

**Water quality impacts from
irrigation development in
the Hakatamea River
catchment**

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Combined volume of reports prepared
to evaluate water quality effects of
existing and potential irrigation in
the Hakatamea River catchment

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Water quality impacts from irrigation development in the Hakataramea River catchment.

Combined reports prepared to evaluate water quality effects of existing and potential irrigation in the Hakataramea River catchment.

Part 1: Executive Summary

Environment Canterbury commissioned this study to assess the effects of increased irrigation on the water quality of the Hakataramea River. This has followed a similar approach to that taken in the Upper Waitaki catchment. It is a desk top study and applies an initial approach to develop an understanding of what could happen to water quality in the Hakataramea River if further irrigation development is to occur in addition to the current irrigation. It also provides an assessment of what the water quality would be like if there were no irrigation of land in the catchment.

The study was made up of four pieces of work.

- 1- Environment Canterbury determined the extent of current and potential irrigation and identified the four scenarios.
- 2- Zemansky, White and Barrell – GNS Science Consultancy, took the 4 scenarios and estimated the impacts on nitrate nitrogen concentrations in soils.
- 3- McDowell – AgResearch Limited, took the 4 scenarios and estimated the loss of phosphorous (P) from agricultural landuse to surface water.
- 4- Norton and Rouse - NIWA, took the results of Zemansky et al, and McDowell and estimated the effect of the nutrient concentrations determined for each scenario on the Hakataramea River.

Irrigation

Environment Canterbury determined the existing and potential irrigation from searches of existing water permits and resource consent applications. Landowners, who attended a

meeting on the Waitaki Catchment Water Allocation Regional Plan in Kurow in November 2005, were asked to identify existing and intended irrigation areas on maps of the area following that meeting. Follow up phone calls were made to help clarify actual landuse practices. The irrigated areas were derived from this exercise and plotted onto maps. The areas plotted did not generally reconcile with the actual areas recorded on the consent data base. The area plotted for both the current and new irrigation (excluding the community scheme) was approximately 25% greater than the consented area. For the purposes of the assessments an adjustment was made to proportion the areas plotted, with the areas consented or being applied for. These adjustments are detailed in Tables 5.2 and 5.4 of Zemansky et al.

The four extent of irrigation scenarios developed were:

Scenario 1 – existing irrigated land uses (Area 2579 hectares)

Scenario 2 – irrigation of land that is currently economically viable to irrigate. This was assumed to be the existing irrigated land plus the area of land that was subject to resource consent applications for taking and using water for irrigation (except for the area proposed for the community scheme). (Area 3981 hectares)

Scenario 3 – all potentially irrigable land. This was assumed to be the existing irrigated land plus the area of land that was subject to resource consent applications for taking and using water for irrigation including the area proposed for the community scheme. Where the scheme overlapped areas mapped in Scenario 2 this land area was deducted to avoid double counting. (Area 17,084 ha i.e. above Wrights Crossing 11,766 hectares, below Wrights Crossing 5318 hectares.)

Scenario 4 – full dryland no irrigation. This assumed no irrigation in the catchment. It assumed all land was managed as dryland sheep farming. It only assessed the effects of this over the areas covered by the irrigation scenarios. Hence it was assessed for the areas covered by each of Scenarios 1, 2 and 3 and not for the entire catchment. The most useful

information that can be taken from this is the results for the community scheme option (i.e. the estimate of dry land farming over the 17,084 hectares). Zemansky et al, and McDowell report on all 3 options within Scenario 4, but Norton and Rouse only report on the third option covering the 17,084 area.

Estimate of nitrate-nitrogen losses to groundwater - summary

GNS Science modelled these four scenarios and developed estimates of nitrate leaching and water drainage losses. Nitrate-nitrogen concentrations in soil solutions were calculated assuming complete mixing. Such concentrations represent maximum nitrate-nitrogen levels at the point of entry to groundwater and would be diluted by natural upgradient groundwater flow.

The following nitrate-nitrogen and water drainage losses, respectively, for the above four scenarios, and calculated soil solution nitrate-nitrogen concentrations were estimated:

- Scenario 1, Current irrigation – 106 tonnes/year of nitrate-nitrogen and 3.2 million m³/year of drainage water. These estimates yield a mean nitrate-nitrogen concentration of 32.7 mg/L
- Scenario 2, New irrigation – 47 tonnes/year of nitrate-nitrogen and 1.4 million m³/year of drainage water. These estimates yield a mean nitrate-nitrogen concentration of 33.4 mg/L.
- Scenario 3, Community scheme irrigation – 537 tonnes/year of nitrate-nitrogen and 15.4 million m³/year of drainage water. These estimates yield a mean nitrate-nitrogen concentration of 34.8 mg/L
- Scenario 4, Dryland sheep –
 - a. Land currently irrigated – 14 tonnes/year of nitrate-nitrogen and 1.2 million m³/year of drainage water. These estimates yield a mean nitrate-nitrogen concentration of 11.2 mg/L

- b. Land to be irrigated in new consent applications – 6 tonnes/year of nitrate-nitrogen and 0.6 million m³/year of drainage water. These estimates yield a mean nitrate-nitrogen concentration of 9.77 mg/L
- c. Land for irrigation under current community scheme – 89 tonnes/year of nitrate-nitrogen and 5.6 million m³/year of drainage water. These estimates yield a mean nitrate-nitrogen concentration of 15.8 mg/L

Estimate of phosphorous losses to surface water - summary

The loss of phosphorus (P) from agricultural land to surface water has the potential to impair water quality. This work examined the likely P losses associated with 1) current irrigation consents, 2) new consents applied for 3) a “community irrigation scheme” and 4) dryland sheep farming in each of the three previous scenarios in the Hakataramea River catchment.

Data for total P losses ranged from 0.01 (largely under dryland sheep farming) to 0.09 kg/ha/yr. Among land uses, deer farmed land lost more P than sheep and beef farmed land with an equivalent slope, and dryland sheep farming lost the least amount of P of any land use. Mean losses of P in scenario 1 were 0.21 kg P/ha/yr, which was less than that lost in scenario 2 (0.30 kg P/ha/yr) but greater than for the community scheme (0.15) due to issues of connectivity and insufficient data to predict loads at points on the catchment’s river.

These losses are relatively small for catchments dominated by grazed pastures but reflect the proposed widespread use of low intensity sheep and beef farming, spray irrigation and flat topography. However, analysis emphasized the importance of irrigation on increasing the P losses by an order of magnitude above current dryland sheep farming, and hence, also emphasized the need for best management practices to be used where appropriate to decrease the potential for P loss.

Assessment of effects of increased nutrient concentrations in the Hakataramea

River - summary

The assessment indicates that the Hakataramea River currently exceeds at times all of the New Zealand Periphyton Guideline maximum biomass criteria for protecting visual aesthetic, benthic biodiversity, trout habitat and angling values. Periphyton biomass predictions for the existing land-use situation were about double the highest guideline criteria. Predictions indicate that if new water take consents were granted to all of those who have applied, except for the storage based community scheme (scenario 2), this could increase algal biomass in the Hakataramea River by about 20% over the existing situation. Irrigation on a community scheme scale (scenario 3) could increase algal biomass by about 60% over the existing situation. If all existing irrigated land and all potentially irrigable land in the catchment was converted to dryland sheep production (scenario 4), this could reduce algal biomass by about half from the existing situation.

Assumptions and biases

The predictions in this report have been based on a number of assumptions, some of which may lead to over-estimates of periphyton biomass while some may under-estimate biomass. Overall, the predictions are best considered as 'average' annual maximum biomass predictions - under different climate and physical habitat conditions the actual periphyton biomass observed can be expected to vary widely in both space and in time, being at times worse and at times better than predictions. The biomass predictions for the existing situation have been corroborated to some extent by actual biomass measurements and observations of periphyton blooms in the River in recent years. We consider these to be best estimates based on available data and methodology.

Conclusions

- Periphyton blooms that breach the New Zealand Periphyton Guidelines occur periodically in the Hakataramea River under the existing conditions. Current water abstraction is a contributor to this situation due to water use for irrigation leading to more intensive land use and lower flows in the river.
- Future land use intensification is likely to cause further breaches in the Guidelines, by increasing the nutrient loading and increasing water takes, leading to further changes in algae biomass and trophic state in the Hakataramea River. This could decrease the value of the River in terms of aesthetic, aquatic ecology, trout habitat and angling values.

- Whether these changes are acceptable is outside the scope of this report and will depend on the objectives for management in this catchment. The Proposed Natural Resources Regional Plan (PNRRP) has set water quality outcomes for this catchment.
- There are a suite of best land management practices (BMPs) that can potentially reduce nutrient losses from land to groundwater and rivers. Some examples are listed in this report. The effectiveness of these methods varies widely with quality of design and care in implementation, and will also be strongly influenced by nutrient loading rates and local conditions such as soils, climate, time-scale, and topography.
- We also note that *Didymosphenia geminata* (didymo), an invasive alga that became established in the lower Waitaki River in 2006, is not currently present in the Hakataramea catchment. If didymo did become established it would be likely to grow to biomass levels that exceed the New Zealand Periphyton Guideline thresholds under all scenarios.

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