

## Memo

Date	07/03/2018
To	Kaikoura Zone Committee
CC	
From	Kimberley Dynes

## Annual water quality indicator update to the Kaikoura Zone Committee

### INTRODUCTION AND PURPOSE

The purpose of this document is to provide an annual update for water quality and ecosystem health monitoring in the Kaikoura zone from.

The Canterbury Water Management Strategy (CWMS) Targets Report (2017) gives a high level overview of monitoring results across Canterbury. This paper presents more detail on the results from water quality and ecosystem health monitoring in the Kaikoura zone.

### WATER QUALITY INDEX

The water quality index used in the CWMS targets reporting is used to summarise routine physical and chemical water quality results into five-categories for river or stream sites. The water quality index compares raw water quality data to recommended water quality guidelines; taking into consideration the number of parameters that do not meet water quality guidelines, the frequency these guidelines are not met, and by how much, to derive a score from 1-100. This score is divided into five categories and ranked to give a single grade from 'very poor' to 'very good'.

The water quality index is intended to provide a summary of key water quality parameters; however it does not provide a detailed analysis of water quality data and should be used only as an indicator of overall water quality.

Parameters included in the index are: nitrate-and-nitrite nitrogen, ammonia-nitrogen, dissolved reactive phosphorus, dissolved inorganic nitrogen, total suspended solids and *Escherichia coli*.

Generally speaking, hill-fed and alpine rivers show better overall water quality index results than spring-fed streams on the flats (Table 1). In 2016-17, All alpine and hill-fed rivers were considered good or very good, while all spring-fed streams were considered fair. These spring-fed streams are susceptible to the influence of surface water run-off and upwelling groundwater. The post-earthquake influence is discussed more indepth for these sites in the memo titled '*Annual lowland streams water quality update to the Kaikoura Zone Committee*'.

**Table 1:** Water quality index for sites in the Kaikoura CWMS zone, July 2008 - June 2017

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Clarence River above river mouth				Very Good	Very Good	Very Good	Very Good	N/A
Clarence River at Molesworth Station				Very Good	Very Good	Very Good	Very Good	Very Good
Blue Duck Creek Above SH1	Poor	Fair	Fair	Fair	Poor	Fair	Fair	Good
Hapuku River SH1	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good
Kahutara River Above Ford Dairy Farm	Fair	Good	Good	Good	Poor	Very Good	Good	Very Good
Kowhai River SH1	Very Good	Very Good	Very Good	Very Good	Fair	Very Good	Very Good	Very Good
Okarahia stream SH1	Fair	Good	Good	Good	Good	Good	Good	Good
Lyell Creek Lagoon	Poor	Fair	Fair	Fair	Good	Fair	Fair	Fair
Lyell Creek Mills Road	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair
Lyell Creek SH1	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair
Warren Creek Rorrison's Rd	Poor	Fair	Fair	Fair	Good	Good	Fair	Fair
Middle Creek Beach Rd	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair

### LAKE TROPHIC LEVEL INDEX (TLI)

Canterbury's lakes are monitored for nitrogen, phosphorus and chlorophyll a. These three parameters are combined into a single index: the trophic level index (TLI).

The TLI scores are categorised onto different trophic states (Table 2). In very general terms the higher the TLI the poorer the water quality.

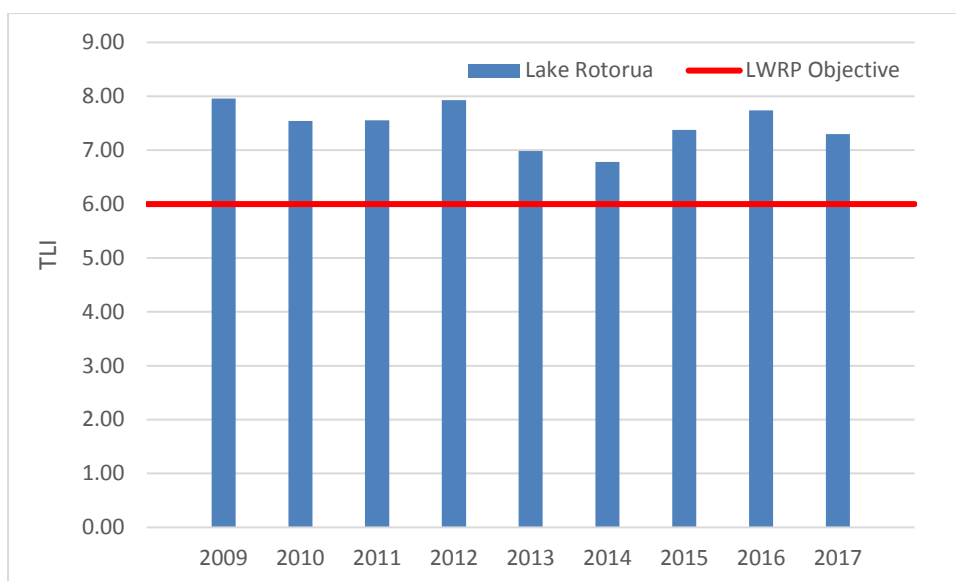
**Table 2:** Description of trophic states

TLI	Trophic state	General Description
<1	Ultra-microtrophic	practically pure, very clean, often have glacial sources
1-2	Microtrophic	very clean, often have glacial sources, very low nutrient enrichment
2-3	Oligotrophic	clear and blue, with low levels of nutrients and algae
3-4	Mesotrophic	moderate levels of nutrients and algae
4-5	Eutrophic	green and murky, with higher amounts of nutrients and algae
5-6	Supertrophic	very high nutrient enrichment and high algae growth
>6	Hypertrophic	saturated in nutrients, highly fertile, excessive algae growth

Lake Rotorua is classified as hypertrophic (Table 3). This site continues to be highly enriched in nutrients and phytoplankton biomass. The Land and Water Regional Plan objective of a TLI of 6.0 has not been achieved yet (Figure 1). Between 2007 and 2017 total nitrogen showed a significant increase. Total phosphorus, phytoplankton biomass and turbidity did not show any statistical change.

**Table 3:** Trophic level index for Lake Rotorua

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
TLI	7.96	7.54	7.55	7.93	6.98	6.78	7.37	7.74	7.30



**Figure 1:** Trophic Level Index for Lake Rotorua

## CONTACT RECREATION

The microbial quality of popular swimming sites around Canterbury is assessed each summer. Freshwater (rivers and lakes) and coastal (beaches and bays) sites are monitored each year to assess baseline conditions, trends and public health risks from contact recreation. This monitoring consists of the routine weekly collection of a water sample from each site, with the water then analysed for faecal indicator bacteria concentrations. The results are reported to Public Health agencies and Territorial Local Authorities (TLAs) at the end of the bathing season. During the bathing season, results that exceed single sample guidelines are reported as soon as possible to the relevant Public Health agency and TLA environmental health staff. In addition, the results are reported on Environment Canterbury's website, which is updated daily with the most recent results. Any site graded "fair" or better is considered suitable for contact recreation.

**Table 4:** Contact recreation grades for bathing sites monitored in the Kaikoura CWMS zone

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
<b>Mangamaunu</b>	Poor	Fair	Good	Poor	Poor	Very Good	Very Good	Very Good	Very Good	Very Good
<b>Gooches Beach</b>	Good	Good	Good	Good	Good	Fair	Fair	Fair	Fair	Good
<b>Armors Beach</b>	Fair	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good
<b>South Bay Beach</b>	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
<b>Peketa Beach</b>			Good	Good	Good	Good	Good	Good	Good	Good
<b>Lyell Creek Lagoon</b>	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor
<b>Kahutara River SH1</b>	Fair *	Fair*	Fair*	Fair*	Fair*	Fair*	Fair*	Fair*	Fair	Good

Since 2012-13, all sites have been considered suitable for contact recreation. The exception to this is Lyell Creek at the Lagoon. *E.coli* concentrations for this site are consistently high. While the Kahutara River is considered fair-good in terms of microbiological water quality, it

can experience temporary health warnings for the presence of cyanobacteria. This is discussed below in the cyanobacteria section.

## CYANOBACTERIA

Cyanobacteria can be either benthic (grows on substrate) or planktonic (cells are suspended in the water column). Certain species have the ability to produce cyanotoxins that may be harmful to humans and animals.

Environment Canterbury monitors rivers and streams for benthic cyanobacteria at freshwater recreational water quality sites. The Kahutara River has had temporary health warnings in the past due to moderate cover of the benthic cyanobacteria *Phormidium*. During this time, mats can detach from the substrate and float downstream and accumulate in the lagoon, where there is high risk of recreational users coming into contact with cyanotoxins associated with these mats. Details of benthic cyanobacteria warnings for the Kahutara River are provided in Table 5.

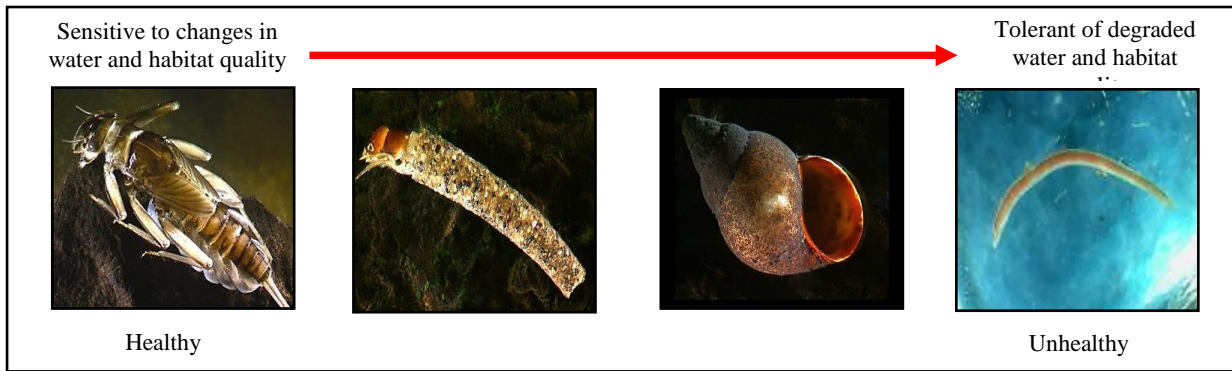
**Table 5:** Kaikoura warnings for potentially toxic cyanobacteria, July 2015-June 2017

Site	Warning	Date	Reason
Kahutara River at SH1/ Lagoon	Warning issued	27/11/14	23% cover of <i>Phormidium</i> , mats detaching and accumulating in lagoon
	Warning removed	21/1/15	<20% cover
	Warning issued	22/12/15	38% cover of <i>Phormidium</i> , mats detaching and accumulating in lagoon
	Warning removed	9/3/16	
	<b>Site was not sampled in 2016-17 as no access following earthquake</b>		
	Warning issued	30/1/18	20% cover of <i>Phormidium</i> , mats detaching and accumulating in lagoon
	Warning removed	Present	

Environment Canterbury monitors phytoplankton concentrations (including planktonic cyanobacteria) in Lake Rotorua. Protocols have been established with Community and Public Health and Christchurch City Council in accordance with MfE & MoH (2009), if thresholds are exceeded which indicate a potential health risk. The alert-level framework is based on biovolume thresholds derived from both total cyanobacteria cell counts and potentially toxic cyanobacteria cell counts. Lake Rotorua frequently exceeds public health trigger values. A permanent health warning is issued for this site.

## ECOSYSTEM HEALTH

Aquatic ecosystem health is measured by what is living in a stream. Invertebrates are a good indicator of aquatic health because they live in the water throughout the year and respond over time to changes in water quality, surrounding land use and their physical habitat. Different invertebrates have variable responses to water and habitat quality. Some species are more sensitive to degraded habitat and water quality and are therefore more likely to suffer from degradation; however other species are more tolerant and likely to be present in abundance when habitat and water quality is compromised. Analysis of the invertebrate data considers the numbers and types of taxa that are sensitive or tolerant to degraded water and habitat quality (Figure 2).



**Figure 2:** The invertebrate community gradually changes in response to degrading conditions. Invertebrates that are present in healthy streams are more sensitive to changes in water and habitat quality, than those that inhabit unhealthy streams

Changes in macroinvertebrate health are typically related to changes to stream habitat, water quality and/or water quantity. For example, elevated nutrient (e.g., nitrogen and phosphate) inputs may affect stream macroinvertebrates through toxicity, excessive aquatic plant growth leading to oxygen depletion and channel choking, or sediment entrapment. Stream health may also be influenced by stock access to the stream and bank erosion.

River flow is also a strong influencing factor on macroinvertebrate health. For example in dry years low flows can limit the macroinvertebrate community and favour certain taxa due to their greater tolerance for instream conditions such as warmer water temperatures or excessive periphyton growth. In contrast, higher flows help keep water temperatures down, prevent the build-up of fine sediment and streambed periphyton and generally result in a greater range of instream habitat for macroinvertebrates. However, flood flows may temporarily reduce macroinvertebrate diversity and abundance due to displacement and mortality. Macroinvertebrate community composition is not typically driven by one factor but a variety of factors over time.

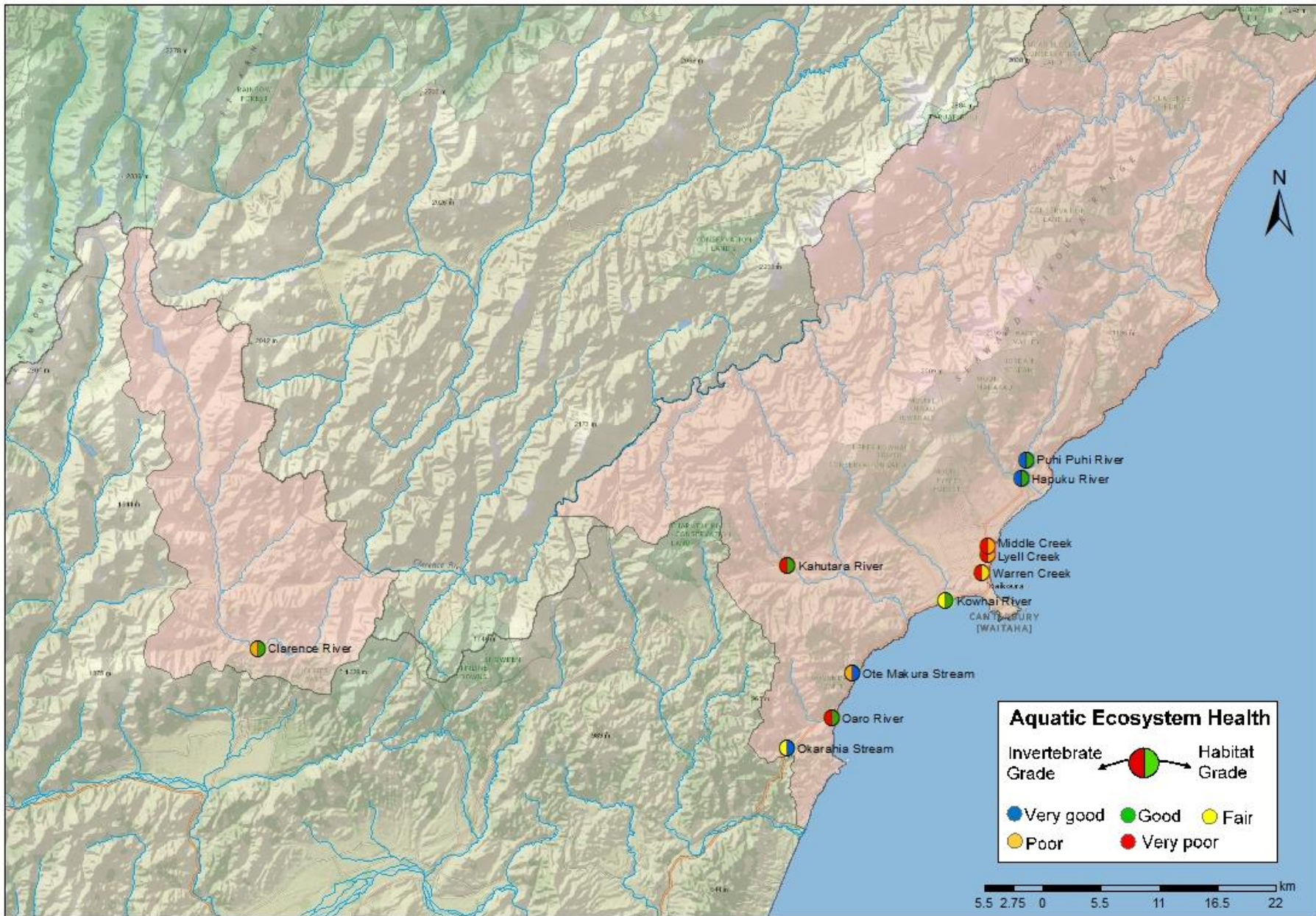
Figure 3 shows stream macroinvertebrate and habitat health grades calculated at Aquatic Ecosystem Health (AEH) monitoring sites during the 2016/2017 summer season. It is not uncommon for ecosystem health to vary between sites or over time within sites. Detailed information and graphs showing macroinvertebrate and habitat grades are presented in Tables 7 and 8.

Generally, macroinvertebrate communities on Kaikoura are healthiest in hill-fed streams, usually where riparian vegetation is dominated by native species. As with many of the river-type categories, the lowest ecosystem health scores in Kaikoura are generally found in the lowland spring-fed streams. These streams are susceptible to surface water run-off and a stable flow regime that does not allow for frequent flushing of the stream.

The discrepancy that is sometimes observed between macroinvertebrate and habitat grades (i.e., poor macroinvertebrate health grades but good habitat health grades) could indicate that there is only a couple of habitat parameters that are scoring low, thus if the majority of habitat parameters are scoring high there will still be a high habitat grade overall. This is important as it highlights that some habitat parameters, such as substrate embeddedness or sediment deposition, may have a greater direct influence on macroinvertebrate community composition,

than some other habitat parameters. Water quality is also an important factor in driving macroinvertebrate health and should also be considered.





**Figure 3:** Map of the Kaikoura CWMS zone, showing habitat and invertebrate grades for 11 sites sampled during the 2016/2017 season. Note that five sites could not be sampled during the 2016/2017 season due to the Kaikoura Earthquake in November 2017.

**Table 7:** Macroinvertebrate health grade category for the 2007/2007 to 2016/2017 period, Kaikoura CWMZ

SITE	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Clarence River Jacks Pass	NS	NS	NS	NS	NS	NS	Fair	Good	Very Poor	Poor	Poor
Clarence River SH1							Very Poor	Fair	Fair	Very Poor	NS
Blackmillier Stream SH1	Good	Very Good	NG	Very Good	Very Good	Fair	Good	Very Good	Very Good	Very Good	NS
Ohau Stream SH1	Good	Fair	Good	Very Good	Very Good	Good	Very Good	Very Good	Very Good	Very Good	NS
Blue Duck Stream Blue Duck Rd	Fair	Fair	Poor	Fair	Very Good	Fair	Fair	Very Good	Fair	Fair	NS
Puhi Puhi Stream Puhi Puhi Rd	Fair	Very Good	Very Poor	Very Good	Fair	Very Good	Poor	Very Good	Fair	Very Good	Very Good
Hapuka River SH1	NS	NS	NS	NS	Good	Very Good	Good	Very Good	Good	Good	Very Good
Middle Creek SH1	Good	Very Good	Very Poor	Very Poor	Very Poor	Very Good	Very Poor	Very Poor	Very Poor	Poor	Very Poor
Lyll Creek Mills Rd	Fair	Very Poor	Very Poor	Very Poor	Good	Good	Very Poor	Poor	Fair	Very Poor	Very Poor
Warrens Creek Rorrison's Road	Very Poor	Very Poor	Very Poor	Very Poor	Good	Good	Poor	Very Good	Very Good	Good	Very Poor
Kowhai River SH1	Poor	Very Good	Fair	Very Good	Good	Good	Poor	Good	Very Poor	Very Poor	Fair
Kahutara SH70	Poor	Poor	Very Poor	Very Good	Poor	Good	Very Poor	Very Good	Very Poor	Poor	Very Poor
Kahutara River Dairyfarm Rd	Fair	Poor	Very Poor	Very Good	Very Good	Very Good	Good	Very Good	Fair	Poor	NS
Ote Makaura Stream Valley Rd	Poor	Fair	Fair	Very Good	Very Good	Good	Good	Fair	Very Good	Poor	Poor
Oaro River SH1	Poor	Poor	Very Poor	Very Good	Very Good	Very Good	Good	Very Good	Very Good	Fair	Very Poor
Okarahia Stream SH1	Fair	Very Good	Very Poor	Very Good	Very Good	Very Good	Fair	Very Good	Good	Fair	Fair

Notes: NG = No grades calculated. NS = No sampling.



**Table 7:** Habitat grade category for the 2007/2008 to 2016/2017 period, Kaikoura CWMZ

SITE	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Clarence River Jacks Pass	NS	NS	NS	NS	NS	NS	Good	Good	Good	Very Good	Good
Clarence River SH1							Good	Very Good	Fair	Good	NS
Blackmillier Stream SH1	Good	Very Good	NG	Good	Good	Good	Very Good	Very Good	Very Good	Very Good	NS
Ohau Stream SH1	Very Good	Very Good	Good	Good	Very Good	Very Good	Good	Very Good	Good	Very Good	NS
Blue Duck Stream Blue Duck Rd	Very Good	Good	Fair	Good	Very Good	Good	Fair	Very Good	Good	Good	NS
Puhi Puhi Stream Puhi Puhi Rd	Very Good	Very Good	Very Good	Good	Good	Good	Good	Very Good	Good	Good	Good
Hapuka River SH1	NS	NS	NS	NS	Good	Good	Fair	Very Good	Good	Fair	Good
Middle Creek SH1	Good	Fair	Fair	Poor	Fair	Fair	Poor	Very Poor	Fair	Fair	Poor
Lyell Creek Mills Rd	Good	Fair	Good	Poor	Good	Fair	Poor	Poor	Poor	Good	Poor
Warrens Creek Rorrison's Road	Very Poor	Good	Good	Fair	Good	Fair	Good	Very Good	Good	Good	Fair
Kowhai River SH1	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Good	Good
Kahutara SH70	Good	Very Good	Good	Very Good	Good	Good	Fair	Very Good	Fair	Good	Good
Kahutara River Dairyfarm Rd	Good	Very Good	Very Good	Good	Good	Good	Fair	Very Good	Fair	Fair	NS
Ote Makaura Stream Valley Rd	Good	Very Good	Fair	Good	Very Good	Very Good	Good	Fair	Good	Good	Very Good
Oaro River SH1	Fair	Fair	Poor	Fair	Good	Good	Fair	Very Good	Good	Good	Good
Okarahia Stream SH1	Good	Good	Poor	Fair	Good	Good	Good	Very Good	Good	Good	Very Good

Notes: NG = No grades calculated. NS = No sampling.

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