Judges Report - 2019 River Awards

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What is the 'Most Improved River Award'?

Each year a "Most Improved River Award" is given for a river or stream showing the greatest improvement in a pre-determined measure of river ecosystem health at a specific water quality monitoring site. As in previous years, the award is based on the most improving *trend* observed in a selected water quality parameter over the last 10 years, rather than on its current state. This year, the judges shifted their focus from a single indicator to a measure that combines *E. coli* (water quality) and the Macroinvertebrate Community Index or MCI (biological health) as the basis for determining improvement. This change was made in response to feedback last year, which asked for a more holistic assessment of river ecosystem health, rather than a focus on just a single water quality indicator. Both indicators have been sampled by regional councils for more than a decade and sufficient data was available to allow for robust judging.

<u>What is *E. coli* and how does it get into our rivers?</u>

E. coli (*Escherichia coli*) is a type of faecal indicator bacteria commonly found in the gut of warm-blooded animals (including people). It naturally occurs in freshwater and is not usually harmful. However, high concentrations of this bacteria indicate faecal contamination. Water contaminated with faecal bacteria will likely contain pathogens such as viruses, bacteria and protozoa that can cause disease in people if they are swallowed or inhaled. These pathogens can also accumulate in some types of shellfish, posing a risk to people if eaten. *E. coli* is often correlated with other contaminants that affect ecological health such as sediment and nutrients, and faecal bacteria concentrations are typically highest in pastoral and urban streams. However, streams draining native forest areas are not totally free from *E. coli* because of faecal deposition by birds and wild animals.

Faecal contamination of waterways from animals can occur via runoff during rainfall events, point discharges, or via direct deposition if animals have direct access to waterways. Human faecal contamination can occur via leaky infrastructure, poorly treated sewage, septic tank systems, or via transport during heavy rain when sewerage systems cannot cope and overflow into stormwater systems. Because of the heightened health risks from sewage contamination via runoff and stormwater, people are often advised to avoid swimming for a couple of days after prolonged or heavy rain. Faecal contamination in water is generally monitored by councils every month and on a weekly basis during the bathing season (November – March).

<u>What can I do to reduce faecal contamination?</u>

The primary method to avoid faecal contamination is to reduce excessive *E. coli* inputs to our waterways. This can be achieved, for example, by upgrading our local sewage treatment plants and by keeping animals away from waterways through fencing, bridging of stock crossings and other suitable farm management practices.

What is MCI?

The macroinvertebrate community index, or MCI, is an indicator of the biological health of a river. It is based on the presence or absence of macroinvertebrates which are small animals without backbones that live on, or just below, the stream bed. Macroinvertebrates can generally be seen with the naked eye and often range from 0.25 mm to 15 cm - in the case of a fully-grown freshwater crayfish. Most are the larvae of insects but other groups such as snails, worms and crustaceans are also common. They play a central role in stream ecosystems by feeding on periphyton (algae), macrophytes, dead leaves and wood, or on each other. Benthic macroinvertebrates are extremely important for processing terrestrial and aquatic organic matter. In turn, they are an important food source for animals further up the food chain, such as wading birds and fish. When the insects become adults, they leave the water and become food for animals such as birds, bats, spiders, etc.

The MCI is based on the tolerance or sensitivity of species (taxa) to organic pollution and nutrient enrichment. For example, mayflies, stoneflies and caddis flies are sensitive to pollution, and are only abundant in clean and healthy streams, whereas worms and snails are more tolerant and can be found in polluted streams. Most benthic invertebrate taxa are assigned a tolerance value ranging from 1 (very tolerant) to 10 (very sensitive). Depending on what species are present (or absent) in a sample, a MCI score is calculated which ranges from <80 (stream is in poor ecological condition) to >119 (stream is in excellent ecological condition).

To effectively compare sites and consider long-term trends, it is important we sample macroinvertebrates during the same season each year (typically summer) as other environmental influences on invertebrate communities can affect the presence and number of animals. For example, the amount of freshwater algae can affect the kind of aquatic invertebrates that make up a macroinvertebrate community and river flows such as floods can wash animals out, reducing the numbers found. Invertebrates are generally not sampled within 2 - 3 weeks following a large flood to allow the macroinvertebrate communities time to recover.

What can I do to improve MCI?

Macroinvertebrates are an important part of river ecosystems. The species composition reflects the health of a waterway, so for sensitive species to be present, the river must be in good ecological condition and have excellent water quality and habitat conditions. Just like other stream ecosystem health parameters, macroinvertebrates are affected by pollution and habitat degradation. So, we need to make sure that the entire stream ecosystem is looked after, and any impacts reduced. For example, shading riverbanks which cool water temperatures or allowing organic matter such as leaves and wood to fall into the river to provide food or habitat are good starting points to improve the macroinvertebrate abundance and diversity.

The Judging Process

As in previous years, data to calculate trends for *E. coli* and MCI were derived from the Land, Air, Water Aotearoa (LAWA) website (www.lawa.org.nz) to determine the award winners in 2019 . LAWA is an online tool that displays state and trend information for over 1400 water quality monitoring sites throughout New Zealand. The current state of a monitoring site is based on median values calculated over the last five years, whereas trends in indicators have been calculated over the last ten years. Our judging process for the most improved river is strictly based on trends regardless of the state of a site. However, we have recognised the need to present information on the state of the winning rivers compared to other rivers around New Zealand. This information on the winning rivers is provided at the end of this report.

Council monitoring networks are often different for water quality and macroinvertebrate sampling, and some councils do not monitor macroinvertebrates at all, or have only started regular monitoring over the last ten years. Because we wanted to assess improvements for both indicators at the same location over a ten-year period, the number of sites that qualified for our assessment was significantly reduced. Often macroinvertebrate monitoring sites are closely located to water quality monitoring sites so we spatially searched for any sites that might be located on the same river but are part of different monitoring networks.

The data were then tested for seasonal effects and analysed with either a seasonal or non-seasonal version of the Mann Kendall Slope test to assess the probability and strength of trends in the data. The Mann Kendall probability value classifies a site into one of five categories (very likely degrading, likely degrading, indeterminate, likely improving, very likely improving). We only considered rivers for an award if they showed a very likely improvement ($p<0.10$) in *E. coli* concentrations *and* MCI scores over the last decade.

Overall, there were 116 sites nationwide that showed very likely improving trends for *E. coli* and 16 sites that showed very likely improvement for MCI over the full 10-year period (2009 – 2018). We did not discriminate on the basis of sampling frequency; most sites assessed for *E. coli* (69) had data collected at the preferred monthly interval throughout the 10-year period, while the remaining *E. coli* sites (47) had only quarterly measurements for at least part of the 10-year period. Macroinvertebrates are generally sampled once a year during summer and all 16 sites were included in our analysis.

The final check on a site's suitability for inclusion in the award list was made following discussions with the relevant Regional Council and other stakeholders. This ensured that changes in infrastructure, land management and/or restoration initiatives on the river had taken place to an extent that we agreed would have been consistent with the observed improvement in the *E. coli* concentrations and MCI scores. The "natural recovery" of MCI or *E. coli* concentrations following an event, such as commercial forest harvesting or an earthquake for example, was not considered to meet the criteria for 'improvement' in this process. As in previous River Awards it was occasionally challenging to clearly identify the initiatives responsible for observed improvements because improvements in water quality can arise from several interacting factors.

We also looked at trend results for other water quality indicators such as water clarity and nutrient concentrations at potential award-winning sites to see if there were multiple lines of evidence for improvement, or if other indicators show a different picture for these sites. All winning sites based on *E. coli* and MCI improvements also showed improvements in at least 2 other indicators over the same period.

This year, there were three contestants that qualified for the "Most improved river" award, however, one of the three rivers showed the greatest improvements in water quality and biological health over the last ten years and was awarded the overall winner. The other two contestants were recognised as finalists.

The three most improved rivers, showing the greatest improvement in both *E. coli* and MCI concentrations over the past decade at the sites specified.

	Site name	*E. coli* Annual improvement *(Sen slope)*	MCI Annual improvement *(Sen slope)*	Region	Also showed very likely improvements for
Winner	Waihopai River upstream Queens Drive	6.13%	1.94%	Southland	Water clarity, dissolved reactive phosphorus, ammoniacal nitrogen, total phosphorus, turbidity
Finalists	Mangatarere River at State Highway 2	3.91%	1.53%	Wellington	Water clarity, dissolved reactive phosphorus, ammoniacal nitrogen, total phosphorus, turbidity
	Avon River Manchester St/ Victoria Square	7.18%	1.40%	Canterbury	Total nitrogen, total oxidised nitrogen, total phosphorus

Of the three award winners, the Waihopai River showed the greatest improvements in *E. coli* concentrations and MCI scores over the last ten years. This was shown by the likelihood and strength of the trends calculated for both indicators. The Waihopai River also showed very likely improvements in five other water quality indicators (i.e., water clarity, dissolved reactive phosphorus, ammoniacal nitrogen, total phosphorus and turbidity).

Looking at improvements or degradations of water quality indicators over time is an important concept for assessing river ecosystem health. However, a key point to consider when looking at trends is what the current state of a particular site is in. This shows whether healthy sites are getting healthier or are degrading, and conversely, whether degraded sites are getting better or worse. The below table shows the state of our winning sites for each water quality parameter. State for all water quality parameters is based on the median calculated over the last five years and is shown in quartiles. This means a site with a state score of 1 is in the best 25% of sites compared to all other sites in the country, score 2 means in the best 50% of sites compared to all other sites in the country, score 3 means in the worst 50% of sites compared to all sites, and score 4 in the worst 25% compared to all other sites in the country. State for MCI is also based on the median calculated from data over the last five years, but state is assessed against an agreed assessment framework: excellent (MCI>120), good (MCI 100-119), fair (MCI 80-99) or poor (MCI<80).

River	*E. coli*	MCI	Black Disc	Dissolved Reactive Phosphorus	Total Phosphorus	Ammoniacal Nitrogen	Total Nitrogen	Total Oxidised Nitrogen	Turbidity
Waihopai	4	Poor	3	2	3	4	4	4	3
Mangatarere	3	Good	2	4	4	4	4	4	2
Avon	3	Poor	NA	3	2	4	4	4	1

Recommendations for future monitoring to support river award process

We strongly commend the current initiatives by regional councils and the Ministry for the Environment to improve the consistency of freshwater monitoring programmes across New Zealand. Regular monitoring is occurring at over 1400 freshwater monitoring sites across our country and the length of the data record has grown to more than 15 years at some of these sites. While this helps our judging process by providing suitable candidates for our awards, we also strongly recommend:

1) a continued focus on a holistic approach of river ecosystem health assessment. This means that a full understanding of river ecosystem health incorporates much more than just measurements of the quality of the water, but also includes the assessment of flow regimes, physical habitat structure, ecosystem function and the biological components of the river ecosystem.
2) increased focus on keeping a clear record of restoration efforts done in a region, such as length of riverbanks planted and fenced, amount of funding spent on restoration actions, etc. For the collected restoration data to be repeatable and measurable, the recording and reporting of actions related to water quality needs to be done in a consistent matter, following robust monitoring protocols.
3) including non-western scientific stream ecosystem health monitoring practices which reflect the thinking behind Te Mana o te Wai (the integrated and holistic well-being of the water) and ki uta ki tai (the emphasis on whole catchment approaches to understanding freshwater systems).
4) increased efforts to standardise the data collection and reporting processes for water quality monitoring by citizen science projects. These data can augment council's water quality data recording and reporting and will likely strengthen local stream ecosystem health assessments.

The judging of the River Awards is sometimes a challenge, but it provides motivation for, and recognition of the efforts being made to restore and protect our river environments in New Zealand. As such we see it as a very worthwhile task and hope to continuously improve the process in future years (feedback on the process is most welcome).

The 2019 judging panel