



Science summary: Upper Lakes Rohe

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Introduction

The Upper Lakes Rohe defines the headwaters of the Clutha/Mata-au catchment, the largest catchment by area and water volume in New Zealand. The rohe contains the glacial lakes Wānaka, Hāwea and Wakatipu and their tributaries. It also incorporates the mountain ranges of the Southern Alps in the north and terraced valleys in the south.

The rohe is dominated by conservation land, with much of the remainder managed by high-country sheep farming. Over the last 30 years conservation land area has increased as indigenous forest and tussock grasslands became protected under covenants.

The urban settlements at Queenstown, Wanaka and Hawea are surrounded by low density urban-rural land use, and resident population has been increasing at a high rate since the early 2000's, and this growth is expected to continue.

Overall, there is a high degree of naturalness in the Upper Lakes Rohe, and as such, changes in land use have the potential to impact water quality both within the rohe and the rest of the Clutha/Mata-au catchment downstream. The rohe is also vulnerable to climate change impacts which may influence the amount of water and timing of water availability within the rohe and the downstream catchment.

Soils and land

The dominant land cover is tussock grasslands followed by indigenous forests and gravel/rock. The main soil type is brown soil, with podzols and raw soils accounting for a further quarter of the rohe, mainly in the north along the Southern Alps. Brown soils are well drained and ideal for forest and grasslands (both native and exotic). Podzols are found at high, wet altitudes over schist bedrock. Raw soils are found on steep, rocky slopes in the mountains and experience intense erosion.

Water quantity

The Upper Lakes Rohe has a steep rainfall gradient and the highest precipitation rates occur in the mountains at the northern edge of the rohe. These mountains drain to the alpine lakes which act as significant water reservoirs, the levels of which are higher in spring due to snowmelt. The Upper Lakes Rohe provides the majority of the flow to the downstream Clutha/Mata-au catchment.

ORC currently monitors flow at six sites within the Upper Lakes Rohe, with access to historical records at other sites, as well as sites monitored by NIWA. Hydrological modelling was completed to provide water allocation information for the un-monitored rivers and streams. The principal water use is non-consumptive hydro-electricity production, followed by water supply. There is very little irrigation use in the rohe.



Lake Wanaka from Mt Iron

Water quality

ORC runs programmes for monitoring water quality and ecology in rivers and streams. When the results from the two programmes are combined, they can indicate the state of the environment for a location. Water quality is monitored at twenty-three river/stream sites and three lakes, and ecological monitoring is undertaken at nine river sites in the Upper Lakes Rohe. Ecological monitoring is also undertaken at nine lake sites.

The results of this monitoring indicate that water quality within this rohe is the best in Otago. There are only a couple of streams within urban areas that experience high *E. coli* counts due to stormwater runoff and presence of wildfowl in the stream. Additionally, clarity is reduced in some of the glacier fed rivers, although this is a natural process. The lake monitoring sites at Wānaka, Hāwea and Wakatipu also have excellent water quality results.

Groundwater

Groundwater use in the Upper Lakes Rohe is generally low, with most water used for community and domestic supplies. The rohe contains two Ground Water Management Zones (GWMZ), composed of shallow alluvial aquifers, which are located around the townships of Glenorchy and Kingston.

ORC monitors groundwater quality in five bores across the two GWMZ. The data indicates some issues, with elevated *E. coli*, nutrients and arsenic levels. Elevated *E. coli* and nutrients are likely due to high septic tank density and shallow boreheads. Elevated arsenic is likely due to the local schist lithology (i.e., geologically sourced).

Biodiversity

The Upper Lakes Rohe has extensive freshwater biodiversity values, including rare and threatened ecosystems and species. Examples of rare and vulnerable ecosystems include ephemeral wetlands, braided rivers, and wetlands. These types of ecosystems contribute disproportionately to national biodiversity by having rare and threatened species; however, they are often threatened through pressures, such as land use change and invasive alien species. Although rare and vulnerable ecosystems are particularly sensitive environments to human activity, little is usually known about their extent and condition, including in the Upper Lakes FMU.

The Upper Lakes FMU has a diverse range of native freshwater fish, invertebrates, birds, plants, and a bat that depend on freshwater ecosystems. The seven native freshwater fishes include three non-migratory galaxias, one migratory galaxias (whitebait), one eel and two bullies. All the non-migratory galaxias are threatened. Freshwater invertebrates include freshwater crayfish and freshwater mussels.

A high proportion of native birds depend on freshwater ecosystems, either as permanent or transient (migratory) populations. Threatened birds include Australasian bittern, black-billed gull, blue duck, and southern crested grebe. Many plants are freshwater-dependent, including the threatened *Brachyscome linearis*, *Crassula peduncularis*, *Crassula multicaulis*, and *Carex strictissima*. The introduced sports fishes include brown trout, rainbow trout, and chinook salmon. Information is often missing at a species level, particularly for freshwater invertebrates, non-vascular plants, and algae. Many native freshwater species are under threat and continue to decline.

