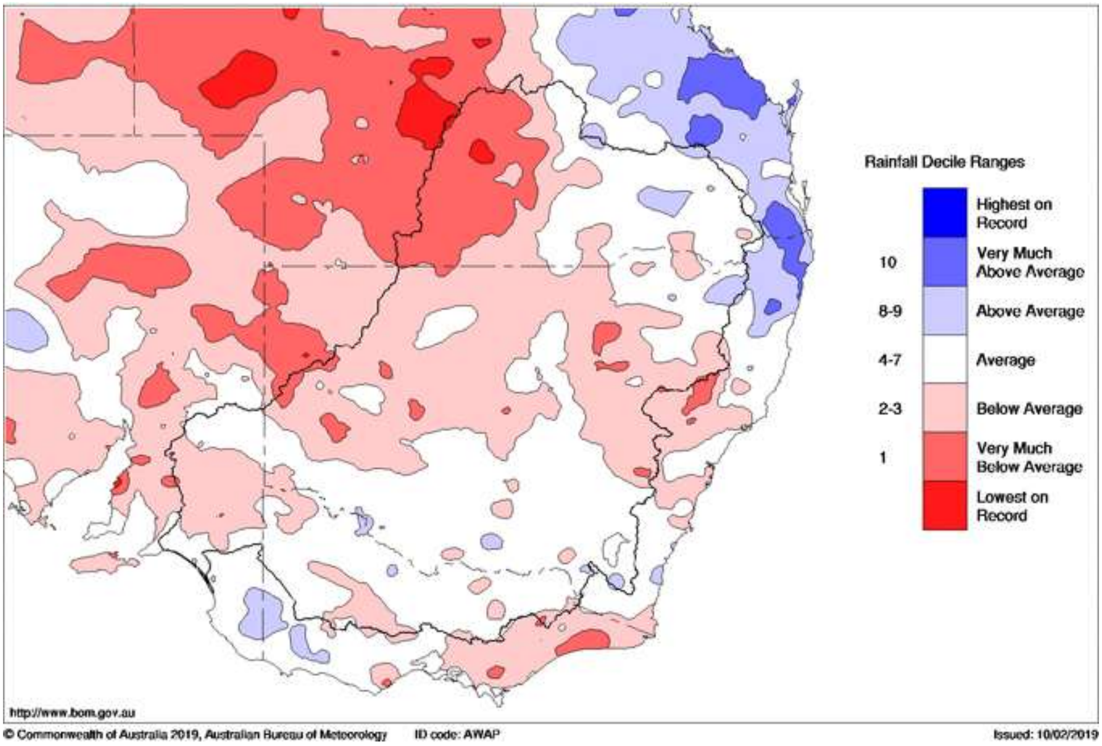

Figure 1: Rainfall in the Murray-Darling Basin from 1 March 2017 to 28 February 2018 (Source: Australian Bureau of Meteorology).

On the 3rd January 2018 a cease-to-flow commenced at Walgett (gauge 422001; Figure 2). By mid-January all gauges below Tara (gauge 422025) were in cease-to-flow conditions. By the 8th March there had been 53 cease-to-flow days at Wilcannia. This is the same day the s.324 restriction was put in place, prohibiting A, B and C-class licence access until 31st March 2018 above Boorooma and 28th April 2018 below Boorooma to Lake Wetherell.

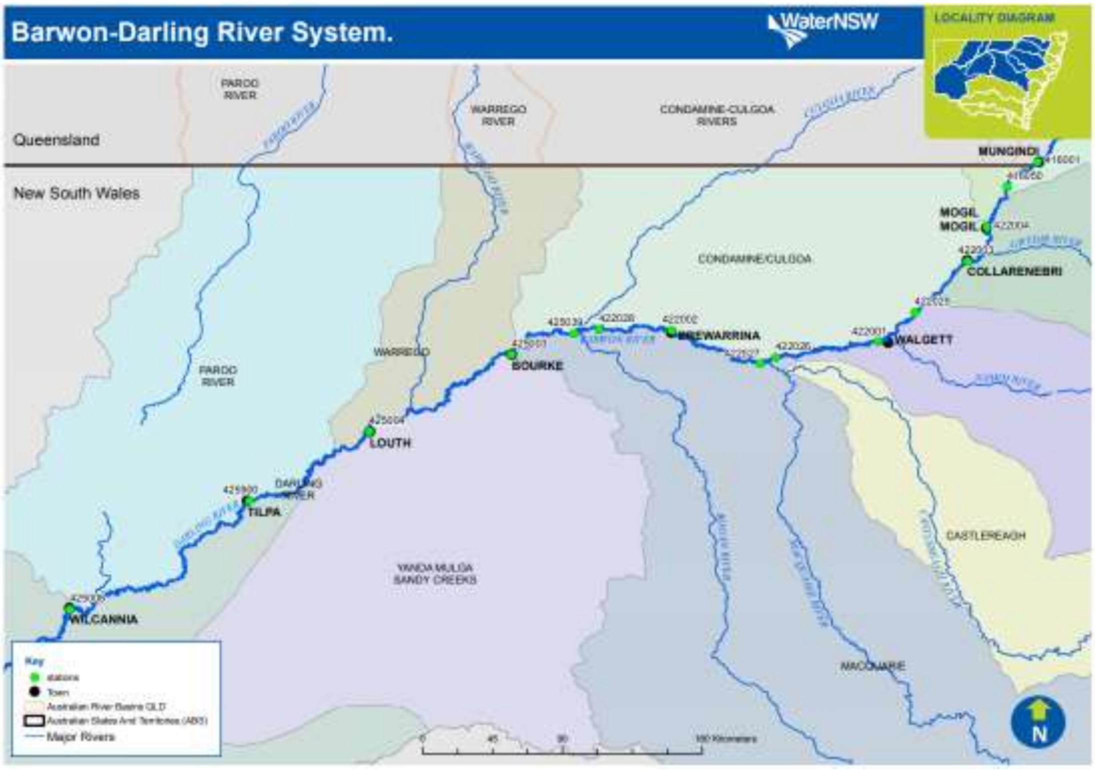

Figure 2: Barwon-Darling River System and key gauging stations (Source: Water NSW).

March to April 2018 flow event

Rainfall in south-west Queensland in early March 2018 generated inflows into the Barwon-Darling from the Moonie, Condamine-Balonne/Culgoa and Warrego river systems. The Moonie River inflow joined the Barwon-Darling River upstream of Mogil Mogil; the Culgoa River inflow arrived upstream of Warraweena and the Warrego River inflow joined downstream of Bourke (Figure 2). The Culgoa River contributed the majority of flows to the Barwon-Darling River.

There were two flow events in the Moonie catchment in Queensland during February and March 2018 (Figure 3 and Figure 4). The first event was relatively small, with 3,900 ML of water flowing past the last gauging station on the Moonie before the Darling River junction (i.e. Gundablouie in NSW). The second flow event was larger, with flows in the Moonie River peaking at Flinton (200 kilometres north of the NSW border) at 6,795 megalitres per day (ML/d) on 6th March (a total volume of about 32,000 ML was observed at Flinton). Between the two events 11,900 ML of water passed Gundablouie, peaking at 1,830 ML/d on 16th March.

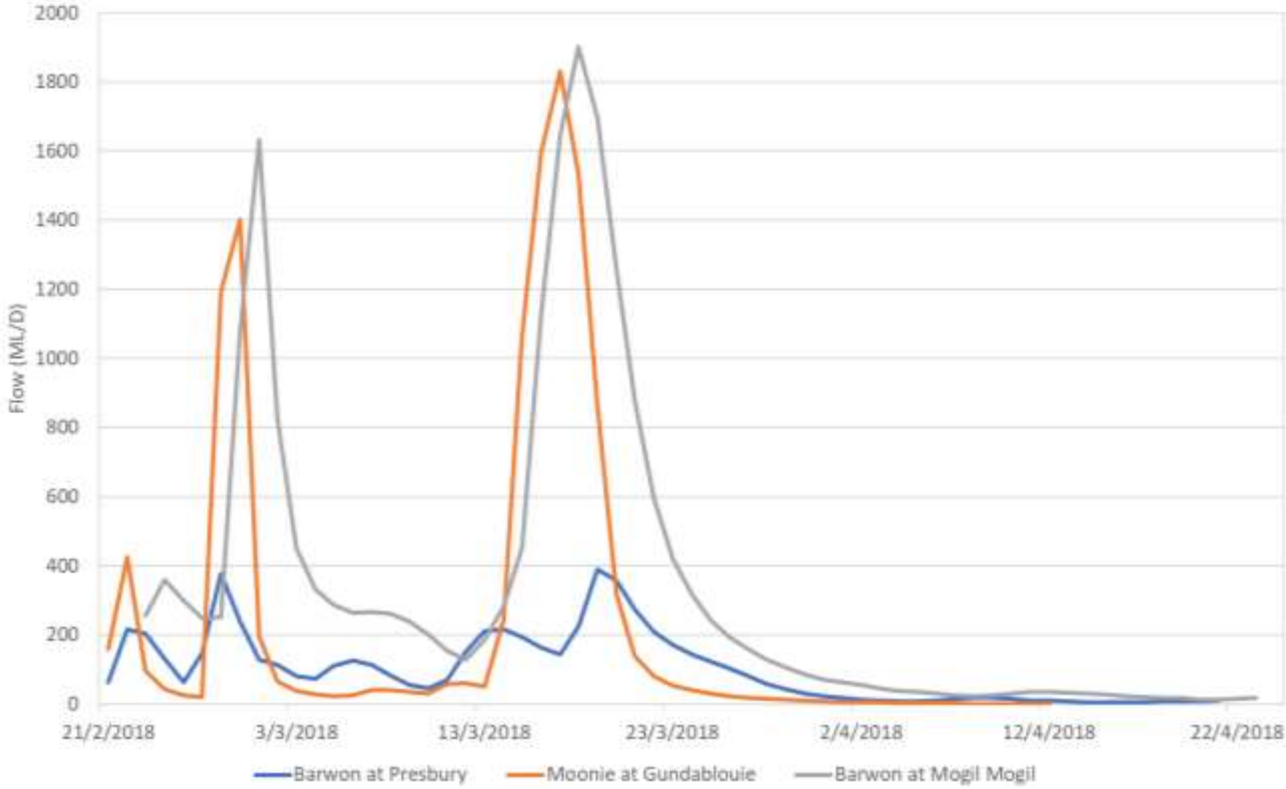

Figure 3: Flow rates at gauges on the Moonie and Barwon rivers due to Moonie inflows.

Flows in the Balonne River in Queensland peaked at St George at 12,880 ML/d on 10th March 2018. Shortly after the flow event additional water was released from regulated storages into the Balonne River to meet environmental, stock and domestic water use needs. Between the two flow events, the total volume of water passing St George was approximately 62,000 ML.

The Balonne River joins the Barwon-Darling system as Culgoa River. Culgoa River flows peaked upstream of Collerina (Mundiwa) on 23rd March 2018 at approximately 2,180 ML/d. Around 12,500 ML of flow was recorded in the Culgoa River at the downstream (d/s) of Collerina gauge, the last gauge before the river joins the Barwon-Darling system downstream of Beemery and upstream of Warraweena. The inflow from the Moonie catchment arrived at Warraweena just after the Culgoa inflow, extending the flows at Warraweena and downstream sections (Figure 5).

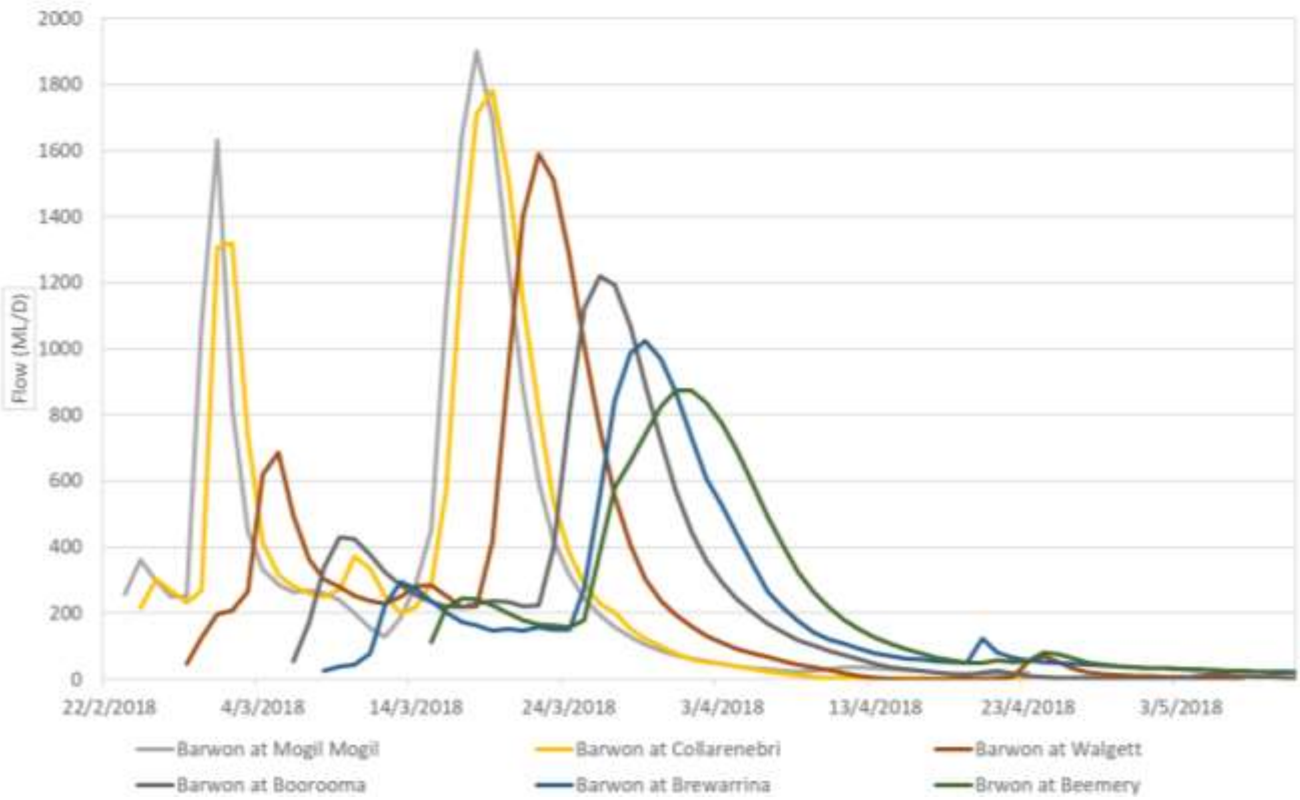

Figure 4: Flow rates at gauges on the Barwon River due to Moonie inflows.

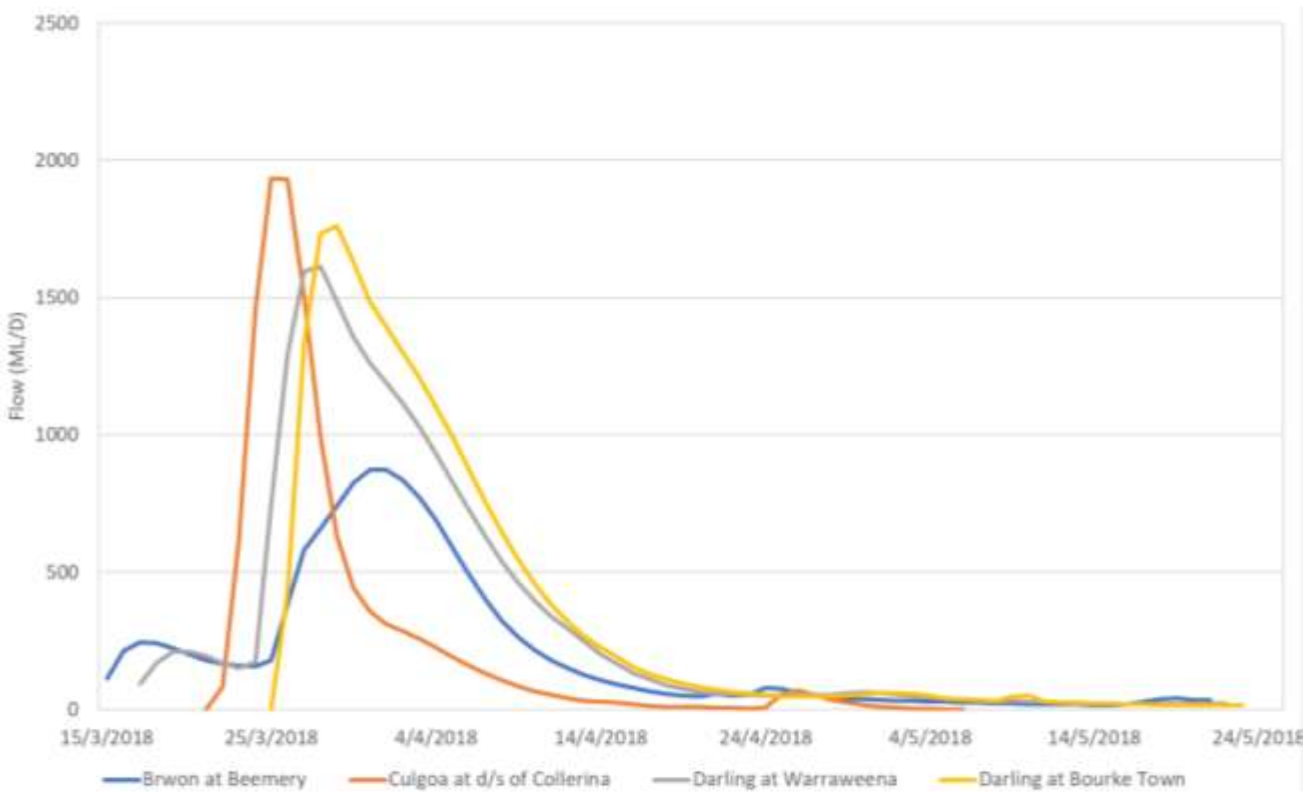

Figure 5: Flow rates at gauges on the Culgoa, Barwon and Darling Rivers due to Culgoa inflows.

Large flows in the Warrego River in Queensland peaked on 12th March at 16,000 ML/d at Wyandra, with a total volume of about 92,000 ML. The Warrego River joins the Barwon-Darling River downstream of Bourke. At Dicks Dam, the last gauging station on the Warrego before the junction, a total flow of 1,900 ML was observed, peaking at 103 ML/d on 1st May. This small inflow into the Barwon-Darling arrived at the tail end of the Culgoa and Moonie inflows and helped to push the flow up to Wilcannia (Figure 6).

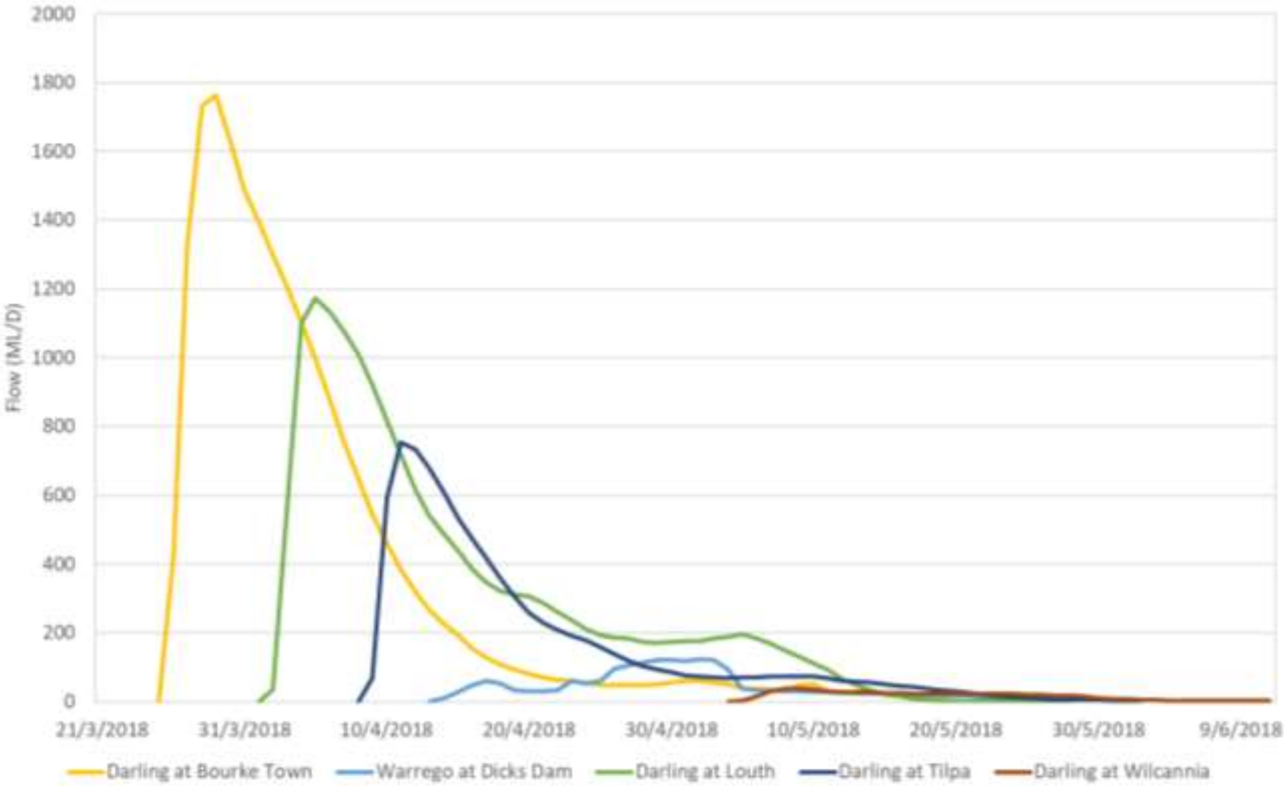

Figure 6: Flow rates at gauges on the Warrego and Darling Rivers due to Warrego inflows.

The timing, peak and total volume of flows passing through the Barwon-Darling are presented in Table 1. The locations of referenced gauging stations are marked on the map at Figure 2.

The 2018 Moonie, Culgoa and Warrego inflow event resulted in a volume of approximately 664 ML of water flowing past downstream Wilcannia. The protection of these flows achieved full connectivity along the Barwon-Darling River and filled the Bourke and Brewarrina weir pools. The water flowing past the Wilcannia gauging station also had to fill and overtop the Wilcannia weir first (the Wilcannia weir holds about 2,300 ML of water). This volume could be added to the 664 ML recorded at the gauge to represent the total volume of water flowing to Wilcannia.

No water from this event reached the Menindee Lakes system.

Table 1: Estimated peak flow volumes and maximum daily flow rates at Barwon-Darling gauging stations (source WaterNSW).

Station number	Station name	Start of event	End of event	Maximum daily flow rate (ML/day)	Total event volume (ML)
416001	Barwon River @ Mungindi	18/2/18	25/04/18	451	6,980
416050	Barwon River @ Presbury	19/2/18	26/04/18	389	6,069
422004	Barwon @ Mogil Mogil	22/2/18	29/4/18	1900	20,124
422003	Barwon @ Collarenebri	23/2/18	22/4/18	1,782	19,330

Station number	Station name	Start of event	End of event	Maximum daily flow rate (ML/day)	Total event volume (ML)
422025	Barwon @ Tara	25/2/18	2/5/18	1,533	16,425
422001	Barwon River @ Dangar Bridge (Walgett)	26/2/18	6/5/18	1,590	17,565
422026	Barwon @ Boorooma	5/3/18	12/5/18	1,219	15,114
422027	Barwon @ Geera	6/3/18	13/5/18	1,227	15,467
422002	Barwon @ Brewarrina	7/3/18	15/5/18	1,023	13,403
422028	Barwon @ Beemery	14/3/18	20/5/18	874	13,686
425039	Darling @ Warraweena	16/3/18	21/5/18	1,613	21,550
425003	Darling @ Bourke,	24/3/18	22/5/18	1,762	20,900
425004	Darling @ Louth	1/4/18	19/05/18	1,174	16,341
425900	Darling @ Tilpa	7/4/18	1/06/18	753	8,622
425008	Darling @ Wilcannia	4/5/18	10/06/18	38	664

Estimated volume of water protected in the Barwon-Darling

Modelling was used to estimate the volume of water protected during the event – that is, the maximum volume of water that could have been extracted if the s.324 order was not in place (Table 2). The modelling approach assumed that where water was able to be extracted, the volume was not available for extraction in the next river section. This means that the total volume of water protected during the event is the sum of estimated volumes for each river section. This equals 15,860 ML of water protected from extraction as a result of the s.324 temporary water restriction.

The results indicate that the greatest flow extraction would have occurred between the Warraweena and Bourke gauges, with high levels of extraction also modelled between the Collarenebri and Tara gauges and Brewarrina and Beemery gauges.

These volumes have been calculated assuming that extractions would have occurred at the maximum extraction rates for the entire period where flow was permissible (i.e. above commence-to-pump access thresholds).

Table 2: Maximum volume of water extractions estimated to have occurred between gauging stations if s.324 restrictions were not in place (source: WaterNSW).

Zone	Estimated maximum volume of water extractions (ML)
Mungindi to Presbury	216
Presbury to Mogil Mogil	142
Mogil Mogil to Collarenebri	545

Zone	Estimated maximum volume of water extractions (ML)
Collarenebri to Tara	2,800
Walgett to Boorooma	116
Geera to Brewarrina	225
Brewarrina to Beemery	2,156
Beemery to Warraweena	0
Warraweena to Bourke	9,660
Bourke to Louth	0
Tilpa to Wilcannia	0

Water losses along the Barwon-Darling

The extraction of water for town water supply, stock and domestic use (basic landholder rights) and irrigation of existing permanent plantings was allowed under the temporary water restrictions. It is reasonable to assume that these extractions occurred and that the flows were affected by these extractions. Pool and groundwater recharge also contributed to flows attenuating downstream. The extended dry conditions experienced prior to the event contributed to the volumes required for pool and groundwater recharge, as weir pools required refilling and riverbeds were dry.

The actual losses observed between Barwon-Darling gauging stations during the event are presented in Table 3. Where the Moonie, Culgoa and Warrego Rivers join the Barwon-Darling River, the losses observed between the last gauges before the junctions and the first gauges after the junctions have been incorporated. For example, the losses observed upstream of the Mogil Mogil gauge include the losses from Presbury (which is on the Barwon-Darling) and Gundablouie (the last gauge on the Moonie before the junction).

Table 3: Actual water losses observed between gauging stations along the Barwon-Darling River.

Zone	Actual losses (ML)*
Mungindi to Presbury	911
Presbury to Mogil Mogil + Gundablouie to Mogil Mogil	-2,073
Mogil Mogil to Collarenebri	794
Collarenebri to Tara	2,905
Collarenebri to Walgett	-1,140
Walgett to Boorooma	2,451
Boorooma to Geera	-353
Boorooma to Brewarrina	2,064

Zone	Actual losses (ML)*
Brewarrina to Beemery	-283
Beemery to Warraweena + Culgoa at downstream of Collerina to Warraweena	4,470
Warraweena to Bourke	650
Bourke to Louth + Dicks Dam to Louth	6,620
Louth to Tilpa	7,719
Tilpa to Wilcannia	7,958

* a negative loss value is indicative of a net gain in flows.

The most significant losses occurred in the downstream reaches of the Barwon-Darling River. A total of 15,677 ML of water was lost between Louth and Wilcannia and a further 6,620 ML lost between Louth and its immediate upstream gauges. As flows continued at upstream sections of the river system, gains were also observed at four locations along the river.

Impacts

The protection of this flow event provided social and cultural benefits for communities along the Barwon-Darling, and secured water for town water supply and stock and domestic use. The event also led to some positive outcomes for water quality and the environment, though larger flows are needed for more significant environmental benefits. Lost pumping opportunity is also an impact for water users.

Town water supply

The protection of flows from extraction resulted in positive outcomes for town water supplies, benefitting many communities along the Barwon-Darling. Replenishing declining town water supplies was one of the primary purposes of the s.324 order. Refilled weir pools reduced pressure on town water supplies that were affected by the drought, including supplies for Bourke, Brewarrina and Central Darling council areas.

The flow event and subsequent refilling of Bourke weir enabled Bourke Shire Council to lift water restrictions on residents of Bourke and North Bourke that had been in place since 15th January 2018 (The Council of the Shire of Bourke, 2018). In the lead up to this event, Bourke was on Level 2 water restrictions and forecasting Level 3 water restrictions in the near future. On the 25th March 2018, the town returned to Level 0 water restrictions meaning there were no water restrictions in place. It is estimated that at full capacity, the Bourke weir pool held approximately 5-6 months of storage for the town (DPIE Senior Urban Water Manager, personal communication, 24th April 2018).

Social and cultural

The flow event provided a range of social and cultural benefits for the communities along the Barwon-Darling River. The protection of flows improved flow connectivity downstream. This resulted in improved capacity for landholders to extract water for stock and domestic use under basic landholder rights, particularly downstream of Bourke. The refilling of natural pools and weir pools also benefited recreational water users, who rely on the river system for activities like swimming, fishing, canoeing and kayaking, boating and water-skiing.

Flow events can also have important social and cultural outcomes for local Aboriginal people who rely on the river and the species living within it for food and employment. Healthy rivers are essential to Aboriginal people for maintaining spiritual, cultural and physical wellbeing (MDBA 2017). The Barkandji people are named after the Barka (Darling) River. In 2017 Barkandji elder Badger Bates explained the importance of the river to the Barkandji people:

> *For me, a healthy river is my life. If we have a healthy river, everything flows. It means I can go out and teach young Australians… about Aboriginal culture, about how to survive in the bush and how they should respect the river…There's nothing to teach if there's no river. The river is everything. It's my life, my culture. You take the water away from us; we've got nothing (Bates 2017).*

Environment

Water quality

Salinity

Salinity is the presence of soluble salts and is measured in water by its ability to transmit an electric current (electrical conductivity or EC). Extended dry spells in a river system can cause dense, saline water to flow along or sit on the bottom of pools. Significant flow events, like that observed in the Barwon-Darling in early 2018, often mobilises these salts leading to temporary increases in river salinity. Salt mobility is influenced by a variety of factors including soil type and connectivity with saline groundwater sources.

Typical water salinity varies with location and the condition of the ecosystem. The Australian and New Zealand Environment and Conservation Council water quality guidelines (ANZECC 2000) suggest that the salinity of lowland rivers in south-east Australia typically ranges between 125 and 2,200 microsiemens per centimetre (µS/cm) in slightly disturbed ecosystem conditions. Excessive amounts of salt in water can have harmful effects on plants and animals, affect drinking water supplies and have negative impacts on cropping and horticulture. Although it is important to note that exceedance of the values for a short period does not necessarily cause significant impacts.

The 2018 Barwon-Darling River flows led to temporary salinity increases at some locations. EC in the Barwon River at both Collarenebri and Walgett did not fluctuate during the flow event, remaining below 500 µS/cm (Figure 7). There was a large spike in EC at the Warraweena gauge on 20th March, coinciding with the arrival of the first peak of the flow event originating from the Moonie River (Figure 8). The electrical conductivity at Warraweena reduced rapidly with the arrival of flow from the Culgoa River, indicating the Culgoa system provides important dilution flows to the Barwon-Darling River. A similar spike in electrical conductivity was not evident upstream at Brewarrina, indicating that the salt was mobilised somewhere between the two gauging stations, possibly from remnant pools where salt had become concentrated by evaporation and from saline groundwater discharge.

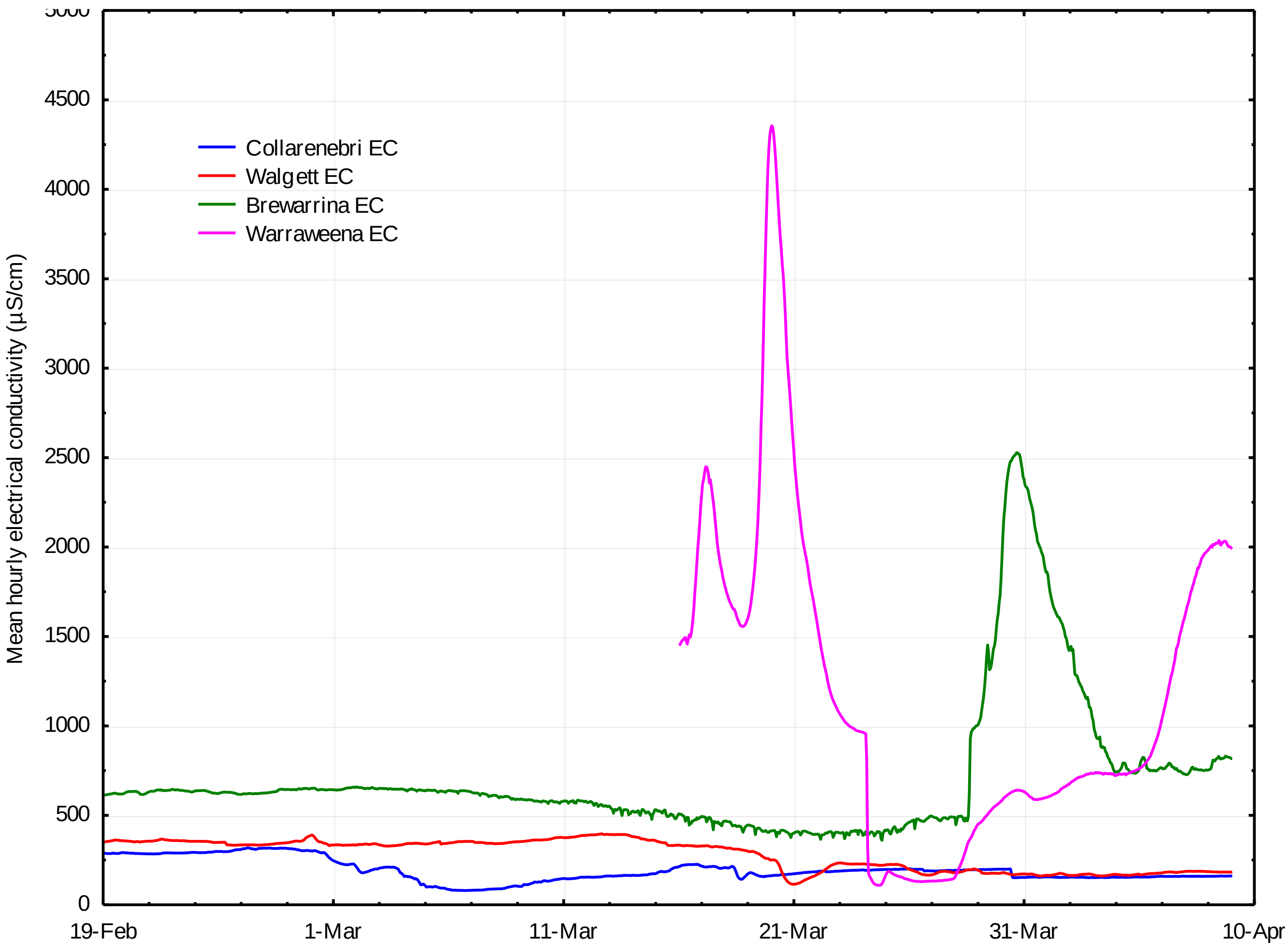

Figure 7: Mean hourly electrical conductivity (EC) at Barwon-Darling River gauges from the 19th February to 10th April 2018.

There was a spike in EC of 2,529 µS/cm at the Brewarrina gauge on 30th March, two days after the peak of the second Moonie River flow had passed. It appears that the wetting up of the higher banks by the second flow mobilised the salts. EC spiked at Warraweena at 2,036 µS/cm around 8th April.

Prior to the arrival of flows at Bourke, the EC in the weir pool was stable at approximately 1,000 µS/cm (Figure 9). During the event, EC increased to almost 2,400 µS/cm around 29th March and then dropped to less than 200 µS/cm by 30th March as the peak of the flow passed. The zero flow conditions in the Darling River prior to the event led to a gradual concentration of salts at Weir 19A. The EC reached almost 11,300 µS/cm before the flows arrived.

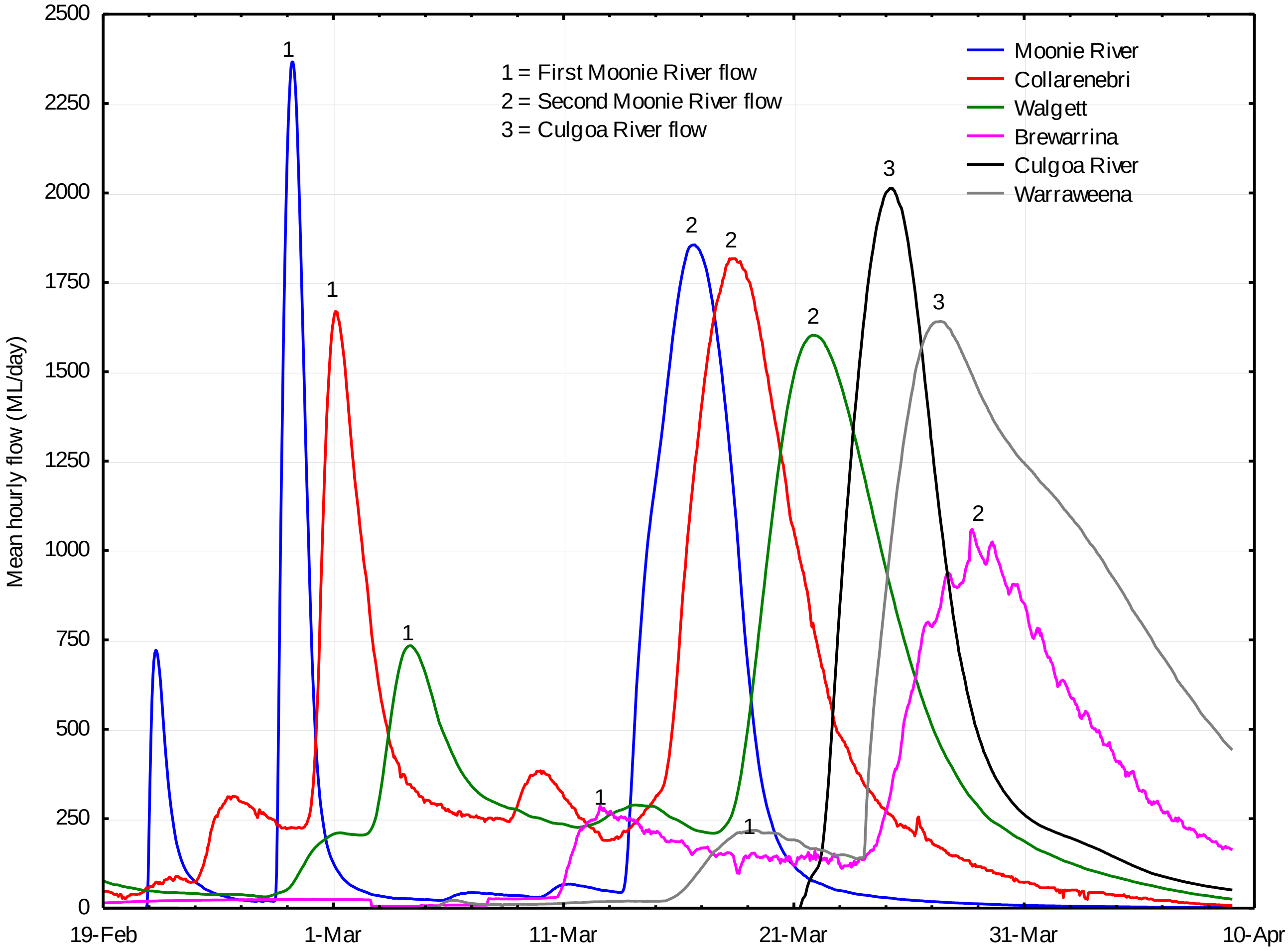

Figure 8: Mean hourly flow in the Moonie, Barwon, Culgoa and Darling Rivers from 18th February to 10th April 2018.

The peak of the flow reached Louth on 4th April, yet the highest EC result of 3,600 µS/cm was three days later on 7th April. It is possible that the denser saline water from Weir 19A and Glen Villa flowed slowly along the bottom of the river channel with the fresher water from upstream flowing over the top, resulting in a delay in the salt slug reaching Louth. The velocity of flows reaching Louth may not have been sufficient to provide the turbulence required to completely mix the saline water through the profile.

Although this event led to local increases in salinity as flows passed along the river system, these increases were temporary, decreasing as river levels reduced. Where salinity has built up due to extended dry conditions, flow events are important for flushing salts downstream.

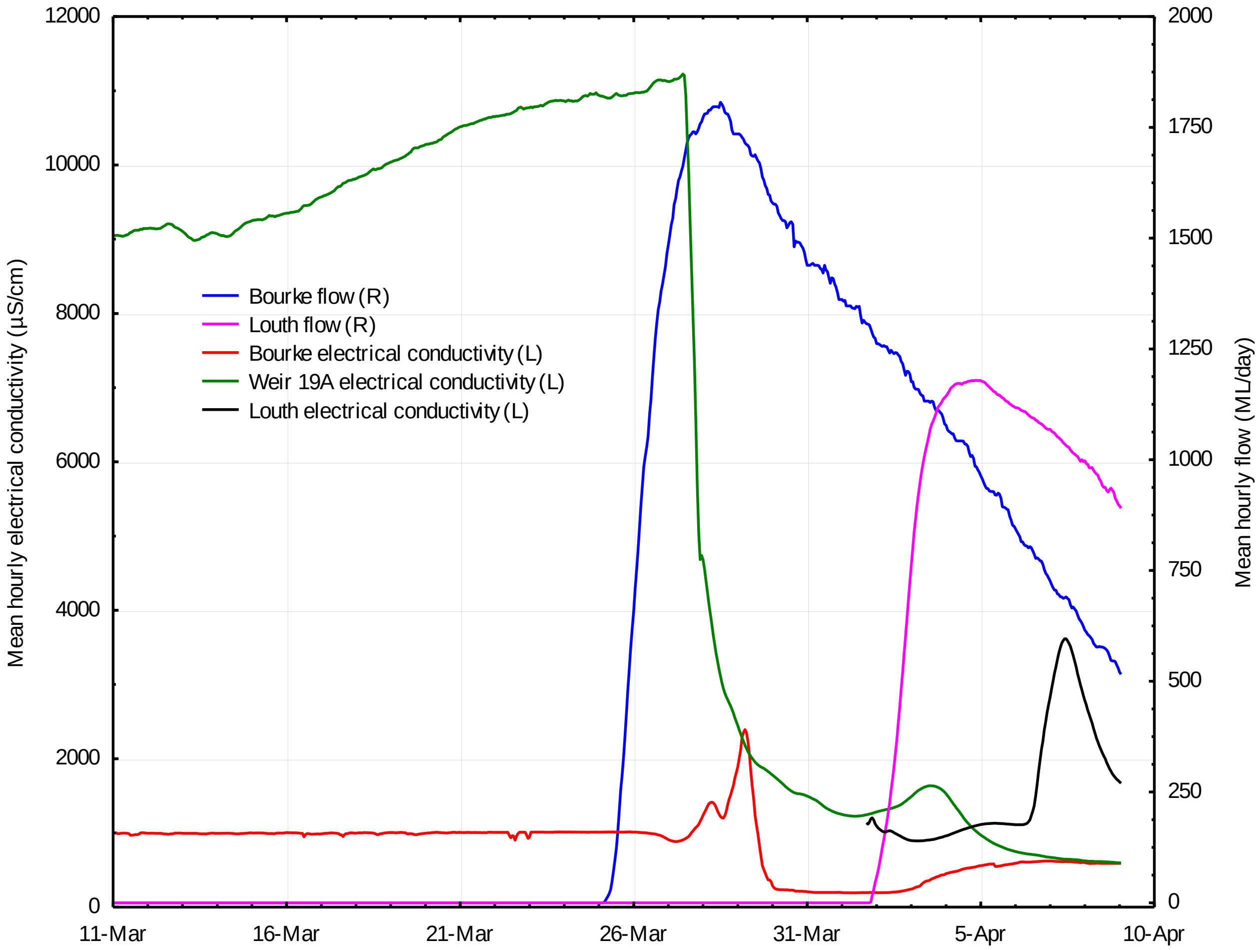

Figure 9: Mean hourly electrical conductivity (EC) and flow in the Darling River at Bourke and Louth.

Blue-green algae

Blue-green algae (also called cyanobacteria) form part of the natural microbial population in most waterbodies (ANZECC 2000). Under certain natural or human-induced conditions toxic algal blooms can occur and these may negatively affect the suitability of the water for drinking, irrigation and recreation and can harm native and stock animals. Algal blooms are most likely to occur when water is stagnant and turbulence (which increases during flow events) is low. The Barwon-Darling River is regularly tested for the presence of blue-green algae.

Low levels of blue-green algae occurred at most sites along the Barwon-Darling River during February and March 2018. These were mostly at green alert level meaning that algae is present, but unlikely to cause problems for domestic, stock or recreational use. A red alert (the highest alert level) was issued for the Darling River at Wilcannia and Darling River at Caulpaulin in early March 2018 but the levels had generally been falling prior to the March and April 2018 flow events.

No blue-green algae were detected in samples collected upstream at Collarenebri and Walgett following the higher flow events in early and mid-March. This suggests that the flows flushed the algae from these locations. Work by Mitrovic *et al*. (2006) identified the flow rates needed to mix water within pools and prevent blooms forming. The key flow rates identified were 510 ML/d at Brewarrina, 450 ML/d at Bourke and 350 ML/d at Wilcannia. This event provided sufficient flows to mix water within pools located between Brewarrina and Bourke, however, it did not exceed the threshold identified for Wilcannia (Department of Agriculture, Water and the Environment 2020).

Large woody habitat and in-channel benches

The protection of flows in the Barwon-Darling River during March-April 2018 inundated a variety of key habitats within the river channel, making the habitat available to native species like fish. Large wood is a major in-channel feature of the Barwon-Darling River and provides important hiding and resting places for fish outside of the main flow of the river, and spawning sites and territorial markers for several native fish species (DPI 2015). Large woody debris also helps to develop scour pools and prevent erosion through bank stabilisation. In-channel benches (relatively flat areas within the river channel) enhance habitat diversity and contribute to productivity processes. Benches influence flow, provide variation in water depth and store carbon, releasing it into the ecosystem when inundated.

Habitat mapping was completed along the 1,100 km reach between Walgett and Wilcannia in 2015 as part of the *Fish and Flows in the Northern Basin* project (DPI 2015). The mapping included important habitat features including large woody debris and in-channel benches. The project also included identifying flow heights needed to inundate these habitat features (commence-to-inundate heights).

Flow data for the March-April event was compared against the known commence-to-inundate heights for large woody habitat (LWH) and in-channel benches between Walgett and Wilcannia. This provides a measure of the additional habitat made available by this flow event. The amount of habitat made available and the length of time for which it was available varied across river sections as the protected flow moved down the system (Table 4).

The DPI habitat mapping project recorded 48,339 pieces of LWH between Walgett and Wilcannia, with the greatest number observed in the Bourke to Tilpa section and the lowest between Brewarrina and Bourke (DPI 2015). Approximately 48 % of the LWH mapped in upstream Walgett-Brewarrina was inundated. This proportion declined further downstream, with 23 % and 27 % of LWH inundated in the Brewarrina-Bourke and Bourke-Tilpa river sections respectively. In the Tilpa-Wilcannia river section, furthest downstream, only 11 % of LWH was inundated. This is to be expected, as losses along the river system meant flow volumes declined gradually as the flow passed downstream.

Habitat mapping recorded 745 in-channel benches between Walgett and Wilcannia, with a total area of 11 ha (DPI 2015). The total habitat area provided by the habitat generally increased moving downstream. This flow event inundated 94 % of in-channel benches between Walgett and Brewarrina, equivalent to 8.4 ha of habitat provided. Downstream in Tilpa to Wilcannia, 27.4 ha of bench area was inundated though this equates to 44 % of the mapped in-channel benches.

Table 4: Inundation of mapped large woody habitat and in-channel benches by river section.

River section	Large woody habitat		In-channel benches	
	Proportion of pieces inundated (%)	Number of pieces inundated	Proportion of benches inundated (%)	Area inundated (Ha)
Walgett – Brewarrina	47.7	3,788	94	8.4
Brewarrina – Bourke	22.6	1,119	48	12.8
Bourke – Tilpa	26.7	2,503	57	10.6
Tilpa – Wilcannia	11	750	44	27.4

The northern connectivity event

This event also contributed to the positive outcomes of the Northern Connectivity Event which followed it (Department of Agriculture, Water and the Environment 2020). The Northern Connectivity Event was a joint release of held environmental water by State and Commonwealth governments from April to July 2018. The event achieved connectivity across 2,000 km of the Barwon-Darling and improved water quality, river habitat and provided opportunities for native fish species to move between pools. The March and April Queensland inflows wet the Barwon-Darling River, contributing to reduced water losses during the Northern Connectivity Event.

Further information about the assessment of the event's environmental benefits is available at Attachment A.

Pumping opportunity

A total volume of 15,860 ML of water was protected from extraction through implementing the s.324 temporary water restrictions. While the protection of this water led to benefits for town water supply, Barwon-Darling communities and the environment, its impact on other water users must also be considered. The s.324 order prevented water extraction by irrigators that may otherwise have been available to pump, potentially causing negative financial outcomes.

The temporary water restrictions were put in place following the end of the summer irrigation season when it could reasonably be presumed watering of crops had ceased and irrigators were entering harvest. This likely reduced the potential impact of the s.324 order on irrigated agriculture. However, it is also reasonable to assume that irrigators may have taken this opportunity to replenish diminished storages, particularly where they were considering a winter irrigated crop.

Communicating the rationale for protecting this flow event from extraction was therefore important to ensure a shared understanding of its importance and value.

Lessons learnt

The outcomes of this flow event and its protection provide useful lessons for future events. These will help to shape policy and decision-making regarding water management, including the use of s.324 orders. The lessons learnt are summarised below.

Effectiveness of the s.324 order

Under the *Water Management Act 2000*, the NSW Government implemented s.324 temporary water restrictions to protect flows from extraction. Protection of this event achieved the desired outcome of re-filling weir pools for town water supply and supporting basic landholder rights. As such, the s.324 order was effective in reducing pressure on Brewarrina and Bourke town water supplies. It also contributed to improving instream environmental conditions and the success of the subsequent Northern Connectivity Event in 2018.

It is important that compliance with restrictions is monitored to ensure their effectiveness. Water NSW visited all active work approvals between Mungindi and Louth between 10th and 20th March 2018 at commencement of the restrictions. Further site visits were made after the lifting of the order to confirm no extractions had taken place. Daily flows at gauging stations were also analysed to identify any unauthorised take.

Communication with water users

Significant effort was invested in communicating the s.324 order to water users. WaterNSW used a range of media platforms including radio advertising, interviews and newspapers to communicate when and where the s.324 order applied. Media interviews were held with ABC Broken Hill, 2WEB

Bourke, and 2CUZFM Bourke (Koori radio), and the media release was sent to ABC Mildura, Tamworth and New England. In addition, WaterNSW advertised the s.324 in eleven different newspapers.[1]

Despite efforts to communicate temporary water restrictions to the community, media coverage is patchy in the Barwon-Darling. The region is not well serviced by major regional media outlets (with the possible exception of Bourke radio 2WEB). Most newspaper distributions are very localised and there are no daily newspapers. The nearest ABC coverage is Armidale or Broken Hill, and the area is not well-served by local TV stations. This means that using media to notify users of an order of this type cannot be done with confidence in the amount of geographic coverage achieved, especially at short notice.

Additionally, WaterNSW did not have access to an internal communication platform populated with customer contact details to distribute information. Anecdotal evidence from customers in the region suggests that during these temporary water restrictions, a number of target audience members did not receive adequate notification. Media exposure must be accompanied by whatever complementary means can be generated to improve the likelihood of successful communication. Compliance with the restrictions cannot be expected if the water users are not aware that they are in place.

Improving transparency

It is important that there is adequate monitoring and reporting protocols in place for such events to account for the outcomes achieved against the objectives of the event. Reporting also needs to be transparent about any unintended impacts to water users as well as lessons learnt.

This event was the first large-scale restriction using a s.324 order. Subsequent events managed via a s.324 order should be analysed and evaluated similarly to this one so that events can be meaningfully compared in terms of their management and outcomes. This will also provide a sound foundation for transparency in reporting and interpreting where improvements have been made based on lessons learned from previous events.

Coordination of events

Flows in the Barwon-Darling originated from inflows from three Queensland valleys: Moonie, Condamine-Balonne/Culgoa, and Warrego. The s.324 order imposed by the NSW Government only applied to water extraction within NSW, therefore water was extracted in Queensland before flows reached the State boundary. A coordinated effort by both State governments to protect flows could have led to better outcomes for communities and the environment.

The capacity for coordinated protection of flows was demonstrated by the Northern Connectivity Event which commenced in April 2018 (Department of Agriculture, Water and the Environment 2020). The release of regulated environmental water into the Barwon-Darling River was a joint undertaking by State and Commonwealth governments. Queensland and NSW protected the flow along the Border Rivers from being extracted before it reached the Barwon-Darling. State and Commonwealth agencies collaborated to communicate information to the public, during and after the event. Interagency coordination contributed to the effective management of this event and provides an example for future flow events.

1 Barrier Daily Truth Broken Hill, Moree Champion, Warialda Standard, Walgett Spectator, Northern Valley Irrigator, Namoi Independent, Tamworth Leader, Sunraysia Daily Mildura, Bourke Western Herald, Brewarrina Newsletter (L Govt), Goondiwindi Argus

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8. Department of Primary Industries (2015). 'Fish and Flows in the Northern Basin: responses of fish to changes in flow in the Northern Murray-Darling Basin – Reach Scale Report'. Final report prepared for the Murray-Darling Basin Authority.

Attachment A: LTWP environmental water requirements

The Long-Term Water Plan (LTWP) currently under development for the Barwon-Darling River identifies environmental water requirements (EWRs) for the river. An EWR describes the characteristics of a flow event (e.g. magnitude, duration, timing, frequency, and maximum dry period) within a particular flow category (e.g. small fresh), that are required for that event to achieve an ecological objective or set of objectives (e.g. to support fish spawning).

The LTWP then uses a risk assessment method to provide an indication of the ecological urgency or demand for a particular flow to meet an EWR. Based on the frequency of a given EWR being met over the past five years and whether or not the maximum interflow period (the maximum time between flow events before a significant decline in the condition of a population is likely to occur) has been exceeded, the EWR is rated on a scale between satisfactory and in urgent demand of being met (Table 5). This risk assessment can provide additional focus to the parts of the hydrograph in urgent need of restoration, and additional impetus for change.

Table 5: Demand rating matrix for EWR assessment.

Interflow period	Frequency met over the last five water years	Frequency within 20% of being met over the last five water years	Frequency not met over the last five water years
Interflow period is currently below the maximum threshold	**Satisfactory**	Not ideal	In demand
Interflow period is within three months of the maximum threshold	In demand	Medium demand	High demand
The maximum interflow period is currently exceeded	Medium demand	High demand	**Urgent demand**

The demand ratings for the Barwon-Darling EWRs were reassessed once the flows protected by the temporary water restriction had passed.

Although the flows provided some level of connectivity from Mogil Mogil to Tilpa, they were insufficient to have a significant impact across the environmental water requirements, with only one ‘in demand’ environmental water requirement changing to ‘satisfactory’ after the event.

Flows above the Culgoa junction were low as the Culgoa provided the greatest contribution to inflows. Downstream of Bourke, flow volumes were reduced as losses were high due to the dry riverbed. The duration of flows above the flow level defined as a small fresh was only six days at Louth – a minimum of 10 days is needed to meet EWRs. At Tilpa, the volume did not reach the small fresh flow threshold.

Additional flows, including larger volume flows, are required across the length of the Barwon-Darling River for further environmental benefits to be achieved.