



North and Coastal Otago

Annual Monitoring Summary

2007-2008

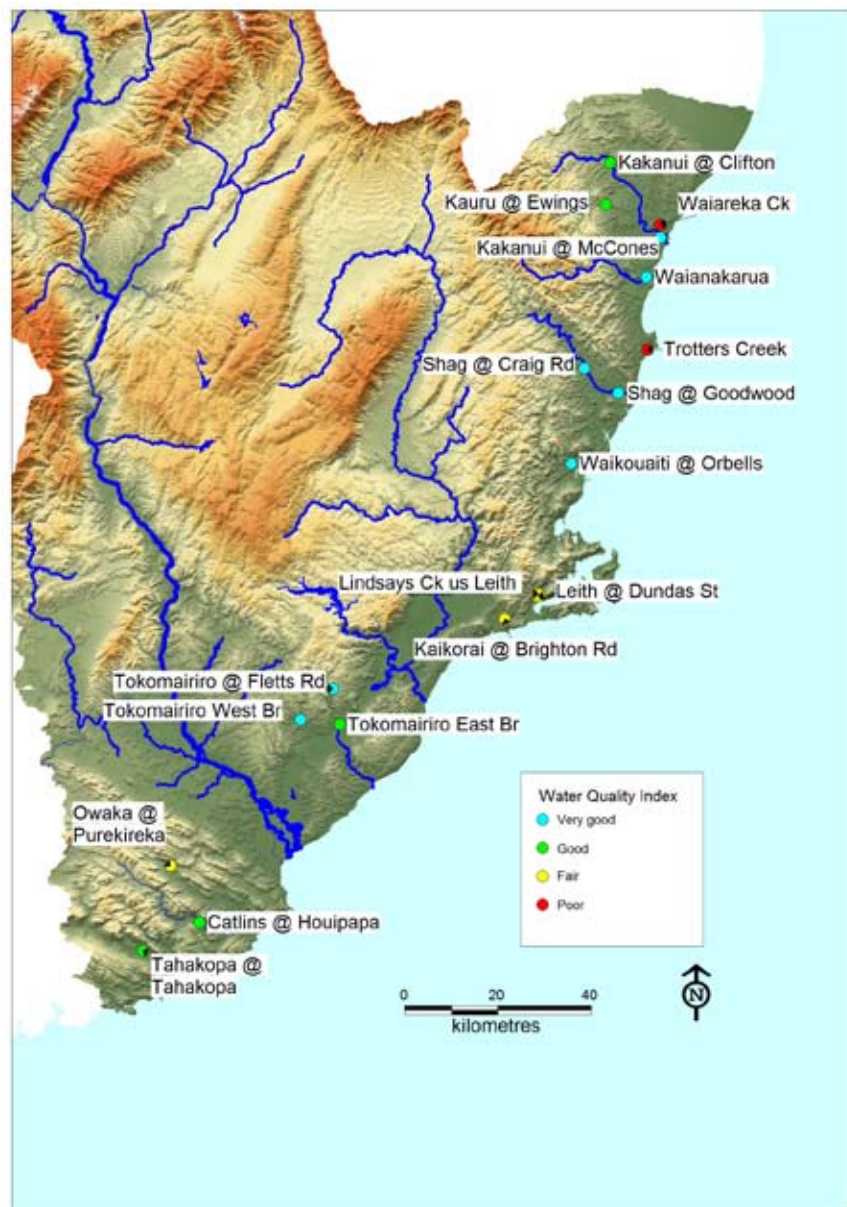
Key points

- Two sites were classified as poor in 2008. This was due to low dissolved oxygen levels in Waiareka Creek and Trotters Creek.
- The Kakanui River had much higher levels of *E. coli* bacteria than in 2007.
- Dunedin's urban streams had high concentrations of nutrients and bacteria.
- The Owaka River had the highest concentrations of NNN and TN. It also had concentrations of bacteria and phosphorus above guideline levels.
- Northern Otago coastal rivers generally showed better water quality than both Dunedin's urban streams and South Otago rivers.
- There is a reasonable correlation between water quality and biological health.

In 2007, the Otago Regional Council (ORC) monitored 18 river and stream sites in the northern and coastal areas of Otago to assess the current state of water quality. A further 11 sites were monitored to investigate water quality in the Kaikorai Stream, the Water of Leith, the Waitati River and Careys Creek. For historical results, refer to previous report cards and longer term trend analysis is available in the 2007 SOE report.

Discharges to water in the North and Coastal Otago river catchments are generally to the coastal environment and mainly comprise treated sewage and industrial discharges. Land use has the greatest effect on water quality and the sites with poorer water quality include the urban sites such as Dunedin city streams as well as streams in intensively farmed catchments such as Waiareka Creek.

North and Coastal Otago monitoring sites



Guidelines and standards

- The ANZECC (2000) guidelines outline trigger values for water quality aspects that put stress on river and stream health. This specifies a level below which the risk of adverse biological effect is low.

Note: the ANZECC trigger values used here are for lowland rivers (< 150m).

- Otago's water quality standards are outlined in the Regional Plan: Water (the Water Plan), which sets targets to maintain and improve water quality within the region.
- The DoH (1992) guidelines for contact recreation waters recommend a season median of 126 *E. coli*/100 ml.

Water quality results

Sites were classified using a water quality index, derived from median values of seven indicator variables: turbidity, dissolved oxygen (% saturation), total nitrogen, nitrite/nitrate nitrogen, total phosphorus, dissolved reactive phosphorus, and *Escherichia coli* (*E. coli*) bacteria.

Median values of these variables were compared with ANZECC and DoH guideline levels, enabling classification of water quality into one of the following groups:

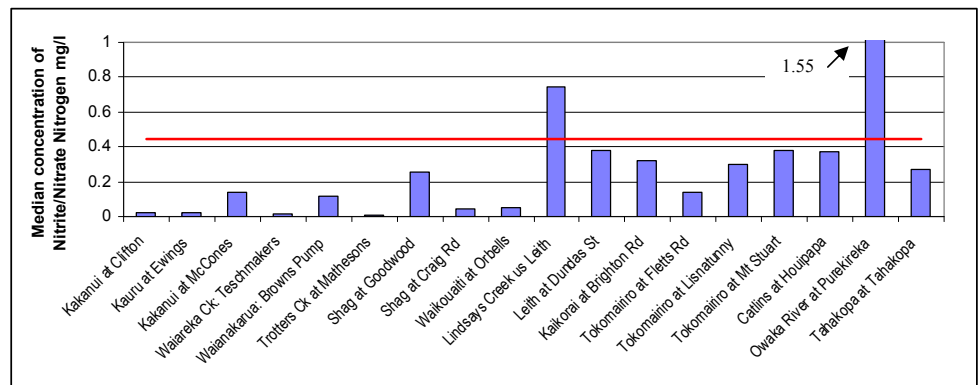
Very good	All seven values comply with guideline values
Good	Five or six median values comply (to include dissolved oxygen)
Fair	Three or four median values comply (to include dissolved oxygen)
Poor	Two or fewer median values comply with guideline values

Selected water quality indicators are displayed in the graphs and discussed below. Overall these graphs show that water quality is generally good or very good, with poorer quality in Dunedin's urban streams and some South Otago rivers.

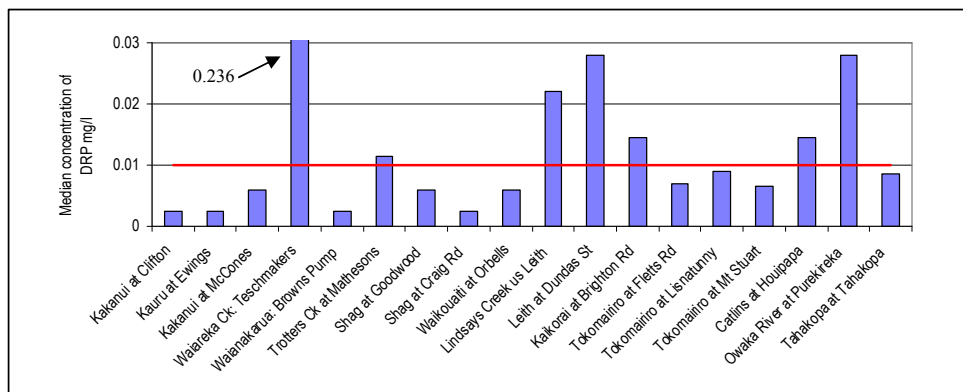
Note: The red lines on these graphs indicate the ANZECC trigger value or the DoH guideline level.

Nutrients

Nitrite/nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It is an important nutrient for algae and other plant growth, but can be harmful in higher concentrations. The median concentration of NNN was above the ANZECC trigger value at two sites: Lindsay's Creek and the Owaka River. All Dunedin urban streams approached the trigger value, as did the Tokomairiro and Tahakopa Rivers while the remainder of sites had median values well below the default trigger.

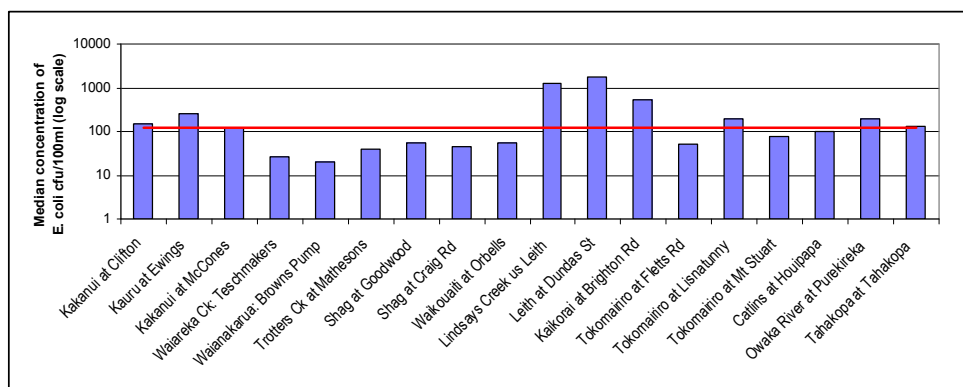


Median dissolved reactive phosphorus (DRP) concentrations were above the ANZECC trigger value for nearly half of all sites analysed. These high-DRP sites include Waiareka Creek, Dunedin's urban streams, the Catlins River at Houipapa and the Owaka River. North Otago coastal rivers generally showed median DRP concentrations lower than the trigger value, with the exception of Waiareka Creek.



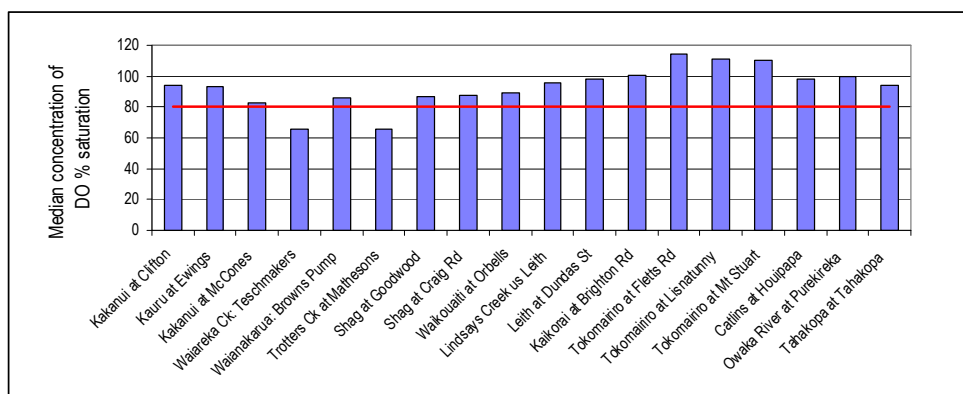
Bacteria

Median levels of *E. coli* bacteria were above the Department of Health guideline level (126 cfu/100ml) at eight of the 18 sites analysed. Levels were highest in Dunedin's urban streams and the Kakanui River. The Tokomairiro River east branch and the Owaka River also had elevated levels of *E. coli*.



Dissolved oxygen

Dissolved oxygen saturations should be **above 80%**, as below this level saturation is considered insufficient for biological health. The median saturation was below the trigger value of 80% at two sites: Waiareka Creek and Trotters Creek. In 2005, Waiareka Creek had extremely low O₂ saturation (20.9%); this situation has improved, probably due to increased flow from the North Otago Irrigation Scheme. Both sites are slow flowing with prolific plant growth, which are both causes of low oxygen levels.



Other analytes

- Ammoniacal nitrogen is the combination of ammonium ions and ammonia (NH₃). Levels of ammoniacal nitrogen were well below the ANZECC guideline level of 0.9 mg/l in all samples analysed. NH₃ is the main toxic component of ammoniacal nitrogen, the toxicity of which is dependent on pH and temperature. Taking these factors into account, levels of NH₃ were also well below the guideline value (0.021 mg/l) at all sites.
- Water at all sites was neutral with respect to pH, falling within ANZECC guideline levels.
- Turbidity was below trigger values at all sites and the highest median level (4.1 NTU) was found in the Owaka River.
- Six sites had median concentrations of total nitrogen elevated above the trigger level of 0.614 mg/l: Waiareka Creek (0.84 mg/l), Lindsay's Creek (0.66 mg/l), Water of Leith at Dundas Street (0.995 mg/l), Kaikorai Stream at Brighton Road (0.615 mg/l) and the Tokomairiro River east branch (0.695 mg/l). The highest result was recorded in the Owaka River at Purekireka (1.65 mg/l).
- Five sites had median concentrations of total phosphorus above the trigger level (0.033 mg/l). Waiareka Creek showed the most significant elevation at 0.28 mg/l, a similar result to last year (0.29 mg/l). Dunedin's urban streams, the Tokomairiro River east branch and the Owaka River also showed elevated concentrations of phosphorus.

Biological indices

- EPT species – this index is a sum of the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) species collected.
- MCI – The Macroinvertebrate Community Index is based on adding the pollution tolerance scores of all species found at a site. Species that are very sensitive to pollution score highly whereas more pollution tolerant species receive a low score.
- SQMCI – The Semi-quantitative Macroinvertebrate Community Index is a variation of the MCI that accounts for the abundance of pollution sensitive and tolerant species.



Caddisfly *Plectrocnemia*
Photograph Stephen Moore

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 and stream; streambed macroinvertebrates (e.g. insects, crustaceans, snails, worms) and periphyton (e.g. algae).

These biological indices put a large amount of information into a compact form. They are therefore inherently coarse tools that give a broad view of general patterns. However, they are useful as the presence or absence, abundance and distribution of species can inform us greatly about the quality and condition of the site at which they live.

Macroinvertebrate health

A key component of the MCI index is the availability of suitable habitat. The MCI index 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 more appropriate to compare changes in MCI values at the same site over a period of time rather than between sites throughout the catchment. However, by understanding the limitation of the MCI index it still can be useful for picking up improvements or deterioration in water quality at individual sites over time.

Criteria for macroinvertebrate health

	Total species	EPT taxa	MCI	SQMCI
Poor	<10	<5	<80	<4
Average	10 - 20	5 - 15	80 - 99	4 - 5
Good	>20 - 30	>15 - 20	100 - 120	>5 - 6
Excellent	>30	>20	>120	>6

North and Coastal Otago macroinvertebrate health 2008

Sample location	Number of taxa	EPT taxa	MCI score	SQMCI
Catlins River @ Houipapa	22	16	123	5.1
Kaikorai Stream @ Brighton Road	9	1	73	1.7
Kaikorai Stream @ Townleys Road	16	2	65	1.8
Kakanui River @ Clifton Falls	19	10	106	5.0
Kakanui River @ McCones	18	8	88	4.2
Kakanui River @ Pringles	15	9	100	4.7
Kauru River @ Ewings	15	8	99	3.2
Lindsay's Creek @ North Road	16	6	83	3.0
Owaka River @ Purekerika	18	8	94	5.0
Owhiro Stream @ Burns Street	7	0	60	3.4
Shag River @ Craig Road	20	9	94	5.5
Shag River @ Goodwood Pump	18	8	90	4.8
Shag River @ Grange	14	9	106	7.0
Tokomairiro River @ Lisnatunny	15	7	108	7.2
Tokomairiro River @ Mt Stuart	15	11	119	4.2
Trotters Creek @ Mathesons	14	1	81	3.7
Waianakarua @ Browns Pump	18	9	113	4.9
Waikouaiti River @ Orbell's	14	4	81	2.9
Water of Leith @ Dundas Street	18	8	98	2.7

Excellent SQMCI scores are found in the Shag and Tokomairiro Rivers; however, the Kakanui River at Clifton, and the Kauru and Waianakarua Rivers, which scored highly last year, had average SQMCI scores this year.

Poorer macroinvertebrate health is generally found in the lower catchments, where habitat for macroinvertebrates is compromised, generally through sediment build-up. Dunedin's urban streams have poorer habitat as well as poorer water quality which impacts on macroinvertebrate health.

Periphyton

Algal samples were collected at 19 sites. Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocol of Biggs and Kilroy (2000).

Site	Bulbochaete (Filamentous Green)	Cladophora (Filamentous Green)	Rhizoclonium (Filamentous Green)	Spirogyra (Filamentous Green)	Oscillatoria (Cyanobacteria)	Cocconeis (Diatom)	Diatoma (Diatom)	Gomphoneis (Diatom)	Melosira (Diatom)	Synedra (Diatom)
Kaikorai Stream @ Townleys Rd						6			8	
Kakanui River @ Clifton Falls	8									7
Kakanui River @ McCones					7					
Kakanui River @ Pringles					6					
Kauru River @ Ewings			6							7
Owaka River @ Purekireki								6	6	
Shag River @ Craig Road							6			
Shag River @ Goodwood Pump					6					
Shag River @ Grange		6								
Waianakarua River @ Browns Pump					6					
Waikouaiti River @ Orbells				7						

The invasive species *Didymosphenia geminata* was only present (rare) in the Kakanui at McCones. Cyanobacteria (blue green algae) were found at eight sites, with the *Oscillatoria* being abundant or dominant in the Kakanui River at McCones and Pringles, the Shag River at Goodwood pump and the Waianakarua River.

- Periphyton samples were analysed according to the "relative abundance using an inverted microscope" method outlined in Biggs and Kilroy (2000).
- Samples were inspected under 200-400x magnification to identify algal species present using the keys of Biggs and Kilroy (2000), Entwisle et al. (1988), Moore (2000) and an unpublished key (National Institute of Water and Atmospheric Research, Christchurch, New Zealand).
- Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocol of Biggs and Kilroy (2000).



Owaka River at Purekireki (ORC)



Cyanobacteria *Oscillatoria*
Source
<http://commons.wikimedia.org>

Fish

- 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, and often streams with large numbers of exotic species show lower densities and diversity among native fish species

Fish

Sixteen sites were electro-fished in the summer of 2008 within the north coast and ocean tributaries, with 13 species of fish observed cumulatively. The most widely distributed species were the Common bully and the Longfin eel, which were each recorded in 73% of the sites. Torrentfish and Koaro were recorded in only 13% of these sites, making them the least common freshwater species in the area. Brown trout were found in 60% of these sites and were the only exotic species observed.

Observations of fish species in the North and coastal catchments 2008

Sites for 2008	Native						Exotic	Number of Species	% Native Species
	Bully sp.	Torrent-fish	Galaxiid	Eel	Lamprey	Black Flounder	Brown Trout		
Kakanui River at Clifton Falls	1				1		1	3	67
Kakanui River at McCones	2	1	1	2	1		1	7	86
Kauru River at Ewings	2		2	1				5	100
Waianakarua River at Browns Pump	2	1	1	2	1			7	100
Trotters Ck at Mathesons	2		1					3	100
Shag River at Craig Road	3		1	2			1	7	86
Shag River at Goodwood Pump	4		2	2			1	9	89
Waikouaiti River at Orbell's Crossing	2		2	1	1			6	100
Lindsay's Creek at North Rd Bridge				1			1	2	50
Water of Leith at Dundas Street	1			1			1	3	67
Kaikorai Stream at Brighton Road	2		1	1	1	1		6	100
Tokomairo River at Lisnatunny	1			1	1		1	4	75
Tokomairo River (w branch) at Mt Stuart	1				1		1	3	67
Owaka River at Purekerika				1			1	2	50
Tahokopa River at Tahokopa	2			1	1		1	5	80
% of sites species is present	87	13	53	80	53	7	67		

The highest rate of fish diversity in the region was observed in the streams of coastal Otago, with six to nine species observed in almost half of the sites surveyed in the area and only 15% of sites having observations of less than three species of fish. The average number of species per site was 4.8, which is higher than the average of 2.3 species per site for Otago (excluding coastal sites). In addition, the percentage of native species per site was higher in north coast and ocean tributaries than in other areas of Otago, with averages of 81% and 47%, respectively.

River flows

Flow statistics were calculated for eight monitoring sites between July 2007 and June 2008. Low flows as well as the highest flows of 2007-08 were also examined.

Flows in the upper Kakanui River at Clifton Falls were slightly below normal (-24%) during 2007/08 with a 7-day low flow of 0.468 m³/s, while further down the catchment at McCones the 7-day low flow was over 60% below normal. In the Kauru River, the largest tributary of the Kakanui River, the 7-day low flow was 54% below mean Annual Low Flow (MALF) at 0.22 m³/s.

Low flows in the Shag River at Craig Rd were moderately (-34%) below MALF while in the Waianakarua River at Browns Pump, the 7-day low flow for this year was less than half of MALF (-58%). In the West Branch of the Waikouaiti River at Lawsons, the 7-day low flow was close to normal (-17%), while in Dunedin, low flows in the Water of Leith at the University of Otago footbridge were close to 50% below MALF (0.15 m³/s). Flows in the west branch of the Tokomairiro River were below normal, with the 7-day low flow of 0.219 m³/s being 41% below MALF.

Significant flooding occurred throughout most of coastal Otago on July 30 2007 with the Kakanui River at McCones (839 m³/s), the Kauru River at Ewings (143 m³/s) and the Shag River at Craig Rd (398 m³/s) all recording their highest flows since records began. The Waianakarua River at Browns Pump recorded a peak flow of 135 m³/s, just 15 m³/s below its maximum recorded flow.

Comparison of 7-day low flows and MALF as well as maximum flows for 2007-08 to historical maximum flows

Site	7-day MALF	2007-08 7-day low flow	% change	Long-term max flow	2007-08 max flow
Kakanui at Clifton	0.616	0.468	-24.0	552.4	215.5
Kakanui at McCones	0.822	0.316	-61.6	839.2	839.2
Kauru at Ewings	0.222	0.102	-54.1	143.7	143.7
Water of Leith at University of Otago footbridge	0.15	0.082	-45.3	433.5	221.7
Shag at Craig Road	0.192	0.126	-34.4	398.4	398.4
Tokomairiro at Mt Stuart (w branch)	0.219	0.129	-41.1	113.8	63.5
Waianakarua at Browns Pump	0.48	0.2	-58.3	151.3	134.9
Waikouaiti at Lawsons (s branch)	0.188	0.155	-17.6	155	147.4

*Note: all flows are given in m³/s

River flows

- The 7-day low flow refers to the lowest 7-day moving average for a given year.
- The 7-day Mean Annual Low Flow (MALF) is the average of all of the 7-day low flows over the term of record.
- The long-term maximum flow is the highest flow recorded at a given site.



Hydrological monitoring station on the Shag River at the Grange



Longfin eel

Recent ORC reports

- Water quality of the Tokomairiro River, May 2007.
- State of Environment Report, Surface Water Quality in Otago, May 2007.
- Water quality of the Water of Leith and Lindsay's Creek, the Kaikorai Stream and the Waitati River and Careys Creek, August 2008.

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