Northland
REGIONAL COUNCIL
Te Kaunihera ā rohe o Te Taitokerau

He Mahere Pāmu mō te Tiaki Waimāori Freshwater Farm Plan

Te horopaki, ngā wero, me ngā uara o te riu hopuwai: Te whakahaere waimāori o Tokerau

Catchment context, challenges and values: Doubtless Bay freshwater management unit

Ihirangi
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How to use this document

This document provides information about the Doubtless Bay freshwater management unit (FMU) to enable you to understand the issues and challenges in the FMU and ensure they are recognised in your freshwater farm plan. It does not provide a template for creating your freshwater farm plan, but it provides guidance on the key things you need to think about as you prepare your plan.

The document is divided into four main sections:

1. **Overview** – This section provides an overview of the Doubtless Bay freshwater management unit (FMU) and a summary of the key challenges to freshwater quality in the FMU.

2. **Context and values** – This section gives you contextual information about the topography, land use, soils, waterbodies, biodiversity, climate, and Māori iwi and hapū in the FMU. It also identifies relevant community, tāngata whenua, biodiversity or other values that you need to consider when preparing your farm plan.

3. **Challenges –** This section focuses on the challenges to freshwater in the FMU. Challenges are presented as subsections, each focusing on a specific challenge.

4. **Central government and regional council rules** – The document ends with a brief overview of relevant central and regional government rules and regulations.

Each section is important. Please check them all before preparing your farm plan. You can read the document from start to finish, or dip into the subsections as you need them.

This document is designed to be read either on a screen or as a printed copy. Links to further information are provided where relevant as you work through the document. If read the document on a screen, simply click the direct links to find the additional information. If you are reading the document in print, look out for the arrow icon alerting you to online resources (see 'Abbreviations and interpretation' below). Type the URL beside the arrow icon into your browser to find an online resource library with all the further information links gathered in one place.

This document works alongside the Te Taitokerau CCCV viewer.

Abbreviations and interpretation

FDE	Farm dairy effluent
FMU	Freshwater management unit
ha	hectare
Land Unit	an area of contiguous or non-contiguous land with similar biophysical features. (definition from RMA Freshwater Farm Plan Regulations 2023)
MCI	Macroinvertebrate community index
TLI	Trophic level index
	Online further information resource

He Tirohanga Whānui Overview

The Doubtless Bay freshwater management unit (FMU) covers 55,000ha (Fig 1). It stretches from the eastern side of the Karikari peninsula, south to Honeymoon Valley, along Ōtangaroa then back north to Takerau and Ōkaituna Bay. The FMU drains into Doubtless Bay, mainly through the Ōruaiti, Taipā, and Awapoko rivers. The state of freshwater affects the ecosystems in rivers, lakes, harbours and estuaries.

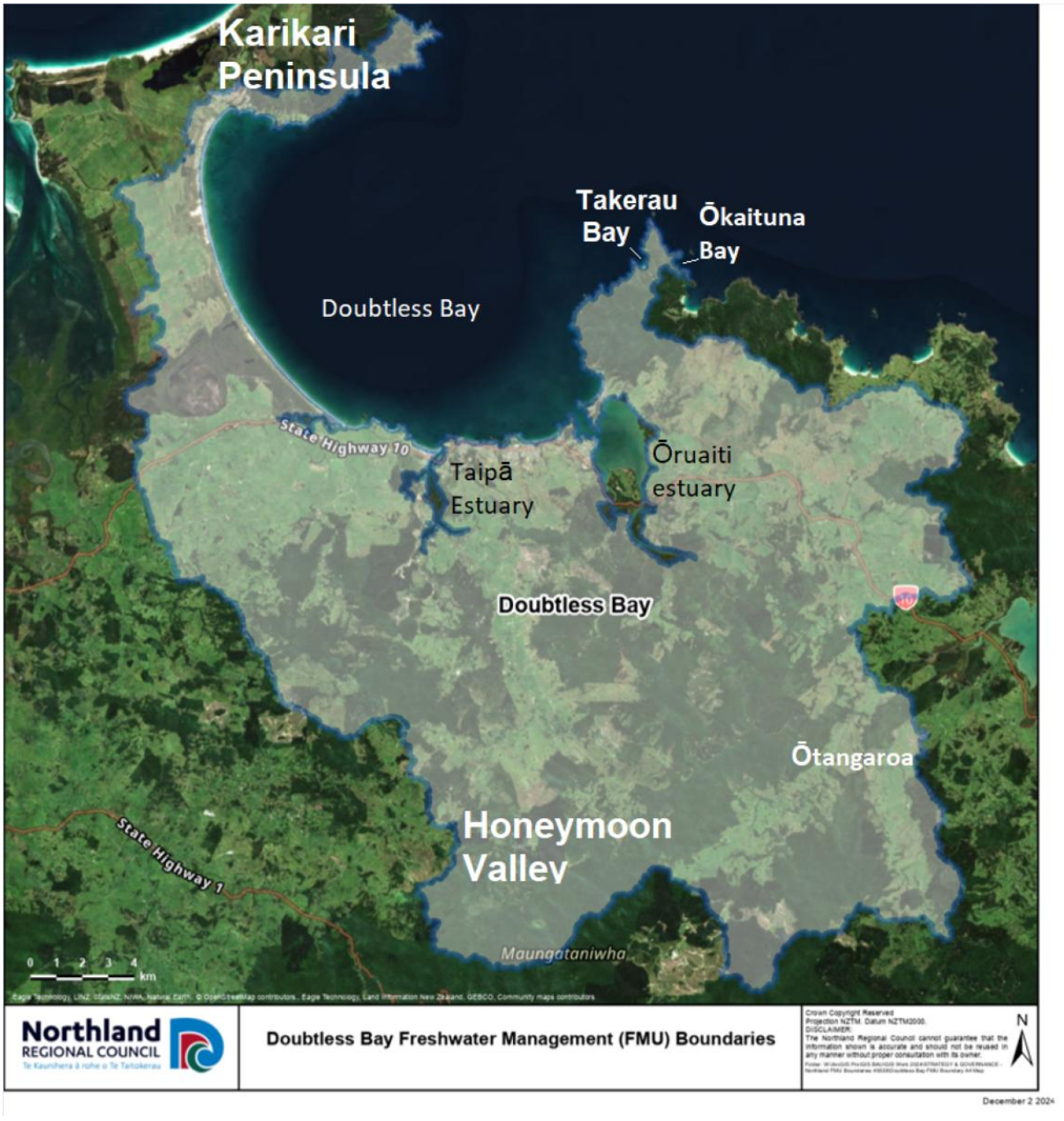
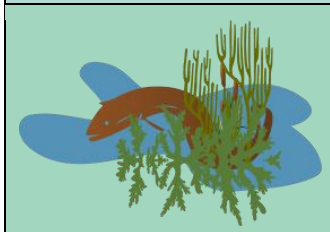


Figure 1: The Doubtless Bay freshwater management unit

Table 1: Summary of causes, impacts, and considerations relating to freshwater quality challenges in the Doubtless Bay FMU

Challenges	Causes	Impact	Things to think about	Helpful map layers
 **Sediment in waterbodies** *Monitoring at Ōruru River indicates clarity and turbidity is elevated due to sediment loss to water.*	• Disturbance or exposure of soils (earthworks or cultivation) without adequate sediment control • Vegetation clearance in riparian areas and on steep/erosion prone land • Run-off or erosion from steep slopes • Cultivation close to waterbodies without filtering vegetation/sediment controls • Gully and streambank erosion • Pugging/heavy stock • Stock access to waterbodies and immediate margins • Farm races without sediment control • Poor drain management	Sediment in waterbodies means less soil on farm. Healthy soils have better production. Sediment in waterbodies affects freshwater plants and animals. Water clarity and plant growth decrease. Stream insects are unable to hold on to substrate covered by sediment. It can affect fish by reducing their ability to feed and clogging their gills. It makes water less appealing for recreation and unsuitable for mahinga kai. It can also mean water is not suitable for human uses, such as drinking, or that treatment costs for town supplies are higher. It affects coastal areas by smothering shellfish beds and reduces habitat quality for fish.	• What soils are on your farm? • What are your steeper areas of pasture and are they eroding? • What is your stock class, grazing intensity and rotation, especially in steep areas close to waterbodies? • What areas do not have riparian planting or filtering buffers? • What areas are high or low risk to cultivate? • How are you managing sediment from earthworks or races? • What areas are likely to result in soil/sediment loss during heavy rain? • When do you undertake drain maintenance and to what extent? Where do you put the drain clearing spoil? • Are your drains fenced? • How can you reduce the sediment loads coming from your drains?	• Fundamental Soils • Terrain: Slope Map • Landcare SedNet • Waterbodies

 **Faecal contamination (*E. coli*) and other pathogens in waterbodies** *All river monitoring sites in the FMU typically grade as poor or very poor state in terms of* E. coli*.*	• Stock in or near waterbodies • Poor management of critical source areas (e.g. stockyards, races/tracks and stock crossings) • Animal effluent disposal near waterbodies, drains, in overland flow paths, or at rates that exceed the absorption capacity of soils • Frequently used unformed stock crossings • Soil compaction leading to overland flow • Poorly managed or maintained human wastewater systems	Faecal contamination can mean water is unsuitable for drinking or domestic uses and that rivers are unsafe to swim in. It can also make mahinga kai unsafe to consume and degrade the mauri of the water so it is unfit for cultural uses. There is a higher risk that people can get sick from water-based recreation.	• Do you have areas where stock can enter waterbodies or immediate margins? • What are the critical source areas and where do they discharge to? • What uses of water downstream of your farm that are sensitive to pathogens? • Do you have areas where effluent collects and washes into waterbodies? • Is your farm effluent system appropriately sized and designed? • Where and when are you irrigating effluent? Is it near waterbodies or overland flow paths and what is the soil saturation? • Is there effluent entering water from your stock crossings? • Are your drains fenced? It could help stock from getting stuck in drains. • Where are your flood risk areas that may increase animal effluent run-off into water?	• Rivers • Registered Drinking Water Supply Sites • Swimming Sites • Fundamental Soils • Flood Risk

 **Elevated nutrients in waterbodies** *Monitoring at Ōruru River indicates elevated phosphorus with a degrading trend very likely.*	• Application of fertiliser, especially close to waterbodies • Urine from animals entering water or filtering through soils • Effluent application at rates that exceed absorption by soils or close to waterbodies • Soil compaction increasing nutrient run-off • Lack of filtering by vegetated riparian buffers • Sediment mobilised by rainfall with high phosphorus content	Elevated nutrients increase the likelihood of algal blooms in waterbodies (especially in hot, dry periods). Algal blooms can be toxic, and reduce the suitability of the water for swimming, and for collecting mahinga kai. Algal blooms can also block light, killing aquatic plants underneath. Algal blooms create a lot of oxygen by photosynthesis during the day and then it uses up nighttime dissolved oxygen levels, causing shock and death of insects and fish. High nitrogen in drinking water negatively affects human health. Some native fish species are particularly sensitive to nitrogen.	• Where and when are you spreading fertiliser and effluent – is the separation from waterbodies adequate? • Do you have stock in or near waterbodies? • How are you managing critical source areas for nutrient run-off (such as overland flow paths or stock crossings)? • Is the silage adequately managed? • How do your soils affect nutrient run off or uptake?	• Fundamental Soils • Waterbodies
 **Riparian vegetation loss**	• Stock accessing riparian areas and grazing vegetation • Vegetation clearance	Loss of riparian vegetation can mean higher water temperatures, increasing the risk of algal blooms and therefore less suitable habitats for native species, which are often adapted to cooler, shaded water.	• Do you have areas where stock access riparian areas? • How far back are your fences from waterbodies?	• Waterbodies • Rivers

Many river margins no longer have riparian vegetation, which reduces the quality of habitats of aquatic native species, many of which are adapted to cooler shaded water and rely on vegetated margins for part of their lifecycle. *Monitoring of macroinvertebrates (a measure of ecological health) at Ōruaiti River indicates poor ecological health.*		Loss of ability of riparian vegetation to filter sediment, animal wastes and nutrients running off the land. Detrimental to native species, which often rely on vegetation next to waterbodies for breeding and feeding. Less vegetation increases stream bank erosion, which increases sedimentation and can undermine fencing.	• Are your waterbody margins planted or maintained in long grass? • Are there areas next to waterbodies where you could plant or enhance vegetation for filtering and shading? • Do you have streambanks that are actively eroding? Could these be stabilised by planting?	
 **Wetland loss** *It is estimated that a fifth of the region was covered in wetlands but now only about 5% of our original wetlands remain (roughly half the national average).*	• Drainage • Grazing • Earthworks • Pest plants	Loss of ecological functions such as sediment trapping and filtration of nutrients. Loss of habitat for native species. Increased flooding risk of areas downstream. Loss of drought resilience, as wetlands act like sponges that release water in dry periods.	• Do you have wetland areas? • Do you have areas that would work well as wetland restoration locations to trap runoff from critical source areas? • Are existing wetlands fenced?	Wetlands

 **Changing climate**	• Increasing annual temperatures • More extreme weather events	Drought leading to increased risk of erosion on hill slopes. Reduced water levels in waterbodies impacting on native species living in them and meaning waterbodies are more sensitive to contaminants (less dilution/assimilative capacity). Increased frequency of algal blooms due to higher water temperatures Flooding leading to nutrients and *E. coli* being transported into waterbodies. Sedimentation in waterbodies from eroding streambanks.	• When and where are you disposing of farm dairy effluent? Are these areas flood-prone or very close to waterbodies? • Are there areas next to waterbodies where you could plant or enhance vegetation for filtering and shading and to reduce streambank erosion? • Do you have steep slopes or banks around waterbodies where you could plant to reduce sediment or nutrients?	Flood Risk

Te Horopaki me ngā Uara
Context and values

Land and land use

The topography of land and how it is used affects freshwater quality. It's important to consider these factors when identifying risks and deciding what actions to include in your freshwater farm plan. For example, steep terrain is more prone to erosion, particularly if it has been converted to pasture – this can lead to poor water quality due to the resulting sediment, *E. coli* and nutrient runoff.

The land in the Doubtless Bay freshwater management unit (FMU) drains to the Mangōnui harbour, Taipa Estuary and directly to the east coast, meaning the state of freshwater affected by land use impacts the state of those coastal areas and their ecosystems.

Topography

The Doubtless Bay FMU generally has a rolling topography.

- Almost half the FMU has slopes between four and 15 degrees.
- One quarter of the FMU has a slope less than three degrees. This is primarily on the Karikari peninsula along with valley floors, such as around the Ōruru and Ōruaiti Rivers.
- Around 15% of the FMU is strongly rolling and the remaining 13% is steep. These steeper areas tend to be on the stronger baserocks on the southern and eastern parts of the catchment, including Pūhangatohorākā and Kaiwhetū.

Slope is a key driver of erosion risk, as are soil type, geology and vegetation type. This should be a focus of your risk assessment and mitigation for your freshwater farm plan. The Te Taitokerau CCCV viewer includes maps of land considered prone to erosion.

www.nrc.govt.nz/CCCVResources

The Te Taitokerau CCCV viewer can indicate the slope of the land on your farm. If you want a more detailed breakdown of the slope or aspect on your farm, Landcare Research – Manaaki Whenua has a useful tool to assess these.

Landcare Research – Manaaki Whenua slope tool

www.nrc.govt.nz/CCCVResources

Land use

Much of the flat and rolling areas of the FMU have been converted to pasture along with some steeper slopes. A significant proportion of the FMU remains in native vegetation, including some of the Maungataniwha Ranges. There is some forestry and a small amount of cropping or orcharding, including viticulture in Taipā, Mangōnui and the end of the Karikari peninsula.

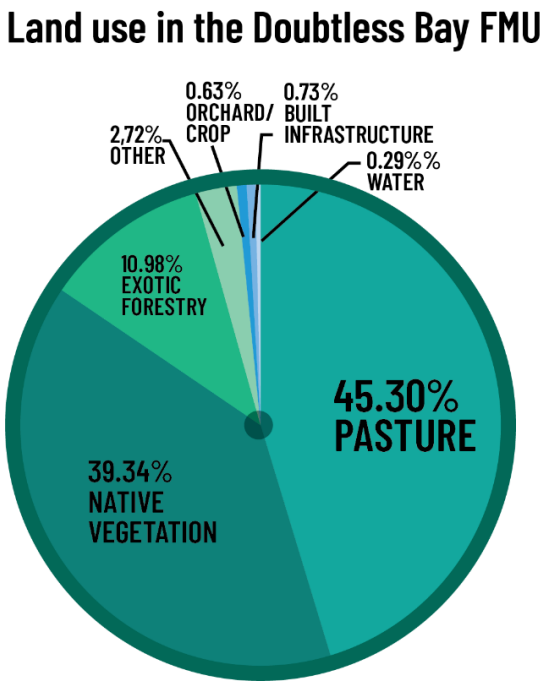


Figure 2: Land use in the Doubtless Bay FMU (2018)

Soils

The Doubtless Bay Freshwater Management Unit (FMU) has a mix of soil types, including clays, sands, and volcanic soils. Each type responds differently to land use and weather and needs specific management to stay healthy and productive.

Sandy soils are mostly found in the northern and western parts of the FMU. The rest of the area is mainly volcanic soils.

A freshwater farm plan should address risks associated with the type of soils on the farm. Different soils may need different approaches to reduce erosion, nutrient loss, or water runoff. Please note that an individual farm might have more than one soil type.

You can use the Te Taitokerau CCCV viewer to identify the soil types on your land and help guide or fine-tune your planning.

www.nrc.govt.nz/CCCVResources

Soil types

Young semi-volcanic soils
Young semi-volcanic soils, formed from weathered volcanic rock, ash, and sedimentary material, are found in upper catchments. They range from fertile loams on gentle slopes to erosion-prone clays on steep terrain. Topsoils are friable and granular but dry quickly, while subsoils are sticky and poorly drained, especially in compacted or steep land areas. Erosion risks include sheet erosion on exposed slopes and deep slips in soils like Takitū and Haunga.

Management includes maintaining dense pasture, avoiding overgrazing, and using subsurface drainage. On steep or marginal land, retiring areas from grazing and planting erosion-control trees like poplars helps reduce degradation and protect waterways.

Young sandstone soils
Young sandstone soils form from banded and shattered sandstone and mudstone rocks, often on steep slopes. These soils are typically winter-wet, with high clay content and poor drainage, making them prone to pugging and difficult to cultivate. They are highly erosion-prone, especially to tunnel gullying, slumping, and landslides during heavy rain. Soil fertility varies widely depending on the parent rock.

Management includes maintaining good pasture cover, avoiding cultivation on steep or wet areas, and using direct drilling for pasture renewal. Retiring marginal land and planting erosion-prone areas can help stabilise slopes and improve long-term productivity.

Mature semi-volcanic soils
Mature semi-volcanic soils, formed from weathered volcanic materials like lava, breccia, scoria, and ash mixed with sedimentary rock, have shallow, drought-prone topsoils over dense, sticky clay subsoils. These subsoils are acidic and rich in iron and aluminium, which can be toxic to plants unless pH is corrected. Poor drainage, pugging, compaction, and surface sealing are common in wet conditions. Erosion risks include sheet erosion and large slips on steep or bouldery terrain.

Management includes maintaining dense pasture, avoiding overgrazing, using no-till practices, planting erosion-control trees like poplars or willows, and retiring marginal land to stabilise slopes and reduce sediment loss.

Old semi-volcanic soils
Old semi-volcanic soils, formed from deeply weathered volcanic rocks like basalt, breccia, and scoria mixed with sedimentary material, are found on rolling to steep terrain. These soils are strongly leached, acidic, and low in fertility. Shallow, friable topsoils can become drought-prone, while dense, sticky subsoils are poorly drained and rich in iron and aluminium oxides. This makes them prone to compaction, pugging, and erosion – especially sheet erosion and slumping on slopes.

Management includes maintaining dense pasture, avoiding overgrazing, and using no-till practices. In erosion-prone areas, planting poplars or willows and retiring marginal land helps stabilise slopes and reduce sediment loss.

Old mudstone soils
Old mudstone soils, formed from weathered sedimentary rock on rolling terrain, are pale due to iron leaching and clay loss. Their structureless, low-clay topsoils are easy to cultivate but prone to turning into dust when dry. These acidic, low-fertility soils have poor drainage, leading to winter wetness and summer drought. Gully and sheet erosion are major risks due to a columnar subsoil structure.

Management includes avoiding heavy winter grazing, maintaining dense pasture, using no-till methods like direct drilling, and planting erosion-control trees such as willows. On steep or marginal land, retiring areas from grazing may be necessary to prevent further degradation.

You can find more information about soil types and how to manage them in our Soil Fact Sheets.

Soil fact sheets

www.nrc.govt.nz/CCCVResources

Drainage

The catchment has a mix of well and poorly drained soils. Poorly drained soils limit deep drainage and lead to more water flowing over the surface. These flows can strip nutrients from soils and transport them into streams and ponds when it rains. Areas with well drained soils have less

overland flow and more connection to groundwater. Contaminants in the water, especially nutrients, then slowly seep into groundwater systems.

Artificial drainage

Artificial drainage is more prevalent in the poorer draining soils of the northwest area of the catchment along with the areas around Ōruaiti. Drainage can expand farmable land and boost economic gain, but it can contribute to water pollution, sediment transport, and nutrient loading in waterbodies.

Drains on a property require careful consideration regarding timing and methods of maintenance to help reduce sedimentation. It's also important to assess whether stock can be excluded from the drains to prevent further contamination and erosion.

Waterbodies

The Doubtless Bay freshwater management unit (FMU) supports rivers, lakes, wetlands, and saltmarsh systems.

Good water quality translates into high biodiversity of healthy indigenous plants, insect, fish, and bird life, which support food collection and aesthetic value for communities. A healthy freshwater environment is valuable for tourism, swimming and public wellbeing.

There are many swimming sites in the FMU. Swimming water quality typically declines after rainfall. For current swim suitability you can use Safeswim or the Land Air Water Aotearoa long term recreational swimming site information. These are available through the Te Taitokerau CCCV viewer, or you can access the direct links below.

Safeswim

www.nrc.govt.nz/CCCVResources

Most monitored swim sites are coastal, but river/lake sites include:

- Lake Rotopōkākā (Coca-cola)
- Taipā Estuary

Long term recreational swimming site information

www.nrc.govt.nz/CCCVResources

It is important to recognise the community values associated with water quality and understand how your farming activity can affect them.

Rivers and lakes

Table 2: Main rivers and lakes in the Doubtless Bay FMU

River/lake	Description
Awapoko River	Aurere and Parapara streams converge at Aurere to form the tidal Awapoko River. Both faecal coliforms and enterococci exceed the coastal water quality standard, indicating that the estuary is often not suitable for contact recreation or shellfish consumption. Nutrients (total nitrogen, ammoniacal nitrogen, total phosphorus and dissolved reactive phosphorus) also exceeded the coastal water quality standards and some exceptional high concentrations were recorded after rain events.
Ōruru River	The Ōruru River originates from the Ōtangaroa Forest and flows north through native forest and scrub. Waikāinga and Te Awapuka streams, numerous smaller streams and the Pēria River drain steep hill country around Maungataniwha and converge below Pēria to become the Ōruru River. In the lower catchment, the river meanders north through pastures, joins the Paranui River, and eventually flows out into the Taipā River and estuary. Monitoring shows degrading trends for *E. coli*, turbidity (an indication of sediment) and phosphorus.
Ōruaiti River	The Ōruaiti River is the largest river in Doubtless Bay FMU. It also begins in the Ōtangaroa forest and flows through mostly pastoral land and some forestry. It then flows out into the Mangōnui Harbour and into Doubtless Bay. Monitoring indicates elevated *E. coli* and likely degrading trend for turbidity. Macroinvertebrate monitoring also indicates degraded ecological health.
Lake Waiporohita	Lake Waiporohita is a small dune lake (6.8 ha) located near Tokerau Beach on the Karikari Peninsula. This shallow lake (maximum depth of 3.5 m) is in a pastoral dominated catchment. The lake has no inflows or outflows. It is identified as an outstanding freshwater body in the Regional Plan for Northland due to its high ecological values. Monitoring indicates it has high levels of nutrients (supertrophic).
Lake Rotopōkākā	Lake Rotopōkākā is located on the east coast of Karikari Peninsula. Water quality is generally good for swimming (except after heavy rain). The ecological state of Lake Rotopōkākā is not monitored by Northland Regional Council. This popular lake gets its brown colour from peat and plant tannins staining the water.

Water quality typically declines from the upper reaches to the lower reaches of a catchment due to impacts from nitrogen, phosphorus, *E. coli* and sedimentation. So, location of the farm will guide the risk assessment and priority actions of a freshwater farm plan.

Information on water quality in the catchment's rivers is available in Northland Regional Council's Environmental Data Hub.

www.nrc.govt.nz/CCCVResources

Outstanding freshwater bodies, such as Lake Waiporohita, are very sensitive to activities in their catchments that can impact water quality. Earthworks, cultivation, vegetation clearance, or drainage that result in sediment entering lakes and elevated nutrients due to fertiliser use or farm effluent discharges.

Outstanding freshwater bodies are mapped in the Te Taitokerau CCCV viewer.

www.nrc.govt.nz/CCCVResources

The Regional Plan applies rules specific to outstanding freshwater bodies: Activities in the beds of lakes and rivers (Section C.2), damming and diversion of water (Section C.3), Land drainage and flood control (Section C.4), the taking and use of water (section C.5), discharges to land and water (Section C.6), land disturbance (Section C.8).

Wetlands

The FMU hosts a variety of wetlands with significant ecological value. Wetlands are home to many threatened plant and animal species. The most significant wetlands in the FMU are on the eastern margin of the Karikari Peninsula between Aurere and Tokerau Beach. The Lake Ōhia wetland complex is the largest and most ecologically significant freshwater wetland in the FMU – it is ranked fourth in the Northland Regional Council Top 150 wetlands.

Pākihi and gumland types of wetlands found here are particularly sensitive to drainage and grazing by livestock. They are characterised by mature or skeletal soils of very low fertility and low pH, wholly mineral or sometimes with peat. They are rain-fed, with poor ability to transport water, frequently saturated but seasonally dry. Usually on level to rolling or sloping land in districts of high rainfall, the soils are old and severely leached of most nutrients. Drainage and grazing can mix up the substrate of these wetlands causing increase in nutrients, displacing closely adapted native flora and fauna of pākihi and gumland.

Wetlands are important because they can:

- improve water quality by removing contaminants before they enter the wider catchment
- mitigate extreme weather conditions such as flooding, by slowing down flow of water; and drought, by releasing water to maintain water flows
- trap topsoil erosion, preventing it from entering coastal areas
- help filter nutrients from fertilisers, chemicals, and animal wastes
- provide biodiversity hotspots and be highly valued by the community for cultural and recreational reasons (for example, tuna/eels and gamebird hunting). Eels, whitebait species and freshwater crayfish thrive in some wetlands. Wetlands are home to threatened species such as bitterns and native plants
- reduce downstream flooding in high rainfall by absorbing water and slowing the flow into lower flood prone areas.

There are rules in the Regional Plan for Northland relating to wetlands, including wetland disturbance (earthworks, drainage or vegetation clearance) and excluding livestock.

Northland Regional Council has mapped a number of wetlands in Northland. These maps are available in the Te Taitokerau CCCV viewer or on Northland Regional Council's maps of known wetlands.

www.nrc.govt.nz/CCCVResources

The Northland Regional Council wetland maps are indicative and for information purposes only. Landowners should seek qualified advice to verify whether a wetland is present.
Restoring wetlands and their ecological functions is essential for sustainability, benefiting both farming and indigenous biodiversity in the FMU. Even small wetland areas can improve biodiversity and act as a filter for sediment and nutrients. Restoration efforts may include stock exclusion, pest and weed management, and the creation of new wetlands. If you have a wetland on your property, your freshwater farm plan needs to consider your contribution to restoration efforts. Wetland restoration or creation also provides an opportunity to reduce impacts of farming on the state of freshwater as they filter out contaminants such as *E. coli*, nutrients and sediment.

For more information:
Looking after your wetland

www.nrc.govt.nz/CCCVResources

Biodiversity

Indigenous habitats in the Doubtless Bay freshwater management unit (FMU) have suffered extensive loss and modification mainly due to historical land clearance for agriculture and forestry. However, the FMU still contains large areas of indigenous forest, shrubland, wetlands, dune lakes and dunelands. These habitats support indigenous ecosystems and unique plants and animals, many of which are classified as threatened or at risk. Your freshwater farm plan needs to recognise and provide for them.

You can find the conservation status of a species in the New Zealand Threat Classification System (NZTCS).

www.nrc.govt.nz/CCCVResources

The NZTCS website has links to other data sources, such as the NZ Freshwater Fish Database. You can also access current NZTCS reports.

There are a wide range of native species that live in and/or use the FMU. The table below describes some of the native species that are indicators of ecosystem health. Looking after these will provide for a wide range of other species as well.

Table 3: Significant native species found in Doubtless Bay FMU

Significant species	Habitat and characteristics
Australasian bittern (Matuku-hūrepo) *Nationally critical (highest threat status), 250-1000 remaining* 	Apex predator found in wetlands lakes, slow moving streams, farm drains, ponds and paddocks. Bitterns are rarely seen as they are shy, camouflaged and spend much of their time hidden in dense aquatic vegetation. Bitterns use a range of habitat across a wide landscape and can travel long distances for food and breeding, so all wetlands should be treated as potential bittern habitat. Bitterns are a key species for indicating landscape scale wetland health.  ***Photo credit: Imogen Warren Photography***
Banded rail (Moho pererū) *At risk – declining* *Source: DOC* 	Disappeared across most of Northland but still found in coastal wetlands. Banded rails consume snails, crabs, insects, worms and spiders. They also feed on dead fish, seeds, and fruit.  ***Photo credit: JJ Harrison - www.jjharrison.com.au***

Eel (Tuna) – Longfin and shortfin

Longfin eels – at risk

Shortfin eels – not threatened

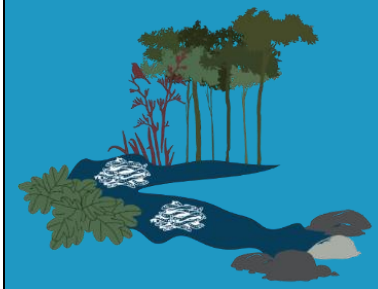
Tuna are a taonga species highly valued by tangata whenua. There are two freshwater eel species – the shortfin and the longfin. There are fewer eels today because of the loss of wetlands, fish passage barriers and historical commercial fishing. Eels migrate upstream as elvers to find suitable adult habitat. Longfins are one of the largest, slowest growing and longest-lived eel species in the world.

Changes caused by drainage, irrigation schemes, and river diversions reduce eel habitat. Culverts and dams can prevent eel migration.

Eels can be susceptible to pollution and their health may be used as an indication of the ecosystem health.

Īnanga and whitebait species

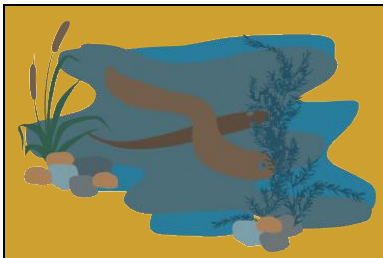
At risk – declining



Īnanga (whitebait) spawning sites are found on the margins of rivers and estuaries that are inundated by spring high tides. Īnanga deposit their eggs between early March and late September on grasses growing on riverbanks, so water levels must be sufficient to inundate the grasses at the correct height for the eggs to hatch. Grazing on river margins reduces the vegetation available for spawning.

The ability to move freely between fresh and coastal waters is important, so in-stream structures such as culverts that do not impede migration help to maintain healthy populations. Special care is also needed in spawning areas if undertaking earthworks, clearing vegetation, or installing structures that can impact on spawning or reduce īnanga access to spawning sites.

Īnanga are caught recreationally and are an important part of freshwater food webs. NRC has developed indicative maps of potential īnanga spawning habitats: Indicative īnanga spawning habitat map These maps are also in the CCCV viewer Te Taitokerau / Northland. Other whitebait species are also living in the rivers of Doubtless Bay – Threatened Koaro, Banded kokopu and Common Smelt



Black mudfish

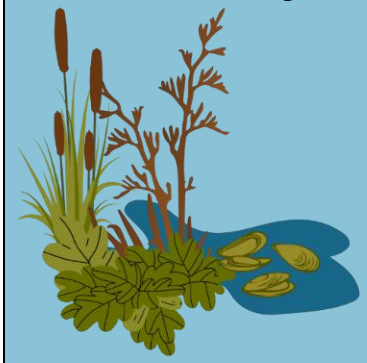
At Risk – declining

Black mudfish live primarily in swamps and wetlands. Spawning takes place at the beginning of the wet season and probably continues until early spring. In addition to the threat from land drainage and development, these fish are also threatened by the presence of gambusia, an aggressive and prolific introduced fish.

Photo credit: Katrina Hansen, original image

Freshwater mussels (Kākahi/Torewai)

Threatened, declining



Freshwater mussels (kākahi/torewai) live in habitats ranging from small, fast-flowing streams to lakes. They are a valuable mahinga kai resource for many Māori.

They are important filter feeders that can clean water and are an indicator of good water quality and habitat.

Unlike marine mussels that attach themselves to surrounding rocks or other substrates, kākahi use their foot to move around, anchor themselves and burrow into sediment.

Freshwater mussels are under threat and declining due to loss of habitat, high nutrient levels, and high levels of sediment.

Native insects

Insects are widely accepted as indicators of stream health in water quality monitoring, as many species are known to be sensitive to pollution or habitat modification. They are also important food sources for fish and birds.

Streamside vegetation, in-stream habitat complexity and stability are important for their lifecycles.

Photo credit: Olly Ball, Steve Pohe Collection

Protecting and enhancing freshwater habitat and biodiversity on farms can lead to better water quality outcomes and is part of an integrated farm planning approach. Actions to consider include:

- fencing off waterbodies, wetlands and remnants of native bush
- stabilising eroding streambanks with vegetation
- Planting shade species for exposed waterbodies
- planting and protection or creation of wetlands
- removing barriers to fish passage
- controlling pest plants and animals
- improving or restoring connections between native bush, wetlands and waterbodies.

Further information on species and ecosystems relevant to the Doubtless Bay FMU is available online.

State of the Environment: Northland Freshwater Fish Monitoring 2023/24

www.nrc.govt.nz/CCCVResources

Climate

Climate is a major influencer of risks and impacts, and it needs to be considered when you write your freshwater farm plan. For example, high rainfall in areas with poorly drained soils equals a high risk of erosion and runoff of contaminants to fresh water. Climate also impacts whether you have good grass cover going into winter, and the ability to leave adequate residuals to protect soils.

Temperature

Summers are generally warm and humid, while winters are mild with rare frosts. The average annual temperature in nearby Kaitaia, for example, ranges from 4-19°C in winter to 10-29°C in summer and the Doubtless Bay freshwater management unit (FMU) gets more than 2,100 hours of sunshine annually.

Changes to our climate are projected to increase temperatures in the FMU by 0.5-1.0°C for all seasons by 2040. This temperature rise may change the crops that can be grown and increase pests and diseases. Higher temperatures might shorten crop maturity periods but can also lead to lower yields due to droughts and floods. Extreme weather events could stress or even kill livestock. An

increase in temperature negatively affects freshwater environments. It can increase the risk or scale of algal blooms, which are detrimental to people, stock and freshwater plants and animals. It can increase the breeding rate of exotic pest species, such as gambusia. Shading streams is an important tool for reducing water temperatures.

Rainfall

Rainfall is generally plentiful throughout the year, with occasional downpours. Dry spells can occur, especially during summer and autumn. The catchment has a median annual rainfall of around 1,300 mm, which is higher than the national median of 1,070 mm. Rainfall varies within the catchment, with the Karikari Peninsula receiving the least rainfall, and the southern ranges receiving the most.

The FMU is generally sheltered, but exposed areas can be very windy, and Northland sometimes experiences gales, often linked to tropical depressions. Northland is prone to droughts and floods, which impact on farming and freshwater systems.

It's important to adapt to temperature increases and rainfall changes. You should plan for how to manage these in your freshwater farm plan. Actions to consider include:

- fencing off waterbodies, wetlands and remnants of native bush to allow plants to shade the waterbodies
- stabilising eroding streambanks with vegetation
- planting waterbodies and protecting or creating wetlands
- controlling pest plants and animals around waterbodies
- ensuring you have a water management plan during droughts
- providing shade for stock to reduce heat stress and water consumption.

Further information

NIWA has regional weather and climate information for Northland.
NIWA Northland weather and climate information

www.nrc.govt.nz/CCCVResources

Stats NZ has rainfall data.
Rainfall data

www.nrc.govt.nz/CCCVResources

Tāngata Whenua

The Doubtless Bay freshwater management unit (FMU) has areas of interest for many Te Taitokerau iwi. Māori have a long heritage in this FMU as kaitiaki over the waterbodies, taonga species, and preservation of kōrero tuku iho (historical kōrero passed down through generations) and pūrākau (myths and legends) that have shaped the cultural identity for each iwi.

Your freshwater farm plan needs to consider how to protect and/or enhance tāngata whenua values and sites of significance on your property, such as wāhi tapu (sacred cultural and spiritual places or areas of significance) and wāhi tūpuna (landscapes and places of ancestral significance, holding cultural and traditional values) mahinga kai (food-gathering sites and areas), and habitats and freshwater migration pathways of taonga species.

For example, you may have an important waterbody that is a migratory pathway for tuna or banded kōkopu on your farm. You might create an action to check any river crossings or culverts to make sure that they are compliant with fish passage rules, so migratory pathways are not compromised. This enhances cultural values like mauri and manaakitanga by ensuring that the whakapapa of these taonga can continue, and your actions are looking after them and preserving their life.

Iwi of Doubtless Bay FMU

Many iwi have associations to Doubtless Bay and iwi may have overlapping areas. Each iwi has significant ongoing interests in maintaining and restoring the health of freshwater and freshwater ecosystems of the FMU, as well as economic interests through land ownership.

Iwi for the Doubtless Bay FMU are:

- Ngāti Kahu
- Ngāti Kahu ki Whangaroa
- Ngāpuhi / Ngāti Kahu ki Whangaroa

www.nrc.govt.nz/CCCVResources

Indicative iwi boundaries can be found in the Te Taitokerau CCCV viewer.

www.nrc.govt.nz/CCCVResources

More information about formally recognised iwi groups

www.nrc.govt.nz/CCCVResources

Information resources

Statutory Acknowledgements

Treaty Settlements and the related Statutory Acknowledgements provide more detail on the specific connections that the respective hapū and iwi have with particular sites and places, as well as their historical associations with the entire catchment area.

Statutory Acknowledgement Document

Treaty of Waitangi statutory acknowledgement areas in the Northland Region

www.nrc.govt.nz/CCCVResources

Ngāti Kahu ki Whangaroa have statutory acknowledgment areas in the Doubtless Bay FMU. They describe their ancestral lands and tribal boundaries as being between the eastern side of the Mangōnui Harbour and the western side of the Whangaroa Harbour (Figure 3).

Figure 3: Rohe map (approximate) – Ngāti Kahu ki Whangaroa

Source: Te Kāhui Māngai website of Te Puni Kōkiri

The Ōruaiti River, from Paewhenua in the west to Ōtangaroa in the south, is of paramount importance as a Ngāti Kahu ki Whangaroa boundary. The river provided a pathway between the coast and the hinterland for Ngāti Kahu ki Whangaroa, as well as an important source of kaimoana.

The coastal marine area adjacent to the area of interest includes the Whangaroa Harbour, Pacific coastline from Kōwhairoa Peninsula in the east, to Tokerau (Doubtless Bay) in the west, and south to Mangōnui Harbour. The water, fisheries and other natural resources on the coastline and along the rivers, including Ōruaiti and Waihapa Bay and their tributaries, are of extreme cultural significance to Ngāti Kahu ki Whangaroa. They contain important awa mahinga kai (waterways with food resources), flora, fauna and fisheries, which were customarily hunted and gathered.

Iwi and hapū Environmental Management Plans
Iwi and Hapū Environmental Management Plans (IHEMPs) and other related iwi/hapū planning documents also provide useful information and direction as to when iwi and hapū wish to be consulted, what is important to them, and their aspirations.

Iwi environmental plans:
Te Rūnanga o Whaingaroa Te Ūkaipō (2022-2027)

www.nrc.govt.nz/CCCVResources

Other useful resources
The New Zealand Archaeological Association maintains a website which is a good source of recorded archaeological sites.

The Regional Plan for Northland includes maps of some sites and areas of significance to tangata whenua in fresh and coastal waters (see section Regional Council and Central Government Rules, for more information).

The resources provided in this document do not give a complete picture. It is recommended that you contact your local marae to enquire about sites relating to freshwater on your property, and for advice to help protect and enhance them. Visit Te Puni Kōkiri (Ministry of Māori Development) for contact information, or Te Kāhui Māngai and Māori Maps to find lists of representative groups for the iwi and hapū in your area.

www.nrc.govt.nz/CCCVResources

Mauri of water

Tāngata whenua spiritually identify with wai (water) in their lands. Rivers have spiritual significance to Māori as well as being a valuable food and water source for many marae. To Māori, water is a taonga (treasure). It must be safeguarded for future generations.

Water has mauri, which connects its ability to sustain life and healing properties to its vitality. To Māori, any discharge of contaminants into water, no matter how well purified in a treatment process, reduces the water's ability to sustain life. It thereby reduces its mauri. If the mauri is reduced in wai, it will start to affect the hauora (health) of communities as well.

Sites and species of significance

Historical and archaeological sites, ancestral lands, waterbodies, wāhi tapu and other taonga are significant to Māori. There are numerous pā sites, terraces, pits and middens along the coasts, and further inland in some areas.

Your freshwater farm plan should consider how your farming operations could affect sites of significance and how to protect them.

We are working to confirm sites of significance in Doubtless Bay. We will update this document with further details as soon as the information is available. If you need urgent assistance with identifying sites of significance to tāngata whenua in Doubtless Bay, please contact Northland Regional Council on 0800 002 004 or info@nrc.govt.nz

Ngā Wero | Challenges

The Doubtless Bay freshwater management unit (FMU) suffers from poor water quality. The biggest challenges the FMU's freshwater faces are sedimentation, *E. coli*, elevated nutrients (phosphorous and nitrogen), wetland loss, riparian vegetation loss, and the changing climate. For a summary of these challenges refer to the table in Section 1.

Identifying your on-farm risks, having regard to these challenges and the actions you can take to address them, should be priorities as you create your farm plan.

Consider where you are in the catchment. Overall, sites higher in the FMU with predominantly bush headwaters have better water quality. As these waterbodies move down the FMU and into farmland there is a greater accumulation of contaminants as the waterbodies are affected by land use activities. However, there are exceptions, so check your individual location: some waterbodies can be degraded even high in the FMU due to intensive land use.

Northland Regional Council monitoring data for contaminants

Raw data (Environmental Data Hub)

www.nrc.govt.nz/CCCVResources

Sediment in waterbodies

Sediment is a widespread issue across Northland, and the Doubtless Bay FMU is no exception. A significant portion of the FMU is high risk for erosion, with some areas potentially generating over 500 tonnes of sediment per square kilometre each year.

The Regional Plan for Northland also identifies about 9% of the FMU as Erosion Prone Land (defined as Land Use Capability (LUC) units 6e17, 6e19, 7e1 - 7e10, 8e1 - 8e3, and 8s1). The FMU generates about 162,218 tonnes of sediment per year from 553 square kilometres. About 15% of sediment comes from areas in woody vegetation, 62% from pasture, and 23% from streambank erosion.

Regional Plan maps

www.nrc.govt.nz/CCCVResources

Erosion degrades both land and freshwater, as eroded materials end up in waterbodies. Heavy rain, land use practices, pugging from stock, low pasture cover, deforestation, and development-related disturbances exacerbate soil erosion, especially in hill country and stream banks. Managing land use is key to controlling erosion.

Your freshwater farm plan should consider the following sources of sediment and how these can be managed on your farm.

Table 4: Sources of sediment

Surface erosion This occurs when soil particles are detached from the surface and carried across the ground by water, wind or gravity.	
Fluvial erosion This happens when running water gouges shallow channels or deeper gullies into the soil. On sloping land, the gullies can cut deep into the subsoil or undermine the surrounding soils.	
Mass movement Otherwise known as slips, slumps or landslides, this is the most common form of erosion in hill country. It is most common after heavy rain.	

Stream bank erosion

Stream bank erosion is a natural process but can be exacerbated by a lack of vegetation and disturbance of the stream bank (e.g. by stock). Faster run-off from pastoral land can also lead to higher flow velocity that can worsen stream bank erosion.

You can find more information about erosion and sources of sediment in the FMU in the Doubtless Bay Catchment Management Plan.

Faecal contaminants (*E. coli*) and other pathogens in waterbodies

E. coli comes from the excreta of warm-blooded animals and is an indicator of the risk of infectious disease from contact with freshwater. Key sources are run-off from farm animals, stock in waterbodies and discharges of human or animal effluent. Wild birds and pest animals are also a common source in Northland.

All monitored river sites in the FMU typically grade as poor (D grade) or very poor (E grade) for *E. coli* (median), indicating unsuitability for human contact or swimming. Additionally, *E. coli* pollution from effluent discharges to water is unacceptable to tāngata whenua and can limit the ability to gather mahinga kai.

The areas in the FMU with lower levels of *E. coli* tend to be in the unmodified bush areas. In pasturelands, sediment and nutrients, along with *E. coli*, runs off into waterbodies, especially where there is limited filtering by vegetated riparian buffers.

Northland Regional Council has collated *E. coli* monitoring data and modelled estimated *E. coli* concentrations across the region.

E. coli monitoring data

www.nrc.govt.nz/CCCVResources

The council has also commissioned research into the state and sources of *E. coli* in Northland. Research indicates that Northland has high levels of *E. coli* in the river networks across the region that appear to be generated from diffuse pollution sources from intensive land uses.

Access the research

www.nrc.govt.nz/CCCVResources

When you create your freshwater farm plan, you will need to consider both diffuse and point sources discharges of *E. coli* in waterbodies. Diffuse sources are widespread or dispersed sources such as runoff from pasture and include (but are not limited to):

- rainfall/overland flow/run-off from pastureland, especially erosion-prone land in extensive or intensive land-use with high connectivity to waterbodies
- poorly drained lowland pasture (e.g., floodplains with shallow water tables)
- application of farm dairy effluent (FDE) to land, generating runoff from poorly drained or saturated soils.

Point sources are from a single fixed point, such as a pipe or drain or dairy shed outfall and include (but are not limited to):

- direct stock access to water bodies
- FDE discharges to water
- farm infrastructure/practices with high connectivity to waterbodies e.g., stock drinking troughs, races, wintering pads, stream crossings and the outfall of drains.
- storm water, storm water systems cross-contaminated with sewerage
- poorly constructed or maintained human wastewater systems.

Source tracking and *E. coli* monitoring in our region have shown that diffuse sources of *E. coli* from pastureland need prioritised management to reduce *E. coli* loads in waterbodies, with ruminants (cattle, sheep) typically being the dominant source of *E. coli* (but this can vary with location and land cover).

Stock exclusion by effective fencing, riparian planting and use of wetlands or detention bunds to intercept overland flow from *E. coli* sources are very effective in reducing faecal loads in waterbodies. Afforestation in highly erodible land and eliminating farm dairy effluent discharges to waterbodies are also encouraged to eliminate *E. coli* pollution.

Elevated nutrients in waterbodies

Nutrient levels (nitrogen and phosphorus) are elevated in parts of the Doubtless Bay FMU:

- The river monitoring site on the Ōruru River indicates phosphorus levels are high and very likely degrading.
- Aurere estuary has elevated nutrients (total nitrogen and total phosphorus) and has failed standards for both shellfish consumption and recreation. Nutrient concentrations in the estuary also contribute to nutrient enrichment in Doubtless Bay and large quantities of macroalgae have been observed near the entrance of the estuary.
- Lake Waiporohita has elevated nutrients as indicated by trophic level index (TLI), which is based on the concentrations of nitrogen and phosphorus, water clarity and algae levels.

Elevated nutrients can result in nuisance algal growth and algal blooms, especially in warmer periods.

Sources of nutrients include fertilisers, farm wastewater discharges, run-off from pasture, livestock in waterbodies, human wastewater systems and feral/wild animals (e.g. water birds). In some cases, dissolved reactive phosphorus can be naturally high due to geology.

Habitat and wetland loss

Land use change, intensification, deforestation, drainage, reduced flows, pollution, sedimentation, nutrient enrichment and spread of invasive species have had significant consequences for our freshwater species, many of which have declining or threatened populations. Stress from compromised habitat reduces immunity in animals and can cause flares of fungal or parasitic diseases in fish populations.

Northland Regional Council monitoring indicates that habitats in the FMU are impacted – macroinvertebrates (animals without a backbone) are an indicator of stream health. Monitoring has shown rivers in the Doubtless Bay typically rank as fair or poor against this indicator.

Wetlands

The Lake Ōhia wetland complex, and the unique Pākihi and gumland wetlands in the Doubtless Bay FMU, have been drained or lost to tilling and grazing. Preventing further loss, drainage and nutrient increases can benefit not only indigenous biodiversity but your farm.

Your freshwater farm plan should identify any wetlands on your farm and set out actions to protect them and, if necessary, restore them. There are also likely to be opportunities to create wetlands in some cases to help reduce sediment, *E. coli* or nutrient loss to freshwater.

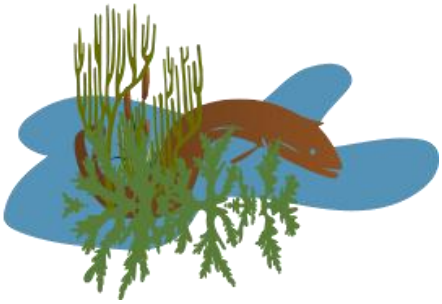
Fish passage

Culverts, weirs, fords, dams, and tide and flood gates are common in streams and rivers throughout the FMU. Many of our fish species are migratory. For example, eels need to swim to the ocean for spawning and the elvers back to the rivers for reaching adulthood. If instream structures are not designed, maintained and installed correctly, they can stop fish migrating and spawning.

NIWA have developed a fish passage assessment tool which helps to show the barriers to fish passage and how to assess the structures on your farm.

NIWA fish passage assessment tool

www.nrc.govt.nz/CCCVResources



Riparian vegetation loss

Vegetation on the margins of waterbodies is an important part of freshwater ecosystems. Most of our aquatic native species are adapted to bush clad waterbodies that provide shade, cooler water temperatures and good connections between freshwater and land that many species rely on for feeding and lifecycles. The loss of this riparian vegetation can reduce habitat quality for native species and result in lower dissolved oxygen, warmer water and more frequent algal blooms.

This is one of the reasons why around 50% of Northland rivers don't score very well against an indicator of aquatic ecosystem health – macroinvertebrate community index (MCI) – which measures the variety and abundance of small animals without backbones that live on or just below the stream bed. In the Doubtless Bay FMU, none of the river monitoring sites score better than 'fair' for MCI, and most score 'poor'.

The state of rivers as measured by MCI is available on the LAWA website (select a river site and turn on the Ecology tab).

Land, Air, Water Aotearoa (LAWA) - River Quality

www.nrc.govt.nz/CCCVResources

Changing climate

Your freshwater farm plan should consider challenges due to climate change, such as drought, extreme weather events and increased water temperatures.

Drought potential is projected to increase due to higher accumulated evapotranspiration, reduced rainfall, and drier soils. It is most accurately projected through potential evapotranspiration deficit accumulation, which considers the difference between water demand for plant growth, soil water capacity, and water loss through evaporation and transpiration.

Much of Northland's primary sector relies on takes from rivers and streams, which can be unreliable water sources during drought – this can have significant economic and social impacts. Reliability of supply from rivers and groundwater is likely to reduce with climate change.

Dry periods can lead to soils cracking. When rain does occur on cracked soils there is greater movement of nutrients into the water systems.

Increased severity of storms, including wind strength and intensity of rainfall, is likely to cause significant slips and erosion, damaging forests and farm infrastructure like fencing and roads. High rainfall in areas with weak bedrock and soils increases the risk of erosion, landslides, stock damage, and runoff of contaminants into freshwater.

Flood hazard zones are shown in the Te Taitokerau CCCV viewer.

www.nrc.govt.nz/CCCVResources

Take care with the timing and location of the application of farm dairy effluent to avoid transport of nutrient and *E. coli to* water during rain events. Flooding can also transport sediment from exposed earth/cultivation if adequate sediment controls are not in place.

Climate change predictions also include rising water temperatures. Higher ocean temperatures causing sea level rise may increase salinity upstream, potentially moving coastal and estuarine habitats and requiring water in-takes to be relocated.

Warmer water temperatures also increase the frequency of algal blooms in rivers and lakes (especially when flows are low and nutrient levels are high). These blooms can limit the ability to take and use water and affect recreational and cultural values for water.

Many of our native freshwater species are adapted to cooler water and shaded waterbodies – climate change is therefore likely to make current issues facing native species even worse. This makes it important to restore riparian cover, increase the area of wetlands to supplement flows in rivers, and use freshwater efficiently.

You can find more info at Northland ClimateWEB.pdf (niwa.co.nz)

www.nrc.govt.nz/CCCVResources

Ngā ture kāwanatanga ā-motu, kaunihera ā-rohe Central government and regional council rules

There are both national and regional rules that are relevant to freshwater farm plans. National rules include:

- The Resource Management Act 1991 Part 9A Freshwater Farm Plans
- The Resource Management (Stock Exclusion) Regulations 2020
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020

www.nrc.govt.nz/CCCVResources

The Ministry for the Environment provides additional information about freshwater farm plans.

Ministry for the Environment – Freshwater Farm Plans

www.nrc.govt.nz/CCCVResources

Regional rules are applied through the Regional Plan for Northland.

Northland Regional Plan

www.nrc.govt.nz/CCCVResources

There can be overlaps between national and regional rules – in these cases the most restrictive rule applies. For more guidance, please see the Northland Regional Council Farmers Hub webpage.

www.nrc.govt.nz/CCCVResources

The sections of the regional plan most relevant to freshwater farm plans are listed below:

C.2 Activities in the beds of lakes and rivers and in wetlands
C.3 Damming and diverting water
C.4 Land drainage and flood control
C.5 Taking and use of water
C.6 Discharges to land and water
C.8 Land use and disturbance activities (including livestock exclusion, earthworks, cultivation and vegetation clearance). There are also catchment specific rules that apply in the Doubtless Bay FMU – see Rules in section E.3.1 of the Regional Plan.

In some cases, rules apply to areas identified on regional plan maps. The regional plan maps most relevant to freshwater farm plans are:

Hill Country and Lowland Areas – these relate to livestock exclusion rules (the rules differ for Hill Country and Lowland areas depending on livestock type). Please note there are also catchment specific livestock exclusion rules that apply in areas mapped as Whangarei Swimming Sites Stock Exclusion Areas.

Erosion Prone Land – tighter controls on earthworks and cultivation are applied to these areas mapped in the regional plan.

Outstanding Freshwater Bodies – these maps identify lakes and rivers (and their catchments) that have very high ecological, cultural, recreational or landscape values and are therefore subject to specific rules.

Priority Drinking Water Abstraction Points - these identify drinking water takes where particular controls on farm wastewater discharges and livestock exclusion are applied upstream of the water take (under Rules C.6.3.1 and C.8.1.2).

Mapped Sites of Significance to Tangata Whenua – these maps show sites and areas of significance to tangata whenua in the regional plan that are in freshwater bodies or the coastal marine area. While the Regional Plan does not include any mapped sites of significance in the Doubtless Bay FMU these maps do not reflect all sites that are important to tangata whenua in the region as many are not mapped or included in the regional plan. It is recommended that the relevant hapū is contacted for information on such sites.

Regional Plan maps

www.nrc.govt.nz/CCCVResources

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REGIONAL COUNCIL
Te Kaunihera ā rohe o Te Taitokerau