

WATER COMPLIANCE REPORT

2018 - 2019 Water Year

snowyhydro
renewable energy

ABOUT THIS REPORT

Since the Snowy Scheme's completion in 1974, Snowy Hydro Limited has carefully managed the water that flows through the Scheme's dams, tunnels, aqueducts and power stations in accordance with our water licence. This report outlines how we are managing the water that flows through the Scheme.

Snowy Hydro operates a complex hydro-electric scheme utilising the water captured by the Scheme to generate energy to meet the market's needs, while also moving water from east to west to support irrigation districts.

Each year, we have to reach certain targets for downstream and environmental water releases. Snowy Hydro has operational flexibility day-to-day to strategically manage our generation and water releases while at the same time giving long-term security to the downstream users around annual water releases. In the Snowy Scheme, water releases and electricity generation are inseparably linked.

Snowy Hydro is operated under the Snowy Water Licence, issued to us by the NSW Government. The licence has many legally-binding and enforceable obligations on the company.

Snowy Hydro is obligated under the Snowy Water Licence 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;
- ◆ Target water releases from Jindabyne Dam into the Snowy River for environmental purposes (Snowy River Increased Flows); and
- ◆ Facilitate additional natural flows to nominated rivers for environmental purposes (Snowy Montane Rivers Increased Flows).

This report is an important channel to educate and inform our stakeholders about the water operations of the Scheme. While we generate energy from the water that moves through the Scheme, we don't own a drop of it; nor do we sell the water or charge people to access it.

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.

The Snowy Water Licence recognises the difficulties inherent in achieving precise release volumes at each release point, so 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 year's 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 about the Snowy Water Licence we encourage people to visit the NSW Department of Primary Industries Water at water.nsw.gov.au

COMPLYING WITH OUR LICENCE

Snowy Hydro complied with all of the requirements imposed upon the company under the Snowy Water Licence during the 2018 - 19 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 and Strzelecki Creek Aqueducts.
- ◆ Environmental releases into the Snowy River from Falls Creek, Bar Ridge and Diggers Creek Aqueducts.

WESTERN RIVER RELEASES

RIVER MURRAY CATCHMENT

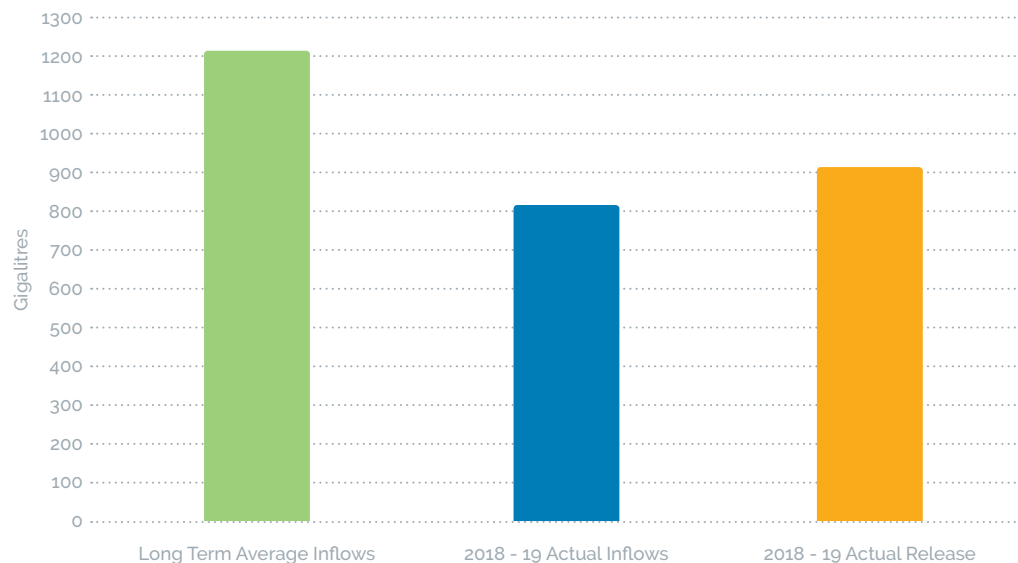
Snowy Hydro complied with its obligation to target the Required Annual Release (RAR) from the Snowy-Murray Development to the River Murray catchment during the 2018 - 19 water year.

The total accounted release volume was 914GL (Note 1GL rounding error). This was made up of:

- 💧 763 GL being the 2018-19 Required Annual Release calculated under the Snowy Water Licence; less
- 💧 47 GL of Net DISV Increase; plus
- 💧 199 GL of pre-release of the 2019-20 Required Annual Release; plus
- 💧 0 GL of Discretionary Above Target Water Releases (water not required for RAR releases that Snowy Hydro is able to release at its discretion)

This total accounted release volume includes 18 GL of Montane environmental flow releases provided to the Geehi and Swampy Plains River which did not flow through Scheme power stations.

Inflows and Releases to the River Murray Catchment during 2018 - 19



MURRUMBIDGEE RIVER CATCHMENT

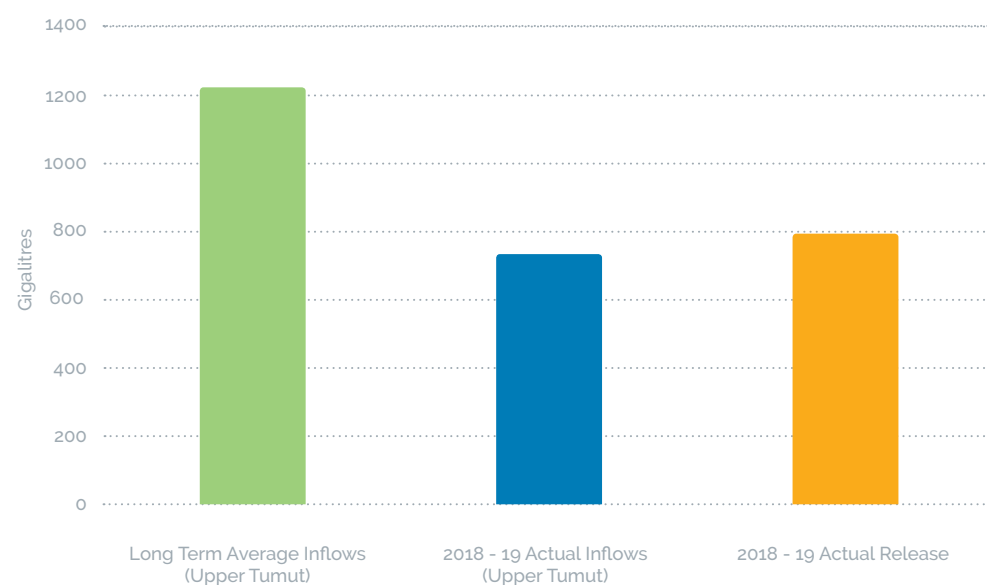
Snowy Hydro complied with its obligation to target the Required Annual Release from the Snowy-Tumut Development to the Murrumbidgee River catchment during the 2018-19 water year.

The total accounted release volume was 793GL. This was made up of:

- 💧 730 GL being the agreed 2018-19 Required Annual Release calculated under the Snowy Water Licence; plus
- 💧 63 GL of pre-release of the 2019-20 Required Annual Release; plus
- 💧 0 GL of Discretionary Above Target Water release (water not required for RAR releases that Snowy Hydro is able to release at its discretion).

This total accounted release volume includes 10 GL 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 Murrumbidgee Catchment during 2018 - 19



ENVIRONMENTAL RELEASES

SNOWY RIVER INCREASED FLOWS

Snowy Hydro complied with its obligation to target releases from Jindabyne Dam for environmental purposes during the 2018 – 19 water year.

The volume of Snowy River Increased Flows (SRIF) released from Jindabyne Dam during the 2018 – 19 water year was 129.4GL, which was 0.8 GL above the target volume of 128.6GL. That deficit is well within the +/-10% annual tolerance around the target volumes allowed under the Snowy Water Licence.

The 2019–20 target has been adjusted up to account for this release deficit.

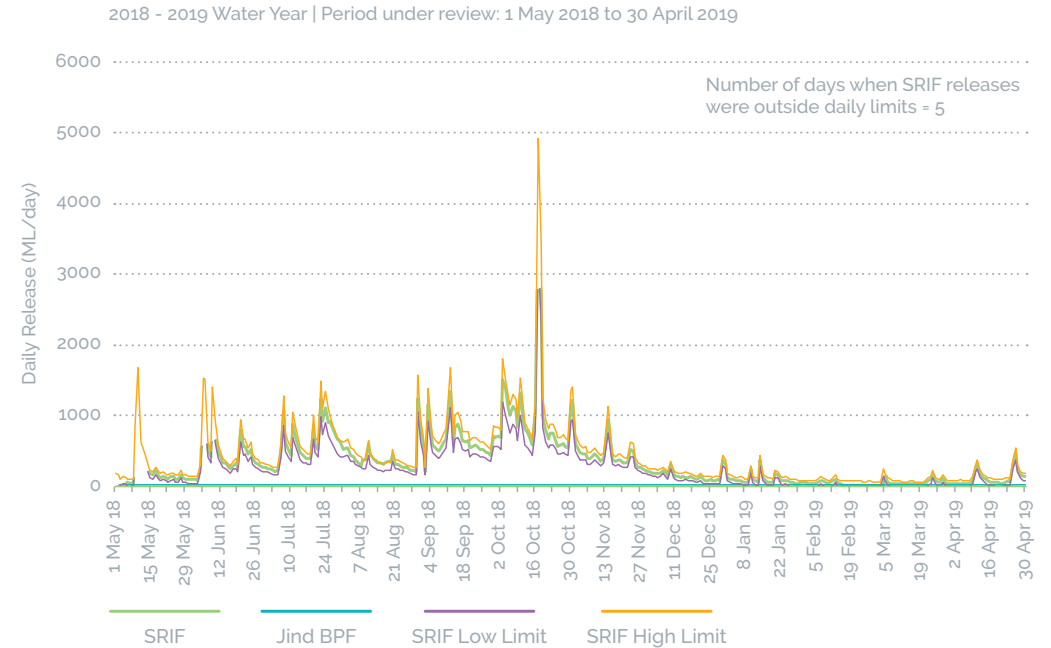
In addition to the environmental releases, 8.5GL Base Passing Flow (BPF) was also released from Jindabyne Dam and 0.5GL riparian flow was released from the Mowamba Weir.

All monthly releases were within the +/-20% monthly tolerance around the target volumes tolerance allowed under the Snowy Water Licence. There were five days where the daily releases were outside the daily target by more than 20%. These were reported to NSW DoI Water. All other releases were within the +/-20% daily tolerance allowed under the Snowy Water Licence.

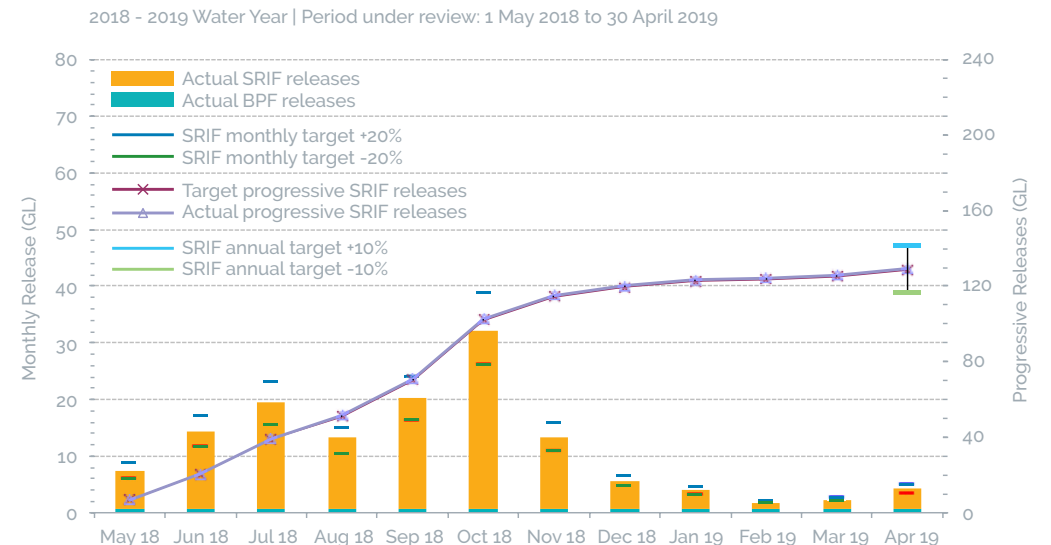
As allocations for the 2018–19 water year once again exceeded 100GL, a flushing flow was Scheduled for the Snowy River as set out on page 5. Due to persistent dry inflows, the reservoir level required to deliver the flushing flow could not be achieved. Snowy Hydro worked closely with NSW DoI Water to deliver a flow with a lower peak and longer duration.

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 (SRIF) and Jindabyne Base Passing Flow (BPF) Releases and Daily Limits



Snowy River Increased Flows (SRIF) and Jindabyne Base Passing Flow (BPF) Releases including Mowamba Riparian Releases



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 macro invertebrates.

A flushing flow had been scheduled for October 2018, but the ongoing drought meant that despite prudent management of storage levels in Jindabyne Dam, the level was not sufficient to make a release from the spillway infrastructure. Snowy Hydro worked closely with the NSW Office of Water to develop an alternative release schedule. The release pattern was set by the NSW Office of Water, with releases peaking at 3.8 GL per day and was discharged through the cone valves.

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.

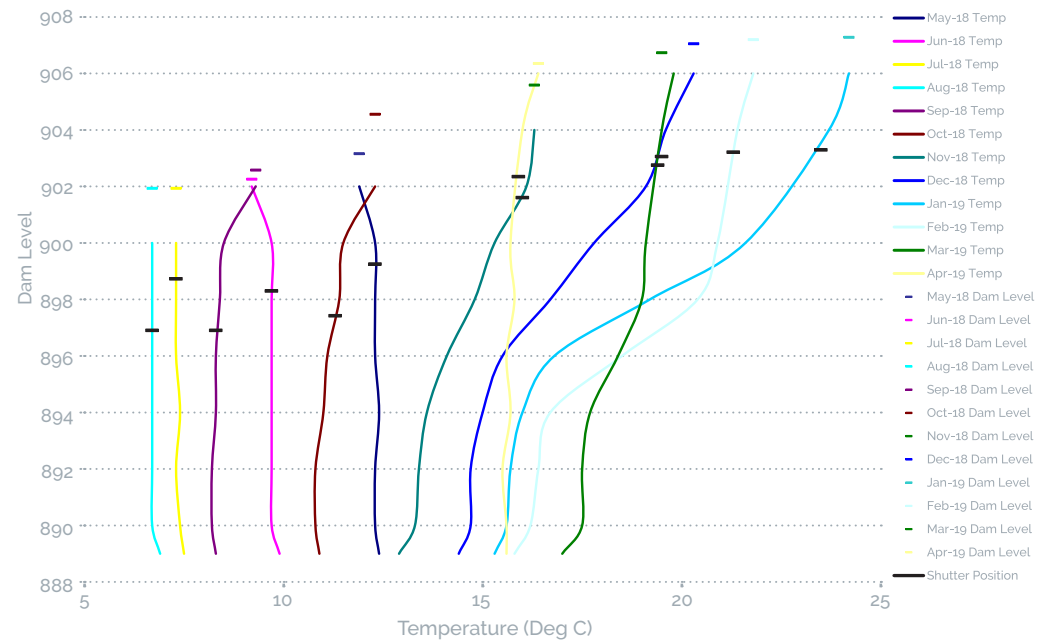
THE TEMPERATURE OF RELEASES FROM LAKE JINDABYNE

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 2018 – 19 water year.

During the 2018 – 19 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),
- ◆ Middle Creek Aqueduct to Middle Creek and Strzelecki Creek Intake on the Geehi River Aqueduct to Strzelecki Creek (tributaries of the Geehi River), and
- ◆ Bar Ridge and Diggers Creek Aqueducts to Tolbar Creek and Diggers Creek respectively (tributaries of the Snowy River).
- ◆ Falls Creek to the Snowy River below Guthega Dam

The target volume for Snowy Montane Rivers Increased Flows totalled 62.1GL, with 5.1GL from Tantangara Dam, 12GL from Goodradigbee Aqueduct, 22.7GL from Middle Creek/Strzelecki Ck, 18.9GL from Bar Ridge and Diggers Creek Aqueducts and 3.4GL from Falls Creek, all to be targeted over the whole water year.

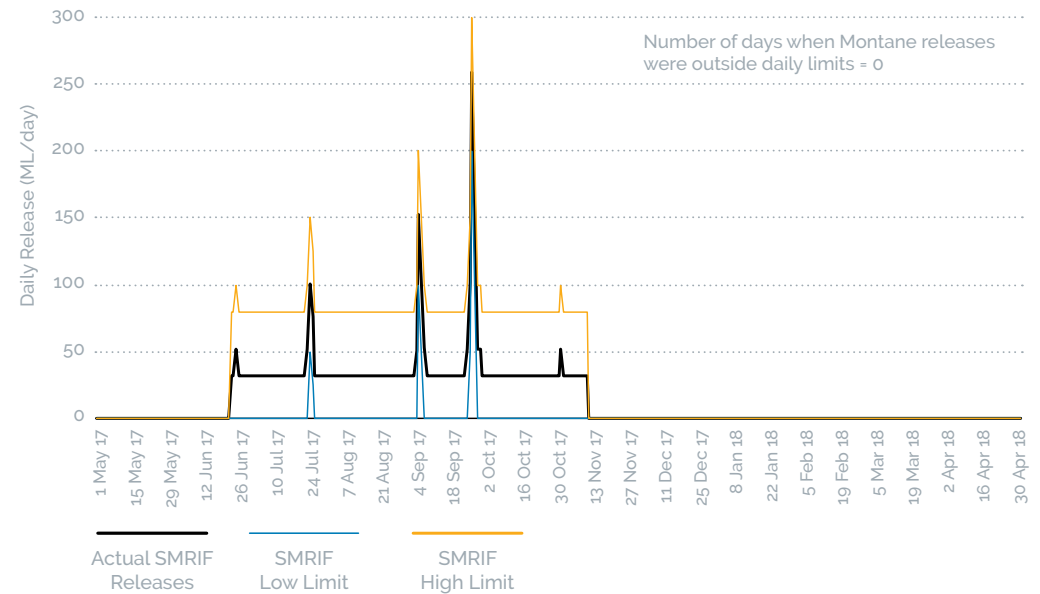
The total actual montane release volume was 43.0GL. This was made up of 5.4GL from Tantangara Dam, 4.9GL from Goodradigbee Aqueduct, 18.4GL from Middle Creek Aqueduct and Strzelecki Ck combined, 11.8GL from Bar Ridge and Diggers Creek Aqueducts combined and 2.5 GL from Falls Creek, released over the whole water year. The Bar Ridge montane release was delivered via Burrungubugge River in the 2018 - 19 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 opposite. All daily, monthly and annual release targets were within the compliance limits.

Monthly releases from Goodradigbee, Middle Creek, Strzelecki Creek, Bar Ridge and Diggers Creek are also provided in the graphs on the following two pages. 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 above/below target delivery of water in these catchments in 2018-2019 reflects the inflows received in these locations. In years when inflows are above average, above average volumes of water will be delivered to these catchments and vice versa.

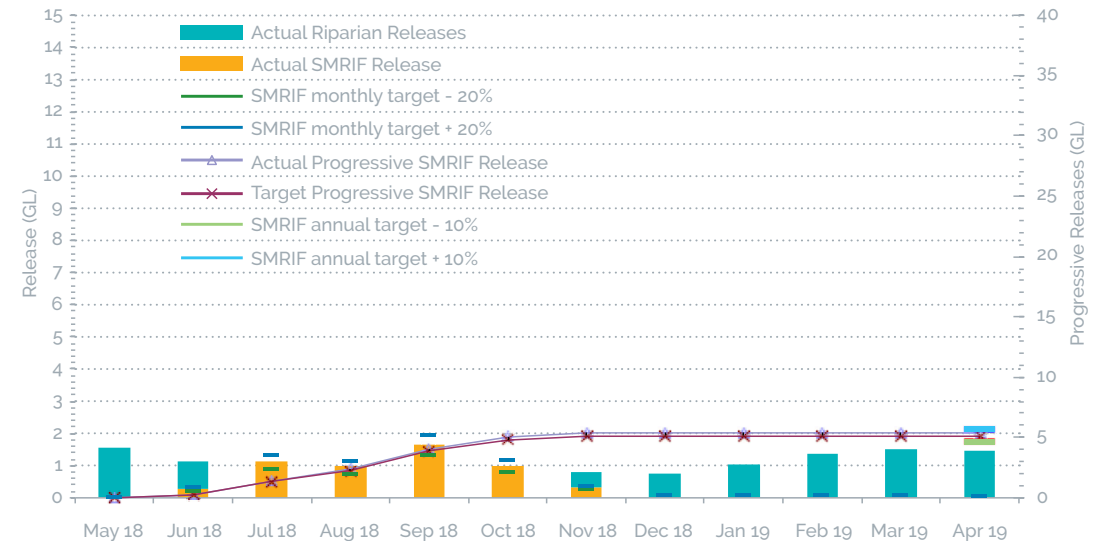
Snowy Montane Rivers Increased Flows (SMRIF) from Tantangara Dam and Daily Limits

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



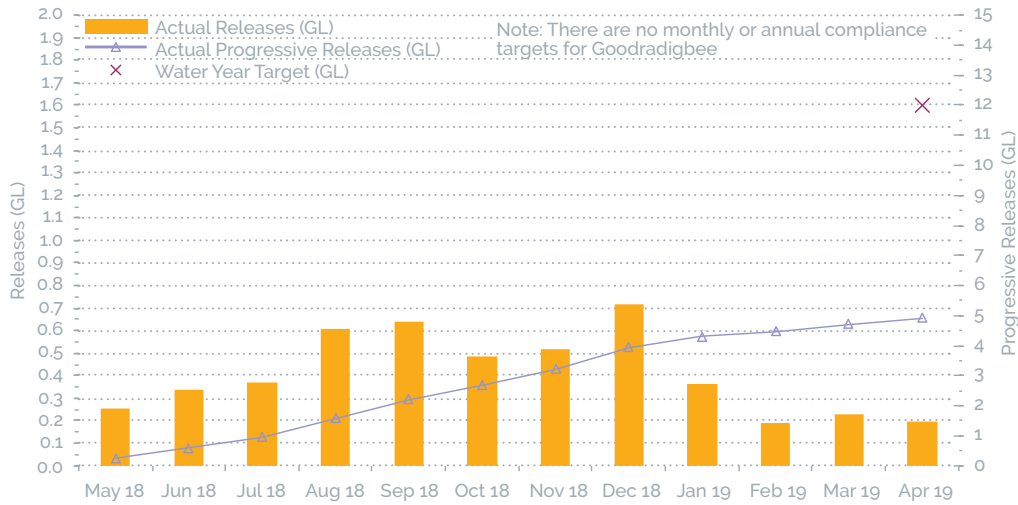
Snowy Montane Rivers Increased Flows (SMRIF) and Riparian Releases from Tantangara Dam

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



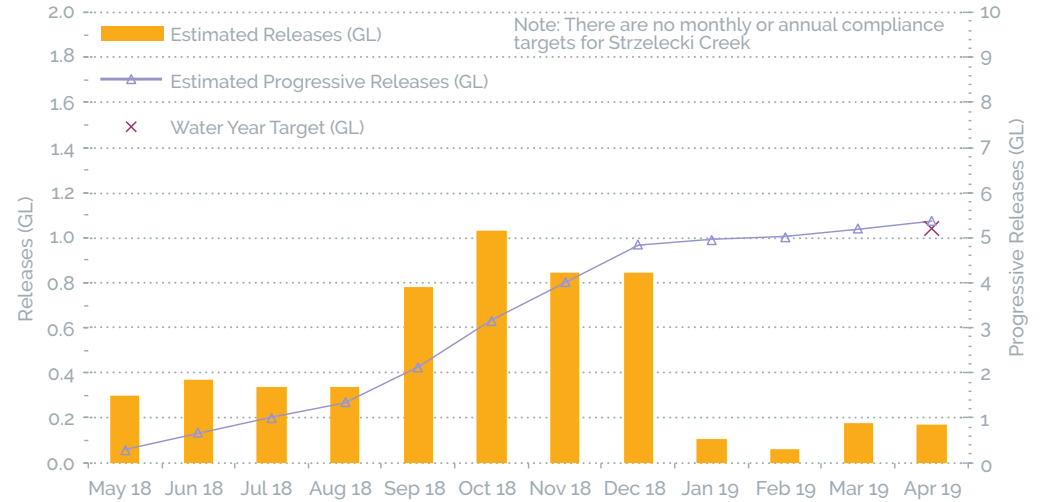
Snowy Montane Rivers Increased Flows (SMRIF) from Goodradigbee Weir

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



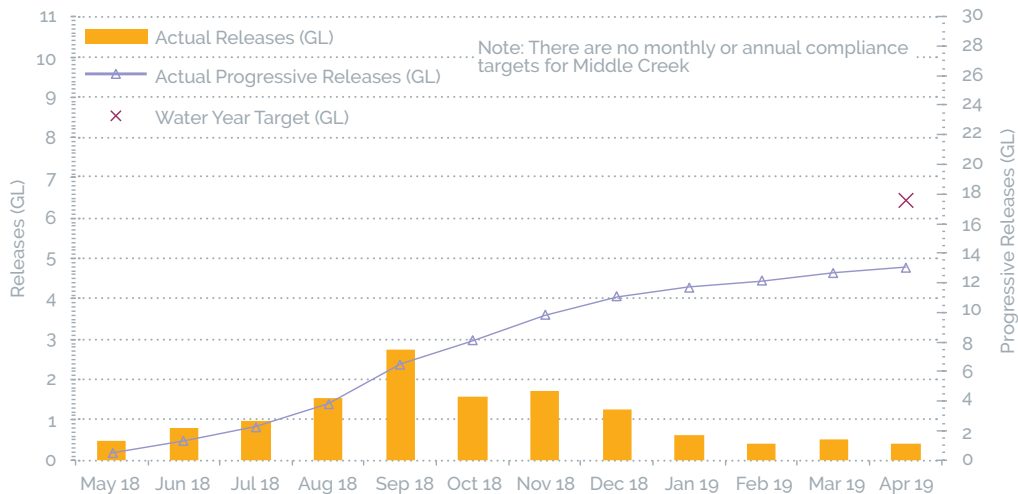
Snowy Montane Rivers Increased Flows (SMRIF) from Strzelecki Creek Aqueduct

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



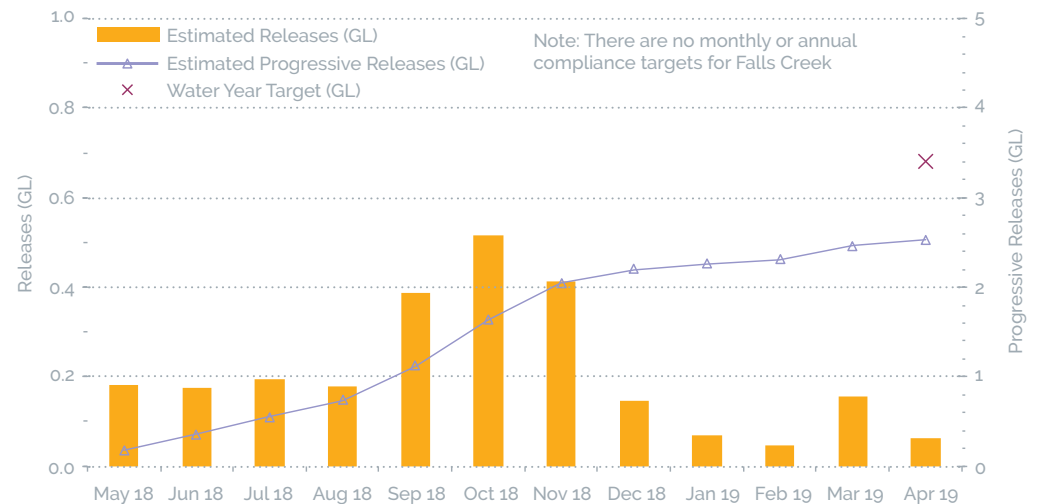
Snowy Montane Rivers Increased Flows (SMRIF) from Middle Creek Aqueduct

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



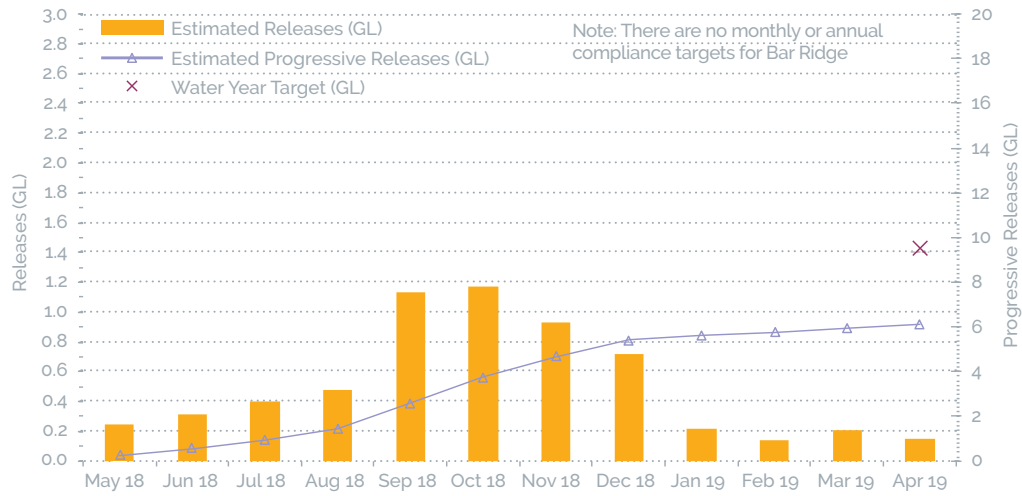
Snowy Montane Rivers Increased Flows (SMRIF) from Falls Creek Aqueduct

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



Snowy Montane Rivers Increased Flows (SMRIF) from Bar Ridge Aqueduct

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



THE TEMPERATURE OF RELEASES FROM TANTANGARA RESERVOIR

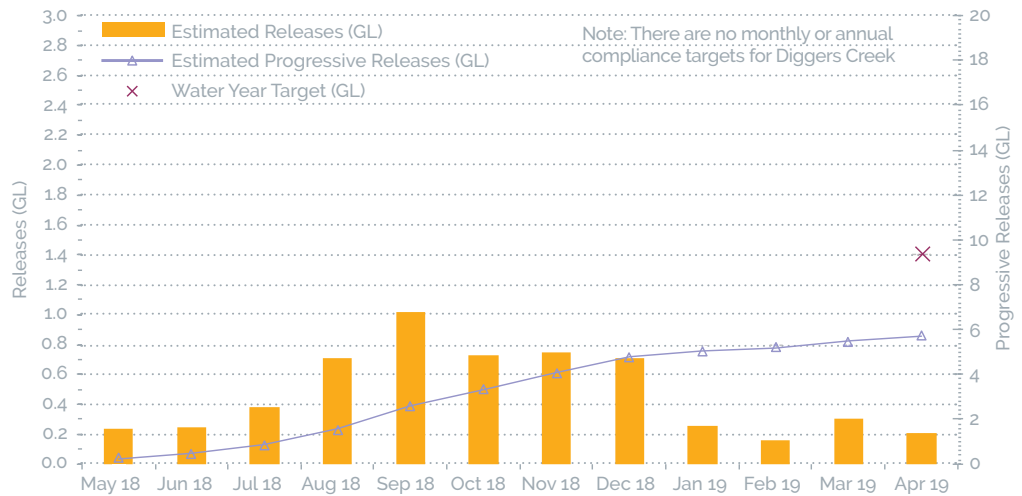
The Snowy Water Licence requires the outlet works at Tantangara Dam to be capable of releasing water from above any thermocline in the reservoir. The thermocline is a thin, but distinct, layer in a large body of water in which temperature changes more rapidly with depth than it does in the layers above 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 below, a persistent thermocline was not present during the 2018 - 19 water year.

Snowy Montane Rivers Increased Flows (SMRIF) from Diggers Creek Aqueduct

2018 - 2019 Water Year | Period under review: 1 May 2018 to 30 April 2019



Tantangara Dam Intake Water Temperatures and Level

