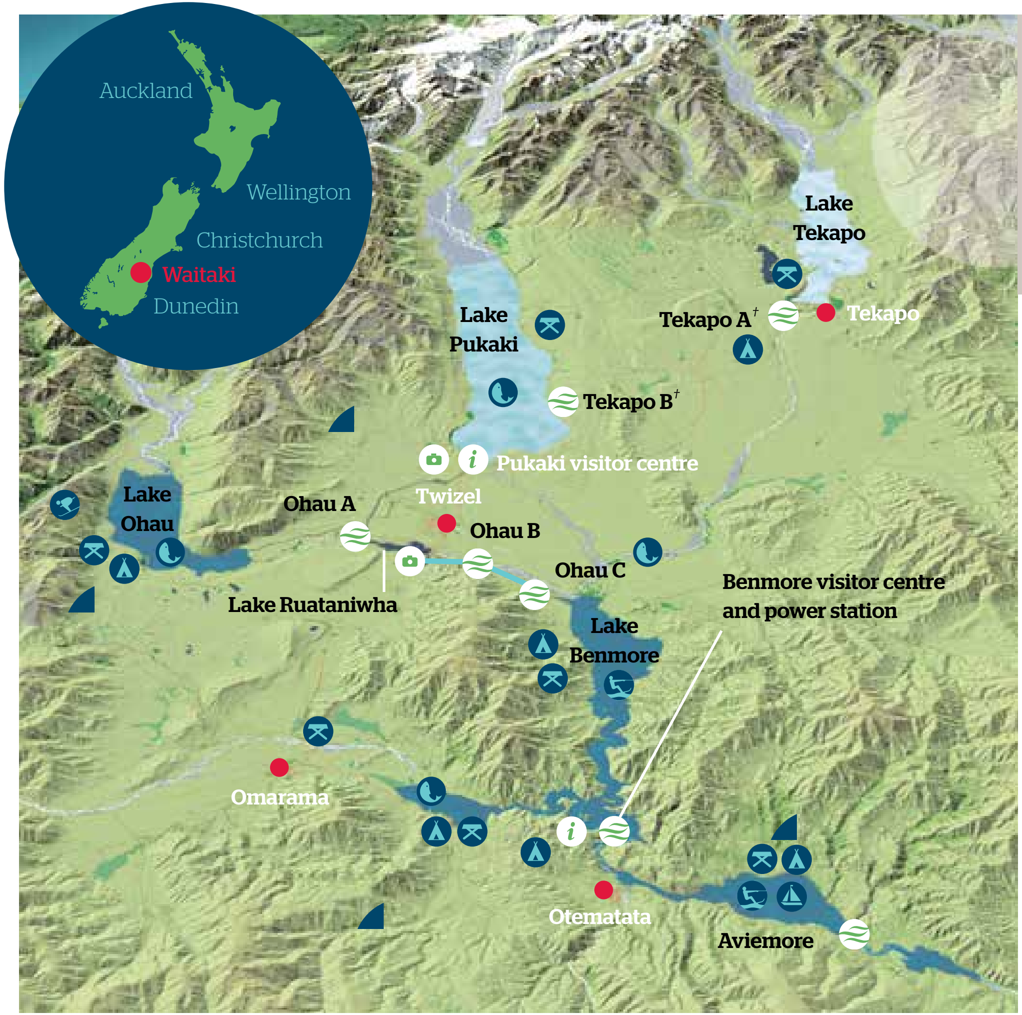
Discover

Waitaki

meridian

Meridian Energy's hydro dam



Activity guide

- Skiing
- Fishing
- Canals
- Lookout
- Picnic
- Water skiing
- Boating
- Information
- Power station
  †*Genesis Energy owned*
- Camping
- Bush walks

There are many places of historical, scenic and recreational interest in the Waitaki Valley

Mount John, an astronomical observatory, is located on the shores of Lake Tekapo. Lake Pukaki is renowned for its scenic views of Aoraki/Mount Cook, and the mountain's visitor centre is located close to the Pukaki high dam. Lake Ruataniwha hosts national rowing competitions every year. The Ohau ski area, behind Lake Ohau, is one of the few New Zealand ski fields on the main divide of the Southern Alps. The surrounding Mackenzie Basin was named after sheep rustler James Mackenzie in 1855. The area is sheep farming country, and in 1895 more than 330,000 sheep perished in a snowstorm. A statue of a sheep dog at the Church of the Good Shepherd by Lake Tekapo pays tribute to James Mackenzie's dog.

If you would like to find out more about things to do in the Waitaki Valley please contact the following:

Kurow Heritage Centre
Phone 03 436 0950
Email museum@kurow.co.nz

Oamaru i-site information centre
Phone 03 434 1656
Email isite@visitoamaru.co.nz

Twizel information centre
Phone 03 435 3124
Email info@twizel.com

The Waitaki hydro scheme consists of eight power stations from Lake Tekapo to Lake Waitaki. Meridian owns and operates six of these stations from a control centre in Twizel, generating energy from water flowing from the Southern Alps out to the sea.

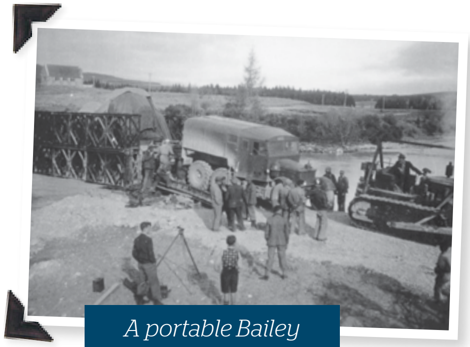
The scheme started in 1904 when Mr P S Hay, who worked in the Government's Public Works Department, recognised the electricity generation potential of the Waitaki Valley. However, it was not until the 1920s that it was possible to begin such a large-scale project. At that time, the Lake Coleridge power station could no longer meet the electricity demand of the South Island, so further development was considered necessary.

The birthplace of the **world's first social welfare system**

Waitaki was a 'make work' project during the 1930s' depression and spawned the trial scheme of the world's first social welfare system. The station is eight kilometres upstream from the township of Kurow, where its Doctor, D G McMillan, Reverend A Nordmeyer and local headmaster, Mr A M Davidson, developed a system aiming to provide free medical treatment to workers and their families if they paid a small weekly sum into a common fund. Later, Dr McMillan and Reverend Nordmeyer became Cabinet Ministers and helped develop a similar scheme for the whole country. New Zealand's new national social welfare scheme was subsequently implemented in 1939.

Four new power stations

The ambitious Upper Waitaki hydro scheme began in 1970. Work continued for 15 years until 1985 when the last station, Ohau C, was commissioned. During that period four power stations were constructed, along with two dams and six canals (totalling 56 kilometres).



A portable Bailey bridge crossing

About Meridian Energy

Meridian Energy is an integrated renewable energy company. We are the largest electricity generator in New Zealand, generating power from 100% renewable resources. We retail electricity to homes, farms and businesses across the country, through our Meridian and Powershop brands.

Meridian is creating a better energy future by leading the way in harnessing the power of renewable energy sources – water, wind and sun. In New Zealand, the company owns and operates seven hydro stations, six within the Waitaki hydro scheme, and wind farms throughout New Zealand.

We also own and operate wind farms in Australia and have a strong pipeline of new generation options in both countries. We've built solar facilities in California and Tonga, and see future opportunities for solar in Australia.

Sustainability is fundamental to our operational approach, reflecting our long-term focus. We work with organisations to preserve the natural environment and protect native plant and animal life, and support local communities through our award-winning Community Fund Programme and national and local sponsorships.

To help our customers manage their energy use, we offer a range of innovative, energy-efficient products and services.

Hydro scheme towns

Otematata

Otematata township was developed in the late 1950s to house the workforce needed to build the Benmore and Aviemore dams and power stations. Its population swelled to more than 4000 in 1963. When the Ministry of Works staff transferred to Twizel in the late 1960s, many of the houses in Otematata were sold as holiday homes. Now Otematata is a popular holiday destination, with lakes, rivers, camping grounds and a golf course within easy reach.

The Māori name 'Otematata' means 'Place of good flint'.

Twizel

Twizel township was built specifically as a residential base for workers on the Upper Waitaki hydro scheme. Its name is taken from the Twizel River that flows nearby. In 1977, 11 years after it was established, Twizel reached its maximum population of 6000. The local primary school became the largest in the country with 1000 pupils. Twizel's population dwindled to around 1300 after the bulk of the Waitaki development was completed in the mid-1980s, and now the community focuses on tourism.

How the Waitaki system works

Facts about electricity generation from Aoraki/Mount Cook through the Waitaki System.

Condensation
As the vapour rises, it cools and changes to droplets.

Precipitation
Water falls to the earth in the form of rain, snow, sleet or hail.

FACT
One cubic metre of water passing through the eight power stations of the Waitaki system generates 2,500 kWh – about 30% of an average household's annual power needs.

KEY
- LAKE
- GENERATION
- CANAL
- * AVERAGE ANNUAL GENERATION
- † OWNED BY GENESIS ENERGY

ENERGY EXPLAINED

Cumec	one cubic metre of water flowing past a given point every second.
kW	1,000 watts.
MW	1,000 kW.
GWh	1,000 MW passing through a given point over an hour.

Evaporation
Water evaporates from the surface of the ocean.

Aoraki / Mount Cook
3,754 m

Lake Tekapo
Storage: 782.36 GWh

Tekapo A†
Commissioned: 1951
*Annual generation: 160 GWh
Station generation output: 25.5 MW
Number of generating units: 1 x 25.5 MW
Net head: 30.5 m
Turbine type: Kaplan
Generator details: 11 kV

Tekapo canal
Length: 25.5 km

Tekapo B†
Commissioned: 1977
*Annual generation: 833 GWh
Station generation output: 160 MW
Number of generating units: 2 x 80 MW
Net head: 145.7 m
Turbine type: Francis
Generator details: 11 kV

Lake Pukaki
Storage: 1679.65 GWh

Pukaki canal
Length: 12 km

Lake Ohau
Storage: 22.02 GWh

Ohau A
Commissioned: 1979
*Annual generation: 1,140 GWh
Station generation output: 264 MW
Number of generating units: 4 x 66 MW
Net head: 59 m
Turbine type: Francis
Generator details: 4 x 13.2 kV

Lake Ruataniwha
Storage: 0.87 GWh

Ohau B canal
Length: 2.4 km

Ohau B and C
(Facts are the same for each station)
Commissioned: 1984 - 1985
*Annual generation: 958 GWh
Station generation output: 212 MW
Number of generating units: 4 x 55.5 MW
Net head: 47.5 m
Turbine type: 4 Francis
Generator details: 4 x 11 kV

Ohau B **Ohau C**

Ohau C canal
Length: 8 km

Ohau C to Benmore
Canal length: 0.5 km

Lake Benmore
Storage: 24.45 GWh

Benmore
Commissioned: 1965
*Annual generation: 2,215 GWh
Station generation output: 540 MW
Number of generating units: 6 x 90 MW
Net head: 92 m
Turbine type: Francis
Generator details: 6 x 16 kV

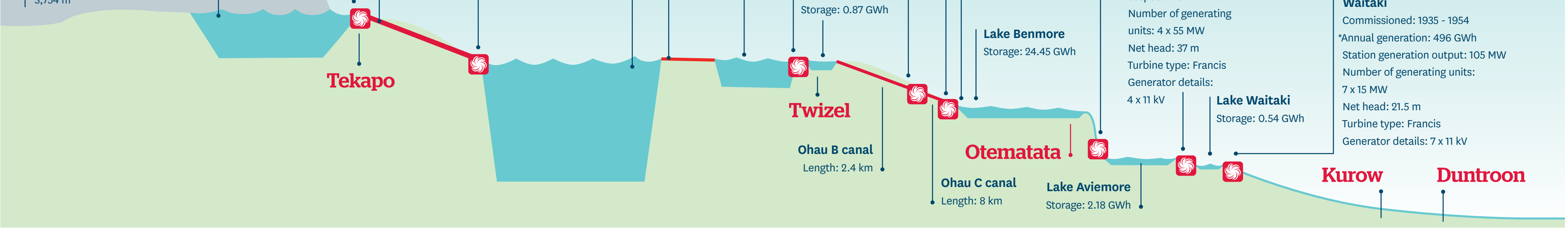
Lake Aviemore
Storage: 2.18 GWh

Aviemore
Commissioned: 1968
*Annual generation: 942 GWh
Station generation output: 220 MW
Number of generating units: 4 x 55 MW
Net head: 37 m
Turbine type: Francis
Generator details: 4 x 11 kV

Lake Waitaki
Storage: 0.54 GWh

Waitaki
Commissioned: 1935 - 1954
*Annual generation: 496 GWh
Station generation output: 105 MW
Number of generating units: 7 x 15 MW
Net head: 21.5 m
Turbine type: Francis
Generator details: 7 x 11 kV

Pacific Ocean



Tekapo A

Construction of the Tekapo A power station started in 1938. It was due to finish in 1943, but work stopped in 1942 as manpower and materials were redirected to the war effort.

Building resumed in 1944 and large camps housing more than 500 people were established. The station was commissioned in 1951. It was the second station to be built as part of the Waitaki hydro scheme.

In 1986 three of the seven turbine blades broke off, causing major damage. A new turbine, manufactured by Tampella of Finland, was installed. Its more efficient design and water usage enable it to work at 42,000 horsepower, producing more electricity using less water.

Tekapo A control gates

The control gates, which are located in Tekapo village, were constructed in the 1940s to regulate Tekapo water outflows to the Waitaki dam. During the construction of Tekapo A a 1.4km tunnel was constructed to divert water from Lake Tekapo to the Tekapo A power station.

Did you know?

The average New Zealand household consumes around 10,000kWh per year (or 10MWh). Tekapo A power station generates an average of 160GWh per year – enough energy to power the equivalent of 16,000 average New Zealand households.

In the 1970s, a 26-kilometre canal was constructed to take outflows from Tekapo A to Lake Pukaki. This meant the water could then be used by four other power stations before entering Lake Benmore.

Life in Tekapo village

Tekapo village, where the workers lived, was very isolated during construction of the power station. There were no movie theatres and the nearest pub was at Burkes Pass, more than 20 kilometres away. Workers kept themselves busy by organising parties and card evenings, ice-skating in winter and having picnics by the lakeside in summer. Very few people owned cars. Those who did shared them in emergencies, such as a hurried dash to Fairlie for the birth of a baby.

View towards Tekapo A.

Did you know?

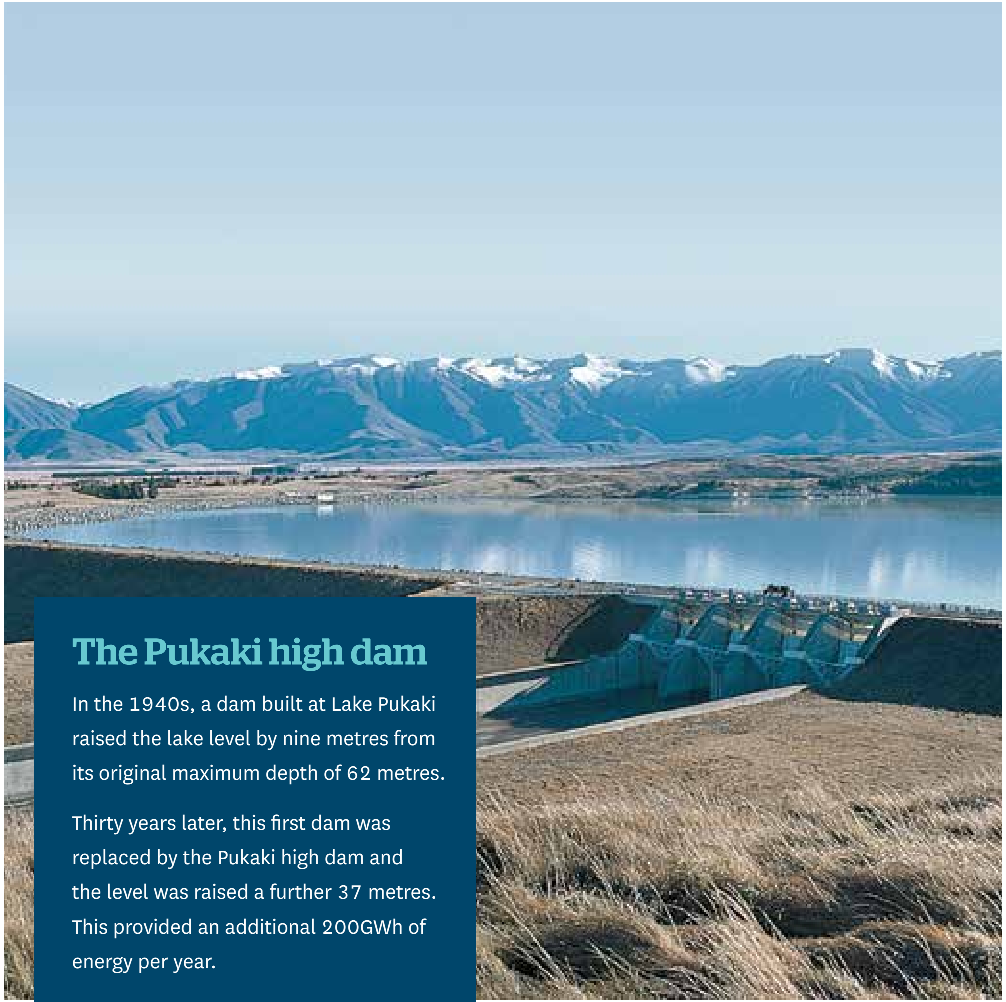
The rotors for the Tekapo B generators were the heaviest objects installed during construction. They weigh 122 tonnes each.

Tekapo B

Tekapo B was the second station to be built in the Upper Waitaki hydro scheme and was commissioned in 1977.

It was constructed on dry land but designed to operate essentially as an island when the level of Lake Pukaki was raised. It's the only power station in New Zealand surrounded entirely by water. Nearly two-thirds of the station is below the water line, and it is waterproofed to above the maximum lake level. Tekapo B is connected to the shore by a 75-metre-long bridge.

Constructing the foundations for the power station proved to be a challenge. The bedrock lay up to 1.6 kilometres under the glacial clay and sediment, too deep to dig through. Therefore hefty concrete raft foundations were built. The power station, which is 46 metres high or as tall as a 14-storey building, was then constructed on these foundations.



The Pukaki high dam

In the 1940s, a dam built at Lake Pukaki raised the lake level by nine metres from its original maximum depth of 62 metres.

Thirty years later, this first dam was replaced by the Pukaki high dam and the level was raised a further 37 metres. This provided an additional 200GWh of energy per year.

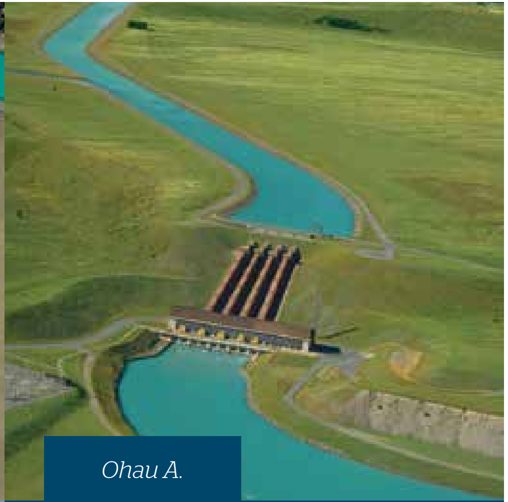
Did you know?

Lake Benmore is the country's largest man-made lake. It's 74.5 square kilometres, and has a shoreline of 116 kilometres. It holds 1.5 times more water than Wellington Harbour.

Benmore

Benmore power station has New Zealand's largest solid-earth dam and New Zealand's largest man-made lake – Lake Benmore. The dam's construction was the biggest job of its kind undertaken in New Zealand. At 540MW, it's the country's second-largest hydro station after Manapouri power station (840MW). Benmore power station was commissioned in 1965.

Benmore.



Ohau A.

Aviemore

In the 1920s, the Aviemore site was identified as a possible site for power generation. However it wasn't until 1961 that the Electric Power Development Board recommended that Aviemore be built.

Construction began in 1962 and presented some unusual challenges. Because part of the dam had to be built across a fault line, it was constructed from both concrete and earth. This was the first time this design had been used in the South Island.

A diversion tunnel was built, which took the outflow from the lake during construction. This was New Zealand's first large-scale use of low-heat cement, which allowed a record rate of concrete to be poured without using cooling coils. Aviemore has the largest steel penstocks (the pipes that bring the water into the powerhouse) of any power station in New Zealand. The penstocks are seven metres in diameter.

Did you know?

The Aviemore power station has the first artificial trout spawning stream in New Zealand. It is a one-kilometre hairpin-shaped channel above the Aviemore tailrace, which channels the water that flows out of the power station. The tailrace allows trout to migrate upstream from Lake Waitaki to spawning grounds close to the dam in Lake Aviemore. Up to 3000 adult trout can move through the tailrace at any one time.

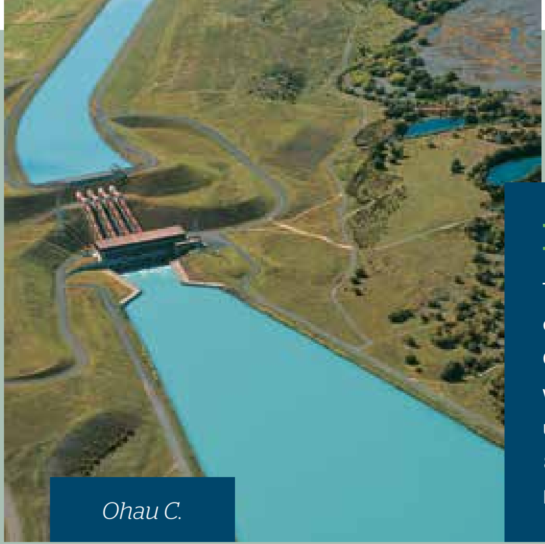
Ohau A

Ohau A power station is located on the man-made Pukaki-Ohau canal and joins the water flows from Lake Ohau with those from Lake Tekapo and Lake Pukaki. Approximately two million cubic metres of rock and gravel – around half a million truckloads – were excavated from the northern bank of the Ohau River to construct the power station. Another half a million cubic metres was removed to create the tailrace – the tunnel that channels the water out of the station. As there was no rock foundation under the power station, substantial concrete foundations had to be built. Construction of the power station began in 1971 and it was commissioned in 1979.

Until the Pukaki-Ohau canal was built, water from Lake Tekapo and Pukaki didn't meet until Lake Benmore. Uniting the water flows at this earlier location considerably increased the hydraulic potential of the area. Water from Ohau A now passes through the Ohau River into Lake Ruataniwha, a man-made lake formed by the construction of the Ruataniwha dam.

Did you know?

Approximately 60,000 cubic metres of concrete (about 15,000 truckloads) and around 2400 tonnes of steel plate were used to construct the four penstocks that channel water into Ohau A power station. The penstocks were constructed in 21-metre sections with a diameter of 5.8 metres, and weigh 59 to 63 tonnes each.



Ohau C.

Did you know?

The Lower Ohau River is only filled when excess water is spilled into it, when Ohau B or C needs to be shut down, or when water is needed for recreational uses. The Upper Ohau River runs at 8–12 cubic metres per second between Lake Ohau and Lake Ruataniwha.

Ohau B *and* Ohau C

These 'twin' stations have the same generating capacity and use similar equipment. Water from Lake Ruataniwha is funnelled through a canal to Ohau B and C. Water flow is controlled by gates in the Ruataniwha dam. A spillway ensures that excess water is diverted into the Ohau River and on into Lake Benmore. A labyrinth weir 1.6 kilometres downstream from Ohau B allows water to be discharged into the Ohau River when necessary, bypassing Ohau C. This provides an emergency overflow so Ohau B can operate if Ohau C is shut down. Ohau B was commissioned in 1984 and Ohau C in 1985. Each station can add around 958GWh of energy a year to New Zealand's power generation capacity. These two power stations complete the Waitaki hydro scheme.

Waitaki

Waitaki was the first power station to be built on the Waitaki River. It was also the first station in New Zealand to be built without diverting the natural river flow. The station was built in stages, starting with a cofferdam (a temporary dam used to hold water during construction) to divert water to the south side of the river. Construction then began on the north side of the river, with 11 sluice gates allowing water to flow while the second section was being built on the south side.

The station's powerhouse was completed in 1934 after the dam was built. It was made of reinforced concrete and was 109 metres long. The powerhouse was extended to 152 metres in the early 1950s to house the final set of generators. The station's first two generators were commissioned in 1935, and a third generator in 1940. Two more generators were installed in 1941 and 1949, bringing the station to its capacity of 75MW. In 1952, upstream from Waitaki, the Pukaki and Tekapo water storage projects were finished. The power station took advantage of the improved water flow, extending the powerhouse to 152 metres and adding two more generators in 1954. This increased the station's capacity to the present-day level of 105MW.

The canals - a crucial part of the Waitaki scheme

A major part of the Upper Waitaki development was the construction of a system of canals to link the power stations on Lakes Tekapo, Pukaki and Ohau. Entirely man-made from local materials and lined with waterproof compacted clay gravels, the canals were designed to take advantage of the natural layout of the land.

All the canals have measures to stop gravel passing into the powerhouse machinery. Some have a settling pond at the end, and all have an armour layer of gravel between the canal lining and the flowing water.

Did you know?

The Waitaki power station was the last station to be built using picks, shovels and wheelbarrows.

The workers were housed in large camps and conditions were harsh. They lived through cold winters, and flooding was common during the six years it took to build the dam.

Waitaki.

Lake Ruataniwha

Rowing competition on Lake Ruataniwha.

Lake Ruataniwha is the newest lake in the Waitaki Basin and is completely man-made.

Built between 1978 and 1981, Lake Ruataniwha has an area of 490 hectares. Its recreational facilities make it extremely popular with visitors. The lake has an international-standard rowing course and the New Zealand rowing championships are held there every second year, alternating with the national secondary school championships.

The Ruataniwha dam

The Ruataniwha dam created Lake Ruataniwha and forms part of State Highway 8 – the main road to Twizel. Before construction on the dam could start, the Ohau River had to be diverted.

A channel was carved through a low, rocky extension of the Benmore Range and covered with a layer of concrete. To divert the river during construction, a structure with three diversion sluice gates was built.

When the dam was completed, these diversion gates were closed and the structure turned into a spillway, which allows excess water to pass safely through the dam. Similar to other spillway structures, there are three control gates in the Ruataniwha spillway, ensuring the maximum resource flow will never exceed 1740 cubic metres per second.

Meridian's continued commitment to the environment

The development of hydro generation has altered the nature of rivers and lakes in the Waitaki catchment. Some parts of braided rivers have been flooded to create storage lakes, and water has been diverted away from other parts of these rivers and into canal systems.

Meridian supports Project River Recovery to help restore and protect the river system and pristine wetland environment. The project, established in 1990 and managed by the Department of Conservation, researches, restores and protects the braided riverbeds and wetlands of the Upper Waitaki Basin. Around 100 hectares of wetlands have been created at four sites, which are home to native fish and water birds (including several endangered and threatened species).
A predator control programme has had a significant impact on native bird egg survival rates, which are two to three times higher than those of similar wetlands.

To preserve the abundant fishing resource of the Waitaki, Meridian funds the release of salmon smelt in the Lower Waitaki River, and works closely with New Zealand Fish and Game to monitor trout spawning.

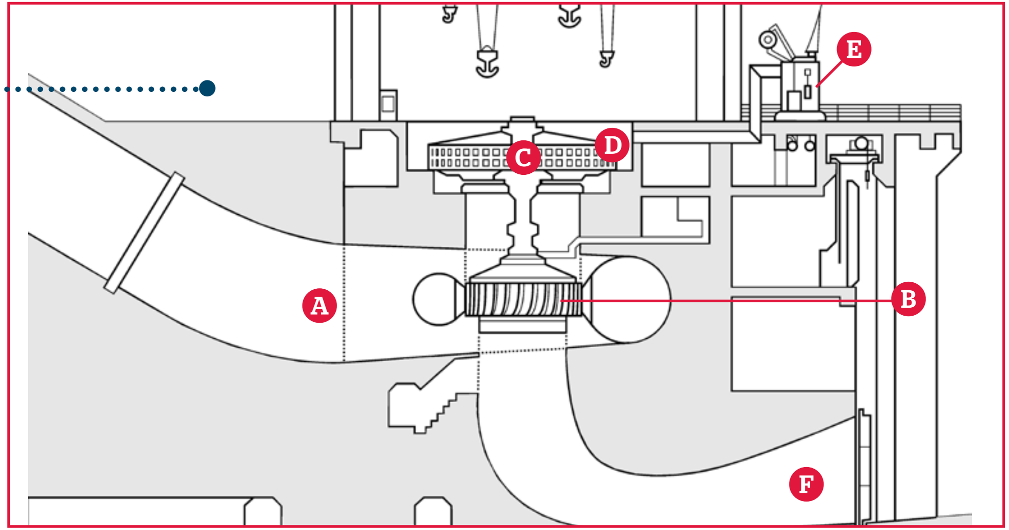
In conjunction with local iwi, Meridian is also carrying out a programme to enable elver – young native eels – to travel safely over the Waitaki dams on their way to their maturing grounds upriver and back to their mating sites in the Pacific Islands.

Hydro power

How does it work?

A hydro power station works by harnessing the energy from falling water. The water held above the power station in a lake or reservoir is channelled through pipes or penstocks A to the turbines B. The height from which the water falls from the reservoir to the turbine, known as the head, determines the amount of energy that can be extracted from a given volume of water.

The turbines extract the energy from the water, turning it into mechanical energy that spins the generator rotor C. Similar to a car alternator, the generator rotor carries a set of electromagnets that spin within a stationary set of insulated copper windings embedded in an iron core called the stator D.



The motion of the magnets within the stator generates electricity in the windings. Most large hydro generators in New Zealand generate between 11,000 and 16,000 volts of alternating current (AC), which is not suited to the energy-efficient, long-distance transmission of electricity. Instead, the generator is connected to a transformer E, which steps up the voltage – usually to 110,000 or 220,000 volts AC – to make long-distance transmission more practical and energy efficient.

The transformer connects to the national grid at a switchyard, which contains the circuit breakers and other connecting switches that allow the generator to be connected and disconnected from the grid as required.

Some of the electricity generated into the grid is also converted from AC to direct current (DC), which makes transmission between the North and South Islands, using special high-voltage undersea cables in Cook Strait, much more practical.

After passing through the turbines, water exits through a draft tube F, back to a river, canal or lake.

WANT TO BE A CUSTOMER?

Please feel free to contact our Energy Centre Team.

Phone	**0800 496 496**
Fax	**0800 497 498**

Monday to Friday, excluding public holidays, between 7.30am and 7.30pm

Email	**info@meridianenergy.co.nz**
Website	**meridian.co.nz**
Address	**Meridian Energy Ltd** **PO Box 2146** **Christchurch Mail Centre 8011**

meridian

MFS0009 12/14 JR