Taieri River catchment

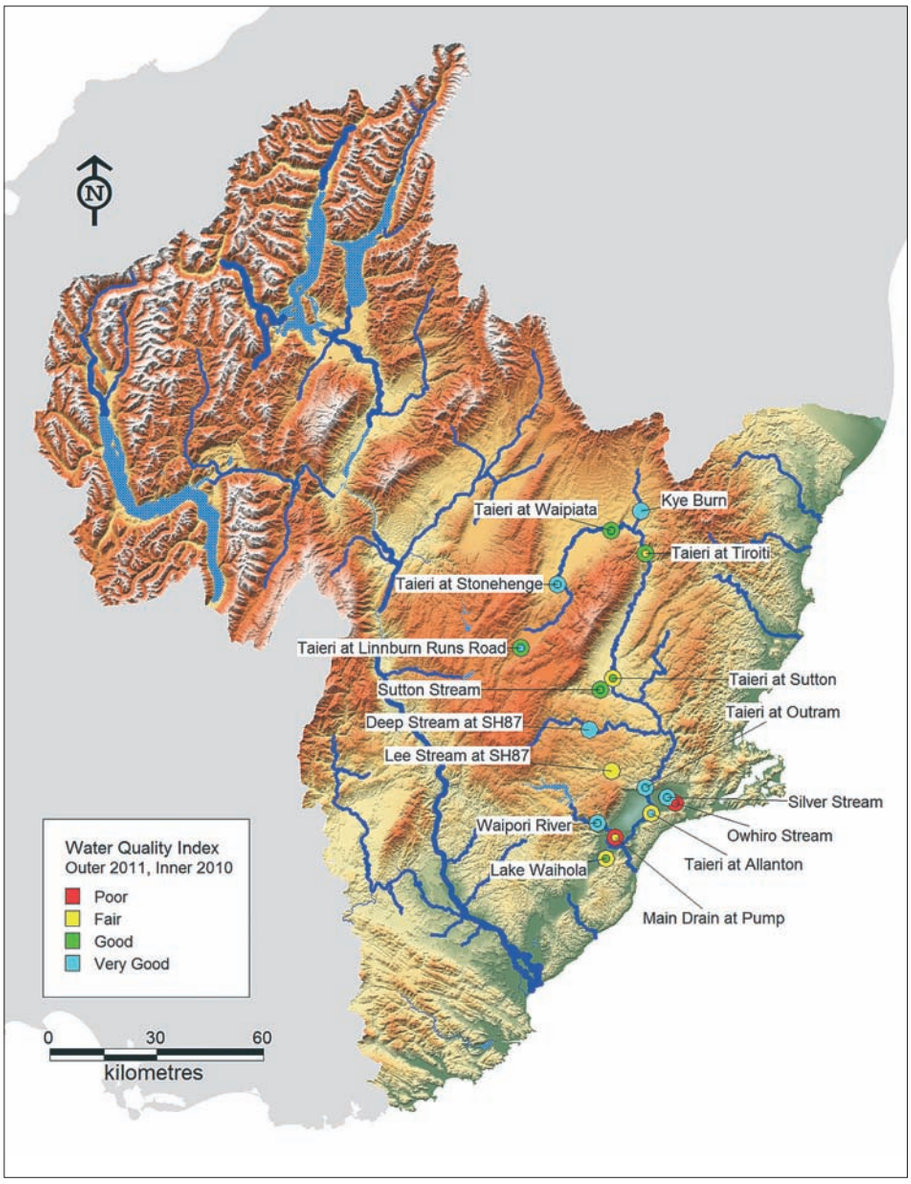
Water quality and ecosystem health
July 2010 to June 2011

Otago Regional Council

Water Quality

Introduction

The Otago Regional Council (ORC) monitored 14 river and stream sites in the Taieri catchment between July 2010 and June 2011, to assess the current state of water quality. Most sites were monitored bi-monthly, but two further sites (Taieri at Outram and the Sutton Stream) were monitored monthly by NIWA as part of the National River Water Quality Network (NRWQN).



Summary

- Water quality was generally very good or good at the majority of sites. The Owhiro Stream and Main Drain sites had the worst water quality with high nutrient (phosphorus), turbidity and bacteria readings
- Silver Stream had a high dominance of diatoms while the upper Taieri sites had diverse, but limited algal growth
- Macroinvertebrate communities were good or excellent. Silver Stream had an average quality macroinvertebrate community
- Kye Burn had a high density of endangered Central Otago Roundhead galaxiids
- Silver Stream had the most diverse fish population which is attributable to its proximity to the coast.

Water quality index

ORC uses a water quality index (WQI) to report water quality. The index is derived from median values of six indicator variables: turbidity; dissolved oxygen (percent saturation); ammonical nitrogen (NH_4); nitrite-nitrate nitrogen (NNN); dissolved reactive phosphorus (DRP) and Escherichia coli *(E. coli)*.

Medians of the six values are compared with ANZECC (2000) and MfE/MoH (2003) guidelines, enabling classification of water quality into one of the four groups.

Guidelines for nutrients

The ANZECC (2000) guidelines outline trigger values for lowland water courses (less than 150 m above sea level). The trigger values specify a level below which the risks of adverse biological effects are considered low.

The horizontal lines in red (in the graphs) depict the relevant ANZECC guideline value.

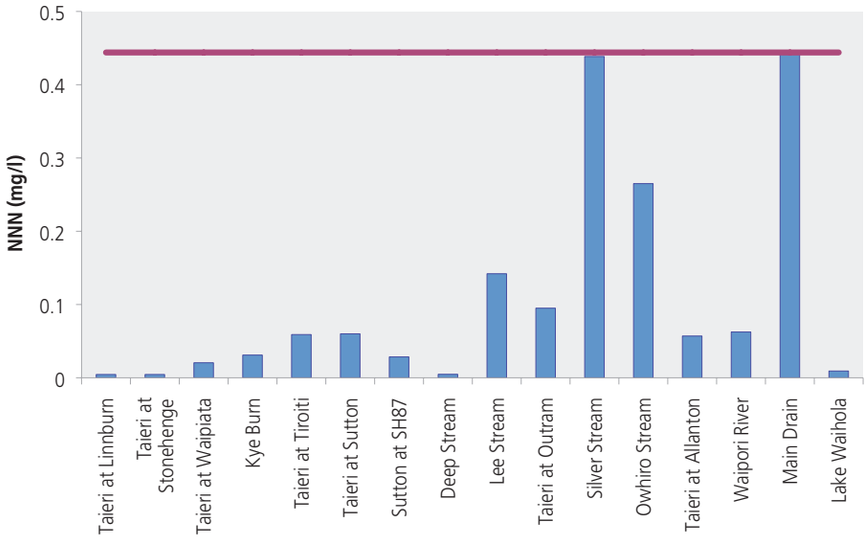
The Otago Regional Plan: Water is currently under review with a proposal to introduce a series of effects-based standards for instream values.

Silver Stream at Riccarton Road.

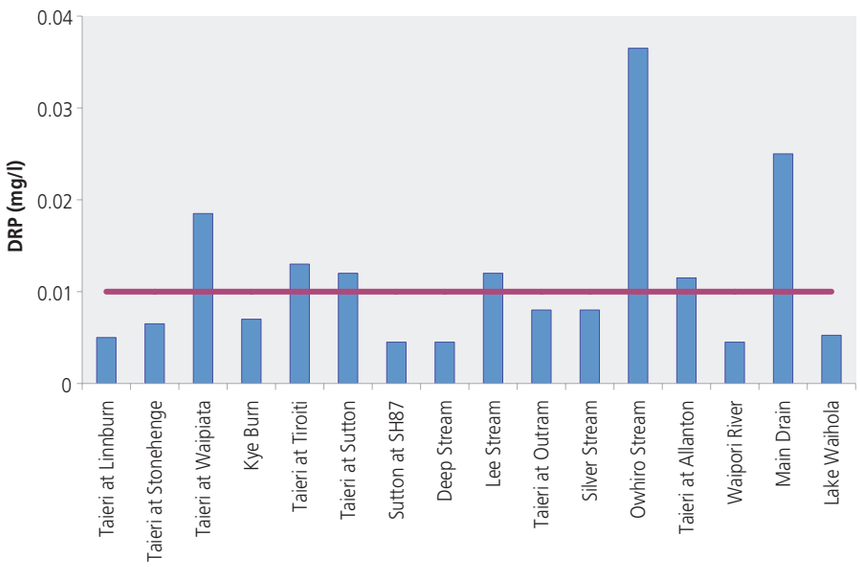
Waipori River at Waipori Reserve.

Nutrients

Nitrite-nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It is an important nutrient for algae and plant growth. As shown below, the majority of sites have NNN concentrations well below the guideline value. Silver Stream (0.439 mg/l) is only just below the guideline value while Main Drain (0.446 mg/l) is just above it. Taieri at Stonehenge and Taieri at Linnburn Runs Road had the lowest concentrations of NNN, with both sites having a median concentration of 0.0045 mg/l.

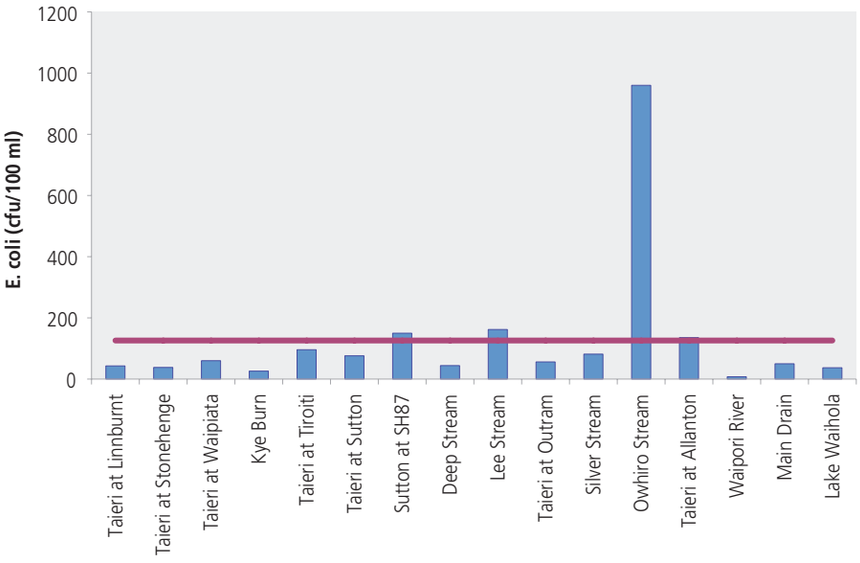


Dissolved reactive phosphorus (DRP) is a growth-limiting nutrient. Sources of DRP can be traced back to point source discharges of wastewater effluent, animal effluent, and fertiliser. The graph below shows that six of the sampling sites had median concentrations of DRP which exceeded the guideline value. Owhiro Stream had the highest concentration followed by Main Drain. This was most likely due to poor land management primarily in the form of winter feed paddocks being too close to streams and drains. The lowest concentrations were found at Waipori River, Deep Stream, and the Taieri at Linnburn Runs Road.



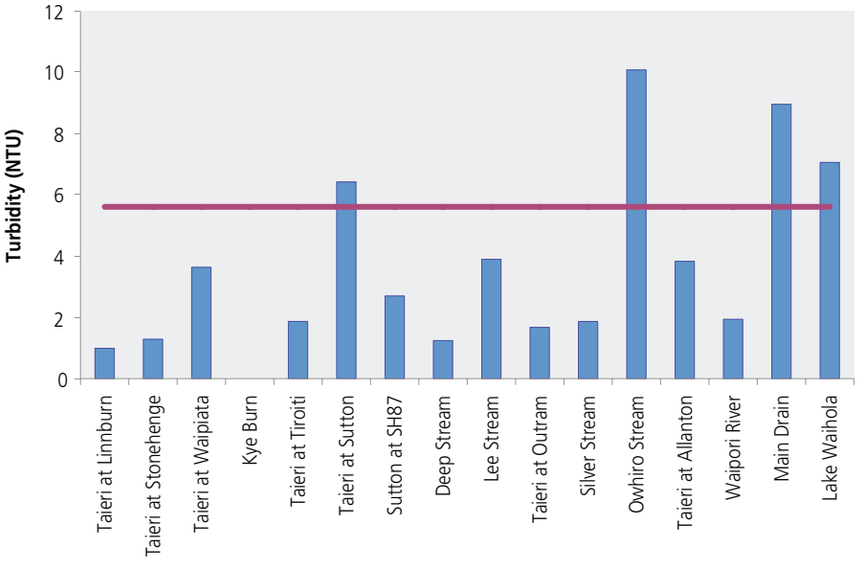
Bacteria

Median concentrations of *E. coli* were above the ANZECC (1992) guideline of 126 cfu/100 ml at seven of the sites. Owhiro Stream had the highest *E. coli* concentration (7.5 times higher than the guideline). All of the sites exceeded the single sample guideline of 260 cfu/100ml at least once during the sampling period.



Turbidity

Turbidity was elevated above the ANZECC guideline at three sites. Owhiro Stream had the highest turbidity reading (10.1 NTU). This was followed by the Main Drain and then by Lake Waihola. Turbidity in the Owhiro Stream is likely due to the combined effects of the stream having a low gradient and being sluggish, erosion of banks due to the stream trying to regain its natural form, and water fowl stirring up streambed sediment. Lake Waihola is susceptible to wind re-suspending lake bottom sediments as the lake is shallow. Deep Stream had the lowest turbidity value of all the sampled sites (the Kye Burn had no turbidity data avaliable).



Guidelines for bacteria

The ANZECC (1992) guidelines recommend a season median of less than 126 cfu (colony forming units)/100 ml.

The Ministry of Health and Ministry for the Environment (2003) guideline recommends that a single sample does not exceed 260 cfu/100 ml.

Kye Burn at SH85

Sow Burn at Patearoa

Guidelines for turbidity

Turbidity is a measure of how much light is able to penetrate the water column to the river bed. Streams with high turbidity often have high suspended sediment loads. Having high turbidity can reduce light penetration, impacting on macrophyte and algae's ability to photosynthesise, and reducing basal food supplies in the process. High sediment loading also tends to smother bed habitat, creating poor fish spawning conditions.

The ANZECC guideline value for turbidity is less than 5.6 NTU (Nephelometric turbidity units).

Ecosystem health

Ecosystem health takes into account a wide range of inter-linked factors such as water quality, habitat, and instream biota. It is generally assessed using two communities that are important to the food chain in rivers: streambed macroinvertebrates (e.g. insects, crustaceans, snails and worms) and periphyton (e.g. algae). Biotic indices are used to compress a large amount of information into a compact and simple form. They are therefore inherently coarse tools which give a broad view of general patterns. However, they are useful as the presence, abundance, or distribution of species can inform us greatly about the quality and condition of the river in which they live.

Limited algal growth in a stream.

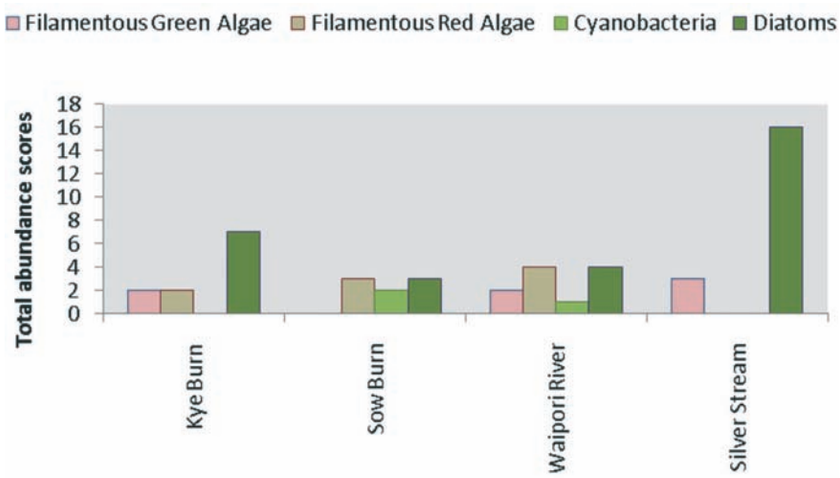
Biggs, B.J.F. & Kilroy, C. (2000) Stream periphyton monitoring manual, Ministry for Environment, Wellington.

Algae (Periphyton)

Excessive amounts of periphyton, in particular, filamentous algae, can reduce the amenity value of waterways by decreasing their aesthetic appearance, reducing visibility, and being a physical nuisance to swimmers. While algae is a useful tool for monitoring the nutrient conditions in rivers and streams, it is just one means of getting a complete overview of the river system. Factors other than nutrient levels also influence the composition of benthic algal communities. These include substrate composition, river flows, the amount of light reaching the river bed, water temperature, and the number of algal grazing macroinvertebrates.

Algal samples were collected from four sites (two in the upper Taieri and two in the lower Taieri). Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocols developed by Biggs and Kilroy (2000). All abundance scores were added up for each algae type (graph below) to give an appreciation of relative abundance.

All streams had diatom communities, with Silver Stream having the most dominant diatom community. Silver Stream had eight species of diatom present. Waipori River had the most diverse algae groups. All four groups of algae were present with diatoms and filamentous red algae being the dominant taxa. None of these sites had any *Didimosphenia geminata* (Didymo) present.



Macroinvertebrates (stream bed insects)

Macroinvertebrates are an important component of streams and rivers as they help with ecosystem processes, and provide food resources for fish. Macroinvertebrates are also good for assessing pollution as different macroinvertebrates have different pollution tolerances. Because they also have a relatively long life span, they are good indicators of environmental conditions over a long period. The main measure of macroinvertebrate communities is the MCI, which is designed specifically for stony riffle substrates in flowing water. MCI values can vary due to the availability of suitable habitat, and not necessarily due to water quality. As substrate type can vary greatly between riffles, it is often appropriate to compare changes in MCI values at the same site over time rather than between sites throughout the catchment. Understanding the limitations of the MCI still makes it a potentially useful tool for picking up changes in ecosystem health.

Macroinvertebrate communities were assessed in the summer of 2010/2011 by taking a single kick net from a variety of habitats in each river. The Sow Burn had excellent macroinvertebrate communities as suggested by MCI and SQMCI scores. This site was dominated by *Deleatidium* mayflies which was followed by *Zealandoperla* species and caddis flies such as *Aoteapsyche* and *Psilochorema*.

	Total Species	EPT Taxa	MCI	SQMCI
Poor	<10	<5	<80	<4
Average	10 to 20	>5 to 15	>80 to 99	>4 to 5
Good	>20 to 30	>15 to 20	>99 to 120	>5 to 6
Excellent	>30	>20	>120	>6

	Total species	EPT taxa	MCI score	SQMCI score
Kye Burn	15	7	93	7
Sow Burn	19	12	128	7.5
Waipori River	13	6	109	5.2
Silver Stream	16	7	105	4.8

Collecting a kick-net sample in the Silver Stream

Indices to measure macroinvertebrate community health

Macroinvertebrate community index (MCI)

The MCI is calculated by adding the pollution tolerance scores of all species found at a site. Species that are very sensitive to pollution score highly. The macroinvertebrates suited to muddy/weedy-bedded, pool like habitats are generally the more tolerant, low-scoring taxa that tend to reduce MCI values.

EPT species

EPT richness is a sum of the total number of: Ephemeroptera (mayflies); Plecoptera (stoneflies) and; Trichoptera (caddisflies) species collected.
EPT taxa are generally sensitive to a range of pollutants including fine sediment and nutrient enrichment.

Semi-quantitative macroinvertebrate community index (SQMCI)

The SQMCI is also based on the ratios of sensitive to tolerant taxa, but SQMCI results are primarily determined by the most abundant taxa (unlike the MCI where all taxa are given equal weight in the calculation.)

Fish facts

Fish species diversity is an indicator of stream ecosystem health

Diversity varies naturally based on a number of factors, including geology, topography, hydrology, groundcover, climate, and altitude

Streams located near coastal environments often contain relatively high species diversity, due to mild climates and the fact that many species spend parts of their lifespan in both fresh and salt water

Exotic species such as trout, are known to limit the range of native species through predation and competition. Often streams with large numbers of exotic species show lower densities and diversity among native fish species.

Juvenille lamprey

Fish

Electric fishing surveys were conducted at three sites in the 2010/2011 summer. The Silver Stream had the greatest fish diversity with five species caught, of which four were native. Common Bullies were the most abundant fish followed by juvenile Lamprey. Lamprey are rarely seen in Otago's waterways. Kye Burn had an abundance of Central Otago Roundhead galaxiids which are considered nationally vulnerable.

The table below summarises fish count data for each species at each site

Site	Inanga	Common Bully	Long fin eel	Lamprey (juvenile)	Central Otago Roundhead galaxiid	Brown trout	Number of species	Percent of native fish (%)
Sow Burn						261	1	0
Kye Burn			3		142	7	3	66
Silver Stream	3	53	18	35		12	5	80

Central Otago Roundhead galaxiid

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