HURITINI / HALSWELL RIVER CATCHMENT

TAUĀKĪ WAI PĀTAUA / VISION AND VALUES

Date: 18 July 2016

CHRISTCHURCH
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HURITINI / HALSWELL RIVER CATCHMENT

TAUĀKĪ WAI PĀTAUA / VISION AND VALUES

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PART 2 SUMMARY OF TECHNICAL REPORTS TO INFORM STORMWATER MANAGEMENT/ PŪRONGA HANGARAU

Executive Summary / Whakarāpopototanga

The Huritini / Halswell River catchment covers an area of approximately 190 km^2. The river originates from scattered spring-fed sources around the southwest and suburban fringes of Halswell, Templeton and Prebbleton that flow into Knights Stream, Te Tauawa a Maka / Nottingham Stream, and some rural drains. These tributaries then combine to form the Huritini / Halswell River which meanders south past Lansdowne Valley and flows into Te Waihora / Lake Ellesmere. The catchment falls within the boundaries of both Christchurch City Council (Council) and Selwyn District Council. Only a small percentage (15%) of the total catchment area sits within the Christchurch City boundary. The catchment is largely urbanised within Christchurch City with rural land beyond the suburb of Halswell.

The catchment has traditionally been a significant source of mahinga kai, and a focus of natural, cultural and heritage values since earliest settlement over 600 years ago. Ongoing development and extensive settlement within the catchment over the last two centuries, combined with the more recent earthquakes of 2010/2011, have seen a degradation of catchment values including, reduced water quality due to pollution and siltation, reduced hydraulic capacity, loss of terrestrial vegetative cover and decreased in-stream habitat for fish and invertebrates.

For over 20 years the Council has focussed on a multi-value approach to the management of its waterways. By identifying six core values – ecology, drainage, culture, heritage, landscape and recreation – as the drivers for improved surface water management, the Council has shown a proven ability to translate legislative requirements and community aspirations into tangible reflections of a more sustainable approach to asset management.

This document focuses on the headwaters of the Huritini / Halswell River catchment within the Christchurch City jurisdiction.

Vision:

The surface water resources of Christchurch support the social, cultural, economic and environmental well-being of residents, and are managed wisely for future generations.

Toitū te marae a Tangaroa, Toitū te marae a Tāne, Toitū te iwi

This Surface Water Plan communicates how this vision is being realised and planned for the Huritini / Halswell River catchment.

Part One of the Plan outlines:

- Current status of the Huritini / Halswell River catchment relative to the Council's six values approach to waterway asset management.
- Surface water management - vision and approaches. Eight approaches, with exemplars, to demonstrate how future protection, enhancement and management of our waterways and surface water can achieve high level outcomes across all six values are identified.

Part Two of this document summarises a number of key technical documents that have been used to inform the development of stormwater management approaches, they detail the necessary infrastructure required for improving water quality and quantity discharges into the river.

Te Waihora / Lake Ellesmere the receiving waters for the Huritini / Halswell River.

Matuku-moana / White-Faced Heron

PART 1 REALISING THE VISION / Te Pae Tawhiti

Introduction / Kupu Whakataki

Purpose of this document

- To identify and summarise the current status of, and key issues within, the Huritini / Halswell River catchment relative to the Council's six values of waterway asset management: ecology, drainage, culture, heritage, landscape and recreation.
- To communicate and facilitate community discussions on how the surface water management approaches available, might be implemented to enhance the six values and realise the vision for the Huritini / Halswell River catchment.
- To highlight, from over 20 years of Council waterway enhancement experience, city-wide projects that have achieved high level outcomes across all six values and that can be used as exemplars for future work in the Huritini / Halswell River catchment

The Catchment

The catchment is located to the south of Christchurch, covers an area of approximately 190 km^2 and sits within the boundaries of both the Selwyn District Council and Christchurch City Council.

The principal waterway within the catchment is the Huritini / Halswell River, with its key tributaries and sub-catchments including, Quaifes Road Drain and Te Tauawa a Maka / Nottingham Stream, Knights Stream and the minor drains in the Halswell Junction Road area. In addition to the river and its tributaries, the catchment is characterised by a number of man-made drains, natural springs, and ponding areas.

The Huritini / Halswell River is a spring-fed river system, arising from Knights and Te Tauawa a Maka / Nottingham Streams, of which approximately 27km flows through the Christchurch District. It originates in the rural land around Prebbleton, Templeton and the suburb of Halswell in the south of Christchurch. The river meanders southwards through industrial, residential and rural land until it discharges into Te Waihora / Lake Ellesmere.

While the overall catchment is predominantly rural land and made up of approximately 65% flat land, the remaining 35% is steep hill country, rising to 500 metres above sea level on Banks Peninsula. The catchment's landscape is characterised by steep Port Hill's sub-catchments to the east, small urban headwater tributaries to the north (including the industrial area of Hornby and residential area of Halswell, large flat rural plains including a 50 km^2 floodplain, and the southern low-lying catchment fringe bordering Te Waihora / Lake Ellesmere.

The part of the upper catchment that sits within the City Council boundary consists of approximately 2300 ha with the predominant existing land use being rural, followed by business zoned land and residential areas with the balance comprising roads and open space. There is increasing pressure, particularly since the earthquakes, on rural areas to be re-zoned for urban/residential development.

Background Investigations & Technical Reports

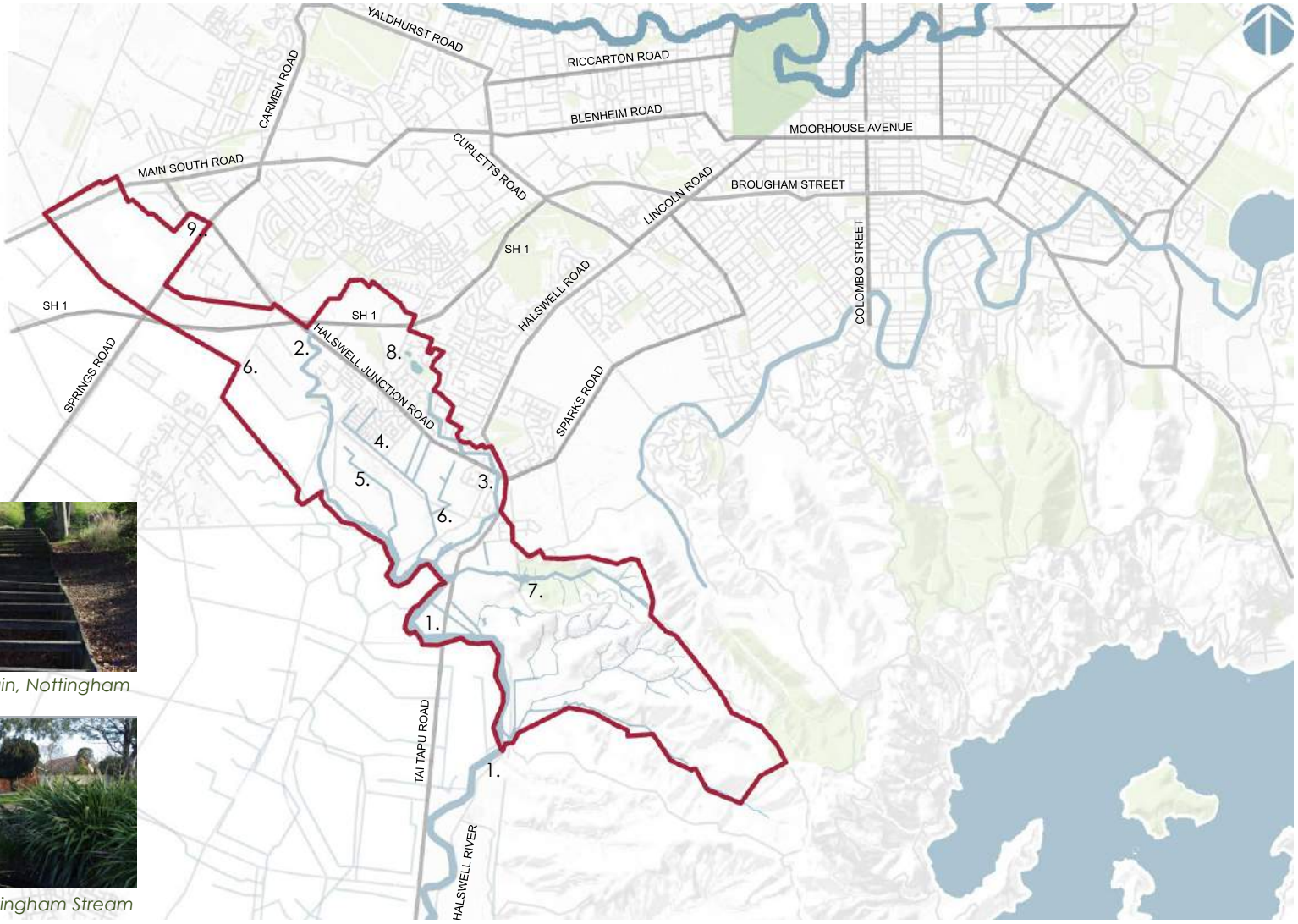
This document is based on a range of reports, investigations and strategy documents that have been adopted by the Council over the last 20 years including:

- Halswell River/Huritini Floodplain Investigation; (Environment Canterbury Technical Report);
- Technical investigations underpinning the Huritini / Halswell SMP;
- South-West Christchurch Area Plan;
- Restoring Knights and Nottingham Streams: An Issues and options Report and Six-values Response to Earthquake Related Damage;
- City-wide Bank Stability and Treatment Options and Guidelines Upstream Waterways (2013);
- Waterways and Wetlands Natural Asset Management Strategy (1999);
- Christchurch City Council Surface Water Strategy 2009-2039;
- Waterways and Wetlands Drainage Guide (2003);
- Infrastructure Design Standards (Part 5);
- Christchurch City Council Public Open Space Strategy 2010-2040;
- Christchurch City Council Biodiversity Strategy 2008-2035;
- Christchurch West Melton Zone Implementation Programme (ZIP) for the Canterbury Water Management Strategy (March 2013);
- Ōtautahi/Christchurch City Landscape Study (Draft, March 2015);
- Mahaanui Iwi Management Plan (2013);
- South-West Christchurch Area Plan Phase 1 Reports (2008).

Given that Council undertakes waterway environmental monitoring reporting on an annual basis, future reports should be read in order to understand the changing environmental state of the river.

Legend

1. Huritini / Halswell River
2. Knights Stream
3. Te Tauawa a Maka / Nottingham Stream
4. Quaifes Road Drain
5. Case Drain
6. Creamery Drain
7. Halswell Quarry Wetland
8. West Lake Reserve
9. Springs, Halswell Reserve



Huritini / Halswell River

Halswell Domain, Nottingham Stream

Knights Stream

Muir Park, Nottingham Stream

Quaifes Road Drain

Case Drain

Creamery Drain

Halswell Quarry Wetland

West Lake Reserve, Halswell

Springs, Halswell Reserve

1.0 CURRENT STATE OF THE SIX VALUES
Te Āhuatanga o Te Wai

Ecology Drainage Culture Heritage Landscape Recreation

1.1 Ecology

The inter-relationships between organisms and their environment.

Existing conditions & values

- The catchment is highly modified in some parts due to large areas of rural development and urbanisation, and other factors such as in-stream obstructions, pollution, stream bank damage, and habitat loss (e.g. riparian vegetation).
- The ecological health of the waterways in the catchment is poor, with pollution tolerant faunal species and eutrophic aquatic vegetation dominating. The Quaifes Road spring-fed drain network has higher ecological values compared to other sites in the catchment. Whereas, the upper reaches of rural Knights Stream are regarded as low value for both fish and invertebrates. The waterway at this location has become greatly modified and the removal of riparian vegetation has greatly decreased bank stability, resulting in bank erosion and large sediment inputs into the waterway.
- There are remnants of native aquatic and riparian plant species (e.g. some of the threatened climbing nettle *Urtica linearifolia* along Knights Stream.
- Native invertebrate taxa and fish species are present throughout the catchment, including species of conservation concern, such as the Kēkewai / Freshwater Crayfish, Tuna / Longfin Eel and Īnanga / Whitebait.
- Te Waihora / Lake Ellesmere, at the mouth of the river, is recognised as a wetland of international significance and has a Water Conservation Order over it that includes recognition of its habitat for wildlife, indigenous wetland vegetation and fish; and significance in accordance with tikanga Māori in respect of Ngāi Tahu history, mahinga kai and customary fisheries. It also supports a commerical eel, flounder and mullet fishery. The seasonal management of the lake openings to the sea is crucial to the recruitment of fish to the waterways of the Huritini / Halswell River catchment.

Issues

- A lack of dense native riparian vegetation, which buffers the waterways from urban and rural land use, and improves ecological habitat for aquatic species; especially tall species that provide shading to the stream channel.
- Contaminants from stormwater, waterfowl and dog faeces, and runoff from agricultural areas.
- Siltation from earthquakes and construction activities, and bank and channel erosion/slumping from earthquakes.
- Historic loss of the original native vegetation cover, reducing seed, fruit and nectar for native birdlife.
- Building, filling and excavating within the riparian margins of waterways.
- On-going loss of mature native and exotic tree stock due to earthquake generated changes to soils, water levels and drainage.
- Barriers to fish and invertebrate migration such as floodgates, culverts and other in-stream obstructions.
- Problem pest species such as grey willow invading wetlands and riparian margins, which can restrict water flow.

Desired outcomes

- Improved water quality through treatment of discharges (e.g. stormwater) prior to entering the waterways.
- Increased number and diversity of native invertebrate and fish species within the catchment.
- Increased use of evergreen tree species to increase shading along river margins and reduce leaf litter fall in autumn.
- Conservation of the remaining areas of native vegetation, including riparian plantings.
- Maintenance and enhancement of habitats and ecological linkages along bird migration routes using riparian planting - particularly between Te Waihora / Lake Ellesmere and Te Ihutai / Avon-Heathcote Estuary, and Ōpāwaho / Heathcote River and the Huritini / Halswell River.

- Identification and management of existing areas of high ecological value.
- Restoration of areas with currently low ecological values or poor water quality through intensive management of water quality, riparian and in-stream habitat enhancement.
- The removal of contaminated sediment within waterways, to improve them as habitats for aquatic macrophytes, fish and invertebrates.
- The use of lighting systems that reduce the effects of light pollution on freshwater fauna.
- Riparian and in-stream habitat enhancement where appropriate, including the use of large boulders to provide laying sites for aquatic insects and specialist habitat, such as riffles, for fish.
- Erosion protection measures, implemented in areas where bank stability is an issue, primarily in the form of riparian planting and soft-engineering options to reduce in-stream sedimentation issues.
- Improved predator control.
- Fencing waterways to exclude livestock.

Halswell Quarry Park Wetland

Pāpango / Scaup

Korimako / Bellbird

Kowhai

1.2 Drainage

The inter-relationships between groundwater and surface water, natural flow regimes and management of storm events.

Existing conditions that influence drainage patterns

- In the north-west the catchment is dominated by unconsolidated gravel, sand and silt. The gravels were deposited by river Waimakariri River overflows pre-dating settlement, and represent the most permeable surface strata in Christchurch.
- There are five main soil types, ranging from sandy Waimakariri and Kaiapoi soils to the siltier Taitapu, Selwyn and Horotane soils.
- Within the catchment, groundwater is used mainly to supply reticulated drinking water, and for commercial, industrial and irrigation purposes. There is one major pumping station located at the boundary of the Huritini / Halswell and Ōpāwaho / Heathcote catchments.
- There are a large number of springs within the catchment contributing significantly to baseflows of all tributaries of the river.
- There are several wetlands within the catchment, including the Halswell Quarry Reserve, Halswell Wetland Reserve and Te Waihora / Lake Ellesmere. The lake is the receiving environment for the Huritini / Halswell River and is recognised as a wetland of international significance, having high cultural and recreational values.
- Te Waihora / Lake Ellesmere is an organically enriched environment due to runoff from surrounding agricultural and pastoral areas; despite this it supports a diverse array of fish and bird life.
- Significant areas of the catchment are rural with a general absence of impervious areas.

Issues

- The continued existence of timber-lined drains with little, if any, additional values apart from drainage.
- Development, contamination and intensification of land-use change from rural to urban negatively impacting on surface water quality and quantity.
- Impervious surfaces, and channelling of water that would otherwise pond and soak away, increasing the rate of stormwater runoff into drains and rivers.
- Land development disturbing the existing soil profile and increasing the deposition of eroded soil into waterways, increasing the risk of flooding, reducing the natural values of waterways, and posing threats to human health.
- Erosion and sedimentation of soils on the Port Hills.
- The low lying flat gradient of the catchment area causes drainage problems.

Desired outcomes

- Affording greater protection to waters that are of particular significance to Ngāi Tahu.
- Stormwater management continuing to focus on reducing levels of contaminants, such as sediment, heavy metals and hydrocarbons, directly entering the river and its tributaries.
- Restricting high-risk activities, such as industrial development, to areas away from vulnerable waterways, and ensuring that there is ongoing close management and monitoring of existing land-use activities already impacting on catchment values.
- Developing a naturalised stormwater network of soil absorption, sedimentation and detention basins, wet ponds, swales and wetlands, to treat and manage the stormwater runoff from existing and new urban developments.
- Ensuring stormwater mitigation facilities are established prior to construction within the contributing catchment.
- Siting stormwater mitigation facilities to avoid interference with public water supply wells and unmanaged or contaminated fill sites.
- Avoiding the diversion of water away from existing springs, and maintaining base flows in waterways.
- Identification and protection of existing springs, and the incorporation of springs and protective buffer zones into the naturalised stormwater network.

- Riparian margins established along stormwater mitigation facilities, rivers and streams to stabilise banks and provide continuous lengths of indigenous planting, enriched and diverse ecological habitats, and improved public access.
- On-site design solutions to ensure developments manage stormwater quality and quantity at the source of collection.

Carrs Road, stormwater basin

Knights Stream

Quaifes Road Drain

Longhurst, Halswell

Longstaff Whincops, watercourse

1.3 Culture

The communities perception of a resource and its values, indicated by community involvement in the management, celebration of past events and planning for the future.

Existing conditions & values

- The Huritini is a significant waterway for Ngāi Tahu, and in particular the hapū of Ngāi Tūāhuriri and Ngāi Te Ruahikihiki as well as other hapū and rūnanga with traditional associations with Te Waihora / Lake Ellesmere.
- The river is an important source of mahinga kai, including kēkewai / freshwater crayfish, tūna / eel, kanakana / lamprey and a variety of other native fish.
- Te Waihora / Lake Ellesmere was, and still is, an important source of mahinga kai for Ngāi Tahu Whānui. The lake, though only partially within the Christchurch District it is the receiving environment of the Huritini / Halswell River and therefore must be acknowledged as such with respect to the downstream consequences of any management decisions taken within the Council's boundary, particularly due to the fee simple ownership of the lakebed by Te Rūnanga o Ngāi Tahu.
- Covering approximately 20,000 ha, the lake is the largest in Canterbury and the fifth largest in New Zealand. Te Waihora is a site of both national and international significance for wildlife – up to 166 species of birds have been recorded on the lake including 133 indigenous species, and up to 43 species of fish including significant fisheries of īnanga/whitebait and tūna/eel.
- The lakebed and its catchment is managed by the Te Waihora Management Board and is subject to the Te Waihora Joint Management Plan (a statutory plan developed with the Department of Conservation), as well as the Whakaora Te Waihora Joint Restoration Programme (with Environment Canterbury) and the Te Waihora Water Conservation Order.
- Ngāi Tahu are heavily involved in the management of the catchment and advocate for improved urban stormwater/wastewater and rural drainage management, as well as the protection, enhancement and restoration of wetland, springs and riparian zones.

Issues

- Lack of a consistent approach to the protection, restoration and enhancement of the Huritini / Halswell River, and the recognition of its natural and cultural values.
- Lack of consistent progress on the identification and revitalisation of mahinga kai and natural spring and wetland sites throughout the catchment.
- Continuation of direct stormwater and drainage inputs into the river and its tributaries, without pre-treatment through swales or wetlands.
- The need to recognise the importance of Ngāi Tahu values, tikanga and the relationships that Ngāi Tahu have with the land and water, in all future catchment management and development initiatives.
- A limited understanding of core Ngāi Tahu values can lead to poor planning and design decisions that may conflict with cultural values or missed opportunities when undertaking work within the river.

Desired outcomes

- Provision of opportunities for Ngāi Tahu Papatipu Rūnanga to exercise rangatiratanga and kaitiakitanga of the natural environment and its resources through meaningful involvement in planning and decision making.
- Recognition of the wāhi taonga status of the river to Ngāi Tahu.
- Recognition and protection of sites of cultural significance including, where appropriate, the marking of these through restoration, interpretation and/or events.
- Identification, protection and enhancement of mahinga kai and natural spring and wetland sites and the improved ability to harvest mahinga kai for cultural purposes.

- Recognition of the Ngāi Tahu natural resource management framework - 'Ki Uta Ki Tai-From the mountains to the sea' - that highlights the connections between all resources and that they must be managed in a sustainable way for the generations to come.
- Protection and emphasis on the stories of the land, its natural drainage and vegetation patterns, cultural features and landmarks. Work with private landowners, while recognising private property rights and the need to use a range of protection methods to achieve desired outcomes as a win-win situation.

Te Waihora / Lake Ellesmere, the receiving waters of the Huritini / Halswell River.

1.4 Heritage

Includes built and natural sites, features and activities of historical, social, cultural, spiritual, architectural, aesthetic, technological, craftsmanship, archaeological, scientific and contextual value.

Existing conditions & values

- Ngāi Tahu, and before them Ngāti Mamoe and Waitaha, maintained a number of settlement and mahinga kai sites throughout the Huritini catchment, which provided a link between the resources of Te Waihora, Te Ihutai and Whakaraupō and the key settlements of Kaiapoi, Rāpaki and Taumutu.
- Key sites and areas included: Ōtūmatua (Kitcheners Knoll), Te Tauawa a Maka (Nottingham Stream), Te Urumānuka, Otāwhito (Hendersons Basin) and Ōteikaiteana (Landsdowne Valley) as well as numerous sites downstream towards Te Waihora.
- The early European history of the area is dominated by farming, producing primary products and industrial activity. The flax and rope industry and wool scouring works were centred on the river.
- Protection is provided for heritage places located in the catchment such as Halswell Quarry, St Mary's Church and graveyard, former Landsdowne Stables, and the Halswell War Memorial.
- There are also a number of buildings, places and features of heritage value which are not protected, including the neighbouring Halswell Domain, early homesteads and rural buildings in the area.

Issues

- Limited public awareness of early Māori and European heritage values within the landscape, with the lack of on-site and written interpretative materials.
- The lack of recognition of, and provision for, multiple values along the river in terms of interpretation and development.
- The need to balance natural and multiple heritage values when they are in conflict with each other.
- Management issues associated with the lack of funding for the maintenance, conservation, preservation and/or protection of significant heritage sites and/or features.
- Lack of understanding of heritage values leading to changes and possible loss of heritage sites.
- Barriers and disincentives to enable use, adaptive re-use and continued use of built heritage.
- The alteration or disappearance of the traditional network of Ngāi Tahu settlements and mahinga kai sites associated with landscape features such as wetlands and river channels.

Desired outcomes

- Improved understanding, protection and/or enhancement of heritage values and built and natural heritage sites and settings, in line with best practice heritage conservation.
- Recognition, protection and/or enhancement of the traditional network of Ngāi Tahu settlement and mahinga kai sites.
- Improved identification, documentation and readily accessible interpretation of heritage values, including through the use of historic names.
- The use of built heritage is further encouraged and adaptive use is enabled.
- Improved representation of heritage patterns and elements as part of local distinctiveness, especially with respect to referencing the range of layers that have influenced our city, the character and treatment of the river and its tributaries as a key natural feature of the city's landscape.
- Provision for settings that provide heritage context and help with interpretation including the provision of physical access to foster engagement with history and deepen the community's connection with, and understanding of, heritage values.
- Recognition of the importance of heritage and ensuring there is a wider understanding that the conservation of places takes time, commitment and resources.

Halswell Quarry Park

Rhodes Domain, Old Tai Tapu Road

Halswell War Memorial

Quarry Managers House, Halswell Quarry Park

1.5 Landscape

The special character of sites and places, their aesthetic qualities and their meaning to the community.

Existing conditions & values

- Urban and rural land-use activities have altered the natural character of the landscape.
- Urbanisation has degraded the unique identity of the catchment created by the diverse mix of indigenous vegetation, waterways, old river terraces and long distant views of the Port Hills / Banks Peninsula.
- New subdivisions have stripped much of the existing vegetation cover, levelled natural landforms and introduced new landscape materials palettes not always reflective of local character or conditions.
- Lifestyle blocks on the fringes of the urban area, with only tenuous links to the productive use of the land, are creating their own type of semi-urban rural character through the introduction of a more urban design palette within the rural environment.

Issues

- Loss of natural character and rural amenity as a result of landuse change/urbanisation.
- Managing landscape change to ensure the retention and protection of remnant aspects of natural character and the highest quality/most valued elements of the landscape.
- Limited views of, and access to, the river and its associated waterways and wetlands.
- Limited protection of natural landforms and regenerating stands of native plants.
- Perception and management of smaller waterways as utility drains.
- Lack of sensitive integration of stormwater infrastructure into rural or more natural landscapes.
- Lack of sensitive integration of built elements within a rural environment.

Desired outcomes

- Vulnerable landscape aspects are protected, maintained and enhanced.
- The use of local landscape features to help shape new developments and the greater use of public open space within them, strengthen the distinction between areas, and maintain the integrity of the local landscape character.
- Improved connectivity along streams by reducing the impact of in-stream structures, such as culverts and low bridges.
- Improved public access and visibility along the major waterways.
- A strengthened local community's relationship to the area, and waterways in particular, through consultation, participation and partnership.
- Protection and enhancement of the existing range of landscape experiences based on the natural and cultural values associated with local waterways.

Halswell Quarry Park

Huritini / Halswell River, Tai Tapu

Longhurst, Halswell

1.6 Recreation

Includes sport (formal, organised, competitive activities) and recreation (informal, unstructured leisure activities) on and beside the river and the structures that support these activities. Recreation opportunities are a combination of a setting and an activity that result in an experience. The setting in particular is dependent on the other five values, and correspondingly can generate an appreciation of those values.

Existing conditions and values

- The catchment has a range of recreation, sports and conservation parks including the 56 ha Halswell Quarry Park with its unique combination of walks, cycle tracks, wetlands, Sister City botanical collections, quarry heritage elements and a dog exercise area. The 26 ha Halswell Domain which neighbours the catchment, is a focus for sport, play, community facilities and a miniature railway.
- Public access along the river and its tributaries is limited and fragmented.
- Development and linking of current stand-alone recreation spaces would open up other recreational opportunities and provide an important diversity of experiences.
- New subdivisions and land developments will potentially provide open space and recreational areas as part of the expanding recreation network within the catchment.
- Margins of the river and its tributaries, have the potential to provide an ideal setting for three of the most popular recreation activities have walking, cycling and jogging.

Issues

- Natural character and rural amenity compromised by landuse changes and urbanisation impacting on the quality, diversity and availability of recreation opportunities.
- Limited access along river margins.
- Degraded waterways and wetlands detracting from the enjoyment of the recreational experience.
- A need to manage open space for both recreation and ecological values.
- The need for recreational activities to respect sites of high cultural significance.

Desired outcomes

- Stronger recreational links along the waterways to cater for changing and more diverse community needs.
- A diverse, connected and attractive public open space network that encourages use and enjoyment.
- A diverse, attractive and well-connected network of parks and reserves is provided to help balance the effects of urban development.
- The quality of the catchment's parks, open spaces and waterways are enhanced in line with to the six values.
- Protection of sufficient land, particularly associated with waterways, are protected for open space purposes, and that the community's aspirations for that open space are met as it is developed.
- Development of service nodes that will concentrate recreational activity and provide facilities for parking, relaxation, and education.

Halswell Quarry Park, Dog Park Reserve

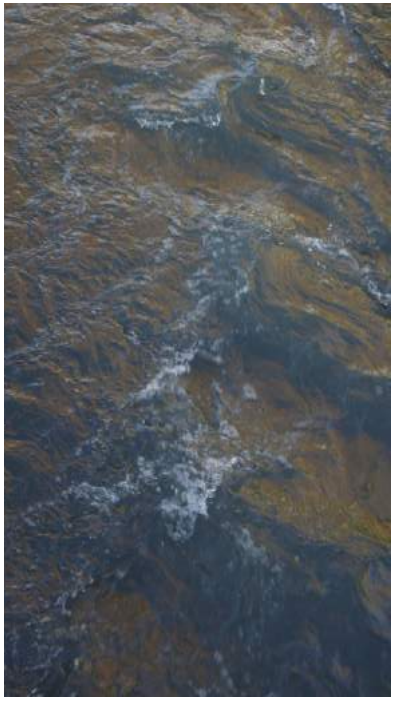
Rail Trail, Christchurch to Little River

Cycling, Rhodes Domain

Playground, neighbouring Halswell Domain

Model boats, neighbouring Halswell Domain

Horse riding, Westlake Reserve



2.0 SURFACE WATER MANAGEMENT APPROACHES
Ngā Mātāpono

Partnerships - Protection & Purchase - Suburban centres
Linkages, Networks & Corridors - Subdivisions - Wetlands
Waterway Restoration - Suburban Greenspace

Vision:

The surface water resources of Christchurch support the social, cultural, economic and environmental well-being of residents, and are managed wisely for future generations.

Toitū te marae a Tangaroa, Toitū te marae a Tāne, Toitū te iwi

2.1 Introduction

The Huritini / Halswell River, including its wider catchment and tributaries, has been of significant importance to manawhenua for over 600 years prior to European settlement and was a major source of mahinga kai and a significant link between settlements and natural resources associated with both the waterways of the catchment and Te Waihora / Lake Ellesmere.

Since European settlement, and the ongoing development of the city's expanding urban environment, the catchment has under-gone a significant degree of degradation through altering natural drainage patterns, pollution, siltation and the removal of native vegetation cover. Since the 2010/2011 earthquakes these issues have been exacerbated to varying degrees throughout the catchment.

The river remains one of a number of iconic natural landscape symbols of our city and still retains a range of cultural, drainage, ecological, heritage, landscape and recreational values throughout its catchment. The vision statement is a call and a reminder that the decision-making for the protection, enhancement and management of the catchment of the Huritini / Halswell River is not for the benefit of the current generation alone, but must reflect a longer term multi-value/multi-generational approach.

The Council has, since the early 1990's, developed a strong and successful history of waterway protection, remediation and enhancement. It was one of the first local authority in New Zealand to adopt a multi-value approach to the management of the city's land drainage system – at the time a revolutionary replacement of the previous Christchurch Drainage Board's single-value focus on land drainage only.

In response to new legislative responsibilities and expectations of the Resource Management Act 1991, the newly amalgamated Council prepared a new City Plan which set in place provisions for the sustainable management of the City's natural and physical resources.

By identifying six core values - ecology, drainage, culture, heritage, landscape and recreation – as the key drivers for surface water management, the Council has been able to translate legislative requirements and a broad philosophy of sustainability into both a natural asset management strategy, tangible values, outcomes, and assets reflective of the broader community's desire for a more sustainable approach to management outcomes.

Over the last 20 years the Council has developed a range of approaches and design solutions that promote the six values of waterways and stormwater management including: improving drainage capacity; enhancing landscape character; improving the quality and relevance of recreational opportunities; enhancing the diversity of ecological values; and improving cultural and heritage values.

The following eight approaches provides a show case of successful city-wide project exemplars implemented by the Council, their strategic partners, developers and key interest and community groups. These approaches provides an insight into the range of solutions available to help Christchurch City realise its long term vision for the Huritini / Halswell River catchment that will maximise the six values attributes within it.

South-West Christchurch Area Plan (2009)

The South-West Christchurch Area Plan was prepared as a statutory document to provide implementation methodology for the Greater

Christchurch Urban Development Strategy and the Christchurch City Plan both of which identified South-West Christchurch, including the Huritini / Halswell River catchment as a major urban growth area.

The Area Plan defines environmental sustainability as the foundation principle on which future development and management within the area will be based. It emphasizes the need to ensure that development must not negatively impact on the natural resources, property and people of the area, and that the natural water systems are maintained and enhanced wherever possible. The Area Plan has also provided the core fundamentals on which the vision for surface water management in this catchment is based.

Muir Park, Halswell

Knights Stream

2.2 Partnerships

Partnerships provide opportunities for the Council to work with Manawhenua, government departments and agencies, statutory parties, private developers, and communities of interest to implement cohesive and integrated approaches reflective of the six values approach to sustainable land-use and surface water management. Exemplar key partnerships include:

Papatipu Rūnanga and Te Rūnanga o Ngāi Tahu

- Council is working with Ngā Papatipu Rūnanga and Mahaanui Kurataiao Ltd to develop a partnership aimed at improved involvement and collaboration over the management of waterways and water infrastructure, including stormwater, across the district.
- Te Rūnanga Ngāi Tahu and Papatipu Rūnanga are also key partners with Council and Regenerate Christchurch in the rebuild of Christchurch post the 2010/2011 earthquakes, and for the Huritini, ensuring core principles and objectives of Ngāi Tūāhuriri for the city and river are realised.
- Key objectives for manawhenua associated with urban development and stormwater management include: elimination of the direct discharge of wastewater and stormwater into waterways; commitment to low impact design principles; sustainability, creativity and innovation; improving water quality in rivers and streams; restoring riparian margins; and protecting and restoring springs, wetlands and mahinga kai.
- Current subdivisions developed by Ngāi Tahu offer examples of collaboration with local authorities to achieve best practise outcomes for stormwater include: Te Whāriki (Lincoln); Prestons (Burwood); and Wigram Skies.

Environment Canterbury (ECan)

- Joint Council / ECan Planning and Consents Protocol for Surface Water Management (2009) - Legislative support and promotion of managing surface water in a more integrated and effective way that also promotes a six values approach to waterway protection and enhancement and a catchment-wide approach to improving surface water quality.

Christchurch West Melton Zone Committee

- A Canterbury Water Management Strategy committee comprising representatives from the community, Ngāi Rūnanga, Council, ECan, and Selwyn District Council.
- Tasked with making non-statutory recommendations associated with water management and issues such as: groundwater quality and flow; improving surface water quality and flow; enhancing degraded ecosystems; indigenous biodiversity; enhancing and managing waterways for recreation and amenity; the efficient use of water, and the management of its demand.
- Fosters educational approaches to drive behaviour change/proactive pollution prevention/community buy-in.
- Working with community stream care groups.

NZ Transport Agency (NZTA)

Key policy and guideline documents and resource consents drive this engagement. NZTA engages with the Council on the consideration and incorporation of catchment and stormwater management best practise on any roading project within the city limits.

Christchurch Southern Motorway

Halswell River planting undertaken by Ladbrooks School

Christchurch Southern Motorway

Knights Stream, Trices Road. Enhancement by neighbouring landowner

2.3 Protection + Purchase + Acquisition

Council has initiated a number of statutory protective mechanisms that protect land from intensification/urbanisation and provide opportunities for application of a six values approach to future stormwater management and stream restoration.

Council's primary mechanisms for the protection of riparian margins are the City Plan waterway setback requirements, a pro-active strategic land purchase policy and the acquisition of riparian land at the time of private subdivision.

The City Plan prescribes a range of waterway setback requirements, dependent on which of the six categories of waterways is affected. The setback ranges from 5 m width for an 'Open Utility Waterway' through to 30m for a 'Downstream River'. Setbacks are designed to provide a buffer between development and the waterway where open space or riparian planting can provide a public amenity with opportunity for maintaining and enhancing water quality through filtering non-point discharges, and for the protection of aquatic habitat and for the unimpeded passage of floodwaters.

In addition to a range of protective mechanisms, Council has, since 1995, purchased land as part of a long term strategy to meet its stormwater management obligations. Land purchase secures Council opportunities to implement six values aligned enhancement and management programs as funding becomes available, and project or community requirements demand. Council land purchases that have, since purchase, been developed as exemplars of six values design, implementation and management include:

- Quaifes - Murphys (Springlands). Property acquisition to preserve significant natural springs, provide stormwater wetland treatment, provide wildlife habitat, recreation and cultural resources.
- Knights Stream Esplanade Reserve (upstream from Whincops Road). Property acquisition to provide a riparian buffer, restoration planting and future recreation link.
- Creamery Ponds. Property acquisition to provide stormater management, passive recreation and core wetland bird habitat.

Actions:

The rezoning of rural land to residential where there are existing waterways can create issues and benefits for fauna and flora along the waterway. These waterways often have either large, old, established trees that are often unsafe and have not been maintained along the banks, or alternatively the banks are in grass, often grazed, with no trees or shrubs. Council will require the subdivision developer to tidy up the banks of waterways within any subdivision and establish riparian planting along the banks to provide shade and shelter to the waterway.

Quaifes Murphy Springlands native planting

Ponds, Creamery Stream

2.4 Suburban Centres

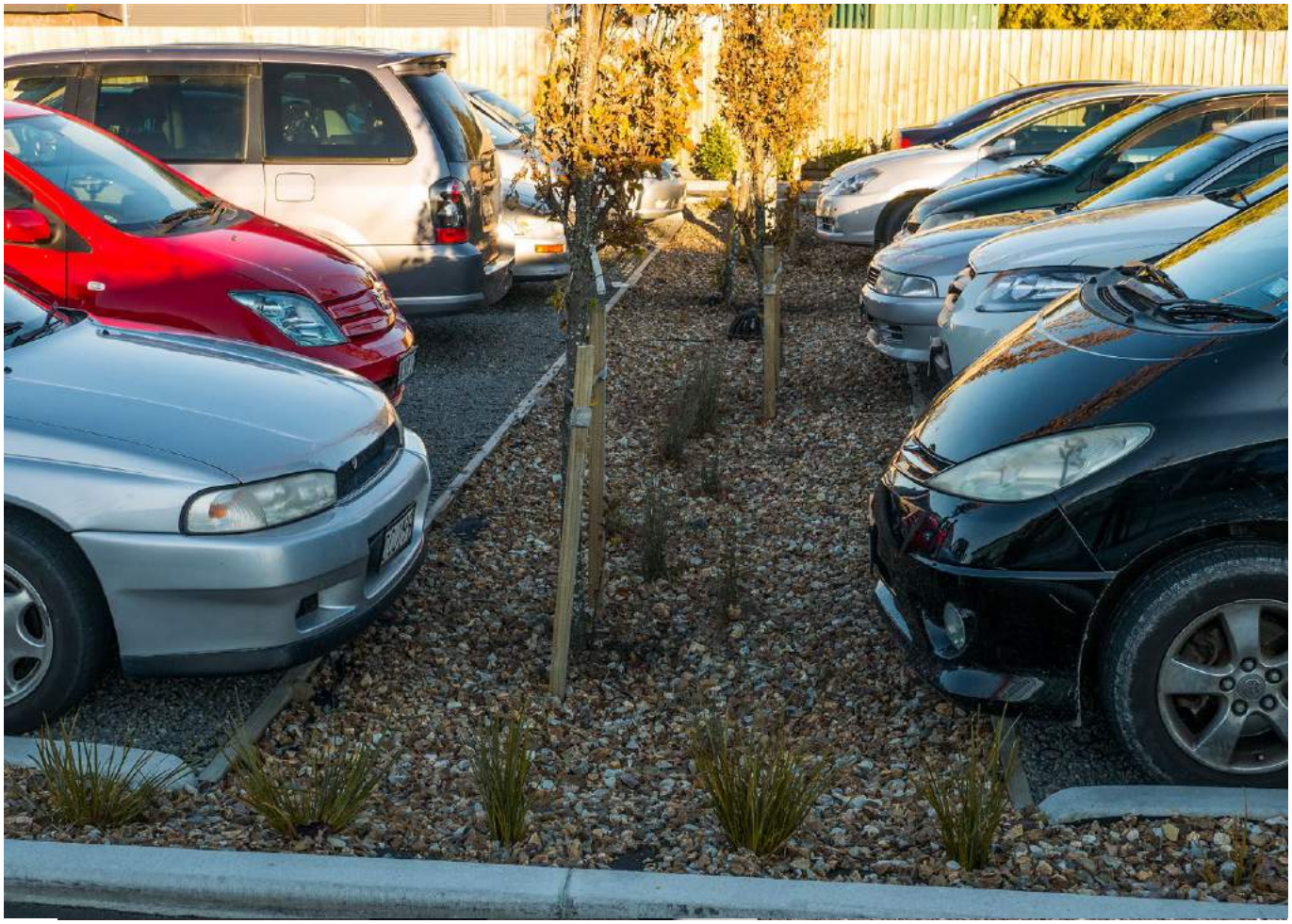
New suburban centres, and/or the redevelopment of existing centres, provide a multitude of opportunities to improve all six values at a local sub-catchment level through the use of sustainable and enhanced surface water treatment devices eg:

- Stormwater tree pits;
- Swales;
- Rain gardens;
- Permeable pavement.

The following suburban centres within the Huritini / Halswell River catchment provide a range of examples and adjoining opportunities for surface water treatment devices to help improve the quality of water before it enters the catchment's waterways:

- Longhurst suburban centre;
- Halswell shopping centre;
- Halswell Community Centre;
- Halswell Library.

Rain garden, Halswell Library



Pervious parking area, Halswell Library

Halswell Shopping centre

Halswell Shopping centre

2.5 Linkages, Networks & Corridors

Linking public open space using existing and/or proposed pedestrian and cycle networks provides opportunities to enhance all six values including the creation of habitat-rich ecological corridors. Examples of stormwater management projects that have recognised the opportunity for linkages, corridors and networks, and provided strengthened ecological, cultural, landscape, heritage and recreational values include:

- Halswell Quarry Park/Kennedys Bush;
- Westlake Reserve;
- Waka Trail, Owaka Road connecting the Ōpāwaho / Heathcote River to the Huritini / Halswell River Catchment;
- Knights Stream Esplanade Reserve: Property acquisition to provide a riparian buffer, restoration planting and future recreation link.

Halswell Quary

Westlake Reserve, Halswell

Longhurst, Halswell

Stallion Reserve, Halswell

2.6 Subdivisions

The 2010/2011 earthquakes have hastened both the development of new subdivisions and the expansion of existing ones. There are numerous recent examples where a combination of legislative and market demands have produced subdivisional outcomes with strong representation across all six values. Some neighbouring examples of the successful integration of subdivision requirements and a high six values outcome that can be showcased for future developments within the catchment include:

- Halswell on the Park;
- Milns Subdivision;
- Longhurst Subdivision;
- Knights Stream Park;
- Quarry View Subdivision.

As part of the development of an urban reserve network, the subdivision process offers the opportunity for the Council to naturalise waterways that were previously timber-lined boxed drains and to obtain esplanade reserves alongside streams and rivers. Although the width of land obtained alongside waterways or esplanade reserves may be restricted by land form (topography), existing buildings or structures, the Council does require vehicle maintenance access alongside the waterways. If its located on public land, the maintenance access can double as informal pedestrian and cycle routes, connecting the urban reserve network.

The Council may through the subdivision process, have the opportunity to purchase land for reserves adjoining the esplanade or waterways, where funding permits. The additional reserve land can be used to provide a wider reserve for pedestrian and cycle access, additional ecological planting and/or buffer planting.

Where reserve land is being obtained through the subdivision process, the Council requires the reserve the reserve to be planted in accordance with an approved landscape plan.

Quarry View Subdivision, Halswell

Longhurst Subdivision, Halswell

Halswell on the Park, Halswell

Quarry View, Halswell

Kirkwood, Halswell

Longhurst Subdivision, Halswell

Halswell on the Park, Halswell

2.7 Wetlands

Over the last 20 years Council has secured the long term protection of a number of wetlands within the Hurutini / Halswell River catchment. Opportunities to enlarge and enhance these existing wetlands to incorporate all six values have been identified. In addition to increasing the number and quality of physical linkages between wetlands, enhancement and appropriate management within them will allow their important roles in the drainage, storage, and cleaning of surface water inputs to increase.

Existing wetlands providing enhanced six values include:

- Halswell Quarry Park;
- Westlake Reserve;
- Knights Stream Park (construction pending);
- Quaifes-Murphy Springlands wetland (construction pending);
- Creamery Ponds.

Halswell Quarry Park

Halswell Quarry Park

2.8 Waterway Restoration

Over the last 20 years the Council has developed a range of enhancement and management 'tools', or design solutions, to promote the six values approach to waterway restoration including: improving drainage capacity; enhancing landscape character; improving the quality and diversity of recreational opportunities; enhancing terrestrial and aquatic ecological values; and improving cultural and heritage values.

Significant waterway restoration projects that strongly reflect these six values and can be used as exemplars for new projects in the future include:

- Nottingham Stream riparian plantings;
- Knights Stream above Whincops Road;
- Huritini / Halswell River, Old Tai Tapu Road.

Huritini / Halswell River, Tai Tapu

Milns Reserve

Knights Stream

Knights Stream, Trices Road

2.9 Suburban Greenspace

Existing greenspace within suburban areas can be enhanced to incorporate positive responses to all six values and mitigate the impacts of urbanisation and increased surface water runoff.

Suburban greenspace projects that exemplify an enhanced six values approach to suburban greenspace development and management include:

- Halswell Quarry Park;
- Westlake Reserve;
- Muir Park;
- Quarry View Park.

Longhurst subdivision, Halswell

Longhurst subdivison, Halswell

Quarry View subdivsion, Halswell

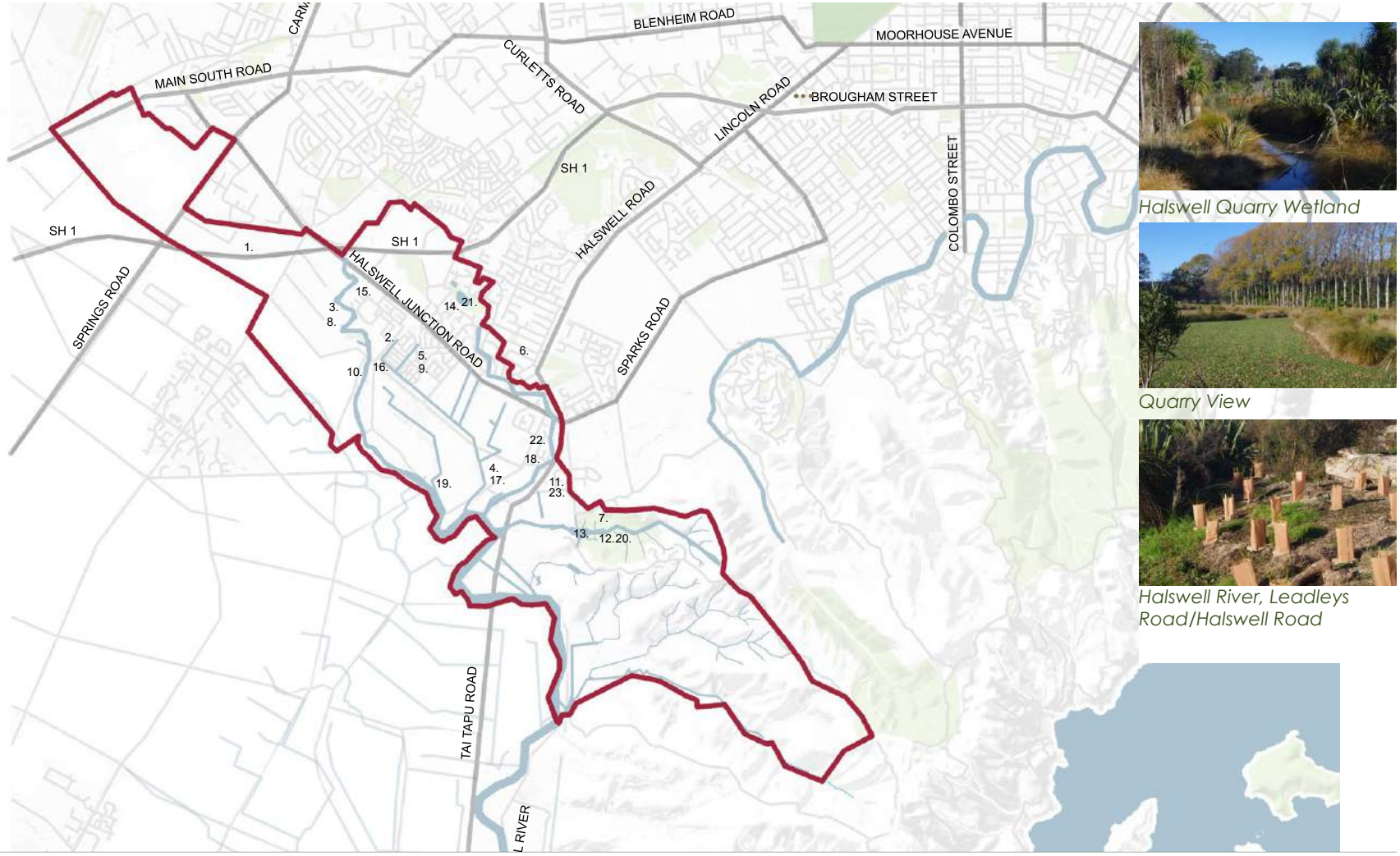
Stallion Reserve, Halswell

2.10 Exemplar sites in the Huritini / Halswell River Catchment

Longhurst Subdivision

Springs, Halswell Reserve

Huritini / Halswell River



Halswell Quarry Wetland

Quarry View

Halswell River, Leadleys Road/Halswell Road

Partnerships

1. NZTA - CHCH Southern Motorway.

Protection & Purchase

2. Quaifes-Murphy (Springlands);
3. Knights Stream Esplanade;
4. Creamery Ponds.

Suburban centres

5. Longhurst suburban centre
6. Halswell shopping centre

Linkages, Networks & Corridors

7. Halswell Quarry Park/Kennedys Bush;
8. Knights Stream Esplanade Reserve

Subdivisions

9. Longhurst Subdivision;
10. Kinghts Stream Park;
11. Quarry View Park.

Wetlands

12. Halswell Quarry Park;
13. Halswell Wetland Reserve;
14. Westlake Reserve;
15. Knights Stream Park (construction pending);
16. Quaifes-Murphy Springs wetland (construction pending);
17. Creamery Ponds.

Waterway restoration

18. Nottingham Stream;
19. Knights Stream.

Suburban greenspace

20. Halswell Quarry Park;
21. Westlake Reserve;
22. Muir Park;
23. Quarry View Park.

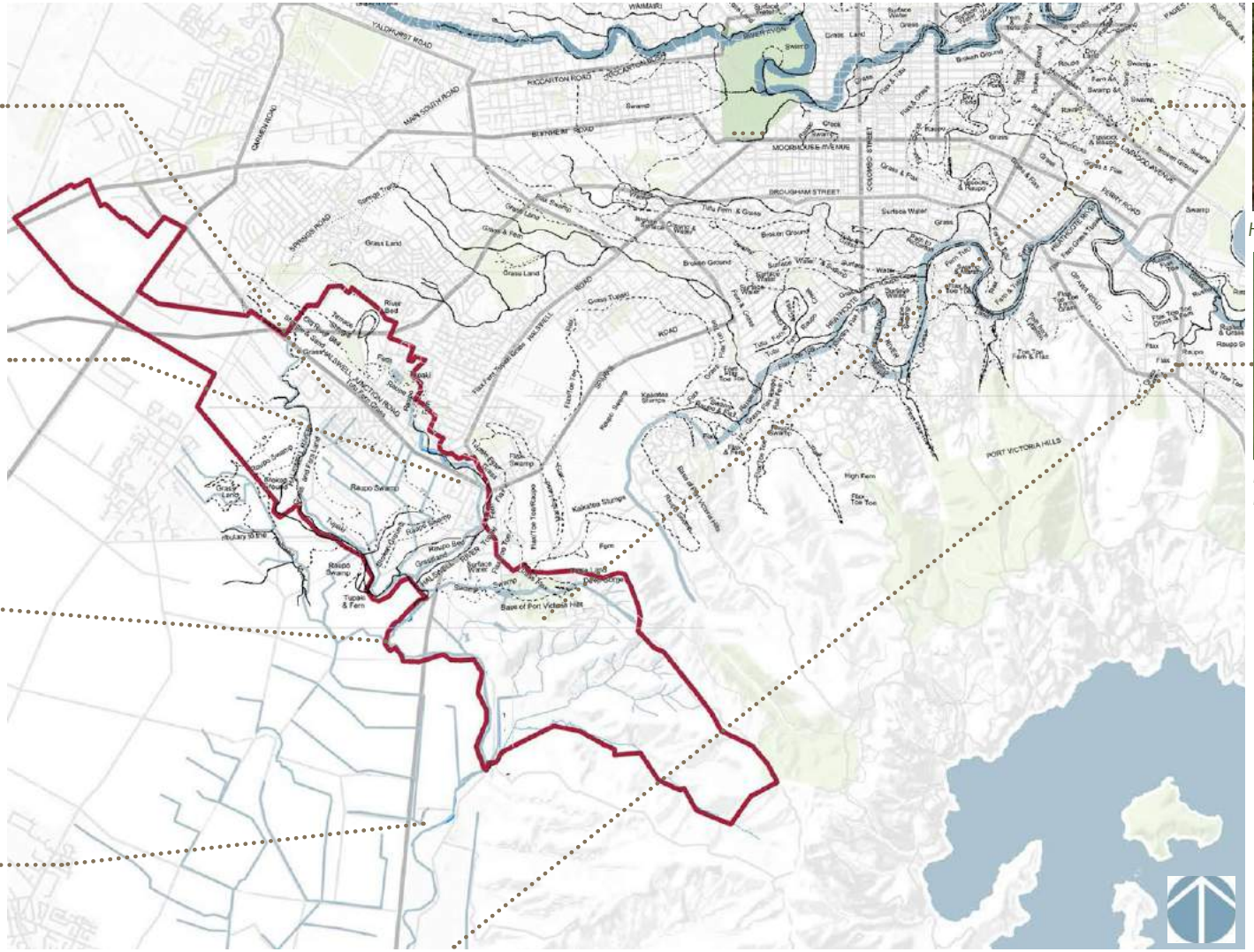
2.11 Huritini / Halswell River Catchment overlying the 1856 Black Maps

Longhurst Subdivision

Halswell Domain

Leadleys Road/Halswell Road

Huritini / Halswell River, Tai Tapu

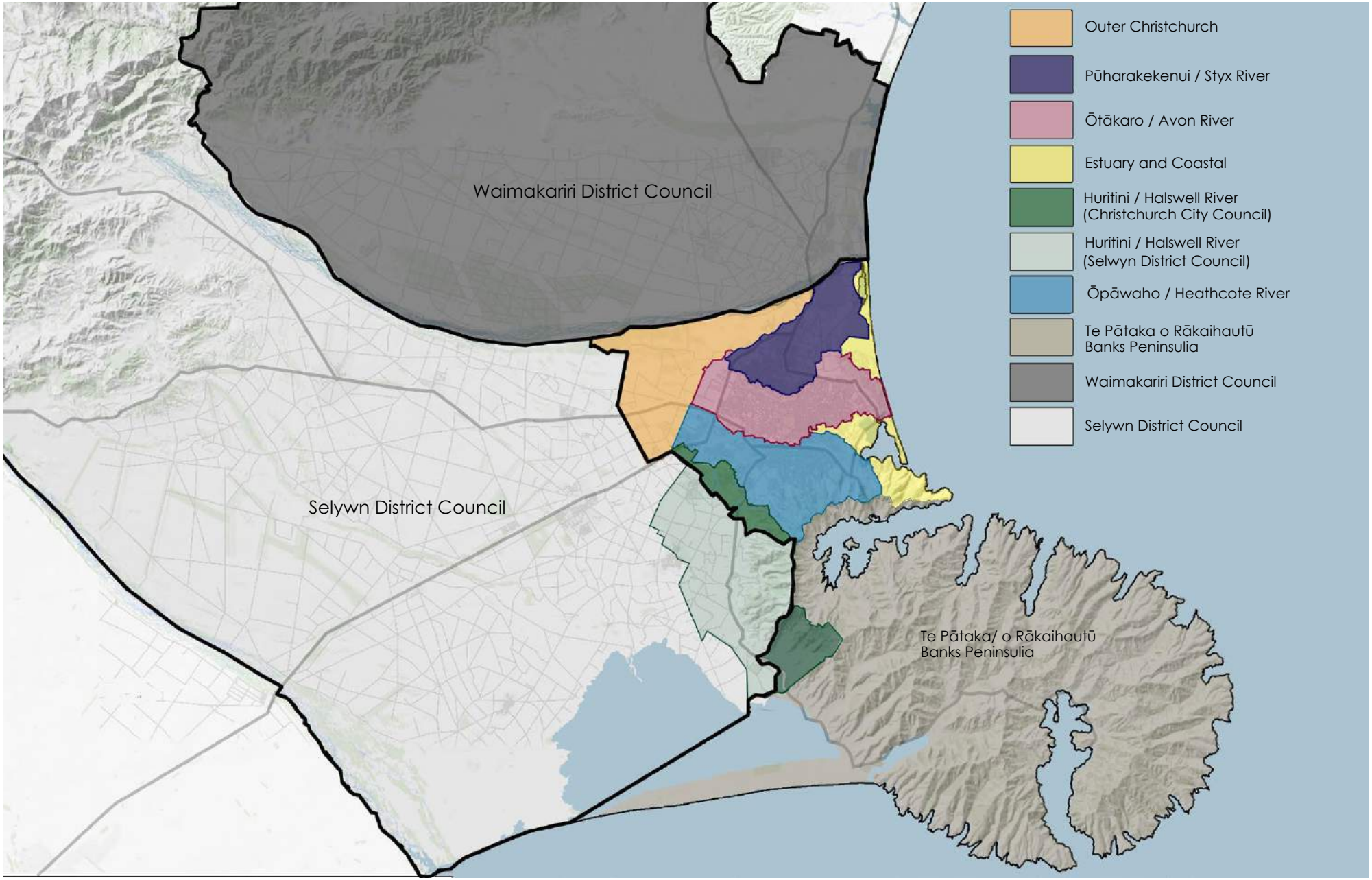


Halswell Quarry Park

Rhodes Domain, Old Tai Tapu Road

The 1856 Black Map is a survey plan (J Thomas & T Cass Chief Surveyors) that shows the original land formation, vegetation, waterways and wetlands of Christchurch at the time of European settlement. It is still relevant today as an indicator of natural drainage and vegetation types.

2.12 Context Plan: Catchment Boundaries within Christchurch




Canterbury
Native Planting

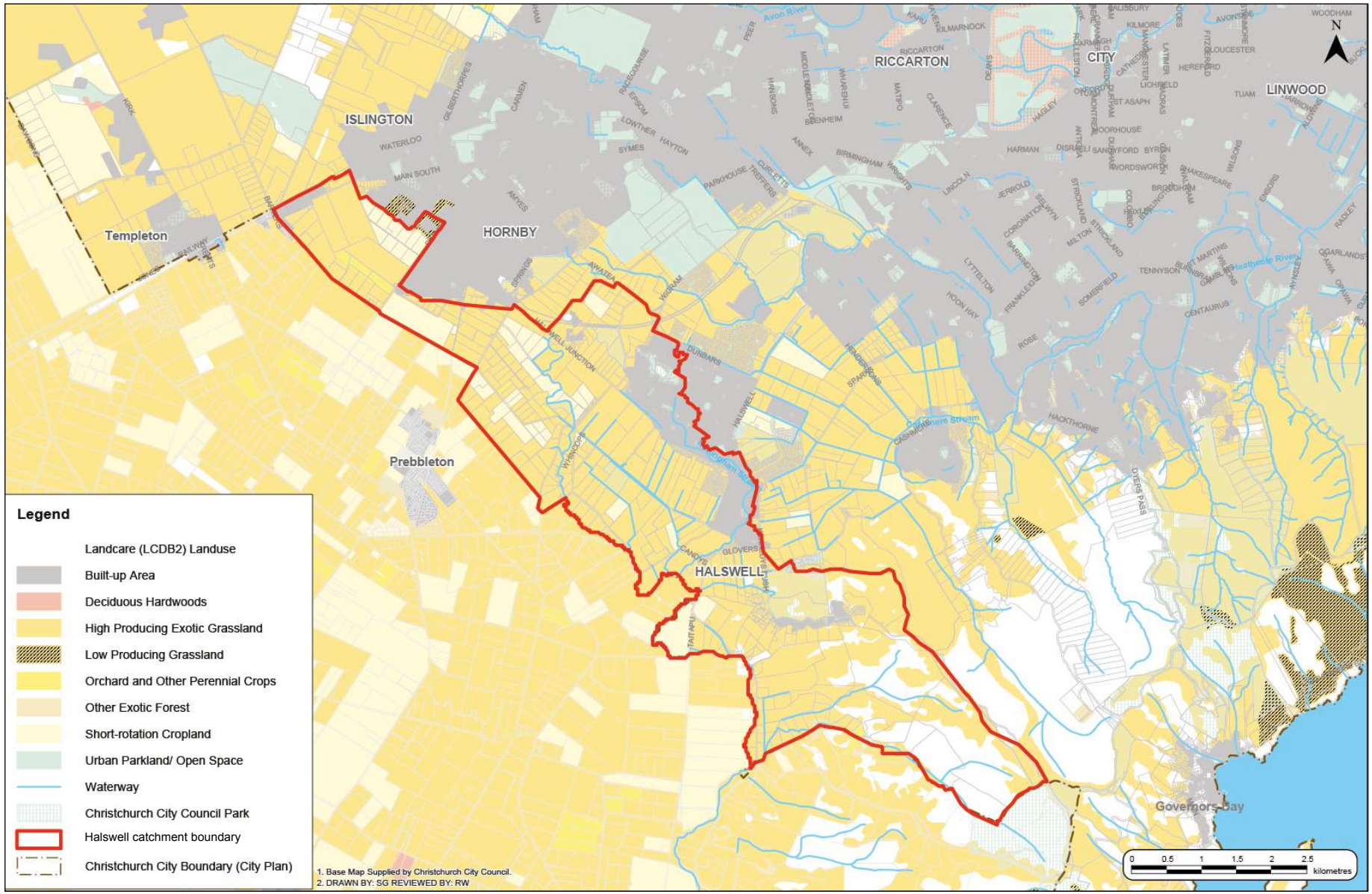
Part 2.0 SUMMARY OF TECHNICAL REPORTS TO INFORM STORMWATER MANAGEMENT Pūrongo Hangarau

3.0 Physical Context / Te Horopaki

3.1 Overview of Catchments

The upper Huritini / Halswell river catchment consists of approximately 2,700 ha with the predominant existing land use being rural with (approximately 72%), followed by business and residential areas (approximately 10% each). The remainder comprises roads and open space. The rural areas are under pressure to be re-zoned to allow for urban development. The catchment is divided into two main landforms; the north-facing Port Hills and the relatively flat Canterbury Plains. The upper catchment has a particularly varied and sensitive water environment, characterised by a number of man-made drains, natural springs, and ponding areas as well as the river and its tributaries (including Nottingham and Knights Streams). There is a strong inter-relationship between surface water and groundwater in Christchurch. Groundwater flows from north-west of the city towards the Port Hills to emerge as the headwaters of the river.

The upper Huritini / Halswell River, its tributaries, and land use are shown in the figure opposite.


Legend
Landcare (LCDB2) Landuse
Built-up Area
Deciduous Hardwoods
High Producing Exotic Grassland
Low Producing Grassland
Orchard and Other Perennial Crops
Other Exotic Forest
Short-rotation Cropland
Urban Parkland/ Open Space
Waterway
Christchurch City Council Park
Halswell catchment boundary
Christchurch City Boundary (City Plan)
1. Base Map Supplied by Christchurch City Council.
2. DRAWN BY: SG REVIEWED BY: RW
0 0.5 1 1.5 2 2.5
kilometres
N
ISLINGTON
HORNBY
Templeton
Prebbleton
RICCARTON
CITY
LINWOOD
HALSWELL
Governors Bay
Avon River
Heathcote River
Cashmere Stream
Halswell River

3.2 Geology

The geology of the Huritini / Halswell River catchment consists of north-facing slopes of the Port Hills, which are generally composed of basaltic flows, ash deposits, and intrusive rocks that dip to the north-west. The basalt and ash deposits are derived from twin volcanoes that formed Banks Peninsula some 6 to 12 million years ago. The limited interconnection of fractures within the basalt permits a minor amount of water movement. However, water emanating from the volcanic strata is reportedly often of poor quality due to high concentrations of dissolved solids.

Surface geology of the Canterbury plains and the majority of the river catchments is dominated by unconsolidated gravel, sand, and silt. Gravel strata occur in sinuous zones extending across the western half of the city. The gravels were deposited by river channels, dating before European settlement times, and represent the most permeable surface strata in Christchurch. Alluvial silt and sand occur throughout much of the central city and to the west, between the gravel channels. They represent overbank deposits of river channels, and tend to be finer grained, with a greater portion of silt and an absence of gravel.

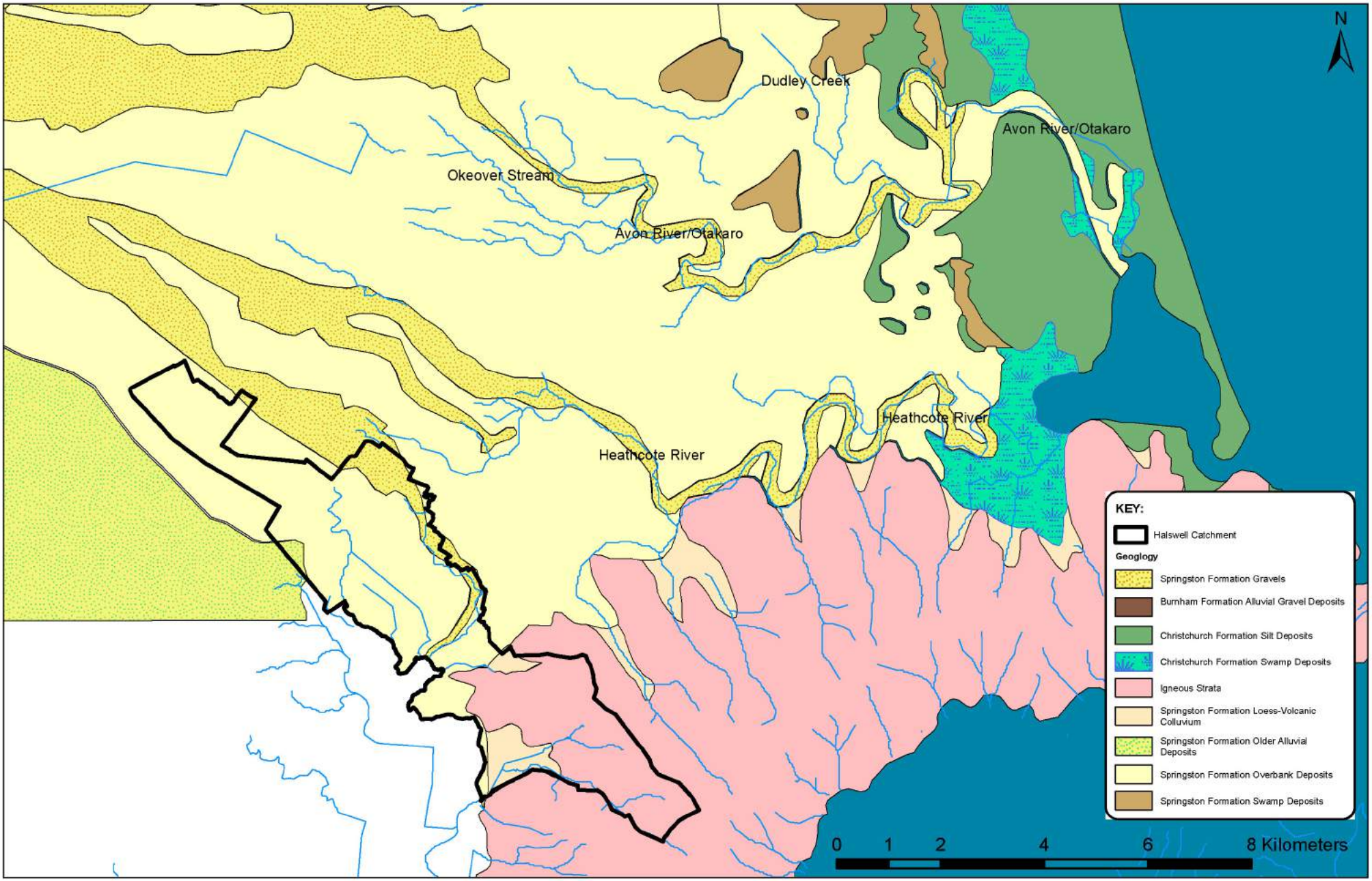
A number of permeable gravel units exist below the surface deposits. The gravels represent regional scale meandering rivers and the confined artesian aquifers of Christchurch. In the east the gravels are overlain by marine and alluvial sands and silts, which are thickest near the coastal margin and thin in a westerly direction. The sands and silts form confining layers to two aquifers. The uppermost confining layer occurs at the surface and is up to 10 m thick in the east, while a second confining layer between the upper and lower aquifers is located between 30 m and 50 m below the surface. The two confining layers dip eastwards and thin westwards.

The presence of a confining layer can act to protect the underlying groundwater resource. The thickness and lithological continuity of the confining layer defines three aquifer vulnerability zones within South-West Christchurch. These include:

- The eastern end of the study area, where the aquifers are confined and protected from the risk of contamination by the low permeability alluvial and marine strata.
- The transitional zone further to the west, which forms the majority of the study area, in which the uppermost confining layer is 1 m thick.
- To the west, where the upper most confining layer pinches out and the aquifers become more vulnerable to contamination from surface activities.

The confining layer also controls artesian groundwater pressures and limits the potential for infiltration of stormwater.

Surface Geology of the Huritini / Halswell Catchment



3.3 Soils

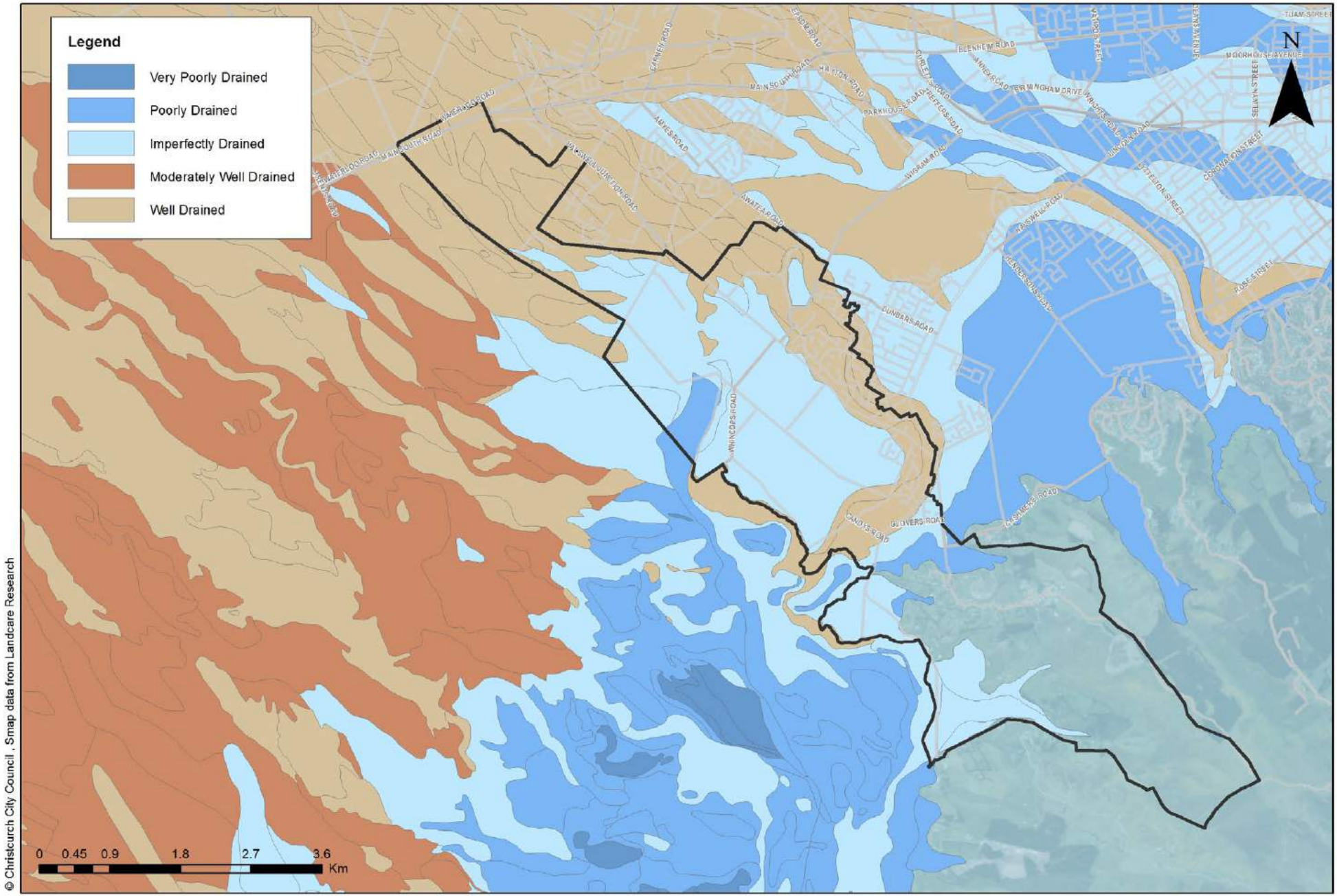
The soils of the catchment include Waimakariri, Kaiapoi, Taitapu, Selwyn, and Horotane soils. All of the soils, except for Taitapu, are recognised as suitable for urban development. Those soils classified as being unsuitable for urban use may be modified so that they are suitable (through the application of fill or by engineering techniques).

It is expected that only the Waimakariri soils would display permeability properties suitable for stormwater infiltration basins, provided they are underlain by free-draining gravels containing a water table at a sufficient depth (i.e., >2.5 m).

Soils on the volcanic rocks of the Port Hills are dominated by loess (a soil derived from wind-blown particles) or colluvium (a transported soil). Loess is typically clay and silt rich and has a very low permeability; however, during summer it is prone to dehydration, which causes fissures. The fissures extend both laterally and vertically, which can cause considerable slope instability and construction issues.

Generally, stormwater infiltration is considered likely to be governed by the distribution of gravels and silts. Areas underlain by gravels at shallow depth are suitable for infiltration, and areas underlain by the overbank silts and sandy silts are suitable for detention.

Christchurch soils from S-map online (http://smap.landcareresearch.co.nz)



3.4 Groundwater

The South-West Christchurch area is endowed with an abundant and high quality groundwater resource which is used for reticulated drinking water as well as commercial, industrial and irrigation purposes. Protection of the groundwater resource is of paramount importance.

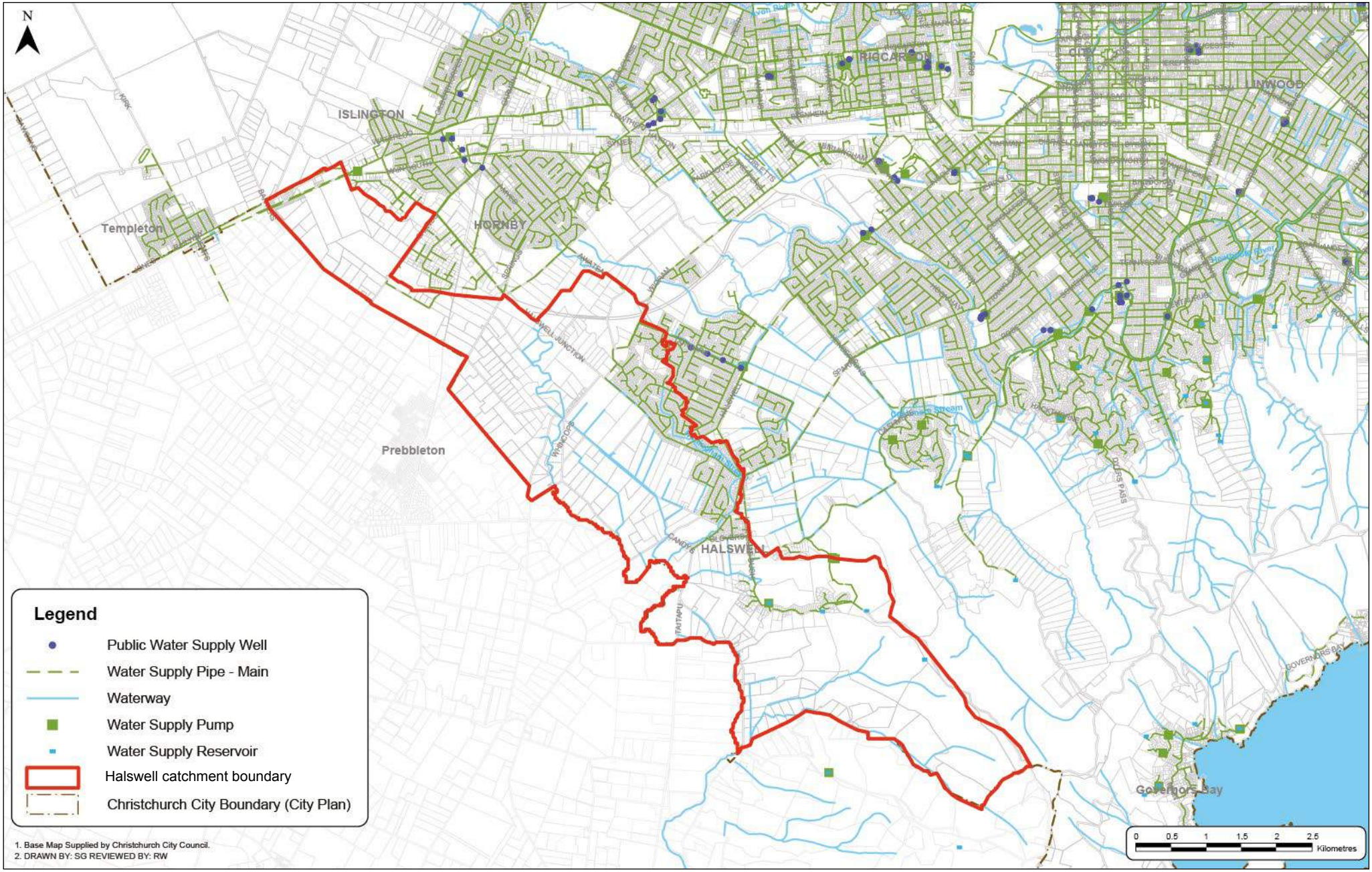
The upper Huritini / Halswell River is located within the Christchurch-West Melton groundwater allocation zone. In the southern part of the catchment, the base of the Port Hills contributes groundwater to the surrounding sedimentary strata. The rate of recharge is not known, but a lack of high yielding wells in the volcanic rock and an apparent lack of influence on groundwater quality suggests that it is small.

Groundwater monitoring data indicates that there is considerable variation in groundwater levels throughout the catchment.

Groundwater within the northern and central parts of the catchment is likely to flow east, and at shallow depths emerges as surface flow in the Knights Stream. Deeper groundwater will be consumed by abstraction, or flow to higher strata along an upward hydraulic gradient, or will flow to the sea via offshore submarine springs. Flow patterns at a smaller scale will be more complex, being influenced by hydraulic conductivity, lithological character, pumping, and infiltration.

Groundwater within the Huritini / Halswell River catchment is used mainly to supply reticulated drinking water, but is also used for commercial, industrial, and irrigation purposes. There is one major pumping station located at the boundary of the Huritini / Halswell and Ōpāwaho / Heathcote catchments. Public drinking water wells are identified in the figure opposite. The protection of groundwater resources is a significant issue for Christchurch, given that the City's drinking water is obtained from groundwater and, prior to the September 2010 earthquake, has required no treatment. Since the September 2010 earthquake and the major 22 February 2011 aftershock, city drinking water supplies have been chlorinated as needed; it is anticipated that this need will reduce as repairs to infrastructure are carried out.

Public Drinking Wells Near the Huritini / Haslwell Catchment



3.5 Springs and Wetlands

There are a large number of springs within the upper river catchment. Artesian pressure forces groundwater up through confining layers until it emerges as a spring. Springs contribute significantly to baseflows within tributaries of the river.

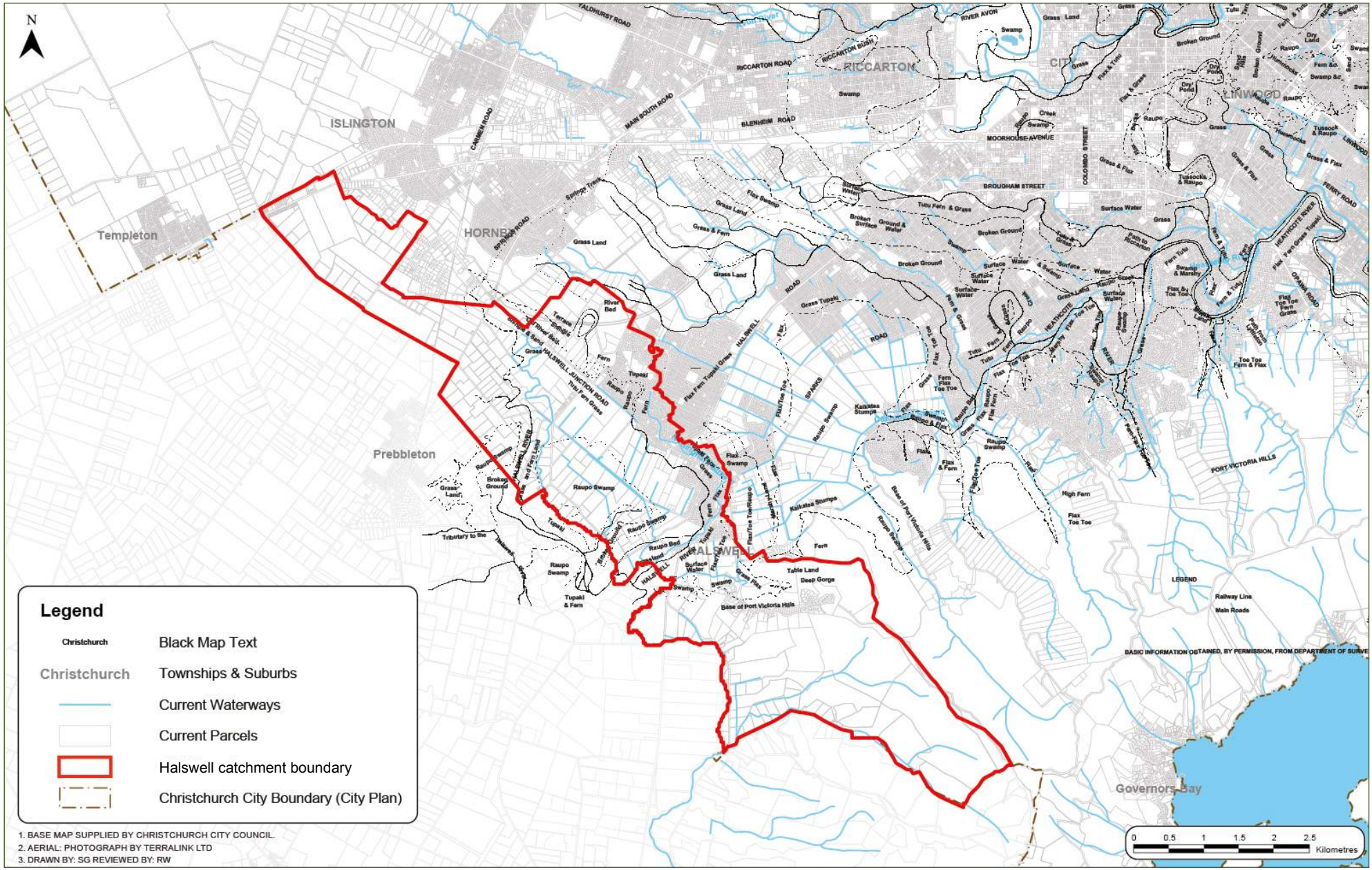
The distribution of springs is controlled by the characteristics of the confining layer over the aquifer. Essentially, this means that springs are found where there is a moderate thickness of confining layer and the groundwater pressures created are sufficient to cause springs to 'break through'. Nine springs occur on the boundary of the Ōpāwaho/ Heathcote and Huritini / Halswell catchments, within paddocks to the east of Knights Stream (in the area to the south-west of the intersection of Quaifes Road and Murphys Road).

Seven springs occur within or to the west of the headwaters of the Huritini / Halswell River. The baseflow of the river at Old Tai Tapu Road Bridge is about 1,000 L/s. Urban development should be carried out in a way that maintains groundwater levels so that these spring flows are not lost, as they are the most important contributors to baseflow. Groundwater in the catchment could also be consumed by abstraction, or will seep into Te Waihora / Lake Ellesmere, or further to the southeast, to the sea.

The distribution of springs indicates the presence of a confining layer that arrests the seepage of surface water into the groundwater system. Therefore, spring distribution can be used to determine if surface water is likely to seep into the groundwater.

The Black Map (opposite) shows the waterways, swamps and vegetation present in 1856 in the Huritini / Halswell River catchment and surrounding areas.

Huritini / Halswell River and Tributaries : Black Map Showing Waterways, Swamps and Vegetation in 1856

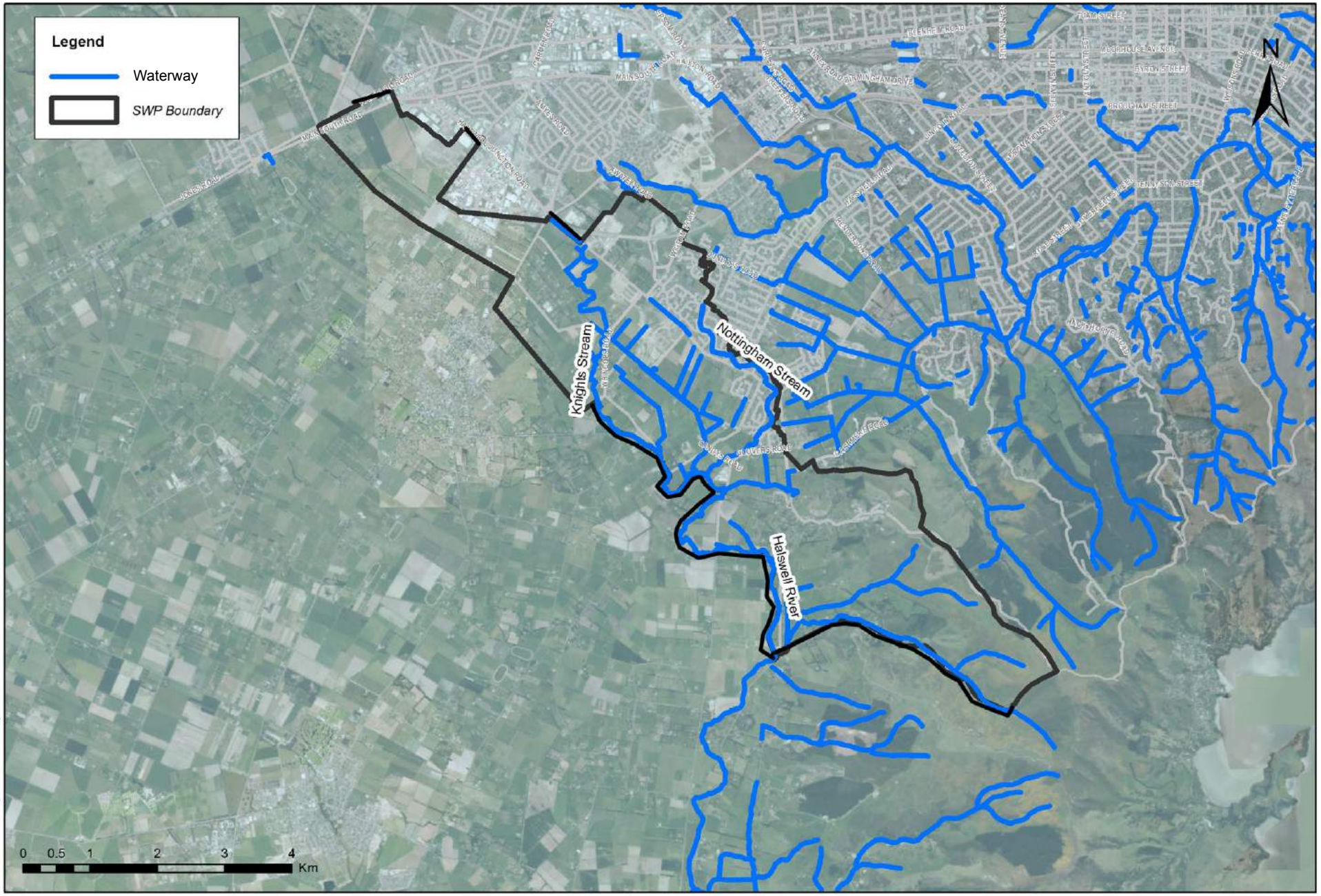


3.6 Surface Water Network

The Huritini / Halswell River receives appreciable flow from Knights Stream, a largely spring-fed tributary fed from rural land around Prebbleton, Templeton, and also from the suburb of Halswell. Other tributaries of the river include Nottingham Stream, Quaifes Road drain and other drains in the Halswell Junction Road area.

From the Knights Stream confluence downstream until the river intersects to SH 75 (Taitapu Rd), the channel is quite uniform in profile. Land use varies between cropping, grazing, and road reserve land. Downstream of SH75 (Taitapu Road) the channel becomes shallower and generally more heterogeneous. Beyond SH 75 the Huritini / Halswell River meanders south for approximately 3km to Lansdowne Valley, where the river reaches the study area boundary. It continues to flow through rural land for approximately 22 km until it discharges into Te Waihora/ Lake Ellesmere.

Surface Water Network of the Huritini / Halswell Catchment



4.0 Freshwater Ecology / Rauropi Wai-māori

An ecological investigation of upper Huritini / Halswell River is presented in the Aquatic Values and Management Report, Report Number 3 of the SMP Technical Series. This investigation assessed the ecology of the Ōpāwaho/Heathcote and Huritini / Halswell catchments, with detailed sampling undertaken in the river's mainstems, as well as several contributing tributaries. The ecological survey included assessments of aquatic habitat, periphyton (algae), macrophytes (aquatic plants), macroinvertebrates (aquatic insects) and fish from 11 sites in the catchment.

4.1 Overview of Ecological Health of Waterways within the Surface Water Plan Area

Of particular relevance to determining the ecological health of waterways that receive stormwater are measures of siltation and the Quantitative Macroinvertebrate Community Index (QMCI) scores. This is because untreated stormwater can contain high suspended sediment concentrations that may deposit on the stream bed, reducing aquatic habitat quality. Also, the QMCI is a good general indicator and integrator of stream water quality and habitat quality, with high QMCI scores occurring at sites with predominantly silt-free stony sediments with good water quality.

All waterways in the Huritini / Halswell River catchment are modified and affected to some degree by rural or urban land use. Overall, stream biota is similar to that of other modified lowland streams in Canterbury and New Zealand, and has limited ecological value on a regional or national scale.

Survey sites in the catchment were dominated by relatively fine embedded sediments, which reflect the greater prevalence of slow-flowing stream habitat. The shallow upper reaches of Nottingham Stream and Knights Stream had somewhat faster flows and coarser substrates than the slower flowing, finer sediment dominated reaches in the Huritini / Halswell River sites.

A total of 37 invertebrate taxa were recorded from the 11 sites in the catchment. The most diverse invertebrate group was two-winged flies and caddisflies, followed by snails and beetles. Kēkewai / Freshwater crayfish were caught while electric-fishing at a site in Dawsons Creek Diversion, two sites in the Quaifes Road Drain network, and two sites in the Huritini / Halswell River.

Seven fish species were identified from the catchment: upland bully, shortfin eel, longfin eel, perch, common bully, inanga, and brown trout. The site with the greatest number of fish species was located on the lower Huritini / Halswell River at Lansdowne. Fish species diversity declined significantly with distance upstream from Te Waihora / Lake Ellesmere.

Overall, stream biota is similar to that of other modified lowland streams in Canterbury and New Zealand, and has limited ecological value on a regional or national scale.

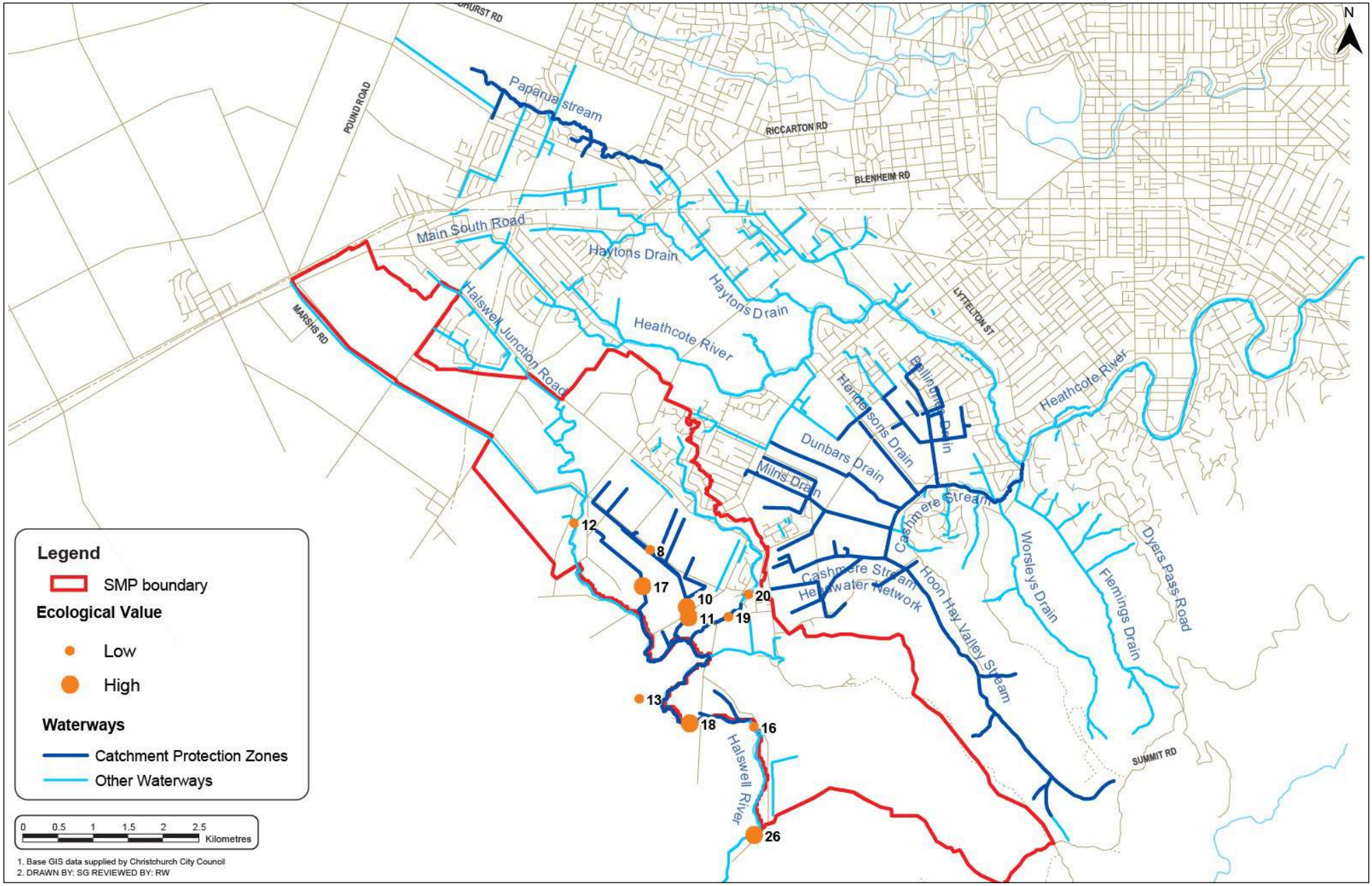
4.2 Areas with High Ecological Value

Two sites were assessed as having high ecological values relative to waterways within the modified environment. These sites are located in the Quaifes Road spring-fed drain network and have a high abundance of Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa and good taxa diversity. The Quaifes Road spring-fed drain network also supported a reasonable freshwater crayfish population; one site also supported a particularly high density of crayfish, and was the only site with a breeding population.

4.3 Areas with Low Ecological Value

The upper reaches of rural Knights Stream were regarded as low value for both fish and invertebrates. During the current study, it became apparent that the waterway has become greatly modified and the removal of riparian vegetation along a 50 m section had greatly decreased bank stability, resulting in bank erosion and large sediment inputs into the waterway. Anecdotal evidence also indicates a loss of some springheads in the vicinity of Marshs Road, and lower flows and siltation in the middle-upper reaches

Location of Sites with High Ecological Value and Catchment Protection Areas



4.4 Management Recommendations

- There needs to be a multi-faceted approach to the management of the catchment.
- Areas with high ecological value need to be maintained, and where possible enhanced, through appropriate management activities.
- Areas with low values should be restored through intensive management of water quality, and riparian and in-stream habitat; particularly in areas that displayed high potential for ecological health (i.e. they had good instream and riparian habitat), but the poor condition of the water is affecting stream health.
- Stormwater management should continue to focus on reducing levels of contaminants (e.g. sediment, heavy metals and hydrocarbons), particularly in the tributaries.
- The removal of contaminated sediment within waterways should be undertaken, with sites prioritised based on ability of upstream macroinvertebrate populations to colonise.
- Deciduous trees in riparian margins should be replaced with evergreen species, to reduce excessive amount of leaf litter input into waterways, which affects water quality.
- Riparian and in-stream habitat should be enhanced where appropriate, including the use of such things as emergent large substrates (which provide laying sites for the eggs of aquatic insects) and specialist habitat (e.g. riffles for bullies).
- Erosion protection measures, primarily in the form of riparian planting and soft-engineering should be implemented in areas where bank stability is an issue to aid in addressing instream sedimentation issues.
- Connectivity along streams should be improved by reducing the impact of in-stream structures, such as culverts and low bridges.
- Lighting systems should be used that reduce the effects of light pollution on freshwater fauna.
- Management of macrophytes and periphyton should be undertaken in a preventative manner rather than mechanical removal which has deleterious effects on fauna.
- Perch compete with native fish for space and food and should be controlled or removed. Adult perch are also known to eat common bullies.

Huritini / Halswell River

5.0 Surface Water Quality / Kounga Waimāori

The majority of water quality data available for the Huritini / Halswell Rivers and its tributaries is summarised Christchurch City Council water quality monitoring program reports from 1989 to 2002. There are ten water quality monitoring sites located within the catchment. This monitoring program provides detailed information about the majority of water quality parameters in the catchment, but there is limited water quality data available for metals prior to 2007.

The following section provides a brief summary of water quality in the catchment, based on water quality data from 1989 to 2002 for most parameters. Also included is a summary of metal data from Christchurch City Council monitoring sites in the South West area from 2007 to 2011. The metals data up to 2002 was primarily from urban sites, including industrial developments and drains, whereas the more recent data includes a mix of drains and more natural waterways.

5.1 Overview of Surface Water Quality within Surface Water Plan Area

Water quality in the upper catchment was characterised by low water quality data from the catchment (up to 2002) was compared to typical stormwater Event Mean Concentrations (EMCs) reported by Williamson (1993) and relevant guidelines in order to assess potential effects.

This comparison showed that pH was typically near neutral (median: 7.6) and within acceptable ranges identified by organisations such as United States Environmental Protection Authority (USEPA). Conductivity and suspended solids concentrations were typically low.

Dissolved oxygen concentrations were generally above the Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) trigger value, and were broadly similar across the sites. Median BOD concentrations were generally low; however, elevated biochemical oxygen demand (BOD) was recorded at the Knights Stream, Saby's Bridge site (median: 9.6 g/m3), at the inlet (median 5.0 g/m³) and outlet of the Halswell Junction Retention Basin (median 8.7 g/m3).

Total ammoniacal nitrogen concentrations in the river were low and consistently below USEPA (1999) chronic toxicity criteria for the temperature and pH ranges detected in the river. Nitrate-nitrogen concentrations were elevated at several sites. The main source of nitrate-nitrogen was a groundwater spring, located somewhere between the two sample sites on the Knights Stream in the upper part of the catchment. Nitrate-nitrogen levels were shown to decrease with distance from this area.

Dissolved reactive phosphorus concentrations were typically elevated and often exceeded the concentrations identified in the New Zealand periphyton guidelines. Faecal coliform numbers were typically elevated with highest numbers found at the Nottingham Stream site (median: 1,500), but all sites showed a wide variation in numbers.

Limited water quality data (up to 2002) clearly indicate that metal concentrations in stormwater are currently high relative to environmental limits, particularly within network waterways servicing industrial catchments.

5.2 Areas of Good Water Quality

Water quality assessments have shown that while some sites in the Huritini / Halswell catchment have reasonable water quality, a significant number do not. Results to date suggest that relevant guidelines are being exceeded for a number of parameters and at a number of sites. Concerns relate particularly to elevated nutrient concentrations and elevated bacterial indicators (Enterococci/E.coli). Metal concentrations are at the lower end of the range reported in the literature for urban stormwater; however, recent water quality data (2007 to 2011) indicate that concentrations of zinc in particular typically exceed ECan water quality standards.

The Huritini / Halswell River at Akaroa Highway site had better water quality than other sites with median lead and zinc concentrations that met ECan guidelines for Spring-fed – Plains waterways; median copper concentrations were slightly above the relevant ECan guidelines.

5.3 Areas of Poor Water Quality

The following are areas where poor water quality results have been recorded:

- Nitrate-nitrogen is elevated within the Knights Stream, the source of which is believed to be a groundwater spring.
- Knights Stream headwater exceeds the (ECan) zinc concentrations for spring fed plains.
- Elevated BOD has been recorded at the Saby's Bridge site in the Knights Stream.
- Metals concentrations in the industrial area near the Halswell Junction Retention Basin are elevated, which is to be expected given the landuse of the area.

5.4 Management Recommendations

- Investigate and manage the source of bacterial indicators and nutrient concentrations in the catchment.
- Improvement in the water quality of tributaries should be undertaken, as this could create substantial benefits downstream in the mainstem.
- Target retrofitting stormwater infrastructure in industrial catchments to improve water quality from these utility drains.
- Given the impact of stormwater runoff was apparent, the focus of the SMP should be stormwater treatment facilities throughout the catchment, particularly for zinc (manage type of roofing material used and/or require treatment for roofing materials).

6.0 Instream Sediment Quality / Kounga Parakiwai

6.1 Overview of Instream Sediment Quality within Surface Water Plan Area

A survey of sediment quality within the upper Huritini / Halswell River catchment involved the collection of samples from 19 sites. This survey assessed the physical characteristics of the sediments, along with metal and polyaromatic hydrocarbon (PAH) concentrations.

Physical characteristics of sediments are known to influence the level of natural or anthropogenic contaminants detected in two ways. The first is that very fine particles with high surface areas relative to their size can absorb and concentrate contaminants, and the second is that coarse sands can dilute contaminant concentrations through their poor sorption characteristics as well as the low concentration of many elements in minerals such as quartz.

The physical characteristics of the sediments collected in the Huritini / Halswell catchment showed that the tributaries of the river typically contained coarser sediments than those in the neighbouring Ōpāwaho/ Heathcote River. The sediments in the Huritini / Halswell River were dominated by fine sand and mud.

Within the upper Huritini / Halswell catchment, sediments from urban catchments had higher concentrations of metals than the mixed and background (rural) catchments (See following figure). The mixed land use sites were all in the main stem of the river, and the catchment was predominantly rural, with some upstream urban influences.

Samples collected from the main stem of the river did not exceed ANZECC (2000) sediment quality guidelines. This indicates that there is low risk of adverse effects to aquatic organisms in the river from the presence of copper, lead, or zinc.

The concentrations of PAHs in the catchment, in all three land use areas, were typically lower than those in the neighbouring Ōpāwaho/Heathcote catchment. At all sites the concentration of PAHs were below the ISQG-low ANZECC guidelines.

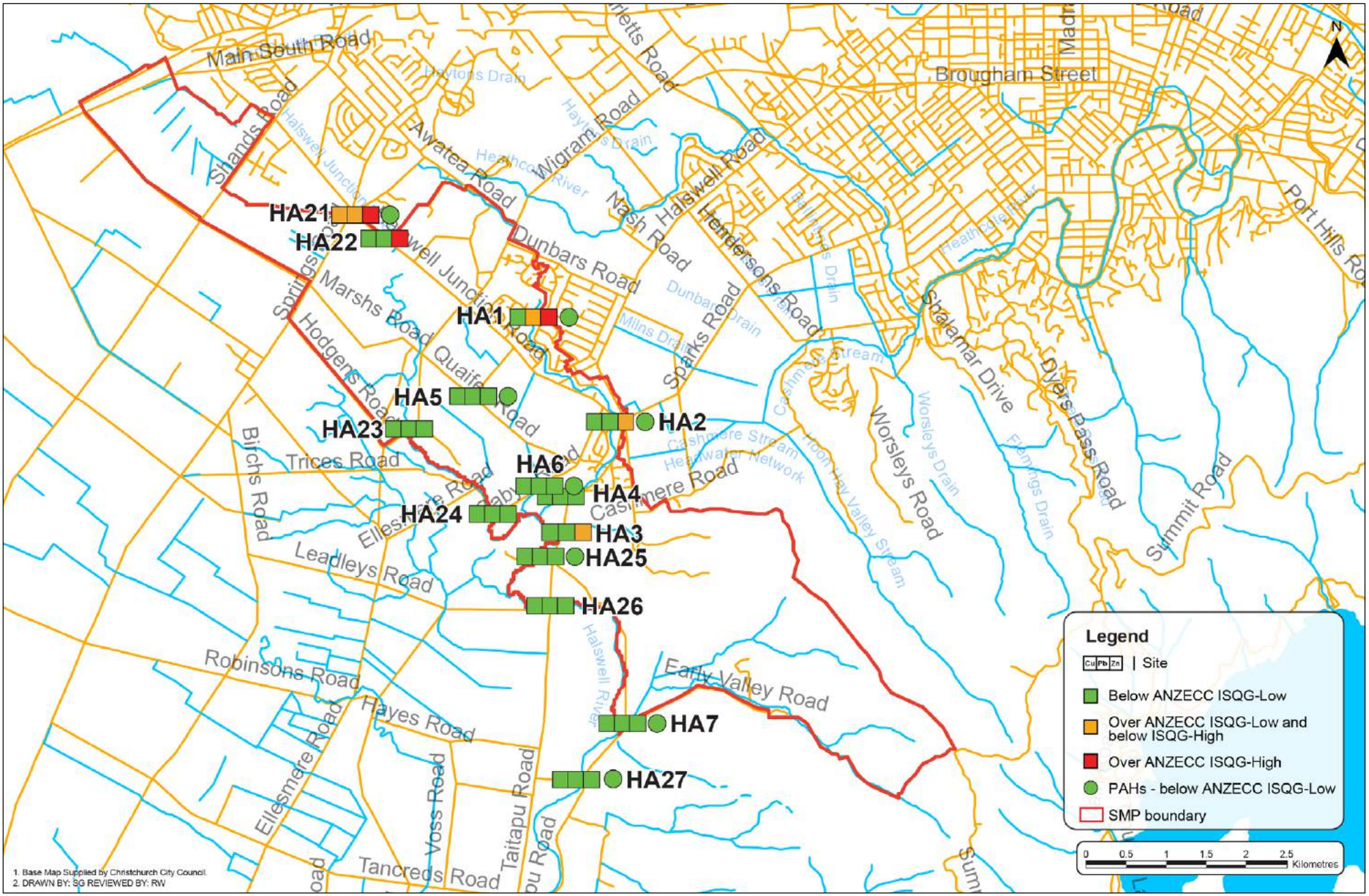
6.2 Areas with Good Sediment Quality

Certain sites within industrial areas in the Huritini / Halswell catchment are significantly degraded with regard to metal contamination in stream sediments. Metal concentrations commonly exceed ANZECC (2000) sediment guidelines at these sites. The exceedance of the ANZECC (2000) sediment guidelines provides an indication that current sediment quality at these sites may be degraded to levels sufficient enough to influence the quality of the aquatic biological community inhabiting the sediments.

6.3 Areas with Poor Sediment Quality

Concentrations of the key metals copper, lead and zinc were generally lower in the Huritini / Halswell River and tributary sediments compared to those in the Ōpāwaho/Heathcote catchment. In the Huritini / Halswell catchment, the sediment texture appeared to have some influence on metal concentrations.

All sediment samples from the main stem of the river and four of nine tributary sites complied with ANZECC (2000) sediment guidelines for copper, lead and zinc. The tributary sites with the best sediment quality were Nottingham Stream (upstream of Candys Road), Quaifes Drain, Creamery Drain and Jones Creek.


HA21
HA22
HA1
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HA26
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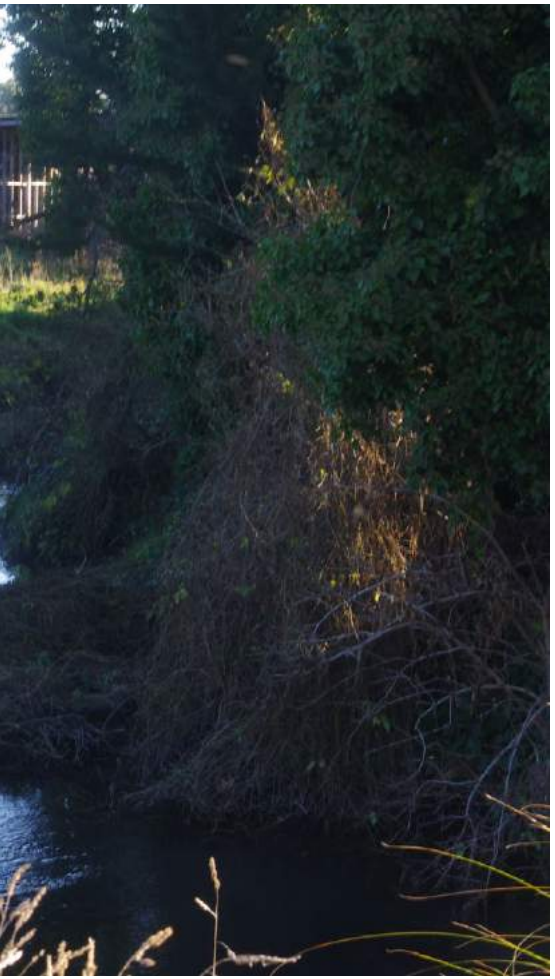
HA27
Main South Road
Shands Road
Awatea Road
Dunbars Road
Wigram Road
Nash Road
Halswell Road
Hendersons Road
Sparks Road
Marshs Road
Hodgens Road
Quaifes Road
Trices Road
Birchs Road
Leadleys Road
Robinsons Road
Hayes Road
Ellesmere Road
Voss Road
Taitapu Road
Tancreds Road
Cashmere Road
Early Valley Road
Brougham Street
Shalamar Drive
Dyers Pass Road
Worsleys Road
Summit Road
Port Hills Road
Halswell River
Cashmere Stream
Heathcote River
Worsleys Drain
Milns Drain
Dunbars Drain
Haytons Drain
Legend
Cu Pb Zn | Site
Below ANZECC ISQG-Low
Over ANZECC ISQG-Low and below ISQG-High
Over ANZECC ISQG-High
PAHs - below ANZECC ISQG-Low
SMP boundary
0 0.5 1 1.5 2 2.5 Kilometres
N
1. Base Map Supplied by Christchurch City Council.
2. DRAWN BY: SG REVIEWED BY: RW

6.4 Management Recommendations

- Catchment-wide measures to control pollutants, such as source control and treatment devices, particularly in areas with high contaminant concentrations, due to the increase in metals observed since the 1980's.
- Control of roading material entering stormwater system and waterways in areas where coal tar was used; given the extensive damage done during the earthquakes, it would be pertinent to develop a management plan to minimise the loss of contaminated material into the stormwater and stream systems during roading reconstructions.
- Sediment toxicity testing to elucidate effects of contaminants on freshwater fauna.
- Further studies to investigate contaminant sources in hotspot areas (from current and historical inputs).
- Removal of sediment to remove contaminants in system.
- Testing of sediments at sites not sampled.
- Event based testing (in both streams and stormwater networks) to determine localised contaminant sources.

Huritini / Halswell River



Huritini / Halswell River

7.0 Flood Risk / Mōrea Waipuke

7.1 Nature of Flooding

The Huritini / Halswell River catchment is a predominantly rural area of 190 km^2 draining the Christchurch suburb of Halswell in the north and farmland in Selwyn District south to Te Waihora / Lake Ellesmere. The approximately 23 km^2 that lies within Christchurch City is urbanised.

The nature of flooding in the Huritini / Halswell River catchment comprises four distinct components:

- Widespread inundation of low-lying pasture for long periods after moderate to extreme long duration storms.
- Inundation of pasture around the shores of Te Waihora / Lake Ellesmere before the gravel bar near Taumutu is breached to lower the lake level.
- Nuisance flooding of Halswell properties along Nottingham Stream during extreme storms.
- Rapid storm runoff from the Port Hills causing erosion followed by flood ponding and sedimentation around the toe of the hills.
- Occasional surface ponding of groundwater in low-lying areas within Knights Stream catchment during spring in years when seasonal groundwater levels are particularly high.

7.2 Catchment Modelling

Environment Canterbury developed a rudimentary computer flood model of the Halswell catchment in the early 1980s. Subsequently, Council modelled the headwaters only in more detail for the South-west Christchurch SMP. From time to time ECan have updated the catchment-wide model which sets the downstream boundary conditions for the Council model. The last update was made in 2014.

Lateral spread and bed heave suffered during the 2010 earthquakes significantly reduced the channel capacity beyond Halswell. Despite dredging that has restored the channel capacity to pre-quake conditions, the river overtops its banks in many locations during two to five year return period events. This results in widespread inundation of farmland in the river floodplain.

The modelling has confirmed that critical storms are long duration, low intensity events. A critical duration of 60 hours was adopted for stormwater detention facilities in the Huritini / Halswell River SMP.

7.3 Flood Mitigation in Nottingham and Knights Streams Catchments

Nottingham and Knights Streams catchments lie almost entirely within Christchurch City. This area is a major centre of new urban growth. Stormwater runoff from new residential and industrial subdivisions is treated in large downsteam treatment and detention basins prior to discharge to the streams, to groundwater and to rural drains to mitigate adverse flooding effects from new urban growth. Runoff from the Westlake catchment in old Halswell is also intercepted and treated in basins downstream.

Detention basin facilities north-west of Springs Road and north-east of Halswell Junction Road discharge by soakage to groundwater. Facilities closer to the Port Hills discharge to surface receiving waters.

Full flood attenuation (FFA) is required for all storms up to the 2% AEP event on the flat. Extra-over partial flood attenuation (PFA) is the standard for developments on the hills. Under PFA the additional urban runoff from new development only is captured in detention basins.

7.4 Te Waihora / Lake Ellesmere Flooding

The Huritini / Halswell River discharges into Te Waihora / Lake Ellesmere which has no natural outlet to the sea. Environment Canterbury and Te Rūnanga o Ngāi Tahu hold the consent for lake opening and control the lake water level within a consented level range. Once the lake level exceeds its maximum an artificial outlet is cut through the gravel bar near Taumutu to allow the lake to empty to its minimum level. The lower reaches of the river are controlled by the lake level. Widespread inundation of land around the shores of the lake that is grazed occurs when lake levels are high.

Flooding on the Huritini / Halswell River floodplain near Landowne Valley

8.0 Stormwater Contaminants / Paitini Wai Āwhā

8.1 Contaminated Land

There are additional risks to groundwater and surface water contamination associated with stormwater discharges from contaminated sites during construction of any development. To avoid this risk, consent conditions are proposed stating that there will be no discharges from construction areas listed on ECan's Listed Land Use Register (LLUR), or from sites which ECan identifies as being contaminated or having a high risk of being contaminated.

Similarly, there is a risk of additional contaminants becoming entrained in the discharges if stormwater treatment facilities are located on contaminated sites. Council does not propose to locate any stormwater treatment facilities on sites which are listed on the LLUR, or identified by ECan as being contaminated or having a high risk of being contaminated and consent conditions are proposed to confirm this.

8.2 Contaminant Load Model

Stormwater contaminants are derived from a number of sources in the upper Huritini / Halswell River catchment such as road surfaces (vehicles on roads); impervious surfaces such as pavements, driveways, parking areas, industrial site yards; building roofs and walls, with the amount of contaminants present varying according to landuse. Information on the concentration of stormwater contaminants enables stormwater managers to evaluate the likely stormwater loads from different catchments within their administrative areas. This information can be used for indicating locations where stormwater may cause adverse effects downstream or where stormwater treatment devices would be most efficient and cost effective.

Priorites for stormwater quality treatment identified in the SMP (CCC 2014) were heavy metals (zinc and copper), nutrients (nitrogen and phosphorus), hydrocarbons and bacterial contamination.

A contaminant load assessment study was undertaken for Council in July 2007, which modelled the four development scenarios (including existing development levels) described in the table below.

Scenario	Description	Timeline
0	Existing Development 2004	2004
1	Permitted in City Plan	2008
1a	Identified in City Plan	2012
2	Sustainable for 2024 growth predictions	2021
3	Maximum possible development	2054

The land use type and area (ha) associated with each scenario was:

Scenario	Land Use Type and Area (Ha)					
	Commercial	Industrial	Rural	Residential	Open Spaces	Roads
0	6	231	2063	178	98	128
1	6	261	1968	244	98	128
1a	6	326	1823	274	136	139
2	6	410	516	1031	489	251
3	6	599	467	887	479	266

8.3 Contaminant Load Modeling (CLM) Results

Under the maximum possible development scenario, total suspended solid loading are expected to increase up to 84.8% on the plains and decrease loadings by up to 12.8% in the hill sub-catchment. Sediment deposition in waterways will cause a significant impact on ecological values within the catchment, and so will require significant reduction via mitigation measures, in order to meet waterway objectives.

In brief, under the maximum possible development scenario the following results are predicted for loads within the receiving waterways, if no mitigation measures are implemented:

- Copper loads would increase by up to 142.3% at the most downstream point of the river, and up to 362% in other receiving water locations (i.e., mainstem and/or tributaries).
- Zinc loads would increase by up to 176.9% at the most downstream point of the river and by up to 776.5% in other receiving water locations.
- PAH loads would increase by up to 190.3% at the most downstream point of the river and by up to 157% in other receiving water locations.
- Total petroleum hydrocarbon (TPH) loads would increase by up to 82.6% at the most downstream point of the river and by up to 167% in other receiving water locations.
- Total nitrogen (TN) loads would increase by up to 32.8% at the most downstream point of the river and by up to 88.8% in other receiving water locations.
- Total phosphorus (TP) loads would increase by up to 184% at the most downstream point of the river and by up to 210% in other receiving water locations.
- Litter loads would increase by up to 52.7% at the most downstream point of the river and by up to 139.1% in other receiving water locations.

In general the results show significant increase in contaminant loads with increased levels of urbanisation, with zinc, copper, PAH and TPH of particular concern. The results indicate that total suspended solids would initially decrease as a result of the completion of residential development on the Port Hills and that sediment loads on the Canterbury Plains slowly increase as a result of residential development under Development Scenarios 1a to 3.

9.0 Stormwater Management Plan (SMP) Mahere Wai āwhā

In order to meet stormwater discharge consent requirements set by ECan, the Council has developed the Huritini / Halswell SMP (separate to this document) to maintain and where appropriate improve existing water quality in the receiving waters. The existing stormwater network is extremely varied and generally consisting of small pipes to open drains and waterways. The current approach is to develop a drainage network based on waterways along green corridors and to limit the amount of piping as much as possible.

The older urban parts of the catchment typically do not have any form of water quantity or quality mitigation. The area serviced by the Halswell Junction Retention Basin is an exception. The more recent subdivisions were required to provide mitigation of water quantity and quality of stormwater discharges. Stormwater mitigation has been based on grassed soil adsorption basins (retention basins) that discharge to ground where suitable hydrogeological conditions exist, and dry detention basins discharging slowly to surface waterways elsewhere. In general, the water quality mitigation is based on capturing and treating runoff from the first 25 mm of each rainfall event, although some earlier systems are based on 15 mm capture. Mitigation of water quantity effects varies greatly, although more recent systems are based on detention or retention of a 2% Annual Exceedance Probability (AEP) event, which is equivalent to a 50 year return period event.

Following an assessment of water quality mitigation options, Council has adopted the option of providing water quality mitigation via soil adsorption basins where suitable soakage conditions exist, and first flush attenuation basins followed by wetlands (or wet ponds) where soakage is not feasible. The adopted mitigation option for water quality will be integrated with water quantity mitigation to form the surface water management scheme.

The choice of mitigation facilities within the different sub-catchments has been strongly influenced by the following factors:

- Water quantity mitigation requires large detention and retention basins to be constructed and therefore water quality mitigation can be located within the land purchased for water quantity.
- The adopted option must have regard to strategies for other values for the South-West Christchurch Area Plan such as recreation, landscape, cultural, heritage, and ecology (aquatic and terrestrial). While other mitigation options (i.e., filtration systems) may exist that can meet the sole requirements for water quality, they cannot meet these other important values that Council must consider to better ensure high ecological and amenity outcomes.
- Council has significant experience in designing and maintaining soil adsorption basins, sedimentation basins, wetlands and wet ponds.

The mitigation strategy also includes the provision of contingency measures or systems to be inserted into the treatment train to cater for any unexpected water quality results. The mitigation strategy is also designed to be flexible, so it can respond to a variety of land use changes and land use types, as well as site restraints (e.g., that may prevent ponds and wetlands from being constructed), and still achieve the receiving environment objectives.

The key design principles for the development of a surface water management scheme are:

- It is fundamentally a 'natural' system, avoiding the over-use of pipes, concrete channels, and pumping stations. As such it will require significant maintenance but not replacement. This approach is consistent with the sustainability principles of the Resource Management Act (RMA).
- Significant land areas are required for the water management facilities, possibly up to 10%, in some instances, of the developed land area for quality and quantity combined. This is much greater than what has been required previously for management of waterways (approximately 1%), where waterway corridors made no provision for stormwater treatment

or for storage. Maximum possible integration of land use with other needs, such as recreational open space, will help to reduce the land cost associated with water quantity and quality treatment by reducing the need for buffer zones. Much of the scheme's water quantity mitigation area could be used for other purposes, such as recreational areas, because ponding would only occur during infrequent, more severe rain events.

- The proposed facilities are typically large and designed to serve large areas, rather than having a proliferation of smaller facilities. Generally, the facilities are clear of the waterway channels (i.e., not 'inline'), although often adjacent to these channels.

- The proposed facilities include several that also treat the adverse effects of earlier developments ('retro fit').

- There is a continuous network of pipes, swales and waterways connecting all facilities. These provide for trickle discharge from soakage facilities, slow release from full flood attenuation (FFA) basins, and secondary emergency overflow paths. This drainage network could also provide the basis for 'green corridors' that satisfy other values.

- Some of the standards being used and solutions being proposed will represent a significant 'raising of the bar' in terms of the level of mitigation being provided and the resulting cost.

A surface water management scheme will consist of water quality (stormwater treatment) and quantity (flood mitigation) components. Hydrological and hydraulic modelling has predicted that the adopted approach will reduce existing flood levels in the neighbouring upper Ōpāwaho/Heathcote River, and the assumption has been made that the same outcome can be expected for the upper Huritini / Halswell River. The soil adsorption basins or sedimentation basins and associated wetlands (or wet ponds) are constructed as part of a treatment train with detention basins downstream.

Longhurst Subdivision

Stallion Reserve, Halswell

9.1 Facilities and Devices in the Stormwater Management Areas

Proposed measures for major subcatchments within the upper Huritini / Halswell River catchment are summarised for each stormwater management area (SWMA) in the following sections. There are instances where a SWMA includes sub catchments from neighbouring Heathcote River catchment.

9.1.1 South-Halswell – Kennedys Bush

This SWMA comprises Knights Confluence, Halswell Quarry, and Lansdowne Valley sub-catchments. Development is mainly limited to the Halswell Quarry sub-catchment, which is currently partly developed on the northern side. The Knights Confluence and Lansdowne Valley sub-catchments are largely undeveloped rural land.

Drainage of the undeveloped rural land is predominantly by soakage to ground, with runoff occurring through ephemeral waterways which discharge to the river. Wetlands within the Halswell Quarry Reserve remain wet during low rainfall periods, probably as a consequence of shallow groundwater in this area. Development of 6 ha on the hill side of the Halswell Quarry sub-catchment has been mitigated with the use of 'Oderings Pond' at the base of the hill.

The preliminary surface water management scheme proposes to develop further facilities to mitigate surface water quality and quantity effects from the proposed land use changes identified in Development Scenario 2. The proposed facilities consist of detention basins, first flush basins, and wetlands.

9.1.2 Knights Stream South-West Halswell

This SWMA comprises Creamery Stream, Cases Drain, Nottingham Stream, Nottingham Headwaters, and Chesmars Drain sub-catchments, as well as parts of the Knights Stream Headwaters and Marshs Road sub-catchments. Development of the catchment is almost complete on the eastern side (Nottingham Headwaters, Nottingham Stream sub catchments) compared to the rural and completely undeveloped land on the south-western side of the catchment (Chesmars Drain and Cases Drain sub-catchments).

Existing drainage in the rural areas is predominantly through Knights Stream or Marshs Road Drain and other tributaries. Some of the waterways are ephemeral, while others are permanent. Current drainage in the developed Nottingham Stream and Nottingham Headwaters sub-catchments is by pipework to Nottingham Stream. An area of 15 ha to the north-west of Nottingham Headwaters is piped to a soil adsorption basin in the corner of Westlake Reserve, for soakage to ground. This facility was installed in 2005.

The preliminary surface water management scheme proposes to develop further facilities to mitigate surface water quality and quantity effects from the proposed land use changes identified in Development Scenario 2. The proposed facilities consist of detention basins sized to the FFA 2% AEP standard.

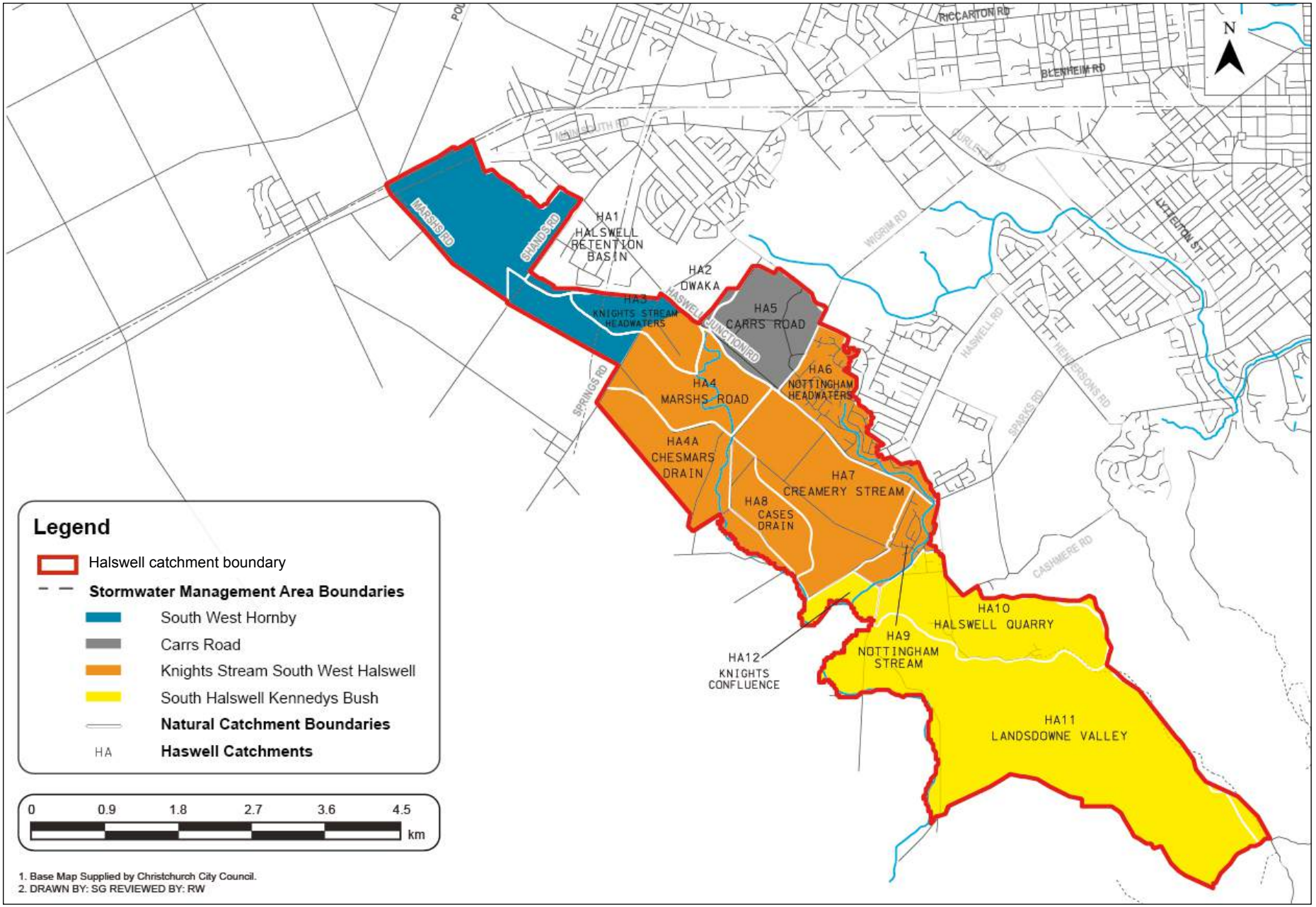
9.1.3 South-West Hornby

This SWMA is comprised of two sub-catchments (Halswell Retention Basin and West Hornby), and parts of two further sub-catchments (Knights Stream Headwaters and Marshs Road). Development of the area is mainly industrial, with the proposed motorway alignment planned to pass through the Knights Stream Headwaters sub-catchment.

In addition to natural ground soakage, the South-West Hornby sub-catchment has engineered ground soakage facilities for individual sites. At present stormwater runoff is conveyed through pipework to the existing Halswell Junction Retention Basin from all sub-catchments except for Marshs Road sub-catchment, which drains excess runoff into the Marshs Road Drain. The retention basin, built in 1990, was designed to fill and overflow in an extreme event into the headwaters of Knights Stream. There has been an on-going issue with leakage from the pond above a certain reduced level. Eventually discharge from the basin will be redirected via Owaka Basin into the Opawaho/ Heathcote River catchment.

The preliminary surface water management scheme proposes to develop further facilities to mitigate surface water quality and quantity effects from the proposed land use changes identified in Development Scenario 2. The proposed facilities consist of soil adsorption basins (with or without under-drains) and detention basins sized to the FFA 2% AEP standard.

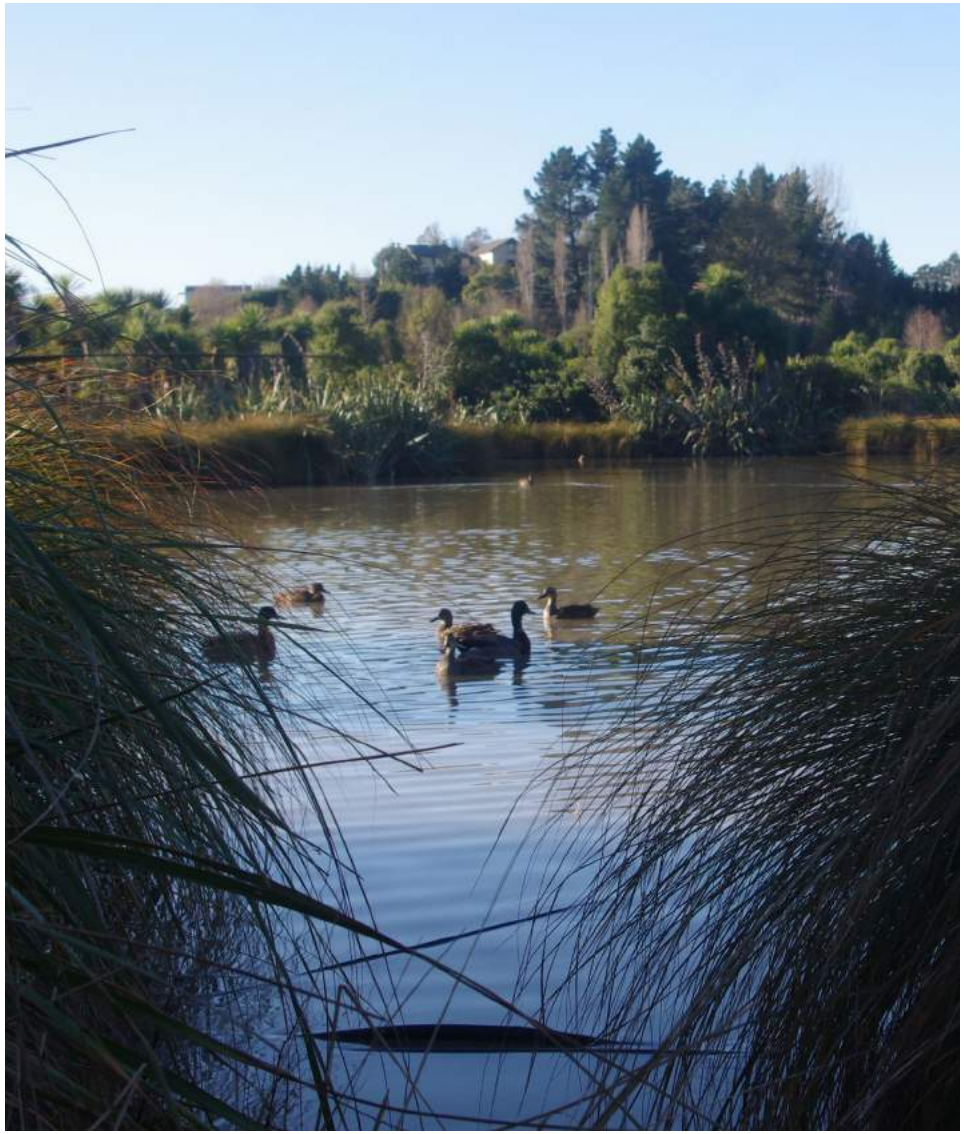
Huritini / Halswell Stormwater Management Areas



9.2 Realistic Outcomes

Implementation of the SMP will be undertaken over a long period (35 years or more). The projection assumes that the construction of facilities (and associated expenditure) will be sporadic due to other planning and infrastructure constraints which impact on land development staging. The programme for the design and construction of facilities will need to be closely aligned with associated planning and infrastructure programmes, to ensure facilities are created ahead of land development.

The implementation of the SMP represents a significant investment to ensure effective management of the catchments and mitigation of potential adverse effects. The implementation of the key measures of the SMP are summarised in the table opposite.



Halswell Quarry Reserve

SMP Measure	Timeframe	Comments
Level of service	The level of service is provided in the subdivision design and is implemented at the time of subdivision construction.	Level of service is subject to review and change.
Environmental education	Implement progressively in conjunction with Environment Canterbury and CWMS Zone Committee.	Awareness of environmental effects of building materials, effects of poor industrial practices and general environmental and waterway awareness.
Industrial stormwater and site management	Implement progressively over five years in conjunction with Environment Canterbury.	Environment Canterbury Pollution Prevention Guide, source control and individual site permitting.
Stormwater quality and quantity mitigation (SWMS and contingency measures)	SWMS Implemented progressively prior to any development.	SWMS will be finalised once the final land use is known following the city plan process is completed.
	Contingency measures may be implemented where water quality does not meet receiving environment objectives.	Measures can be implemented in existing and new areas.
Sediment and erosion control for construction of new subdivisions and other developments	Draft plans will be developed and provided with subdivision consent applications and finalised during detailed design and prior to construction.	
Low impact design and source control	Implemented progressively. SWMS elements implemented as part of the SWMS other initiatives will be developed over time in conjunction with Environment Canterbury.	
Waterway enhancement programmes	Implemented under existing waterway enhancement programmes as waterways are prioritised. Natural Asset Management Strategy identifies waterways within South-West Christchurch.	
Green Print initiatives and land use controls	Implemented progressively with development and over time.	
Monitoring and reporting.	Implemented prior to development for baseline conditions.	
Further investigations.	Implemented as required or when receiving environment objectives are not met.	
Operation and Maintenance (develop and implement plans) of stormwater systems.	Plans developed prior to construction of facilities and implemented after construction.	
SMP Reviews.	Implemented as required or when receiving environment objectives are not met.	

10.0 Supporting Technical Investigation Reports / Pūrongo Hangarau Anō

Christchurch City Council and contracted consultants have carried out a large number of investigations which have been summarised and incorporated into the Huritini / Halswell River SMP. The relevant investigations and reports are listed in the table below.

In addition, a range of 'Phase 1' reports were prepared by Christchurch City Council in 2007 and 2008 as background reports to the South West Area Plan.

Report	Organisations Involved	Report Reference
Pilot Study Stage One, South-West Christchurch SMP Technical Report No. 1	Kingett Mitchell Limited and Pattle Delamore Partners Limited	Kingett Mitchell (2005b)
Sediment Quality Survey, South-West Christchurch SMP Technical Report No. 2	Kingett Mitchell Limited	Kingett Mitchell (2005a) Appendix C of the AEE
Aquatic Values and Management, South-West Christchurch SMP Technical Report No. 3	Aquatic Ecology Ltd, EOS Ecology Ltd and Kingett Mitchell Limited	EOS et al. (2005) Appendix D of the AEE
Water Quantity Assessment, South West Christchurch SMP. Technical Report No. 4	Kingett Mitchell Limited, Christchurch City Council, Pattle Delamore Partners Limited (Groundwater Appendices) and NIWA (Surface Water Modelling Appendices)	Golder (2011a) Appendix E of the AEE
Water Quality Assessment, Golder 2011b South West Christchurch SMP. Technical Report No. 5	Kingett Mitchell Limited, Pattle Delamore Partners Limited (Groundwater Appendices)	Golder (2011b) Appendix F of the AEE

Nottingham Stream

11.0 References / Kōhiko Kōrero

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