Barwon–Darling valley annual surface water quality report: 2021-2022

Key Points

- Flow during July 2021 to June 2022 was characterised by heavy rain falling across much of the catchment. This rain resulted in flooding across all catchments in the Northern Basin leading to large flows in the Barwon-Darling system.
- Large tributary inflows led to a hypoxic blackwater event that threatened aquatic ecosystems from December 2021 through to April 2022. Dissolved oxygen levels rapidly dropped below the critical ecological threshold of 2 mg/L and remained below this level for about a month, however no large fish deaths were reported.
- Flooding was the main driver of water quality in the Barwon-Darling. The water quality index indicated that of the 8 sites in the catchment, 5 were rated as poor and 3 as moderate. Compared to 2020 to 2021 results, the water quality index scores for all 8 sites were lower in 2021 to 2022.
- All sites were below their respective Basin Plan agriculture and irrigation salinity targets of 957 µS/cm (microSiemens per centimetre) upstream of Menindee Lakes and 833 µS/cm downstream of Menindee Lakes. The median and 80th percentile at Wilcannia were both less than the End-of Valley targets of 389 µS/cm and 453 µS/cm respectively.
- Blue-green algal blooms were not a major problem over the 2022 summer. A red-alert warning for algal blooms was issued at the end of February 2022 for the Darling River at Wilcannia and further downstream towards Menindee Lakes.

The water quality data used in this report is collected on a monthly frequency at 8 sites in the Barwon–Darling valley for the State Water Quality Assessment and Monitoring Program. The program is responsible for collecting, analysing and reporting the ambient water quality condition of rivers in NSW. This annual report summarises the surface water quality data collected in the Barwon–Darling Valley from July 2021 to June 2022. The location of monitoring sites is shown in Figure 1.

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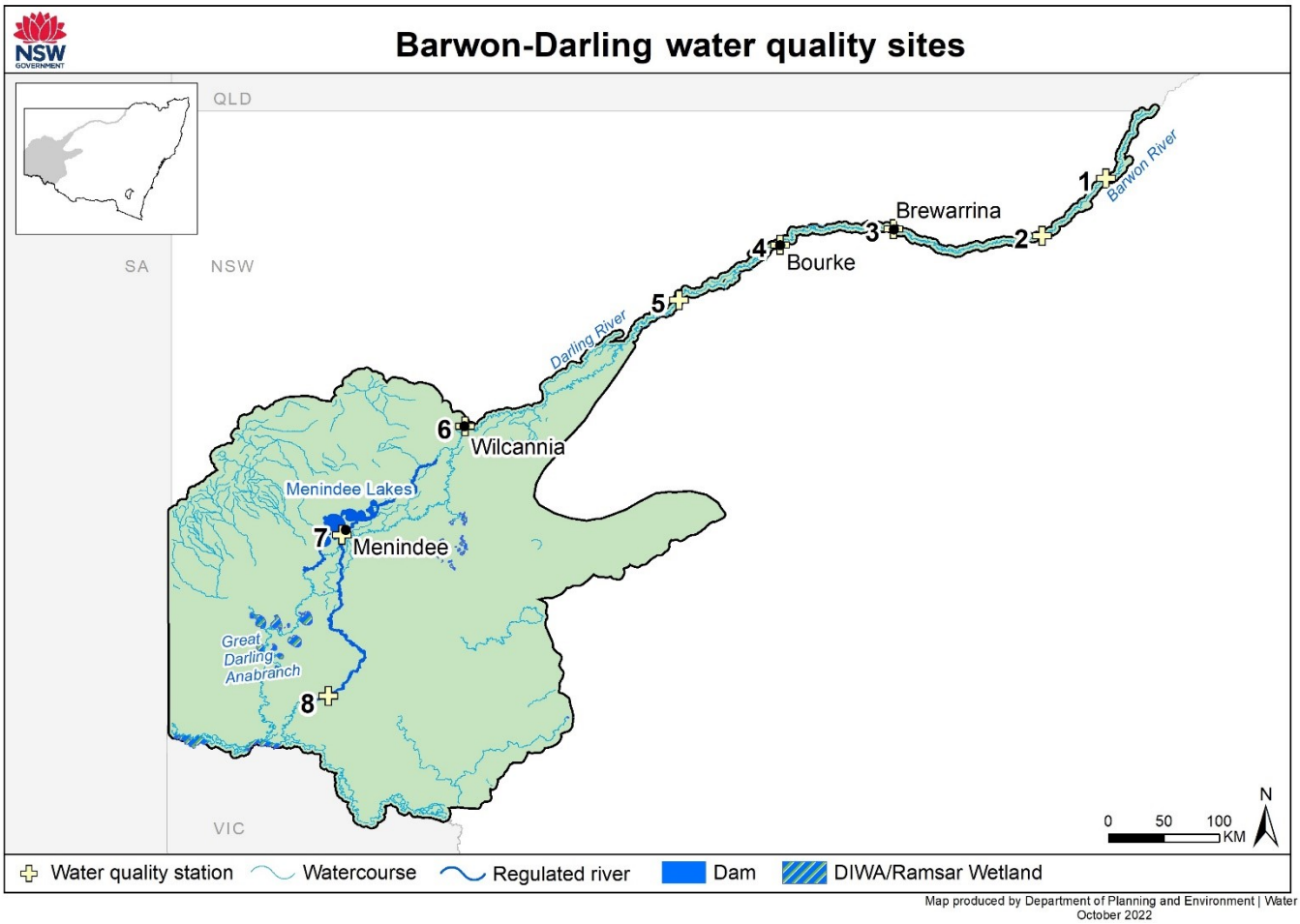

Figure 1: Location of routine water quality monitoring sites in the Barwon–Darling valley

Table 1: Site information for each monitoring site in the Barwon–Darling River catchment. Refer to Figure 1 and site numbers for location of each site

Site number	Site name	Water Quality Zone	Station number
1	Barwon River at Collarenebri	Barwon	422003
2	Barwon River at Dangar Bridge (Walgett)	Barwon	422001
3	Barwon River at Brewarrina	Barwon	422002
4	Darling River at Bourke	Upper Darling	425003
5	Darling River at Louth	Upper Darling	425004
6	Darling River at Wilcannia	Upper Darling	425008
7	Darling River at Weir 32	Lower Darling	425012
8	Darling River at Burtundy	Lower Darling	425007

Catchment description

The Barwon, Darling and West region covers a large area of western NSW. The region is characterised by extremely low relief, low rainfall and climatic variability.

The Barwon–Darling connects the river systems of the northern Murray–Darling Basin with those of the south. It is considered unregulated from Mungindi on the NSW-Queensland border to Menindee Lakes in south-west NSW, despite there being 15 weirs between Mungindi and Wilcannia (NSW Office of Water 2012) and approximately 100 in-stream structures. The weirs provide important storage pools for local town water supplies and to meet irrigation needs. They also create major barriers to fish movement (NSW DPI 2015) and can be associated with algal blooms (Mitrovic et al. 2003).

Upstream of Bourke, inflows are received from all of the major river valleys in the northern Murray-Darling Basin, including from the Intersecting Streams, Border Rivers, Gwydir, Namoi and Macquarie and Castlereagh rivers. Downstream of Bourke and further west, the Paroo and Warrego are the only major tributaries that contribute intermittent flows but can provide significant volumes during flood events.

Flows in the Lower Darling are regulated by releases from Menindee Lakes. There are two major river systems in the Lower Darling, the Darling River and the Great Darling Anabranch. The Darling Anabranch Lakes are listed in the Directory of Important Wetlands.

Grazing is the dominant land use along the Barwon and Darling Rivers. Cropping (dryland and irrigated) is largely concentrated between Mungindi and Brewarrina, with some areas of irrigated cotton around Bourke and irrigation of horticulture crops near Wentworth.

Catchment conditions during 2021-2022

Flow during 2021–2022 was characterised by heavy rain falling across much of the catchment with November recording the highest total rain (Figure 2A). High inflows led to flooding with peak discharge at Bourke reaching over 73,000 ML/day in January 2022 (Figure 2C). Whilst the floods helped native fish move along the river system and provided some of the biggest flows into Menindee Lakes in almost 10 years, there was also a risk of hypoxic blackwater events (refer to Extreme Water Quality Events). The lakes' total storage level was above full capacity in October 2021 (Figure 2B). Daily releases from the lakes occurred at a rate of around 3.5 GL/day, comprising 2.5 GL/day from Weir 32 into the lower Darling and 1 GL/day into the Great Darling Anabranch.

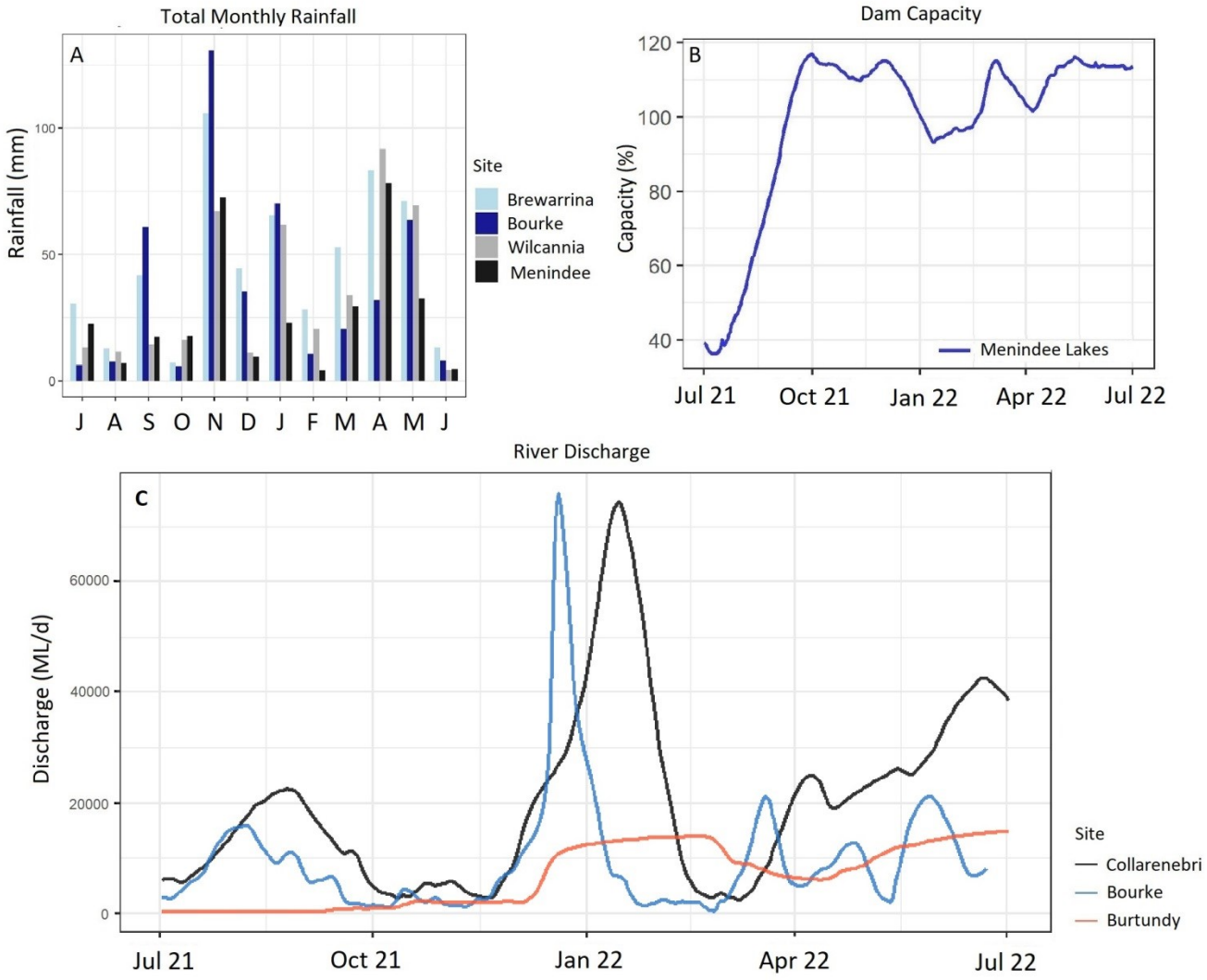

Figure 2: Catchment conditions for selected stations in the Barwon–Darling catchment from July 2021 to June 2022 for A: Monthly total rainfall (mm) B: Dam capacity (%) and C: River discharge (ML/day).

Water quality for water dependent ecosystems

NSW uses a Water Quality Index (WaQI) as a tool to communicate complex and technical water quality data in a simple and consistent way. The WaQI score was calculated for each monitoring site using total nitrogen, total phosphorus, turbidity, pH, dissolved oxygen and electrical conductivity. The index compares the monthly water quality results against a set of predetermined water quality targets to calculate a score between 1 and 100. A score of 100 represents a site in pristine condition, while a score of one is a very highly degraded site. The results from the WaQI are summarised in Figure 3. Sites where there has been a change of less than 5 points in WaQI score, have been identified with horizontal arrows. Arrows pointing up or down indicate the score has increased/decreased by more than 5 points.

The majority of the monitoring sites in the Barwon Darling system rated as poor, with the Barwon River at Collarenebri and Darling River at Weir 32 and Burtundy rating as moderate. The low water quality index scores can be attributed to the high turbidity and nutrient concentrations caused by continued flooding throughout most of 2021 to 2022.

Compared to 2020 to 2021 results, the water quality index scores for all 8 sites were lower in 2021 to 2022. The Darling River at Bourke declined from good to poor, the Darling River at Weir 32 and Burtundy declined from good to moderate and the Darling River at Louth and Wilcannia declined from moderate to poor.

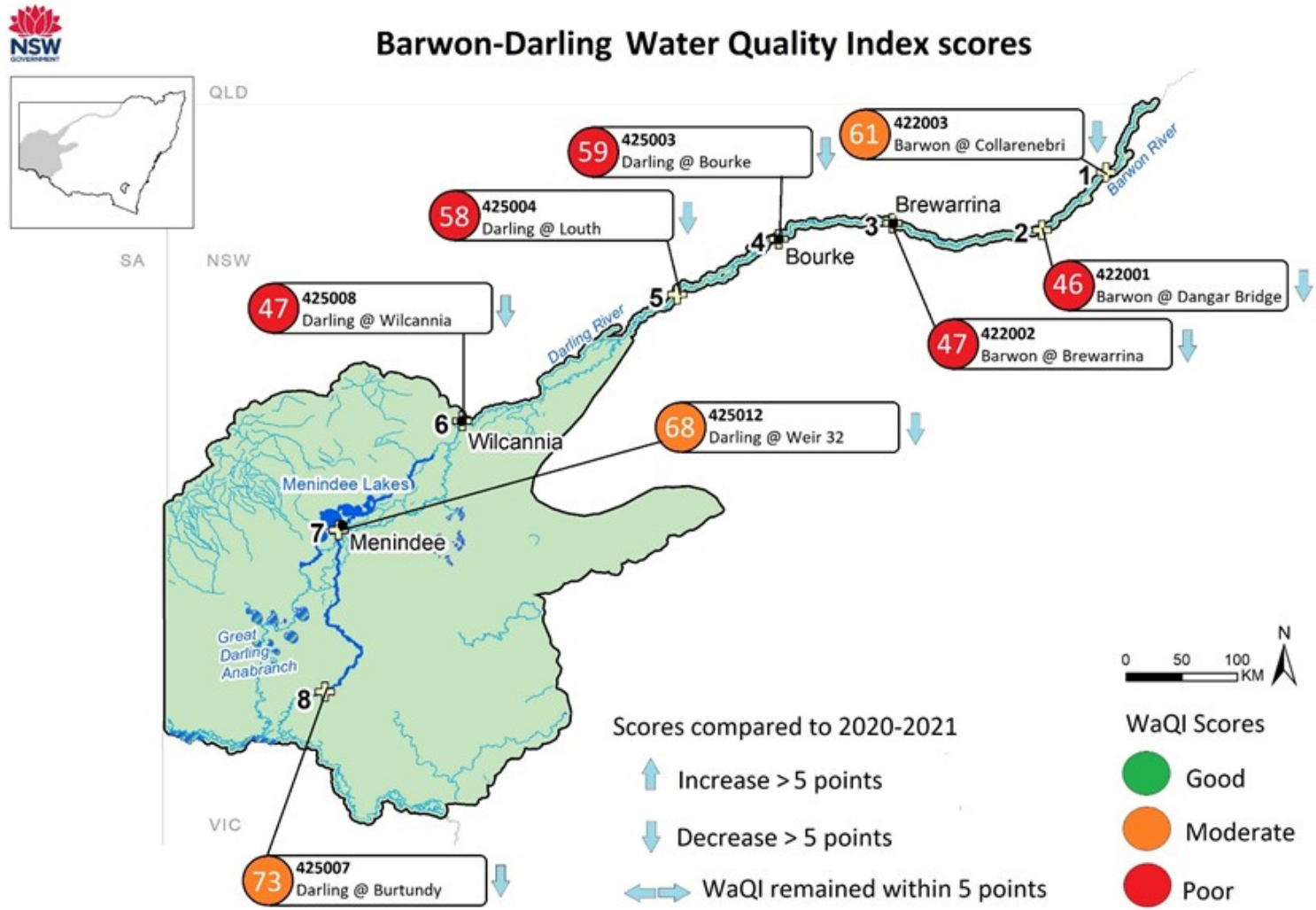

Figure 3: Water quality index scores for the Barwon–Darling valley

Turbidity, total nitrogen and total phosphorus increased with distance down the Barwon and Darling rivers as floodwaters transported soil and attached nutrients downstream. The results are lower in the Darling River downstream of Menindee Lakes as some of this material was deposited within the lakes.

While the median dissolved oxygen levels were above critical levels for fish health, there were low results during the hypoxic blackwater event from December 2021 to 2022. The high turbidity in western rivers reduces light penetration, reducing aquatic plant growth and higher water temperature reduces the solubility of oxygen in the water column. In addition, major flooding resulted in the flushing of organic matter off the lowland floodplains and into waterways. The rapid breakdown of this material by bacteria caused dissolved oxygen levels in the major rivers of the Northern Murray Darling Basin to decline to critical levels for fish health in December 2021.

Due to the diluting effects of the consistent high flows through 2021 to 2022, electrical conductivity at all sites was low.

Summary statistics for the key water quality parameters at each monitoring site in the Barwon Darling system have been displayed as box plots (Figure 4). The box plots show the annual 25th, 50th and 75th percentile values, with error bars indicating the 10th and 90th percentile values for each site.

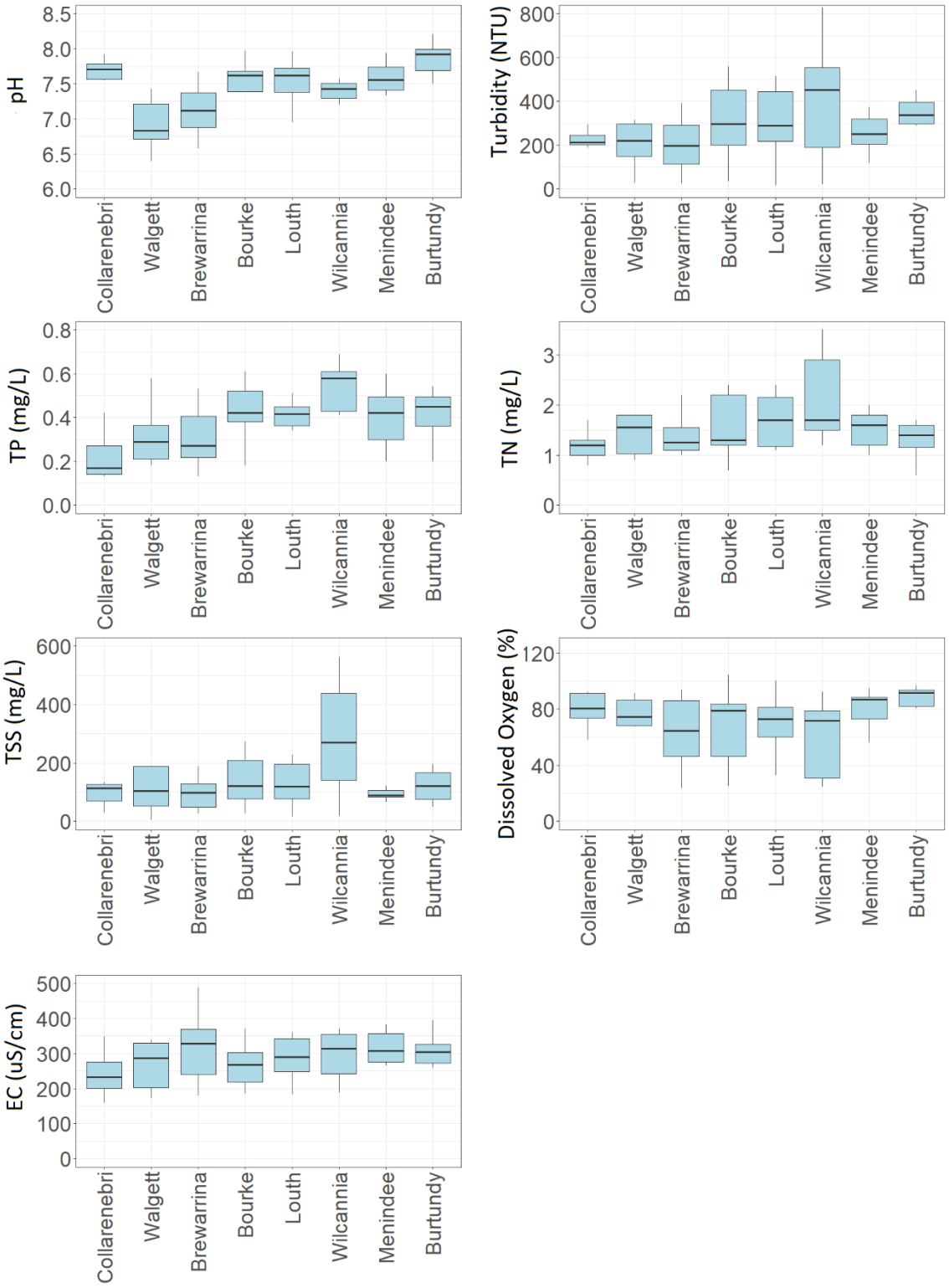

Figure 4: Water quality data for water quality parameters by site, moving upstream to downstream from left to right

Irrigation and salinity

There are 2 Basin Plan agriculture and irrigation salinity targets for the Barwon–Darling valley.

- 957 µS/cm for sites upstream of Menindee Lakes and;
- 833 µS/cm downstream of Menindee Lakes.

There are 17 continuous electrical conductivity monitoring sites in the Barwon–Darling – valley extending from Mungindi to Burtundy and down the Great Darling Anabranch. There is also a cluster of electrical conductivity monitoring sites around the Upper Darling salt interception scheme located between Bourke and Louth. There is one irrigation infrastructure operator in the lower Darling River at Pomona (Wentworth).

All sites had a 95th percentile electrical conductivity lower than the Basin Plan agriculture and irrigation salinity target of 957 µS/cm for the sites upstream of Menindee Lakes and 833 µS/cm downstream of Menindee Lakes. Figure 5 shows selected sites where there was some fluctuation in electrical conductivity between sites, but due to the diluting effects of the consistent high flows, electrical conductivity at all sites was low. Electrical conductivity in the Darling River at Burtundy did not exceed the Basin Plan target for managing water flows (830 µS/cm) at any stage during 2021 to 2022.

The recommencement of flows down the Great Darling Anabranch via the Lake Cawndilla outlet did not result in a high salinity event as the first flush progressed down the system.

The Basin Salinity Management Strategy End-of-Valley salinity targets for the Darling River at Wilcannia are:

- the median electrical conductivity does not exceed 389 µS/cm
- the 80th percentile electrical conductivity does not exceed 453 µS/cm and;
- the annual salt load does not exceed 576,400 t/year.

The 2021 to 2022 median (312 µS/cm) and 80th percentile (380 µS/cm) did not exceed the respective End-of-Valley targets, while due to the very high flows the annual salt load of 1,112,088 t/year exceeded the target value.

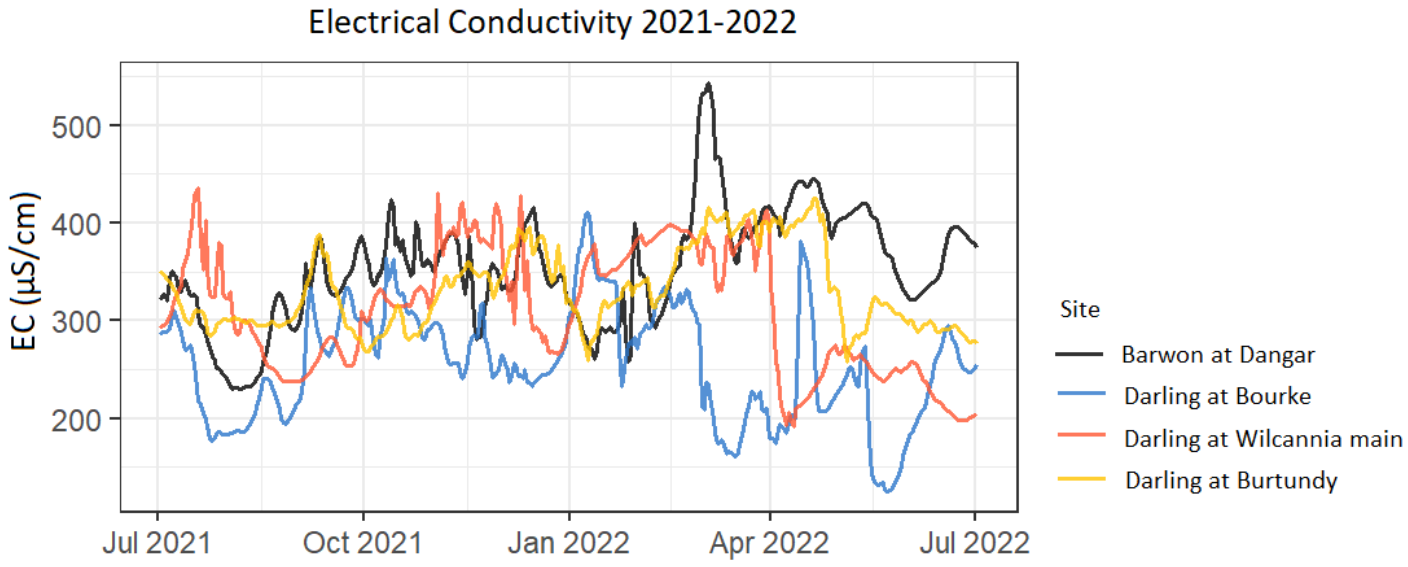

Figure 5: Electrical conductivity (µS/cm) at selected sites in the Barwon–Darling valley

Recreation

Exposure to blue-green algae (cyanobacteria) through ingestion, inhalation or contact during recreational use of water can impact human health. A colour alert scale is used with a green alert warning indicating low numbers of blue-green algae but requiring monitoring, an amber alert warning being a heightened level of alert with increased sampling and surveillance, and a red alert warning being a state of action where waters are unsuitable for recreational use. For more information about blue-green algae and algal alerts see the WaterNSW algae web page (Algae - WaterNSW).

Due to large-scale flooding across the Northern Basin from November 2021, blue-green algal blooms were not a major issue. However, there were a few red alerts for the Darling- River at Wilcannia and downstream in the Menindee Lakes area at the end of February 2022. Table 2 lists selected sites from July 2021 to June 2022. Water releases were managed in and out of the system after flooding with water users downstream from Wilcannia to Menindee informed to find alternative water supplies.

Table 2: Distribution of algal alert levels along Barwon–Darling July 2021 to June 2022

	Jul					Aug					Sep					Oct					Nov					Dec					Jan					Feb					Mar					Apr					May					Jun				
Darling R at Wilcannia	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*											*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Menindee Lakes at Lake Wetherell Site 1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*										*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Menindee Lakes at Lake Wetherell Site 3	*	*	*	*	*	*	*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Menindee Lakes at Lake Wetherell Site 4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*								*	*			*	*	*	*	*	*	*	*	*	*	*	*
Pamamaroo Inlet (Site 9)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Pamamaroo Outlet / Regulator (Site 10)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Darling R at Tolarno	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Darling R at Pooncarie	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Darling R at Burtundy	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Darling R at Ellerslie	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Darling R at Tapio	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Key: * Nil/Low alert | Green alert | Amber alert | Red alert

Extreme water quality events

In 2021, NSW experienced one of its wettest Novembers on record resulting in flooding in all catchments across the Northern Basin. Flood flows entered the Barwon and upper Darling rivers from all tributaries and led to a hypoxic blackwater event. Hypoxic, or low oxygen blackwater is a feature of Australian lowland river systems and occurs when organic material, such as sticks, leaves, bark and grass is broken down in the floodwater or washed off the floodplain into the river. The breakdown of this material by bacteria can rapidly use up all the oxygen in the water. The dark appearance of the water is due to the release of tannins as the organic matter decays.

As the floodwaters from the Border Rivers, Gwydir, Namoi, Castlereagh and Wambuul / Macquarie catchments entered the Barwon River, dissolved oxygen levels began to decline. Dissolved oxygen levels rapidly dropped below the critical ecological threshold of 2 mg/L and remained below this level for about a month. As a result of these low oxygen conditions, it was anticipated that fish could start to gasp at the water surface, and that fish deaths could occur.

A peak discharge of over 120,000 ML/day was recorded in the Barwon River at Walgett in late December 2021. This peak decreased to over 73,000 ML/day at Bourke in mid-January 2022 and over 36,000 ML/day at Wilcannia in mid-February. The management of these inflows into the Menindee Lakes, and their release, was a careful balancing act, which was continually monitored and adjusted as needed. Agencies and scientific experts worked together to monitor the dissolved oxygen levels throughout the river system and advise the best operational measures to minimise the risk to aquatic life.

NSW Fisheries investigated 5 fish death reports in December 2021 and determined the cause was likely due to widespread flooding in the northern Murray Darling Basin and associated organic material entering waterways resulting in the deoxygenation of the water and subsequent fish deaths.

The 5 reports listed on the Department of Primary Industries website for 1 July 2021 - 30 June 2022 were:

- Barwon River, near Collarenebri (19 December) - Report of 7 dead Murray Cod.

- Barwon River, near Bourke (21 December) - Report of hundreds of dead fish. Species affected included Murray Cod, Golden Perch, Bony Herring and Common Carp (introduced species).
- Darling River, near Bourke (22 December) - Report of 10 dead shrimp and yabbies.
- Barwon River, near Brewarrina (22 December) - Report of approximately 18 dead fish. Species affected included Bony Herring and Golden Perch.
- Darling River, near Bourke (24 December) - Report of less than 10 dead Murray Cod.

Despite the very low dissolved oxygen results recorded during this hypoxic blackwater event, only a small number of fish deaths were reported in the Barwon and Darling rivers. This indicates that fish were able to migrate into refuge areas of oxygenated water until better quality water arrived from upstream.

Summary

The quality of the water in a river or stream reflects underlying climate and geology and the multiple activities and land uses occurring in a catchment area. Numerous factors contribute to the observed results.

In 2021 to 2022, flooding was the key driver of water quality. Increased runoff carries high volumes of sediment and attached nutrients into waterways resulting in all 8 water quality monitoring sites in the Barwon – Darling system being rated as moderate or poor. In contrast, the high flows maintained electrical conductivity below the irrigation targets.

Large tributary inflows led to a hypoxic blackwater event in December 2021. Dissolved oxygen levels rapidly dropped below the critical ecological threshold of 2 mg/L and remained below this level for about a month. NSW Fisheries investigated 5 fish death events, though only small numbers of dead fish were reported.

The management of inflows of hypoxic blackwater from the Northern Basin catchments into the Barwon and Darling rivers, and releases from Menindee Lakes, was a careful balancing act, which was continually monitored and adjusted as needed. Agencies and scientific experts worked together to monitor the dissolved oxygen levels throughout the river system and advise the best operational measures to minimise the risk to aquatic life.

Although hypoxic blackwater events may result in the loss of fish and other aquatic life, the impacts of these events on the environment are usually short-term, as the river water re-oxygenates again as the flooding subsides. Naturally occurring events such as these underpin the broad health of rivers. They provide nutrients to drive the overall production of our river and wetland systems. In the longer term, native fish, water birds and other organisms benefit from the increased production in the river, boosting food supplies and supporting breeding cycles.

For more detailed information about water quality issues in the Barwon–Darling – catchment see the Barwon–Darling surface water quality technical report (https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0004/456925/Water-quality-technical-report-for-the-Barwon-Darling-surface-water-resource-plan-area-SW12.pdf).

References and further information

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