2 Water

An Important Natural Resource

2.1 Evolution of the Surface Water Environment

Movement of the braided Waimakariri River has been the dominant force to shape the Christchurch area and the surrounding Canterbury Plains (Figure 2-1). From its early position near present-day Kaiapoi, the river weaved across the plains, once reaching as far south as Lake Ellesmere/Te Waihora. The river's interaction with the coastline and the volcanic rock of the Port Hills formed a landscape of large freshwater and saltwater wetlands, small meandering waterways, sand dunes, and old gravel beds. Drainage courses down the slopes of the Port Hills once cut through forest, and later (after fires) through tussock-covered loess slopes.

In the subtle interplay between contours, groundwater levels, and soil types, carex swamps occupied the lowest, wettest areas, while slightly higher regions vast expanses of flax and toe toe or mixed grass and flax communities. Tidal parts of rivers and the edges of estuaries supported extensive salt and river marshes.

A multitude of bird, fish, and invertebrate species thrived in the waterway and wetland habitats of Christchurch.

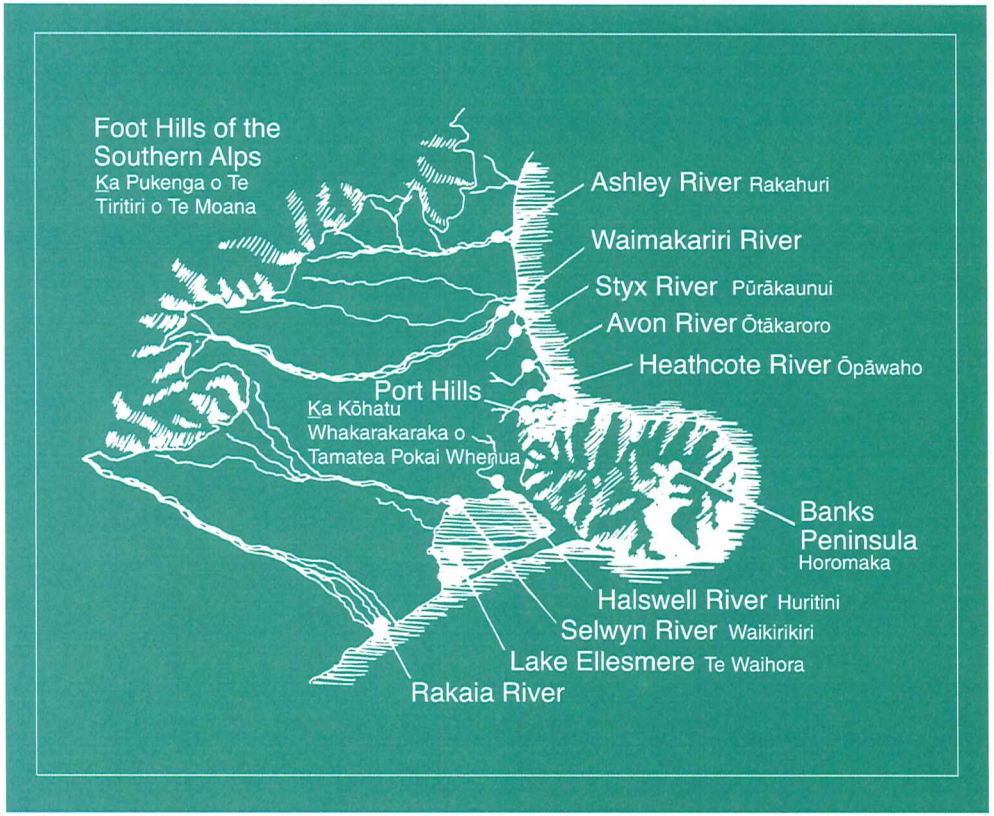
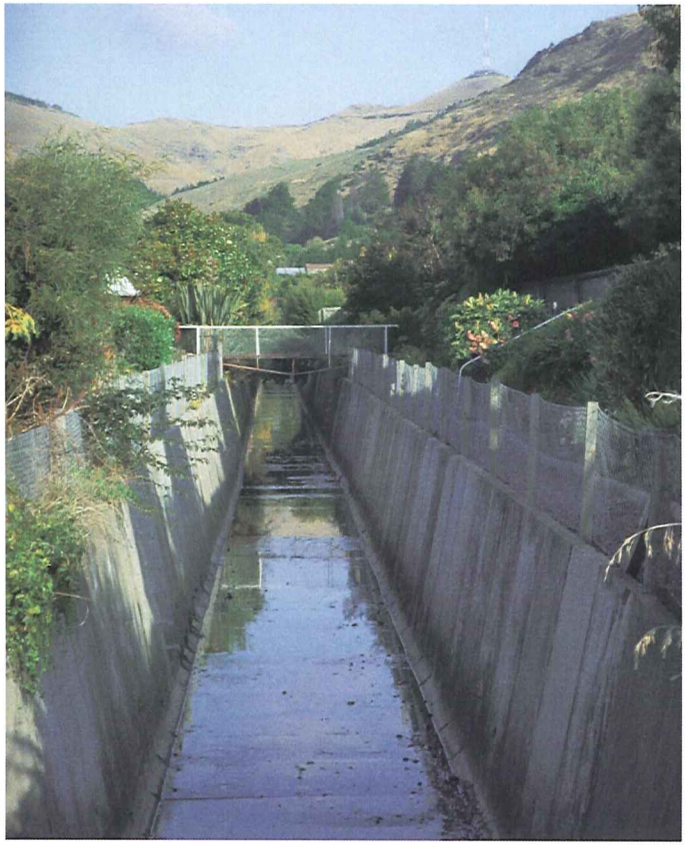


Figure 2-1: Rivers of the Canterbury Plains

The Waimakariri River - from the mountains to the sea

The three waves of Māori inhabitants used and allocated portions of waterways for rituals, travel, and food. Later, European settlers sought greater control of natural drainage patterns to develop the land and improve living conditions. To achieve hydraulic efficiency, they drained wetlands and filled low-lying land. Waterways were piped or turned into channels, often with steepened banks to hasten water flow and to maximise land use for development.

Sibleys Drain
A natural waterway encased in concrete



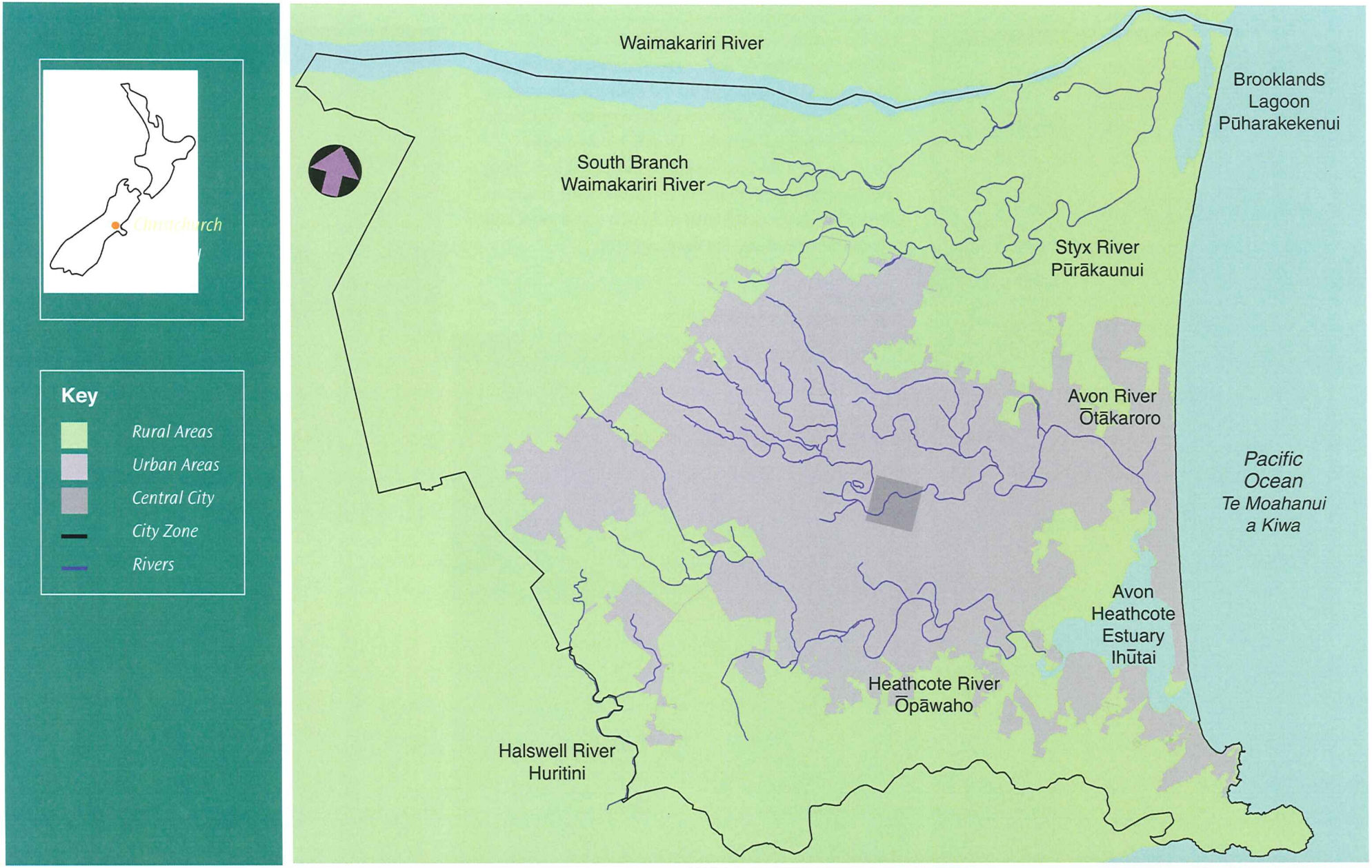


Figure 2-2: Major waterways within the Christchurch District

2.2 Waterways Today

Natural waterways in the Christchurch area reflect the former paths of the Waimakariri River, which today forms the northern boundary of Christchurch City/Ōtautahi (Figure 2-2). The south branch of the Waimakariri River and the Styx River/Pūrākaunui flow north into the Waimakariri River, while the Avon/Ōtākaroro and Heathcote/Ōpāwaho Rivers flow east into the Avon-Heathcote Estuary (Te Ihūtai). All these waterways carry spring flows derived from aquifers fed by rainfall and by the Waimakariri River. In the waterways' middle and lower reaches, base flow is augmented by groundwater inflows near the surface. Coastal tides cause significant water level changes in the lower reaches and in coastal wetlands.

Port Hills waterways from Hoon Hay Valley to the coast eventually flow into the Heathcote River. Port Hills waterways south of Hoon Hay Valley to McQueens Valley flow into the Halswell River/ Huritini and then into Lake Ellesmere/Te Waihora.

The waterways of Christchurch range from rivers several metres wide to narrow tributaries with intermittent flow. A range of waterway types is illustrated in Table 2-1.

Water-races also form part of the waterway network, and provide aquatic and riparian habitat. For the last 100 years, these open channels have carried stock water along property boundaries and roads to the drier parts of the Canterbury Plains. Twenty per cent of the Paparua stock water-race is located within Christchurch City boundaries. Water for the race is abstracted from the Waimakariri River. Sediment from river water is settled in ponds before distribution to four main water-races.

Waterway Classification

Category	Length (km)
Utility Waterways	153
Hillside Waterways	16
Environmental Asset Waterways	125
Rivers (Upstream)	38
Rivers (Downstream)	52

Numerals indicate the length of each type of waterway in the Christchurch area (1998)

Waterway classification is outlined in further detail in Part B.

Table 2-1: Waterway Classification, Christchurch City Plan.

2.3 Wetlands, Basins and Ponds

Wetlands is a collective term for "permanently or intermittently wet land, shallow water and land water margins. Wetlands may be fresh, brackish or saline, and are characterised in their natural state by plants and animals that are adapted to living in wet conditions" (Buxton, R.B, 1991). Wetlands may be natural or constructed.

Once a dominant feature of the Christchurch landscape, wetlands have been extensively modified by urbanisation. Today, examples of earlier wetland landscapes are limited to a few sites in and around the city, such as:

- Travis Wetland (freshwater)
- Riccarton Bush (swamp forest)
- Brooklands Lagoon (estuarine).

A pond is defined as a pool of still water, natural or constructed. Some examples are:

- Horseshoe Lake, formed by natural movement of the Avon/Ōtākaroro River.
- Ponds in the Christchurch Botanic Gardens and in Janet Stewart Reserve, constructed for their aesthetic and wildlife values.
- A former shingle quarry in Westlake Reserve, now an enhanced landscape feature. This pond reveals the underlying nature of groundwater and its seasonal fluctuations.
- Bromley Oxidation Ponds, which treat effluent from the waste water treatment plant prior to discharge into the Avon-Heathcote estuary (Te Ihūtai). They are also an important wildlife habitat.

A **basin** is defined as a natural or artificial depression that stores water temporarily. It can be designed to be totally dry between rainfall events, or to retain a permanent wetted area. Some examples are:

- Wigram Retention Basin, built to alleviate flooding and to improve the quality of waters entering the Heathcote River. This area also has a wet pond (i.e. permanently wet land).
- Wrights Road Retention Basin, which forms part of a community park and is dry except when rainfall is very high.
- Natural retention basins, where ponding occurs on natural floodplains after storms. These basins are ephemeral. Examples include rural land in the vicinity of Hendersons Road, Cashmere Valley, and land adjacent to the Styx River/Pūrākaunui, near Brooklands.

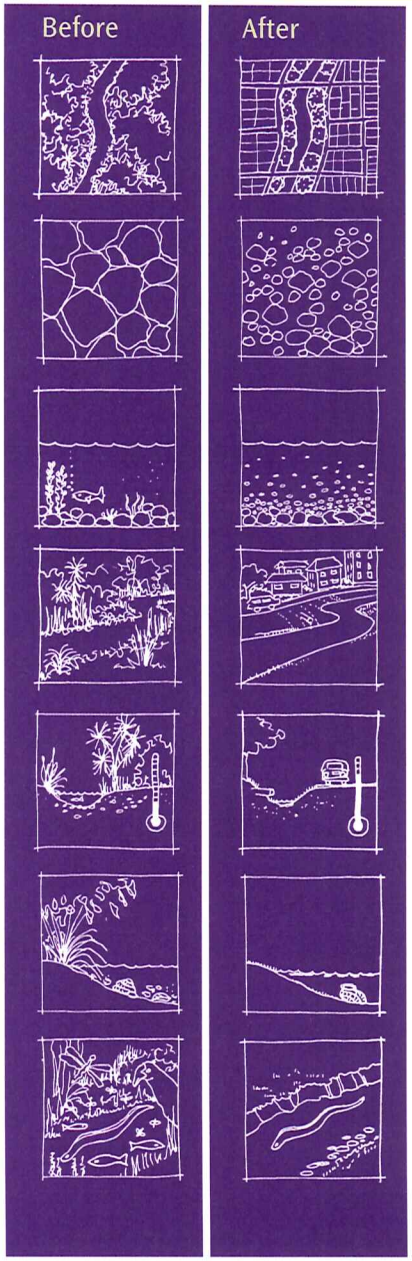
Refer to Part B for more information on design of wetlands, ponds, and basins.

Saltmarsh at Pleasant Point, Avon-Heathcote Estuary / Ihūtai

Figure 2-3: The Black Map

A compilation of the Black Maps (1856) and sites of significance to Māori is a useful restoration and landscape resource, giving a good indication of vegetation associations in Christchurch prior to drainage works. Cross-hatched areas represent sites of significance to the Waitaha people, while numbered sites are sites of significance to the Ngāi Tahū people.

Table 2-2: Urbanisation Impacts on Aquatic Ecosystems



Loss Of Wetland & Riparian Buffers

A stream ecosystem is dependent on its extensive freshwater wetlands, floodplains, riparian buffers, seeps, springs, and flood channels. These can be lost during urbanisation.

Changes In Substrate Quality

An urban stream can receive a massive pulse of sediment that has eroded from construction sites in the catchment. As a result, the substate can change from a mixture of coarser-grained particles to a mixture of fine and coarse particles.

Loss Of Habitat Diversity

Channelisation of streams can occur in urban areas. This includes the straightening and realigning of a natural channel, sometimes with the addition of reinforced streambeds and banks. The resulting habitat offers little diversity or complexity.

Increased Pollution Levels

Pollutant levels in urban streams are often one to two orders of magnitude greater than in a non-developed catchment. This is a result of increased hard surfaces and stormwater systems that transport contaminated stormwater directly to streams.

Increased Hard Surfaces

Hard (impervious) surfaces and accompanying stormwater systems can contribute to lower base flows, faster runoff of stormwater flows, and increased water temperatures. Intensive urbanisation can raise stream water temperatures by 5-10° C, due to a combination of loss of shading (from riparian vegetation removal), lower water levels and addition of warm stormwater (heated during residence time on hard surfaces).

Shift In Energy Source

In a natural headwater stream, the aquatic community is driven by an energy source made up of decomposing vegetation, woody debris, and falling insects. This type of ecosystem is lost through urbanisation. In urban streams, reduced tree canopies combined with nutrient accumulation result in an increase in primary producers (aquatic plants and algae).

Reduction In Biological Diversity

Urban streams in intensively developed areas support only a fraction of the fish and aquatic invertebrates that exist in an undeveloped watershed. The reduced diversity is caused by the above factors as well as barriers to fish access, predation, and disturbance.

Refer to Part B for more information.

Adapted from Auckland Regional Council "Stormwater Treatment Devices: Design Guideline Manual", Publication #10, 1992

2.4 Ecology

Although the natural landscape has been heavily modified and degraded in Christchurch, many wildlife species continue to inhabit the area. Their survival is due partly to the variety of habitats provided by an extensive network of waterways and wetlands. Birds and plants are the most visible species, but fish and invertebrates are also major components of these ecosystems.

Plants

Planting to achieve ecological goals means understanding an ecosystem and its function (for example, whether freshwater or saltwater wetlands, ephemeral or permanent water) and the requirements of species that inhabit the ecosystem. Using native plants creates habitat for native birds and invertebrates, thus helping to restore and sustain the city's unique biodiversity. Overhanging vegetation shades waterway and wetland margins and supplies food, shelter, and breeding sites for birds, fish, and invertebrates. Tall trees provide roosting and nesting sites for birds.

Birds

The city's waterways and wetlands are known internationally for the range and number of bird species they support. Of the 106 species recorded in the Christchurch area since 1980, 76 make use of waterways, wetlands, and coastal habitats.

Coastal species form the vast majority of these birds. Regular inhabitants of Christchurch include more than one per cent of the world's population of New Zealand Shoveler, New Zealand Scaup (a diving duck endemic to New Zealand), South Island Oystercatcher, Variable Oystercatcher, Eastern Bar-tailed Godwit, Red-billed Gull, and White Fronted Tern. Usually these birds are found on the Avon-Heathcote Estuary/Te Ihūtai or on Brooklands Lagoon (Pūharakekenui). However, approximately 20 per cent (1999) of the world's population of New Zealand Scaup are dispersed along 24 waterways in the city.

Little Cormorant (Phalacrocorax melanoleucos) at Janet Stewart Reserve

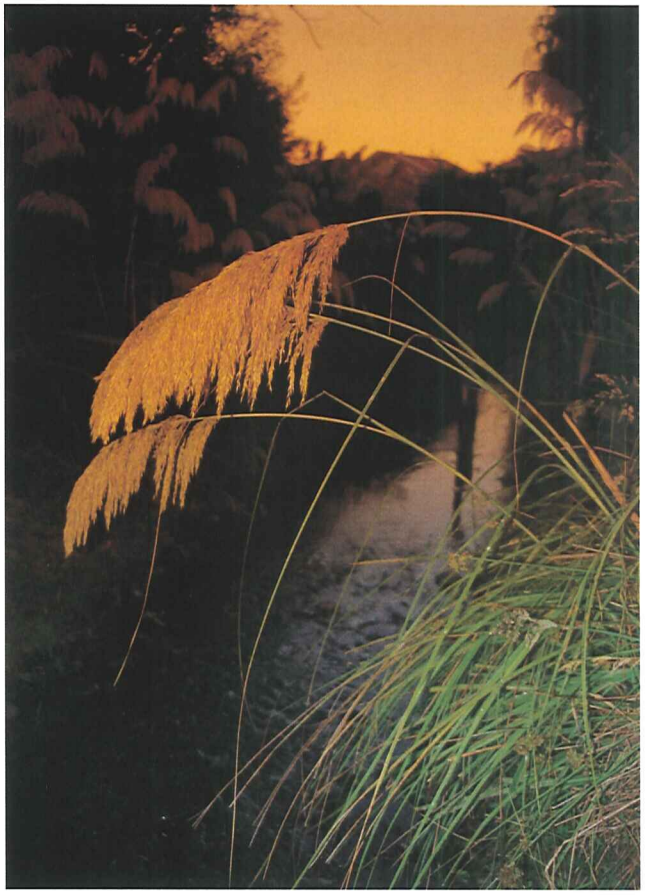
Top: Hound's tongue fern (Phymatosorus pustulatus)
Bottom: Lake clubrush (Schoenoplectus validus)

Fish

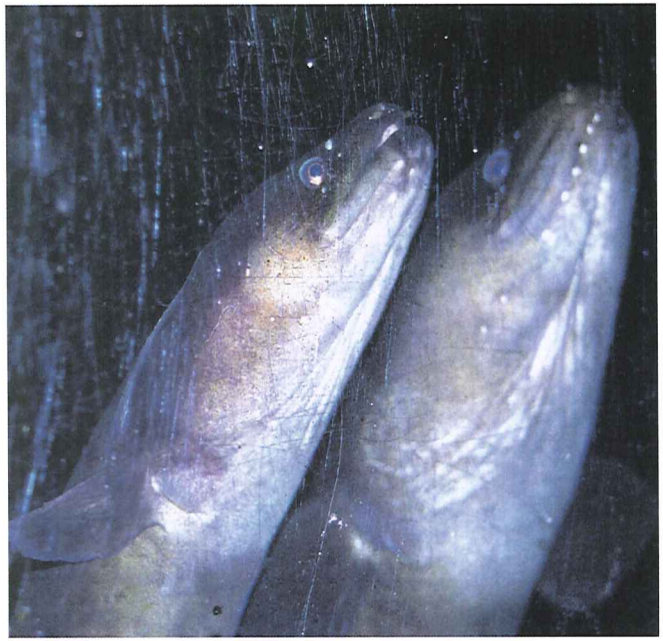
Six of the 10 native freshwater fish species found in the Christchurch area are considered common. The shortfinned eel is the most common because it has low requirements for instream cover, is more tolerant of indifferent water quality, and when a juvenile can navigate past obstacles that block the passage of other fish. The longfinned eel needs logs and vegetation for shelter, and is less common in seriously degraded habitats.

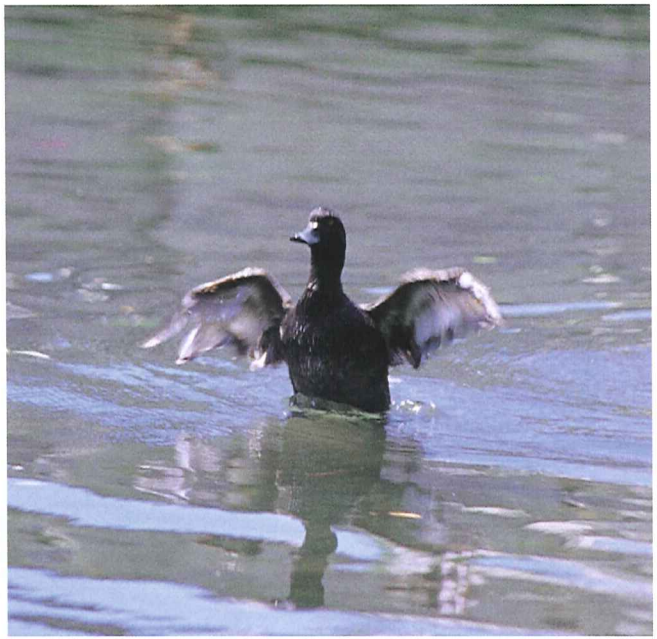
Inanga, or adult whitebait, are found in slow-flowing parts of the city's rivers and in Travis Wetland. Three bully species are also widespread; the giant bully inhabits the lower reaches of waterways, while common and upland bullies occur in rivers, streams, and drains throughout the city.

The Heathcote/Ōpāwaho and Avon/Ōtākaro Rivers have surprisingly good recreational small trout fisheries in their middle and lower reaches, given that they drain a largely urban catchment. This is due to reasonably good food and water quality, steady flows, improved riparian management, and the dispersed nature of sufficient spawning habitat (clean gravels) in the middle and upper reaches.



Top right: Paradise Shelduck (Tadorna variegata)
Bottom right: Toetoe (Cortaderia richardii)





Invertebrates

A range of terrestrial and aquatic invertebrates occur throughout Christchurch, although comparatively little is known about how well they are thriving. Invertebrates form a substantial portion of the diet of many birds and fish, and are therefore an important component of the food chain.

The health of aquatic invertebrates is closely linked to the state of the instream environment, the nearby terrestrial (riparian) habitat and the wider surrounding catchment. They are therefore useful as indicators of stream ecological health. Streams running though the greatly modified urban environment have been heavily impacted on, and consequently aquatic invertebrate communities are not as diverse within Christchurch as they once were.

Stream surveys have been conducted throughout the city using aquatic invertebrates to help assess instream ecological values and restoration success.
The results identify restoration measures that effectively improve instream ecological values.
Contact the Parks and Waterways Unit for more information on this collaborative work with NIWA.

Top: Red damselfly (Xanthocnemis zealandicus)
Bottom left: Longfin eel (Anguilla dieffenbachii)
Bottom right: Scaup (Aythya novaseelandiae)

2.5 Landscape

Water is an important landscape feature in the Christchurch environment, owing to the city's location beside the coast and the visual prominence of the lower stretches of several rivers Avon/Ōtākaroro, Heathcote/Ōpāwaho, and Styx/Pūrākaunui, as well as the Avon-Heathcote Estuary (Te Ihūtai) and Brooklands Lagoon (Pūharakekenui). Smaller tributary waterways are not as readily visible to the public, since they are located mainly within private properties.

Water is valued for its life-supporting capacity and for its own special qualities, which include:

- the changing nature of water (eg falling rain, pools, evaporation)
- the sounds of moving water
- ripples and turbulence
- reflections from water bodies and wet surfaces
- the cooling nature of water
- water's cleansing and freshening effects on the landscape and the life within it.

A waterway or wetland adds a sense of identity and character, whether viewed in a small or large context. For example, the Avon River/Ōtākaroro is perceived as an icon of Christchurch, its images printed on numerous postcards and calendars. On a more modest scale, a waterway or wetland may form a feature in a neighbourhood, or even within a single site.

Unfortunately, many city waterways are considered nuisances and managed in consequence as utilities. These waterways are usually channelised with no base flow, or are hidden from view by piping or fences. With a little imagination, however, these waterways too can become features in the Christchurch landscape.

City form	
	• the meandering shapes of waterways contrast with the grid-like patterns of city streets
	• waterways provide visual and functional boundaries to neighbourhoods
	• waterways provide links between city neighbourhoods
	• landforms associated with waterways and wetlands provide visual relief on an otherwise flat plains landscape.

Table 2-3: Waterways are an important component of city form

Residential development occurring either side of the Styx River Green Corridor, upstream of Main North Road

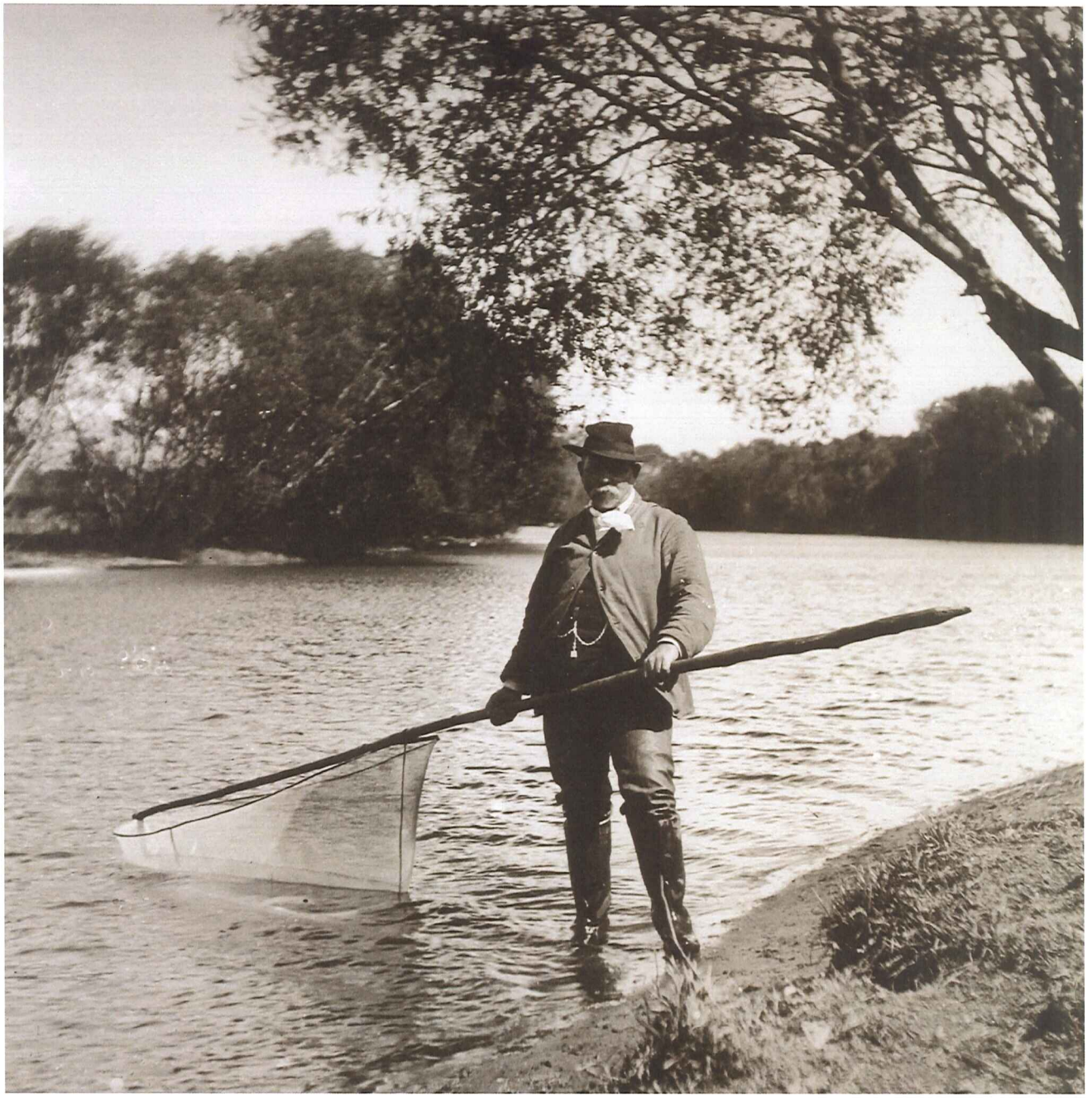
2.6 Recreation

Recreational activities associated with waterways and wetlands offer a special experience of nature. Activities include boating, walking, wildlife watching, fishing and water play.

The linear nature of waterways also provides opportunities for the development of walkways and cycleways within a pleasant environment, away from the noise, hustle, and bustle of roads.

Public access to and along rivers, streams and wetlands is identified as a matter of national importance in the Resource Management Act (1991). The full potential of landscape, social/cultural, recreational and heritage values are likely to be achieved only if public access is available.

At times, however, public access may need to be restricted to protect wildlife habitat and other ecological values.



White baiting in style, Avon River
W.A. Taylor, Canterbury Museum
Ref: 1/4 Plate, box 60/61 (date unknown)

Punting, paddling and peddling

2.7 Heritage

Heritage values are diverse and include natural features and built structures, as well as particular activities or values associated with a site. Some sites may have special character or significance based on their cultural, architectural, or ecological features. The significance of others may depend more on their amenity value or visual appeal.

Heritage adds to Christchurch's distinctive identity. Heritage values associated with waterways and wetlands include:

- brick and stone work associated with old bridges and culverts
- ferry wharves and warehouses, eg along the lower Heathcote River/Ōpāwaho
- landforms associated with earlier movement of the Waimakariri River
- significant natural heritage sites, eg Riccarton Bush
- earlier uses, eg access to water for horses and boating
- Māori canoe portage sites, eg at Owaka Road, Halswell, and at Victoria Square (known as Ūrunga Ū, a gathering place for waka (canoes) carrying goods for trade)
- mahika kai (food-gathering) sites
- Pā sites located along the waterways and estuarine areas.

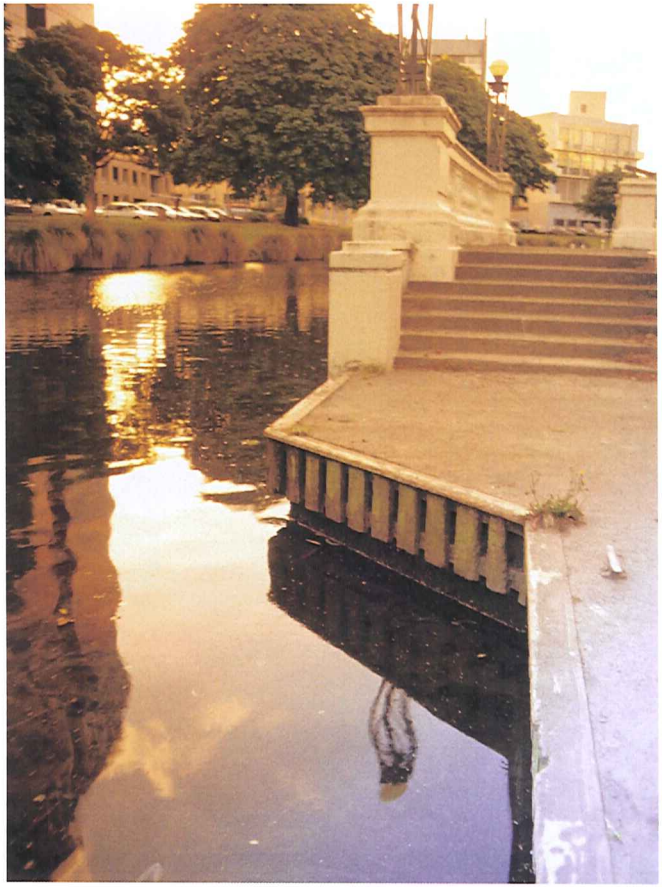
Avon River, New Brighton 1930
W.A. Taylor, Canterbury Museum
Ref: 13696

Bank Rotunda, Avon River, Cambridge Terrace

Prominent baking powder businessman and brass band enthusiast T J Edmonds donated the money to build this octagonal band rotunda, opened in 1929 and built of reinforced concrete and stucco plaster finish.

Edmonds' gift included not only the rotunda (designed in High Renaissance style by Christchurch-born architect Victor Hean) but also the circular seat, lighting standards along the river, the curved balustrade wall along the riverbank, the steps down to the landing at the river's edge, and seats for the reserve.

After years of disuse, in 1986 the rotunda was transformed into a restaurant.



2.8 Culture

2.8.1 A Maori Perspective

The Resource Management Act (1991) and the Treaty of Waitangi require that due consideration be given to issues of importance to tākata whenua. Waterways and wetlands are regarded as tāoka (treasures) and are therefore accorded high value in Māori society.

Natural Systems

Mythologically, water was central to creation of the world. Life began beneath the sea, from which the land surfaced and life forms were placed upon the earth.

In geological terms, water is seen as the substance of the veins of the earth (Papatuanuku), which carry the vital forces to replenish life. Whakapapa (genealogy, the relationships between different components of a system) describes the various forms of water in the context of creation. For example, Parawhenuamea (constantly replenishing) describes the elemental nature, water, who with the sea (Kiwa) formed all terrestrial forms of water on earth. The formation of rocks, gravels, and sand by hydrological processes was recorded in the whakapapa.

The structuring of thought through whakapapa by the keepers of knowledge imparted information about geological and atmospheric systems. Often the mythic and poetic dimensions of the knowledge were over-emphasised by early observers and writers, so that the underlying scientific systems that explained the conceptual origin of the universe were misinterpreted, lost, or re-invented.

Rapaki Rock, Port Hills, Christchurch - a gathering place for tohuka tapu

Māori Eel Weir, South Brighton
W.A. Taylor, Canterbury Museum Ref: X753 (date unknown)

Knowledge Transmission

Sections of waterways were (and still are) allocated to groups and individuals, who observed their patterns and characteristics. Guardians protected and managed the mauri (life force) of waterways. A waterway was treated as a garden, with an emphasis upon cleanliness. Rivers, mountains, and other landmarks defined 'home'. These relationships with the land and water were (and continue to be) shaped by migration, settlement, food gathering, and knowledge systems.

Mixing of Waters

Every water body is considered to have identifiable characteristics that determine its appropriate uses. The nation of Te Rapuwai is reputed to have initially classified the water systems in the South Island as follows: Waitohi, for institutional baptism; Waimataitai, for farming of shellfish; and Waiora, for healing (Tau, et al, 1990). Further classifications have since been made.

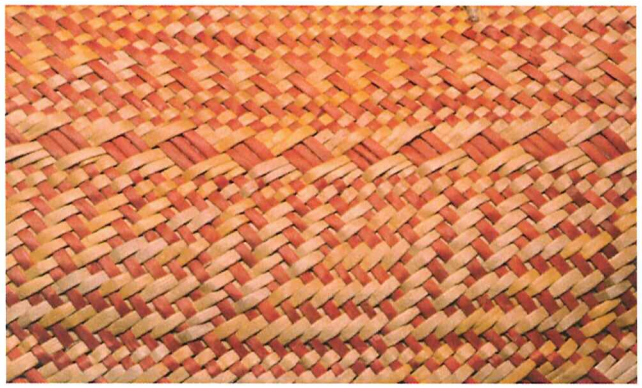
The different uses intended for different waters mean that mixing waters of incompatible character can be unacceptable. It could be argued, of course, that water has been mixed beyond any level of distinction to worry about mixing waterways and water types. Nevertheless, it is consistent with the restoration theme of this Guide to reconsider the effects of mixing waters: surface water and groundwater; coastal and river water; industrial and waste water; and drinking and washing water.

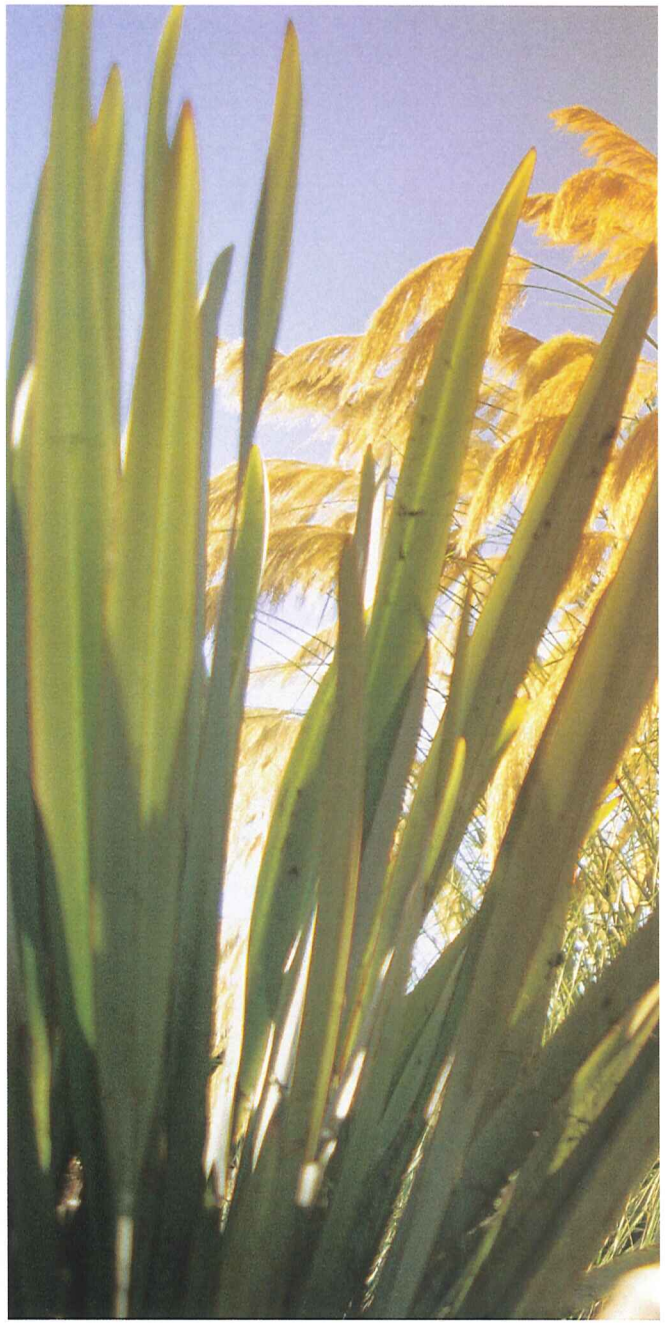
Interpreting Water

Water is interpreted in both sacred and practical terms. Spiritually, water was used as an agent for the removal of tapu (sacredness) and in other ceremonial rites. Specific practices and restrictions originated with priests (tohuka) and were enforced by leaders.

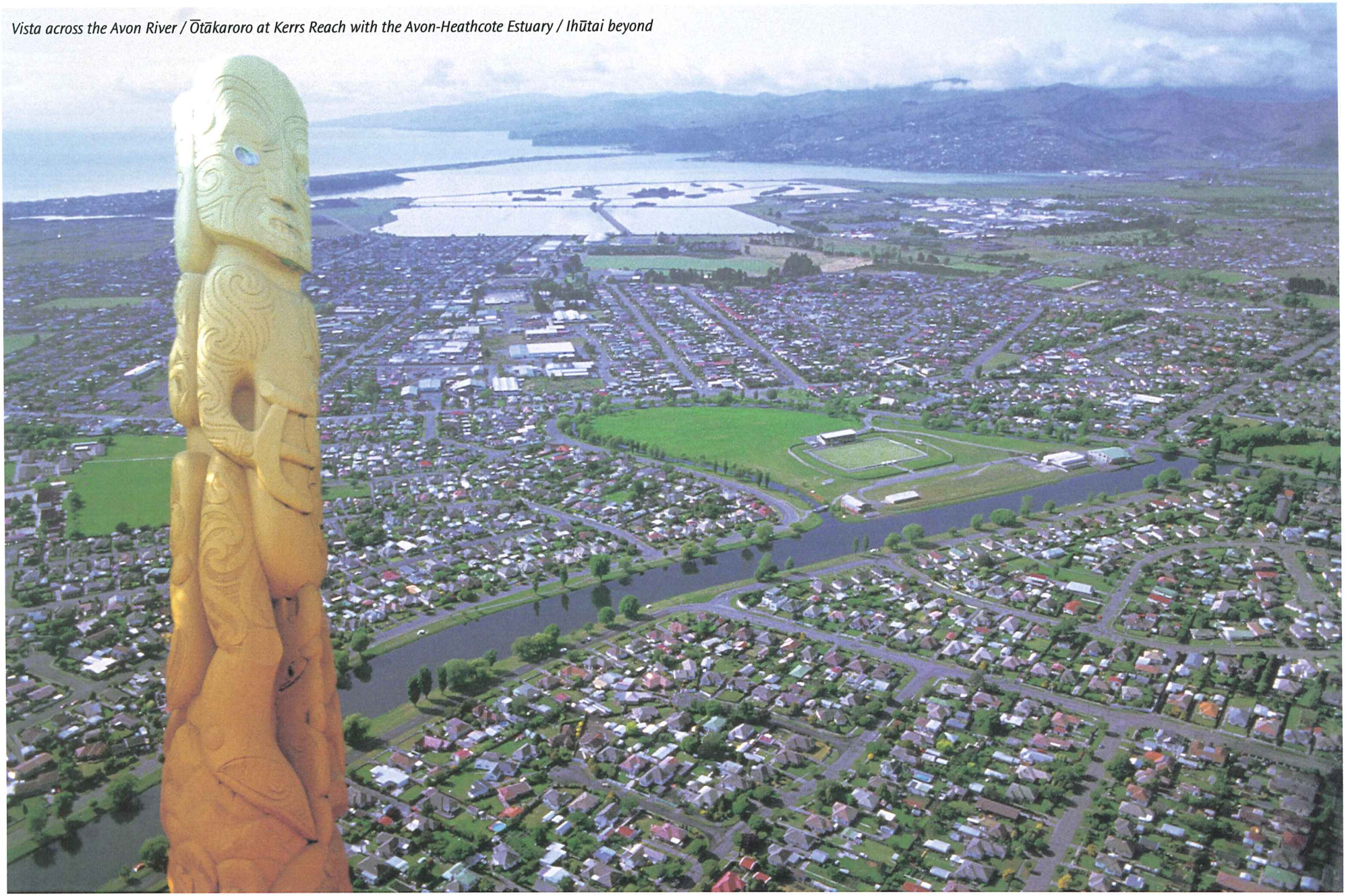
Protection of sacred sites and waters, a 'sense of place', and the importance of mahika kai have all shaped the use of waterways and wetlands. It follows that quality of water is of high value to Māori. Urbanisation has invariably degraded water and habitat quality. Policies to improve water quality of waterways and wetlands in Christchurch are therefore of critical importance to Māori resource managers.

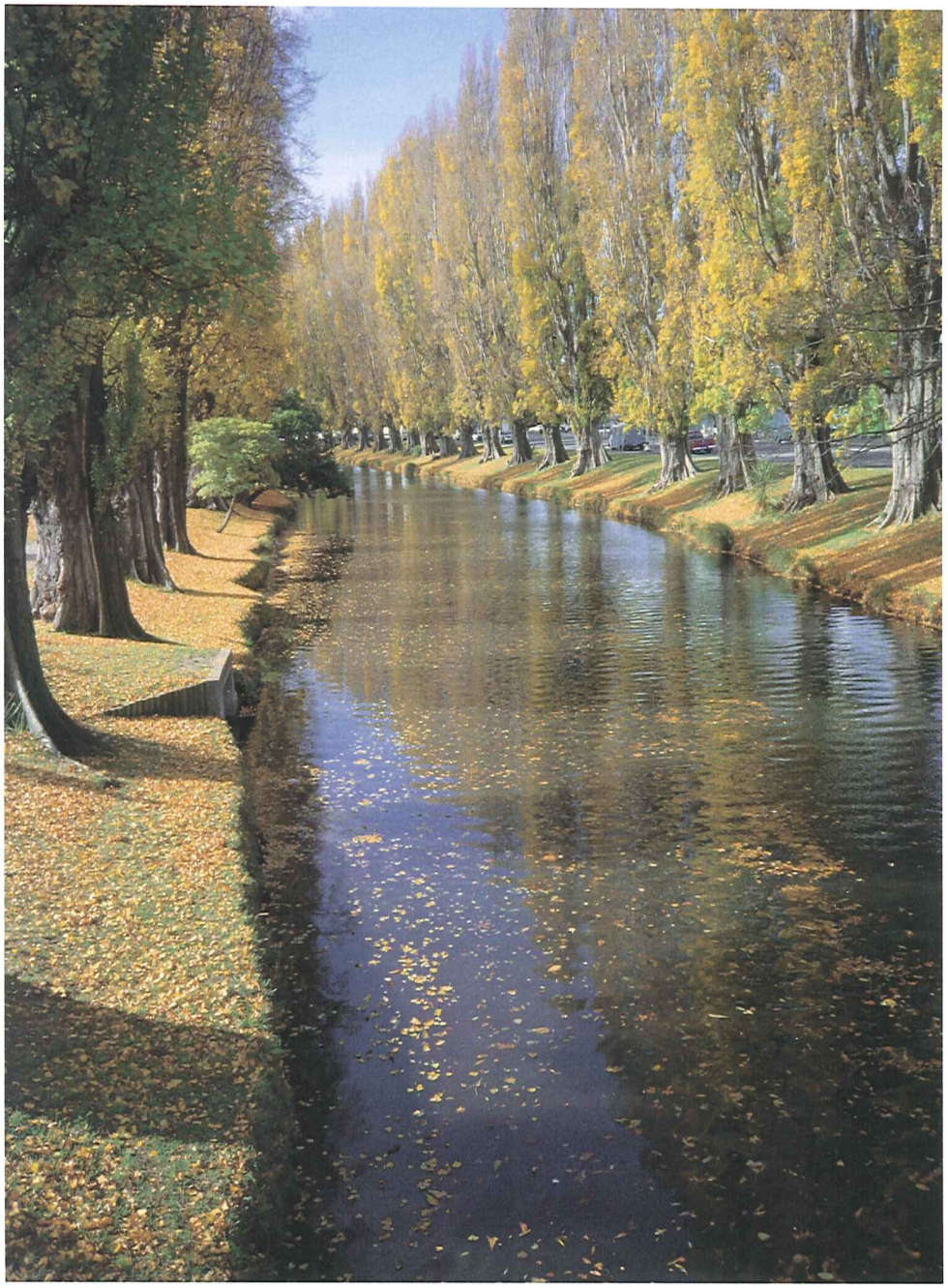
Weaving by Master Weaver Cath Brown





Vista across the Avon River / Ōtākaroro at Kerrs Reach with the Avon-Heathcote Estuary / Ihūtai beyond





2.8.2 Other Cultures

Māori and European inhabitants have placed contrasting values upon water. European settlers drained wetlands, turning them into ploughed fields to allow "a better life, in terms of simple materialism, more comfort and money....To the settler, land was money; but to the Māori it was life itself and more" (Sinclair, 1969). The path to reconciliation has been provided by the Resource Management Act's philosophy of sustainable management, which gives due recognition to the Treaty of Waitangi.

Poplar-lined Avon River / Ōtākaroro from Manchester Street bridge

2.9 Drainage

Natural drainage involves the movement of water across the surface of the ground, soakage into the ground, and flow through soils and gravels beneath the ground's surface. Movement ranges from hillside waterfalls in heavy rain to areas where groundwater (water table) movements associated with seasonal changes set the flow.

The quantity of water flowing through a landscape creates different landforms. Wide floodplains reflect the large quantities of runoff associated with sporadic storms and spring melts. A much smaller, meandering channel within a floodplain is the result of spring flows and wetland discharges in the upper reaches.

The fluctuating nature of surface and groundwater levels provides for a much greater range of habitats than would otherwise be available. Within these riparian margins and wetland areas, wildlife values and biodiversity are often greatest. The aim is to maximise opportunities to restore ecosystems within the necessary limits of sound urban stormwater management.

Natural processes are dynamic. It is vital to retain sufficient land adjacent to waterways to allow natural drainage processes to occur, while maintaining the system's capacity to drain surface water from the catchment. Drainage systems must remain reliable; every effort should be made to identify and protect floodplains, overflow channels or secondary flow paths, and natural retention basins.

Ponding in Hoon Hay Valley following the August 1992 snow storm