



WATER REPORT

2012-2013

snowyhydro
renewable energy





FOREWORD

TO OUR LOCAL COMMUNITIES AND STAKEHOLDERS

Throughout my career I have been extensively involved with water, having led some of Australia's largest electricity and water organisations. I have a deep understanding of the value of water, and I recognise the importance of keeping communities and stakeholders informed about water matters.

The annual Snowy Hydro Water Report is an important tool through which we are able to improve community, lake user and stakeholder understanding of the complex obligations contained within the *Snowy Water Licence*.

Snowy Hydro has produced the Water Report for the past five years and in that time we have seen an improvement in understanding, which is a great result. However, independent community survey results tell us that there are a few misconceptions remaining about water and Snowy Hydro – namely, water ownership, release regimes and the allocation of water to irrigators downstream.

To address these misconceptions, this year the Water Report takes on a new format to clearly demonstrate the broader context around the interrelated facets of Snowy Scheme water operations. We will look at the cycle of water in the Scheme from when we receive inflows as rain and snow, to how the water is stored and then released, including environmental releases.

This report also includes analysis of water data and facts to further improve community and stakeholder understanding of Snowy Hydro's water operations. Such facts include the water content of snow, variations in run-off and the operations of our lakes and reservoirs. To assist event organisers, we have also included information on lake foreshores and public access arrangements.

We have also included significant information about water ownership. Snowy Hydro does not own the water that is stored in and released from the Snowy Scheme. It is very important that our communities, stakeholders and lake users understand this fact.

I ask that you read this Water Report, keeping in mind that all our water operations and obligations occur within the context that Snowy Hydro is an energy business. We must earn enough revenue to pay for the maintenance and upgrade of the massive infrastructure that is the Snowy Scheme in order to continue to meet the obligations of the *Snowy Water Licence*.

I encourage you to take the time to read this report to learn more and develop an understanding of the facts and realities of water operations of Snowy Hydro. I also encourage you to provide us with feedback, as we are always looking for opportunities to improve this Water Report and better explain our water operations to communities, stakeholders and lake users.



Paul Broad
CEO and Managing Director
Snowy Hydro Limited





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UNDERSTANDING WATER & OUR BUSINESS

The fundamental driver for water operations of the Snowy Scheme is the *Snowy Water Licence*.

The *Snowy Water Licence*, issued by the New South Wales Government, regulates Snowy Hydro in terms of what we can do with the water in the Snowy Scheme. It has many legally binding, enforceable obligations on the company.

The *Snowy Water Licence* states that Snowy Hydro has the right to collect, divert, store and release water. That, in no way, represents any form of ownership of the water. The parties who have an entitlement to releases from the Snowy Scheme own all of the water in the Scheme. This includes the states of New South Wales and Victoria, irrigators from those states, downstream town water supplies and the environment.

The water you see in Lake Jindabyne, Tantangara Reservoir or Lake Eucumbene has been secured and allocated to the above mentioned parties by the Government.

Snowy Hydro has some flexibility around the short-term timing of releases to maximise energy generation throughout the year, however, by the end of each water year (which ends in April), Snowy Hydro has to have released a predetermined volume of water out of the Scheme. This is one of the legally binding obligations set out in the *Snowy Water Licence*.

Snowy Hydro is obligated under the *Snowy Water Licence*, administered by the NSW Government through the NSW Office of Water, to:

- Target water releases to the River Murray and Murrumbidgee River catchments, the annual volumes of which are determined according to highly prescriptive formulae set out in the *Snowy Water Licence*;
- Targeting water releases from Jindabyne Dam into the Snowy River for environmental purposes (Snowy River Increased Flows); and
- Facilitating additional natural flows to nominated Rivers for environmental purposes (Snowy Montane Rivers Increased Flows).

To generate electricity Snowy Hydro must release water from the Snowy Scheme, and to release water from the Snowy Scheme, Snowy Hydro must generate electricity. In this way, water releases and electricity generation are inseparably linked.

Snowy Hydro must operate the Snowy Scheme to first meet its water release obligations and then to maximise electricity market opportunities within the constraints imposed by the *Snowy Water Licence*.

Snowy Hydro also has to fund both the debt and operating costs of the Snowy Scheme through its participation in the highly competitive National Electricity Market (NEM). Those electricity revenues pay for the increasing costs of maintaining and operating the Snowy Scheme, including the costs associated with making environmental flows.

Downstream water users (irrigators and environmental entitlements holders) have never been charged for the water regulation services provided to them each year.

In summary, Snowy Hydro has flexibility from day to day in releasing water from the Snowy Scheme as an outcome of generating electricity. Each year, we have to reach certain targets for releases. The short-term flexibility allows us to run our electricity business, while at the same time giving long-term security to the downstream users around annual water releases.

Whilst the *Snowy Water Licence* recognises the difficulties inherent in achieving precise release volumes at each release point, any shortfall or excess is accounted and generally dealt with by an 'unders and overs' approach whereby the shortfall or excess is added or subtracted to the following years target, i.e. there is no way that Snowy Hydro can consistently 'under-deliver' water to any aspect of the release program.

For more information and a full copy of the *Snowy Water Licence* we encourage people to visit www.water.nsw.gov.au

WATER YEAR —
THE SNOWY HYDRO WATER YEAR COMMENCES
ON 1 MAY AND CONCLUDES ON 30 APRIL EACH
CALENDAR YEAR.

1 GIGALITRE (GL) —
EQUAL TO 1,000 MEGALITRES (ML).

1 MEGALITRE (ML) —
EQUAL TO 1 MILLION LITRES (L).

OVERVIEW OF SNOWY HYDRO

Snowy Hydro is a growing business providing a range of price risk hedging products to participants in the competitive National Electricity Market (NEM). We operate and maintain the 4,100 megawatt (MW) Snowy Scheme and also own and operate the 300MW Valley Power gas-fired power station and the 320MW Laverton North gas-fired power station, both located in Victoria. Snowy Hydro also owns Red Energy, an electricity and gas retailer operating in Victoria, New South Wales and South Australia.

The shares in Snowy Hydro are owned by the New South Wales Government (58%), Victorian Government (29%) and the Commonwealth Government (13%) and the company operates under an independent board.

Electricity generation is not our core business; risk management is. Rather than generating constantly (which there is not enough water for), we have developed our business to capitalise on periods when demand for generation is high. Examples of high demand days are the hot days when everyone turns on their air conditioner. Snowy Hydro effectively acts as an insurer for NEM participants. Participants purchase insurance contracts with us that dictate under what market conditions we will switch on our generating units and provide electricity to cover their energy requirements. This provides security of electricity supply and price to NEM participants. Key to our success is our ability to have reliable and available plant ready to meet market needs at all times.

“SNOWY
HYDRO DOES
NOT OWN
WATER”

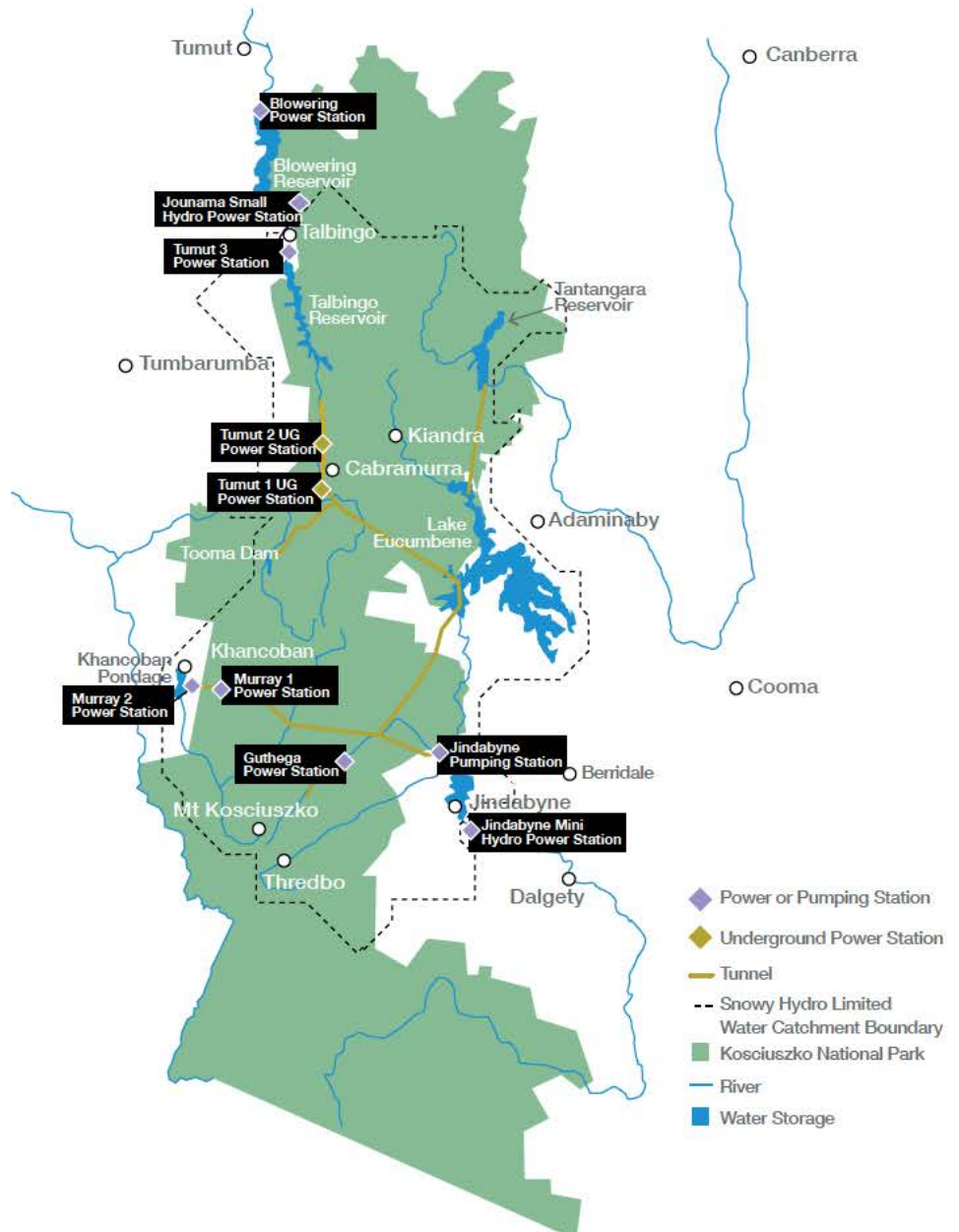
HOW THE SNOWY SCHEME WORKS

The Snowy Scheme was designed to collect and store water, including water that would otherwise flow east down the Snowy River to the coast, diverting it through trans-mountain tunnels and power stations and then releasing it west of the Snowy Mountains into the catchments of the River Murray and the Murrumbidgee River, where it can be used for town water supply, irrigation and environmental uses.

The Snowy Scheme includes:

- Nine power stations – Murray 1, Murray 2, Blowering, Guthega, Tumut 1 (located 366m below ground level), Tumut 2 (located 244m below ground level), Tumut 3, Jounama Small Hydro Power Station and Jindabyne Mini Hydro Power Station;
- One pumping station at Jindabyne and a pump storage facility at Tumut 3 Power Station;
- 16 major dams with a total storage capacity of 7,000GL or almost 12 times the volume of Sydney Harbour;
- 145km of inter-connected tunnels and pipelines and 80km of aqueducts; and
- 33 hydro-electric turbines with a generating capacity of 4,100MW.

The Snowy Scheme comprises two major developments: the Northern Snowy-Tumut Development and the Southern Snowy-Murray Development. The water in Lake Eucumbene, our large long-term storage lake, is split between the two developments based on where the water was collected from.



THE SNOWY-TUMUT DEVELOPMENT

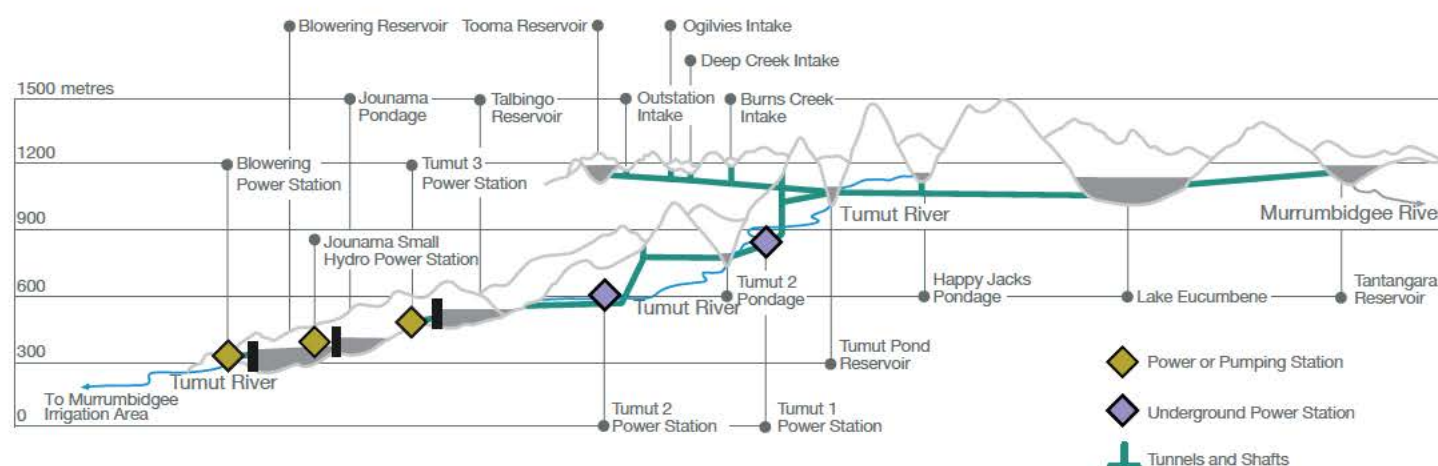
The Snowy-Tumut Development consists of five power stations and 16 generating units. It collects the headwaters of the upper Murrumbidgee, Tooma and Eucumbene Rivers. Those waters are diverted through trans-mountain tunnels to Tumut Pond Dam where they join the waters of the Tumut River and flow through Tumut 1 and Tumut 2 underground power stations, discharging into Talbingo Reservoir. Water stored in Talbingo Reservoir then passes through the Tumut 3 Power Station and into Jounama Pondage.

Three of the six generating units at Tumut 3 Power Station also have large pumps fitted that can be used to pump water from Jounama Pondage back up into Talbingo Reservoir, thereby 'recycling' water. Water cannot be pumped any further uphill than Talbingo Reservoir.

Water is released from Jounama Dam into Blowering Reservoir either through the Jounama Small Hydro Power Station or through the radial release gates at Jounama Dam.

Blowering Power Station is located on Blowering Dam and is leased from NSW State Water Corporation. Water releases from Blowering Dam are controlled by State Water – a New South Wales State-Owned Corporation – to provide for downstream town water supply, extractive and environmental use requirements.

Blowering Power Station is therefore a 'run of river' plant that operates when State Water releases water from Blowering Dam into the Tumut River, which joins the Murrumbidgee River near Gundagai. On the Murrumbidgee River at Gundagai, the Snowy Scheme contributes around 25% of inflows during average inflow years but can provide up to 60% of the total inflows to this location during drought years.



THE SNOWY-MURRAY DEVELOPMENT

The Snowy-Murray Development consists of four power stations with 17 generating units and one pumping station. Water in the upper Snowy River is diverted at Guthega Dam through Guthega Power Station and back into Island Bend Dam. Inflows into the relatively small Guthega Pondage are seasonal and spills of the reservoir are common, particularly during the spring snowmelt period.

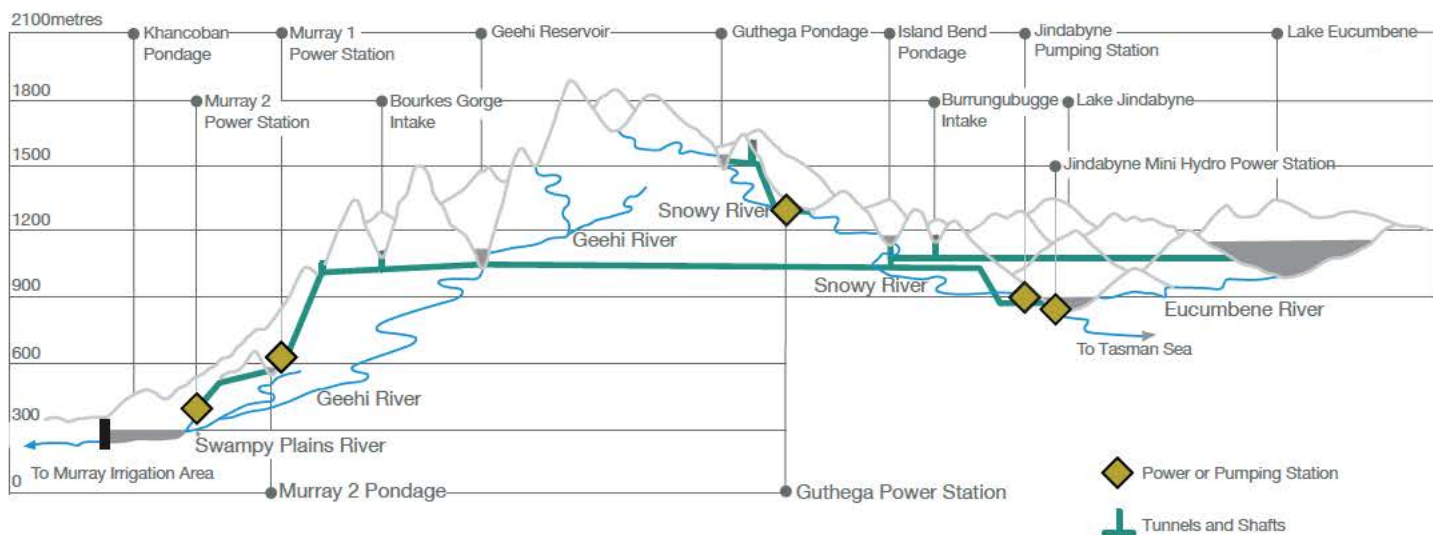
During times of high inflows, water flowing into Island Bend Pondage is diverted to Lake Eucumbene for storage and subsequently transferred to the River Murray catchment at a later time. At times of low inflows, water from Island Bend Pondage is diverted to Geehi Reservoir through a trans-mountain tunnel, together with water transferred back from Lake Eucumbene.

The Jindabyne Pumping Station pumps water from Lake Jindabyne, normally using off-peak power (typically at night and on weekends) into Geehi Reservoir on the western side of the Great Dividing Range.

Water from Lake Jindabyne cannot be pumped back to Lake Eucumbene or to Island Bend Dam.

Additionally, the Jindabyne Small-hydro Power Station allows Snowy Hydro to recover a small amount of electricity from some of the environmental releases made from Jindabyne Dam into the Snowy River.

From Geehi Reservoir, with additional water from the Geehi River, the water from Island Bend and Eucumbene passes through Murray 1 and Murray 2 power stations. Khancoban Dam regulates water released from Murray 2 Power Station down the Swampy Plains River which is a tributary of the upper River Murray. On the River Murray at Hume Dam, the Snowy Scheme contributes inflows of only around 8% during average inflow years but can contribute up to 33% of inflows during drought years.



UNDERSTANDING WATER & THE SCHEME

Snowy Hydro receives public enquiries about whether the snow melt from a good winter season, a large thunderstorm or weeklong rain event will fill the lakes. The total volume of Snowy Scheme storages is massive and it will take a number of consecutive years of above average inflows to return our total storage volumes, particularly Lake Eucumbene to above average levels. To understand why, we have outlined some the key operational features of the Scheme.

**“IT WILL TAKE
A NUMBER OF
CONSECUTIVE
YEARS OF ABOVE
AVERAGE INFLOWS
TO RETURN OUR
STORAGE TO
AVERAGE LEVELS”**

WATER CONTENT OF SNOW...

Understanding the water content of snow, and what it means for spring inflows into the Snowy Scheme, is really important in understanding water. While it is often said that 1mm of rain equals 1cm of snow, this rule of thumb applies more to the conditions experienced in the colder climates of North America and Japan.

In the Snowy Mountains, the density (or water content) of freshly fallen snow is about 20-25%: 1mm of rain equals about 5mm (0.5cm) of snow. Fresh snow has a relatively low water content, and as the winter season progresses, the average density of snow on the ground tends to increase as it compresses. Throughout the season, the density of the snowpack in the Snowy Mountains generally ranges from as little as 25% to up to 50%. So, if there is a two metre snowpack, that would be the equivalent of between 50 and 100cm of water sitting on the mountain at that point.

How much of this water makes it into the reservoirs when the snow melts is another matter. Snowmelt is strongly impacted by the weather conditions experienced during late winter and spring, and small changes in the weather can lead to vastly different outcomes for inflows. For example:

- Heavy rain falling on a dense snowpack melts the snow quickly and maximises runoff.
- Hot northerly winds help to melt the snow but when the air is dry, much of the water can evaporate rather than run off into the streams or rivers.

So, an above average snowpack at the start of the season may not provide much water for the storages if spring is dry, but average snowfall during winter can lead to high spring runoff if the ideal rainfall events are received.

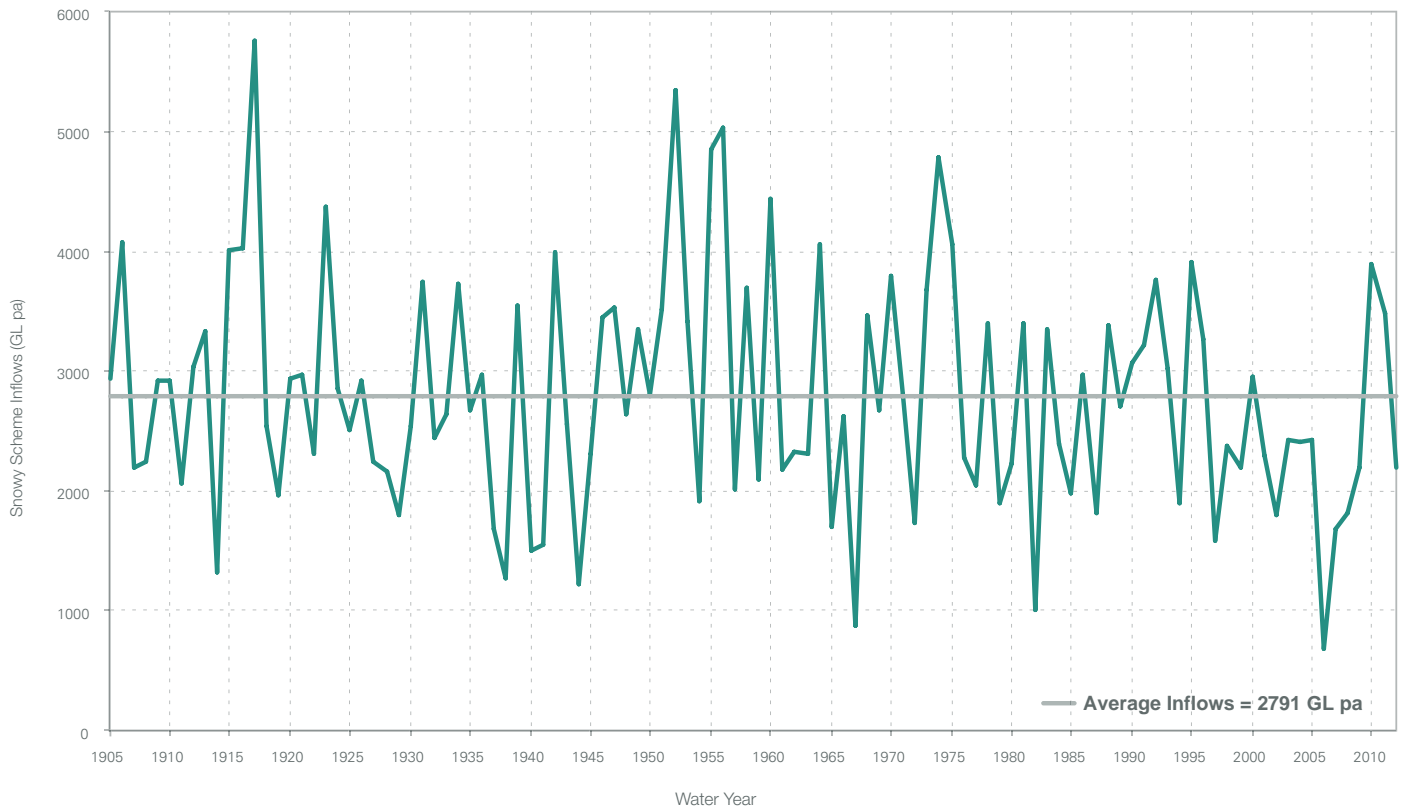
Other catchment conditions can also impact runoff yield. For example, bushfires can change the vegetation cover and soil properties and may affect the amount of water absorbed into the ground for many years. The flora that reshoots after a bushfire will also draw more moisture from the ground.

We can expect to receive around 50% of our inflows from snowmelt and rain during spring, so a bad snow season can have a significant impact on the total inflows for the year.

The Snowy Scheme was designed to cope with large variability inflows. In the last 101 years of data, inflows have ranged from 683GL seen in 2006/07 during the worst drought on record, to 5761GL almost a century ago in 1917. The average is around 2800GL.



SNOWY SCHEME INFLOWS FROM MAY 1905 TO APR 2013



EUCUMBENE – THE CENTRAL STORAGE...

It is important to understand that Eucumbene Reservoir is a long-term storage. That is, it is designed to capture and store water over multiple years, even when it is wet.

Broadly, the Scheme is designed to release a similar amount of water down the Tumut and Swampy Plains River each year. In a wet year, the balance of inflows to the top of the Scheme is sent to Eucumbene for storage while in a dry year, the stored water is used to make up the releases. This helps smooth out the dry and the wet years in the areas below the Scheme and increase the security of supply of water to irrigators and other users on the Western Rivers.

In fact, the large storage capacity of Lake Eucumbene means that it has never been at Full Supply Level throughout its entire history. The long-term average level of Lake Eucumbene is 59% gross capacity. The highly variable inflows to the Scheme (shown on page 15) also mean that there is no such thing as a 'normal' lake level. It is part of our normal operation for levels in all of our lakes to fluctuate up and down both within and between years.

**“THE LONG-
TERM AVERAGE
LEVEL OF LAKE
EUCUMBENE
IS 59% GROSS
CAPACITY”**



THE OPERATION OF TANTANGARA...

Snowy Hydro receives enquiries from the public wanting to understand why Tantangara is generally kept at low levels. Essentially when water is available in Tantangara Dam, it is diverted to Lake Eucumbene via Eucumbene Portal.

Tantangara is a small reservoir being only 1/18 the size of Lake Eucumbene. The reason for consistent diversion to Eucumbene is that Tantangara Reservoir is relatively shallow and in a high wind area. This means that the longer water stays in the storage, the more water is lost to evaporation. Therefore, the sooner water can be transferred to Lake Eucumbene, the less water that is lost to evaporation.

People may have noticed that Tantangara reservoir has been at higher levels in the last few years. This is due to an increase in allocations to the Snowy Montane Rivers Increased Flows Program, an environmental flow program delivered by Snowy Hydro that is specified in the *Snowy Water Licence*.

Most years, Snowy Hydro will be making releases from Tantangara reservoir to the Murrumbidgee River. In order to ensure security of supply for these releases, in future Snowy Hydro will generally hold the lake high enough so that we could still deliver the required releases during two low inflow years in a row. This means that in future, the gross storage level of Tantangara will usually be sitting around 20% full in comparison to the previous average of just over 10%.

WATER CANNOT BE PUMPED FROM JINDABYNE TO EUCUMBENE...

There is still some confusion around the physical limitations around the design of the Snowy Scheme, particularly in relation to the misunderstanding that water can be moved from Lake Jindabyne to Lake Eucumbene. If Lake Eucumbene is at any point above minimum operating level, it is impossible. The below diagrams explain why:

Diagram 1: Cross-section of the Snowy-Murray Development of the Snowy Scheme where you can clearly see the Jindabyne-Island Bend Tunnel and the Eucumbene-Snowy Tunnel. You will see the clear difference in elevation between Lake Eucumbene and Lake Jindabyne.

Diagram 2: With Lake Eucumbene being above minimum operating level, it is beyond the capability of the Jindabyne Pumping Station to pump to this elevation.

The pumps are designed to only pump water from Lake Jindabyne to Geehi Reservoir via the Snowy-Geehi Tunnel only.

Water in Lake Jindabyne can only be pumped to Geehi Reservoir and then released via the Murray 1 and then Murray 2 Power Stations and then into Khancoban Pondage and the Murray catchment.

Jindabyne Pumping Station has the capacity to pump only around 2.4 gegalitres (GL) of water per day to Geehi Reservoir. Even if you assume zero inflows into Lake Jindabyne, it would take more than a month of non-stop pumping to drop the level of Lake Jindabyne by 2-3 metres. This means that it is impossible to reduce lake levels quickly by pumping alone, especially when inflows are high.

Any water in storages below Tumut Pond Dam on the Snowy-Tumut development, and anything below Island Bend and Geehi Dams on the Snowy-Murray development cannot be transferred back to Eucumbene Dam. Simply, water does not flow uphill and the pump capability at Jindabyne is only sufficient to lift water from Jindabyne to the Snowy-Geehi Tunnel across to Geehi Reservoir. Similarly, the pumps at Tumut 3 also only pump from Jounama Pondage back to Talbingo Reservoir.

It is not physically possible to move water uphill from Talbingo Reservoir to higher storages, hence why we say every raindrop or snowflake that falls in the Geehi catchment or below Tumut Pond Dam in the Tumut catchment moves straight through the Snowy Scheme, particularly during wet years or flood events.

DIAGRAM 1

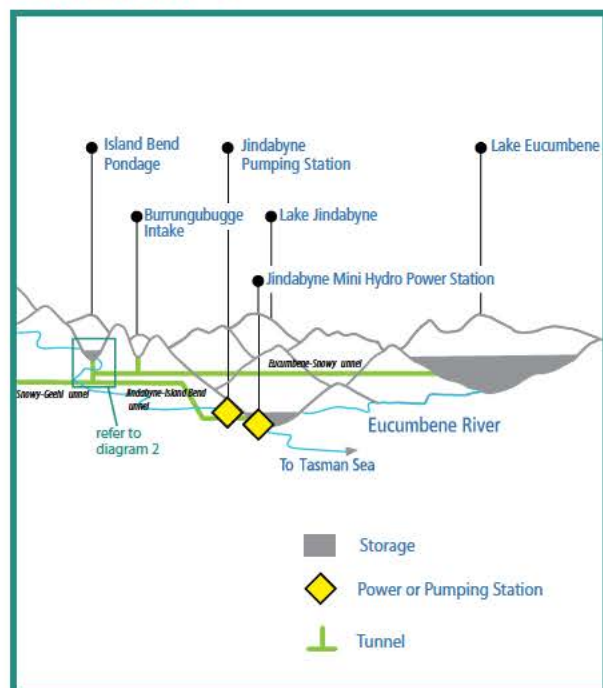
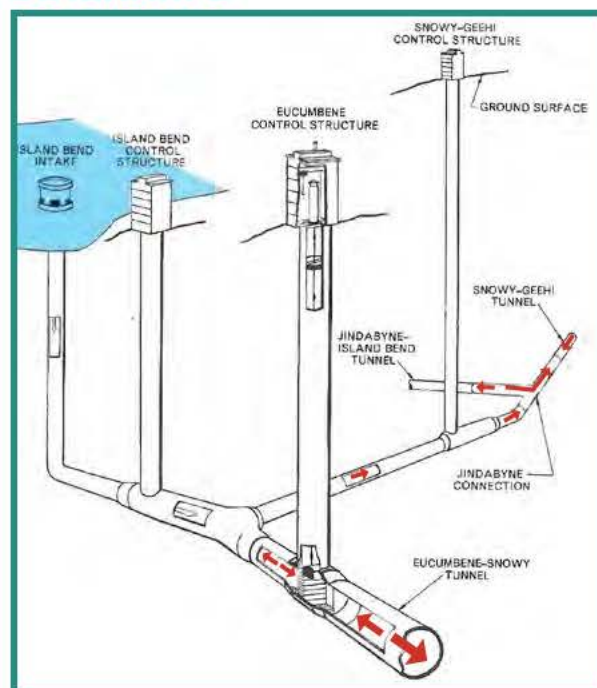


DIAGRAM 2



JINDABYNE LEVELS VS EUCUMBENE LEVELS...

Lake Jindabyne is a much smaller storage than Lake Eucumbene and therefore can fill much faster due to its capacity – Jindabyne is 1/7 the size of Eucumbene.

Snowy Hydro's obligation under the *Snowy Water Licence* to release environmental flows into the Snowy River means that Lake Jindabyne needs to be kept significantly higher than historical levels. This is to ensure enough water is available to complete the annual program of environmental releases as well as to deliver flushing flows via the original gated spillway.

Because flushing flows require the use of the spillway, the level of the lake needs to be higher than the base of the spillway gates in order to enable the releases to occur. The bigger the flushing flow, the higher the lake needs to be to deliver the targeted flow. In general, in years when a flushing flow is required, the level of the lake will be 6-7 metres higher than the long-term historical average. Holding the lake higher in winter and spring means that there is also a much greater risk of the Lake reaching full supply level and possibly even spilling in wet years.

Lake Eucumbene

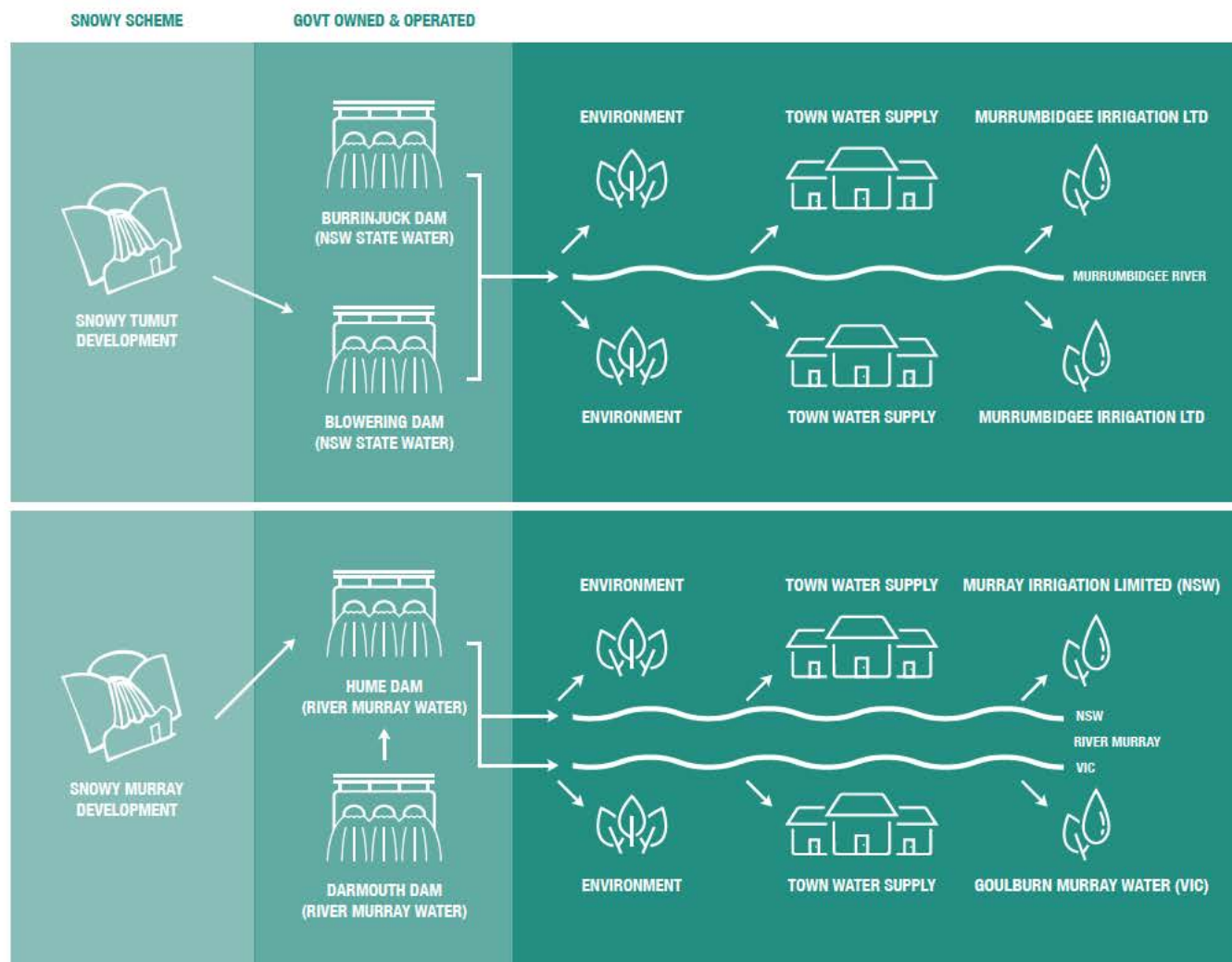


SNOWY HYDRO DOES NOT DETERMINE ALLOCATIONS TO WESTERN RIVER USERS...

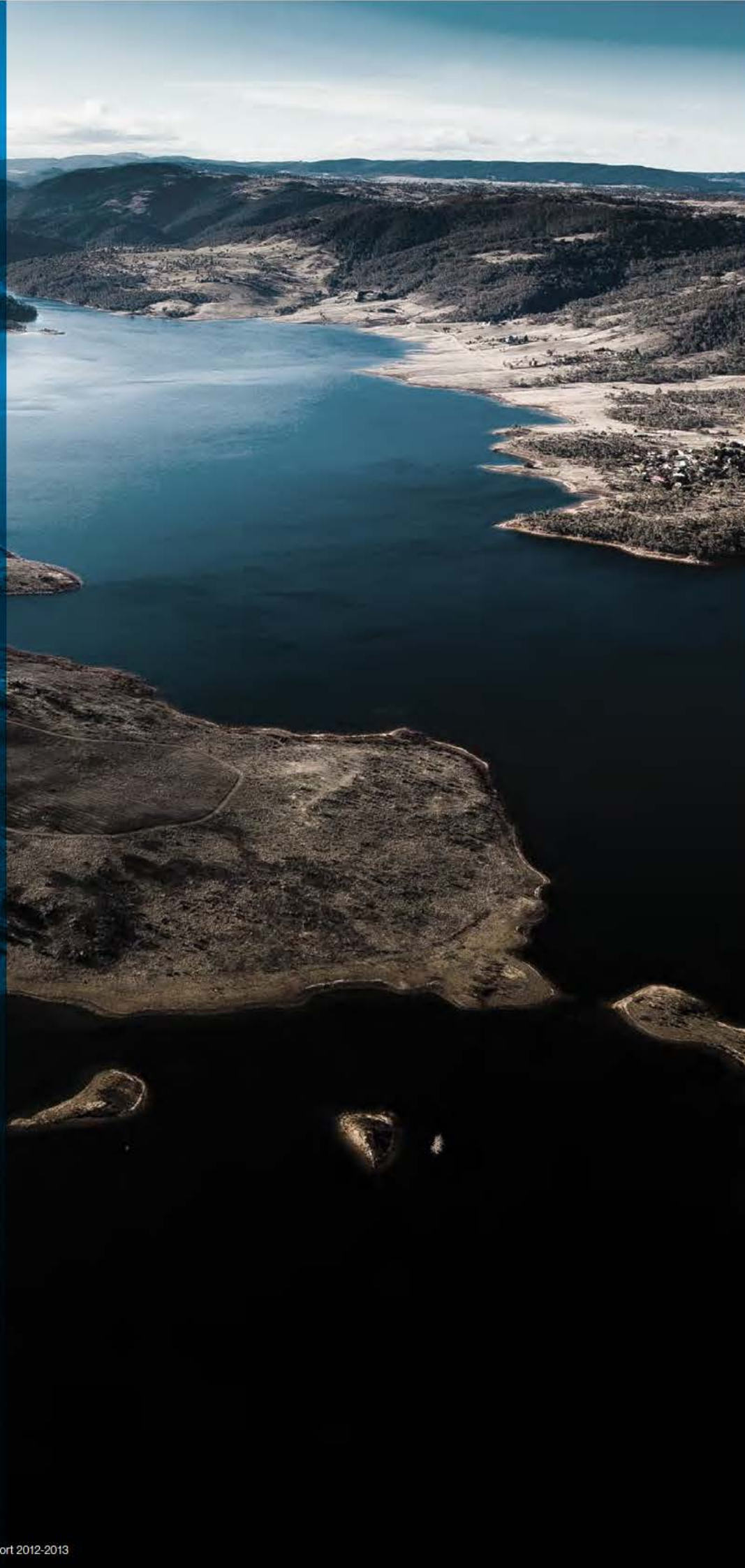
Snowy Scheme releases and the other River Murray and Murrumbidgee River catchment inflows are re-regulated by Hume Dam on the River Murray and Blowering Dam on the Tumut River – neither of which are owned or controlled by Snowy Hydro.

Water releases for extractive and environmental uses along the Upper River Murray are managed by the Murray-Darling Basin Authority, principally through releases from Dartmouth and Hume Dams (the Snowy Scheme does not make releases into nor has any control over the operation of Dartmouth Dam).

Water releases for extractive and environmental uses along the Murrumbidgee River are managed by the NSW State Water Corporation, principally through releases from Blowering and Burrinjuck Dams (again, the Snowy Scheme does not have any control over the operation of Burrinjuck Dam).



2012-2013 WATER YEAR



THE 2012-2013 WATER YEAR – WHAT WATER CAME IN...

2012-2013 INFLOWS

Snowy Scheme inflows for 2012–13 were 2,188GL which is about 78% of the long term average of 2,791GL.

We would need multiple years of average or above average inflows to see major sustained improvements in lake levels. In 2012-2013 we only received three quarters of the average, therefore further increasing the time it will take for storages to return to long-term average levels.

SNOWY SCHEME STORAGES FOR 2012-2013

Snowy Scheme storage levels are referred to in different measurements, being 'active storage' and 'gross storage'.

Active storage is the water that generally can be accessed by either pumping or through release via dams or through power stations. Gross storage is the total amount of water behind the dam wall including the water that cannot ordinarily be accessed due to the design of the Snowy Scheme infrastructure.

For the purposes of our business operations, active storage is used, whereas recreational users are generally more interested in and familiar with gross storage. For example, Lake Jindabyne could experience a 0% active storage level but the lake itself would be then at approximately 44% gross storage. This remaining water cannot be accessed via the pumping station due to the physical design limitations of the Snowy Scheme.

At the end of the 2011–12 water year, Snowy Scheme active storage was 3,054GL. This is equivalent to 57.6% of the Snowy Scheme active storage capacity.

During the 2012–13 water year, Snowy Scheme active storage decreased by 757GL, with active storage totalling 2,296GL at the end of the year, which is 43.3% of the active storage capacity.

SNOWY SCHEME INFLOW FOR MAY 2012 - APR 2013



SNOWY SCHEME ACTIVE STORAGE FOR 2012 - 2013 WATER YEAR



LAKE LEVELS

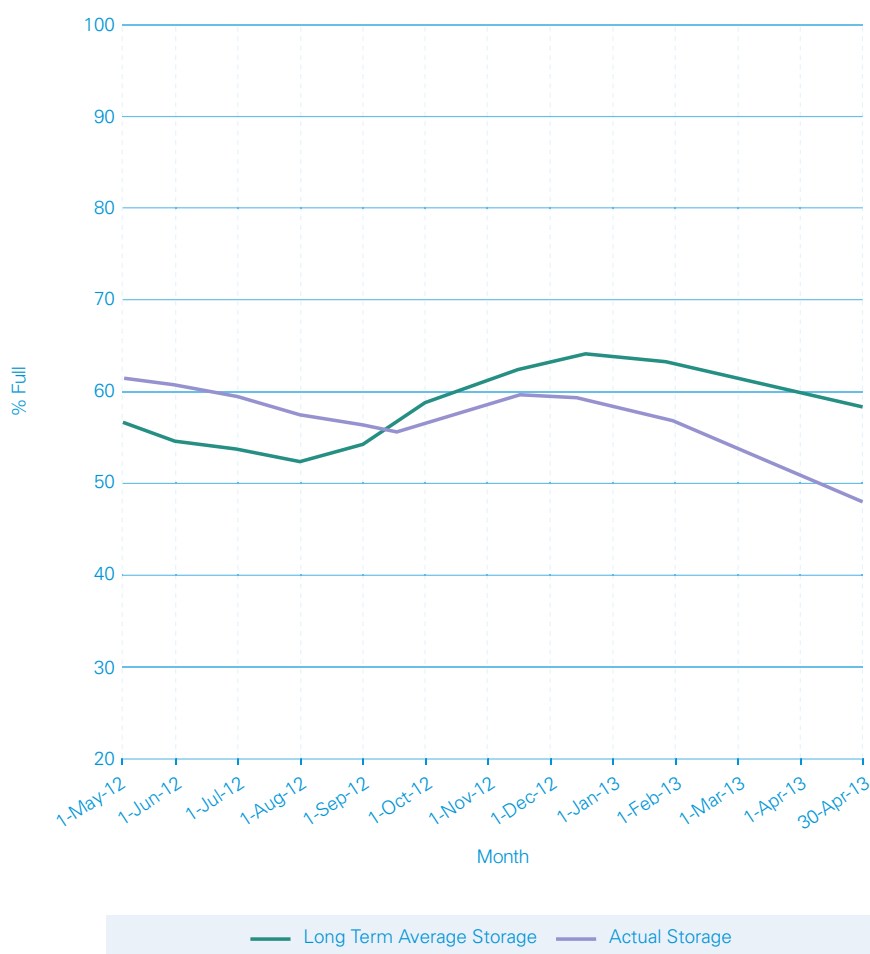
The below average inflows experienced in 2012-13 halted the rise in lake levels observed in the previous year.

The Snowy Scheme's main storage, Lake Eucumbene, ended the 2012-13 year lower than the previous year and below the long-term average storage level.

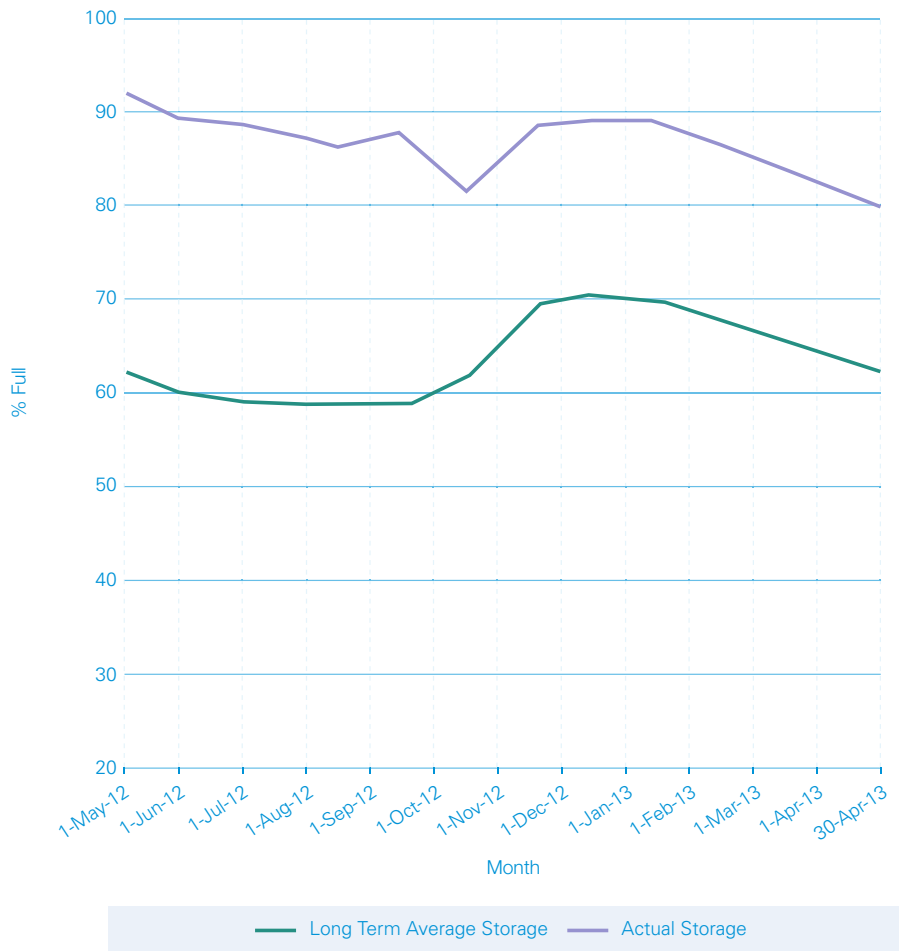
Whilst the level of Lake Jindabyne at the end of the 2012-13 water year was also lower than that of the previous year, the storage level remains well above the long term average storage level. As discussed earlier, this is in order to ensure security of supply for the environmental flows and flushing flows out of Jindabyne Dam into the Snowy River.

Snowy Hydro reports gross storage levels to local tourism operators and the local community on our website. Lake Levels for our three main storages of Jindabyne, Eucumbene and Tantangara are provided weekly and are available at snowyhydro.com.au. Our website also includes a lake level comparison calculator where it can be seen that lake levels have improved since the height of the worst recorded drought of 2006-07 in line with improvements in annual inflows.

LAKE EUCUMBENE GROSS STORAGE FOR 2012 - 2013 WATER YEAR



LAKE JINDABYNE GROSS STORAGE FOR 2012 - 2013 WATER YEAR



Lake Jindabyne



COMPLYING WITH OUR LICENCE – WHAT WATER WENT OUT...

Snowy Hydro complied with all of the requirements imposed upon the company under the *Snowy Water Licence* during the 2012–13 water year including each water release target relating to:

- The Required Annual Release to the River Murray catchment
- The Required Annual Release to the Murrumbidgee River catchment
- Environmental releases into the Snowy River from Jindabyne Dam
- Environmental releases into the Murrumbidgee River from Tantangara Dam
- Environmental releases into the Goodradigbee River from Goodradigbee Aqueduct
- Environmental releases into the Geehi River from Middle Creek Aqueduct

WESTERN RIVER RELEASES

RIVER MURRAY CATCHMENT

Snowy Hydro complied with its obligation to target the Required Annual Release (RAR) from the Snowy-Murray Development to the River Murray catchment during the 2012–13 water year.

The total accounted release volume was 1167GL. This was made up of:

- 549GL being the 2012–13 Required Annual Release calculated under the *Snowy Water Licence*; plus
- 240GL of pre-release of the 2013–14 Required Annual Release; plus
- 115GL of Above Target Water Releases (water not required for RAR releases that Snowy Hydro is able to release at its discretion); plus
- 262GL of Above Target Water from a Relaxation Volume Reduction; in 2012-13.

This total accounted release volume includes 17GL of Montane environmental flow releases provided to the Geehi and Swampy Plains River which did not flow through scheme power stations.

MURRUMBIDGEE RIVER CATCHMENT

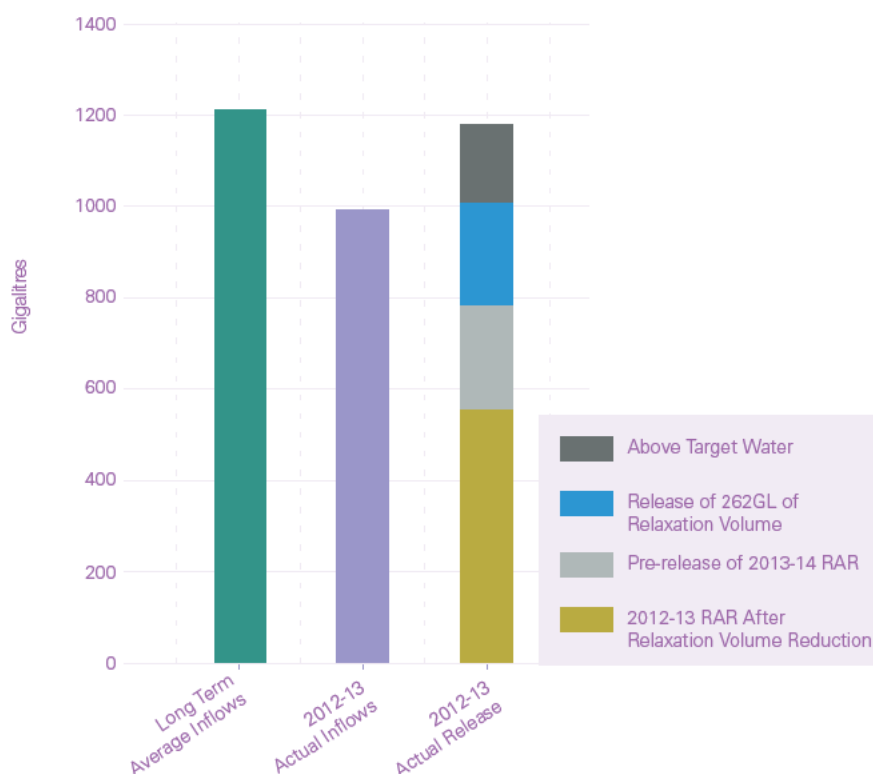
Snowy Hydro complied with its obligation to target the Required Annual Release from the Snowy-Tumut Development to the Murrumbidgee River catchment during the 2012–13 water year.

The total accounted release volume was 1256GL. This was made up of:

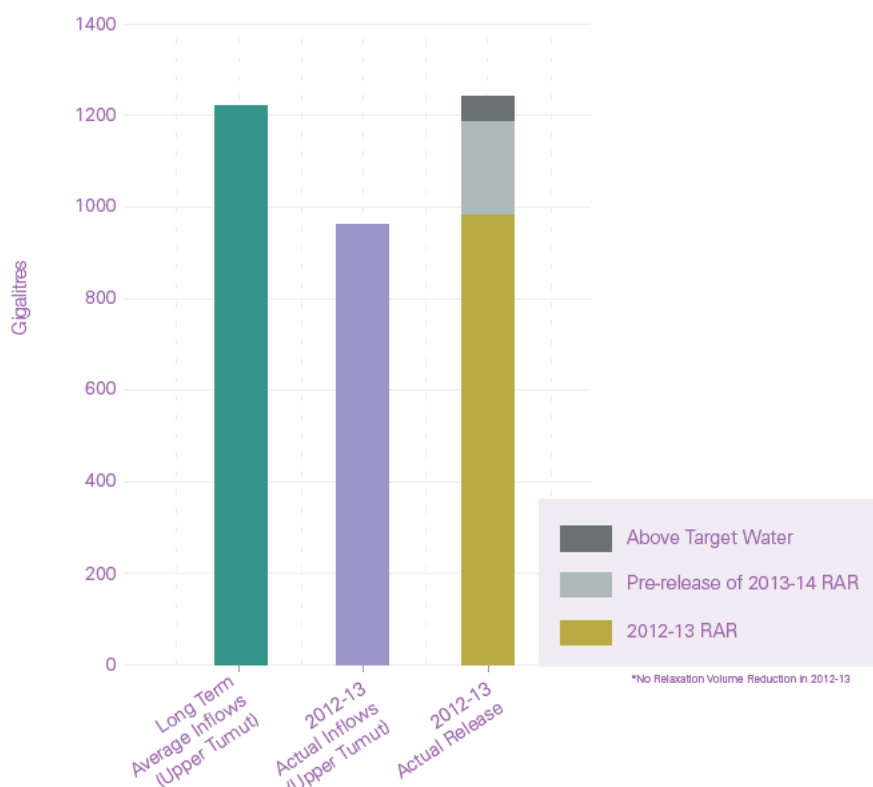
- 983GL being the 2012–13 Required Annual Release calculated under the *Snowy Water Licence*; plus
- 200GL of pre-release of the 2012–13 Required Annual Release; plus
- 74GL of Above Target Water release (water not required for RAR releases that Snowy Hydro is able to release at its discretion).

This total release volume includes 36GL of montane environmental flow releases provided to the Murrumbidgee and Goodradigbee Rivers which did not flow through scheme power stations.

INFLOWS AND RELEASES TO THE RIVER MURRAY CATCHMENT DURING 2012-2013



INFLOWS AND RELEASES TO THE MURRUMBIDGEE CATCHMENT DURING 2012-2013



ENVIRONMENTAL RELEASES

SNOWY RIVER ENVIRONMENTAL FLOWS

As an outcome of the Snowy Water Inquiry commissioned in 1998 into flows down the Snowy River, the releases from the Scheme into the Snowy River have increased. The key element of the environmental flow arrangements under the *Snowy Water Licence* (known as the Snowy River Increased Flows Program (SRIF)) is that the total volume of environmental flows delivered to the Snowy River each year is determined by allocations to entitlements secured by water savings achieved by the Governments to date.

Snowy Hydro does not own the entitlements for the Snowy River environmental flows and is not responsible for securing water savings or for setting the release targets. Snowy Hydro is simply required to meet release targets notified to it by the NSW Office of Water under the *Snowy Water Licence*.

While additional releases to the Snowy River have been occurring since 2002, until 2011-12 water had been limited due to the impact of prolonged droughts and low water availability. With improved inflows, as well as the NSW Office of Water and Victorian Department of Sustainability and the Environment securing over \$400million of water entitlements, the Snowy River is now subject to secure environmental flows.

The table opposite sets out the major steps and accountabilities in the process, from securing water savings on the western rivers through to the actual release of environmental flows.

MAJOR STEP	WHO IS RESPONSIBLE
Securing verified water savings from water savings projects on the River Murray or Murrumbidgee River (or purchase of water entitlements)	Water for Rivers waterforrivers.org.au
Transferring verified water savings into Environmental Entitlements.	NSW Office of Water water.nsw.gov.au VIC Department of Sustainability and Environment dse.vic.gov.au
Calculating annual allocations from the Environmental Entitlements each year (in arrears).	NSW Office of Water water.nsw.gov.au VIC Department of Sustainability and Environment dse.vic.gov.au
Apportioning the annual allocations between the Snowy River Increased Flows and River Murray Increased Flows.	NSW Office of Water water.nsw.gov.au
The determining of annual, monthly and daily release volumes for Snowy River Increased Flows.	NSW Office of Water water.nsw.gov.au
Notifying Snowy Hydro of annual, monthly and daily release volumes for Snowy River Increased Flows.	NSW Office of Water water.nsw.gov.au
Providing infrastructure to enable Snowy River Increased Flows from Jindabyne Dam and modifying existing infrastructure to enable Snowy Montane Rivers Increased Flows.	Snowy Hydro snowyhydro.com.au
Targeting releases of Snowy River Increased Flows from Jindabyne Dam and those structures nominated for Snowy Montane Rivers Increased Flows.	Snowy Hydro snowyhydro.com.au

SNOWY RIVER INCREASED FLOWS

Snowy Hydro complied with its obligation to target releases from Jindabyne Dam for environmental purposes during the 2012–13 water year.

The volume of Snowy River Increased Flows (SRIF) released from Jindabyne Dam during the 2012–13 water year was 154.7GL, which was 0.5GL below the target volume of 155.2GL. That shortfall is well within the $\pm 10\%$ annual tolerance around the target volumes allowed under the *Snowy Water Licence*. The 2013–14 target will be increased to account for this release deficit.

In addition to the environmental releases, 8.5GL Base Passing Flow (BPF) was also released from Jindabyne Dam and 0.5GL riparian flow was released from the Mowamba Weir.

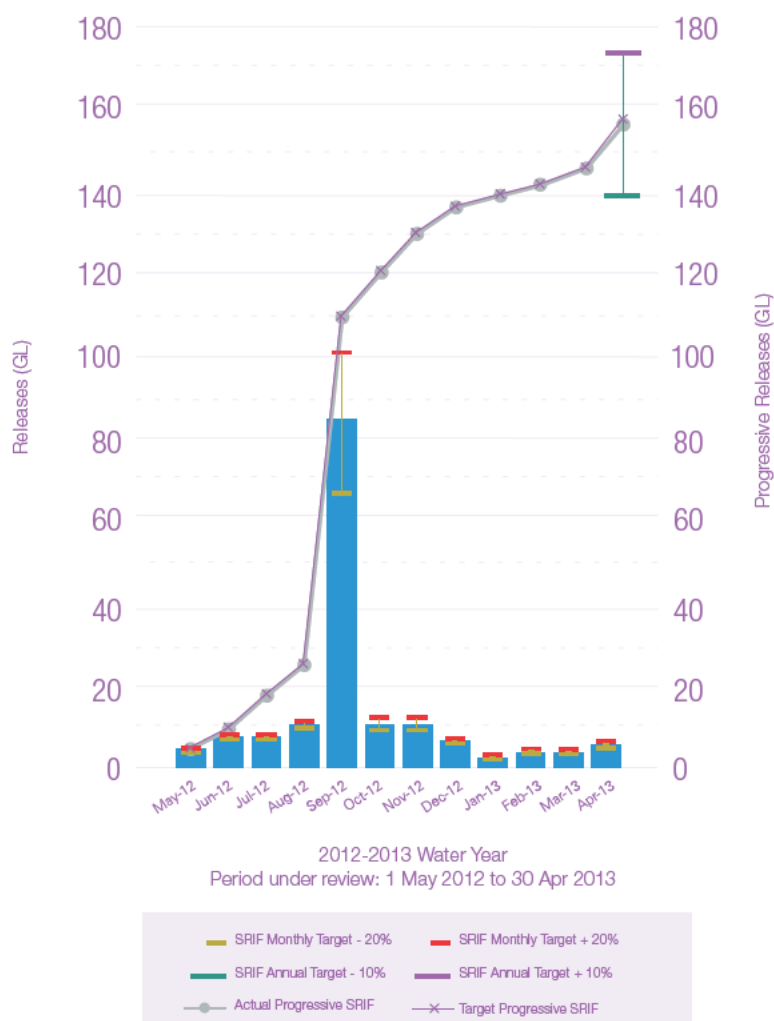
All monthly releases were within the $\pm 20\%$ monthly tolerance around the target volumes allowed under the *Snowy Water Licence*.

All except one of the daily release targets were well within the $\pm 20\%$ daily tolerance allowed under the *Snowy Water Licence*. This occasion occurred in May 2012 due to an incorrect target setting

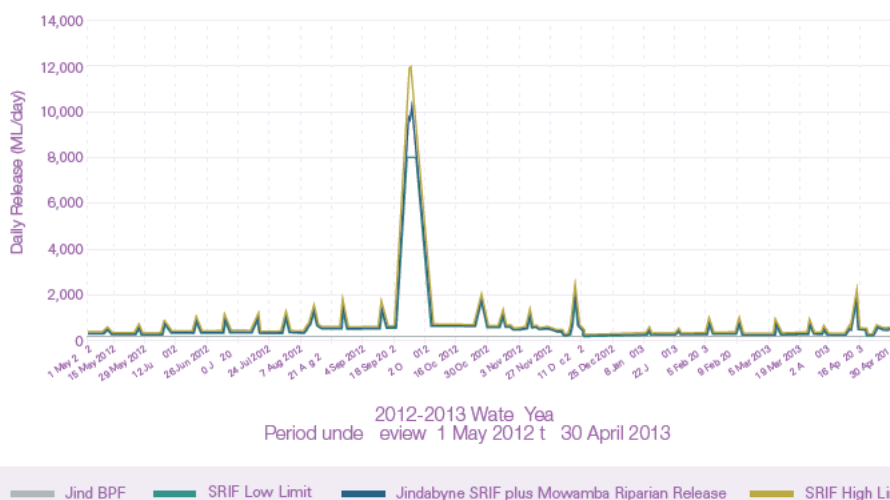
As allocations for the 2012–13 water year once again exceeded 100GL, a flushing flow was delivered to the Snowy River as set out on page 23.

The comparison of the annual, monthly and daily release targets for the Snowy River Increased Flow releases against the actual releases is shown in the following charts.

SNOWY RIVER INCREASED FLOWS AND JINDABYNE BASE PASSING FLOW RELEASES INCLUDING MOWAMBA RIPARIAN RELEASES



SNOWY RIVER INCREASED FLOWS (SRIF) AND JINDABYNE BASE PASSING FLOW (BPF) RELEASES AND DAILY LIMITS



An aerial photograph of the Jindabyne Dam, showing a large concrete structure with multiple spillway gates. Water is cascading over the spillway, creating a large, white, turbulent flow. The surrounding landscape is rugged and hilly, with some vegetation and a road visible on the left side.

DELIVERING 'FLUSHING FLOWS' OUT OF JINDABYNE DAM INTO THE SNOWY RIVER

In any year when allocations exceed 100GL, Snowy Hydro can be instructed by NSW Office of Water to deliver a flushing flow to the Snowy River. A flushing flow is defined as a day when the release target exceeds the 5GL capacity of the other release infrastructure at Jindabyne Dam meaning that the spillway gates must be opened to achieve the flow target.

The intent of the flushing flows is to mimic the effect of the Spring snow melt in the Snowy River. These high flows are intended to scour the bed of the channel and remove fine sediment to improve the habitat of the river for fish and macroinvertebrates.

In September 2012 Snowy Hydro delivered another flushing flow following on from the first in October 2011. The release pattern was set by the NSW Office of Water with releases peaking at 10GL per day and was discharged through the large spillway gates as well as the cone valves. This resulted in Jindabyne lake levels dropping sharply by almost two and a half vertical metres over two weeks as the water was released into the Snowy River.

The NSW Office of Water, working with representatives across local, state and Commonwealth Government agencies, was responsible for the advice to downstream landholders and other stakeholders that would be impacted by the increased Snowy River levels. It is estimated that the Snowy River rose downstream of Jindabyne Dam between approximately 1.8 to 3.6 metres during this time.

Snowy Hydro Engineers, Hydrologists, Technical and Support staff spent months in the planning of the releases with the focus on safety of the public, especially on site, where a temporary public viewing area was established.

The temporary public viewing area was adjacent to the spillway and included a controlled parking area so people could come and see the releases first hand.

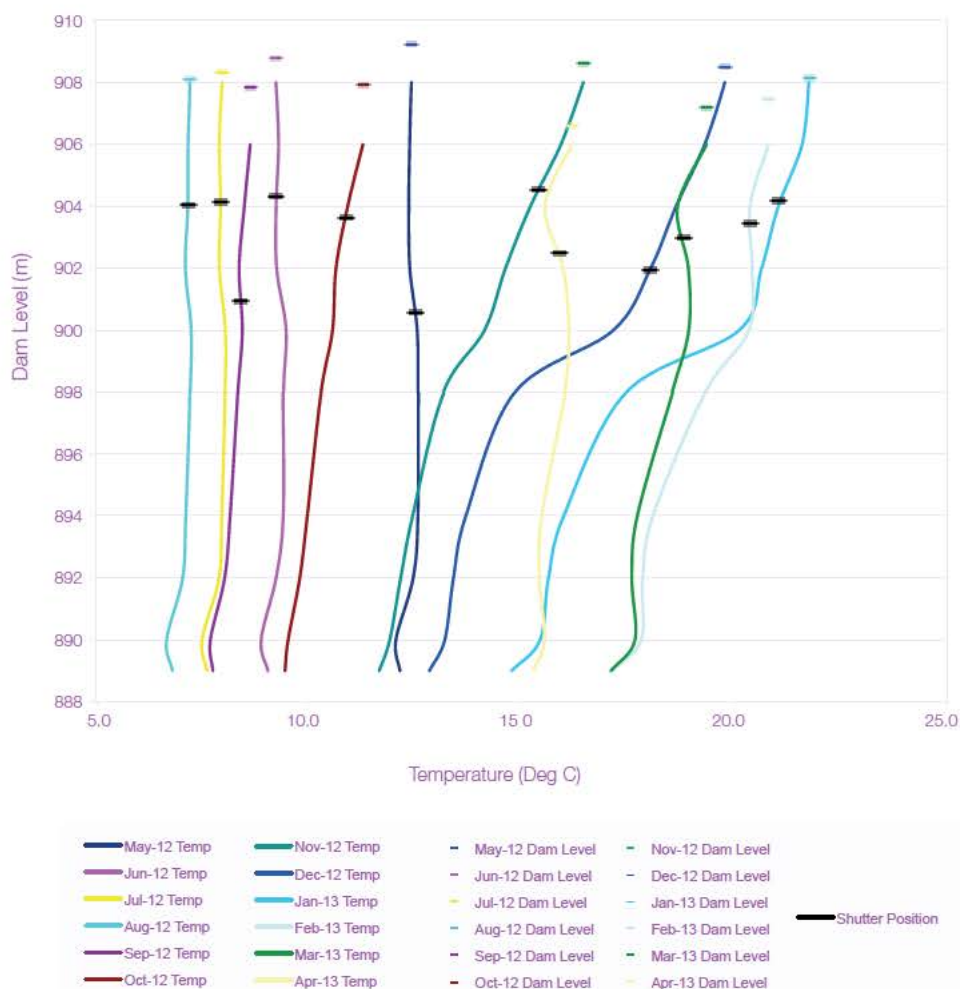
THE TEMPERATURE OF RELEASES FROM LAKE JINDABYNE

The *Snowy Water Licence* requires the outlet works at Jindabyne Dam to be capable of releasing water from above any thermocline in the reservoir. The thermocline is a thin but distinct layer in a large body of water in which water temperature changes more rapidly with depth than it does in the layers above or below. Typically, as the summer progresses, the surface waters warm and the deeper waters remain cold. This causes a lack of mixing between the upper and lower layers, which can result in the lower layer having reduced oxygen levels. For these reasons the deeper waters within reservoirs are generally viewed as having undesirable water quality characteristics for releases, hence the requirement for the outlet works to be able to draw from above the thermocline.

The intake works at Jindabyne are located at the end of a channel excavated into the bank of Lake Jindabyne. In addition to the variable level shutters in the intake tower, the level of the base of the channel means that the deeper waters of the reservoir are inaccessible. This means that the thermocline is only likely to be above the levels of the intake channel when the lake is at much higher levels.

Snowy Hydro undertakes temperature monitoring at the intake tower to detect the presence of a thermocline and adjusts shutter height as necessary. As can be seen in the chart opposite, all releases were made from above the thermocline.

JINDABYNE DAM INTAKE WATER TEMPERATURES AND LEVEL



SNOWY MONTANE RIVERS
INCREASED FLOWS

Snowy Hydro complied with its obligation to target Snowy Montane Rivers releases for Environmental purposes during the 2012–13 water year.

During the 2012–13 water year, Snowy Hydro was directed to make Snowy Montane Rivers Increased Flows (SMRIF) from the following locations:

- Tantangara Dam to the Murrumbidgee River
- Goodradigbee Aqueduct to the Goodradigbee River (a tributary of the Murrumbidgee River); and
- Middle Creek Aqueduct to Middle Creek (a tributary of the Geehi River).

This was the first year that releases had been targeted from Middle Creek Aqueduct to the Geehi River and signals the continuing implementation of this environmental flows program.

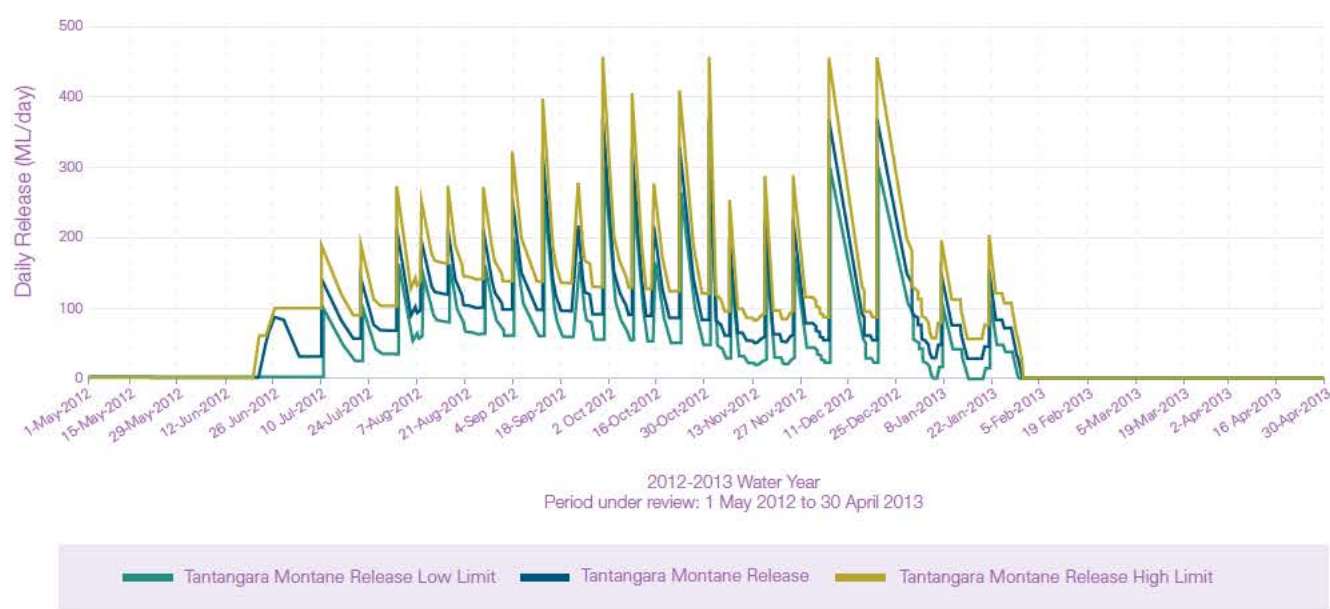
The target volume for Snowy Montane Rivers Increased Flows totalled 54.7GL, with 25.2GL from Tantangara Dam to be released during winter, spring and autumn, 12.0GL from Goodradigbee Aqueduct to be targeted over the whole water year and 17.5GL from Middle Creek to be targeted over the whole year.

The total actual montane release volume was 53.1GL. This was made up of 26.0GL from Tantangara Dam released during winter spring and autumn, 9.8GL from Goodradigbee Aqueduct over the whole water year and 17.3GL from Middle Creek aqueduct over the whole water year.

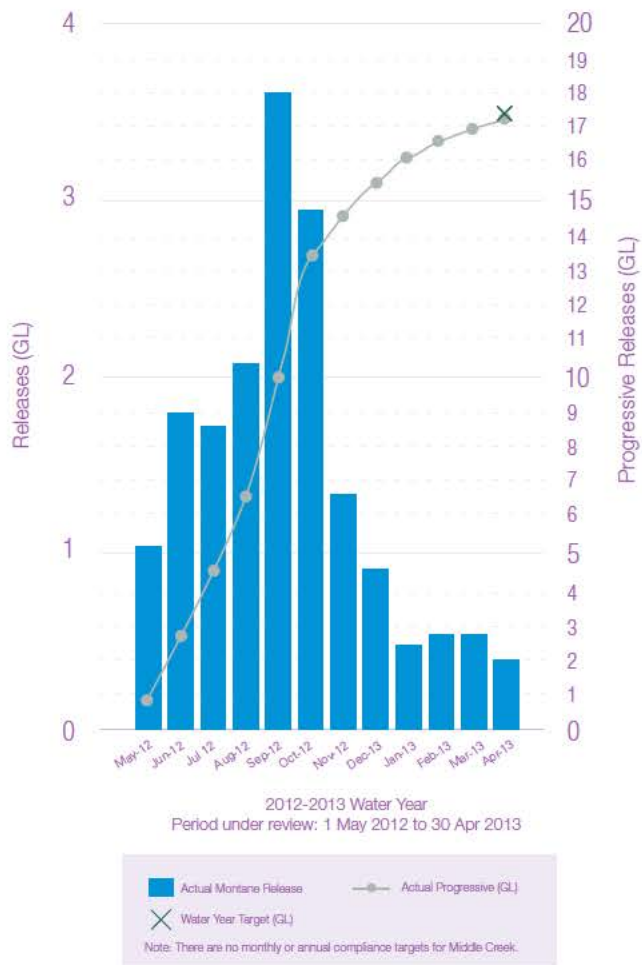
The comparison of the annual, monthly and daily release targets for the Snowy Montane Rivers Increased Flows against the actual from Tantangara Dam is set out in the graphs below and opposite. All daily, monthly and annual release targets were within the compliance limits.

Monthly releases from Goodradigbee and Middle Creek are also provided in the graphs opposite. As these releases are made from small catchments and the inflows (and therefore releases) cannot be predicted or controlled, there are no annual compliance targets for these releases. The below target delivery of water in these catchments in 2012-13 reflects the below average inflows received in these locations. In years when inflows are above average, above average volumes of water will be delivered to these catchments.

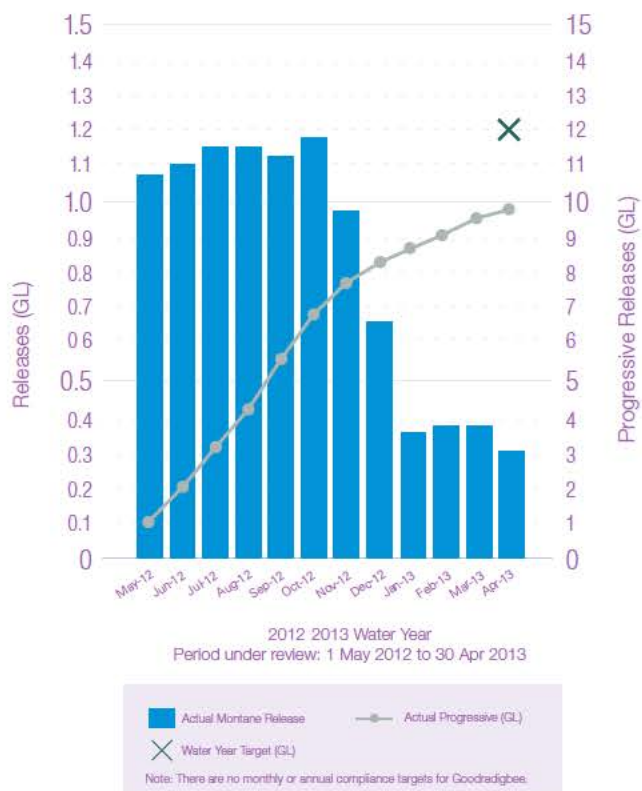
SNOWY MONTANE RIVERS INCREASED FLOWS FROM TANTANGARA DAM AND DAILY LIMITS



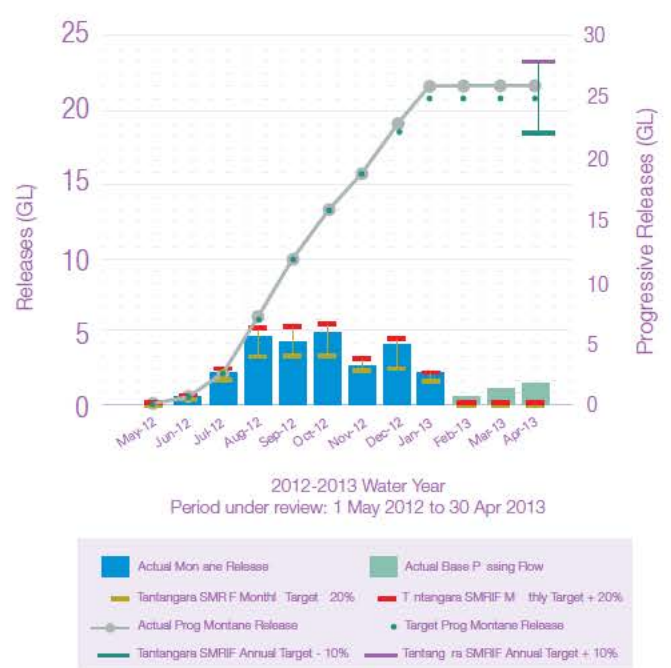
SNOWY MONTANE RIVERS INCREASED FLOWS FROM MIDDLE CREEK WEIR



SNOWY MONTANE RIVERS INCREASED FLOWS FROM GOODRADIGBEE WEIR



SNOWY MONTANE RIVERS INCREASED FLOWS AND BASE PASSING FLOW FROM TANTANGARA DAM



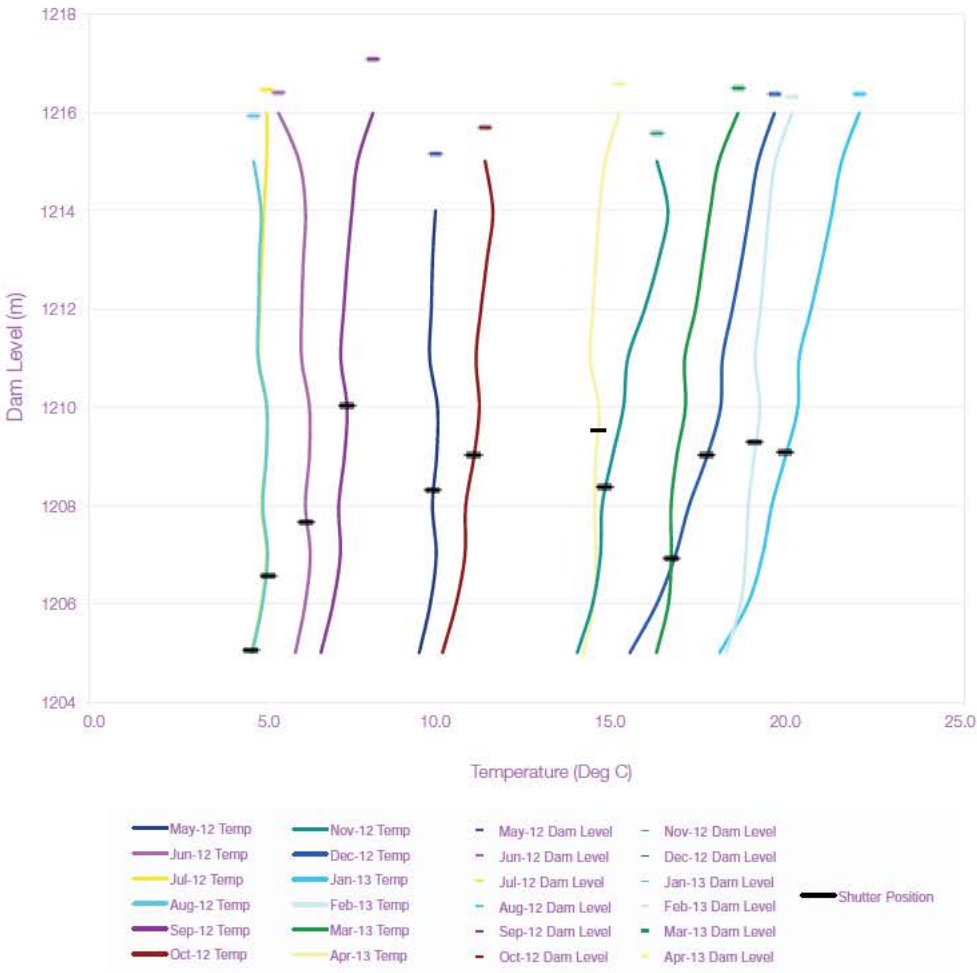
THE TEMPERATURE OF RELEASES FROM TANTANGARA RESERVOIR

The *Snowy Water Licence* requires the outlet works at Tantangara Dam to be capable of releasing water from above any thermocline in the reservoir. The thermocline is a thin but distinct layer in a large body of water in which temperature changes more rapidly with depth than it does in the layers above or below. Typically, as the summer progresses, the surface waters warm and the deeper waters remain cold. This causes a lack of mixing between the upper and lower layers, which often results in the lower layer having reduced oxygen levels. For these reasons the deeper waters within reservoirs are generally viewed as having undesirable water quality characteristics for releases, hence the requirement for the outlet works to be able to draw from above the thermocline.

The new intake works at Tantangara Dam are located on the upstream face of the dam wall. They comprise a series of ‘telescoping’ shutters to create a variable level off-take.

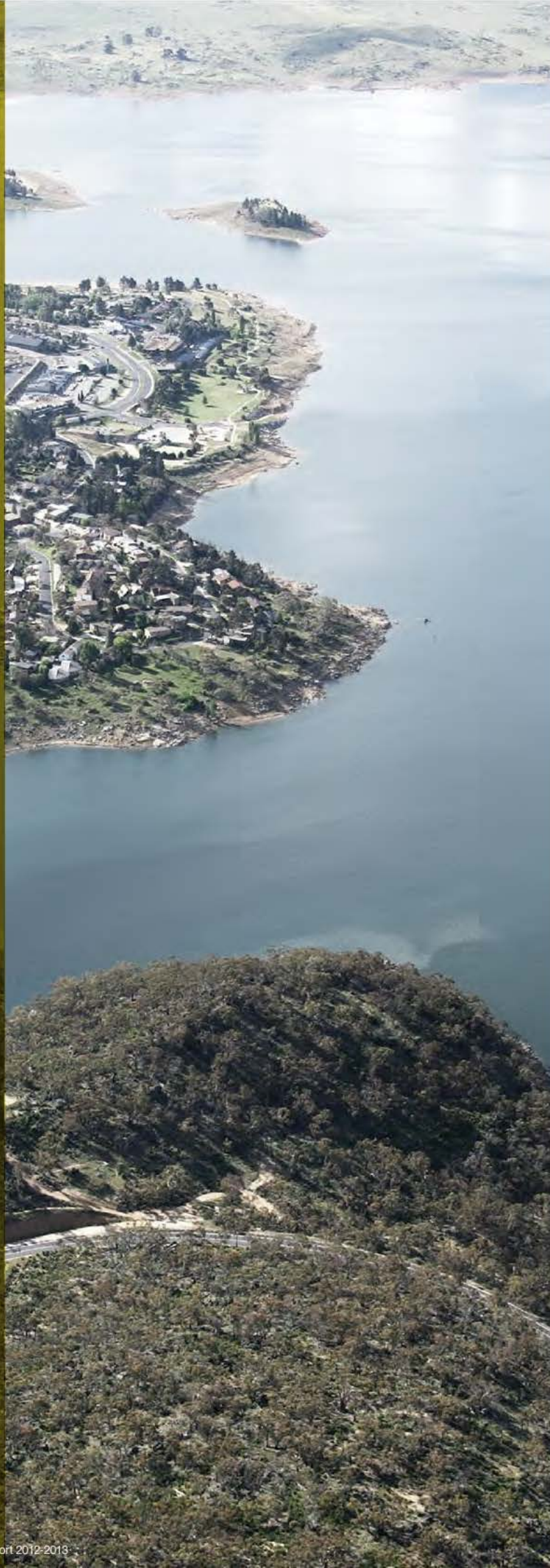
Snowy Hydro undertakes temperature monitoring at the intake tower to detect the presence of a thermocline and adjusts the shutter height as necessary. As can be seen in the chart opposite, a persistent thermocline was not present during the 2012-13 water year.

TANTANGARA DAM INTAKE WATER TEMPERATURES AND LEVEL





LAKES & FORESHORES



Jindabyne

LAKE & FORESHORES

WHO MANAGES WHAT?

With so many large water storages, the Scheme has become a base for many tourism and recreational opportunities. Therefore, it is easy to assume that Snowy Hydro holds accountability for all the lakes and their foreshores. The reality is somewhat different.

With a number of these storages adjoining national parks or private lands, many different agencies and organisations are responsible for different aspects of recreational management and access.

The following table sets out the major accountabilities across Scheme storages:

ACTIVITY	WHO IS RESPONSIBLE
Recreational Boat Access <i>**Snowy Hydro allows boat access on all major storages. Smaller storages such as Island Bend, Guthega and Tumut Pond are prone to having quick rise and fall of levels therefore boating is not recommended.</i>	<ul style="list-style-type: none"> • Shire Councils • NPWS for locations within the National Park i.e. Waste Point at Jindabyne • Private lakeside operators i.e. Buckenderra Holiday Park on Lake Eucumbene
Recreational Boating Safety	<ul style="list-style-type: none"> • NSW Maritime • NSW Water Police • NSW Marine Rescue
Accommodation & Camping	<ul style="list-style-type: none"> • Private Caravan Parks • NPWS i.e. Denison Camping Area, Lake Eucumbene
General Public and vehicular access	<ul style="list-style-type: none"> • Snowy Hydro for areas such as Yens Bay, Rushes Bay, Middlingbank, Seven Gates around Lake Eucumbene • Snowy River Shire Council for the southern foreshore of Lake Jindabyne from Curiosity Rocks to Coppertorn Point (Note: This includes the foreshore area and footpath in front of Jindabyne township). • NPWS for the foreshore areas that adjoin the KNP
Stocking of Trout in Snowy Scheme Lakes	<ul style="list-style-type: none"> • NSW Fisheries
Lake based event approvals	<ul style="list-style-type: none"> • Page 37

WHERE IS YOUR EVENT TAKING PLACE?

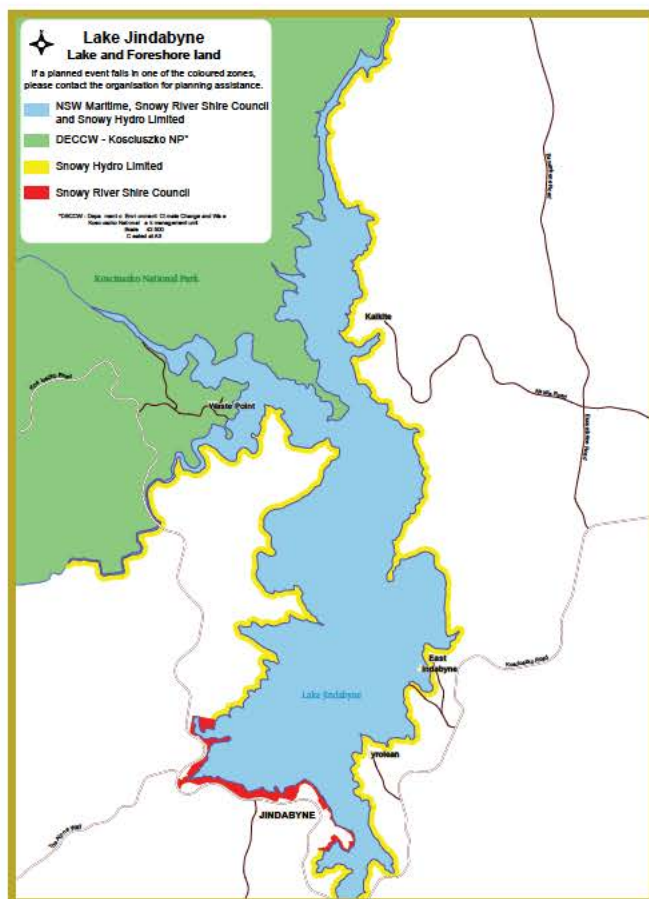
The Lakes of Jindabyne and Eucumbene are popular areas for a range of activities and events. These events provide an opportunity to promote the region and are an important part of local community life. Given the various land ownership arrangements, regulatory and licence obligations of each stakeholder, it is critical that all events and commercial activities are properly managed and importantly, legally conducted.

This step by step guide provides a clear overview of the specific needs dependant on the location or type of event or activity taking place. Using the below table, and referencing against the maps opposite, you can see the approvals required for running events and activities on Lake Jindabyne and Lake Eucumbene.

LAND ONLY (in pink only)	LAND ONLY (not in pink only)	INVOLVES ANY WATER
Obtain an event application pack from Snowy River Shire Council Environmental Services Department Jindabyne 02 6451 1550 www.snowyriver.nsw.gov.au		
Submit Development Application to Snowy River Shire Council		Contact NSW Maritime to obtain Aquatic License information ph: 13 12 56
	Obtain a license from Snowy Hydro. Contact lands.team@snowyhydro.com.au	
	Snowy Hydro required to sign Development Application (land owners consent)	
	Submit Development Application and Snowy Hydro license to Snowy River Shire Council	
Development Application Approved (subject to Council determination)		
		Submit Aquatic License application to NSW Maritime with a copy of Council Approval.
		Aquatic License Approved (subject to NSW Maritime determination)

- Approval timeframes for larger events may be up to 3 months.
- Separate approvals from Department of Environment Climate Change and Water (DECCW) will be required if your event takes place in any part of Kosciuszko National Park.
- Some community events are exempt from this process.

- Land only (in pink only)
- Land only (not in pink only)
- Involves any water
- Involves all 3
- Land only (not in pink) and involves any water



CAMPING NOT PERMITTED ON LAKE FORESHORES

Camping is not permitted on lake foreshores except for in established caravan park areas and NPWS areas such as Denison at Lake Eucumbene.

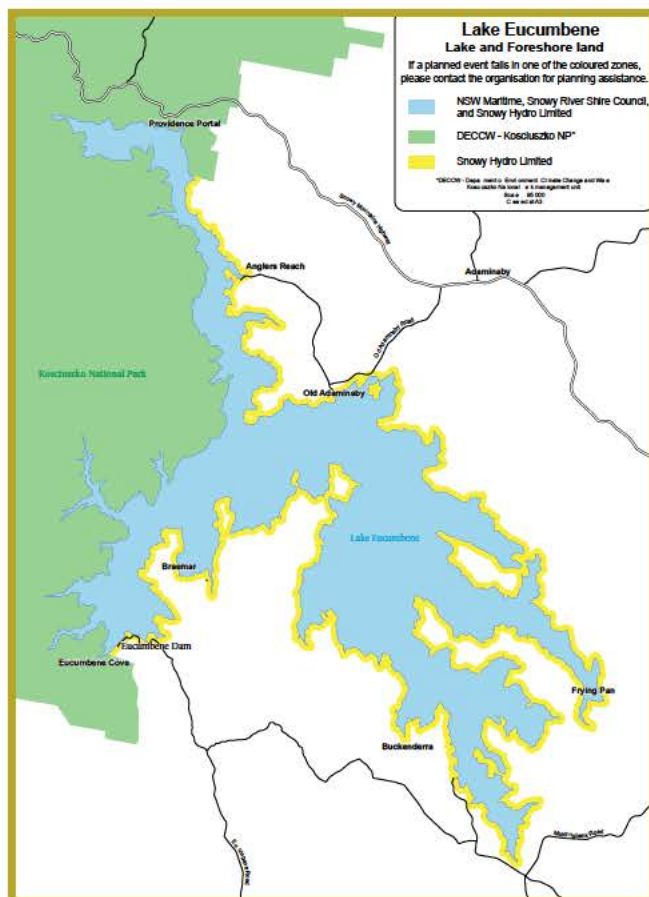
Snowy Hydro cares for over 22,000 hectares of land outside Kosciuszko National Park, approximately 600km of this is foreshore around water storages like Jindabyne, Eucumbene, Khancoban and Talbingo/Jounama, as well as numerous smaller lakes.

These foreshores play a crucial role on the edge of storages holding the water in the Scheme, but they also provide opportunities for a variety of recreational and community activities. This creates the enormous challenge in keeping foreshores safe and free from rubbish and human waste. The scale of the area and the fact that visitors are welcome to access most of the foreshore any time, makes this a big challenge. Snowy Hydro is committed to the task, but frankly cannot do it without the active contribution of everyone who enjoys and benefits from the use of these areas, from farmers to fishermen, local tourism businesses and Councils.

Everyone can contribute to helping with these challenges by:

- keeping to the existing tracks,
- taking rubbish with you,
- using toilets provided; and
- camping only in designated areas and caravan parks. You can also report antisocial or dangerous behaviour to the local police when you see it.

The long term plan for these foreshores is to maintain them as safe and environmentally healthy edges to the hydro storages, which in turn will ensure that their recreational value is not impacted over time. We ask that everyone who enjoys use of these areas to support us in working together to make this happen.







making excellence a habit™

VERIFICATION STATEMENT

Snowy Hydro Limited commissioned BSI incorporating NCSI to verify the data from its Water Operations Report for the 2012-2013 Water Year in respect of the volumes that it was required to target and the actual releases made to meet those targets.

Responsibilities of the Verifier:

NCS International was not responsible for the preparation of any part of the report. The audit was carried out using recognised assessment techniques based on ISO19011 with the Water Operations Report as the core reference. The audit was office based and included interviews with staff.

Scope:

Numerical values provided in the Water Operations Report were compared with the required target volumes from the approved Annual Water Operating Plan (2012-2013 Water Year) and actual releases were compared with a sample of entries from the water accounting databases. Records of maintenance and calibration of equipment used in monitoring water flows were also reviewed.

The verification reviewed data for reasonableness and where practical checked the order of magnitude, but detailed calculations were not carried out.

Verification Statement:

Based on the data review process applied during the audit, no discrepancies were identified in the Water Operations Report for the 2012-2013 Water Year and the report provides a fair representation of the required target volumes and Snowy Hydro Limited's water operations.

Chee Meng Wong
Senior Auditor
BSI incorporating NCSI
30 August 2013

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snowyhydro
renewable energy