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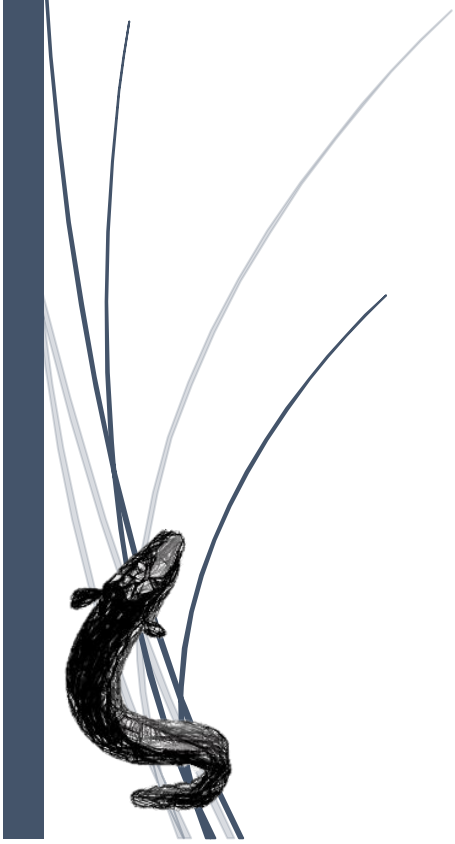
Waimatuku Stream Catchment

Review of values, freshwater restoration programmes and research needs

Prepared for:

Department of Conservation



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Introduction

The Department of Conservation's (DOC) Ngā Awa River Restoration Programme (Ngā Awa) began in 2019 with the vision of "Working together with our communities towards healthy, thriving rivers from source to sea"[1]. The Waimatuku Stream catchment has been identified as one of the 14 priority rivers under Ngā Awa. DOC will work with the relevant entities and agencies such as: Ngāi Tahu ki Murihiku, Environment Southland (ES), Forest and Bird, Fish and Game - Southland, and the angler and community groups to develop a restoration plan. The purpose is to improve the Waimatuku Stream catchment's ecological integrity and resilience with an emphasis on biodiversity restoration.

The objectives of Ngā Awa are:

- River ecosystems and species thrive from mountain to sea,
- Restored rivers enrich people's lives,
- Collaborate with others,
- Co-design and co-lead with iwi/hapū/whānau, and
- Recognise climate change.

To inform future restoration planning, DOC commissioned this report to collate and review all available information sources to document known conservation values of freshwater habitats of the Waimatuku Stream catchment.

This report collated existing material in the published and grey literature, it does not provide a new analysis of data.

This report is not a Ngāi Tahu cultural values report or an evaluation of restoration activities on cultural values and activities. Such a report would need to be conducted in partnership with mana whenua and is beyond the scope.

Figure 1: Lower Waimatuku Stream (Source: Pryor Rodgers)

[1] Department of Conservation 2022

Catchment description

The Waimatuku Stream flows along the Southland Plains between the Aparima catchment which lies to the west and the Ōreti catchment to the east. The headwaters of the Waimatuku Stream are fed by a large swamp area, the Bayswater Peat Bog, with several small springs throughout the Drummond district contributing to its flow. Middle Creek is the largest of the tributaries.

Historically the Southland Plains were cloaked by mixed hardwood forests with braided rivers, swamps and bogs scattered throughout the landscape and home to a rich diversity of flora and fauna.[2] The Waimatuku Stream meandered across its relatively swampy floodplain and through the Waimatuku Bush (Figure 2).[3] An early portrayal of the Waimatuku Stream describes:

> For the sportsman, this stream has been a paradise, not perhaps so much today as in the early days before it was deepened and straightened. It provided a wonderful breeding and feeding ground for ducks, pukeko, and towards the beach, black-swan; also provided a bountiful supply of trout, whitebait and flounder, and good and reasonably safe swimming and boating for the younger people. (Strange, 1969, p.44)

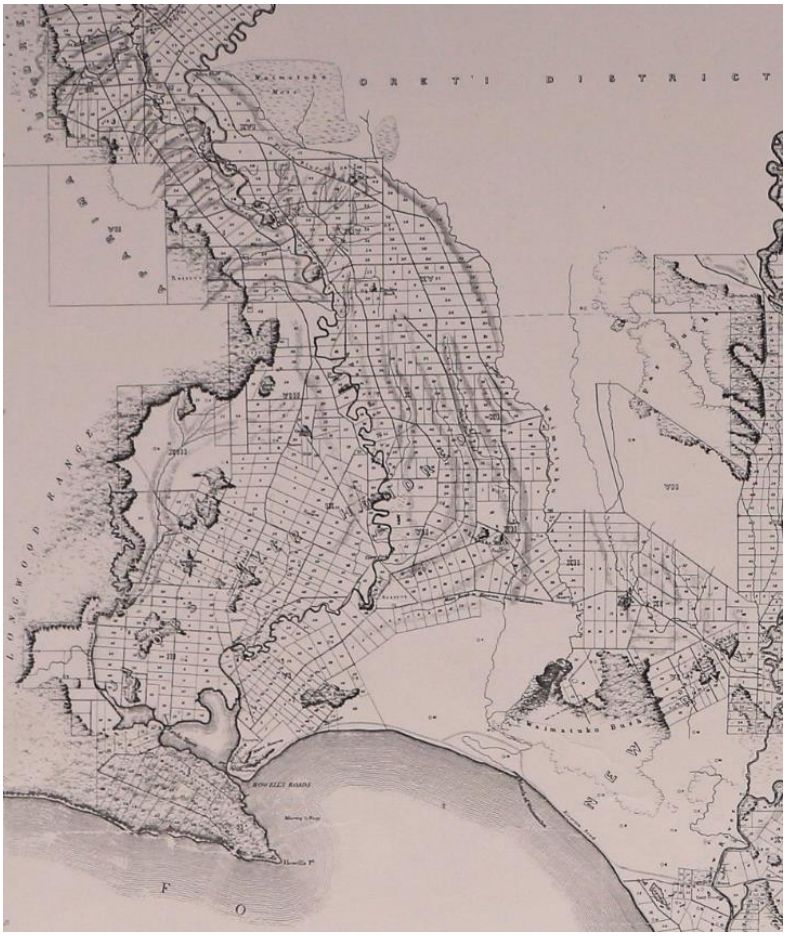

Figure 2: A map of the 'Province of Southland' from 1865 illustrates what the catchment looked like post European Settlement. The 'Waimatuku Bush' can be seen in the lower catchment. Source: Invercargill City Library and Archives.

[2] DOC 2008
[3] Cyclopedia Company Ltd 1905

In the 1920's the process of dredging began to deepen and straighten the stream bed, this was undertaken in two parts and took over 20 years in total.[4] Making it one of the earliest streams to be straightened in Southland and resulting in the channelised stream with relatively uniformed bank margins that we see today. The mouth of the estuary was cut in the 1990s to minimise erosion to the surrounding sandhills, today the estuary and mouth area is very active and is currently recutting its way to its original course. [5]

Today the Waimatuku Stream has moderate flows, with few floods or extreme low flow events due to much of the flow being derived from groundwater. It is a low elevation, low-relief catchment.[6] The Waimatuku Stream is tidal in its lower reaches, flowing through the Waimatuku Estuary before reaching the Foveaux Strait/Te Ara a Kiwa at Ōreti Beach.[7]

The Waimatuku catchment is 43 km in length and 190 km^2, it is a sub-unit of the Aparima Freshwater Management Unit (FMU).[8] Most information relating to the catchment in this report uses the catchment boundaries as described by the Waimatuku catchment sub-unit (Figure 3).

The catchment is dominated by farmland including sheep, beef and dairy.[9]

Bayswater Peat Bog

Bayswater Bog is a raised, rainfed peat bog. It ranges from 1 - 9 m in depth and covers an area of 12.2 km^2, 2 km^2 drains to the Aparima river, while the remaining 10.2 km^2 drains to the east forming the Waimatuku Stream.[10]

It is the largest wetland on the Southland Plains and is thought to be between 15,000 to 20,000 years old.[11] The wetland is a raised dome mire type bog, with the deepest peat (9 m) at the centre, this is the deepest bog in Southland. [12] The sloped margins of domed bogs typically drain down to a peripheral stream or swamp called a lagg.[13] It is likely that historically there would have been a "lagg wetland" around the wetland margin; this is now largely gone as a result of land development and drainage. [14]

Lakes

Big Lagoon is a shallow coastal lake situated inland of the Waimatuku Estuary, it has an area of almost 17 ha and is 7 m deep. It is surrounded by high producing farmland. The lake is in poor health.[15]

[4] Strange 1969
[5] LAWA 2023
[6] Environment Southland & Te Ao Marama 2023
[7] LAWA 2023
[8] Environment Southland 2019
[9] Stevens & Robertson 2010
[10] Robertson 1983 as cited in Hitchcock 2014
[11] Rance n.d.-a
[12] Rance n.d.-a
[13] Johnson & Gerbeaux 2004
[14] Rance n.d.-a
[15] Lakes380 2023b

Long White Lagoon is situated near the mouth of the Waimatuku River. It is the last in a small series of coastal lagoons and lakes situated along the coast between Invercargill and Riverton. Long White Lagoon consists of a series of semi-ephemeral freshwater lakes which have historically been modified and drained for agricultural land reclamation. It has an area of 1.4 ha, and it is 15 m deep, the waters are in hypertrophic condition with common algal blooms. There are high faecal levels. It is a habitat for common bullies.[16]

Figure 3: Waimatuku catchment sub-unit, of the Aparima FMU. Source: Environment Southland and Te Ao Marama (2023)

[16] Lakes 380 2023b

Estuary

The Waimatuku Estuary is a small 20 ha, relatively long, shallow (mean depth at high water 0.5 - 1 m), short residence type tidal river estuary with an upper saline limit (at high tide) that extends approximately 4.5 km inland from the mouth.[17] The estuary drains to the sea at the Ōreti Beach embayment through a sand dominated barrier beach and modified marram grass duneland and has relatively small intertidal flats. The single tidal opening at the mouth of the estuary periodically constricts, naturally reducing the salt intrusion[18] and requiring artificial opening a couple of times per year.[19]

Much of the back dunes have been significantly modified, levelled and grassed to be used for grazing. The upper estuary has also been modified with a strip of fescue and flax fenced off from the grazed pasture. In the lower estuary there are small patches of saltmarsh. Within the estuary there are areas of aquatic macrophytes (*Ruppia spp*) and also nuisance macroalgae. The estuary is included in ES long-term coastal monitoring programme. [20]

Climate

The climate in the Waimatuku catchment is classified as cool and dry (the category assignment criteria define cool: mean annual temperature <12°C and dry: mean annual effective precipitation <500 mm), based on the temperature and rainfall in the upstream catchment.[21]

The coastal zone is subjected to cold, salt-laden winds from the south and west, and the intermediate zone has a temperate climate with few severe frosts with winds from the south, west and northwest. [22] The average annual rainfall is 1,020 mm/yr.[23]

Surface water hydrology

The Waimatuku Stream has a relatively stable average flow, with a mean flow of 2.347 cumecs and a median flow of 1.509 cumecs[24], it has a substantial baseflow and the capacity to carry flows in the excess of triple the average flow.[25] The highest recorded flood was 40.9 cumecs in July 2023, which was 1.88 m above normal level. [26]

The 7 Day Mean Annual Low Flow is 0.616 cumecs, with the lowest flow recorded in April 2022 at 0.347 cumecs. Mean monthly flow as reported in Hitchcock (2014) and Figure 4 and 5 shows a seasonal pattern of low stream flows during the first four months of the year rising substantially in June and remaining high through winter and spring.[27] Within the Waimatuku surface water zone there are few surface water abstractions and allocation levels are low.[28]

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[17] Robertson & Robertson 2018

[18] Defined as a shallow, short residence time tidal river with adjoining lagoon estuary (SSRTREs) by the Estuary Trophic Index.

[19] Stevens & Robertson 2011

[20] Robertson & Robertson 2018

[21] Snelder & Biggs (2002) and https://shiny.niwa.co.nz/nzrivermaps/

[22] Environment Southland & Te Ao Marama 2023

[23] Environment Southland 2019

[24] https://envdata.es.govt.nz/index.aspx?c=flow&tab=hydro

[25] Hitchcock 2014

[26] https://envdata.es.govt.nz/index.aspx?c=flow&tab=hydro

[27] Wilson 2011 as cited in Hitchcock 2014

[28] https://www.lawa.org.nz/explore-data/southland-region/water-quantity/surface-water-zones/waimatuku-surface-water-zone/

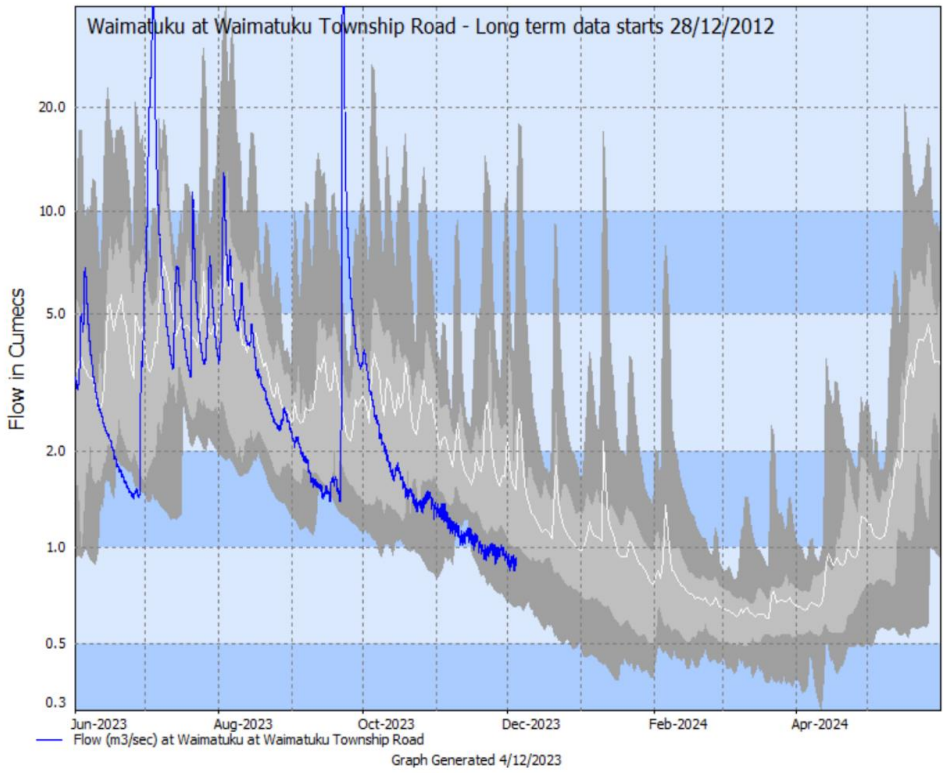


Figure 4: Waimatuku flow at Waimatuku Township Rd. The bottom and top of the dark grey areas represent the lowest and highest recorded values. The light grey area represents the typical values. The white line is the median value and the blue line represents data from the current year[29]. Source: Environment Southland, https://envdata.es.govt.nz/index.aspx?c=flow&tab=graph

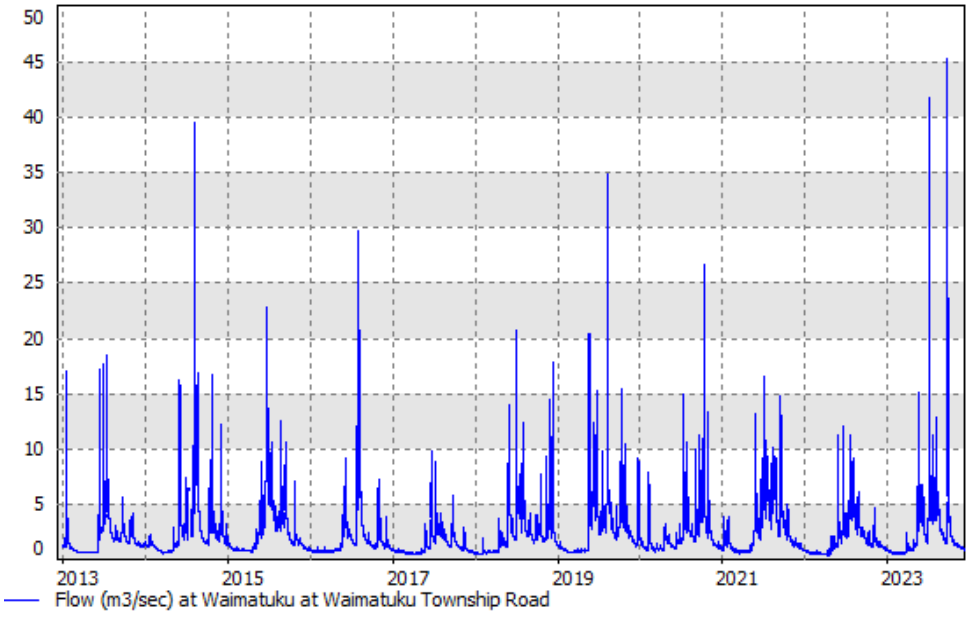


Figure 5: Waimatuku Stream at Waimatuku Township Road January 2013 - 05 December 2023 (cumecs). Data Source: Environment Southland, https://envdata.es.govt.nz/index.aspx?c=flow&tab=graph

[29] https://www.es.govt.nz/environment/water/low-water-levels/long-term-river-flow-data

Geology and Groundwater

The majority of the Waimatuku Catchment area overlies the Waimatuku Groundwater Management Zone (GMZ), with the western edge of the catchment overlying part of the lower Aparima GMZ.

The Waimatuku GMZ occupies a historic channel of the Aparima River, which formed during the last interglacial period (130,000 to 70,000 years before present) when the river flowed southwards from Wreys Bush before diverting westwards to its current course.[30]

The characteristic of the Waimatuku GMZ consists of a topography that is extensively flat to undulating alluvial terrace. The aquifer system comprises a relatively thin layer of reworked alluvium overlying older, stratified gravel deposits in the excess of 80 metres thick in the Drummond area. The depth to groundwater ranges from two to four metres below ground level, with a seasonal variation of less than a metre. The thick gravel layer in this area hosts an aquifer system that is highly connected to surface streams. The system is recharged by local rainfall that soaks through the soil, with little, if any recharge occurring from the Aparima River. Groundwater discharge occurs via baseflow to the surface drainage network in the Waimatuku catchment. [31]

Southland has been mapped into a range of physiographic zones. Due to biogeochemical and hydrological processes, each zone is different in the way contaminants build up and move through the soil, areas of groundwater and into surface water. Each zone has common attributes that influence water quality, such as climate, topography, geology and soil type.[32] These zones differ in the way contaminants are transported and attenuated within the catchment.

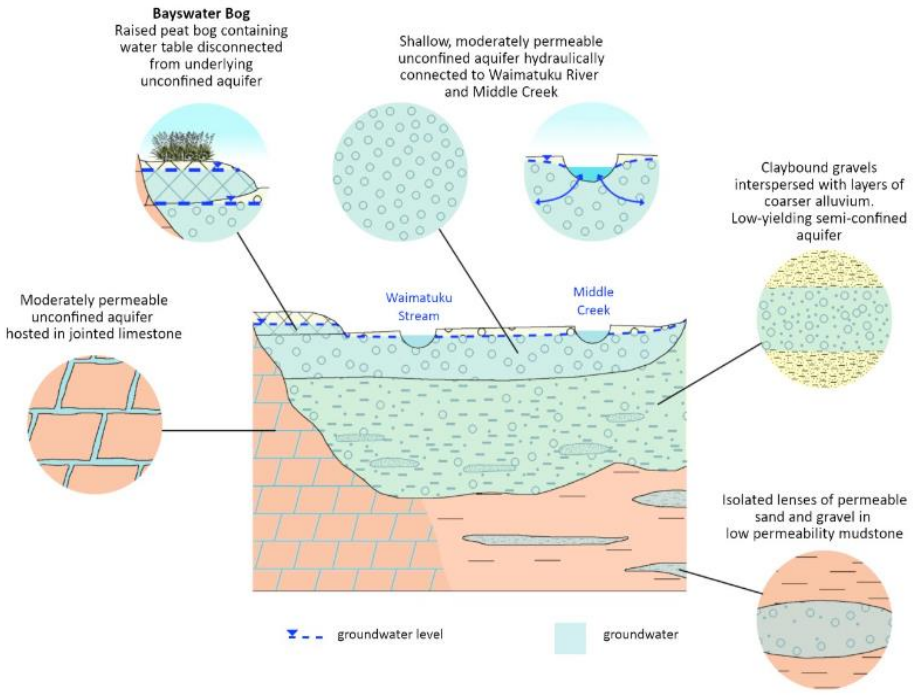


Figure 6: Generalised conceptual hydrogeological understanding of the Waimatuku GMZ. Source: Environment Southland.[33]

[30] Environment Southland n.d.-a
[31] Environment Southland n.d.-a; Hughes 2017
[32] Environment Southland n.d.-b
[33] Environment Southland n.d.-a

Large areas of the Waimatuku catchment fall into the Central Plains physiographic zone, with pockets of Peat Wetlands, Gleyed and Oxidising Zones. There are smaller areas of Lignite/Marine terraces towards the coast (Figure 7).[34]

Central Plains physiographic zone is characterised by clay-rich soils that shrink and crack when dry and swell when wet. Wet soils are prone to waterlogging, resulting in extensive artificial drainage networks. Dry soils are prone to shrinking and cracking, allowing drainage to bypass the soil to the underlying aquifer. Underlying gravel hosts an extensive 'unconfined' aquifer system. A dense network of streams flow through this zone. Streams and aquifers are not diluted or 'flushed' by major rivers. Drainage patterns to waterways for this zone vary depending on whether soils are wet (water mainly flows via artificial drainage into nearby streams) or dry (rainfall drains rapidly through soil cracks to underlying aquifer).

Aquifers and streams in this zone are prone to contamination build up as they don't experience dilution by a major river. During heavy or prolonged rainfall contaminants move quickly via artificial drains to streams. Some denitrification does occur in the soil but this does not offset the amount of nitrogen lost through drains. During summer rain, water and contaminants move rapidly from the land surface, through soil to underlying groundwater. Contaminants in shallow aquifers also make their way to streams, adding to the contamination load. More information on each zone can be found in Table 1.

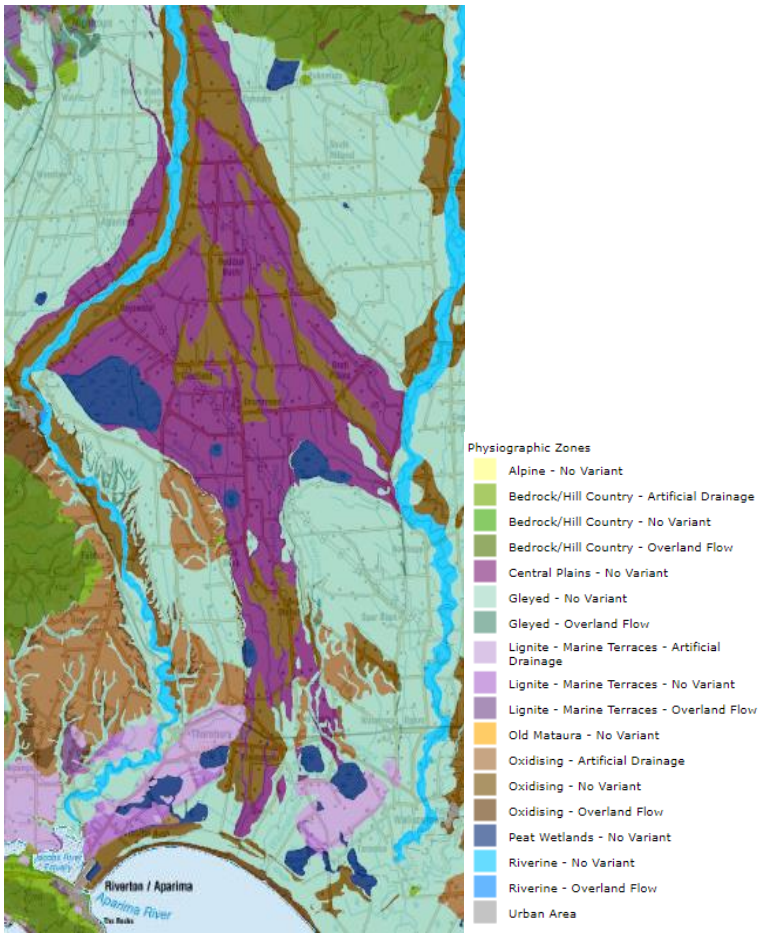


Figure 7: Physiographic zones in the Waimatuku catchment. Data source: Environment Southland, Beacon www.es.govt.nz

[34] Environment Southland n.d.-b

Table 1: Summary of the physiographic zones that occur within the Waimatuku catchment and the main contamination risks: Source: Environment Southland Physiographic zone factsheets.

Physiographic zones	**Description**	**Water Quality Contamination Risks**	**Mitigation needs**
Central Plains[35]	This zone includes areas of clay-rich soils found in the central part of the Southland Plains. These soils can crack extensively in summer as they dry out. And swell when wet in winter and early spring, becoming poorly drained.	Aquifers and streams in this zone are prone to contamination build up as they don't experience dilution by a major river. Wet soils: During heavy or prolonged rainfall contaminants move quickly via artificial drains to streams. Some denitrification does occur in the soil but this does not offset the amount of nitrogen lost through drains. Dry soils: During summer rain, water and contaminants move rapidly from the land surface, through soil to underlying groundwater. Contaminants in shallow aquifers also make their way to streams, adding to the contamination load.	Practices applicable to all zones: • Capture nutrients, sediment and microbes in wetlands and sediment traps. • Nutrient management. • Riparian management. • Effluent management. Reduce the effects of artificial drainage by: • Protecting soil structure, particularly in gullies and near stream areas. • Reducing phosphorus use and loss. • Reducing the accumulation of surplus nitrogen in the soil, particularly during autumn and winter.

[35] https://www.es.govt.nz/repository/libraries/id:1tkqd22dp17q9stkk8gh/hierarchy/Physiographic%20zone%20factsheets/central-plains.pdf

Physiographic zones	Description	Water Quality Contamination Risks	Mitigation needs
			• Capturing contaminants at drainage outflows. Reduce the effects of deep drainage by: • Reducing the accumulation of surplus nitrogen in the soil, particularly during autumn and winter.
Peat Wetlands[36]	Peat accumulates in areas where there is a naturally high water table, above poorly permeable rock. Peat soils are extremely acidic and have high levels of organic matter. They require extensive drainage in order to support agriculture.	Due to the fluctuating water table, when the water table is high streams are at risk of receiving high levels of contaminants via overland flow. When the water table is lower, streams receive contaminants via the extensive drainage system. Phosphorus loss is high, as it's poorly retained and leaches easily through the soil. Contaminant loss via artificial drains occurs following heavy rainfall or when the water table is near the surface.	Practices applicable to all zones: • same as above. Reduce the effects of deep drainage of phosphorus and microbes by: • Reducing phosphorus use or loss. • Reducing the transport of microbes. Reduce the effects of overland flow by: • Protecting the soil structure, particularly in gullies and near stream areas. • Managing critical source areas. • Reducing phosphorus use or loss.

[36] https://www.es.govt.nz/repository/libraries/id:1tkqd22dp17q9stkk8gh/hierarchy/Physiographic%20zone%20factsheets/peat-wetlands.pdf

Physiographic zones	Description	Water Quality Contamination Risks	Mitigation needs
			Reduce the effects of artificial drainage by: • same as above.
Gleyed[37]	The Gleyed zone is found in low-lying areas. Soils are poorly drained, prone to waterlogging, and have distinctive grey or rust-coloured spots or mottles. Soils and aquifers can remove some to all nitrogen via denitrification.	Artificial drainage rapidly moves excess soil water and contaminants to rivers and streams particularly during heavy rainfall.	Practices applicable to all zones: • same as above. Reduce the effects of artificial drainage by: • same as above. Reduce the effects of overland flow by: • same as above.
Oxidising[38]	The Oxidising zone is characterised by soil water and groundwater that contain high levels of oxygen, which allows nitrogen to accumulate.	High risk of nitrogen build up in groundwater. Following heavy or prolonged rainfall contaminant losses to rivers and streams may occur via overflow or artificial drainage.	Practices applicable to all zones: • same as above. Reduce the effects of artificial drainage by: • same as above. Reduce the effects of overland flow by: • same as above.

[37] https://www.es.govt.nz/repository/libraries/id:1tkqd22dp17q9stkk8gh/hierarchy/Physiographic%20zone%20factsheets/gleyed.pdf
[38] https://www.es.govt.nz/repository/libraries/id:1tkqd22dp17q9stkk8gh/hierarchy/Physiographic%20zone%20factsheets/oxidising.pdf

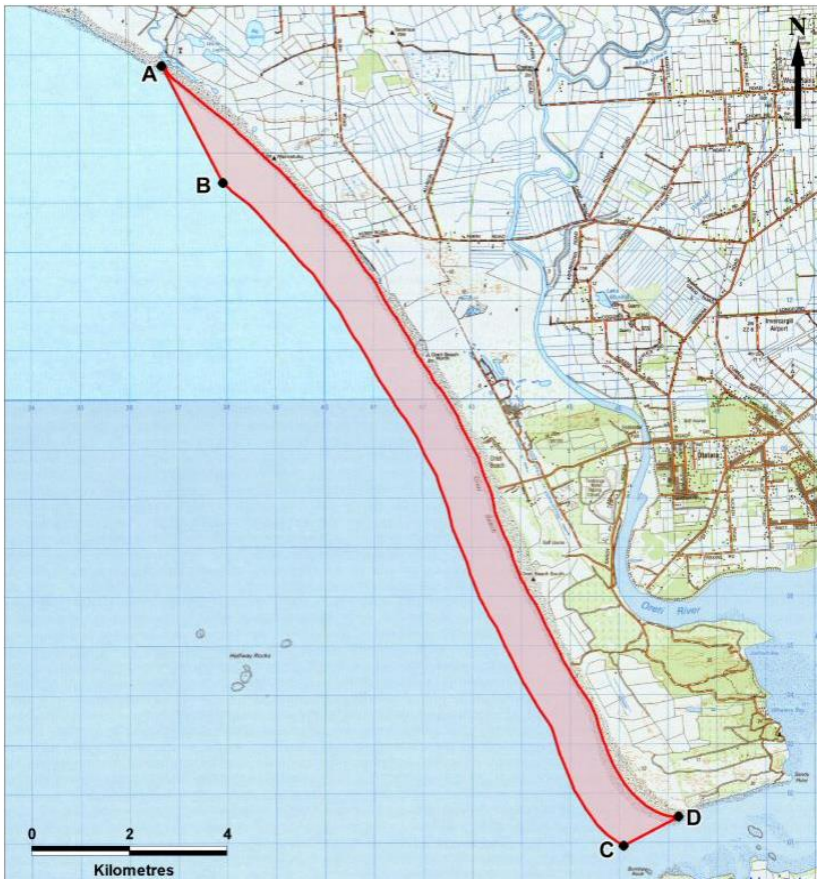
Physiographic zones	Description	Water Quality Contamination Risks	Mitigation needs
Lignite - Marine Terraces	This zone refers to areas where organic-rich sediment occurs at or near the land surface. Distinct sediment types: Lignite and coal - found inland. Marine terrace - found along the South Coast. The geology strongly influences water quality.	Little nitrogen build-up in deeper groundwater due to high rates of denitrification. Phosphorus build-up in soils is low where lignite and marine sediments are close to the surface. Streams are at risk from contaminants moving via overland flow and artificial drainage during heavy rainfall and when soils are wet.	Practices applicable to all zones: ● same as above. Reduce the effects of overland flow by: ● same as above. Reduce the effects of artificial drainage by: ● same as above.

Mana whenua

Te Rūnaka o Ōraka-Aparima and Te Rūnanga o Waihopai have shared kaitiaki interests in the Waimatuku Stream, as the awa denotes the boundary between the two rūnanga takiwā. The takiwā of Te Rūnaka o Ōraka-Aparima extends east to the Waimatuku, the other Murihiku Rūnaka (Te Rūnanga o Awarua, Te Rūnanga o Waihopai and Hokonui Rūnaka) have shared interests in this area.

The Waimatuku Stream flows into Te Ara a Kiwa/Foveaux Strait, whose importance to mana whenua is recognised with a Statutory Acknowledgement. Statutory Acknowledgements were included as part of the Cultural Redress elements of the Crown's Settlement Offer to Ngāi Tahu and were aimed at restoring the ability of mana whenua to give practical effect to their kaitiaki responsibilities. Statutory Acknowledgements are one of the instruments created to recognise the mana of Ngāi Tahu in relation to a range of sites and areas. The neighbouring rivers, Ōreti and Aparima, both have Statutory Acknowledgements.

The Ōreti Mātaitai Reserve (Figure 8) was established in 2010 and commences at the Waimatuku Stream mouth and runs east to the New River Estuary/Kōreti. Tangata tiaki/kaitiaki are appointed to the mātaitai under the Fisheries (South Island Customary Fishing) Regulations 1999. Those appointed can determine management and sustainability measures within the reserve. Commercial fishing within the mātaitai is prohibited, and tangata tiaki/kaitiaki may authorise any individual to take fish, aquatic life or seaweed for customary food gathering purposes from within the mātaitai. No customary fishing may take place without authorisation.[39]



[39] Fisheries (Declaration of Oreti Mataitai Reserve and Appointment of Tangata Tiaki/Kaitiaki) Notice 2010

Figure 8: Ōreti Mātaitai Reserve. Source: Ministry of Primary Industries https://www.mpi.govt.nz/dmsdocument/15235-Oreti-Southland-Mataitai-Reserve-

Values

Environmental and Conservation

Public Conservation and Reserve Areas

The majority of the Waimatuku catchment is in private ownership and pasture, however there are some areas of public conservation and reserve area (Figure 9).

In the upper catchment DOC administers two public conservation areas the Bayswater Peatland Scenic Reserve (recorded area 518.9 ha) and the Drummond Swamp Wildlife Management Reserve (256.42 ha). In the mid catchment there is a small section of stewardship area (Conservation area - Waimatuku Stream, 1.2 ha) adjacent to a fixed marginal strip, which has no access points other than over private land.[40] And in the lower catchment there are four marginal strips administered by the Department of Conservation which range from 4.39 ha to 51 ha. Three of these are no longer aligned to the Waimatuku Stream apart from in small areas.[41]

Figure 9: Conservation areas in the Waimatuku Catchment: upper catchment (top left), mid-catchment (top right) and lower catchment (bottom left). Source: DOC maps.

[40] Jane Bowen (DOC) pers comms

[41] https://doc-deptconservation.opendata.arcgis.com/datasets/72354ba9bf7a4706af3fdfe60f86eea1_0/explore?location=-46.208157%2C168.211126%2C12.20

There are a number of areas managed by the Southland District Council: the Otautau New Cemetery on Bayswater Road, the Calcium Isla Banks Cemetery, the Drummond McFarland Park and the Drummond Rugby Club.[42]

There are several QEII covenant areas within the catchment area that cover a range of different wetland types and hold significant pockets of biodiversity within the catchment. The QEII covenant with publicly available information includes:

- one at the corner of Hundred Line Rd and Drummond-Heddon Bush Rd, [43]
- a micro-covenant within the 'Blueberry Country' Farm by Bayswater Peat Bog, [44]
- areas of Long White Lagoon, [45]
- Big Lagoon (32 ha),[46] and
- a raised peat bog in Drummond. [47]

Graeme and Jan Appleby have protected the raised peat bog on their dairy farm in Drummond with a QEII covenant. The restoration work they have undertaken includes significant weed control (predominantly gorse), and planting. Since the protection (~2016) they have seen a regeneration of the wetland which is home to the Australasian bittern, skinks and orchid species. It is a nesting site for the Harrier Hawk and tui and bellbirds utilising the Eucalyptus shelter[48].

Within the catchment there have been two High Value Area (HVA) ecological surveys which have been provided to landowners by Environment Southland, in total covering approximately 27.72 ha.[49] This information and data from these surveys cannot be shared without landowner permission. For restoration purposes, collaboration with landowners will likely promote data sharing.

Vegetation

The majority of the Waimatuku Catchment is covered in exotic grassland (90%, Table 5), however there are pockets of unique vegetation from the upper catchment to the estuary and surrounding sand dunes.

[42] Southland District Council n.d.
[43] Heddon Bush School
[44] McAvinue 2022
[45] Rance 1992; https://www.sern.org.nz/news/sern-spring-field-trip/
[46] Ratley 2012
[47] Graeme Appleby pers comms
[48] Graeme Appleby pers comms; https://www.facebook.com/environmentsouthland/videos/graham-and-jan-appleby-nominee-southland-community-environ/1815510478479049/
[49] Polly Bulling (ES) pers comms

Figure 10: 'The Donut' Source: Heddon Bush School Facebook.

Upper catchment

- In the upper catchment there is a QEII Open Space Covenant that is looked after by the local school (Heddon Bush School). The tamariki have affectionately called the stand 'The Donut'. It is a small stand (~1 ha) of kahikatea remnant forest. This patch of forest has been fenced since 1986 to protect it from stock damage and in 2008 DOC developed a restoration plan for the site.[50] The school along with the owners, QEII Trust, Environment Southland and others have been planting, weeding and trapping the area since ~2010. [51]

Bayswater Peatland Bog

- Bayswater Peatland Bog is a Scenic Reserve. Due to the peaty nature of the soil (acidic, waterlogged, infertile) the conditions for vegetation growth in this bog are difficult, however specialised flora has evolved to cope with these conditions. These bogs tend to have limited flora which is dominated by a few species (*Empodisma minus*/wirerush, *Leptospermum scoparium*/mānuka, *Dracophyllum oliverii*/bog inaka or turpentine, *Gleichenia dicarpa*/tangle fern and *Sphagnum cristatum*/sphagnum moss). Some of the specialised plants include sundews, which are insectivorous.[52]
- *Lepidothamnus laxiflorus*/pygmy pine and *Halocarpus bidwilli/*bog pine are now uncommon or lost due to past fire disturbance. [53]
- In 1993 Rance recorded only one exotic species which was gorse. The native species recorded included: ferns, herbs, lycophytes, an orchid (swamp sun orchid), rushes and allied plants, sedges, trees and shrubs including mānuka (At Risk declining).[54]
- In 2006 more exotics were recorded (*Agrostis capillaris/*browntop, *Betular pendula*/Silver birch*, Holcus lanatus*/Yorkshire fog, *Hypochaeris radicata/*catsear*, Rubus fruiticosus agg.*/blackberry, *Sorbus aucuparia subsp. aucuparia*/rowan and *Ulex europaeus*/gorse). The native species recorded include similar structural classes as in 1993, with the exception of

[50] Pat Hoffman (DOC) pers comms 2024; DOC 2008
[51] Heddon Bush School
[52] Rance n.d.-a
[53] Rance n.d.-a
[54] Rance 1993

the lycophytes. *Gentianella lineata* a dicotyledon herb was recorded which is classified as 'At Risk - Relict' and is only found south of Otago and on Stewart Island.[55]

- A more recent visit by DOC recorded a considerable amount of silver birch from sapling size to mature trees throughout the bog. There were also large clumps of mature gorse, blackberry, rowan saplings, blueberry plants near the border with the Blueberry farm and pasture grass encroaching on the bog.[56]

Figure 11: Bayswater Peat Bog. Source: Department of Conservation.

Drummond Swamp

- The Drummond Swamp is classified as a Wildlife Management Reserve and is one of the larger reserves on the Southland Plains (256.42 ha). The vegetation is typical of peat bogs on the Southland Plains. [57]
- A vegetation survey was undertaken in 2008 which identified *Empodisma minus*/wirerush to be the dominant community (50-90% cover) with *Gleichenia dicarpa*/tangle fern, sphagnum moss and *Dracohyllum oliverii*/swamp inaka. Lowland flax is common on the northern side of the wetland and there are small localised scale mossy hollows containing *Baumea rubiginosa* and *B. tenax.* [58]
- There was a large, disturbed area during the vegetation survey which was thought to have been created by an old gull colony. This area was dominated by exotic grasses and soft rush.[59]
- The woody flora is limited with bog pine, celery pine and pygmy pine all absent.
- The plants recorded in 1988 include a range of natives including ferns, herbs (sundews, mountain daisy, harakeke), lycophytes, orchids (onion-leaved orchid, leek orchid and the swamp sun orchid), rushes and allied plants, sedges and tree and shrubs (including the 'At Risk- Declining' mānuka).[60]
- Exotic species cover the structural classes of grasses, herbs, rushes and allied plants and trees and shrubs. These include species such as thistles, silver birch, black berry and broom. Of the 36 exotic species recorded in 2008, 11 are considered a conservation concern. [61]

Long White Lagoon

- In 1992 a vegetation survey recorded four species classified as 'At Risk - Declining' these are: *Leptospermum scoparium var. scoparium*/mānuka, *Isolepis basilaris*/pygmy clubrush, *Epilobium insulare*/ willowherb and *Mazus arenarius*.

[55] Lange 2004; Rance 2006
[56] Kaitlyn Hamilton (DOC) pers comms 2023
[57] Rance et al. 2008
[58] Rance et al. 2008
[59] Rance et al. 2008
[60] Rance 1988
[61] Rance et al. 2008

- *Mazus arenarius* is a small mat forming herb that is only found in the lower South Island and Stewart Island (only 7 known sites on each island).[62]There are a range of ferns, grasses, native sedges, herbs, grasses, rushes, trees and shrubs (such as cabbage tree/tī kōuka, bush lawyer/tātarāmoa, lancewood/horoeka) and a native leek orchid (*Prasophyllum colensoi*). And exotic herbs, grasses, rushes, sedges, trees and shrubs, including problematic weeds such as blackberry.

Waimatuku Mouth Turf Community

- There are a range of native sedges recorded as well as native and exotic rushes, herbs and grasses recorded around the Waimatuku River Mouth. *Oxybasis ambigua* whose threat status is 'At Risk - declining' has also been recorded in the area.[63]

Wetlands

There are a range of wetlands in the Waimatuku Catchment. Bayswater Bog, Waimatuku Wetland and Drummond Peat Swamp are recognised as regionally significant. Bayswater Bog has also been recognised by DOC as one of the top 1000 ecosystems nationally due to its scale and relatively intactness, Long White Lagoon was also included in this list.[64] A number of these wetlands have been proposed as regionally significant wetlands by the Proposed Water and Land Plan (Table 2). These wetlands are: Big Lagoon, Thornbury Peatland and the Waimatuku Estuary.

Big Lagoon and Thornbury Peatland were assessed for significance using the Southland Regional Policy Statement criteria of representativeness, rarity, diversity and ecological context. While the Waimatuku Estuary is proposed to be included because it is identified as having Dune Slacks as part of the Coastal Wetland in Appendix 2 of the Southland Regional Policy Statement (See Table 2).[65]

[62] Lange 2003; Rance 1992

[63] Rance n.d.-b

[64] Ros Cole (DOC) pers comms.

[65] Environment Southland 2017a; Environment Southland 2017b

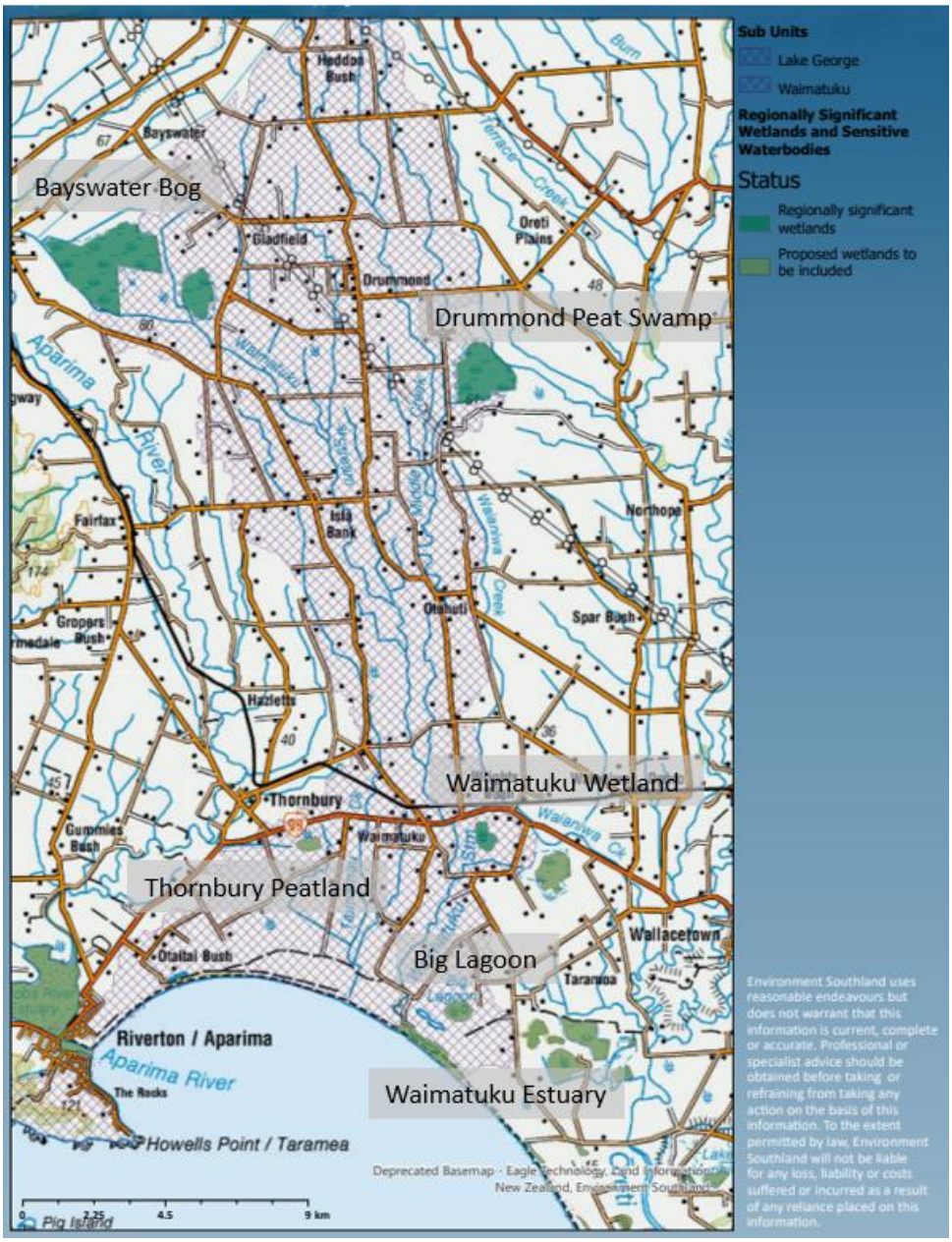


Figure 12: Regionally significant and proposed regionally significant wetlands in the Waimatuku catchment. Data source: Environment Southland, Beacon https://maps.es.govt.nz/index.aspx?app=water-and-land&ext=1126883,4820931,1373775,4939715

Table 2: Regionally significant and proposed regionally significant wetlands in the Waimatuku catchment. Data source: Proposed Southland Water and Land Plan Section 42 Hearing Report and Southland Regional Policy Statement 2017.

Wetland name	Proposed/Regionally significant	RPS- Significance criteria	Baseline Reference
Bayswater Bog (ID 8)	Regionally significant wetland		

Drummond Peat Swamp (ID28)	Regionally significant wetland		
Thornbury Peatland (ID 96)	Proposed wetland to be included	Representativeness	RAP 4, Southland Plains Ecological District Protected Natural Areas Programme Report (Walls & Rance, 2003)
Waimatuku Wetland (ID 109)	Regionally significant wetland		
Big Lagoon (ID10)	Proposed wetland to be included	Representativeness; Rarity/Distinctiveness; Diversity.	RAP 8, Southland Plains Ecological District Protected Natural Areas Programme Report, Walls & Rance (2003); WERI 0137
Waimatuku Estuary (ID108)	Proposed wetland to be included	Appendix 2 Schedule of Threatened, at risk and rare habitat types. Coastal wetlands - Dune Slacks	

Notes on the Regional Policy Statement significance criteria

Appendix Two: Schedule of Threatened, At Risk and Rare Habitat Types

- Coastal wetlands - Dune slacks are small, nutrient enriched, vegetated, moist depressions between dunes close to the sea. They occur where wind has eroded hollows or depressions in raw sand, or where water is permanently or seasonally ponded especially during high tides when they periodically hold slack water (scarcely moving).

Appendix 3: Significance Assessment Criteria

- Representativeness - Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district or coastal biogeographic region. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.

- Rarity/Distinctiveness - Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, freshwater environment, or coastal biogeographic region.
- Diversity and Pattern - Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.

Freshwater Fish

The Waimatuku catchment has a range of native fish species recorded of both migratory and non-migratory species (Table 3). The threat categories range from Nationally Vulnerable, At-Risk to Not Threatened. The climate change vulnerability has been assessed as highly vulnerable for both kanakana/lamprey and the tuna/longfin eel.

The majority of the freshwater fish species recordings (Table 3) were collated from the New Zealand Freshwater Fish Database (NZFFD), with the most recent additions of 2022 and 2023 being detected by eDNA surveys. Environmental DNA (eDNA) are the traces of genetic material that are left behind by either living species that have passed through the water, air or soil or dead things whose genetic material is still detectable in that environment. Molecular techniques capable of targeting eDNA are now widely used in environmental research and are increasingly being incorporated into monitoring programmes worldwide. The main advantages of these approaches are increased sensitivity, faster sampling times and, in many cases, they are cost-effective relative to traditional approaches. However, there are important caveats that do need to be considered; for example, the data are not quantitative, and robust validation is required to avoid false positives and negatives.[66]

In late 2023 DOC undertook a comprehensive eDNA sampling survey of the Waimatuku catchment (Appendix 6, Figure 27). These surveys detected fish species that had previously not been recorded in the Waimatuku catchment including Giant Kōkopu and Kōaro, both were recorded in the Taunamau Stream rather than the Waimatuku Stream and Kōaro was only a tentative detection.

Gollum galaxias have only been recorded using eDNA in this catchment, however, were caught and positively identified while carrying out the 2023 DOC survey.[67] Giant bullies were also detected which had not been recorded since 1938, although this was only a tentative detection in one of the lagoons. The eDNA sampling recorded species that have been consistently recorded in the Waimatuku catchment including longfin and shortfin tuna.

Apart from Inanga, no migratory galaxiids were recorded as part of the eDNA survey within the Waimatuku Stream[68] (Giant Kōkopu and Kōaro were detected in the Taunamau Stream). As the Waimatuku Stream is a popular whitebaiting site, it would be interesting to samples some of the catches to better understand the whitebait species that are making up these catches.

In 2010 Moate studied the growth of Brown Trout in the Waimatuku Stream, they found that Brown Trout distribution and productivity is significantly reduced (according to spawning and juvenile surveys, angler catch rates and angling counts, which was further supported by fyke netting, field observations, water parameter effects and anecdotal comments from anglers and landowners). The

[66] Schallenberg et al. 2023
[67] Jane Bowen (DOC) pers comms.
[68] Jane Bowen (DOC) pers comms.

otolithometry indicated brown trout were growth limited and diet samples found few mayflies, replaced by caddis with a reliance on crustacea and fish.[69]

The eDNA surveys by DOC provide important information for the Waimatuku catchment, prior to these, from our understanding, there has been no systematic and repeated survey of freshwater species distribution within the catchment. The majority of the records were pre-2000 and there were a number of important sites not included (such as Bayswater Peat Bog, the coastal lagoons and lakes and wetlands). The eDNA surveys collected samples from many of these important sites. It is recommended these surveys within the catchment are repeated over time to tailor management and restoration activities to certain species. Such surveys should be repeated to enable the assessment of the effectiveness of restoration activities.

[69] Moate 2010

Table 3: Freshwater species found in scientific surveys in the Waimatuku Stream and surrounding creeks, Conservation Status and Climate Change Vulnerability Assessment ranking. * notes an eDNA result, 2022 results sourced from Wilderlabs and 2023 results from DOC.[70]

Freshwater Species	**Scientific Name**	**Conservation Status**[71]	**Additional conservation status information**[72]	**Age of records/location**	**Climate Change Vulnerability Assessment ranking**[73]
Black flounder	*Rhombosolea retiaria*	Not threatened	Data Poor	1979 (Taunamau Creek) 1985, 1991, 2012, 2022*, 2023* (Waimatuku Stream) 2022*, 2023* (Middle Creek)	_
Brown trout	*Salmo trutta*	Introduced and naturalised		1979, 1985, 2004, 2012,2022*,2023* (Waimatuku Stream) 1979, 2023*(Taunamau Creek) 1982,2012,2023* (Ayre Creek) 2022*,2023* (Middle Creek)	_

[70] Some species included as in eDNA have 'tentative' detections, see Appendix Six for further detail.
[71] Dunn et al 2018; Grainger et al. 2018
[72] Dunn et al 2018; Grainger et al. 2018
[73] Egan et al 2020

Freshwater Species	Scientific Name	Conservation Status[71]	Additional conservation status information[72]	Age of records/location	Climate Change Vulnerability Assessment ranking[73]
Common bully	*Gobiomorphus cotidianus*	Not threatened	Data Poor	1961,1985, 1991,2004, 2023* (Waimatuku Stream) 1981,1994, 1996, 2023* (Middle Creek) 1982 (Ayre Creek) 2023*(Taunamau Creek) 2023* (Big Lagoon) 2023* (Long White Lagoon)	_
Common Smelt	*Retropinna retropinna*	Not threatened		1985 (Waimatuku Stream)	_
Giant bully	*Gobiomorphus gobioides*	At risk - naturally uncommon	Data Poor Range Restricted	1938 (Waimatuku Stream) 2023* (Big Lagoon)	_
Giant Kōkopu	*Galaxias argenteus*	At risk- declining	Partial decline	2023* (Taunamau Creek)	Moderate
Giant or shortjaw kōkopu	*Galaxias argenteus/postvectis*			2023* (Taunamau Creek)	_

Freshwater Species	Scientific Name	Conservation Status[71]	Additional conservation status information[72]	Age of records/location	Climate Change Vulnerability Assessment ranking[73]
Gollum galaxias	*Galaxias gollumoides*	Threatened - Nationally vulnerable	Data Poor	2022*, 2023* (Middle Creek) 2022*, 2023* (Waimatuku Stream) 2023* (Ayr Creek) 2023* (Taunamau Creek)	_
Inanga	*Galaxias maculatus*	At risk - declining	Conservation Dependent Secure Overseas	1979, 2023* (Taunamau Creek) 1985, 2004, 2023* (Waimatuku Stream) 2022*, 2023* (Middle Creek)	High
Kōaro	*Galaxias maculatus*	At risk- declining	Partial decline	2023* (Taunamau Creek)	High
Lamprey/Kanakana	*Geotria australis*	Threatened - nationally vulnerable	Data Poor Secure Overseas	2004, 2012, 2023* (Waimatuku Stream) 2023* (Middle Creek)	Very high

Freshwater Species	**Scientific Name**	**Conservation Status**[71]	**Additional conservation status information**[72]	**Age of records/location**	**Climate Change Vulnerability Assessment ranking**[73]
Longfin eel/Tuna	*Anguilla dieffenbachii*	At risk - declining	Conservation Dependent Data Poor	1981, 1993, 1994, 1996, 2022*, 2023* (Middle Creek) 1993 (Middle Creek tributary) 1982, 1994, 1995, 1996 2012, 2023* (Ayre Creek) 1982, 1985, 1991, 2004,2012, 2015, 2022*, 2023* (Waimatuku Stream) 2023*(Big Lagoon) 2023*(Long White Lagoon) 2023*(Taunamau Creek)	Very high
New Zealand sole	*Peltorhamphus novaezeelandiae*			2023* (Waimatuku lower lagoon)	_
Redfin Bully	*Gobiomorphus huttoni*	Not threatened	Partial Decline	1961, 1982, 2004, 2015, 2023* (Waimatuku Stream) 2023* (Taunamau Creek) 2023* (Middle Creek)	_

Freshwater Species	Scientific Name	Conservation Status[71]	Additional conservation status information[72]	Age of records/location	Climate Change Vulnerability Assessment ranking[73]
Shortfin eel	*Anguilla australis*	Not threatened	Increasing	1982, 2023* (Ayre Creek) 2012, 2015, 2022*, 2023* (Waimatuku Stream) 1993 (Middle Creek tributary) 1994, 2022*, 2023* (Middle Creek) 2023* (Taunamau Creek) 2023* (Big Lagoon) 2023* (Long White Lagoon)	High
Torrentfish	*Cheimarrichthys fosteri*	At risk - declining		1985,2004 (Waimatuku Stream)	_
Unidentified bully	*Gobiomorphus*			1978, 1979, 2009, 2015, 2023* (Waimatuku Stream) 1979 (Taunamau Creek) 1981 (Middle Creek) 1982 (Ayre Creek)	_

Freshwater Species	Scientific Name	Conservation Status[71]	Additional conservation status information[72]	Age of records/location	Climate Change Vulnerability Assessment ranking[73]
Unidentified eel	*Anguilla*			1978, 1979 (Waimatuku Stream)	_
Unidentified galaxiid	*Galaxias*			1979, 1985(Waimatuku Stream) 1982, 1994, 1995 (Ayre Creek) 1994, 1996 (Middle Creek)	_
Upland bully	*Gobiomorphus breviceps*	Not threatened	Data Poor	1961, 1985, 1991, 2012, 2022*, 2023* (Waimatuku Stream) 1982, 1994, 1995, 2012, 2023* (Ayre Creek) 1981, 1994, 1996, 2022*, 2023* (Middle Creek) 2023* (Taunamau Creek)	_
Upland or kaharore bully	*Gobiomorphus breviceps or mataraerore*			2023* (Taunamau Creek) 2023* (Waimatuku Stream)	_

Freshwater Species	Scientific Name	Conservation Status[71]	Additional conservation status information[72]	Age of records/location	Climate Change Vulnerability Assessment ranking[73]
				2023* (Ayr Creek) 2023* (Middle Creek)	
Invertebrate Species					
Kōura	*Paranephrops*[74]	At risk - declining		1979, 2012, 2015, 2022*, 2023* (Waimatuku Stream) 1981,1994,1996, 2023* (Middle Creek)	Moderate

[75]

[74] Most likely *P. zealandicus* (with the known distribution of the two species from the NZFFD)
[75] NZTC for *P. zealandicus*

Fish Passage Barriers

The current National Policy Statement for Freshwater Management 2020 requires Regional Councils to protect habitats of threatened freshwater species and management for fish passage. ES is currently embarking on a five-year programme to retrofit 250 fish passages in Southland, as part of the Governments Jobs for Nature Programme. The project aims to retrofit baffles, spat rope and ramps to culverts to remove in-stream barriers. Barriers to fish passage are identified through surveys with the majority of remediation being done within the roading network.[76]

Within the Waimatuku catchment there had previously been limited fish passage barrier surveys, with potential for more extensive surveys and remediation.[77] Through the ES work programme there are a number of barriers where remediation work has been undertaken, there are some structures identified that need maintenance or further investigation, and many have been assessed as not currently significant barrier (see Figure 14).

Prior to the fish passage surveys undertaken by the Department of Conservation late 2023, all records in the NIWA Fish Passage Assessment Tool were considered historic. Of these historic recordings most structures identified are of low risk, a number are unidentified, there are a number considered high risk particularly in the upper catchment and some considered very high risk.

The most recent assessments undertaken by DOC (see Figure 13) show a range of structure considered high risk, and two in the lower catchment considered very high risk. These structures are predominantly culverts while the low-risk structures are bridges.

For future restoration efforts it will be important to gain a better understanding of the potential fish passage barriers on private land, are the majority of recent surveys have been on parts of the Waimatuku Stream that is accessible by public roading.

[76] https://www.es.govt.nz/jobs-for-nature/fish-passage-project?ed-step=1; Kelly 2020

[77] Polly Bulling (ES) pers comms 2023

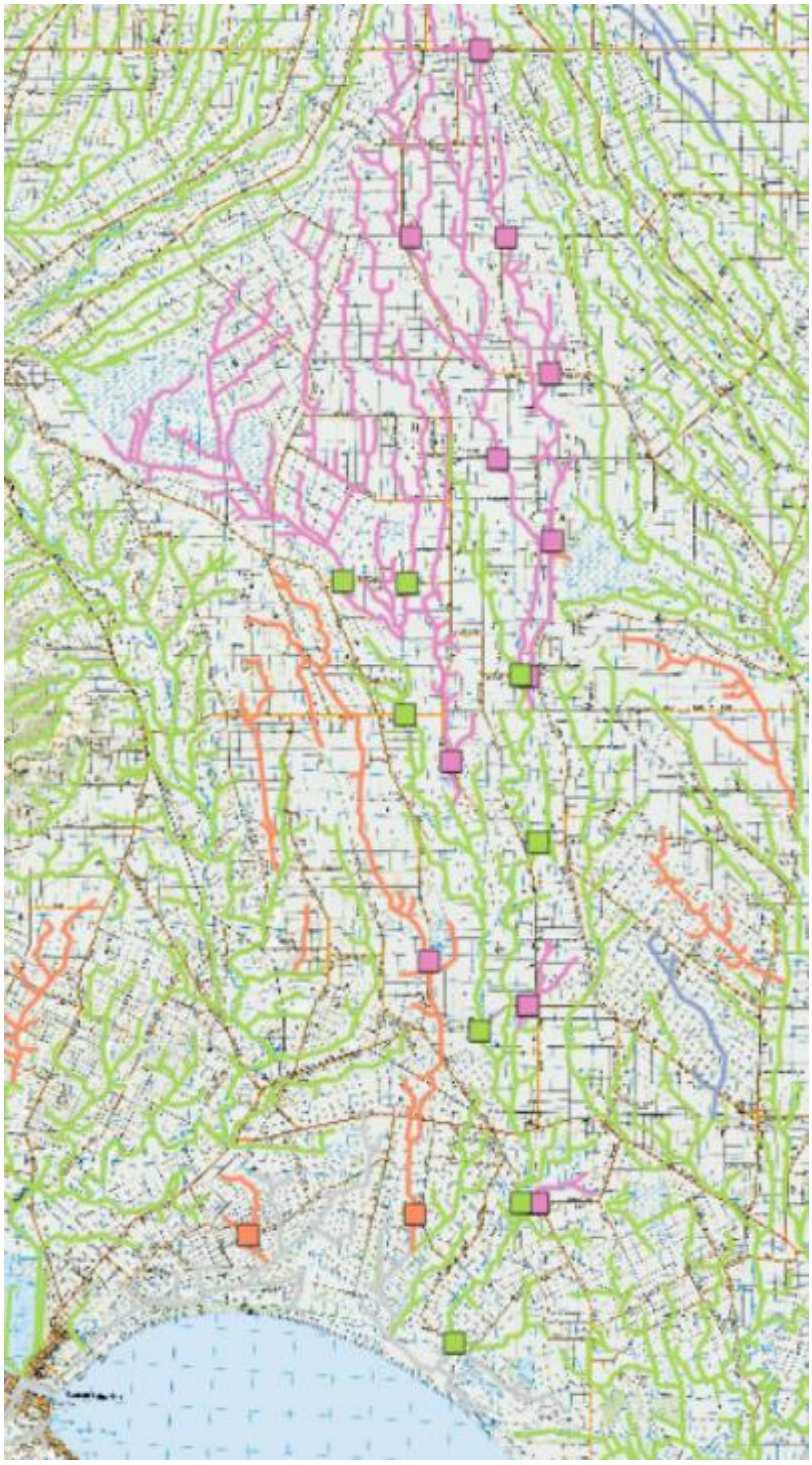


Figure 13: Fish passage assessment within the Waimatuku Catchment (not including historic recordings). Orange= very high risk, pink= high risk, green = low risk. Source: NIWA Fish Passage Assessment Tool.

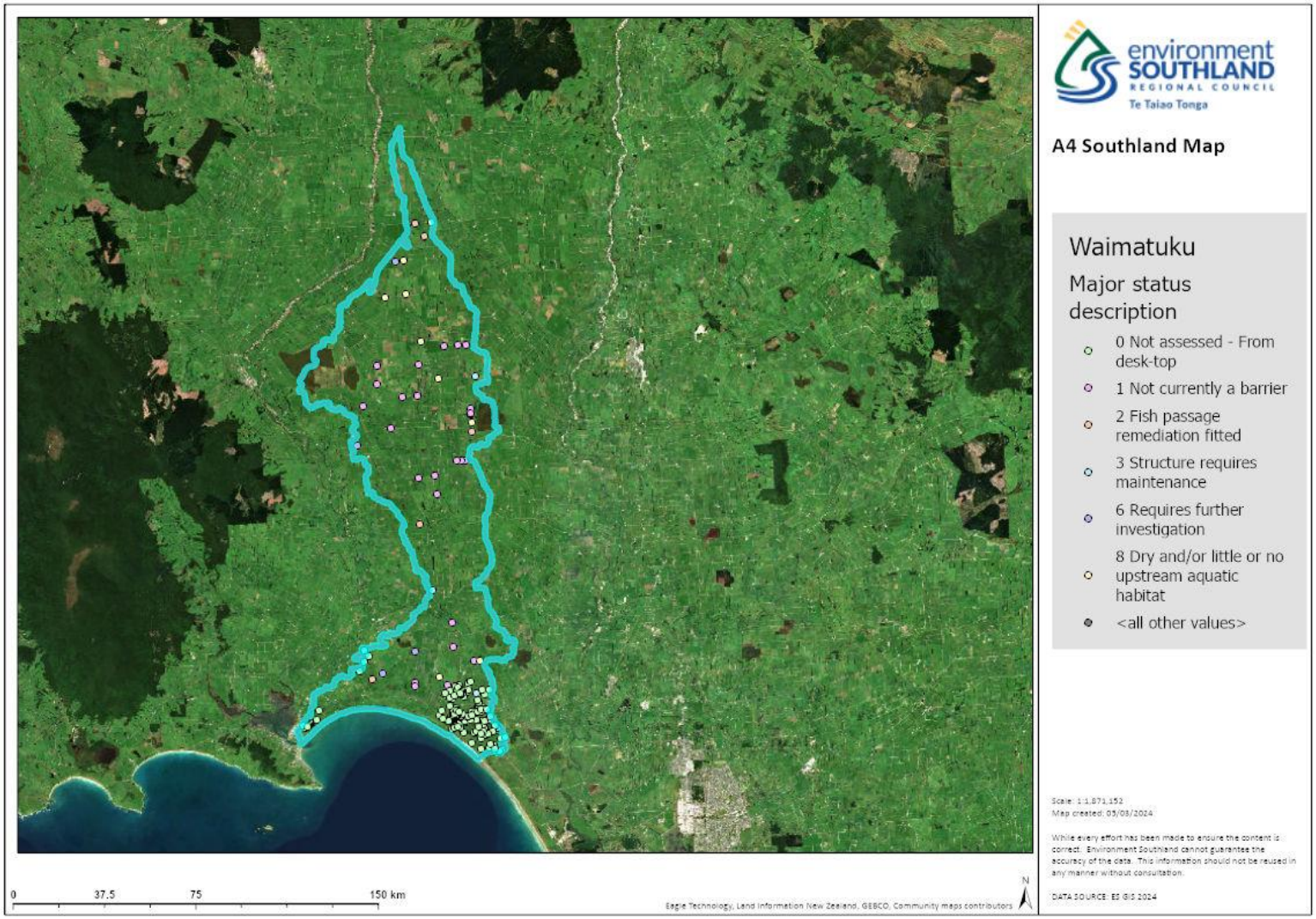


Figure 14: Fish Passage status in the Waimatuku Catchment. Source: Environment Southland

Fish Spawning Habitat

There is little information on where threatened species habitat is in the Waimatuku Catchment, or inanga spawning areas. Identification of spawning sites and their condition would be useful for future restoration efforts.

Birds

The Waimatuku Stream catchment has a range of bird species that are associated with freshwater and estuarine habitats as part of their life cycles. The bird species recorded in the locality of the Waimatuku Estuary are diverse, and include both non-migratory and migratory. There have been a number of threatened species recorded in recent years, these include: the black-fronted tern, caspian tern, the spotted shag and Foveaux (Stewart Island) Shag. A number of species considered "At-Risk" are also recorded (Table 4).

Table 4 lists bird species either recorded by eDNA monitoring in the Waimatuku Catchment or from sightings listed in the New Zealand Bird Atlas eBird Portal, and is not a definitive list of all freshwater/estuarine bird species that can be found in the catchment.

New Zealand Bird Atlas eBird Portal collates submissions from birding enthusiasts, the sightings are not spread across the whole catchment and the majority of the sightings are from the lower Waimatuku Stream and estuarine areas. The eBird taxonomy and common names are sometimes different to those used in New Zealand, any eBird records that used an 'uncommon' name for a species was corrected to the common name, keeping the original name used in eBird in brackets.[78]

Bayswater Peat Bog has been recorded as being a nesting habitat for the harrier hawk and black billed gulls. And is home to the Australasian bittern, fernbird, white faced heron, pūkeko and ducks.[79]

Further surveys should be considered to establish a baseline on which restoration efforts can be assessed against.

[78] Common names were found by searching the uncommon name on nzbirdsonline.org.nz
[79] Rance (n.d.-a)

Table 4: Bird species either observed and recorded in eBird (+) or detected using eDNA sampling (*) in the Waimatuku Stream catchment and conservation status. Source: New Zealand Bird Atlas eBird Portal https://ebird.org/atlasnz/home and Wilder Labs wilderlab.co.nz

Species	**Scientific Name**	**Conservation Status**[80]	**Additional conservation status information**[81]	**Date of last sighting/ detection**
Native				
Australasian Shoveler	*Anas rhynchotis*	Not threatened	Secure Overseas	2023+ 2023*
Australian Coot (Eurasian Coot)	*Fulica atra australis*	At Risk - Naturally Uncommon	Increasing, Secure Overseas	2023+
Pūkeko (Australian Swamphen)	*Porphyrio melanotus*	Not threatened	Increasing, Secure Overseas	2023+ 2023*
Black-billed gull	*Larus bulleri*	At-risk, declining	Climate Impact, Conservation Research Needed, Recruitment Failure	2023+
Black fronted tern	*Chlidonias albostriatus*	Threatened- nationally endangered	Climate Impact, Conservation Research Needed, Partial Decline, Recruitment Failure, Sparse	2023+

[80] Robertson et al. 2021
[81] Robertson et al. 2021

Species	Scientific Name	Conservation Status[80]	Additional conservation status information[81]	Date of last sighting/ detection
Black Shag	*Phalacrocorax carbo* [82]	At Risk - Relict	Conservation Research Needed, Data Poor Size, Data Poor Trend, Secure overseas, Sparse	2022+ 2023*
Black Swan	*Cygnus atratus*	Not threatened	Secure Overseas	2023+
Brown or Grey teal	*Anas chlorotis or gracilis*	Brown teal – Threatened- Nationally increasing. Grey teal - Not threatened.	Brown teal - Conservation dependant, Increasing, Range restricted Grey Teal - Increasing, Secure Overseas	2023*
Caspian Tern	*Hydroprogne caspia*	Threatened - nationally vulnerable	Climate Impact, Secure Overseas, Sparse	2021+
Banded dotterel (Double-banded Plover)	*Charadrius bicinctus bicinctus*	At-risk - declining	Conservation Dependant, Climate Impact, Conservation Research Needed, Data Poor Species, Partial Decline	2023+
Eastern Bar-tailed godwit (Recorded in eBird as Bar-tailed godwit)	*Limosa lapponica bauer*	At-risk - declining	Climate Impact, Threatened Overseas	2023+

[82] Robertson et al. 2021 defines taxonomy as *Phalacrocorax carbo novaehollandiae*

Species	Scientific Name	Conservation Status[80]	Additional conservation status information[81]	Date of last sighting/ detection
Grey warbler (Grey Gerygone)	*Gerygone igata*	Not threatened		2021+
Grey Teal	*Anas gracilis*	Not threatened	Increasing, Secure Overseas	2023+
Little Shag (Little Pied Cormorant)	*Microcarbo melanoleucos*	At Risk – Relict	Conservation research needed, data poor trend	2022+ 2023*
NZ Fantail/Piwakawaka	*Rhipidura fuliginosa*	Not threatened	Both North and South Island Species – Extreme fluctuations	2020+ 2023*
New Zealand Fernbird[83]	*Poodytes punctatus*			2022+
New Zealand Pipit	*Anthus novaeseelandiae novaeseelandiae*	At risk- declining	Climate Impact, Conservation Research Needed	2022+
New Zealand Scaup	*Aythya novaeseelandiae*	Not threatened	Increasing	2023+ 2023*
Paradise Shelduck	*Tadorna variegata*	Not threatened		2023+ 2023*

[83] 5 subspecies. South Island Fernbird *Bowdleria punctata punctata* - At Risk Declining Climate Impact, Data Poor Species, Data Poor Trend

Species	**Scientific Name**	**Conservation Status**[80]	**Additional conservation status information**[81]	**Date of last sighting/ detection**
Pied Shag (Pied Cormorant)	*Pharacrocorax varius*	At Risk – Recovering	Conservation Dependant	2023* 2023+
Pied Stilt	*Himantopus himantopus leucocephalus*	Not threatened	Secure Overseas	2023+
Red-billed gull (Silver gull)	*Chroiocephalus novaehollandiae*	At Risk – Declining	Climate Impact	2023+
Royal Spoonbill	*Platalea regia*	At risk - naturally uncommon	Increasing, Range Restricted, Secure Overseas, Sparse	2023+ 2023*
Silver eye	*Zosterops lateralis*	Not threatened	Secure Overseas	2022+ 2023*
Sooty shearwater	*Puffinus griseus*	At risk, declining	Conservation Dependant, Climate Impact, Secure Overseas	2023[84]+
South Island Pied Oyster Catcher (South Island Oyster Catcher)	*Haematopus finschi*	At Risk – Declining	Climate Impact	2020+
Southern Black-backed gull (Kelp Gull)	*Larus dominicanus*	Not threatened	Secure Overseas	2020+

[84] Might have been a dead one. Jane Kitson pers comms.

Species	**Scientific Name**	**Conservation Status[80]**	**Additional conservation status information[81]**	**Date of last sighting/ detection**
Spur-winged plover (Masked Lapwing)	*Vanellus miles novaeholladiae*	Not threatened	Secure Overseas	2020+
Swamp harrier	*Circus approximans*	Not threatened	Secure Overseas	2023+
Spotted Shag	*Stictocarbo punctatus*	Threatened - nationally vulnerable	Climate Impact, Conservation Research Needed	2023+
Foveaux Shag (Stewart Island Shag)	*Leucocarbo stewartia*	Threatened – Nationally vulnerable	Conservation Dependant, Conservation Research Needed, Data Poor Size, Data Poor Trend, Partial Decline	2021+
Tui	*Prosthemadera novaeseelandiae novaeseelandiae*	Not threatened	Increasing	2022+
Variable Oystercatcher	*Haematopus unicolor*	At risk, recovering	Climate Impact, Increasing	2023+
Welcome Swallow	*Hirundo neoxena neoxena*	Not threatened	Secure Overseas, St	2020+ 2023*
White-fronted tern	*Sterna striata striata*	At risk, declining	Climate Impact, Conservation Research Needed, Data Poor Trend	2023+
White-faced heron	*Egretta novaehollandiae*	Not threatened	Secure Overseas	2023+

Species	Scientific Name	Conservation Status[80]	Additional conservation status information[81]	Date of last sighting/ detection
Non-resident natives				
Eastern Cattle Egret (Cattle egret- *Bubulcus ibis*)	*Ardea ibis coromanda*	Non-Resident Native-migrant	Secure Overseas	2023*
Pectoral Sandpiper	*Calidris melanotos*	Non-resident native, vagrant	Secure Overseas	2021+
Ruddy Turnstone	*Arenaria interpres*	Non-resident native, migrant	Secure Overseas	2023+
Sharp-tailed Sandpiper	*Calidris acuminata*	Non-resident native, migrant	Secure Overseas	2021+
White-winged Black tern	*Chlidonias leucopterus*	Non-resident, migrant	Secure Overseas	2023+
Introduced and Naturalised				
Blackbird	*Turdu merula*	Introduced and naturalised	Secure Overseas	2022+ 2023*
Canadian Goose	*Branta canadensis*	Introduced and naturalised	Secure Overseas	2023+ 2023*

Species	**Scientific Name**	**Conservation Status[80]**	**Additional conservation status information[81]**	**Date of last sighting/ detection**
Common chaffinch	*Fringilaa coelebs*	Introduced and naturalised	Secure Overseas	2023+*
Common starling	*Sturnus vulgaris*	Introduced and naturalised	Secure Overseas	2023*
Dunnock	*Prunella modularis*	Introduced and naturalised	Secure Overseas	2023*
European Starling	*Sturnus vulgaris*	Introduced and naturalised	Secure Overseas	2022+
Eurasian skylark	*Alauda arvensis*	Introduced and naturalised	Secure Overseas	2023*+
Goldfinch	*Carduelis carduelis*	Introduced and naturalised	Secure Overseas	2022+ 2023*
Greenfinch	*Carduelis flammea*	Introduced and naturalised	Secure Overseas	2022+
Feral Goose (Greylag Goose)	*Anser anser*	Introduced and naturalised	Secure Overseas	2023+
House Sparrow	*Passer domesticus*	Introduced and naturalised	Secure Overseas	2022+ 2023*

Species	**Scientific Name**	**Conservation Status[80]**	**Additional conservation status information[81]**	**Date of last sighting/ detection**
Lesser Redpoll[85]	*Acanthis cabaret*			2023+
Magpie	*Gymnorhina tibicen*	Introduced and naturalised	Secure overseas	2022+ 2023*
Mallard	*Anas platyrhynchos*	Introduced and naturalised	Secure Overseas	2023+ 2023*
Mallad x Pacific Black Duck hybird				2021+
Pigeon	*Columba livia*	Introduced and naturalised	Secure Overseas	2022+ 2023*
Song thrush	*Turdus philomelos*	Introduced and naturalised	Secure Overseas	2023*+
Yellowhammer	*Emberiza citronella*	Introduced and Neutralised	Secure Overseas	2023+

[85] Common redpoll is classified as Introduced and Naturalised.

Lizards

Bayswater Peat Bog is home to a population of native skinks, large intact habitats like Bayswater Bog now provide some of the largest and most intact habitat for native lizards on the Southland Plains.[86]

Insects

Bayswater Peat Bog supports a range of invertebrates including the Ghost moth/hepialid moth (*Heloxycanus patricki*) which is restricted to southern New Zealand peat bogs and has a two-year life cycle with emergence occurring every second year.[87]

Cultural Values

Ingoa

The name 'Waimatuku' refers to the tangata Waimatuku, who spent time at the coastal nohoanga site at the river mouth. Waimatuku was considered to be second-in-charge of a war-party, and was slain in the same battle as the noted rangatira Kaweriri. The naming of the awa honours him.[88] A modern day interpretation of that name is that of the matuku (the Australasian bitten/*Botaurus poiciloptilus*).[89] On the east the catchment boundary is Ōtāneāniwa/Wrights Bush, and to the west is Ōtaetae/Otaitai Bush. [90]

Te Ara Tawhito

Matewaewae tracks along the Waimatuku Mouth, and is a Te Ara Tawhito (traditional travel route) that led from Riverton along Ōreti Beach, across Kōreti/New River Estuary to Mokomoko and across to Awarua/Bluff Harbour. [91]

Mahinga Kai

Mahinga kai encompasses the resource harvested, the ability to access the resource, the site where gathering occurs, the act of gathering and using the resource, and the good health of the resource. Within the Waimatuku Catchment, a number of highly valued customary species have been recorded such as kanakana, tuna and whitebait.

Along the Ōreti Beach coastline is one of the few remaining toheroa populations. The main bed of adult toheroa is at the southeast end of the beach (at the New River Estuary entrance) with numbers of adult toheroa dwindling closer to and on the other side of the Waimatuku Stream.[92] Toheroa are only able to be harvested with a customary fishing permit.

Taonga Species

The catchment contains many species considered taonga to mana whenua, including plants, birds and aquatic species. It is important to understand that during the negotiation for the Ngāi Tahu Claims Settlement, the Crown did not recognise all sites or all taonga species that were considered important by mana whenua. Some are listed with the Ngāi Tahu Claims Settlement Act 1998 and a

[86] Rance n.d.-a
[87] Rance n.d.-a
[88] Muriel Johnstone pers comms; Environment Southland & Te Ao Marama (2023); https://kahurumanu.co.nz/atlas
[89] https://kahurumanu.co.nz/atlas
[90] https://kahurumanu.co.nz/atlas
[91] https://kahurumanu.co.nz/atlas
[92] Beentjes 2020

more expansive list for Southland is included in the pSWLP (Appendix 1). However, what is considered taonga is best determined in discussions with mana whenua.

Archaeological sites

There are many archaeological sites recorded throughout the Waimatuku Catchment. These are centred on the river mouth and south of Isla Bank Rd.[93] It is recorded in the Ngāi Tahu Report V2 that the Waimatuku was once a Ngāi Tahu kaika, and that a reserve of 200 acre was requested but failed to set aside during the Murihiku purchase.[94]

Heritage information held by DOC records an adze found in the Bayswater Peatland Scenic Reserve, middens/oven sites and artefacts found in the mid-catchment and artefacts found within the lower catchment.

Māori Land

There is around 100 ha of Māori freehold land within the Waimatuku catchment sub-unit which is situated on the western boundary of the sub-unit (Figure 15).

For restoration, collaboration with, and participation by, mana whenua is required to understand and incorporate mana whenua aspirations for the catchment.

Figure 15: Māori freehold land, as indicated by dark red lines. Source: Manaaki Whenua/Landcare Research, Our Environment

[93] https://nzaa-archsite.hub.arcgis.com/apps/4b86c77cbfb942d48166909d8d93142c/explore
[94] Waitangi Tribunal 1991

Recreational and aesthetic values

There are a number of recreational values contained within the catchment, including whitebaiting, trout fishing, waterfowl hunting and the Te Araroa Trail.

Whitebaiting

While there are no whitebaiting stands along the Waimatuku Stream, the stream is a popular whitebaiting location. In 1988 the stream was described as being under heavy fishing pressure and that "This small stream has a significant fishery out of proportion to its size"[95]. There is no information about current fishing pressure during the whitebait season, or the species that are caught.

Hunting

The Waimatuku catchment supports game waterfowl species that have been hunted annually during the game bird hunting season.[96]

Trout fishing

The Waimatuku catchment supports a brown trout fishery, which was historically a productive lowland fishery. The Waimatuku Stream and its tributaries provide a spawning habitat for the brown trout fishery.[97] There has been a significant decline in angler usage of the Waimatuku stream since the first survey in 1994/1995, the lowest numbers were recorded in 2007/2008 however the most recent survey shows that angler numbers have increased since then.

Angler effort (angler-days +/-se)[98]

1994/95 = 1,424 +/-422

2001/02 = 487 +/-255

2007/08 = 72+/-47

2014/15 = 240 +/-115

2021/22=382+/-215

Moate (2010) found that angling values on the Waimatuku Stream are considerably reduced due to low trout numbers, few mayfly hatches, difficult physical access, poor water clarity and faecal pollution perceptions.

Te Araroa Trail

The Te Araroa trail spans the length of the country from Cape Reinga to Bluff, it follows the beach from Riverton to Invercargill, passing across the Waimatuku River mouth.

Other

[95] Kelly 1988
[96] Fish and Game 2018
[97] Fish and Game 2018
[98] Stoffels & Unwin 2023

In a study investigating the recreational use of Oreti Beach the recreational activities listed below were recorded on the beach at the mouth of the Waimatuku Stream[99]:

- Sitting in vehicle,
- Sunbathing and sand play
- Picnicking
- Surfing
- Swimming
- Moving vehicles - motorcycles, dog-running
- Turning points -motorcycles
- Walking and running
- Misc Activities

Economic Values

The main township within the catchment is Drummond, which grew after the 1890's when the Gladfield Estate was broken into smaller lots. The early Pākehā settlers drained swamps, farmed sheep and grew a range of crops such as oats, wheat, linseed and grasses. Today the population within the Waimatuku catchment is around 1,000 people.[100]

Farming within the catchment is predominantly sheep, beef and dairy farming on flat and artificially drained land. Within the Waimatuku sub-unit, it is estimated that 13,600 ha (of the total 25,400 ha) is farmed. [101]

Land Cover

Using the catchment boundaries described by the Land, Air, Water Aotearoa (LAWA) website, the majority of the 2018 land cover in the Waimatuku Stream catchment comprised of 90% exotic grassland (with the majority made up of high producing exotic grasslands and only 1% low producing exotic grasslands), 5% cropping/horticulture, 3% Other herbaceous vegetation (herbaceous freshwater vegetation).

Vegetation land cover changes from 1996 to 2018 include an 865% (227 ha) increase in low producing grassland, 50% increase in lake or pond (14 ha), and a 1% increase in high producing exotic grassland (128 ha). During this timeframe gorse and/or broom has decreased by 85% (-57 ha), herbaceous freshwater vegetation by 33% (-307 ha) and exotic forests by 15%.

More detailed analysis of the New Zealand Land Cover Database would be required to identify the areas where changes have occurred. Data collection and further analysis of land cover changes in the last decade and the reasons behind those changes would be useful for restoration in the catchment. Particularly as the largest decrease in land cover (in area) was experienced by herbaceous freshwater vegetation, which is described as "herbaceous wetland communities occurring in freshwater habitats where the water table is above or just below the substrate surface for most of the year. The class includes rush, sedge, restiad and sphagnum communities and other wetland species but not flax nor willows which are mapped as Flaxland and Deciduous hardwood"[102] (note neither category is recorded in the Waimatuku catchment).

[99] Scott et al 2014
[100] Environment Southland and Te Ao Marama (2023)
[101] Environment Southland and Te Ao Marama (2023)
[102] Thompson, Grüner & Gapare (2003)

Table 5: Waimatuku catchment area percentage land cover in 2018 and area percentage change from 1996. Source: https://www.lawa.org.nz/download-data/#land-cover New Zealand Land Cover Database (LCDB) version 5.0

Broad Category	**Detailed Category**	**Area 2018 (ha)**	**Area as % of Catchment Area 2018 (%)**	**Area change: 2018 area minus 1996 area (ha)**	**Area change as a % of 1996 area (%)**
Cropland	Short-rotation Cropland	990	5.18	0	0
Forest	Deciduous Hardwoods	8	0.04	0	0
	Exotic Forest	65	0.34	-11.33	-14.89
	Forest - Harvested	6	0.03	5.51	0
	Indigenous Forest	6	0.03	0	0
Grassland/other herbaceous vegetation	High Producing Exotic Grassland	16961	88.78	127.73	0.76
	Low Producing Grassland	254	1.33	227.41	864.97
	Flaxland	7	0.03	0	0
	Herbaceous Freshwater Vegetation	626	3.27	-306.78	-32.90
Scrub/shrubland	Gorse and/or Broom	10	0.05	-56.71	-84.98
	Mixed Exotic Shrubland	12	0.06	0	0
	Matagouri or Grey Scrub	20	0.10	0	0

Broad Category	Detailed Category	Area 2018 (ha)	Area as % of Catchment Area 2018 (%)	Area change: 2018 area minus 1996 area (ha)	Area change as a % of 1996 area (%)
Urban/bare/lightly-vegetated surfaces	Sand or Gravel	45	0.24	0	0
	Built-up Area (settlement)	18	0.09	0	0
	Urban Parkland/Open Space	29	0.15	0	0
Water bodies	Lake or Pond	42	0.22	14.17	50.26
	River	6	0.03	0	0

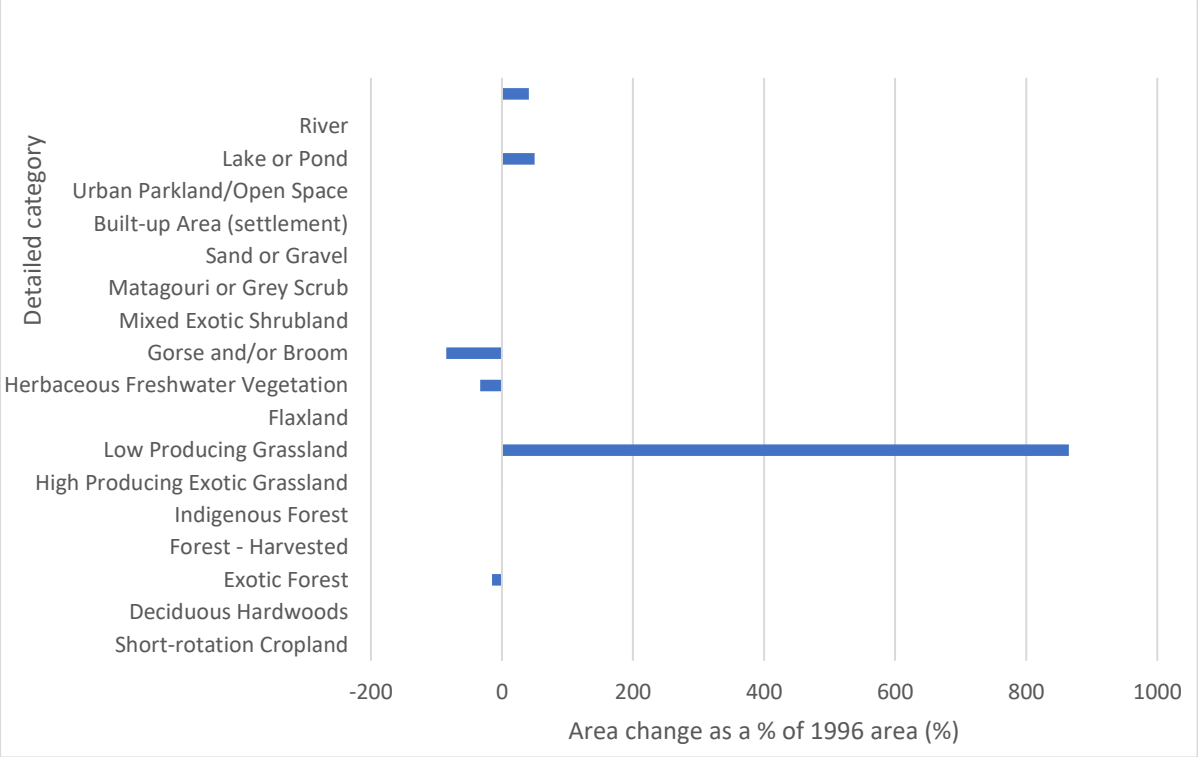


Figure 16: Land cover percentage area change from 1996. Source: https://www.lawa.org.nz/download-data/#land-cover New Zealand Land Cover Database (LCDB) version 5.0

Resource Consents

Resource consents can provide further information about the different uses in the catchment. Within the Waimatuku catchment (as defined by the FMU subunit) there are almost 300 active consents, the majority of these are water permits for consumptive groundwater takes for dairy operations. Land use permits is the second largest group which consists of a range of subgroups (see Table 6) within this there is one consent for planting pines and eucalyptus for harvest, dairy consents consist of the third largest group and these are largely made up of consents to discharge effluent. Within the discharge permits one is for the discharge of treated sewage to land.[103]

There are a number of consents that expire within the next three years, these are largely made of dairy consents and water permits. Mitigations attached to future resource consents could provide opportunities for restoration, including those to minimise sediment and nutrient run-off, fish passage and protection or rehabilitation of habitat.

Table 6: Summary of current resource consents in the Waimatuku Catchment, as of January 2024. Source: Environment Southland (Beacon, www.es.govt.nz).

Consent Type	**Subtype**	**Number of consents**
Water Permit	Groundwater Take (Consumptive)	109
Dairy Consent	To Land	59
Land Use Permit	Land Use (Feedpad)	32
	Effluent Storage	19
	Land Use (Other)	12
	Expanded Dairy Farm	8
	Bore	4
	Dairy conversion	3
	Land Use (Farming)	2
	Planting LU	1
Discharge Permit	To Land	9
Coastal Permit	Reclaim CMA	1

[103] See https://maps.es.govt.nz/index.aspx?app=consents&ext=1126883,4820931,1373775,4939715 for further information on current resource consents.

Legislation and Planning Framework

Various pieces of legislation and policies are relevant when considering the restoration and conservation values in the Waimatuku Catchment. These include the:

- Ngāi Tahu Claims Settlement Act 1998 (NTCSA),
- Te Rūnanga o Ngāi Tahu Act 1996,
- Conservation Act 1987,
- Resource Management Act 1991,
- Wildlife Act 1953,
- Biosecurity Act 1993,
- Fisheries Act 1996,
- Fisheries (South Island Customary Fishing) Regulations 1999,
- Reserves Act 1977,
- Te Ture Whenua Māori Act 1993, and
- Whitebait Fishing Regulations 1994.

Figure 17 provides an overview of some of the statutory framework and hierarchy within the legislative framework for the Waimatuku Catchment. In addition to the overview, more specific detail has been provided on the Ngāi Tahu Claims Settlement Act 1998, Ngāi Tahu ki Murihiku Iwi Management Plan 2008, Southland Murihiku CMS 2016, Resource Management Act 1991, National Policy Statement for Freshwater Management 2020, National Environmental Standards for Freshwater 2020, National Environmental Standards for Plantation Forestry 2018, and proposed Southland Water and Land Plan.

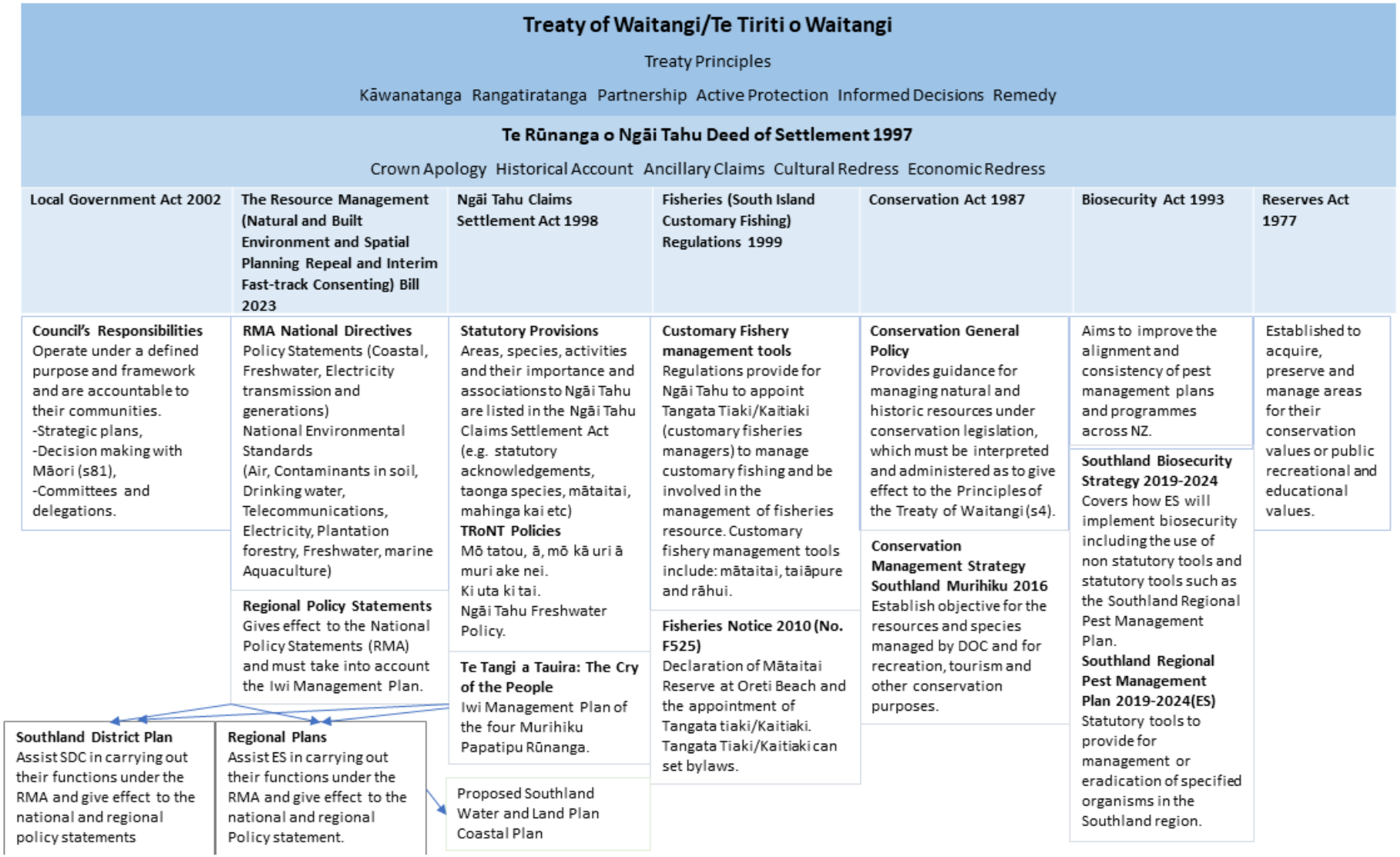


Figure 17: Example of the statutory hierarchy within the legislative framework for the Waimatuku catchment.

Ngāi Tahu Claims Settlement Act 1998

After years of negotiations, legislation was passed in 1998 that put into effect the terms and redress package agreed to by Ngāi Tahu and the Crown to mitigate and remedy breaches of the Treaty of Waitangi made by the Crown. The NTCSA includes several mechanisms specifically designed to be used in implementing other legislation such as the Resource Management Act 1991 and Conservation Act 1987.

A significant component of the Ngāi Tahu Settlement is elements of cultural redress, which seek to restore the ability of Ngāi Tahu to give effect to its kaitiaki responsibilities. These include:

- Ownership and control: pounamu, high country stations, specific sites and wāhi taonga;
- Mana recognition: Statutory Acknowledgements, Deeds of Recognition, Tōpuni, dual place names;
- Mahinga kai: Nohoanga, customary fisheries management, taonga species management, coastal space;
- Management Input: Statutory Advisor, dedicated memberships, Department of Conservation protocols, Resource Management Act implementation, and heritage protection review.

Statutory Acknowledgement - A Statutory Acknowledgement is an acknowledgement by the Crown of Ngāi Tahu's special relationship with identified areas, namely Ngāi Tahu's particular cultural, spiritual, historical, and traditional association with those areas (known as statutory areas).

Taonga species – Under the Settlement Act, the Crown acknowledged the special relationship of Ngāi Tahu with the taonga species, which include 49 bird species, 54 plant species and 6 marine mammal species. Ngāi Tahu are to be involved in DOC threatened species recovery groups and consulted over species management actions. Te Rūnanga o Ngāi have a role as advisor to Fish and Game Councils in relation to native game bird management. Fish and Game Councils were also encouraged to co-opt a person nominated by Ngāi Tahu onto their regional councils, which they have done throughout the Ngāi Tahu rohe.

Customary fisheries included eight separate but connected elements within the Customary Fisheries section of the crown settlement offer:

1. Acknowledgement – The special Ngāi Tahu relationship to 'taonga' fish species, being species currently only managed for conservation values, were acknowledged by the Crown (species are: Kowaro/Canterbury mudfish, Kaeo/Sea tulip, Koeke/Common shrimp, Taiwharu/Giant kōkopu, Piripiripohatu/Torrentfish, Paraki/Common smelt and Kokopu/Giant bully).
2. Advisory Committees – Te Rūnanga o Ngāi Tahu will be recognised as an advisory committee to the Minister of Fisheries and the Minister of Conservation and must be consulted. The Ministers must have particular regard to the advice of Te Rūnanga in relation to the management of the customary fisheries.
3. Customary Kaimoana Regulations – The Ngāi Tahu Claims Settlement Act 1998 promulgated the development of the Fisheries (South Island Customary Fishing) Regulations 1999. These regulations encompass fisheries resources in freshwater and marine areas (that are subject

to the Fisheries Act 1996). Ōreti Mātaitai Reserve most western point is the mouth of the Waimatuku River.

4. Customary Freshwater Fisheries Regulations – Regulations similar to the Kaimoana Regulations are to be developed for customary freshwater fisheries managed under the Conservation Act.

5. Non-commercially Harvested Species – Seven species not currently taken under commercial permits will be formally excluded from commercial fishing (species are: Toheroa, Karengo/Sea Lettuce, Rimurapa/Bull kelp, Kanakana/NZ lamprey, Waikākahi/Freshwater mussel and Kōura/Freshwater crayfish). In addition to complying with existing legislative requirements, the Minister of Fisheries would have to recognise and provide for the views of Ngāi Tahu before changing that status.

6. Shellfish Quota – Should certain shellfish species ever be introduced into the Quota Management System, Ngāi Tahu will have a right of first refusal to purchase up to 40% of quota in each species at market price. This is in addition to the 20% of quota which must be provided to the Treaty of Waitangi Fisheries Commission for allocation to iwi (species are: Pipi/Kakahi, Tuatua, Tuaki/Cockle, Pupu/Mudsnail and Kuhakuha/Surfclam).

7. Temporary Closure – Provisions which used to exist in the Fisheries Act to allow the Minister to temporarily close specific fisheries (thereby giving effect to rāhui) were reintroduced under the Fisheries (South Island Customary Fishing) Regulations 1999.

8. Eel Management Plan – In the Settlement Offer, the Crown confirmed its general support for the South Island Eel Management Plan (formulated by Ngāi Tahu, northern South Island iwi and non-Māori commercial and non-commercial eel fishers) and has undertaken to implement certain specific aspects of the plan.

Te Tangi a Tauira: The Cry of the People: Ngāi Tahu ki Murihiku Iwi Management Plan 2008

The RMA specifies that local authorities must take into account any relevant planning document recognised by an iwi authority and lodged with the Council. The Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan, Te Tangi a Tauira (Cry of the People), consolidates mana whenua values and perspectives on natural resource and management issues. The document assists Ngāi Tahu ki Murihiku in carrying out kaitiaki roles and responsibilities.

Numerous policies directly relate to the holistic management of freshwater. A summary of Ngā Rūnanga Papatipu ki Murikihu Aspirations for Freshwater is provided below, as important considerations in relation to Waimatuku values and restoration.

The most relevant policy sections in Te Tangi Tauira are:

3.1 Huringa Ahua o Te Rangi/ Climate change

3.5 Te Rā a Takitimu/Southland Plains:

- O Te Whenua/Land: Farming effluent, forestry & stock transport
- O Te Wai/ Water: General Water Policy, Rivers, Discharge to Water, Water Quality, Water Quantity – Abstractions, Activities in the Beds and Margins of Rivers

- Mahinga kai and Biodiversity: Mahinga kai, Ngā Pononga a Tāne a Tangaroa – Biodiversity; Repo- wetlands, Riparian Zones, Freshwater Fisheries
- Wāhi Tapu me Te Wāhi Taonga: Wāhi ingoa/ Place Names

3.6 Te Ākau Tai Tonga/Southland Coastal Environment:

- O Te Whenua/Land: Coastal Land Use and Development, Coastal Access
- O Te Wai/Water: Coastal Water Quality
- Mahinga kai and Biodiversity: Coastal ecosystems, Marine Birds.

4.7 Ngā Ara o Te Whakatinanatanga/ Implementation Tools, Methods and Mechanisms

Summary of Ngā Rūnanga Papatipu ki Murikihu Aspirations for Freshwater [104]

1. The waterways are to meet their respective cultural expectations/values through maintenance or restoration. No water body within Murihiku can be allowed to have water quality degrade further.

- Ensure the protection, restoration and enhancement of the productivity and life supporting capacity of mahinga kai, indigenous biodiversity, air, water, land, natural habitats and ecosystem, and all other natural resources valued by Ngāi Tahu ki Murihiku.[105]
- Strive for the highest possible standard of water quality that is characteristic of a particular place/waterway, recognising principles of achievability. This means that we strive for drinking water quality in water we once drank from, contact recreation in water we once used for bathing or swimming, water quality capable of sustaining healthy mahinga kai in waters we use for providing kai. [106]
- Ensuring the health and wellbeing of freshwater is a prerequisite for ensuring the continued health and wellbeing of mahinga kai resources and ultimately the people.[107]

2. In exercising kaitiakitanga, we work actively to ensure that spiritual, cultural and mahinga kai values of the takiwā are upheld and sustained for future generations.

- Water is central to all Māori life. It is a taonga left by ancestors to provide and sustain life. It is for the present generation, as tangata tiaki, to ensure that the taonga is available for future generations in as good as, if not better quality. [108]
- There is a mutual understanding of iwi and local authority values and responsibilities with respect to the environment, effective management of resource by councils, and effective performance of kaitiaki by Ngāi Tahu ki Murihiku. [109]

3. Ensuring skills, activities and knowledge relating to freshwater and mahinga kai are fostered and passed onto future generations.

- Mō tātou, a mō ka uri a muri ake nei – for us and our children after us.

[104] From Cain 2014 as cited in Kitson 2021
[105] Ngāi Tahu ki Murihiku 2008
[106] Ngāi Tahu ki Murihiku 2008
[107] Te Rūnanga o Ngāi Tahu 1999
[108] Te Rūnanga o Ngāi Tahu 1999
[109] Ngāi Tahu ki Murihiku 2008

- Ensure the protection, restoration and enhancement of the productivity and life supporting capacity of mahinga kai, indigenous biodiversity, air, water, land, natural habitats and ecosystem, and all other natural resources values by Ngāi Tahu ki Murihiku. [110]
- Ngāi Tahu ki Murihiku do not believe we should be granting consents for activities where we do not know what the effects may be over the long term. Anything over 25 years is essentially making decisions for the next generation. [111]
- Water management needs to recognise and accommodate places specific uses as such sites and the cultural values and uses they sustain cannot be relocated to other locations in the catchment.[112]

4. Imbed cultural values throughout freshwater management from defining the issues to value setting and monitoring. Narrative, visual and cultural indicators are key management tools.

- Water is a holistic resource. The complexity and interdependency of different parts of the hydrological system should be considered when developing policy and managing the water resource.[113]
- Resource management agencies do not always appreciate the depth and value of traditional environmental knowledge held by members of the Ngāi Tahu whānui. In many resource management forums, scientific and technical expertise is seen to be superior to traditional knowledge and tikanga. [114]
- By developing an informative and highly visual resource for Ngāi Tahu whānui and the wider community, we have made it possible to explore a historical landscape in an open and non confrontational context for information sharing, thus utilising publicly available data and private sources of knowledge (such as whānau, hapū and iwi archives). This resource can hopefully serve as 'common ground' for catchment-level thinking and management.[115]
- Specificity is needed in value setting.
    - For example: "Flows needed to protect mahinga kai" Indicators[116]:
        - Oxygen – higher flows oxygenate deeper water. Colder waters hold oxygen.
        - Food
        - Habitat
        - Temperature – species have optimal temperature ranges for survival
        - Cover – debris in stream; vegetation in and beside stream; pools and overhang banks; etc

[110] Ngāi Tahu ki Murihiku 2008
[111] Ngāi Tahu ki Murihiku 2008
[112] Tipa 2011 as cited in Kitson 2021
[113] Te Rūnanga o Ngāi Tahu 1999
[114] Te Rūnanga o Ngāi Tahu 1999
[115] Tipa 2013 as cited in Kitson 2021
[116] Tipa 2010. *A Freshwater Strategy that delivers opportunities for Ngāi Tahu whānui, Gail Tipa, Presentation to Ngāi Tahu Freshwater Strategy hui 2010.* as cited in Kitson 2021

- Life cycle stages – triggered by freshes
- Gathering – methods, fishing experience and catch rates change
- Transportation / accessibility
- Turbidity – amount is dependent on velocity and turbulence
- Sediment in stream

- Incorporation of indicators used by tangata whenua to assess the health of a waterbody, eg.[117]

Shape of the river	Natural river mouth environment
Sediment in the water	Water quality
Water quality in the catchment	Abundance and diversity of species
Flow characteristics	Natural and extent of riparian vegetation
Flow variations	Use of river margin
Flood flows	Temperature
Sound of flow	Catchment land use
Movement of water	Riverbank condition
Fish are safe to eat	Water is safe to drink
Uses of the river	Clarity of the water
Safe to gather plants	Is the name of the river an indicator?
Indigenous vs. exotic species	Natural river mouth environment

Southland Conservation Management Strategy 2016

The Southland Murihiku Conservation Management Strategy 2016 (CMS) describes the conservation values present in Southland and provides guidance for the Department's work in the form of a vision, objectives, outcomes for Places, policies and milestones, translating the Department's strategic outcomes.

Sections within the CMS relevant to the Waimatuku Catchment are:

- 2.6 Freshwater Wai Māori
- 2.7 Lowlands Te Rā a Takitimu Place
- 2.9 Foveaux Te Ara a Kiwa Place
- Appendix 1: Work or activities of the Department of Conservation that may meet the requirements of section 4(3) of the Resource Management Act 1991 for exemptions from land use consents in Southland Murihiku
- Tracks, roads and car parking areas for visitor purposes: Te Araroa Trail - sections on public conservation land.

[117] Ngāi Tahu ki Murihiku 2008

- Signs: all public conservation land in Southland Murihiku.
- Appendix 5: Threatened and at risk indigenous flora and fauna present in Southland Murihiku.
- Appendix 6: Threats or pests and wild animals present in Southland Murihiku
    - Bamboo and silver birch has been identified for Drummond Swamp Wildlife Management Reserve
    - Blackberry and Silver birch has been identified for Bayswater Peatland Scenic Reserve
- Appendix 8: Marine habitats and ecosystems in Southland Murihiku
    - The Oreti Mātaitai Reserve is listed as a protected area.
- Appendix 13: Ngāi Tahu Claims Settlement Act 1998 provisions relating to Southland Murihiku.

Resource Management System

The Resource Management Act 1991 (RMA) has been Aotearoa New Zealand's main law governing how people interact with natural resources, plan their urban environments and undertake development. As well as managing air, soil, water and the coastal marine area, the RMA regulated land use and the provision of infrastructure.

In 2019 a significant programme of work began to reform the resource management system. In August 2023 the Spatial Planning Act (SPA) and the Natural and Built Environment Act (NBA) began coming into effect, the SPA and NBA were intended to work together as an integrated system. The Natural and Built Environment Act set out how the environment would be protected and used. It covered land use, along with environmental protection, water takes, and discharges and use of coastal marine areas.

In late December 2023 the Resource Management (Natural and Built Environment and Spatial Planning Repeal and Interim Fast-track Consenting) Bill gained Royal Assent. The Repeal Act essentially 'winds back the clock' so that the Resource Management Act 1991 continues to apply. Almost all resource management activities and areas continue to be covered by the Resource Management Act 1991 (RMA), however the repeal legislation retains the NBA fast-track consenting process. Any consent issued will be treated like a consent under the RMA.

Under the previous resource management system the Resource Management Act and its planning tools regulate land and water use, and water allocation within the catchment. The RMA has national-level policy statements and environmental standards that are given effect through Regional and District plans in Southland. Regional and District plans can impose stricter policies and plans than the national instruments. The plans with relevance for the Waimatuku River Catchment are:

- Southland Regional Policy Statement 2017
- Proposed Southland Water and Land Plan (operative in part; administered by ES)
- Regional Coastal Plan for Southland 2013 (administered by ES)
- Southland District Plan 2018.

National Policy Statement for Freshwater Management 2020

National Policy statements are instruments provided for under the RMA to prescribe objectives and policies for matters of national significance. The National Policy Statement for Freshwater Management (NPSFM) first came into effect in 2011, then superseded the NPSFM 2014 (that

introduced the national significance of Te Mana o te Wai and the National Objectives Framework), then superseded by an amendment in 2017, and then replaced by the NPS-FM 2020. The NPS-FM 2020 came into force in September 2020. Te Mana o Te Wai was recognised as the fundamental concept for freshwater management. It is a matter of national significance that freshwater management gives effect to Te Mana o te Wai. Te Mana o te Wai provides for a hierarchy of obligations:

- First, the health and well-being of water bodies and freshwater ecosystems,
- Second, the health needs of people (such as drinking water),
- Third, the ability of people and communities to provide for their social, economic and cultural wellbeing.

To implement the NPS-FM 2020 includes:

- Active involvement of tangata whenua in freshwater management (including decision making),
- Integrated whole-of-catchment management, including effects on the receiving environment (ki uta ki tai),
- Management through a National Objectives framework, where degraded water bodies are improved, and other waterbodies maintained (or improved if the community chooses),
- No further loss of wetlands, protection of wetlands and promotion of restoration,
- Habitats of indigenous fish are protected.

Under the NPS-FM 2020, regional councils are required to identify Freshwater Management Units in their region, and to define their important values and set clear objectives and limits for water quality and quantity. Compulsory values to include in FMUs (or part of an FMU) are:

- **Ecosystem Health**: Water quality, Water quantity, Habitat, Aquatic life, ecological processes.
- **Human contact**: Human health from connecting with the water in a range of different activities
- **Threatened species**: This refers to the extent to which an FMU or part of an FMU that supports a population of threatened species has the critical habitats and conditions necessary to support the presence, abundance, survival, and recovery of the threatened species. All the components of ecosystem health must be managed, as well as (if appropriate) specialised habitat or conditions needed for only part of the life cycle of the threatened species.
- **Mahinga Kai**:
    - *Mahinga kai – kai is safe to harvest and eat*. Mahinga kai generally refers to freshwater species that have traditionally been used as food, tools, or other resources. It also refers to the places those species are found and to the act of catching or harvesting them. Mahinga kai provide food for the people of the rohe and these sites give an indication of the overall health of the water. For this value, kai would be safe to harvest and eat. Transfer of knowledge is able to occur about

the preparation, storage and cooking of kai. In FMUs or parts of FMUs that are used for providing mahinga kai, the desired species are plentiful enough for long-term harvest and the range of desired species is present across all life stages.

- *Mahinga kai – Kei te ora te mauri (the mauri of the place is intact*). In FMUs or parts of FMUs that are valued for providing mahinga kai, customary resources are available for use, customary practices are able to be exercised to the extent desired, and tikanga and preferred methods are able to be practised.

There are other values that must be considered in the FMU process: natural form and character; drinking water supply; wai tapu; transport and tauranga waka, fishing; hydro-electric power generation; animal drinking water; irrigation, cultivation, and production of food and beverages; commercial and industrial uses.

The NPS-FM 2020 also includes stronger requirements for Regional Councils for management of Fish Passage.

As of April 2024, the Government has announced its intentions to begin work on a replacement NPS-FM in 2024. In preparation for this the repeal legislation extends the date that councils are required to notify freshwater plan changes by three years (to 31 December 2027). The Government has also announced it will amend the RMA to change how councils apply Te Mana o te Wai to individual consent applications.[118]

National Environmental Standards for Freshwater 2020

The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (Freshwater NES) regulates activities that pose risks to the health of freshwater and freshwater ecosystems. The standards are designed to:

- protect existing inland and coastal wetlands,
- protect urban and rural streams from in-filling,
- ensure connectivity of fish habitat (fish passage),
- set minimum requirements for feedlots and other stockholding areas,
- improve poor practice intensive winter grazing of forage crops,
- restrict further agricultural intensification until the end of 2024,
- limit the discharge of synthetic nitrogen fertiliser to land and require reporting of fertiliser use.

In many cases, people will need to apply for a resource consent from their regional council to continue carrying out regulated activities.

National Environmental Standards for Plantation Forestry 2018

The National Environmental Standards for Plantation Forestry (NES-PF) regulates activities that pose risks to the environment. The NES-PF applies to any forest of at least one hectare that has been planted specifically for commercial purposes and will be harvested.

The eight core regulated activities are:

[118] Ministry for the Environment 2024

- afforestation,
- pruning and thinning to-waste,
- earthworks,
- river crossings,
- forest quarrying,
- harvesting,
- mechanical land preparation,
- replanting.

Some examples of the conditions under the NES-PF regulations are:

- setbacks when planting next to rivers, lakes, wetlands, and coastal areas.
- management plans for earthworks, forest quarrying, and harvesting activities to identify environmental risks and how they will be managed
- identification and maintenance of stormwater and sediment control measures for forestry activities.

The permitted conditions for planting setbacks are relative to specified water bodies, eg Afforestation must not occur—

(a) within 5 m of—

(i) a perennial river with a bankfull channel width of less than 3 m; or

(ii) a wetland larger than 0.25 ha; or

(b) within 10 m of—

(i) a perennial river with a bankfull channel width of 3 m or more; or

(ii) a lake larger than 0.25 ha; or

(iii) an outstanding freshwater body; or

(iv) a water body subject to a water conservation order; or

(v) a significant natural area; or

(c) within 30 m of the coastal marine area.

If foresters cannot meet permitted activities around these activities, then they will need to apply for a resource consent. The NES-PF provides tools for identifying the risks of wilding conifer spread, erosion, and disturbance to waterways while fish are spawning.

Proposed Southland Water and Land Plan

The proposed Southland Water and Land Plan (pSWLP) was publicly notified in 2016. The pSWLP implements some objectives and policies from the NPS-FM.[119] Provisions of the plan have been progressing through the Environment Court since 2019.

The objectives of the proposed plan have been resolved through the Court process, with the nineth interim decision having been released by the Environment Court in September 2023. Environment Southland had amended the objectives in February 2021 and made part of the plan operative.[120]

The amended objectives places Ki Uta ki Tai and Te Mana o te Wai as being at the forefront of freshwater and land management. It also provides a stronger base for improving water quality, freshwater, wetlands, coastal lagoons and estuarine ecosystem health and providing for taonga species (including fish passage).

The National Objectives Framework in the NPS-FM 2020 outlines the approach all regional councils must take to manage freshwater in their regions, this guides the Plan Change Tuatahi (first plan change to the pSWLP) work programme and requires ES to identify visions, values, goals, targets, limits and actions to realise the community aspirations for all FMUs. It must also include policies and methods to achieve those limits, in accordance with the NPS-FM. [121] The Waimatuku Stream is in the Aparima Freshwater Management Unit.

ES and TAMI have worked together to identify to identify communities' values and aspirations for freshwater and estuaries. These values then led to the development of draft environmental outcomes (objectives). These objectives describe what hauora (or healthy resilience) would look like. The Southland Regional Forum was a community-based group that advised ES's council and TAMI board members on how to achieve the communities' aspirations for freshwater. Their report 'Achieving the Communities Aspirations for Freshwater' was finalised in mid-2022, and offers a range of recommendations to address the gap between where the regions freshwater is now and where it should be. [122]

The next steps for Plan Change Tuatahi include:

- 2023-2024 – Opportunities for community input on the limits, rules and actions that will help shape Plan Change Tuatahi.
- 2024- ES and TAMI make decisions and release Plan Change Tuatahi by the end of 2024.
- 2024-25 Public submissions and independent review of Plan Change Tuatahi by Freshwater Planning Panel.
- From 2025 – Apply conditions and rules, ensure compliance, measure and monitor progress.[123]

[119] Environment Southland 2018
[120] Environment Southland n.d.- c
[121] Environment Southland 2018
[122] More information can be found here https://waterandland.es.govt.nz/plan-change-tuatahi/steps-to-plan-change-tuatahi
[123] Environment Southland n.d. -d

Freshwater Farm Plans

Freshwater Farm Plans are intended as a practical way for farmers and growers to identify, manage and reduce the impact of farming on the freshwater environment. With actions tailored to the farms physical environment and what is important in that specific catchment.

Freshwater Farm Plans have been legislated of Part 9A of the RMA and the Resource Management (Freshwater Farm Plans) Regulations 2023.[124] In Southland there is also a requirement for Farm Environment Management Plans (FEMP) under Appendix N of the pSWLP.[125]

Southland was one of the first regions nationally to require Freshwater Farm Plans, and the Aparima catchment (along with Fiordland and Islands catchments) was one of the first catchment in Southland to require the Freshwater Farm Plans. As part of the Aparima FMU, regulations went live for the Waimatuku sub-catchment in August 2023. Farm operators are required to have their plans completed and submitted for certification by February 2025.

ES and TAMI have worked together to produce catchment context tools to provide information on the context, challenges and values for the Aparima FMU.[126]

[124] Ministry for the Environment 2023b
[125] Environment Southland 2023
[126] Environment Southland n.d.-e; Environment Southland & Te Ao Marama 2023

State of the Waimatuku Catchment Waterbodies

Waimatuku Stream

In the proposed Southland Land and Water Plan surface water quality has different standards according to the Surface Water Quality Management Units (SWQMU). The Waimatuku sub-unit has four different SWQMUs, the majority of the catchment is lowland hard bed, lowland soft bed borders the catchment, there are pockets of lowland/coastal lakes and a small area of spring fed in the upper catchment (Figure 18).

ES monitors water quality monthly in the Waimatuku Stream at Lorneville Riverton Highway which is within the lowland hard bed SWQMU. Water quality results (nutrient concentrations, water clarity and *E. coil*) are detailed below. Water quality at this site has been assessed against the relevant national and regional standards and guidelines (Appendix 2). Three sites are monitored for ecological data by ES: Lorneville Riverton Highway, Waimatuku Township Road and Rance Road, these sites are all lowland hard bed SWQMU. A summary of the sites located within the Waimatuku Stream as reported in Norton et al. (2019) is provided in Appendix 3.

Land use above the Environment Southland monitoring site is predominantly dairy farming (53% plus 3% dairy support), followed by sheep and beef farming (38%)(Figure 19). [127]

As part of the Aparima Community Environmental Project, three sites upstream of the ES monitoring site on the Waimatuku Stream are being monitored, aligned to ESs timing and methodology. At present there is only six months of data available (median results June- December 2021 available in Appendix 4), however this monitoring programme is ongoing.[128]

[127] Moriarty et al. 2019

[128] Aparima Community Environmental

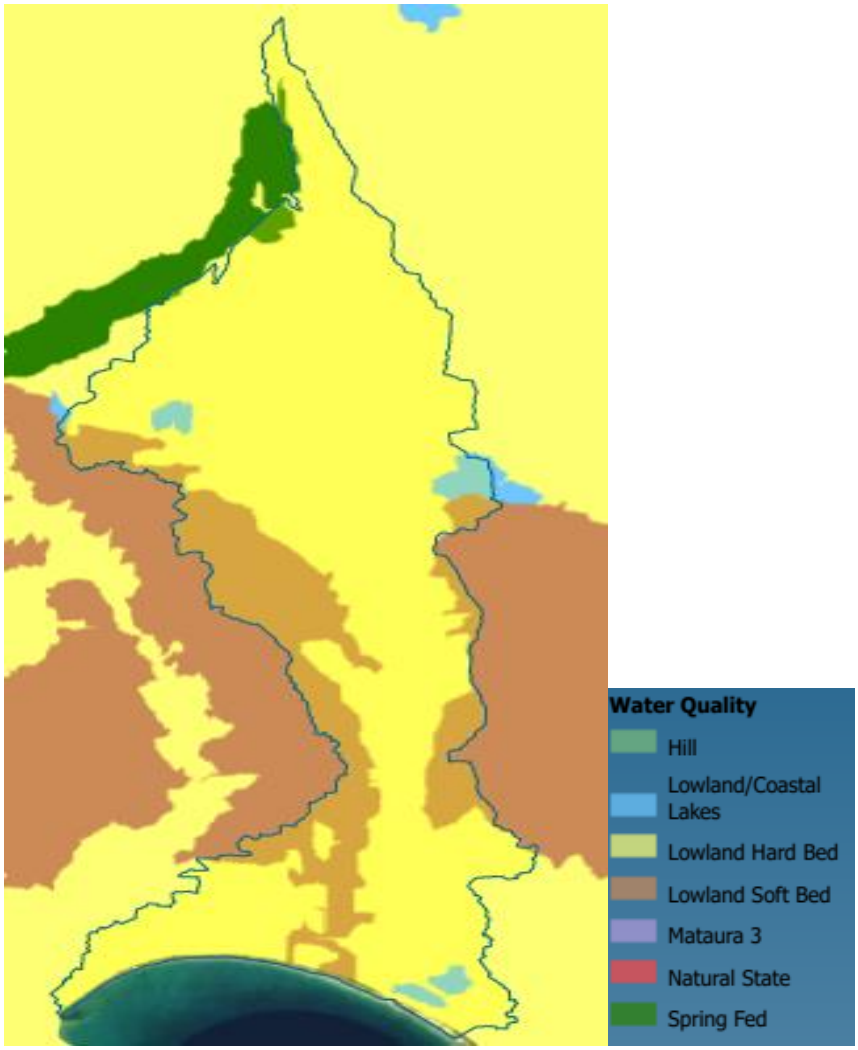


Figure 18: Surface Water Quality Units in the Waimatuku Catchment. Source: Environment Southland (Beacon www.es.govt.nz).

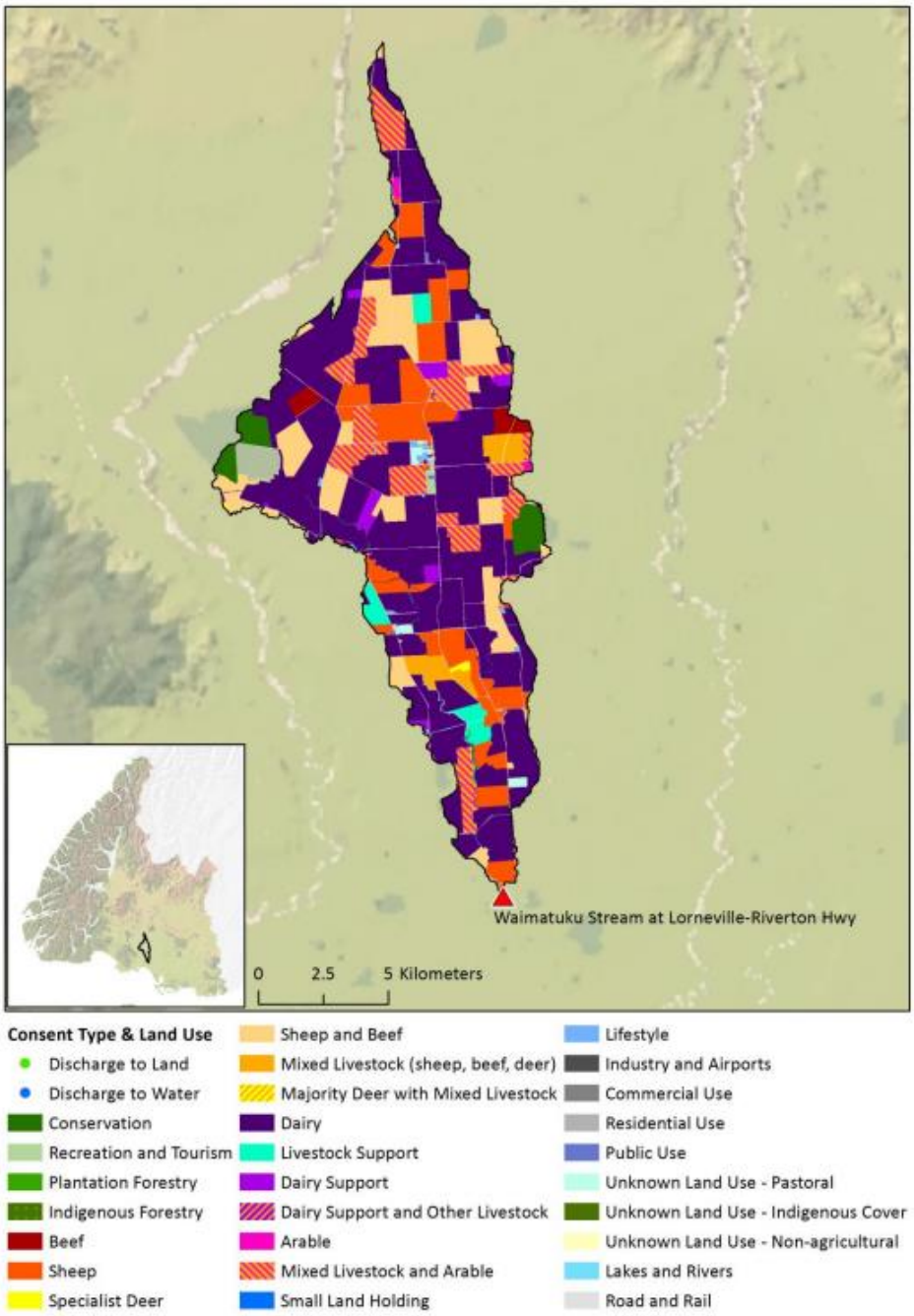


Figure 19: Land use in the Waimatuku Catchment above the ES monitoring site. Source: Moriarty et al 2019.

Nutrient Concentrations

High nutrient concentrations of Total Oxidised Nitrogen (TON) and Dissolved Reactive Phosphorus (DRP) can impact ecosystem health.

The DRP state of 'D Band' (at the Lorneville Riverton Highway site) indicates that ecological communities are 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. The 10-year trend was very likely degrading.[129]

The NPSFM 2020 does not provide an equivalent against ecosystem health for TON. The trend ranges from 5-year very likely improving, 10-year likely degrading and 15-year likely improving. The state is within the worst 25% of all sites. [130]

Water clarity

Water clarity can be impacted by the amount of sediment suspended in the water column. Water quality (black disc) fails against the pSWLP standard, and the 10-year trend is likely degrading. [131]

Escherichia coli

Escherichia coli (*E. coli*) is an indicator of the risk of *Campylobacter* infection if you are to swim or directly contact the water. *E coli* is assessed as E Band in the NPSFM standards, this is the poorest band with >7% predicted average infection risk. The quality of water is unsuitable for water contact uses. The trend ranges from 5-year very likely degrading, 10-year likely degrading and 15-year likely improving. [132]

Faecal pollution

To examine the source of faecal pollution five samples were collected throughout 2015 at Lorneville Riverton Highway site, three samples under base flow and two following rainfall.

Under baseflow conditions *Campylobacter* was present in two of the three samples (0.9-9.3 MPN/100 ml), molecular analysis techniques identified the likely *Campylobacter* sources as a combination of wildfowl, 'not-wildfowl' and unknown sources. Ruminant pollution was found to account for less than 10% of the overall pollution at this site. Wildfowl contamination markers were present in all samples, with sheep and human contamination detected in the June sample. [133]

Following rainfall *Campylobacter* was detected in both samples, both contained contaminants from a wildfowl source, the February sample contained an unknown source and April detected human contamination. Faecal source tracking identified that ruminant pollution increased after rainfall, but still accounted for less than half the overall pollution. Neither ovine nor bovine specific markers were detected. Moriarty et al. (2019) note it is interesting that there is no specific indication of contamination from cattle given that dairy farming dominates the sub catchment. [134]

Human faecal pollution was detected during sampling (it was only detected in three other sites throughout the Aparima FMU) in two of the five samples (one under baseflow and one following rainfall). Seepage from septic tanks at local properties and/or run off might be the potential source of contamination, as may be the small number of septic tanks from local farm houses upstream of the sampling site. [135]

[129] Lawa.org.nz
[130] Lawa.org.nz
[131] Lawa.org.nz
[132] Lawa.org.nz
[133] Moriarty et al. 2019
[134] Moriarty et al. 2019
[135] Moriarty et al. 2019

Table 7: Water Quality data from Lorneville Riverton Highway Site compared to relevant water quality thresholds and trends. Source: LAWA lawa.org.nz

	5 year median	**NPSFM band**	**Against pSWLP standards**	**Against ANZECC trigger value**	**5 year trend**	**10 year trend**	**15 year trend**
E. coli (n/100ml)	515	E			Very likely degrading	Likely degrading	Likely improving
Clarity (m)	1.16		Fail		NA	Likely degrading	Likely improving
Turbidity (NTU)	3.2				Very likely degrading	Likely degrading	Likely improving
Total nitrogen (mg/L)	4.4				Very likely improving	Likely degrading	Likely improving
Total Oxidised nitrogen (mg/L)	3.8				Very likely improving	Likely degrading	Likely improving
Dissolved inorganic nitrogen(mg/L)	3.81				Very likely improving	Likely degrading	Likely improving
Ammoniacal nitrogen (mg/L)	0.013	A			NA	Likely degrading	Likely improving
Nitrate nitrogen (mg/L)	3.8	C			Very likely improving	Very likely degrading	Likely improving

	5 year median	NPSFM band	Against pSWLP standards	Against ANZECC trigger value	5 year trend	10 year trend	15 year trend
Dissolved reactive phosphorus (mg/L)	0.046	D			Indeterminate	Very likely degrading	Very likely degrading
Total phosphorus (mg/L)	0.081				Very likely degrading	Very likely degrading	Very likely degrading

Macroinvertebrate Community Index

The Macroinvertebrate Community Index (MCI) is an indicator of stream ecological health. This index is based on the tolerance or sensitivity of some benthic invertebrates to organic enrichment. Environment Southland monitors macroinvertebrates annually. The MCI score just passes in the C Band when assessed by the NPSFM 2020 and passes the pSWLP standard at the Lorneville Riverton site, but the other two sites are below the national bottom line and fail against the pSWLP standard. This indicates moderate organic pollution or nutrient enrichment at Lorneville Riverton and severe organic pollution or nutrient enrichment at the remaining sites.

The Quantitative Macroinvertebrate Community Index is below the national bottom line as described in the NPSFM and fails the pSWLP standard at all sites, indicating sever organic pollution or nutrient enrichment, as communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment.

Table 8: Macroinvertebrate Community Index and Quantitative Macroinvertebrate Community Index data from Waimatuku Stream sites compared to relevant water quality thresholds and trends. Source: LAWA lawa.org.nz

Parameter	Lorneville Riverton	Waimatuku Township Rd	Rance Rd
MCI 5-year median	90.7	87.6	87.3
Range			
NPSFM band	C	D	D
Against pSWLP	Pass	Fail	Fail
Trend	NA	NA	10 year - Indeterminate

Parameter	Lorneville Riverton	Waimatuku Township Rd	Rance Rd
QMCI Score	4.13	4.48	4.29
NPSFM band	D	D	D
Against pSWLP	Fail	Fail	Fail
Trend	NA	NA	10 year - Indeterminate

Vegetation

Moate (2010) recorded the riparian zones as being dominated by agricultural grasses and planted shelterbelts of flax, pine and gum along with broom and gorse. There was extensive fencing along the stream, however some areas were still accessible to stock. The banks of the stream were covered in Bittersweet, and the waters edge was dominated with Monkey Musk and Watercress. The streambed was covered in growth of aquatic weeds (water buttercup and curley pondweed).[136]

It would be useful to understand the current state of the riparian zone, the vegetation cover and potential restoration activities that could benefit this zone.

TICI Scores

As part of the eDNA surveys undertaken in the Waimatuku catchment, TICI scores were generated for each sample when possible. Taxonomy-independent community index (TICI) is a score calculated for each eDNA sample as the mean indicator score of the indicator sequences detected, to gauge and track the ecological health of waterways. The TICI is still in development and should be interpreted as an experimental tool at this stage.[137]

The TICI were poor or average for all sites, with sites in the upper catchment receiving more 'Poor' scores than those in the lower catchment.

Table 9: TICI Scores for the Waimatuku Catchment. Source:Wilderlabs.co.nz

Site	Taunamau Ross Rd	Taunamau upstream	Waimatuku 04 - Rance Rd	Waimatuku 05 - Waimatuku Twp Rd	Waimatuku 06	Waimatuku 08 - Fraser Rd	Waimatuku 10	Waimatuku 11 - Middle Creek	Waimatuku 12- Ayr Creek	Waimatuku 13- Fairfax Rd
TICI Score	95.21	89.51	92.48	92.46	90.7	92.72	97.51	89.51	92.53	93.64
TICI Rating	Average	Poor	Average	Average	Average	Average	Average	Poor	Average	Average
Site	**Waimatuku 14- Middle Creek**	**Waimatuku 15- Middle Creek**	**Waimatuku 16- Robertson Rd**	**Waimatuku 17**	**Waimatuku 22- Middle Creek**	**Waimatuku 23**	**Waimatuku 24**	**Waimatuku 25**	**Waimatuku 26**	**Waimatuku 28**
TICI Score	89.71	90.18	93.18	94.62	89	88.45	89.31	88.56	94.11	88.47
TICI Rating	Poor	Average	Average	Average	Poor	Poor	Poor	Poor	Average	Poor

[136] Moate 2010

[137] https://www.wilderlab.co.nz/tici

Groundwater

The Waimatuku Stream is largely fed from groundwater and runoff sources, so the quantity groundwater for recharging the surface water and the quality including the contamination levels, especially phosphorus and nitrate, are important.

There are two long term groundwater monitoring well in the Waimatuku Groundwater Zone, one in the upper catchment at the intersection of Gladfield Rd and Flynn Rd and one in the mid catchment just north of Waimatuku on Waimatuku Flat Rd.[138]

Upper catchment[139]

- *E. coli* has been detected at least once between 2018-2022. Drinking Water Standards New Zealand (DWSNZ) benchmark is that *E. coli* must not be detected in a 100 mL sample of drinking water.
- The five-year median for chloride 31 mg/L (DWSNZ benchmark is 250 mg/L).
- The five-year median for DRP is 0.01 mg/L P.
- The five-year median for nitrate nitrogen is 9.5 mg/L N, the DWSNZ maximum acceptable standard is 11.3 mg/L, concentrations above this can pose a risk to bottle-fed infants.
- The five-year median for electrical conductivity is 354 µS/cm.

Mid catchment[140]

- *E. coli* has been detected at least once between 2018-2022.
- The five-year median for chloride 33 mg/L. The 10 and 15 year trends are very likely degrading.
- The five-year median for DRP is 0.04 mg/L P, the 10 year trend is likely degrading. The five-year median for nitrate nitrogen is 1.7 mg/L N, the 10 year trend is likely improving, while the 15 year trend is very likely degrading.
- The five-year median for electrical conductivity is 296 µS/cm. The 10 and 15 year trends are very likely degrading.

[138] https://www.lawa.org.nz/explore-data/groundwater-quality/#/tb-region
[139] https://www.lawa.org.nz/explore-data/groundwater-quality/#/tb-region
[140] https://www.lawa.org.nz/explore-data/groundwater-quality/#/tb-region

Wetlands

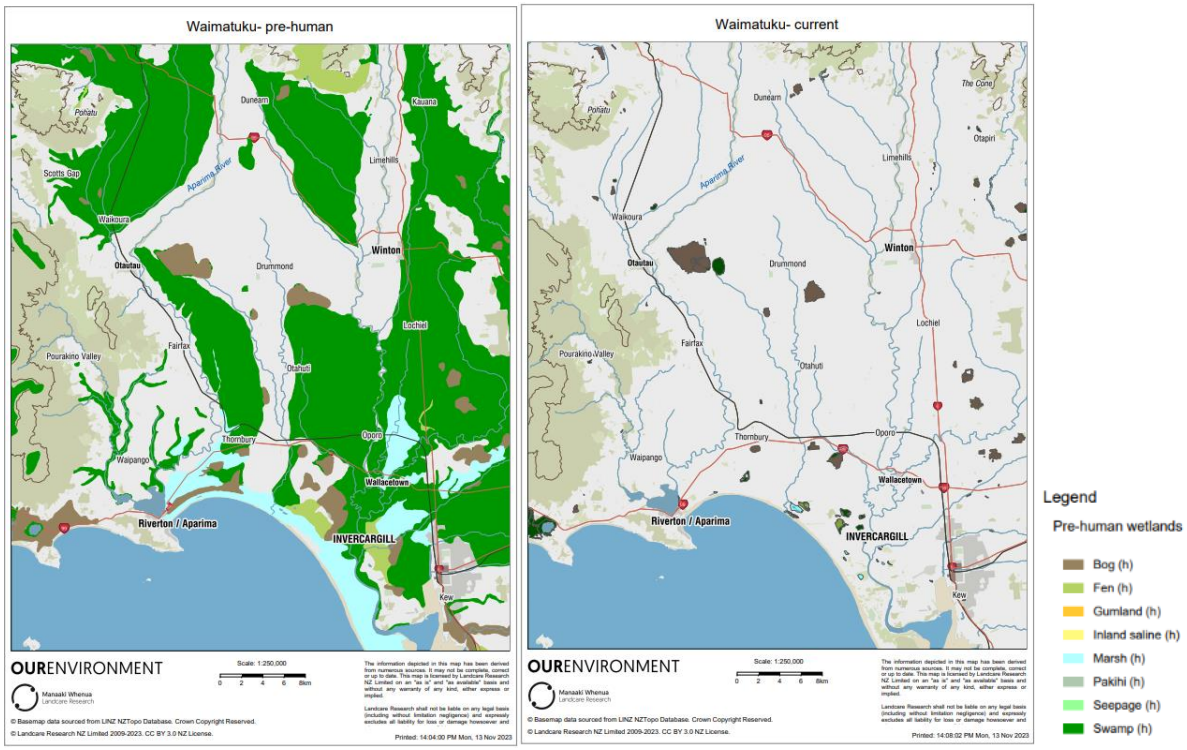


Figure 20: Changes in wetland cover in the Waimatuku catchment. Source: Manaaki Whenua Our Environment NZ Land Atlas https://ourenvironment.scinfo.org.nz/maps-and-tools/explore-nz-landcover-change

Wetlands are important ecosystems for a range of species, and contribute significantly to the hydrology of catchments, buffering the extremes of both high and low flows.

In the developed areas of Southland 90% of wetlands have been lost from circa 1840 to 2010[141]. This significant loss of wetlands is clear to see from Figure 20 which demonstrates the loss of wetlands in the Waimatuku catchment.

ES commissioned a mapping exercise of wetlands >0.5 ha in size (excluding public conservation lands), to monitor changes in wetland extent from 2007 to 2015 using aerial photography.[142] The total wetland extent lost across the region in that time was 1,362 ha (~7% of the 2007 wetland area). This wetland loss was concentrated in lowland areas of Southland, with over 1,200 ha lost (~11% of the 2007 lowland wetland area).

Another study used remote sensing images from 1990–2012 for three regions of Southland, to determine whether wetlands present in 1990 exhibited any change. Of the 32,814 ha of wetlands assessed across Southland, 3452 ha were no longer present in the landscape and a further 3943 ha were at risk. Most of the change in wetland extent occurred on the Southland Plains.[143] The rate of wetland loss in Southland since 1990 is 0.5% of wetland area yr−1, but when taking into account wetlands that have been partially drained, the rate of decline increases to 1.0% yr−1.

[141] Fitzgerald et al. 2010 as cited in Kitson 2021

[142] Ewans 2018

[143] Robertson et al. 2019

The predominant cause of the loss of wetlands is conversion to other land use, typically to pasture used for agriculture.[144] Outlined below are some of the wetlands in the Waimatuku catchment where partial or total loss has occurred:

- Figure 21 was included as part of Ewans (2018) report, they highlighted the loss of 39 ha between 2007 and 2014/15 adjacent to Bayswater Peat Bog, they note given this wetland is dominated by indigenous vegetation, consents would have been required for the water diversion (Regional Council) and vegetation clearance(District/City council).
- Figure 22 shows the changes to the Bayswater Peat Bog since 1996/97, between 2012/13 and 2018/19 a significant chunk of this wetland was converted to 'low producing grassland'. It is important to note that the wetland identified by Boundary Rd completely disappears by 2018/19.
- Figures 23 and 24 show a similar pattern of wetland loss or partial loss for the mid and lower catchment.

As identified in the policy analysis section, the National Environmental Standards 2020 now requires stronger protection of natural wetlands. However, it will require monitoring and enforcement by Environment Southland to prevent further loss.

There are important information gaps for the wetlands within the catchment. The wetland loss for the catchment is unknown and it would be useful to investigate this further. The condition of the current wetlands, work is required to understand if the remaining wetlands are protected or at risk from being lost.

A. Wetland ID 210 (2007)

B. Wetland ID 210 (2014-15) – loss of 39ha.

Figure 21: Wetland loss from the wetland adjacent to Bayswater Peat Bog between 2007 to 2014/15 . Source: Ewans 2018

[144] Robertson et al. 2019

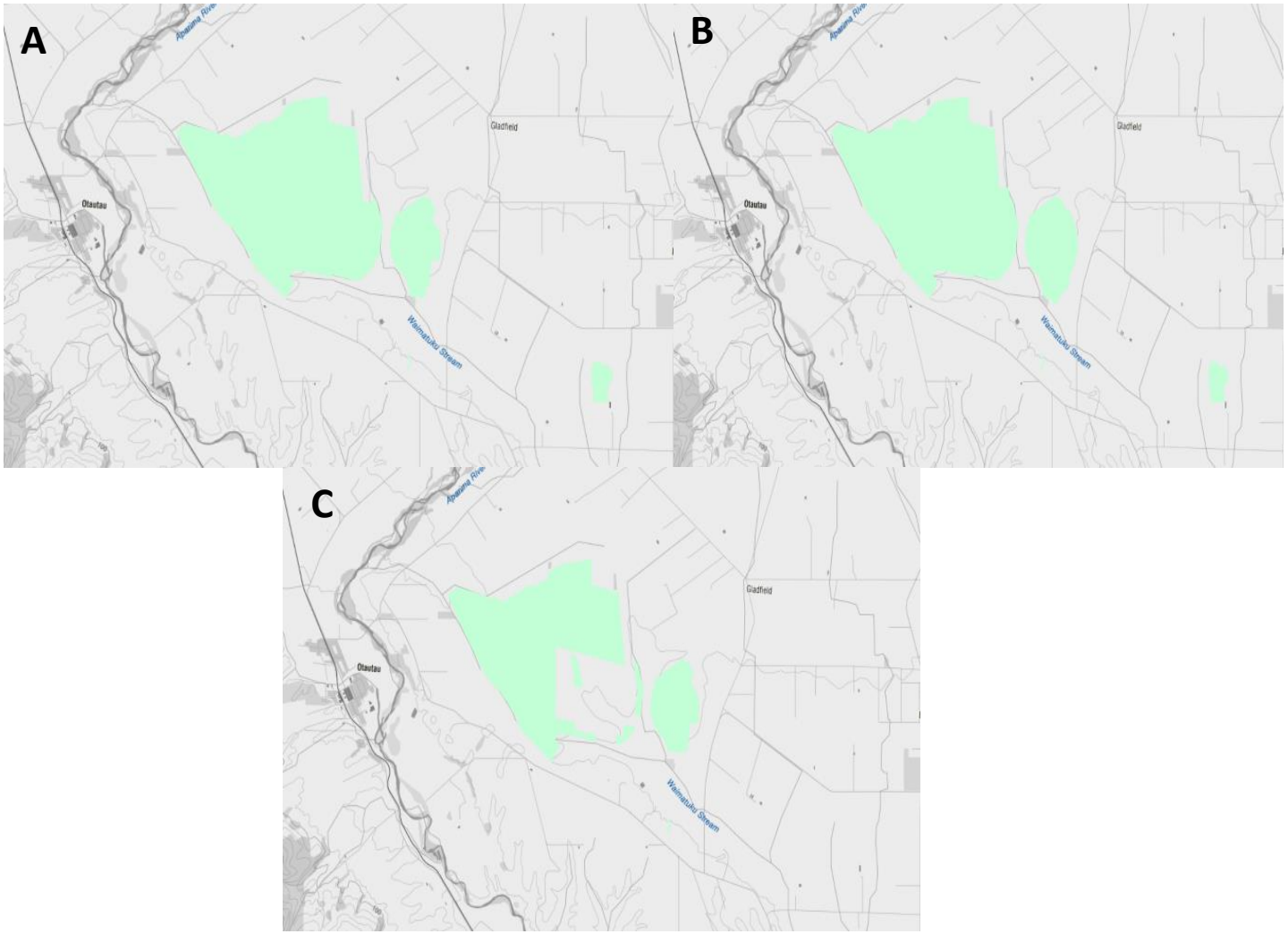


Figure 22: Bayswater Peat Bog and Waimatuku Wetland. A:1996/97, B:2012/13, C:2018/19 Source: Manaaki Whenua https://ourenvironment.scinfo.org.nz/maps-and-tools/explore-nz-landcover-change

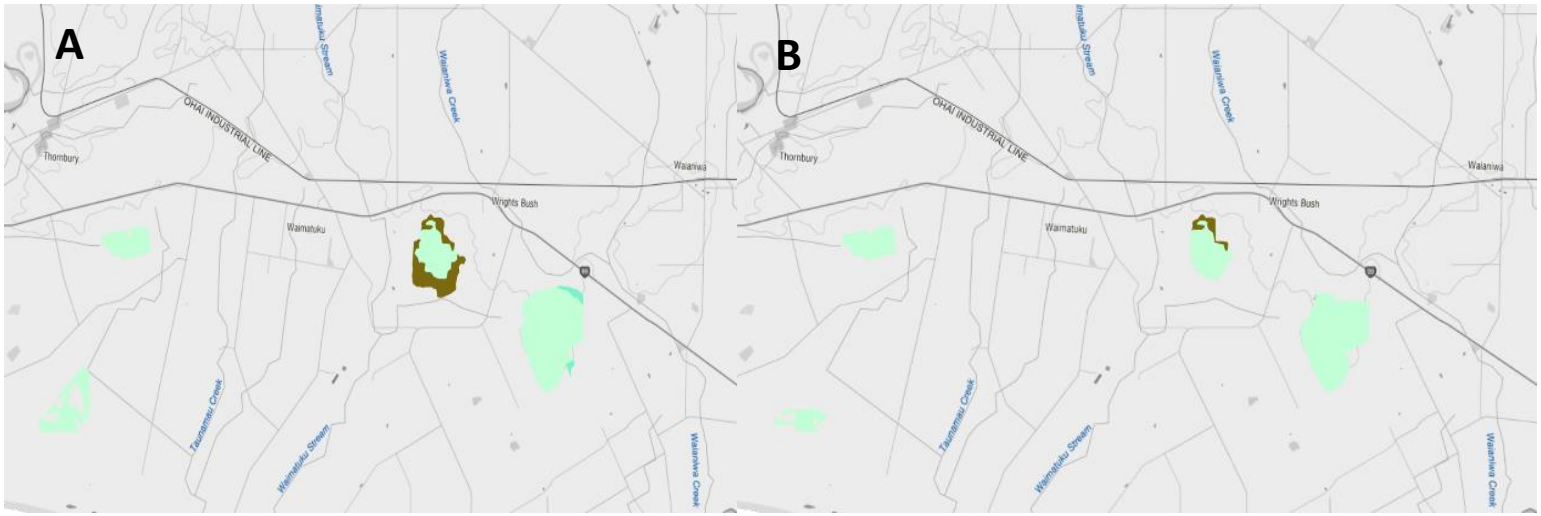


Figure 23: Wetland in the mid catchment. A:1996/97 and B:2018/19.Source: Manaaki Whenua.https://ourenvironment.scinfo.org.nz/maps-and-tools/explore-nz-landcover-change

Figure 24: Wetland coverage in the lower catchment. A:1996/97 and B:2018/19. Souce: Manaaki Whenua https://ourenvironment.scinfo.org.nz/maps-and-tools/explore-nz-landcover-change

Lakes

Big Lagoon and Long White Lagoons surface water, sediment samples and sediment cores have been collected as part of the Lakes380 project. The surface water and sediment quality information are a one-off sample and have been provided in Appendix 5.

Schallenberg et al (2023) estimated the Trophic Level Index using the Sediment Bacterial Trophic Index (SBTI)[145] with data that was collected as part of the Lakes380 research programme. The SBTI data was collected for 41 lakes (and modelled for the remaining 912 lakes in Southland), in the Waimatuku Catchment this included Big Lagoon and Long White Lagoon.

Long White Lagoon

Long White Lagoon is classified by ES as 'Lowland Shallow' and 'Swamp/wetland' by the FENZ geomorphic classification. It is surrounded by 91% exotic grasses, 9% non-native vegetation and no natives.

Long White Lagoon was determined as hypertrophic (SBTI=5.6, total phosphorus=0.45 g/m^3, total nitrogen=5.98 g/m^3, Chlorophyll-a = 0.023 g/m^3). Long White Lagoon is one of 12 (1.3% of all lakes) lakes in Southland modelled to be supertrophic. The proposed regional bottom line for lake TLI in Southland has been set to 5, meaning any lakes in a supertrophic or hypertrophic category must be improved.

Long White Lagoon system was surrounded in flax and comprosma species in the early 1980's. It was a refuge for waterfowl during game season and had excellent feeding and breeding habitat for waterfowl. Species that were recorded as being present include: little shag, black billed gull, spur-winged plover, marsh crake, mallard, black backed gull, hedge sparrow.[146]

Big Lagoon

Big Lagoon is classified by ES as 'Lowland Shallow' and 'Beach/coastal' by the FENZ geomorphic classification. It is surrounded by 71% exotic grasses, 18% forestry and 11% native vegetation.

Big Lagoon was determined as mesotrophic (SBTI=3.5, total phosphorus=0.25 g/m^3, total nitrogen=1.89 g/m^3, Chlorophyll-a = 0.033 g/m^3).

Big Lagoon was a large open lagoon surrounded by flax and manuka, with grazing to the edge of the lake. It is recorded as an important Paradise Duck moulting area, with up to 200 birds recorded. Other species recorded include: mallard duck, black swan, black billed gull, pied silt, shoveler, black backed gull, spur-winged plover. [147]

Extensive restoration work has taken place at Big Lagoon, as it was almost entirely drained. Sampling found very low freshwater fish number.[148]

[145] SBTI is an approach developed by the Lakes380 team (Pearsons et al. 2022 as cited in Schallenberg et al 2023)

[146] McKinlay 1984

[147] McKinlay 1984

[148] Stuart 2021

Waimatuku Estuary

The Waimatuku Estuary is a tidal river estuary (also called a "shallow short residence time tidal river estuary" (SSRTRE)). It is small, shallow, relatively long and moderately-highly flushed. It extends 4.5 km inland, has small intertidal flats dominated by a central channel, and with a single tidal opening that periodically constricts, naturally reducing salt intrusion.

The Waimatuku Estuary has a relatively low susceptibility to eutrophication, primarily due to its highly flushed nature, it has high freshwater inflow and few poorly flushed areas. The nutrient load received from both riverine and groundwater sources are considered high (estimated catchment N areal loading of 2877 mg N m-2 d-1 exceeds the guideline for low susceptibility SSRTRE estuaries of ~2000 mg N m-2 d-1). When the estuary's mouth is closed the assimilative capacity for nutrients is very quickly exceeded.[149]

Various monitoring has occurred in the estuary in 2008, 2010, 2011, 2012 and 2018.

The most recent monitoring places the estuary in a low-moderate state overall in relation to the subtidal channel condition and trophic status (this has deteriorated since 2012, Figure 25). Eutrophication (presently expressed as nuisance macroalgal production and reduced sediment oxygenation in the upper-middle estuary) and to a lesser extent sedimentation are expected to be ongoing issues in the estuary. [150]

Eutrophication

The New Zealand Estuary Trophic Index (ETI) has been applied to Southland estuaries to provide Condition (impairment) Bands (A- Minimal Eutrophic Symptoms to D- High Eutrophic symptoms) by assessing state against thresholds for:

- Primary indicators: Macroalgal biomass and cover,
- Secondary indicators: Macroinvertebrates, sediment redox potential, sediment Total Organic Carbon, Sediment total Nitrogen.

As the macroalgae component cannot be applied to the subtidal situations an ETI score cannot be given to the Waimatuku Estuary. However, the presence of eutrophic symptoms in the upper-mid estuary in 2018 indicated that this threshold was exceeded for subtidal benthic macroalgae and sediment oxygenation. The water quality results in the overlying waters had low chlorophyll a (phytoplankton) concentrations, despite the presence of above threshold nutrient concentrations. [151]

2018 Survey results

- Opportunistic macroalgae was present at sites in the upper-middle estuary, while there was extensive benthic microalgae growing on lower estuary sands.
- Sediment mud content was low in the mid-estuary, with the lower estuary sediments dominated by sand and the upper estuary dominated by mud. Excessive deposition of muds is currently only a problem in the deeper, less well flushed upper estuary.

[149] Robertson & Robertson 2018
[150] Robertson & Robertson 2018
[151] Robertson & Robertson 2018

- Sediment oxygenation depth was moderate (aRPD 0.5-2 cm) in the mid-estuary sites, deeper (aRPD >5 cm) in the sandy lower estuary, and poor (aRPD <0.5 cm) in the upper estuary muds.
- The benthic indicators of organic enrichment (total organic carbon) and nutrient enrichment (total nitrogen and phosphorus) were at low-moderate concentrations across the sites monitored.
- High value rooted aquatic macrophytes were present throughout the mid-upper estuary.
- Seagrass (*Zostera capricornia*), present in 2011 and 2012, was not observed in the estuary in 2018. [152]

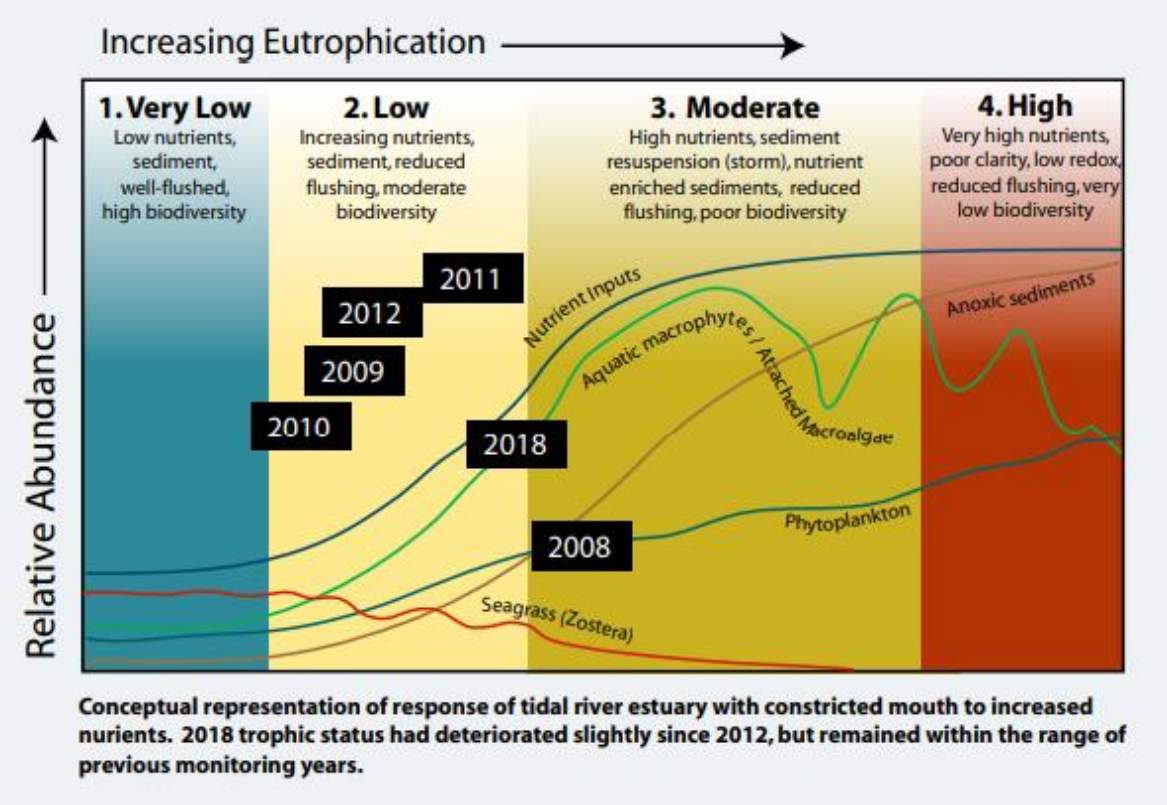


Figure 25: Waimatuku Subtidal channel condition and trophic state. Source: Robertson & Robertson (2018).

[152] Robertson & Robertson 2018

Past and present research and restoration within the catchment

Private landowners and catchment groups

There are seven QEII covenant areas within the catchment area that cover a range of different wetland types and hold significant pockets of biodiversity within the catchment.

Waimatuku Catchment Group

Waimatuku Catchment Group was founded in 2016 and now comprises 76 members. The vision of the group is to "Enhance the water quality and biodiversity in the Waimatuku catchment while improving recreational opportunities and economic sustainability for ourselves, our community and future generations". The groups goals are to:

- Increase community involvement in the water quality discussion;
- Learn more about local biodiversity;
- Explore new technologies to improve the environmental performance of our farms;
- Build relationships with other Catchment Groups

The group has been engaged in planting days, biodiversity field days, information events and community activities. And is currently working with ES and SDC to develop a picnic area at the bottom of the catchment.[153]

Aparima Community Environment Group

The Waimatuku Catchment group is part of the larger Aparima Community Environment (ACE) group which is made up of six farmer-led Aparima catchment groups. ACE has been operating since 2018 with the long term goal of enhancing the mana and resilience of the catchment for future generations. It is supported by Thriving Southland.[154]

ACE Community Project has four current workstreams.[155]

Sediment traps

- ACE is creating a network of sediment traps (an area where the runoff from land will collect and settle for sufficient time to allow any sediment in suspension to drop out before the water drains away through an overflow or spill way). Documenting, recording and analysing all aspects.
- Six sediment traps will be constructed across the Aparima catchment groups. There are currently case studies with information available, one is located in the Waimatuku Catchment.
    - The Dietsches operate a large dairy property in the upper Waimatuku catchment, bordering the Bayswater Bog in the Drummond area.
    - A number of sediment traps were constructed in three different areas of the property, all utilising small gully and swale areas. Some of these areas were being

[153] https://www.thrivingsouthland.co.nz/waimatuku/
[154] https://storymaps.arcgis.com/stories/574dc5c9937445599d5ccd7225ec41f6
[155] https://www.thrivingsouthland.co.nz/ace_about-us/

used as farm forestry blocks, with sediment traps being installed after the trees had been harvested.[156]

The Future Farming

- The Future Farming workstream is exploring alternative farm systems that can meet a wide range of regulations, including nutrient and greenhouse gas regulations. The focus of the workstream is to work with farmers to identify practical alternative systems that can be implemented.
- Five farms have been selected as case studies; they have had their baseline data collected and modelled in Overseer and Farmax to provide a detailed picture of the farms' environmental footprint during the baseline period. The current phase of the project involves individual workshops to help develop a suite of possible mitigations for each farm. These mitigations strategies will be modelled to determine what reductions in environmental footprints could be achieved, and the impact on the financial sustainability of the farm.
- The findings of this workstream will allow farmers and land users, within the ACE catchment and Southland region, to see the detailed impacts of different nutrient and greenhouse gas mitigations on current farming systems, and how these could work on their own farms.

Stream Walks and Water Testing

- Water quality information and habitat data is going to be collected on stream walks.
- Stream walks are undertaken to build awareness and engage the community. During each stream walk a range of monitoring tools can be used including: SHMAK, Rapid Habitat Assessment, macro invertebrate monitoring, riparian condition assessment methods and eDNA testing.

Delivery of Farm Environment Management Plans and implementing good farming practice

- ACE brings together key primary sector, council and scientific experts to support farmers to continue learning and implementing good farming practices and support farmers to develop a farm environment plan and trial innovative practices.

Environment Southland

Earlier sections in this report provide an overview of the long-term water quality, ecological and estuary monitoring conducted by Environment Southland. Environment Southland has freshwater management responsibilities in the catchment, including protection of habitat, fish passage, wetlands, biosecurity, water quality and water quantity.

The Biodiversity team at Environment Southland provides rapid ecological surveys for private landowners, HVA reports). HVA reports identify ecological values and provide information on how to protect those values. There are two HVA reports in the Waimatuku catchment, in total covering approximately 27.72 ha. HVA information and data cannot be shared without landowner permission. For restoration purposes, collaboration with landowners will likely promote data sharing.

156 https://www.thrivingsouthland.co.nz/site_files/24893/upload_files/CASESTUDYACEDirkeDietschev1.pdf?dl=1

Environment Southland is currently embarking on a five-year programme to retrofit 250 fish passages in Southland, as part of the Governments Jobs for Nature Programme.

Southland District Council

In relation to restoration, the Southland District Council has responsibility for management of land use activity, reserve management and roading and roadside spraying in the catchment.

Department of Conservation

The Department of Conservation has recently undertaken a baseline eDNA survey (some results included in this report). This information will be used to:

- Improve the distributional knowledge of freshwater species in the catchment.
- Provide a baseline survey which presence/absence can be compared in future years.
- Identify the presence of non-migratory galaxiids (Gollum galaxiids and possibly southern flathead) or other threatened fish species (such as kanakana) and their habitats, to inform future work, or prioritise restoration efforts.
- Communication and advocacy purposes.
- Provide a guide on ecosystem health through Taxon-Independent Community Index scores. This tool is still in development, but essentially seeks to provide a score based on ecosystem health similar to MCI.

Rapid habitat assessments and fish passage assessments were also carried out at many of the eDNA survey sites.

Fish and Game

Fish and Game Southland manages sports fish and gamebird species. This agency provides free advice, resources and some support around the development of wetlands.

Within the Waimatuku catchment Fish and Game have:

- Undertaken electric fish (with results available on the Freshwater Fish Database (FWFD)),[157]
- Record angler usage as part of the National Angler Survey,[158]
- Supported the thesis of David Moate who studied Brown trout diet and growth in the Waimatuku Stream,[159]
- Big Lagoon and the Waimatuku Wetland are included as part of the annual national count of shoveler ducks, which is used to monitor changes in the New Zealand population.[160]

Other

Lakes380

Lakes380 - Our Lakes' Health: past, present, future was a five-year research project that aimed at enhancing the understanding of the environmental, social and cultural histories of 10% of New Zealand's 3,800 lakes (>1 ha).[161] As part of this programme surface water, sediment sample and sediment cores have been collected from Big Lagoon and Long White Lagoon. [162]

[157] Cohen Stewart (Fish and Game) pers comms
[158] Stoffels & Unwin 2023
[159] Moate 2010
[160] McDougall 2023
[161] https://lakes380.com/
[162] Dr Susie Woods (Cawthron) pers comms

Summary of threats, information gaps, opportunities and actions

It has been 100 years since work started in the Waimatuku Stream to deepen and straighten the stream.[163] Since that time it has been substantially altered, and now flows through a heavily modified catchment. However, within the Waimatuku catchment there are pockets of remaining biodiversity that hold significant value. These pockets are often centred around the remaining wetlands, lakes and estuary and are home to a range of threatened flora and fauna species.

The water quality within the Waimatuku catchment is degraded for a number of attributes. ES and TAMI (2023) have determined that a state of hauora and healthy resilience in the Waimatuku (and Taunamau) catchment will be supported when:

- sources of *E. coli* from human activity are prevented from reaching waterbodies as much as possible.
- erodible lands and waterbody margins are stabilised.
- sediment is prevented from reaching waterbodies as much as possible.
- the flow of water is slowed by reintroducing bends, pools and wetland margins to straightened and channelised waterbodies.
- wetlands are protected and re-established or restored.
- nitrogen and phosphorus are reduced to levels that restore water quality to within the natural range for waterbodies.
- natural habitat and biodiversity is abundant in riparian margins and instream.

The contamination reductions required for the Waimatuku (and Taunamau) catchment to be consistent with the hauora objectives (which includes a 20% spatial exceedance criteria) are as follows (brackets are the bottom and top of the 90% confidence intervals):

- *E. coli* - estimated 86% (71-95) reduction,
- Total Nitrogen -estimated 69% (50-82) reduction,
- Total Phosphorus - estimated 43% (3-71) reduction,
- Sediment (visual clarity)- estimated 55% reduction, and
- Suspended sediment - estimated 33% reduction.[164]

The Waimatuku Stream is important to mana whenua: its ingoa (name) highlights the significant connection to tupuna, it is home to taonga species, its coastal reaches edge the Ōreti Mātaitai and flows into Te Ara a Kiwa (Statutory Acknowledgement) and is the border of the Ōraka-Aparima Rūnaka and Waihopai Rūnaka takiwā. Any future restoration activity should be undertaken in partnership with mana whenua. Agreement on the process should be co-developed with mana whenua, who will have restoration and management aspirations which Ngā Awa could align to and support.

[163] Strange 1969

[164] https://waterandland.es.govt.nz/science-and-economics/contaminants-and-numbers

Prior to restoring what has been lost or degraded, the first step needs to be prevention of further habitat loss or degradation within the catchment.

Figure 26: Waimatuku Stream looking upstream from Fraser Road. The channelisation, stock in close proximity to the stream and some riparian vegetation can be seen. Source: Pryor Rodgers.

Table 10: Summary of key conditions, threats, information gaps and recommended opportunities and actions.

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
			HABITAT	
STREAM	**WATER QUALITY AND ECOSYSTEM HEALTH** Modelling suggests that substantial nitrogen, phosphorus, sediment and *E. coli* load reductions are required to support a state of hauora in the Waimatuku (and Taunamau) zones.[165] ***Water clarity/sediment:*** Water clarity can be impacted by the amount of sediment suspended in the water column. Water clarity fails against the pSWLP standard, and the 10-year trend is likely degrading. ***Elevated nutrients:*** The DRP state of 'D Band' indicates that	Threats to stream habitat include: ***Sedimentation and elevated nutrients.*** Land use such as agricultural activities, stock in streams and creek erosion. ***Faecal sourced Pathogens/E. Coli*** *Campylobacter* was present at the Lorneville Riverton Highway site, the sources were wildfowl, 'non-wildfowl, unknown and a small percentage of ruminant. Human faecal pollution was also detected. ***Stream maintenance:*** straightening of the stream originated in the 1920s.	There is a general lack of information on the ecological health, habitat quality and flora and fauna values and threats across the Waimatuku Catchment. More detailed information on land cover change. More current information on fish barriers, particularly on private land. The potential and risks from aquatic pests as temperatures rise with climate change. The extent of terrestrial pest plants and animals in the catchment.	***Catchment-wide surveys to document stream water quality and ecosystem health*** Connect to the Waimatuku Catchment Group to better understand the water quality monitoring that is being undertaken. Coordinate with ES, mana whenua, and landowners to develop a comprehensive survey throughout the Waimatuku catchment (ki uta ki tai) to determine current ecosystem health and to identify priority areas for closer attention to understand pressures. Work with ES to undertake sediment-source tracking work that will better enable targeted remedial actions working with landowners. ***Support restoration of Riparian margins:*** Recent DOC surveys noted very narrow riparian setback in some places.[166] A survey to determine the current condition of riparian margins would be useful, including identification of where wider riparian margins and fencing is needed. Connect with the riparian aspirations of the community. Connect with the community on aquatic restoration.

[165] Environment Southland and TAMI 2023
[166] Jane Bowen (DOC) pers comms.

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
	ecological communities are impacted by substantial DRP elevation above natural reference conditions. The NPSFM 2020 does not provide an equivalent against ecosystem health for TON. The state is within the worst 25% of all sites. Elevated nutrient can impact on habitat and aquatic species. ***E. coli:*** Elevated *E. coli* levels indicates health risks for human contact with the water. *E coli* is assessed as E Band in the NPSFM standards, this is the poorest band with >7% predicted average infection risk. The quality of water is unsuitable for water contact uses. ***MCI:***	***Removal of indigenous vegetation and loss of wetlands:*** Removal of habitat and increasing the potential for sediment, nutrients and pathogen run-off. ***Potential risk of aquatic pest plants and animals***: Removal of habitat, and/or competition/predation of native species. ***Terrestrial pest plants***: Woody pest plants such as gorse and broom can invade wetlands and riparian margins. ***Pest animals***: Riparian and restoration plantings and existing vegetation can be browsed and damaged by mammalian herbivores. Predation of riparian and aquatic animals.	The existence and condition of fencing of remaining indigenous flora areas. The threatened indigenous plant species within the aquatic environment, and their conservation and restoration requirements.	***Indigenous vegetation*** Determine the areas where landcover change have occurred and are continuing to occur. Identify risks and potential risks of such changes. Using DOC expert knowledge, data from past unpublished surveys and targeted surveys, assess the threats, protection and restoration needs of threatened indigenous freshwater dependent/associated plants in the catchment. Assess the extent, issues, and risks of terrestrial plant and animal pests in the catchment. Develop and implement a management plan from this assessment. Develop advice on drain and stream maintenance: Coordinate with ES to provide advice on the best drain and stream maintenance techniques to promote ecosystem health and restoration. ***Fish Passage*** Coordinate with ES to create a fuller inventory of barriers to fish movement, particularly on private land, and identify priority areas. Connect to the ES Fish Passage Barrier project and find areas for collaboration. Budget for this project is available until 2025. ***Other*** Identify risks of potential aquatic pest incursions. Work with ES, Fish and Game, NIWA to identify the potential

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
	The MCI score just passes in the C Band when assessed by the NPSFM 2020 and passes the pSWLP standard at the Lorneville Riverton site, but the other two sites are below the national bottom line and fail against the pSWLP standard. This indicates moderate organic pollution or nutrient enrichment at Lorneville Riverton and severe organic pollution or nutrient enrichment at the remaining sites. **LANDCOVER/RIPARIAN MARGINS** ***Removal of indigenous vegetation***: Vegetation land cover changes from 1996 to 2018 include a 865% (227 ha) increase in low producing grassland and a decrease in herbaceous freshwater vegetation by 33% (-307 ha).	Stock in unfenced areas can damage streams and existing vegetation. ***Inappropriately designed culverts and infrastructure***: Impacts on fish habitat and fish migration.		risks and impacts of incursions from aquatic pests as temperatures rise with climate change. Ensuring appropriate conditions have been provided for in resource consents and general resource consent advocacy. Utilise consent processes to ensure reduced threats to the stream.

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
	Wetland loss is covered below. **CONNECTIVITY** ***Fish passage issues in the catchment*** The NIWA Fish Passage Assessment Tool highlights that recent structures assessed consist of low risk, and high to very high risk. **PEST PLANTS AND ANIMALS** No freshwater aquatic pests, plants or fish have been identified in the catchment. Terrestrial weed species are a concern around some of the wetlands. The extent of terrestrial pest animal species is unknown.			
WETLANDS	In lowland Southland wetland extent (of wetlands >0.5 ha) decreased by 11%	Threats to wetland habitat in Southland include: ● drainage	Assessment of the extent and current condition of wetlands and the rate of wetland	**Assess the extent, condition, protection and threats of existing wetlands**.

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
	between 2007 and 2015.[167] There are a number of Regionally Significant and proposed Regionally Significant Wetlands within the catchment. Some of the wetlands are in Public Conservation Land. Invasive weeds have been recorded as a problem for Drummond Swamp and Bayswater Peat Bog.	• stock access • invasive weeds • plantation forestry • fires • quarrying • inundation • altered hydrology.[168] Threats specifically noted in the Waimatuku catchment include: • land conversion, • Invasive weeds. Blueberries have established as weeds in Waikato peat systems, it will be important to ensure wilding blueberries do not establish in Bayswater from the neighbouring blueberry farm. [169]	loss in the Waimatuku catchment. Determine if the remaining wetlands are protected or at risk from being lost. Determine if wetlands are protected by QEII covenants. Evaluate the mechanisms behind wetland loss in the catchment. Evaluate the NES for Freshwater provisions to improve wetland protection. Analysis of the Resource Management (Stock Exclusion) Regulations 2020 and their ability to	Utilise the expert knowledge within DOC to identify biodiversity values, management needs and restoration opportunities. Bayswater Peat Bog plays an important role in the Waimatuku hydrological system, further investigation into the impacts of wetland loss from this bog on the stream would be useful.[170] Work with the QEII Trust to connect with landowners with wetlands in QEII covenants to gain more information on these pockets of biodiversity and determine support that might be needed. Weed control management is required for Drummond Swamp and Bayswater Peat Bog. The NPS-FM (2020) requires that every regional council must identify and map every natural inland wetland in its region (excluding DOC estate) that is: a. 0.05 ha or greater in extent; or b. of a type that is naturally less than 0.05 ha in extent (such as an ephemeral wetland) and known to contain threatened species.

[167] Ewans 2018
[168] Ewans 2016; Rate and Lloyd as cited in Kitson 2021
[169] Campbell, Clarkson & Clarkson 2003
[170] Hitchcock 2014

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
			adequately protect wetlands. Identify the current risk of invasive weeds in each wetland.	Work with ES, mana whenua, landowners, Fish & Game and other stakeholders to map wetlands, develop action plans and identify restoration opportunities. Work with ES to ensure they are taking compliance action when illegal drainage of wetlands is identified, and work towards reinstatement of wetlands in the catchment. ***Restoration/development of wetlands for whitebait species*** Restoration opportunities within the lower catchment could provide habitat for whitebait species to mature.
LAKES/LAGOONS	Big Lagoon is in a mesotrophic state. Long White Lagoon is in a supertrophic state. One sampling event for each lake has collected water quality and sediment quality information. Sampling found low fish numbers in Big Lagoon since restoration.[171]		Lack of baseline (other than one sampling event) information on the environmental and ecological state of the lakes.	Schallenberg et al (2023) recommend monitoring and interventions for mesotrophic (and eutrophic) lakes such as Big Lagoon to prevent degradation below the national bottom line. For supertrophic lakes such as Long White Lagoon they recommend a more targeted sampling to identify the drivers of degradation, once the main stressors are identified a tailored restoration plant should be developed. Sediment cores have been sampled from both lakes, however resources availability have prevented these from being analysed by the Lakes380 project. Analysis of these cores would provide useful information on the

[171] Stuart 2021

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
				history vegetation and changes to land cover over time. Further water quality and sediment quality monitoring to build on the baseline information collected by Lakes380. Increase connectivity to Big Lagoon to surrounding waterways to increase habitat potential for freshwater fish. [172]
ESTUARY	The Waimatuku Estuary has a relatively low susceptibility to eutrophication, primarily due to its highly flushed nature, high freshwater inflow and few poorly flushed areas. The nutrient load received from both riverine and groundwater sources are considered high. Small areas of saltmarsh.	Absence of extensive vegetated margin. Opportunistic macroalgae was present at sites in the upper-middle estuary. Extensive benthic microalgae growing on lower estuary sands. Excessive deposition of muds is currently only a problem in the deeper, less well flushed upper estuary. Sediment oxygenation depth was poor in the upper estuary. Seagrass was present in the surveys in 2011 and	Nutrient loading to the catchment and its impact on the estuary. Sediment load to the estuary and its impact. Current distribution of seagrass. Potential impacts of sea level rise on the estuary.	Robertson & Robertson (2018) emphasise the need to manage nutrients and to a lesser extent fine sediment to the estuary. Develop management and/or restoration plans for the estuary, including revegetating the margins to help buffer excess nutrients. And protecting the remaining saltmarsh. Further monitoring to determine seagrass presence/distribution, and potentially a management and/or restoration plan to protect remnants.

[172] Stuart 2021

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
		2012 but absent in the 2018 survey.		
FLORA AND FAUNA				
INVERTEBRATES	Benthic invertebrates are monitored by ES at three sites for ecosystem health purposes, using the MCI (see above). This has limited value in terms of identifying rare communities or understanding the distribution and abundance of valued taonga species (e.g., kōura and waikākahi). Kōura are found in the catchment, and have the conservation status of 'At risk – Declining'. Anecdotal angler evidence of a decline in mayflies which is thought to impact trout growth. [173]	Threats to aquatic invertebrate communities include: ● elevated nutrient and sediment levels in runoff from surrounding land and upstream catchments ● nuisance periphyton growths ● fine sediment deposition on natural hard substrate rivers and streams ● climate change causing water temperatures to generally increase ● generally poor water quality, including low water clarity and emerging contaminants	The distribution, abundance and health of aquatic invertebrates in the Waimatuku Stream.	***Catchment-wide surveys to determine species' distribution, abundance and level of protection*** Specific surveys of the catchment for kōura. ***Restoration opportunities*** Assess restoration opportunities for kōura. ***Promotion and education*** Provide support, education and wānanga opportunities around the uniqueness and value of kōura to the community. ***Develop advice on drain and stream maintenance*** (See in Streams above)

[173] Moate 2010

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
		• inadequate protection of riparian margins • Changes to channels and removal through stream works and drain management.		
FISH	The Waimatuku catchment has a range of native fish species recorded of both migratory and non-migratory species. The most threatened species recorded are the Gollum galaxias and kanakana/lamprey which are both considered Nationally Vulnerable. The species considered 'At Risk' are: Giant bully, Inanga, Tuna/Longfin eel and Torrentfish.	Threats to fish and fish communities include: • fine sediment deposition affecting spawning habitat for some species, e.g. Kanakana, Inanga. • generally poor water quality • inadequate protection of riparian margins including the removal of vegetation that provide shade and filter nutrients and sediment, and access by stock elevating nutrients and causing bank	There is a lack of information on the catchment wide species occurrence, abundance, condition, distribution, and population structure of freshwater fish species. The composition of whitebait species caught. There is little information on the habitat of threatened species, and the potential for restoration. The extent and condition of inanga	***Catchment wide species distribution survey*** A systematic and repeatable survey of freshwater species distribution within the catchment. It is recommended that such a survey would include measures of abundance, condition, and population structure of threatened and taonga freshwater fish species. With mana whenua and the community, develop a protection and restoration plan for threatened and taonga freshwater fish species in the catchment. There was relatively strong signal for kanakana in the eDNA surveys at one site, it could be beneficial to further investigate this site with other methods to try locate spawning areas.[175] ***Survey to identify significant spawning sites for whitebait*** Assess the extent and condition of inanga spawning habitat in the lower catchment. Surveys to identify the composition of the whitebaiters catch.

[175] Jane Bowen (DOC) pers comms.

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
	Brown trout population distribution and productivity is significantly reduced. [174]	erosion, and damaging inanga spawning areas • barriers to fish movement, particularly for migration to complete life cycles • species that are predatory or compete for habitat • channelization of smaller watercourses altering habitat and changing local hydrology • introduction or expansion of undesirable species (e.g., due to climate change) • commercial and recreational harvesting • Fish mortalities due to contamination events.	spawning habitat in the lower catchment. Barriers to passage of migratory species (see Stream). Climate change effects on threatened species including emerging biosecurity threats, such as invasive freshwater fauna and flora species, and disease.	***Whitebait habitat restoration*** Whitebaiting in the catchment is highly valued, therefore protection and restoration activities could provide a catchment focal point for the community. This could link to restoration and development of wetlands for whitebait species. ***Promotion and education*** Provide support, education and wānanga opportunities around the uniqueness and value of the different freshwater fish species in the catchment, including inanga and kanakana. ***Develop advice on drain and stream maintenance*** (See in Streams above) ***Fish Passage inventory and priority*** (See in Streams above)

[174] Moate 2010

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
BIRDS	The Waimatuku catchment, particularly around the estuary and mouth, has a diverse assemblage of bird species. Many are connected to the freshwater or estuary habitats as part of their life cycle. There are a variety of 'At risk and 'Threatened Species. Fish and Game have undertaken yearly shoveler duck counts at Big Lagoon and the Waimatuku Wetland. The current known bird assemblages have relied on sightings listed by birding enthusiasts, with sightings concentrated at the lower Waimatuku Estuary.	Threats to birds include: • predation by exotic mammalian predators (stoats, ferrets and cats) • human-related mortality (e.g., hunting, shot as pests, electrocution from power lines) • loss of habitat through the likes of drainage, removal of indigenous vegetation	Distribution and population status of bird species across the Waimatuku Catchment. Particularly the Matuku/Australasian bittern. Available connected habitat for Matuku has been highlighted as a Ngāi Tahu indicator for this catchment.[176] Habitat use and management of habitat of threatened and species.	***Species distribution across the catchment*** Surveys and overlaying DOC database information on bird sightings and distribution across the catchment. ***Assessment of threats and restoration opportunities of threatened and taonga freshwater and estuarine bird species.*** This may include approaches, such as reinstatement of open-water wetlands for whitebait habitat that would benefit estuarine birds

[176] Environment Southland and TAMI 2023

VALUE	CONDITION/STATUS	THREATS	INFORMATION GAPS	OPPORTUNITIES & ACTIONS
LIZARDS	There is little information about the lizard fauna in the catchment, however skink populations have been mentioned for Bayswater Bog and a private QEII covenant.	Threats to lizards include: ● predation by exotic mammalian predators ● loss of habitat ● fire	More information on the skink populations, and other lizard species within the catchment.	***Address knowledge gaps:*** with expert knowledge and collation of past survey work data by DOC. Use this to determine further survey and information needs for restoration and conservation.

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Appendix One: Taonga Species

As recorded in Appendix M of the proposed Southland Land and Water Plan.

Birds

Name in Māori	Name in English	Scientific name
Hoiho	Yellow-eyed penguin	*Megadyptes antipodes*
Kāhu	Australasian harrier	*Circus approximans*
Kākā	South Island kākā	*Nestor meridionalis meridionalis*
Kākāpō	Kākāpō	*Strigops habroptilus*
Kākāriki	New Zealand parakeet	*Cyanoramphus* spp
Kakaruai	South Island robin	*Petroica australis australis*
Kakī	Black stilt	*Himantopus novaezelandiae*
Kāmana	Crested grebe	*Podiceps cristatus*
Kārearea	New Zealand falcon	*Falco novaeseelandiae*
Karoro	Black-backed gull	*Larus dominicanus*
Kea	Kea	*Nestor notabilis*
Kōau	Black shag	*Phalacrocorax carbo*
	Pied shag	*Phalacrocorax varius varius*
	Little shag	*Phalacrocorax melanoleucos brevirostris*
Koekoeā	Long-tailed cuckoo	*Eudynamys taitensis*
Kōparapara *or* Korimako	Bellbird	*Anthornis melanura melanura*
Kororā	Blue penguin	*Eudyptula minor*
Kōtare	Kingfisher	*Halcyon sancta*
Kōtuku	White heron	*Egretta alba*
Kōwhiowhio	Blue duck	*Hymenolaimus malacorhynchos*
Kūaka	Bar-tailed godwit	*Limosa lapponica*
Kūkupa/Kererū	New Zealand wood pigeon	*Hemiphaga novaeseelandiae*
Kuruwhengu/Kuruwhengi	New Zealand shoveller	*Anas rhynchotis*
Mātā	Fernbird	*Bowdleria punctata punctata* and *Bowdleria punctata stewartiana* and *Bowdleria punctata wilsoni* and *Bowdleria punctata candata*
Matuku moana	Reef heron	*Egretta sacra*
Miromiro	South Island tomtit	*Petroica macrocephala macrocephala*
Miromiro	Snares Island tomtit	*Petroica macrocephala dannefaerdi*
Mohua	Yellowhead	*Mohoua ochrocephala*
Pākura/Pūkeko	Swamp hen/Pūkeko	*Porphyrio porphyrio*
Pārera	Grey duck	*Anas superciliosa*
Pateke	Brown teal	*Anas aucklandica*
Pīhoihoi	New Zealand pipit	*Anthus novaeseelandiae*
Pīpīwharauroa	Shining cuckoo	*Chrysococcyx lucidus*
Pīwakawaka	South Island fantail	*Rhipidura fuliginosa fuliginosa*
Poaka	Pied stilt	*Himantopus himantopus*
Pokotiwha	Snares crested penguin	*Eudyptes robustus*

Pūtakitaki	Paradise shelduck	*Tadorna variegata*
Riroriro	Grey warbler	*Gerygone igata*
Roroa	Great spotted kiwi	*Apteryx haastii*
Rowi	Ōkārito brown kiwi	*Apteryx mantelli*
Ruru koukou	Morepork	*Ninox novaeseelandiae*
Takahē	Takahē	*Porphyrio mantelli*
Tara	Terns	*Sterna* spp
Tawaki	Fiordland crested penguin	*Eudyptes pachyrhynchus*
Tete	Grey teal	*Anas gracilis*
Tīeke	South Island saddleback	*Philesturnus carunculatus carunculatus*
Tītī	Sooty shearwater/Muttonbird/Hutton's shearwater Common diving petrel South Georgian diving petrel Westland petrel Fairy prion Broad-billed prion White-faced storm petrel Cook's petrel Mottled petrel	*Puffinus griseus* and *Puffinus huttoni* and *Pelecanoides urinatrix* and *Pelecanoides georgicus* and *Procellaria westlandica* and *Pachyptila turtur* and *Pachyptila vittata* and *Pelagodroma marina* and *Pterodroma cookii* and *Pterodroma inexpectata*
Tītitipounamu	South Island rifleman	*Acanthisitta chloris chloris*
Tokoeka	South Island brown kiwi	*Apteryx australis*
Toroa	Albatrosses and Mollymawks	*Diomedea* spp
Toutouwai	Stewart Island robin	*Petroica australis rakiura*
Tūī	Tūī	*Prosthemadera novaeseelandiae*
Tutukiwi	Snares Island snipe	*Coenocorypha aucklandica huegeli*
Weka	Western weka	*Gallirallus australis australis*
Weka	Stewart Island weka	*Gallirallus australis scotti*
Weka	Buff weka	*Gallirallus australis hectori*

Plants

Name in Māori	Name in English	Scientific name
Akatorotoro	White rata	*Metrosideros perforata*
Aruhe	Fernroot (bracken)	*Pteridium aquilinum* var *esculentum*
Harakeke	Flax	*Phormium tenax*
Horoeka	Lancewood	*Pseudopanax crassifolius*
Houhi	Mountain ribbonwood	*Hoheria lyalli* and *H. glabata*
Kahikatea	Kahikatea/White pine	*Dacrycarpus dacrydioides*
Kāmahi	Kāmahi	*Weinmannia racemosa*
Kānuka	Kānuka	*Kunzia ericoides*
Kāpuka	Broadleaf	*Griselinia littoralis*
Karaeopirita	Supplejack	*Ripogonum scandens*
Karaka	New Zealand	*Corynocarpus laevigata*

	laurel/Karaka	
Karamū	Coprosma	*Coprosma robusta, coprosma lucida, coprosma foetidissima*
Kātote	Tree fern	*Cyathea smithii*
Kiekie	Kiekie	*Freycinetia baueriana* subsp *banksii*
Kōhia	NZ Passionfruit	*Passiflora tetranda*
Korokio	Korokio Wire-netting bush	*Corokia cotoneaster*
Koromiko/Kōkōmuka	Koromiko	*Hebe salicfolia*
Kōtukutuku	Tree fuchsia	*Fuchsia excorticata*
Kōwahi Kōhai	Kōwhai	*Sophora microphylla*
Mamaku	Tree fern	*Cyathea medullaris*
Mānia	Sedge	*Carex flagellifera*
Mānuka Kahikātoa	Tea-tree	*Leptospermum scoparium*
Māpou	Red matipo	*Myrsine australis*
Mataī	Mataī/Black pine	*Prumnopitys taxifolia*
Miro	Miro/Brown pine	*Podocarpus ferrugineus*
Ngaio	Ngaio	*Myoporum laetum*
Nīkau	New Zealand palm	*Rhopalostylis sapida*
Pānako	(Species of fern)	*Asplenium obtusatum*
Pānako	(Species of fern)	*Botrychium australe* and *B. biforme*
Pātōtara	Dwarf mingimingi	*Leucopogon fraseri*
Pīngao	Pīngao	*Desmoschoenus spiralis*
Pōkākā	Pōkākā	*Elaeocarpus hookerianus*
Ponga/Poka	Tree fern	*Cyathea dealbata*
Rātā	Southern rātā	*Metrosideros umbellata*
Raupō	Bulrush	*Typha angustifolia*
Rautāwhiri/Kōhūhū	Black matipo/Māpou	*Pittosporum tenuifolium*
Rimu	Rimu/Red pine	*Dacrydium cypressinum*
Rimurapa	Bull kelp	*Durvillaea antarctica*
Taramea	Speargrass, spaniard	*Aciphylla* spp
Tarata	Lemonwood	*Pittosporum eugenioides*
Tawai	Beech	*Nothofagus* spp
Tētēaweka	Muttonbird scrub	*Olearia angustifolia*
Tī rākau/Tī Kōuka	Cabbage tree	*Cordyline australis*
Tīkumu	Mountain daisy	*Celmisia spectabilis* and *C. semicordata*
Tītoki	New Zealand ash	*Alectryon excelsus*
Toatoa	Mountain Toatoa, Celery pine	*Phyllocladus alpinus*
Toetoe	Toetoe	*Cortaderia richardii*
Tōtara	Tōtara	*Podocarpus totara*
Tutu	Tutu	*Coriaria* spp
Whaririki	Mountain flax	*Phormium cookianum*
Whīnau	Hīnau	*Elaeocarpus dentatus*
Wī	Silver tussock	*Poa cita*
Wīwī	Rushes	*Juncus* all indigenous *Juncus* spp and *J. maritimus*

Freshwater Fish and Shellfish

Name in Māori	Name in English	Scientific name
Inanga	(whitebait species)	*Galaxias maculatus*
	Banded kokopu	*Galaxias fasciatus*
Koaro	(whitebait species)	*Galaxias brevipinnis*
	Shortjaw kokopu	*Galaxias postvectis*
Taiwharu	Giant kokopu	*Galaxias argenteus*
	Upland bully	*Gobiomorphus breviceps*
	Bluegill bully	*Gobiomorphus hubbsi*
Kokopu/hawai	Giant bully	*Gobiomorphus gobioides*
	Common bully	*Gobiomorphus cotidianus*
	Redfin bully	*Gobiomorphus huttoni*
Tuna	Longfin eel	*Anguilla dieffenbachii*
Tuna	Shortfin eel	*Anguilla australis*
Kanakana	lamprey	*Geotria australis*
	Alpine galaxias	*Galaxias paucispondylus*
	Gollum galaxias	*Galaxias gollumoides*
	Southern flathead galaxias	*Galaxias depressiceps*
Piripiripohatu	Torrentfish	*Cheimarrichthys fosteri*
Paraki/ngaiore	Common smelt	*Retropinna retropinna*
	Black flounder	*Rhombosolea retiaria*
Koura/kewai	Freshwater crayfish	*Paranephrops planifrons, Paranephrops zealandicus*
Kakahi	Freshwater mussels	*Echyridella menziesi*
Pipi/Kākahi	Pipi	*Paphies australe*
Tuaki	Cockle	*Austrovenus stutchburgi*
Tuaki/Hākiari, Kuhakuha/Pūrimu	Surfclam	*Dosinia anus, Paphies donacina, Mactra discor, Mactra murchsoni, Spisula aequilateralis, Basina yatei, or Dosinia subrosa*
Tuatua	Tuatua	*Paphies subtriangulata, Paphies donacina*
Waikaka/Pūpū	Mudsnail	*Amphibola crenata, Turbo smaragdus, Zedilom spp*

Appendix Two: National and Regional Surface Water Quality Standards and guidelines used to assess the environmental state.

Source: Kitson 2021

Parameter (units)					
Rivers					
NPSFM 2020					
Macroinvertebrate Community Index (MCI)	**A**	≥130			
	B	≥110 and <130			
	C	≥90 and <110			
	National bottom- line	90			
	D	<90			
E. coli (n/100 mL)		% exceedances over 540/100mL	% exceedances over 260/100mL	Median concentration /100 mL)	95th percentile of E. coli/100 mL
	A	<5%	<20%	≤130	≤540
	B	5-10%	20-30%	≤130	≤1000
	C	10-20%	20-34%	≤130	≤1200
	D	20-30%	>34%	>130	>1200
	E	>30%	>50%	>260	>1200
Total oxidised nitrogen (TON) (nitrate + nitrite N) toxicity (mg/L)	**A**	≤1			
	B	>1.0 and ≤2.4			
	National bottom- line	2.4			
	C	>2.4 to ≤6.9			
	D	>6.9			
Dissolved Reactive Phosphorus (DRP) (mg/L)	**A**	≤ 0.006			
	B	> 0.006 and ≤0.010			
	National bottom- line	0.010			
	C	> 0.010 and ≤ 0.018			
	D	>0.018			

Proposed Southland Water and Land Plan standards			
	Surface Water Quality Management Units		
	Lowland soft bed	Lowland hard bed	Natural State
Macroinvertebrate Community Index (MCI)	80	90	The natural quality of the water shall not be altered.
Faecal Coliforms (n/100 mL)	1,000	1,000	
Benthic Periphyton Biomass (Ash Dry Weight, g/m^2)	NA	35	
Benthic Periphyton Chlorophyll *a* (mg/m^2)	NA	120	
Water clarity (m, at median flow)	>1.3	>1.6	

ANZECC 2000 guidelines

	Upland Median	Lowland Median
Water clarity [b] (m)	>0.8	>0.6
NH_4-N [b] (g m^{-3})	<0.01	<0.021
NO_3-N [b] (g m^{-3})	<0.167	<0.444
TN [b] (g m^{-3})	<0.295	<0.617
DRP [b] (g m^{-3})	<0.009	<0.01
TP [b] (g m^{-3})	<0.026	<0.033

Appendix Three: Summary of water quality

Table 11: State summary for sites located on the Waimatuku Stream. All sites are lowland hardbed, except for the Fairfax Isla Banks Rd which is lowland soft bed. All information is sourced from Norton et al (2019) Appendix 6.

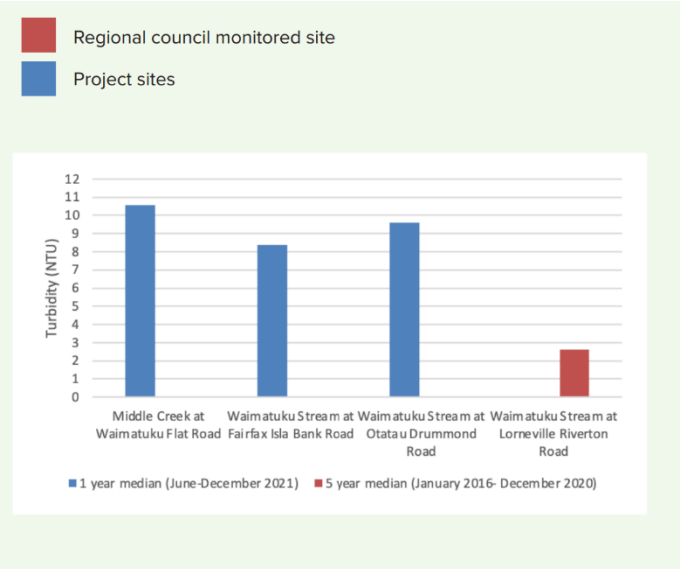
Site	Year	Periphyton (Chl-a mg/m2)	Nitrate toxicity (mg/L)	Ammonia toxicity (mg/L)	Dissolved Oxygen (mg/L)	E coli (E.coli/100 mL)	MCI	Temperature Summer (oC Dec-Mar)	Temperature Winter (oC May-Sep)	*E. coli* popular bathing sites (E coli/100 mOL)	Clarity (visible distance, m)	Deposited fine sediment (%)	Suspended fine sediments (turbidity, FNU)	Benthic cyanobacteria (% cover)	Filamentous periphyton (% cover)	Diatoms and cyanobacteria (%cover)	Dissolved Reactive Phosphorus (mg/L)	Fish (IBI)	Dissolved inorganic nitrogen (mg/L)	Deposited fine sediment (%cover)	Deposited fine sediment (Quorer method)
		National Compulsory attributes					Southland attributes										Additional national compulsory attributes requiring an action plan		Additional attributes for information		
Lornevi lle Riverto n Hwy	2010																				
	2016																				
	2019																				
Bayswa ter Peat Bog	2010																				
	2016																				

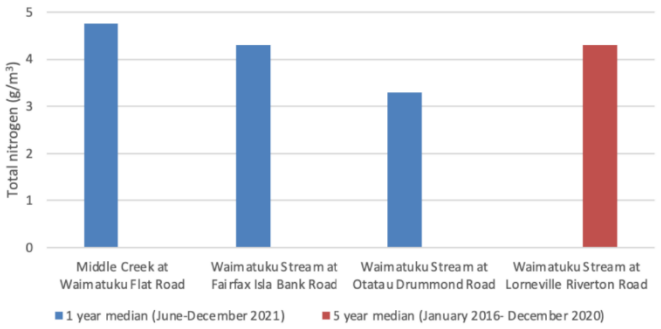
Site	Year	Periphyton (Chl-a mg/m2)	Nitrate toxicity (mg/L)	Ammonia toxicity (mg/L)	Dissolved Oxygen (mg/L)	E coli (E.coli/100 mL)	MCI	Temperature Summer (oC Dec-Mar)	Temperature Winter (oC May-Sep)	*E. coli* popular bathing sites (E coli/100 mOL)	Clarity (visible distance, m)	Deposited fine sediment (%)	Suspended fine sediments (turbidity, FNU)	Benthic cyanobacteria (% cover)	Filamentous periphyton (% cover)	Diatoms and cyanobacteria (%cover)	Dissolved Reactive Phosphorus (mg/L)	Fish (IBI)	Dissolved inorganic nitrogen (mg/L)	Deposited fine sediment (%cover)	Deposited fine sediment (Quorer method)
		National Compulsory attributes					Southland attributes										Additional national compulsory attributes requiring an action plan		Additional attributes for information		
	2019																				
Rance Rd	2010																				
	2016																				
	2019																				
Waimatuku Township Rd	2010																				
	2016																				
	2019																				
Fairfax Isla	2010																				

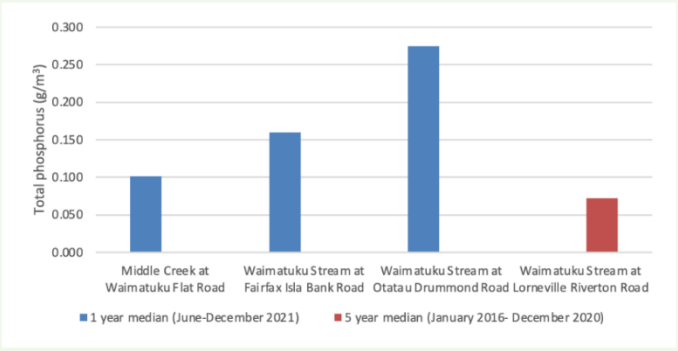
Site	Year	Periphyton (Chl-a mg/m2)	Nitrate toxicity (mg/L)	Ammonia toxicity (mg/L)	Dissolved Oxygen (mg/L)	E coli (E.coli/100 mL)	MCI	Temperature Summer (oC Dec-Mar)	Temperature Winter (oC May-Sep)	*E. coli* popular bathing sites (E coli/100 mOL)	Clarity (visible distance, m)	Deposited fine sediment (%)	Suspended fine sediments (turbidity, FNU)	Benthic cyanobacteria (% cover)	Filamentous periphyton (% cover)	Diatoms and cyanobacteria (%cover)	Dissolved Reactive Phosphorus (mg/L)	Fish (IBI)	Dissolved inorganic nitrogen (mg/L)	Deposited fine sediment (%cover)	Deposited fine sediment (Quorer method)
		National Compulsory attributes					Southland attributes										Additional national compulsory attributes requiring an action plan		Additional attributes for information		
Bank Rd																					
	2016																				
	2019																				

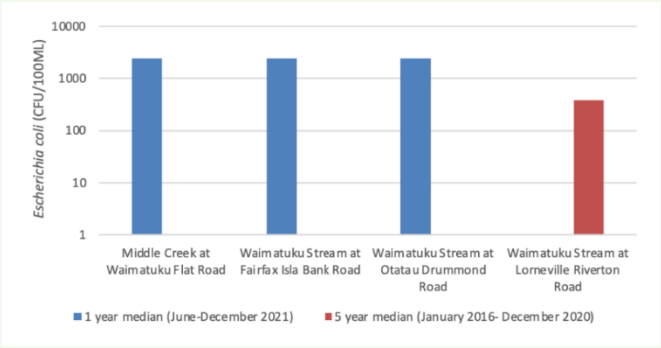
A	Very good
B	Good
C	Fair
D	Poor
E	Very poor (E coli only)
Pass	
Fail	

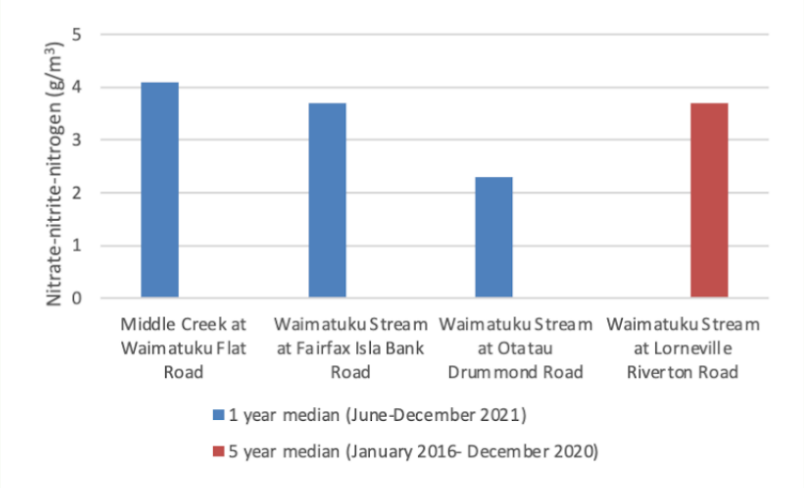
Appendix Four: Aparima Community Environment Project: Water Quality Results for the Waimatuku Stream

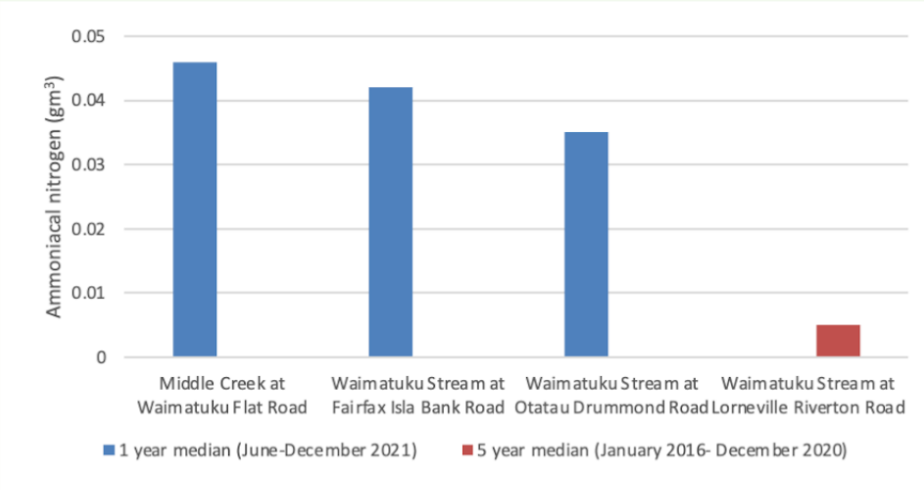


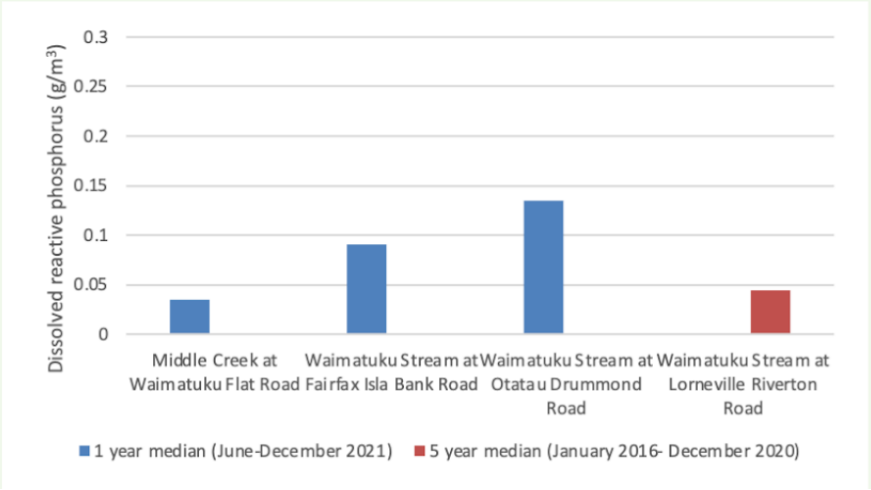







Nitrate-nitrite-nitrogen (g/m³)
5
4
3
2
1
0
Middle Creek at Waimatuku Flat Road
Waimatuku Stream at Fairfax Isla Bank Road
Waimatuku Stream at Otatau Drummond Road
Waimatuku Stream at Lorneville Riverton Road
1 year median (June-December 2021)
5 year median (January 2016- December 2020)


Ammoniacal nitrogen (gm³)
0.05
0.04
0.03
0.02
0.01
0
Middle Creek at Waimatuku Flat Road
Waimatuku Stream at Fairfax Isla Bank Road
Waimatuku Stream at Otatau Drummond Road
Waimatuku Stream at Lorneville Riverton Road
1 year median (June-December 2021)
5 year median (January 2016- December 2020)


Dissolved reactive phosphorus (g/m³)
0.3
0.25
0.2
0.15
0.1
0.05
0
Middle Creek at Waimatuku Flat Road
Waimatuku Stream at Fairfax Isla Bank Road
Waimatuku Stream at Otatau Drummond Road
Waimatuku Stream at Lorneville Riverton Road
1 year median (June-December 2021)
5 year median (January 2016- December 2020)

Appendix Five: Long White and Big Lagoon surface water and sediment data

Source: Lakes380

Lake	Units	Big Lagoon	Long White Lagoon
Date.Survey		24/02/2019	24/02/2019
Latitude		-46.354037	-46.356922
Longitude		168.176776	168.1644
East_NZMG		2138597	2137288
North_NZMG		5417418	5417305
PRIMARY FENZ class		Warm, shallow, very small	W
GEOMORPHIC Class		B	S
Max Depth of lake (modelled)	m	2.9	
Lake Area	ha	16.5	1.4
Lake Volume	m3	160101	13485
Lake Elevation	m	15.34	15.29
Sampled Max depth of lake as measured by Lakes380 - NOTE we may not have always got to the deepest part of the lake	m	7	15
Sampling site depth	m	7	14
Secchi Disk depth	m	0.48	0.19
Depth of thermocline	m	NA	NA
Altitude of lake L380	m	15.3	15.3
Surface Bulk Total Nitrogen	g/m3	1.89	5.98
Surface Bulk Nitrite	g/m3	<0.002	0.0013
Surface Bulk Nitrate	g/m3	0.0039	<0.002
Surface Bulk Total Kjeldahl Nitrogen	g/m3	1.89	5.97
Surface Bulk Total Phosphate	g/m3	0.25	0.45
Surface Bulk Total Suspended Solids	g/m3	16	67
Surface Bulk Volatile Suspended Solids	g/m3	20.3	58.3
Surface Dissolved Organic Carbon	g/m3	26	31.8
Surface Total Organic Carbon	g/m3	30.8	54.5

Surface Dissolved Inorganic Nutrients - Nitrite	g/m3	<0.001	0.0025
Surface Dissolved Inorganic Nutrients - Nitrate	g/m3	0.0068	0.0068
Surface Dissolved Inorganic Nutrients - Ammonia	g/m3	0.006	<0.005
Surface Dissolved Inorganic Nutrients - Dissolved Reactive Phosphorous	g/m3	0.036	0.004
Surface Arsenic	g/m3	0.0018	0.0024
Surface Cadmium	g/m3	<0.00001	<0.00001
Surface Chromium	g/m3	0.0005	<0.0002
Surface Copper	g/m3	0.0016	0.0004
Surface Lead	g/m3	0.0029	0.0003
Surface Mercury	g/m3	<0.0001	<0.0001
Surface Nickel	g/m3	0.0008	0.0002
Surface Zinc	g/m3	0.0053	0.0016
Surface Chlorophyll	g/m3	0.033	0.023
Bulk Sediment - Organic Matter	g/100g dry wt	63.9	80.1
Bulk Sediment - Carbonates	g/100g dry wt	36.1	19.9
Bulk Sediment - Total Organic Carbon	g/100g dry wt	1.8	0.5
Bulk Sediment - Total Nitrogen	g/100g dry wt	15.6	9.1
Bulk Sediment -Iron	mg/kg dry wt	0.95	0.84
Bulk Sediment - Manganese	mg/kg dry wt	25100	17200
Bulk Sediment - Aluminium	mg/kg dry wt	286	299
Bulk Sediment - Calcium	mg/kg dry wt	14600	10300
Bulk Sediment - Lead	mg/kg dry wt	6010	16400
Bulk Sediment - Copper	mg/kg dry wt	69.3	6.35
Bulk Sediment - Cadmium	mg/kg dry wt	21.3	8.27
Bulk Sediment - Zinc	mg/kg dry wt	0.1	0.048

Bulk Sediment - Phosphorus	mg/kg dry wt	39.3	30.2
Bulk Sediment - Sulfur	mg/kg dry wt	1680	645

Appendix Six: DOC eDNA sampling results

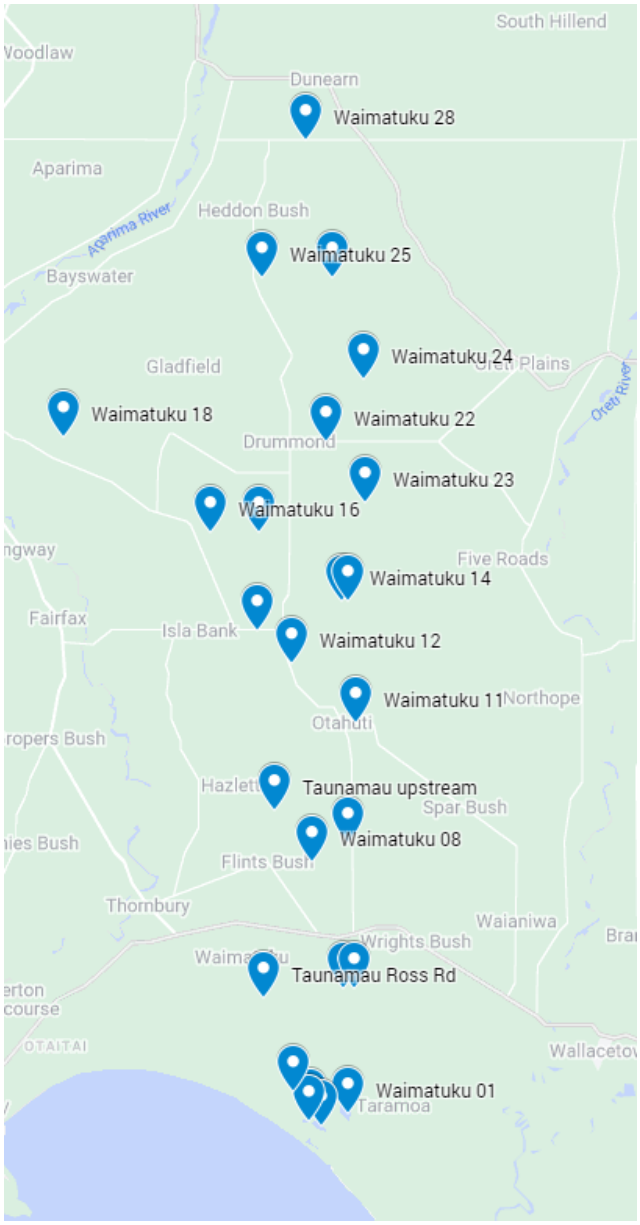


Figure 27: eDNA sampling sites. Source: locations provided by DOC.

Table 12: eDNA results for freshwater fish and koura in the Waimatuku Catchment. Each site had six samples taken, apart from Waimatuku 3a, 3b and 3c which had two each. The number in the table indicates in how many samples the species was recorded and the * indicates if there were <100 times the unique taxa was counted in that sample.

CommonName	Taunamau Ross Rd	Taunamau upstream	Waimatuku 01 - Big Lagoon	Waimatuku 03a - Long White Lagoon	Waimatuku 03b	Waimatuku 03c	Waimatuku 04 - Rance Rd	Waimatuku 05 - Waimatuku Twp Rd	Waimatuku 06	Waimatuku 08 - Fraser Rd	Waimatuku 10	Waimatuku 11 - Middle Creek	Waimatuku 12 - Ayr Creek
Southern koura; kōura	0	0	0	0	0	0	0	0	0	1*	0	2**	0
Black Flounder; freshwater flounder	0	0	0	0	0	0	6******	5	1	5***	0	5*****	0
Brown trout	6	4****	0	0	1*	0	6	5	1	6	0	6	6***
Common bully	6	1	5*	1*	2	0	6	6*	2	6	3	5	0
Giant bully	0	0	1*	0	0	0	0	0	0	0	0	0	0
Giant kokopu	1*	5*	0	0	0	0	0	0	0	0	0	0	0
Giant or shortjaw kokopu; kokōpu	0	1*	0	0	0	0	0	0	0	0	0	0	0
Gollum galaxid	1*	6	0	0	0	0	0	3*	4*	5***	6	6	6
Īnanga	6	6	0	0	0	0	6	5****	6*	3***	3*	6***	0
Koaro; kōaro	1*	0	0	0	0	0	0	0	0	0	0	0	0
Longfin eel; tuna	6	6	5*****	2*	0	0	6	6	6	6*	6	6	6*
New Zealand sole	0	0	0	0	1*	0	0	0	0	0	0	0	0
Pouched lamprey; kanakana	0	0	0	0	0	0	3***	1*	0	3***	0	0	0
Redfin bully	6	0	0	0	0	0	6	5	1	5	0	3	0
Shortfin eel; tuna	0	5****	6****	2	2**	1*	2**	6*****	4****	3***	3***	6	5****
Torrentfish	0	0	0	0	0	0	4***	0	0	0	0	0	0
Upland bully	5**	6	0	0	0	0	6*	5	1	6	1	6	6
Upland or kaharore bully	6******	6	0	0	0	0	4*	5	1	6*	0	6*	6

CommonName	Waimatuku 13 - Fairfax Rd	Waimatuku 14 - Middle Creek	Waimatuku 15 - Middle Creek	Waimatuku 16 - Robertson Rd	Waimatuku 17	Waimatuku 18 - Bayswater Bog	Waimatuku 22 - Middle Creek	Waimatuku 23	Waimatuku 24	Waimatuku 25	Waimatuku 26	Waimatuku 28
Southern koura; kōura	1*	0	0	0	0	0	0	0	0	0	0	0
Black Flounder; freshwater flounder	2**	3***	0	0	0	0	0	2**	0	0	0	0
Brown trout	6	6	6	6	6*	0	6*	6*	0	0	0	0
Common bully	0	1	0	0	0	0	0	0	0	0	0	0
Giant bully	0	0	0	0	0	0	0	0	0	0	0	0
Giant kokopu	0	0	0	0	0	0	0	0	0	0	0	0
Giant or shortjaw kokopu; kokōpu	0	0	0	0	0	0	0	0	0	0	0	0
Gollum galaxid	6	6*	6	6	6	0	6	6	6	6*****	6	6
Īnanga	2**	0	0	0	0	0	0	0	0	0	0	0
Koaro; kōaro	0	0	0	0	0	0	0	0	0	0	0	0
Longfin eel; tuna	6	6	6	6	6	2*	6	6	6	6******	6	2**
New Zealand sole	0	0	0	0	0	0	0	0	0	0	0	0
Pouched lamprey; kanakana	1*	1*	2**	5*****	0	0	0	0	0	0	0	0
Redfin bully	2**	0	0	0	0	0	0	0	0	0	0	0
Shortfin eel; tuna	5***	6***	6	6***	3***	6	3***	6	6	6**	3***	2**
Torrentfish	0	0	0	0	0	0	0	0	0	0	0	0
Upland bully	6	6	6	6****	5	0	6	6	6	2*	6	6
Upland or kaharore bully	6	6	6	6	3***	0	6***	6**	6****	0	6	6