Otago Regional Council

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MEMORANDUM

To: Anita Dawe

From: Jason Augspurger and Tom Dyer

Date: 26/02/2024

Re: LWRP surface water quality programme regional summary

Purpose

The purpose of this memo is to summarize the surface water quality programme completed for the Otago Land and water regional plan (LWRP).

Context

Otago Regional Council (ORC) has developed a report suite to inform the new LWRP. These reports provide information for setting baseline, and target, attribute states (Whitehead 2018; Snelder and Fraser 2021; Neverman and Smith 2022a; Neverman and Smith 2023; Snelder and Fraser 2023; Augspurger 2024a; Augspurger 2024b). This reports suite also provides information on current state (Ozanne et al. 2023) and the magnitude of change that may be possible through good management practice (GMP) type scenarios on pastoral land uses (Sise et al. 2022; Neverman and Smith 2022b; Neverman and Smith 2023; Augspurger 2024b; Augspurger 2024c).

These reports contain a large amount of information, at various spatial scales, for multiple attributes. This memo aggregates results from the differing information sources and spatial scales to present a summary assessment of regional state and change potential under a mitigation type plan. This summary does not override results from other reports; it is provided as a brief overview of patterns present in underlying technical reports.

Comparison to the National Objective Framework (NOF) Tables

When compared to the attribute tables in the NPSFM (Ministry for the Environment 2020), headwater catchments tend to achieve higher grades (i.e., A-band) than lowland reaches. However, all FMUs have monitoring sites (Ozanne et al. 2023; Augspurger 2024a) and modelled segments (Whitehead 2018; Snelder and Fraser 2021; Snelder and Fraser 2023) which fail to meet the national bottom line for at least one attribute. When considering the major four contaminants (nitrogen, phosphorus, *E.coli* and sediment), *E.coli* is most often the attribute for which sites and segments fail to comply with the national bottom line. However, many FMUs have sites which also fail to comply with clarity bottom lines and the total nitrogen and total phosphorus nutrient criteria which provide for the periphyton bottom lines. This indicates measures which reduce loads of these contaminants are required (Augspurger 2024a).

Trends

While national bottom lines may be altered in future policy statements, trend analyses provide an assessment of long-term patterns present in each water quality attribute. Trend analysis is the preferred methods for investigating patterns or tracking whether sites are progressing toward meeting desired outcomes (Milne et al. 2023), and have well established standard procedures (Snelder et al. 2021). Trend analysis was included in the report suite to provide context on whether sites are improving or degrading across a 10- and 20- year period irrespective of bottom lines. Trend results determined for individual sites are presented in two reports (Ozanne et al. 2023; Augspurger 2024a).

Assessments of trends across spatial scales larger than a monitoring site are useful for evaluating pressures and patterns over broad areas (Snelder et al. 2022). To provide a broadscale picture on water quality trends in Otago, the site-based trends were statistically aggregated to both regional and river class levels (Snelder 2024).

The regional aggregation of trend results indicates that, over the 20-year trend period, both phosphorus and ammoniacal nitrogen levels are improving (i.e., decreasing). However, dissolved inorganic nitrogen, total nitrogen, *E.coli*, and turbidity are degrading (increasing). Over the 10-year trend period, the regional results indicate improving phosphorus, ammoniacal nitrogen, and turbidity. *E.coli* is likely to be degrading across the region and the outcomes from total nitrogen and dissolved inorganic nitrogen are uncertain. An uncertain regional trend result does not mean strong trends are not present as finer spatial scales. Instead, they mean there are sites, or areas, which have improving trends but there are also areas which have degrading trends.

While trend cause attribution is difficult (T.H. Snelder et al. 2022)[1], these patterns are consistent with national patterns indicating intensification. In the context of the current Regional Plan: Water (RPW, ORC 2004), increasing nitrogen and *E.coli* levels across the 20-year period indicate the plan has allowed water quality degradation and land use intensification. The 10-year results for nitrogen indicate that while some areas are likely improving, others are likely to be degrading (Ozanne et al. 2023).

When split by management class, hill class rivers (including those in the Dunstan and Manuherekia Rohe, and Taieri FMU) have nitrogen levels which are likely to be degrading over the 10-year period. This indicates that, in some areas of Otago, intensification is still likely occurring. Further, these patterns indicate the current water

[1] 10-year trend period are particularly difficult to interpret as climate variation can over-ride the signals from land use

plan will not stop similar intensification in the Upper Clutha and other headwater catchments where less intensification has occurred to date.

Improvement through mitigation scenarios

Under clause 3.13, the NPSFM states "to achieve the target attribute state of any nutrient attribute, and any attribute affected by nutrients, regional councils must also set, at a minimum, appropriate instream concentrations or exceedance criteria for nitrogen and phosphorus". To determine suitable nutrient levels in Otago, the nitrogen and phosphorus reductions required to comply with potential attribute bands in lakes, estuaries, nitrate toxicity and nutrients to periphyton biomass were modelled (Snelder and Fraser 2023). In general[2], periphyton biomass in river environments is the most limiting receiving environment modelled.

To help understand the magnitude of change required to achieve different periphyton target attribute states, different scenarios were compared. The reductions in nitrogen and phosphorus achieved through a good management scenario and a good management plus scenario were compared to the required nutrient reductions identified through modelling (Sise et al. 2022; Augspurger 2024b; Augspurger 2024c). These scenarios comprise a range of relatable hypothetical land use or behavioural scenarios intended to reduce the impacts of land use on water quality.

Results indicate reductions of nitrogen and phosphorus achieved through mitigation-based scenarios can appear large "on-land" (i.e. >20%), but are unlikely to result in multi-band changes to water nutrient levels (Augspurger 2024b). Instead, mitigation-based scenarios lead to within band improvements. For sites where trends are degrading, the within band improvement may be realised as reversing or halting a degrading trend. For sites which are currently improving, within band or between band improvements are more likely. A mitigation-based plan is therefore unlikely to "overshoot" if large improvements (i.e. multi-band improvements) in water quality are desired.

Sediment results are more varied, with some areas improving one to two bands whereas others improve within band (Neverman and Smith 2022a; Neverman and Smith 2022b; Neverman and Smith 2023). Notably, ORC has previously monitored turbidity. Turbidity generally correlates with the visual clarity attribute in the NPSFM. However, this relationship varies among sites and is often site specific. As there is insufficient overlap in monitoring data, turbidity is converted to clarity using a nationally derived equation. This calculation may lead to errors in estimation of both baseline and the mitigated load required to achieve the bands.

Improvement scenarios were not modelled for *E.coli*, as uncertainty is very high for load (Snelder and Fraser 2021), loss estimate, and mitigation potential.

While modelling indicates a mitigation-based scenario is unlikely to result in multi-band improvements, recent studies in areas where mitigations have already been

[2] In some catchments, estuaries or lakes may be a more limiting receiving environment. However, the modelling for estuaries and lakes carries large uncertainty in load reduction required (Snelder and Fraser 2023; Augspurger 2024b).

applied indicate rivers are now showing improving trends (Ozanne et al. 2023; McDowell et al. 2023).

Potential to reduce uncertainty

In the short to medium term (5-10 years), it is unlikely that uncertainties associated with these studies can be significantly reduced (Snelder and Fraser 2023). These types of assessments require long-term monitoring data. To reduce uncertainty, more sites with long records would be required. Therefore, while additional nuance may be added, the overall conclusions from the suite of studies are unlikely to change.

Conclusion

From the suite of reports related to surface water quality for the LWRP, we can conclude:

1. The current water plan has not stopped intensification in Otago. While some areas may be improving over the most recent 10-year period, others are degrading and there is potential for further degradation to occur. Therefore, to improve water quality, measures which stop further degradation are required regardless of whether sites fall below national bottom lines.
2. On-farm reductions achieved through a mitigation-based actions can lead to improvement in water quality. This improvement is expected to be realized as improvement in trend or within band improvement for nutrients and, in many locations, sediment.
3. In the short to medium term (5-10 years), it is unlikely that uncertainties associated with these studies can be significantly reduced. While additional nuance may be added, the overall conclusions from the suite of studies are unlikely to change.

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