

Water quality and ecosystem health in Otago

Water quality
Ecosystem health

July 2008 to June 2013
January 2013



Introduction

The Otago Regional Council (ORC) is responsible for managing Otago's surface-water resources and carrying out regular and extensive long-term water-quality monitoring, as part of its State of Environment (SOE) programme. This report card documents the results of water-quality (July 2008 to June 2013), and macroinvertebrate, periphyton and fish (2013), monitoring.

Water quality

Water Plan Change 6A (PC6A), notified on 20 March 2013, sets out the numerical limits for acceptable water quality for all catchments in the Otago region (Schedule 15). The receiving water limits (outlined in Table 1) are applied as five-year, 80th percentiles, when flows are at or below median flow.

Table 1: Water quality standards (five-year, 80th percentiles, when flows are at or below median flow)

Schedule 15	Nitrite-nitrate nitrogen mg/l	Dissolved reactive phosphorus mg/l	Ammoniacal nitrogen mg/l	<i>Escherichia coli</i> cfu/100ml	Turbidity NTU	Total nitrogen mg/l	Total phosphorus mg/l
Group 1	0.444	0.026	0.1	260	5		
Group 2	0.075	0.010	0.1	260	5		
Group 3	0.075	0.005	0.01	50	3		
Group 4			0.1	126	5	0.55	0.033
Group 5			0.01	10	3	0.1	0.005

Most SOE sites were monitored every two months, and a further eight were monitored monthly by NIWA, as part of the National River Water Quality Network. To enable classification of each site into one of four groups (Table 2), ORC uses a water quality index. Figure 1 shows the results.

Table 2: Water quality index

Grade	Number of parameters complying with water quality standards (June 2008 to July 2013)
Excellent	All five parameters (Table 1) comply
Good	Four (of the five) values comply
Fair	Three (of the five) values comply
Poor	Two or fewer (of the five) values comply

Parameters

Nutrients: Nitrite-nitrate nitrogen (NNN) is a form of nitrogen, mainly derived from land drainage. Sources of dissolved reactive phosphorus (DRP) can be traced to point-source discharges of wastewater effluent, animal effluent and fertiliser. DRP is the biologically available component of phosphorus. Both NNN and DRP are important nutrients for algae and plant growth.

***E. coli*:** These bacteria are used as an indicator of the risk to human health of harmful micro-organisms present in water (e.g. human or animal faeces). They are also a risk to stock drinking water.

Turbidity: Turbidity is a measure of the cloudiness of water, determined by how much light is scattered by suspended particles. Streams with 'high turbidity' often have high-suspended sediment loads. Having high turbidity can reduce light penetration, which can affect the ability of macrophyte and algae to photosynthesise, reducing basal food supplies. High-sediment loading also tends to smother the habitat, which reduces macroinvertebrate and fish-spawning habitat.

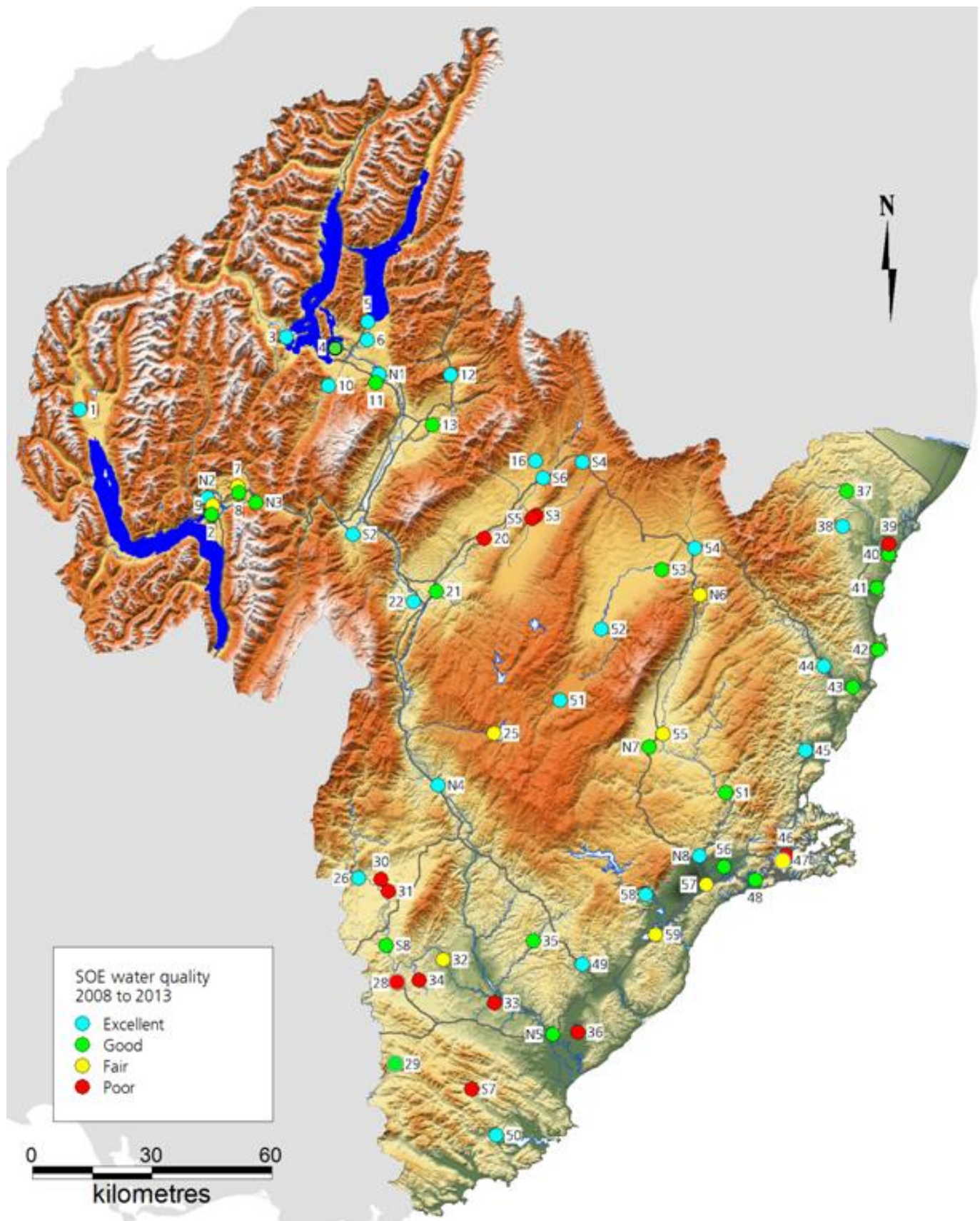


Figure 1: Results of five years of SOE water-quality monitoring. Site numbers refer to sites in Tables 3 and 4.

Water-quality monitoring: Results

Table 3: Site number, PC6A group and results. The orange cells show where the 80th percentile below median flow exceeded the PC6A standards. The grey cells indicate the additional parameters to those in PC6A.

	PC6A	Site name	NNN	NH ₄ -N	DRP	<i>E. coli</i>	Turb.	Total N	Total P
			mg/l	mg/l	mg/l	cfu/100ml	NTU	mg/l	mg/l
Site no.	Group 1		0.444	0.1	0.026	260	5		
28	1	Waipahi at Cairns Pk	0.638	0.02	0.023	916	22.6	1.23	0.09
29	1	Waipahi at Waipahi	0.926	0.01	0.021	260	3.4	1.24	0.057
30	1	Heriot Burn	1.47	0.033	0.039	1900	10.1	1.778	0.094
31	1	Crookston Burn	1.11	0.012	0.032	1300	3.2	1.38	0.049
32	1	Pomahaka at Burkes	0.556	0.01	0.014	302	3.6	0.81	0.039
33	1	Waiwera River	1.2	0.02	0.033	580	4.7	1.38	0.068
34	1	Wairuna	1.21	0.07	0.1	1600	16.4	1.78	0.209
35	1	Waitahuna	0.085	0.01	0.014	538	3.9	0.398	0.046
46	1	Lindsay's Ck u/s Leith	0.802	0.017	0.027	900	3.3	0.972	0.048
47	1	Leith at Dundas St	0.422	0.009	0.035	1200	4	0.64	0.054
48	1	Kaikorai at Brighton Rd	0.185	0.01	0.017	1780	3.3	0.442	0.045
49	1	Tokomairiro (west. br.)	0.148	0.01	0.012	252	3	0.49	0.04
50	1	Catlins at Houipapa	0.286	0.01	0.018	202	3.3	0.482	0.036
S7	1	Owaka at Purikikea	1.054	0.0818	0.042	2680	24	1.55	0.082
S8	1	Waikoikoi	0.4072	0.0594	0.0256	748	4.8	0.746	0.059
	PC6A	Site name	NNN	NH ₄ -N	DRP	<i>E. coli</i>	Turb.	Total N	Total P
Site no.	Group 2		0.075	0.1	0.01	260	5		
6	2	Hawea River	0.018	0.009	0.005	2	0.4	0.05	0.006
7	2	Mill Creek	0.48	0.009	0.007	300	2.4	0.61	0.025
10	2	Cardrona River	0.04	0.009	0.006	53	0.9	0.096	0.009
11	2	Luggate Creek	0.005	0.009	0.017	73	0.7	0.068	0.02
12	2	Lindis River at Peak	0.019	0.009	0.007	77	0.7	0.07	0.014
13	2	Lindis at Ardgour	0.155	0.009	0.007	140	0.9	0.22	0.011
16	2	Dunstan Creek	0.046	0.009	0.008	120	1	0.13	0.012
20	2	Manuherikia (Ophir)	0.057	0.02	0.04	430	5.6	0.368	0.071
21	2	Manuherikia (Galloway)	0.025	0.009	0.018	190	3.8	0.27	0.038
22	2	Fraser River	0.037	0.009	0.005	30	1.3	0.168	0.021
26	2	Pomahaka (upstream)	0.049	0.009	0.01	216	3.3	0.206	0.024
37	2	Kakanui at Clifton	0.037	0.009	0.006	300	0.5	0.14	0.011
38	2	Kauru at Ewings	0.032	0.009	0.008	67	0.3	0.148	0.011
39	2	Waiareka Creek	0.304	0.011	0.147	280	1.7	1.104	0.185
40	2	Kakanui at McCones	0.285	0.01	0.005	26	0.6	0.396	0.012
41	2	Waianakarua at Browns	0.307	0.009	0.008	40	0.4	0.398	0.009
42	2	Trotters Creek	0.384	0.019	0.007	55	1.6	0.526	0.015
43	2	Shag at Goodwood	0.498	0.012	0.009	150	0.7	0.692	0.016
44	2	Shag at Craig Rd	0.088	0.009	0.006	56	0.6	0.27	0.012
45	2	Waikouaiti at Orbells	0.026	0.009	0.005	76	1	0.22	0.018
51	2	Taieri at Linnburn	0.0045	0.009	0.005	109	1.4	0.17	0.016
52	2	Taieri at Stonehenge	0.01	0.009	0.007	85	2.4	0.27	0.028
53	2	Taieri at Waipiata	0.035	0.01	0.043	220	4.9	0.45	0.081
54	2	Kye Burn	0.049	0.009	0.008	113	1.4	0.2	0.015
55	2	Taieri at Sutton	0.056	0.01	0.014	348	3.5	0.358	0.04
56	2	Silver Stream d/s	0.327	0.01	0.01	230	2.2	0.57	0.017
57	2	Taieri at Allanton	0.043	0.02	0.013	370	3.3	0.38	0.037
58	2	Waipori River	0.056	0.009	0.005	97	3.5	0.262	0.022
N2	2	Shotover River	0.023	0.006	0.001	4	3.6	0.048	0.016
N4	2	Clutha at Millers Flat	0.046	0.004	0.001	60	3.2	0.13	0.007
N5	2	Clutha at Balclutha	0.131	0.009	0.003	134	3	0.29	0.012
N6	2	Taieri at Tiroiti	0.032	0.006	0.018	282	3.8	0.337	0.047
N7	2	Sutton at SH87	0.018	0.01	0.008	446	1.7	0.298	0.032
N8	2	Taieri at Outram	0.041	0.009	0.008	166	2.4	0.331	0.033
S1	2	Three O'clock Stream	0.105	0.0184	0.0098	68.8	0.56	0.206	0.018
S2	2	Bannock Burn	0.0019	0.0158	0.0058	64.4	4.9	0.168	0.016
S3	2	Ida Burn at Auripo Rd	0.0366	0.0838	0.049	1324	5.4	0.338	0.084
S4	2	Ida Burn at SH85	0.008	0.0232	0.006	35	1.18	0.066	0.023
S5	2	Pool Burn at Auripo Rd	0.1098	0.1762	0.1058	262	2.97	0.868	0.176
S6	2	Manuherikia (Blackst.)	0.0027	0.0224	0.007	110	3.67	0.128	0.022

Table 3 (continued)

	PC6A	Site name	NNN	NH ₄ -N	DRP	<i>E. coli</i>	Turb.	Total N	Total P
Site no.	Group 3		0.075	0.01	0.005	50	3		
1	3	Dart River	0.024	0.009	0.005	11	exempt	0.13	0.094
3	3	Matukituki River	0.066	0.009	0.005	15	2.4	0.09	0.015
N1	3	Clutha at Luggate	0.041	0.003	0.001	2	0.9	0.072	0.003
N3	3	Kawarau at Chards	0.029	0.017	0.002	10	2.6	0.101	0.014

Table 4: Lake sites, numbers, results and PC6A group. The red cells indicate where the 80th percentile exceeded the PC6A standards. The grey cells show additional parameters to those in PC6A.

	PC6A	Site name	NNN	NH ₄ -N	DRP	<i>E. coli</i>	Turb.	Total N	Total P
Site no.	Group 4			0.1		126	5	0.55	0.033
8	4	Lake Hayes	0.01	0.018	0.024	9	2.2	0.44	0.062
9	4	Lake Johnson	0.006	0.05	0.04	3	2.4	0.85	0.08
25	4	Lake Onslow	0.005	0.009	0.005	2	7.3	0.29	0.041
36	4	Lake Tuakitoto	0.493	0.071	0.043	310	13.9	1.494	0.119
59	4	Lake Waihola	0.075	0.012	0.008	90	23.6	0.716	0.088
	PC6A	Site name	NNN	NH ₄ -N	DRP	<i>E.coli</i>	Turb.	Total N	Total P
Site no.	Group 5			0.01		10	3	0.1	0.005
2	5	Lake Hawea	0.019	0.009	0.005	1	0.6	0.055	0.005
4	5	Lake Wakatipu	0.028	0.009	0.005	1	0.8	0.08	0.007
5	5	Lake Wanaka	0.035	0.009	0.005	1	0.5	0.08	0.005

Water quality: Summary

Figure 1 shows that most of the sites with ‘excellent’ river water quality were in Central Otago and the upper Clutha, where land-use tends to be low-intensity sheep farming and/or dominated by tussock lands. Poorer water quality was found in river catchments with high-intensity farming or in streams draining urban environments.

Two sites in Group 1 (out of 15) had ‘excellent’ water quality (Tokomairiro River at the west branch bridge and the Catlins River); four ‘good’; two ‘fair’ and seven ‘poor’. Schedule 15 limits were most often exceeded for *E. coli* and NNN. Most of the ‘poor’ sites were in south-west Otago, in intensive-farming landscapes. The Dunedin urban streams also had ‘poor’ water quality.

Nineteen sites in Group 2 (out of 40) had ‘excellent’ water quality. Most of these were the upper sites in the Taieri and Clutha river catchments. Thirteen sites had ‘good’ water quality, including most of the coastal rivers, such as the Kakanui, Waianakarua and Shag. NNN was the parameter that often exceeded the Schedule 15 limit. Mid-catchment river sites, such as the Manuherikia and the Lindis at Ardgour Road, also fell into this category. Four sites had ‘fair’ water quality, three of which were in the Taieri River (Sutton, Tiroiti and Allanton). All three failed to meet the Schedule 15 limit for DRP and *E.coli*. Of the four sites with ‘poor’ water quality, three were located in small, low-gradient streams. The other was in the Manuherikia, where DRP, *E.coli* and turbidity exceeded the Schedule 15 limit.

Of the four sites in Group 3, the Dart River, Clutha at Luggate and the Matukituki River had ‘excellent’ water quality, while the water quality of the Kawarau River was ‘good’.

One Group 4 site had ‘good’ water quality (Lake Hayes), three were ‘fair’ (Lakes Johnson, Onslow and Waihola), and one was ‘poor’ (Lake Tuakitoto). All exceeded Schedule 15 limits for total phosphorus (TP). Lake Tuakitoto was the only small lake to exceed the *E. coli* limit.

Of the three Group 5 sites (Wakatipu, Wanaka and Hawea) two had excellent water quality, while Lake Wakatipu exceeded the TP Schedule 15 limit.



Catlins River at Houipapa



Kye Burn at SH85



Waipahi River at Waipahi

Macroinvertebrates

Macroinvertebrates are an important component of streams and rivers because they aid ecosystem processes and provide food for fish. Because different macroinvertebrates have differing pollution tolerances, they are good for assessing pollution. As they have a relatively long life span, they are good indicators of environmental conditions over a prolonged period. The main measure of macroinvertebrate communities, the MCI index, is designed specifically for stony-riffle substrates in flowing water. MCI values can be affected by factors other than water quality, so it is more informative to consider changes in MCI values at the same site over a period, rather than among sites throughout the catchment.

Macroinvertebrate communities were assessed in the summer of 2012/2013 by taking a single kick net from a variety of habitats in each river. The highest macroinvertebrate diversity was found in the Kye Burn, with 27 species, 16 of which were EPT taxa. Conversely, the Kaikorai Stream had low species richness and a poor SQMCI score. This site was dominated by midges (Orthocladiinae and Tanytarsini), although EPT species were also present, including *Deleatidium* mayflies.

Table 4: EPT, MCI and SQMCI scores

CATEGORY	Site no.	No. of taxa	EPT richness	MCI	SQMCI
Excellent		n/a	n/a	>120	>6
Good		n/a	n/a	>100 -120	>5 - 6
Average		n/a	n/a	80 to 100	4 - 5
Poor		n/a	n/a	<80	<4
SITE					
Cardrona River at Mt Barker	10	17	9	106	7.0
Catlins River at Houipapa	50	25	14	114	6.0
Heriot Burn at Parkhill Road	30	14	7	93	5.4
Kaihiku Stream at Clifton		22	8	75	4.4
Kaikorai Stm at Brighton Rd	48	12	3	68	2.2
Kakanui River at Clifton Falls	37	24	13	110	6.1
Kakanui River at McCones	40	19	9	95	4.6
Kauru River at Ewings	38	20	12	118	6.2
Kye Burn at SH85	54	27	16	115	6.8
Lindis River at Ardgour Road	13	16	8	109	3.8
Lindsay's Creek at North Rd	46	14	5	93	3.0
Luggate Creek at SH6 Bridge	11	16	8	108	5.8
Manuherikia at Blackstone		19	11	99	5.2
Mill Creek at Fish Trap	7	10	4	98	6.0
Owaka River at Duttons Rd		9	3	80	3.9
Shag River at Craig Road	44	16	8	105	5.5
Shag River at Goodwood	43	19	8	88	5.6
Silver Stream at Riccarton Rd	56	17	5	89	3.0
Sow Burn at Patearoa		22	14	115	7.3
Tokomairiro at Coal Gully Rd		16	8	90	3.5
Tokomairiro (west. Br)	49	18	9	114	5.2
Trotters Creek at Mathesons	42	14	6	94	3.4
Waianakarua River	41	17	9	111	5.27
Waiareka Ck at Taipo Road	39	12	4	77	4.4
Waikouaiti River at Orbells	45	14	6	89	3.5
Waipahi River at Cairn Peak	28	26	12	100	5.3
Waipahi River at Waipahi	29	21	10	93	4.5
Waipori River at Falls Reserve	58	16	8	115	4.7
Wairuna River	34	17	6	92	4.3
Waitahuna at Tweeds Br.	35	17	10	116	5.8
Waiwera River	33	28	12	93	4.1
Water of Leith at Dundas St	47	20	7	88	4.5

Indices to measure macroinvertebrate community health

The macroinvertebrate community index (MCI) is calculated by averaging the pollution tolerance scores of all species found at a site and multiplying it by 20. Species that are very sensitive to pollution score highly (up to 10); while invertebrates suited to muddy/weedy-bedded, pool-like habitats are generally more tolerant, low-scoring taxa.

EPT richness is the total number of the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxa collected. It is a more meaningful index than MCI, as EPT taxa are generally sensitive to a range of pollutants, including fine sediment and nutrient enrichment.

Semi-quantitative macroinvertebrate community index (SQMCI) is also based on the ratios of sensitive to tolerant taxa, but SQMCI results are mainly determined by the most abundant taxa (unlike the MCI where all taxa are given equal weight in the calculation).

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 useful in monitoring the nutrient conditions of rivers and streams, they are only one method used to gain an overview of the river system. Factors other than nutrient levels also influence the composition of benthic algal communities, including substrate composition, river flows, amount of light reaching the river bed, invertebrate grazing and water temperature.

Algal samples were collected from 32 sites. Algae were given an abundance score ranging from 1 (rare) to 8 (dominant), based on the protocols developed by Biggs and Kilroy (2000).

All sites were dominated by diatom communities, with the Shag River at Craig Road having the most. *Didymo* was present in the Lindis River, Kakanui River, Luggate Creek and Manuherikia River. *Phormidium* had an abundance score of four or more in the Kakanui River, Waianakarua River, lower Waipahi River and Waikouaiti River. The Tokomairiro at the west branch bridge had the least dominance of any algal types, possibly because the fine sediment on the stream bed provides an unstable surface for algae.

Table 5: Periphyton abundance scores (2013)

Site No.	Site	Diatoms																
		Achnanthes	Achnanthidium	Cocconeis	Cymbella	Didymosphenia	Encyonema	Epithemia	Eunotia	Fragilaria	Frustulia	Gomphoneis	Gomphonema	Melosira	Naviculoid diatom	Nitzschia	Pinnularia	Rhoicosphenia
10	Cardrona											2		1	3			
50	Catlins River			2							4	3		6	3	2		
30	Heriot Burn													2				
	Kaihiku Stream			2								1		7	1			2
48	Kaikorai Stream			3	1									3	2	1	1	
37	Kakanui Clifton				3	4		3				3	2					
40	Kakanui at McCones				4			2					4		3	4		
38	Kauru River			2									3	4	3	1	1	3
54	Kye Burn											1	4					
13	Lindis River (lower)				4	3						3	3		1	2		2
46	Lindsay Creek		1		1			1	1	2	1	1	2	3	1			1
11	Luggate Creek				3	3		3					4	4				
	Manuherikia (upper)				1	3		2					4	3				1
7	Mill Creek			1	1									1				
	Owaka River		1										2	3				1
44	Shag Craig Rd	5		3	2								3	4	3	2		
43	Shag River (lower)	4			4								4	4				
56	Silver Stream										1		2	4				
	Sow Burn (upper)				2								3		2			
	Toko (Coal Gully)			2									3	2	5	2		
49	Toko. (w. br. br.)														1			
42	Trotters Creek												2	2	1	1		
41	Waianakarua				7		7							3		3		
39	Waiareka Creek				1									1				
45	Waikouaiti River	2		2	3			3					3	3				
28	Waipahi (upper)		1											2				
29	Waipahi (lower)		2	2										5	2			
58	Waipori River														1			
34	Wairuna River		6	2										3				
35	Waitahuna River			1								1	3					
33	Waiwera River			2										2	3		1	
47	Water of Leith									3	3		3	6	3	2		

Table 5 (continued)

Site No.	Site	Synedra (D)	Tabellaria (D)	Microspora (FG)	Mougeotia (FG)	Oedogonium (FG)	Stigeoclonium (FG)	Ulothrix (FG)	Audouinella (FR)	Nostoc (Cy)	Oscillatoria/Phormidium(Cy)	Placoma(Cy)	Rivularia(Cy)	Cosmarium(Cy)
10	Cardrona	1							2				3	
50	Catlins River	2			2			1			1			
30	Heriot Burn								4	5			4	
	Kaihiku Stream	1		2	3					1				
48	Kaikorai Stream	1												
37	Kakanui Clifton	8								1				
40	Kakanui McCones	5		1							4			3
38	Kauru River	2									1		3	
54	Kye Burn	2							7		2			
13	Lindis River (lower)	1		1				3			2			1
46	Lindsay's Creek	3	1											
11	Luggate Creek								1					
	Manuherikia (upper)									2				
7	Mill Creek	1												
	Owaka River			3	5							4		
44	Shag Craig Rd	5		5	2					5				
43	Shag River (lower)	3	3				2							
56	Silver Stream	4	7	3							3			
	Sow Burn (upper)	2	4		2								4	
	Toko.(Coal Gully)	4							5					
49	Toko. (w. br. br.)	2							3					
42	Trotters Creek	7									2			
41	Waianakarua										6		2	
39	Waiareka Creek								4		1		1	
45	Waikouaiti River	3	4								5			
28	Waipahi (upper)								3	4			2	
29	Waipahi (lower)						3				6		5	
58	Waipori River		1		3	1			3					
34	Wairuna River							3						
35	Waitahuna River								7				5	
33	Waiwera River	1			2			1						
47	Water of Leith	2						1						

D=diatom, FG=Filamentous green algae, FR=filamentous red algae, Cy=Cyanobacteria



Phormidium



Didymosphenia geminata



Mougeotia



Gomphoneis

Fish monitoring

Electric fishing was conducted in the summer of 2013 at 27 sites in 23 streams in Otago. Twenty species of fish were collected across these sites, several of which are of conservation concern. Longfin eels, redfin and bluegill bullies, torrentfish, inanga, koaro and lamprey are classified as 'declining', and the Clutha flathead galaxias is classified as 'nationally vulnerable'.

The most widespread fish species found were brown trout (26 sites), longfin eels (22) and upland bullies (14). Giant bullies, roundhead galaxias and perch were each found at one site, while koaro, common smelt and rainbow trout were each found at two sites.

The greatest diversity and abundance of fish was observed at sites close to the coast, such as the Waianakarua River at Browns Pump (11 species), and the Kakanui at McCones (10 species), mainly due to the presence of diadromous species (migrate to sea for part of their life-cycles), such as eels, bullies (except upland), torrentfish, inanga, koaro, black flounder, lamprey and smelt). As some diadromous species, such as longfin eels and koaro, are strong swimmers, and able to climb steep waterfalls and man-made structures, they were found at inland sites too. Koaro and common bullies can form land-locked populations in tributaries of lakes.

Table 6: Fish species

	Site number	Shortfin eel	Longfin eel	Common bully	Giant bully	Redfin bully	Bluegill bully	Upland bully	Torrentfish	Black flounder	Canterbury galaxias	Clutha flathead galaxias	Inanga	Koaro	Roundhead galaxias	Lamprey	Common smelt	Perch	Rainbow trout	Brown trout
Cardrona	10		1					125				18		4					98	1
Heriot Burn	30		5					4				1								68
Kakanui (lower)	40	26	56	766			1364		12	1			2			5	3			3
Kakanui (upper)	37	2	1					264			181			4						20
Kaikorai	48	1	30	210		10				1			22							19
Kye Burn	54														64					34
Leith Stream	47		2			24														68
Lindis(lower)	13							438												53
Lindis Crossing								389											1	20
Lindsay's Creek	46	5	6																	140
Luggate	11																			218
Mill Creek	7		1	498														21		32
Owaka River	57		3																	47
Shag Craig Rd	44	6	15	23			19	683								6				4
Silver Stream	56		13	8									17			10				19
Sow Burn			1																	523
Trotters Creek	42		3	535	1	4					1		1 ³ - 2 ³							1
Trotters Gorge			1					4			1									11
Tokomairiro (w)	49		5			7		36								64				263
Waianakarua	41	9	2	277			457	10	27	11	30		2			93	7			
Waiareka	39			2									2							3
Waikouaiti	45	9	26	396			70		1	19			30			3				1
Waipahi (upper)	28		2					55												4
Waipahi (lower)	29		2					9												4
Wairuna	34	2	14					113				2								3
Waitahuna	35		2					9												9
Waiwera	33		4					43												136

Summary: Ecosystem health and water quality

Ecosystem health in Otago: To assess the state of ecosystem health, 32 sites were monitored for algae and macroinvertebrates, and 27 were monitored for fish.

- **Algae:** Eleven sites contained the potentially toxic algae, *Phormidium*. The greatest abundance of *Phormidium* was found in the Waipahi and Waianakarua rivers. The Lindis River had both *Didymosphenia geminata* and *Phormidium*.
- **Macroinvertebrates:** Macroinvertebrate monitoring showed that 50% of sites had 'excellent' or 'good' SQMCI scores, and 44% had 'good' MCI scores. MCI scores at three sites indicated 'poor' water quality, while the SQMCI scores of eight were 'poor'.
- **Fish:** Brown trout were found at 26 sites, longfin eels at 22 and upland bullies at 14. Giant bullies, roundhead galaxias and perch were each found at one site, while the koaro, common smelt and rainbow trout were collected at two.

Water quality in Otago: The water quality of 67 river and stream sites was assessed between July 2008 and June 2013; 26 had 'excellent' water quality, 20 'good', 8 'fair' and 13 'poor'.