WAI CONNECTION
TATAI KI TE WAI

MOUNTAINS TO SEA CONSERVATION TRUST

EOS ECOLOGY

TE AWA KAIRANGI/HUTT RIVER

FOCUS CATCHMENT MAP SERIES

A map-based overview of the general known state of your focus catchment

APRIL 2025

Focus catchment © Greater Wellington Regional Council

Produced by EOS Ecology
for 'Wai Connection – Tatai Ki Te Wai'

© EOS Ecology / www.eosecology.co.nz

Publication 1 / Edition 1

DISCLAIMER – The information contained in this document has no official status and does not constitute official advice. Further, this information is not intended to replace or serve as a substitute for the official documents cited within or any other official guidance. While every effort has been made to ensure the information in this document is accurate at the time of publishing, we make no representations or warranties as to the accuracy of the information. We do not accept any responsibility or liability to any person for error of fact, omission, interpretation or opinion that may be present, nor for any consequences of any decisions based on this information, on any ground, including for any loss, damage or expense that may arise. All references to websites and organisations not within EOS Ecology are for convenience only and should not be taken as endorsement of those websites or information contained in those websites nor of organisations or people referred to. We do our best to ensure all links are current at the date of publication. However, we cannot guarantee that external websites or documents will remain accessible or unchanged over time. If you encounter any broken links or outdated information, please let us know. EOS Ecology accepts no responsibility or liability for any loss, damage or costs relating to actions made as a result of reading or in reliance on the information provided in this document. You should not rely upon the information in this document as a basis for making business, legal, or other decisions.

© COPYRIGHT – All maps, infographics and photographs within this publication are copyright of EOS Ecology or the credited photographer. They may not be used without permission.

RECOMMENDED CITATION – EOS Ecology 2025. Te Awa Kairangi/Hutt River Focus Catchment Map Series – April 2025. EOS Ecology, Christchurch. 99p.

Produced by & © EOS Ecology

Contents

Produced by & © EOS Ecology

Purpose of this resource

This map series provides an overview of the general known state of your 'Wai Connection – Tatai Ki Te Wai' (www.waiconnection.nz) focus catchment. We've gathered together existing information available from national and regional datasets – displaying it in relation to your specific focus catchment area. This information includes a mix of:

1. modelled information mapping – available at a national level, plus
2. site-specific data – survey information actually collected in your region.

The majority of data has been obtained from publicly available online sources which anyone can access – we've just presented it in one cohesive package, and provided additional interpretation so you can better understand what it may mean for your catchment.

The intention of this map series is to:

- summarise the present state of the catchment in terms of waterway classifications, geology/soil types, land cover, protected areas etc.
- summarise the past state of the catchment in terms of vegetation types
- show the location of actual survey data for waterway water quality and ecology (fish and invertebrate data), and summarise this data based on key grouping variables.

This information will help you:

- better understand your catchment as a whole
- identify knowledge gaps and explore possible future directions to fill them
- identify what appear to be the key issues or challenges for your catchment
- inform decisions around catchment priorities/interventions that should help with improving the health of your waterways.

Explaining modelled information

Each map provides further information on where the displayed data was obtained from, and a brief explanation of how the information used was modelled if it's not based on actual data. While we wouldn't expect all modelled information to be accurate at a site level, it can still give you an idea of the patterns across your catchment – therefore helping you understand the state of your entire catchment.

NOTE: Where you feel the modelled information shown on the map deviates substantially from what you can actually see at the site, you can use these maps as a means to further discussions between your catchment group and your Regional Council about the value of developing updated map layers based on actual data – to a level that would be accepted by regional authorities in their wider use. As we're using modelled information consistently available at a national level, this information may vary slightly from what your Regional Council may use if they are using regionally-specific datasets.

Caveats on use

The map series and related information presented here are intended as an open forum of information and knowledge sharing. It is not intended to be used in any regulatory process or to disadvantage users or landowners in any way in such processes. We also acknowledge that the majority of information presented in this map series has been sourced from publicly available online sources, or directly from your Regional Council. On each map we indicate where the map layer information has come from. Finally, much of the information presented is sourced from national- or regional-level datasets, and are unlikely to be suitable for fine-scale use e.g., work done at land parcel and smaller scale.

While every effort has been made to ensure the information in this document is accurate at the time of publishing, the information included here (which does not purport to be comprehensive) has been compiled by us and has not been independently verified. While this information has been prepared in good faith, no representation, warranty, assurance or undertaking (express or implied) is or will be made and no responsibility or liability is or will be accepted by us, our officers, employees or agents in relation to the adequacy, accuracy, completeness or fairness of the information presented, or of any other information (whether written or oral), notice or document supplied or otherwise made available by us to any interested party. We do not accept any responsibility or liability to any person for error of fact, omission, interpretation or opinion that may be present, nor for any consequences of any decisions based on this information, on any ground, including for any loss, damage or expense that may arise. EOS Ecology accepts no responsibility or liability for any loss, damage or costs relating to actions made as a result of reading, or in reliance on the information provided in this document. You should not rely upon the information in this document as a basis for making business, legal, or other decisions.

These maps are to provide you with a greater understanding of how your catchment and its waterways function. They are not intended to meet the needs of the 'Catchment Context, Challenges and Values' (CCCV) for a Freshwater Farm Plan (FWFP), as defined in the regulations. The CCCV work will be undertaken by your Regional Council and made available to the public based on a regional rollout across the country.

Further information:

- Report: MfE (2023), available at https://environment.govt.nz/assets/publications/Freshwater/Guidance-on-preparing-catchment-context-challenges-and-values-information.pdf

Produced by & © EOS Ecology

WAI CONNECTION™ TATAI KI TE WAI

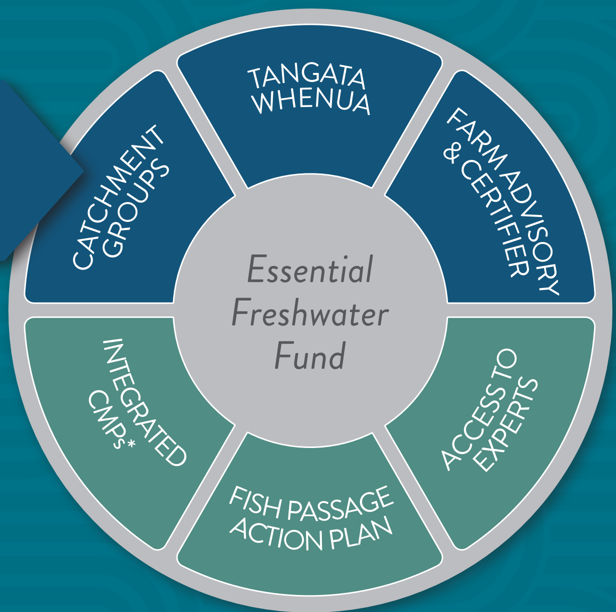
This map series has been produced with funding from ‘Wai Connection – Tatai Ki Te Wai’ (www.waiconnection.nz).

‘Wai Connection’ is a Mountains to Sea Conversation Trust (MTSCT) community catchment group engagement project. The project offers on-the-ground support to assist with catchment issues through tailored, catchment-specific change. It works to build community involvement, equity, and a shared vision of ecological sustainability as the basis of a healthy community.

‘Wai Connection’ is supporting the Government’s *Essential Freshwater (EF)* package, which is part of a new national direction to protect and improve our rivers, streams, lakes, and wetlands. ‘Wai Connection’ helps empower community catchment groups by providing knowledge, tools and expert support to help identify issues in their local catchment. We connect people with their waterway, and promote collaboration between local catchment groups, NGO’s, hapū/iwi, Regional Council, Central Government, and primary industry working within the catchment – helping deliver on the aims of the *EF* package.

The *EFF* covers six focus areas, with ‘Wai Connection’ sitting within ‘Catchment Groups’:

* CMPs = Catchment Management Plans



Produced by & © EOS Ecology

MOUNTAINS TO SEA CONSERVATION TRUST

Mountains to Sea Conservation Trust is the National Project Support Team for ‘Wai Connection’.

The Northland-based Mountains to Sea Conservation Trust (MTSCT) (CC23406) was established in 2002, as a charitable umbrella for the Experiencing Marine Reserves (EMR) marine education and Whitebait Connection (WBC) freshwater education programmes. The Trust sees education as a vital part of society and central to all environmental restoration.

Both programmes involve young people, their parents and the wider community. Their goal is to empower and support communities to achieve marine and freshwater conservation through science based experiential programmes, resources, projects and community engagement.

The above three images © Tasman Bay Guardians

EOS ECOLOGY SCIENCE + ENGAGEMENT www.eosecology.co.nz

EOS Ecology is the National Technical Support Team provider for ‘Wai Connection’. As part of this national support we have developed this map series that tells the ecological story of each focus catchment for catchment groups supported by ‘Wai Connection’.

EOS Ecology provides industry-leading expertise in surface water ecology, engagement and science communication. Our science team specialises in freshwater ecology, estuary/coastal ecology, riparian ecology, sedimentation, restoration, and GIS. The science team is complemented by our science interpretation, graphic design, written communication and engagement experts.

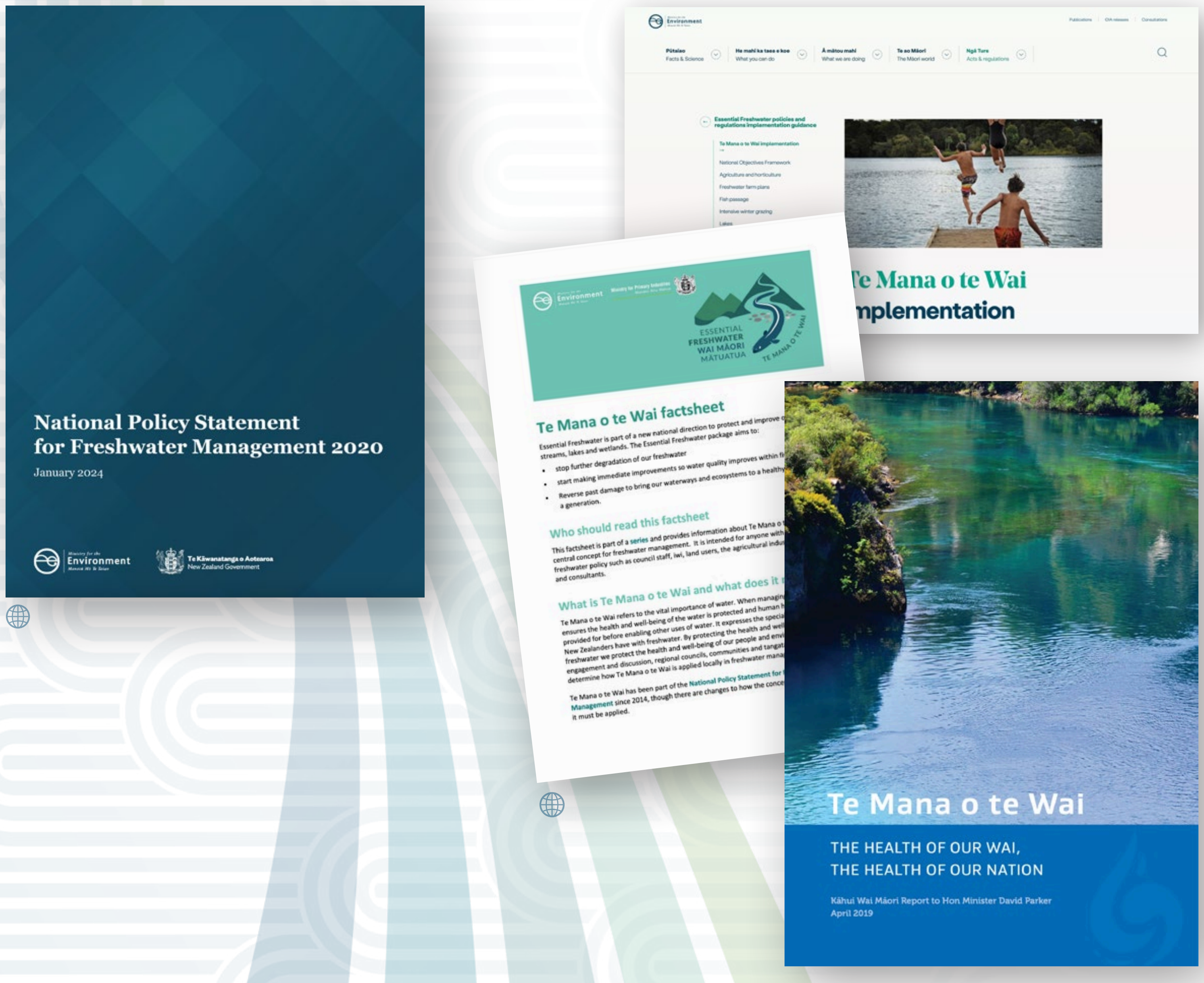
Since 2001, our team of scientists and science communicators have worked towards environmental improvement around New Zealand. We also use this expertise to educate and engage – developing and delivering participatory science programmes to school students of all ages, and working with community groups towards positive environmental outcomes. We’ve been working with MTSCT since 2016.

The above three images © EOS Ecology

Te Mana o te Wai

Te Mana o te Wai, or mana of the water, is about recognising the vital importance of clean, healthy water for maintaining the health of our water bodies, freshwater ecosystems, and the communities that rely upon them for their sustenance and wellbeing.

An integral part of the *Essential Freshwater (EF)* package is recognising and implementing the principles of Te Mana o te Wai. Te Mana o te Wai recognises the life-supporting capacity of freshwater, the connection all New Zealanders have with freshwater, and places it at the centre of all decision making. Following this approach prioritises the health and wellbeing of water bodies and freshwater ecosystems, followed by the health needs of people, then the ability of people and communities to provide for their social, economic, and cultural wellbeing, now and into the future.



The National Policy Statement for Freshwater Management 2020 (NPS-FM 2020; New Zealand Government, 2024) presents six principles of Te Mana o te Wai, which describe the rights and responsibilities of those involved in freshwater management. These principles are as follows:

» **Mana whakahaere** – the power, authority, and obligations of tangata whenua to make decisions that maintain, protect, and sustain the health and well-being of, and their relationship with, freshwater.

» **Kaitiakitanga** – the obligation of tangata whenua to preserve, restore, enhance, and sustainably use freshwater for the benefit of present and future generations.

» **Manaakitanga** – the process by which tangata whenua show respect, generosity, and care for freshwater and for others.

» **Governance** – the responsibility of those with authority for making decisions about freshwater to do so in a way that prioritises the health and well-being of freshwater now and into the future.

» **Stewardship** – the obligation of all New Zealanders to manage freshwater in a way that ensures it sustains present and future generations.

» **Care and respect** – the responsibility of all New Zealanders to care for freshwater in providing for the health of the nation.

Further information

» https://environment.govt.nz/acts-and-regulations/freshwater-implementation-guidance/te-mana-o-te-wai-implementation

Wanganui River, West Coast © EOS Ecology

Produced by & © EOS Ecology

Ki uta ki tai
A catchment-based approach

Ki uta ki tai is the recognition and management of the interconnectedness of the whole environment – from the mountains, springs and lakes, down the rivers to hāpua/lagoons, groundwater, wahapū/estuaries and to the sea. This catchment-based approach, and understanding the effects of the use and development of land on a whole-of-catchment basis, helps us to better manage our catchments in an integrated way.

How a catchment works:

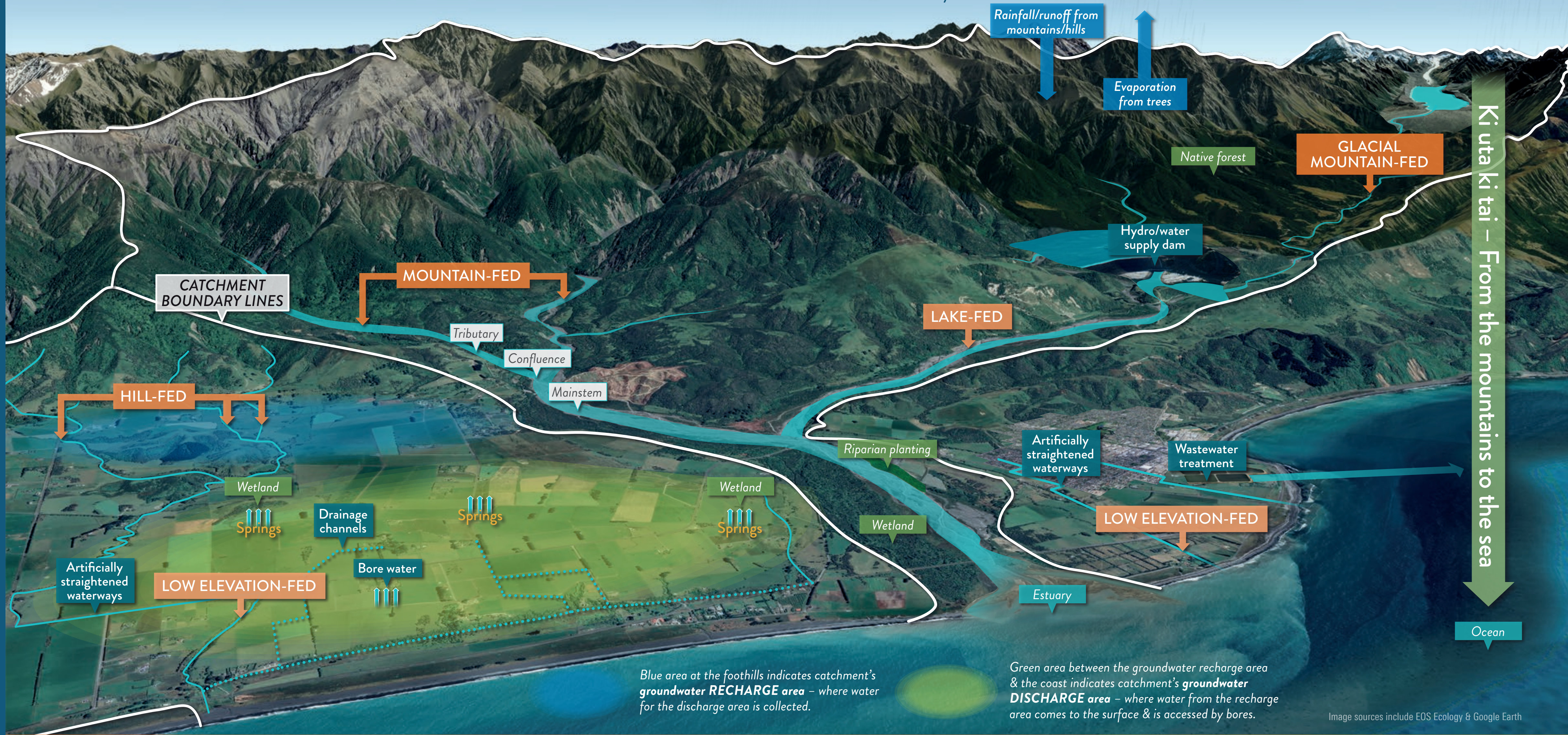
All rainfall in a catchment runs off the surface of the land (called surface water) and flows downwards towards the lowest point of the basin – which could be a stream, river or wetland. Every catchment or subcatchment has one major waterway (called the mainstem) that every other waterway flows into. These smaller waterways are called tributaries, and they carry water from all areas of the catchment – eventually merging together and flowing into the mainstem. Surface waterways can be classified by their main water source, which is often based on topography. The main sources of flow are glacial mountain, mountain, hill, low elevation, and lakes.

Catchments also include the water flowing below the ground (called groundwater). Groundwater gets filtered through porous underground materials, which is why it flows much more slowly than surface water. Rainfall increases the amount of groundwater by soaking through the land in a process called recharge. Groundwater can resurface to become surface water via springs. This happens in a number of ways depending on the geography and geology of the catchment.

Produced by & © EOS Ecology

Source of flows in freshwater catchment areas

This infographic summarises the natural processes that takes place within freshwater catchments and the different sources of flow for waterways.



Waterway source of flow classifications

GLACIAL MOUNTAIN-FED

Source of flow is from glacial mountain terrain. Strong seasonal pattern of flows: typically low flows in winter (when the water is locked up in ice) whilst high flows extend further into summer (when ice & snow is melting). High turbidity due to fine glacial sediment (known as 'glacial flour') in the water. Typically a more disturbed system with a high amount of large flow events: very frequent high flood flows lead to unstable substrates & channels with wide, active gravel bed flood plains.

MOUNTAIN-FED

Source of flow is from mountainous terrain without glaciers. Strong seasonal pattern of flows: typically low flows in winter (when water is locked up in snow) & high flows extend further into summer (when ice & snow is melting). Naturally high suspended solids & sediment load. Typically a more disturbed system with many large flow events: very frequent high flood flows means unstable substrates & channels with wide, active gravel bed flood plains.

HILL-FED

Source of flow is from hill country terrain. Strong seasonal pattern: low flows in late summer, high flows in spring due to rainfall & snow melt. High to medium sediment loads depending on catchment geology & land use. Where the valley is broad so that the river channel is unconstrained, the channel morphology is characterized by unstable substrates & wide, active gravel bed flood plains; including braided river systems.

LAKE-FED

Source of flow is from large lakes. These have a more stable flow regime, low suspended solids & sediment load. Waterways fed by lakes typically a have a stable channel & substrate, which may be 'armoured' (i.e. large stable stones) due to winnowing of fine material & lack of bed sediment supply (which is entrained in the lake).

LOW ELEVATION-FED

Source of flow is from low elevation land. Very marked seasonal flow patterns: high in winter, low in summer. Low sediment supply. Often more stable, low-gradient, entrenched channels with low flow velocity & silty-sandy substrates. Water velocity during large flow events still remains low due to low channel slope.

Other waterway types

INTERMITTENT OR EPHEMERAL WATERWAYS

Not all waterways are perennial (have water all year round). Some will dry up for parts of the year. Intermittent refers to waterways that flow seasonally (i.e., they flow every autumn & winter). Ephemeral refers to waterways that only flow for short periods of time, usually after rain events. It is sometimes hard to identify an intermittent/ephemeral waterway if you are only seeing it during one season of each year – visiting a stream throughout the year will allow you to work out its flow permanency.

SPRINGS

Springs (& spring-fed waterways) typically have a stable flow regime (with no or negligible flood flows), low nutrient status in hill & mountain areas, or higher nutrient status when in catchments draining pastoral areas.

Freshwater springs

Aotearoa New Zealand is home to an abundance of freshwater springs, that are an important part of the water cycle, providing fresh water to humans and creating unique biodiversity hotspots. Springs found in Aotearoa range from cold-water springs (found across the country) to hot-water springs in geothermal regions (there are currently 129 identified geothermal areas nationwide). Aotearoa is also home to the largest cold-water springs in the Southern Hemisphere – Te Waikoropupū springs located in Tākaka.

Springs create a unique environment that supports stygofauna – aquatic invertebrates that are specially adapted to living in groundwater habitats. These unique invertebrates have evolved to a life in darkness and to the stable environment that typifies groundwater habitats, so they can be impacted by land use change and groundwater extraction.

Although the compilation of a spatial database of Aotearoa springs has been recommended as an important part of effectively managing spring habitats (Scarsbrook *et al.*, 2007), there is currently no comprehensive nationwide dataset available. Regional councils tend to have the best information available on springs in their area. For example, Environment Canterbury holds a database of 2000+ spring locations.

For the purposes of the Focus Catchment Map Series, springs data has been sourced from regional councils where available.

Refer to Section 2.2 of this FCMS for details and locations of the known springs in your catchment.

Groundwater is water found beneath the land's surface. These wet zones can be shallow (0–30 m below the surface) – and so more affected by changes to land – to deep (200+ m below the surface). Groundwater fills the spaces between sediment (ranging from fine silt through to gravels) and finds its way through gaps between particles and cracks in the rock. Groundwater becomes surface water once it's above the land's surface, e.g., in streams, rivers, lakes, wetlands, ponds, etc.

Aquifers are underground layers of rock or sediment that hold and allow the movement of groundwater through them (referred to as permeable). There are two types of aquifers:

» **Unconfined:** allows water to percolate down/through from the overlying layer of geology.

» **Confined:** when the groundwater is confined by an overlying layer of geology (such as dense clay), which restricts the movement of groundwater from above. This means water can only enter the aquifer through its recharge zone or through fractures in the confining layer.

Springheads are where groundwater emerges from below the land's surface. Springheads may form rivers or streams, lakes, ponds or wetlands where they emerge. These are the three spring types most likely to be found:

» **Gravity spring:** groundwater in unconfined aquifers moves downhill due to gravity and seeps through to the surface.
» **Artesian spring:** natural water sources from pressurised underground confined aquifers.
» **Seepage spring:** groundwater from aquifers (typically unconfined) slowly emerges through porous soil or rock layers.

See the graphic on the next page to see the different types of springs illustrated and explained in further detail.

Springs bubbling up through a sandy streambed. © EOS Ecology

Further information

» For more information about groundwater go to www.lawa.org.nz/learn/factsheets/groundwater/groundwater-basics

» For more information about geothermal areas in Aotearoa go to www.nzgeothermal.org.nz/geothermal-in-nz/nz-geothermal-fields

» Death, R., Barquín, J. & Scarsbrook, M. 2004. Biota of cold-water and geothermal springs. In: Harding, J., Mosley, P., Pearson, C. & Sorrell, B. (ed). *Freshwaters of New Zealand.* New Zealand Hydrological Society Inc. and New Zealand Limnological Society Inc., Christchurch. p30.1–30.14

» White, P., Clausen, B., Hunt, B., Cameron, S., & Weir, J. 2001. Groundwater-surface water interaction. In: Rosen, M. & White, P. (ed). *Groundwaters of New Zealand.* New Zealand Hydrological Society Inc., Wellington. p133–160.

» Scarsbrook, M., Barquín, J., & Gray, D. 2007. New Zealand coldwater springs and their biodiversity. *Science for Conservation 278*. Department of Conservation, Wellington. 72 p. www.doc.govt.nz/documents/science-and-technical/sfc278entire.pdf

Produced by & © EOS Ecology

Understanding freshwater springs

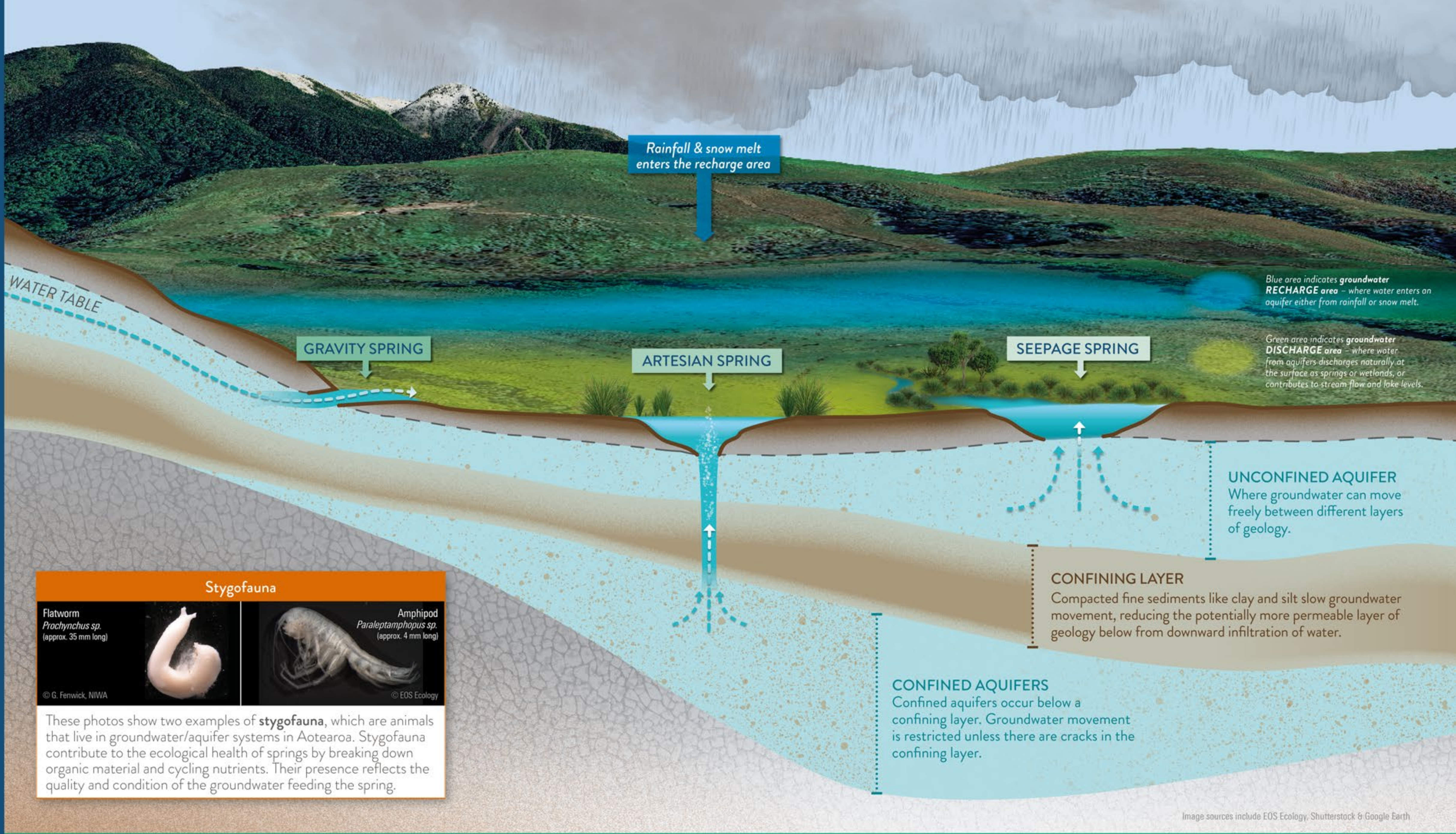
Freshwater springs are locations where groundwater emerges at the Earth's surface.

This transition from groundwater to surface water occurs in a variety of geological settings – meaning that springs can vary greatly in size and flow rate – but all tend to result in freshwater habitats characterised by more stable water temperatures and flow.

The water in springs is mainly fed by groundwater from underground aquifers. A groundwater catchment that feeds a spring rarely reflects that of the surface water catchment due to the complex nature of the underlying geology and flow paths. This means that the area of land influencing a spring can be larger or smaller than what's indicated by its surface water catchment boundary.

Because springs and spring-fed streams are fed by groundwater, any changes in groundwater quality or quantity can impact the surface water habitats and biodiversity at the springhead. If we're looking after springs and the surface water systems that they feed, we should not only adopt a surface water ki uta ki tai (mountains to the sea) catchment-based approach, but should also look outside of the surface water catchment boundary to where the springs recharge areas are. For example, if nutrients seep into groundwater either in or outside of the surface water catchment, they can result in high nutrient levels in spring-fed surface waters.

For more details on the connection between surface and groundwater refer to the 'Ki uta ki tai – A Catchment-based Approach' infographic on page 5, and the 'Nitrogen Cycle' infographic in Section 4 of this FCMS.



Types of springs *(these are three spring types most likely to be found)*

GRAVITY SPRING

- A **gravity spring** forms when groundwater from an unconfined aquifer gently moves to the surface under the influence of gravity. They are typically found at the base of hill slopes.
- Gravity springs can look like wet ground at the base of a hill slope.

ARTESIAN SPRING

- When groundwater is under pressure in a confined aquifer and has sufficient force to flow naturally to the surface, the resulting springs are known as **artesian springs**.
- The water from artesian springs makes its way to the surface through fractures in the confining layer, without the need for pumping.

SEEPAGE SPRING

- When groundwater emerges from a (typically) unconfined aquifer, the flow is typically more diffuse and not forced to the surface, resulting in a **seepage spring** when the water table is high.
- Seepage springs are commonly associated with wetlands and exhibit slow, gradual flow where groundwater meets the surface, without the pressure seen in artesian springs.

Produced by & © EOS Ecology

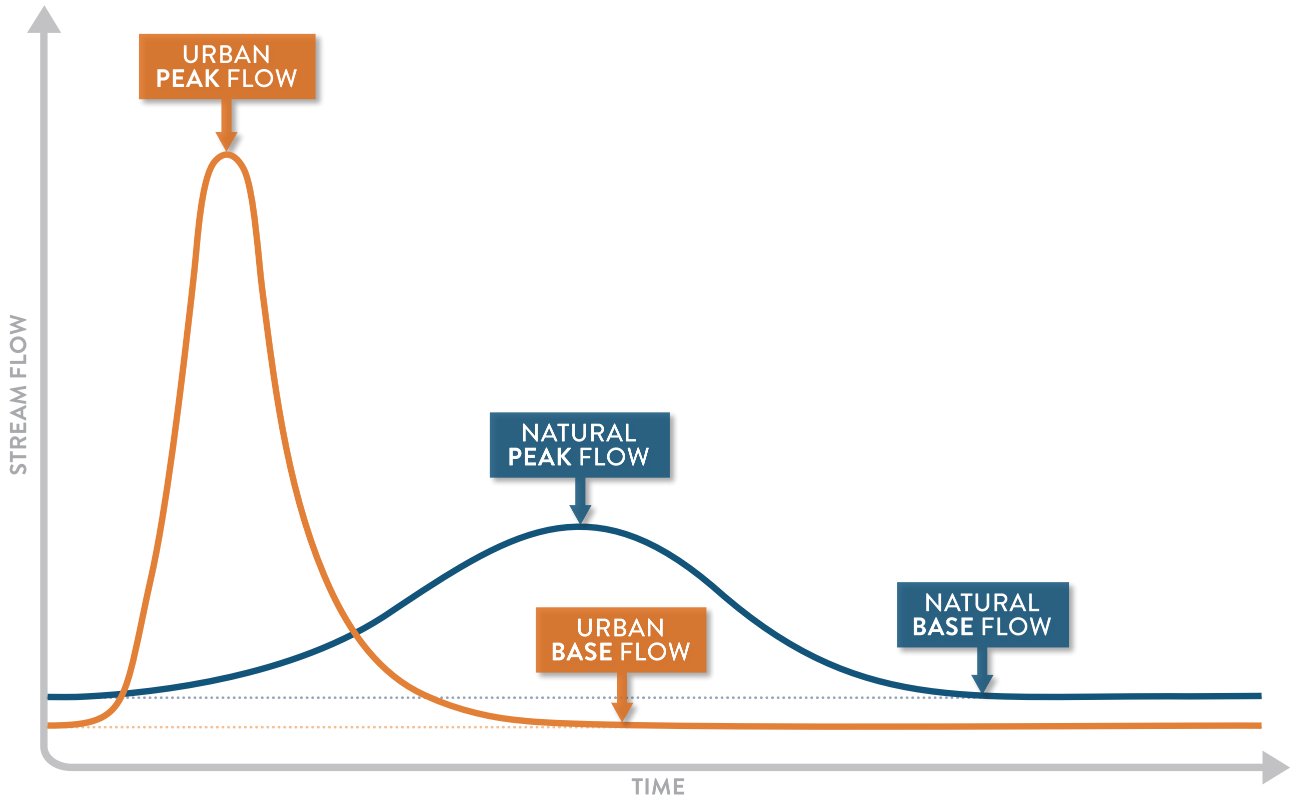
Stormwater systems

Stormwater is rainwater that runs off hard surfaces. The primary function of stormwater systems is to collect stormwater runoff and move it away from properties as quickly as possible to avoid flooding and damage to property. It's an efficient system of rainfall collection and transport, but it can impact on how streams in urban catchments function.

Altered flow regimes

Natural and urban water systems handle rainfall very differently, due to fundamental changes in how water moves through these environments (i.e., pervious vs impervious surfaces).

COMPARISON OF NATURAL VS URBAN WATER SYSTEM FLOWS



Natural water systems

Base flow in a natural stream is higher, meaning there is more water to sustain life.

Peak flow in a natural stream occurs much later in a rain event and is much lower in height due to the absorption capacity of the natural environment.

Urban water systems

Base flow in an urban stream is lower, meaning there is less water to sustain life.

Peak flow in an urban stream is much higher and occurs much earlier in a rain event due to impervious surfaces, reduced infiltration, and faster runoff.

Urban stream syndrome (USS)

Urban stream syndrome (USS) is a term used to describe the ecological degradation of waterways within urbanised areas. Waterways affected by USS display a particular set of symptoms, including flashy flows, elevated concentrations of pollutants, warmer water temperatures, straightened channels with simplified/homogeneous habitats, more fragmented habitats and support fewer species. Many of these symptoms are related to the changes brought about by urban stormwater such as:

- altered flow regimes
- pollutants
- disconnected riparian zone and flood plains
- simplified habitats
- fragmented habitats.

As urban streams change, the invertebrate population shifts – with mainly tolerant species (like snails, worms, and midges) surviving, while more sensitive insects (such as stoneflies, mayflies, and caddisflies) disappear. This pattern is consistent in urban environments worldwide.

Reducing the impact of stormwater & USS

Incorporating water sensitive urban design or green infrastructure into urban areas can help mitigate the effects of stormwater on urban waterways. It does this by slowing runoff through attenuation (reducing flow risk), and infiltration (trapping or reducing contaminants).

Rain gardens, vegetated swales, green roofs, permeable paving, rainwater tanks, detention ponds, and constructed wetlands are all examples of green infrastructure that can help to reduce the flashiness of urban stream flows, and to improve the quality of stormwater that's discharging to natural waterways.

While these examples may all operate at different scale within a catchment, their key features are an ability to slow, hold, and filter stormwater runoff from hard surfaces. Widespread integration of water sensitive urban design or green infrastructure can therefore help to reduce USS.

Further information

- Suren, A.M. 2000. Effects of urbanisation. In: Winterbourn, M.J. & Collier, K.J. (ed). *New Zealand Stream Invertebrates: Ecology and Implications for Management.* New Zealand Limnological Society, Christchurch. p260–288.
- Suren, A. & Elliott, S. 2004. Impacts of urbanisation on streams. In: Harding, J., Mosley, P., Pearson, C. & Sorrell, B. (ed). *Freshwaters of New Zealand.* New Zealand Hydrological Society Inc. and New Zealand Limnological Society Inc., Christchurch. p35.1–35.18.
- Walsh, C.J., Roy, A.H., Feminella, J.W., Cottingham, P.D., Groffman, P.M. & Morgan, R.P. 2005. The urban stream syndrome: current knowledge and the search for a cure. *Journal of the North American Benthological Society 24(3)*: 706–723.

Impacts of urban stormwater systems on natural water systems

Stormwater is rainwater that runs off hard surfaces in cities and towns, such as roads, rooftops, and driveways.

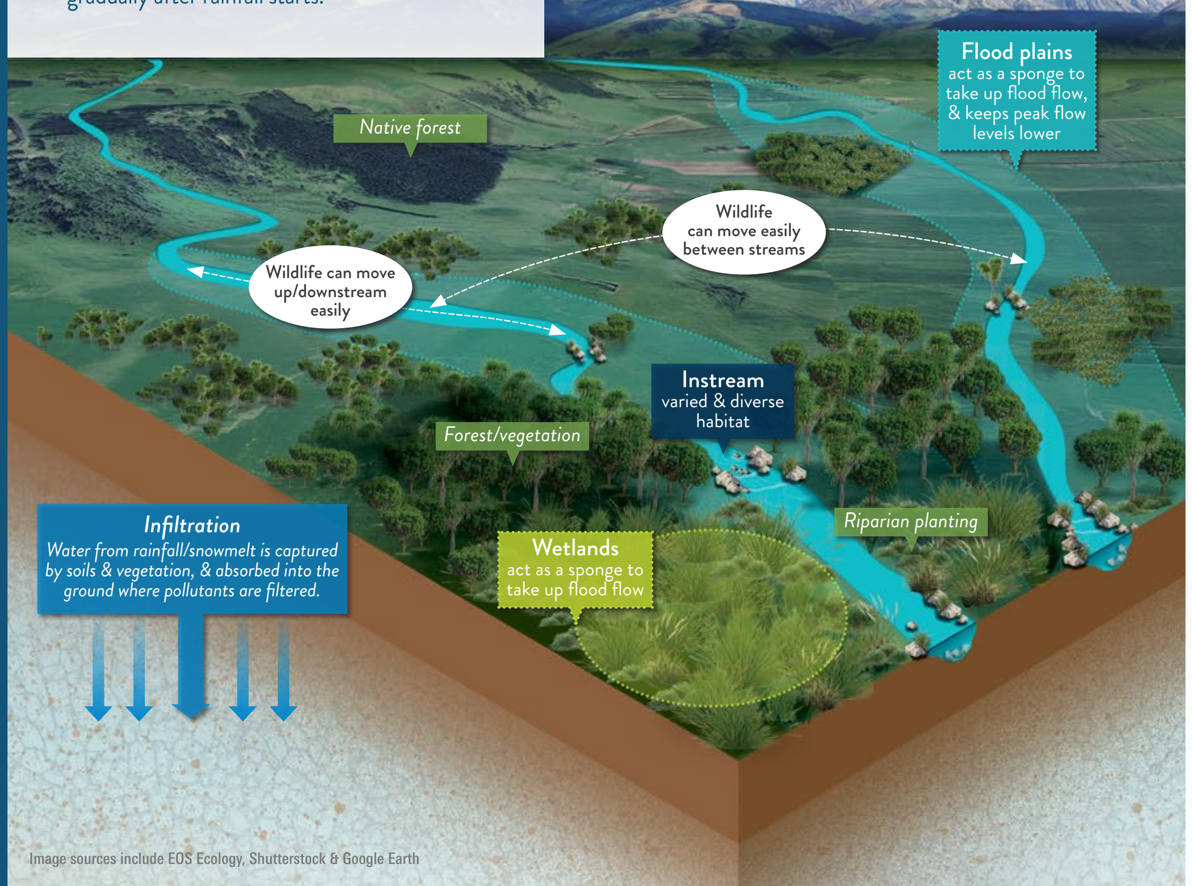
Unlike natural landscapes, these impervious surfaces prevent water from soaking into the ground.

Stormwater networks consist of hard infrastructure such as lined drains, pipes, pipe outfalls, culverts. These systems efficiently direct stormwater to nearby 'receiving environments' like waterways, lakes, or coastal areas.

This infographic summarises both natural & urban water systems.

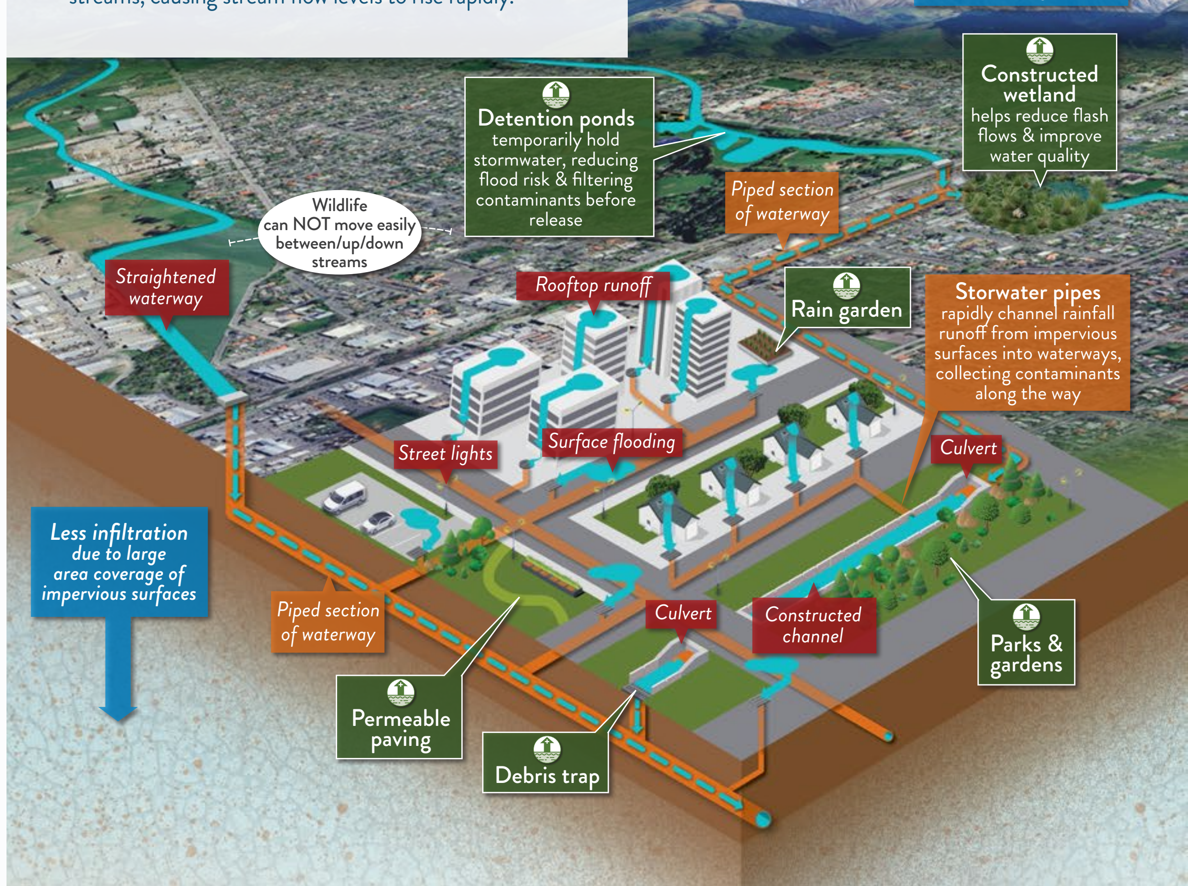
Natural water system

Rainfall is captured by soils & vegetation, stored by wetlands & lakes. It evaporates back into the atmosphere, is absorbed into the ground, or may spread out onto floodplains during rain events. It takes some time for rainfall to travel through a natural catchment before reaching surface water environments. This means that stream flow levels increase gradually after rainfall starts.



Urban water system

Urban areas are made up mostly of impervious surfaces (i.e., surfaces that don't absorb water). When rain falls on these impervious surfaces, water can't be slowed down, absorbed by plants, or soak into the ground. Instead, the rain runoff quickly collects pollutants, & flows into the stormwater network, which efficiently transports it to the nearest stream. Even a small rain event can send large volumes of stormwater into streams, causing stream flow levels to rise rapidly.

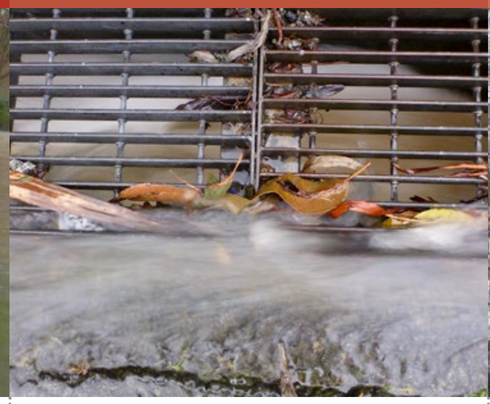


Symptoms of urban stream syndrome – *changes caused by stormwater networks in urban catchments*

ALTERED FLOW REGIMES

More impervious surfaces, and an efficient piped delivery of stormwater lead to altered flow regimes, resulting in lower low flows and more extreme and frequent flood flows (i.e., flashy flows). Low flows are exacerbated by widened waterways designed to accommodate flood flows, but providing even less water depth during base flows.

POLLUTANTS



During rain events pulses of contaminated water enter streams. This stormwater can contain pollutants such as heavy metals, fine sediment, and polyaromatic hydrocarbons. Water temperatures increase as a result of impervious surfaces heating up rainwater runoff, less riparian shade, and less water in the stream during base flow levels.

DISCONNECTED RIPARIAN ZONE & FLOOD PLAIN

The more stormwater pipes connecting the wider catchment to a waterway, the less influence the riparian zone has on a stream. This is partly because the process of riparian vegetation trapping overland flow is circumvented by stormwater pipes directing stormwater straight to the stream, waterways are constrained within deeper and wider channels, with less connection to a riparian flood- or fresh-plain, where water would naturally spread onto during elevated flow.

SIMPLIFIED HABITATS

With greater storm flows to deal with, streams are widened and straightened, meaning they have simplified or homogeneous habitats. This means they're unable to support diverse communities of living organisms, and provide fewer areas of refuge during storm flows.

FRAGMENTED HABITATS

Instream structures (e.g., culverts, pipes) act as potential barriers to the movement of fish and invertebrates. Streetlights and hard surfaces (e.g., roads, roofs) can confuse invertebrates and disrupt their life cycle.

Refer to Section 2.5 of this FCMS for a map of the stormwater network in your catchment.

Produced by & © EOS Ecology

1.

PARENT CATCHMENT – Overview

Area statistics

		Area		Combined waterway length over stream order 1[1] (>1)	
		ha	%[3]	km	%[3]
Country	Aotearoa New Zealand [2]	26,605,656	100.00	203,664	100.00
Island	Te Ika-a-Māui/North Island [2]	11,387,085	42.80	90,794	44.58
Region	Te Upoko-o-te-Ika-a-Māui/ Wellington	811,960	3.05	6,502	3.19
Parent catchment	Te Whanganui a Tara/ Wellington Harbour	117,469	0.44	875	0.43
Focus catchment	Te Awa Kairangi/Hutt River	63,922	0.24	510	0.25

1 Based on the River Environment Classification (REC) layer REC5.
2 Based on Land Information New Zealand (LINZ) NZ Coastlines and Islands Polygons (Topo 1:500k) layer.
3 Percentages may not total 100% due to rounding.

For information about 'stream order' (SO) see page 14.
NOTE: We've included SO1 in the data & maps following. This means the waterway length shown in them will be longer than in this table.


Focus catchment © Greater Wellington Regional Council

Parent catchment area information

Parent catchment	Te Whanganui a Tara/Wellington Harbour
Focus catchment	Te Awa Kairangi/Hutt River
Iwi & Iwi areas of interest *based on 'Iwi Areas of Interest' & iwi associated with 'Marae of Aotearoa' online layers from Te Puni Kōkiri/Ministry of Māori Development*	Ngāti Kahungunu, Rangitāne, Muaūpoko, Ngāti Toa Rangatira, Te Atiawa ki Whakarongotai, Te Atiawa, Taranaki Whānui ki te Upoko o te Ika, Ngāti Kahungunu ki Wairarapa - Tāmaki Nui ā Rua, Ngāti Awa
Marae *based on 'Marae of Aotearoa' from Te Puni Kōkiri/ Ministry of Māori Development)*	Pipitea, Te Tatau o Te Pō, Te Herenga Waka, Waiwhetū, Te Hau-ki-Tūranga
Regional Council	Wellington Region 100%
Regional Council Catchment Management Units (CMU) this falls within[1] *if known*	Te Awa Kairangi/Hutt River and tributaries
Regional Council Zone Committee *if relevant*	N/A
Territorial local authority	Kapiti Coast District 1%, Porirua City 1%, Upper Hutt City 46%, Lower Hutt City 31%, Wellington City 21%
Key catchment group this map series is produced for	Taranaki Whānui ki Te Upoko o Te Ika a Māui
Known groups[2] with an environmental interest *includes catchment groups/collectives, community groups, advocacy groups[3], iwi organisations[3], industry[3]/organisations[3]/ trusts[3]/societies[3] with an environmental focus*	Friends of Mawai Hakona Stream - Upper Hutt , Friends of Owhiro Stream, Friends of Waipāhihi Karori Stream - F.O.W.K.S., Friends of Waiwhetū Stream, Guardians of Tyers Stream (Kaitiaki o Waitohi), Pareraho Forest Trust, Te Hononga ki Te Upoko (Wellington Cathchments Collective), Chartwell Bush Forest & Bird, Wellington Branch, Predator Free Crofton Downs , Friends of Baring Head, Makaracarpas Restoration Group, MIRO, Moa Conservation Trust, Mt Albert Fenceless Sanctuary, Naenae Nature Trust, Places for Penguin (Wellington Forest and Bird), RAMBO (Rats and Mustelid Blitzing Otari), Remutaka Forest Park Trust, Tanera Gully Restoration Project, Te Motu Kairangi - MIramar Ecological Restoration, Trelissick Park Group, Upstream: Friends of Central Park, Karori Sanctuary Trust, Wellington Natural Heritage Trust, Wild Aro, Zealandia

1 Check with your council to see your CMU boundary.
2 Based on information obtained from online sources and a survey by 'Wai Connection' Provider Organisations.
3 Information is based on that available at the time via existing sources, and as such, some groups may be underrepresented.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Focus & Parent Catchment

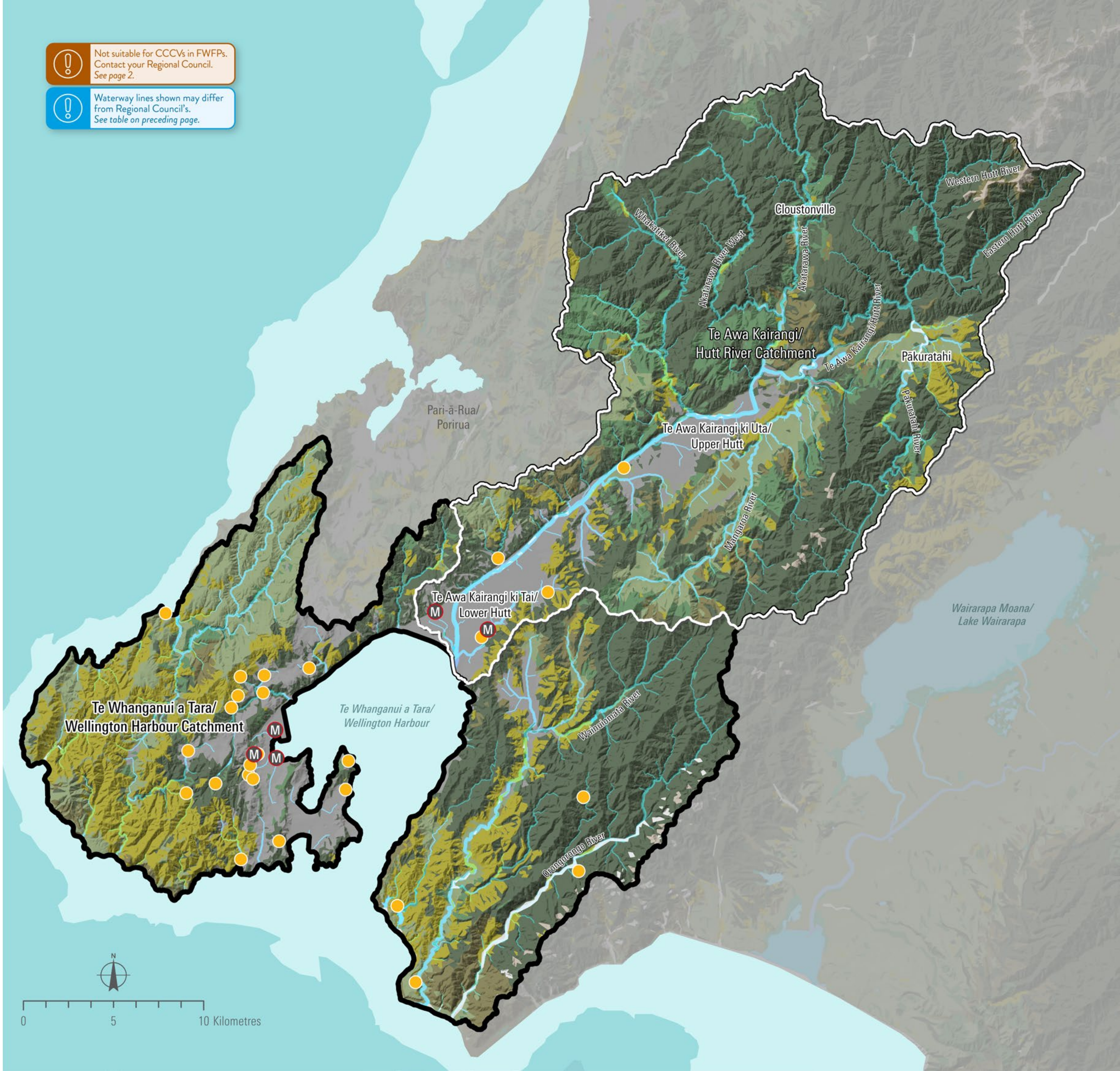
Catchment Map Series: Map 1.1

- Marae
- Known community catchment groups
- Waterways (stream order >1)

BOUNDARIES:

- Focus catchment
- Parent catchment
- Subcatchment

PLEASE NOTE: Legends may show items that are not present on the map. Refer to the data tables on the preceding page for what is present in your catchment, as this is what you will see displayed on the map.



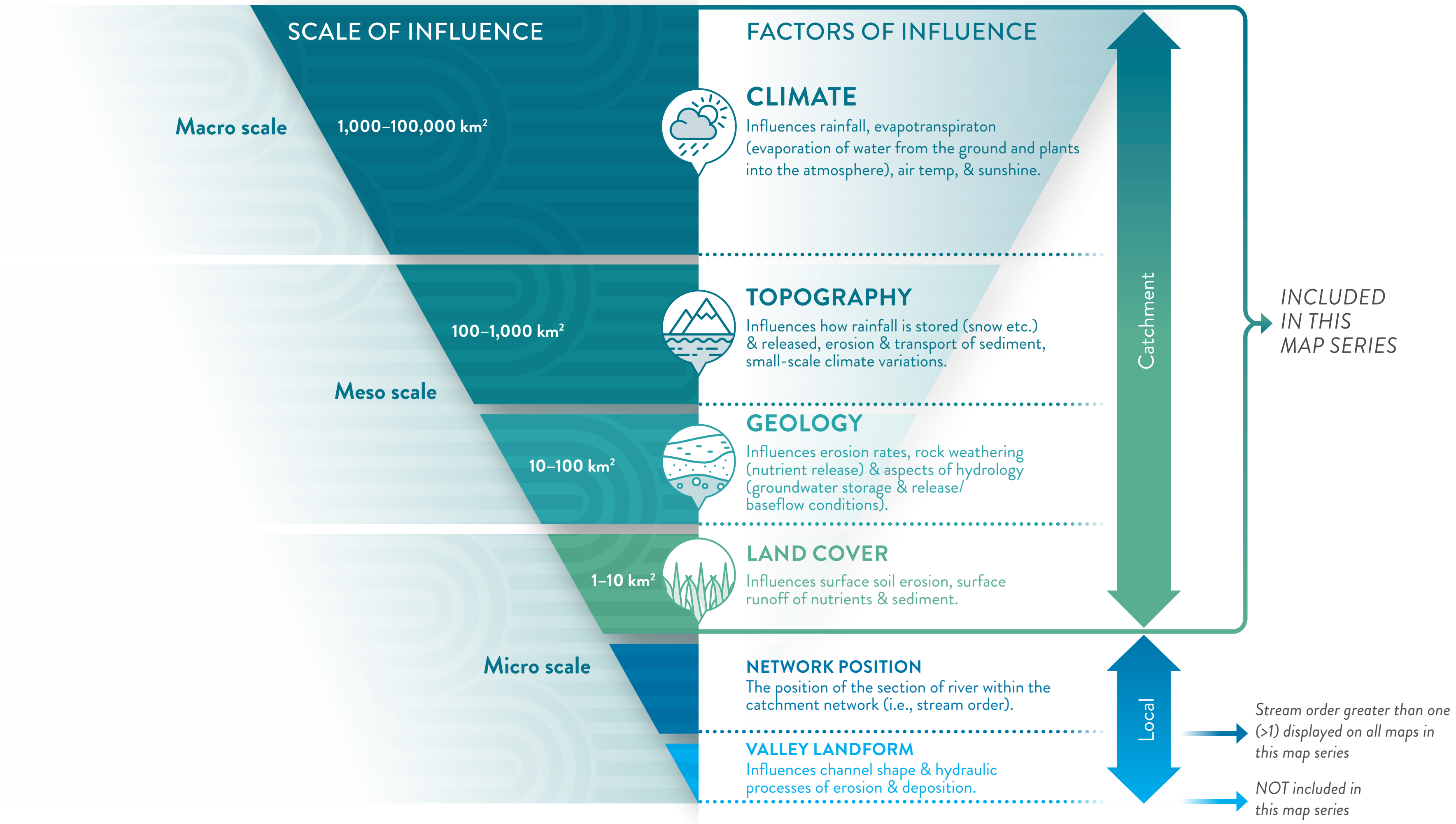
Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Marae (Marae of Aotearoa; Te Puni Kōkiri/Ministry of Māori Development), known community catchment groups (EOS Ecology), waterways (River Environment Classification (REC); NIWA), boundaries (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand) base map (LCDB v5; Maanaki Whenua/Landcare Research).

FOCUS CATCHMENT – Factors affecting catchment processes

The following maps show you the first four 'catchment level' classifications for the waterways within your focus catchment. The New Zealand River Environment Classification (REC) organises information about the physical characteristics of our rivers. Individual river sections are mapped according to physical factors such as climate, topography, geology, and catchment land cover. Sections of river that have similar REC classifications can then be grouped together, no matter where they are in the country, as they are influenced by similar catchment-level features.

Key factors that define the 6 REC classification levels



This REC-based information is mapped for New Zealand's entire river network – over 425,000 kilometres of waterway. Different types of waterways respond differently to the pressures placed on them – the REC can be used to identify the key characteristics of different river environments, allowing for tailored management strategies and approaches to reduce these pressures for each classification type.

Information from these four REC layers is also used in a variety of ways as follows:

- To help develop policy, plans, and regulations for waterways.
- Provide a framework for monitoring and assessing the health and condition of water bodies – by categorising rivers and streams, it enables consistent evaluation of environmental indicators.
- Contributes to water quality and 'state of the environment' reporting undertaken by Regional Councils.
- Can be a useful tool in assessing the vulnerability of different river environments to the impacts of climate change, helping with planning adaptation and mitigation measures.

Knowing what the first four REC classifications are for your waterways in your focus catchment will help you to better understand your catchment's waterways, and how they might be managed and monitored.

Further information

- Report: Snelder *et al.* (2010)

Produced by & © EOS Ecology

Focus catchment © EOS Ecology

2.1 Climate

This map uses modelled information to show the main climate class (the first of four 'catchment level' River Environment Classifications (REC)) associated with waterways in your catchment.

Climate influences rainfall, evapotranspiraton (evaporation of water from the ground and plants into the atmosphere), air temperature, and sunshine. The REC climate class layer is based on a subdivision of the country into six categories as the macro scale (1,000–100,000 km²), and is the largest scale REC layer.

Notes on limitations/use

» The REC waterway layer does not show the exact locations of waterway channels within the landscape, and is unlikely to be accurate at a site scale. Exercise caution when using the layer to locate a specific stream reach.

Summary of climate class categories in your focus catchment

Category	Proportion in focus catchment – Length (km)	Proportion in focus catchment – Length (%[1])	Further information[2] – Temperature	Further information[2] – Effective Rainfall
Warm-Extremely-Wet (WX)	0	0	≥12°C	>1,500 mm
Warm-Wet (WW)	37	7.35	≥12°C	500–1,500 mm
Warm-Dry (WD)	0	0	≥12°C	<500 mm
Cool-Dry (CD)	0	0	<12°C	<500 mm
Cool-Wet (CW)	303	59.45	<12°C	500–1,500 mm
Cool-Extremely-Wet (CX)	169	33.21	<12°C	>1,500 mm
No Data	-	-	-	-

1 Percentages may not total 100% due to rounding.
2 From Snelder *et al.* (2010).


Focus catchment © EOS Ecology

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Waterway line – colour *See table above.*	Indicates the key climate class for each REC segment of waterway.	Large-scale patterns in climate cause patterns in flow and temperature regime of rivers, as well as broad patterns in water quality. Waterways in catchments with higher rainfall have high flows and flood more frequently. Waterways with high rainfall tend to have higher water quality (due to greater dilution potential). Waterways whose catchments have low temperatures have lower maximum water temperatures, which reduces impacts on freshwater fauna.	Developed by NIWA as part of the River Environment Classification (REC) layer, and assigned using criteria related to mean annual precipitation, evaporation and air temperature of the catchment of each network section. The climatic data were provided by Manaaki Whenua/Landcare Research and are consistent with the climate data underlying the Land Environments of New Zealand (LENZ) classification system. Because of the partial independence of climate and topography, the REC uses direct measures of precipitation minus potential evapotranspiration and temperature to assign each network section to a climate category.
Waterway lines – thickness	Indicates the stream order (SO) from SO 2 upwards. The smallest stream order, SO 1, is not shown on the map.	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

These line weights represent stream order (SO) which relate to the relative size of the stream (the smallest, SO 1, is not shown on the maps).

The thicker the line = the larger the waterway, independent of the colour it's drawn in on the map.

SO 2
SO 3
SO 4
SO 5
SO 6
SO 7
SO 8

Produced by & © EOS Ecology

Te Awa Kairangi/Hutt River

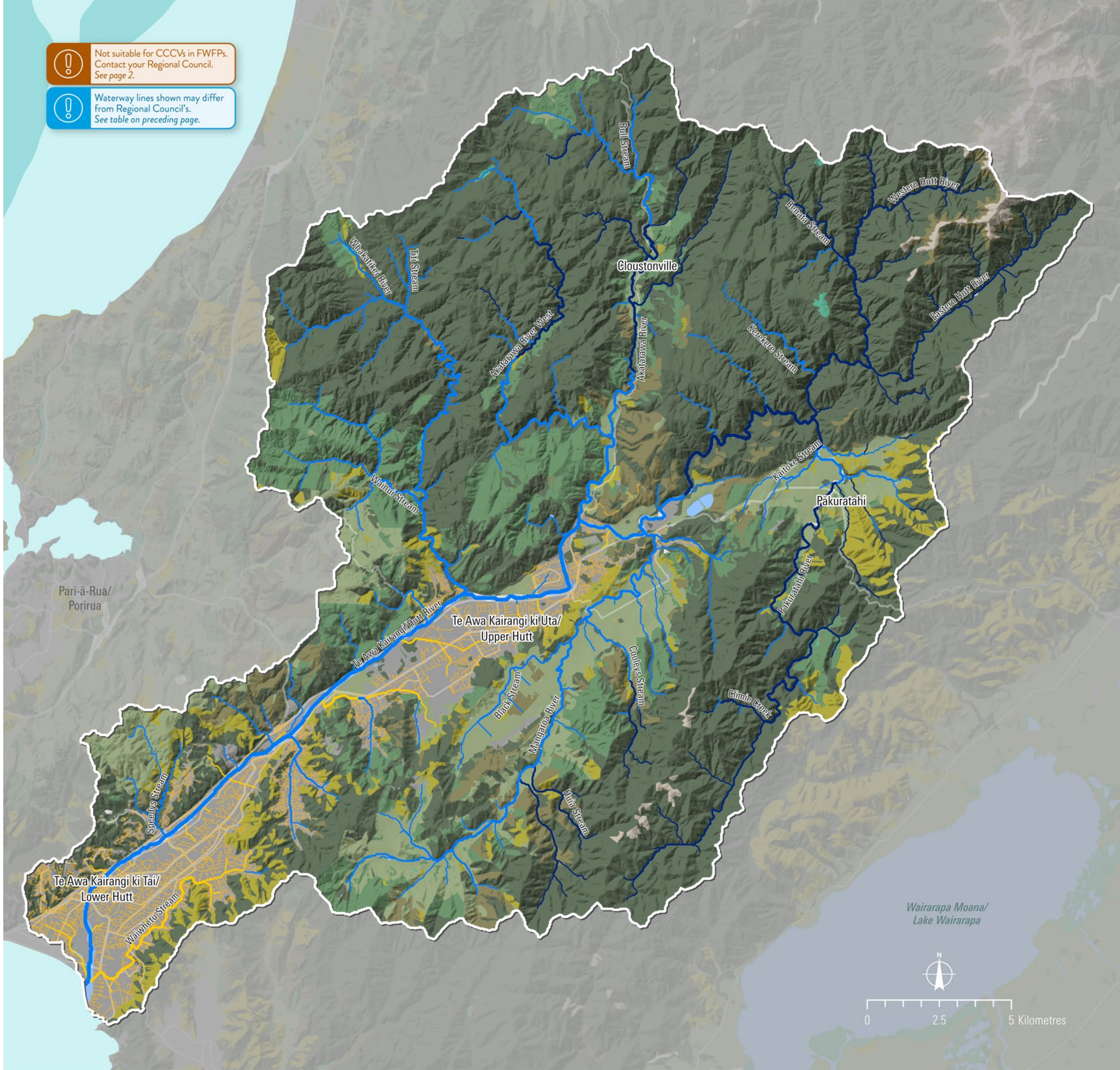
Climate Class

Focus Catchment Map Series: Map 2.1

Stormwater pipes
Roads
Focus catchment

CLIMATE CLASS: waterways (stream order >1)

- Warm-Extremely-Wet (WX)
- Warm-Wet (WW)
- Warm-Dry (WD)
- Cool-Dry (CD)
- Cool-Wet (CW)
- Cool-Extremely-Wet (CX)
- No Data



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: NIWA
- Key layer source url: https://data.mfe.govt.nz/layer/51845-river-environment-classification-new-zealand-2010
- Interactive map where this layer is used: https://shiny.niwa.co.nz/nzrivermaps
- Report: Snelder *et al.* (2010)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Climate class (River Environment Classification (REC); NIWA), waterways (REC; NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

2.2 Topography & flow types

This map uses modelled information to show the main topography/source of flow (the second of four 'catchment level' River Environment Classifications (REC)) associated with waterways in the catchment, and what level of flow permanency there may be.

Topography influences how rainfall is stored (snow etc.) and released, erosion and transport of sediment, and small-scale climate variations. The REC topography class layer is based on a subdivision into six categories at the meso scale (100–1,000 km²). Catchments are typically defined by their topography, which also helps to define the source of flow and waterway types within a catchment.

See page 5 for where the topography/source of flow types can be found in an indicative catchment, and further information about the topography class and flow permanency waterway types.

Notes on limitations/use

- The REC waterway layer does not show the exact locations of waterway channels within the landscape, and is unlikely to be accurate at a site scale. Exercise caution when using the layer to locate specific stream reach.
- There is some difficulty in accurately determining the ephemeral/intermittent nature of a waterway based on available online data sources. As such, the classification of 'ephemeral/intermittent' on the provided map should be considered with caution and confirmed on site.
- The springs layer only indicates springs that have been mapped by the indicated provider, and so may not show all springs within a catchment.

Summary of waterway topography class categories & estimated flow permanency for your focus catchment

Category		Proportion in focus catchment – Length (km)	Proportion in focus catchment – Length (%[1])	Further detail[2]
FLOW PERMANENCY (estimated for all stream orders)	Intermittent/ ephemeral flow	24	4.61	Intermittent refers to waterways that flow seasonally. Ephemeral refers to waterways that only flow for short periods of time, usually after rain events.
	Perennial flow	487	95.39	Perennial refers to when there is surface water flow all year round.
TOPOGRAPHY CLASS (source of flow)	Glacial mountain (GM)	0	0	Similar to the Mountain (M) category: low flows in winter, high flows extend further into summer. High turbidity due to fine glacial sediment.
	Mountain (M)	3	0.55	Strong seasonal pattern of flows: low flows in winter, high flows in summer. High suspended solids and sediment load. Very frequent high flood flows lead to unstable substrates and channels with wide, active gravel bed flood plains.
	Hill (H)	271	53.21	Strong seasonal pattern: low flows in late summer, high flows in spring due to rainfall and snow melt. High to medium sediment loads depending on catchment geology and land use. Where the valley is broad so that the river channel is unconstrained, the channel morphology is characterized by unstable substrates and wide, active gravel bed flood plains.
	Low Elevation (L)	236	46.24	Very marked seasonal flow patterns: high in winter, low in summer. Low sediment supply. Stable, low-gradient, entrenched channels with low flow velocity and silty-sandy substrates. Flood flow velocities are low due to low channel slope.
	Lake (Lk)	0	0	Stable flow regime. Low suspended solids and sediment load. Stable channel and substrates, which may be 'armoured' (i.e. large stable stones due to winnowing of fine material and lack of sediment supply).

1 Percentages may not total 100% due to rounding.
2 From Snelder *et al.* (2010).

Summary of number of springs in your focus catchment

Category	# of mapped springs	Further detail
Springs	No data found in this focus catchment	Springs (and spring-fed waterways) typically have a stable flow regime (with no or negligible flood flows), low nutrient status in hill and mountain areas, or higher nutrient status when in catchments draining pastoral areas.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Waterway line – colour *See table above.*	The key topography/source of flow class for each REC segment of waterway.	Topography is the dominant cause of patterns in flow regime at meso-scales. It influences how precipitation is stored (due to snow pack and lakes) and released from a catchment as well as erosion and transport of sediment. Topography also influences small-scale climate variation within a catchment.	Developed by NIWA as part of the REC layer, that indicates the source of flow for that segment of waterway. Assigned based on the elevation within which more than 50 percent of total annual rainfall occurs. Five categories Glacial-Mountain (GM), (Mountain (M), Hill (H), Low-Elevation (L), and Lake (Lk)) are assigned using GIS-based topographic data and appear in the REC GIS coverage.
Waterway lines – solid vs dashed lines *See table above.*	Indicates whether or not the flow in the waterway section is likely to be perennial (flowing all year round) or intermittent/ ephemeral (seasonal or event-based flow).	Whether a waterway is permanently flowing or not will affect what can live there, and how it is best to manage it. Some regulations may also relate to a specific flow permanency (i.e., ephemeral/intermittent vs perennial).	Uses the 'mean annual low flow' (MALF) data attached to the REC layer produced by NIWA. It indicates the modelled average flow rate during the lowest flow period over the course of a year for sections of waterway line. The differentiation between intermittent/ ephemeral vs perennial flow was set at a MALF value of 0.004 cumecs (m³/s).
Springs – dots *See table above.*	The location of known/mapped springs, based on the available information sources.	Springs can provide groundwater flow to waterways. Springfed waterways have more stable flow, and usually low suspended sediment. Some stream fauna have evolved to these stable conditions and may not be found outside of these stable systems.	Obtained from your Regional Council. Contains site location data for springs that are known to your Regional Council.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. ***May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.***

For information about 'stream order' (SO) see page 14.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Topography & Flow Types

Focus Catchment Map Series: Map 2.2

Mapped spring locations — *No data found in this catchment*

Stormwater pipes

Roads

Focus catchment

FLOW PERMANENCY:

Intermittent/ephemeral flow (estimated as mean annual low flow (MALF) <0.004 cumecs)

Perennial flow

TOPOGRAPHY CLASS/SOURCE OF FLOW: waterways (stream order >1)

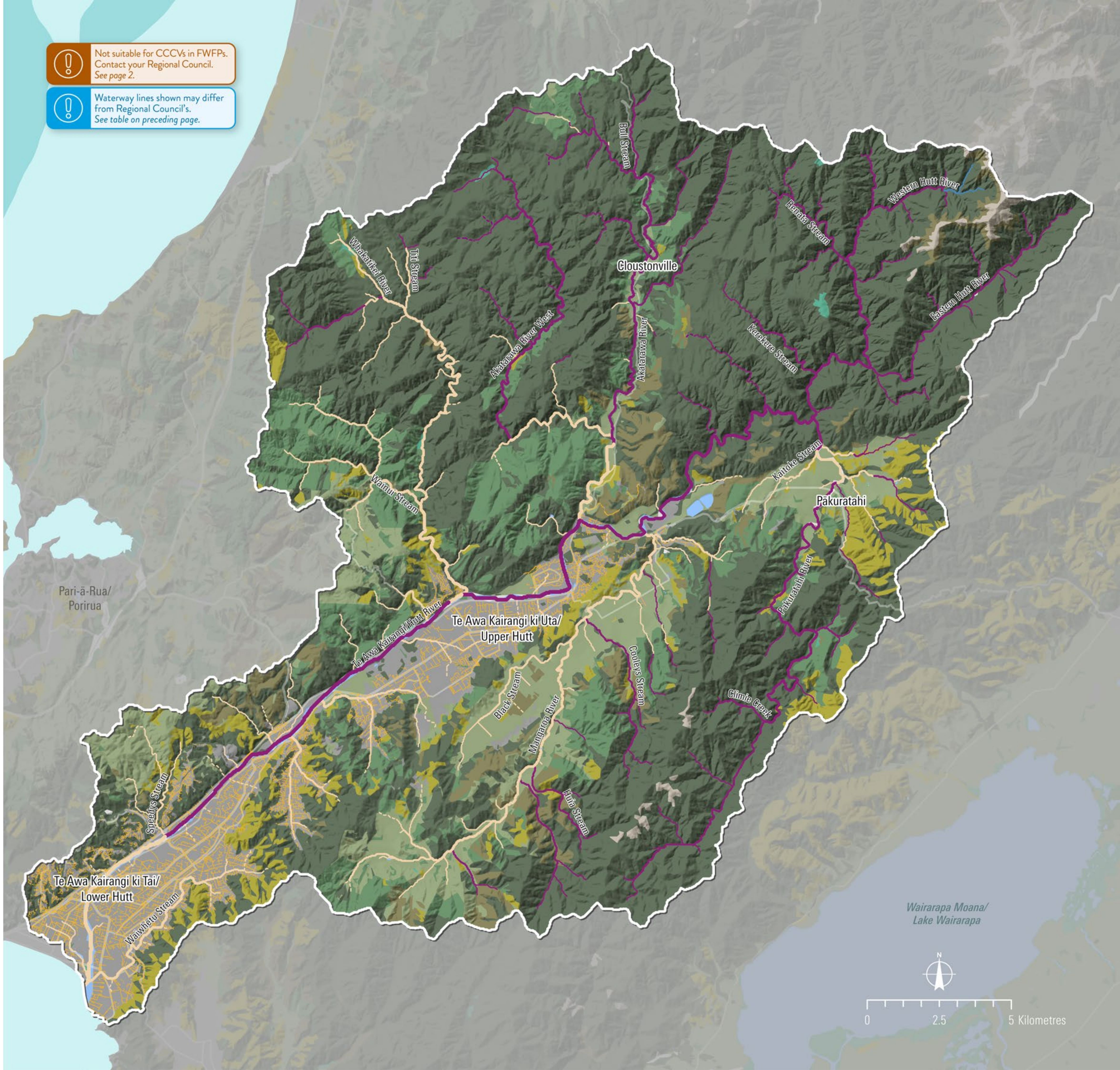
Glacial Mountain (GM)

Mountain (M)

Hill (H)

Low elevation (L)

Lake (Lk)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- REC 'topography/source of flow' layer developed by: NIWA
- REC 'topography/source of flow' source url: https://data.mfe.govt.nz/layer/51845-river-environment-classification-new-zealand-2010
- Interactive map where this layer is used: https://shiny.niwa.co.nz/nzrivermaps
- Report: Snelder *et al.* (2010)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Topography class (River Environment Classification (REC); NIWA), flow permanency (EOS Ecology based on modelled mean annual low flow (MALF) from the REC), mapped spring locations (Regional Council), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

2.3 Geology

This map uses modelled information to show the geology class (the third of four 'catchment level' River Environment Classifications (REC)) associated with waterways in the catchment.

Geology influences erosion rates, rock weathering (nutrient release) and aspects of hydrology (groundwater storage and release/baseflow conditions). The REC geology layer broadly describes the dominant rock types present in the catchment of each REC layer segment, based on a subdivision of the country into seven categories at the meso scale (10–100 km^2). The geology REC class further subdivides the patterns defined by the 'source of flow' (the Climate + Topography REC layers shown in Maps 2.1 and 2.2).

Notes on limitations/use

» The REC waterway layer does not show the exact locations of waterway channels within the landscape, and is unlikely to be accurate at a site scale. Exercise caution when using the layer to locate specific stream reach.

Summary of waterway geology class categories for your focus catchment

Category	Proportion in focus catchment – Length (km)	Proportion in focus catchment – Length (%[1])	Further detail
Alluvium (Al)	3	0.59	Rainfall infiltration is high, tending to reduce flood frequency. Typically a high degree of surface water and groundwater interaction. Base flows may be sustained by seepage or springs or may reduce in the downstream direction as water flows into the groundwater system. Water chemistry reflects the nature of the parent material. NOTE: the source NZ Land Resources Inventory (LRI) layer doesn't discriminate the parent material for alluvium, meaning the geochemistry of this category is variable.
Hard-Sedimentary (HS)	469	91.92	Infiltration of rainfall is variable. Where geology is fractured, infiltration is high, meaning infrequent floods but sustained base flow. Low natural nutrient concentration and suspended sediment. Relatively coarse substrates (cobble, gravel, sands) depending on local morphology.
Plutonic (Pl)	0	0	Infiltration of rainfall tends to be low. Low natural nutrient concentration. Low suspended sediment. Substrates tend to be 'bimodal', either large (boulder to cobble) or fine (sands) depending on local morphology.
Soft-Sedimentary (SS)	32	6.27	Low infiltration resulting in increased floods and low base flow. High natural phosphorus concentration. Bed substrates tend to be relatively fine (silts and mud), and suspended sediment concentrations high because of relatively soft parent material.
Volcanic-Acidic (VA)	0	0	A broad category with considerable variation. Very high infiltration in areas of tephra or scoria resulting in low flood frequency and sustained base flow. Concentration of phosphorus tends to be high. Substrates tend to be fine (sands, silts and mud), unless the stream channel is steep and eroding.
Volcanic-Basic (VB)	0	0	A broad category with considerable variation. Phosphorus concentration tends to be high relative to other geology categories. Substrates tend to be angular, well packed and stable.
Miscellaneous (M)	7	1.37	Covers a number of rock types that occur infrequently, including peat. Hydrology and water chemistry characteristics are therefore variable. Also used in urban areas where the LRI did not properly determine rock type.
No Data	0	0	No data available for this area.

[1] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Waterway line – colour *See table above.*	The key geology class for each REC segment of waterway.	Catchment geology can influence water chemistry and the rate of catchment erosion which influences sediment supply. As it also controls groundwater storage capacity and transmissivity it will have an effect on base flow. Knowing your catchment geology classifications will help you to set your water quality data into context.	Developed by NIWA as part of the REC layer, that indicates the surface geology for that segment of waterway. Assigned based on the 'toprock' geology categories from the NZ Land Resources Inventory (LRI) and categorised into seven geological categories.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | eos

Te Awa Kairangi/Hutt River

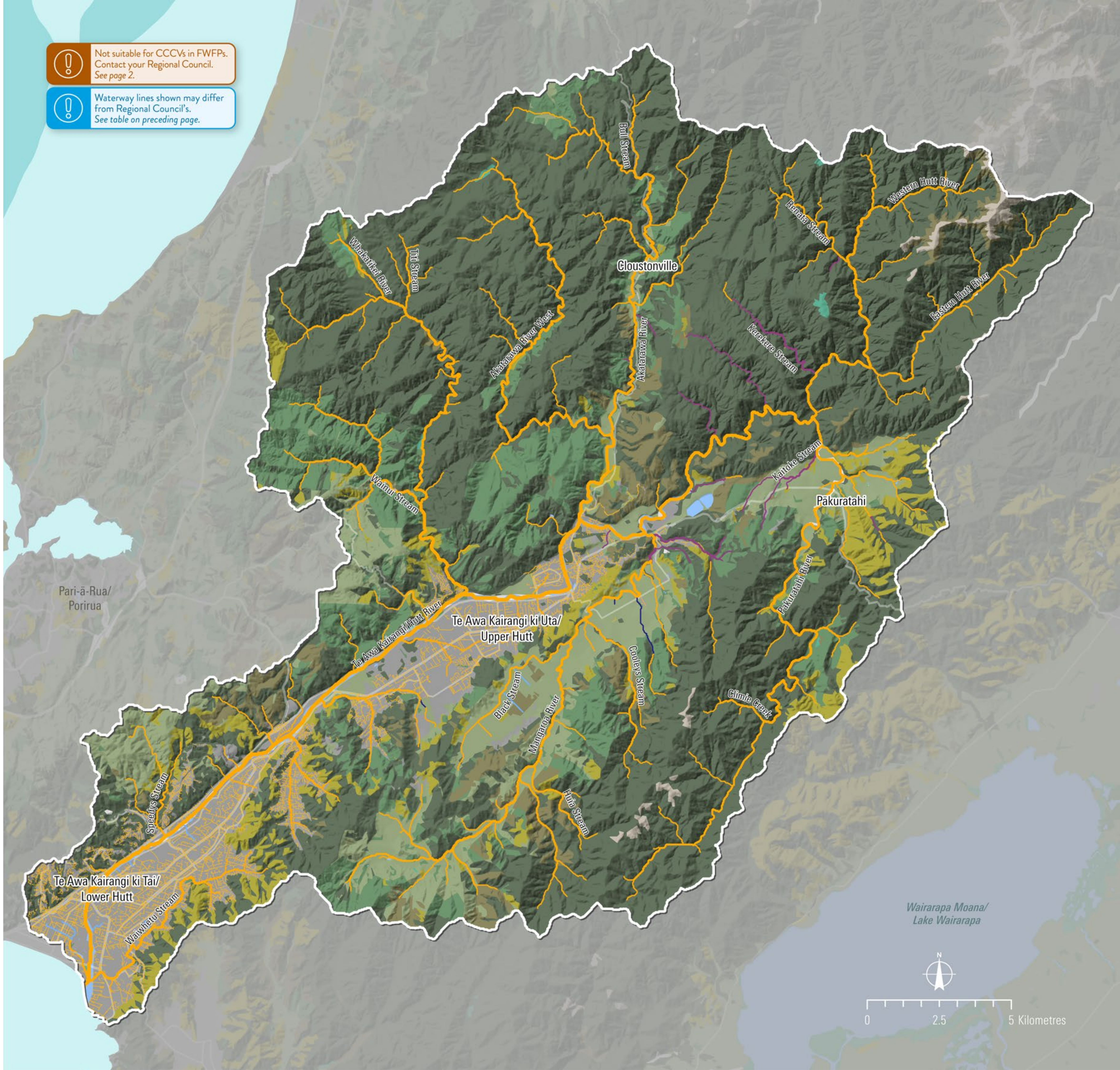
Geology

Focus Catchment Map Series: Map 2.3

- Stormwater pipes
- Roads
- Focus catchment

GEOLOGY CLASS: waterways (stream order >1)

- Alluvium (Al)
- Hard-Sedimentary (HS)
- Plutonic (Pl)
- Soft-Sedimentary (SS)
- Volcanic-Acidic (VA)
- Volcanic-Basic (VB)
- Miscellaneous (M)
- No Data



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: NIWA
- Key layer source url: https://data.mfe.govt.nz/layer/51845-river-environment-classification-new-zealand-2010
- Interactive map where this layer is used: https://shiny.niwa.co.nz/nzrivermaps
- Report: Snelder *et al.* (2010)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Geology class (River Environment Classification (REC); NIWA), waterways (REC; NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

2.4 Land cover class

This map uses modelled information to show catchment land cover (the fourth of four 'catchment level' River Environment Classifications (REC)) associated with waterways in the catchment.

Based on the Land Cover Data Base (LCDB) the REC land cover class determines the dominant land use class in the catchment of each REC layer segment, based on subdivision of the country into nine categories at the micro scale (1–10 km²).

Notes on limitations/use

- The REC waterway layer does not show the exact locations of waterway channels within the landscape, and is unlikely to be accurate at a site scale. Exercise caution when using the layer to locate specific stream reach.
- The REC layer was last updated in 2010 and so may not reflect more recent updates in the LCDB layer (which was updated in 2018–2019).

Summary of waterway land cover class categories for your focus catchment

Category	Proportion in focus catchment – Length (km)	Proportion in focus catchment – Length (%[1])	Further detail
Bare (B)	0	0	This category tends to occur over large areas only in mountainous catchments. The hydrological and water chemistry characteristics of this class tend to accentuate the characteristics of the Mountain Topography/Source-of-Flow category. Runoff response is rapid, low nutrient concentration and suspended sediment tends to be high.
Exotic Forest (EF)	26	5.04	Flow regime dependent on the age of the forest. Mature forests display a regime relatively similar to that found in native forest. Recently logged forests display a regime similar to pastoral sites. Variable nutrient and suspended sediment concentrations depending on the cutting cycle of the forest. Nutrients for mature forests are typically lower than for rivers with a Pastoral (P) land cover category.
Indigenous Forest (IF)	299	58.60	Flood peaks are attenuated by vegetation, and low flows are generally more sustained than Pastoral (P) or Bare (B) land cover categories. Nutrient concentrations tend to be low. Suspended sediment concentrations tend to be low resulting in high water clarity.
Pastoral (P)	88	17.20	Flood peaks tend to be higher and recede faster. Low flows are generally more extreme relative to catchments with natural land cover. Nutrient concentrations are high relative to natural land cover categories. Erosion rates tend to be high, resulting in low water clarity and fine substrates (silts and mud) compared to natural land cover.
Scrub (S)	56	10.95	Flood peaks are attenuated by vegetation, and low flows are generally more sustained than Pastoral (P) or Bare (B) land cover categories. Nutrient concentrations tend to be low. Suspended sediment concentrations tend to be low resulting in high water clarity.
Tussock (T)	0	0	Flood peaks are attenuated by vegetation, and low flows are generally more sustained than Pastoral (P) or Bare (B) land cover categories. Nutrient concentrations tend to be low. Suspended sediment concentrations tend to be low resulting in high water clarity.
Urban (U)	42	8.21	Flood peaks are very 'peaky' and recessions return quickly to base flow. Base flows are very low. High concentration of many contaminants. High suspended sediment load during development and typically low afterwards. High fine substrates (silts and mud) relative to natural land cover categories.
Wetland (W)	0	0	This was present in the REC layer dataset but no information was provided in Snelder *et al.* (2010) re this category.
Unclassified (M)	0	0	This was present in the REC layer dataset but no information was provided in Snelder *et al.* (2010) re this category.

[1] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Waterway line – colour *See table above.*	The key land cover class for each REC segment of waterway.	Catchment land cover is the dominant control of rainfall capture or runoff, potential evapotranspiration, and erosion and runoff processes. This means land cover categories can indicate differences in flow regime, nutrient and sediment supply, as well as the type of sediment reaching the stream that will form the channel substrate. Land cover may explain why waterways that are otherwise similar (with the same Climate, Topography/Source-of-Flow and Geology classification), may have different water quality characteristics.	Developed by NIWA as part of the REC layer, and assigned using criteria related to land cover data provided by the New Zealand Land Cover Database (LCDB) to classify seven major categories of land cover to REC waterways, at a characteristic scale of approximately 1 to 10 km² (i.e. micro-scale).
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

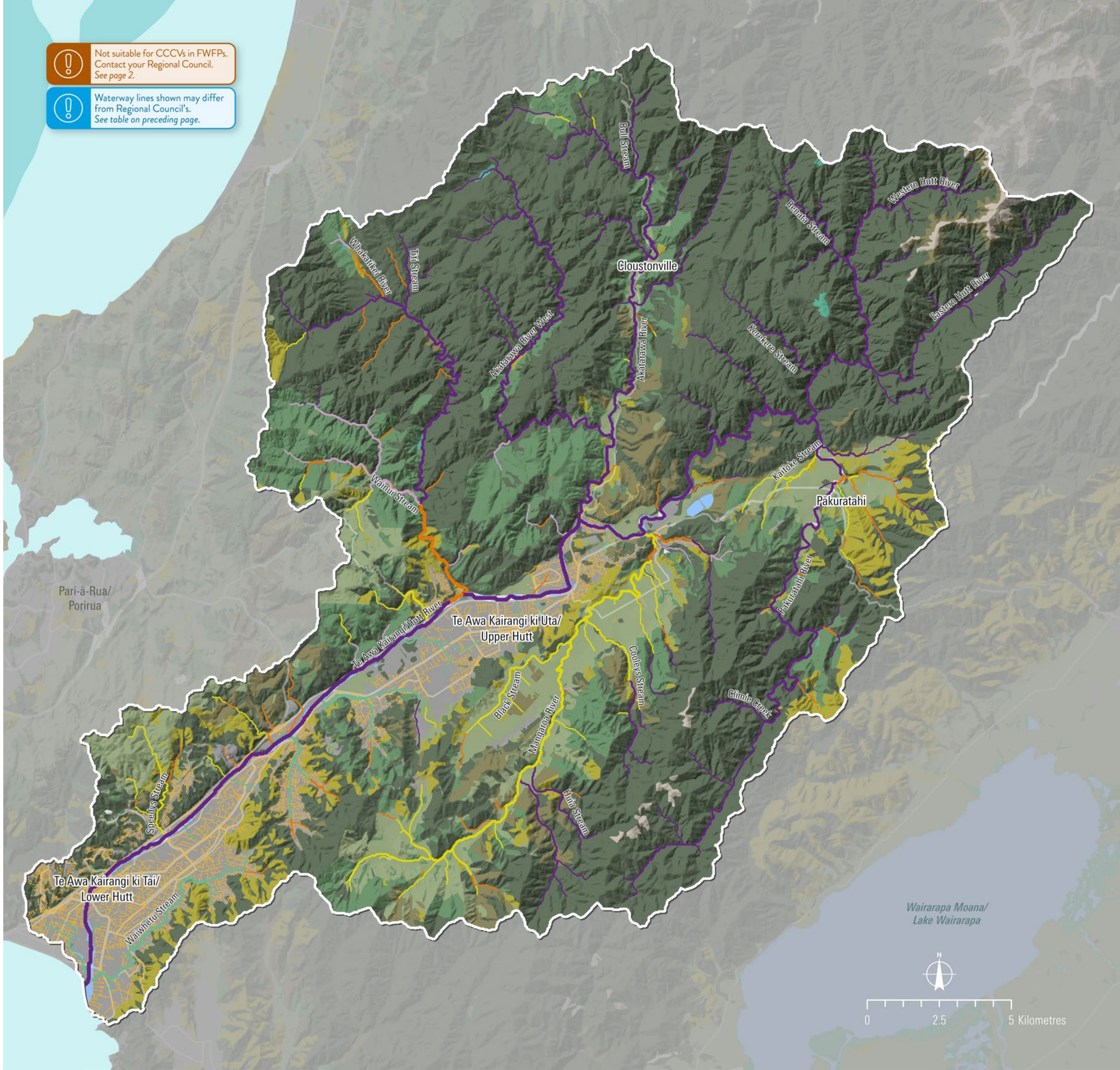
Land Cover Class

Focus Catchment Map Series: Map 2.4

- Stormwater pipes
- Roads
- Focus catchment

LAND COVER CLASS: waterways (stream order >1)

- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: NIWA
- Key layer source url: https://data.mfe.govt.nz/layer/51845-river-environment-classification-new-zealand-2010
- Interactive map where this layer is used: https://shiny.niwa.co.nz/nzrivermaps
- Report: Snelder *et al.* (2010)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Land cover class (River Environment Classification (REC); NIWA), waterways (REC; NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

2.5 Stormwater network

This map uses information provided by your Council[2] to show the locations of stormwater pipes, constructed channels and natural waterways that make up, or are connected to, the wider stormwater network in the catchment.

Stormwater networks are a large part of urban catchments, serving to capture rainfall runoff from hard surfaces, and transporting it via underground pipes to waterways. The stormwater network also includes open channels, and waterways that are the receiving environment for stormwater discharges. Within an urban environment, stormwater and the stormwater network has an overarching influence on all waterways in the catchment, and can contribute to the development of urban stream syndrome (USS).

For more details on USS, stormwater systems, and 'Impacts of urban stormwater systems' infographic refer to pages 8–9.

Notes on limitations/use

- The REC waterway layer, which is used in all other maps in this FCMS, is not shown on this map because there is a difference in the level of detail between the REC waterway layer and the stormwater network as mapped by Council. In general, Council stormwater network layers will be more detailed that what is available in the REC waterway layer.
- Of the layers mapped here, only the stormwater pipes layer will be shown in subsequent maps in this FCMS.

Summary of stormwater in your focus catchment

Category	Proportion in focus catchment – Length[1] km	%	Further detail
Stormwater pipes	637.7	25.7	Underground pipes that transport stormwater from roads, properties, and open areas into receiving environments (i.e., waterways, lakes, coastal areas). They form part of the broader stormwater network, including culverts (structures that channel water under roads), and subsoil drains (systems designed to remove excess groundwater from soil surrounding building foundations), to help manage urban water/flood levels.
Channels	130.9	5.3	Manmade/constructed waterways built specifically to move stormwater from urban areas. These can have base/banks that are lined (concrete/other manmade materials) or unlined (earth base and banks). They don't carry natural stream flows.
Watercourses	1717.0	69.1	Naturally occurring waterways, that carry a natural permanent or intermittent/ephemeral flow of water. These are not manmade/constructed.
TOTAL	2485.7	100.0	

[1] The length of waterways shown in this table will not correspond with those shown in the table in Section 1.1, due a difference in the scale/level of detail between the different layer types.

Summary of stormwater treatment facilities present in your focus catchment

Stormwater treatment facility type	Number of facilities	Further detail
Constructed wetland	0	Stormwater treatment facilities are used for both water quality (treatment) and quantity (retention) control. The ones listed here are those that have been recorded by your Council[2].
Raingarden	0	
Dry detention pond	0	
Wet detention pond	0	

[2] Council refers to either the city council, district council or unitary authority who is responsible for the urban area in your FCMS.
Refer to the map on the next page for further layer source information.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Stormwater pipes	The extent of stormwater pipes identified as being part of the urban stormwater network.	Understanding the location and extent of the piped stormwater network within your catchment may help understand and interpret environmental monitoring data. The more impervious surfaces and stormwater network in a catchment, the greater the impact to catchment waterway health.	Developed by your Council[3], based on the known public stormwater assets within the urban area. Stormwater pipes represent the reticulated stormwater network, including pipelines, culverts, and subsoil drains. Private stormwater pipes may not be included on this layer.
Channels	The extent of constructed channels identified as being part of the urban stormwater network.	In urban environments, the stormwater network is interconnected with constructed and natural waterways. Understanding the location of constructed channels can help inform decisions on potential actions to enhance the health of these channels, which may be straighter and wider, or have a more homogenous habitat than natural waterways.	Developed by your Council[3], based on the known stormwater assets within the urban area. The channel layer represents the open or daylighted parts of the stormwater network, including lined and unlined constructed channels.
Watercourses	The extent of natural waterways (i.e., not manmade/constructed channels) identified as being part of the urban stormwater network.	In urban environments, the stormwater network is interconnected with natural waterways. Understanding the locations and relative proportions of natural waterways compared to the length of the piped network is essential for interpreting environmental monitoring data. Knowledge of the location of natural watercourses can also guide informed decision-making for prioritising.	Developed by your Council[3], based on the known stormwater assets within the urban area. The watercourses layer represents natural assets (not constructed) with a natural flow of water.
Stormwater treatment facility	The location of stormwater treatment facilities used for both water quantity and water quality control within the stormwater network.	Knowledge of the existing stormwater treatment facilities within the stormwater network can help with the interpretation of environmental monitoring data, such as comparisons between waterways with and without stormwater treatment facilities upstream. It can also help to identify areas where additional stormwater treatment could be of most benefit.	Developed by your Council[3], based on the known stormwater assets within the urban area. Stormwater treatment facilities include detention basins (wet and dry), constructed wetlands, and community raingardens.

[3] Council refers to either the city council, district council or unitary authority who is responsible for the urban area in your FCMS.
Refer to the map on the next page for further layer source information.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Urban Stormwater Network

Focus Catchment Map Series: Map 2.5

Roads

Focus catchment boundary

STORMWATER NETWORK:

Stormwater pipes

Channels

Watercourses

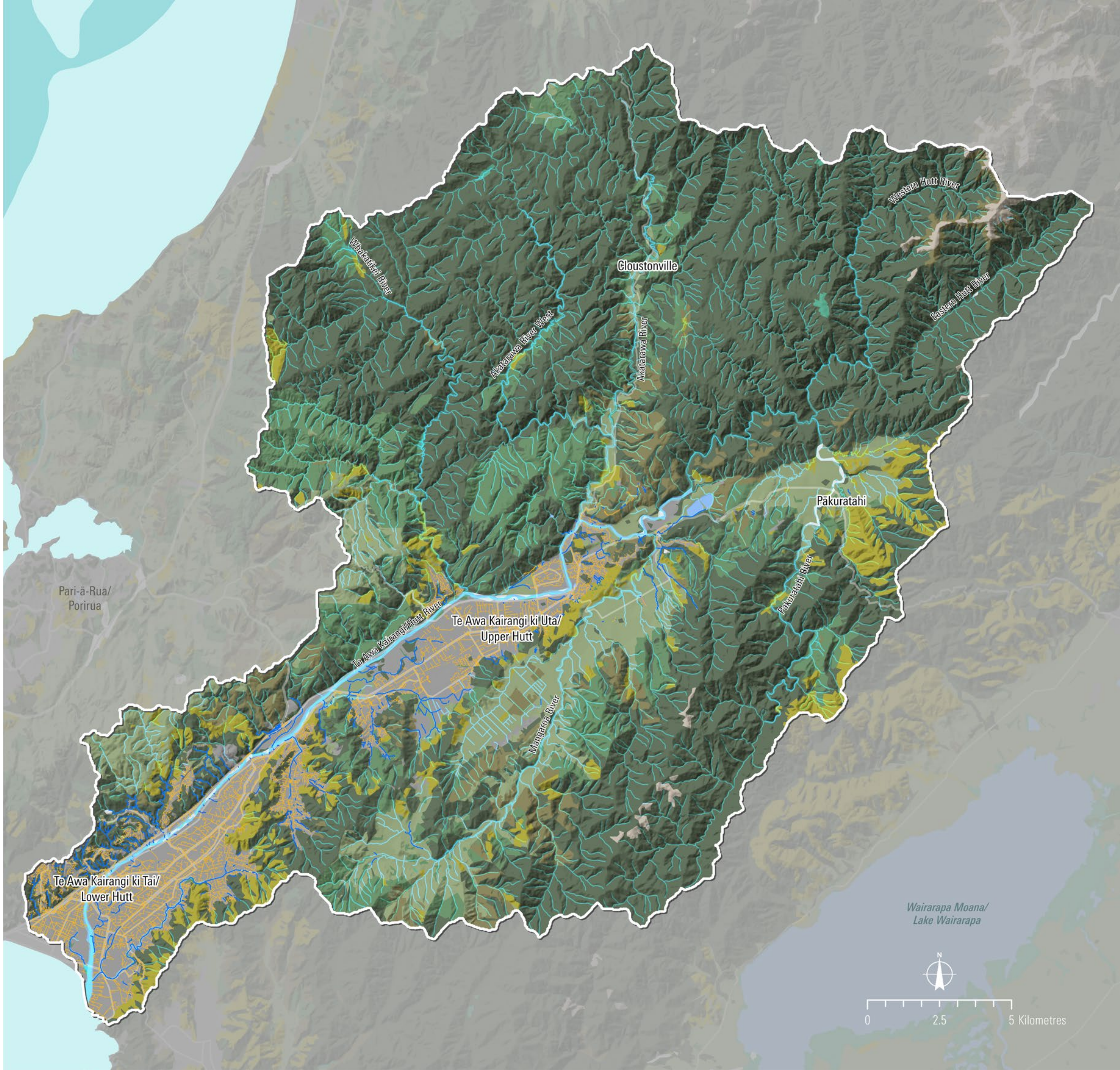
STORMWATER TREATMENT FACILITIES:

Constructed wetland

Raingarden

Dry detention pond

Wet detention pond



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source layers (stormwater network and stormwater treatment facilities) from: Wellington Water
- Stormwater pipes:https://gis.wellingtonwater.co.nz/server1/rest/services/Councils/Regional_Stormwater_Pipes/FeatureServer
- Channels: https://gis.wellingtonwater.co.nz/server1/rest/services/Councils/Regional_Stormwater_Open_Channels/FeatureServer
- Watercourses: https://services.arcgis.com/xdsHIIxuCWByZiCB/arcgis/rest/services/LINZ_NZ_River_Name_Lines_Pilot/FeatureServer

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Stormwater pipes (City Council/Unitary Authority), channels (City Council/Unitary Authority), watercourses (City Council/Unitary Authority), stormwater treatment facilities (City Council), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on River Environment Classification (REC) watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

3. FOCUS CATCHMENT – Land management aspects

The following pages present some maps that are based on modelled information about the land within your focus catchment.

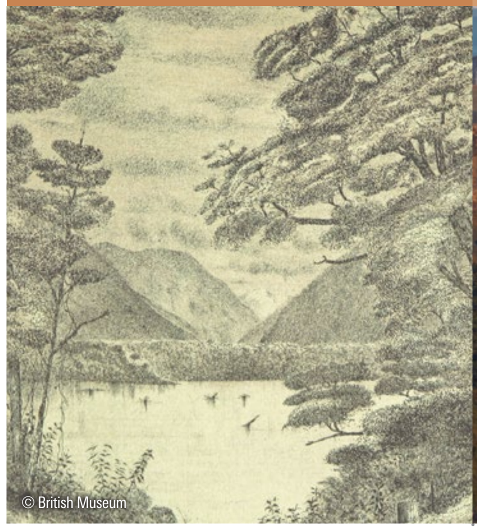
These maps can help you to better understand some aspects of your catchment's land management that may have a relationship to the health and wellbeing of your catchment's waterways. In general these cover four key areas:

- land cover/vegetation past
- land cover/vegetation past present
- soil types and soil drainage
- existing threatened and protected areas.

These layers have been based on datasets available at a national level. Your Regional Council may have more regionally specific layers available.

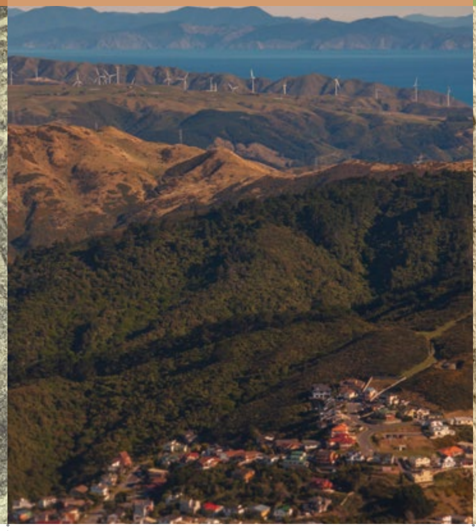
Land cover/vegetation types

Past



- Helps you understand the ultimate limitations of your catchment, what vegetative systems dominated in the past, and what would, therefore, be suitable for any restoration planting today.

Present



- Helps you understand the current land cover on a catchment-wide basis. Comparing to the past vegetation map can help show how the catchment has changed since human habitation.

Soil drainage

Types

- Helps with informing decisions around land management, including erosion control, nutrient management, water resource management, wetland formation, and land use planning.

Drainage

- Helps you understand the ultimate limitations of your catchment in terms of soil drainage, why some areas of your catchment may be wet or dry, and how that may influence surface runoff and stream flows.

Threatened & Protected areas

Threatened environments

- Shows you the indigenous vegetation cover in your catchment, and the legal protection afforded. It can help you identify where conservation efforts are most needed and/or where habitat restoration projects can have the greatest impact.

Protected areas

- Shows you what areas are legally protected to safeguard biodiversity, native species and ecosystems. Includes reserves, conservation areas, marginal strips, wildlife areas, marine areas, and national parks.

All images © EOS Ecology unless stated otherwise.

Produced by & © EOS Ecology

Focus catchment © Greater Wellington Regional Council

3.1 Land cover/vegetation types – past

This map uses modelled information to show the expected past vegetation cover, in the absence of human intervention.

This map layer aims to reconstruct the likely biological character of New Zealand's pre-human past.

Summary of the past land cover/vegetation type categories for your focus catchment

Category	Proportion in focus catchment – Area – ha	Proportion in focus catchment – Area – %[1]	Further detail
Unclassified	268	0.42	Unclassified areas include permanent snow & ice, rivers, lakes, urban areas etc.
Kauri	0	0	Kauri/taraire-kohekohe-tawa forest. Sizeable areas of dense old-growth kauri are confined to the Hokianga district, whilst the most extensive areas of abundant young kauri are between the Bay of Islands and Whangarei and on Great Barrier Island.
Podocarp (native conifers)	2,849	4.47	Kahikatea-pukatea-tawa, Matai-kahikatea-totara, Kahikatea-totara and Rimu-matai-miro-totara/kamahi, Rimu-matai-miro-totara/kamahi forest types.
Totara-broadleaf	15	0.02	Hall's totara/broadleaf and Hall's totara-miro/kamahi-southern rata broadleaf forest types. Hall's totara/broadleaf forest found on montane sites lacking beech including the Hauhungaroa Range, southern Ruahine and northern Tararua Ranges, Taranaki, inland Marlborough, south Canterbury and Otago. Hall's totara-miro/kamahi-southern rata-broadleaf forest occurs in wet, steep hill country in the Westland beech gap.
Rimu-tawa	9,948	15.61	Rimu/tawa-kamahi forest. Softwoods tend to be very occasional in this class, though rimu, the most common by far is usually a large tree. Formerly common on hill country over most of the North Island, but much reduced by logging and clearing. Fairly large tracts remain between Mt Pirongia and Wanganui and in the northern Urewera country.
Rimu-matai-broadleaf	1,205	1.89	Kahikatea-matai/tawa-mahoe and Matai-totara-kahikatea-rimu/broadleaf-fuchsia forest types. Kahikatea-matai/tawa-mahoe is found on dry dune land and low hill country in Hawkes Bay, Manawatū, Wairarapa and coastal Marlborough and Canterbury, including Banks Peninsula. Matai-totara-kahikatea-rimu/broadleaf-fuchsia found on inland foothills and loess-mantled downs from South-Canterbury to Southland. Broadleaf, fuchsia and tarata are the most common species, but kamahi is widespread in the south. Pokaka is locally abundant, particularly on poorly drained soils.
Rimu-broadleaf-beech	39,944	62.66	Hall's totara-miro-rimu/kamahi-silver beech-southern rata and Rimu-miro/kamahi-red beech-hard beech forest types.
Podocarp-beech	0	0	Rimu-miro/tawari-red beech-kamahi-tawa forest. Mainly occurs on very rough hill country, usually confined to the fringes of large tracts of virgin forest. Largest area can be found on the Mamaku Plateau.
Rimu-rata-kamahi-broadleaf	1,860	2.92	Rimu-miro-totara/kamahi and Matai-totara/black/mountain beech forest types.
Upland Podocarp-beech-rata-kamahi	0	0	Hall's totara/silver-beech-kamahi-southern rata forest type.
Beeches	6,444	10.11	Silver beech, Red beech-silver beech, Mountain beech-red beech and Mountain beech forest types. Silver beech forest occurs mostly in the southern South Island east of the main divide, but also forms almost pure treeline forests at higher elevation in the northern South Island and the Tararua Ranges. Mountain beech forest is largely confined to sites east of major mountain ranges where dry föhn winds and cold temperatures produce highly stressful conditions, most notably around the South Island's southern lakes, in inland Canterbury and those parts of the Kaimanawa Mountains that lie east of the Tongariro volcanoes.
Wetlands (partial)	426	0.67	Wetlands occur where the water table is at or near the surface of the land, or where the land is covered by water, either permanently or temporarily. They can include streams, swamps, bogs, lakes, lagoons, estuaries, mudflats and flood plains. Most extensive in the lowlands of Northland, Waikato, coastal Bay of Plenty, and Southland.
Dunelands	575	0.9	Hilly areas of sand found behind beaches, most extensive along the west coast of the North Island in Northland, Auckland, Waikato and Manawatū, and in coastal Canterbury and Southland.
Scrub, tussock-grassland & herbfield above treeline	214	0.34	Most extensive about the South Island's main divide, but significant areas also occur on the North Island's volcanoes, and along the crests of the Kaimanawa Mountains and Ruahine and Tararua Ranges.
Scrub, shrubland & tussock-grassland below treeline	0	0	Occurs in the drought- and frost-prone inland basins and wide river valleys of Marlborough, Canterbury and Otago.

[1] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid shapes *See table above.*	What the dominant vegetation types in your catchment would have been prior to human arrival.	Provide a context for both the assessment of the biodiversity value of surviving forest remnants and for the management and/or restoration of sites. If you want to do any native tree planting or revegetation then this will tell you what tree types will do the best based on soil, topography, and climatic conditions.	Developed by Manaaki Whenua/Landcare Research using statistical tools relating the distributions of major canopy tree species to environmental variables that effect tree physiological processes, which were used for interpolation of point climate data and the analysis of spatial patterns. Environmental values were estimated both for a large set of irregularly distributed plots describing forest composition, and points on a 1-km grid across New Zealand. Predictions of species abundance were then made for the grid data set, and the resulting matrix was classified to derive groups of similar composition.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Notes on limitations/use

- Manaaki Whenua/Landcare Research note the modelled results agree closely with published descriptions of New Zealand's forests, including for sites that are 10% deforested.
- The REC waterway layer is not exact and not accurate at a site scale.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

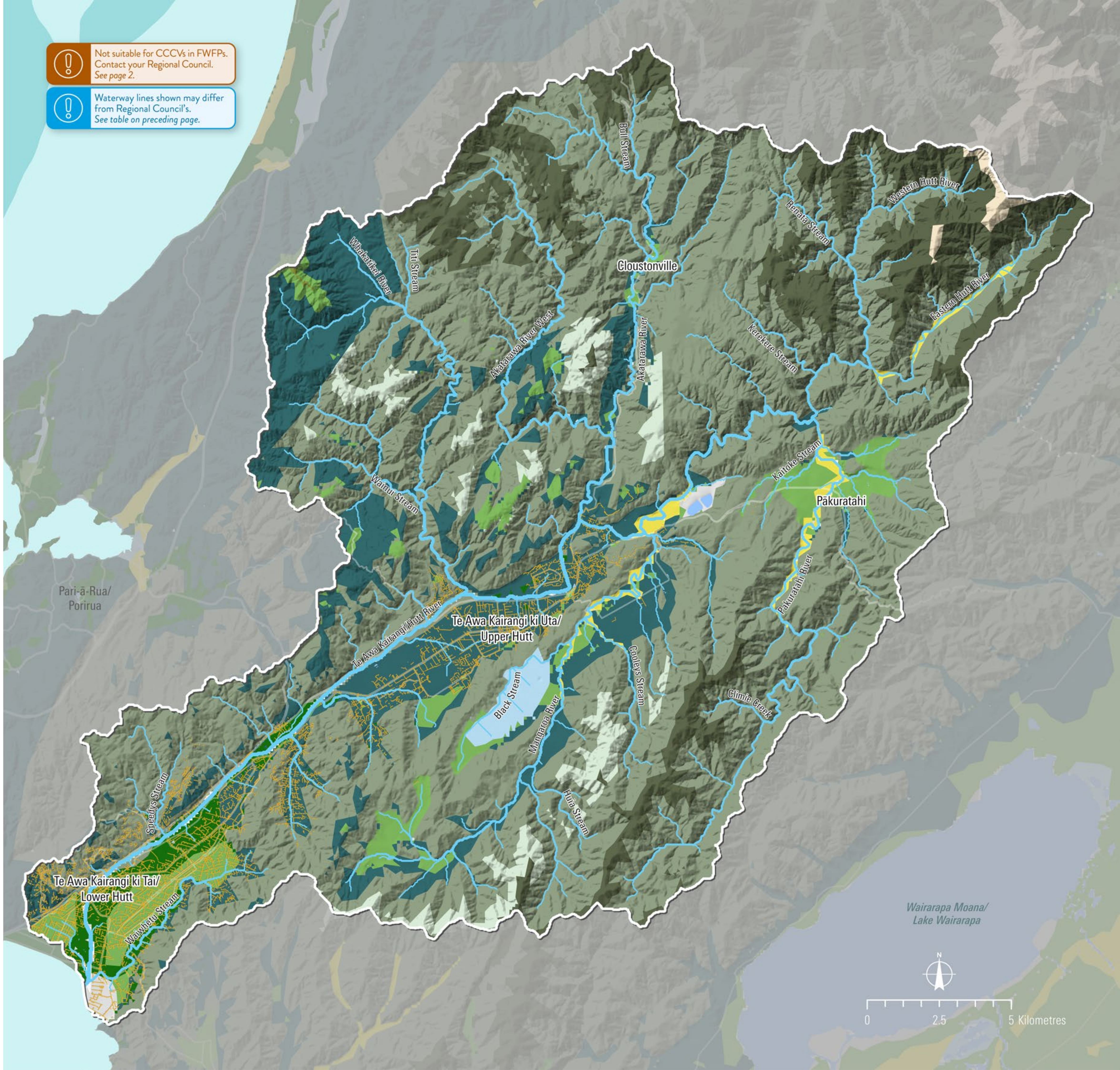
Past Vegetation Types

Focus Catchment Map Series: Map 3.1

- Waterways (stream order >1)
- Stormwater pipes
- Roads
- Focus catchment

VEGETATION TYPES:

- Unclassified
- Kauri
- Podocarp (native conifers)
- Totara-broadleaf
- Rimu-tawa
- Rimu-matai-broadleaf
- Rimu-broadleaf-beech
- Podocarp-beech
- Rimu-rata-kamahi-broadleaf
- Upland Podocarp-beech-rata-kamahi
- Beeches
- Wetlands (partial)
- Dunelands
- Scrub, tussock-grassland & herbfield above treeline
- Scrub, shrubland & tussock-grassland below treeline



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: Manaaki Whenua/Landcare Research
- Key layer source url: https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Habitats/lenz_potnatveg/485,408,409,422,423,424,410,411,393,412,425,417,418,419,420
- Report: Leathwick (2001)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Vegetation types (Potential vegetation of NZ; Manaaki Whenua/Landcare Research), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand).

3.2 Land cover/vegetation types – present

This map uses modelled information to show the main current vegetation types present in your focus catchment, that are also related to broad land cover/use themes.

These categories include natural land cover classes (i.e., forests, grasslands, etc.), as well as modified land cover classes (i.e., urban areas, crops, and industrial areas).

Notes on limitations/use

- Land Cover Database Version 5 (LCDB5) was released in January 2020 and includes corrections to all time steps 1997/97, 2001/02, 2008/09, 2012/13 and 2018/19. Changes to land cover after 2019 will not be represented.
- LCDB is suitable for use in national and regional environment monitoring, forest and shrubland inventory, biodiversity assessment, trend analysis and infrastructure planning. It may not be accurate at a site scale.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of the dominant land cover classification for your focus catchment

Catchment type classification[1]	Further detail	Dominant land cover
Urban	More than 15% of the catchment area has urban land cover.	
Pastoral	Less than 15% of the catchment area has urban land cover, and pastoral land cover is greater than 25% or covers the largest proportion of the catchment.	
Exotic forest	Less than 15% of the catchment has urban land cover, less than 25% of the catchment has pastoral land cover, and exotic forest covers the largest proportion of the catchment.	
Native	Less than 15% of the catchment has urban land cover, less than 25% of the catchment has pastoral land cover, and native forest covers the largest proportion of the catchment.	✓

[1] Our Freshwater 2020 (MfE & Statistics NZ, 2023).

Summary of land cover/vegetation type categories for your focus catchment

Category	Proportion in focus catchment – Area ha	Proportion in focus catchment – Area %[2]	LCDB5 map layers that are combined into the category shown in the map
Artificial bare – Urban	5,889	9.21	Built up area (settlement), surface mine or dump, transport infrastructure, urban parkland/open space
Farming – Exotic grassland/cropping/ horticulture	6,449	10.09	High Producing Exotic Grassland, Low Producing Grassland, Orchard Vineyard & Other Perennial Crops, Short-rotation Cropland
Forest – Exotic	7,459	11.67	Deciduous Hardwoods, Exotic Forest, Forest Harvested
Forest – Indigenous	38,800	60.70	Broadleaved Indigenous Hardwoods, Indigenous Forest
Natural bare/ lightly-vegetated	89	0.14	Alpine Grass/Herbfield, Gravel or Rock, Landslide, Permanent Snow and Ice, Sand or Gravel
Other herbaceous	60	0.09	Flaxland, Herbaceous Freshwater Vegetation, Herbaceous Saline Vegetation
Scrub/shrubland – Exotic	2,513	3.93	Gorse and/or Broom, Mixed Exotic Shrubland
Scrub/shrubland – Indigenous	2,134	3.34	Fernland, Mangrove, Manuka and/or Kanuka, Matagouri or Grey Scrub, Sub Alpine Shrubland
Tussock grassland	258	0.40	Tall Tussock Grassland
Water bodies	270	0.42	Estuarine Open Water, Lake or pond, River (these are not shown on the map as they are presented in the waterways layer)

[2] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid shapes *See table above.*	The main vegetation types and broad land use themes for your catchment.	It is helpful to understand the broad vegetation types and land use themes. It is also useful for helping to understand and interpret ecological/environmental monitoring data.	Developed by Manaaki Whenua/Landcare Research, the Land Cover Database Version 5 (LCDB5) is a multi-temporal, thematic classification of 33 land cover and land use classes designed to be compatible with earlier LCDB versions. Land cover features are described by a polygon boundary, a land cover code, and a land cover name at each nominal time step (the most recent being summer 2018/19). The classes are defined based on evidential data and satellite imagery combined with visual mapping and scripted blending-in of land cover change and improvements. For this map series, the 33 LCDB5 classifications have been conflated into ten categories – as per the 'medium' classification grouping used by LAWA, with an additional conflation of 'exotic grassland and cropping/horticulture' into one grouping.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

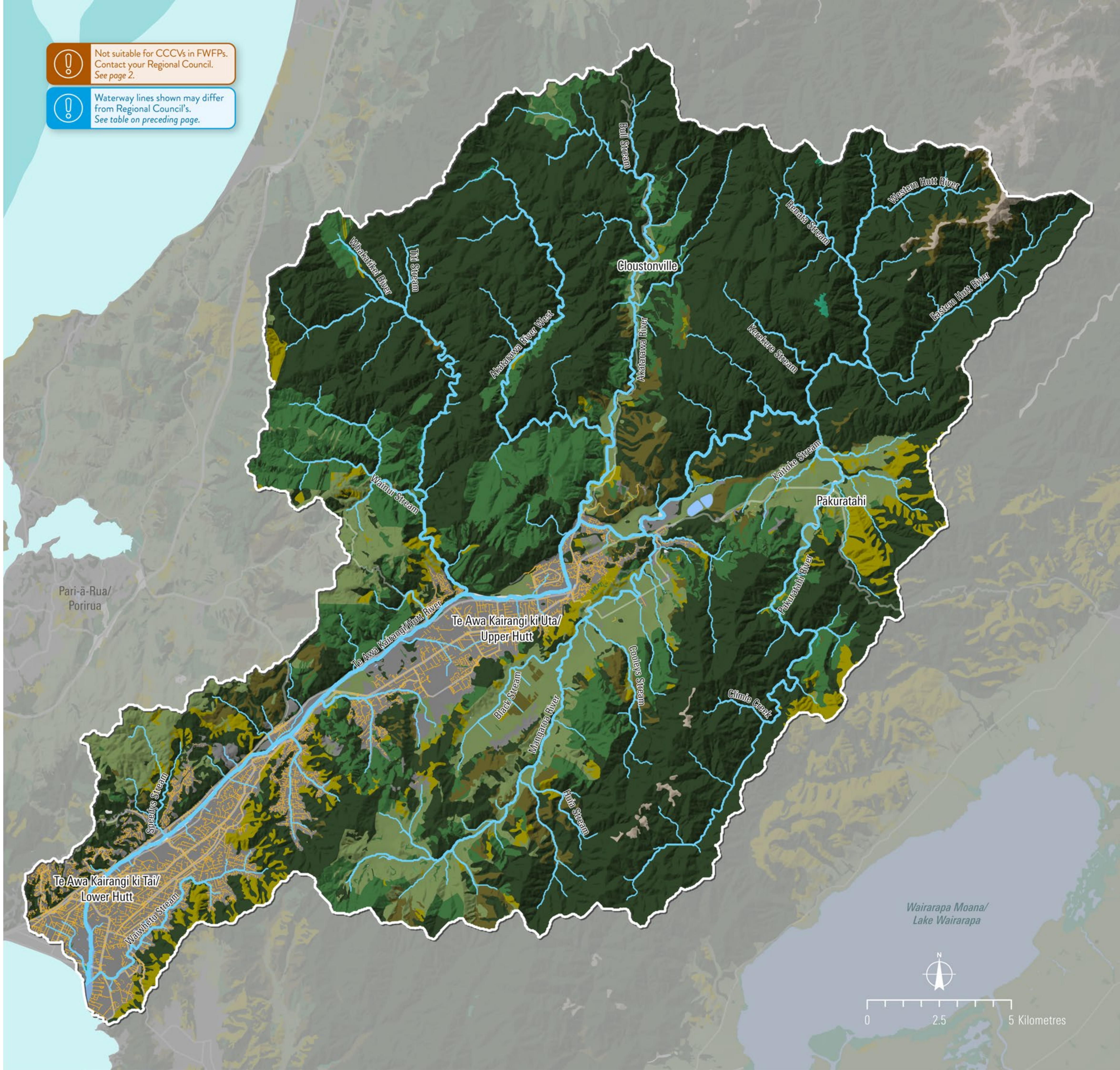
Present Land Cover/Vegetation Types

Focus Catchment Map Series: Map 3.2

- Waterways (stream order >1)
- Stormwater pipes
- Roads
- Focus catchment

LAND COVER/VEGETATION TYPES:

- Artificial bare — Urban
- Farming – Exotic grassland/cropping/horticulture
- Forest – Exotic
- Forest – Indigenous
- Natural bare/lightly-vegetated
- Other herbaceous
- Scrub/shrubland – Exotic
- Scrub/shrubland – Indigenous
- Tussock grassland
- Water bodies



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: Manaaki Whenua/Landcare Research for the underlying LCDB5 layer
- Key layer source url: www.lawa.org.nz/learn/factsheets/land/calculating-land-cover-state

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Land cover/vegetation types (LCDB v5; Manaaki Whenua/ Landcare Research), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand).

3.3 Soil type

This map uses modelled information to show the main soil groups within your focus catchment.

There are 15 soil orders for Aotearoa, which can be further broken down into 74 soil groups. The soil orders are the highest, most generalised level of the classification and provide the national overview of our soils (Hewitt, 2013). These orders are further divided into 74 soil groups, which are based on variations in factors such as drainage status, parent material, and chemical and physical properties.

Notes on limitations/use

- Manaaki Whenua/Landcare Research has compiled the source information from data derived from numerous sources. The information may not be complete, correct, or up to date.
- A consistent soils data layer at the national, regional and local scale. However, it is unlikely to be accurate at the site scale.
- S-Map (https://smap.landcareresearch.co.nz/maps-and-tools/app) provides improved online maps of NZ soils but does not provide data for all of NZ. As such it has not been used here.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of the soil groups present in your focus catchment

Order	Group	Proportion in focus catchment – Area ha	%[1]
Allophanic (L)	Gley (LG)	0	0
	Impeded (LI)	0	0
	Orthic (LO)	0	0
	Perch-Gley (LP)	0	0
Anthropic (A)	Fill (AF)	0	0
	Truncated (AT)	0	0
Brown (B)	Acid (BA)	4,541	7.93
	Allophanic (BL)	4,910	8.57
	Firm (BF)	9,500	16.59
	Mafic (BM)	0	0
	Orthic (BO)	31,998	55.87
	Oxidic (BX)	0	0
	Sandy (BS)	0	0
Gley (G)	Acid (GA)	0	0
	Orthic (GO)	480	0.84
	Recent (GR)	0	0
	Sandy (GS)	0	0
	Sulphuric (GU)	0	0
Granular (N)	Orthic (NO)	0	0
	Oxidic (NX)	0	0
	Perch-Gley (NP)	0	0

Order	Group	Proportion in focus catchment – Area ha	%[1]
Melanic (E)	Mafic (EM)	0	0
	Orthic (EO)	0	0
	Perch-Gley (EP)	0	0
	Rendzic (ER)	0	0
	Vertic (EV)	0	0
Organic (O)	Fibric (OF)	422	0.74
	Humic (OH)	0	0
	Mesic (OM)	0	0
Oxidic (X)	Perch-Gley (XP)	0	0
	Nodular (XN)	0	0
	Orthic (XO)	0	0
Pallic (P)	Perch-Gley (PP)	0	0
	Argillic (PJ)	0	0
	Duric (PU)	0	0
	Fragic (PX)	0	0
	Immature (PI)	357	0.62
	Laminar (PL)	0	0
Podzols (Z)	Densipan (ZD)	0	0
	Groundwater-Gley (ZG)	0	0
	Orthic (ZO)	0	0
	Pan (ZX)	0	0
	Perch-Gley (ZP)	0	0

Order	Group	Proportion in focus catchment – Area ha	%[1]
Pumice (M)	Impeded (MI)	0	0
	Orthic (MO)	0	0
	Perch-Gley (MP)	0	0
Raw (W)	Fluvial (WF)	0	0
	Gley (WG)	0	0
	Hydrothermal (WH)	0	0
	Orthic (WO)	0	0
	Rocky (WX)	0	0
	Sandy (WS)	0	0
	Tephric (WT)	0	0
Recent (R)	Fluvial (RF)	617	1.08
	Orthic (RO)	0	0
	Rocky (RX)	0	0
	Sandy (RS)	0	0
	Tephric (RT)	0	0
Semiarid (S)	Aged (SA)	0	0
	Argillic (SJ)	0	0
	Immature (SI)	0	0
Ultic (U)	Albic (UE)	0	0
	Densipan (UD)	0	0
	Perch-Gley (UP)	0	0
	Sandy (US)	0	0
	Yellow (UY)	4,452	7.77

[1] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid shapes *See table above.*	Shows you which of the 74 soil groups are present in your catchment.	Helps with informing decisions around land management, including erosion control (through the erosion susceptibility of different soils), nutrient management (including optimising nutrients and soil fertility, determining suitable crops, and managing nutrient runoff), water resource management, wetland formation (some soils are more conducive to wetland formation), and land use planning (matching soil types with land uses in the catchment).	Developed by Manaaki Whenua/Landcare Research, the New Zealand Soil Classification (NZSC) classifies soils into three hierarchical structures (order, group, subgroup); of which the first two are shown here. Based on the New Zealand Genetic Soil Classification, the NZSC represents the best attempt to classify NZ soils based on the current state of knowledge.

Produced by & © EOS Ecology

Te Awa Kairangi/Hutt River

Soil Type

Focus Catchment Map Series: Map 3.3

- Waterways (stream order >1)
- Stormwater pipes
- Roads
- Focus catchment

SOIL GROUPS:

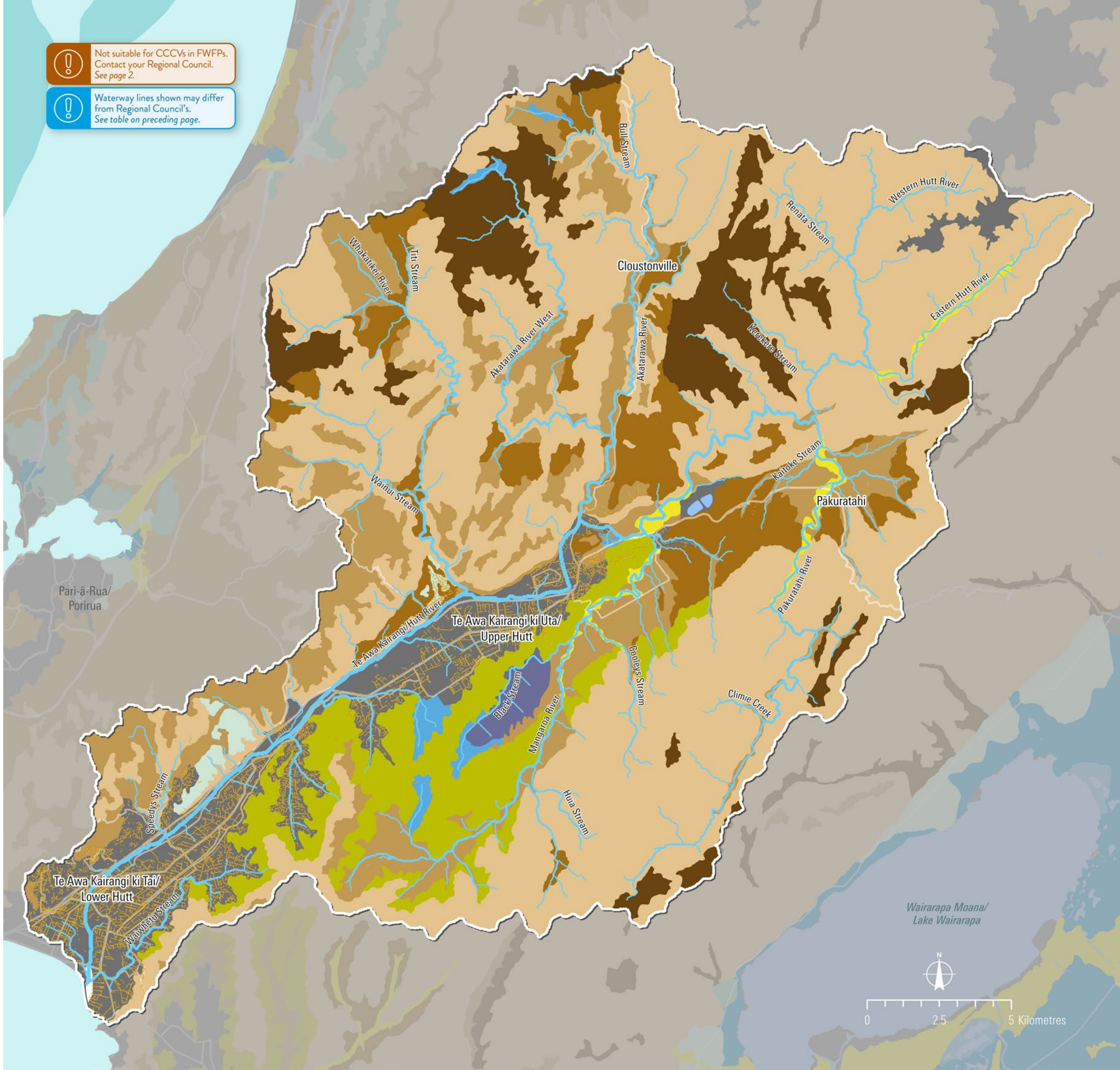
- Gley (LG)
- Impeded (LI)
- Orthic (LO)
- Perch-Gley (LP)
- Fill (AF)
- Truncated (AT)
- Acid (BA)
- Allophanic (BL)
- Firm (BF)
- Mafic (BM)
- Orthic (BO)
- Oxidic (BX)
- Sandy (BS)
- Acid (GA)
- Orthic (GO)
- Recent (GR)
- Sandy (GS)
- Sulphuric (GU)
- Orthic (NO)
- Oxidic (NX)
- Perch-Gley (NP)
- Mafic (EM)
- Orthic (EO)
- Perch-Gley (EP)
- Rendzic (ER)
- Vertic (EV)
- Fibric (OF)
- Humic (OH)
- Mesic (OM)
- Perch-Gley (XP)
- Nodular (XN)
- Orthic (XO)
- Perch-Gley (PP)
- Argillic (PJ)
- Duric (PU)
- Fragic (PX)
- Immature (PI)
- Laminar (PL)
- Densipan (ZD)
- Groundwater-Gley (ZG)
- Orthic (ZO)
- Pan (ZX)
- Perch-Gley (ZP)
- Impeded (MI)
- Orthic (MO)
- Perch-Gley (MP)
- Fluvial (WF)
- Gley (WG)
- Hydrothermal (WH)
- Orthic (WO)
- Rocky (WX)
- Sandy (WS)
- Tephric (WT)
- Fluvial (RF)
- Orthic (RO)
- Rocky (RX)
- Sandy (RS)
- Tephric (RT)
- Aged (SA)
- Argillic (SJ)
- Immature (SI)
- Albic (UE)
- Densipan (UD)
- Perch-Gley (UP)
- Sandy (US)
- Yellow (UY)
- No data

Further information

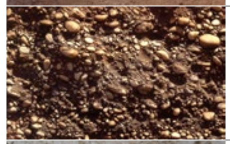
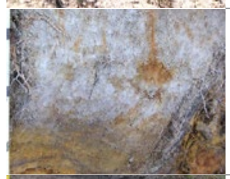
- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source layer data developed by: Manaaki Whenua/Landcare Research
- Interactive map where this layer is used: https://doi.org/10.26060/9vfz-hw43
- Information on soil orders & groups: www.nzsoils.org.nz/Topic-Classifying_Soils/Introduction_and_Soil_Orders_NZMaps

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Soil groups (Soils MapViewer; Manaaki Whenua/Landcare Research), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names (Land Information New Zealand).



Summary of soil orders

Relative age	Soil order		Short description	Soil groups in each order						
		Granular (N)	Clayey soils formed from strong weathering of volcanic rocks or ash. Low nutrient reserves and low phosphorus, slowly permeable with limited rooting depth. Highly productive used for horticulture, but only found in the North Island.	Orthic (NO)	Oxidic (NX)	Perch-Gley (NP)				
Old soils		Oxidic (X)	Clayey soils formed from weathering of volcanic ash or dark volcanic rock. High clay content but still friable. Low phosphorus reserves (but phosphorus retention is high), moderate-rapid infiltration rates with limited rooting depth. Soil water deficits common in summer. Found in Auckland and Northland.	Nodular (XN)	Orthic (XO),	Perch-Gley (XP)				
		Ultic (U)	Strongly weathered clayey subsoils with slow permeability. Dispersive surface soil horizons susceptible to livestock treading damage and erosion. Strongly acidic with low nutrient reserves, with biologically active topsoils (lots of soil organisms).	Albic (UE)	Densipan (UD)	Perch-Gley (UP)	Sandy (US)	Yellow (UY)		
		Allophanic (L)	Dominated by allophane minerals. Natural fertility is low but ability to retain phosphorus is high (up to 30 tonnes/ha of phosphorus may be locked away in intensively farmed topsoils). Topsoils are stable and resist impact of machinery/stock damage in winter. Low erosion except on steep slopes/exposed sites.	Gley (LG)	Impeded (LI)	Orthic (LO)	Perch-Gley (LP)			
		Brown (B)	Brown/yellow-brown subsoil below dark grey-brown topsoil. Relatively stable topsoils, and biologically active (lots of soil organisms, especially earthworms). Occur where summer droughts and waterlogging in winter is uncommon. Most extensive soils, covering 43% of New Zealand.	Allophanic (BL)	Acid (BA)	Firm (BF)	Mafic (BM)	Orthic (BO)	Oxidic (BX)	Sandy (BS)
		Gley (G)	Light grey subsoils that together with 'organic' soils, represents the original extent of our wetlands. High groundwater tables, so strongly affected by waterlogging in winter/spring and can remain wet all year. Chemically reduced, organic matter high, soil organisms restricted due to anaerobic conditions.	Acid (GA)	Orthic (GO)	Recent (GR)	Sandy (GS)	Sulphuric (GU)		
		Melanic (E)	Black or dark grey well structured topsoils, with neutral or alkaline (contains lime) subsoils. Stable topsoils that shrink on drying and swell on wetting. Highly fertile soils, biologically active (lots of soil organisms), and grow high quality pinot noir.	Mafic (EM)	Orthic (EO)	Perch-Gley (EP)	Rendzic (ER)	Vertic (EV)		
Mature soils		Organic (O)	Formed by partly decomposed remains of wetland plants (peat) or forest litter. Together with 'gley' soils, represents the original extent of our wetlands. Acts like a sponge, holding 20 times their weight in water. Low bulk densities (light soils), high shrinkage when dried. Strong-extremely acid, nutrient-deficient, organic matter high, soil organisms restricted due to anaerobic conditions.	Fibric (OF)	Humic (OH)	Mesic (OM)				
		Pallic (P)	Pale coloured subsoil due to low iron oxide content. Weak structure and high density (heavy soils – a cubic metre can weigh >1.8 tonnes), that are dry in summer and wet in winter. Slow permeability with limited rooting depth. Susceptible to erosion due to potential for slaking and dispersion. Med-high nutrient content, strongly worm-mixed at the A-B horizon boundary.	Argillic (PJ)	Duric (PU)	Fragic (PX)	Immature (PI)	Laminar (PL)	Perch-Gley (PP)	
		Podzols (Z)	Strongly acid soils that occur in high rainfall areas, usually associated with forest trees with an acid leaf litter. The contrast in horizons displays the potent effect that particular tree species (like Kauri) can have on soil formation. Often with compacted B horisons. Slow permeability, limited root depth, low natural fertility, low biological activity.	Densipan (ZD)	Groundwater-Gley (ZG)	Orthic (ZO)	Pan (ZX)	Perch-Gley (ZP)		
		Pumice (M)	Sandy or gravelly soils dominated by pumice or pumice sand with a high content of natural glass. Mostly derived from volcanic eruptions that created Lake Taupo. Low clay content, low soil strength, high macroporosity. Low reserves of nutrient elements, generally resistant to livestock treading damage.	Impeded (MI)	Orthic (MO)	Perch-Gley (MP)				
		Semiarid (S)	Dry for most of the growing season and needs irrigation to produce crops. High nutrient levels, low organic matter and low biological activity as so dry. High slaking and dispersion potential; soils are erodible. Lime and salts accumulate in the lower subsoil (as rain not sufficient to leach through). Rabbits thrive in such soils, with >800 rabbits/km^2 recorded.	Aged (SA)	Argillic (SJ)	Immature (SI)				

Produced by & © EOS Ecology

Relative age	Soil order		Short description	Soil groups in each order						
Young soils		Anthropic (A)	Soils substantially modified by humans, where the original character of the soil and the normal soil properties are lost. Mostly in urban areas and where there has been mining (including gold dredging).	Fill (AF)	Truncated (AT)					
		Raw (W)	Infant soils that may never grow older/lack distinct topsoil development because of active erosion, rockiness, or sedimentation. Associated with mountains, braided rivers, estuaries/beaches. High water table, limited fertility, nitrogen-deficient, little organic matter. Only sparse vegetation (moss, lichen, ephemeral herbaceous plants).	Fluvial (WF)	Gley (WG)	Hydrothermal (WH)	Orthic (WO)	Rocky (WX)	Sandy (WS)	Tephric (WT)
		Recent (R)	Weakly developed, showing limited signs of soil-forming processes. Found on young land surfaces (alluvial floodplains, unstable steep slopes, slopes with volcanic ash). High spatial variability and variable soil texture. Deep rooting, high plant-available water capacity, high natural fertility; normally has a well established cover of vascular plants. The highest recorded carrot production in the world was from 'Recent Soil' on the Taieri Plain.	Fluvial (RF)	Orthic (RO)	Rocky (RX)	Sandy (RS)	Tephric (RT)		

Soil images sourced from https://soils.landcareresearch.co.nz

Loess subsoil eroding on a cut face in the Port Hills (soil order: Pallic (P), soil group Fragic (PX)).

Produced by & © EOS Ecology

3.4 Soil drainage

This map uses modelled information to show the main drainage characteristics of soils within your focus catchment.

This map uses information on the soil profile to describe the likelihood of seasonal wetness as a dominant drainage class.

Summary of the soil drainage categories for your focus catchment

Category	Proportion in focus catchment – Area		Further detail
	ha	%[1]	
Very poorly drained	313	0.49	Peaty topsoil OR soils with 50% or more low-chroma colours on cut faces at less than 10 cm from the mineral soil surface.
Poorly drained	705	1.10	Soils that are within 15 cm of the base of the A-horizon, or within 30 cm of the mineral soil surface, have 50% or more low-chroma colours on cut faces.
Imperfectly drained	673	1.05	Soils that have a horizon between 30–60 cm of the mineral soil surface with 50% or more low chroma mottles on cut faces, OR soils that have in the top 30 cm of the profile or within 15 cm of the base of the A-horizon, 2% or more redox segregations or 50% or less low chroma colours on cut faces.
Moderately well drained	7,926	12.40	Soils that have a horizon between 60–90 cm of the mineral soil surface with 50% or more low chroma mottles on cut faces OR soils that have a horizon between 30–90 cm of the mineral soil surface with 2% or more redox segregations.
Well drained	4,961	7.76	Soils that have no horizon within 90 cm of the mineral soil surface with more than 2% or more redox segregations.
No data	49,342	77.19	No data has been provided for this area.

[1] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid shapes *See table above.*	A relatively simple classification of the soil profile that describes the likelihood of seasonal wetness.	Knowing soil drainage characteristics in your focus catchment will help with understanding how water moves through the catchment, and where your greater risk areas are for surface water runoff. You can also use this map to connect your observations of seasonal wetness with different soil types shown in the map, and so help confirm relevance.	Developed by Manaaki Whenua/Landcare Research, based on the occurrence within specific depths of redox segregation and low chroma colours indicative of waterlogging and reduction (Milne *et al.* 1995). Contains the dominant drainage class in the polygon. Where there are two dominant classes with the same proportion, the worst or least generally desirable class is used.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Notes on limitations/use

- A consistent and comprehensive soils data layer at the national, regional and local scale. However, it is unlikely to be accurate at the site scale. As such it would not be suitable for use in Freshwater Farm Plans.
- Some areas have not been mapped for soil drainage via this layer.
- The REC waterway layer is not exact and not accurate at a site scale.

Produced by & © EOS Ecology

Te Awa Kairangi/Hutt River

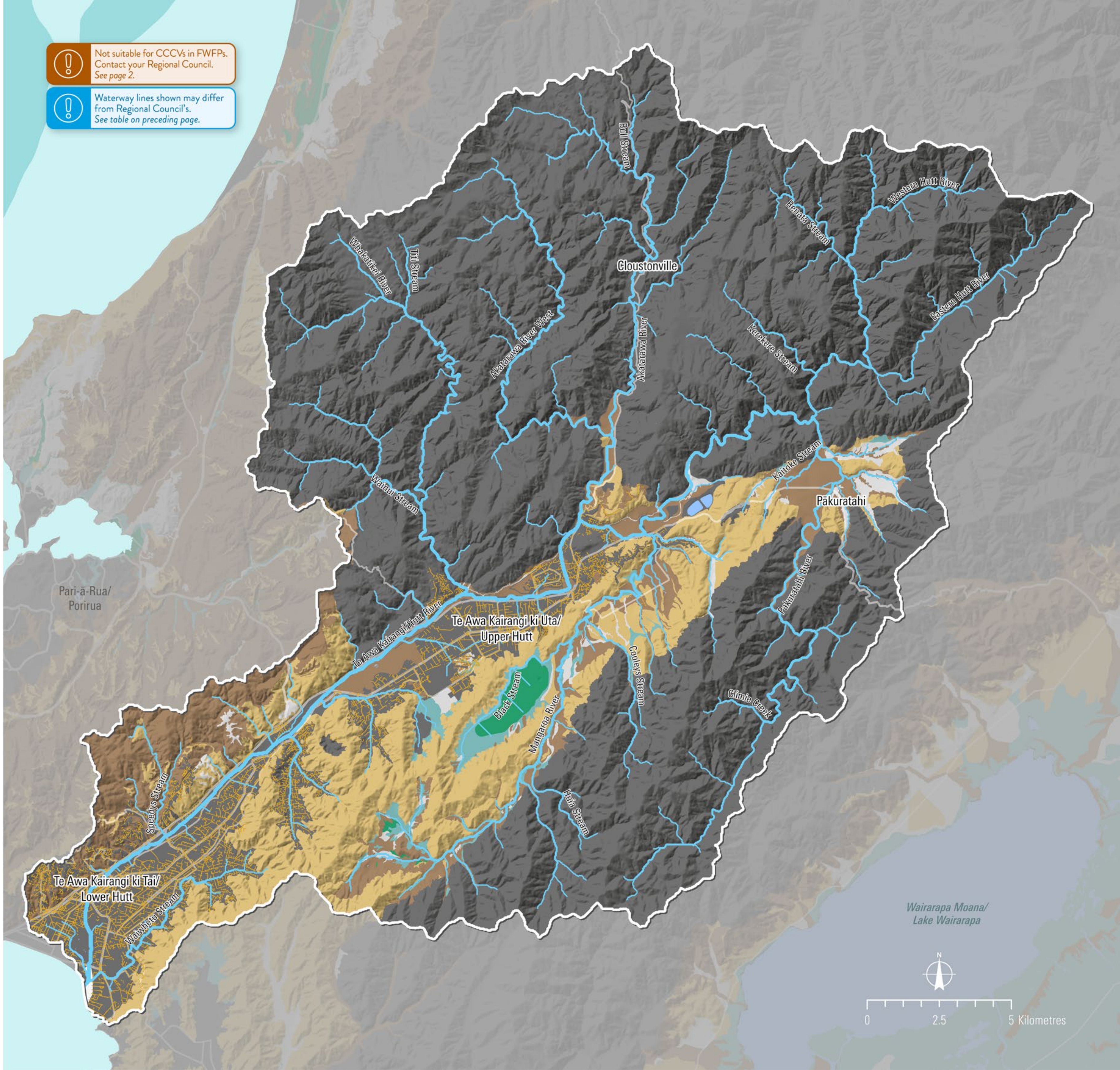
Soil drainage

Focus Catchment Map Series: Map 3.4

- Waterways (stream order >1)
- Stormwater pipes
- Roads
- Focus catchment

SOIL DRAINAGE:

- Very poorly drained
- Poorly drained
- Imperfectly drained
- Moderately well drained
- Well drained
- No data



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source layer data developed by: Manaaki Whenua/Landcare Research
- Key layer source url: https://lris.scinfo.org.nz/layer/119599-s-map-soil-drainage-aug-2024/
- Interactive map where this layer is used: https://smap.landcareresearch.co.nz/maps-and-tools/app

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Soil drainage (SMap; Manaaki Whenua/Landcare Research), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand).

3.5 Threatened environments

This map uses modelled information to show the state of indigenous vegetation cover in your catchment and the legal protection afforded.

This can be helpful in identifying areas where conservation efforts are most needed and/or where habitat restoration projects can have the greatest impact.

Summary of the threatened environment class categories for your focus catchment

Category	Proportion in focus catchment – Area – ha	Proportion in focus catchment – Area – %[1]	Further detail
<10% indigenous cover left	8,367	13.13	Environments with <10% indigenous cover left. In these environments, the loss of habitats for indigenous species has been greatest in the past. Little indigenous biodiversity remains in these environments.
10–20% indigenous cover left	1,754	2.75	Environments with 10–20% indigenous cover left. Indigenous biodiversity in these environments has been severely reduced and remaining habitats are sparsely distributed in the landscape.
20–30% indigenous cover left	8,246	12.94	Environments with 20–30% indigenous cover left. Indigenous biodiversity in these environments has been much reduced and habitats are seriously fragmented.
>30% left & <10% protected	507	0.80	Indigenous vegetation in these environments are less reduced (>30% indigenous cover left) and fragmented than the above categories, but have little protection (<10% of the area legally protected). The remaining indigenous vegetation is poorly represented in private or public conservation areas.
>30% left & 10–20% protected	0	0	As for the above category, with more indigenous habitat protected from clearance (10–20% of the area legally protected).
>30% left & >20% protected	44,611	70.02	As for the above category, with >20% of the area legally protected from clearance. Indigenous vegetation cover is still vulnerable to threats such as pests, weeds, logging and other extractive land uses.
No data	229	0.36	No data has been provided for this area.

[1] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid shapes *See table above.*	Shows how much native (indigenous) vegetation remains within land environments, and how past vegetation loss and legal protection are distributed across Aotearoa's landscape.	Helps you to understand what level of remnant habitats remain. In combination with the 'past vegetation' and 'protected areas' maps it could be used to help prioritise restoration to restore lost species, linkages and buffers.	Developed by Manaaki Whenua/Landcare Research using a combination of three national databases: » Land Environments New Zealand (LENZ) level IV: LENZ classifies New Zealand's terrestrial environments on the basis of abiotic variables (climate, soil and landform) that are major drivers of spatial patterns in most living organisms. Thus used as a surrogate for the potential full range of terrestrial ecosystems and biodiversity. » Land Cover Database version 4 (LCDB4): where the 33 cover classes are assigned to either an indigenous (20) or exotic (13) category. Uses indigenous vegetation as a surrogate for indigenous biodiversity. » Protected Areas Network (version 2012):where the percentage of each land environment covered by legal protection for the purpose of natural heritage protection is used as a surrogate for the relative vulnerability of the remaining indigenous biota to pressures such as land clearance or incompatible land uses.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Notes on limitations/use

- Protected area information remains inconsistently collected and managed across multiple agencies and sources in New Zealand.
- Unlikely to be accurate at a site scale.
- The REC waterway layer is not exact and not accurate at a site scale.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

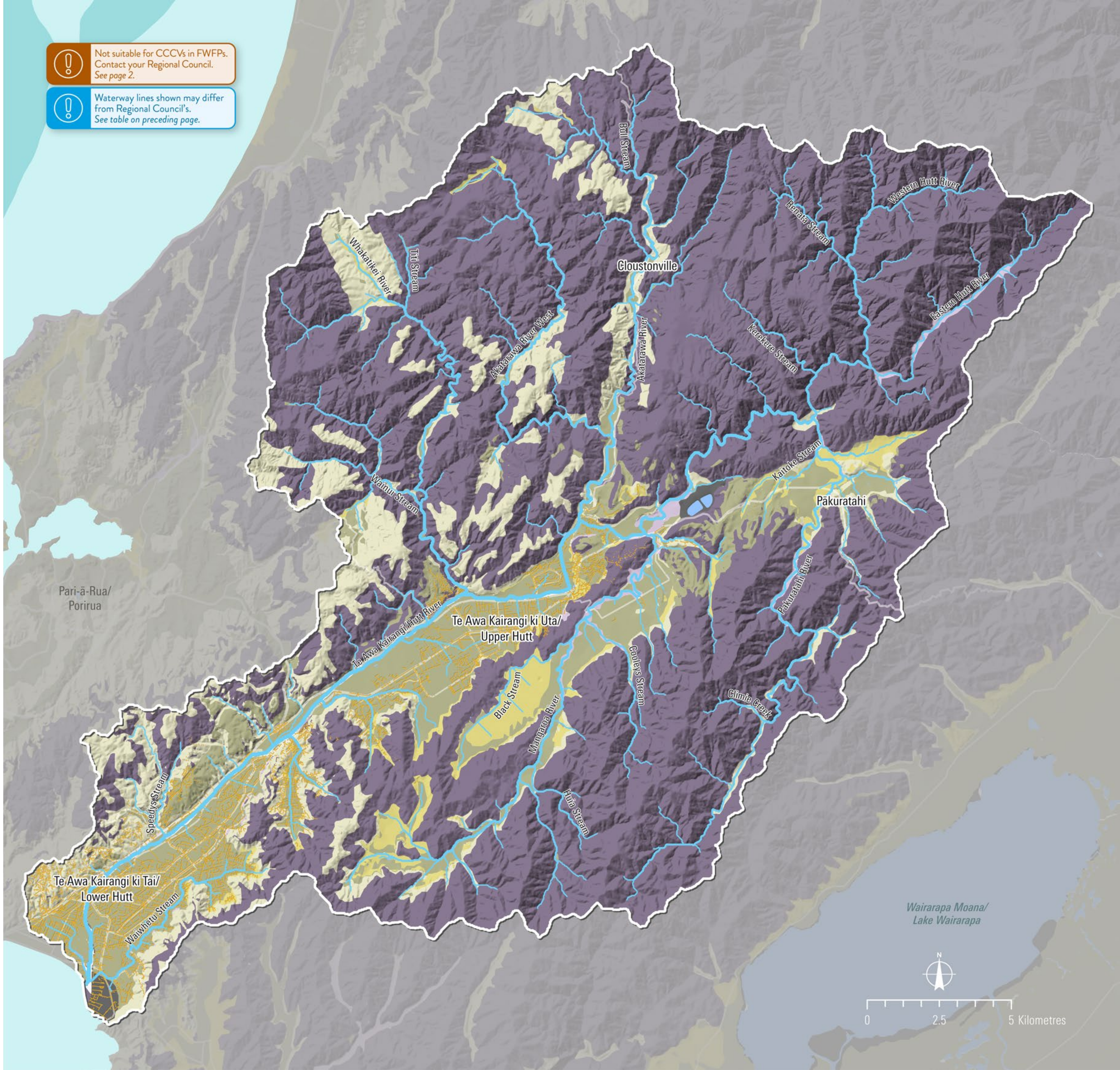
Threatened Environment Classification

Focus Catchment Map Series: Map 3.5

- Waterways (stream order >1)
- Stormwater pipes
- Roads
- Focus catchment

THREATENED ENVIRONMENT CLASSES:

- <10% indigenous cover left
- 10–20% indigenous cover left
- 20–30% indigenous cover left
- >30% left & <10% protected
- >30% left & 10–20% protected
- >30% left & >20% protected
- No data



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: Manaaki Whenua/Landcare Research
- Key layer source url: https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Habitats/lenz_tec/490,414,491,415,399,400
- Report: Cieraad *et al.* (2015)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Threatened Environment Classes (Threatened Environments Classification 2012; Manaaki Whenua/Landcare Research), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand).

3.6 Protected areas

This map shows areas that are legally protected to safeguard biodiversity, native species, and ecosystems.

These areas include those protected by:

- Department of Conservation (DOC)
- Queen Elizabeth II National Trust (QEII)
- Nature Heritage Fund Covenants
- Regional Councils (including regional parks in Auckland, Bay of Plenty, Horizons, and Wellington)
- Nga Whenua Rahui
- Area covenant registered on landowner's Certificate of Title and binding on future owners of the site.

Notes on limitations/use

- Based on online datasets and only as accurate as the source data.
- Boundaries may have been based on unsurveyed parcels defined to varying degrees of accuracy. As such, the boundaries are indicative only.
- Protected areas (DOC & LINZ): The dataset includes reserves but is not a complete set. Privately owned reserves are excluded from the dataset as they are not crown land. Also, the dataset does not contain a complete list of reserves 'vested' in Local Authorities or 'controlled and managed' by other organisations. The dataset is continually being updated, however, as errors or omissions are discovered and new land transactions are completed.
- The data represents best endeavours to maintain an accurate record of conservation land and covenants but is unlikely to be accurate at a site scale.
- The REC waterway layer is not exact and not accurate at a site scale.

Breakdown of the different types of protected area categories for your focus catchment

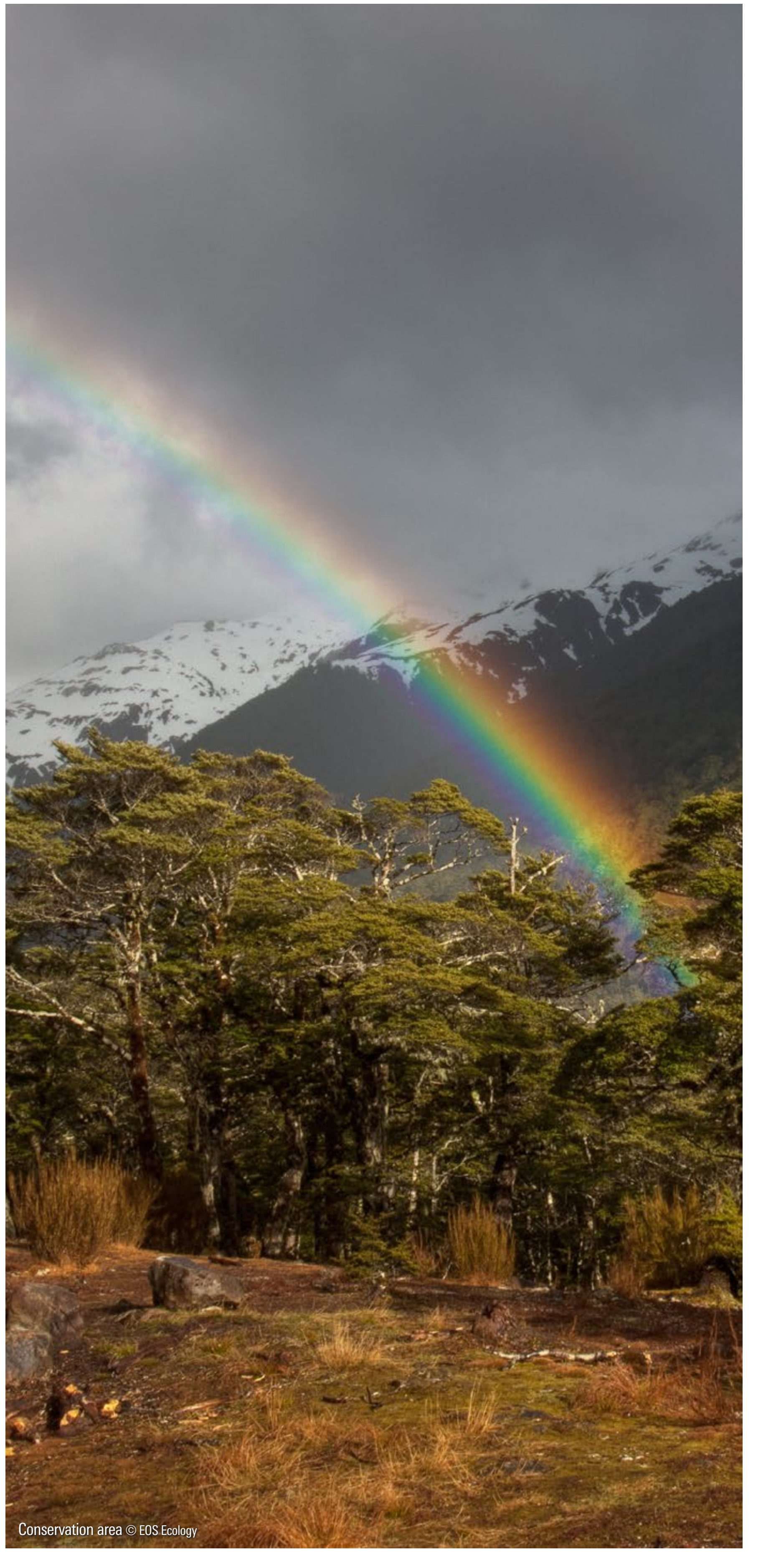
Data Source	Protected Areas Type	Proportion in focus catchment – Area – ha	Proportion in focus catchment – Area – %[1]	# of disparate areas
DOC & LINZ	Reserve[2]	1,446	2.26	70
	Conservation area[2]	1,210	1.89	7
	Marginal strip[2, 3]	1	0	2
	Wildlife area[2]	0	0	0
	National Park[2]	0	0	0
	Other[2]	0	0	0
DOC	Conservation Covenant	38	0.06	2
QEII Trust	Open Space Covenant	277	0.43	26

1 Percentages may not total 100% due to rounding.
2 Sourced from LINZ, derived from NaPALIS.
3 As per Part 4A Marginal Strips of the Conservation Act 1987 – www.legislation.govt.nz/act/public/1987/0065/latest/DLM104697.html

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid shapes *See table above.*	Tells you the number and extent of protected areas within your catchment. Includes land areas, most of which are administered by DOC, and are protected by the Conservation, Reserves, and National Parks. Also includes conservation covenants administered by DOC or QEII National Trust.	It can be used by itself to report on the status of protected areas, or in combination with other databases to inform a range of conservation management matters.	DOC & LINZ Protected Areas: administered by Land Information New Zealand (LINZ), derived from the National Property and Land Information System (NaPALIS), which is a centralised database for all DOC and LINZ administered land. DOC Conservation Covenant Areas: a database administered by DOC that shows covenants from a range of sources. Conservation covenants are a voluntary legal agreement between a landowner and authorised agency which gives formal protection to the natural, cultural, historical and/or significant values of a site. The land is owned by the landowner who manages it in accordance with the agreement. QEII National Trust Open Space Covenant Boundaries: An inventory of registered and formalised open space covenants based on data from councils, DOC, surveyors and LandOnline.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.



Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

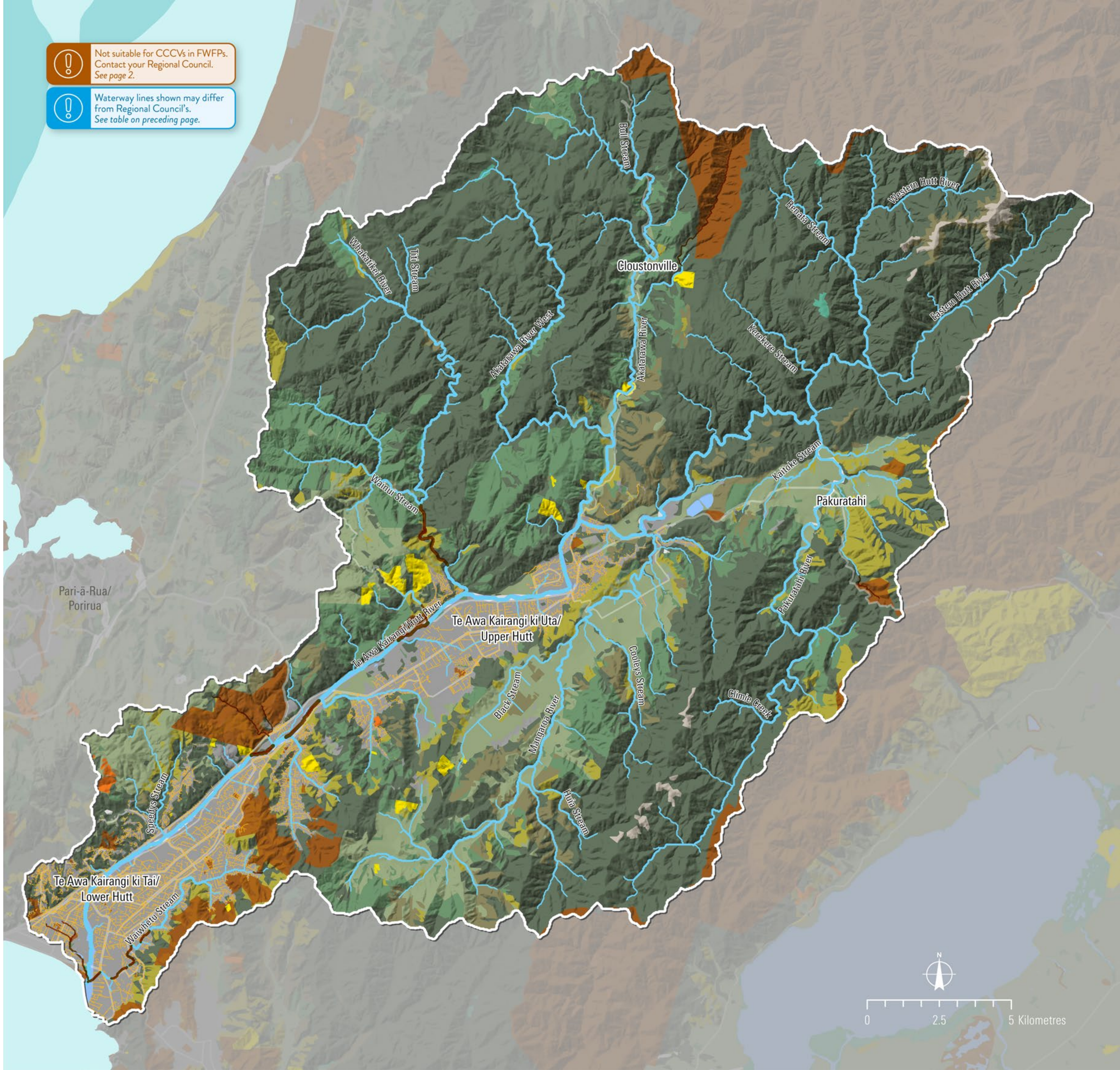
Protected Areas

Focus Catchment Map Series: Map 3.6

- Waterways (stream order >1)
- Stormwater pipes
- Roads
- Focus catchment

PROTECTED AREA:

- DOC & LINZ Protected Areas
- DOC Conservation Covenant
- QEII Trust Open Space Covenant



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: Department of Conservation (DOC) & Land Information NZ (LINZ) (protected areas), DOC (conservation covenant), Queen Elizabeth II National Trust (QEII National Trust)/Ngā Kairauhī Papa (open space covenant)
- Key layer source url: Protected areas (https://data.linz.govt.nz/layer/53564-protected-areas), Conservation covenant (www.arcgis.com/home/item.html?id=e35ba07f91aa47df9651f423f4ff11d0), Open space covenant (www.arcgis.com/home/item.html?id=c999fef049714675934fdb8af5b6b46b)
- Interactive map where this layer is used: Protected areas: https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Habitats/lenz_prot_areas
- A table of DOC administered Protected Areas that links to primary land parcels: https://data.linz.govt.nz/table/53561-protected-areas-to-parcel-association

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Protected Areas (DOC & LINZ), Conservation Covenant (DOC), Open Space Covenant (QE II National Trust/Ngā Kairauhī Papa), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

4.

FOCUS CATCHMENT – Water quality data

The following maps present information about the water quality of your focus catchment and are based on actual data from the testing of water samples, along with some modelled information. These maps can help you to better understand the water quality health of your waterways, and help you work out where there might be greater pressures on your waterways and their inhabitants.

Water quality describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect to its suitability for a particular purpose such as drinking and swimming, or to support the plants and animals that live in it. They can broadly be broken down into the categories described below.

Use of interpretation bands for assessing the health of waterways in relation to water quality data

There are a range of interpretation bands that can be used when looking at water quality data. The following are a list of interpretation bands used in this map series:

NOF National Objectives Framework (NOF) bands: The NOF is one component of the NPS-FM 2020 (New Zealand Government, 2024). It requires Regional Councils to go through a process of identifying freshwater management units (FMUs) within their region and identifying the values of each individual FMU. They then need to set environmental outcomes and identify attributes for each value. Each attribute needs baseline states, targets and limits set, while preparing action plans to achieve the stated environmental outcomes. The NOF provides interpretation bands for 22 different attributes, with most attributes having four (A–D) or five (A–E) described bands and a national bottom line. Water quality measures can be compared to the NOF bands as an assessment of ecosystem health (MfE & Stats NZ, 2023). Supporting human connection through activities such as swimming is also assessed with some interpretation bands. There are a range of monitoring criteria that need to be met for the NOF bands to be used and so these bands won't be suitable for use on all available data. In this map series we have only used the NOF bands when presenting Regional Council monitoring that is available on the LAWA website – www.lawa.org.nz.

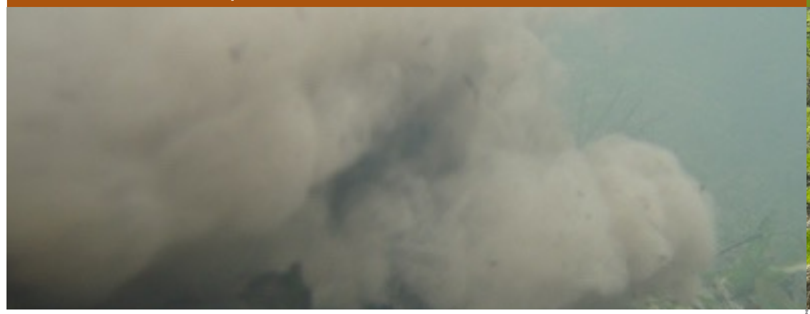
ANZG Australian & New Zealand Guidelines for fresh & marine water quality (ANZG, 2018): These are nationally relevant guidelines that provide a generic starting point for assessing water quality. These are appropriate guidelines for use where there is an absence of more relevant regional or local guidelines. It provides default guideline values (DGV) for physical and chemical stressors (such as ammoniacal nitrogen, turbidity, pH) and toxicants (such as metals, surfactants, aromatic hydrocarbons).

MfE MfE (2003) microbiological water quality guidelines for marine & freshwater recreational areas: These guidelines provide local authorities with interpretation bands that may be used for informing the community about the health risks of swimming in waterways and beaches.

S 'Streamed' guidelines for water clarity data: These are nationally applicable interpretation bands for clarity tube data, based on the original Stream Health Monitoring Assessment Kit (SHMAK) interpretation bands Biggs *et al.* (2002). See www.streamed.nz for further information.

Water quality categories

Suspended Sediment *(included in this section)*



» Sediment that is suspended in the water column. High levels of Suspended Fine Sediment (SFS) can impact ecological communities by altering growth of freshwater plants, affecting the feeding ability of fish, and smothering streambed habitat. Very fine sediment does not settle easily out of the water, remaining suspended in the water for a long time. Larger sediment particles (like sand) are heavier and drop out of the water column more quickly, where it can smother the streambed substrate.

» The amount of SFS in the water column can be measured as visual clarity. It is measured in metres, where a higher measurement means less SFS (water appears clearer), and a lower measurement means more SFS (water appears murkier or 'turbid'). Water clarity can vary with in-stream disturbances, such as animals in the waterway or an increase in flow. But fine sediment also enters streams from the surrounding land – from unsealed road surfaces, construction sites/developments, vegetation clearance, or eroding slopes or streambanks.

Nutrients *(included in this section)*

» Includes nitrogen species (nitrate-nitrite nitrogen, ammoniacal nitrogen, dissolved inorganic nitrogen) and phosphorus (dissolved reactive phosphorus). While important for plant growth, elevated nutrient levels in waterways can cause unwanted plant/algae growth, which can smother stream beds/choke streams, lower oxygen, or affect water pH. At higher levels, soluble nutrients such as ammonia nitrogen and nitrate-nitrogen can be toxic to instream life.

» There are also risks to human health. The Drinking Water Standards for New Zealand (New Zealand Government, 2022) indicate the current maximum acceptable value for nitrate-nitrogen in drinking water is 11.3 mg/L.

» The nitrogen cycle is shown on the next page.

Faecal matter *(included in this section)*

» *E. coli* are a common bacteria found in the guts of warm-blooded mammals & birds. They're known as a Faecal Indicator Bacteria (FIB), since the detection of these bacteria signal that water has been contaminated with faecal matter, and may contain other pathogens that could cause illness if ingested.

» While the presence of *E. coli* does not show the source of the contamination (e.g., birds, dogs, humans), it does show that there is a possible presence of illness-causing pathogens, which has implications for mahinga kai, swimming, and other recreational use. As such, *E. coli* is often used as a measure of the suitability of freshwater for human contact.

Heavy Metals *(not included in this section)*

» Urban waterways are more likely to have high levels of heavy metals, since common sources of heavy metal contamination include stormwater runoff from roads, roofs, and other impervious surfaces. In high concentrations, heavy metals can have toxic effects on instream life, with some species being more sensitive to these effects than others. For this reason, the ANZG (2018) for water quality set default guideline values for the protection of a specified percentage of species (such as 80–99% level of species protection).

Dissolved Oxygen (DO) *(not included in this section)*

» A measure of how much oxygen is available in the water. Low levels of DO are stressful for instream life. The lower the DO or the longer the duration of low DO, the greater the stress levels.

» Oxygen enters waterways mainly from the atmosphere and groundwater, but dangerously low levels of DO can develop in waters that are warm, slow flowing, have excessive plant growth or large quantities of organic matter. Water bodies with excessive macrophyte/algal growth can have wildly fluctuating DO levels between day/night due to plants releasing oxygen during the day and absorbing it at night.

All images © EOS Ecology.

Produced by & © EOS Ecology

Nitrogen cycle

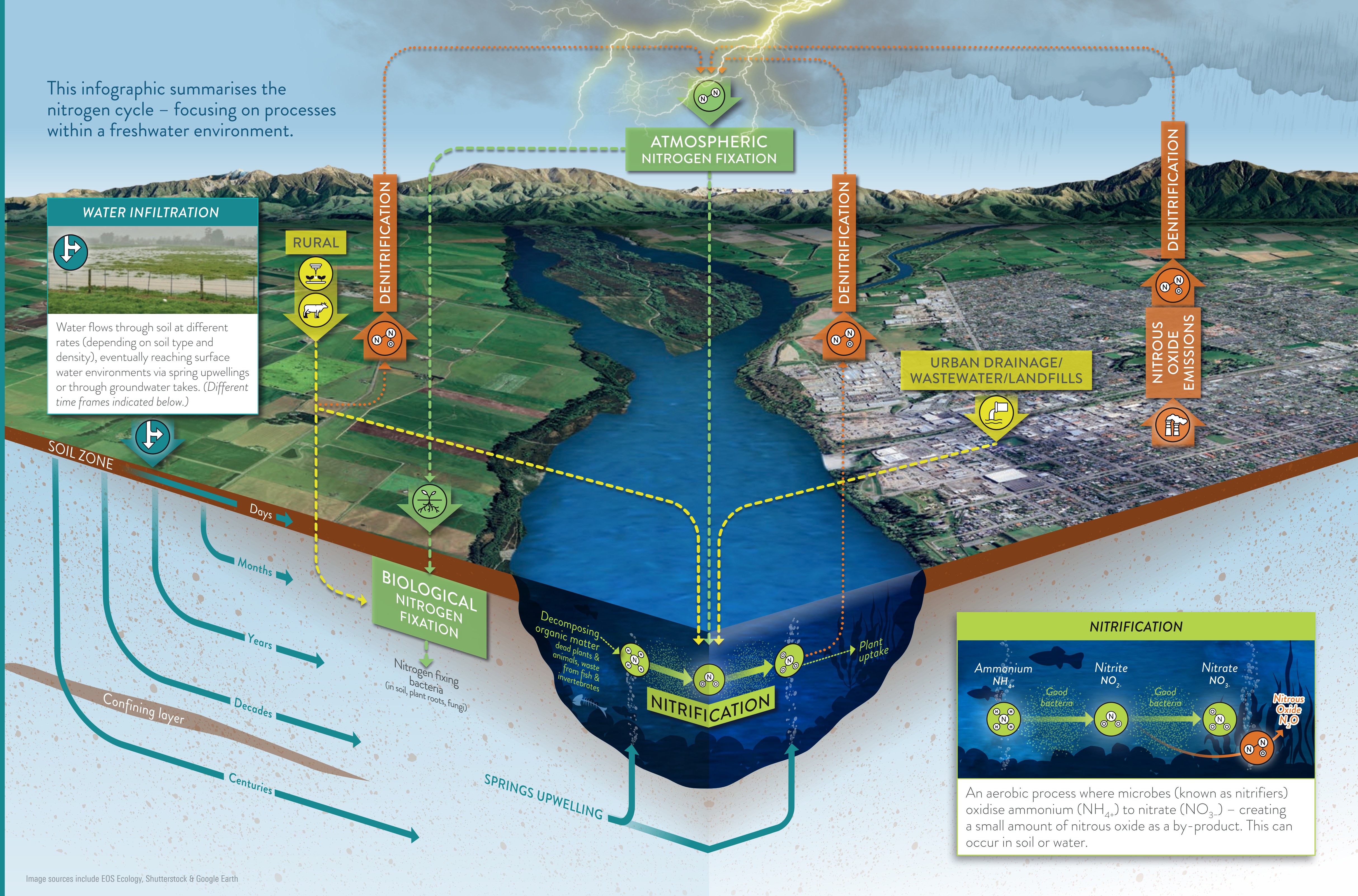
The nitrogen cycle starts with nitrogen gas in the air. Bacteria thriving in soil, around plant roots, and in water, convert it to forms useful for other biochemical and biological processes.

Understanding nitrates and their impact on your catchment's waterways:

Nitrate (NO_3), a compound formed when nitrogen combines with oxygen, poses concerns for waterways when it becomes elevated.

An important nutrient for plant growth and naturally present in low quantities, elevated nitrate levels indicate contamination from human activities – including infiltration from fertilised lawns/cropland/pasture, urine patches, leaky septic systems, run-off from animal manure/urine, and industrial discharges.

The adverse effects of excess nitrates on your catchment's water bodies include excessive plant/algae growth. This can smother stream beds, reduce oxygen in the water and alter water pH, eventually harming fish, macroinvertebrates and their ecosystems. At very high levels nitrate is toxic to fish and some aquatic invertebrates.



Nitrogen inputs

RURAL

URBAN DRAINAGE/ WASTEWATER/LANDFILLS

For rural areas, the main nitrogen inputs come from synthetic fertilisers and urea in animal urine, which rapidly hydrolyses in the soil to ammonium and is then nitrified to nitrate (see nitrification diagram). Nitrate can also enter waterways directly from wastewater, landfills, animal feedlots, septic systems, or urban drainage.

Nitrogen fixation

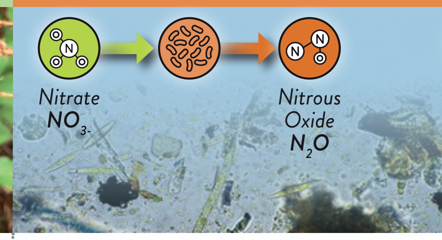
ATMOSPHERIC

BIOLOGICAL

This is where molecular nitrogen (N_2) in the atmosphere is converted into nitrogen compounds useful for other biochemical/biological processes. Fixation can occur through atmospheric (lightning), biological (nitrogen-fixing bacteria), or industrial processes (not shown).

Nitrogen outputs

DENITRIFICATION



An anaerobic process where microbes known as denitrifiers convert nitrate into nitrogen, with some released into the atmosphere as nitrous oxide. This can occur in soil, water, or air.

NITROUS OXIDE EMISSIONS

Nitrous oxide is emitted during some industrial processes, burning fossil fuels, treating solid wastes, and when naturally occurring microbes act on nitrogen in soils.

Produced by & © EOS Ecology

4.1 Suspended sediment – yield

This map uses modelled information to show the estimated mean annual suspended sediment load (the mass of sediment passing down a river/estuary over a 12-month time period), measured in tonnes/year.

The estimated national suspended sediment load to Aotearoa's coast is 181.1 megatonnes per year, with 61% (111.6 megatonnes per year) from the North Island and 39% (69.5 megatonnes per year) from the South Island. This map shows the estimated load for the subcatchments within your focus catchment.

Notes on limitations/use

As reported by Hicks *et al.* (2019) for the modelled dataset:

- Based on modelled data, calibrated nationally against river mean annual suspended sediment loads from 273 monitoring sites. The 'corrected' model (used here) reflects adjustments across the calibration catchments to ensure the modelled loads at the catchment outlets reflected the observed sediment loads. While a calibration process has been carried out to verify the accuracy of the underlying model the sediment load data provided are estimates only, and subject to uncertainty.
- It is assumed that there are no significant losses of sediment to floodplain storage, since many large NZ rivers are currently isolated from their floodplains by flood-protection embankments.
- Net sediment supply from eroding streambanks is implicitly included, on the basis that it is captured at the model calibration sites, along with sediment delivered from upstream hill-slope erosion processes.
- The contribution of coarse-grained, gravelly sediment moving as bedload is not included.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of suspended sediment yield by subcatchment

Subcatchment suspended sediment yield tonnes/year	# of subcatchments	%[1] of subcatchments
0–50	45	42.06
50–200	38	35.51
200–500	9	8.41
500–2,000	12	11.21
2,000–5,000	0	0
>5,000	2	1.87

[1] Percentages may not total 100% due to rounding.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Waterway lines – colour 0–50 50–200 200–500 500–2,000 2,000–5,000 >5,000	Shows you the sediment yield from each segment of river. The waterway lines' colour and width is according to the groupings shown in the map key.	Within those subcatchments that you want to focus on, you can see where in that subcatchment the sediment yield is higher – you can then visit those areas to see where the sediment might be coming from. This will help you to target any actions.	A model developed by NIWA that generates a mean annual sediment load for each 1-ha grid-cell based on average slope, mean annual rainfall (30 year mean annual 'normal' rainfall), land cover (Land Cover Data Base V3 (LCDB3) conflated to six functional groups), and erosion terrain classification (30 m resolution digital terrain model developed by Manaaki Whenua/Landcare Research and classified into 12 groups) in that grid-cell. Data has been applied to version 2 of the REC2 waterway lines, summing the sediment loads from all raster units upstream and routing these loads down the stream network, taking into account entrapment in lakes and reservoirs.
Solid shapes *See table above.*	The modelled sediment yield that is discharging from that subcatchment area into your mainstem channel. If all other variables are equal, you can generally expect that larger catchments will have a larger sediment load overall.	It can show you what subcatchments you might want to focus on in terms of sediment control (i.e., focus first on those catchments that have more sediment discharging into the mainstem).	Subcatchment watershed areas generated using NIWA's REC layer to select all REC segments and related watersheds upstream of each confluence point to the mainstem. The subcatchment watershed is then colour-coded according to the groupings shown in the map key based on the sediment yield (tonnes/year) value at the confluence point to the mainstem.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Suspended Sediment – Yield

Focus Catchment Map Series: Map 4.1

Stormwater pipes

Roads

Focus catchment

SUSPENDED SEDIMENT YIELD – **WATERWAY**:
tonnes/year

0–50

50–200

200–500

500–2,000

2,000–5,000

>5,000

SUSPENDED SEDIMENT YIELD – **SUBCATCHMENT**:
tonnes/year

0–50

50–200

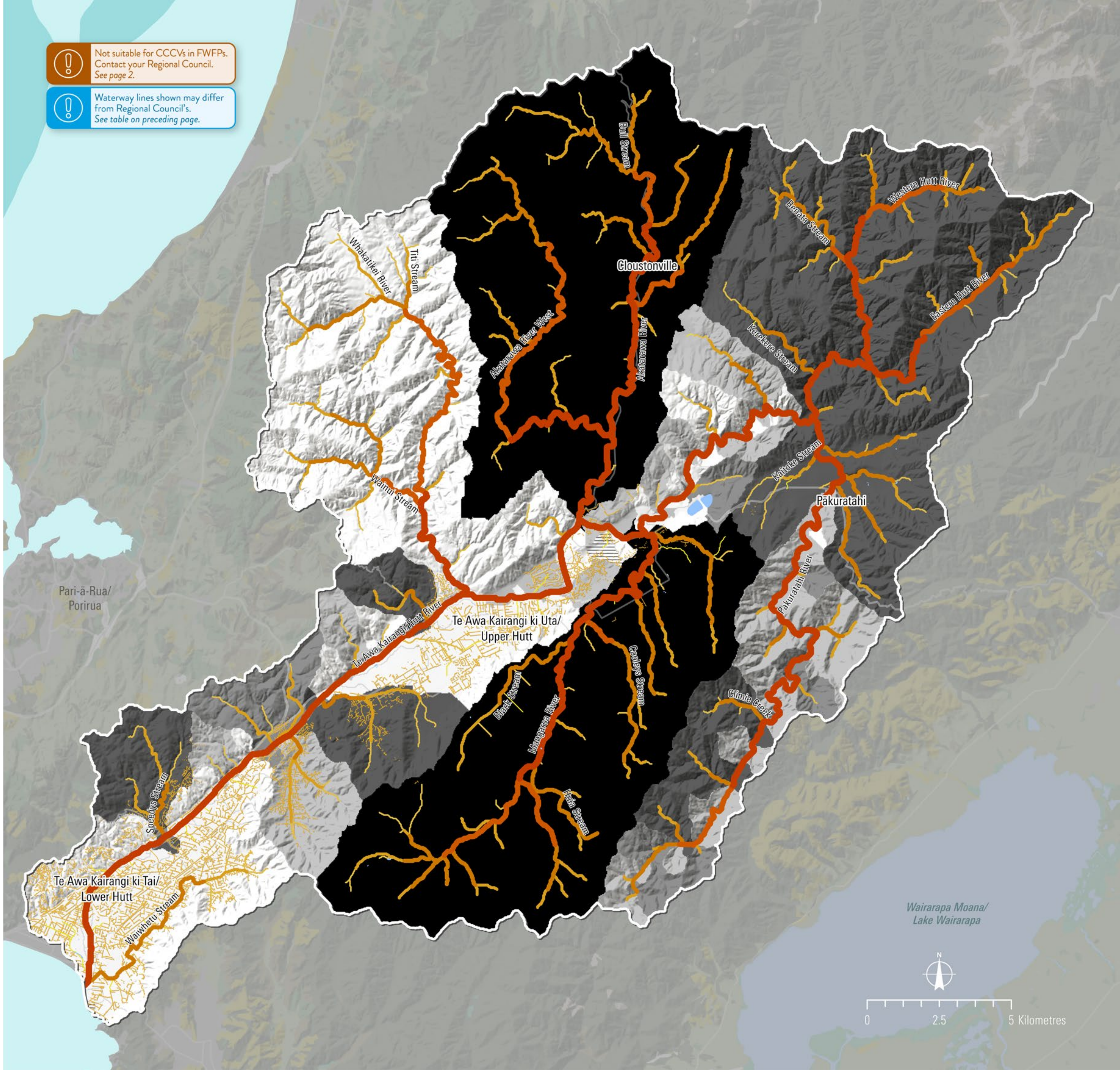
200–500

500–2,000

2,000–5,000

>5,000

No data



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- ***Note: Legend may show items not present on the map. See page 11 for more details.***
- Source model/layer data developed by: NIWA
- Key layer source url: https://data.mfe.govt.nz/layer/103686-updated-suspended-sediment-yield-estimator-and-estuarine-trap-efficiency-model-results-2019
- Interactive map where layer is used: https://web.nz.dhigroup.com/CoastalSedimentSourcePortal
- Report: Hicks *et al.* (2019)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Suspended sediment yield waterway (Suspended Sediment Yield Estimator (SSYE); NIWA), suspended sediment yield subcatchment (EOS Ecology based on SSYE; NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

4.2 Suspended sediment – discharge

This map uses modelled information to show the estimated mean annual suspended sediment load (the mass of sediment passing down a river/estuary over a 12-month time period), measured in tonnes/year and standardised for area (tonnes per km^2 per year).

Taking into account the size of the subcatchments within your focus catchment, we can estimate what the suspended sediment discharge from each of your subcatchments would be.

Notes on limitations/use

As reported by Hicks *et al.* (2019) for the modelled dataset:

- Based on modelled data, calibrated nationally against river mean annual suspended sediment loads from 273 monitoring sites. The 'corrected' model (used here) reflects adjustments across the calibration catchments to ensure the modelled loads at the catchment outlets reflected the observed sediment loads. While a calibration process has been carried out to verify the accuracy of the underlying model the sediment load data provided are estimates only, and subject to uncertainty.
- It is assumed that there are no significant losses of sediment to floodplain storage, since many large NZ rivers are currently isolated from their floodplains by flood-protection embankments.
- Net sediment supply from eroding streambanks is implicitly included, on the basis that it is captured at the model calibration sites, along with sediment delivered from upstream hill-slope erosion processes.
- The contribution of coarse-grained, gravelly sediment moving as bedload is not included.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of suspended sediment discharge by subcatchment

Subcatchment suspended sediment yield tonnes/km^2/year	# of subcatchments	%[1] of subcatchments
<15	32	29.91
15–30	7	6.54
30–60	18	16.82
60–120	25	23.36
120–240	17	15.89
240–480	7	6.54
>480	1	0.93

1 Percentages may not total 100% due to rounding.

Sediment plume © EOS Ecology

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid shapes *See table above.*	The modelled sediment yield that is discharging from that subcatchment area into your mainstem channel – but standardised for area (km^2).	It can show you what subcatchment has the greatest relative amount of sediment discharge, irrespective of the size of the catchment (i.e., standardised for a set area). When you compare this to the previous map you might find that the larger catchments may not be the ones that are discharging the highest concentration of suspended sediment. It can help you further target where you may want to focus on in terms of sediment control (i.e., whether to focus on those catchments that have a higher concentration of sediment discharging into the mainstem irrespective of catchment size, or those that have the most sediment load (which will be influenced by catchment size as well as concentration)).	Base model developed by NIWA, generates a mean annual sediment load for each 1-ha grid-cell based on average slope, mean annual rainfall (30 year mean annual 'normal' rainfall), land cover (Land Cover Data Base V3 (LCDB3) conflated to six functional groups), and erosion terrain classification (30 m resolution digital terrain model developed by Manaaki Whenua/Landcare Research and classified into 12 groups) in that grid-cell. Data has been applied to version 2 of the REC waterway lines, summing the sediment loads from all raster units upstream and routing these loads down the stream network, taking into account entrapment in lakes and reservoirs. Subcatchment watershed areas were then generated using NIWA's REC layer to select all REC segments and related watersheds upstream of each confluence point to the mainstem. The subcatchment watershed is then colour-coded according to the groupings shown in the map key based on taking the sediment yield (tonnes/year) value at the confluence point to the mainstem (as per Map 4.2) and dividing it by the area of upstream watershed.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Suspended Sediment – Discharge

Focus Catchment Map Series: Map 4.2

Waterways (stream order >1)

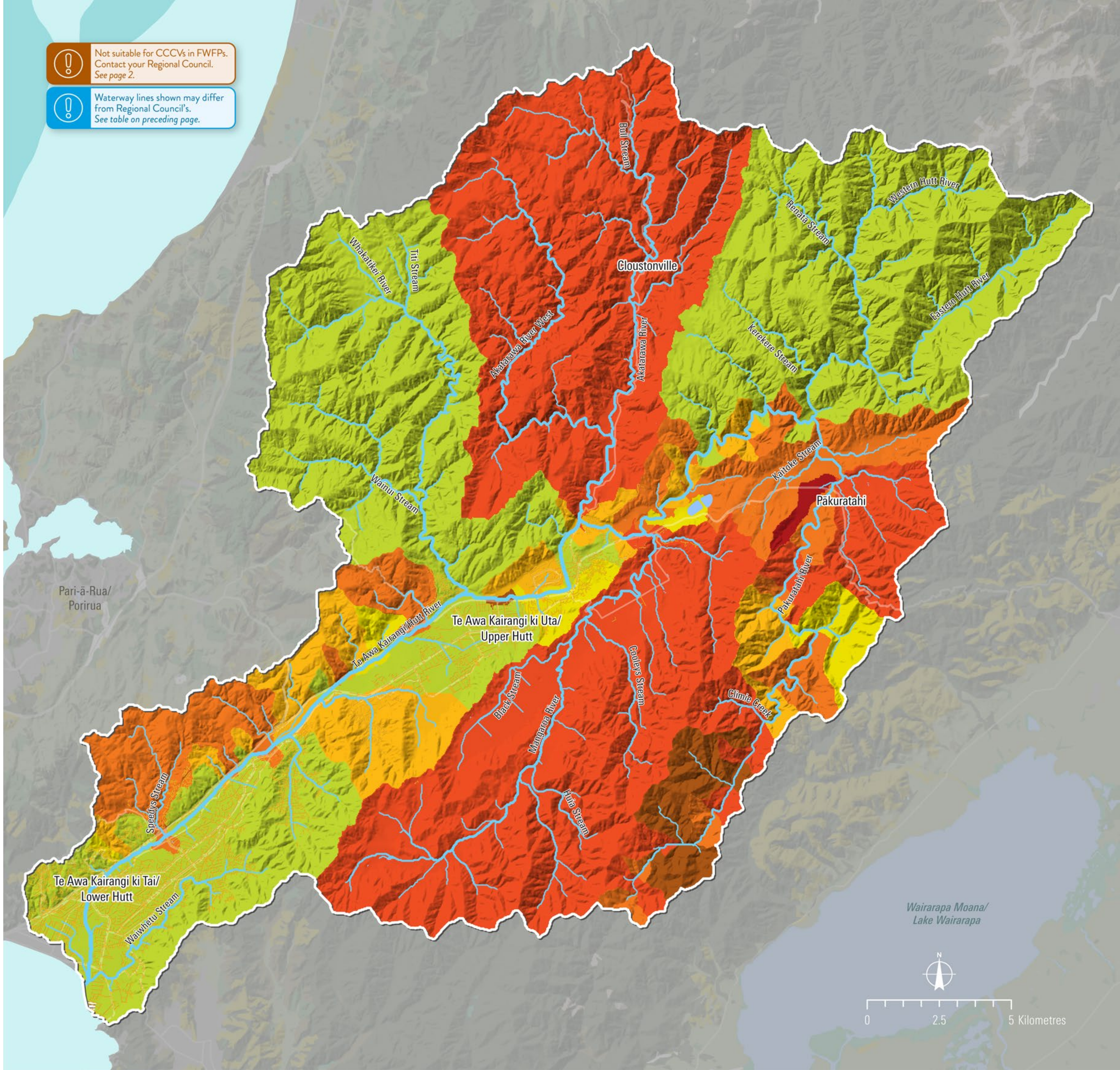
Stormwater pipes

Roads

Focus catchment

SUSPENDED SEDIMENT YIELD — **SUBCATCHMENT**: tonnes/km²/year

- <15
- 15–30
- 30–60
- 60–120
- 120–240
- 240–480
- >480
- No data



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source model/layer data developed by: NIWA
- Key layer source url: https://data.mfe.govt.nz/layer/103686-updated-suspended-sediment-yield-estimator-and-estuarine-trap-efficiency-model-results-2019
- Report: Hicks *et al*. (2019)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Suspended sediment yield subcatchment (EOS Ecology based on Suspended Sediment Yield Estimator (SSYE); NIWA), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

4.3 Suspended sediment – visual clarity

This map shows actual data on visual clarity in waterways in your catchment, with data interpretation using two types of data interpretation bands.

The amount of Suspended Fine Sediment (SFS) in the water column can be measured as its visual clarity. It is measured in the field, using a black disk or water clarity tube, with the results reported as the distance (m) of visibility. A higher measurement means less SFS (water appears clearer) and a lower measurement means more SFS (water appears murkier or turbid). High levels of SFS can impact ecological communities by altering growth of freshwater plants, affecting the feeding ability of fish, and smothering streambed habitat. The interpretation bands for SFS reflect the fact that higher levels of SFS have a greater impact on instream invertebrates, fish and plants.

Notes on limitations/use

» The NPS-FM (2020) states that assigning an attribute state to a site is based on a monthly monitoring regime where sites are visited on a regular basis regardless of weather and flow conditions. Five years of data is required to grade a site. Sites that LAWA determine haven't met this are coded as 'insufficient data' in the map shown here.

» The REC waterway layer is not exact and not accurate at a site scale.

Summary of suspended fine sediment data from LAWA water quality sites[1]

Site name	Site REC land cover class[2]	Suspended sediment class[3]	Visual clarity median[4] m	NOF attribute band (See band explanations table at bottom of page)
Hutt River 300m Dnstr of Kaitoke Weir	Indigenous Forest (IF)	3	NA	Insufficient data
Hutt River at Boulcott	Indigenous Forest (IF)	3	2.74	Insufficient data
Mangaroa River at Te Marua	Pastoral (P)	3	1.41	Insufficient data
Waiwhetu Stream at Whites Line East	Urban (U)	2	1.41	Insufficient data
Whakatikei River at Riverstone	Scrub (S)	3	3.31	Insufficient data
Hutt at Kaitoke	Indigenous Forest (IF)	3	6.07	A

1 Site name, data, and attribute band information taken directly from the 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). NA indicates insufficient data to assign a value. Medians are based on five consecutive years of data.
2 Site REC land cover class from the River Environment Classification (REC) database.
3 The suspended sediment class (SSC) is determined by a combination of the climate/geology/topography classes from the REC database (see Table 23, NPS-FM 2020).
4 According to the National Environmental Monitoring Standards (NEMS, 2019), visual clarity values should have a measurement resolution of three significant figures, but are presented here with two decimal places for reporting purposes.

Summary of suspended fine sediment data from 'other' (or one-off/sporadically surveyed) sites

Site/s REC land cover class category	# of sites in class	Date of last survey	# of surveys	Clarity tube – 'Streamed' interpretation bands: Average median[5,7] visual clarity m	Min.[6,7] m	Max.[6,7] m	Sites in poor / very poor / extremely poor categories #	%	Black disc – ANZG: Average median[5,7] visual clarity m	Min.[6,7] m	Max.[6,7] m	Sites that are below DGV within that land cover class (below DGV) #	%
Scrub (S)	2	19 Aug 2024	114	0.36	0.03	0.61	2	100	3.66	0.49	10.12	0	0
Pastoral (P)	1	19 Aug 2024	58	0.42	0.06	0.66	1	100	1.64	0.62	4.44	0	0
Indigenous Forest (IF)	6	16 Jul 2024	245	0.30	0.03	0.72	4	100	3.79	0.31	9.64	0	0
Urban (U)	3	02 Sep 2024	118	0.23	0.07	0.58	3	100	1.31	0.54	3.70	1	33

5 Medians are calculated based on the last five years of data for each site, and the average of these medians is presented for each REC land cover class.
6 Minimum and maximum values are based on the last five years of data for each site.
7 According to the National Environmental Monitoring Standards (NEMS, 2019), visual clarity values should have a measurement resolution of three significant figures, but are presented here with two decimal places for reporting purposes.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Site dots/shapes *See tables above and on the following page*	Locations where visual clarity has been measured using black disc or clarity tube, with colouration related to NOF attribute band (LAWA sites), 'Streamed' interpretation bands (other sites with clarity tube data), or Default Guideline Value (DGV) (other sites with black disc data).	Provides an indication of whether visual clarity is likely to be an issue or challenge for your catchment, by comparing your results to national guidelines.	Data collected by Regional Council. LAWA sites: The median value and related attribute band assignment was taken directly from 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). The attribute band value to use is determined by a site's River Environment Classification (REC) climate, topography and geology classes (see Sections 2.1–2.3 to see these for this focus catchment). 'Other' sites: The median value for each site was compared against the 'Streamed' interpretation bands for visual clarity (clarity tube data) or to the ANZG (2018) DGV relevant to that site (black disc data). DGVs were determined based on assigning each site to the relevant REC climate and topography classes (see Sections 2.1 and 2.2 to see these for this focus catchment). Any > or < values were first transformed as follows before analysis: < converted to 0.5x the detection limit; > substituted with 1.1x the reporting limit.
Waterway lines – colour *See table above*	The key land cover class for each REC segment of waterway. It is also used as a grouping variable for the 'other' sites in the summary table.	Helps to see if there are any spatial patterns in the water quality data.	Developed by NIWA as part of the REC layer. See Section 2.4 for more information.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

...continued over page

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Suspended Sediment – Visual Clarity

Focus Catchment Map Series: Map 4.3

- Stormwater pipes
- Roads
- Focus catchment

LAWA WATER QUALITY SITES:
using NPS-FM 2020 NOF interpretation bands

- Band A – Excellent
- Band B – Good
- Band C – Fair
- Band D – Poor
- Insufficient data

'OTHER' WATER QUALITY SITES:
using 'Streamed' interpretation bands – clarity tube data

- Extremely good
- Very good
- Poor
- Very poor
- Extremely poor

'OTHER' WATER QUALITY SITES: using MfE (1994) guidelines – water clarity of recreational waters (black disk data)

- Greater than 1.6 m
- Less than 1.6 m

REC LAND COVER CLASS: waterways (stream order >1)

- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)

Further information

» *Also see 'Notes on limitations/use' on preceding page.*

» *Note: Legend may show items not present on the map. See page 11 for more details.*

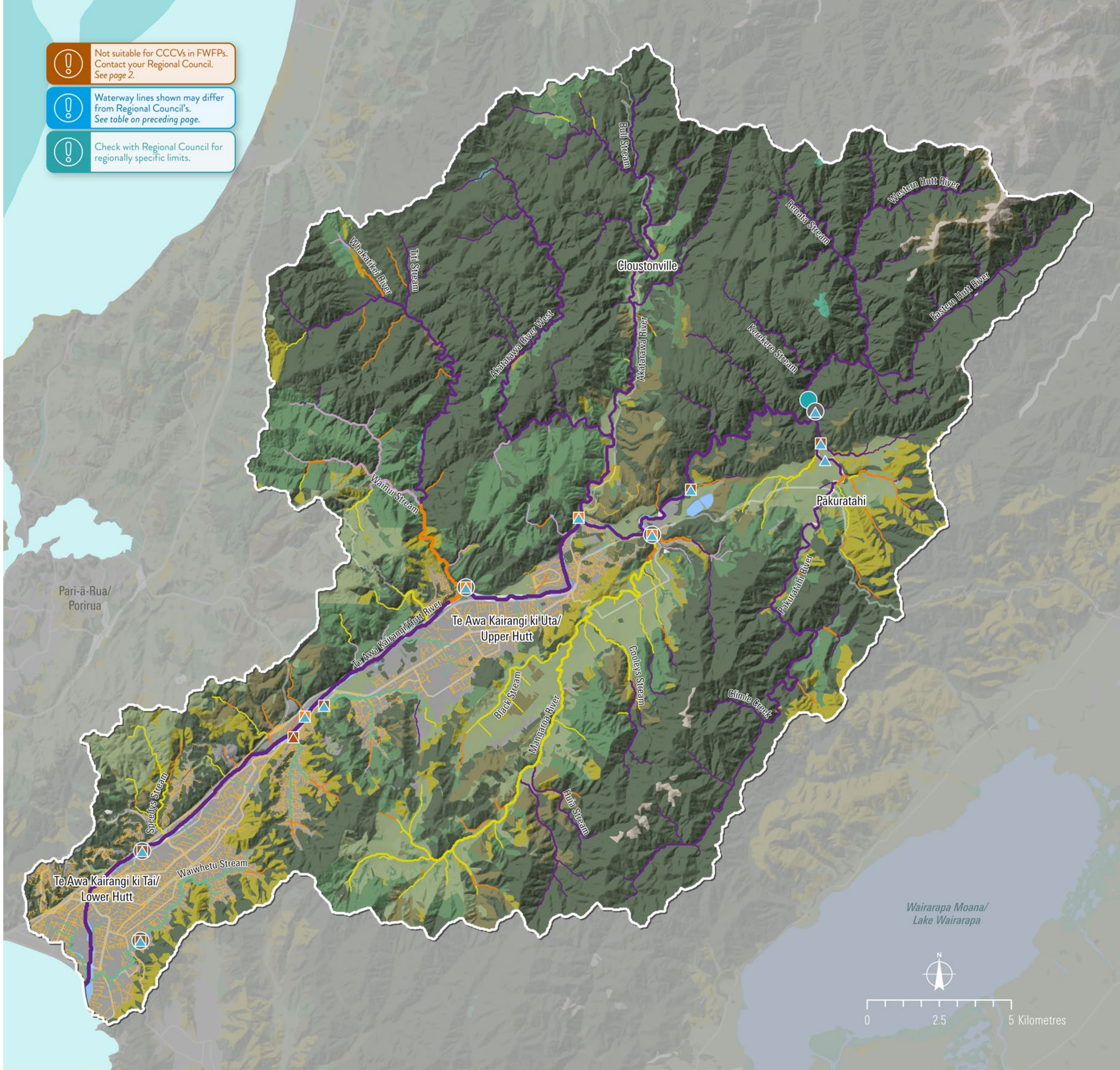
» LAWA and 'other' water quality sites: monitored/sampled by Regional Council

» LAWA water quality site data: www.lawa.org.nz/download-data/#river-water-quality

» 'Streamed' visual clarity interpretation bands: www.streamed-eos-ecology.hub.arcgis.com/pages/about-water-clarity

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: LAWA water quality sites (Land Air Water Aotearoa (LAWA) data set), other water quality sites (Regional Council data set), REC land cover class (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).



NPS-FM 2020 NOF attribute state by suspended sediment class interpretation bands for LAWA sites

	Suspended fine sediment (SFS)	Numeric attribute state by suspended sediment class visual clarity – m			
		1	2	3	4
A	Minimal impact of suspended sediment on instream biota. Ecological communities are similar to those observed in natural reference conditions.	≥1.78	≥0.93	≥2.95	≥1.38
B	Low to moderate impact of suspended sediment on instream biota. Abundance of sensitive fish species may be reduced.	<1.78 to ≥1.55	<0.93 to ≥0.76	<2.95 to ≥2.57	<1.38 to ≥1.17
C	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.	<1.55 to >1.34	<0.76 to >0.61	<2.57 to >2.22	<1.17 to >0.98
National bottom line		1.34	0.61	2.22	0.98
D	Impacts on growth of multiple species, and starts approaching acute impact level (that is, risk of death) for sensitive species at higher concentrations (>20 mg/L).	<1.34	<0.61	<2.22	<0.98

This table shows four different value sets for each attribute band, known as the 'suspended sediment class' in the NPS-FM 2020. Determining which attribute band applies at a location requires defining the location's suspended sediment class (SSC) using a combination of the climate/geology/topography classes from the River Environment Classification (REC) database (Table 23, NPS-FM 2020).

> greater than | < less than | ≥ greater than or equal to |≤ less than or equal to | m = metres

'Streamed' water clarity tube interpretation bands[1]

m	Explanation
>0.99	**Extremely good** – very clean water
0.70–0.99	**Very good** – slightly turbid. May restrict plant growth and suspended sediment could settle on the stream bed.
0.55–0.69	**Poor** – represents the point at which the level of suspended sediment could start to affect stream life, both through light restriction and sediment settling on the stream bed.
0.35–0.54	**Very poor** – very turbid water that is likely to silt up the stream bed and be detrimental to most stream life. A review of what is happening upstream should be done – this will most likely be caused by an obvious disturbance (upstream or in the catchment).
<0.35	**Extremely poor** – extremely turbid water that will create a silty stream bed and be detrimental to most stream life. An immediate review of what is happening upstream is needed.

[1] www.streamed.nz – interpretation bands based on Biggs *et al.* (2002).

ANZG (2018) Default Guideline Value (DGV)

Above/ below DGV	Interpretation
Above	The median visual clarity at this site is above the recommended threshold for species protection in slightly to moderately disturbed systems (20th percentile). Visual clarity is inversely related to turbidity and is harmful at low values. Actual DGVs vary by REC climate and topography/source of flow class.
Below	The median visual clarity at this site is below the recommended threshold for species protection in slightly to moderately disturbed systems (20th percentile). Actual DGVs vary by REC climate and topography/source of flow class. Values below this threshold indicate that there is a potential risk of adverse effects at a site and this should trigger further investigation.

Produced by & © EOS Ecology

Produced by & © EOS Ecology

4.4 Suspended sediment – turbidity

This map shows actual data on turbidity in waterways in your catchment, with data interpretation using national guidelines.

Turbidity is a measure of the cloudiness of water based on how light is scattered by suspended fine sediments in the water column. It is a proxy water clarity measure of suspended sediment and may be measured in nephelometric turbidity units (NTU) or Formazin Nephelometric Units (FNU). Turbidity can be measured continuously using loggers installed in the stream, or a sample can be collected and sent to a laboratory for testing.

Notes on limitations/use

- Some catchments and waterways may have naturally high turbidity including naturally highly coloured brown-water streams, glacial flour affected streams and rivers, and some lake-fed waterways where phytoplankton reduces water clarity.
- The REC waterway layer is not exact and not accurate at a site scale.
- Turbidity is not a standardised measurement and different sensors will give different readings. This makes comparison with guidelines difficult.

Summary of turbidity data from LAWA water quality sites [1]

Site name	Site REC land cover class[2]	Median turbidity[3] NTU	ANZG (2018) category
Hutt River at Boulcott	Indigenous Forest (IF)	1.53	Below DGV
Mangaroa River at Te Marua	Pastoral (P)	1.80	Below DGV
Waiwhetu Stream at Whites Line East	Urban (U)	4.30	Below DGV
Whakatikei River at Riverstone	Scrub (S)	0.96	Below DGV

1 Site name, data, and attribute band information taken directly from the 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). NA indicates insufficient data to assign a value. Medians are based on five consecutive years of data.
2 Site REC land cover class from the River Environment Classification (REC) database.
3 According to the National Environmental Monitoring Standards (NEMS, 2019), turbidity values should have a measurement resolution of 0.1, but are presented here with two decimal places for reporting purposes.

Summary of turbidity data from 'other' (or one-off/sporadically surveyed) sites

Site/s REC land cover class category	# of sites in class	Date of last survey	# of surveys	Average median[4] turbidity[6] NTU	Min.[5,6] NTU	Max.[5,6] NTU	ANZG (2018) Sites that exceed the DGV within that land cover class: above DGV #	%
Urban (U)	4	02 Sep 2024	203	5.33	0.96	115.00	3	75
Pastoral (P)	2	19 Aug 2024	116	2.17	0.41	183.00	1	50
Indigenous Forest (IF)	13	19 Aug 2024	901	1.09	0.03	270.00	1	8
Scrub (S)	2	19 Aug 2024	113	0.77	0.03	270.00	0	0
Exotic Forest (EF)	1	12 Aug 2015	18	1.35	0.27	5.40	0	0

NTU = nephelometric turbidity units

4 Medians are calculated based on the last five years of data for each site, and the average of these medians is presented for each REC land cover class.
5 Minimum and maximum values are based on the last five years of data for each site.
6 According to the National Environmental Monitoring Standards (NEMS, 2019), turbidity values should have a measurement resolution of 0.1, but are presented here with two decimal places for reporting purposes.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Site dots/ shapes *See tables above and on the right.*	Locations where water samples have been collected and analysed for turbidity, with colour equating to DGV interpretation.	Provides an indication of whether turbidity is likely to be an issue or challenge for your catchment, by comparing your results to national guidelines.	Data collected by Regional Council. LAWA sites: The median value was taken directly from 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). 'Other' sites: The median value for each site's data was compared against the ANZG (2018) DGV relevant to that site. DGVs were determined based on assigning each site to the relevant REC climate and topography classes (see Section 2.1 and 2.2 to see these for this focus catchment). Any > or < values were first transformed as follows before analysis: < converted to 0.5x the laboratory detection limit; > substituted with 1.1x the reporting limit.
Waterway lines – colour See table above.	The key land cover class for each REC segment of waterway. It is also used as a grouping variable for the 'other' sites in the summary table.	Helps to see if there are any spatial patterns in the water quality data.	Developed by NIWA as part of the REC layer. See Section 3.4 for more information.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

ANZG (2018) Default Guideline Value (DGV)

Above/ below DGV	Interpretation
Below	The median turbidity at this site is below the recommended threshold for species protection in slightly to moderately disturbed systems (80th percentile). Actual DGVs vary by REC climate and topography/ source of flow class.
Above	The median turbidity at this site exceeds the recommended threshold for species protection in slightly to moderately disturbed systems (80th percentile). Actual DGVs vary by REC climate and topography/ source of flow class. Exceeding this threshold indicates that there is a potential risk of adverse effects at a site and this should trigger further investigation.

Produced by & © EOS Ecology

Te Awa Kairangi/Hutt River

Suspended Sediment – Turbidity

Focus Catchment Map Series: Map 4.4

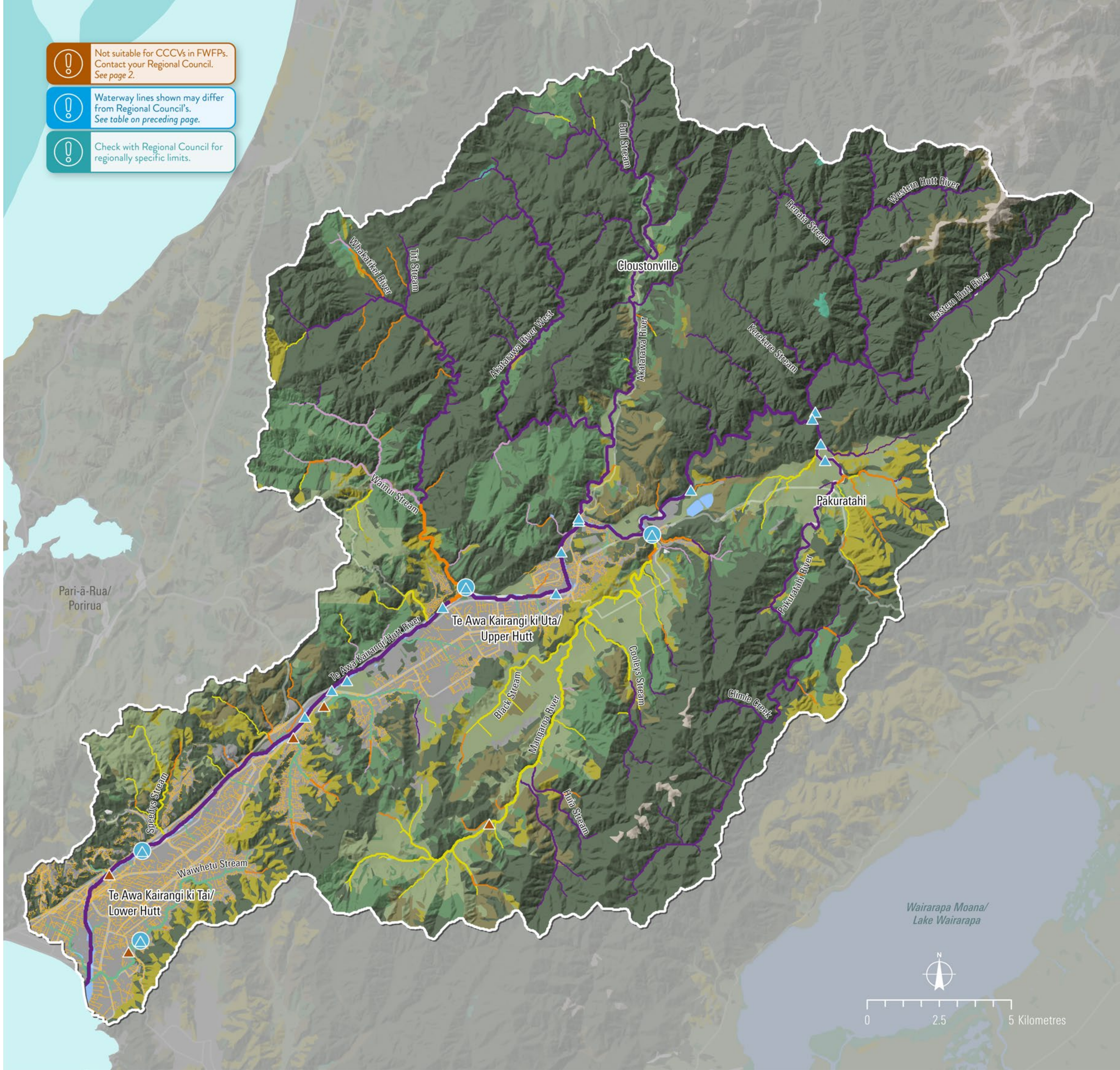
- Stormwater pipes
- Roads
- Focus catchment

ANZG (2018) DEFAULT GUIDELINE VALUE (DGV):

LAWA sites	'Other' sites	
●	▲	Above DGV
●	▲	Below DGV

REC LAND COVER CLASS: waterways (stream order >1)

- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- LAWA and 'other' water quality sites: monitored/sampled by Regional Council
- LAWA water quality site data: www.lawa.org.nz/download-data/#river-water-quality
- ANZG (2018) DGVs for turbidity: www.waterquality.gov.au/anz-guidelines/your-location/new-zealand DGVs are for each combination of climate and topography class within the REC.

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: LAWA water quality sites (Land Air Water Aotearoa (LAWA) data set), other water quality sites (Regional Council data set), REC land cover class (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

4.5 Nutrients – nitrate nitrogen (nitrate N)

This map shows actual data on nitrate N in waterways in your catchment, with data interpretation using two types of data interpretation bands.

Nitrate (NO_3-) is a soluble form of nitrogen that is made up of one nitrogen atom (N) bonded to three oxygen atoms (O). When groundwater enters waterways it can include nitrate leachate from urine patches or fertiliser on pastures, runoff or leaching of effluent. Nitrate can also enter waterways directly via sewage discharges and stock in waterways. While nitrate is an important nutrient for plant growth, too much in waterways can cause excessive plant/algae growth, which can smother stream beds, destroy habitat, reduce the amount of oxygen, or affect water pH.

Nitrate N (NO_3-N) is a common measurement used in waterway monitoring. It measures the amount of nitrogen (N) in the nitrate (NO_3) molecule, but doesn't include the oxygen molecules. Nitrogen is often the most ecologically relevant aspect of nitrate in waterways. Nitrate N can be measured using self test kits, or collecting a water sample to send to a laboratory for testing. It can also be measured continuously using onsite loggers.

Notes on limitations/use

- NOF attribute bands for nitrate N toxicity focus on species protection against toxic effects, but do not account for the sub-lethal or indirect effects that can occur at lower concentrations, such as nuisance algal blooms.
- NOF attribute states must be based on monthly monitoring regardless of weather and flow conditions and five years of data is required to grade a site. Where sites have not met these criteria, LAWA grades them as NA and these are presented as 'insufficient data' on the map.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of nitrate N data from LAWA water quality sites[1]

Site name	Site REC land cover class[2]	Median Nitrate N[3] mg/L	95th percentile Nitrate N[3] mg/L	NOF attribute band *See band explanations table at bottom of page*
Hutt River 300m Dnstr of Kaitoke Weir	Indigenous Forest (IF)	NA	NA	Insufficient data
Hutt River at Boulcott	Indigenous Forest (IF)	0.1790	NA	A
Mangaroa River at Te Marua	Pastoral (P)	0.3700	NA	A
Waiwhetu Stream at Whites Line East	Urban (U)	0.4800	NA	A
Whakatikei River at Riverstone	Scrub (S)	0.1310	NA	A
Hutt at Kaitoke	Indigenous Forest (IF)	0.0350	NA	A

1 Site name, data, and attribute band information taken directly from the 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). NA indicates insufficient data to assign a value. Medians are based on five consecutive years of data.
2 Site REC land cover class from the River Environment Classification (REC) database.
3 Laboratories typically provide nitrate N values to a resolution of three significant figures, however we have used four decimal places for reporting purposes.

Summary of nitrate N data from 'other' (or one-off/sporadically surveyed) sites

Site/s REC land cover class category	# of sites in class	Date of last survey	# of surveys	Average median[4] nitrate N[6] mg/L	Min.[5,6] mg/L	Max.[5,6] mg/L	ANZG (2018) Sites that exceed the DGV guidelines within that land cover class: above DGV #	%
Urban (U)	31	02 Sep 2024	378	0.6064	0.0010	2.4000	26	84
Pastoral (P)	4	19 Aug 2024	152	0.6445	0.0600	3.9000	4	100
Exotic Forest (EF)	8	12 Aug 2015	33	1.2356	0.3500	2.2000	8	100
Indigenous Forest (IF)	18	19 Aug 2024	341	0.2328	0.0052	1.0300	13	72
Scrub (S)	2	19 Aug 2024	112	0.0955	0.0160	0.3500	0	0

4 Medians are calculated based on the last five years of data for each site, and the average of these medians is presented for each REC land cover class.
5 Minimum and maximum values are based on the last five years of data for each site.
6 Laboratories typically provide nitrate N values to a resolution of three significant figures, however we have used four decimal places for reporting purposes.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots/ shapes *See table above.*	Locations where water samples have been collected and analysed for nitrate N, with colours equating to NOF attribute band (LAWA sites) or DGV 'other' sites interpretation.	Provides an indication of whether nitrate N is likely to be an issue or challenge for your catchment, by comparing your results to national guidelines.	Data collected by Regional Council. LAWA sites: the median value and related attribute band assignment was taken directly from 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). 'Other' sites: the median value for each site's data was compared against the ANZG (2018) DGV relevant to that site. DGVs were determined based on assigning each site to the relevant REC climate and topography classes (see Section 2.1 and 2.2 to see these for this focus catchment). Any > or < values were first transformed as follows before analysis: < converted to 0.5x the laboratory detection limit; > substituted with 1.1x the reporting limit.
Waterway lines – colour *See table above.*	The key land cover class for each REC segment of waterway. It is also used as a grouping variable for the 'other' sites in the summary table.	Helps to see if there are any spatial patterns in the water quality data.	Developed by NIWA as part of the REC layer. See Section 2.4 for more information.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

NPS-FM 2020 National Objectives Framework (NOF) interpretation bands (for LAWA sites)

Nitrate toxicity (NO_3-N)		Band limits mg NO_3-N/L Annual median	Annual 95th percentile
How limit is calculated:		Annual median	Annual 95th percentile
A	High conservation value system. Unlikely to be effects even on sensitive species.	≤1.0	≤1.5
B	Some growth effect on up to 5% of species.	>1.0 to ≤2.4	>1.5 to ≤3.5
National bottom line		2.4	3.5
C	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.	>2.4 to ≤6.9	>3.5 to ≤9.8
D	Impacts on growth of multiple species, and starts approaching acute impact level (that is, risk of death) for sensitive species at higher concentrations (>20 mg/L).	>6.9	>9.8

> greater than | ≤ less than or equal to | mg NO_3-N = milligrams of nitrate-nitrogen per litre of water

ANZG (2018) Default Guideline Value (DGV)

Above/ below DGV	Interpretation
Below	The median concentration of nitrate N at this site is below the recommended threshold for species protection in slightly to moderately disturbed systems (80th percentile). Actual DGVs vary by REC climate and topography/ source of flow class.
Above	The median concentration of nitrate N at this site exceeds the recommended threshold for species protection in slightly to moderately disturbed systems (80th percentile). Actual DGVs vary by REC climate and topography/source of flow class. Exceeding this threshold indicates that there is a potential risk of adverse effects at a site and this should trigger further investigation.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Nutrients – Nitrate N

Focus Catchment Map Series: Map 4.5

Stormwater pipes
Roads
Focus catchment

LAWA WATER QUALITY SITES:
using NPS-FM 2020 NOF interpretation bands

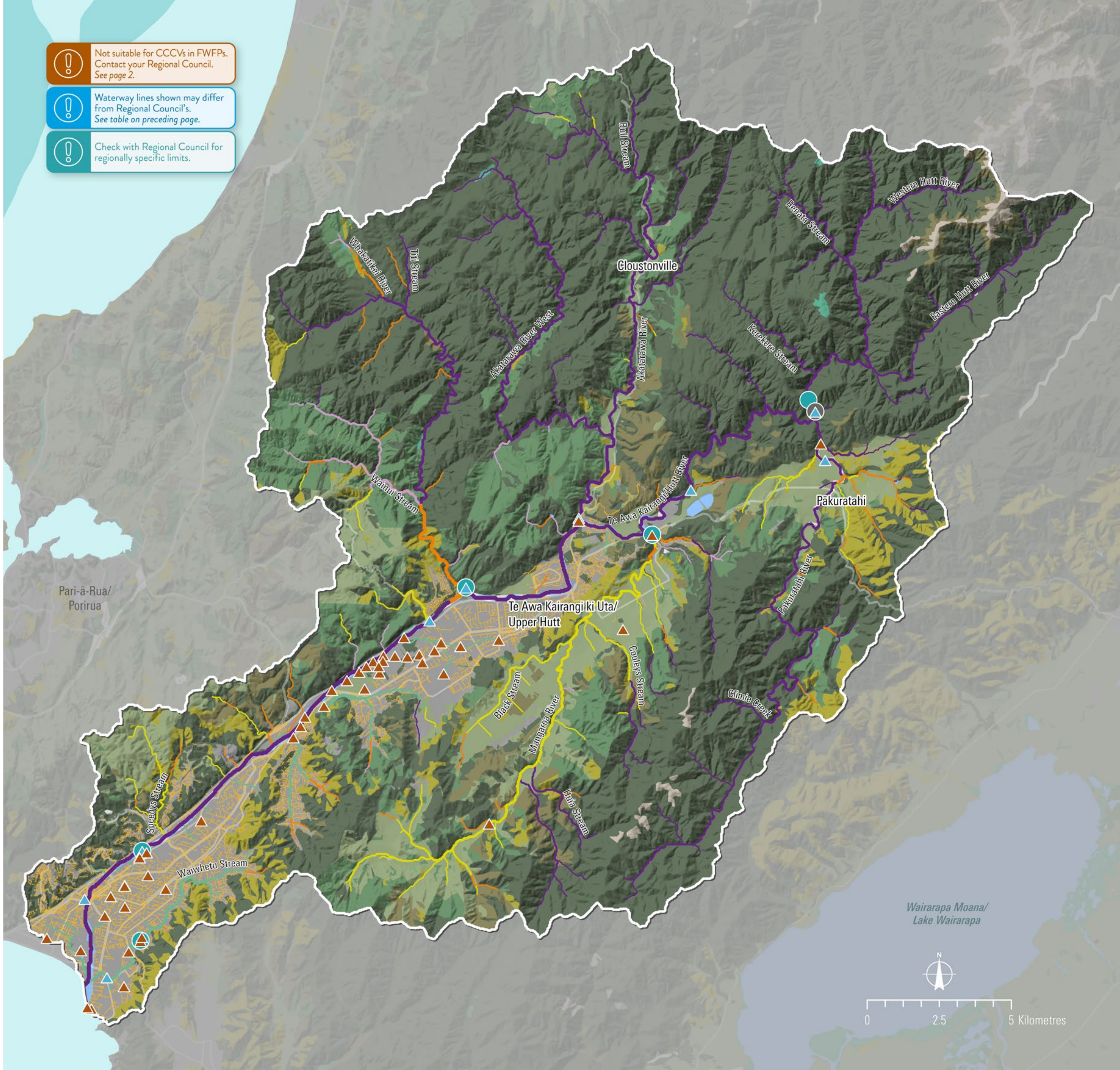
- Band A – Excellent
- Band B – Good
- Band C – Fair
- Band D – Poor
- Insufficient data

'OTHER' WATER QUALITY SITES:
using ANZG (2018) Default Guideline Value (DGV)

- Above DGV
- Below DGV

REC LAND COVER CLASS: waterways (stream order >1)

- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- LAWA and 'other' water quality sites: monitored/sampled by Regional Council
- LAWA water quality site data: www.lawa.org.nz/download-data/#river-water-quality
- ANZG (2018) DGVs for nitrate: www.waterquality.gov.au/anz-guidelines/your-location/new-zealand DGVs are for each combination of climate & topography class within the REC.

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: LAWA water quality sites (Land Air Water Aotearoa (LAWA) data set), other water quality sites (Regional Council data set), REC land cover class (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

4.6 Nutrients – dissolved reactive phosphorus (DRP)

This map shows actual data on DRP in waterways in your catchment, with data interpretation using two types of data interpretation bands.

DRP is a measure of the inorganic phosphorus compounds that are dissolved in water. It occurs at naturally low concentrations in water, although this depends on the geology in the catchment. DRP in waterways can come from natural sources such as weathering of rocks, as well as from manmade sources such as agricultural or urban runoff, fertiliser, eroding soils, and sewage discharges. As DRP is an essential nutrient for aquatic plants, high concentrations can contribute to excessive plant/algal growth, which can smother stream beds, destroy habitat, and reduce the amount of oxygen in the water.

DRP can be measured using self test kits, or collecting a water sample to send to a laboratory for testing. Sensors for continuously measuring DRP in real time are still in development.

Notes on limitations/use

- Note that some rivers in acid-volcanic geological terrains may have naturally high levels of DRP (STAG, 2020).
- NOF attribute states must be based on monthly monitoring regardless of weather and flow conditions and five years of data is required to grade a site. Where sites have not met these criteria, LAWA grades them as NA and these are presented as 'insufficient data' in the map.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of DRP data from LAWA water quality sites[1]

Site name	Site REC land cover class[2]	Median DRP mg/L	95th percentile DRP mg/L	NOF attribute band (See band explanations table at bottom of page)
Hutt River 300m Dnstr of Kaitoke Weir	Indigenous Forest (IF)	NA	NA	Insufficient data
Hutt River at Boulcott	Indigenous Forest (IF)	0.0048	0.0086	A
Mangaroa River at Te Marua	Pastoral (P)	0.0103	0.0150	C
Waiwhetu Stream at Whites Line East	Urban (U)	0.0265	0.0486	D
Whakatikei River at Riverstone	Scrub (S)	0.0084	0.0116	B
Hutt at Kaitoke	Indigenous Forest (IF)	0.0040	0.0057	A

1 Site name, data, and attribute band information taken directly from the 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). NA indicates insufficient data to assign a value. Medians are based on five consecutive years of data.
2 Site REC land cover class from the River Environment Classification (REC) database.

Summary of DRP data from 'other' (or one-off/sporadically surveyed) sites

Site/s REC land cover class category	# of sites in class	Date of last survey	# of surveys	Average median DRP[3] mg/L	Min.[4] mg/L	Max.[4] mg/L	ANZG (2018) guidelines: Sites that exceed the DGV guidelines within that land cover class: above DGV #	%
Urban (U)	31	02 Sep 2024	340	0.0624	0.0020	2.2706	13	42
Pastoral (P)	4	19 Aug 2024	140	0.0277	0.0020	0.0580	2	50
Exotic Forest (EF)	8	12 Aug 2015	33	0.0115	0.0020	0.0380	2	25
Scrub (S)	2	19 Aug 2024	113	0.0061	0.0015	0.0158	0	0
Indigenous Forest (IF)	18	19 Aug 2024	341	0.0038	0.0005	0.1400	0	0

3 Medians are calculated based on the last five years of data for each site, and the average of these medians is presented for each REC land cover class.
4 Minimum and maximum values are based on the last five years of data for each site.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots/shapes *See tables above and on the right.*	Locations where water samples have been collected and analysed for DRP, with colouration related to NOF attribute band (LAWA sites) or DGV (other sites) interpretation.	Provides an indication of whether DRP is likely to be an issue or challenge for your catchment, by comparing your results to national guidelines.	Data collected by Regional Council. LAWA sites: the median value and related attribute band assignment was taken directly from 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). 'Other' sites: the median value for each site's data was compared against the ANZG (2018) DGV relevant to that site. DGVs were determined based on assigning each site to the relevant REC climate and topography classes (see Section 2.1 and 2.2 to see these for this focus catchment). Any > or < values were first transformed as follows before analysis: < converted to 0.5x the laboratory detection limit; > substituted with 1.1x the reporting limit.
Waterway lines – colour *See table above.*	The key land cover class for each REC segment of waterway. It is also used as a grouping variable for the 'other' sites in the summary table.	Helps to see if there are any spatial patterns in the water quality data.	Developed by NIWA as part of the REC) layer. See Section 2.4 for more information.
Waterway lines – thickness	Indicates the stream order from SO 2 upwards (the smallest stream order, SO 1, is not shown on the map).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. *May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.*

For information about 'stream order' (SO) see page 14.

...continued over page

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Nutrients – Dissolved Reactive Phosphorus

Focus Catchment Map Series: Map 4.6

- Stormwater pipes
- Roads
- Focus catchment

LAWA WATER QUALITY SITES:
using NPS-FM 2020 NOF interpretation bands

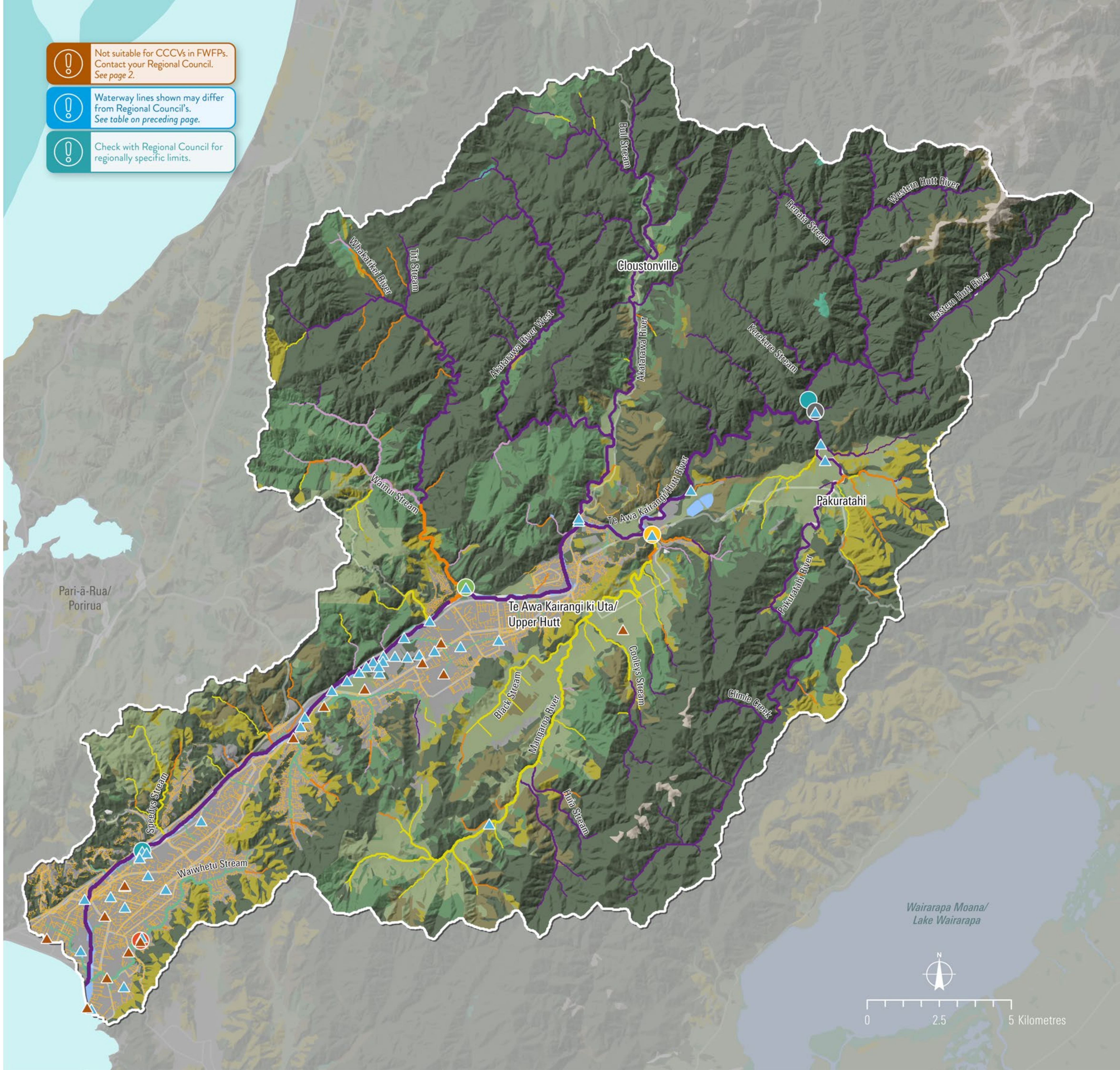
- Band A – Excellent
- Band B – Good
- Band C – Fair
- Band D – Poor
- Insufficient data

'OTHER' WATER QUALITY SITES:
using ANZG (2018) Default Guideline Value (DGV)

- Above DGV
- Below DGV

REC LAND COVER CLASS: waterways (stream order >1)

- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- LAWA and 'other' water quality sites: monitored/sampled by Regional Council
- LAWA water quality site data: www.lawa.org.nz/download-data/#river-water-quality
- ANZG (2018) DGVs for DRP: www.waterquality.gov.au/anz-guidelines/your-location/new-zealand DGVs are for each combination of climate & topography class within the REC.

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: LAWA water quality sites (Land Air Water Aotearoa (LAWA) data set), other water quality sites (Regional Council data set), REC land cover class (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

*continued from previous page...***4.6 Nutrients – dissolved reactive phosphorus (DRP)**

NOF NPS-FM 2020 National Objectives Framework (NOF) interpretation bands (for LAWA sites)

Dissolved reactive phosphorus (DRP)		Band limits (mg/L)	
How limit is calculated:		Annual median	95th percentile
A	Ecological communities and ecosystem processes are similar to those of natural reference conditions. No adverse effects attributable to dissolved reactive phosphorus (DRP) enrichment are expected.	≤0.006	≤0.021
B	Ecological communities are slightly impacted by minor DRP elevation above natural reference conditions. If other conditions also favour eutrophication, sensitive ecosystems may experience additional algal and plant growth, loss of sensitive macroinvertebrate taxa, and higher respiration and decay rates.	>0.006 & ≤0.010	>0.021 & ≤0.030
C	Ecological communities are impacted by moderate DRP elevation above natural reference conditions. If other conditions also favour eutrophication, DRP enrichment may cause increased algal and plant growth, loss of sensitive macroinvertebrate and fish taxa, and high rates of respiration and decay.	>0.010 & ≤0.018	>0.030 & ≤0.054
D	Ecological communities impacted by substantial DRP elevation above natural reference conditions. In combination with other conditions favouring eutrophication, DRP enrichment drives excessive primary production and significant changes in macroinvertebrate and fish communities, as taxa sensitive to hypoxia are lost.	>0.018	>0.054

> greater than | < less than | ≤ less than or equal to | mg/L = milligrams per litre of water

ANZG ANZG (2018) default guideline value (DGV)

Above/below DGV	Interpretation
Below	The median concentration of DRP at this site is below the recommended threshold for species protection in slightly to moderately disturbed systems (80th percentile). Actual DGVs vary by REC climate and topography/source of flow class.
Above	The median concentration of DRP at this site exceeds the recommended threshold for species protection in slightly to moderately disturbed systems (80th percentile). Actual DGVs vary by REC climate and topography/source of flow class. Exceeding this threshold indicates that there is a potential risk of adverse effects at a site and this should trigger further investigation.

Produced by & © EOS Ecology

Produced by & © EOS Ecology

4.7 Faecal indicator bacteria – *E. coli*

This map shows actual data on *E. coli* in waterways in your catchment, with data interpretation using two types of data interpretation bands.

E. coli is a commonly measured faecal indicator bacteria that comes from the gut of warm-blooded animals. The presence of *E. coli* in water samples is an indicator of faecal contamination, and while it does not show the source of the contamination (e.g., birds, dogs, humans), its presence means there could also be illness-causing pathogens present. Whilst most strains of *E. coli* are harmless to humans and form part of a healthy intestinal tract, some strains of are harmful. As such *E. coli* is used as a measure of the suitability of freshwater for human contact. Band A represents the lowest level of risk of infection and Band E the highest risk of infection.

E. coli is typically measured in the laboratory, using grab samples of water collected from the waterway. Real time solutions for *E. coli* monitoring are being developed and tested both overseas and in New Zealand, but are not widely used at present.

Notes on limitations/use

- NOF attribute states must be based on monthly monitoring regardless of weather and flow conditions and five years of data is required to grade a site. Where sites have not met these criteria, LAWA grades them as NA and these are presented as 'insufficient data' in the map.
- The NPS-FM (2020) includes four numeric NOF attribute states for *E. coli* and the attribute band must be determined by satisfying all of these, or if that is not possible, according to the worst numeric state.
- The predicted average infection risk that are used to generate *E. coli* NOF attribute bands are based on a random exposure on a random day, ignoring any possibility of not swimming during high flows or at times when a no-swim advisory is in place. Actual risk will be less if a person does not swim during high flows.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of *E. coli* data from LAWA water quality sites[1]

Site name	Site REC land cover class[2]	% exceedances over 540/100 mL	% exceedances over 260/100 mL	Median concentration /100 mL	95th percentile *E. coli* *E. coli*/100 mL	NOF attribute band *See band explanations table at bottom of page*
Hutt River 300m Dnstr of Kaitoke Weir	Indigenous Forest (IF)	NA	NA	NA	NA	Insufficient data
Hutt River at Boulcott	Indigenous Forest (IF)	18.2	34.5	130	2725	D
Mangaroa River at Te Marua	Pastoral (P)	NA	NA	340	NA	Insufficient data
Waiwhetu Stream at Whites Line East	Urban (U)	69.1	90.9	1000	16750	E
Whakatikei River at Riverstone	Scrub (S)	NA	NA	35	NA	Insufficient data
Hutt River 300m Dnstr of Kaitoke Weir	Indigenous Forest (IF)	0	3.6	6	126	A

1 Site name, data, and attribute band information taken directly from the 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality).
NA indicates insufficient data to assign a value. Medians are based on five consecutive years of data.
2 Site REC land cover class from the River Environment Classification (REC) database.

Summary of *E. coli* data from 'other' (or one-off/sporadically surveyed) sites

Site/s REC land cover class category	# of sites in class	Date of last survey	# of surveys	Average median[3] *E. coli*/100 mL	Min.[4] *E. coli*/ 100 mL	Max.[4] *E. coli*/ 100 mL	Sites that fall within MfE/MoH (2003) surveillance, alert & action levels: Acceptable/Green Mode (No single sample >260 *E. coli*/100 mL) #	Acceptable/Green Mode %	Alert/Amber Mode (Single sample >260 *E. coli*/100 mL) #	Alert/Amber Mode %	Action/Red Mode (Single sample >550 *E. coli*/100 mL) #	Action/Red Mode %
Urban (U)	12	02 Sep 2024	273	597	1	33000	6	50	0	0	6	50
Pastoral (P)	2	19 Aug 2024	76	170	1	8000	1	50	0	0	1	50
Scrub (S)	2	19 Aug 2024	113	45	5	5000	0	0	0	0	2	100
Exotic Forest (EF)	1	12 Aug 2015	18	155	18	2400	0	0	0	0	1	100
Indigenous Forest (IF)	15	19 Aug 2024	711	94	1	8800	1	7	0	0	14	93

3 Medians are calculated based on the last five years of data for each site, and the average of these medians is presented for each REC land cover class.
4 Minimum and maximum values are based on the last five years of data for each site. Note that maximum reported *E. coli* values will depend on laboratory methods. The upper limit of the Colilert test is 2,420 *E. coli* per 100mL, without the use of dilution.

...continued over page

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Faecal Indicator Bacteria – *E. coli*

Focus Catchment Map Series: Map 4.7

- Stormwater pipes
- Roads
- Focus catchment

LAWA WATER QUALITY SITES:
using NPS-FM 2020 NOF interpretation bands

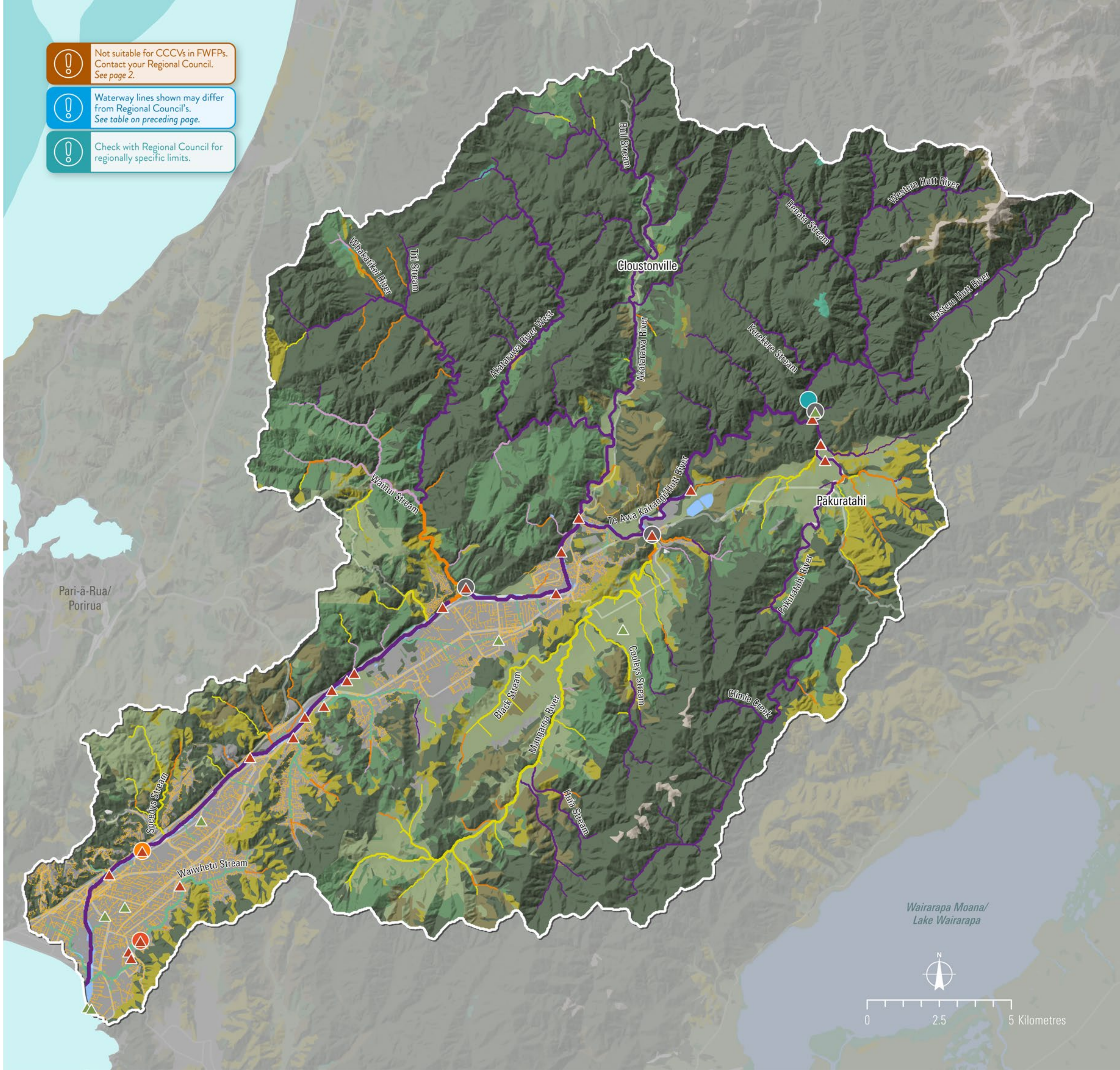
- Band A – Excellent
- Band B – Good
- Band C – Fair
- Band D – Poor
- Band E – Very Poor
- Insufficient data

'OTHER' WATER QUALITY SITES: using MfE (2003) surveillance, alert & action levels for freshwater contact recreation

- Acceptable/Green Mode
- Alert/Amber Mode
- Action/Red Mode

REC LAND COVER CLASS: waterways (stream order >1)

- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- LAWA and 'other' water quality sites: monitored/sampled by Regional Council
- LAWA water quality site data: www.lawa.org.nz/download-data/#river-water-quality
- Surveillance, alert & action interpretation bands: MfE (2003)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: LAWA water quality sites (Land Air Water Aotearoa (LAWA) data set), other water quality sites (Regional Council data set), REC land cover class (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

continued from previous page...

4.7 Faecal indicator bacteria – *E. coli*

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots/ shapes *See table above.*	Locations where water samples have been collected and analysed for *E. coli*, with colouration related to NOF attribute band (LAWA sites) or MfE (2003) surveillance, alert and action levels (other sites) interpretation.	Provides an indication of whether *E. coli* is likely to be an issue or challenge for your catchment, by comparing your results to national guidelines.	Data collected by Regional Council. LAWA sites: The percentage exceedances, median, 95th percentile values, and related attribute band assignment was taken directly from 'River water quality state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). 'Other' sites: The median value for each site's data was compared against the MfE (2003) surveillance, alert and action levels for freshwater contact recreation for each site. Any > or < values were first transformed as follows before analysis: < converted to 0.5x the laboratory detection limit; > substituted with 1.1x the reporting limit.
Waterway lines – colour *See table above.*	The key land cover class for each REC segment of waterway. It is also used as a grouping variable for the 'other' sites in the summary table.	Helps to see if there are any spatial patterns in the water quality data.	Developed by NIWA as part of the REC layer. See Section 2.4 for more information.
Waterway lines – thickness	Indicates the stream order (SO).	It can indicate the relative size of a stream section, with a larger stream order (thicker line) meaning a likely larger waterway.	Developed by NIWA as part of the REC layer, that assigns stream order for sections of waterway line. Headwaters start at SO 1. When same-order tributaries meet, it increases by one downstream. If sections with different orders meet, the downstream section takes the higher order. ***May differ to waterway lines used by your Regional Council if they have a more detailed or modified map layer they use.***

For information about 'stream order' (SO) see page 14.

NPS-FM 2020 National Objectives Framework (NOF) interpretation bands (for LAWA sites)

Escherichia coli (E. coli)		Attribute state is determined by satisfying all four Band limits.	Band limits *E. coli*/100 mL			
Description of risk of Campylobacter infection (based on *E. coli* indicator):			% exceedances >540	% exceedances >260	Median concentration	95th percentile
A	For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 1%.		<5%	<20%	≤130	≤540
B	For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 2%.		5–10%	20–30%	≤130	≤1000
C	For at least half the time, the estimated risk is <1 in 1,000 (0.1% risk). The predicted average infection risk is 3%.		10–20%	20–34%	≤130	≤1200
D	20–30% of the time the estimated risk is ≥50 in 1,000 (>5% risk). The predicted average infection risk is >3%.		20–30%	>34%	>130	>1200
E	For more than 30% of the time the estimated risk is ≥50 in 1,000 (>5% risk). The predicted average infection risk is >7%.		>30%	>50%	>260	>1200

< less than | > greater than | ≤ less than or equal to | /100 mL per 100 millilitres of water

Produced by & © EOS Ecology

Produced by & © EOS Ecology

FOCUS CATCHMENT – Ecological data

Ecological data can be defined as the collection of information about the ecology of a system. For freshwater environments this usually covers living organisms such as plants (periphyton and macrophytes), macroinvertebrates, and fish.

Aquatic Plants *(not included in this section)*

Periphyton

Macrophytes

Macroinvertebrates *(included in this section)*

Fish *(included in this section)*

All images © EOS Ecology.

Periphyton

- Algae, cyanobacteria (blue-green algae), and microbes that live attached to underwater surfaces, which gives river rocks that slippery feeling. They grow more when there are increased nutrient levels in the water, especially in summer when water temperatures are usually higher and flows more stable. Since periphyton are at the base of the food chain, any changes have flow-on effects up the food chain.
- Periphyton ranges from barely visible films, to thick mats or long green or brown filaments. Periphyton are primary producers – they get their energy from sunlight via photosynthesis. Chlorophyll *a* (chl-*a*) is the main type of chlorophyll found in algae, and is used to quantify the amount of algae growing in a water body (measured as chl-a/m^2). A higher amount of chl-*a* means that there is more algal biomass, which is usually a result of greater levels of nutrients. Periphyton proliferations are common in high nutrient water bodies, especially when flows are low and during the summer months when water temperatures are high.
- Periphyton communities are important to waterway ecosystems as they are an energy source for many stream invertebrates, which in turn serve as food for larger animals (fish and birds). However, excessive periphyton growth can degrade the environment, decreasing oxygen levels and even producing toxins that can kill fish, and negatively impacting on human values such as aesthetics, recreation, and water supply.

Macrophytes

- Plants that live in or near water. May be submerged (growing below the water surface), floating (free floating on water surface), or emergent (rooted within the wetted channel but with stems extending above the water surface).
- For lakes, the composition of submerged aquatic plant communities is a key indicator of the health of the lake ecosystem. Lake submerged plant indicators (LakeSPI) are indices that characterise the health of a lake based on the composition of the community of native and invasive plants growing there. The presence and abundance of invasive or weed species is known to have an impact on the diversity and abundance of native aquatic plants and so a higher proportion of native aquatic vegetation and a lower proportion of invasive aquatic vegetation in a lake community represents a system with better ecological condition.
- For waterways with abundant nutrients and a lack of shade, the excessive growth of macrophytes can be a major challenge, with channels completely obscured by emergent macrophytes in some cases.
- LakeSPI info: https://niwa.co.nz/our-science/freshwater-and-estuaries/lakespi-keeping-tabs-on-lake-health/how-lakespi-works and www.lawa.org.nz/learn/factsheets/lakespi

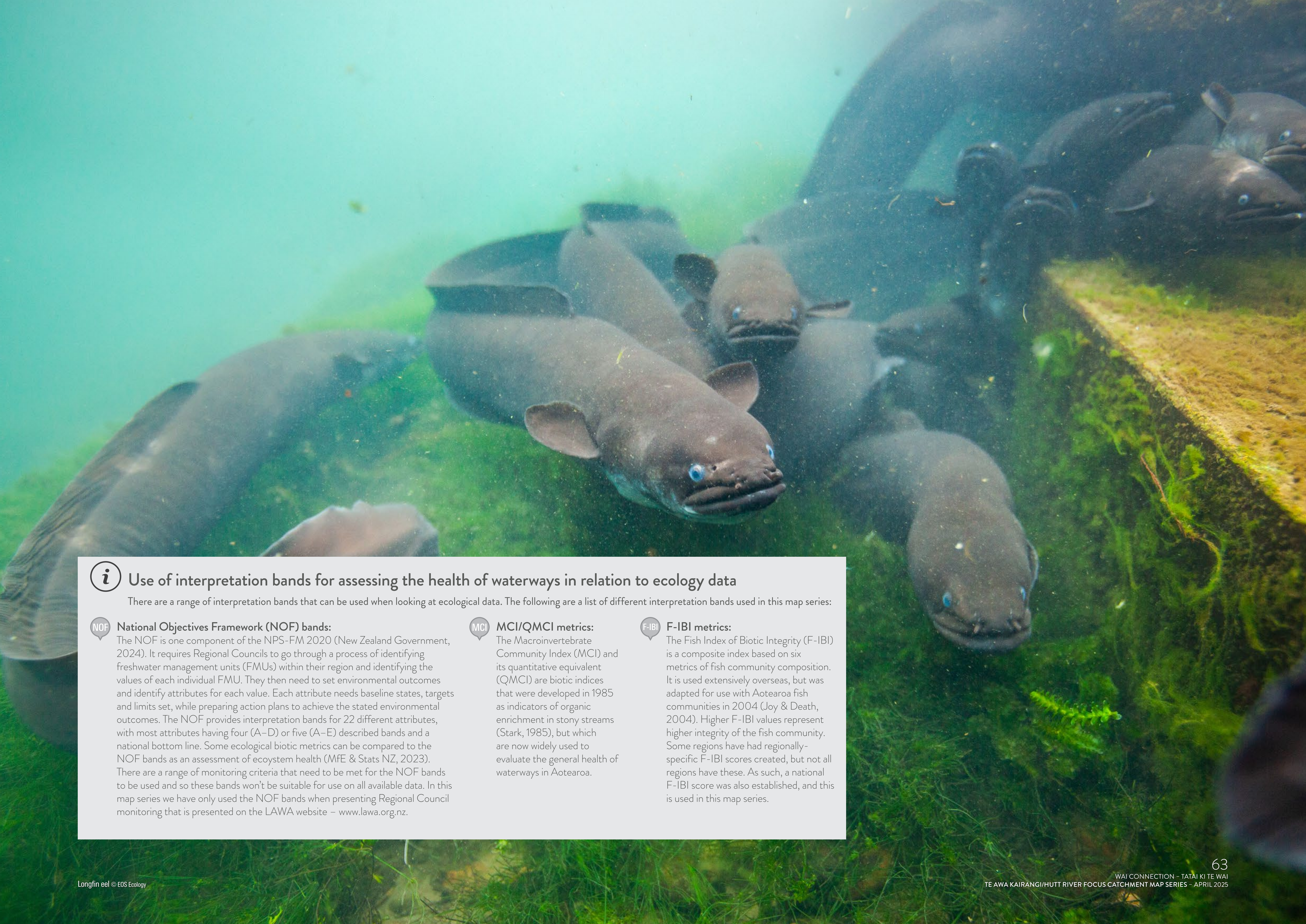
Macroinvertebrates

- Invertebrates are small animals without backbones. They represent the most diverse group of animals on our planet (accounting for 95% of described animals) and live in almost every environment. Freshwater invertebrates are those found in rivers, streams, lakes, seepages, and groundwater. Some (such as snails, worms, and crustaceans) live their entire lives in water, while others (insects such as (mayflies, caddisflies, stoneflies, midges) only spend their juvenile stage in water and emerge as flighted adults to live in the riparian zone along the waterway's edge. In this way, freshwater insects can fly to other parts of the stream where they will enter the water to lay their eggs and start the life cycle over.
- Freshwater invertebrates are an important part of our waterway ecosystems, as they form part of the food chain, and help transfer energy originally created by plants higher up the food chain. They also help link freshwater (stream-based) and terrestrial (land-based) food webs – the flighted adult stage of freshwater insects are eaten by land-based animals such as spiders, birds, and small mammals. They perform other essential functions, such as sediment mixing and nutrient cycling, and may play a role in influencing algal biomass and community structure. They also have intrinsic biodiversity and ecological values – almost all freshwater invertebrates found here are native to Aotearoa, and many are endemic (found nowhere else in the world).

Fish

- Aotearoa has some 57 species of native freshwater fish, with most of these being endemic (found nowhere else in the world). These include tuna/eels, galaxiids (īnanga, kōaro, banded kōkopu, giant kōkopu, shortjaw kōkopu, etc.), bullies (common bully, redfin bully, bluegill bully, upland bully, etc.), piharau/kanakana (lamprey), mudfish (kōwaro/Canterbury mudfish, brown mudfish, black mudfish, etc.), torrentfish, smelt, and some estuarine/marine fish that swim upstream into freshwater (black flounder, yellow-eyed mullet).
- We also have 21 introduced exotic fish species. Some are pests (such as koi carp, gambusia/mosquitofish, rudd, brown bullhead catfish) whilst others are valued for recreation (such as brown trout, rainbow trout, Chinook salmon). In fact, tourists from around the world come to Aotearoa specifically to fish for trout.
- Many of our native freshwater fish are diadromous, requiring access to and from the ocean at some stage in their lifecycles. Artificial structures placed in waterways (such as culverts, weirs, pipes, dams etc.) can prevent fish from reaching their preferred habitat. Alternatively, some natural or manmade barriers can provide protected habitat for some of our fish species that don't require access to the sea and which are susceptible to introduced fish species (such as kōwaro/Canterbury mudfish).

Produced by & © EOS Ecology



Longfin eel © EOS Ecology

Use of interpretation bands for assessing the health of waterways in relation to ecology data

There are a range of interpretation bands that can be used when looking at ecological data. The following are a list of different interpretation bands used in this map series:

National Objectives Framework (NOF) bands:
The NOF is one component of the NPS-FM 2020 (New Zealand Government, 2024). It requires Regional Councils to go through a process of identifying freshwater management units (FMUs) within their region and identifying the values of each individual FMU. They then need to set environmental outcomes and identify attributes for each value. Each attribute needs baseline states, targets and limits set, while preparing action plans to achieve the stated environmental outcomes. The NOF provides interpretation bands for 22 different attributes, with most attributes having four (A–D) or five (A–E) described bands and a national bottom line. Some ecological biotic metrics can be compared to the NOF bands as an assessment of ecoystem health (MfE & Stats NZ, 2023). There are a range of monitoring criteria that need to be met for the NOF bands to be used and so these bands won't be suitable for use on all available data. In this map series we have only used the NOF bands when presenting Regional Council monitoring that is presented on the LAWA website – www.lawa.org.nz.

MCI/QMCI metrics:
The Macroinvertebrate Community Index (MCI) and its quantitative equivalent (QMCI) are biotic indices that were developed in 1985 as indicators of organic enrichment in stony streams (Stark, 1985), but which are now widely used to evaluate the general health of waterways in Aotearoa.

F-IBI metrics:
The Fish Index of Biotic Integrity (F-IBI) is a composite index based on six metrics of fish community composition. It is used extensively overseas, but was adapted for use with Aotearoa fish communities in 2004 (Joy & Death, 2004). Higher F-IBI values represent higher integrity of the fish community. Some regions have had regionally-specific F-IBI scores created, but not all regions have these. As such, a national F-IBI score was also established, and this is used in this map series.

5.1 Macroinvertebrates – MCI & QMCI

This map shows actual data on freshwater macroinvertebrates (MCI and QMCI scores) in your catchment, and interpretation of the data using two types of data interpretation bands.

» **Macroinvertebrate Community Index (MCI):** A biotic index developed in 1985 as an indicator of organic enrichment in stony streams (Stark, 1985). It is now widely used to evaluate the general health of waterways in New Zealand. Biotic indices are measures that provide a single number to summarise a complex set of biological information, allowing the value calculated for an individual site to be easily classified according to the condition of the site.

» **Quantitative Macroinvertebrate Community Index (QMCI):** The quantitative (i.e., numbers-based) variant of MCI.

The MCI and QMCI are now both included as ecosystem health attributes in the NPS-FM 2020, along with the Macroinvertebrate Average Score Per Metric (ASPM), which is not presented here.

Notes on limitations/use

» The NPS-FM specifies that for those waterways that are naturally soft-bottomed, as defined in Table 25 of the NPS-FM, the soft-bottomed MCI score should be used. The data file downloaded from LAWA does not specify whether soft bottomed indices have been used, so we cannot determine whether this requirement has been met.

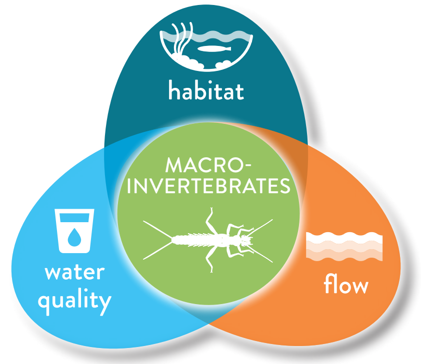
» Some waterways that are in pristine condition are placed in Band 'B' (indicating mild enrichment) because of naturally limited invertebrate communities (e.g., high country areas above the tree line) or limited data available (e.g., in Fiordland). This is because the NPS-FM attribute bands were based on setting the national bottom line at an MCI of 90 instead of previous iterations that were set at 80. The unintended consequence is that all other bands were also increased by 10 points, which pushed Band 'A' to an MCI value that is rarely found. Further discussion on this can be found in the Freshwater Science and Technical Advisory Group (STAG) Supplementary Report to the Minister for the Environment (STAG, 2020).

» The REC waterway layer is not exact and not accurate at a site scale.

Summary of MCI & QMCI data from LAWA ecology sites[1]

Site name	Soft and/or hard bottomed waterway[2]	MCI median	QMCI median	NOF attribute band (see band explanations table at bottom of page)
Hutt River at Boulcott	Naturally hard bottomed	114	5.1	C
Mangaroa River at Te Marua	Naturally hard bottomed	119	6.4	B
Waiwhetu Stream at Whites Line East	Naturally hard bottomed	68	2.8	D
Whakatikei River at Riverstone	Naturally hard bottomed	131	6.9	A

1 Site name, data, and attribute band information taken directly from the 'River macroinvertebrate state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). NA indicates insufficient data to assign a value. If a site falls within different attribute bands for MCI and QMCI, the NOF attribute band and colour is assigned according to the lower of the two. Medians are based on five consecutive years of data.
2 The REC groups that are classified as naturally soft bottomed are defined in Table 25 of the NPS-FM 2020 based on the Climate/Topography/Geology catchment level REC classifications: WD_Low_Al; WD_Low_VA; WD_Lake_Any; WD_Low_SS; WW_Low_Al



Summary of MCI & QMCI data from 'other' (or one-off/sporadically surveyed) sites[3]

Site/s REC land cover class category	# of sites in class	Date of most recent survey	MCI most recent average	QMCI most recent average	Sites within Stark & Maxted (2007) & Stark (1998) interpretation bands[4]															
					Excellent: clean water				Good: doubtful quality or possible mild pollution				Fair: probable moderate pollution				Poor: probable severe pollution			
					MCI >119		QMCI >5.99		MCI 100–119		QMCI[5] 5.00–5.99		MCI 80–99		QMCI 4.00–4.99		MCI <80		QMCI <4.00	
					#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Exotic Forest (EF)	1	28 Jan 2015	85	4.0	0	0	0	0	-	-	-	-	1	100	-	-	-	-	1	100
Indigenous Forest (IF)	8	17 Jan 2024	131	7.0	7	88	7	88	1	13	-	-	-	-	1	13	-	-	-	-
Pastoral (P)	4	06 Dec 2023	117	6.1	2	50	2	50	2	50	2	50	-	-	-	-	-	-	-	-
Scrub (S)	4	17 Jan 2024	129	6.6	4	100	2	50	-	-	2	50	-	-	-	-	-	-	-	-
Urban (U)	14	17 Jan 2024	85	3.9	1	7	1	7	2	14	1	7	4	29	2	14	7	50	10	71

3 Values presented are from the most recent data collected from each site and are averaged for each REC land cover class. Data obtained April 2025.
4 There will be double the number of sites presented in this table vs what you see on the map, as the MCI and QMCI score for each site is included in this table. We have done this because there is sometimes a difference in the interpretation bands when using MCI (presence/absence data) vs QMCI (abundance) data. In contrast, the map on the facing page is only presenting the lower (i.e., worst) of the two interpretation bands, if they differ at a site.
5 There is an error in the QMCI table given in Stark & Maxted (2007) for this score, which is incorrectly given as 5.0–5.90. As such we have used the value referred to in Stark (1998), which is 5.0–5.99.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Site dots/shapes *See table above.*	Locations where macroinvertebrate samples have been collected and analysed for MCI and QMCI, with colouration related to NOF attribute band (LAWA sites) or Stark (1998)/Stark & Maxted (2007) (other sites) interpretation.	Provides an indication of the ecological health of your catchment, by comparing your results to national guidelines.	Data collected by Regional Council. LAWA sites: Median values and related attribute band assignment taken directly from the 'River macroinvertebrate state and trend results (Oct 2024)' downloaded from LAWA (www.lawa.org.nz/download-data/#river-water-quality). If a site falls within different attribute bands for MCI and QMCI, the map colour is assigned according to the lower of the two attribute bands. 'Other' sites: Obtained direct from Regional Council, the most recent value for each site's data was compared against the Stark (1998)/Stark & Maxted (2007) interpretation bands. If a site falls within different interpretation bands for MCI and QMCI, the map colour is assigned according to the lower of the two interpretation bands.
Waterway lines – colour *See table above.*	The key land cover class for each REC segment of waterway. It is also used as a grouping variable for the 'other' sites in the summary table.	Helps to see if there are any spatial patterns in the water quality data.	Developed by NIWA as part of the River Environment Classification (REC) layer. See Section 3.4 for more information.

NPS-FM 2020 NOF macroinvertebrate interpretation bands for LAWA sites explained

Band descriptions: Macroinvertebrate Community Index (MCI) & Quantitative Macroinvertebrate Community Index (QMCI)		Band limits: MCI	QMCI
A	Macroinvertebrate community, indicative of pristine conditions with almost no organic pollution or nutrient enrichment.	≥130	≥6.5
B	Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment.	≥110 to <130	≥5.5 to <6.5
C	Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment.	≥ 90 to <110	≥ 4.5 to <5.5
National bottom line		90	4.5
D	Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment.	<90	<4.5

> greater than | < less than | ≥ greater than or equal to | ≤ less than or equal to

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI
MOUNTAINS TO SEA CONSERVATION TRUST
EOS ECOLOGY

Te Awa Kairangi/Hutt River

Macroinvertebrates
– Macroinvertebrate Community Index (MCI)

Focus Catchment Map Series: Map 5.1

- Stormwater pipes
- Roads
- Focus catchment

LAWA ECOLOGY SITES: using NPS-FM 2020 NOF interpretation bands

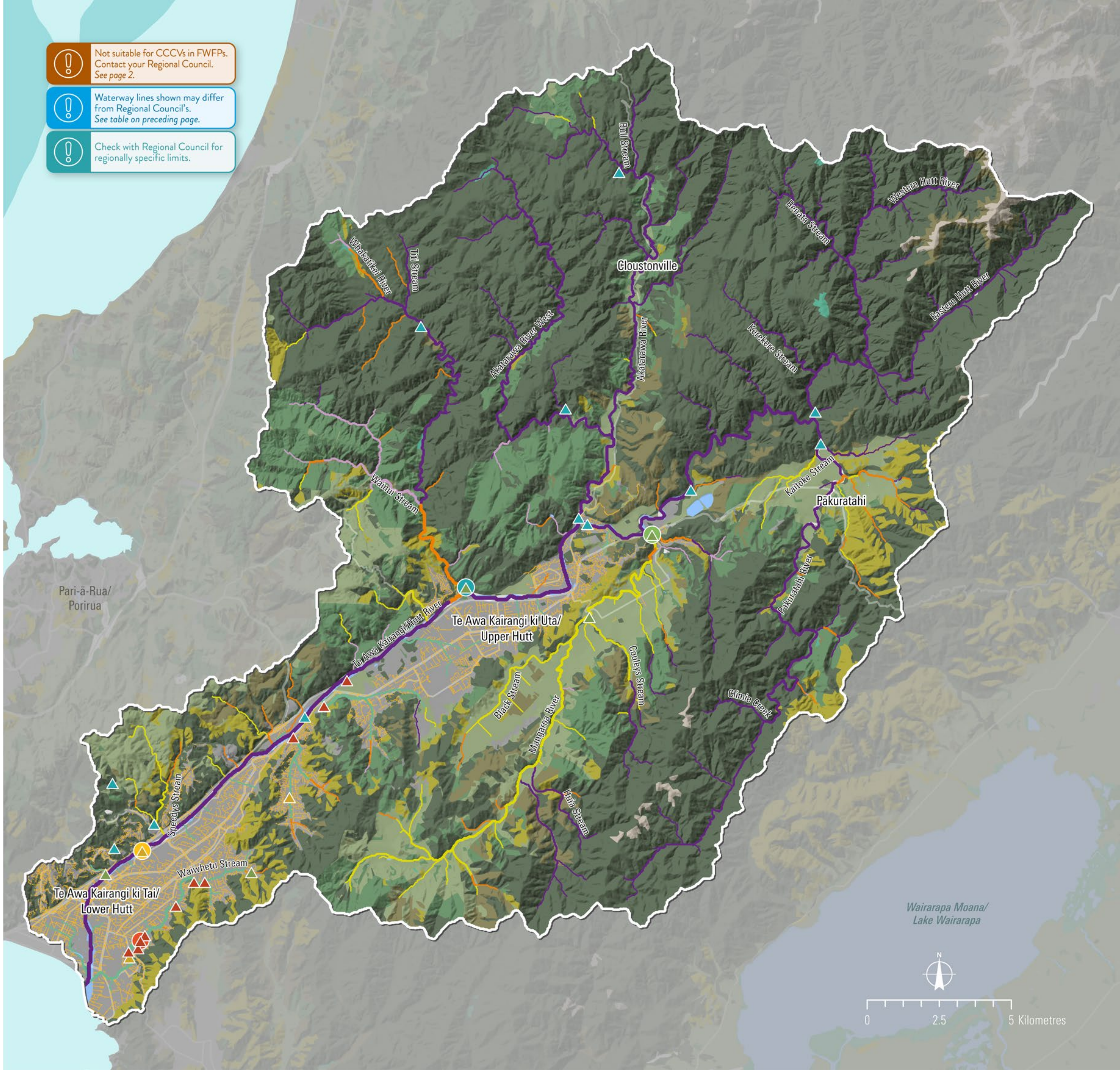
- Band A – Excellent
- Band B – Good
- Band C – Fair
- Band D – Poor
- Insufficient data

'OTHER' ECOLOGY SITES: using Stark (1998) MCI/QMCI bands

- Excellent – clean water
- Good – doubtful quality or possible mild pollution
- Fair – probable moderate pollution
- Poor – probable severe pollution

REC LAND COVER CLASS: waterways (stream order >1)

- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- LAWA and 'other' sites: monitored/sampled by Regional Council
- LAWA ecology data: www.lawa.org.nz/download-data/#river-water-quality
- 'Other' ecology data: obtained from Regional Council

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: LAWA water quality sites (Land Air Water Aotearoa (LAWA) data set), other water quality sites (Regional Council data set), REC land cover class (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

5.2 Macroinvertebrates – diversity & common taxa

This map shows actual data on freshwater macroinvertebrates in your catchment, with information about species diversity, the proportion of sensitive taxa, and the most common macroinvertebrate taxa found at the survey sites.

Information about the number of macroinvertebrate species found in a waterway, and how many of those species are sensitive to pollution can help us understand the health of our waterways. We know that EPT taxa (made up of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera)) are more sensitive to habitat or water quality degradation. This means that sites that have a high EPT abundance are generally in better health than sites with low EPT abundance.

Notes on limitations/use

» The REC waterway layer is not exact and not accurate at a site scale.

Summary of macroinvertebrate taxa richness & EPT richness/abundance[1]

Site/s REC land cover class category	# of sites in class	Date of last survey	# of surveys	Taxa richness most recent average	EPT taxa richness most recent excl. Hydroptilidae[2]	% EPT most recent excl. Hydroptilidae[2]
Bare (B)	0	-	0	-	-	-
Exotic Forest (EF)	1	01 Jan 2015	3	19	5	5.4
Indigenous Forest (IF)	8	01 Jan 2024	98	26	15	77.9
Pastoral (P)	4	12 Dec 2023	27	28	14	69.3
Scrub (S)	4	01 Jan 2024	50	29	16	67.9
Tussock (T)	0	-	0	-	-	-
Urban (U)	14	01 Jan 2024	44	21	5	11.7
Wetland (W)	0	-	0	-	-	-
Unclassified (M)	0	-	0	-	-	-

1 Values presented are from the most recent data collected from each site and are averaged for each REC land cover class. Data obtained April 2025.
2 Hydroptilidae are a group of caddisflies (Trichoptera) that are tolerant of degraded conditions. They are removed from these metrics to make the data more representative of taxa sensitive to degraded conditions.

Mayfly – *Coloburiscus*

Stonefly – *Stenoperla*

Caddisfly – *Oecetis*

All images © EOS Ecology.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Dot – size & colour % EPT abundance excl. Hydroptilidae: >75; 51–75; 25–50; <25 Taxa richness: ≥25; 20–24; 15–19; 10–14; <10	The circle size represents the macroinvertebrate taxa richness at each site, with larger circles indicating higher diversity. The colour of the circle represents the percentage of EPT individuals that are recorded at that site.	Helps you to understand the condition of waterways in the catchment and to identify areas where instream habitat or water quality may be impacting the macroinvertebrate community.	Based on raw data obtained from the Regional Council. Values for the most recent survey at each site are presented. Taxa richness, EPT taxa richness, and % EPT have been calculated from the data provided by regional councils, at the taxonomic resolution outlined in Annex D of the National Environmental Monitoring Standards (NEMS) for Macroinvertebrates.
Waterway lines – colour *See table above.*	The key land cover class for each REC segment of waterway. It is also used as a grouping variable for the summary table.	Helps to see if there are any spatial patterns in the water quality data.	Developed by NIWA as part of the River Environment Classification (REC) layer. See Section 3.4 for more information.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Macroinvertebrates – Diversity & EPT Abundance

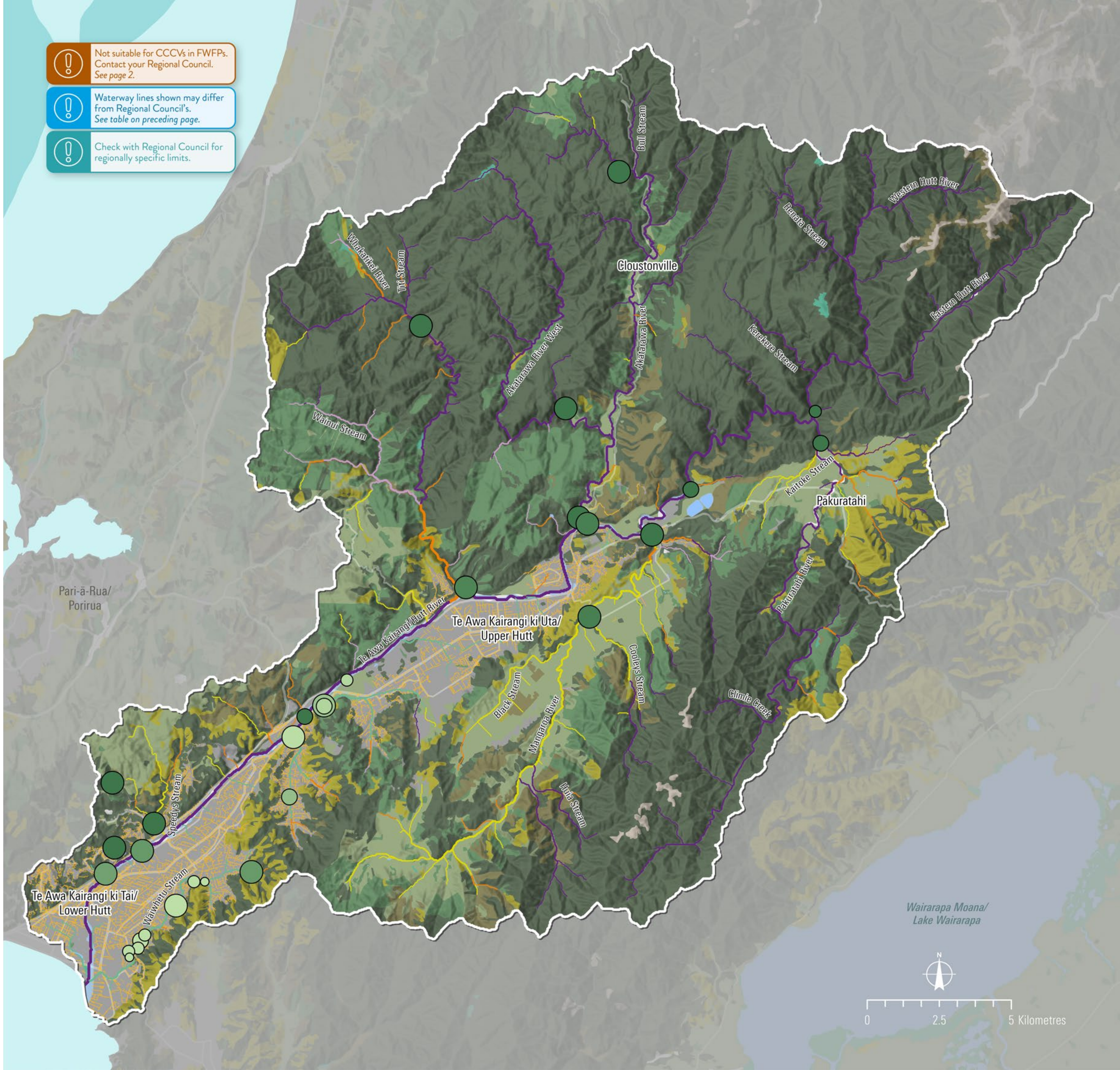
Focus Catchment Map Series: Map 5.2

Stormwater pipes
Roads
Focus catchment

TAXA RICHNESS:
- ≥25
- 20–24
- 15–19
- 10–14
- <10

% EPT ABUNDANCE: excluding Hydroptilidae
- >75
- 51–75
- 25–50
- <25

REC LAND COVER CLASS: waterways (stream order >1)
- Bare (B)
- Exotic Forest (EF)
- Indigenous Forest (IF)
- Pastoral (P)
- Scrub (S)
- Tussock (T)
- Urban (U)
- Wetland (W)
- Unclassified (M)



Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Data obtained from Regional Council.

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Taxa richness and % EPT abundance (EOS Ecology based on Regional Council data), REC land cover class (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

Summary of the most abundant macroinvertebrate taxa recorded in your catchment[1]

This table includes details on the relative abundance of the five most abundant taxa recorded at sites from each of the REC land cover class categories for waterways in your catchment. This is based on the most recent data record per site, and should give you an insight to the types of invertebrates that define your catchment's waterways. The facing page shows images of some macroinvertebrates from each of the three sensitivity groupings (low/medium/high) – see if any of the most abundant taxa in your catchment are shown there.

Species grouping taxa order	Taxa name	Sensitivity group[2]	MCI score[3] hard bottom	Description[4]	Average % abundance 5 most common taxa at ALL sites last survey	Average % abundance of 5 most common taxa per REC land cover class last survey								
						Bare (B)	Exotic forest (EF)	Indigenous forest (IF)	Pastoral (P)	Scrub (S)	Tussock (T)	Urban (U)	Wetland (W)	Unclassified (M)
Mollusca	*Potamopyrgus*	Low	4	A widespread, endemic freshwater snail that is found in most NZ streams and rivers and feeds by grazing on biofilms on submerged surfaces. May be found in very high densities in some waterways. Often known as the NZ mud snail in other parts of the world, where they may be considered invasive and present at nuisance densities.	35.7	-	86.2	-	-	5.4	-	63.9	-	-
Ephemeroptera	*Deleatidium*	High	8	A relatively common endemic mayfly with larvae that are typically found in swift flowing, stony bottomed streams. Adults are terrestrial. Larvae feed by scraping algae and organic matter from submerged hard surfaces and are relatively sensitive to instream habitat condition and water quality.	25.6	-	-	45.0	17.7	22.7	-	-	-	-
Ephemeroptera	*Coloburiscus*	High	9	Distinctive mayfly nymphs with spiny gills on the top of their abdomens. Typically found in cool, swift flowing, stony bottomed, bush covered streams. Prolific filter feeds, using their hairy legs to trap drifting food particles. Relatively sensitive to instream habitat condition and water quality.	7.7	-	-	-	7.9	12.3	-	13.6	-	-
Diptera	Orthocladiinae	Low	2	A diverse group of nonbiting midges from the Chironomidae family. Larvae live in a wide range of freshwater habitats, including both hard and soft sediment waterways where they feed on algae and fine organic matter. Larvae are tolerant of the impacts of rural and urban land use and may be present in high abundance in enriched waterways with plentiful algae.	6.1	-	1.0	4.7	-	4.4	-	8.0	-	-
Oligochaeta	Oligochaeta	Low	1	A group that includes both earthworms and many small freshwater worms. Feeding on fine organic matter within sediments, they are common in a wide range of freshwater environments, with a high tolerance for poor water quality and abundant fine sediment.	5.1	-	-	7.1	-	-	-	6.4	-	-
Trichoptera	*Hydropsyche (Aoteapsyche)*	Low	4	An uncased caddis larvae that may be abundant in stony bottomed streams with moderate to good water quality. These larvae gather food by constructing a net to filter small drifting particulate organic matter from the water column, feeding on both algae and small invertebrates. Adults are terrestrial.	-	-	4.0	-	13.9	-	-	-	-	-
Trichoptera	*Pycnocentrodes*	Medium	5	Cased caddis larvae that construct small mobile cases covered with sand and stones. Larvae are typically found in stony bottomed streams, while adults are terrestrial. Larvae feed on fine organic matter and algae and are moderately sensitive to instream habitat condition and water quality.	-	-	-	-	8.9	-	-	-	-	-
Crustacea	*Paracalliope*	Medium	5	Widespread and common freshwater amphipod. Abundant in lowland, slow-flowing streams, especially where macrophytes are extensive. A collector-gatherer that typically feeds on deposited organic matter and biofilms.	-	-	2.4	-	-	-	-	-	-	-

1 Values presented are from the most recent data collected from each site and are averaged for each REC land cover class. Data obtained April 2025.
2 Groups macroinvertebrate taxa into three broad sensitivity classes, based on their MCI tolerance values (low sensitivity = those with a tolerance score of 1–4, medium sensitivity = 5–7, high sensitivity = 8–10).
3 Each macroinvertebrate taxa is assigned an MCI tolerance value that indicates how sensitive it is to habitat and water quality degradation. The higher the tolerance value the more sensitive they are to habitat/water quality degradation. These values are then used in a calculation to create the overall MCI (or QMCI) score for a sample. Only hard bottom scores used.
4 For further information on these macroinvertebrate taxa, visit the Landcare Research freshwater invertebrates guide at www.landcareresearch.co.nz/tools-and-resources/identification/freshwater-invertebrates-guide.

...continued over page

Produced by & © EOS Ecology

Overview of the more common species of macroinvertebrates by SENSITIVITY GROUPING

LOW sensitivity group
Tolerance value: 1–4


Worm – Oligochaeta
Tolerance value: 1


Chironomid – *Chironomus*
Tolerance value: 1


Chironomid – Orthocladiinae
Tolerance value: 2


Caddisfly (Hydroptillid) – *Oxyethira*
Tolerance value: 2


Crustacea – Ostracoda
Tolerance value: 3


Snail – *Physella*
Tolerance value: 3

Fly – *Austrosimulium*
Tolerance value: 3

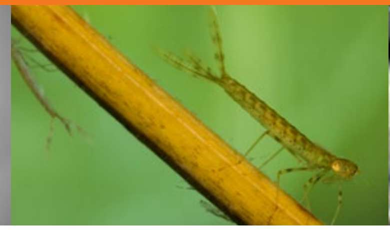

Fly – Muscidae
Tolerance value: 3


Snail – *Potamopyrgus*
Tolerance value: 4


Caddisfly – *Hydropsyche (Aoteapsyche)*
Tolerance value: 4

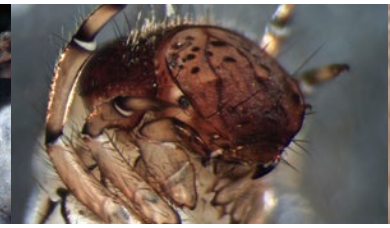
MEDIUM sensitivity group
Tolerance value: 5–7


Mite – Acarina
Tolerance value: 5


Damselfly – *Xanthocnemis*
Tolerance value: 5

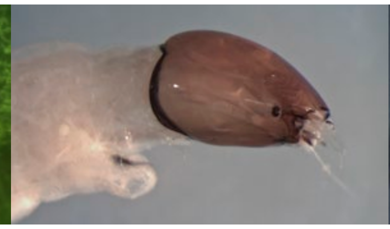

Stonefly – *Zelandobius*
Tolerance value: 5


Caddisfly – *Triplectides*
Tolerance value: 5


Caddisfly – *Pycnocentrodes*
Tolerance value: 5


Caddisfly – *Hydrobiosis*
Tolerance value: 5


Amphipod – *Paracalliope*
Tolerance value: 5


Chironmid – Tanypodinae
Tolerance value: 5


Caddisfly – *Hudsonema*
Tolerance value: 6


Beetle – Elmidae
Tolerance value: 6


Caddisfly – *Oecetis*
Tolerance value: 6


Mayfly – *Zephlebia*
Tolerance value: 7


Mayfly – *Neozephlebia*
Tolerance value: 7


Dobsonfly – *Archicauliodes*
Tolerance value: 7


Caddisfly – *Pycnocentria*
Tolerance value: 7

HIGH sensitivity group
Tolerance value: 8–10


Mayfly – *Deleatidium*
Tolerance value: 8


Caddisfly – *Polyplectropus*
Tolerance value: 8


Caddisfly – *Psilochorema*
Tolerance value: 8


Mayfly – *Coloburiscus*
Tolerance value: 9


Caddisfly – *Olinga*
Tolerance value: 9


Stonefly – *Megaleptoperla*
Tolerance value: 9


Caddisfly – *Hydropsyche (Orthopsyche)*
Tolerance value: 9


Stonefly – *Stenoperla*
Tolerance value: 10


Stonefly – *Zelandoperla*
Tolerance value: 10


Caddisfly – *Helicopsyche*
Tolerance value: 10

All images © EOS Ecology unless stated otherwise.

Produced by & © EOS Ecology

Abundant macroinvertebrate taxa recorded in your catchment...continued

Species grouping taxa order	Taxa name	Sensitivity group[2]	MCI score[3] hard bottom	Description[4]	Average % abundance 5 most common taxa at ALL sites last survey	Average % abundance of 5 most common taxa per REC land cover class last survey								
						Bare (B)	Exotic forest (EF)	Indigenous forest (IF)	Pastoral (P)	Scrub (S)	Tussock (T)	Urban (U)	Wetland (W)	Unclassified (M)
Coleoptera	Elmidae	Medium	6	Commonly known as riffle beetles, both adults and larvae are aquatic. Larvae are long and slender and typically found in stony bottomed streams where they feed on fine organic matter and are able to burrow into streambed sediments. Although adults are aquatic, they are not streamlined or designed for swimming.	-	-	-	4.7	-	-	-	-	-	-
Ephemeroptera	*Zephlebia*	Medium	7	Mayfly nymphs with double abdominal gills and a flattened body shape. A high abundance of Zephlebia nymphs is generally indicative of good habitat and water quality because they are a fairly sensitive taxa. Nymphs may be found in soft or hard bottomed streams where they feed by scraping algae and other organic matter from stone surfaces.	-	-	-	-	11.8	-	-	6.1	-	-
Trichoptera	*Olinga*	High	9	An endemic smooth cased caddisfly that is commonly found in hard bottomed streams within bush covered areas. Feeds on both fine organic matter and leaf litter, they are relatively sensitive to instream habitat condition and water quality.	-	-	-	7.0	-	-	-	-	-	-
Diptera	*Polypedilum*	Low	3	These non-biting midge larvae have a worm-like body form and a distinctive head. The larvae are tolerant of varying water quality and can be found in both hard- and soft-bottomed streams, where they typically feed on fine organic matter, including streambed algae.	-	-	-	-	-	15.8	-	-	-	-
Diptera	*Maoridiamesa*	Low	3	A genus of non-biting midges from the Chironomidae family. Larvae are characterised by a segmented, worm-like body with a well-defined head and a distinct black collar. Larvae can be found in both hard- and soft-bottomed streams, where they feed on streambed algae and fine organic matter. Larvae may occur in high abundance in areas with plentiful streambed algae.	-	-	1.0	-	-	-	-	-	-	-

1 Values presented are from the most recent data collected from each site and are averaged for each REC land cover class. Data obtained April 2025.
2 Groups macroinvertebrate taxa into three broad sensitivity classes, based on their MCI tolerance values (low sensitivity = those with a tolerance score of 1–4, medium sensitivity = 5–7, high sensitivity = 8–10).
3 Each macroinvertebrate taxa is assigned an MCI tolerance value that indicates how sensitive it is to habitat and water quality degradation. The higher the tolerance value the more sensitive they are to habitat/water quality degradation. These values are then used in a calculation to create the overall MCI (or QMCI) score for a sample. Only hard bottom scores used.
4 For further information on these macroinvertebrate taxa, visit the Landcare Research freshwater invertebrates guide at www.landcareresearch.co.nz/tools-and-resources/identification/freshwater-invertebrates-guide.

Produced by & © EOS Ecology

Mayfly – *Coloburiscus*

5.3 Fish diversity

This map shows actual data on fish diversity in your catchment, based on fish surveys using conventional and eDNA survey methods.

Fish are typically surveyed in wadeable waterways using conventional methods such as electrofishing, netting/trapping, and visual spotlighting. However, the collection and analysis of water samples for environmental DNA (eDNA) is increasingly being used as an alternative, or in addition to conventional fish survey methods. eDNA surveys can detect fish from a considerable distance upstream of the sample point, which needs to be taken into account when interpreting the data.

Notes on limitations/use

- The NZFFD data displayed here only includes records from 1980 onwards, using conventional fishing methods (electrofishing, netting/trapping, and visual spotlighting). Also note that not all fish surveys are uploaded to the NZFFD.
- eDNA sampling may detect fish species that are actually some distance upstream of the sampling point, meaning that care should be taken when interpreting the point-based data shown for eDNA samples. eDNA testing also can't distinguish between living and dead organisms or provide information on the abundance of different species.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of fish diversity – fish surveys post 1980

Elevation metres above sea level m ASL	# of sites[1] surveyed		Total fish diversity	# of threatened species
	NZFFD[2] conventional fish survey methods	eDNA[3]		
Mountain (>1,000)	-	-	-	-
Hill (400–1,000)	-	-	-	-
Moderately Low (100–400)	79	14	13	6
Low (60–100)	21	3	14	7
Very Low (<60)	49	19	22	9
OVERALL	149	36	23	9

1 To account for repeat sampling or variable accuracy of GPS coordinates, and to avoid duplication of data records, sites here are defined as any sampling event record that is located within 30 m of each other (i.e., there is overlap of a 15 m radius around the location of each record) for conventional fishing methods and within 200 m (i.e., there is overlap of a 100 m radius around the location of each record) for eDNA records.
2 New Zealand Freshwater Fish Database (NZFFD). Results based on data download April 2025.
3 Environmental DNA (eDNA) fishing records are shown separately in this table, since records of eDNA sampling are increasingly being included in the NZFFD, but this method appears to have greater ability to detect rare or hard to identify species compared to conventional fish survey methods. eDNA sampling may also detect the presence of a taxon further down a waterway than they actually occur, hence, care should be taken when plotting these locations as point data on a map (NIWA, 2021). Results based on data download April 2025.


Bluegill bullies – *Gobiomorphus hubbsi* © EOS Ecology

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots & squares – size & colour % threatened species: <25; 25–50; 50–75; >75 Species diversity: Conventional: >6; 4–6; 1–3; 0. eDNA: >10; 6–10; 1–5; 0	The circle/square size represents the fish species diversity at each site, with larger circles/squares indicating higher diversity. The colour of the circle/square represents the percentage of species at that site that are threatened species.	Helps you to understand the distribution of fish within the waterways of the catchment. This enables you to recognise parts of the catchment that may be hotspots of biodiversity or have high importance because of the presence of threatened fish species. This can be useful in terms of prioritising actions in the catchment.	Based on conventional fish survey data obtained from the New Zealand Freshwater Fish Database (NZFFD; that is maintained by NIWA, but holds fish survey data collected by organisations across Aotearoa) and publicly available eDNA data obtained from Wilderlab (that tests water samples for organisations across Aotearoa) or NZFFD. For NZFFD conventional data, only data from 1980 onwards using conventional fishing methods (electrofishing, netting/trapping, and visual spotlighting) is included. Species diversity and % threatened species are calculated based on presence of species across all records related to a site (i.e., a species may only be recorded once for a site). A site is classified as per footnote 1 in the table above.
Solid shapes – elevation bands *See table above.*	Elevation bands provide a visual representation of the height above sea level for the land within the catchment. The elevation data is displayed as bands so that it is quick and easy to distinguish the relative heights of land within the catchment.	NZ fish communities have naturally low diversity and typically include many migratory species, which are strongly influenced by elevation and distance from the coast. Having an understanding of the height of the land within the catchment can help to understand the patterns of fish diversity displayed in the map.	Based on the broad elevation bands used in the NIWA River Environment Classification (REC), grouped according to the clustered REC groups defined in Table 26 of the NPS-FM 2020, with the 'low' REC group further split into three levels to allow for further consideration of fish penetration with elevation.
Waterway lines – solid vs dashed lines Intermittent/ephemeral flow (estimated as mean annual low flow (MALF) <0.004 cumecs) Perennial flow	Indicates whether or not the flow in the waterway section is likely to be perennial (flowing all year round) or intermittent/ephemeral (seasonal or event-based flow) .	Whether a waterway is permanently flowing or not will affect what can live there and how it is best to manage it. Some regulations may also relate to a specific flow permanency (i.e., ephemeral/intermittent vs perennial).	Uses the 'mean annual low flow' (MALF) data attached to the REC layer produced by NIWA, that indicates the modelled average flow rate during the lowest flow period over the course of a year for sections of waterway line. The differentiation between intermittent/ephemeral vs perennial flow was set at a MALF value of 0.004 cumecs (m^3/s).

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Fish Diversity (post 1980)

Focus Catchment Map Series: Map 5.3

Stormwater pipes

Roads

Focus catchment

FLOW PERMANENCY:

Intermittent/ephemeral flow
(estimated as mean annual low flow (MALF) <0.004 cumecs)

Perennial flow

% THREATENED SPECIES:

<25

25–50

50–75

>75

SPECIES DIVERSITY:

Conventional		eDNA	
○	>6	□	>10
○	4–6	□	6–10
○	1–3	□	1–5
○	0	□	0

ELEVATION BANDS: metres above sea level (m ASL)

Mountains (>1,000)

Hill (400–1,000)

Moderately Low (100–400)

Low (60–100)

Very Low (<60)

Further information

» *Also see 'Notes on limitations/use' on preceding page.*

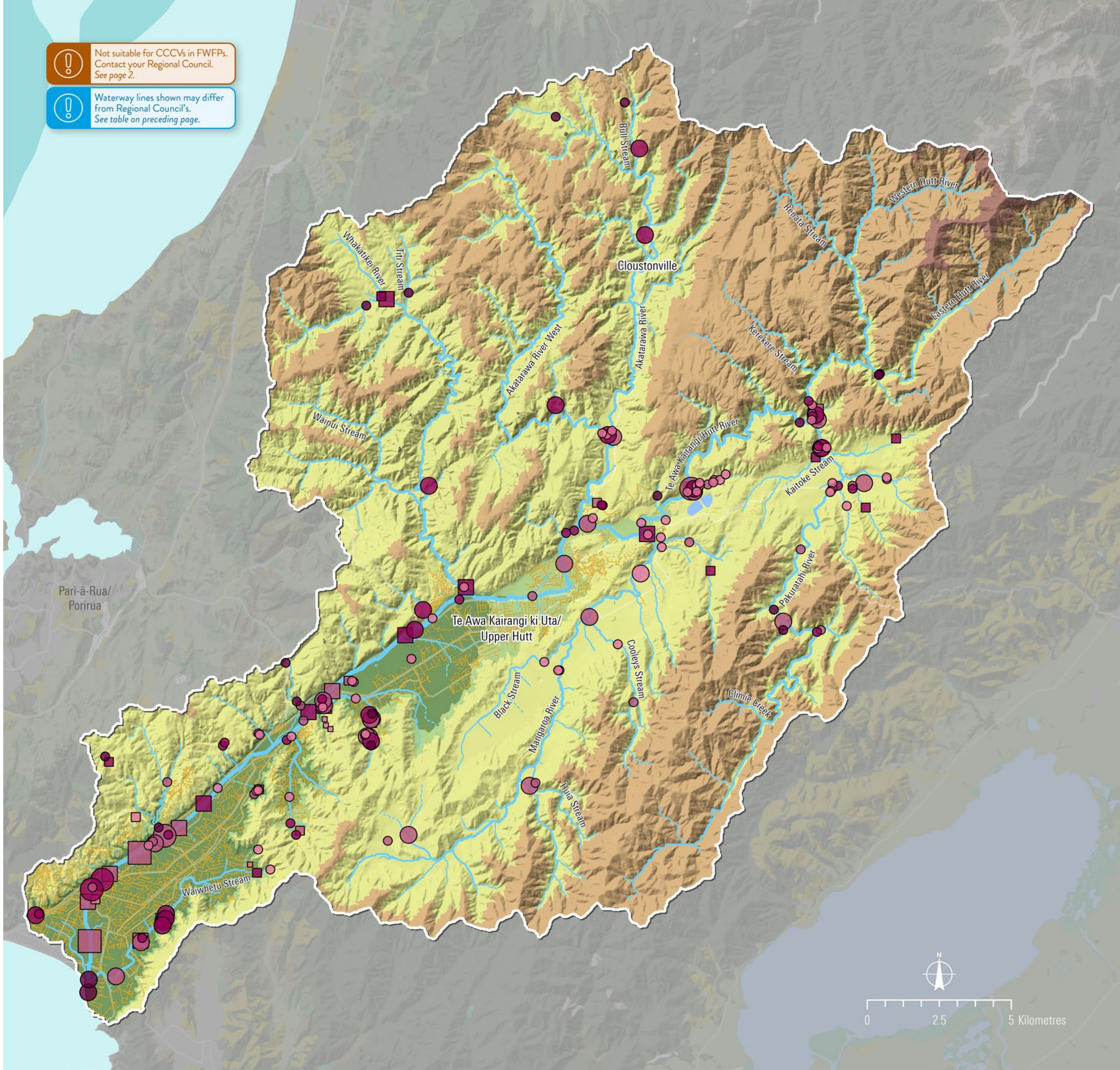
» *Note: Legend may show items not present on the map. See page 11 for more details.*

» Data obtained from:
New Zealand Freshwater Fish Database (NZFFD; conventional fish survey & eDNA data), Wilderlab (eDNA data)

» Key data source urls:
https://nzffdms.niwa.co.nz || www.wilderlab.co.nz/explore

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Flow permanency (EOS Ecology based on modelled mean annual low flow (MALF) from the River Environment Classification (REC); NIWA), % threatened species and fish diversity (EOS Ecology based on New Zealand Freshwater Fish Database (NZFFD) and Wilderlab DiscoverDNA database), elevation bands (EOS Ecology based on NZ topographic contour layer; Land Information New Zealand (LINZ)), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (LINZ), base map (LCDB v5; Manaaki Whenua/Landcare Research).



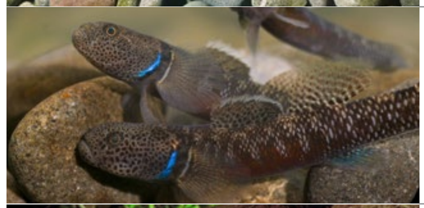
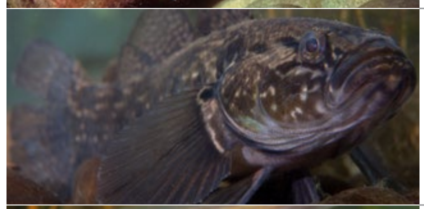
Fish species present in your focus catchment

The table includes details on how common each fish species is within your catchment (% of sites) based on all known records (conventional fish surveys and eDNA data obtained from the NZFFD and Wilderlab) from 1980 onwards, as well as their distribution among the elevation bands and waterway stream order (larger waterways are stream order (SO) >4, medium-small waterways are SO 1–4). This should help you understand the fish values of your catchment.

Species grouping	Species name	Common name	Threat classification	Migratory status	Presence at ALL sites[1]		Presence at sites[1] based on elevation & stream order (SO)																			
							Very low				Low				Moderately low				Hill				Mountain			
							SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4	
					# of sites	% of sites[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]
Bullies	*Gobiomorphus dinae*	**Dinah's Bully**	Not Threatened	Non-diadromous	31	16.8	4	9	2	9	5	26	2	40	17	19	1	25	-	-	-	-	-	-	-	-
Bullies	*Gobiomorphus huttoni*	**Redfin Bully**	Not Threatened	Diadromous–Amphidromous	69	37.3	15	33	12	52	8	42	4	80	29	33	1	25	-	-	-	-	-	-	-	-
Bullies	*Gobiomorphus cotidianus*	**Common Bully**	Not Threatened	Diadromous–Amphidromous	49	26.5	21	47	13	57	6	32	-	-	8	9	1	25	-	-	-	-	-	-	-	-
Bullies	*Gobiomorphus hubbsi*	**Bluegill Bully**	At Risk –Declining	Diadromous–Amphidromous	29	15.7	2	4	14	61	1	5	2	40	9	10	1	25	-	-	-	-	-	-	-	-
Bullies	*Gobiomorphus mataraerore*	**Kaharore Bully**	Not Threatened	Non-diadromous	3	1.6	-	-	-	-	1	5	-	-	2	2	-	-	-	-	-	-	-	-	-	-
Bullies	*Gobiomorphus gobioides*	**Giant Bully**	At Risk –Naturally Uncommon	Diadromous–Amphidromous	14	7.6	7	16	5	22	2	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eels	*Anguilla australis*	**Shortfin Eel**	Not Threatened	Diadromous–Catadromous	74	40.0	28	62	16	70	5	26	2	40	22	25	1	25	-	-	-	-	-	-	-	-

1 To account for repeat sampling or variable accuracy of GPS coordinates, and to avoid duplication of data records, sites here are defined as any sampling event record that is located within 30 m of each other (i.e., there is overlap of a 15 m radius around the location of each record) for conventional fishing methods and within 200 m (i.e., there is overlap of a 100 m radius around the location of each record) for eDNA records. Results based on data download April 2025.
2 Percentages will not total to 100% across rows or down columns.
3 The % values are based on the number of sites with each species present, out of either the total number of sites overall (for % presence at all sites), or the number of sites within the relevant elevation and stream order grouping (for the elevation and stream order columns).

Produced by & © EOS Ecology

	Species description
	DINAH'S BULLY *(Gobiomorphus dinae)*: Recently identified as a distinct species from the Cran's bully. Inhabits interstitial spaces among cobbles and boulders in moderately flowing streams. Widespread across the southern North Island, with isolated populations in the Bay of Plenty.
	REDFIN BULLY *(Gobiomorphus huttoni)*: Extensively found from sea level to inland areas (up to 400 m elevation and 266 km inland). Can navigate substantial barriers for upstream movement. Typically associated with deep water and large substrate during the day, transitioning to shallower water and finer substrate at night.
	COMMON BULLY *(Gobiomorphus cotidianus)*: The most prevalent and widespread native freshwater fish in New Zealand. Found in streams and lakes throughout the country. Typically has seven first dorsal spines, occasionally eight.
	BLUEGILL BULLY *(Gobiomorphus hubbsi)*: Widespread from sea level to 100 km inland. Capable of overcoming modest barriers for upstream movement. Thrives in swift, broken rapids, often inhabiting larger braided gravelly rivers. Less commonly found in riffles of smaller streams. Notable for its distinctive blue gill membrane.
	KAHARORE BULLY *(Gobiomorphus mataraerore)*: Recently identified as a distinct species from the upland bully. Common across most freshwater habitats. Occupies spaces between cobbles and boulders. Widespread but patchy distribution across southern North Island and northern South Island.
	GIANT BULLY *(Gobiomorphus gobioides)*: Cryptic nocturnal fish, hiding in daytime under debris and vegetation. Common at low elevations, mainly in estuaries and nearby waterways, rarely venturing more than 10 km inland. Resemble common bullies but with only six first dorsal spines.
	SHORTFIN EEL *(Anguilla australis)*: Widespread across New Zealand. While they can penetrate inland as far as longfin eel they are more commonly found at low elevation lakes, wetlands and rivers. Significant taonga species and a very important mahinga kai resource.

...continued over page

Diadromous	Fish that travel/migrate between salt water and fresh water as part of their life cycle.
Non-diadromous	Fish that do not migrate between the sea and freshwater.
Catadromous	Migrate down river to the sea to spawn.
Anadromous	Migrate up river from the sea to spawn.
Amphidromous	Migrate from fresh–salt water or from salt–freshwater at some stage of their life cycle, other than the breeding period.
Anadromous capable	Describes a species that has the potential to display diadromous migration patterns, but can also have populations or individuals that remain non-diadromous or resident in freshwater environments.
Lacustrine	Associated with lakes.

Common Bully – *Gobiomorphus cotidianus*

All images © EOS Ecology unless stated otherwise.

..continued...Fish species present in your focus catchment

					Presence at ALL sites[1]		Presence at sites[1] based on elevation & stream order (SO)																			
							Very low				Low				Moderately low				Hill				Mountain			
							SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4	
Species grouping	Species name	Common name	Threat classification	Migratory status	# of sites	% of sites[2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]	#	% [2,3]
Eels	*Anguilla dieffenbachii*	**Longfin Eel**	At Risk –Declining	Diadromous–Catadromous	104	56.2	24	53	12	52	10	53	2	40	54	61	2	50	-	-	-	-	-	-	-	-
Eels	*Anguilla r einhardtii*	**Australian Longfin Eel**	Non-resident Native–Coloniser	Diadromous–Catadromous	1	0.5	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater/ estuarine	*Retropinna retropinna*	**Common Smelt**	Not Threatened	Diadromous–Anadromous	8	4.3	3	7	5	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater/ estuarine	*Aldrichetta forsteri*	**Yelloweyed Mullet**	Not Threatened	Non-diadromous	4	2.2	2	4	2	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater/ estuarine	*Rhombosolea retiaria*	**Black Flounder**	Not Threatened	Non-diadromous	2	1.1	-	-	2	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater/ estuarine	*Mugil cephalus*	**Grey Mullet**	Not Threatened	Diadromous–Anadromous	1	0.5	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Introduced	*Salmo trutta*	**Brown Trout**	Introduced and Naturalised	Anadromous-capable	83	44.9	8	18	12	52	4	21	3	60	53	60	3	75	-	-	-	-	-	-	-	-
Introduced	*Oncorhynchus mykiss*	**Rainbow Trout**	Introduced and Naturalised	Anadromous-capable	2	1.1	1	2	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1 To account for repeat sampling or variable accuracy of GPS coordinates, and to avoid duplication of data records, sites here are defined as any sampling event record that is located within 30 m of each other (i.e., there is overlap of a 15 m radius around the location of each record) for conventional fishing methods and within 200 m (i.e., there is overlap of a 100 m radius around the location of each record) for eDNA records. Results based on data download April 2025.
2 Percentages will not total to 100% across rows or down columns.
3 The % values are based on the number of sites with each species present, out of either the total number of sites overall (for % presence at all sites), or the number of sites within the relevant elevation and stream order grouping (for the elevation and stream order columns).

Produced by & © EOS Ecology

	Species description
	LONGFIN EEL *(Anguilla dieffenbachii)*: Widespread throughout New Zealand in a variety of habitats from sea level to 1,150 m elevation. Excellent climbers as juveniles. Significant taonga species and a very important mahinga kai resource.
 © Shutterstock	AUSTRALIAN LONGFIN EEL *(Anguilla reinhardtii)*: Recently self-introduced to New Zealand, first reported in the 1990s. Displays a faster growth rate compared to longfin and shortfin eels. Covered in dark spots, exclusively found in the North Island, with a preference for rivers over lakes.
	SMELT *(Retropinna retropinna)*: Widely distributed at low elevations throughout New Zealand. Capable of inland penetration when stream gradients are low. Forms land-locked populations in lakes as well.
	YELLOWEYED MULLET *(Aldrichetta forsteri)*: Primarily a marine and estuarine species, occasionally entering freshwater for foraging at low elevations. Distinguished by its bright yellow eye. Widespread in estuaries and rivers, occupying open water.
	BLACK FLOUNDER *(Rhombosolea retiaria)*: Evolved to lie on one side of their bodies for ambushing small prey. Prefers estuarine environments but also found in low-gradient rivers and lowland lakes. Widespread but exhibits a patchy distribution, with the highest occurrence on the east coast of the South Island.
 © Shutterstock	GREY MULLET *(Mugil cephalus)*: Primarily marine and estuarine, it briefly enters low-elevation freshwater for foraging. Recognizable by a pale yellow eye, it's prevalent from Nelson northward, with Waikato rivers being the most common habitats. Inhabits open water within estuaries and rivers.
	BROWN TROUT *(Salmo trutta)*: Introduced in 1867, Brown Trout are found in diverse habitats throughout New Zealand, ranging from estuaries and low elevation tidal lakes to fast-flowing boulder headwater streams and subalpine lakes. Highly territorial, they out-compete other fish species for available food sources.
	RAINBOW TROUT *(Oncorhynchus mykiss)*: An exotic species introduced in 1886, now widespread throughout New Zealand, primarily in lakes or rivers associated with lakes.

...continued over page

Focus catchment © EOS Ecology

All images © EOS Ecology unless stated otherwise.

..continued...Fish species present in your focus catchment

Species grouping	Species name	Common name	Threat classification	Migratory status	Presence at ALL sites[1]		Presence at sites[1] based on elevation & stream order (SO)																				
							Very low				Low				Moderately low				Hill				Mountain				
							SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4		SO 1–4		SO >4		
					# of sites	% of sites[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	#	%[2,3]	
Introduced	*Oncorhynchus nerka*	**Sockeye Salmon**	Introduced and Naturalised	Diadromous–Anadromous	1	0.5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lamprey	*Geotria australis*	**Piharau/lamprey**	Threatened–Nationally Vulnerable	Diadromous–Anadromous	4	2.2	1	2	3	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Migratory galaxiid/ whitebait	*Galaxias maculatus*	**Īnanga**	At Risk –Declining	Diadromous–Amphidromous	27	14.6	15	33	10	43	1	5	-	-	1	1	-	-	-	-	-	-	-	-	-	-	
Migratory galaxiid/ whitebait	*Galaxias brevipinnis*	**Kōaro**	At Risk –Declining	Diadromous–Amphidromous	38	20.5	2	4	8	35	1	5	1	20	26	29	-	-	-	-	-	-	-	-	-	-	
Migratory galaxiid/ whitebait	*Galaxias argenteus*	**Giant Kōkopu**	At Risk –Declining	Diadromous–Amphidromous	20	10.8	14	31	1	4	5	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Migratory galaxiid/ whitebait	*Galaxias fasciatus*	**Banded Kōkopu**	Not Threatened	Diadromous–Amphidromous	23	12.4	12	27	2	9	4	21	-	-	5	6	-	-	-	-	-	-	-	-	-	-	
Migratory galaxiid/ whitebait	*Galaxias postvectis*	**Shortjaw Kōkopu**	Threatened–Nationally Vulnerable	Diadromous–Amphidromous	2	1.1	-	-	1	4	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	
Non-migratory galaxiid	*Galaxias aff. divergens "northern"*	**Dwarf Galaxias (Nelson-Marlborough-North Island)**	At Risk –Declining	Non-diadromous	29	15.7	1	2	7	30	1	5	-	-	19	21	1	25	-	-	-	-	-	-	-	-	

[1] To account for repeat sampling or variable accuracy of GPS coordinates, and to avoid duplication of data records, sites here are defined as any sampling event record that is located within 30 m of each other (i.e., there is overlap of a 15 m radius around the location of each record) for conventional fishing methods and within 200 m (i.e., there is overlap of a 100 m radius around the location of each record) for eDNA records. Results based on data download April 2025.
[2] Percentages will not total to 100% across rows or down columns.
[3] The % values are based on the number of sites with each species present, out of either the total number of sites overall (for % presence at all sites), or the number of sites within the relevant elevation and stream order grouping (for the elevation and stream order columns).

Produced by & © EOS Ecology

	Species description
	SOCKEYE SALMON *(Oncorhynchus nerka)*: Introduced in the early 1900s for sea-run stock, but hydroelectric dams caused landlocking. Now confined to Waitaki River Valley, mainly Lake Ohau and Lake Benmore. Inhabits lake open waters, migrating to spring-fed gravelly tributaries for spawning.
	PIHARAU/LAMPREY *(Geotria australis)*: Migrate from the ocean to freshwater in spring, refraining from feeding. After 18 months, they spawn. Larval lampreys live for years, filter feeding in sandy substrates. Juveniles migrate to sea, parasitically feeding on other fish. Important mahinga kai resource.
	ĪNANGA *(Galaxias maculatus)*: Most common whitebait species, naturally widespread in freshwater systems worldwide. Highly valued as a food source in its whitebait juvenile stage. Prefers gentle-flowing lowland rivers, lakes, and streams. Limited inland penetration due to poor climbing. Habitat degradation is a risk for this species.
	KŌARO *(Galaxias brevipinnis)*: Widespread from sea level to high elevations, due to its exceptional climbing ability. Favors swift-flowing cobble streams in forests and tussock streams draining into high-elevation lakes. Highly valued as a food source, particularly in its whitebait juvenile stage.
	GIANT KŌKOPU *(Galaxias argenteus)*: Widespread whitebait species at low elevations, rare on the east coasts of New Zealand. Minor part of whitebait fishery due to late spring migration. Cryptic adults, prefer gently flowing swampy pools, streams, and lake edges with dense vegetation.
	BANDED KŌKOPU *(Galaxias fasciatus)*: Found throughout New Zealand, displaying excellent climbing abilities to penetrate well inland, although primarily located at low elevations. Prefers pools in small, slow-flowing, tannin-stained streams. Whitebait species that makes up significant contribution of catch in some rivers.
	SHORTJAW KŌKOPU *(Galaxias postvectis)*: Patchy distribution, more common in North Island, except east coast. Found in north/west of the South Island, with a small population south of Fiordland. Prefers boulder streams with forest cover. Minor part of the whitebait fishery. Riparian forest loss is a risk for this species.
	DWARF GALAXIAS (Nelson-Marlborough-North Island) *(Galaxias aff. divergens 'northern')*: A non-migratory galaxias species that spans Marlborough to Hawke's Bay, with a disjointed Bay of Plenty population likely due to volcanism. Thrives in slow riffles and runs in shallow side braids or upland headwaters.


Kōaro – *Galaxias brevipinnis*

All images © EOS Ecology unless stated otherwise.

5.4 Fish Index of Biotic Integrity (F-IBI)

This map shows actual data on fish surveys in the waterways in your catchment, and interpretation of the survey data using the Fish Index of Biotic Integrity (F-IBI) and nationally relevant interpretation bands.

The ecosystem health of wadeable rivers may be measured using fish biotic indices. The F-IBI is a composite index based on six metrics of fish community composition. It is used extensively overseas but was adapted for use with New Zealand fish communities in 2004. F-IBI values for this catchment are based on actual records from the New Zealand Freshwater Fish Database (NZFFD), from 1980 to the present. Higher values for the F-IBI represent higher integrity of the fish community and this is reflected in the values for each attribute band.

Notes on limitations/use

- Fish data input into the F-IBI calculator only includes records from NZFFD (1980 onwards, using conventional fishing methods (electrofishing, netting/trapping, and visual spotlighting).
- The NPS-FM F-IBI interpretation bands require at least annual sampling between Dec–Mar (inclusive) using electrofishing, spotlighting, or netting/trapping methods (as per Joy *et al.* (2013). The annual sampling requirement has not been met here.
- While regionally based F-IBI interpretation bands exist for some parts of New Zealand (Joy, 2004a, 2004b, 2010, 2014, 2015, 2019) they are not available for all regions. The NPS-FM 2020 provides the only nationally consistent interpretation bands for the F-IBI and such it has been used here.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of Fish Index of Biotic Integrity (F-IBI) – conventional fish surveys post 1980[1]

Elevation metres above sea level m ASL	NOF attribute band (# of sites[2]) Band A Excellent	Band B Good	Band C Fair	Band D Poor	Zero fish recorded (# of sites[2])
Mountain (>1,000)	-	-	-	-	-
Hill (400–1,000)	-	-	-	-	-
Moderately Low (100–400)	12	14	32	21	0
Low (60–100)	4	7	7	3	0
Very Low (<60)	13	14	19	3	0

1 Uses data obtained from the New Zealand Freshwater Fish Database (NZFFD) using conventional fishing methods of electrofishing, netting/trapping, and visual spotlighting. Results based on data download April 2025.
2 To account for repeat sampling or variable accuracy of GPS coordinates, and to avoid duplication of data records, sites here are defined as any sampling event record that is located within 30 m of each other (i.e., there is overlap of a 15 m radius around the location of each record) for conventional fishing methods and within 200 m (i.e., there is overlap of a 100 m radius around the location of each record) for eDNA records.

Redfin bully – *Gobiomorphus huttoni* © EOS Ecology

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots & squares – colour *See table on right.*	The dots represent the location of fish survey data recorded in the New Zealand Freshwater Fish Database (NZFFD) or Wilderlab database. The dot colour shows the attribute bands in the NPS-FM 2020.	It can help you understand how healthy the fish community is at each site, based on the F-IBI score interpretation bands.	F-IBI values are generated using NZFFD fish survey data from 1980 onwards using conventional fishing methods (electrofishing, netting/trapping, and visual spotlighting). F-IBI values are generated for each NZFFD record by inputting into MfE's F-IBI Calculator (https://mfenz.shinyapps.io/fish-ibi-calculator). These records are then grouped into 'sites' as per footnote 2 in the table above. The F-IBI score per record is then averaged for each 'site' and then a NOF attribute band from the NPS-FM 2020 is assigned to the site, based on that site-averaged F-IBI score. As the F-IBI Calculator does not generate an F-IBI score for records with no fish present, if a site includes records with no fish present, these records are excluded from the calculation of the site-averaged F-IBI score. F-IBI uses six metrics of fish community composition, including number of native species, number of native species with specific habitat requirements, number of intolerant species, and proportion of introduced species (Joy & Death, 2004; MfE, 2019). Because of the influence that elevation and distance from the coast has on NZs fish fauna, the F-IBI calculator uses maximum species richness lines to assess the potential species richness of each site. The F-IBI score goes from 0–60, with higher scores indicating a healthier native fish community.
Solid shapes – elevation bands *See table above.*	The solid colour shapes on the land illustrate the elevation bands and provide a visual representation of the height above sea level for the land within the catchment. The elevation data is displayed as bands so that it is quick and easy to distinguish the relative heights of land within the catchment.	NZ fish communities have naturally low diversity and typically include many migratory species, which are strongly influenced by elevation and distance from the coast. Having an understanding of the height of the land within the catchment can help to understand the patterns of fish diversity displayed in the map.	Based on the broad elevation bands used in the NIWA River Environment Classification (REC), grouped according to the clustered REC groups defined in Table 26 of the NPS-FM 2020, with the 'low' REC group further split into three levels to allow for further consideration of fish penetration with elevation.

NPS-FM 2020 National Objectives Framework (NOF) interpretation bands (for ALL sites)

	Fish Index of Biotic Integrity (F-IBI)[1]	Band limits (average)
How limit is calculated:		Numeric attribute state
A	High integrity of fish community. Habitat and migratory access have minimal degradation.	≥34
B	Moderate integrity of fish community. Habitat and/or migratory access are reduced and show some signs of stress.	≥28 to <34
C	Low integrity of fish community. Habitat and/or migratory access is considerably impairing and stressing the community.	≥18 to <28
D	Severe loss of fish community integrity. There is substantial loss of habitat and/or migratory access, causing a high level of stress on the community.	<18

< less than | ≥ greater than or equal to

1 The A-D band thresholds in the NPS-FM 2020 were derived from the quartiles of F-IBI scores calculated with the national dataset (NZFFD) from 2010–2017. Therefore, the A band represents the top 25 percent nationally, B band the top 50 percent, C band the top 75 percent and the D band is the lowest 25 percent.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Fish Index of Biotic Integrity (F-IBI)

Focus Catchment Map Series: Map 5.4

- Waterways (stream order >1)
- Stormwater pipes
- Roads
- Focus catchment

FISH SURVEY SITES: using NPS-FM 2020 NOF interpretation bands

- Band A – Excellent
- Band B – Good
- Band C – Fair
- Band D – Poor

FISH SURVEY SITES:

- Zero fish recorded

ELEVATION BANDS: metres above sea level (m ASL)

- Mountains (>1,000)
- Hill (400–1,000)
- Moderately Low (100–400)
- Low (60–100)
- Very Low (<60)

Further information

» *Also see 'Notes on limitations/use' on preceding page.*

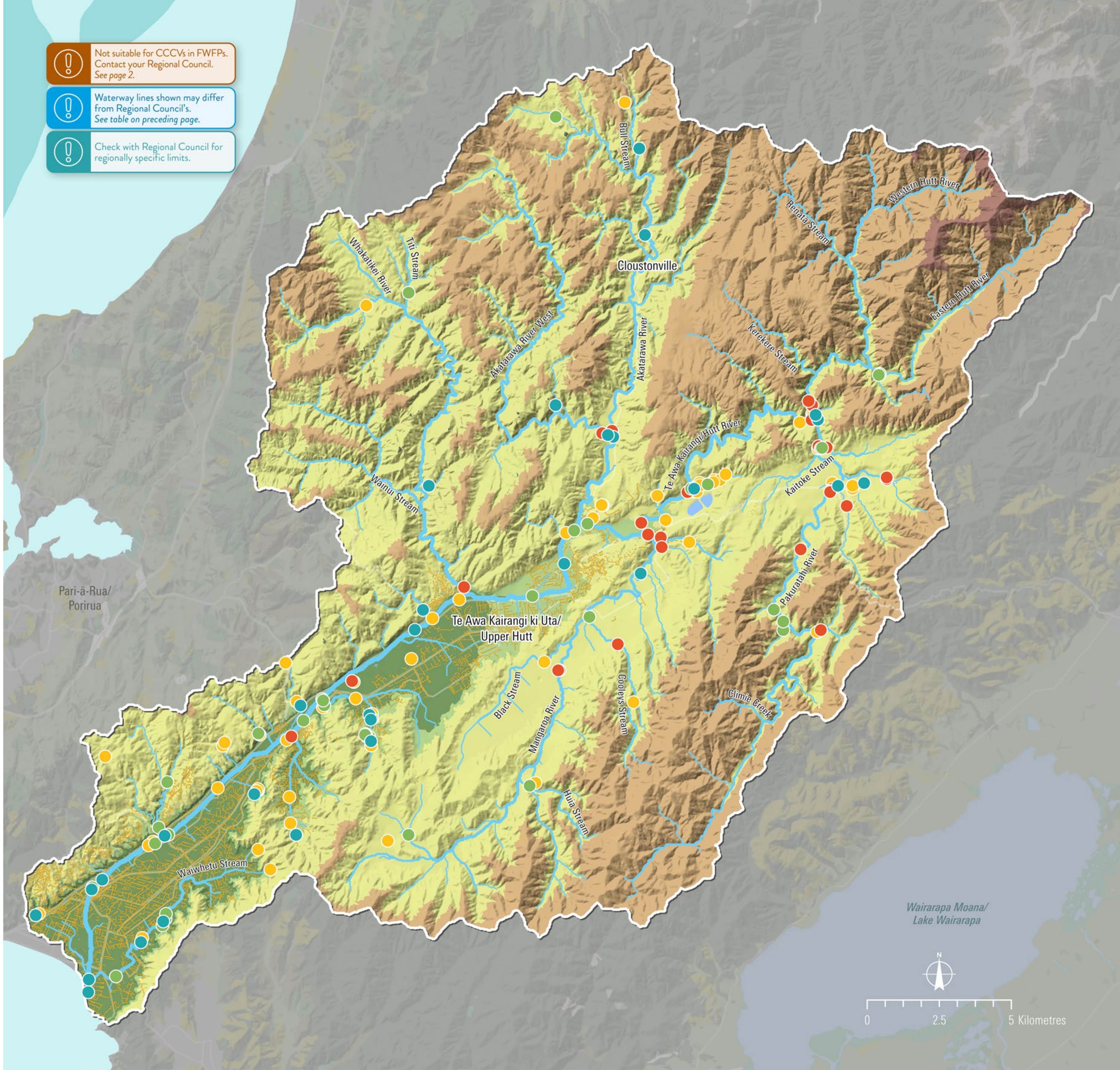
» *Note: Legend may show items not present on the map. See page 11 for more details.*

» Data obtained from: fish data obtained from NZFFD and input into MfE's Fish IBI Calculator (MfE, 2023c; https://mfenz.shinyapps.io/fish-ibi-calculator)

» Information on the F-IBI calculator: https://environment.govt.nz/publications/using-the-fish-ibi-calculator-to-meet-the-nps-fm & https://environment.govt.nz/publications/fish-index-of-biotic-integrity-in-new-zealand-rivers

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Fish survey sites (EOS Ecology based on New Zealand Freshwater Fish Database (NZFFD) and using the Ministry for the Environment Fish IBI calculator), elevation bands (EOS Ecology based on NZ topographic contour layer; Land Information New Zealand (LINZ)), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), roads (ESRI Vector Tile Service), focus catchment (EOS Ecology based on REC watersheds), names & hill shading (LINZ), base map (LCDB v5; Manaaki Whenua/Landcare Research).



5.5 Fish passage & migratory fish

This map shows actual data on the distribution of migratory fish species in your catchment, along with the location of instream structures that may present a risk to fish passage.

Many of Aotearoa's freshwater fish species require access to the ocean to complete their life cycle. Natural or artificial instream structures (dams, perched culverts, weirs, waterfalls) may prevent the upstream and/or downstream migration of fish, and can have a major influence on fish distribution. However, not all barriers are a bad thing – in some places barriers have been installed to protect threatened non-migratory endemic fish species from predation by introduced fish.

Instream structures that have the potential to restrict fish passage are commonplace in Aotearoa. The Fish Passage Assessment Tool (FPAT; https://fishpassage.niwa.co.nz) can be used to assess and document whether instream structures are acting as fish migration barriers.

Notes on limitations/use

- Not all instream structures in a catchment will appear on the FPAT.
- The FPAT site includes structures (known as 'historic results') that have been sourced from other GIS layers (e.g., NIWA road & rail intersects; NZTA asset management) and have not been formally assessed for fish passage risk. These are indicated as 'not assessed' on the map.
- FPAT assessments can be submitted by anyone, including those without specialist knowledge of NZ freshwater fish and fish passage. Therefore, the accuracy of the FPAT results cannot be guaranteed.
- The REC waterway layer is not exact and not accurate at a site scale.

Summary of distribution of migratory fish & barriers – conventional fish surveys post 1980[1]

Elevation metres above sea level m ASL	# of migratory fish species known NZFFD	# of barriers that protect threatened non-migratory endemic fish species FPAT	# of barriers in each FPAT risk category			
			Very high / High	Moderate	Low / Very low	Not assessed
Mountain (>1,000)	-	-	-	-	-	-
Hill (400–1,000)	0	0	0	0	9	39
Moderately Low (100–400)	8	0	115	34	264	561
Low (60–100)	9	0	49	9	34	58
Very Low (<60)	12	2	215	48	180	189
OVERALL	12	2	379	91	487	847

1 Based on conventional fish survey methods (electrofishing, netting/trapping, and visual spotlighting) only. Results based on data download April 2025.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots – colour *See table above.*	Location and risk to fish passage for instream structures in the catchment that are included in the FPAT dataset.	Provides an indication of potential fish passage issues in the catchment to help guide remediation efforts.	Based on data obtained from the Fish Passage Assessment Tool (FPAT; that is maintained by NIWA, but holds data collected by anyone using the tool). The FPAT records have been downloaded and mapped according to risk to fish passage.
White dots – size Diversity of migratory fish >6 4–6 1–3 0	The circle size represents the diversity of migratory fish at each site, with larger circles indicating higher migratory fish diversity.	Provides a spatial representation of migratory fish diversity in relation to known fish barriers within the waterways of the catchment, to help inform remediation efforts.	Based on conventional fish survey data obtained from the New Zealand Freshwater Fish Database (NZFFD) that is maintained by NIWA, but holds fish survey data collected by organisations across Aotearoa. Only data from 1980 onwards using conventional fishing methods (electrofishing, netting/trapping, and visual spotlighting) is included. eDNA data is not included, as it is not location-specific enough to be useful in this context. To account for repeat sampling or variable accuracy of GPS coordinates, and to avoid duplication of data records, sites here are defined as any sampling event record that is located within 30 m of each other (i.e., there is overlap of a 15 m radius around the location of each record). Migratory fish species are defined as those known to require access to the sea for part of their life cycle. Migratory species present at a site is calculated based on presence of species across all records related to a site (i.e., a species may only be recorded once for a 'site').
Solid shapes – elevation bands *See table above.*	Elevation bands provide a visual representation of the height above sea level for the land within the catchment. The elevation data is displayed as bands so that it is quick and easy to distinguish the relative heights of land within the catchment.	NZ fish communities have naturally low diversity and typically include many migratory species, which are strongly influenced by elevation and distance from the coast. Having an understanding of the height of the land within the catchment can help to understand the patterns of fish diversity displayed in the map.	Based on the broad elevation bands used in the NIWA River Environment Classification (REC), grouped according to the clustered REC groups defined in Table 26 of the NPS-FM 2020, with the 'low' REC group further split into three levels to allow for further consideration of fish penetration with elevation.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | eos ECOLOGY

Te Awa Kairangi/Hutt River

Fish Passage & Migratory Fish

Focus Catchment Map Series: Map 5.5

- Waterways (stream order >1)
- Barrier protecting native fish
- Railways
- Stormwater pipes
- Roads
- Focus catchment

FEATURES WITH A RISK TO FISH PASSAGE:
using Fish Passage Assessment Tool (FPAT) interpretation bands

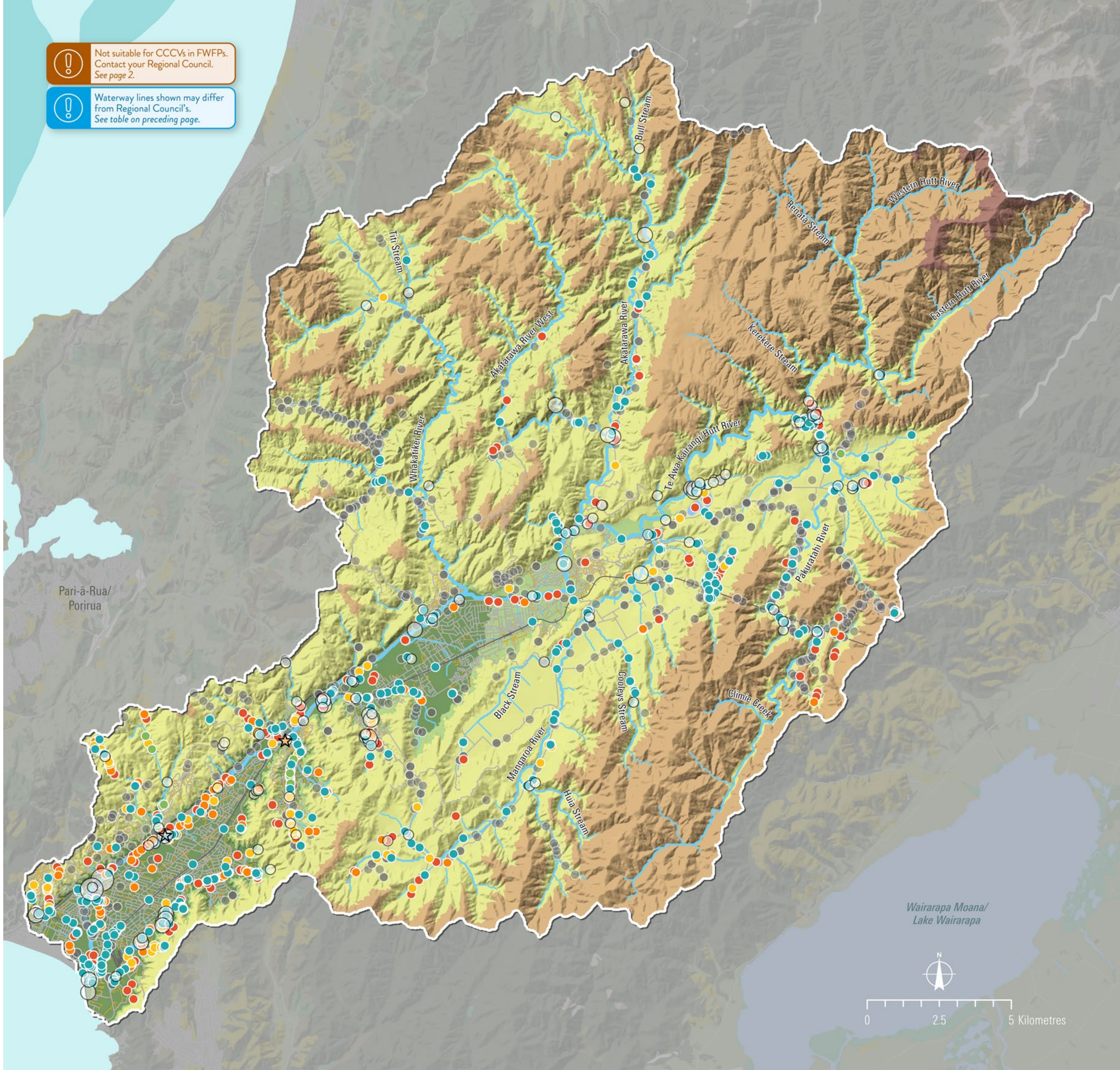
- Very low
- Low
- Moderate
- High
- Very high
- Not assessed

DIVERSITY OF MIGRATORY FISH:

- >6
- 4–6
- 1–3
- 0

ELEVATION BANDS: metres above sea level (m ASL)

- Mountains (>1,000)
- Hill (400–1,000)
- Moderately Low (100–400)
- Low (60–100)
- Very Low (<60)



Further information

» *Also see 'Notes on limitations/use' on preceding page.*

» *Note: Legend may show items not present on the map. See page 11 for more details.*

» Data obtained from:
Fish data – NZFFD || FPAT data – https://fishpassage.niwa.co.nz

» Report: Franklin (2022)

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Risk to fish passage and barrier protecting native fish (Fish Passage Assessment Tool (FPAT); NIWA), diversity of migratory fish (EOS Ecology based on New Zealand Freshwater Fish Database (NZFFD) data), elevation bands (EOS Ecology based on NZ topographic contour layer; Land Information New Zealand (LINZ)), waterways (River Environment Classification (REC); NIWA), stormwater pipes (City Council/Unitary Authority), focus catchment (EOS Ecology based on REC watersheds), names & hill shading, railways & roads (LINZ), base map (LCDB v5; Manaaki Whenua/Landcare Research).

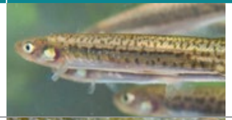
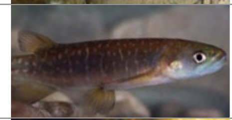
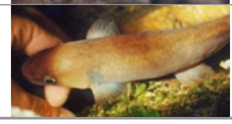
5.6 Whitebait fish species – distribution & spawning

This map shows actual data on the location of the five whitebait species which may be in your focus catchment, that will help with working out where whitebait spawning might be occurring. Available records of observed īnanga spawning sites in the tidally influenced reaches of the catchment near the coast is also indicated.

'Whitebait' is the common collective term used for the five native species of the fish family Galaxiidae that make up the whitebait run in rivers around Aotearoa. Our native whitebait species have special spawning habitats, where they lay their eggs on the riverbanks when the banks are temporarily underwater. The presence of whitebait species in the waterways of a catchment suggests a strong likelihood of spawning occurring in the system, as migratory galaxiids will not return to sea after migrating into a freshwater system as whitebait.

Of the whitebait species, īnanga have very specific spawning habitat requirements and so only spawn in a limited area (within the tidal section of waterways around the 'saltwater wedge' zone) – allowing us to anticipate the potential area where their spawning habitats may be found. Īnanga spawning sites can be confirmed through egg searches along the riverbank near the 'saltwater wedge' zone. The spawning behaviour of the other four whitebait species is less known, but is likely to be close to where adults are found, meaning the presence of adult fish could indicate that spawning habitat is nearby. See EOS Ecology (2023) for more information.

Summary of adult whitebait species recorded in your focus catchment

Site marker on map		Common name	Scientific name	Spawning habitat requirements	Max. elevation	# of sites[1] adults recorded at
small pink dot		Īnanga	*Galaxias maculatus*	Eggs are laid in riparian vegetation of low salinity coastal waterways, in the tidally influenced area of channel near the upper limit of saltwater intrusion (i.e., the saltwater wedge zone).	Close to sea level	17
purple dot		Kōaro	*Galaxias brevipinnis*	Eggs are laid directly on the rocky banks of fast-flowing mountain streams with good forest cover.	Up to 1,300 m	21
yellow dot		Banded kōkopu	*Galaxias fasciatus*	Eggs are laid in gravel or riparian vegetation at the high-water line of a bank.	Up to 550 m	13
red-brown dot		Giant kōkopu	*Galaxias argenteus*	Eggs are laid in the riparian vegetation of coastal wetlands, coastal lakes, and forest streams.	Close to sea level	16
blue dot		Shortjaw kōkopu	*Galaxias postvectis*	Eggs are laid in gravel or damp leaf litter at the high-water line of a bank.	Up to 500 m	-

All images © EOS Ecology.

[1] To account for repeat sampling or variable accuracy of GPS coordinates, and to avoid duplication of data records, sites here are defined as any sampling event record that is located within 30 m of each other (i.e., there is overlap of a 15 m radius around the location of each record). Results based on data download April 2025.

Summary of īnanga adult records & spawning areas (in coastal areas only of parent or focus catchment)

Site marker on map	Spawning habitat requirements	# sites adults recorded at	Īnanga spawning: Observed at # sites
orange square	Eggs are laid in riparian vegetation of low salinity coastal waterways, in the tidally influenced area of channel near the upper limit of saltwater intrusion (i.e., the saltwater wedge zone).	46	2

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots – colour *See table above.*	The circles represent the sites where adult migratory galaxiids/whitebait were recorded, with the colour and size of the circles representing the whitebait species (variation in circle size allows for better visibility when multiple species are present at the same site).	You can see which of the five whitebait species are found in the focus catchment, and where īnanga have been recorded in the focus and/or parent catchment. The presence and location of adult whitebait (excluding īnanga) can give you a general idea of where that species may be spawning, which can help you to identify and prioritise actions in the catchment around protecting and enhancing whitebait spawning habitat.	Based on conventional fish survey data obtained from the New Zealand Freshwater Fish Database (NZFFD) that is maintained by NIWA, but holds fish survey data collected by organisations across Aotearoa. Only data from 1980 onwards using conventional fishing methods (electrofishing, netting/trapping, and visual spotlighting) is included. eDNA data is not included, as it is not location-specific enough to be useful in this context. The number of whitebait fish species present are calculated based on presence of species across all records related to a site (i.e., a species may only be recorded once for a site). A site is classified as per footnote 1 in the table above.
Solid squares *See table above.*	The squares represent the location of observed īnanga spawning sites.	Īnanga spawning zones are limited to the tidally influenced section of rivers near the coast (around the saltwater wedge). If spawning habitat hasn't been identified already, then the presence of īnanga in the catchment could mean that there is īnanga spawning in the lower reaches of your catchment. If spawning sites haven't been confirmed, you can help with spawning habitat assessments and īnanga egg surveys. You can then help improve the fishery by focusing īnanga spawning bank management actions in these areas.	Observed spawning site data obtained from the New Zealand Īnanga Spawning Sites collaborative database, which includes the location of īnanga spawning sites recorded by a number of research groups and government organisations from 1983–2013.

Notes on limitations/use

- The Whitebait Watch citizen science project (www.inaturalist.org/projects/whitebait-watch) contains an alternative and more updated database of observed īnanga spawning sites across New Zealand. However, this dataset was not able to be used due to the location of the sites being obscured.
- Sea level rise will affect tidal inundation parameters, and as such the location of known īnanga spawning sites and potential īnanga spawning areas may change in the future.
- The REC waterway layer is not exact and not accurate at a site scale.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Awa Kairangi/Hutt River

Whitebait Species & Īnanga Spawning

Focus Catchment Map Series: Map 5.6

Waterways (stream order >1)

Roads

BOUNDARIES:

Focus catchment

Parent catchment

Subcatchment

WHITEBAIT SPECIES: focus catchment

Īnanga (focus & parent catchment)

Kōaro

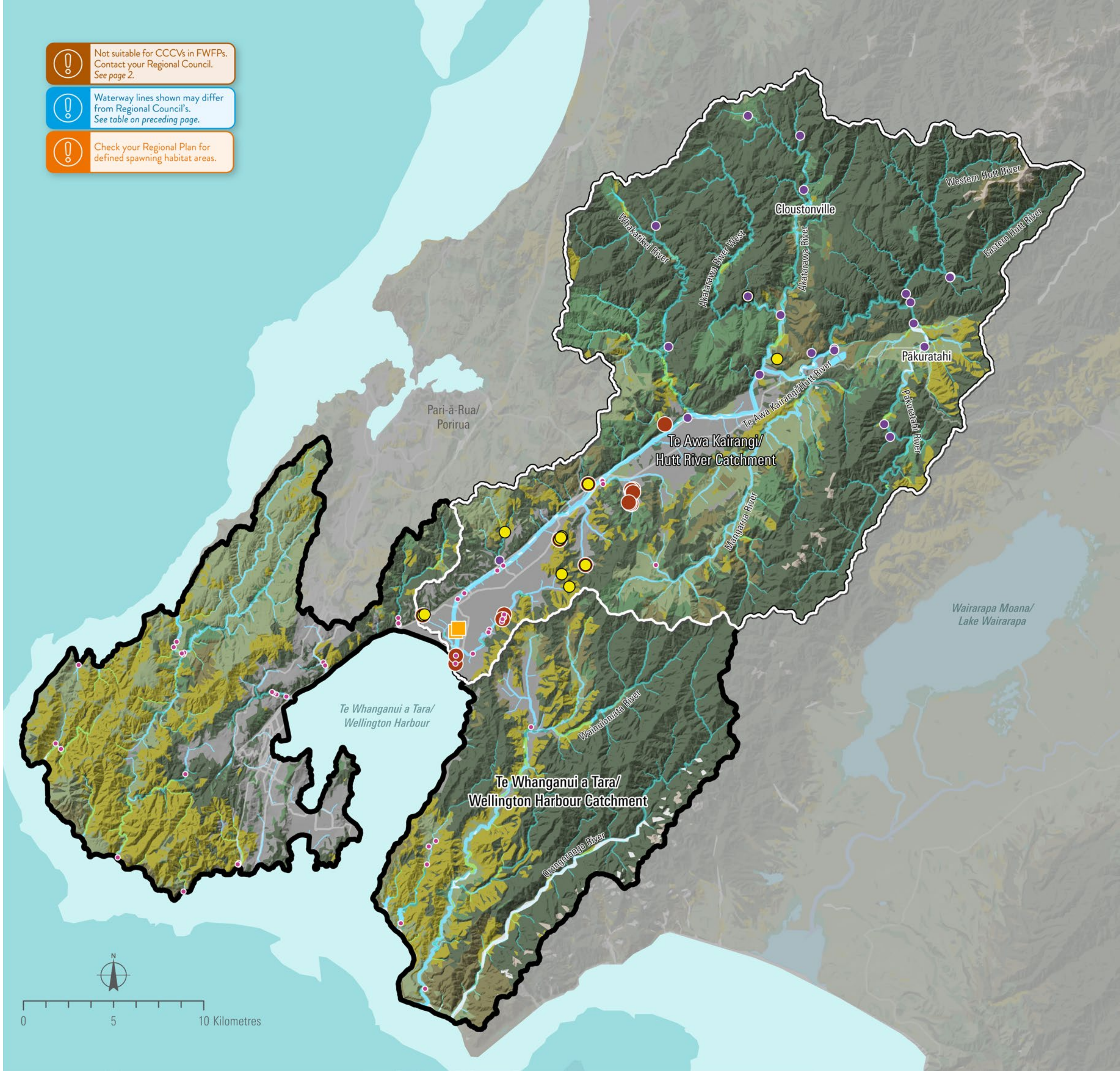
Banded kōkopu

Giant kōkopu

Shortjaw kōkopu

ĪNANGA SPAWNING:

Observed



Further information

» *Also see 'Notes on limitations/use' on preceding page.*

» *Note: Legend may show items not present on the map. See page 11 for more details.*

» Fish data obtained from: New Zealand Freshwater Fish Database (NZFFD)

» Īnanga spawning sites data obtained from: New Zealand Īnanga Spawning Site Database

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Whitebait species (EOS Ecology based on New Zealand Freshwater Fish Database (NZFFD)), īnanga spawning observed (NZ Īnanga Spawning Sites database), waterways (River Environment Classification (REC); NIWA), roads (ESRI Vector Tile Service), catchment boundaries (EOS Ecology based on REC watershed), names & hill shading (LINZ), base map (LCDB v5; Manaaki Whenua/Landcare Research).

6. Connection to the coast

The following pages present some maps regarding the coastal receiving environments of the catchments in your region. Coastal receiving environments form the intermediary zone between freshwater catchments and ocean ecosystems. To better manage our catchments in an integrated way, it is important to recognise the interconnectedness of the whole environment, and consider the effects of our freshwater catchments on coastal habitats, from the mountains to the sea – ki uta ki tai.

Coastal receiving environments are complex and dynamic systems that come in a variety of forms. They are often (but not always) characterised by the mixing of saline seawater with freshwater draining from the catchment, and may also have additional hydrodynamic effects driven by the movement of the tides. Coastal receiving environments can be categorised into five hydrosystems, which are broad units of aquatic habitat classification based on general landform, hydrological parameters, and distinctive features of water salinity, water chemistry, and temperature. The five hydrosystems present in coastal receiving environments span a gradient from primarily freshwater (palustrine, lacustrine, riverine) to brackish (estuarine) and saline (marine) systems. Further information about these hydrosystems is outlined in the table below.

Maps 6.2–6.5 present information regarding modelled and measured water quality parameters related to discharge from the major catchments in your region to the coastal receiving environments. The degree to which these discharges affect the health of the coastal ecosystem and its inhabitants can vary depending on the physical parameters of the coastal system. Considering the hydrosystem and geomorphic classification (presented in Map 6.1) of the local coastal features can help you work out where the discharge from major catchments may have the greatest impact on the coastal receiving environments in your region. Some sensitivities to sediment and nutrient inputs are outlined for each geomorphic class in Section 6.1.

Water quality describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect to its suitability for a particular purpose such as swimming, or to support those plants and animals that live in it. Sediments and nutrients can impact coastal ecosystems, and unnatural levels discharging from freshwater catchments may impact the coastal receiving environments. Faecal contamination can cause diseases in people through contact with water containing faecal pathogens or through consumption of some types of shellfish where faecal pathogens can accumulate. Further information about water quality issues is outlined in the table on the next page.

Hydrosystem categories – *Further information about these hydrosystems definitions can be found in Johnson & Gerbeaux (2004)*

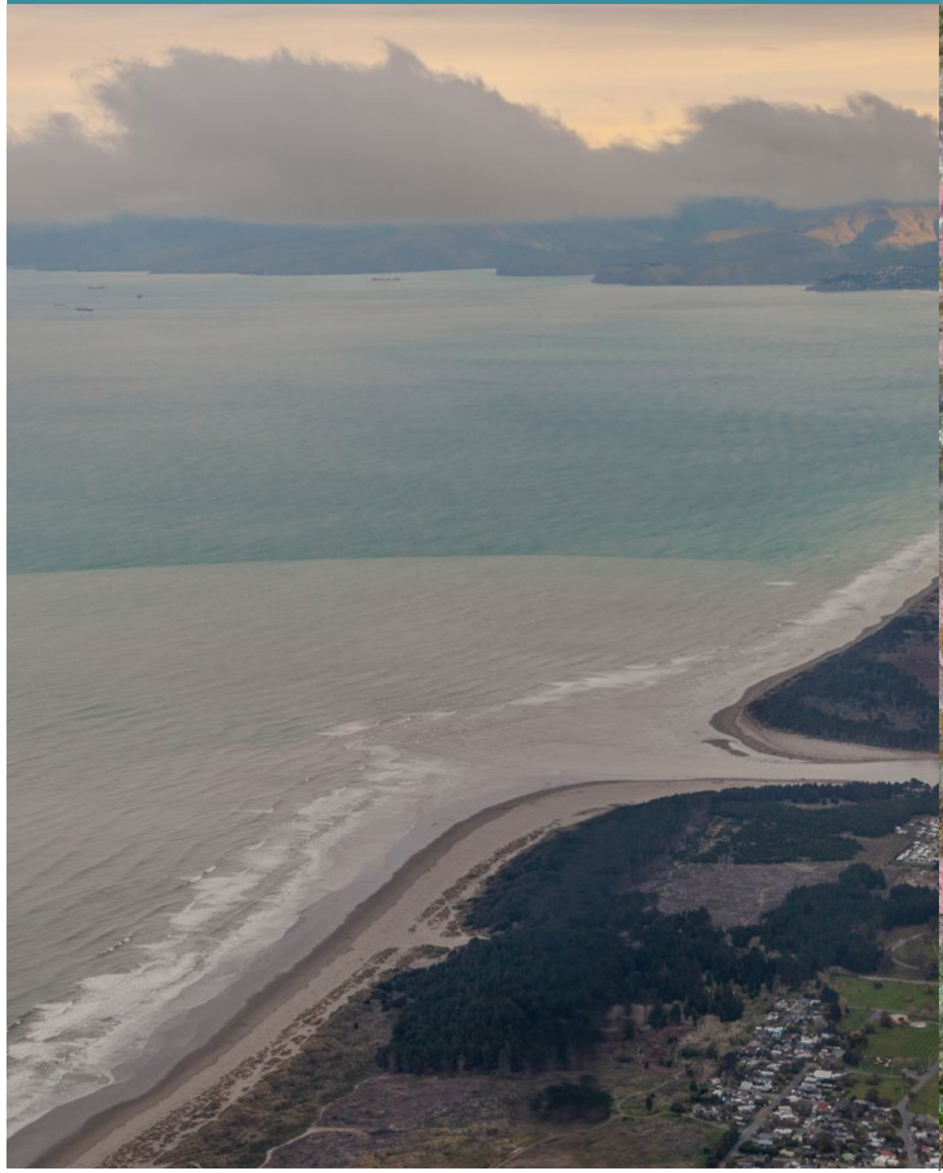
Palustrine	Lacustrine	Riverine	Estuarine	Marine
				
» Freshwater wetlands fed by rain, groundwater, or surface water, but not directly associated with rivers, lakes, or estuaries. Most wetlands are palustrine.	» Bodies of open, predominantly fresh water, large enough to be influenced by characteristic lake features and processes (fluctuating water level, wave action). Usually permanent and often deep water, with no/only slow flow. Lakes can be arbitrarily defined as having a major dimension of 0.5 km or more.	» The dominant function is continually or intermittently flowing freshwater in open channels. Includes open flowing waters, beds, and margins (riparian zones) of natural and artificial waterway channels. Near its downstream end, the riverine hydrosystem meets tidal influence and merges with the estuarine hydrosystem; the boundary is where salinity is 5 parts per thousand.	» Where freshwater and seawater mix, where tidal fluctuations play a functional role. Includes subtidal and intertidal zones in estuaries, tidal river mouths, coastal lagoons, as well as wet ground in supratidal zones (above the high tide mark) where surface water and groundwater are affected by sea salts. The inland limit is where salinity is 5 parts per thousand.	» The saline waters of the open sea.

All images © EOS Ecology.

Produced by & © EOS Ecology

Water quality issues

Suspended sediment	Nutrients	Faecal contamination



All images © EOS Ecology.

Suspended sediment

Fine sediment that does not settle out of the water column within a catchment may ultimately wash downstream to the coastal receiving environment, where it can prevent light from reaching submerged plant life. This will limit photosynthesis and impact the ability of fish and invertebrates to breathe and find food. It also interferes with species that need to see to hunt (including some fish, birds, and marine mammals), and clogs the feeding structures of filter feeders such as shellfish. Natural processes cause suspended fine sediments to quickly drop out of the water column in high salinity brackish water and seawater, and if sediment loads are high enough this can smother the seabed.

Nutrients

Elevated nutrients in coastal environments can cause excessive aquatic plant growth and algae blooms, with flow on effects including decreased light penetration through the water column and reduced dissolved oxygen levels. In some cases, algal blooms can release toxins into the environment that are harmful to aquatic life and can pass through the food chain to humans.

- **Nitrogen:** See Section 4 for information about the nitrogen cycle. Nitrate is one of the primary forms of nitrogen that can be taken up by algae and aquatic plants, and is usually present in very low concentrations in coastal environments under natural conditions. It is the most problematic nutrient in most coastal ecosystems.
- **Phosphorus:** Phosphorus attaches strongly to soils and fine sediments, and often enters waterways and coastal systems through surface runoff and erosion. Dissolved reactive phosphorus (DRP) is the form of phosphorus that can be easily taken up by algae and aquatic plants.

Faecal contamination

Faecal indicator bacteria (FIB) come from the gut of warm-blooded animals (including humans), and are used to monitor faecal contamination in aquatic environments. The presence of FIB in a water sample signals that the water has been contaminated with faecal matter and may contain other pathogens that could cause illness. The FIB used to determine the long-term water quality grade in recreational coastal waters is enterococci, and high counts of these bacteria indicate that there is an increased risk of gastroenteritis or infections of ears, eyes, nasal cavity, skin, and upper respiratory tract for people that come in contact with this water. Collecting and eating mahinga kai from waters with high enterococci counts may also cause illness.

6.1 Coastal features – geomorphic classification

This map uses modelled information to show the geomorphic class of the coastal features identified in the coastal receiving environments of the major catchments across your region.

The broad hydrosystem categories were divided into eleven geomorphic classes by Hume *et al.* (2016). Each geomorphic class is based on specific geomorphologic (the shape and depth of the coastal feature) and hydrodynamic (volume of freshwater inflow, tidal regime) factors. Further information about the hydrosystem categories can be found on the opening page to this section.

Notes on limitations/use

- While the systemised classification of New Zealand's hydrosystems undertaken by NIWA is the most comprehensive to date, it does not cover the entirety of Aotearoa's coastline. The coastal receiving environment of some catchments may not include an identified coastal feature.
- Not all geomorphic classes represent end-of-river environments, and therefore not all of the identified coastal features will be associated with the coastal receiving environment of a catchment.

Summary of coastal features by geomorphic class in coastal receiving environments of the major catchments in your region

Hydro-system	Geomorphic class	# sites in each class across your region	Total area coastal receiving environments ha[1]		Further detail[2]
			Parent catchment	Region	
Palustrine	1. Damp sand plain lake	1	0	8	Small, shallow (1–2 m deep) systems, typically freshwater with no connection to the sea. Often found in depressions between sand dunes, and also known as dune lakes or coastal lakes. Highly susceptible to nutrient loading.
Lacustrine	2. Waituna-type lagoon	3	32	698	Large (several km²) shallow (2–3 m deep) coastal lagoons barred from the sea by a barrier or barrier beach. Typically freshwater and fed by small streams, although may have occasional brackish pockets. Highly sensitive to nutrient loading.
Riverine	3. Hāpua-type lagoon	1	4	4	Narrow (10's–100's of m), elongated (<100 m to several km) and shallow (several m) river mouth lagoons, formed by strong longshore sediment transport, and usually have no tidal inflow. Tend to receive high sediment loads from the catchment, and can be sensitive to nutrient and fine sediment loading under certain conditions.
	4. Beach stream	3	0	5	Very shallow streams that flow over a beach rather than cutting a subtidal channel through the sediment to the sea. No tidal inflow, except during storm events that are coupled with high tides. Can be sensitive to nutrient and fine sediment loading under certain conditions.
	5. Freshwater river mouth	1	0	0	Rivers with a large flow that cuts a permanent subtidal channel through the shoreline and connects to the sea. Despite a permanent connection to the sea, the river channel is steep enough to prevent tidal ingress. Generally insensitive to nutrient and fine sediment loading.
Estuarine	6. Tidal river mouth	8	0	103	Elongate, narrow and shallow (several m) basins with a connection to the sea for most of the time. River flow is a significant proportion of the basin's volume, with little tidal input. Tend to receive high sediment loads from the catchment, but have low to very low sensitivity to nutrient and fine sediment loading.
	7. Tidal lagoon	0	0	0	Shallow (1–3 m deep), circular to elongate basins with simple shorelines and extensive intertidal area. Narrow sea entrance, constricted by a spit or sand barrier. Strong reversing tidal current flow in with small while river input compared to tidal inflow. Moderately sensitive to nutrients and fine sediments under certain conditions.
Estuarine/ Marine	8. Shallow drowned valley	1	0	747	Shallow (<5 m deep) with complex shorelines and numerous narrow arms leading off a main central basin or channel. Extensive intertidal flats cut by drainage channels that range in size from small tidal creeks to large harbours. Moderately sensitive to nutrients and fine sediments under certain conditions.
	9. Deep drowned valley	1	8,541	8,541	Large, deep (10–30 m deep), mostly subtidal systems formed by partial submergence of an unglaciated river valley. Remains open to the sea. Both river and tidal inputs are small proportion of total basin volume. Moderately sensitive to high loads of nutrients and fine sediments.
	10. Fjord	0	0	0	Long, narrow, deep (70–140 m) u-shaped basins with steep sides or cliffs, formed in glacial valleys flooded by the sea. Subtidal basin with small intertidal areas in the headwaters. Both river and tidal inputs are small proportion of total basin volume. Moderately sensitive to high loads of nutrients and fine sediments.
Marine	11. Coastal embayment	6	394	461	Indentation in the shoreline with a wide entrance. Shallow to medium depth (4–8 m), circular to elongate in shape. Marine systems with little river influence and wide entrances open to the ocean. Moderately sensitive to high loads of nutrients and fine sediments.

[1] Not all coastal features with an assigned geomorphic class have an associated area measurement, and so these areas may be underestimated.
[2] Further information about the geomorphic class: Hicks *et al.* (2019), Hume *et al.* (2016), Hume (2018), Robertson *et al.* (2016).

Produced by & © EOS Ecology

WAI CONNECTION
TATAI KI TE WAI

MOUNTAINS TO SEA CONSERVATION TRUST

Te Upoko-o-te-Ika-a-Māui/ Wellington

Coastal Features – Geomorphic Class

Focus Catchment Map Series: Map 6.1

Waterways (stream order >1)

BOUNDARIES:

- Focus catchment
- Parent catchment
- Major catchment
- Regional

SITE GEOMORPHIC CLASS:

1. Damp sand plain lake
2. Waituna-type lagoon
3. Hapua-type lagoon
4. Beach stream
5. Freshwater river mouth
6. Tidal river mouth
7. Tidal lagoon
8. Shallow drowned valley
9. Deep drowned valley
10. Fjord
11. Coastal embayment

Further information

» *Also see 'Notes on limitations/use' on preceding page.*

» *Note: Legend may show items not present on the map. See page 11 for more details.*

» Source model/layer data developed by: NIWA

» Key layer source url: https://data.mfe.govt.nz/layer/53565-nz-coastal-hydrosystems

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Geomorphic class (NIWA), waterways (River Environment Classification (REC); NIWA), regional boundary (Stats NZ), catchment boundaries (EOS Ecology based on REC watersheds), hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

6.2 Suspended sediment – discharge to coast

This map uses modelled information to show the estimated mean annual suspended sediment load (the mass of sediment passing down a river/estuary over a 12-month time period) discharged from major catchments across your region to the coastal receiving environments, measured in tonnes/year.

Mud content is an indicator of estuary health, and refers to the amount of silt and clay particles (collectively called 'mud') that has washed off the land and settled in estuary sandflats. This mud can impact the plants and animals living in an estuary. To determine mud content measurements, sediment samples are collected from the top 2 cm of the estuary substrate and sent to a laboratory for testing.

Notes on limitations/use

- Suspended sediment discharge is based on modelled information – so are estimates only and subject to uncertainty.
- Modelled suspended sediment information presented on this map doesn't take into account sediment deposition by settling, sediment resuspension by waves, or sediment re-entrainment (sediment stirring by coastal currents) by currents within the coastal receiving environment to indicate overall measures of suspended sediment in coastal ecosystems. Additional modelling produced by NIWA and discussed in Hicks et al. (2019) takes these factors into account in coastal hydrosystems, but cautions these results are suitable for indicating relative sedimentation rates across different coastal hydrosystems (i.e., geomorphic classes), but not for providing reliable estimates of sediment deposition rates in individual systems.
- This model does not cover the entirety of Aotearoa's coastline.

Summary of suspended sediment discharge from major catchments in your region

Suspended sediment discharge tonnes/year	# of sites in each band	
	Parent catchment	Region
0–5,000	5	7
5,000–50,000	2	4
50,000–250,000	1	5
250,000–1,000,000	0	3
1,000,000–4,000,000	0	1
>4,000,000	0	0

Summary of annual mean mud content bands for estuary health monitoring sites[1]

Mud content band	# of sites in each band		Band description
	Parent catchment	Region	
≤3%	0	0	A small amount of mud is beneficial as the fine particles contain organic matter that some macrofauna feed on. The most diverse macrofauna communities (small organisms feeding on organic mud particles) are often found where there is around 3% of mud content, with diversity starting to decline beyond this.
3–10%	1	5	Macrofauna communities are most resilient when mud content is <10%.
10–30%	0	7	Major declines in macrofauna resilience at 10–25% mud content, with impoverished communities around 30% mud content.
30–60%	0	1	Macrofauna communities are unbalanced when mud content is >30%.
>60%	0	5	Macrofauna communities are degraded when mud content is >60%.

[1] Site locations, data, mud content values and interpretation band information taken directly from the LAWA site under 'Estuary Health' (www.lawa.org.nz/explore-data/estuaries).

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots – colour *See table above.*	The modelled sediment yield that is discharging from major catchments in your region to the coastal receiving environment. If all other variables are equal, you can generally expect that larger catchments will have a larger sediment load overall.	It can show you how the sediment yield discharged from your parent catchment compares to other major catchments in your region. This, in combination with an understanding of the geomorphic class of the coastal features in the coastal receiving environment, may help you determine if sediment control efforts in your catchment would improve coastal ecosystem health. As not all estuaries are monitored for mud content, this modelled data can help you understand if there is a high sediment risk for receiving estuary environments.	Base model developed by NIWA, generates a mean annual sediment load for each 1-ha grid-cell based on average slope, mean annual rainfall (30-year mean annual 'normal' rainfall), land cover (Land Cover Data Base V3 (LCDB3) conflated to six functional groups), and erosion terrain classification (30 m resolution digital terrain model developed by Manaaki Whenua/Landcare Research and classified into 12 groups) in that grid-cell. Data has been applied to version 2 of the REC waterway lines, summing the sediment loads from all raster units upstream and routing these loads down the stream network, taking into account entrapment in lakes and reservoirs. The river sediment loads were used to estimate mean suspended sediment supply from the catchments of 399 New Zealand coastal systems (Hicks *et al.*, 2019). Each site is then colour-coded according to the groupings shown in the map key.
Solid squares – colour *See table above.*	The location and annual mean mud content value of estuary health monitoring sites in 2023.	It can tell you whether the amount of mud settling in estuaries is impacting the estuary environment (for those sites that your Regional Council monitors). You can compare the relative mud content recorded from these sites with the modelled sediment discharge yield to see if there is a correlation.	Data collected by Regional Council. Presented as annual mean mud content based on the most recent sampling year (2023). Data and related mud content band assignations were taken directly from LAWA (www.lawa.org.nz/explore-data/estuaries/#/tb-data). As there are no national guidelines to assess mud content, the set of guidelines developed by LAWA have been used here.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Upoko-o-te-Ika-a-Māui/ Wellington

Suspended Sediment – Discharge to Coast – Mud Content

Focus Catchment Map Series: Map 6.2

Waterways (stream order >1)

BOUNDARIES:

- Focus catchment
- Parent catchment
- Major catchment
- Regional

SUSPENDED SEDIMENT DISCHARGE: major catchment – tonnes/year

- 0–5,000
- 5,000–50,000
- 50,000–250,000
- 250,000–1,000,000
- 1,000,000–4,000,000
- >4,000,000

MUD CONTENT: estuary monitoring sites – using LAWA interpretation bands

- ≤3%
- 3–10%
- 10–30%
- 30–60%
- >60%

Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- Source suspended sediment model developed by: NIWA
- Suspended sediment report: Hicks *et al.* (2019)
- LAWA estuary health monitoring sites: monitored/sampled by Regional Council

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Suspended sediment discharge (Hicks *et al.* (2019) based on Suspended Sediment Yield Estimator (SSYE); NIWA), mud content (Land Air Water Aotearoa (LAWA) data set), waterways (River Environment Classification (REC); NIWA), regional boundary (Stats NZ), catchment boundaries (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

6.3 Nutrients – nitrate nitrogen (nitrate N) – discharge to coast

This map uses modelled information to show the estimated mean annual nitrate N load (the mass of nitrate N passing down a river/estuary over a 12-month time period) discharged from major catchments across your region to the coastal receiving environments, measured in tonnes/year.

Nitrate (NO_3-) is a soluble form of nitrogen that is made up of one nitrogen atom (N) bonded to three oxygen atoms (O). Nitrate N (NO_3-N) is a common measurement used in aquatic monitoring. It measures the amount of nitrogen (N) in the nitrate (NO_3-) molecule, but doesn't include the oxygen molecules. Nitrate N in aquatic environments can come from natural sources, as well as from manmade sources, such as agricultural or urban runoff, and sewage discharges (see the nitrate cycle infographic in Section 4). While nitrate is an important nutrient for plant growth, too much in a coastal environment can cause excessive plant/algae growth, which can alter habitats, reduce the amount of dissolved oxygen in the water, and in some cases release toxins associated with harmful algal blooms.

Notes on limitations/use

- Based on modelled data – so are estimates only and subject to uncertainty.
- Model represents the tonnes per year yield of nitrate N from major catchments, but does not take into account the mixing/dilution of freshwater with seawater or biological processes to indicate overall measures of nitrate N in coastal ecosystems. Potential nutrient concentrations within estuaries was previously modelled by the CLUES Estuary model, which took into account the dilution of freshwater into a coastal system. That has since been archived, and while NIWA plans to re-integrate CLUES Estuaries into an updated CLUES Pro model, this was not available at the time of producing this document.
- The model does not cover the entirety of Aotearoa's coastline.

Nitrate (NO_3-) is a soluble form of nitrogen that is made up of one nitrogen atom (N) bonded to three oxygen atoms (O). Nitrate N (NO_3-N) is a common measurement used in aquatic monitoring. It measures the amount of nitrogen (N) in the nitrate (NO_3-) molecule, but doesn't include the oxygen molecules. Nitrate N in aquatic environments can come from natural sources, as well as from manmade sources, such as agricultural or urban runoff, and sewage discharges (see the nitrate cycle infographic in Section 4). While nitrate is an important nutrient for plant growth, too much in a coastal environment can cause excessive plant/algae growth, which can alter habitats, reduce the amount of dissolved oxygen in the water, and in some cases release toxins associated with harmful algal blooms.

Summary of nitrate N discharged from major catchments into coastal receiving environments

Nitrate N discharge tonnes/year	# of sites in each band	
	Parent catchment	Region
0–10	5	9
10–100	2	8
100–500	1	4
500–2,000	0	0
2,000–5,000	0	1
5,000–10,000	0	0
>10,000	0	0

Eleven-armed starfish © EOS Ecology

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots – colour *See table above.*	The modelled amount of nitrate N that is discharging from major catchments in your region to the coastal receiving environment. If all other variables are equal, you can generally expect that larger catchments will have a larger nutrient load overall.	It can show you how the nitrate N yield discharged from your parent catchment compares to other major catchments in your region. This, in combination with an understanding of the geomorphic class of the coastal features in the coastal receiving environment, may help you determine if nutrient control efforts in your catchment would improve coastal ecosystem health.	Base data from the CLUES model, which was developed by NIWA and predicts annual average loads/yields of nutrients (total nitrogen (TN) and total phosphorus (TP)) and estimates of nutrient concentrations for each river reach in the River Environment Classification (REC) stream network. The total annual catchment nutrient loads and ratios were extracted from CLUES for 446 New Zealand estuaries/coastal systems and included in the default dataset for the NIWA ETI 1 tool (https://shiny.niwa.co.nz/Estuaries-Screening-Tool-1). Nitrate N yields were calculated by multiplying the value for TN (tonnes/year) by the associated estimated ratio of nitrate N in TN. Each site is then colour-coded according to the groupings shown in the map key.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Upoko-o-te-Ika-a-Māui/ Wellington

Nutrients – Nitrate N – Discharge to Coast

Focus Catchment Map Series: Map 6.3

Waterways (stream order >1)

BOUNDARIES:

- Focus catchment
- Parent catchment
- Major catchment
- Regional

NITRATE N DISCHARGE: major catchments – tonnes/year

- 0–10
- 10–100
- 100–500
- 500–2,000
- 2,000–5,000
- 5,000–10,000
- >10,000

Further information

» *Also see 'Notes on limitations/use' on preceding page.*

» *Note: Legend may show items not present on the map. See page 11 for more details.*

» Source model/layer data developed by: NIWA using Catchment Land Use for Environmental Sustainability (CLUES) model https://niwa.co.nz/freshwater/our-services/catchment-modelling/clues-catchment-land-use-for-environmental-sustainability-model

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Nitrate-N discharge (EOS Ecology based on nutrient loads & ratios from Catchment Land Use for Environmental Sustainability (CLUES) model data in ETI tool 1; NIWA), waterways (River Environment Classification (REC); NIWA), regional boundary (Stats NZ), catchment boundaries (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

6.4 Nutrients – dissolved reactive phosphorus (DRP) – discharge to coast

This map uses modelled information to show the estimated mean annual dissolved reactive phosphorus (DRP) load (the mass of DRP passing down a river/estuary over a 12-month time period) discharged from major catchments across your region to the coastal receiving environments, measured in tonnes/year.

DRP is a measure of the phosphorus compounds that are dissolved in water. It occurs at naturally low concentrations in water, although this depends on the geology in the catchment. DRP in aquatic environments can come from natural sources such as weathering of rocks, as well as from manmade sources such as fertiliser or urban runoff, eroding soils, and sewage discharges. As DRP is an essential nutrient for aquatic plants, high concentrations can contribute to excessive plant/algal growth, which can alter habitats, reduce the amount of dissolved oxygen in the water, and in some cases result in the release of toxins associated with harmful algal blooms.

Summary of DRP discharged from major catchments in your region

DRP discharge tonnes/year	# of sites in each band	
	Parent catchment	Region
0–10	7	12
10–50	1	5
50–100	0	3
100–250	0	2
250–500	0	0
500–1,000	0	0
>1,000	0	0

Wellington region © Shutterstock

Notes on limitations/use

» Based on modelled data – so are estimates only and subject to uncertainty.

» Model represents the tonnes per year yield of DRP from major catchments, but does not take into account the mixing/dilution of freshwater with seawater or biological processes to indicate overall measures of DRP in coastal ecosystems. Potential nutrient concentrations within estuaries was previously modelled by the CLUES Estuary model, which took into account the dilution of freshwater into a coastal system. That has since been archived, and while NIWA plans to re-integrate CLUES Estuaries into an updated CLUES Pro model, this was not available at the time of producing this document.

» The model does not cover the entirety of Aotearoa's coastline.

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots – colour *See table above.*	The modelled DRP yield that is discharging from a major catchment into the coastal receiving environment. If all other variables are equal, you can generally expect that larger catchments will have a larger nutrient load overall.	It can show you how the DRP yield discharged from your parent catchment compares to other major catchments in your region. This, in combination with an understanding of the geomorphic class of the coastal features in the coastal receiving environment, may help you determine if nutrient control efforts in your catchment would improve coastal ecosystem health.	Base data from the CLUES model, which was developed by NIWA and predicts annual average loads/yields of nutrients (total nitrogen (TN) and total phosphorus (TP)) and estimates of nutrient concentrations for each river reach in the River Environment Classification (REC) stream network. The total annual catchment nutrient loads and ratios were extracted from CLUES for 446 New Zealand estuaries/coastal systems and included in the default dataset for the NIWA ETI 1 tool (https://shiny.niwa.co.nz/Estuaries-Screening-Tool-1). DRP yields were calculated by multiplying the value for TP (tonnes/year) by the associated estimated ratio of DRP in TP. Each site is then colour-coded according to the groupings shown in the map key.

Produced by & © EOS Ecology

WAI CONNECTION TATAI KI TE WAI | MOUNTAINS TO SEA CONSERVATION TRUST | EOS ECOLOGY

Te Upoko-o-te-Ika-a-Māui/ Wellington

Nutrients – Dissolved Reactive Phosphorus – Discharge to Coast

Focus Catchment Map Series: Map 6.4

Waterways (stream order >1)

BOUNDARIES:

- Focus catchment
- Parent catchment
- Major catchment
- Regional

DRP DISCHARGE: major catchments – tonnes/year

- 0–10
- 10–50
- 50–100
- 100–250
- 250–500
- 500–1,000
- >1,000

Further information

» *Also see 'Notes on limitations/use' on preceding page.*

» *Note: Legend may show items not present on the map. See page 11 for more details.*

» Source model/layer data developed by: NIWA using the Catchment Land Use for Environmental Sustainability (CLUES) model https://niwa.co.nz/freshwater/our-services/catchment-modelling/clues-catchment-land-use-for-environmental-sustainability-model

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: DRP discharge (EOS Ecology based on nutrient loads & ratios from Catchment Land Use for Environmental Sustainability (CLUES) model data in ETI tool 1; NIWA), waterways (River Environment Classification (REC); NIWA), regional boundary (Stats NZ), catchment boundaries (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

6.5 Faecal indicator bacteria – Enterococci

This map shows actual data from enterococci faecal indicator bacteria monitoring undertaken by your Regional Council in the coastal receiving environment of major catchments across your region.

Enterococci is a genus of bacteria that is found in the gut of humans and other animals. Its presence in water samples is used to indicate faecal contamination in recreational sites along the coast. Low counts of enterococci are considered safe for swimming and other recreation, but high levels are not safe as it can cause gastroenteritis or a variety of infections. The presence of enterococci in water samples does not show the source of the contamination (e.g., humans, birds, dogs), but it is likely the source is relatively localised rather than coming from high in the catchment.

Enterococci is typically measured in the laboratory, using grab samples collected from coastal recreational water quality monitoring sites.

Notes on limitations/use

» Data presented helps you decide where to swim. Use for other purposes should be done with caution. For questions that relate to human health, contact your regional public health agency.

» Faecal indicator bacteria monitoring involves weekly data collection over the recreational bathing season only (around Nov/Dec to Feb/Mar). Long-term grades based on data collected from 2017/18–2022/23 (published by LAWA 20 Oct 2023). Ongoing monitoring will occur, and long-term grades may change over time.

» Long term grades are assigned by LAWA. A site must have at least 50 sample results over five recreational bathing seasons and be part of a recent monitoring programme to have an assigned grade. Sites that hadn't been regularly monitored in either of the two previous bathing seasons were excluded, even if they had at least 50 data points.

» The long-term grade is risk-based and doesn't necessarily reflect the conditions on a particular day.

» These monitoring sites are not intended to represent the complete suitability for swimming at our coastal beaches at a national level.

Summary of recreational water quality long-term grades (based on enterococci monitoring) of coastal sites across your region

Recreational water quality long-term grade	Indicator counts – 95th percentile of enterococci/100 mL (defined by MfE, 2003)	Description of risk[1]	Map site marker	# of sites in each band	
				Parent catchment	Region
Excellent	0–40	Risk of illness is <1% from contact with the water during summer bathing period.	● (teal)	1	1
Good	41–200	Risk of illness is <5% from contact with the water during summer bathing period.	● (green)	15	21
Fair	201–500	Risk of illness is between 5–10% from contact with the water during summer bathing period.	● (yellow)	10	17
Poor	more than 500	Risk of illness is >10% from contact with the water during summer bathing period.	● (red)	9	21
NA = Insufficient data		Not enough data to determine the long-term grade at this site.	● (grey)	0	0

[1] Long-term grade band descriptions taken directly from the LAWA site under the 'Coastal and freshwater recreation monitoring' factsheet (www.lawa.org.nz/learn/factsheets/coastal-and-freshwater-recreation-monitoring). The 95th percentile bands align with the Microbiological Assessment Category (MAC) interpretation bands for coastal sites (MfE, 2003).

How to read the map

Items in the map key	What it shows you	Why it is useful to know	How it is calculated
Solid dots – colour *See table above.*	The locations of popular/accessible swim spots where water samples have been collected and analysed for faecal contamination (indicated by enterococci bacteria), with colouration related to the calculated long-term grade water quality at for the monitoring site. The long-term grade gives a precautionary guide to the risk for swimming over the recreational bathing season.	The long-term grade provides an indication of whether faecal contamination is an ongoing issue at that monitoring site. Most sources of faecal contamination in coastal waters are localised, so it may alert you to a need for efforts in the lower catchment related to possible faecal contaminant sources.	The long-term grade is calculated based on the 95th percentile of enterococci/100 mL taken from weekly monitoring results collected by your Regional Council over the recreational bathing season for the previous five years. The final grade is presented on the LAWA site (www.lawa.org.nz/explore-data/swimming). The data presented here was obtained directly from LAWA in Nov 2023.

Recreational beach © EOS Ecology

Produced by & © EOS Ecology

Te Upoko-o-te-Ika-a-Māui/ Wellington

Faecal Indicator Bacteria – Enterococci – Coastal Monitoring

Focus Catchment Map Series: Map 6.5

Waterways (stream order >1)

BOUNDARIES:

- Focus catchment
- Parent catchment
- Major catchment
- Regional

LONG-TERM RECREATIONAL WATER QUALITY GRADE:
using LAWA interpretation bands

- Excellent
- Good
- Fair
- Poor
- Insufficient data

Further information

- *Also see 'Notes on limitations/use' on preceding page.*
- *Note: Legend may show items not present on the map. See page 11 for more details.*
- LAWA water quality sites: monitored/sampled by Regional Council
- LAWA water quality site data: www.lawa.org.nz/download-data/#can-i-swim-here?

Map © EOS Ecology / www.eosecology.co.nz

Layer sources: Long term recreational water quality grade (Land Air Water Aotearoa (LAWA) data set), waterways (River Environment Classification (REC); NIWA), regional boundary (Stats NZ), catchment boundaries (EOS Ecology based on REC watersheds), names & hill shading (Land Information New Zealand), base map (LCDB v5; Manaaki Whenua/Landcare Research).

7. References

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia. www.waterquality.gov.au/anz-guidelines

Biggs, B., Kilroy, C., Mulcock, C. & Scarsbrook, M. 2002. New Zealand stream health monitoring and assessment kit – stream monitoring manual version 2. National Institute of Water and Atmospheric Research (NIWA).

Cieraad, E., Walker, S., Price R. & Barringer, J. 2015. An updated assessment of indigenous cover remaining and legal protection in New Zealand's land environments. *New Zealand Journal of Ecology* 39(2).

Death, R., Barquín, J. & Scarsbrook, M. 2004. Biota of cold-water and geothermal springs. In: Harding, J., Mosley, P., Pearson, C. & Sorrell, B. (ed). *Freshwaters of New Zealand.* New Zealand Hydrological Society Inc. and New Zealand Limnological Society Inc., Christchurch. p30.1–30.14

EOS Ecology, 2023. Love NZ whitebait activity book. National whitebait spawning education programme from Whitebait Connection and EOS Ecology. EOS Ecology, Christchurch. 26 p.

Franklin, P. 2022. Fish passage assessment tool mobile application user guide – version 2.0. National Institute of Water and Atmospheric Research, Hamilton. NIWA Report No. 2018349HN, prepared for Ministry for Business Innovation & Employment and Ministry for the Environment. 78 p.

Gray, D. & Harding, J.S. 2007. Braided river ecology: A literature review of physical habitats and aquatic invertebrate communities. *Science for Conservation* 279: 53.

Hewitt, A. 2013. Survey of New Zealand soil orders. In: Dymond, J.R. (ed). *Ecosystem services in New Zealand* – Conditions and Trends. Manaaki Whenua Press, Lincoln, New Zealand. Pp. 121–131.

Hicks, M., Semadeni-Davies, A., Haddadchi, A., Shankar, U. & Plew, D. 2019. Updated sediment load estimator for New Zealand. National Institute of Water & Atmospheric Research, Christchurch. NIWA client report 2018341CH.

Hume, T. 2018. Fit of the ETI trophic state susceptibility typology to the NZ coastal hydrosystems classification. National Institute of Water and Atmospheric Research, Christchurch. NIWA client report 2017007CH.

Hume, T., Gerbeaux, P., Hart, D., Kettles, H. & Neale, D. 2016. A classification of New Zealand's coastal hydrosystems. National Institute of Water and Atmospheric Research, Hamilton. NIWA client report HAM2016-062.

Johnson, P. & Gerbeaux, P. 2004. Wetland types in New Zealand. Department of Conservation, Wellington. 184 p.

Hicks, M., Semadeni-Davies, A., Haddadchi, A., Shankar, U. & Plew, D. 2019. Updated sediment load estimator for New Zealand. National Institute of Water & Atmospheric Research, Christchurch. NIWA client report 2018341CH

Joy, M.K. & Death R.G. 2004. Application of the index of biotic integrity methodology to New Zealand freshwater fish communities. *Environmental Management* 34:415–428

Joy, M. 2004a. A Fish Index of Biotic Integrity (IBI) for the Auckland Region. Palmerston North, New Zealand.

Joy, M. 2004b. A Fish Index of Biotic Integrity (IBI) for the Wellington Region. Palmerston North, New Zealand.

Joy, M. 2010. A Fish Index of Biotic Integrity (IBI) For the Southland Region.

Joy, M. 2014. A Fish Index of Biotic Integrity (IBI) for the Tasman-Nelson Region. Palmerston North, New Zealand.

Joy, M. 2015. A Fish Index of Biotic Integrity (IBI) for Horizons Regional Council. Palmerston North, New Zealand.

Joy, M. 2019. A Fish Index of Biotic Integrity (IBI) for the Northland Region. Wellington, New Zealand.

Joy, M., David, B. & Lake, M. 2013. New Zealand Freshwater Fish Sampling Protocols (Part 1): Wadeable Rivers and Streams. Massey University: Palmerston North, New Zealand. 52 p.

Leathwick, J. R. 2001. New Zealand's potential forest pattern as predicted from current species–environment relationships. *New Zealand Journal of Botany* 39: (3): 447–464. DOI: 10.1080/0028825X.2001.9512748

Milne, J.D.G., Clayden, B., Singleton, P.L. & Wilson, A.D. 1995. *Soil description handbook* (revised edition). Manaaki Whenua Press, Lincoln. 157 p.

Ministry for the Environment & Ministry of Health. 2003. Microbiological water quality guidelines for marine and freshwater recreational areas. Ministry for the Environment, Wellington. 159 p.

Ministry for the Environment. 2019. Fish Index of Biotic Integrity in New Zealand Rivers 1999–2018. Wellington: Ministry for the Environment. www.environment.govt.nz & www.stats.govt.nz. 52 p.

Ministry for the Environment. 2023. Freshwater Farm Plans – Guidance on preparing catchment context, challenges and values information. Wellington: Ministry for the Environment. 12 p. Available at https://environment.govt.nz/assets/publications/Freshwater/Guidance-on-preparing-catchment-context-challenges-and-values-information.pdf

Ministry for the Environment & Stats NZ 2023. New Zealand's Environmental Reporting Series: Our Freshwater 2023. Available from www.environment.govt.nz & www.stats.govt.nz. 52 p.

Produced by & © EOS Ecology

National Environmental Monitoring Standards (NEMS) 2019. National Environmental Monitoring Standards - Water Quality Part 2. Ministry for the Environment, Wellington. Available from www.nems.org.nz

New Zealand Government 1987. Conservation Act 1987. Part 4A Marginal strips. Date of assent 31 March 1987. Version as of 23 December 2023. Available at: www.legislation.govt.nz/act/public/1987/0065/latest/DLM103610.html. Accessed: 10 September 2024.

New Zealand Government 2022. Water Services (Drinking Water Standards for New Zealand) Regulations 2022. New Zealand Government, June 2022.

New Zealand Government 2024. National Policy Statement for Freshwater Management 2020. New Zealand Government, amended January 2024. 75 p.

NIWA 2021. New Zealand Freshwater Fish Database Help File. National Institute of Water and Atmospheric Research. https://niwa.co.nz/information-services/nz-freshwater-fish-database/help. 15 p.

O'Donnell, C.F.J., Sanders, M., Woolmore, C. & Maloney, R.F. 2016. Management and research priorities for conserving biodiversity on New Zealand's braided rivers. Department of Conservation, Wellington, New Zealand. 46 p.

Robertson, B.M., Stevens, L., Robertson, B., Zeldis, J., Green, M., Madarasz-Smith, A., Plew, D., Storey, R., Hume, T. & Oliver, M. 2016. NZ Estuary Trophic Index Screening Tool 1. Determining eutrophication susceptibility using physical and nutrient load data. Prepared for Envirolink Tools Project: Estuarine Trophic Index, MBIE/NIWA Contract No: C01X1420.

Scarsbrook, M., Barquín, J., & Gray, D. 2007. New Zealand coldwater springs and their biodiversity. *Science for Conservation 278*. Department of Conservation, Wellington. 72 p. www.doc.govt.nz/documents/science-and-technical/sfc278entire.pdf

Snelder, T., Biggs, B. & Weatherhead, M. 2010. *New Zealand River Environment Classification User Guide*. Ministry for the Environment, Wellington. 144 p.

STAG 2020. Freshwater Science and Technical Advisory Group Report supplementary report to the Minister for the Environment. https://environment.govt.nz/assets/Publications/Files/freshwater-science-and-technical-advisory-group-supplementary-report.pdf. 138 p.

Stark, J.D. 1985. A macroinvertebrate community index of water quality for stony streams. Taranaki Catchment Commission, Wellington. Water & Soil Miscellaneous Publication No. 87. 53 p.

Stark, J.D. 1998. SQMCI: A biotic index for freshwater macroinvertebrate coded-abundance data. *New Zealand Journal of Marine and Freshwater Research* 32(1): 55–66.

Stark, J.D. & Maxted, J.R. 2007. A user guide for the Macroinvertebrate Community Index. Cawthron Institute, Nelson. Report No. 1166. 66 p.

White, P., Clausen, B., Hunt, B., Cameron, S., & Weir, J. 2001. Groundwater-surface water interaction. In: Rosen, M. & White, P. (ed). *Groundwaters of New Zealand.* New Zealand Hydrological Society Inc., Wellington. p133–160.

WAI CONNECTION TATAI KI TE WAI
MOUNTAINS TO SEA CONSERVATION TRUST
Produced by EOS Ecology for
'Wai Connection – Tatai Ki Te Wai'
www.eosecology.co.nz

© EOS Ecology / www.eosecology.co.nz