



# WATER

OPERATIONS REPORT  
2010 - 2011

**snowyhydro**  
*renewable energy*

# Foreword

This is the fourth annual *Water Operations Report* that has been prepared by Snowy Hydro. As with the previous three reports, this report will be widely distributed to our company's stakeholders and those local communities and businesses associated with the Snowy Scheme, both in hard copy and online.

This *Water Operations Report* describes how the Snowy Scheme operates, Snowy Hydro's water operations in the 2010–11 water year (1 May 2010–30 April 2011) and how Snowy Hydro met its obligations under the *Snowy Water Licence* during that water year.

Highlights of the 2010–11 water year included:

- the strong recovery of inflows into the Snowy Scheme;
- co-operative management of high inflow events between State Water and Snowy Hydro to mitigate flooding on the Tumut River;
- arrangements put in place with the NSW Office of Water to reduce the annual release amount to the Murrumbidgee catchment to further reduce the impact of continuing wet conditions;
- commitment by the NSW Office of Water to review the *Snowy Water Licence* to improve the operation of the Dry Inflow Sequence formula during drought recovery; and

- increased Snowy River Environmental Flows and the repayment of the Mowamba Borrow as a result of a special, one-off arrangement to allocate additional water to the Snowy River.

Snowy Hydro makes available to the public a large amount of information regarding the water operations of the Snowy Scheme – principally through this *Water Operations Report* and further more detailed information on our company's website [www.snowyhydro.com.au](http://www.snowyhydro.com.au)

Snowy Hydro is committed to improving stakeholder understanding and appreciation of the many responsibilities and stringent obligations that our company has to comply with in relation to the water resources of the Snowy Scheme. Through reading the information contained in this report, we trust that the community and stakeholders will be more informed of the facts about water management of the Snowy Scheme.

On page 31 of this document you will find an independent audit report that provides verification of the data contained within this 2010–11 *Water Operations Report*. Further information including terminology, calculation of data and *Snowy Water Licence* obligations can be found by visiting [www.snowyhydro.com.au](http://www.snowyhydro.com.au)



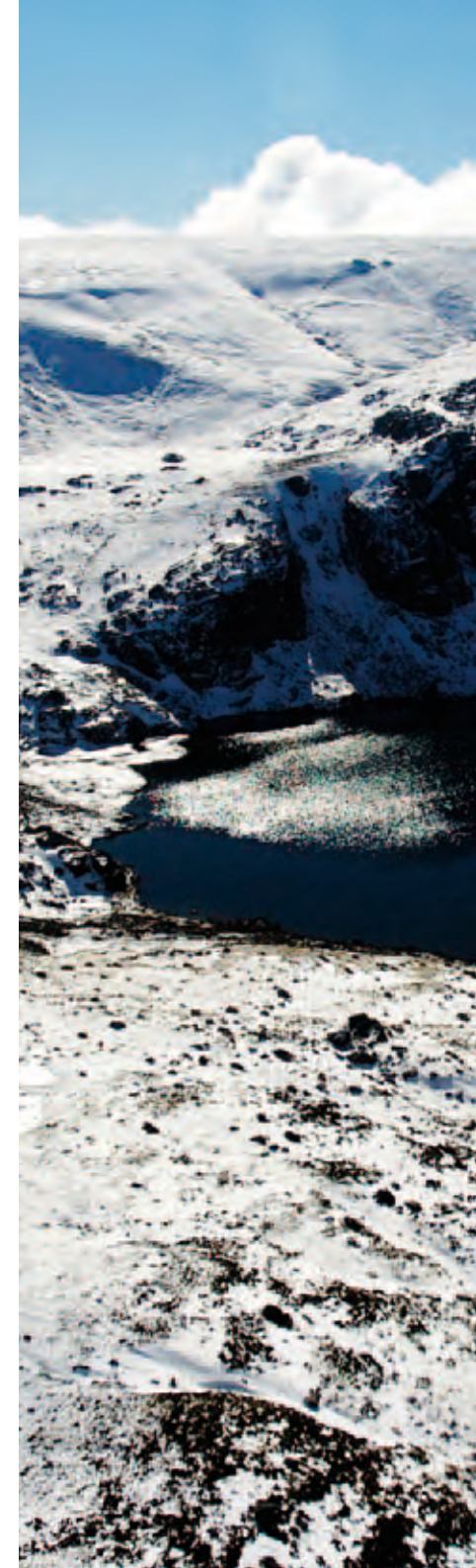
---

**David Harris**  
Executive Officer, Water  
Snowy Hydro Limited

---

# Contents

|   |    |   |    |
|---|----|---|----|
| PURPOSE OF THIS REPORT                                  | 04 | DRY INFLOW SEQUENCE VOLUME<br>AND INFLOW RECOVERY | 16 |
| KEY RESULTS   | 05 | INFLOWS   | 18 |
| OVERVIEW OF SNOWY HYDRO                                 | 06 | WESTERN RIVER RELEASES                            | 20 |
| THE SNOWY WATER LICENCE AND<br>THE SNOWY HYDRO BUSINESS | 07 | ENVIRONMENTAL RELEASES                            | 22 |
| DOWNSTREAM FROM THE<br>SNOWY SCHEME                     | 08 | SNOWY RIVER INCREASED FLOWS                       | 24 |
| HOW THE SNOWY SCHEME WORKS                              | 09 | SNOWY MONTANE RIVERS<br>INCREASED FLOWS           | 26 |
| THE SNOWY-TUMUT DEVELOPMENT                             | 12 | STORAGES  | 29 |
| THE SNOWY-MURRAY DEVELOPMENT                            | 13 |   |    |





# Purpose of this report

The main purpose of this 2010-11 *Water Operations Report* is to provide Snowy Hydro's many stakeholders with information on how our company performed in the 2010-11 water year in meeting the many obligations specified under the *Snowy Water Licence*.

The obligations essentially relate to:

1. targeting 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*;
2. targeting water releases from Jindabyne Dam into the Snowy River for environmental purposes (Snowy River Increased Flows); and
3. facilitating potential additional natural flows over nominated Snowy Scheme aqueducts and targeting releases from Tantangara Dam, both for environmental purposes (Snowy Montane Rivers Increased Flows).

---

## Understanding this Report

- The Snowy Hydro water year commences on 1 May and concludes on 30 April each calendar year.
  - Volumes in this report are quoted in gigalitres (GL). 1 gigalitre is equal to 1,000 megalitres (ML). 1 megalitre is equal to 1 million litres.
  - Since the commencement of the operation of the Snowy Scheme, water release volumes have been set as targets and any minor differences between the target and actual release volumes (excess or shortfall) are carried over to the next water year. This is done in the form of 'overs and unders' and is expressly permitted in the *Snowy Water Licence* in recognition of the difficulties inherent in achieving precise release volumes using infrastructure on the large scale of that comprising the Snowy Scheme.
-

# Key results

Snowy Hydro complied with all of the requirements of the *Snowy Water Licence* imposed upon the company during the 2010-11 water year.

During the 2010-11 water year, Snowy Hydro complied with 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 from Tantangara Dam
- environmental releases from Goodradigbee Aqueduct

The 13-year period of prolonged drought, which included the lowest inflow year on record during 2006-07, now appears to be over with our first year of above average inflows recorded this water year. Despite this, in excess of five consecutive years of average inflows are still required to see Lake Eucumbene storage levels restored to long term average levels.

Photo: Guthega Dam



# Overview of Snowy Hydro

The shares in Snowy Hydro Limited 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. Today, Snowy Hydro's portfolio includes Red Energy, two gas fired generation plants in Victoria and the Snowy Mountains Hydro-electric Scheme.

The Snowy Scheme was built over a 25-year period from 1949 to 1974. It includes 16 major dams, nine power stations, 145km of interconnected tunnels and 80km of aqueducts. The Snowy Scheme only became a reality when the Governments worked out a way to pay for the construction and maintenance of the Snowy Scheme, which was from the sale of the Snowy Scheme's electricity output.

The Snowy Mountains Hydro-electric Authority was responsible for the construction and maintenance of the Snowy Scheme under the direction of the Snowy Mountains Council.

From 1998, when the National Electricity Market (NEM) was formed, the electricity output from the Snowy Scheme was bid into the NEM with all other energy companies in an open, competitive marketplace. Snowy Hydro Trading Pty Ltd was formed to trade the electricity output of the Snowy Scheme in the NEM.

In 2002, the Snowy Mountains Council and the Snowy Mountains Hydro-electric Authority were abolished and the Snowy Scheme was transferred to Snowy Hydro Limited.

Snowy Hydro now operates the 3,950 megawatt (MW) Snowy Scheme and also owns and operates the 300MW Valley Power gas-fired power station and the 320MW Laverton North gas-fired power station, both located in Victoria.

Red Energy, an electricity and gas retailer, is a subsidiary of Snowy Hydro Limited. Red Energy currently operates in Victoria, New South Wales and South Australia and has over 300,000 electricity and gas retail customers.

Snowy Hydro today is a growing business providing a range of price risk hedging products to participants in the competitive NEM.

snowyhydro  
renewable energy

# The Snowy Water Licence and the Snowy Hydro business

To ensure that the benefits of the Snowy Scheme could be maximised for both water security and electricity generation, a set of operating principles and water accounting rules was developed by the Commonwealth, New South Wales and Victorian Governments under the 1957 Snowy Agreement.

On Corporatisation of the Snowy Scheme in 2002, the key elements of those operating principles and water accounting rules were codified and carried forward in the *Snowy Water Licence* issued by the New South Wales Government.

The *Snowy Water Licence* is not a freedom to act, as is the case with most licence arrangements. Rather, it is a bundle of a few rights and numerous, legally binding and enforceable obligations. The many legally binding obligations imposed on Snowy Hydro under the *Snowy Water Licence* include obligations with regard to targeting water releases from the Snowy Scheme.

Snowy Hydro's rights to collect, divert, store and release water under the *Snowy Water Licence* in no way represent any form of ownership of the water. All of the water in the Snowy Scheme is owned by the parties who have an entitlement to releases from the Snowy Scheme. This includes the States of New South Wales and Victoria, irrigators from those states and environmental entitlement holders.

---

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, electricity generation and their associated market impacts are inseparably linked.

The mandatory nature of the obligations imposed upon Snowy Hydro by the *Snowy Water Licence* means that, as a practical matter, Snowy Hydro operates 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*.

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

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

# Downstream from the Snowy Scheme

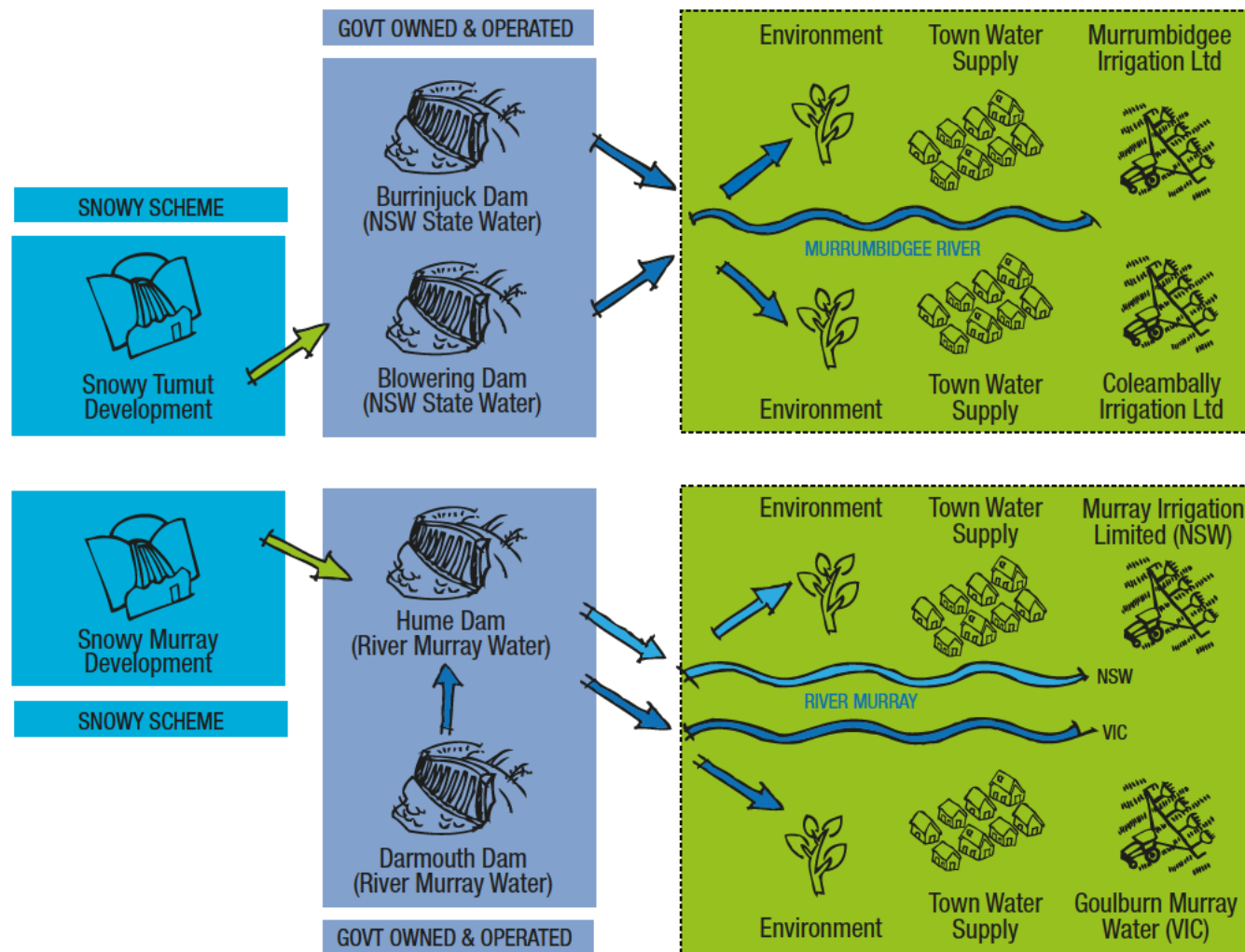
Snowy Scheme releases and other River Murray and Murrumbidgee River catchment inflows are re-regulated by Hume Dam on the River Murray and Blowering Dam on the Tumut River – neither of which are owned or controlled by Snowy Hydro.

**Snowy Hydro has no involvement or even influence in the allocation or delivery of water to downstream extractive and environmental water users.**

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 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 make releases into nor has any control over the operations of Burrinjuck Dam).

Snowy Hydro does not have operational control of Blowering Dam and this is highlighted on page 16 and 17 that describes the events of December 2010 along the Tumut River and the subsequent Ministerial Inquiry into flooding along the Tumut River in late 2010. On 16 August 2011 the Inquiry reported that Snowy Hydro did not exacerbate flooding and in fact mitigated flooding during the high inflow events.



# How the Snowy Scheme works

The Snowy Scheme has the distinction of being one of the most complex, multi-purpose, multi-reservoir hydro schemes ever built.

The Snowy Scheme's features include:

- 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
- 16 major dams and 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
- 33 turbines with a generating capacity of 3,950MW.

The Snowy Scheme was designed to collect and store water, including water that would otherwise flow east of the Snowy Mountains 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, extractive and environmental uses.

The Snowy Scheme comprises two major developments: the northern Snowy-Tumut Development and the southern Snowy-Murray Development.

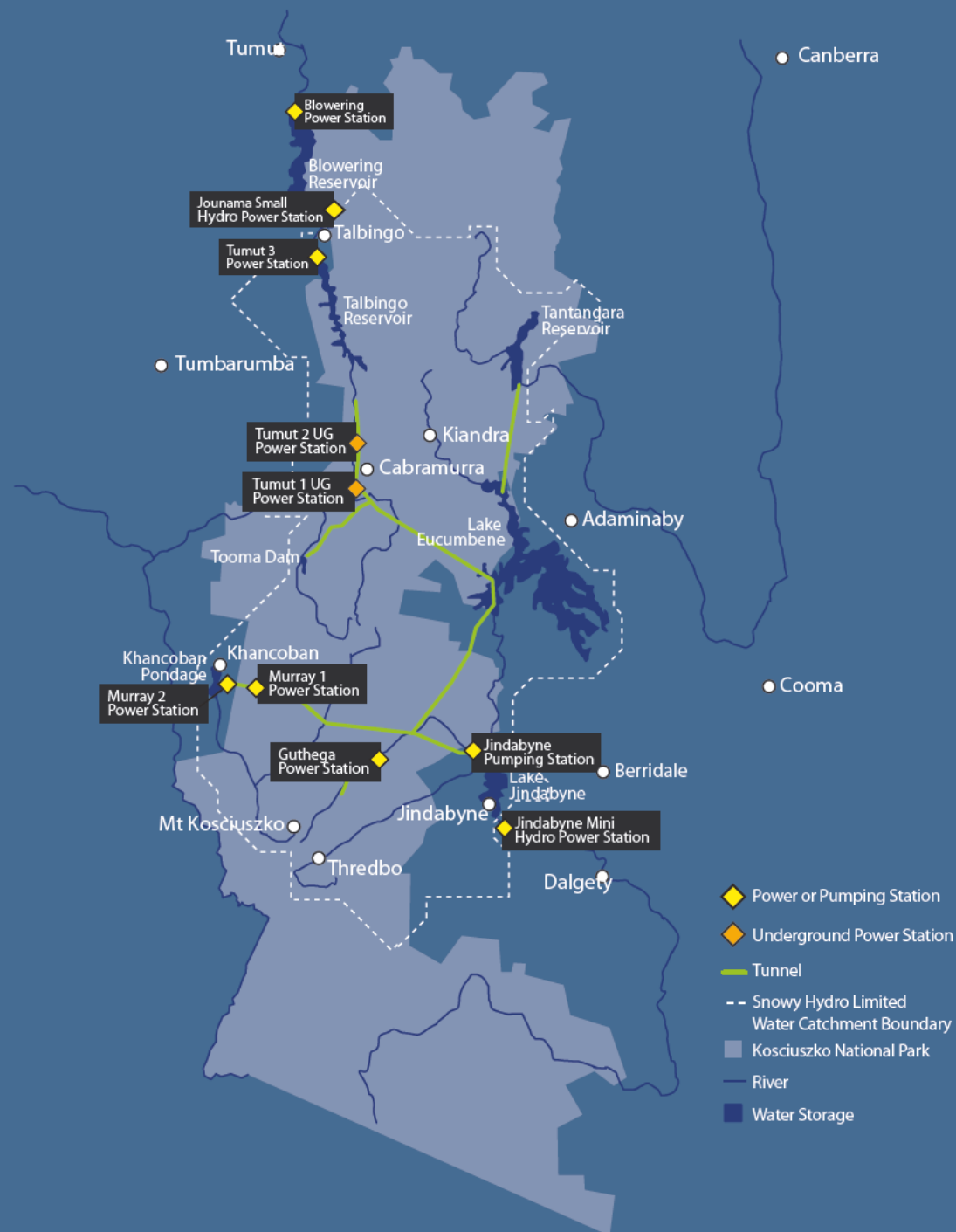
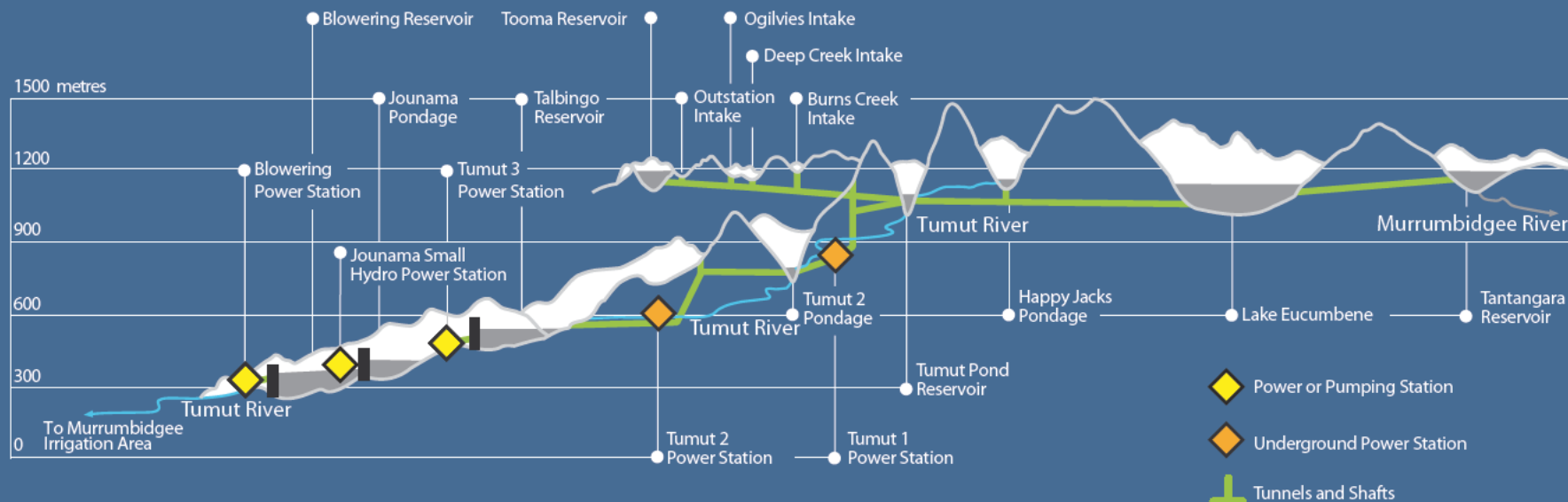




Photo: Lake Jindabyne





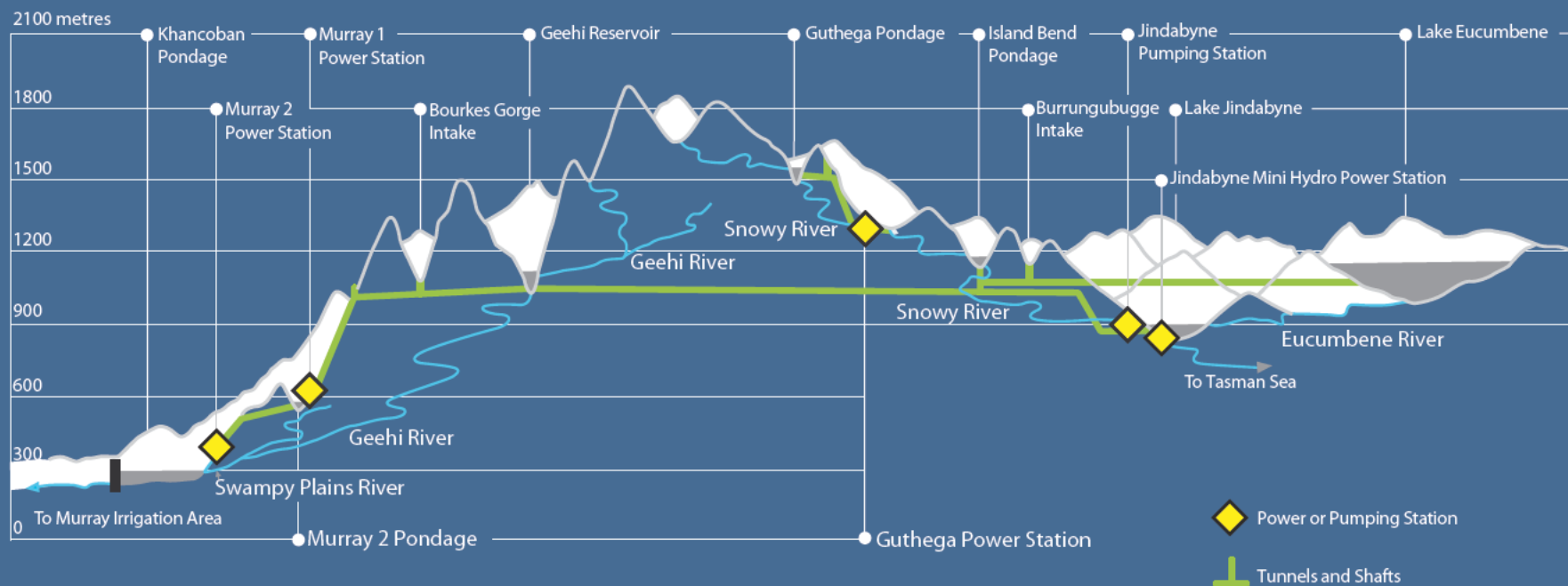
# The Snowy-Tumut Development

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 generators at Tumut 3 Power Station have pumps that can be used to pump water from Jounama Pondage back up into Talbingo Reservoir, thereby 'recycling' water. Water is generally released from Jounama Dam into Blowering Reservoir through the Jounama Small Hydro power station 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 as State Water releases water from Blowering Dam into the Tumut River, which joins the Murrumbidgee River near Gundagai.

On the Murrumbidgee River, as at Gundagai, the Snowy Scheme contributes inflows of around 25% during average inflow years but 60% 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. Inflows into the relatively small Guthega Pondage are seasonal. 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 times of low inflows, water from Island Bend Pondage is diverted to Geehi Reservoir through a trans-mountain tunnel, together with water which flows back from Lake Eucumbene. The Jindabyne Pumping Station pumps water from Lake Jindabyne, normally using off-peak power, into Geehi Reservoir on the western side of the Great Dividing Range.

Additionally, the Jindabyne Mini Hydro Power Station allows Snowy Hydro to recover a small amount of electricity from some of the environmental releases into the Snowy River.

Water from Lake Jindabyne cannot be pumped back to Lake Eucumbene.

From Geehi Reservoir, with additional water from the Geehi River, the water passes through Murray 1 and Murray 2 power stations. Khancoban Dam regulates water released from Murray 2 Power Station down the Swampy Plain River which is a tributary of the upper River Murray.

On the River Murray, as at the Hume Dam, the Snowy Scheme contributes inflows of around 8% during average inflow years but 33% during drought years.



Photo: Guthega Dam



# Dry Inflow Sequence Volume and Inflow Recovery

Snowy Hydro's primary obligation under the *Snowy Water Licence* is to release a calculated volume of water annually to each of the River Murray and Murrumbidgee River catchments. Each of these volumes is calculated principally by reference to inflows.

In drought years, the volume of water to be released from the Snowy Scheme is reduced under the formulae set out in the *Snowy Water Licence*. This is known as the Dry Inflow Sequence Volume (DISV) reduction.

This reduces the releases to be made from the Scheme during dry periods but it also means that a "debt" is run up for every year that our releases are reduced under the *Snowy Water Licence*.

This reduction to the volume of water to be released from the Snowy Scheme has been applied since the 2006-07 water year, which was the lowest year on record for inflows into the Snowy Scheme. In 2006-07 only 683GL flowed into the Snowy Scheme storages compared to long term average annual inflows of around 2,800GL.

However, in the 2010-11 water year, the RAR was higher than in previous years because it included a volume of accumulated DISV water; the "debt" that under the original provisions in the *Snowy Water Licence* must be repaid as soon as inflow conditions improve.

Significant rainfall occurred in much of New South Wales, including Snowy Hydro catchment areas, in the second half of 2010. Indeed, Blowering and Burrinjuck Dams experienced record inflows in December of that year. These wet conditions caused flooding on the Tumut River in October and December 2010.

Recognising the risk posed by making those releases, Snowy Hydro commenced discussions with the NSW Office of Water to reduce the RAR for that water year. A one-off reduction was agreed, in accordance with clause 13.1 of the *Snowy Water Licence*, on 23 December 2010, but only in relation to the Snowy-Tumut Development.

Furthermore, in April 2010 the NSW Office of Water commenced discussions with Snowy Hydro that ultimately lead to the removal of the requirement to release accumulated DISV water in wet years, and so avoid the scenario of having to release an increased RAR during periods of high rainfall. This, together with a number of other amendments, took effect on 4th October 2011.

---

Given the forecast for continuing wet conditions, releasing the full RAR could have potentially exacerbated downstream flooding.

---

---

## Tumut River Flood Management in 2010

The catchments of the Snowy Scheme experienced heavy rainfall in the latter half of 2010 culminating in flooding on the Tumut River. Leading up to this, Snowy Hydro voluntarily reduced its releases from the Snowy-Tumut Development so as not to exacerbate downstream conditions. These actions were subsequently acknowledged in a Ministerial review conducted by the NSW Office of Water.

In recognition of the continuing wet conditions, Snowy Hydro reached agreement with the NSW Office of Water to reduce the total volume of its releases from the Snowy-Tumut Development in the 2010-11 water year.

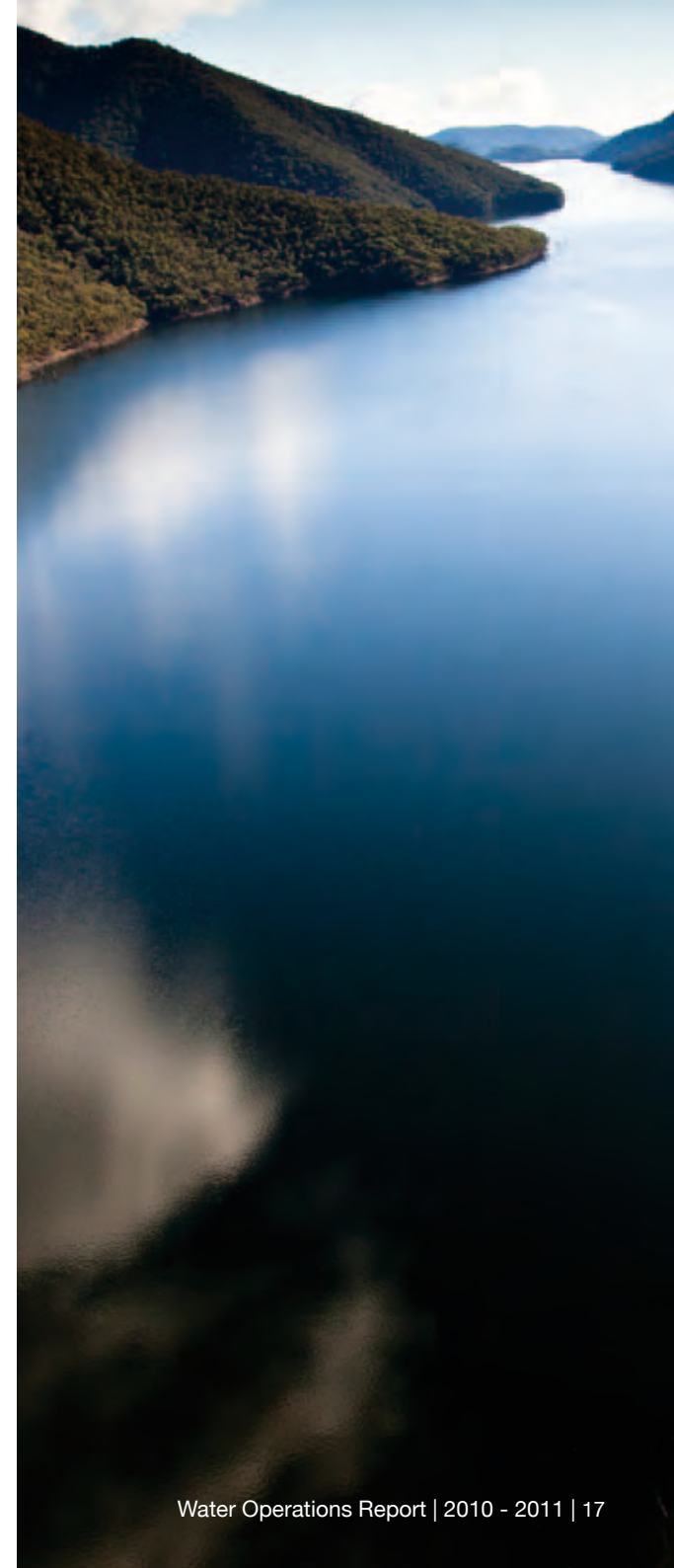
Discussions also started to formally amend the *Snowy Water Licence* so that it would not require additional releases to be made from either of the Scheme's developments when conditions change from "dry" to "wet". These formal amendments became effective on 4th October 2011.

---

## The Flood Management Review

Prior to both flood events, Snowy Hydro had reduced releases from Jounama Pondage below 'natural' inflows. In this respect, Snowy Hydro went beyond the obligations imposed on it by the *Snowy Water Licence*, which states that Snowy Hydro must not release water from Jounama Dam in excess of natural inflows if Blowering Dam is spilling and the operating channel capacity of the Tumut River is being exceeded.

These voluntary, additional reductions in releases had the effect of delaying inflows into Blowering Dam, giving State Water an additional buffer to delay downstream releases, and thereby mitigate the downstream flood events. This was subsequently acknowledged in the Ministerial review of water management during the 2010 flood events in the Tumut River and Murrumbidgee River carried out by the NSW Office of Water.

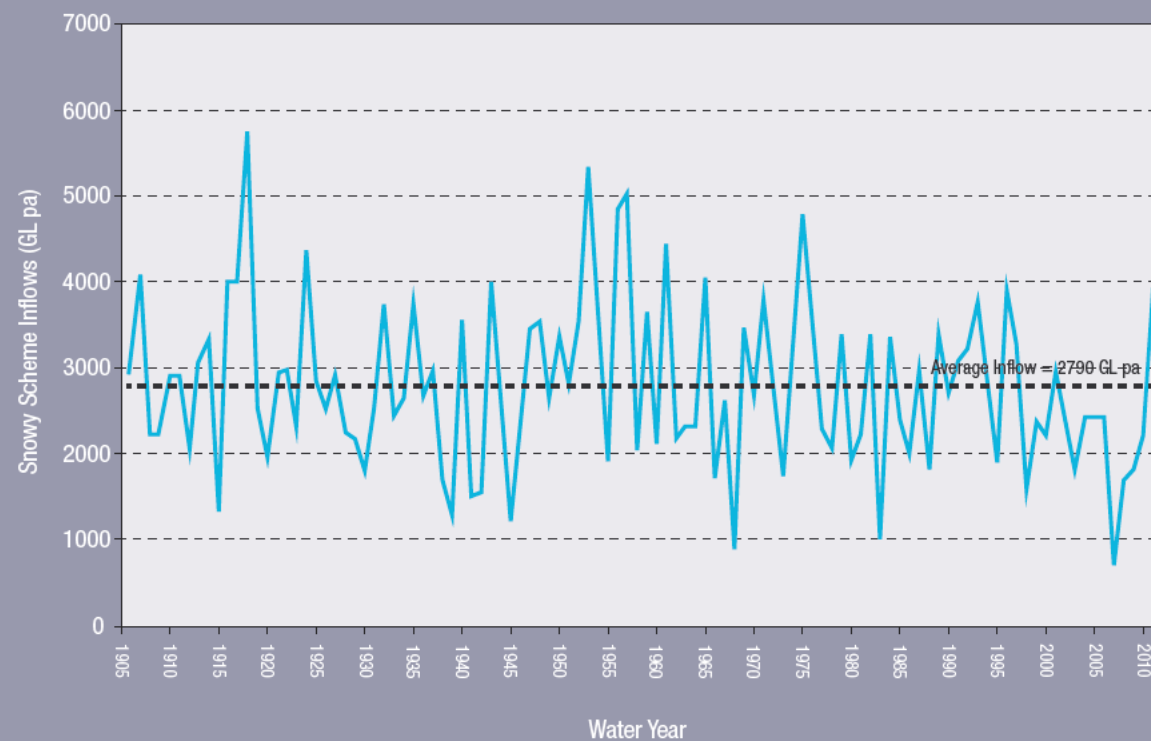


# Inflows

## Snowy Scheme inflows

The historical record of annual inflows into the Snowy Scheme is characterised by high variability with annual inflows ranging from less than 700GL to well over 3,908GL.

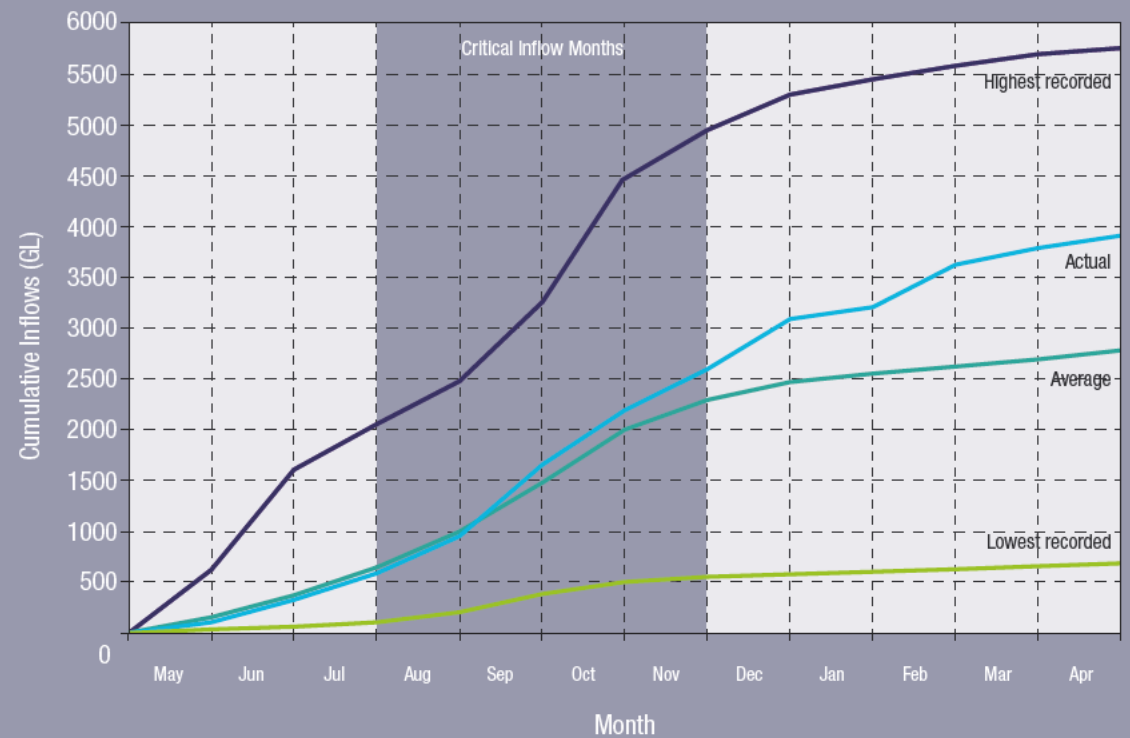
Snowy Scheme Inflows from May 1905 to April 2011



## Snowy Scheme inflows for 2010/11

During the 2010-11 water year inflows improved markedly on the previous year. Snowy Scheme inflows were 3,908GL which is about 140% of the long term average of 2,790GL. This is an improvement on last year's inflows which were about 79% of the long term average.

Snowy Scheme Inflow For May 10 - Apr 11



# Western River Releases

## River Murray Catchment

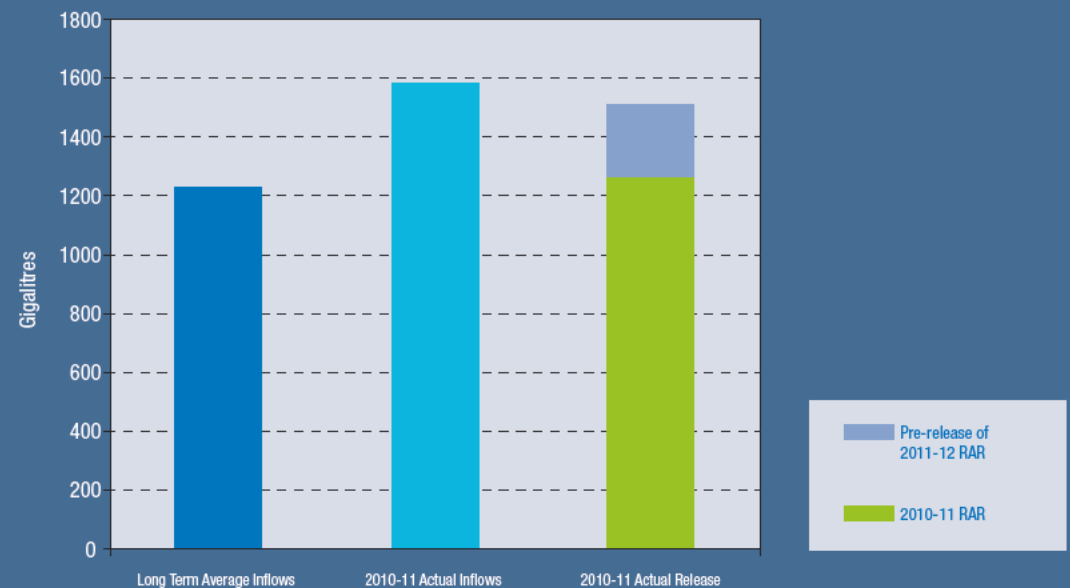
Snowy Hydro complied with its obligation to target the Required Annual Release (RAR) from the Snowy-Murray Development to the River Murray catchment during the 2010-11 water year.

The total actual release volume was 1,497GL. This was made up of 1,275GL being the 2010-11 Required Annual Release calculated under the *Snowy Water Licence*, plus 222GL of pre-release of the 2011-12 Required Annual Release as approved by the NSW Office of Water.

The calculated Required Annual Release volume for the Snowy-Murray Development is nominally set at 1,062GL. In the 2010-11 water year this nominal amount was adjusted as follows:

- Increased by the difference between the previous years DISV and the current year's DISV,
- reduced by the volume of water savings allocated to the Snowy-Murray Development to allow environmental releases to be made,
- a pre-release made in 2009-10; and
- repayment of prior year's water deals.

Inflows and Releases to the River Murray Catchment during 2010-11



## Murrumbidgee River Catchment

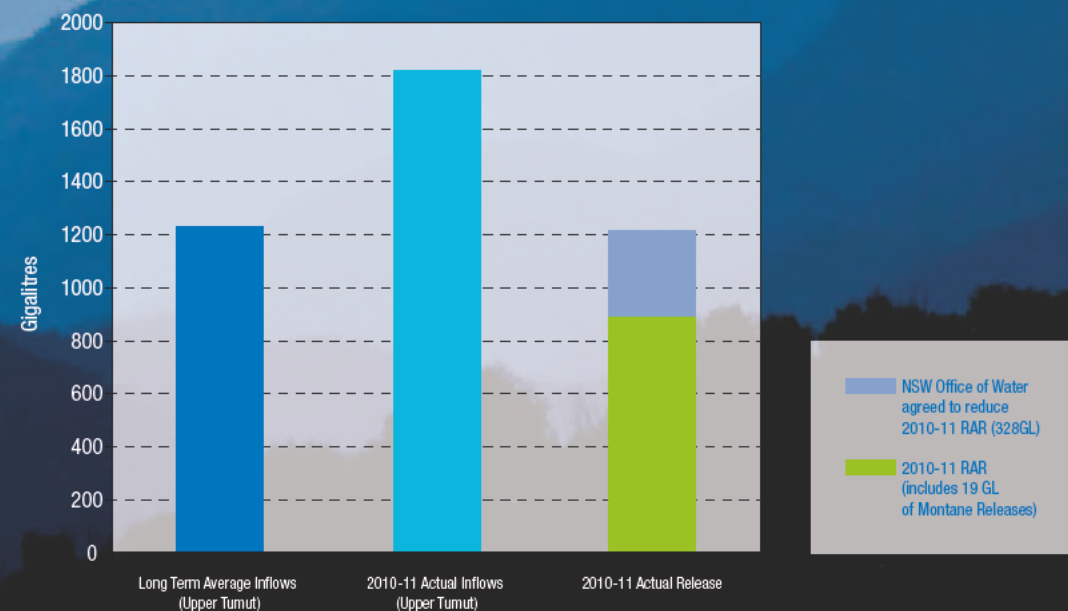
Snowy Hydro complied with its obligation to target the Required Annual Release from the Snowy-Tumut Development to the Murrumbidgee River catchment during the 2010-11 water year.

The total actual release volume was 891GL. This was made up of 1,219GL being the 2010-11 Required Annual Release calculated under the Snowy Water Licence less 328GL reduction in the 2010-11 Required Annual Release as approved by the NSW Office of Water under clause 13.1 of the Snowy Water Licence. This total release volume includes 20GL of montane releases.

The calculated Required Annual Release volume for the Snowy-Tumut Development is nominally set at 1,026GL. In the 2010-11 water year this nominal amount was adjusted as follows:

- Increased by the difference between the previous years DISV and the (lower) current year's DISV,
- reduced by the volume of water savings allocated to the Snowy-Tumut Development to allow environmental releases to be made,
- a pre-release made in 2009-10; and
- repayment of prior year's water deals.

Inflows and Releases to the Murrumbidgee Catchment during 2010-11





# Environmental Releases

---

## Snowy River Environmental Flows

---

The key element of the environmental flow arrangements under the *Snowy Water Licence* is that the total volume of environmental flows each year is determined by the annual allocations attaching to entitlements secured from water savings achieved by the Governments to date.

Snowy Hydro 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.

---

The table on the opposite page 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.

During the 2010-11 water year, additional water was allocated to the Snowy River by the NSW Office of Water over and above the water secured via long term savings on the western rivers. This volume of additional water was sufficient to fully repay the outstanding 32.1GL balance of the Mowamba Borrow and allow an additional 24.2GL of water to be released. This additional release took the form of two events, the first in November 2010 and the second in April 2011 as shown in the daily release chart on page 24.

| 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<br><a href="http://www.waterforrivers.org.au">www.waterforrivers.org.au</a>  |
| Transferring verified water savings into Environmental Entitlements.  | NSW Office of Water & VIC Dept of Sustainability and Environment<br><br><a href="http://www.water.nsw.gov.au">www.water.nsw.gov.au</a> & <a href="http://www.dse.vic.gov.au">www.dse.vic.gov.au</a> |
| Calculating annual allocations from the Environmental Entitlements each year (in arrears).  | NSW Office of Water & VIC Dept of Sustainability and Environment<br><br><a href="http://www.water.nsw.gov.au">www.water.nsw.gov.au</a> & <a href="http://www.dse.vic.gov.au">www.dse.vic.gov.au</a> |
| Apportioning the annual allocations between the Snowy River Increased Flows, River Murray Increased Flows and the Mowamba Borrow.                                       | NSW Office of Water<br><br><a href="http://www.water.nsw.gov.au">www.water.nsw.gov.au</a>   |
| The determining of annual, monthly and daily release volumes for Snowy River Increased Flows.   | NSW Office of Water considering the advice of the Snowy Scientific Committee<br><br><a href="http://www.water.nsw.gov.au">www.water.nsw.gov.au</a>  |
| Notifying Snowy Hydro of annual, monthly and daily release volumes for Snowy River Increased Flows  | NSW Office of Water<br><br><a href="http://www.water.nsw.gov.au">www.water.nsw.gov.au</a>   |
| Providing infrastructure to enable Snowy River Increased Flows from Jindabyne Dam and modifying existing infrastructure to enable Snowy Montane Rivers Increased Flows. | Snowy Hydro<br><br><a href="http://www.snowyhydro.com.au">www.snowyhydro.com.au</a>   |
| Targeting releases of Snowy River Increased Flows from Jindabyne Dam and those structures nominated for Snowy Montane Rivers Increased Flows.                           | Snowy Hydro<br><br><a href="http://www.snowyhydro.com.au">www.snowyhydro.com.au</a>   |

# Snowy River Increased Flows

Snowy Hydro complied with its obligation to target releases from Jindabyne Dam for environmental purposes during the 2010-11 water year.

The volume of Snowy River Increased Flows (SRIF) released from Jindabyne Dam during the 2010-11 water year was 62.3GL, which was 1.1GL in excess of the target volume of 61.2GL. That excess is well within the +/-10% annual tolerance around the target volumes allowed under the *Snowy Water Licence*. The 2011-12 target will be adjusted to account for this additional release.

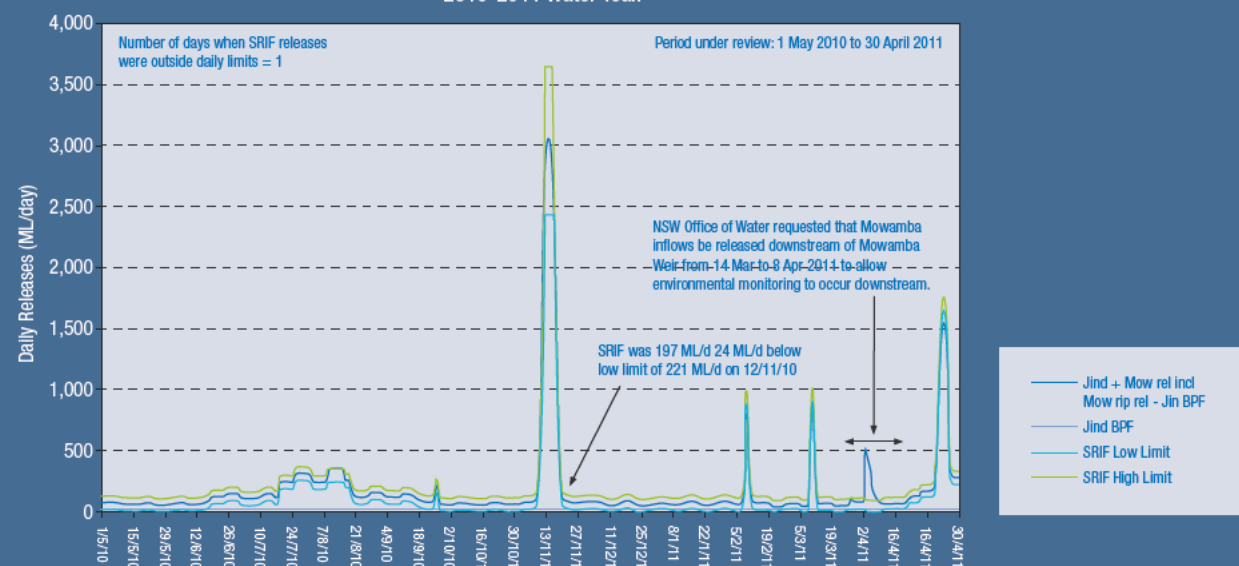
In addition to the environmental releases, 8.5GL Base Passing Flow (BPF) was also released from Jindabyne Dam and 0.5GL riparian flow was released from the Mowamba Weir.

All monthly releases were well within the +/-20% monthly tolerance around the target volumes allowed under the *Snowy Water Licence*.

All except one daily release target were well within the +/-20% daily tolerance allowed under the *Snowy Water Licence*. That one occasion occurred during the ramping down of releases after the major scheduled peak release in November 2010.

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 and Daily Limits.  
2010-2011 Water Year.



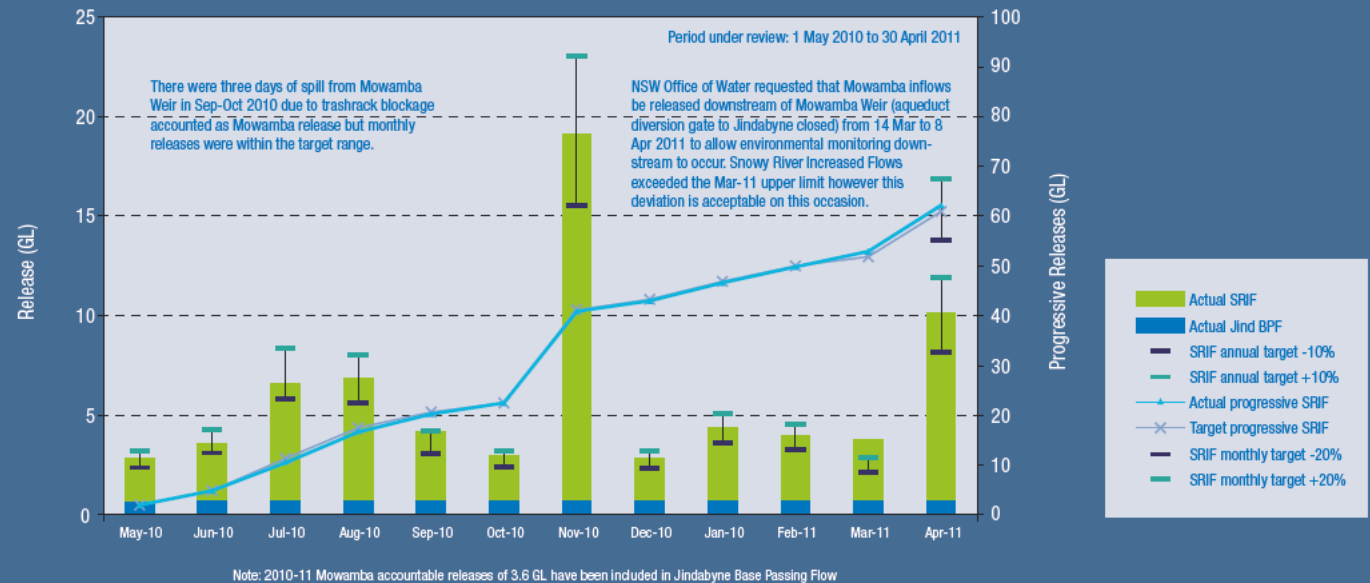
## Releases from Lake Jindabyne

The *Snowy Water Licence* requires the outlet works at Jindabyne Dam to be capable of releasing water from above any thermocline in the reservoir. A 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 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.

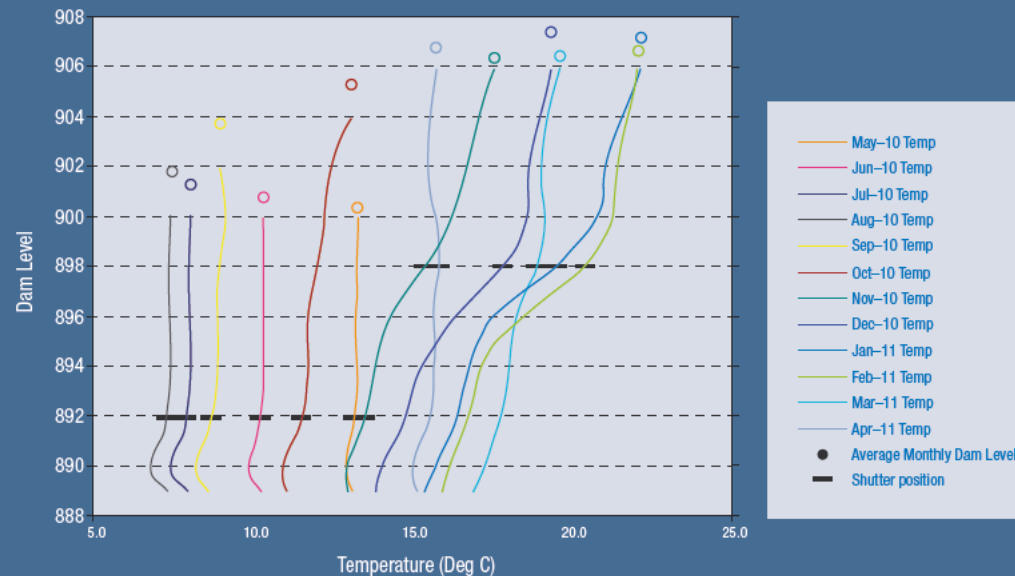
The new intake works at Jindabyne are located at the end of a channel excavated into the bank of Lake Jindabyne. In addition to the variable level shutters in the intake tower, the level of the base of the channel means that the deeper waters of the reservoir are inaccessible. This means that the thermocline 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.

Snowy River Increased Flows and Jindabyne Base Passing Flow releases including Mowamba riparian releases. 2010-2011 Water Year.



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 2010-11 water year. Snowy Hydro was directed to make Snowy Montane Rivers Increased Flows (SMRIF) from Tantangara Dam and Goodradigbee Aqueduct during the 2010-11 water year.

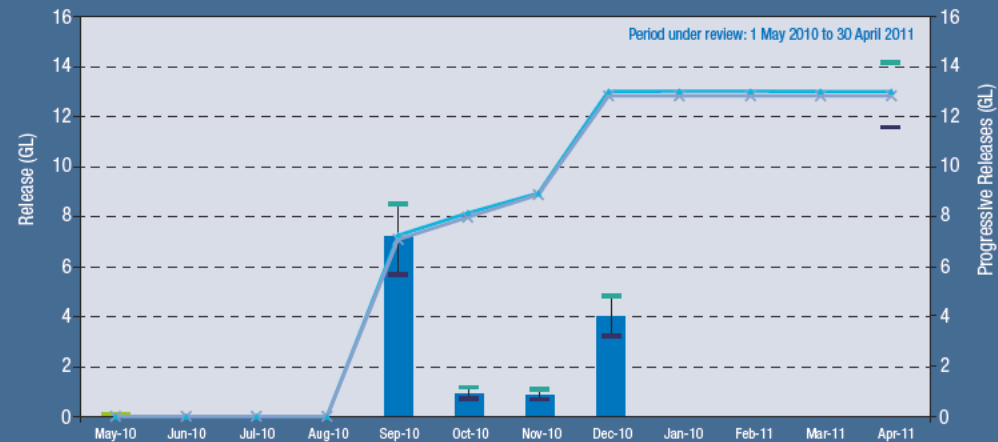
The target volume for Snowy Montane Rivers Increased Flows totalled 18.5GL, with 12.9GL from Tantangara Dam to be released during the spring period and 5.6GL from Goodradigbee Aqueduct to be released over the whole water year.

The total actual montane release volume was 19.6GL. This was made up of 12.9GL from Tantangara Dam released during the spring period and 6.7GL from Goodradigbee Aqueduct over the whole water year.

Riparian releases of 0.1GL were released from Tantangara Dam during the year to maintain the water supply for Cooma township during low inflow months and are accounted as Tantangara Base Passing Flows.

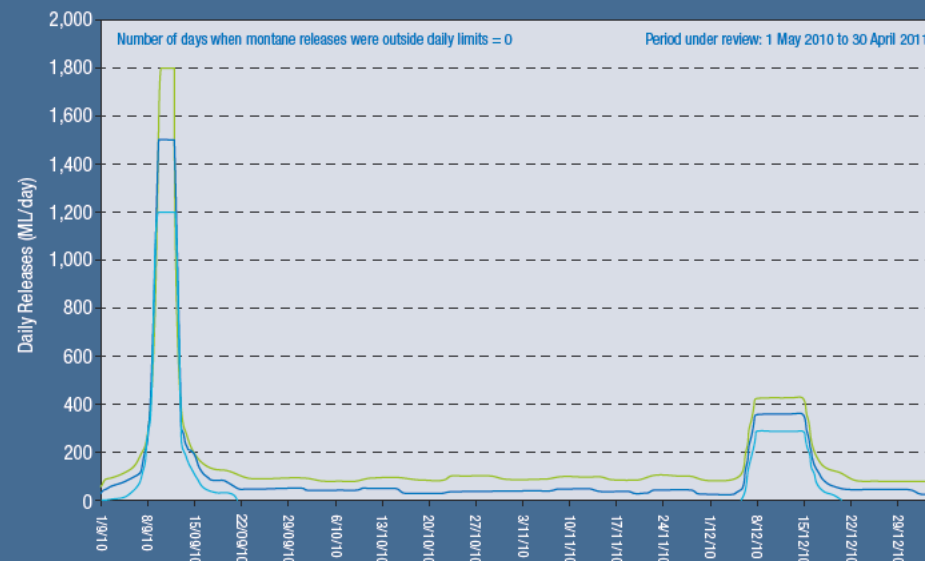
The comparison of the annual, monthly and daily release targets for the Snowy Montane Rivers Increased Flows against the actual from Tantangara Dam and monthly releases from Goodradigbee Aqueduct is set out in the graphs to the right.

Snowy Montane Rivers Increased Flows and Base Passing Flow from Tantangara Dam.  
2010-2011 Water Year.



Notes: All riparian releases are being accounted as base passing flow in 2010-2011 Water Year.  
Tantangara nominal BPF target for 2010-2011 Water Year = 2.0GL, actual BPF = 0.1GL  
Tantangara SMRIF release target for 2010-2011 Water Year = 12.9GL, actual release = 12.9GL

Snowy Montane Rivers Increased Flows from Tantangara Dam and daily limits.



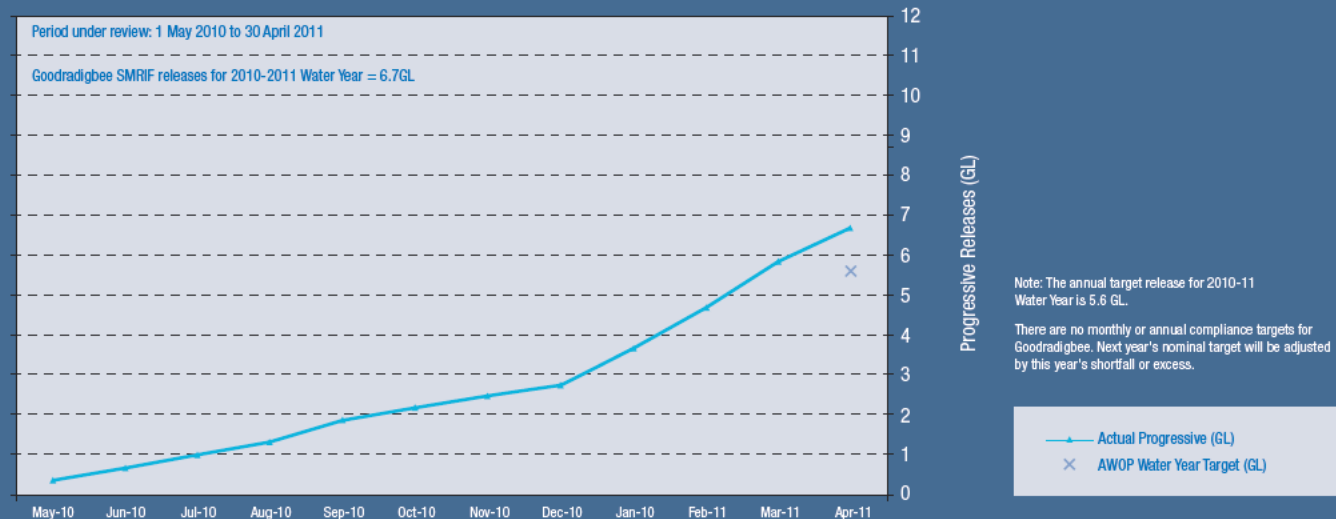
## Releases from Tintangara Reservoir

The *Snowy Water Licence* requires the outlet works at Tintangara Dam to be capable of releasing water from above any thermocline in the reservoir. A 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 Tintangara 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 shutter height as necessary. As can be seen in the chart opposite, all releases were made from above the thermocline.

Snowy Montane Rivers Increased flows from Goodradigbee Weir. 2010-2011 Water Year.



Tintangara Dam Intake Water Temperatures and Level.

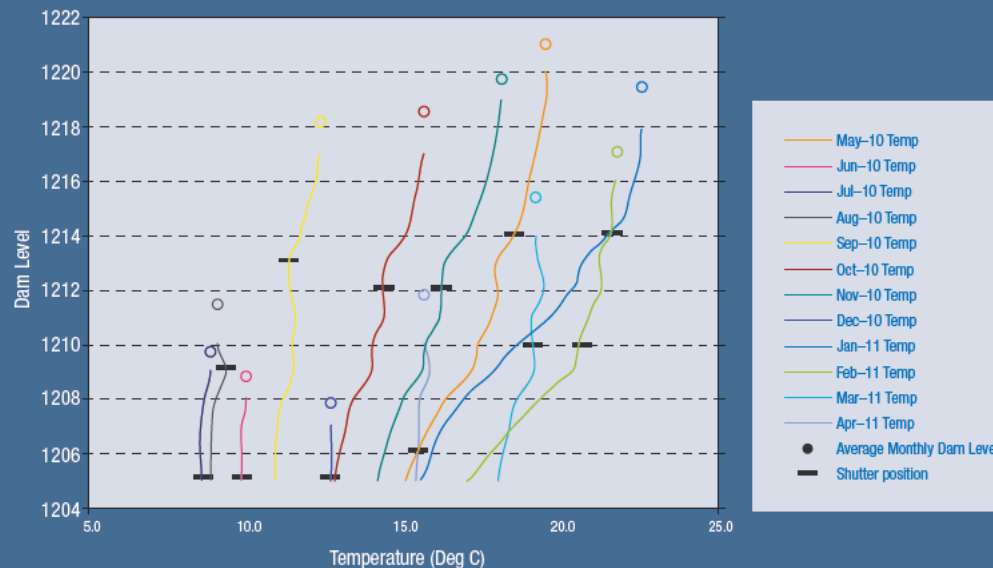




Photo: Talbingo Dam & Reservoir

# Storages

## Snowy Scheme storage for 2010-11

Snowy Scheme storage levels are referred to from time to time in different measurements, they 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.

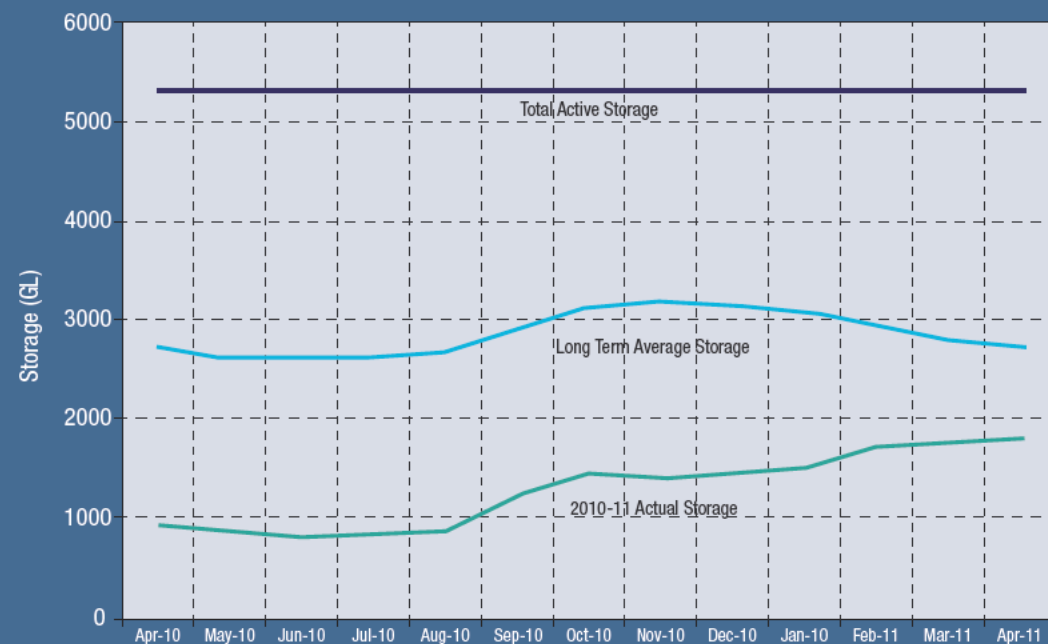
Gross storage is the total amount of water behind the dam wall including the water that cannot ordinarily be accessed due to the design of the Snowy Scheme.

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 42% 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 2009-10 water year, Snowy Scheme active storage was 935GL. This is equivalent to 17.6% of the Snowy Scheme active storage capacity.

During the 2010-11 water year, Snowy Scheme active storage increased by 847GL, with active storage totalling 1,782GL at the end of the year, which is 33.6% of the active storage capacity.

Snowy Scheme Active Storage For 2010-11 Water Year



## Lake Levels

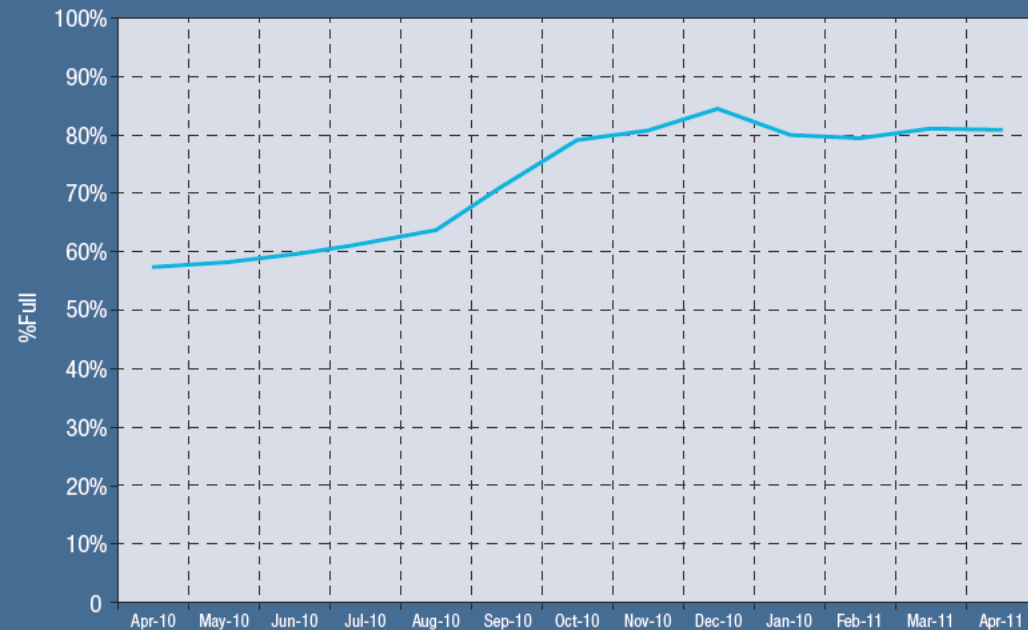
With the recovery in inflows, storage levels improved significantly from the previous year.

The Snowy Scheme's main storage, Lake Eucumbene is now higher than the previous year. It is important to appreciate that Lake Eucumbene is a massive storage. In excess of five consecutive years of average inflows are still required to see Lake Eucumbene storage levels restored to long term average levels.

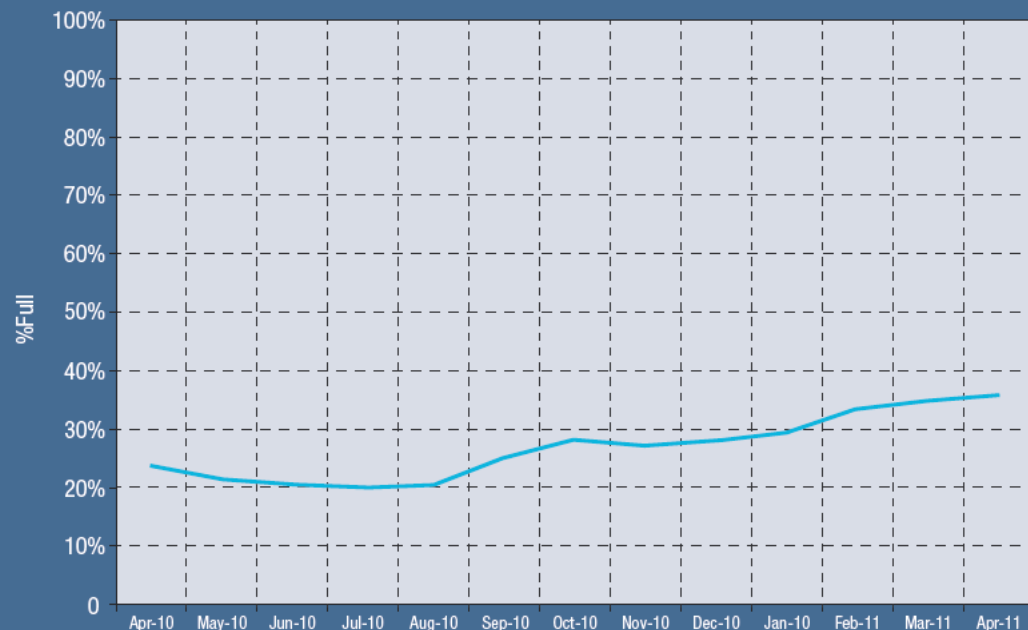
Snowy Hydro reports gross storage levels to local tourism operators and the local community on our website. Lake Levels for our three main storages of Jindabyne, Eucumbene and Tantangara are provided weekly and are available at [www.snowyhydro.com.au](http://www.snowyhydro.com.au)

Our website also includes a lake level comparison calculator where it can be seen that lake levels have improved since 2006-07 in line with improvements in annual inflows.

Lake Jindabyne Gross Storage For 2010 / 11 Water Year



Lake Eucumbene Gross Storage For 2010 / 11 Water Year





## VERIFICATION STATEMENT

Snowy Hydro Limited commissioned NCS International to verify the data from its Water Operations Report (WOR) for the 2010-2011 Water Year, in respect to 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 WOR. The audit was carried out using recognised assessment techniques based on the ISO 19011 standard, with the WOR as the core reference document. The audit was office based and included interviews with key staff members.

### Scope:

Numerical values provided in the WOR were compared with the required target volumes from the approved Annual Water Operating Plan (2010-11 Water Year). Actual releases were compared with a sample of entries from the water accounting databases. Records of maintenance and calibration of equipment records used in monitoring of water flows were also reviewed.

The verification reviewed data for reasonableness and where practical, the auditor checked the order of magnitude of data, 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 2010-2011 Water Year. The WOR provides a fair representation of the required target volumes and Snowy Hydro Ltd. water operations.

Robert Gardiner  
Auditor  
NCS International Pty Ltd  
29 November 2011

NCS International Pty Ltd  
Website: [www.ncs.com.au](http://www.ncs.com.au)  
Email: [info@ncs.com.au](mailto:info@ncs.com.au)  
Call: 1300 856 554

**wegiveyoutheworld**

© 2011 NCS International Pty Ltd. All rights reserved. NCS International Pty Ltd is a registered company in Australia. NCS International Pty Ltd is a registered company in Australia. NCS International Pty Ltd is a registered company in Australia.

Snowy Hydro Limited  
PO Box 332  
Cooma NSW 2630  
Tel: 1800 623 776  
Email: [communityfeedback@snowyhydro.com.au](mailto:communityfeedback@snowyhydro.com.au)  
Web: [snowyhydro.com.au](http://snowyhydro.com.au)



**snowyhydro**  
renewable energy