



LINDIS CATCHMENT AND BENDIGO-TARRAS BASIN

**Information sheet
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BACKGROUND

Location

Located east of Wanaka and Luggate, north of Cromwell, west of St Bathans and Omarama, the Lindis catchment includes the areas of Ardgour, Tarras, Lindis Valley and the Lindis Pass. The catchment covers an area of 984 km² and is bounded in the north by Breast Hill, Little Breast Hill and Mt Melina, in the east by Dromedary Hill, Old Man Peak and Chain Hills, in the south by the Dunstan Mountains and in the west by the Clutha River/Mata-Au, Trig Hill and Grandview Mountain.

The catchment, shown in Figure 1, consists of a steep river valley, ranging in elevation from 220 m above sea level at the Clutha River/Mata-Au (Clutha) confluence, to 1,925 m at Mount Melina, in its higher reaches.

The main water body of the catchment, the Lindis River, flows 55 km in a south-westerly direction into the Clutha, about 6 km upstream of Lake Dunstan. Major tributaries of the Lindis River include Camp Creek, Cluden Stream and Breast Creek.

In its upper and middle reaches the Lindis River is a meandering stream wandering laterally across a single river channel. In its lower reach the Lindis River is of a braided alluvial nature and is very dynamic in nature.

The lower Lindis catchment overlaps with part of the Bendigo-Tarras Basin, a complex groundwater system that is strongly integrated with the flows in the Clutha and Lindis rivers. The Bendigo-Tarras Basin, shown in Figure 2, comprises four separate aquifers (also referred to in this Information Sheet as allocation zones), each of which is characterised by distinct hydrological properties.

Topography, geology and soils

The topography of the Lindis catchment varies from river flats along the banks of the lower reaches of the Lindis River to gently undulating and strongly rolling hinterland, further up the catchment. The catchment is characterised by its smaller scale compared to Central Otago's standard pattern of large-scale basin and range topography. The old erosion surface is warped into a set of north-east-trending folds, with elements of the overlying Manuherikia Group sediments. Haast Schist underlies most of the region and is often exposed as tors (rocky outcrops).

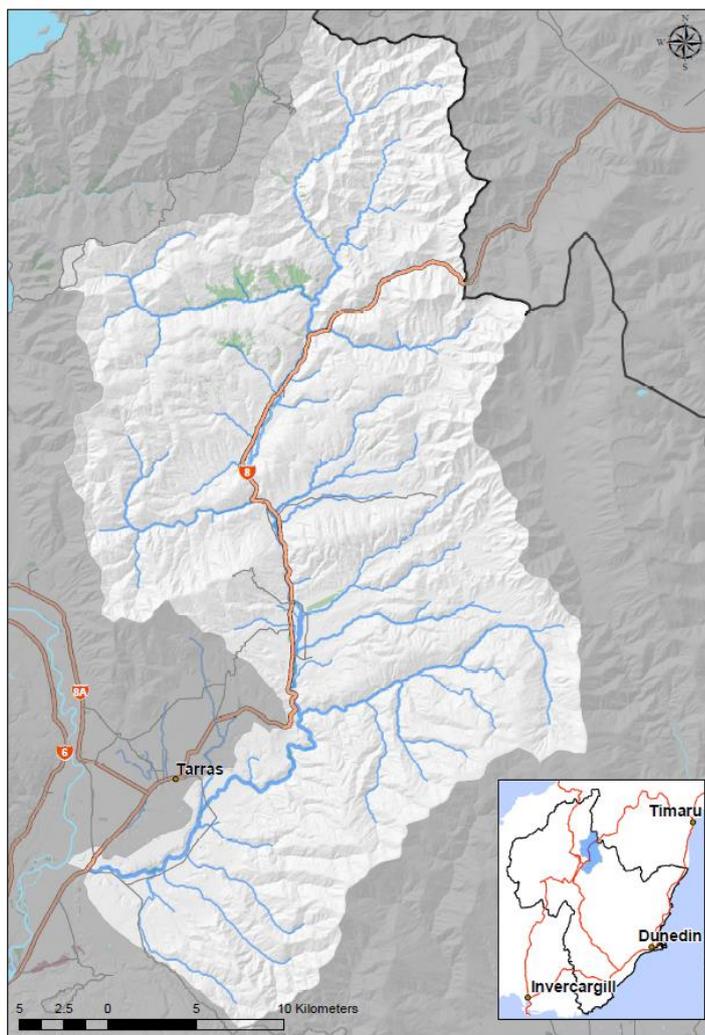


Figure 1. The Lindis catchment

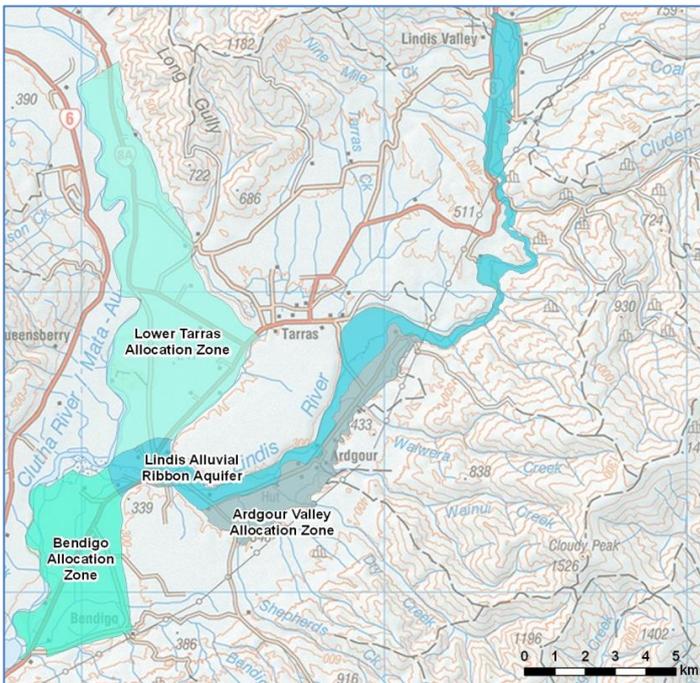


Figure 2. Aquifers of the Bendigo-Tarras Basin

Soils throughout the Lindis catchment are sandy and loam-based, with areas of low to moderate fertility. Soil types range from brown-grey earths in the driest zone (less than 500 mm of rainfall) and yellow-grey earths in the lower mountain slopes, to highcountry yellowbrown earths above 700 m. Increasing elevation is also associated with decreasing fertility, increasing acidity and leaching. The valley floors contain some areas of recent soils on the alluvium of flood plains and fans.

Morven Hills pastoral lease, which is largely encompassed by the Lindis catchment, contains two soil sites of regional importance (Chain Hills and Double Peak) and two of national importance (Dip Creek Beech and Dip Creek Totara).

Climate and rainfall

The headwaters of the Lindis River receive large amounts of rain and snow (800-1500 mm per year) during winter and spring. In contrast, the lower Lindis catchment is one of the driest areas in New Zealand, with low rainfall combined with high temperatures throughout summer. The Tarras rainfall site recorded an average of around 500 mm per year, with the minimum being about 300 mm per year. Figure 3 illustrates the modelled rainfall patterns for the catchment.

Monthly rainfall averages calculated from three local rainfall sites show that although averages differ between sites, the overall monthly rainfall trends are similar: the periods of highest average rainfall occur in the months of May and December, while the periods of lowest rainfall generally occur in February and June-July.

Land uses

With its dry climate and low availability of water, the Lindis catchment has traditionally been dominated by pastoral farming, particularly sheep (including merino wool) and beef farming.

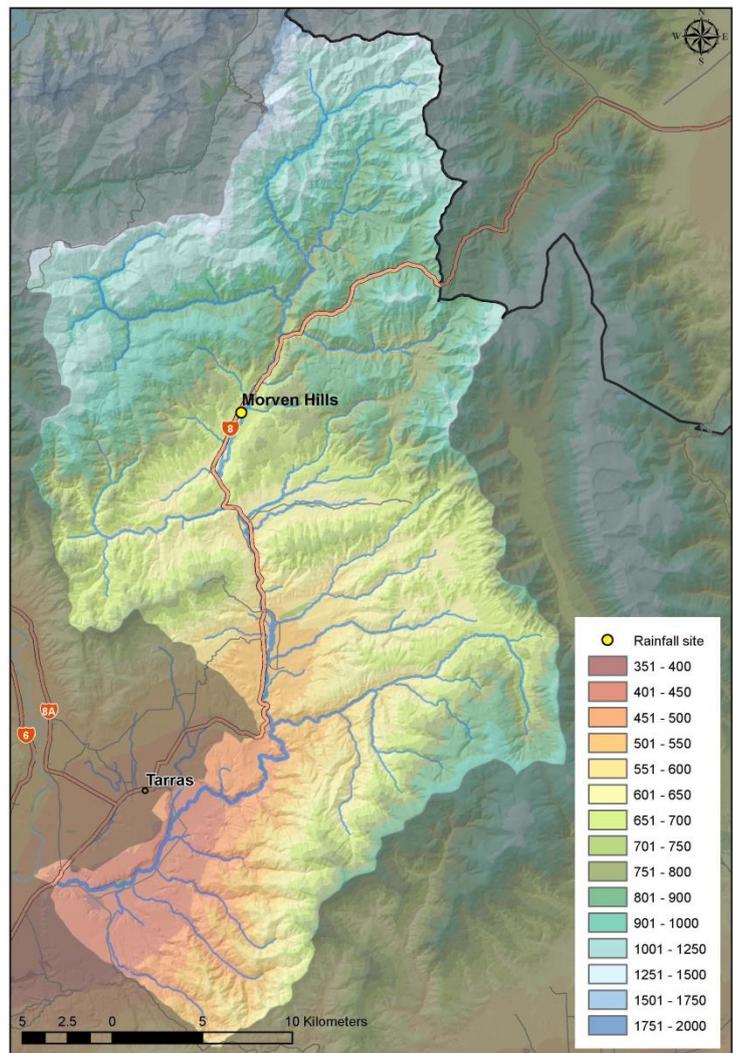


Figure 3. Modelled rainfall in the Lindis catchment

Within the area are a number of past and present Crown pastoral leases, including Morven Hills, Cluden, Cloudy Peak, Ardgour, the Lindis group (Shirlmar, Geordie Hills, Nine Mile, Merivale, Longacre and Timburn), Bargour, Forest Range, Rostriever, Breast Hill, Lake Hawea and Dalrachney Station.

More recently, the lower catchment and the Tarras and Bendigo areas have witnessed an increase in the number of life-style blocks and dairy-support operations. Deer farming and viticulture are also prominent, with more than 14 wineries located within the area. Other land uses include crop farming and horticulture (e.g. flowers and vegetables).

SURFACE AND GROUNDWATER HYDROLOGY

Hydrology and river-flow data of the Lindis River

The Otago Regional Council (ORC) maintains two permanent flow recorders on the Lindis River: one on Ardgour Road 3 km upstream from the State Highway 8 (SH8) bridge, and one further upstream at Lindis Peak. Figure 10 shows the location of both flow recorder sites.

The ORC has been collecting continuous hydrological information on the Lindis River from the Lindis Peak flow recorder since the mid-1970s. A second flow recorder was installed at Ardgour Road in 2005. A summary of flow statistics for these flow recorder sites is given in Table 1.

Table 1. Flow statistics for the Lindis River at the Lindis Peak and Ardgour monitoring sites

Monitoring site	Lowest recorded flow (l/s)	Mean recorded flow (l/s)	Mean annual low flow (l/s)
Lindis Peak - measured ¹	186	6,164	1,348
Ardgour Road – measured ²	94	5,427	252
Ardgour Road - naturalised ³	266	7,197	1,864

Flows in the Lindis River are generally high during spring, due to rainfall and snowmelt, but are greatly reduced during summer. During the non-irrigation season (May-September), flow patterns at the Lindis Peak and Ardgour Road flow monitoring sites are similar, with typically higher flows occurring at Ardgour Road. Figure 4 shows the low flow patterns at both flow monitoring sites.

The measured mean annual low flow (MALF) at Lindis Peak monitoring site is 1,348 l/s. However, measured low flows in the lower catchment at Ardgour Road monitoring site regularly drop below 250 l/s most years due to a combination of low natural flows, water taking and moderate losses to groundwater.

Historically, the Lindis Peak monitoring site has been used as a proxy for 'natural' flows for the entire catchment, as water taken from the Lindis River has a significant impact on the surface flows in the middle and lower reaches of the river during the irrigation season.

A hydrology study was undertaken by ORC in the period 2012 and 2014 to estimate the naturalised flows in the lower reach of the Lindis River. Using the flow records from the Lindis Peak monitoring site and six tributaries a naturalised MALF of 1,860 l/s has now been estimated for the Ardgour Road monitoring site. This is 16.5% greater than the previous MALF estimate of 1,600 l/s made in 2008.

¹ Term of record: 38 years

² Term of record: 9 years

³ The naturalised Ardgour Road flow was calculated by adding 50 l/s to the Lindis Peak flow to account for upstream takes, and then summing together the flows from six monitored tributaries.

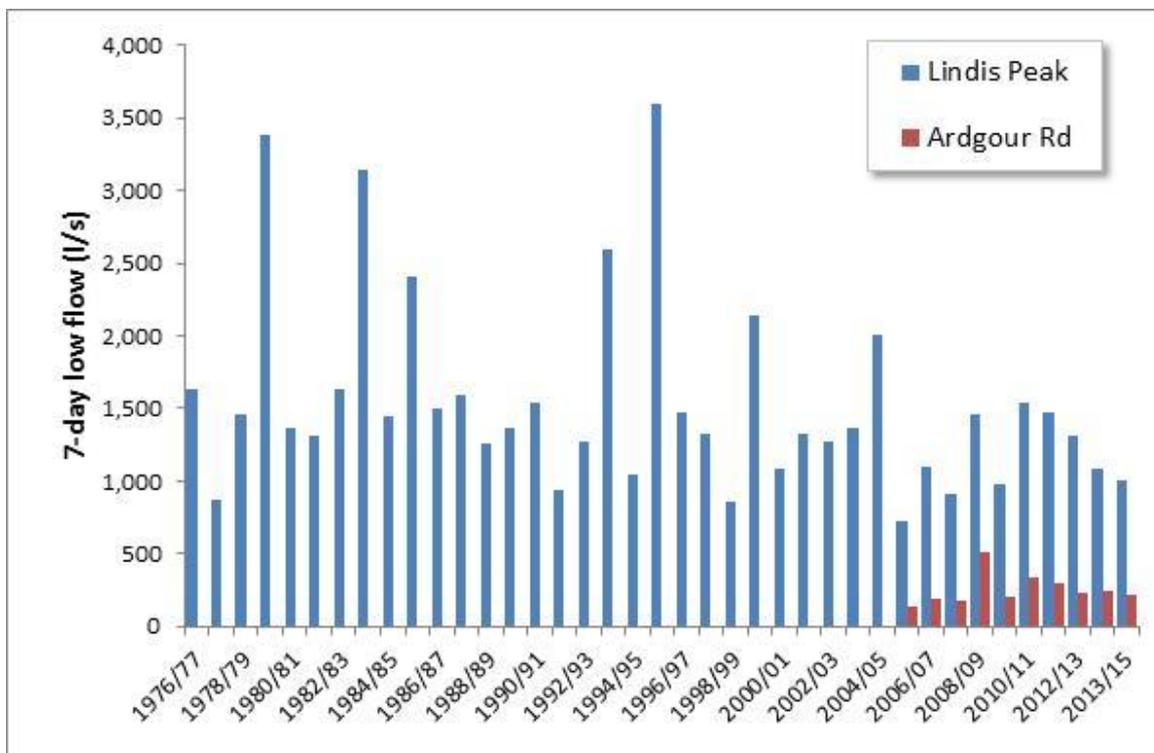


Figure 4. Low flow patterns in the upper (Lindis Peak) and lower (Ardgour Road) Lindis River

Figure 5 compares the flows at Lindis Peak (upstream of most surface water takes) and at Ardgour Road (downstream of most surface water takes) and shows the effects of taking on the river. Although the red line (the Ardgour Road flow) is above the blue line (the Lindis Peak flow) throughout winter and spring, during summer, flows at Ardgour Rd are well below those at Lindis Peak and can drop below 100 l/s in a dry year.

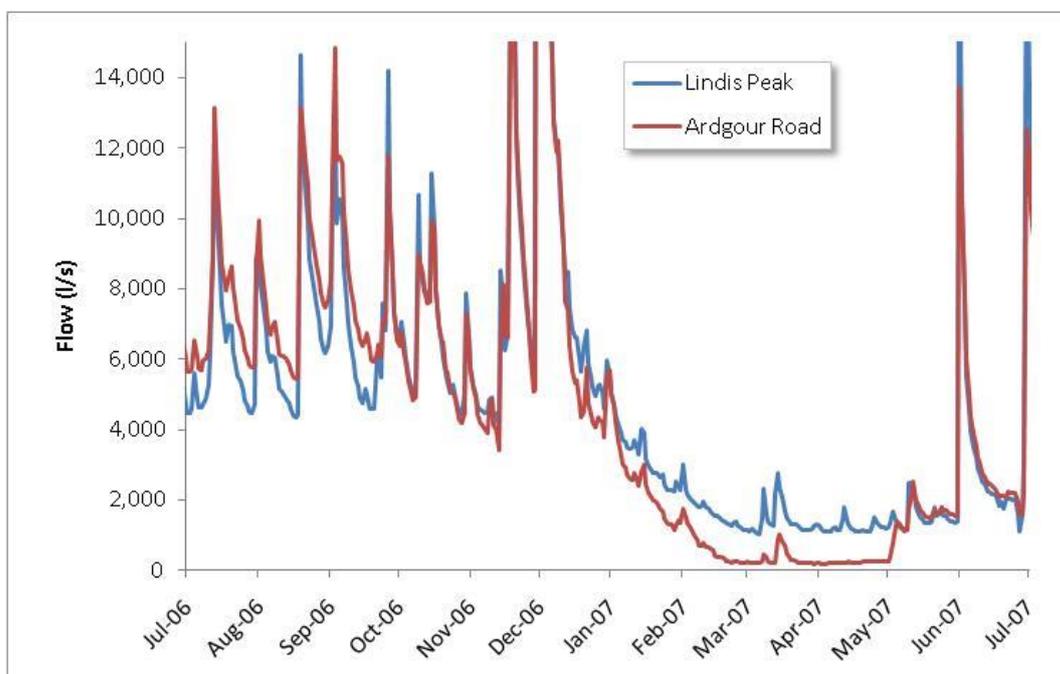


Figure 5. Comparison of the flows at Lindis Peak (upper catchment) and Ardgour Road (lower catchment)

Research suggests that under natural conditions the river would typically flow the entire way to the Clutha throughout the year. However, due to a combination of low natural summer flows, losses to groundwater and water abstraction, the Lindis River now generally flows intermittently upstream of the Ardgour Road flow recorder, and is completely dry between the SH8 bridge and the Clutha confluence, from January through to the end of April. In dry seasons the river can be dewatered for

nearly 2 kilometres immediately upstream from the Clutha confluence, while the amount of dry river bed along various sections of the river upstream of the SH8 bridge can total up to 3 kilometres.

Groundwater hydrology

Four aquifers can be found within the Bendigo-Tarras Basin and the Lindis Valley. These include:

- the Lower Tarras and Bendigo Aquifers, which are both located on the eastern banks of the Clutha;
- the Lindis Alluvial Ribbon Aquifer, which follows the Lindis River from Lindis Valley to the Clutha confluence; and
- the Ardgour Valley Aquifer, located along the eastern side of the lower Lindis Alluvial Ribbon Aquifer between Thompson Gorge Road and The Point.

The Clutha is the dominant source of recharge for the Bendigo and Lower Tarras aquifers. These aquifers also receive a modest volume of land-surface recharge from rainfall and infiltration from irrigation and smaller surface streams. Land-surface recharge occurs sporadically and requires large rainfall events to saturate soils and to create the potential for aquifer recharge. In the summer months, irrigated land contributes significantly more recharge than non-irrigated land, due to irrigated soils having a lower initial moisture deficit when rainfall occurs.

The Ardgour Valley Aquifer receives most of its inflows through land surface recharge, whereas the Lindis Alluvial Ribbon Aquifer hydrology is dominated by the Lindis River.

Groundwater development has been concentrated in the Bendigo Aquifer, where the presence of a zone of higher permeability sediments associated with an old Clutha river channel allows the aquifer to respond to increased groundwater abstraction with increased infiltration from the Clutha. Permeability in the Lower Tarras Aquifer is generally lower and significant groundwater development has not occurred in this aquifer, except in locations close to the Clutha where higher permeability gravels occur.

Interaction between groundwater and the Lindis River

The Lindis River strongly interacts with the Lindis Alluvial Ribbon Aquifer. The Lindis River is the most important source of recharge for this aquifer, but at times the aquifer discharges water back into the Lindis River.

Below the SH8 bridge the Lindis River consistently loses surface flow to groundwater all year round, while the river upstream of the SH8 bridge has both gaining and losing reaches.

During winter and spring, when snowmelt and rainfall in the upper catchment replenishes the shallow aquifer, the river upstream of the SH8 bridge is generally a gaining reach (Figure 6:A), gaining flow due to naturally high groundwater levels. As summer progresses and groundwater levels gradually decline due to pumping and natural drainage, the river between the SH8 bridge and the Ardgour Road bridge and upstream from the Ardgour Road bridge begins to lose water to groundwater (Figure 6:B). As the groundwater levels in the lower Lindis catchment continue to decline over the irrigation season, the reach between the SH8 bridge and the Ardgour Road bridge becomes disconnected from the aquifer (Figure 6:C).

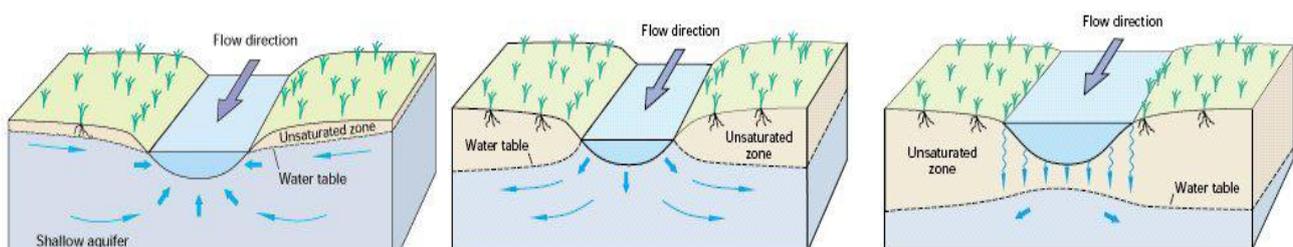


Figure 6. (from left to right): Gaining reach (A) connected losing reach (B) disconnected losing reach (C) (Winter et al., 1998)

The most significant losing reaches are likely to occur at low flows during summer below the Ardgour Road flow monitoring site, above Ardgour Road bridge, and especially downstream of the SH8 bridge.

The rate of flow losses to groundwater is likely to vary depending on the groundwater level, the degree of connectedness between the river and the underlying aquifer, the wetted perimeter and permeability of the river bed. Groundwater takes from the Lindis Alluvial Ribbon and Ardour Valley Aquifers also contribute to stream depletion in the Lindis River downstream from the SH8 bridge.

In 2007-2008, in a situation of low surface flow conditions, the rate of flow loss to groundwater in the 3 km long river stretch between the Ardgour Road flow monitoring site and the Clutha confluence was estimated to be 440 l/s. More recent observations carried out in January 2015 indicated that at times the rate of surface flow loss to groundwater over the same stretch of river can be as much as 550 l/s.

Flooding

Flooding occurs in various locations along the length of the river. Mostly it is observed between Morven Hills and Black Bridge, on Goodger Flat and the flats below Elliots Bridge and, further downstream, near Ardgour Road bridge. In recent decades, flood flows have been experienced in 1983, 1987, 1995, 1999 and 2009.

The Lindis catchment is also subject to thunder plumps. These are short but violent downpours of rain in connection with thunderstorms that usually occur in the early evening and tend to cause extreme damage.

Bank erosion occurs along the entire length of the Lindis River, while fence damage and stock losses during flooding events have also been considerable. One of the main problems associated with flooding in the area is the isolation of private properties and communities due to the inundation of roads or damage to transport infrastructure. Flood mitigation works, such as willow clearing, shoal removal, protection planting and the construction of minor flood banks, have been undertaken in various locations along the river.

NATURAL VALUES AND CATCHMENT ECOLOGY

The Lindis River and its tributaries support a rich ecosystem that provides habitat for a range of native plants and animals.

Schedule 1A of the Regional Plan: Water for Otago (Water Plan) recognises the value of the Lindis River as important habitat for eels, trout, trout spawning and juvenile retention. The river is also recognised within the Schedule for its gravel bed composition and for being free of aquatic weeds, although its lower reaches are now infected with *Didymosphenia geminata* (didymo).

Fish

The Lindis River provides spawning and juvenile brown trout habitat is regarded by many as playing an increasingly important role for juvenile recruitment to the nationally important Lake Dunstan and Upper Clutha fisheries, especially in light of the reduced river flows and the proliferation of didymo in many Central Otago rivers. The middle and upper reaches of the river also support a small adult brown trout fishery, despite flow levels naturally falling below those required for optimum adult trout habitat.

Isolated populations of the Clutha flathead galaxiid can be found in tributaries where high gravel bed movement provide for favourable environmental conditions and where these native fish are protected from trout predation by natural and human-made trout migration barriers. The Clutha flathead galaxiid, which is classified as "Nationally Critical", is endemic to the region and its distribution is currently confined to a small number of creeks and streams in the upper Clutha system.



Figure 7. Fish kill in the lower Lindis River

Other native fish species present in the Lindis River and its tributaries include common bully, upland bully and longfin eel. Longfin eel is listed as 'In Decline'.

An important aspect of the current hydrology of the lower Lindis River is the sudden reduction in surface flows once irrigation begins in the middle reaches. This event has led to annual fish kills such as those observed in February 2008 (Figure 7).

It is likely that the dewatering and subsequent fish kills observed in 2008 have occurred consistently in the lower Lindis River downstream of the SH8 bridge since the time when large surface water takes started to have an impact on the catchment hydrology.

Flora

The vegetation of the Lindis catchment comprises higher-altitude snow tussock, developed mid-altitude short-tussock grasslands, communities of lower-altitude scabweed and high-producing exotic grasslands on the alluvial flats. In the Morven Hills area, the hill-slopes are dominated by exotic grass species, with fescue tussock becoming common as altitude increases. The gullies and some hill-faces contain shrublands, where sweet briar is prominent.

Notable vegetation includes the 'nationally endangered' sedge, *Carex inopinata* and the wetland herb, *Triglochin palustris*, also nationally endangered. The 'nationally critical' forget-me-not, *Myosotis cheesemani*, the climbing broom, *Carmichaelia kirkii*, and the dwarf broom, *Carmichaelia vexillata*, in 'serious decline', is found in the Cluden Station area. Within the Lake Hawea pastoral lease, there are also two populations of the 'nationally vulnerable' shrub, *Hebe cupressoides*, and two populations of the tree daisy, *Olearia fimbriata*, in 'serious decline'.

Invertebrates

The Lindis catchment contains a diverse invertebrate community, dominated by mayfly, stonefly and caddisfly, as well as pollution-tolerant taxa such as midges and worms.

The rare moth, *Pseudocoremia n.sp.* "Olearia", which is in 'serious decline', can be found in the Morven Hills area, while the 'nationally endangered' moth, *Asaphodes stinaria*, is present in the Cluden area.

Reptiles

Otago skinks ('nationally critical') have been observed at several sites: Trig. P Dip Creek, lower Farmers Gully, Upper Farmers Gully, Hogget Block and G-Mars, near Deep Creek; Glenfoyle and Sandy Point. Grand skinks ('nationally critical') have also been observed on the Forest Range and Rostriever properties and the Lake Hawea pastoral lease.

Other reptiles present in the catchment include McCann's skinks, common skinks, cryptic skinks, Southern Alps geckos, common geckos, Cromwell Gorge geckos and Roys Peak geckos.

Birds

The Lindis River supports various species of waterfowl and wading birds, including the endangered black fronted tern, which has been observed below the SH8 Bridge, paradise shelduck (putangitangi), black shag (kawau), black-backed gull (karoro), South Island pied oystercatcher (torea) and spur-wing plover. Other birds that have been identified in the catchment include the rifleman (titipounamu), grey warbler (riroriro), fantail (piwakawaka), New Zealand falcon (karearea), harrier hawk (kahu), pipit

(pihoihoi), silvereye (tauhou), welcome swallow, sparrow, blackbird, quail, chaffinch, yellowhammer, California quail, starling, magpie and chukor.

Two bird species are of particular significance: wild emus and the eastern New Zealand falcon. Emus have been spotted with their young in the area, which may be the first instance of this species breeding in the wild in New Zealand. The New Zealand falcon ('gradual decline') has been observed in the Morven Hills area.

Water quality

Water quality in the Lindis River is monitored at the Lindis Peak and Ardgour Road flow-monitoring sites. The water quality at Lindis Peak is classified as 'excellent', meaning that the river meets all water-quality limits introduced by Plan Change 6A (Water Quality), while the water quality at Ardgour Road is classified as 'good', because it meets all limits except nitrate-nitrate nitrogen. Notable trends in the water quality of the Lindis River (2006-2011) are an increase in total nitrogen and a decrease in total phosphorus in the lower Lindis (Ardgour Road). There has been no significant change in water quality parameters at the Lindis Peak monitoring site over this period.

In the summer of 2011/12, the Ardgour Road monitoring site had a Macroinvertebrate Community Index (MCI) score of 109, which is an indication of 'good' water quality.⁴

COMMERCIAL, SOCIAL AND CULTURAL VALUES

The water resources of the Lindis catchment and the Bendigo-Tarras Basin play an important role in supporting the economic, social and cultural wellbeing of the local and wider community.

Water takes from these water resources provide for a variety of uses, including domestic and communal water supply, stock water supply, winemaking, frost fighting and pasture irrigation. The river also supports active and passive recreational activities and plays an important role in the spiritual beliefs and cultural traditions of Kāi Tahu.

Economic/commercial values

Irrigation

Various economic activities in the Lindis catchment rely on the physical and aesthetic qualities of the Lindis River.

Farms and wineries are heavily dependent on the availability of water from the Lindis River for irrigation, frost fighting and stock water and without a reliable supply of water the economic viability of these businesses reliant on irrigation water would languish and become vulnerable to drought events. In early 2015 the total size of the irrigated area in the wider Lindis area was estimated to be around 3,000 ha. Comparison with historic data reveals that the size of the irrigated area has increased significantly in the last decade due to the shift from traditional irrigation methods, such as flood and border dyke irrigation, to spray irrigation.

More than 4,000 l/s is currently allocated from the Lindis River and its connected groundwater resources. Information provided by local irrigators in 2014 suggests that generally no more than 2,300 l/s is actually taken from the river. Most irrigation seasons the amount of water that can be taken from the river is even less, as the water deficit gradually increases throughout summer. Water availability is therefore often reduced to 70 to 75% or less, especially when water is taken under a deemed permit with low priority.

The low reliability of water supply from the Lindis River combined with the growing size of the area under irrigation has encouraged various irrigators in recent years to shift towards more reliable sources of water supply, such as the Clutha or the aquifers in the Bendigo-Tarras Basin. The volume of groundwater allocated from these water sources is currently estimated to be well over 14 Mm³/yr.

⁴ The MCI categories are: poor: less than 80; fair: 80–99; good: 100–119; excellent: greater than 119

While efficient irrigation systems such as K-line and centre pivot are becoming widespread, traditional flood and border dyke irrigation are still a common irrigation practice, particularly in the mid and upper catchment.

The availability of irrigation water for the agricultural sector in the Lindis River makes a sizable contribution to the local and regional economy through on-farm employment and by supporting associated industries such as agricultural contractors and primary-processing industries. BERL Economics (2015) estimated the value added impacts from the use of water from the Lindis for irrigation for the local economy to be NZ\$1.75 million, but also noted that economic productivity in the Lindis is already constrained by substantial fluctuations and natural restrictions in water availability. When considering indirect and induced effects for the wider region, irrigation from the Lindis contributes up NZ\$4.3 million to the Central Otago economy.

Tourism

The growth of Central Otago as a holiday destination has also stimulated the local tourism industry. The scenic Lindis Pass route (State Highway 8), which follows the Lindis River for a considerable distance, is now a popular tourist route linking the Mackenzie basin with Central Otago and the Southern Lakes Region. The route brings many domestic and international tourists to the Lindis area, boosting revenue for the small number of tourist oriented shops, food outlets, hospitality businesses and recreational activity providers in the Tarras area.

Iwi values

Water occupies a significant role in the spiritual beliefs and cultural traditions of Kāi Tahu, and the health of water bodies and the condition of water is of particular consideration. The spiritual or cultural beliefs, values or uses associated with water bodies of significance to Kāi Tahu in Otago are identified in Schedule 1D of the Water Plan.

Schedule 1D recognises the relationship Kāi Tahu have with the Lindis River, its waahi taoka values (treasured resources that are valued and reinforce the special relationship Kāi Tahu have with Otago's water resources), its healing and health giving powers (rongoa) and its role in providing cultural materials (traditional weaving materials, such as raupo and paru, and medicines).

The Lindis River was an important source of mahika kai for Maori on the inland route that led from Lakes Hawea and Wanaka over the Lindis Pass to the Waitaki River. The usual route is noted as following Longslip Creek from the Ahuriri River, down the Pass Burn to the Lindis River and then over Mount Grandview to Lake Hawea.

The river contains tuna (long-fin eel), a recognised taoka species for Kāi Tahu that forms a key component of their tribal identity. For Kāi Tahu the increasing loss of mahika kai areas and species in the wider region has heightened the importance of protecting those that remain.

Kāi Tahu promote a holistic and integrated approach to the management of the water resources in the Lindis River in order to provide for aquatic ecosystems, natural character, cultural and recreational values over the entire length of the river. Kāi Tahu has indicated that the lack of flow continuity limits their ability to develop a meaningful relationship with the river.

Historic value

The Lindis area was the site of the first gold rush in Otago when gold was found in the Lindis River in 1857. Road builders rediscovered gold in 1861, and about 300 gold-miners flocked to the area. Although the remoteness of the area, the cost of supplies and the opening of more lucrative fields (such as Gabriel's Gully, near Lawrence) meant most miners left the district a few months later, a number of historic sites, buildings and artefacts remain today throughout the catchment as testimony to the area's mining heritage.

The Lindis Pass is also the site of the release of the first red deer (*Cervus elaphus scoticus*) in Otago. The herd flourished due to a lack of predators and competition. These deer, now the only remaining pure British red deer in the world, are widespread, but are under threat from interbreeding with escapee farm deer.

Various heritage sites are scheduled in the Central Otago District Plan, including the historic buildings in Morven Hills, the Cob Stables at Rocky Point, the ruins of the Lindis Pass Hotel, originally

constructed in 1873, and the 1,085 ha Bendigo Historic Reserve, with its wide range of relics from the hard-rock and quartz mining days. There are also many unscheduled, yet identified, historic sites, most of which are protected under the Heritage New Zealand Pouhere Taonga Act 2014.

Recreational value

The Lindis River supports various outdoor and water-based recreational activities, such as trout angling, eeling, hunting, motorcycling, four-wheel driving, swimming, horse riding, kayaking, tramping, picnicking, camping, mountain biking and walking.

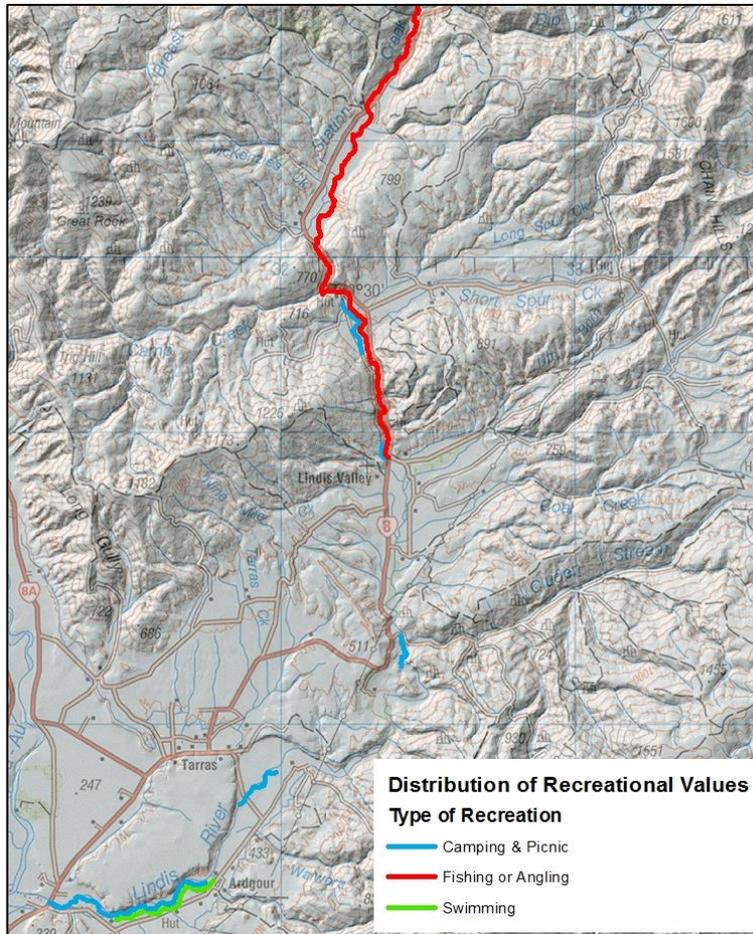


Figure 8. Recreational values supported by the Lindis River

An angler survey undertaken in 2007/08 (Unwin, April 2009) showed that the number of anglers in the Lindis, between October and January, increased from 150 in the 2001/02 season to 330 in the 2007/08 season. During the same period, the number of anglers recorded fishing in Lake Dunstan increased from 19,480 (2001/02) to 26,140 (2007/08). These figures show that fishing remains an important recreational pursuit within the region and has grown in popularity.

The Lindis can be easily accessed and provides an intimate and tranquil setting for camping and angling. Several camping sites and picnic areas can be found along the river. Accurate data regarding campsite occupancy is not available. However, popular camping areas are located immediately upstream of the SH8 bridge, near the Cluden Stream confluence and in the Goodger Flat area (including the Department of Conservation Campsite in the Nine Mile historic reserve). Anecdotal evidence suggests that these camp sites are often permanently occupied throughout the summer holiday period.

Due to its small size the Lindis River also provides a safe location for swimming and paddling.

The distribution of recreational values in the Lindis is shown Figure 8.

The Lindis River's importance as a recreational asset is recognised in the Central Otago Outdoor Recreation Strategy. The nearby Lake Dunstan has been identified in the Water Programme of Action: Potential Water Bodies of National Importance for Recreation (July 2004) as a valuable water resource for recreation purposes, tourism and scenic value.



Figure 9. Lindis River in June 2008

Aesthetic value

The Lindis area is well known for its natural beauty, with the Lindis Pass, in particular, being recognised for its iconic, tussock-clad hills. The Water Plan recognises the scenic value of the Lindis Valley and lists the Lindis River in Schedule 1A as an area with a high degree of naturalness above 900 m.

The Department of Conservation's Lindis Pass Scenic Reserve, an area comprising 403 ha of sub-alpine snow tussock grassland, also covers part of the northern section of the catchment.

WATER TAKES WITHIN THE CATCHMENT

Water from the Lindis River provides for a variety of uses, including domestic, communal and stock water supply, wine making, frost fighting and pasture irrigation.

Permitted surface water takes

Under the Resource Management Act (RMA) and the Water Plan, water can be taken from the Lindis River and its tributaries for an individual's reasonable household/stock drinking water needs and for fire-fighting purposes. The setting of a minimum flow in the Lindis River will not directly affect these takes. The Water Plan also permits small water takes, subject to meeting the specified conditions. The ORC does not hold information on permitted water takes.

Consented surface water takes (and groundwater takes managed as surface water)

There are 33 surface water takes from the Lindis River and its tributaries as at June 2015. Of these, 20 are deemed permits (see next section), and of the remaining 13 consented surface water takes, 10 are primary allocation and 3 are supplementary allocation takes.

Under the Water Plan, some groundwater takes are also managed as surface water. These include:

- takes from within the Lindis Alluvial Ribbon Aquifer
- takes within 100 m of a connected perennial surface water body in the Lindis catchment
- takes that are part of any groundwater take more than 100 m from the Lindis River (or one of its tributaries) and that affect surface water flows by more than 5 l/s.

Within the Lindis catchment, there are currently 7 consented groundwater takes that are subject to the primary allocation regime and any minimum flow for primary allocation water takes.

Overall, the catchment is over-allocated with a consented instantaneous primary water take of 4002.72 l/s. New primary allocation is only available when the instantaneous take is less than 50% of MALF, or, for catchments listed in Schedule 2A of the Water Plan, the primary allocation limit listed in Schedule 2A. As The Lindis River is not included in Schedule 2A and 50% of MALF for the Lindis River has been determined to be 930 l/s, no new primary allocation is available.

Table 2 gives an overview of the consented surface water and connected groundwater takes in the Lindis catchment.

Deemed permits

Deemed permits (also known as ‘mining privileges’) were issued under very early mining legislation, including the Mining Act 1926, and allowed the taking, damming and discharging of water. As gold mining declined, this water was increasingly used for irrigation. The Crown acquired a number of the higher priority, significant mining privileges, which were used for irrigation schemes, and these were transferred to community irrigation groups.

In 1991, under the RMA, every mining privilege was deemed to become a water permit for the taking or damming of water on the same terms and conditions as the original mining privilege. Deemed permits expire on 1 October 2021 (RMA Section 413(3)). After this date, water permits will need to be sought if water is to be taken or dammed.

Table 2. Consented water takes within the Lindis catchment (June 2015)

Water take	Number of consents	Combined monthly volume (m ³)	Combined instantaneous take rate (l/s)	Purpose	Water source
Primary surface water permit granted under the RMA	10	1,988,588 ⁵	298.23 ⁶	Irrigation, stock water, domestic and communal supply, storage, frost fighting	Lindis River, unnamed tributary, unnamed springs
Deemed permits (managed as primary allocation)	20	9,201,956	3,469.66	Irrigation, stock water, domestic supply, wine making	Lindis River, Cluden Stream, Eight Mile Creek, Little Rocky Hill Creek, Long Spur Creek, McKenzie Creek, Nine Mile Creek, Shepherds Creek, Station Creek, Timburn, Wainui Creek and Waiwera Creek
Groundwater permits (managed as primary allocation)	7	562,887.5	234.83	Communal and domestic supply, irrigation	Lindis Alluvial Ribbon Aquifer,
Total primary permits	37	11,753,431.5	4,002.72		
Supplementary surface-water permits	3	255,793	140	Irrigation, stock water, communal supply, storage, frost fighting	Lindis River, Cluden Swamp, Dry Creek

Consented groundwater takes

The Clutha River terraces on either side of the Clutha and the Bendigo-Tarras basin are becoming increasingly used for irrigated pasture and grape vines. In particular, the groundwater resources in the lower Tarras and Bendigo aquifers now provide an alternative and reliable source of water supply for irrigators in the lower Lindis catchment.

There are currently more than 40 consented groundwater takes within the Bendigo-Tarras Basin, including groundwater takes that are located within 100 m from the Clutha. Most of these takes are located within the Lower Tarras and the Bendigo allocation zones. Table 3 provides an overview of the consented groundwater takes (excluding groundwater takes allocated as surface water from the Clutha) in these zones.

⁵ This volume does not include water permits 2006.254 (14 l/s) to retake augmentation water and 2003.110 (555.5 l/s) to retake water that has been discharged into the Cluden Stream from the Tarras main race.

⁶ As for footnote 5.

New groundwater allocation is available as long as the combined yearly volume of take is less than 50% of the aquifers' mean annual recharge (MAR), or a tailored allocation limit identified in Schedule 4A of the Water Plan. Fifty percent of MAR for the Lower Tarras and Bendigo allocation zones is estimated to be around 19.49 Mm³/yr and 18.80 Mm³/yr respectively. Therefore, as Table 3 shows, further allocation remains available.

Table 3. Consented groundwater takes from the lower Tarras and Bendigo allocation zones (June 2015)

Water source	Number of consents	Combined yearly volume (Mm ³ /yr)	Purpose of use
Lower Tarras allocation zone	7	11.05	Irrigation, stock water, domestic and communal supply, storage, frost fighting, fire fighting
Bendigo allocation zone	17	8.38	Irrigation, stock water, communal supply, storage
Ardgour Valley allocation Zone	0	0	NA

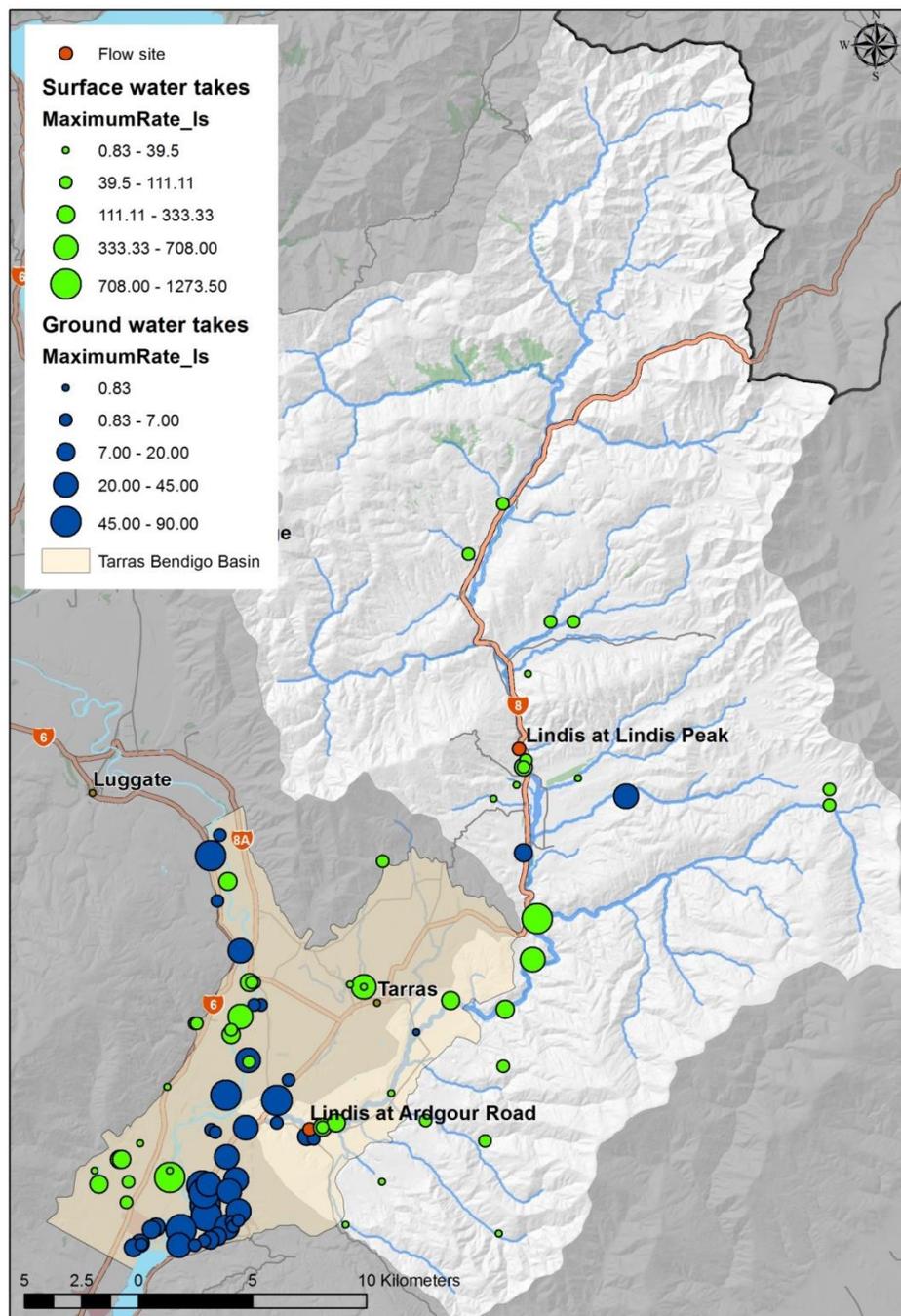


Figure 10. The Lindis catchment and Bendigo-Tarras Basin. (1 June 2015)

FURTHER INFORMATION

BERL Economics (2015)	Economic impacts of minimum flow regimes on the Lindis River
Central Otago District Council (2008)	Central Otago District Plan
growOTAGO (2004)	growOTAGO project. www.growotago.orc.govt.nz
Kāi Tahu ki Otago (2005)	Natural Resource Management Plan 2005
Land Information New Zealand (2002)	Conservation Resources Report, Merivale, Long Acre, Geordie Hills, Shirlmar, Nine Mile and Timburn Station Crown Pastoral Land Tenure Review
Land Information New Zealand (2005)	Conservation Resources Report: Part 1, Lake Hawea Crown Pastoral Land Tenure Review
Land Information New Zealand (2005)	Conservation Resources Report: Part 1, Morven Hills Crown Pastoral Land Tenure Review
MAF (July 2004)	Water Programme of Action: Potential Water Bodies of National Importance - Technical Working Paper
OPUS International Consultants (2015)	Lindis Catchment: Hydrological analysis to support an economic assessment of the potential impact of a minimum flow regime for the Lindis River
Otago Regional Council (2004)	Regional Plan: Water for Otago
Otago Regional Council (2008)	Management flows for aquatic ecosystems in the Lindis River
Otago Regional Council (2010)	Bendigo and Tarras Groundwater Allocation Study
Otago Regional Council (2012)	State of the Environment Report: Surface water quality in Otago
Otago Regional Council (2014)	Lindis Catchment Water Resource Study
Otago Fish and Game Council (2004)	Resource Report for Morven Hills Station Crown Pastoral Lease, 31 March 2004
Tarras Community Association (2007)	Tarras Community Plan, August 2007
Unwin, M. (April 2009)	Angler usage of lakes and river fishers managed by Fish and Game New Zealand: Results from the 2007/08 National Angling Survey. <i>NIWA Client Report CHC2009-046</i>
Winter, T.C., Harvey, J.W., Franke, O.L. and Alley, W.M. (1998)	'Ground Water and Surface Water: A Single Resource,' <i>U.S. Geological Survey Circular</i>

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