

Water quality and ecosystem health in Otago



Water quality
Ecosystem health

July 2009 to June 2014
January 2014

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 2009 to June 2014), and macroinvertebrate, periphyton and fish (2014), 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

Nutrients: Nitrite-nitrate nitrogen (NNN) and dissolved reactive phosphorus (DRP) are the biologically available nutrients used for algae and plant growth. NNN is a form of nitrogen, mainly derived from land drainage and DRP is a form of phosphorus mainly sourced from effluent and fertiliser. Ammoniacal nitrogen (NH₄) can indicate the presence of effluent in water.

E. coli: *Escherichia coli* (*E. coli*) are used as an indicator of the presence of harmful micro-organisms in water (e.g. human or animal faeces) and whether water is suitable for stock drinking, swimming, surfing or other recreational activities.

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 photosynthesis. High-sediment loading also tends to smother the habitat, which reduces macroinvertebrate and fish-spawning habitat.

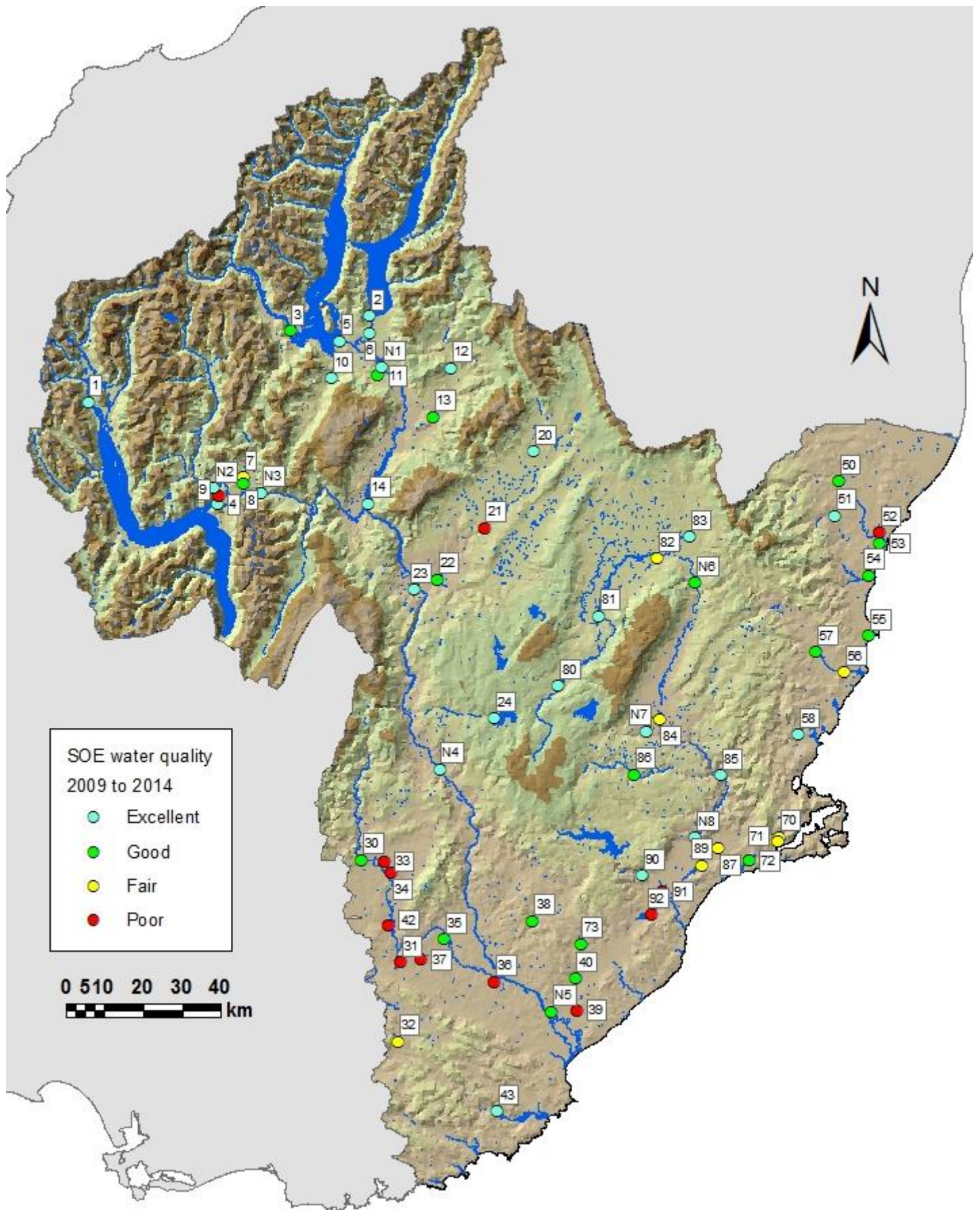


Figure 1: Results of five years of SOE water-quality monitoring. Site numbers refer to sites in Tables 3 and 4.

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	E.coli	Turb.	Total N	Total P
			mg/l	mg/l	mg/l	cfu/100ml	NTU	mg/l	mg/l
No.	Group 1		0.444	0.1	0.026	260	5		
31	1	Waipahi at Cairns Pk	0.726	0.021	0.021	916	10.70	1.242	0.077
32	1	Waipahi at Waipahi	1.296	0.010	0.019	262	3.40	1.588	0.051
33	1	Heriot Burn	1.720	0.026	0.040	2400	6.60	2.200	0.083
34	1	Crookston Burn	1.636	0.028	0.036	3020	4.48	1.876	0.059
35	1	Pomahaka at Burkes	0.706	0.009	0.013	160	3.52	0.990	0.034
36	1	Waiwera	1.031	0.016	0.032	1180	4.60	1.330	0.069
37	1	Wairuna	1.286	0.049	0.100	1800	13.18	1.792	0.164
38	1	Waitahuna	0.081	0.009	0.015	500	3.84	0.390	0.038
40	1	Lovells Creek	0.384	0.009	0.0158	1150	1.68	0.798	0.0438
41	1	Owaka at Purekireka	1.066	0.008	0.0312	1520	5.66	1.59	0.059
42	1	Waikoikoi	0.534	0.0128	0.0292	1280	5.60	0.906	0.064
43	1	Catlins at Houipapa	0.303	0.010	0.017	208	3.42	0.488	0.036
70	1	Lindsays Creek	0.802	0.011	0.022	1020	3.26	0.972	0.048
71	1	Leith at Dundas Street	0.370	0.009	0.030	720	4.13	0.608	0.058
72	1	Kaikorai at Brighton Rd	0.234	0.011	0.017	3300	3.28	0.490	0.045
73	1	Tokomairiro (West Br)	0.226	0.012	0.012	414	2.74	0.512	0.033
	PC6A	Site Name	NNN	NH₄-N	DRP	E.coli	Turb.	Total N	Total P
No.	Group 2		0.075	0.1	0.01	260	5		
6	2	Hawea at Camphill Br	0.018	0.009	0.005	2	0.62	0.055	0.005
7	2	Mill Creek at Fish Trap	0.474	0.011	0.008	362	3.14	0.592	0.026
10	2	Cardrona at Mt Barker	0.043	0.009	0.005	81	1.03	0.122	0.008
11	2	Luggate Creek at SH6 Br	0.005	0.009	0.018	112	1.08	0.080	0.021
12	2	Lindis at Lindis Peak	0.014	0.009	0.006	80	0.72	0.062	0.008
13	2	Lindis at Ardgour Road	0.191	0.009	0.007	109	0.64	0.268	0.007
14	2	Lake Dunstan	0.036	0.009	0.007	5	1.28	0.08	0.013
20	2	Dunstan Creek	0.048	0.009	0.008	98	1.03	0.130	0.011
21	2	Manuherikia at Ophir	0.073	0.020	0.040	460	5.50	0.398	0.069
22	2	Manuherikia at Galloway	0.028	0.009	0.018	187	4.04	0.286	0.038
23	2	Fraser at Marshall Rd	0.036	0.013	0.005	36	1.57	0.162	0.019
30	2	Pomahaka at Glenken	0.051	0.009	0.009	302	1.67	0.284	0.021
50	2	Kakanui at Clifton	0.038	0.009	0.005	352	0.46	0.140	0.008
51	2	Kauru at Ewings	0.026	0.009	0.006	180	0.28	0.130	0.009
52	2	Waiareka Creek	0.414	0.011	0.150	624	1.78	0.980	0.185
53	2	Kakanui at McCones	0.290	0.009	0.005	90	0.68	0.400	0.010
54	2	Waianakarua	0.266	0.009	0.008	56	0.45	0.364	0.009
55	2	Trotters Creek	0.384	0.014	0.005	85	1.55	0.558	0.015
56	2	Shag at Goodwood Pump	0.460	0.010	0.011	230	0.61	0.640	0.016
57	2	Shag at Craig Road	0.088	0.009	0.006	136	0.60	0.270	0.010
58	2	Waikouaiti	0.019	0.009	0.005	90	0.93	0.180	0.009
80	2	Taieri at Linnburn	0.0048	0.0092	0.005	142	1.70	0.182	0.0164
81	2	Taieri at Stonehenge	0.010	0.009	0.008	114	2.28	0.250	0.028
82	2	Taieri at Waipiata	0.028	0.010	0.048	400	4.52	0.450	0.083
83	2	Kye Burn at SH85 Bridge	0.039	0.009	0.007	254	1.54	0.190	0.011
84	2	Taieri at Sutton	0.062	0.009	0.013	390	3.36	0.364	0.039
85	2	Three O'Clock Stream	0.056	0.005	0.002	35	0.49	0.190	0.010
86	2	Deep Stream	0.001	0.005	0.0024	380	0.92	0.18	0.01
87	2	Silverstream at Riccarton	0.345	0.014	0.009	440	2.11	0.606	0.017
88	2	Owhiro Stream	0.2852	0.098	0.0432	1328	14.16	0.908	0.1312
89	2	Taieri at Allanton	0.046	0.014	0.013	296	3.58	0.364	0.032
90	2	Waipori	0.056	0.009	0.005	54	3.50	0.250	0.020
91	2	Main Drain	0.392	0.53	0.028	470	12.70	2.8	0.158

Table 3 (continued)

	PC6A	Site Name	NNN	NH ₄ -N	DRP	E.coli	Turb.	Total N	Total P
No.	Group 2		0.075	0.1	0.01	260	5		
N2	NIWA 2	Shotover at Bowens Peak	0.021	0.006	0.001	4	3.6	0.048	0.021
N4	NIWA 2	Clutha at Millers Flat	0.046	0.004	0.001	69	3.0	0.107	0.007
N5	NIWA 2	Clutha at Balclutha	0.119	0.009	0.002	138	3.0	0.187	0.010
N6	NIWA 2	Taieri at Tiroiti	0.045	0.006	0.018	354	4.0	0.342	0.045
N7	NIWA 2	Sutton at SH87	0.020	0.009	0.007	341	1.8	0.266	0.024
N8	NIWA 2	Taieri at Outram	0.040	0.008	0.008	127	2.4	0.336	0.028
	PC6A	Site Name	NNN	NH ₄ -N	DRP	E.coli	Turb.	Total N	Total P
No.	Group 3		0.075	0.01	0.005	50	3		
1	3	Dart at The Hillocks	0.028	0.009	0.005	11	Exempt	0.172	0.094
3	3	Matukituki	0.070	0.010	0.005	60	2.70	0.100	0.015
N1	NIWA 3	Clutha at Luggate Br.	0.043	0.003	0.001	3	1.0	0.068	0.003
N3	NIWA 3	Kawarau at Chards	0.030	0.022	0.002	11	2.6	0.102	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	E.coli	Turb.	Total N	Total P
No.	Group 4			0.1		126	5	0.55	0.033
8	4	Lake Hayes	0.012	0.018	0.028	50	2.40	0.426	0.060
9	4	Lake Johnson	0.008	0.106	0.043	16	14.6	1.618	0.098
24	4	Lake Onslow	0.005	0.009	0.005	5	4.438	0.286	0.029
39	4	Lake Tuakitoto	0.545	0.054	0.048	210	14.16	1.600	0.146
92	4	Lake Waihola	0.072	0.012	0.009	105	27.12	0.716	0.094
	PC6A	Site Name	NNN	NH ₄ -N	DRP	E.coli	Turb.	Total N	Total P
No.	Group 5			0.01		10	3	0.1	0.005
2	5	Lake Hawea	0.020	0.009	0.005	1	0.73	0.055	0.005
4	5	Lake Wakatipu	0.08	0.009	0.005	3	0.78	0.08	0.005
5	5	Lake Wanaka	0.035	0.009	0.005	1	0.47	0.060	0.005

Water quality: Summary

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.

One site in Group 1 (out of 16) had 'excellent' water quality (Catlins River); five 'good'; three '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. Compared to last year two sites had improved a grade and three sites had dropped a grade.

Seventeen sites in Group 2 (out of 37) had 'excellent' water quality. Most of these were the upper sites in the Taieri and Clutha river catchments. Twelve sites had 'good' water quality, including most of the coastal rivers, such as the Kakanui, Waianakarua and Shag. *E. coli* and NNN were the parameters that most often exceeded the Schedule 15 limit. Mid-catchment river sites, such as the Manuherikia and the Lindis at Ardour Road, also fell into this category. Six sites had 'fair' water quality, three of which were in the Taieri River (Waipiata, Sutton 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. Compared to last year no sites had improved a grade and five sites had dropped a grade.

Of the four sites in Group 3, the Dart River, Clutha River (Luggate) and Kawarau River had 'excellent' water quality, while the water quality of the Matukituki River was 'good'. Compared to last year one site had dropped a grade.

One Group 4 site had 'excellent' water quality (Lake Onslow), one was 'good' (Lake Hayes) and three were 'poor' (Lakes Johnson, Tuakitoto and Waihola). All exceeded Schedule 15 limits for total phosphorus (TP). Lake Tuakitoto was the only small lake to exceed the *E. coli* limit. Compared to last year one site (Onslow) had improved two grades and two sites had dropped a grade.

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 (Orthoclaadiinae and Tanytarsini), although EPT species were also present, including *Deleatidium* mayflies.

Table 4: EPT, MCI and SQMCI scores

Site no.	CATEGORY	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				
10	Cardrona Mt Barker	21	10	108	6.5
43	Catlins River	24	14	113	6.3
20	Dunstan Ck	20	12	116	6.0
33	Heriot Burn	17	7	91	5.9
	Kaihiku Stream	18	7	74	4.5
72	Kaikorai Brighton Rd	9	2	73	1.7
50	Kakanui at Clifton	28	17	116	4.9
53	Kakanui at McCones	25	11	92	4.6
51	Kauru River at Ewings	25	15	119	6.0
83	Kye Burn at SH85	16	8	104	7.7
13	Lindis at Ardgour Rd	24	12	106	5.3
12	Lindsay Creek	18	4	79	3.3
11	Luggate Ck at SH6	19	13	108	5.6
	Manuherikia Blackst.	13	8	117	7.1
21	Manuherikia Ophir	16	8	108	7.0
7	Mill Creek Fish Trap	18	7	87	5.8
41	Owaka River	20	12	104	5.5
57	Shag at Craig Road	15	7	99	5.3
56	Shag at Goodwood	18	8	88	5.9
87	Silver Stream	16	6	98	3.9
	Sow Burn at Patearoa	22	12	114	7.4
73	Tokomairiro West Br	23	12	119	5.1
	Toko. Coal Gully	12	7	92	3.6
55	Trotters Creek	19	8	88	4.0
54	Waianakarua	22	12	114	4.2
52	Waiareka Creek	10	0	64	4.7
58	Waikouaiti River	19	8	88	3.3
32	Waipahi Cairns Peak	24	13	108	5.1
32	Waipahi at Waipahi	20	8	85	4.8
90	Waipori River	14	8	109	4.1
37	Wairuna River	20	7	82	3.7
38	Waitahuna River	14	9	111	6.8
36	Waiwera River	25	9	88	3.6
71	Water of Leith	27	11	96	3.0

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																			
		<i>Cocconeis</i> (D)	<i>Cymbella</i> (D)	<i>Diatoma</i> (D)	<i>Didymosphenia</i> (D)	<i>Epithemia</i> (D)	<i>Fragilaria</i> (D)	<i>Frustulia</i> (D)	<i>Gomphonopsis</i> (D)	<i>Gomphonema</i> (D)	<i>Melosira</i> (D)	Naviculoid (D)	<i>Nitzschia</i> (D)	<i>Rhoicosphenia</i> (D)	<i>Rhopalodia</i> (D)	<i>Stauroneis</i> (D)	<i>Synedra</i> (D)	<i>Tabellaria</i> (D)	<i>Closterium</i> (P)	<i>Cosmarium</i> (P)	<i>Pediastrum</i> (P)
10	Cardrona Mt Barker				2				2		2										
43	Catlins River	2							2	1	4	7									
20	Dunstan Ck							1													
33	Heriot Burn								3		4		3		2						
	Kaihiku Stream											2	2	1					5		
72	Kaikorai Brighton Rd								5	2			2	3				2			
50	Kakanui at Clifton		2		2	5			5	2	2	3	1								
53	Kakanui at McCones	2	2	3	7	1			3		2	3	3			6				2	
51	Kauru River at Ewings		1							7		1									
83	Kye Burn at SH85								2	2		3									
13	Lindis at Ardgour Rd		5									4	2				3				
12	Lindsay Creek	1										3	1				1				
11	Luggate Ck at SH6				2								3	2		1					
	Manuherikia Blackst.								1	2			2			1					
21	Manuherikia Ophir		3										2								
7	Mill Creek Fish Trap								3		1		2	2							
41	Owaka River	1		2						2		4	2								
57	Shag at Craig Road	2							3	4		3	2	2							
56	Shag at Goodwood			4					4		7		5				4	4			
87	Silver Stream		5							1	4	3	1								
	Sow Burn at Patearoa	2								2		3									
73	Tokomairiro West Br									3			6	2							
	Toko. Coal Gully									1		2	1								2
55	Trotters Creek		1								2	1									8
54	Waianakarua		8								3			3							6
52	Waiareka Creek									3											1
58	Waikouaiti River	2	3						6		2		4				5			2	1
32	Waipahi Cairns Peak										2		2	1							
32	Waipahi at Waipahi	2									8	4		1			2				
90	Waipori River											2					3	4			
37	Wairuna River									2		7	2	1						1	
38	Waitahuna River											2									
36	Waiwera River	2							2	3	1	5	3								
71	Water of Leith		3								2		5	4			1	2			

Table 5 (continued)

Site No.	Site	<i>Microspora</i> (FG)	<i>Mougeotia</i> (FG)	<i>Oedogonium</i> (FG)	<i>Rhizoclonium</i> (FG)	<i>Stigeoclonium</i> (FG)	<i>Ulothrix</i> (FG)	<i>Vaucheria</i> (FYG)	<i>Audouinella</i> (FR)	<i>Oscillatoria</i> / <i>Phormidium</i> (CY)	<i>Rivularia</i> (CY)	<i>Closterium</i> (P)	<i>Cosmarium</i> (P)	<i>Pediastrum</i> (P)
10	Cardrona Mt Barker					2			4		5			
43	Catlins River					1	2							
20	Dunstan Ck								5		2			
33	Heriot Burn								7					
n/a	Kaihiku Stream				2		2	5	3	1		5		
72	Kaikorai Brighton Rd													
50	Kakanui at Clifton	2		1						3				
53	Kakanui at McCones									3			2	
51	Kauru River at Ewings					3				2				
83	Kye Burn at SH85								3	2				
13	Lindis at Ardgour Rd		3							8				
12	Lindsay Creek		2				2							
11	Luggate Ck at SH6		2											
n/a	Manuherikia Blackst.	2							4	3	4			
21	Manuherikia Ophir								3	5				
7	Mill Creek Fish Trap								4					
41	Owaka River									6	4			
57	Shag at Craig Road								3	7				
56	Shag at Goodwood						4			5				
87	Silver Stream													
n/a	Sow Burn at Patearoa								2		4			
73	Tokomairiro West Br								3					
n/a	Toko. Coal Gully									6				
55	Trotters Creek													
54	Waianakarua									3				
52	Waiareka Creek					1				2				
58	Waikouaiti River									4			2	1
31	Waipahi Cairns Peak									2				
32	Waipahi at Waipahi									3				
90	Waipori River		3						3	4				
37	Wairuna River									1		1		
38	Waitahuna River								6	2				
36	Waiwera River	3		2	2					1				
71	Water of Leith													



Phormidium



Didymosphenia geminata



Mougeotia



Gomphoneis

D= diatom, FG= Filamentous green algae, FYG= Filamentous yellow green algae, FR= filamentous red algae, CY = Cyanobacteria, P= Phytoplankton

Fish monitoring:

Electric fishing was conducted in the summer of 2013 at 26 sites in 23 streams in Otago. Nineteen 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 (25 sites), longfin eels (17) and upland bullies (12). The greatest diversity and abundance of fish was observed at sites close to the coast, such as the Waianakarua River at Browns Pump (12 species) and the Waikouaiti at Orbell's (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	Torrent fish	Koaro	Inanga	Galaxias sp	Canterbury galaxias	Lamprey	Upland bully	Common bully	Bluegill bully	Redfin bully	Rainbow trout	Perch	Smelt	Brown trout
Cardrona Mt Barker*	10				6		4			177				61			4
Catlins River	33		16							2							43
Kaikorai Brighton Rd	72		16			17					57		39				16
Kakanui at Clifton	50	6			174			18		338							6
Kakanui at McCones	53	12		4		24					437	2090	25				3
Kye Burn at SH85**	83		4														18
Lindis at Ardgour Rd	13									835							36
Lindis at Crossing										223							2
Lindsay Creek	12		2			4											170
Luggate Ck at SH6	11													4			180
Mill Creek	7		4		10						840				58		63
Owaka River	41		6														34
Shag at Craig Rd	57	28	21						13	1695	3	8	16				2
Silverstream	56		8			39			3		11				112		8
Sow Burn																	139
Tokomairiro West Br	73	2	4						28	76			10				276
Trotters Creek Gorge													2				27
Trotters Ck at M***	55		3			87					66	1	2				1
Waianakarua	54	2	2	16	1	4		12	18		89	1034	6			2	
Waiareka Creek	52		2			2											2
Waikouaiti River	58	10	12			37			6		410	506	342			8	4
Waipahi Cairns Peak	31		10				2			57							16
Waipahi at Waipahi	32		2				1			2							3
Wairuna River	37	4	4				42			64							2
Waiwera River	36		3							24							151
Water of Leith	71									1			11				13

*2 Clutha flathead galaxias, **242 Central Otago roundhead galaxias, *** 1 Black flounder

Summary: Ecosystem health and water quality

Ecosystem health in Otago: To assess the state of ecosystem health, 34 sites were monitored for algae and macroinvertebrates, and 26 were monitored for fish.

- **Algae:** 21 sites contained the potentially toxic algae, *Phormidium*. The greatest abundance of *Phormidium* was found in the Lindis and Shag rivers. The Kakanui River had both *Didymosphenia geminata* and *Phormidium*.
- **Macroinvertebrates:** Macroinvertebrate monitoring showed that 53% of sites had 'excellent' or 'good' SQMCI scores, and 50% had 'good' MCI scores. MCI scores at four sites indicated 'poor' water quality, while the SQMCI scores of eight were 'poor'.
- **Fish:** Brown trout were found at 25 sites, longfin eels at 17 and upland bullies at 12. Clutha flathead galaxias, Central Otago roundhead galaxias and flounder were each found at one site, while Torrent fish, Canterbury galaxias, common smelt, perch and rainbow trout were collected at two.

Water quality in Otago: The water quality of 67 river and stream sites was assessed between July 2009 and June 2014; 25 had 'excellent' water quality, 19 'good', 9 'fair' and 14 'poor'.