

Water Quality and Ecosystem Health in Otago Rivers and Lakes

Otago Regional Council monitors the state of over 100 river and lake sites across the Otago Region.

A combination of monthly water sample collection, continuous data sensors and annual surveys of stream life are used to assess the following components of ecosystem health:



WATER QUALITY

- o **Nitrogen and phosphorus** - essential nutrients for plant growth. Increased levels of these nutrients can contribute to algal blooms and excessive growth of aquatic plants. In lakes **total nitrogen** (TN) and **total phosphorus** (TP) are measured. In rivers **dissolved reactive phosphorus** (DRP) is measured as well as nitrogen forms that can be toxic to aquatic life - **ammoniacal nitrogen** and **nitrate nitrogen**.
- o **Dissolved oxygen** - the amount of oxygen dissolved in water. Low dissolved oxygen (DO) levels can affect fish and other aquatic organisms that require oxygen to breathe. Decaying organic matter (aquatic plants and algae) and high temperatures can reduce DO levels. In deep lakes which seasonally stratify into distinct layers, DO is measured at the lake bottom and in the mid-hypolimnion (bottom layer).
- o **Suspended fine sediment** - fine particulate matter (sand, silt or clay) in the water column that can impact water clarity. Sediment is a natural occurrence in rivers resulting from processes like water movement, erosion and weathering of rocks however activities such as agriculture, horticulture, forestry and earthworks can increase fine sediment inputs.

PHYSICAL HABITAT

- o **Deposited fine sediment** - fine particulate matter (sand, silt or clay) that settles on the bed of a river. It can fill spaces between cobbles and reduce available habitat for aquatic life.

ECOSYSTEM PROCESSES

- o **Ecosystem metabolism** - the production of oxygen and carbon dioxide by all the individual organisms that make up the ecosystem. It represents how energy is created (primary production) and used (respiration) within an aquatic ecosystem and is a functional indicator of ecosystem health.

AQUATIC LIFE

The range and diversity of flora and fauna in waterways are measured by the following indicator groups:

- o **Macroinvertebrates** – freshwater invertebrates such as insects, worms and snails. These organisms are sensitive to changes in water quality and habitat. The **Macroinvertebrate Community Index (MCI)** is a measure based on the presence of these organisms.
- o **Fish** – the Fish Index of Biotic Integrity (Fish-IBI) assesses the richness of fish species by comparing the fish species present at a site to the expected species in the absence of human impacts.
- o **Periphyton** – algae and slime that grows on the rocks and other stable substrates that make up the streambed, measured as chlorophyll-a. It is an important food resource in aquatic food webs but can proliferate and become a nuisance. Excess growth is related to nutrient levels, amount of shading, temperature, stream substrate and number of flushing flows.
- o **Phytoplankton** – algae that grows in the water column of lakes, measured as chlorophyll-a. It is often closely linked to the amount of nutrient enrichment in a lake ecosystem.
- o **Lake Submerged Plants** – aquatic plant communities in lakes. Community composition is measured by underwater divers using the **Lake Submerged Plant Indicators (LakeSPI)** method that reports a **Native Condition Index** and an **Invasive Impact Index**.

Water quality measures important for human health are also monitored:

HUMAN CONTACT

- o **E. coli** – *Escherichia coli* are faecal indicator bacteria found in the gut of warm-blooded animals. *E. coli* are measured monthly throughout the year at state of the environment monitoring sites and during the summer at popular primary contact recreation sites.
- o **Cyanobacteria** – microscopic organisms that multiply and form blooms, which can be suspended in the water column (planktonic) or attached to rocks (benthic). Also known as toxic algae or blue/green algae, some species produce toxins that are harmful to animals.

This summary report presents a regional overview of the current state of the ecosystem health and human contact values as described by the **National Policy Statement – Freshwater Management (NPS-FM)**. The most recent 5 years of data (2020-2025) is used to assess current state. For each indicator, results from each site are graded A-E according to the attribute bands of the National Objectives Framework in the NPS-FM. For some attributes there is a defined 'national bottom line' indicating a minimum acceptable standard. The number of sites assessed for each attribute is noted with 'n' in the figure captions below.

Attribute band:

A Excellent

B Good

C Fair

D Poor

Learn more about these measures at **LAWA Glossary & Factsheets**

View monitoring sites and explore the data **LAWA – Otago Region**

RIVER ECOSYSTEM HEALTH

Attribute band:

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

Water quality

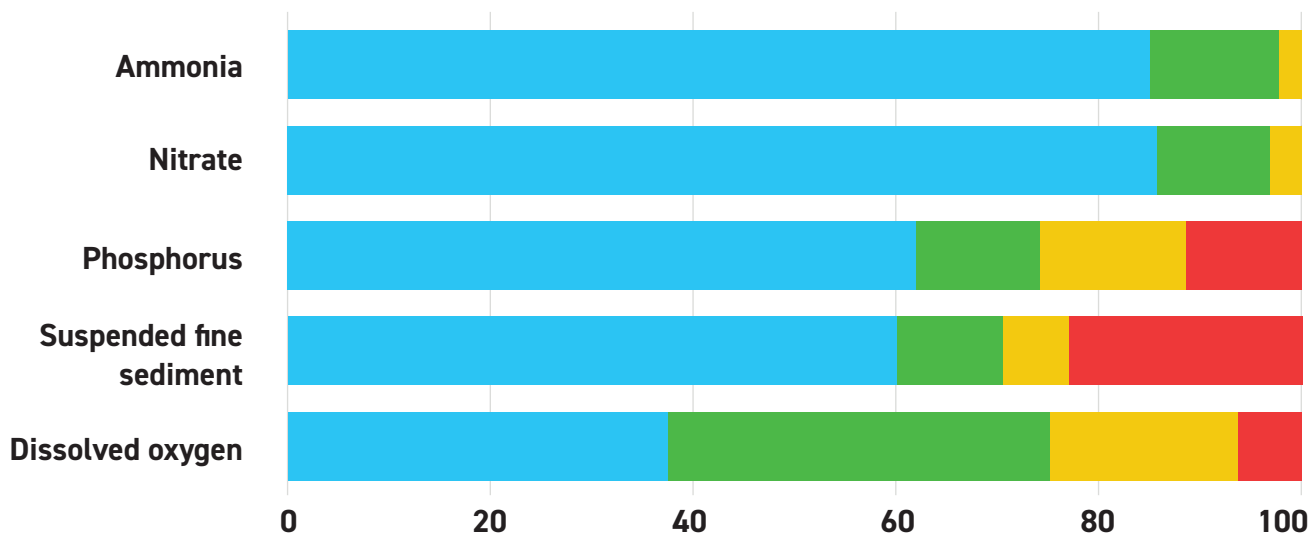


Figure 1 | Percentage of rivers sites graded as A, B, C or D for five water quality attributes. Nutrients and suspended sediment n=105, Dissolved oxygen n=15

Otago's water quality is characterised by excellent water quality at higher elevation sites under predominately native vegetation cover or conservation land. These sites tend to be in the upper catchments of the large lakes (e.g. Hāwea, Whakatipu and Wānaka) and tributaries of the upper Clutha Mata-Au. The poorest water quality is found in urban streams (e.g. Dunedin & Coast FMU) and in the lowland rivers and streams of catchments where intensive agriculture is the predominant land use (e.g. Manuherekia Rohe, Lower Clutha Rohe, North Otago FMU).

The national bottom line was exceeded for ammonia toxicity at two sites and for nitrate toxicity at three sites. About 20% of sites do not meet the national bottom line for suspended fine sediment (D band). Some sites have naturally elevated levels of suspended sediment. Twelve sites are graded D for dissolved reactive phosphorus which indicates that levels are higher than natural conditions.

All but one of the 16 sites monitored for dissolved oxygen are above the D band. Deployment of continuous monitoring sensors across the network is ongoing.

Physical habitat

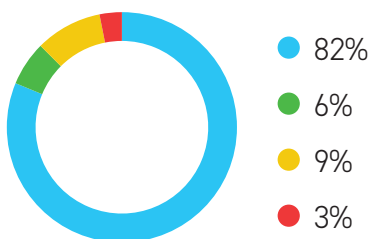


Figure 2 | Percentage of rivers sites graded A, B, C or D for deposited fine sediment, n=32

Ecosystem processes

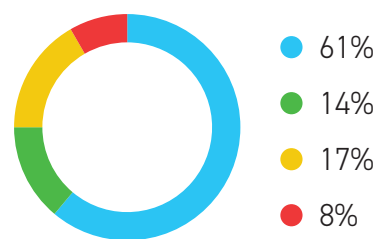


Figure 3 | Percentage of rivers sites graded A, B, C or D for ecosystem metabolism, n=36

Most sites are in the A band with just one site graded in the D band. Grades are interim as a 5-year data record is not yet available.

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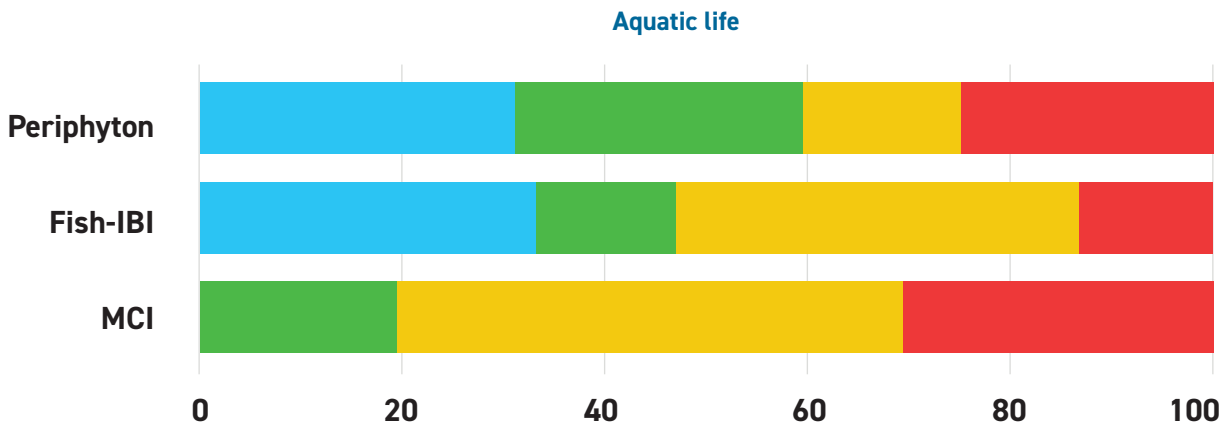


Figure 4 | Percentage of river sites graded A, B, C or D for aquatic life attributes. MCI n =78, Fish-IBI n=15 Periphyton n=32.

Of the 32 sites monitored for periphyton nine are below the national bottom line. For the Macroinvertebrate Community Index (MCI) 24 of 78 sites are below the national bottom line. About 60% of the 15 sites assessed for Fish-IBI are graded C or D indicating some loss of habitat or migratory access has impacted fish communities at these locations.

LAKE ECOSYSTEM HEALTH

Attribute band:

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

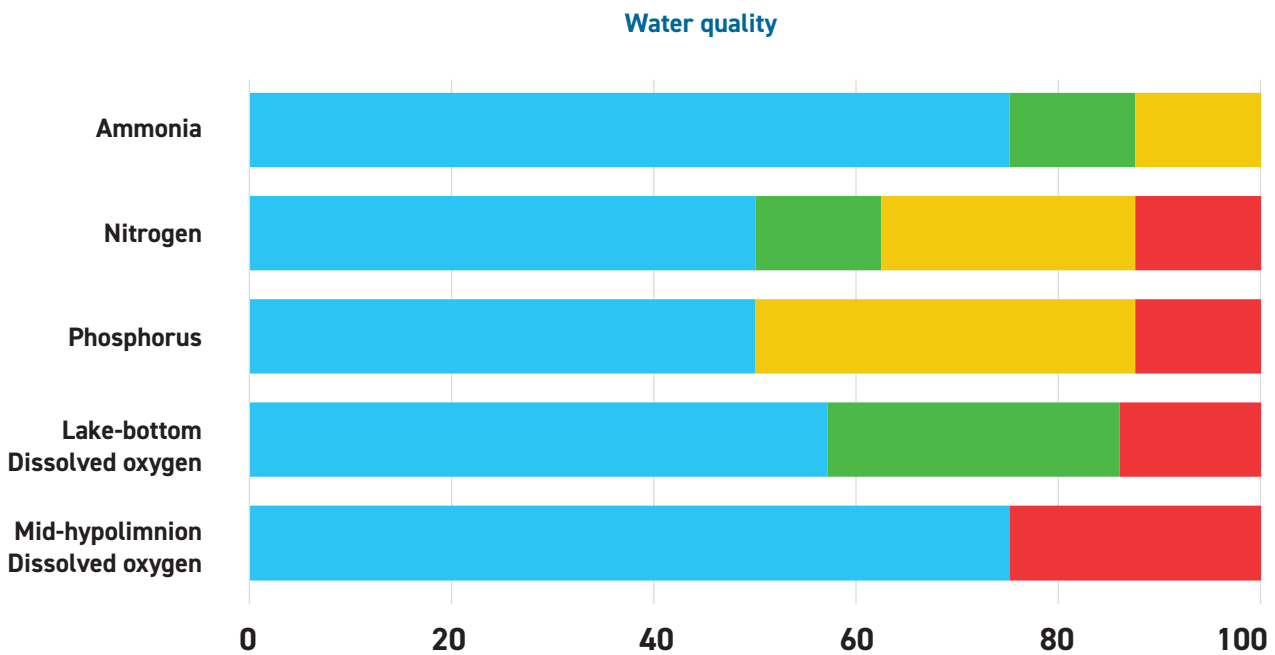


Figure 5 | Percentage of lake sites graded A, B, C or D for five water quality attributes. Nutrients n=8, Dissolved oxygen bottom n=7 and mid-hypolimnetic n=4.

Eight lakes are routinely monitored across Otago – the large lakes in the Upper Lakes and Dunstan Rohe (Lakes Whakatipu, Hāwea, Wānaka and Dunstan) have excellent water quality and low nutrients levels.

Lake Tuakitoto is the only site that does not meet the national bottom line for total nitrogen, phosphorus, and ammonia toxicity.

Lakes Hayes, Waihola and Onslow are also impacted by elevated nutrient levels. Lake Hayes does not meet the national bottom line for lake-bottom dissolved oxygen or mid-hypolimnetic dissolved oxygen.

Aquatic life

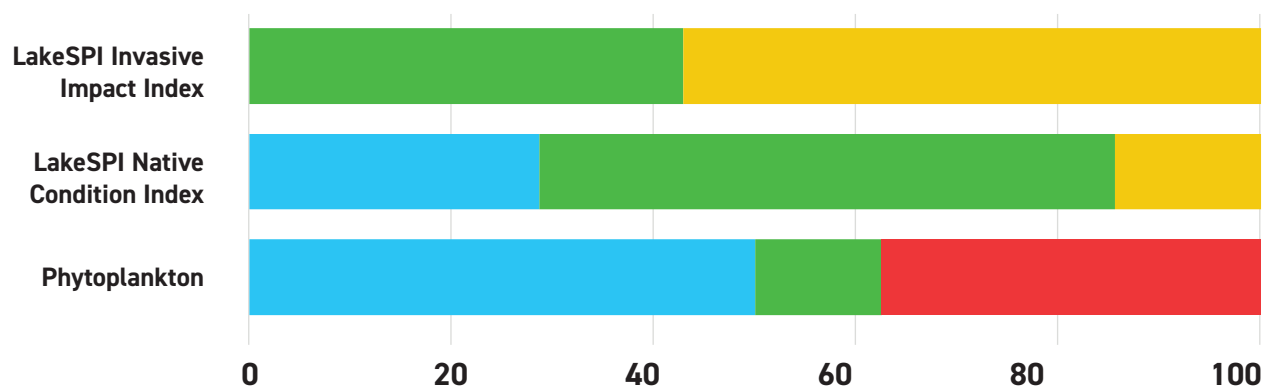


Figure 6 | Percentage of lake sites graded A, B, C or D for aquatic life attributes, Lake SPI n=7, Phytoplankton n=8

Three lakes do not meet the national bottom line for phytoplankton – Lake Hayes, Lake Tuakitoto and Lake Waihola.

Results for the LakeSPI Invasive Impact Index reflect moderate impacts from invasive plants at four of seven monitored sites (grade C).

HUMAN CONTACT

Attribute band:

- A Excellent
- B Good
- C Fair
- D Poor
- E Very Poor

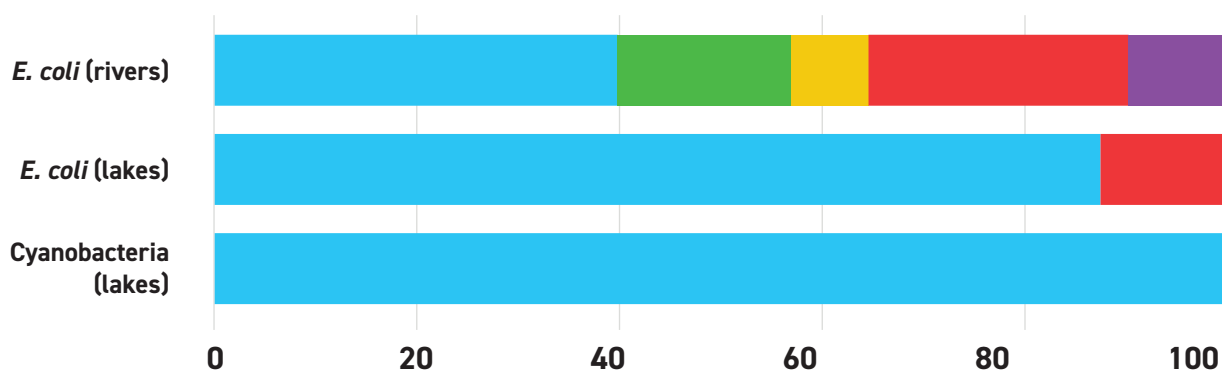
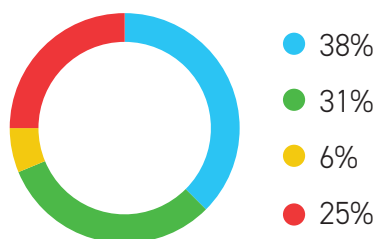


Figure 7 | Percentage of lake and river sites graded as A, B, C, D or E (E. coli only) for human health attributes. Data from year-round monthly monitoring. Rivers n=1-5, Lakes n=6

All lake sites were graded A for cyanobacteria and about 90% of sites were graded A for *E. coli*.

For *E. coli* in rivers, 2% of sites are graded D and a further 10% are graded E. These tend to be lowland sites in catchments with larger areas of urban development and intensive agricultural land use (e.g., Lower Clutha Rohe, Manuherekia Rohe, Catlins FMU, Dunedin & Coast FMU, North Otago FMU). About 60% of sites are graded A or B – these sites are mostly located in the Upper Lakes and Dunstan Rohe or in upper catchment areas with predominately native forest or conservation land cover.



During the summer we monitor 16 freshwater swimming sites across Otago. Based on data for the last five summers 69% of sites are graded Excellent or Good. One site is graded Fair and four sites are graded Poor (below the national bottom line).

Figure 8 | Percentage of freshwater sites graded A, B, C or D for *E. coli* at swimming sites (lakes and rivers). Data from weekly monitoring during the summer bathing season only, n=16