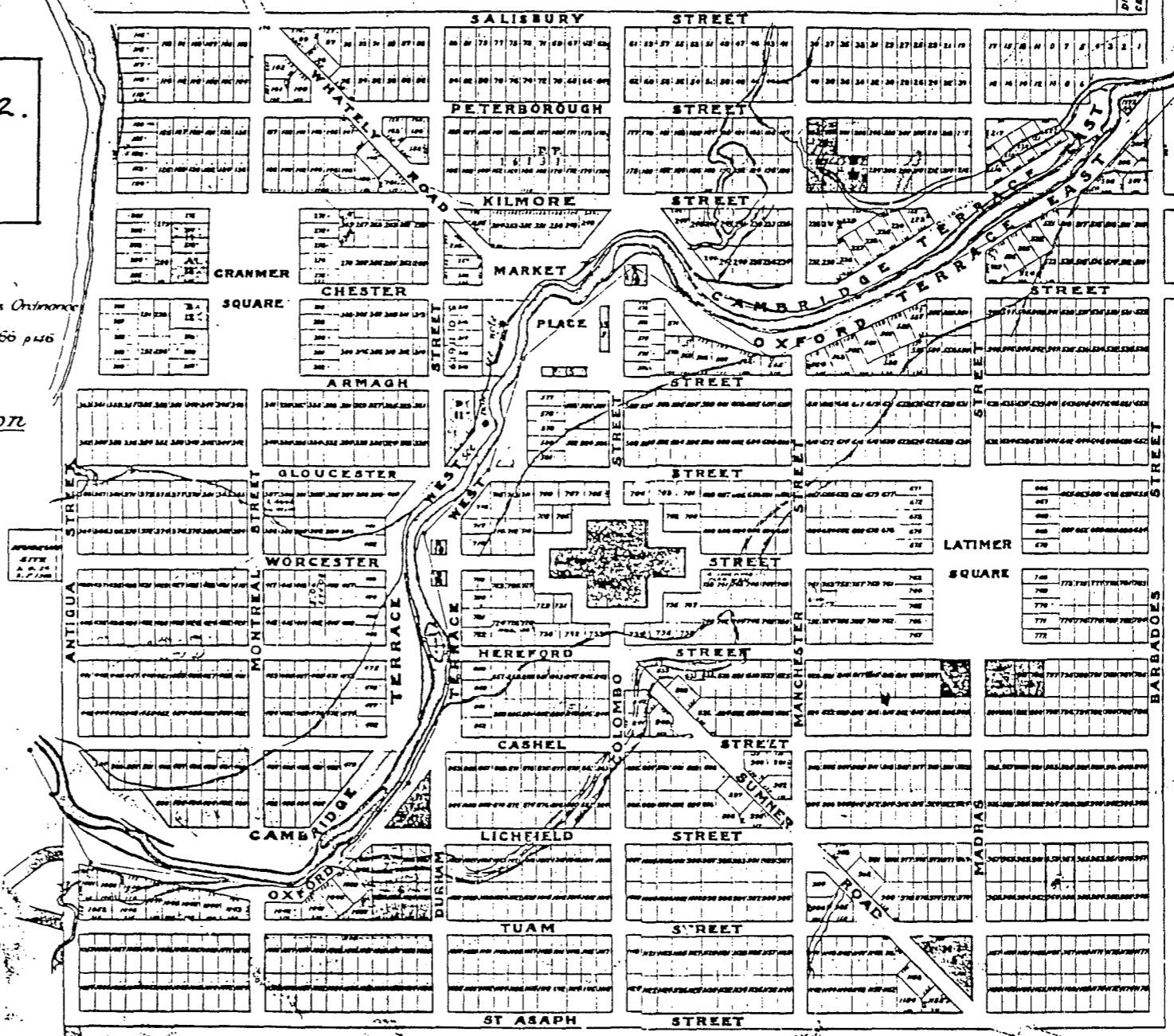
Pl. T.53, 751 & 753 being all the land in CT. 369/181
 (287) Taken for Pub. Buildings. of Govt.
 Gaz 1959 p. 492.

Scale 4 Chains to an Inch
 TOWN RESERVE
 24

PLAN OF CHRISTCHURCH 1852.
 ATTRIBUTED TO E. JOLLIE

Roads closed, Diversion Roads Ordinance
 1866 p. 153
 Canterbury Prov. Gazette 1866 p. 46

For this portion
 see
 Sheet 1



- Reserves
- A. Barracks and School
 - B. Church of England
 - C. Church of England Cemetery
 - D. Hospital
 - E. Association Store
 - F. Immigration Barracks
 - G. Survey Office
 - H. Exchange Institute
 - I. Town Hall
 - J. Police Court
 - K. Post Office
 - L. Jail
 - M. Castle Market
 - N. Abattoir
 - O. Observatory

Plot of
CHRISTCHURCH

March 1850

B.M. 273 is considered to be
 the original plan of Christchurch
 (See File B/3/45 fo. 251)

Chief Surveyor
 18/2/57

Black Map 273

21/04/1

Thomas G. G. G.
 Thomas G. G. G.

Surveyed by E. J. Jollie

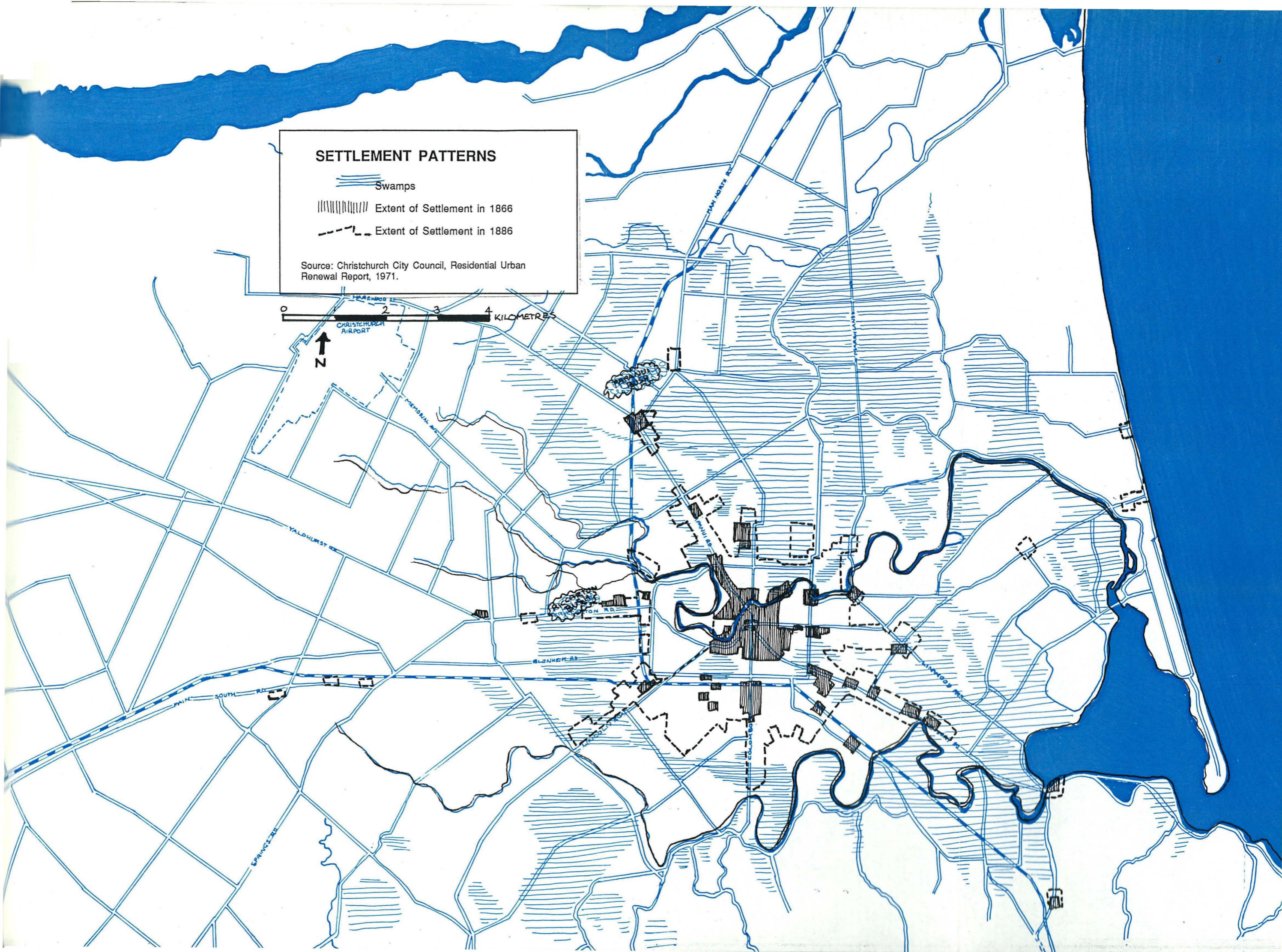
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SETTLEMENT PATTERNS

- Swamps
- Extent of Settlement in 1866
- Extent of Settlement in 1886

Source: Christchurch City Council, Residential Urban Renewal Report, 1971.

0 2 3 4 KILOMETRES



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3. Stevens, New Zealand Adrift. p.331.
4. *ibid.*, p.78.
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6. Christchurch City Council - Horseshoe Lake. p.8..
7. Hanare Rakiihi Tau. Paper given at Urban Landscape Seminar, 8 Sept. 1989.
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9. Penney, Beyond the City. p.23.
10. Johnstone in Knox(ed). p.78.
11. *ibid*.
12. Scotter, Port Lyttelton. p.3.
13. *ibid.*, p.4.
14. Anderson, Old Christchurch. p.7.
15. Deans, Deans Letters. p.79.
16. *ibid.*, p.80.
17. *ibid.*, p.92.
18. Wigram, The story of Christchurch. p.8.
19. Wigram, p.6.
20. Penney, p.22.
21. Wigram, p.8.
22. Hercus, City built upon a Swamp. p.5.
23. Maling, Torlesse Papers. p.53.
24. *ibid.*, p.55.
25. Morrison, The Evolution of a City. p.6.
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27. Hercus, p.5.
28. Hercus, p.7.
29. Penney, p.7.
30. Hercus, p.6.
31. Quoted in Retter, p.35.

- 32.Christchurch Drainage Board, Report 1963. p.78.
- 33.Morrison, p.6.
- 34.Ibid., p.9.
- 35.Retter, p.69.
- 36.Morrison, p.2.
- 37.Jollie, Reminiscences. pp.27-29.
- 38.Anderson, p.50.
- 39.Retter, p.56.
- 40.Carrington, quoted in Retter, p.56.
- 41.Wigram, p.225.
- 42.Morrison, p.12.
- 43.Morrison, p.43.
- 44.Anderson, p.6.
- 45.Hercus, p.6.
- 46.Jollie, p.32.
- 47.Ibid., p.116.
- 48.Ibid.
- 49.Jollie, p.32.
- 50.Anderson, p.53.
- 51.Ibid., p.63.
- 52.Hart, p.12-14.
- 53.Anderson, p.105.
- 54.Penney, p.88.
- 55.Morrison, p.8.
- 56.Hercus, p.6.
- 57.Morrison, p.15.
- 58.Lamb, 1981. p.79.
- 59.Penney, p.40.
- 60.Morrison, p.31.
- 61.Ibid., p.47.
- 62.Penney, p.47.

- 63.Oliver, p.57.
- 64.Penney, p.7.
- 65.Morrison, p.76.
- 66.Morrison, p.76.
- 67.New Zealand Federation of University Women, p.17.
- 68.Penney, p.127.
- 69.New zealand Federation of University Women, p.17.
- 70.Morrison, p.80.
- 71.Wigram, p.44.
- 72.Hart, p.p.13-14.
- 73.Anderson, p.274.
- 74.Strongman, p.131.
- 75.Morrison, p.12.
- 76.Federation of University Women, p.12.
- 77.Morrison, p.22.
- 78.Webster, p.123.
- 79.Ibid., p.123-33.

CHAPTER FOUR

USE AND MODIFICATION OF LANDFORMS

The arrival of the European with their technological capacities and pioneering ideal of power over nature, did much to alter the natural state of primitive Christchurch. Most of this modification of the land was done out of the necessity for living and the imposition of European ideals on an 'untamed' landscape.

Metropolitan Christchurch represents the complete modification that man has made, through his constructive and destructive activities...Here the original features of the site including the climate are in places masked, modified or even obliterated.¹

The major modifications to the landforms were the draining of the swamps and the levelling of the sandhills and terraces. Because the area was so very flat and rather monotonous, especially in the eyes of settlers whose main aim in coming was to make a new life for themselves, the topographical features were largely ignored or modified to make the land suitable for habitation.

THE DRAINING OF THE SWAMPS.

The Deanses were probably the first to drain land in the greater Christchurch area and according to H.S Baverstock² this drainage system still serves the cricket and football grounds of Christchurch Boys High.

Farming their new land, was the most immediate concern for the Canterbury Settlers and the draining and clearing of the swampy land was for many years to be their major occupation. Jane Deans gives us some idea what they were up against:

From about the quay to Christchurch was one large flax swamp, so soft and boggy that it would not carry the weight of a sheep or cow till those ditches or drains had carried off a great quantity of water, when the land began to get solid, and cattle were turned on to tread it down. Then people made more ditches and began to cultivate it.³

The following extract from 'St. Albans, From Swamp to Suburb' will serve well to illustrate the problems the new swampdwellers had:

The settlers quickly learned that it was only by constructing drains through their properties that they would be able to farm at all. Little help came from the Provincial Government and it was not until the Avon Road Board was formed in 1863 and a centralised authority organised a comprehensive system of arterial drains, that the efforts of the individual settlers became really effective. Once the main drains were formed, their tributaries, constructed by the farmers, could form a network over the whole swamp area. These closed drains were made by putting thick layers of scrub at the bottom of deep trenches and then covering them in again with soil. The average life of the closed drains was only about ten years so they had to be constantly replaced.⁴

Once the land was dry the vegetation had to be cleared and ploughed.

The drainage system and the cultivation resulted in the peat soil being broken into extremely fine texture. The soil had a high percentage of humus and was thus extremely productive, but the strong nor'westers used to carry it off the fields. The settlers spread sand over the peat to mix them together to help solidify the ground and to keep it more open...

..as the settlers put more work into their fields, another problem arose, for the land sank as the water content was removed by the drainage. Soon the remains of the bewared forest of white pine(kahikatea), black pine(matai) and totara protruded above the soil. It could not be burned because of the danger of setting fire to the peat, so it was stacked around the fences and used when required.⁵



Figure 4.1. Drain leading from Travis swamp.

Open drains are still found in most parts of Christchurch.

"The clearing of the heavy swamp in the south west area led the early settlers to make use of the only commercial byproduct - the flax by taking it to one of the many flax mills along the Halswell river".⁶ Flax mills, in fact, sprang up all over Christchurch where the swamp was being cleared. For Mr. Shands in Riccarton (Wharenui Street) the flax and swamp vegetation caused a different kind of problem:

Much of this land was so wet and swampy that he had many problems. The Bush at the time, extended over Riccarton Road at two points - Kauri Street and Puriri Street. To off-set his problems he is said to have built a sixty foot tower from which he could .. survey his property.⁷

Drainage of the swamps for farming purposes was not an easy task but once the water table had been sufficiently lowered these areas became the most fertile and productive areas. "The land which Boag bought (where Burnside School now stands) was untouched swamp land that he gradually turned into fertile land".⁸ And, "Isaac Mawson took up land at Brookside ... tackled the clearing of swamp growth on his 162 hectare lot and by draining, cultivation and hard work brought out the natural fertility of the land".⁹

Marshlands, part of the large Sandhills Run, was for many years used only for grazing cattle which could be effectively done by rotating stock from swamps on summer to the sandhills in winter. Dairying continued in areas where the soil was too poor for cropping or where stumps spoilt good soil. But by 1903 a small Polish community was growing vegetables in the rich and productive soil left after draining the swamp.¹⁰ Today this area is still known for its vegetables and orchards.

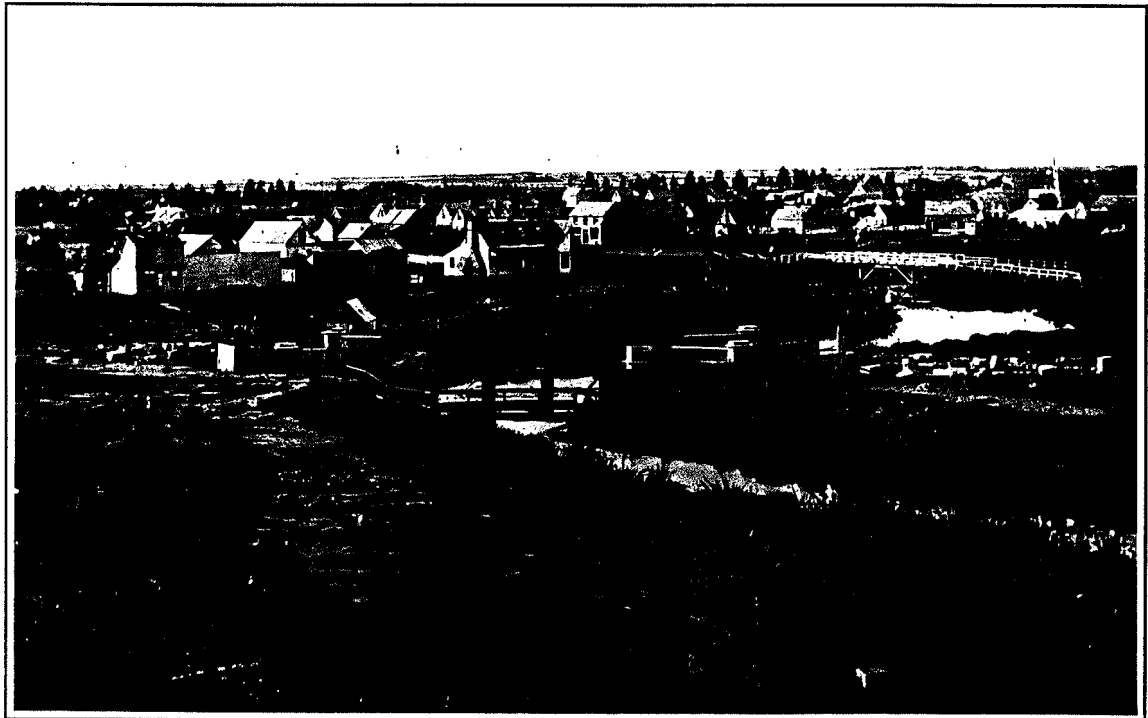


Figure 4.2. **Victoria Square, 1864.**

After ten years of development, some of the original vegetation remained at the river margins.
Photo: A.C.Barler, Canterbury Museum.

Fooks's Run was between Kerr's Run and Papanui Road, and "as it was so near to Christchurch, the sound land was bought by speculators and settlers almost at once, Fooks bought several hundred acres himself. Nevertheless as late as 1863 he had 600 acres of leasehold left which showed how unattractive the Papanui swamp appeared as possible farming land".¹¹ Part of this land is still used for temporary stock grazing but is rapidly being developed for residential sections.

Looking at New Brighton today it is hard to believe that part of it was one of the typical swamps that lay between the foredunes and inland sanddunes. Even before it became a popular seaside resort the area attracted dairy farmers because of the advantage of rotating stock from swamp to sandhills. But by 1868 'Rambler' wrote; "Only a few years ago New Brighton was an unclaimed swamp, and no signs of habitation were visible in the neighbourhood. It is now a well-cultivated settlement".¹²

The draining of the swamps was an expensive exercise and one man who seemed to have had enough finance and the manpower to undertake such a task was J. Cracroft Wilson. With the help of his Indian labourers he cleared the large swamp on his Cashmere estate for productive farmland. The clearing of the swamp in this area induced further development of the area at the base of the port Hills.

Building problems associated with swampy land would haunt the residents of Christchurch for many years. In the swampy areas it would take years for the peat to compress sufficiently for structures not to crack.

Mr. J.S.Fletcher, a director of Fletcher Holdings,...said that the Washbourne Creek which meanders over part of the site seemed to be in the path of most of the very deep foundations which the manufacturing plants required. In one case running sand was also encountered necessitating driving bluegum piles into the area until a solid base could be prepared for the heavy concrete foundations needed.¹³

DRAINAGE AUTHORITIES.

Establishing a town on a flat site, where the drainage of the area would be a problem, was an enormous task. Although most of the town itself was on a relatively high spot the areas where the later suburbs sprang up were for the most part swampy and liable to flood during the winter. The residents of early Christchurch had to face many years of health problems and hardship before an adequate drainage system was developed.



Figure 4.3. Oxford Tce., 1858.

River levels were much higher before the swamps were drained.
Photo: Barker, Canterbury Museum.

Because the city spread beyond the Town Belts and did not develop the way its founders envisaged it, the young settlement had to contend with difficult political problems and a continuous lack of finances. "For more than 50 years after the city was founded, each settlement had its own local governing authority...conflicts between the City Council (established in 1862) and other local authorities (Roads Boards) over surface drainage and sewage problems made it impossible to design a comprehensive scheme for the whole area".¹⁴ The lack of purpose and unanimity between the authorities where to retard and hamper things like draining swamps, making roads, and clearing rivers.

Many complaints were laid as regard the health of the residents. Lady Barker, whose ten year old son died in 1866, wrote;

Our loss is one too common out here, I am told: infants born in Christchurch during the autumn very often die. Owing to the flatness of the site of the town, it is almost impossible to get a proper system of drainage; and the arrangement seems very bad, if you are to judge the evil smells which are about in the evening.¹⁵

The city was becoming an increasingly unhealthy place to live and it was only the fear of illnesses brought on by the lack of adequate drainage and removal of sewerage that brought any action. By the mid-1870's Central Government with its overriding legislative authority finally intervened and, in 1875, passed the Christchurch District Drainage Act. "Only after 25 years of settlement, when the population of the city had reached 12000, was the adequate drainage of the swamp infested area to be undertaken for the first time".¹⁶

One of the first things the new board did was to appoint J. Curruthers to draw up a scheme for the drainage of the city as well as fix a Christchurch datum at 50 feet below the floor of the Cathedral against which high and low sea-levels could be measured. " Mr.W.Clark, an English Consulting Engineer, was then engaged to submit a scheme, which finally converted the ratepayers to a programme of underground sewage sewers and some stormwater sewers as well"....'It appears to me indispensable that the measures to be adopted should not only

comprise the removal of...surface water, but should, as far is possible, aim at lowering the level of saturation of the subsoil beneath the city, and ensure a greater depth of dry soil over its entire surface".¹⁷

Besides the underground stormwater sewers laid down in the city area according to Clark's scheme, miles of open drains were constructed in the rural areas. "One of the main reasons for the construction of all these drains and stormwater sewers was that in addition to the land being so low-lying the natural creeks, are all on ridges formed by deposition of spoil on the banks during flood, and so artificial drains were required in between the creeks, paralleling them till a low enough outfall could be obtained".¹⁸

Draining swamps, controlling the many creeks through artificial drains and piping as well as keeping up with growing city was not an easy task. Flooding, in times of heavy rains kept the Drainage Board busy for many years. For example, one of the streams which caused the residents as well as the Board many problems was Frees creek. This was a large stream with several branches draining part of the 2000 acre swampland of St Albans south of Edgeware Road. It used to bubble forth from large cones of sand and crossed Bealey Avenue between Barbados and Manchester Streets. Piped in 1900, it now enters the Avon River opposite the Avon Motor Lodge.



Figure 4.4. **The Modern Frees Creek.**
Entering the Avon opposite the Avon Motor Lodge.

The Christchurch Drainage Board had an interesting problem in the Winters Road area where surface flooding caused a lagoon to form during wet weather. The grade of the drain had to be reversed to take water which would normally flow into the Avon River, to Styx river.¹⁹ (This was an infringement on traditional Maori values which forbid the mixing of the water of the two rivers.)

Approximately 11 hectares of Horseshoe Lake was occupied by a lagoon in 1868 (lake area now 2.5 hectares) with a dairy farm on the adjacent land. In 1903 the District Surveyor suggested planting willows along the edge of the 'impassable raupo swamp'²⁰ and this is probably the date from which the present willow-dominated vegetation originated. By 1909 gorse invasion led to the tendering for removal and this became an ongoing problem. By 1923 the Drainage Board was controlling the drainage of the area. The Horseshoe Lake area had been used to dump rubbish for many years and by 1954 the City Council allowed controlled rubbish dumping to fill some of the lowlying areas.

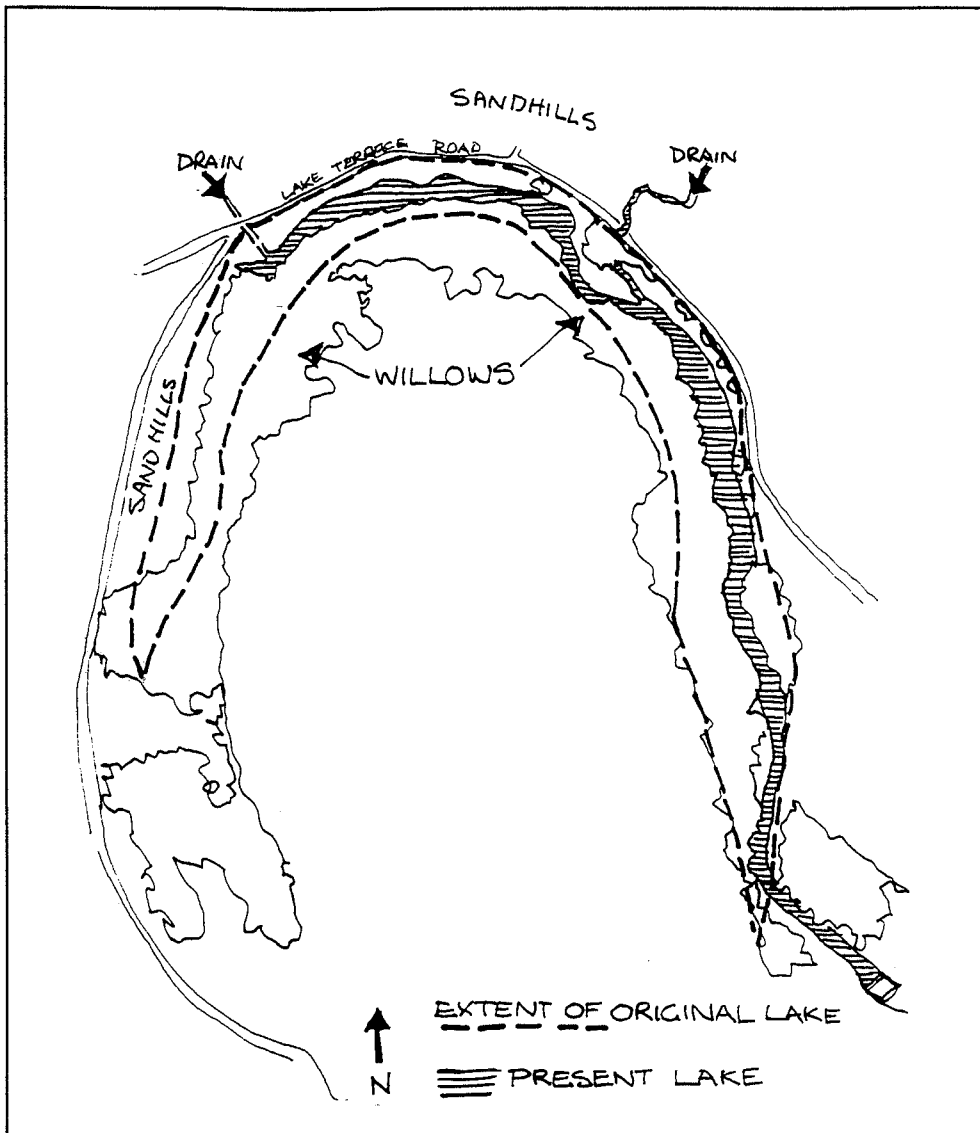


Figure 4 5 Horseshoe Lake.
Source Christchurch City Council Report.

In 1886, the lowlying land between Barbados Street and Fitzgerald Avenue, was partly under water and people had to be moved from houses in boats. The addition of more drains however did not prevent continued flooding in a spreading Christchurch. Severe flooding in 1910 and 1925 led City Engineer Galbraith to remark that the drains were overtaxed. One reason for this was probably further growth of the city with increased paving and roading. In his report Galbraith emphasised: "that sufficient and adequate drainage should be provided before any road reconstruction be carried out. Meetings were held between the Board and the Council from 1925 onward".²¹

During the thirties and forties a lot of work was done to the drains and sewers through the use of unemployed labour. But this did not prevent severe flooding in 1941 and subsequent years. The Engineers report of that year stated that:

development of the district accounts for the increased flooding with less rainfall, and therefore the present exceptional flooding will probably become the normal flood of the future if the capacity of the Board's Main Stormwater Drainage System is not materially enlarged as settlement and paving increases.²²

The floods of 1945 accentuated this, which led Scott to remark that, "it has been fortunate the floods of magnitude have not occurred during times of extra high spring tides, as far as available records indicate".²³ And, "Providence has spared Christchurch a major flood since 1945".²⁴



Figure 4.6. **Washbourne Creek** which flows through Hagley Park. This is the stream by which the Deans brothers towed their goods to Riccarton.



Figure 4.7. **Dudley Creek**. Used to drain the Marshlands swamps, now much reduced still flows through the northern suburbs.

The most recent flood protection works done by the Drainage Board, was the diverting of the Heathcote River through the Woolston Cut. This was done to alleviate flooding in the Opawa area.

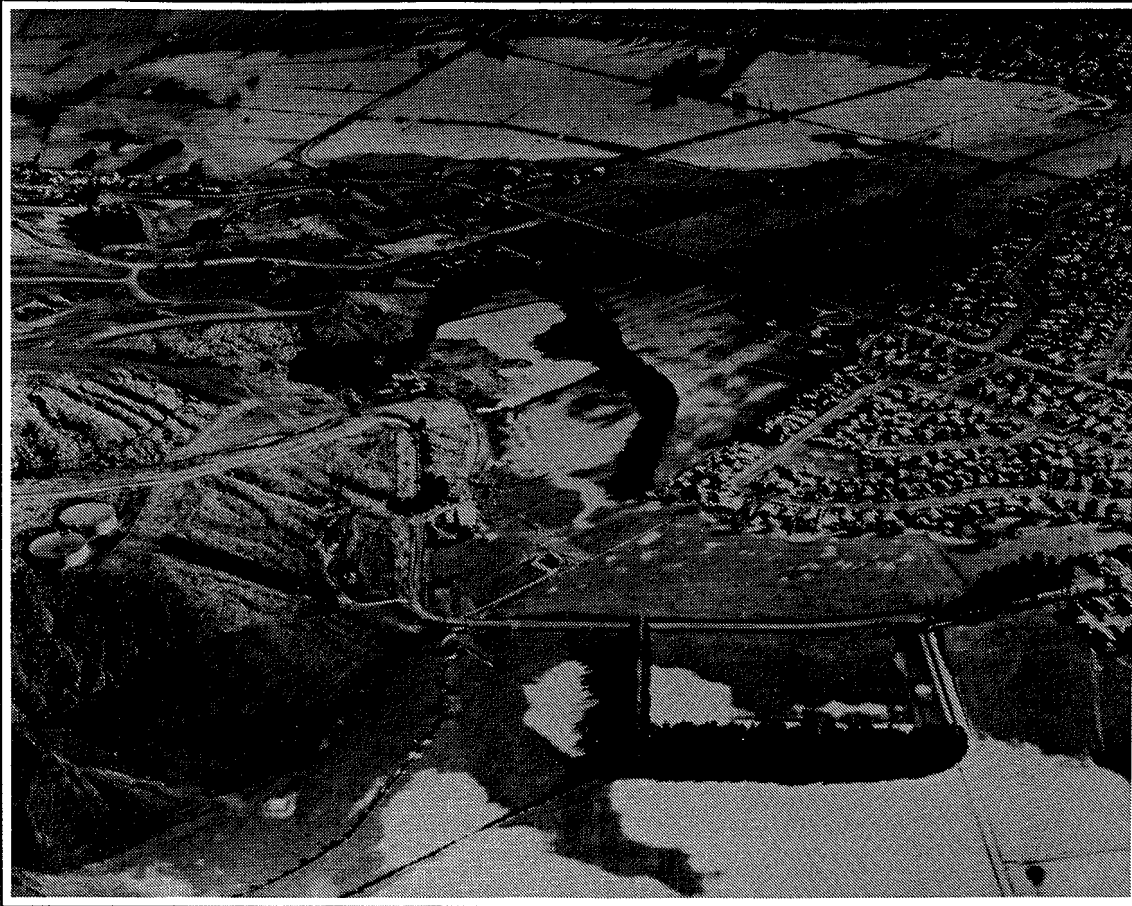


Figure 4 8 **Flooding at the Base of the Port Hills, 1977.**
 Photo: V C Browne and Son.

In the early years of occupation, the draining of the swamps was a necessity but it altered the natural drainage patterns because the land which acted as sponges for the retention of water now had to shed the surface water faster which in turn caused further flooding. This was also enhanced by an altered 'civilized' surfacing of roads and pavements.

It took many years to drain the Christchurch swamps but the work has been so efficient that very few swampy areas are left and those that are, have been subjected to further alteration in the form of exotic plant invasion and the elimination of native plants and the compaction of the soil by grazing. No unmodified natural swamps are left.

THE SANDHILLS.

The early settlers built their town first on the higher and drier spots. These higher areas were of mainly two types, the sanddunes left by the retreating shoreline and the ridges and terraces of the alluvial fan 'lobes' deposited by the Waimakariri when it travelled over the area.

Ridges and Terraces.

The surface lobes of the Waimakariri shingle fan extend into the Christchurch lowland area, no further east than where it meets the sanddunes laid down by the shoreline formed 2000 to 4000 years ago. The subsurface gravels which form the major component of the fans, are located just below a surface of loam to provide a relatively consolidated foundation. This foundation was reworked by the Waimakariri itself, as well as by the smaller rivers that took its place when it vacated the area, to form river terraces and ridges or 'high spots.'

Parts of Ferry Road, Papanui Road, Riccarton Road, Lincoln Road and Colombo Street were originally tracks sited on ridges through the swamps. As we have seen the Maori used these ridges to move across the floodplain as well as sites for temporary camps. It is hardly



Figure 4.9. Travis Swamp.
One of the few swampy areas left in Christchurch.
Photo: V.C.Browne and Son.

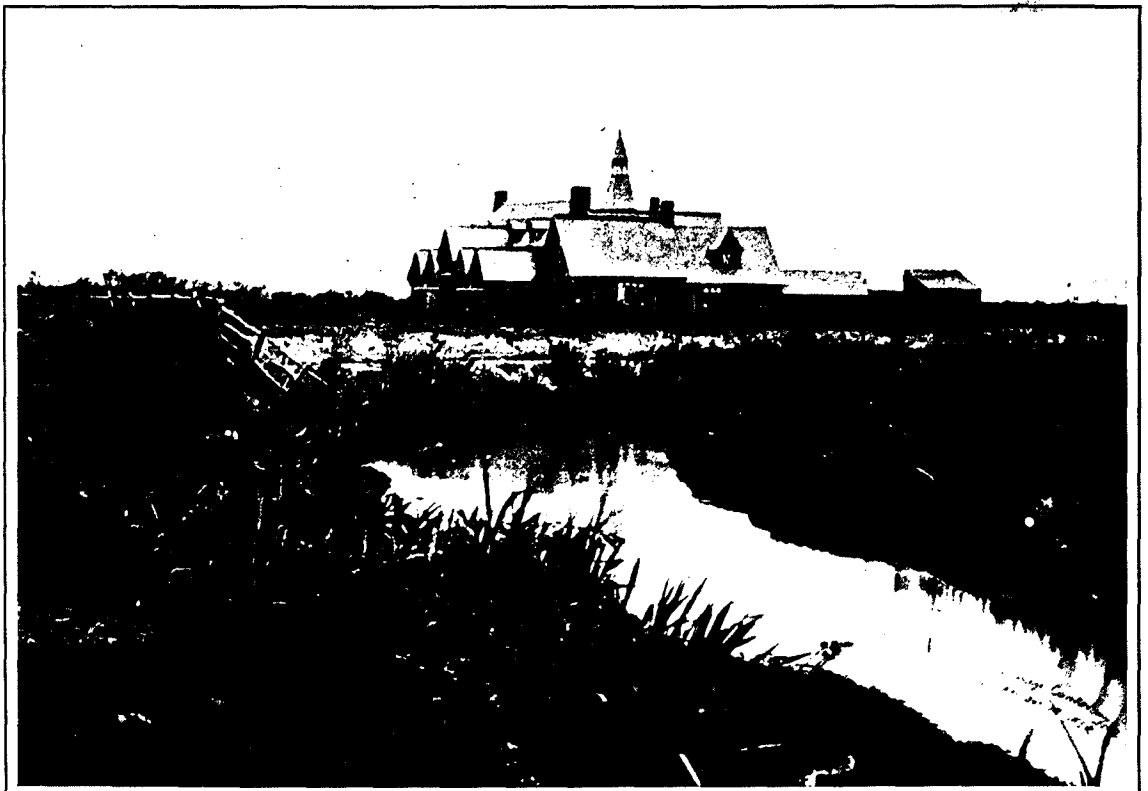


Figure 4.10. Christ College.
One of the early Christchurch buildings taking advantage of the higher terraces.
Photo: Barker, Canterbury Museum.

surprising then that these were the most favoured areas for the tents and homes of the European settlers.

One of the first houses built on Cambridge terrace was that of Mr. Cridland who, as a surveyor, would have chosen a sensible spot on which to build. The site adjoins that of the present Canterbury Club and, "it stood alone in the block which extends as far westward as Montreal Street. Much of the land then consisted of sand hills in which the Harper boys sometimes turned up a Maori skeleton, or relic, of Pre-historic days".²⁵

In 1852 J.Wakefield described early Christchurch "from a low sandhill on the north side of the river".²⁶ Although the exact spot of this observation site is not known, both banks of the Avon, from Hagley park to Stanmore road had and to some degree still has, many high spots marking raised terraces. One such terrace on the south bank, just below its intersection with Fitzgerald avenue, served as a natural grandstand in the early days of boat racing on the Avon.²⁷



Figure 4.11. Avonside Drive near Fitzgerald Avenue.
Older Christchurch homes now occupy the terrace which served as grandstand.

The Provincial Council buildings built in the late 1850's made use of an old river terrace. We owe Anderson this description of how it looked; "The whole pile stands on the west bank of the Avon, the sloping side of which is laid out in terraces, planted with trees and flowering shrubs".²⁸ And] This building is one of the few which could make use of the river terrace as most of these disappeared in order to form the banks and roads which border the Avon. Jolly had planned to keep the river as an open green 'lung' and today roads follow the river almost continuously from its mouth up to the northern side of Hagley Park.

Christchurch is so level in appearance that it is difficult to realise that any levelling should be necessary; but there are signs of it in several places - as Armagh Street, where the old provincial buildings are an appreciable height above the ground - and the same terrace that rose here was cut through in Chester Street, as shown by the elevated railed footway along the side of the Supreme court.²⁹

An example of one of the few high spots remaining in the city area is a distinctive knoll in Hagley Park where the pines grow, in fact the whole of the northern side of Hagley Park is still very undulating and we are most fortunate that it was developed into a golf course which retained the natural features rather than the sportsfields which called for the levelling of most of the landforms in the rest of the park. Along the banks of the Avon, across the bordering roads, there are still many houses perched on river terraces.

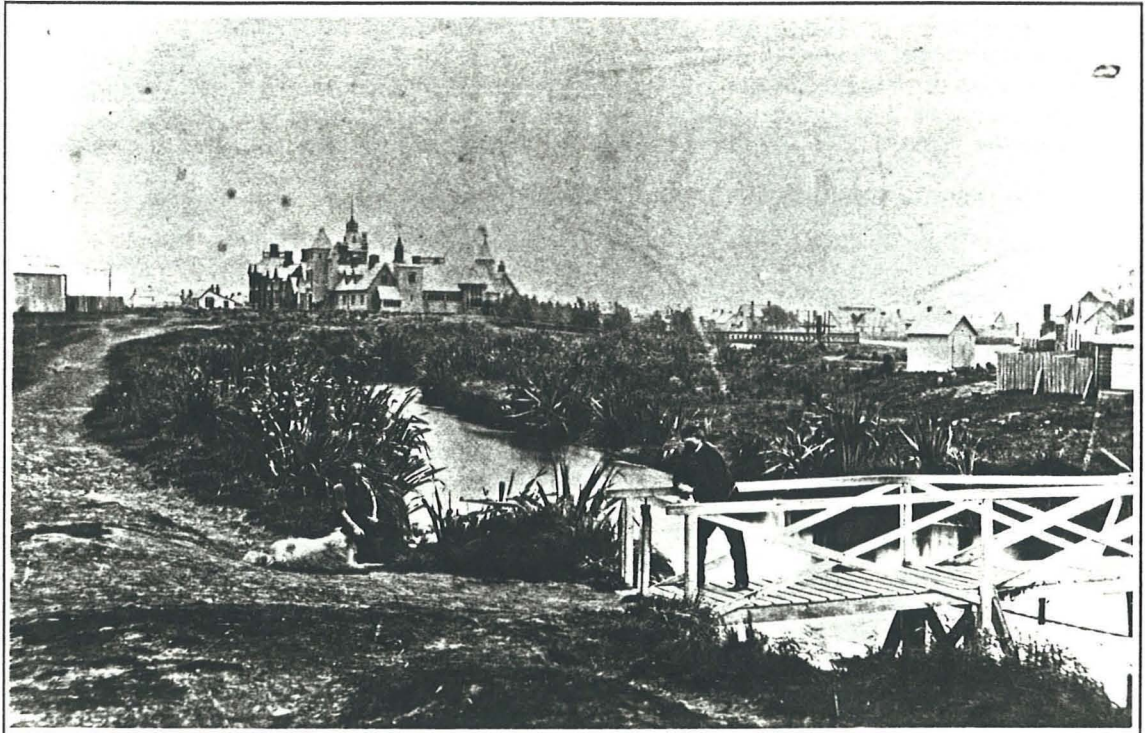


Figure 4.12. **Avon River and Provincial Council Buildings, 1860's.**
Taken from the Hereford Street Bridge.
Photo: Barker, Canterbury Museum.

Behind a hillock that was long a landmark in Riccarton, by virtue of it being the highest spot for miles, H.J.Hall built an imposing home in 1857. Many years later, Trans Holdings established their office on that part of the knoll which "Mr. J.P. Cronin, the executive President laughingly calls 'Mt. Riccarton'".³⁰ Today part of this mound is a reserve on the corner of Riccarton Road and Mandeville Street.



Figure 4.13. **Corner of Riccarton Road and Mandeville Street.**
Part of a remaining river terrace.

The reason many of these high spots of Waimakariri origin disappeared was, of course, because the gravel served as useful material for road fill. Sand Ridge was one of the early farms situated on a wide shingle and sand bank which ran from Addington to Waltham. The farm later became a suburb of Christchurch - west and east of Colombo street between Milton and Southey Streets. The gravel that made up this ridge has long since been removed for foundations and fill. The only reminder of its ever having been there is in the name of the Sandridge Hotel in Sydenham.

Drainage and de-watering, caused the compaction of surface and sub-surface peat, silt and clay which lay between the shingle lobes and this would have further exposed the near surface gravels.³¹ Although not documented, the gravel pits which dot the Christchurch suburban landscape were sited on these shingle lobes.

The Sanddunes of Beach Origin.

East of the interface with the old shoreline, the high spots are different as they were the remnants of beach dunes left by the retreating shoreline.

These sand dunes were covered with grass which tempted the early settlers as grazing areas. Here then, were the early runs, like the Sandhills Run which was settled in 1852 as a dairy farm and another between Waimairi Beach and the Waimakariri which in the 1880's carried 2,000 sheep. "Between Marshlands and the coast...Small dairy farms and market gardens are located on the loams among the dunes. Tillage is restricted to house gardens. Farm houses are often situated on dunes overlooking the lowlying dairy farms".³²

This area was popular for dairy farming because the combination of swamps and sandhills gave the farmers the opportunity for rotational grazing.

In order to make room for better growths, they burned the 'rushes' and shrubs which appeared to be occupying good ground. Moreover, the cattle and sheep...wandered over the dunes, breaking the surface, and pulling up some of the sand-binding plants. The result was soon manifest. The unstable hills were turned into wandering dunes, the fertile flats were buried with sand, and desert conditions grew apace. Introduced plants also made their appearance, but economically were generally of a worthless kind.

With the stable dunes it was worse. These clad with various native grasses, shrubs, and bracken fern, and beneath a layer of loamy sand. Burning the shrubs, etc., here did no harm, but rather good at first, preparing the way for various useful grasses. Later on overstocking played its part, and, notwithstanding their quite stable character, the fixed dunes gradually began to revert to the active conditions.³³

The native vegetation of manuka, wild irishman and tussock was replaced by broom, lupin and gorse. Gorse and lupins were planted on the sandhills to protect homes from the winds and the frequent sandstorms. Because of the gorse, fires became a common sight; "There were outbreaks of fire on the sandhills which have now largely disappeared from the centre of Linwood".³⁴

Cultivation on the sandhills was avoided but as land became scarce closer to town, settlement spread to where the Avon takes its course through the sandhills. Many of the sandhills are still recognisable today in Linwood and Richmond. Travelling through these sandhills was a problem in the early days. A letter written in 1867 by some New Brighton residents, complained about a fence Peter Kerr, the owner of the Sandhills Run, had run across the track, "by so doing he has entirely shut us in by sandhills".³⁵ There were times when Papanui Road became so bogged that the road north was diverted along the sandhills of North Richmond.³⁶

Professor Bickerton was an early resident who "set up his home amongst the sandhills". This was in Wainoni where he converted his 12 hectares into pleasure gardens, part of which contained an artificial lake.³⁷

The first two cemeteries were situated near the Avon, "above which they are at their highest parts elevated 10 or 12 feet. The soil consists of peat and sandy clay, and is in spots quite swampy".³⁸ A 1883 report by Nedwill, Christchurch Medical Officer recommended the planting of trees, "with the double object of absorbing dampness from the soil and noxious exhalations".³⁹ The following year, on his recommendation, all new burials were transferred to the sandhills of the Linwood cemetery.



Figure 4.14. **Linwood Cemetery.**
Developed on the inner dune ridge.

The sandhills were also used for dumping rubbish and nightsoil. The Bromley Reserves, vested in the City by Provincial Council in 1870, became the site for a cemetery, smallpox hospital, slaughterhouse and municipal purposes. "Finally (in the late 1890's) a suggestion that the new abattoirs be placed far away in the sandhills near Belfast solved the problem of the City Council and satisfied the suburbs"⁴⁰.

The furore caused when a site for the Christchurch Public Hospital was discussed, not only serves as an example of early attitudes towards Hagley Park (which at the time was a tussock covered paddock), but also the sandhills. Those who were against the violation of a public Park as a site for the hospital met their protagonists with the slogan; "Let the Government purchase a site - not filch public reserves".⁴¹ An alternative site was suggested on Kerr's Sandhills Run but was objected to as being too far, "no one surely would propose that the hospital be established at a distance so as to render it necessary that broken limbs and suffering bodies should be carried over an extent of rough country, swampy sandhill and tussocks".⁴² And a Mr. Cass agreed saying; "If it had been on a hill there would have been an excuse for abstaining from visits of charity".⁴³ No doubt the fervour of the issue at stake would have magnified the problems because nowhere did the sandhills exceed 6-7 meters.

The Linwood sandhills inspired Anderson to write nostalgically:

I have a fancy for Gloucester street. When I first attended the Gloucester Street school I remember the boys used to go along that street and Armagh Street, across the Belt (Fitzgerald avenue) to the wild area of sandhill, where they would make slides down the steep sides of some of the higher dunes. There were a very few houses scattered there, in the midst as it seemed to me of wastes of gorse and broom; and I know I thought it the very edge of the wilderness. Now it is thickly covered with houses, some of them perched on the top of my dunes; the vacant sandhills lie a mile or two beyond behind the cemetery across Buckleys road; and even these are quickly being covered with pretty modern bungalows, and the wastes reclaimed.⁴⁴

This was written in 1949 and these areas have now long been established as one of Christchurch's older suburbs and although settlement has obscured the original outline of the sandy ridges, there remains a hint of the original landforms where houses stand 4-5 metres above the ground. Although some of the houses are perched on top of dunes, roads in the area "cut unerringly through the old sand dunes with no changes in width, height or curbing. The natural topography is completely ignored, and hardly notices its existence".⁴⁵



Figure 4.15. **Brittan Street.**
Roads in Linwood and Richmond where cut through the sandhills.



Figure 4.16. **Siddal Street.**
One of the many high spots in Richmond that stood out amongst the swamps and attracted the first homes.

Most of the sandhills that dotted the Christchurch area 150 years ago, have disappeared into swamps and roadfill. In those early years they served to make life amongst the swamps bearable as "a group of residents on Papanui Road wrote, 'The east side path is so slippery in wet weather it is quite dangerous...needs a few loads of Kaiapoi sand'"⁴⁶.

It was in 1947 that Anderson wrote about the sandhills as "wastes", but even today the sandhills are flattened and ignored.



Figure 4.17. Burwood, off Lake Terrace Road.
Sand dunes are still levelled to make room for residential development.

DUNE MANAGEMENT.

Pine planting on the dunes north of New Brighton was undertaken as early as 1883 by the City Council, but these were largely neglected and were either burnt or covered by drifting sand.

Grazing was allowed to continue and as the sandbinding pingao was eaten out, the stable dunes became unstable and were moving unchecked towards the fertile marshlands area. "These wandering dunes reached almost to the Lower Styx Road, a distance of one and a half miles from the sea, while further south they were more than 2 miles inland".⁴⁷

In 1900 the Christchurch City Council withdrew the grazing lease and in 1909 started a policy of forestation. Various pine species were experimented with but most of these failed. It was not until 1915 that the quick growing qualities of *Pinus radiata* was realised and since 1929 this has been the only species grown.

The landward fringes of the Bottle Lake dunes were planted first, and between 1909 and 1930 the plantation was slowly advanced into the unstable dune area. About 1930 it became obvious that even though the trees were stabilising the area planted, there was an inland drift of sand from the unplanted dunes which threatened to invade the established forest. There were still some 1800 acres of unstable dunes to seaward. The trees to the west were sheltering these dunes from the westerly and southerly winds, and movement inland from the east was greater than might normally be expected. Dunes some forty feet high which have banked up against the few surviving trees of the block planted sixty years ago, are still visible today.⁴⁸

The coastline was serrated and prevented the foredune from forming into a natural even line thereby affording the plantation little protection. Between 1932 and 1940 an artificial foredune was constructed from Waimairi beach to Spencer Park. A fence was made from loosely knit brush and as sand accumulated up against the fence, marram grass was planted to stabilize it.



Figure 4.18. **The Foredune at New Brighton.**
 Management of these dunes is an ongoing problem.



Figure 4.19. **Burwood Forest.**
 Pine planting as management tool.

Although some form of artificial foredune was in existence at New Brighton around 1906 this, and subsequent man-made dunes, were not very effective. After 1941 when Christchurch City Council came into possession of the New Brighton area, these were rebuilt and although effective, constantly need maintenance. Gaps left for users of the beaches, are protected from wind erosion by fences and brick walls. More recent City Council policy has been to re-establish the native pingoa on the foredunes. Waimairi District Council has special zoning for the sandhills because they are so prone to erosion. These are Rural C for conservation (poorer soil) and Rural R for recreation.

LEVELLING AND ROAD FORMATION.

When the Maori travelled to their fishing grounds in the Estuary and lake Ellesmere, they followed the sandy ridges of coastal sanddunes and old river terraces. And when the Europeans came and before the swamps were drained, they too formed tracks on the higher and drier areas. Jane Deans described the road to their farm: "There was a dry ridge between the swamp on the east side, and the bush on the west, which was turned to account as a track to reach what is now the great Riccarton, South and West Coast Road".⁴⁹

A settler's description of the conditions of the town streets is quoted by Morrison:

In summer - the sun blazing fiercely on the rough cinder-coloured asphalt and the broad roads covered with great cinder coloured boulders of stone; again in winter you see the same flat view dimly lighted, your path most days wet and damp, and after rain it is dreadful to cross the broad road from one side to the other, the filth being unutterable and more like a bog than anything civilized.⁵⁰



Figure 4.20. **Corner of Montreal and Gloucester Streets.**

The first rough roads did not provide for runoff.

Source: Coates.

Making those primitive roads through the swamps is described in 'St Albans' as follows: "Dry tracks were first made by putting down layers of flax and scrub and covering this with many drayloads of sand".⁵¹ Because of the swampy and uneven nature of the Christchurch area roading was a major concern running concurrently with the draining of the swamps. In many ways the draining of the swamps was hampered, as fill was brought in to level the roads it cut off major natural draining ditches. At first the roads were laid out above the adjacent ground causing runoff into properties. This was remedied by digging drainage ditches alongside the roads. One such ditch alongside Riccarton Road, was used to float logs down from Riccarton Bush.⁵²

Mr. W.B.Bray, appointed to solve the problem of surface drainage, devised a plan adopted in 1862, which "was to keep the level of the streets below that of the adjoining sections, so that the surplus artesian water and the surface drainage could be run down the side channels - a marked feature in the city of to-day".⁵³ In St.Albans, as in many of the early Borough Council Districts, roading was a costly and slow business which ruined the surface of existing roads: "It was no wonder that when one of the councillors saw 4000 yards of boulders passing along Papanui Road to the city, he suggested that they look into the possibility of closing the public road".⁵⁴ "Over long years the roads absorbed rock, shingle, metal and clay. In spite of all these problems.. and the never-ending cubic metres of boulders and shingle that had to be tipped in its hungry soil, road formation went ahead".⁵⁵

Filling the old river channels must have taken up many of these cubic metres and would have been an enormous task in the days before modern earthmoving equipment. "I remember where the Waimakariri once flowed across the Main South Road between Hornby and Islington. This was a low portion (now mainly levelled) used to be full of water after heavy rain".⁵⁶

The first cemeteries built in the swampy areas near the river also needed filling "Wesleyan cemetery was low at street level (facing Salisbury street). 1,300 loads of earth were carted on to it; but because of poor drainage it remained far from satisfactory".⁵⁷



Figure 4.21. **Marshlands Road.**

Roads through the swamps lie appreciably higher than the surrounding land.

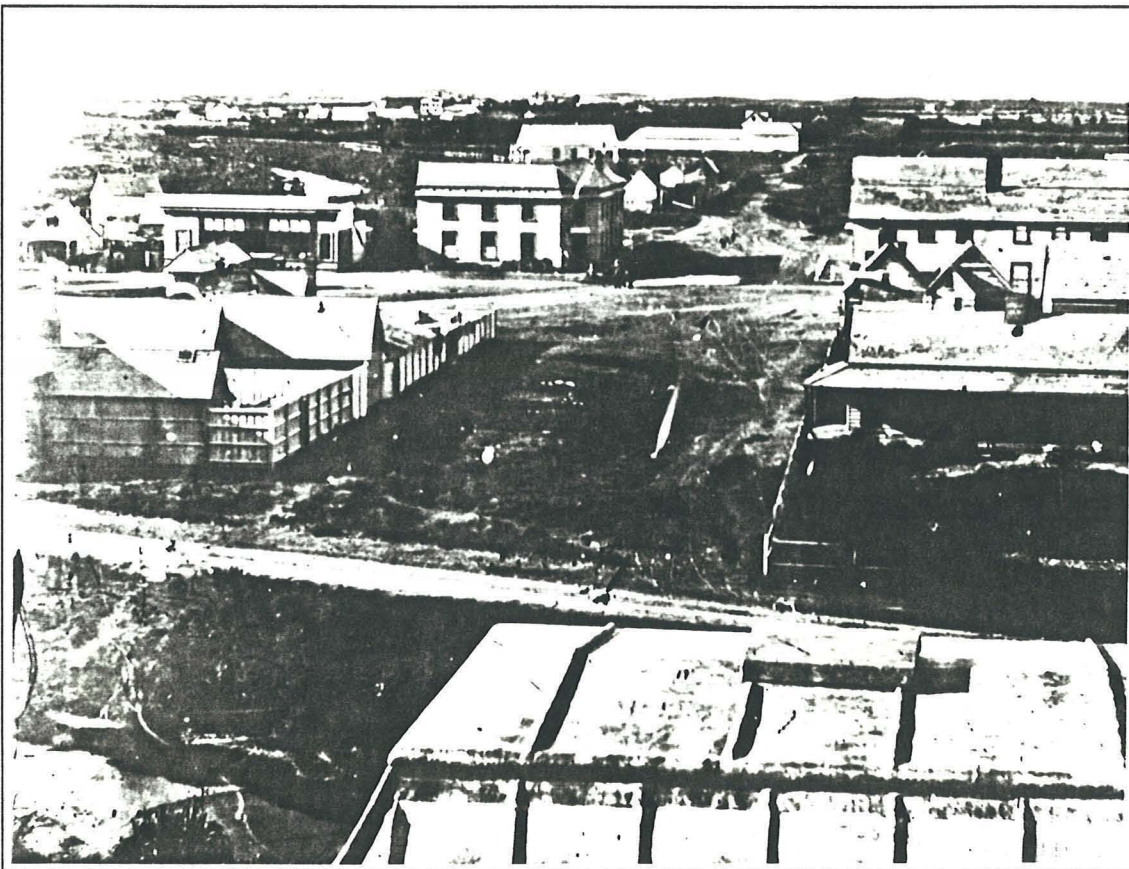


Figure 4.22. **Armagh Street from the Provincial Council Buildings, 1860.**

The area in the foreground used to be a gravel pit.

Photo: Barker, Canterbury Museum.

Gullies, which proved a health hazard because people used them to get rid of slops and waste, had to be filled. Private properties also had depressions where water and waste accumulated. Sometimes the Council obliged private owners by supplying material for fill, but one such hollow in Cathedral Square, the property of a Mr. Symington, was not considered as it "would require some thousands of loads of earth" to fill.⁵⁸

Asphalting of the roads was not seriously attempted until the late nineties when Cathedral Square and some of the main streets in the centre of the city were treated with a mixture of tar and sand. Proper macadamising was not undertaken in any systematic roading scheme for Christchurch city until after 1911.⁵⁹

WHERE DID THE FILL COME FROM?

The need for roading material and the levelling of the area, changed the face of Christchurch in many ways. The first obvious source of fill material was the sandhills. After this gravel pits were dug to provide hardfill for the roads and though there does not seem to be documented information on the location of all of these pits, some of the early literature gives some indication of the extent of the first gravel pits and earthworks.

A very early shingle pit was in Victoria Square (Market Square). This seemed to have formed a lagoon adjacent to the Avon which was used as a rubbish dump and the loss of which was regretted by the city surveyor in 1874. By 1878 this pit was filled in again and reclaimed to form Oxford terrace, but not before many complaints sparked of a poem which appeared in the Littelton Times under the heading: **"An elaboration of the information desired respecting restoration of the excavation in the Market Place, Christchurch, to its original elevation:"**

In the Market Place at Christchurch was made an excavation.
The gravel taken thence being used for reparation
Of the Heathcote Ferry Road, then in great dilapidation.
The Colonists' Society desiring information,
Resolved on Tuesday last, after due deliberation,
That the Secretary do put himself into communication
With Mr Godley, Resident Agent of the Association,
And request of him to answer, without prevarication,
If he at present purposes to effect a restoration
Of the Market Place at Christchurch, to its original elevation.
It was strongly represented then, that the preservation
Of the peoples' lives and limbs from such a situation
As that in Christchurch they find themselves if through precipitation,
They tumbled into head over heels said recited excavation,
Was a question which merited their first consideration,
That dirty roads and dark nights were sufficient botheration
(When moon and stars were clouded, and no illumination
Appeared in neighbouring cottages, to afford an intimation
To the luckless traveller) without this infernal excavation.

The Colonists' Society would be glad of information,
as to what's intended to be done about the restoration
Of the Market Place at Christchurch, to its original elevation.⁶⁰

Gravel in those early years seemed to have been fairly inaccessible as workmen were required to spread it lightly. Gravel pits appeared in Cathedral Square and Hereford Street and a minute of the Council records that in April, 1862, "the Christchurch public was cautioned against removing earth sand or gravel from the streets or from opening a gravel-pit in the public streets".⁶¹ The Council, however seemed to have no qualms in moving gravel from one street in order to fill holes in another and "when the Council in April, 1862 sought permission of the Provincial Government to take gravel from the Government Domain, such permission was withheld; but in the following month it was the Provincial Government's turn to come, cap in hand, to the Council and ask if it might obtain, from the streets of the city, gravel sufficient for its purposes".⁶²

One source of gravel for the Council's work was that of private properties and "from a Mr Marshall's property at the south-east corner of Montreal and Cashel streets, it obtained large quantities of the precious metal..."⁶³ By 1866 it was reported by the city surveyor that "no gravel pits remained in the city".⁶⁴

Hagley Park was one of the earliest sites for fill material, although for many years, until more bridges were built, it was fairly inaccessible to some parts of the city. An extract from Lamb gives us an idea of the condition of the park, which served as play-grounds for the Christ College pupils during the first few decades: "The park, in its then primitive state, marked by gravel pits and covered by scrub and high grass, possessed the very features that were needed to provide ground cover for the skirmishing parties".⁶⁵ In 1897, to commemorate the Diamond Jubilee of Queen Victoria, the swamp to the west of the Armagh Street Bridge was dug out and formed into a five acre lake and named Victoria Lake.⁶⁶ In 1915, Albert Lake was excavated to provide soil for part of the Botanical Gardens. The Directors' house was built in 1920 with funds from the sale of shingle from pits in the Gardens which were subsequently developed into a series of ponds for the bog gardens ponds, rock gardens and an iris pond.

Further afield, McLeans Island and the old southern branch of the Waimakariri is pitted with many quarry sites, which quickly fill with water to form lakes. Having poor soil the area is zoned R, and has been successfully developed into a wide range of recreational activities such as a rifle range, car club, steam museum, and wildlife parks. "Peacock Springs is one of the best examples in the world of how the different needs of the environment and a dynamic business based on exploitation of the land, can be reconciled".⁶⁷ A successful quarrying operation was begun in 1965 and soon became one of the country's biggest quarries. The abundance of underground water enabled owners Neil and Diana Isaacs, to gradually transform the discarded pits into a "study in conservation" where they have created a refuge for all sorts of exotic wildlife as well as a commercial salmon farm.

Ashbys pit in Waimairi Road has been the object of many different development proposals but apparently these always falter from a lack on finance. The area, like many gravel pits, was used as an uncontrolled rubbish dump. Known by some locals as 'Lake Bryndwyr', it was for many years used as a swimming place for school children. The Sockburn Swimming Pool has been built in a gravel pit and Riccarton High School on a filled pit. A gravel pit in Johns Road is at the moment on the Waimairi District Council drawing boards for future development as a recreation area with a lake for model boats to take some pressure off 'the Groyne's'.



Figure 4.23. Ashby/Bitumix Pit off Johns Road.
One of the many quarry sites which dot the outskirts of Christchurch.

The Port Hills has also been scarred by quarry sites and served as a source for fill and stone. A disused quarry off Rangatira Road, has been converted into tennis courts. Victoria Park on the slopes of the Port Hills, was originally a quarry reserve. In 1883 it was converted into a recreation ground. Another source of fill material has been the silt removed from the Avon and

Heathcote rivers. Over the last few decades, for example, the northern parts of the suburb of Wainoni have been 'reclaimed' as residential land.

Although the holes dug for obtaining fill material are a feature of the outlying areas of Christchurch and, on the whole un attractive, they do provide interesting opportunities for development.

THE URBAN RIVERS.

Prior the European settlement many small tributaries drained the surrounding lowlying swampland. After the Canterbury Settlers arrived and human modification of the rivers took place, these tributaries started to disappear. For the last 125 years the rivers have served as outlets for stormwater drainage from the Christchurch area. "Accordingly their morphology, hydrolic characteristics and bottom conditions have undergone major transformations".⁶⁸

As we have seen the Avon and Heathcote were important communication links from the time that humans first inhabited their banks. In the pre-European days the rivers and estuaries were important hunting and fishing grounds for the Maori who used to camp on the banks. The Deans brothers were the first Europeans to use the Avon as a means to transport their goods. The fact that the river was navigable was important in the selection of the site and in the days before road ad rail transport became viable the Avon and Heathcote served the settlers well as a means of bringing their household goods to the new settlement.

When land transport became dominant, the river became a recreational resource. Rowing and pleasure trips to New Brighton by steam or paddle ships became popular but these activities took their toll on the rivers as wave action eroded the banks. Straightening of the river and periodic removal of silt to facilitate these activities, as well as keeping the river clear as a drainage channel, changed its character.



Figure 4.23. The Avon River Near New Brighton.

The river became a recreational resource in the early years.
Photo: W.H.Taylor, Canterbury Museum.

The gradual draining of the swamps slowly lowered the water table which caused the river to become shallower and lose power to remove its silt load. As the natural catchment area became paved and built over, surface runoff into the rivers increased. Willows and other introduced weeds like watercress, was rapidly choking the river as silt and mud brought down by storm water provided fertile beds for exotic plants. These in turn caught more mud and rubbish which played havoc with navigation. This brought complaints from rowers and other river users.

POLLUTION IN THE RIVERS.

It was not only the silt and weeds which were a problem. From the time the settlers arrived the rivers were used as receptacles for all sorts of waste. The rivers which were to serve as sources of pure drinking water, rapidly became unhealthy. Both the Avon and Heathcote Rivers became increasingly polluted as a result of urban development and industrialisation.

The siting of the Public Hospital was an example of the City Council's lack of concern for the use of the river as a drain for waste disposal. An editorial in the Lyttelton Times of April 1862, condemned not only the architecture but the pollution of the river:

There is a strange looking building with excrescences like feelers stretching towards the road on the Avon at the Hagley Park end of the town. This is the new hospital and it is said to be curiously incommodious inside. The drainage of this is so arranged as to have an outfall into the river!...Now, gentlemen of Christchurch, submit quietly to this, and your beautiful river will soon become a filthy and poisonous open sewer.⁶⁹

It was mainly the fear of diseases like typhoid and cholera, which were spreading through the small community, that spurred the City Council to do something about a proper drainage and sewerage system.

MANAGEMENT OF THE CHRISTCHURCH RIVERS

The City Council and Drainage Board are the authorities that have had the job of clearing the rivers and controlling the flow. The 'civilizing' of the city and surrounding areas caused many problems in the control of the rivers.

Early problems were exotic weeds invading the bottom and banks of the rivers. Watercress invasion was the cause of a romantic, if impractical suggestion for its control. "The idea of using swans for the work of clearing the river was mooted at a meeting of the Council in



Figure 4.25. A modern dredge, clearing silt from the Avon River.

August, 1864, and a 'Committee on Swans' was set up accordingly to look into the question".⁷⁰ The Council bought thirteen pairs. Two quickly found their way to Ellesmere and although they were brought back and various ways were tried to keep them in the Avon, they all soon took flight for "the lagoons near the mouth of the Opihi River, nearly 100 miles to the south, and so foundered one of the Council's more diverting projects".⁷¹

The weeds not only congested the river but posed a flood danger. In response to residents whose properties were flooded the previous winter on the south side of the river between Barbados Street and Fitzgerald Avenue, a Report by the city surveyor in 1887, stated;

The original hard bottom of the river I find to be at depths varying from 4 to 8 feet below ordinary water level; and in some parts of the river where the current is strong and there is no growth of weeds, the hard bottom is quite free from mud or other deposit. But over the greater portion of the bed of the river there is a layer of soft mud varying from one to 4 feet in thickness.... 'Remove the mud, he said, and the weeds will to a great extent disappear'.⁷²

The Christchurch Drainage Board was not so much concerned with river pollution, but saw their task as, 'maintaining the river as a main drain for the district through which it flowed' and engineer Cuthbert in his report of July 1894 thought that the river was acting as a very efficient drain and had never been so clear of obstruction in the 15 years he had been working for the board.⁷³

The lack of adequate finance seemed to have been an on going problem for the improvement of the river. In 1897 a body called the Floral Fete Committee was formed to raise funds for this purpose. Although the Committee had raised a fair amount by 1902 and had made it available to the Drainage Board, the Board replied that it had no scheme that would be "acceptable to all parties concerned".⁷⁴ Consensus on any plans by the Board to improve the

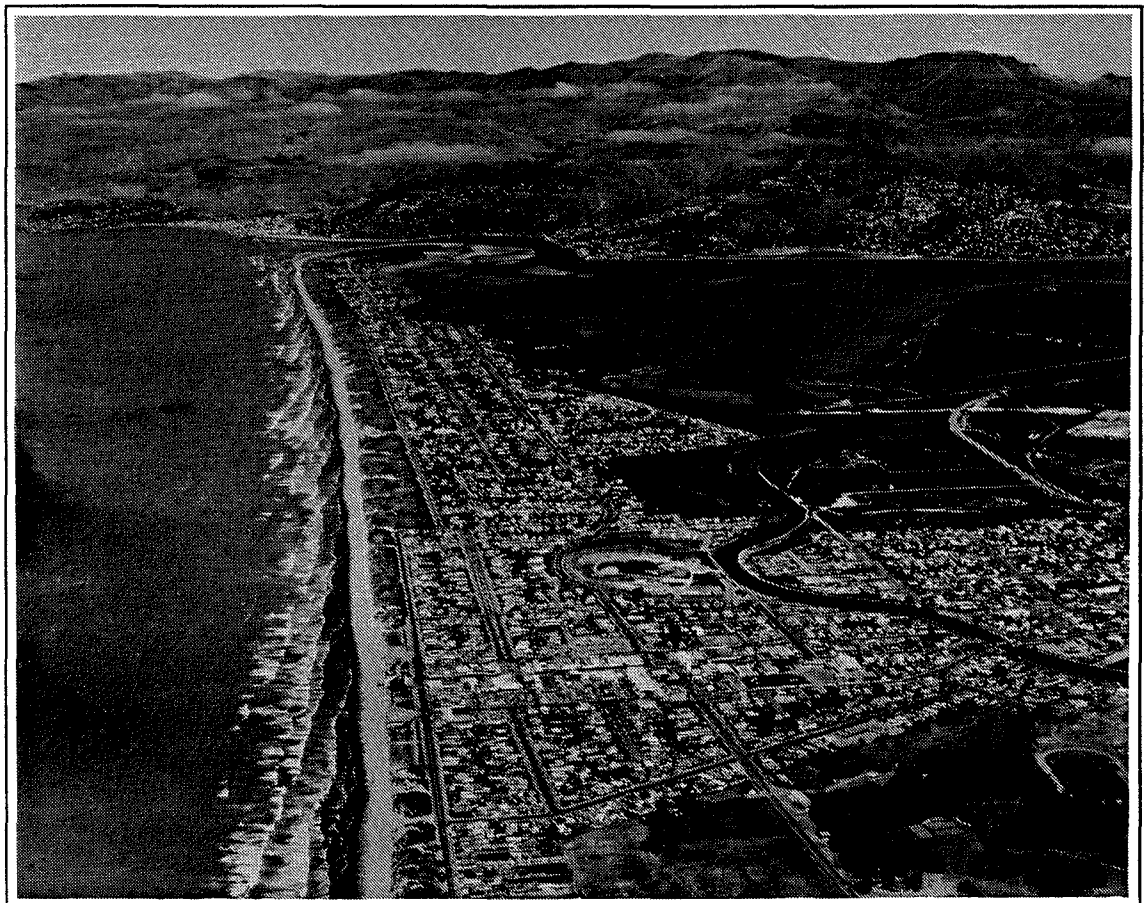


Figure 4.26. The New Brighton Spit.
Showing the loop of Owles Tce. between the Avon and the shore.
Photo: V.C.Browne and Son.

flow of the river was difficult to find. Suggestions for building weirs and dams were usually followed by concerns about flooding from residents of low lying areas. The funds raised by the Floral Fete Committee helped in the establishment of the Avon Improvement League. The extent of public concern for their river became clear when by February 1904, 350 people had joined the League but neither it nor the Drainage Board seemed to have come up with any viable schemes.

This state of affairs continued until 1909 when the Board bought its first weed cutting launch and in 1916 Cuthbert reported that "the removal of silt deposits and the close cutting of weeds by the weed cutter has lowered the water level in the Avon River".⁷⁵ In 1915 a survey of the river by local body engineers recommended the construction of three small weirs, one of which may still be seen just downstream from the Antigua Boatsheds.

By 1924 the Christchurch Drainage Board had set up its own River Improvement Committee which became responsible for the dredging and clearing of the river. In 1945 an excavator dragline was purchased as the first stage of their River Improvement Programme. Further heavy duty machines were purchased in 1952 especially for pulling willowroots. The dragline is used to dredge the lower reaches of the Avon where between 130 and 220 cubic metres were hauled from the river every day and the silt dumped on Drainage Board land in Avondale, Bexley and Travis swamp.⁷⁶

If one compares the maps of old Christchurch with that of the modern city, it is obvious that many kinks in the rivers have disappeared. Some of the major changes of the Avon, have been at Owle Terrace and Union Street in New Brighton where a large loop was filled in. The diversion of the river to provide for an Olympic size rowing mile was carried out at Kerrs Reach during 1949/50. "It removed a bad throttle in the river and improved the flood runoff

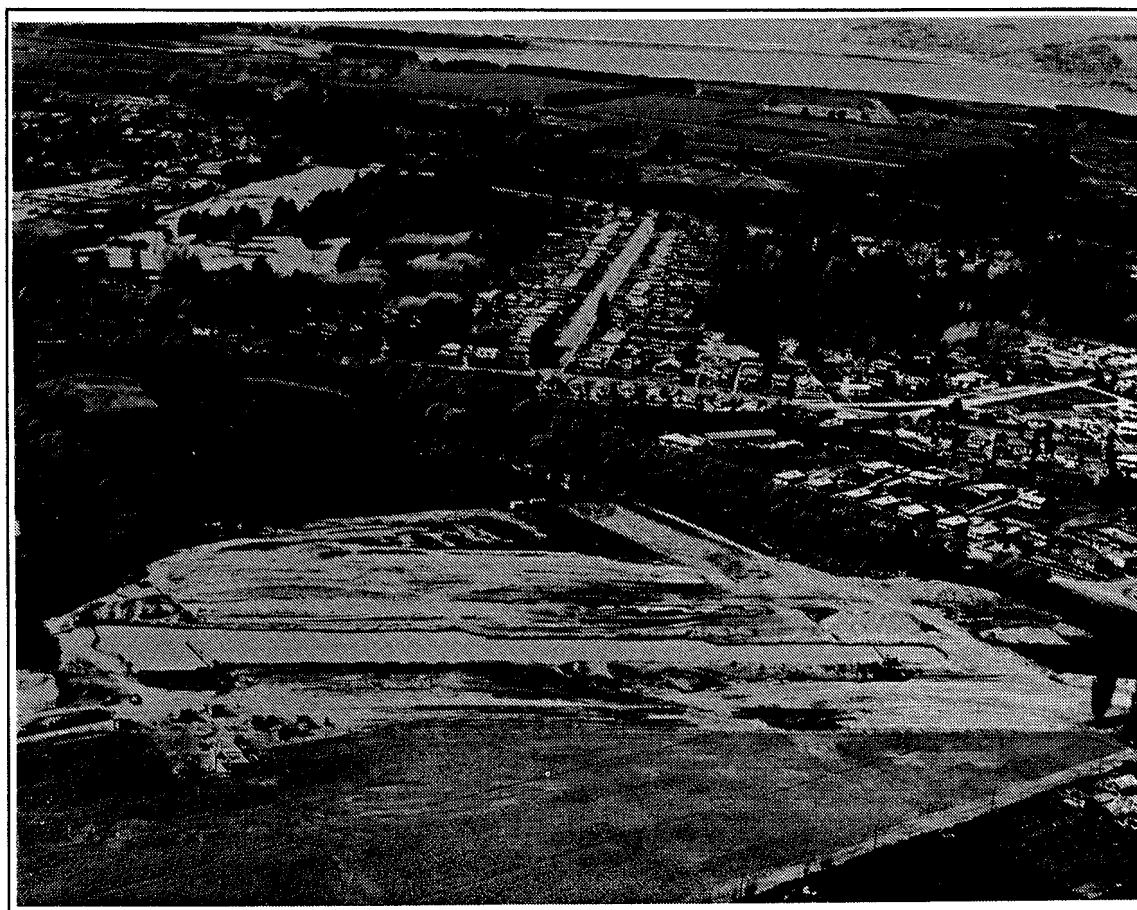


Figure 4.27. Kerr's Reach.

An artificial rowing mile was created in 1950.
Photo: V.C.Browne and Son.

but leads to the deposition of silt in this extra wide sluggish portion of the river".⁷⁷ As mentioned above, the Woolston cut is the most recent modification to the Heathcote.

These modifications to the rivers have been necessary in order to achieve adequate falls and prevent local flooding. The islands left by these diversions would be an ideal area in which to recreate some of the original swampy nature of the river.



Figure 4.28. **Kerr's Reach.**
The cut from the diversion became fill for a grandstand.



Figure 4.29. The sluggish portion left after Kerr's Reach diversion.

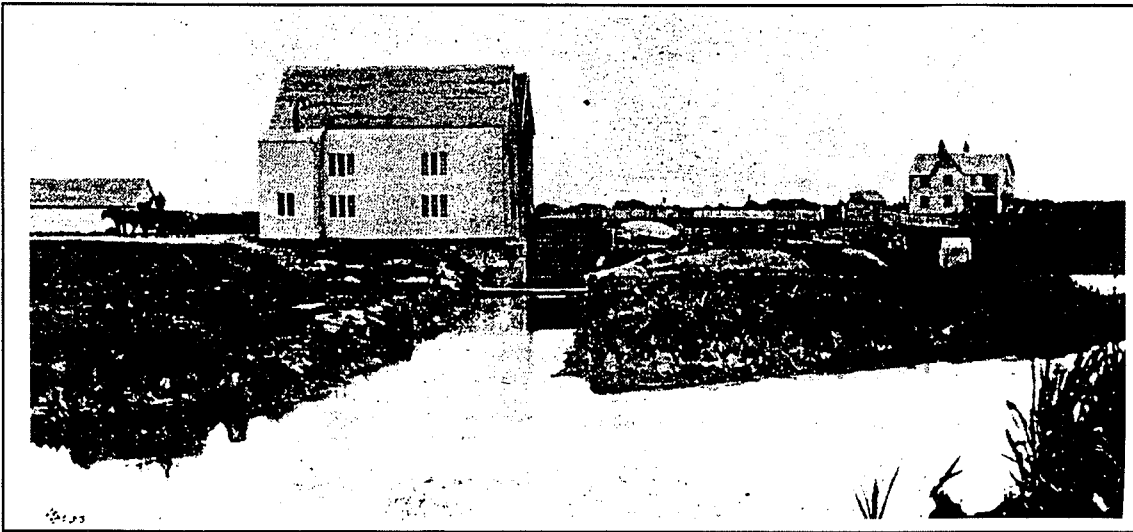


Figure 4.30. Riccarton Mill in the 1860's.
Source: The Press, Jubilee Edition. December, 1900.

WATER AS ENERGY SOURCE.

The Avon provided the early settlers with a source of energy which they used to drive their mills. These mills brought about modifications to the river some of which still exist today. It was the pioneer Deans Brothers, who built the first mill in the Christchurch area. As early as 1854, there was a corn mill situated 180m from the present Carlton Mill bridge and by 1858, it was taking water from a race fed by a dam on the Avon, however the original race was not very satisfactory so another was cut to bring water from the Wairarapa Stream".⁷⁸ Anderson does not remember the mill but:

I new the race well,...I liked the many little bridges that led across the race to the private properties lying between it and the river; they had the appearance of little fortress-homes with their defending moat, but friendly in so far that the portcullises were never down, and the bridges were never up.⁷⁹

Another mill was situated on the island between Hereford and Worcester Streets: "After the removal of the mill dam near the Hereford Street Bridge in 1888, the water level upstream had dropped noticeably, and the Council frequently received complaints about unpleasant smells arising from the exposed mudflats".⁸⁰

W.D.Wood leased and later purchased, from the Deanses, the land where the Avon is joined by its tributaries, the Wairarapa and Waimairi streams. (This was part of a section bought by Torlesse whose choice of site "within the bend of the Wairarapa Stream showed his appreciation of site".⁸¹) Here they set up a flour mill operated by a water wheel which needed the construction of a water-race and weir to give a drop of 121-152 centimetres. A man-made island was formed and a very successful mill, later known as Flemmings Mill, occupied this site for 113 years until it was sold in 1974 to make room for the Christchurch Girls High School. During 1981-82, the Drainage Board, Mona Vale Management Joint Committee and the Ministry of Works and Development redeveloped the Monavale weir system. This redevelopment included the renewal of the existing weir on the Avon River (including a fish ladder), the opening of the then stagnant mill-race by the construction of a new weir to control water flows, and the development of a low stopbank between the two weirs in Mona Vale Grounds. The site offered a unique opportunity for the landscape architecture firm of Boffa, Miskell and partners who got a water supply via a 375 mm diameter take off pipeline laid on to feed an ornamental pool in the schoolgrounds.

Up to 1903 water-power for factories in and around Christchurch was derived from the waters and streams closeby. Industrial centres developed in localities where there was water sufficient for purposes of mills and machines in the early stages of industrialization, for example,....the Heathcote valley, Woolston and Riccarton.⁸²

With the development of electricity with the building of Lake Coleridge in 1914, the need for water power became obsolete and the mills on the rivers of Christchurch disappeared.

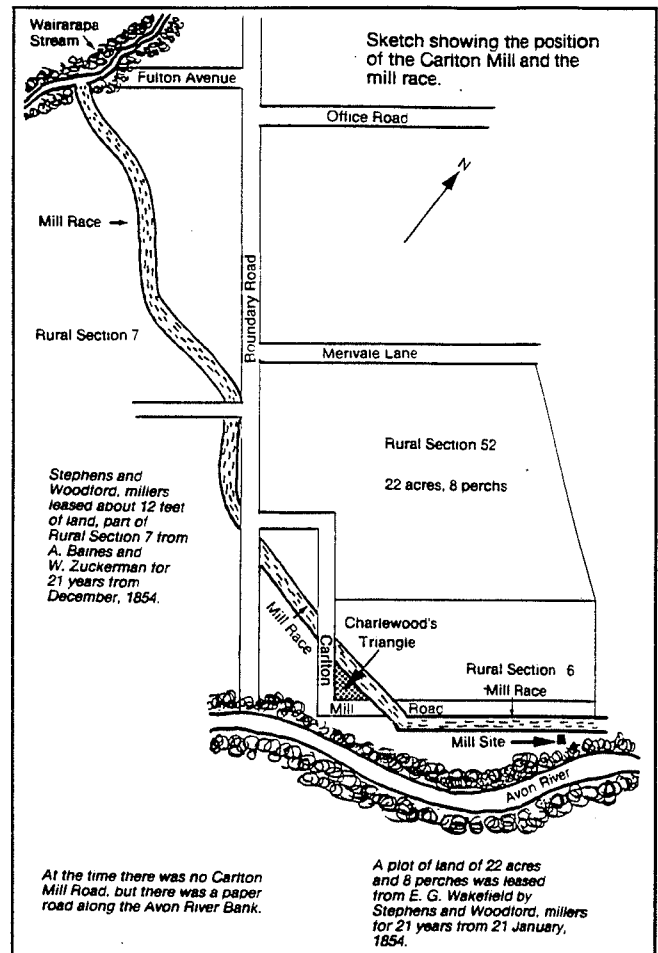


Figure 4.31. **The Carlton Mill Race.**
Source: St Albans, Federation of University Women.

A RIVER FOR SWIMMING IN.

Before the levelling of the river bottom and lowering of water-level, the Avon for many years, had been used as a refreshing retreat from the scorching Nor'westers. Early settlers had favoured swimming holes in the natural pools which then existed in the Hagley Park and Fendalton areas.

In 1876 the City Council constructed a Public Swimming Bath by dredging a channel 45 x 14.5 metres between Rhododendron Island and Cambridge Terrace. This channel was initially 2.7 metres deep but in 1877 it was decided to enlarge and deepen the pool to 3.5 metres. In order to achieve this the Council had to dredge out "the Whole Area and Street" and according to Lamb; "this wording suggests that only by encroaching on Cambridge Terrace was ample width obtained for the baths".⁸³

Over the years there were many complaints about the pollution from the hospital and the baths eventually closed in 1886 due to the popularity of New Brighton as a recreational location.

THE SINKING OF ARTESIAN WELLS.

One of the reasons that Thomas sited the town where it is, was the supply of pure drinking water. Initially, the early settlers did take water for domestic use from the rivers and tributaries.

In the outer reaches of the town drinking water was obtained from pools that were formed by springs. One such pool known as the "Waterholes",⁸⁴ situated behind Dollarwise in Church Corner, was used as a resting place for travellers and watering place for stock. It was also used by locals who often walked for miles to obtain drinking water from the holes which contained water for most of the year. Another pool near where Perveral Street is now, was

about 20 by 3.4 metres and used by locals for domestic water and bathing. Apparently 68 thirsty bullocks on their way from the plains to the sale yards, "scenting water landed in the swamp and did not come out".⁸⁵

As the rivers and streams became increasingly polluted, wells were sunk into the shallow unconfined groundwater layer. Groundwater levels had been lowered as a result of the draining of the swamps and because it was unconfined this layer soon became polluted and could no longer serve a growing population. As the city grew a more adequate supply of water was needed and although Von Haast advised against boring into the aquifers, his 'advice', and that of the city surveyor, Moore, was not heeded and the City Council proceeded in 1864 to sink some deep wells. By the end of that year there were seven of these.

The total number of artesian wells sunk within metropolitan Christchurch since the 1860's is unknown but probably numbers about 10 000. They range from about 25 to 180 metres deep with corresponding artesian water levels ranging from just below ground surface to about 10 metres above ground surface.⁸⁶

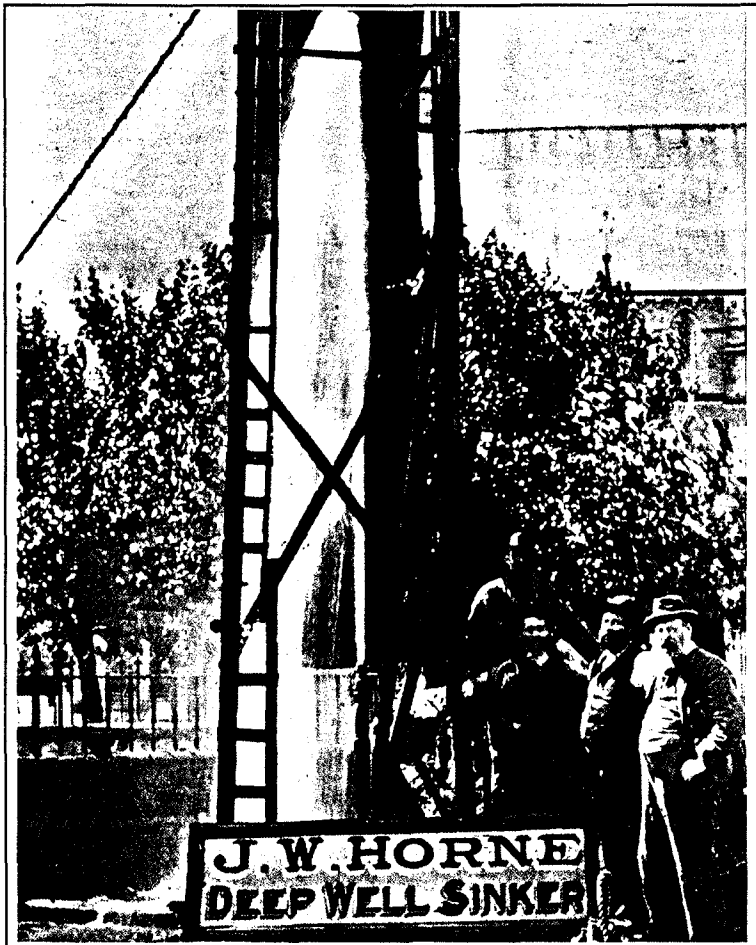


Figure 4.32. Early Well Sinkers.

Source: North Canterbury Catchment Board.

Today, groundwater is the sole source of domestic water for the metropolitan area. Every day, we pump 300 000 cubic metres of water from wells throughout the city for drinking water, industrial and irrigation purposes.⁸⁷ Records from two wells operative since 1895 at the Canterbury museum, "show that a decline in water level of almost 1.0 m occurred over the period 1895 - 1905. Since then water levels have remained steady, apart from seasonal fluctuations, through to the present day".⁸⁸

According to the Artesian Aquifer Report, the groundwater system has adjusted to the artificial abstraction of water from the aquifers.

Prior to any abstractions (pre-European times) the system was presumably in a steady state, i.e. inflows to the groundwater (recharge) were balanced by outflows (springflow, upward leakage and outflow to the sea).... Abstraction by man results

in an adjustment in spring flow and storage, and less outflow to sea. The baseflow of the urban springfed streams is considered to have declined over the years, as have ground water levels indicating less storage. No measurements have been made of submarine outflow to the sea, however, this has also probably reduced, resulting in a landwards shift of the seawater/freshwater interface. At present, however, because of the piezometric gradient is still above sealevel, the interface remains considerably offshore.⁸⁹

The conclusion drawn from identifying these trends [short-term abstraction periods] is that current abstractions from the aquifers beneath Christchurch are having a significant effect on bore water levels resulting in a reduction in artesian freeflow. At present, however, the groundwater resource does not appear to be over-exploited.⁹⁰



Figure 4.33. Well being sunk in Woodbury Street, Avonhead 1989.

There is however a limit to the quantities of groundwater that can be abstracted without damaging the physical structure of the confined aquifer layers. This can occur when the aquifer collapses due to the compaction of gravels causing a permanent reduction in the waterbearing capability. This will also lead to localised land subsidence. The North Canterbury Catchment Board closely monitors wells locally as well as regionally. The present high quality of the confined groundwater beneath Christchurch is however potentially at risk from factors other than abstraction as the following summary shows:

The factors which are of major concern and which should be considered when determining the safe yield are:

- (i) decline in groundwater levels;
- (ii) decrease in springflow;
- (iii) interference between bores;
- (iv) inflow of poor quality recharge water;(migration of shallow unconfined inland plains groundwater, with elevated nitrate concentrations and coliform bacteria, into the confined coastal aquifers)
- (v) over-pumping;
- (vi) reversal of present upwards hydraulic gradient; (allowing downward leakage of contaminants from the surface). and
- (vii) sea water intrusion.⁹¹

Under the Water and Soil Conservation Act 1967, users of groundwater for all purposes other than reasonable domestic requirements of individual households, stockwater drinking, and fire fighting, must obtain a water right from the Regional Water Board. The investigation, monitoring, supervision and administration of water

rights is essential for the continued development of the groundwater resource especially in areas where the demand for groundwater is high and may exceed the safe yield of the aquifers.⁹²

THE AVON-HEATHCOTE ESTUARY.

At the time of European settlement in 1850, the lowland that formed the catchment basin of the estuary was mainly swampland. The vegetation around the estuary and the two rivers that feed it was dominated by raupo and flax interspersed fern tutu and with patches of tussock occurring on small areas of slightly higher ground. These conditions were all playing a vital part in the fragile ecosystem of the estuary.

The estuarine system is far from static and a major contributing factor to this dynamism is the Sumner bar which undergoes periodic changes and controls the mouth of the estuary. This bar was to cause many boats to flounder with the loss of some lives and although many schemes were proposed to make this entry safe, the bar has only been modified by nature.

As the catchment basin for the estuary became 'civilized', and the rivers were used to drain rubbish and effluent, the quality of the water feeding the estuary deteriorated. Initially, it was only household slops that were drained into the rivers, but as industries grew around the rivers, especially the Heathcote, industrial waste was also dumped into the rivers. Woolston became heavily industrialized and in 1903 employed one fifth of the total New Zealand workforce. Factories were discharging untreated toxic wastes from the woolscouring, rubber, glue and starch industries. Chemicals such as arsenic, acids, lead, copper, tar and oils were being discharged.

Not only the discharge of waste but, "the rapid urbanization and change in vegetation appear to have resulted in an increase in sedimentation supply to the Avon and Heathcote Rivers. The sediment was deposited in the estuary as a 50-60 cm thick layer of distinctive mud, and this resulted in a decrease in the tidal volume of the estuary by an estimated 30% between 1850 and 1875".⁹³ The normal currents could not remove this rapid sedimentation and the altered conditions radically changed the benthic invertebrate community, killing many species but favouring others. After 1875 less sediment was available due to altered run-off surfaces and drainage and the estuary; "gradually responded with an increased tidal compartment to a present volume slightly greater than that of 1850 and which appears to be approaching stability. The estuary remains a net exporter of sediment."⁹⁴

Reclamation for urban development has destroyed and altered the vegetation around the rivers and estuary. Most of the perimeter is seawall or some form of shore protection and a causeway separates McCormacks bay which changed the tidal regime. The estuarine reaches of the Avon and Heathcote rivers, "differ greatly and most instructively, in that the Avon is as natural as one can expect of a stream flowing through a city whereas the Heathcote has been greatly polluted by industrial wastes".⁹⁵

According to Morgan, "from a biological point of view there are three types of pollution".⁹⁶ There is poisonous pollution (chemicals acids etc.) which kill life. Insanitary pollution affects human life through the spread of disease. There is also ecological pollution which modifies the natural history of a region and in the Avon-Heathcote Estuary this is caused by organic matter being discharged. In the past, this would have come from factories but now comes mainly from the sewage works and artificial fertilizer which add to the nutrient content of the estuary.

ESTUARY MANAGEMENT.

In 1878 the Christchurch Drainage Board was formed and an organised start was made on an underground sewage system. Effluent was pumped to the Bromley Sewage farm where it was subjected to primary treatment before being discharged into the estuary. In 1926 the farm was replaced by a two stage system at the Bromley Sewage Purification Works where it undergoes a secondary treatment, that of biological oxidation in a series of ponds before being discharged.

Scientific studies in the estuary have been ongoing. The first biological survey was done in 1928 and this formed a base against which later studies were measured. Because the estuary serves as a useful area of study, the University of Canterbury Zoology department have

carried out studies in the area which are significant for the management of the area. The estuary is a unique ecosystem and: "The Avon-Heathcote Estuary is rather a special case in New Zealand on account of its urbanization".⁹⁷

The estuary is not only the drainage basin for stormwater and discharge area of effluent from the sewage works, but it serves as a recreation and sports area, an important area of "open space" for Christchurch. It is also a feeding ground for fish and birds and a nursery for flounder and other fish. "Not all of these uses are compatible, but any management decisions must take all possible uses and values into account".⁹⁸ Under the Christchurch District Planning Scheme 1979, the estuary receives its own recreational zone classification.



Figure 4.34. The Avon - Heathcote Estuary.

Photo: J.H.Weeber.

THE WAIMAKARIRI RIVER.

As we have already seen, the Waimakariri was the major sculptor of the lowland in which Christchurch is situated and one can assume that it would have continued its landforming duties had man not interfered. It was, however, to cause many problems before humans mastered this natural creator.

When the first Europeans came to Canterbury there would be local Maoris still around in whose time a great flood in the Waimakariri River had swept down the Avon, one of its ancient courses to the sea.⁹⁹

Evidence of this is a kanuka log found, buried under 2 metres of shingle, near Christchurch Airport and which was dated as being less than 200 years old. No minor flood could have caused such a depth of shingle to be deposited.

The instability of the Waimakariri led John Deans in 1840, to recognise, that the river had not yet established a uniform gradient to the sea. Early settlers soon became aware of traces of previous river courses. These could be seen in the shape of the existing Styx and Avon Rivers, Horseshoe Lake and Bottle Lake, as well as the Islington channel and Halswell River.

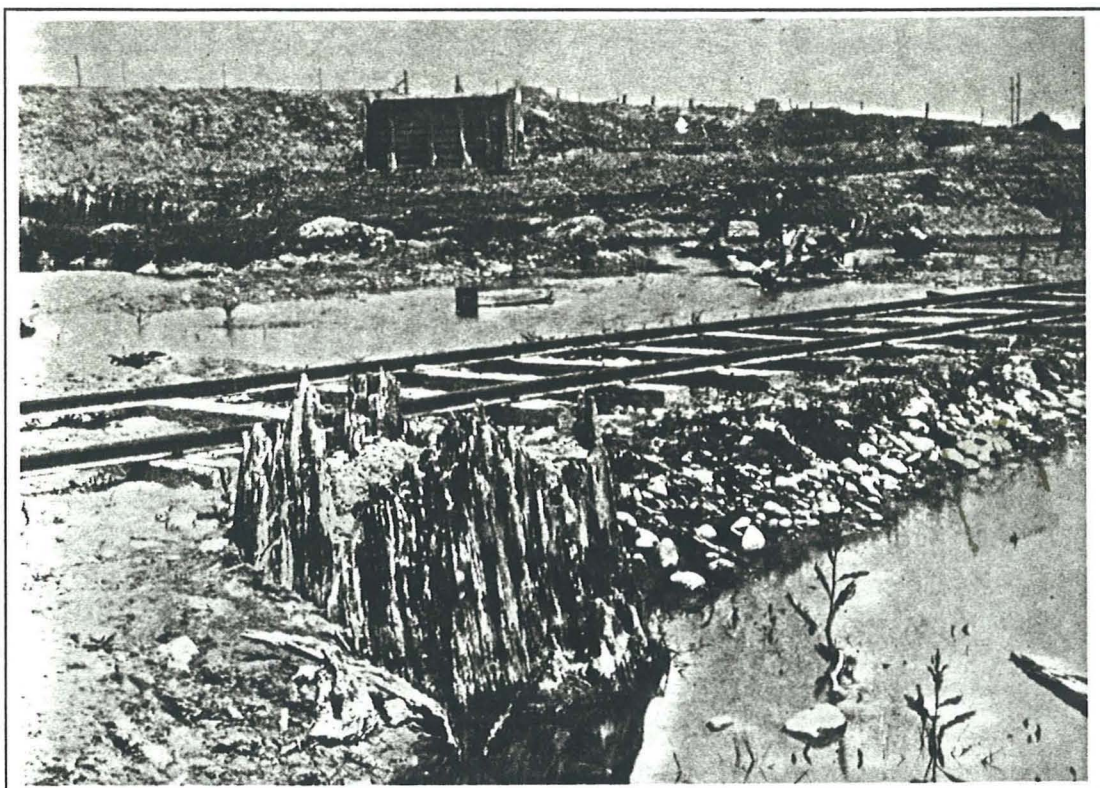


Figure 4.35. Totara stumps in a gravel pit in Sockburn.
The Waimakariri snapped off the trunks and subsequently buried the forest.
Source: Spreight, 1917.



Figure 4.36. Waimakariri Riverbed north of Christchurch Airport.

Samuel Butler arrived at Lyttelton in January 1860. During a journey to his run at Rangitata, he described the nature of the Waimakariri as follows:

They [his bullock team] are now going down into an old river-bed formerly tenanted by the Waimakariri, which then flowed into Lake Ellesmere, ten or a dozen miles south of Christ Church, and which now enters the sea at Kaiapoi, it has others which it has discarded with fickle caprice for the one in which it happens to be flowing at present, and which there appears some reason for thinking it is soon going to tire of. If it eats about a hundred yards more of its gravelly bank in one place, the river will find an old bed several feet lower than its present; this bed will conduct it into Christ Church. Government had put up a wooden defence, at a cost of something like 2000 Pounds, but there was no getting any firm starting-ground, and a few freshes carried embankment, piles, and all away, and ate a large slice off the bank into the bargain; there is nothing for it but to let the river have its own way. Every fresh changes every ford, and to a certain extent alters every channel; after every fresh the river may shift its course directly onto the opposite side of its bed, and leave Christ Church in undisturbed security for centuries; or, again, any fresh may render such a shift in the highest degree improbable, and sooner or later seal the fate of our metropolis. At present no one troubles his head much about it, although a few years ago there was a regular panic upon the subject.¹⁰⁰

The people of Christchurch had only to wait about six years before they panicked again.

FLOODS IN THE CHRISTCHURCH AREA.

One of the main reasons for siting the new town were it is, was its proximity to the Avon river. John Deans who had been living in the area for almost ten years wrote that he had "never seen the river...rise or fall more than four or five inches".¹⁰¹ Thus when the site selectors made their choice they did not foresee any danger of flooding especially not from a source outside their area.

W.B.Brae a civil engineer, settled at Avonhead, and who often warned against the possibility of inundation by the Waimakariri, prompted a poet to write;

At Avonhead lived one Mr Bray
Who every morning used to say,
I should not be much surprised to-day
If Christchurch City were swept away
By the rushing, crushing, flushing, gushing
Waimakariri River.

After minor flooding in 1859, various well documented debates¹⁰² took place the on possible dangers of inundation of Christchurch and what could be done to prevent it. But as the river behaved itself for a few years, not many people troubled themselves about this, and little was done to protect the city. Smaller floods had severely damaged Kaiapoi Island and Kaiapoi but it did not seem to have worried the residents of Christchurch unduly.

On February 5, 1868, Christchurch was severely flooded by the Avon in its worst flood to date. Referred to as the "Great Flood", it was caused by a heavy downpour in the foot hills. These foot hills and much of the plains had undergone drastic changes in the ten or more years prior to the flood. As settlers took up runs in the hinterland they 'fired the tussock' in order to plant English grasses for their stock. In this way the fragile soils of the plains became weakened and susceptible to erosion. The Waimakariri and Selwyn Rivers flooded the lower reaches of the plains as they broke their banks. The Waimakariri overflowed into its old channels which sent water down Harewood Road towards Papanui and Fendalton Roads and into the city. Many shops in the city centre were flooded and waters swept at the base of Godley monument in the square.

It was only after these floods that any serious attempts were made by the residents of Christchurch to control their troublesome neighbour.

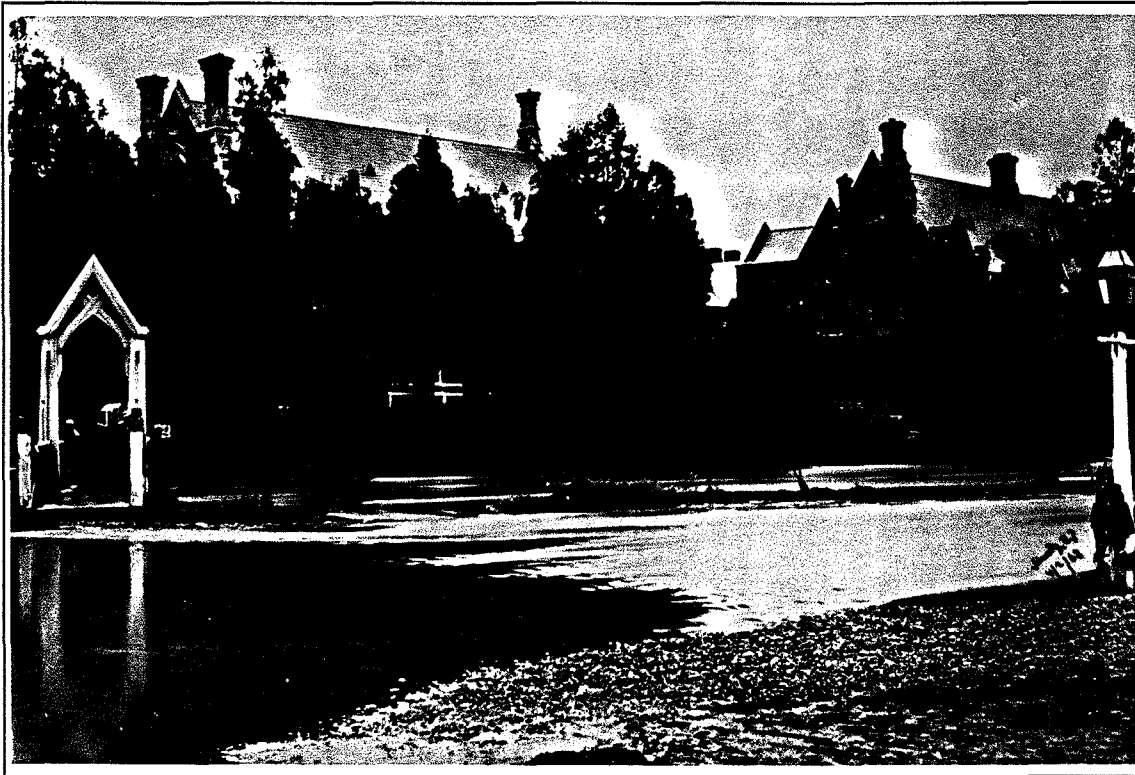


Figure 4.37. Flooding by the Avon River, February 4, 1868.

Gloucester Street Bridge.

Photo: D.L.Mundy, Canterbury Museum.

CONTROLLING THE WAIMAKARIRI RIVER.

The main trouble with the Waimakariri was its gradient. This averaged 1 in 200, which is about par for the course of snow-fed rivers, but whereas the Rakaia and Rangitata continued this grade to the sea, the Waimakariri flattened out for the last 15km. From there on the easier pace allowed its load of flood-borne detritus to be dumped on what could be called the terminal face of its "fan" or "cone", leading in turn to the instability of its course.¹⁰³





Although some protective work had been done since 1859 by the Provincial Government, this was mostly ineffectual as the floods of 1868 has shown. In the year following these floods, the South Waimakariri River District was formed which operated through a nominated Board of Conservators. A number of groynes were constructed to block off possible overflows to the Avon and Styx Rivers.

In 1880 an elected body of nine members, the South Waimakariri River Board of Conservators, was formed with the responsibility of maintaining the south side of the river only. Some forty years later, in 1923, because of complaints from residents on the north side of the river, the Waimakariri River Trust was set up by the Waimakariri River Improvement Act 1922, with powers and responsibilities relating to *both* sides of the river. Under the Act, the Trust was empowered, "as far as finances would permit", to carry out works that would safeguard the City of Christchurch from flooding. H.F.Hay prepared a scheme which was to regulate the lower 40 kilometres of the river by a system of stopbanking and diversions which were to straighten and shorten the course of the river.

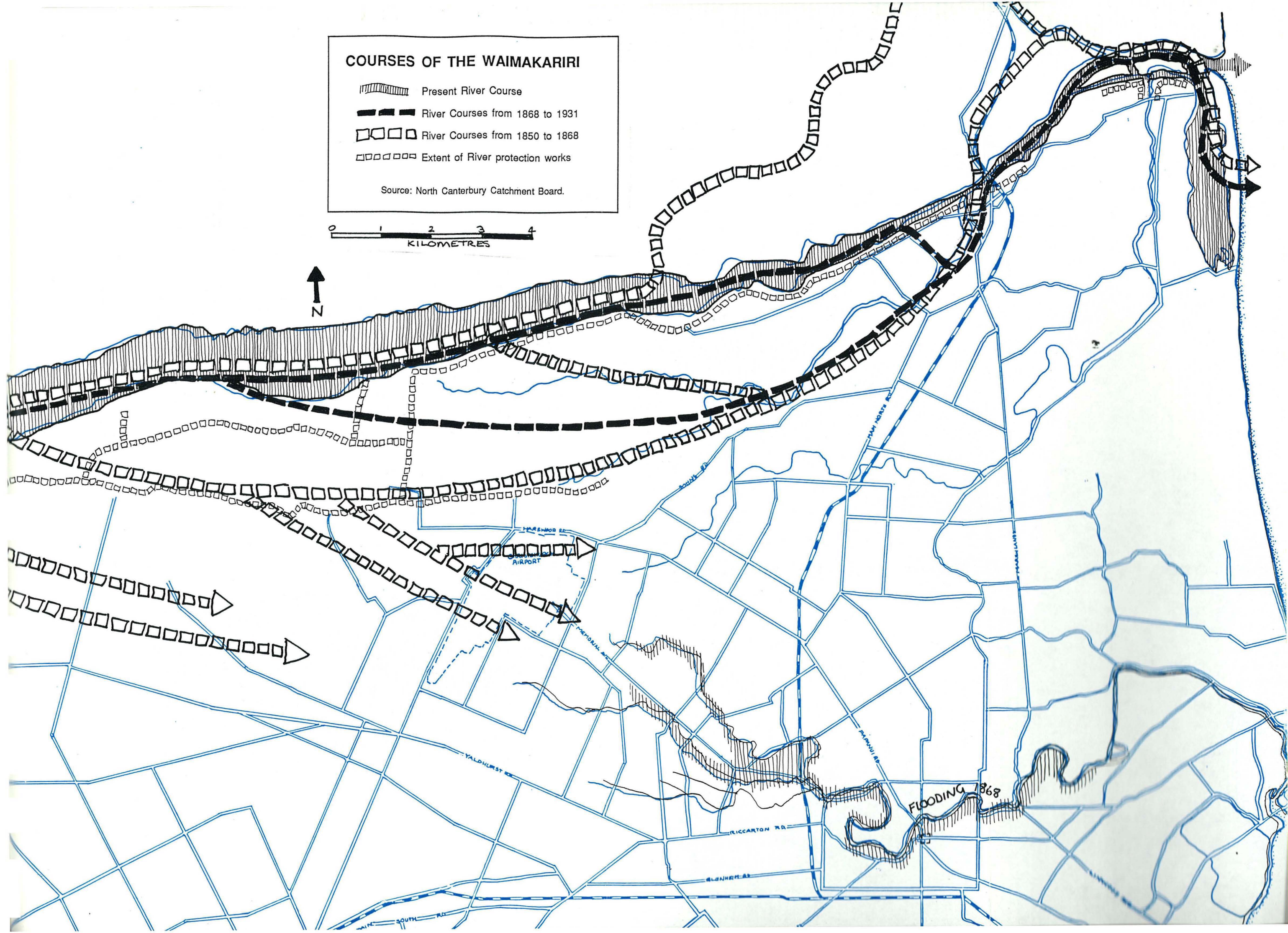
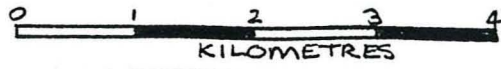
In 1947 the Waimakariri River Trust was dissolved and their assets and responsibilities came under auspices of North Canterbury Catchment Board. (In November 1989 these will become the responsibility of the Canterbury United Council.)

In the 1960 report of the Waimakariri River Improvement Scheme, it was noted that:

COURSES OF THE WAIMAKARIRI

-  Present River Course
-  River Courses from 1868 to 1931
-  River Courses from 1850 to 1868
-  Extent of River protection works

Source: North Canterbury Catchment Board.



Hay's scheme generally succeeded, in spite of progressive aggradation, in keeping floods out of Kaiapoi and Christchurch but that the embankments which were the principle feature of the works (apart from Wrights cut) proved less and less capable over the years of containing major floods.¹⁰⁴

The 1960 Report, drawn up by the North Canterbury Catchment Board, involved a ten year programme for flood protection and river control for a 58km. stretch of the river from the gorge bridge to the mouth. The objectives of the programme were as follows:

- a) to pass without overflow the design flood of 4730 cumecs safely to the sea;
- b) to deal with the problem of aggradation in the lower reaches as far as appears practicable and necessary;
- c) to combat erosion.¹⁰⁵

Achieving these aims involved the raising and strengthening of existing stopbanks, providing greater bank protection by planting and the construction of groynes, as well as the improvement of channel capacity through diversions and floodgates.

The significance of the aggregation of shingle, which is the result of the Waimakariri's gradient, was dealt with in the Report at some length. In the previous 25 years, the mean bedlevel in the reach downstream of the old crossbank, had risen by up to 1 metre. This was caused by a shingle aggregation rate of 152,000 cubic metres per year. "To demonstrate the significance of such an increase in bed level, a reduction in the effective stopbank height of 300 mm reduces the design standard from 100 years to 50 years, while a reduction of 1.0 m reduces the standard from 100 years to 10 years".¹⁰⁶ To negate aggregation the report proposed amongst other measures, to encourage commercial extraction of shingle. Figures indicate that: "the average annual gross aggradation between 1930 and 1981 has been 188,000 square metres p.a., which would indicate a desirable level of commercial extraction of between 160,000 and 200,000 square metres per year".¹⁰⁷ Between 1961 and 1968 much of this extraction went into the construction of the northern motorway. Results of surveys by the N.C.C.B. since 1960, "show that the combination of works and commercial extraction of shingle are sufficient to maintain satisfactory mean bed levels under the conditions which have existed over the last twenty years".¹⁰⁸



Figure 4.38. Gravel Extraction from the Waimakariri.

Work on the new River Improvement Scheme began in 1963, and there have been three large floods since then, in 1967, 1970 and 1979. These were successfully contained but "together inflicted some \$300,000 worth of damage to the protective works, mainly to groyne heads and plantings".¹⁰⁹

At present, the grade from the Gorge to Coutts Island has an average fall of 1 in 200, while from the seaward end of the island to the mouth, about 5km. from the coast, it changes character with a gradient of 1:525. This also marks the point at which the river enters the zone of swamps and lagoon which originally ran along the coast behind the barrier dunes, but which have now largely been drained. River load changes from large rocks at the headwaters to only sand and silt near the mouth. The estimated annual discharge is 3 million tons of which one million is sand.

Within one century of human occupation this powerful force of nature has, to a great extent, been tamed and its natural flow forced to go where we want it to go. We have, however, to keep a close eye on the river. "Unless there is a flood of enormous proportions some time in the future, Christchurch should remain safe from the threats of Waimakariri invasion".¹¹⁰

THE SWAMP FORESTS.

Polynesians, whether by accident or desire, initiated drastic changes in the near primitive vegetation by the simple means of fire; whereas the European settler, armed with a variety of cultural devices exploited a complex range of communities from the near primitive residuals to vast tracts of secondary vegetation.¹¹¹

Pre-Canterbury Settler populations continued the decimation of the forests on Banks Peninsula and if these had been more accessible, we would not even have remnants left. But the values and immediate needs of the first residents of Christchurch were different from now. However, in 1852 an unknown Indian Army Officer wrote this about the trees of Banks Peninsula: "It is strange to see these trees, which in England would be looked on as priceless gems, considered an encumbrance, and burned, cut down, and destroyed, as if they were the enemies of civilisation - to see men commence to cultivate a new land, by destroying that which the refinement of cultivation, in an old one, aims to produce".¹¹²

When the settlers arrived at the top of the bridle path, they were dismayed to find nothing to be seen "but the great wide bare plain stretching for miles on either side...the two clumps of bush were conspicuous objects in the landscape".¹¹³ These were Riccarton and Papanui Bushes, remnants of the swamp forests which once covered the plains, before the effects of the climate and the river and before man interfered.

When the Deans brothers arrived on the plains they settled near what is now called Riccarton Bush. At that time there were about 55 acres and it was one of the few landmarks on the plains that greeted the early settlers. In exchange for land, they gave half of the original bush to the Canterbury Settlers who very quickly made use of it as a timber source and the bush was exhausted of timber by 1857.

Fortunately, before his death in 1854, John Deans had expressed a wish that the bush still remaining should be permanently preserved from destruction. In order to protect the bush, a belt of English trees was planted to serve as shelter belt. Later, when these were removed, the timber was used to panel the new Riccarton House. In 1914, the remaining 16 acres of bush were presented to the public of Canterbury as a reserve and is run by a board of trustees: "The preservation of standing bush on such valuable land as that of Riccarton involved a very great pecuniary sacrifice, but it is also on the higher ground of sentiment and old association that Canterbury owes a debt of gratitude to the Deans family".¹¹⁴ Names have been fixed on the trees and paths deter the public from destroying vegetation. Artificial irrigation has to be supplied to maintain the wet conditions needed for this type of habitat.

Papanui Bush was however not so fortunate and disappeared within two years of the settlers arriving. We have, as the only reminder of what it was like, a description from Hart: "It was a charmingly pretty spot, that Papanui bush, full of dells and shady vales, and many a picnic party has spent a merry day there..".¹¹⁵



Figure 4.39. Daffodils in Hagley Park.

THE 'ENGLISHNESS' OF CHRISTCHURCH.

Colonists to a new country always seem to bring something of the 'old country' with them, whether it is a belief that theirs' is the better culture or merely something sentimental to hold onto in a strange new place. When the new place is undeveloped and equitable in climate and physical structure, it is so much easier to impose the old ways and ideals on the new.

When Christ Church has grown to a pretty town, when the young oak of England stands by the side of the giant trees indigenous to New Zealand, when the avenues to gentlemen's houses are lined by the graceful and beautiful shrubs that yield their fruits, when the green grass of England is sprouting in her meadows, fenced by hawthorn and hedges, when daisies and buttercups flower over the land....., then there will be but one thing wanting to make New Zealand the Eden of the World - the charm of age, the vestiges of the past, the spot endeared by old associations and traditions.(Unknown Indian Army Officer, 1852.)¹¹⁶

Round the banks of the river, I can see in my minds eye a walk planted with trees, the regular promenade of the place, like Christ Church walk at Oxford... (Henry Sewell, 1853).¹¹⁷

Three years after the settlers arrived in Christchurch a man named Potts gave tangible expression to the idea that Canterbury should be a slice of old England.... He fostered the love of English plants and was foremost in promoting a lively interest in horticulture.¹¹⁸

The Press itself came to the defence of the willows, saying that they grace Christchurch its characteristic appearance, reminding the visitor of 'classic Cambridge'. p 97

I may as well here correct an error, which I had been under, and which you may, perhaps, have shared with me - native grass cannot be mown. (Samuel Butler)¹¹⁹

The Forium Lenox, or New Zealand flax, is looked on by all colonists as the good angel of the country, which will yet shower wealth and abundance on the land. (Samuel Butler).¹²⁰

The *Phormium tenax* did, for a few years, provide an income for some, but it soon disappeared from the banks of rivers and streams.

It was traditional in English churchyard cemeteries to plant cypress, yew and myrtle. Our early settlers carried on the tradition.¹²¹

It is very generally recognised that there is nothing south of the Line which so closely resembles an English Park as does Hagley, and this is due, firstly, to the manner in which the original planting was carried out, but even more to the constant thinning of the plantation.¹²²

In August 1864 the west bank of the river between Gloucester and Worcester Streets was being fenced and made to slope down to the water line. In reporting this development, the city surveyor also mentioned the planting of 76 trees, comprising 36 Lombardy poplars, 20 laburnums and 20 pinasters.¹²³

The Christchurch Beautifying Association which was formed in 1897, did more than any other group to help the acceleration of the Christchurch facelift: "its objects.... were the artistic and scenic improvement of the city, and the cultivation of all that is beautiful.....Work done planting of riverbanks and various waste places with trees and flowers..."¹²⁴

Today New Zealanders are looking for a cultural identity in their cityscapes and it has become fashionable to plant native vegetation in their gardens. The Urban Landscape 2020 are also advocating the introduction of native planting in metropolitan Christchurch. The 'Englishness' of Christchurch is however also part of our cultural identity and it would be a pity if we were to lose that aspect of in our cityscape. We perhaps owe it to our great grandchildren to retain some of the visible vestiges of their roots. Christchurch can accommodate both native and exotic landscapes.

SCHEMES PROPOSED FOR CHRISTCHURCH.

Over the years, many different schemes have been proposed for various parts of the city. It would be interesting to imagine what Christchurch would have been like if some of the schemes had been implemented. By examining the early maps of Christchurch, one would think that the founders of the city "thought that Christchurch should have the look of a Little Amsterdam or Little Venice".¹²⁵ One finds canal reserves from the Estuary to the Avon river via Linwood Avenue and from the Avon to the Styx via Marshlands Road. There was also scheme to link the Halswell with the Heathcote. The Provincial Council had appointed Dobson in 1858, to investigate the possibility of finding cheap transport to the harbour.

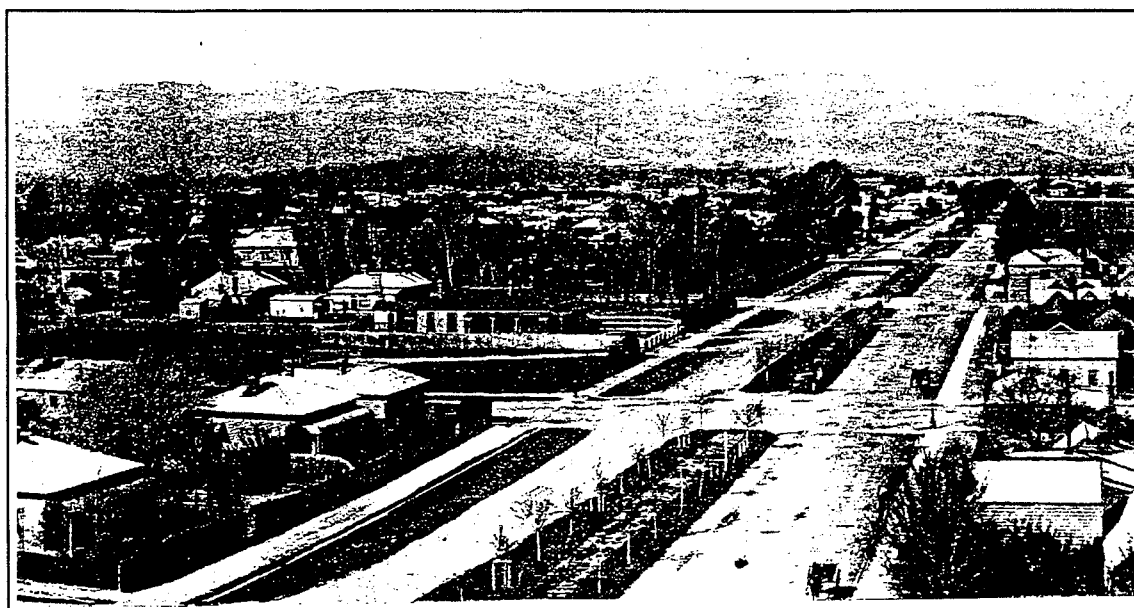


Figure 4.40. Linwood Avenue.

This wide avenue owes its width to the canal schemes of the 1860's.

Source: The Press, Jubilee Edition, December, 1900.

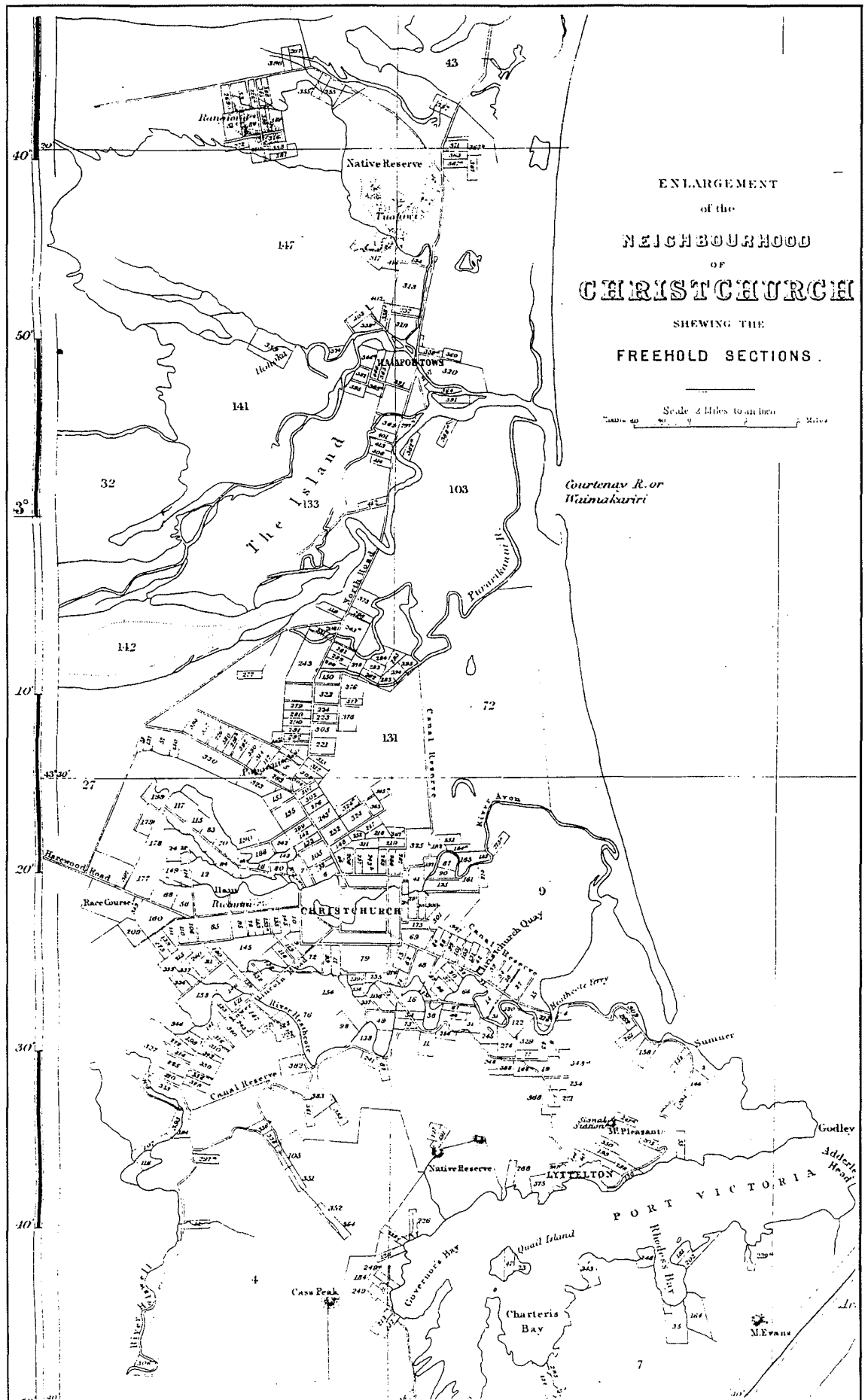


Figure 4.41. Map of the Province of Canterbury, 1856. Showing the Canal Reserves.

Besides the canal schemes, there were many even more ambitious proposals such as those for an artificial harbour in the estuary. "Organisations such as the Port Christchurch League and the Christchurch Canal League lobbied strongly in favour of the artificial harbour. The schemes were not finally abandoned until 1944, when the government opted for a road tunnel to Lyttelton".¹²⁶

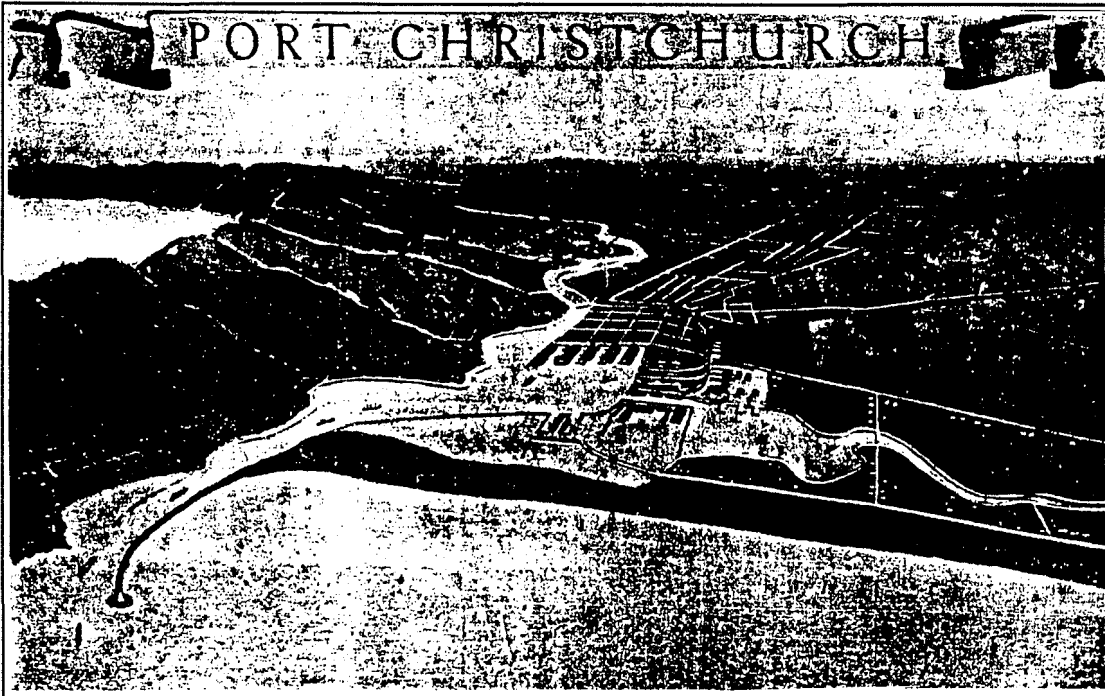


Figure 4.42. Port Christchurch.

Source: Canterbury Museum.

After the floods in 1868 J. Hector, government geologist, "suggested that the city would be further protected by constructing a storm-water channel to take the flood-water from near the Carlton Bridge, along the North belt, and back into the river near the cemetery, and so in effect diverting a body of water which would otherwise flow through the city".¹²⁷ Another proposal to divert the Avon along Fitzgerald Avenue, was made by Dr. Turnbull who suggested that by raising an embankment at the hospital, a serpentine lake be formed in Hagley Park from the Carlton corner to the hospital. "Below the hospital the dry riverbed would be the main drain of the city, covered over for use as building sites or pleasure grounds and flushed at stated intervals with water from the lake".¹²⁸

Before artesian water flowed in Christchurch various ways of getting pure water to the residents were suggested. Consider the following example from the Lyttelton Times of 1861: "We have heard of some gigantic scheme of bringing the waters of the Styx by an immense aquaduct to Christchurch, and thence via the tunnel to Lyttelton. Unless some descendants of the Pelasgi are resident in the South Seas, we can only consider this as the way not to do it".¹²⁹ Two years later the eminent geologist Julius von Haast also suggested an aquaduct instead of boring for artesian water.¹³⁰

In March 1897, in order to solve the problem of excess mud and silt from the Avon, a member of the Drainage Board proposed the following: "to restore the river to a satisfactory condition, it would be necessary to introduce into it an extra supply of water...The first thing to do was to construct a water race, 12 ft. wide and 1 ft. 6 in. deep, from the Waimakariri River to the head of the Avon - a distance of about ten miles. By this means, 'a body of water travelling 4 miles per hour would empty into the Avon about 40,000 gallons per minute'. The cost of the scheme he estimated to be 500 Pounds - surely a considerable underestimate, even at those times".¹³¹

In 1915, H.T.J.Thacker in 1915 declared: "My idea about a fresh supply of water for the river would be to sink a series of deep stratum wells, from the Carlton Bridge to the East Belt bridge. These wells would supply each 300 gallons of water per minute, and you will find that the flow per day for, say, twenty wells at different point, would be a good many millions".¹³²

Although some schemes did go ahead, for example the Lyttelton tunnel, most of these schemes failed. Many of them were impractical or too expensive to finance. Today we also have our schemes, for example, the Victoria Square tower and the gondola on the Port Hills. In most instances finance is no longer the main obstacle. An increased environmental awareness has become more important to the success or failure of these schemes.

1. Johnston in Knox(ed.) 1969,p.93.
2. Quoted in Lamb, 1981, p.63.
3. Deans, Jane, p.4.
4. New Zealand Federation of University Women, p.22.
5. Ibid., p.23.
6. Penney, p.38.
7. Ibid., p.11.
8. Ibid., p.14.
9. Ibid., p.119.
10. Morrison, p.80-81.
11. Acland, p.62.
12. Quoted in Lamb, 1981, p.23.
13. Penney, p.200.
14. Christchurch Artesian Aquifers, p.8.
15. Quoted in Lamb, 1981, p.72.
16. Hercus, p.6.
17. Scott, p.21.
18. Ibid., p.22.
19. Ibid., p.31.
20. Christchurch City Council, Horseshoe Lake, p.39.
21. Ibid., p.26.
22. Ibid., p.30.
23. Ibid., p.33.
24. Ibid., p.78.
25. Lamb, 1981, p.35.
26. Ibid., p.33.
27. Ibid., p.129.
28. Anderson, p.168.
29. Ibid., p.329.
30. Penney, p.200.
31. J.H. Weeber, personal conversation.

32. Biggs, p.47.
33. Cockayne, p.10.
34. Morrison, p.34.
35. Quoted in Lamb, 1981, p.22.
36. Morrison, p.30.
37. Lamb, 1981, p.31.
38. Ibid., p.72.
39. Ibid.
40. Morrison, p.96.
41. Bennet, p.16.
42. Ibid.,
43. Ibid.
44. Anderson, p.279.
45. Densem, p.31.
46. New Zealand Federation of University Women, p.35.
47. Biggs, p.27.
48. Ibid., p.30.
49. Deans Jane, p.5.
50. Morrison, p.43.
51. New Zealand Federation of University Women, p.23.
52. Penney, p.7.
53. Wigram, p.131.
54. New Zealand Federation of University Women, p.35.
55. Penney, p.62.
56. Ibid., p.185.
57. Lamb, 1981, p.72.
58. Lamb, 1963, p.24.
59. Morrison, p.43.
60. Hart, p.38-39.
61. Morrison, p.42.
62. Lamb, 1963, p.22.

63. *Ibid.*, p.23.
64. *Ibid.*
65. Lamb, 1981, p.126.
66. Trittenbach, p.106.
67. Publicity Brochure, Peacock Springs.
68. Scott, p.2.
69. Littelton Times, April 1862.
70. Lamb, 1963.
71. *Ibid.*
72. Lamb, 1981, p.141.
73. *Ibid.*
74. Quoted in Lamb, 1981, p.146.
75. Scott, p.25.
76. Scott, p.35.
77. Scott, p.35.
78. New Zealand Federation of University Women, p.83.
79. Anderson, p.445.
80. Trittenbach, p.120.
81. Penney, p.19.
82. Morrison, p.84.
83. Lamb, 1981, p.5.
84. Penney, p.38.
85. *Ibid.*, p.63.
86. The Christchurch Artesian Aquifers, p.15.
87. Molloy (ed.), Unpublished paper, p.11-12.
88. *Ibid.*, p.14.
89. The Christchurch Artesian Aquifers, p.144.
90. *Ibid.*, p.72.
91. *Ibid.*, p.150.
92. *Ibid.*, p.148.
93. Christchurch City Council, The Avon Heathcote Estuary, p.23.

94. Stephenson, p.23.
95. Morgan in Knox (ed.) 1969, p.553.
96. Ibid., p.561.
97. Ibid., p.553.
98. Christchurch City Council, The Avon-Heathcote Estuary, p.14.
99. Logan, p.9.
100. Streatfield, p.84-85.
101. Deans, p.15.
102. Wigram, p.156. Logan, p.15-25.
103. Logan, p.15.
104. North Canterbury Catchment Board, Waimakariri, 1982, p.3
105. Ibid., p.6.
106. Ibid., p.12.
107. Ibid., p.13.
108. Ibid.
109. Ibid., p.143.
110. Ibid., p.143.
111. Molloy in Knox(ed.), p.359.
112. Tancred, p.26.
113. Hart, p.11.
114. Wigram, p.39.
115. Hart, p.27.
116. Tancred, p.32.
117. Lamb, 1981, p.36.
118. Morrison, p.131.
119. Streatfield, p.46.
120. Ibid., p.43.
121. Lamb, 1981, p.73.
122. Wigram, p.245.
123. Ibid., p.93.
124. Wigram, p.248.

125. Penney, p.22.
126. Christchurch City Council, The Avon-Heathcote Estuary, p.12.
127. Wigram, p.159.
128. Clark, p.18.
129. Littelton Times, 2 November, 1861.
130. Lamb, 1981, p.38.
131. Ibid, p.148.
132. Littelton Times, 23 January, 1815.

CHAPTER FIVE

THE LANDFORMS TODAY

WHAT REMAINS?

The Christchurch area is basically flat lowland with an imperceptible average 2% slope towards the sea. Before the town was built it did however have a characteristic topography, not spectacular, but enough to give the area a gently undulating appearance. Some of the landforms were slightly enhanced by the drop in groundwater levels when the swamps were drained but most of these subsequently disappeared as the modern cityscape was imposed on the land.

THE RIVERS.

The three rivers and their tributaries are the principle and very important outlets for the stormwater drainage of the whole district. They have saved the expense of large and costly conduits and are vital for keeping the metropolis area drained and healthy. (Christchurch Drainage Board).¹

The rivers have been 'civilized' to conform to human living standards. Before the Europeans arrived they were much deeper and bordered by wetland vegetation. Now, along parts of the rivers, the banks slope down in a managed way and are planted with English grasses and trees. In other areas artificial banks, gabions and stone wall have been constructed to control the rivers and protect properties. The mouth of the Avon is the only area left that still has a slight resemblance to the natural river.

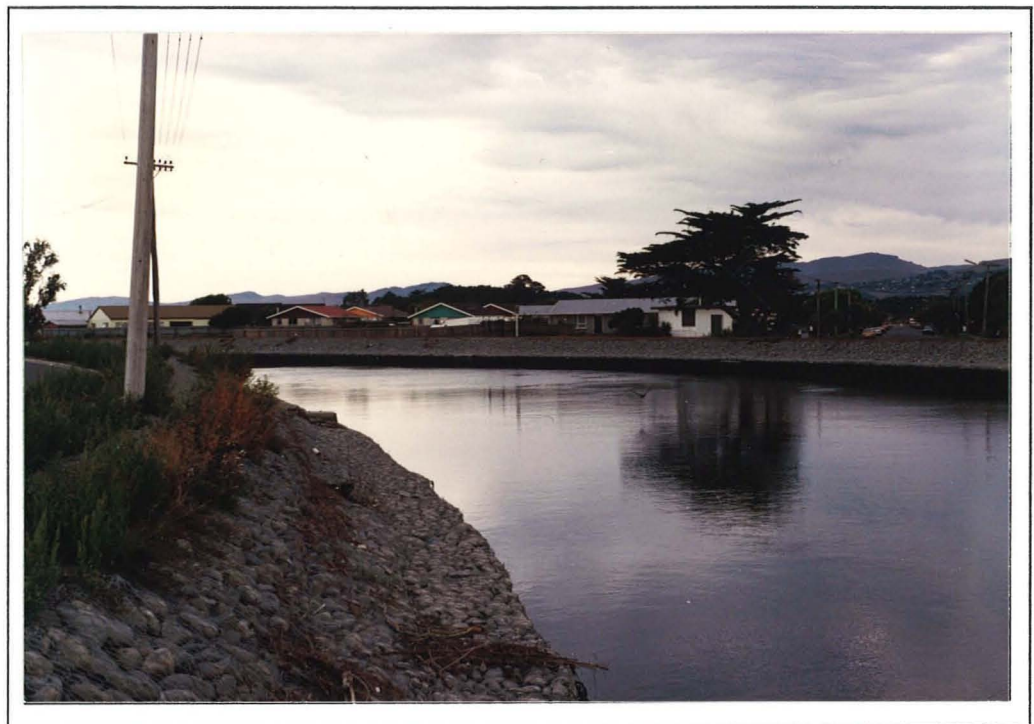


Figure 5.1. The Avon River, New Brighton. Artificially contained.

To maintain the river as drainage outlet it *needs* to be controlled and engineered in order to provide adequate slope. The solutions for this are however those of engineers. A naturalist solution may be possible, for example, rivers and streams could be 'engineered' to form floodplains and although such areas may seem unattractive in the eyes of many people, Christchurch would gain valuable wildlife habitats.

Many tributaries of the Avon and Heathcote have disappeared or have been contained in open and underground drains. They form a complicated network through the suburbs of Christchurch. Sometimes residents living adjacent to the drains try to do something 'creative' to them but on the whole they are ignored. These drains are ideal 'wastelands' which could be 'naturalised' to become public walkways and wildlife corridors.



Figure 5.2. Eric Street, Papanui.

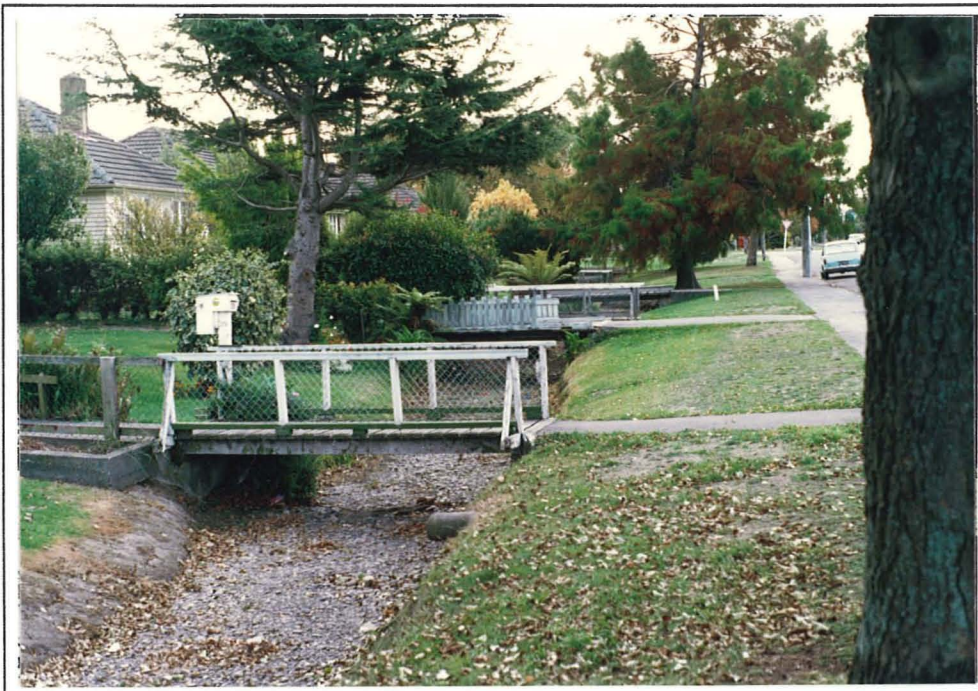


Figure 5.3. Brookside Terrace, Bryndwr.

'River frontage' is again an attractive drawcard in the real estate world. Before the lowering of the groundwater levels, the properties adjacent to streams and rivers were 'unhealthy' places. Now they have become somewhat of a status symbol and a property with a 'stream-boundary' in the Fendalton/Ilam areas would fetch 10-15% more than neighbouring properties.² This however does not hold true for all areas of Christchurch. One finds many beautiful gardens alongside the Avon River northwest of Hagley Park. Although the river itself is public land, these areas are inaccessible to the public. At present one can see some of these gardens from Mona Vale and Riccarton Bush, but so many more are hidden. It would be an interesting tourist venture that could take parties up the streams to view these gardens? Fortunately the lower reaches of the river are accessible and:

The River, winding through the City Centre, forms one of the City's most important amenity assets, providing a pleasant and restful area where people can sit and relax, eat their lunch or feed the ducks.³



Figure 5.4. The Avon River. A recreational resource.

THE SANDHILLS.

Most of the sandhills of Christchurch have been levelled. The foredune, however, is cared for because it *needs* to be. If this protective landform were not necessary, it too would long since have disappeared as residents would have preferred a seaview. After years of stabilizing the dune with exotic grasses and lupin, the Christchurch City Council is now trying to re-establish the native pingao. The southern part of the spit is saved from residential development, mainly because it is unstable. This enables the 'derelict' or 'waste' land to be preserved as a reserve.

Although most of the old river terraces and sandhills were destroyed in the effort to fill swamps and level the area for roads, some isolated areas can still be recognised as the original landforms, but the vegetation has been modified with the loss of many native species. Areas that were planted with pines in an effort to control the dunes from spreading into fertile or populated areas, are now mature and attractive forests and although not native to the area, do provide us with a visual and recreational amenity.

Sandhills north of Queen Elizabeth II Park, are the latest group of sandhills to come under the developers bulldozers. The new suburb of Parklands may just as well have been anywhere else in Christchurch. The only part of the area which acknowledges the fact that it was built on sandhills, are the hills in the park adjacent to the shopping centre. These however have been covered with 'English' lawn.



Figure 5.5. Recreation Reserve, Parklands.

Almost all of the eleven golf courses in the Christchurch area are situated on comparatively natural undulating ground and these areas provide us with clues as to what the natural landform was like. Windsor, Waimairi, Shirley, Ascot, Avondale and the Municipal Golf links in the Rawhiti Domain are all on old dune ridges. Hagley Park Golf Course is sited on old Avon River and Waimakariri terraces. Golf courses around Christchurch Airport in Harewood were developed on the terraces and old riverbed of the Waimakariri River.



Figure 5.6. Hagley Park Golf Course.



Figure 5.7. Shirley Golf Course.



Figure 5.8. Linwood and Richmond. High spots were once the foredune of Pegasus Bay.

When looking up (or down) some of the streets of Christchurch it is still possible to see evidence of Waimakariri shingle lobes. For example when looking from Blenheim Road towards Riccarton Road up the connecting streets, there is a distinct rise which diminishes as one nears Hagley Park.



Figure 5.9. **Wigram Road, Halswell.** Further inland, old Waimakariri courses are still recognisable although modified by cultivation.

THE WAIMAKARIRI.

Besides giving form to our present landscape, the Waimakariri has played an important part in the lives of Christchurch residents. For many years it threatened the city. Now, through the efforts of many generations, Christchurch and Kaiapoi are safe but we still pay a percentage of our rates to protect us from inundation. It also means that the river no longer runs freely.

The vegetation on the banks of the Waimakariri has been changed through the planting of willows and poplars in an attempt to stabilise its banks. In 1971 Molloy did however, recognise pockets of 'steppe-like grassland' in natural condition at Harewood and Halkett.⁴

Through the control and channelling of the Waimakariri, large areas of dry land have become available, most notably McLeans Island. These areas are shingly, and have little agricultural value but provide us with recreational areas in the form of wildlife parks, a motor-camp, shooting range, autoclub etc.,. The area is ideal for the preservation and re-creation of typical river terrace vegetation.

Further east, 'The Groyne' is another important recreational area for the city. Here the restraints of river control have become an opportunity. Creative use has been made of river management tools such as stopbanking and groynes. Extensive native planting is re-creating a valuable wetland habitat.

For more than a hundred years, the Waimakariri has been the source of water for the watterraces that feed the farms on the plains. These watterraces form an important component of the patchwork patterns of the Canterbury Plains. The watterraces are ideal areas for the development of wildlife corridors but attitudes towards the maintenance of these would have to change as herbicides are still the predominant management tool.



Figure 5.10. **Stopbanks.** Containing the lower reaches of the Waimakariri River.



Figure 5.11. **Race Intake.**

The mouth of the Waimakariri used to flow through Brooklands Lagoon but in the 1940's, after a severe storm, the river breached the spit which enclosed this waterbody. Protection works control and minimise the length of the river as well as keep the mouth in its present position. Waimairi County Council zoning in this area provide for both recreational use and the protection of a valuable wetland habitat.



Figure 5.12. **The Mouth of the Waimakari.** Brooklands Lagoon and the Styx River at the bottom of the picture.
Photo: John Weeber.

THE SWAMPS.

The extent of agricultural development in Canterbury means that most existing wetlands are no longer in their natural state. Besides drainage, wetlands in Canterbury have suffered modification as a result of such factors as the increased input of nutrients from farm runoff and topdressing, oversowing of introduced grasses, natural encroachment of introduced grasses and weeds, grazing and/or trampling by stock, burning, and the abstraction of water for irrigation and other rural and domestic purposes. For these reasons, it is important that those wetlands of ecological or representative importance remaining in the Canterbury Region are protected for their conservation values.⁵

In 1971 Molloy noted some of the wetland areas still remaining in the Christchurch area.p25 One of these was at New Brighton between the Avon and New Brighton Road. "This swamp is Crown land, classified as a recreational reserve, and controlled and managed by the Christchurch City Council. In my view it should be re-classified to protect its plants, soils and wildlife and perhaps even be re-named the 'Cockayne Reserve'".⁶ Today the Cockayne

Reserve is a good example of a natural swamp although the vegetation is fairly depauperate in the eyes of botanists. Another wetland habitat recognised by Molloy, is at the mouth of the Avon where there is "an extensive area of estuarine vegetation, tidal mud flats and islands...representing the best of this ecosystem. The future of this particular area seems predictable, but it is to be hoped that some parts will be retained in their present state in the course of urban development".⁷ Although the wetland conditions still remain, the area seems to be used as an unofficial rubbish dump.



Figure 5.13. Near the Mouth of the Avon. Wetland area used as a rubbish dump.

There are other areas which still afford the natural ground conditions necessary for the re-creation of freshwater wetlands. Some of these are the Styx river, Horse Shoe Lake and Travis Swamp.

HORSESHOE LAKE.

This typical ox-bow lake, was probably an old meander of the Avon and is an integral part of the land drainage system to the north and west of the lake. Although it has been extensively altered, parts of the area provide us with a good example of a swamp in near natural condition as well as an association between swamp and sandhills. Boating, fishing, shooting and snaring of native game was prohibited in 1904 when the area was temporarily reserved as a sanctuary for wild fowl. (This was an infringement of Maori values who traditionally used the area for gaming.) In 1954 the purpose of the reserve changed from 'preservation of Wild Fowl' to 'Recreation and Municipal Purposes'.

Although the area is dominated by willows, a significant proportion of young native trees and shrubs are regenerating under the willow canopy in the wetland adjacent to the lake. The only raupo left in 1980 was a small remnant growing in a pond flanked by flax. On the Lake Terrace Road side, the bank of the lake was recently consolidated and encroaching willows removed. Prior to this the bank dropped steeply from beside the road to a swampy, unstable shelf bordering the lake. The banks of both this area and the Dudley Creek diversion were grassed and exotic trees planted. This was done as recently as 1979.

There is a small part of the reserve which is being kept and managed as swampland. Alterations or fluctuations in the lake level could disrupt the vegetation of this adjoining

swampland. To monitor this the Christchurch Drainage Board in 1980 undertook a comprehensive botanical survey as well as the establishment of three study areas.

Christchurch City Council Major Management Objectives for Horseshoe Lake include:

- 1) the wilderness character of the reserve shall be preserved.
- 2) the opportunities for public enjoyment of the natural qualities of the reserve shall be improved.
- 3) the flora and fauna shall be protected to allow natural associations to evolve.⁸



Figure 5.14. Horseshoe Lake.



Figure 5.15. Horseshoe Lake.
Sandhills used as BMX track.

At present, a temporary BMX track is utilising the sandhills on the western side of the lake. A Christchurch City council statement in 1981 recommended: "The lack of vegetation around the bare track contrasts starkly with the adjacent willowland and the golf course over the road...Tree and shrub planting may be undertaken ... to help blend the existing bare site with the surrounding landscape".⁹ This attitude still reflects the assumption that everything has to be grassed and treed to 'blend' in the English tradition. This is an ideal situation where development can highlight the diversity and natural association of swamp and sandhills.

TRAVIS SWAMP.

To a large extent the development of Christchurch was dependant on the draining of the swamps. So successful were the early settlers, that Travis Swamp is the only extensive area of swampland left. And now this area is also under threat and has become a contentious issue between developers and conservationists.

The swamp is typical of a lowlying area that was trapped between sandhills and where a freshwater wetland eco-system developed. Given time and continued natural conditions, a kahikatea swamp forest might have evolved. On the north western side are a few remnants of the sandhills but they have now been largely removed. A Post Office stands on the levelled area that was the last of a manuka stand.

Ever since Travis Swamp was part of the large Sandhills Run, it has been used for grazing cattle. In the last few years it has been considered for development, but these schemes have mostly failed because of a lack of finances. Travis Country Estates who now own the area, intend a residential development. In order to achieve this, they plan to import sand from elsewhere and fill the area to a height of one and a half metres. The North Canterbury Catchment Board however, are withholding water-rights on the condition that 35 Ha of the land be protected as natural swampland. An appeal to the planning tribunal against this ruling was withdrawn by Travis Estates. David Norton, in letter to the editor of The Press expressed his pleasure at this but added: "I must, however, express my concern that Mrs. Anne Flanagan is reported as still endeavouring to have the whole swamp protected. This was not the objective of all the groups involved in the Travis Swamp debate, and represents an unrealistic approach to nature conservation in urban Christchurch".¹⁰

It is clear that the extent of area to be preserved, is a contentious issue even amongst the conservationists. Norton would like to see only part of the area conserved while Colin Meurk wants the *total* area developed as a regional park with "recreational, educational, conservation and tourist potential".¹¹

Given the virtual elimination of Christchurch's natural estate, within the space of a mere 150 years, the Travis Swamp area must be regarded as an invaluable, natural monument - ranking alongside the kahikatea forest of Riccarton Bush, the remaining salt and brackish marshes of the Avon-Heathcote Estuary, Brooklands Lagoon and Lake Ellesmere, the pingao dunelands of Kaitorete Spit, and the silver tussock and dry shrublands of the Port Hills. These are the few representatives we have left of the pre-European vegetation of the greater Christchurch Area. They are the touchstones upon which the future generations will interpret and judge their environmental roots and natural history and their ancestors' foresight and industry.¹²

THE STYX MILL BASIN.

Once, the Styx River was, like the Avon and Heathcote, also an old channel of the Waimakariri and the catchment area between it and the Avon caused many interesting problems for the drainage board. As was mentioned earlier, water in the Preston/Winters Road area, destined for the Avon, had to be diverted to the Styx.

Attitudes to the control and management of the Styx River have changed within the controlling body, Waimairi County Council. Landscape architects have become involved in the development of the area so that, where the Styx Mill basin used to be an engineering problem, the emphasis is now on environmental issues. Here an area of 'wasteland' will become an acceptable 'wilderness' area as swales and tributaries are planted with native vegetation.

Murchison Park, is an example of where the natural swales have been kept and enhanced by the re-establishment of native planting. The park is situated in the suburb of Redwood which

lies on the northern borders of the extinct Papanui Bush. During the development of the suburb many buried logs were removed from the once swampy land. The land was saved by the Waimairi County Council from the usual sportsfield development. The natural watercourse which is piped from under the residential area to the park, is freed to run through the park into swales. The genetic stock for the native vegetation comes from Riccarton Bush. The grass is at times kept long to form a natural cross country course. Close this area is Owen Mitchell Park which lies on the site where, on the old maps of Christchurch, springs were indicated. The solution to this area was to fill it in for sportsgrounds. Naturally there have been problems keeping the field dry.¹³

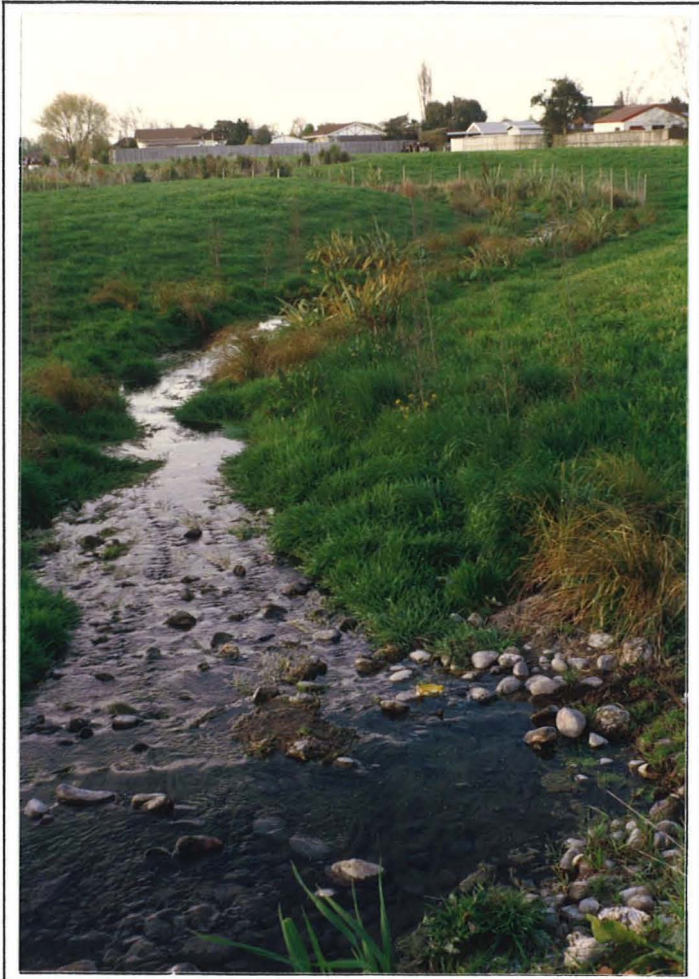


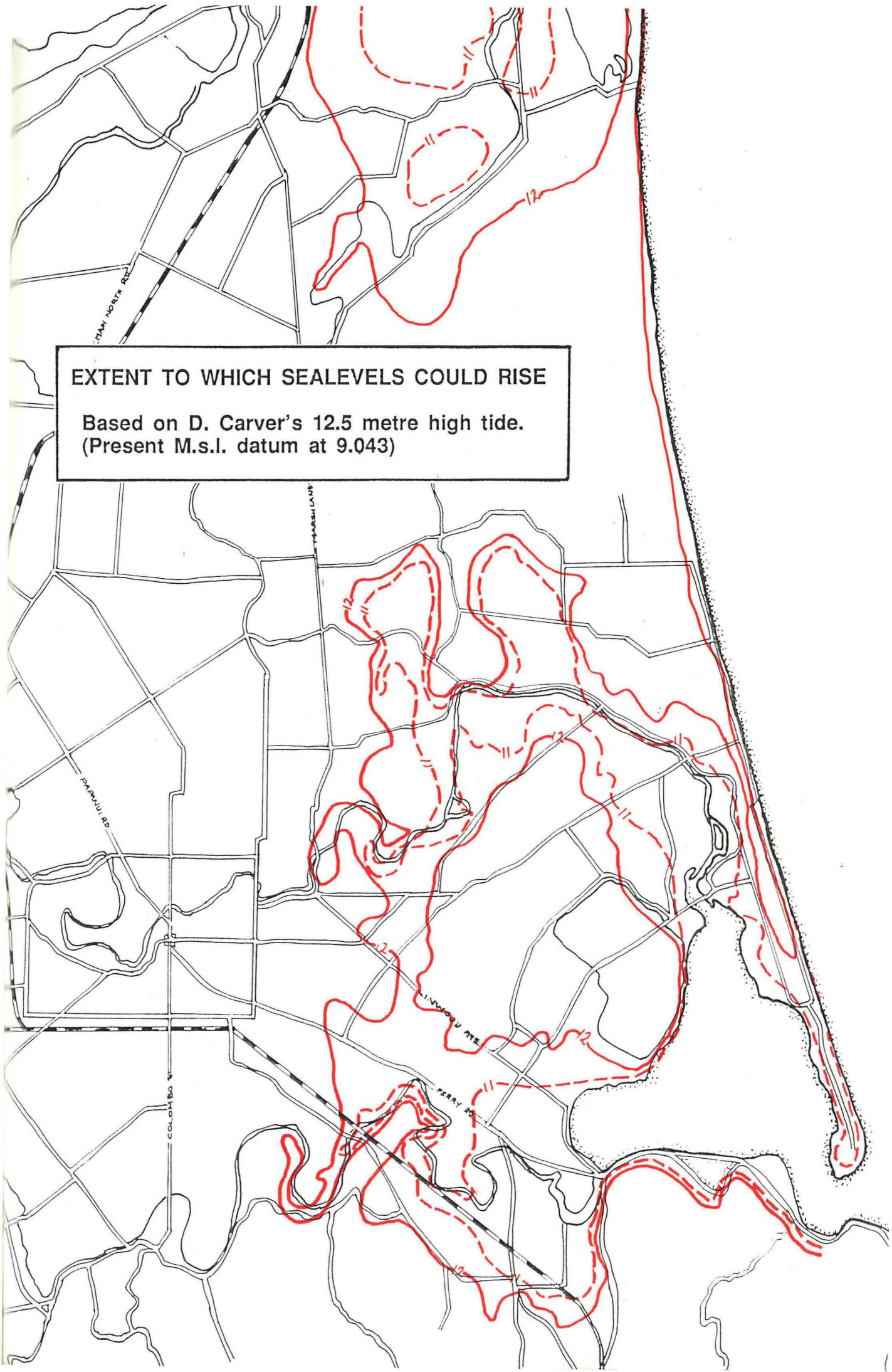
Figure 5.16. Murchison Park, Redwood.

WHAT ABOUT THE SEALEVELS?

As we have noted, the earth has undergone alternating periods of warming and cooling. In more recent historical times (before 1200 AD.) there was a global warm period during which the early polynesians came to New Zealand. After this the climate deteriorated again and between 1550 and 1850, the earth entered a "Little Ice Age". When the settlers arrived, temperatures were rising and climatic conditions were improving. This period of warming peaked in 1940-60 when the average mean temperatures were about 0.5 C warmer than in 1880-90.¹⁴

Since the late 1960's there appears to have been a significant change in weather patterns. This shift has seen a slight global cooling, and more significantly, an increase in seasonal variability, attributed to a weakening of the global atmosphere circulation.¹⁵

EXTENT TO WHICH SEALEVELS COULD RISE
Based on D. Carver's 12.5 metre high tide.
(Present M.s.l. datum at 9.043)



Technically, the earth is still in an ice age, while another glacial period is probably inevitable, there is no evidence that one is imminent. More likely is a return to another 'little ice age' in which global climate reverts to that characteristic of the period between 1550 and 1850.¹⁶

Sun spot studies also indicate a short-term deterioration of weather patterns while the sun adjusts to an eleven year cyclical reversal of its poles.

The above mentioned climatic patterns are natural phenomena and man can do little but adjust. However, in the short term that they have been on the earth, humans have caused major modifications not only to the surface but also to the atmosphere of the earth which can have potentially disastrous effects on the climatic patterns. Industrialization with its increased burning of fossil fuels as well as global deforestation have altered the carbon dioxide content of the atmosphere. This is causing the so-called "greenhouse effect". Most studies indicate that if the present rate of pollution of the atmosphere continues, there will be a doubling of atmospheric carbon dioxide levels between 2025 and 2050.¹⁷

Although "there is no definite observational evidence that increasing atmospheric carbon dioxide levels are having any effect on the present climate"¹⁸, climatologists agree that temperatures will increase by an estimated 2 degrees at the equator and 8 degrees at the poles. This increase is predicted mainly in the lower atmosphere while there will be a cooling in the upper atmosphere. One possible scenario of this global warming is the melting of the ice sheets at the poles which could mean a rise of sealevels. Estimates vary amongst scientist and will also vary from location to location, but these range from half to two metres by the year 2050.¹⁹

So, while there are experts who believe that we are heading towards another "little ice age", which would mean the locking up of water in ice sheets, others predict a period of warmer climatic conditions. Evidence for the latter hypothesis seem to be more convincing, at least to the Christchurch Drainage Board, which has suggested legislating for higher basement levels of new houses built in the areas that might be affected by a rise in sea level.²⁰

It is often stated that the sealevel 'problem' is not one of rising water levels but of man encroaching too near the shore. There is a considerable degree of truth in this, as most of the areas commonly described as being 'at risk' are heavily occupied lowlands, including river deltas, barrier islands and former tidal wetlands.²¹

WHAT DOES THE PREDICTED RISE MEAN FOR CHRISTCHURCH?

The Spit will probably move, sand dunes may become unstable and beach sand levels will change. Aquifers may become contaminated. The estuary will be altered destroying the habitat for birds and aquatic lifeforms. In both the Avon and Heathcote Rivers the influence of tidal movements extend upstream approximately 12 km. Saline water penetration in the Avon reaches the lower end of Kerr's Reach and in the Heathcote normally not above Radley Street.(although the Woolston cut would have extended this further inland.) A rise in sealevel will mean that saline intrusion will move further up the rivers leading to a loss of trees. Minor problems associated with the widescale flooding are; an increase in wave action may damage coastal structures and block coastal stormwater outfalls. There will be increased groundwater levels near the coast, backwater effects in pipelines and drains will lead to wider flooding and there will be gorging in the sanitary sewer systems.

Problems for the residents of Christchurch will be widescale flooding and the extent of this can be seen on the map compiled by D. Carver from the Drainage Board. Because maximum tide level recorded at Ferrymead is 10.88 metres, he has taken 10.5 as a reasonable base to calculate his predictions.

The rise in sealevels will of course, not happen overnight and nature will probably adapt. To retain and maintain the cultural systems will be a costly exercise. Although this future rise is still not proven, chances are that it will happen unless global efforts are made to reduce the carbon dioxide levels in the atmosphere. It is also important that our city and landscape planners make provision for this in future planning.

CONSERVATION AND RESTORATION.

There are few unmodified landforms left in the Christchurch area. There are areas which can still be called 'swamp' or sanddune, but their eco-systems have suffered from human interference. If we were to consider these remnants worthy of preservation and restoration, resources would have to be adequate and dedication to the task ongoing.



Figure 5.17. **Avonhead.**
Natural swale of one of the tributaries of the Avon river.



Figure 5.18. **The Mouth of the Avon.**
One of the few spots where the original vegetation has not been extensively altered.



Figure 5.17. **The Avon River.**
Attempt at re-creating native vegetation.



Figure 5.17. **The University of Canterbury.**
Re-creating river terraces?

Not many people appreciate the particular beauty of a natural wetland or sanddune. Do we preserve these areas for the privileged few, or sacrifice these valued eco-systems for the sake of providing more housing estates?. There is an increasing environmental awareness, and this awareness needs to include an appreciation of our natural heritage. Christchurch was built on a swamp. There are few areas left to remind us of this. Remnant swamps and sanddunes can become living museums. Christchurch was an important area for the Maori for whom the waterways had a special meaning. It was a new home for British settlers who successfully implanted their culture on the landscape. Most of all the area had diverse and

interesting eco-systems. Somehow these¹ must be reconciled if the city wants to reflect a New Zealand identity.

In their proposal, "A Conservation Strategy for Christchurch", Rackham and Roper-Lindsay argue for the idea of an 'urban ecology' and the sustainability of ecosystems within the city. They also identified a continuum of 'natural' landscapes ranging from natural habitats through to artificial nature which "can form a useful framework for description, planning and management".²²

To guide the evolution of this city's natural environment into the next century, there needs to be a partnership and dialogue between the local and regional councils and their works and parks departments, local Government representatives (DOC, Landcorp, MAF, DSIR), the universities, Ngai Tahu people, landscape architects, developers, business people, tourist operators, conservation groups, schools and other community groups or individuals.²³

'Natural Resources,' are no longer only those elements which are considered as useful and necessary for human existence. "Assets which contribute to the non-material well being are also viewed as natural resources".²⁴ These assets are natural and scenic landscapes and recreational amenities. In Christchurch they include the rivers, swamps and sandhills. "After a century of draining and diking wetlands to make building sites and farm fields, the U.S. has changed course, as experts.... seek ways to save, restore, or even recreate the lands that are now seen as a natural resource".²⁵ There are many areas in Christchurch which are considered derelict land. These areas are ideal for the establishment of pockets of native vegetation. These could reflect the original diversity of the Christchurch lowland.

This dissertation has attempted to shed some light on the natural formation and human transformation of the Christchurch lowland landforms. It is important that we identify and conserve the remnants, as these form part of our natural and cultural heritage.

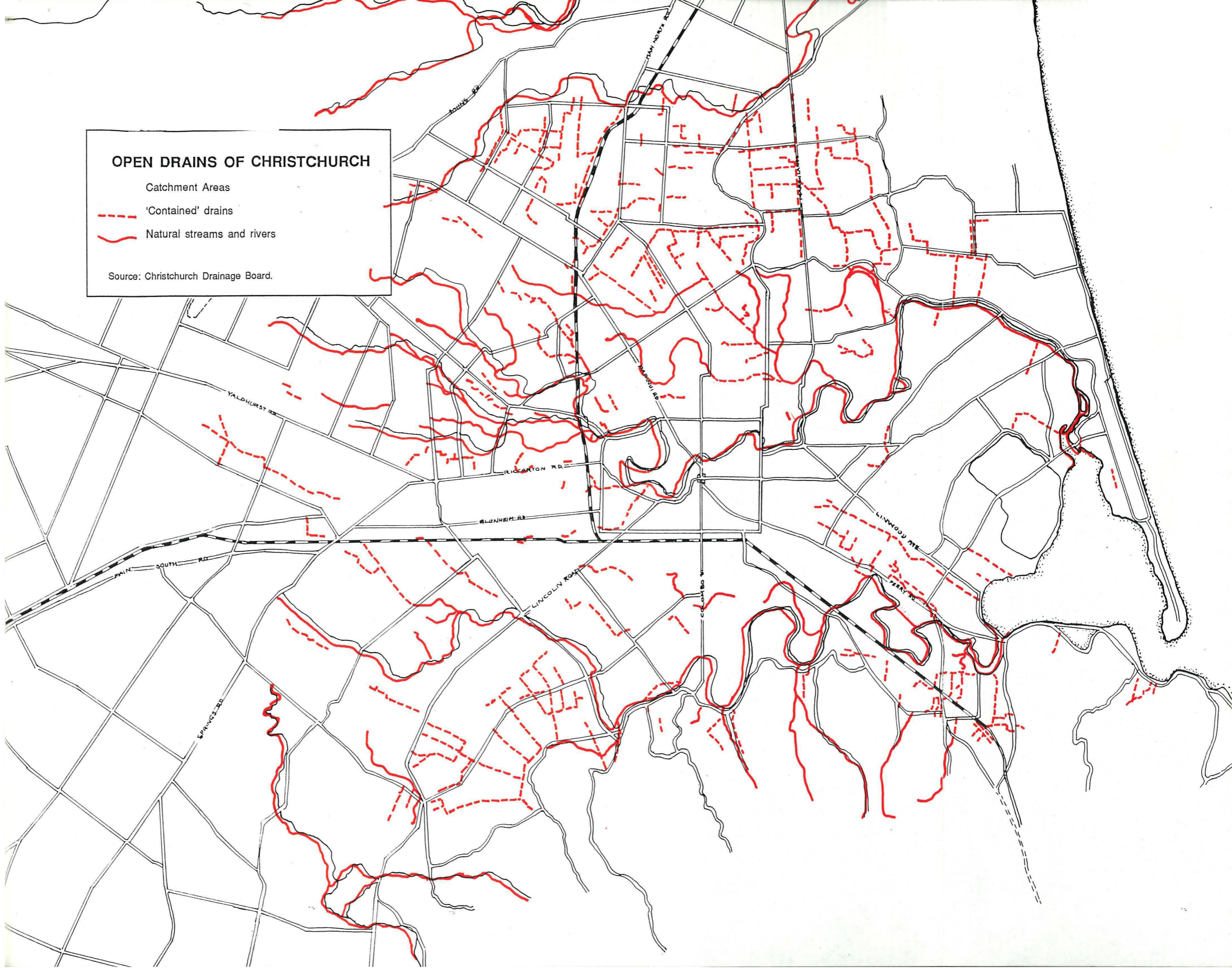
OPEN DRAINS OF CHRISTCHURCH

Catchment Areas

--- 'Contained' drains

— Natural streams and rivers

Source: Christchurch Drainage Board.



- 1.Scott, p.1.
- 2.Carter, R, (Harcourts Real Estate) Personal conversation.
- 3.Christchurch City Council, Open space, p.52.
- 4.Molloy, 1971. p.30.
- 5.Petrie, p.4.
- 6.Ibid., p.34.
- 7.Ibid., p.35.
- 8.Ibid., p.28.
- 9.Christchurch City Council, Horseshoe Lake, p.18.
- 10.The Press, August, 10, 1989.
- 11.Ibid.
- 12.Meurk, 1988, Travis Swamp Revisited.
- 13.Greenup, A. Personal Conversation.
- 14.Stevens, New Zealand Adrift, p.330-334.
- 15.Preddey, p.15.
- 16.Ibid., p.67.
- 17.Ibid., p.21.
- 18.Ibid., p.19.
- 19.Carter, p.66.
- 20.Carver, D., Personal Conversation.
- 21.Carter, p.65-66.
- 22.Rackham and Roper-Lyndsay, Seminar Paper, September, 1989.
- 23.Meurk and Norton, 1988.
- 24.Kirby, V., Lecture notes.
- 25.Planning, February, 1989. p.4.

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