Clutha River / Mata-Au

Monitoring Summary July 2008 - June 2009

Otago Regional Council

Contents

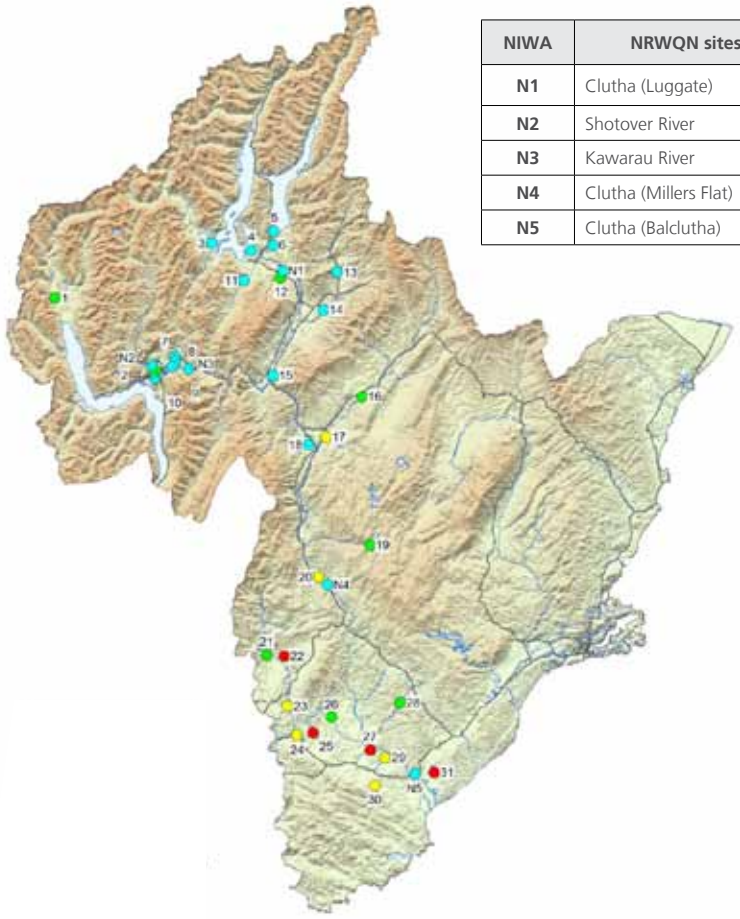
Water quality monitoring

Between July 2008 and the end of June 2009 the Otago Regional Council (ORC) monitored 26 river and stream sites in the Clutha catchment to assess the current state of water quality. Most sites were monitored bimonthly, but five further sites (Clutha River/Mata-Au at Luggate, Millers Flat and Balclutha, the Kawarau River and the Shotover River) were monitored monthly by NIWA as part of the national river water quality network (NRWQN). Sites were classified using a water quality index, and the results are shown in the map below (NRWQN sites denoted by an N).

Sites were classified using a water quality index, derived from median values of six indicator variables: turbidity, dissolved oxygen (% saturation), ammoniacal nitrogen, nitrite-nitrate nitrogen, dissolved reactive phosphorus, and Escherichia coli (*E.coli*) bacteria. Median values of these variables were compared with ANZECC and MfE/MoH 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

There are few significant point source discharges to freshwater in the Clutha catchment and land use has the greatest effect on water quality. The sites with poorer water quality are generally intensively farmed, such as in South West Otago, whereas sites with good water quality are in the upper catchment including the large lakes and upper tributaries.



NIWA	NRWQN sites
N1	Clutha (Luggate)
N2	Shotover River
N3	Kawarau River
N4	Clutha (Millers Flat)
N5	Clutha (Balclutha)

1	Dart River	9	Hayes Creek	17	Manuherikia (Galloway)	25	Wairuna Stream
2	Lake Wakatipu	10	Lake Johnson	18	Fraser River	26	Pomahaka downstream
3	Matukituki River	11	Cardrona River	19	Lake Onslow	27	Waiwera River
4	Lake Wanaka	12	Luggate Creek	20	Benger Burn	28	Waitahuna Stream
5	Lake Hawea	13	Lindis River at Peak	21	Pomahaka (Upstream)	29	Kaihiku d/Stream
6	Hawea River	14	Lindis at Ardgour	22	Heriot Burn	30	Kaihiku u/Stream
7	Mill Creek	15	Lake Dunstan	23	Waikoikoi Stream	31	Lake Tuakitoto
8	Lake Hayes	16	Manuherikia (Ophir)	24	Waipahi (downstream)		

Key Points

- South West Otago's surface water is typically high in nutrients, exceeding the ANZECC water quality guidelines for nitrogen and phosphorus.
- The median level of *E. coli* was generally below the MfE/MoH guideline level at all sites except in the Pomahaka River catchment in South West Otago.
- There is a reasonable correlation between water quality and biological health.

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 (Water Plan), which sets targets to maintain and improve water quality within the region.
- The 1992 ANZECC guidelines recommend a season median of less than 126 *E.coli*/100ml
  The Mfe/MoH (2003) guideline recommends that a single sample does not exceed 260 *E.coli*/100ml

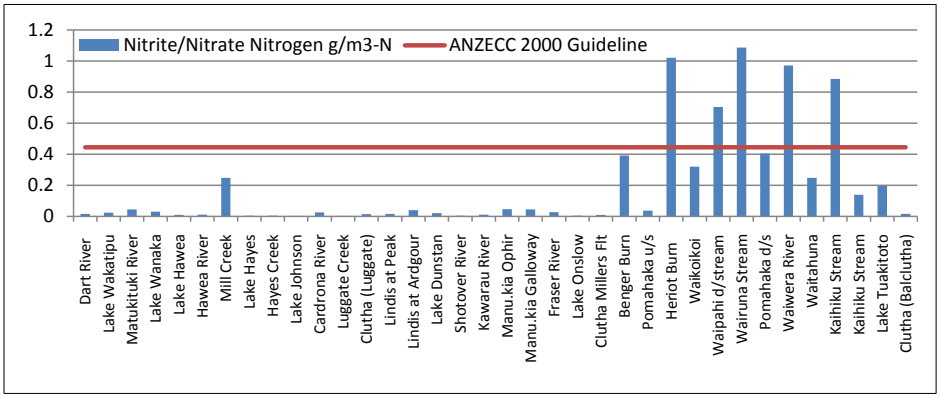
Note: *The red lines on these graphs indicate the ANZECC trigger value or the MfE/MoH guideline level.*

Water quality results

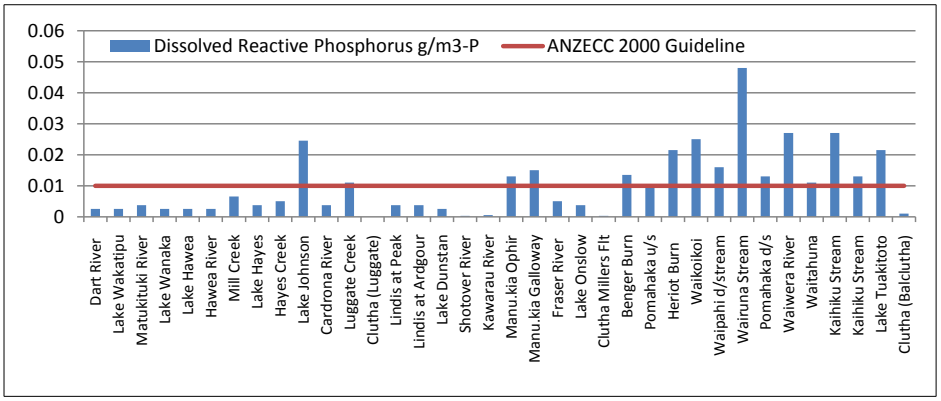
Selected water quality indicators are displayed in the graphs and discussed below. Overall these graphs show that water quality in the lakes and mainstem of the Clutha River/Mata-Au is generally very good, but poorer water quality is evident in the Pomahaka catchment.

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 five sites, four of which are in the Pomahaka River catchment.

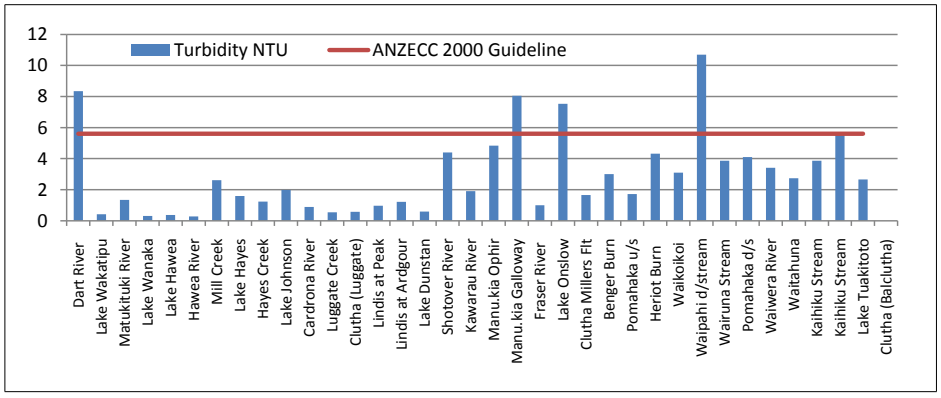


Median dissolved reactive phosphorus (DRP) concentrations were above the ANZECC trigger value at 14 of the sites monitored. These high DRP sites included Lake Johnson, Luggate Creek, both sites in the Manuherikia River, all sites in the Pomahaka catchment and Lake Tuakitoto.



Turbidity

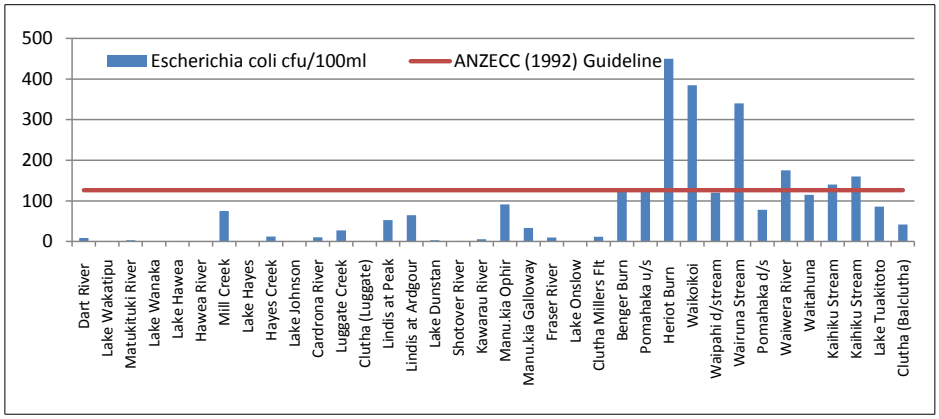
Turbidity was elevated above the ANZECC trigger value at five sites: the two shallow lakes (Lake Onslow and Lake Tuakitoto) where sediment is likely to be resuspended by wind, the Dart River with naturally high suspended solids, the lower Manuherikia River, and the Wairuna Stream.



Bacteria

Median levels of *E. coli* were above the ANZECC (1992) guideline (126 cfu/100ml) at four sites in the Pomahaka catchment: the Heriot Burn, Waikoikoi Stream, Wairuna Stream and Waiwera River, as well as the Kaihiku Stream and Benger Burn.

All other sites showed median bacteria levels below the trigger value; however, *E.coli* levels are likely to be high immediately following rainfall events.



Other analytes

- NH_3 is the main toxic component of ammoniacal nitrogen, the toxicity of which is dependent on pH and temperature. Taking these factors into account, none of the sites had NH_3 concentrations likely to be toxic to fish (>0.021 mg/l).
- Dissolved oxygen saturations should be above 80%, median levels were above this at all sites other than the Waiwera River (78%) and Lake Tuakitoto (64%).
- Total nitrogen was elevated above the trigger level at most sites in the Pomahaka catchment, as well as Lake Johnson, Lake Tuakitoto and the Bengerburn.
- Total phosphorus was elevated above the ANZECC trigger value in Lake Johnson, Lake Hayes and Hayes Creek, Lake Tuakitoto, Lake Onslow, the Manuherikia sites, the Benger Burn and most sites in the Pomahaka catchment.

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.

Cased caddisfly (Helicopsyche). Source, Landcare Research

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 streams: 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 and are 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 about the quality and condition of the stream.

Criteria for macroinvertebrate health

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

Clutha River/Mata-Au macroinvertebrate health 2008 - 2009

	Total species	EPT taxa	MCI	SQMCI
Cardrona River at Mt Barker	18	10	101	6.8
Fraser River at Marshall Road	24	13	97	9.7
Heriot Burn at Parkhill/Kelso Road	20	10	111	5.1
Lindis River at Ardgour Road	19	11	96	2.7
Luggate Creek at SH6 bridge	22	11	105	5.1
Manuherikia River at Blackstone	24	13	103	7.4
Mill Creek at Fish Trap	16	4	86	4.2
Waipahi River at Cairns Peak	21	11	98	4.9
Waipahi River at Waipahi	22	9	87	4.4
Waitahuna River at Tweeds Bridge	16	8	111	5.7
Waiwera River 1km upstream Clutha	18	7	82	1.9

Only two sites recorded poor SQMCI scores (Lindis River and the Waiwera River); these sites were also rated as poor in 2008. In 2008, Luggate Creek and the Fraser River also had poor SQMCI values; however, this year they moved to the good category. The Waipahi River, which had a poor SQMCI in 2007, improved in 2008 to a rating of average.

MCI scores and total species scores at all sites were average or good. This is an improvement from 2008 when three sites had an MCI rating of poor, and Mill Creek had a poor rating for total species. Only Mill Creek (above Lake Hayes) scored poorly for EPT species, which is due to marginal habitat suitability rather than water quality.

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 are a useful tool for monitoring the nutrient conditions in rivers and streams, it is just one method used in order to get a complete overview of the river system. Factors other than nutrient levels also influence the composition of benthic algal communities. These include substrate character, the flow regime of the river, the amount of light reaching the river bed and the water temperature.

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

Algal species recorded in 2009

Site	Cardrona River @ Mt Barker	Fraser River @ Marshall Road	Heriot Burn @ Parkhill/Kelso Road	Lindis River @ Ardgour Road	Luggate Creek @ SH6 bridge	Manuherikia River @ Blackstone	Mill Creek @ Fish Trap	Waipahi River @ Cairns Peak	Waipahi River @ Waipahi	Waitahuna River @ Tweeds bridge	Waiwera River 1km upstream Clutha
Filamentous Green											
Microspora									2		4
Mougeotia	3				3						
Oedogonium					3						
Spirogyra				1							
Stigeoclonium		4							6		
Filamentous Red											
Audouinella		4	2		1					7	
Nostoc					5						
Oscillatoria	6						4	1	5		
Rivularia									3		
Phytoplankton											
Asterionella						5					
Closterium									1		
Cosmarium						1					
Scenedesmus						1					
Diatoms											
Cocconeis										2	2
Cymbella				2			1		2	1	3
Didymosphenia	3	2		8		2					
Epithemia					1						
Frustulia	2	4	2	4	3	3	5	6	5	3	3
Gomphoneis	4	5			2	4	2			2	4
Gomphonema			2						3	2	2
Hantzschia											
Melosira		3			2		3	3	4		5
Naviculoid diatom	3	3		6		4	4	4			4
Nitzschia		3		4			1	2	4		
Pinnularia								2			
Stauroneis						3					
Surirella					1						
Synedra				1				1			
Tabellaria						5					2

The invasive species *Didymosphenia geminate* (Didymo) was present in four samples (Cardrona River at Mt Barker, Fraser River at Marshall Road, Lindis River at Ardgour Road and the Manuherikia River at Blackstone). Cyanobacteria (blue green algae) were found at five sites (Cardrona River, Luggate Creek, Mill Creek and both sites on the Waipahi River).

Periphyton

- 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).

Diatom *Didymosphenia geminatia* **(Didymo). Source, Environment Southland**

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

Fish

Electro-fishing was conducted in the summer of 2008 in 16 streams across the Clutha catchment, with nine species of fish observed in the 16 surveyed streams. Fish species diversity among Clutha sites averaged four species per site, which is slightly lower than the Otago average of 4.83 species per site.

Observations of fish species in the Clutha catchment 2009

Site	Bully	Common bully	Upland bully	Eel	Longfin eel	Clutha flathead galaxias	Koaro	Roundhead galaxias	Koura (Crayfish)	Lamprey (adult)	Lamprey: (Juvenile)	Perch	Brown trout	Number of species	% fish exotic
Bengerburn at Ettrick			166			2			1		1		14	5	8
Bengerburn at SH8	1												1	2	50
Cardrona at Mt Barker			253				28						15	3	5
Cardrona River at SH6			226						17				60	3	20
Heriot Burn	2		9	4	5								43	5	70
Kaihiku at Clifton Rd		1	2	4	2				3				14	6	56
Kaihiku at Hillfoot Rd			33		2								84	3	71
Kye Burn at SH85					8			94					7	3	6
Lindis River at Ardgour Rd			180										16	2	8
Lindis River at Peak		9	540										23	3	4
Luggate Creek at SH6													373	1	100
Mill Creek at Fish Trap		65						5				1	68	4	93
Waipahi at Clements Rd			3		4				2				11	4	55
Wairuna River at Millars Rd				3	2						1	2	6	5	57
Waitahuna at Tweeds			2	1							2		13	4	72
Waiwera at Hillfoot			8		6								3	3	18

Diversity was generally highest at sites closer to the coast, though no more than six species of fish were recorded at any single site in the Clutha catchment. At least one exotic species was present at all the sites surveyed, with brown trout found at all sites. Eels were absent from all sites surveyed above the Clutha hydro dams.

Upland bully (Gobiomorphus breviceps) source, NIWA

River flows

The rate of flow is an important determinant of the biological health of a stream or river, especially the extreme high and low flows. Low and high flow statistics have been calculated for a number of sites throughout the catchment for the period from 1 July 2008 to 30 June 2009.

It was not an exceptional season with rainfall in late December and late February keeping low flows moderate. The lowest flows occurred in late January/ early February and most were around the mean annual low flow (MALF).

In the Cardrona and Lindis catchments, the 7-day low flows were lower than those experienced last year while in the Manuherikia and Pomahaka catchments low flows were higher this year. In late May, flood flows occurred throughout the catchment. Peak flows during this event were well above mean annual flood flows in the Lindis, Manuherikia and Waipahi catchments, with flows in other catchments around the annual flood flow. The Pomahaka River at Burkes Ford had its highest flows in March 2009, from high flows above Leithen Glen. High flows also occurred in May.

Comparison of high and low flows during 2008/09 to historical records

Site	7-day low flows			Flood flows	
	2008/09	Historical (MALF)	% change	2008/09	Historical (mean annual flood)
Cardrona River at Mount Barker	0.806	0.955	-16	53.9	68
Lindis River at Lindis Peak	1.46	1.56	-6	261	90
Mill Creek at Fish Trap	0.204	0.245	-17	2.50	3.6
Dunstan Creek at Beattie Road	0.292	0.371	-21	116	39
Manuherikia River at Ophir	2.52	2.13	18	356	158
Waitahuna River at Tweeds Bridge	0.796	0.627	27	52.1	46
Pomahaka River at Burkes Ford	3.14	4.49	-30	375	350
Waipahi River at Waipahi	0.473	0.515	-8	113	62
Lovells Stream at SH 1	0.004	0.018	-78	8.55	13

***Note: all flows are given in m^3/s**

River flow facts

- The 7-day low flow refers to the lowest 7-day average flow 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 mean annual flood is the average flood flow expected each year based on the length of the record.

Hydrological monitoring station, Clutha River/Mata-Au

Recent Otago Regional Council reports

- Monitoring the effects of irrigation run off on water quality (Thompsons Creek, Ida Burn, Chatto Creek), May 2006.
- Water quality of The Lindis and Cardrona Rivers, May 2006.
- State of Environment Report, Surface Water Quality in Otago, May 2007.

The Clutha River / Mata-Au at Beaumont

Further information on the Taieri River is available on the ORC website:

www.orc.govt.nz

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