NSW Intersecting Streams valley annual surface water quality report: 2022–2023

Key Points

- Flow during July 2022 to June 2023 was characterised by heavy rain falling across much of the catchment in spring 2022. This rain resulted in several large flow events but not major flooding as was experienced in other catchments. Rainfall and discharge were much lower throughout 2023.
- Oxygen levels were at safe levels in the Intersecting Streams catchment and may have provided an oxygenated refuge for fish from the Barwon and Darling rivers.
- Flooding was the main driver of water quality in the Intersecting Streams catchment. The water quality index indicated that of the 6 sites in the catchment, one was rated as poor and 5 were moderate. Compared to the 2021–2022 results, the water quality index score for 4 sites decreased and the remaining 2 sites showed minimal change.
- All sites apart from the Culgoa River at Brenda were below the Basin Plan agriculture and irrigation salinity target. The median and 80th percentile electrical conductivity exceeded the Basin Salinity Management Strategy End-of-Valley salinity targets in all 4 river systems.

The water quality data used in this report is collected on a monthly frequency at 6 sites for the Intersecting Streams water quality monitoring program. This program is responsible for collecting, analysing and reporting the ambient water quality condition of rivers in the Intersecting Streams on behalf of the Dumaresq-Barwon Border Rivers Commission. This annual report summarises the surface water quality data collected in the Intersecting Streams Valley from July 2022 to June 2023. The location of monitoring sites is shown in Figure 1.

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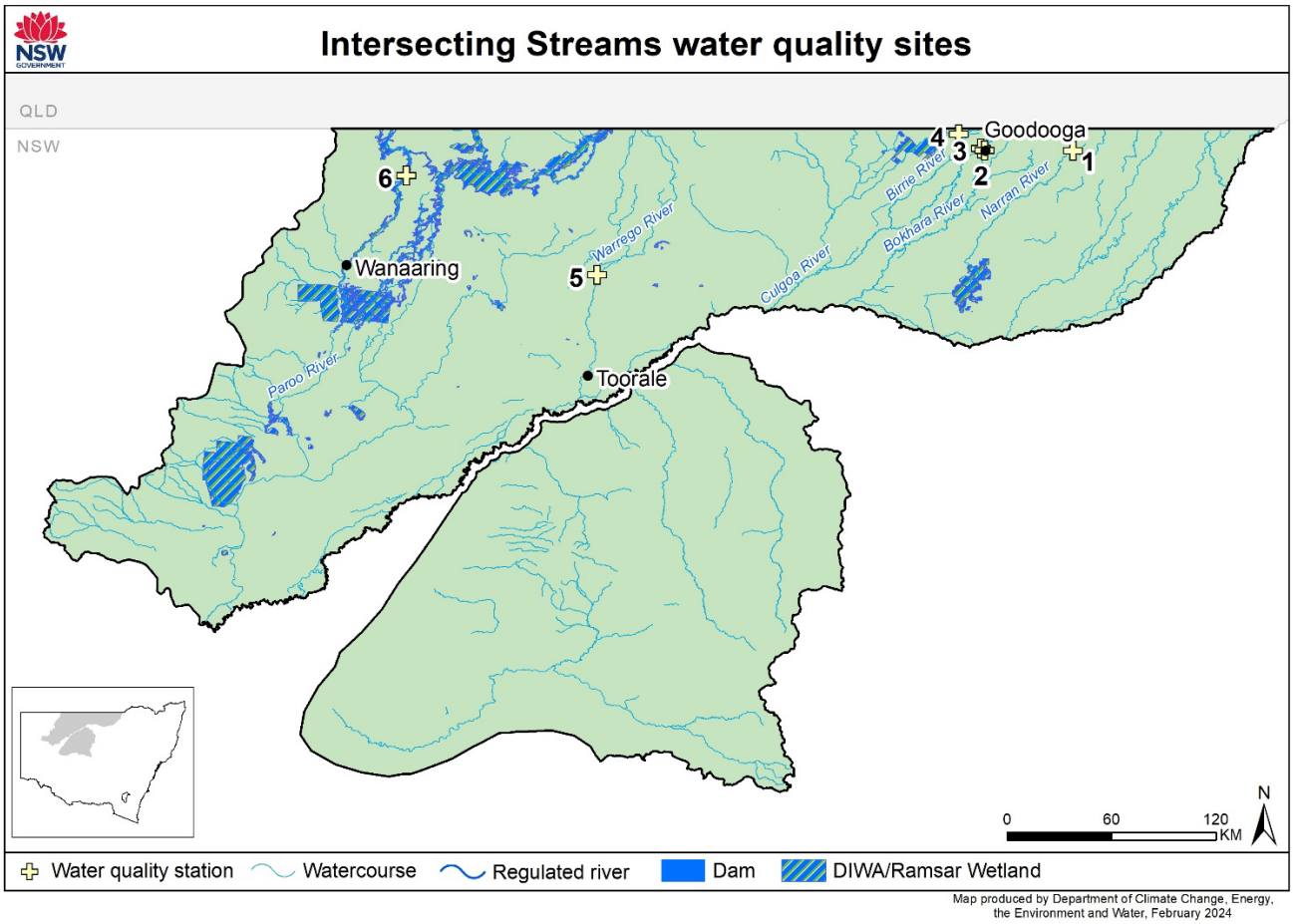

Figure 1: Location of routine water quality monitoring sites in the NSW Intersecting Streams

Table 1: Site information for each monitoring site in the Intersecting Streams catchment. Refer to Figure 1 and site numbers for location of each site.

Site number	Site name	Water Quality Zone	Station number
1	Narran River at New Angledool	Intersecting Streams lowlands	422012
2	Bokhara River at Goodooga	Intersecting Streams lowlands	422014
3	Birrie River near Goodooga	Intersecting Streams lowlands	422013
4	Culgoa River at Brenda	Intersecting Streams lowlands	422015
5	Warrego River at Fords Bridge Bywash	Intersecting Streams lowlands	423002
6	Paroo River at Willara Crossing	Paroo lowlands	424002

Catchment description

The Intersecting Streams catchment is in north-western NSW and covers an area of approximately 120,000 km^2. The area comprises 6 catchments. The Yanda Creek catchment occurs entirely within NSW and is located to the south of the Darling River. The other 5 water sources originate in

Queensland and flow across the border into NSW. These are the Narran, Culgoa, Moonie, Warrego and Paroo Rivers. The Intersecting Streams are characterised by low relief with elevations ranging from 100 to 300 metres above sea level.

The Intersecting Streams consists of ephemeral streams and wetlands. Three of the wetlands in the Intersecting Streams are Ramsar sites. The terminal Narran Lake, at the end of the Narran River system, is listed under the Ramsar Convention for international ecological importance. One section of the site was listed in 1999, and a further 3,104 hectares was added in 2016. It now covers a total area of 8,447 hectares and comprises the whole floodplain area within Narran Lake Nature Reserve. The Paroo River wetlands Ramsar site consists of two parts: Nocoleche Nature Reserve (71,133 hectares) near Wanaaring and the Peery Lake section of Paroo–Darling National Park (67,171 hectares) near White Cliffs. The Paroo River is considered the last free-flowing river in the Murray-Darling Basin and is protected through an inter-governmental agreement between NSW and Queensland.

Land use in the NSW Intersecting Streams valley is predominantly grazing with some opportunistic dryland cropping during wetter years. A detailed description of climate, land and water usage and water regulation infrastructures can be found in the Intersecting Streams resource description report (DoIW 2018, DPIE 2019).

Catchment conditions during 2022–2023

Flow during 2022–2023 was characterised by heavy rain falling across much of the catchment from September to November 2022 followed by consistently dry conditions from January 2023 (Figure 2A). Discharge within the Intersecting Streams catchment (Figure 2B) peaked on the Culgoa River above 30,000 ML/day in late September. Other high flows occurred in November on the Paroo River (over 10,000 ML/day) and in September and October on the Narran River peaking above 6,000 ML/day. Discharge in the Warrego River remained low throughout the year peaking at around 850 ML/day.

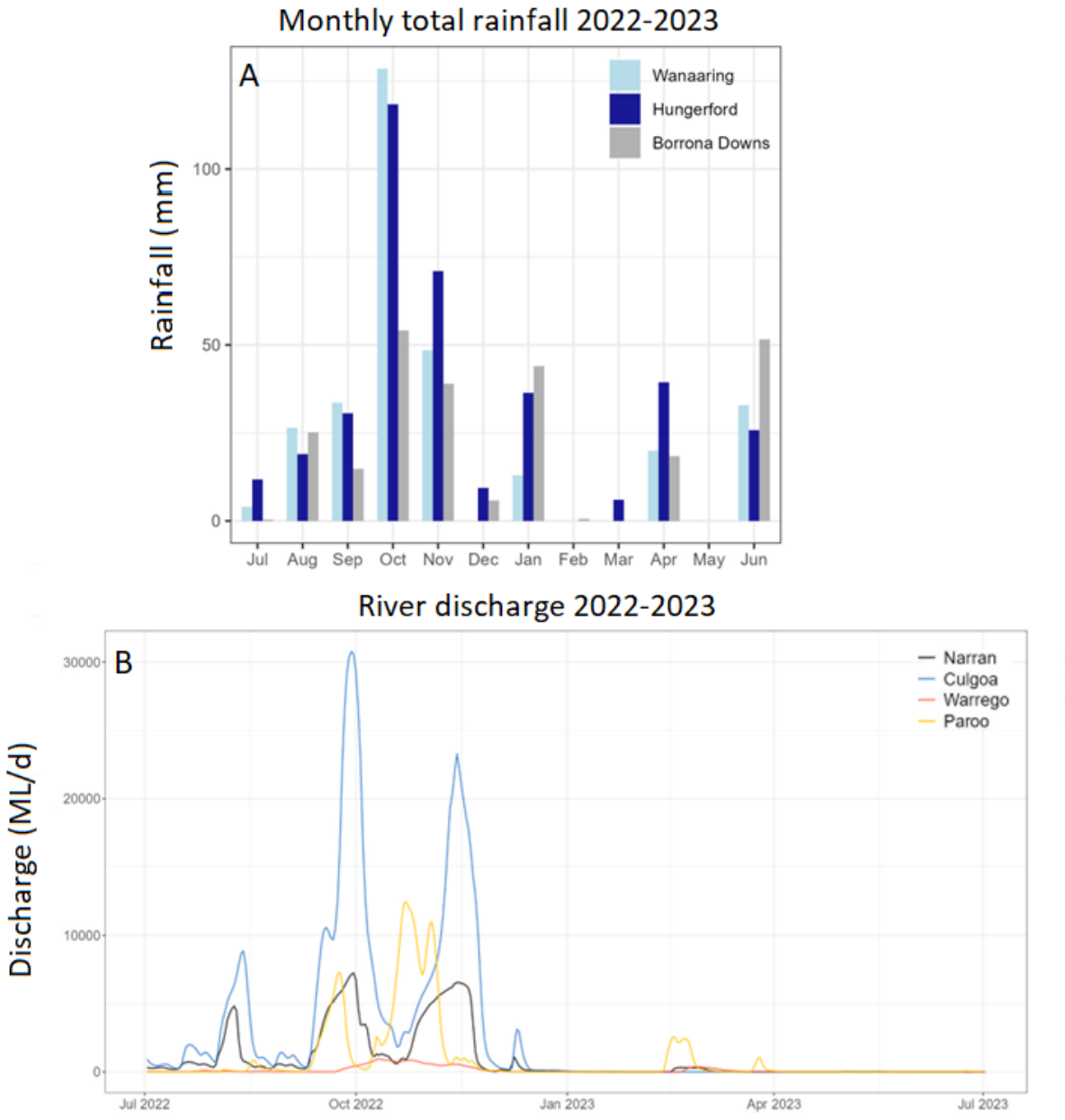

Figure 2: Catchment conditions for selected stations in the intersecting streams catchment from July 2022 to June 2023 for A: Monthly total rainfall (mm) B: River discharge (ML/day)

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. This value can then be categorised to rate the general water quality at a monitoring 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 water quality index category ratings in the Intersecting Streams Valley declined in 2022–2023 for one of the 6 sites compared to 2021–2022.

- The Warrego River at Fords Bridge Bywash declined from moderate to poor.
- All other sites remained moderate from the previous year.

The Warrego River at Fords Bridge Bywash had the lowest index score in 2022–2023 mainly due to higher turbidity and nutrient concentrations.

Compared to the 2021–2022 results, the water quality index score for 4 sites decreased (Birrie River near Goodooga, Culgoa River at Brenda, Warrego River at Fords Bridge Bywash, and Paroo River at Willara Crossing). The remaining 2 sites showed minimal change.

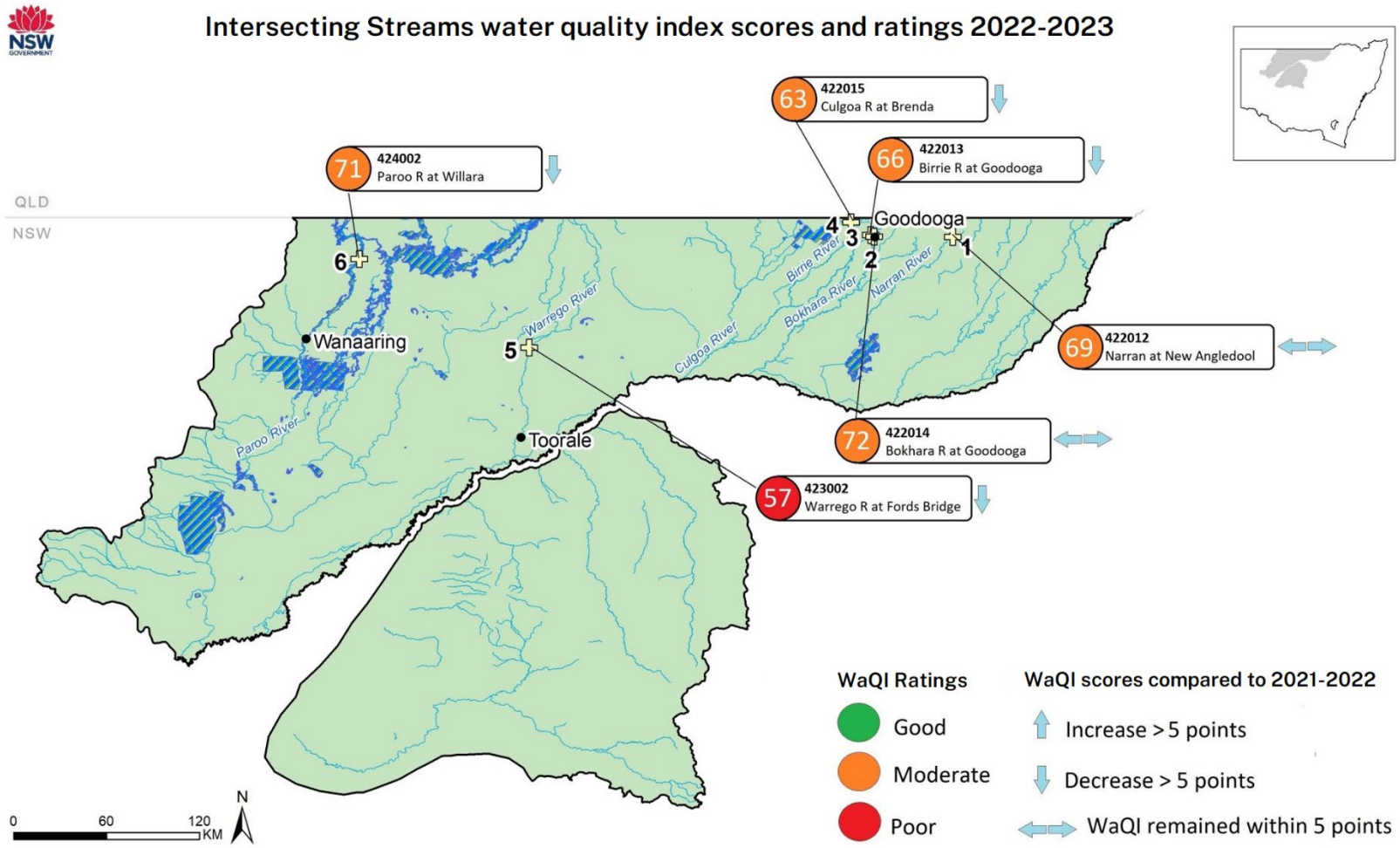

Figure 3: Water quality index scores and ratings for the Intersecting Streams valley

There was only minor variability in pH, turbidity, total nitrogen and total phosphorus across the Narran, Culgoa, Birrie and Bokhara rivers, with very little variation in median values across the 4 valleys.

The median pH was around 7.5 at all sites, with some lower readings in Paroo River. There is unlikely to be any impact on the health of aquatic ecosystems or agricultural enterprises from these lower pH readings.

Despite lower flows in the Warrego River than the other monitoring sites during 2022 to 2023, the median turbidity was the highest of the 6 sites. In the Intersecting Streams, the bulk of suspended sediment is made up of very fine clay particles. These very fine clay particles can remain in suspension in the water column, even when the river is not flowing, giving the rivers a muddy or turbid appearance. Total phosphorus was also highest in the Warrego River.

Dissolved oxygen levels were lower in the Narran, Culgoa and Paroo rivers, though the median dissolved oxygen levels were above critical levels for fish health. The breakdown of organic matter flushed off the lowland floodplains and into waterways by bacteria can cause dissolved oxygen levels to decline. In addition, water can hold less oxygen as the water temperature increases, which can lead to low oxygen levels in western rivers. However, oxygen levels in the Intersecting Streams were better than those being experienced during major flooding in the Barwon and Darling rivers during 2022 and may have provided oxygenated refuge areas for fish to move into.

River salinity is generally not a major water quality issue in the Intersecting Streams compared to other catchments, maintaining the continued use of the water for human needs. Electrical conductivity was consistent across the Narran, Bokhara, Birrie and Culgoa rivers with lower results in the Warrego and Paroo Rivers.

Summary statistics for the key water quality parameters at each monitoring site in the NSW Intersecting Streams 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.

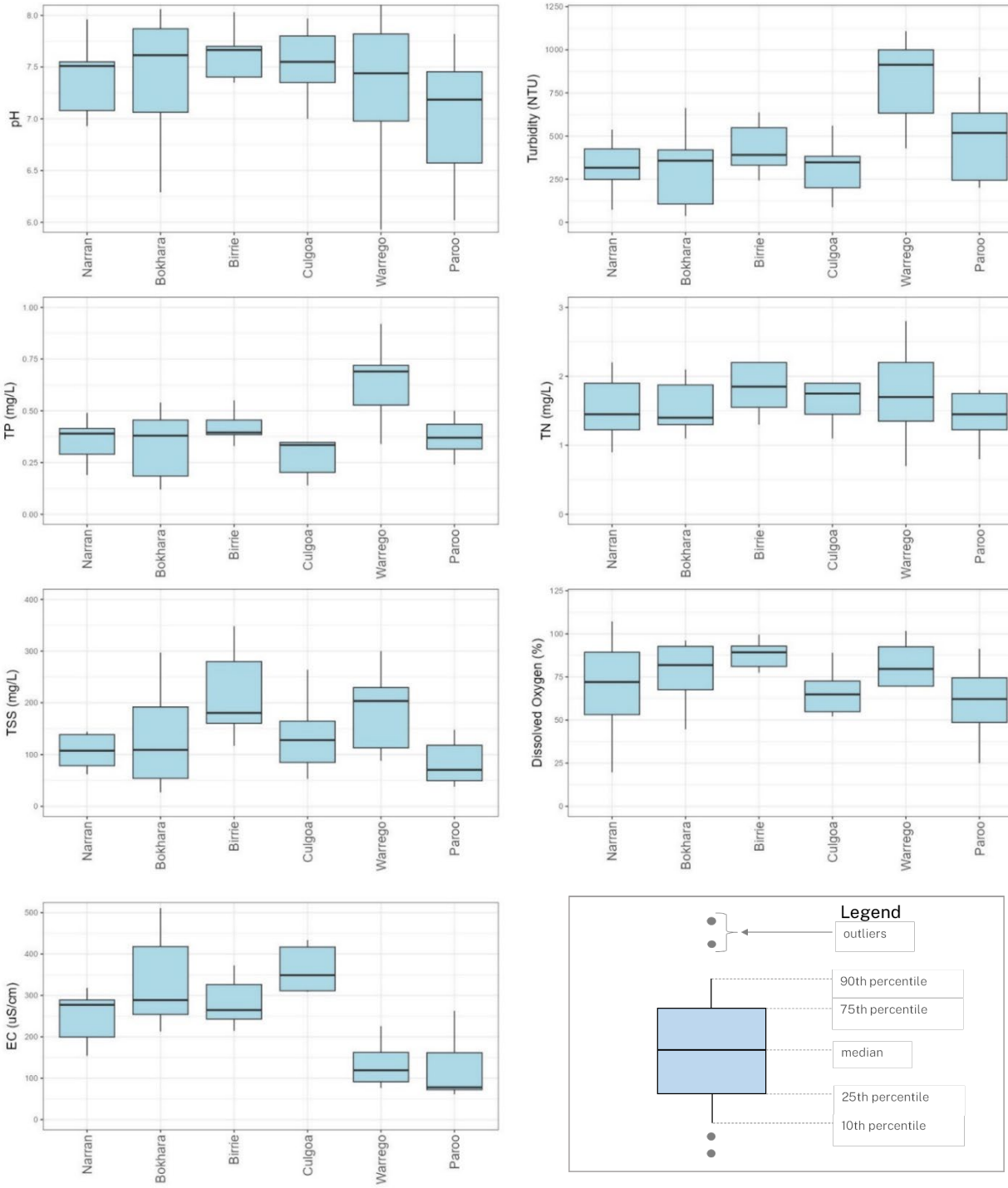

Figure 4: Water quality data by site, moving upstream to downstream from left to right. The water quality parameters shown are pH, Turbidity, Total phosphorus (TP), Total nitrogen (TN), Total suspended solids (TSS), Dissolved oxygen, and electrical conductivity (EC).

Irrigation and salinity

There are 6 continuous electrical conductivity monitoring sites in the NSW portion of the Intersecting Streams. Four sites are plotted in Figure 5. This figure shows electrical conductivity was higher in the Culgoa River than in the Narran and Warrego rivers and Cuttaburra Creek.

The Basin Plan agriculture and irrigation salinity target in the Paroo and Warrego rivers is 838 µS/cm. For all other catchments, this target is 957 µS/cm. All of the Intersecting Streams sites apart for the Culgoa River at Brenda had electrical conductivity below their respective Basin Plan agriculture and irrigation salinity targets. Electrical conductivity in the Culgoa River increased above 957 µS/cm in April 2023 when the river had stopped flowing, allowing salts to become more concentrated by evaporation.

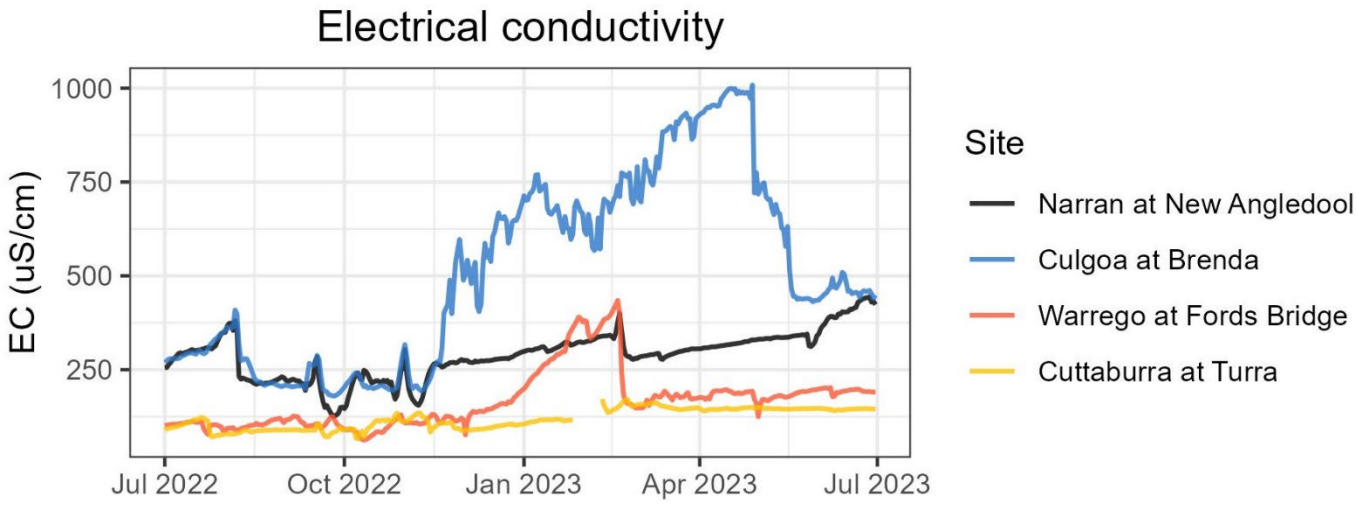

Figure 5: Electrical conductivity (µS/cm) at selected sites in the Intersecting Streams valley

There are four End-of-Valley salinity sites located in the NSW Intersecting Streams.

- Narran River at Angledool
- Culgoa at Brenda
- Warrego River at Barringun
- Cuttaburra Creek at Turra

Table 2 compares the electrical conductivity results to the target values (target values in brackets). The median and 80th percentile electrical conductivity exceeded the Basin Salinity Management Strategy End-of-Valley salinity targets in all four river systems. High flows transported high salt loads that exceeded targets in the Narran and Culgoa Rivers, but not in the Warrego River or Cuttaburra Creek.

Table 2: End-of-Valley salinity results for Intersecting Streams (targets in brackets)

Assessment site	Median electrical conductivity (µS/cm)	80 percentile electrical conductivity (µS/cm)	Salt load (t/year)
Narran River at New Angledool	288 (160)	323 (210)	45,885 (10,000)
Culgoa River at Brenda	461 (170)	729 (210)	150,418 (29,000)
Warrego River at Barringun	114 (101)	137 (110)	3,176 (4,800)
Cuttaburra Creek at Tura	116 (100)	146 (130)	4,860 (5,500)

* values in red indicate readings have exceeded the salinity target

Recreation

Exposure to blue-green algae (cyanobacteria) through ingestion, inhalation or contact during recreational use of water can impact on 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).

Nutrients from the upper catchment, combined with warm, still water during summer, provide ideal conditions for algal growth. Despite this, harmful algal blooms are a rare occurrence highlighting other issues such as high turbidity that could restrict algal growth. As a result, routine algal monitoring is not conducted in the Intersecting Streams valley and no algal alerts for blue-green algae were reported in 2022–2023.

Extreme water quality events

Spring 2022 was wettest spring on record (since 1900) for New South Wales. In October, heavy rainfall led to widespread flooding in the Murray–Darling Basin, impacting many towns in inland New South Wales (Figure 6 - BoM, 2023). The heavy rains led to substantial increases in water storage levels, with many storages spilling.

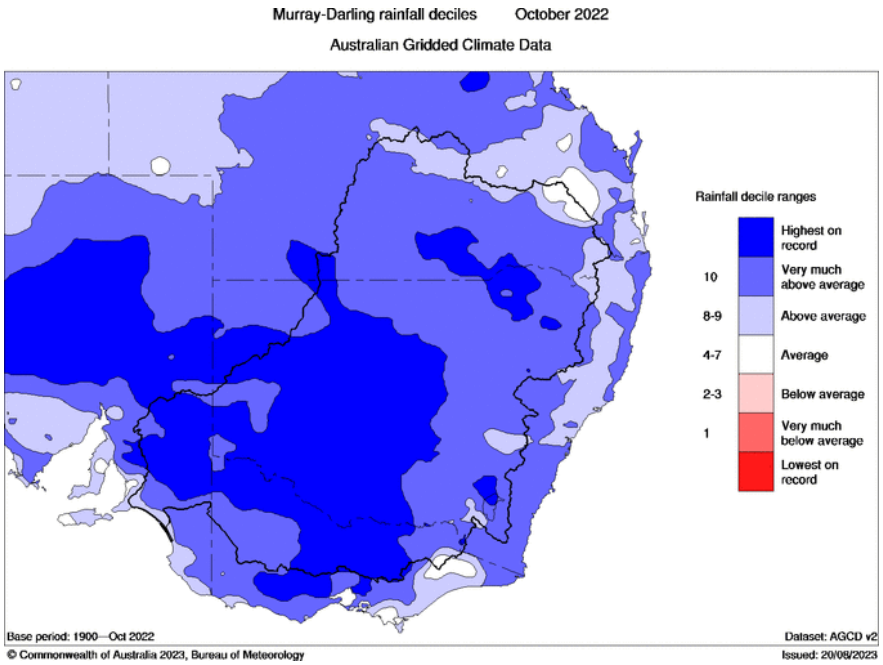

Figure 6: Murray Darling rainfall deciles for October 2022. (Source: BoM).

With flooding on this scale came an increased risk of hypoxic blackwater events. 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 and may lead to fish deaths. The dark appearance of the water is due to the release of tannins as the organic matter decays.

Although the adjacent Barwon-Darling River catchment experienced low dissolved oxygen levels below the critical threshold for fish health during flooding in 2022, monitoring in the Intersecting Streams showed oxygen levels were at safer levels. Significant rainfall events in the catchment last year also provided favourable conditions for fish breeding, leading to a high biomass of fish, particularly carp in western rivers. NSW Fisheries investigated a fish death report at Lower Warrego, near Bourke in December 2022. Hundreds of dead carp were reported. The suspected cause was stranding following reduction in flow as floodwaters receded.

Summary

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

In 2022 to 2023, there were high flows in the Intersecting Streams catchments, but not flooding to the same extent experienced in other catchments. Agencies and scientific experts worked together to monitor the dissolved oxygen levels throughout the river system and assess the risk to aquatic life. A high biomass of fish (particularly carp) due to good flows over the preceding years meant that there was more stress on aquatic animals competing for resources and greater consumption of dissolved oxygen as waters receded.

Although floods and 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 Intersecting Streams catchment see the Intersecting Streams surface water quality technical report (https://www.industry.nsw.gov.au/__data/assets/pdf_file/0020/305750/Water-quality-technical-report-for-the-Intersecting-Streams-surface-water-resource-plan-area-SW13.pdf).

Long-term water quality trends

Analysis of WaQI ratings from 2012–2023 to 2022–2023 shows very consistent WaQI ratings at all sites in the NSW Intersecting Streams (Figure 7). All sites have a long-term median WaQI rating of moderate. The range of WaQI ratings was small across all sites suggesting ratings were generally consistent throughout the 10-year period, with some large changes in some years in response to significant droughts and floods occurring in a catchment.

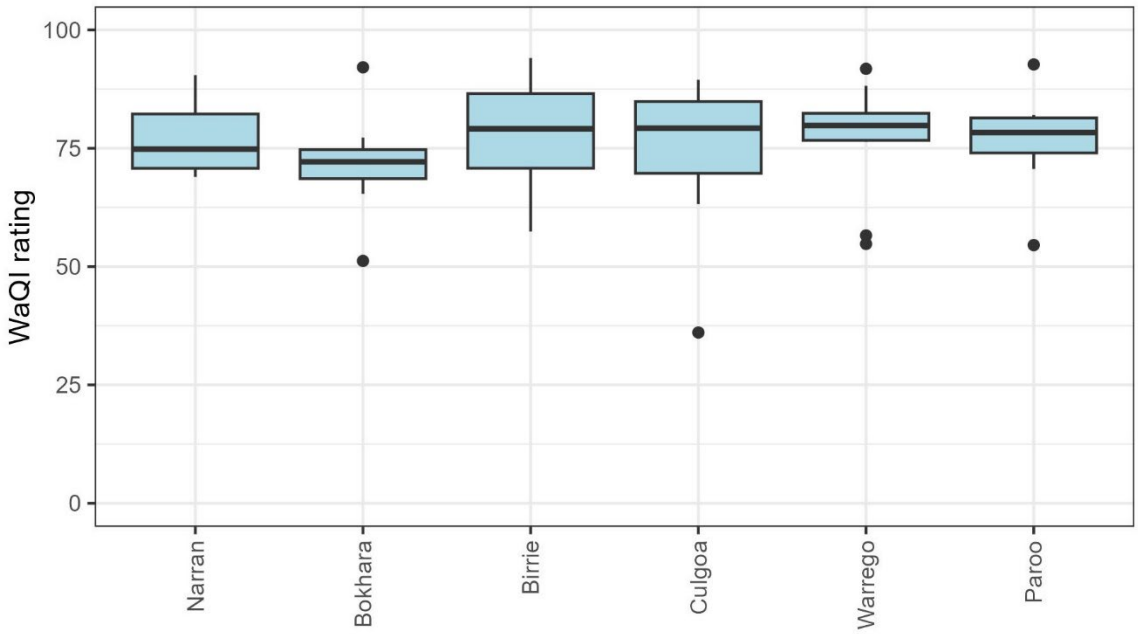

Figure 7: Boxplots showing long-term (2012–2013 to 2022–2023) WaQI ratings for every site in the NSW Intersecting Streams

The number of sites with ratings of good, moderate and poor fluctuated from year to year in response to the significant droughts and floods occurring over the past 10 years (Figure 8). The number of sites with a poor rating remained at zero until continuing drought in 2018–2019 saw the quality of the water in the Intersecting Streams deteriorate at all monitoring sites. Once flows returned to these systems the number of poor sites returned to zero again. The number of good and moderate sites fluctuated from year to year depending on which drivers (flood or drought) were impacting water quality in each catchment at the time.

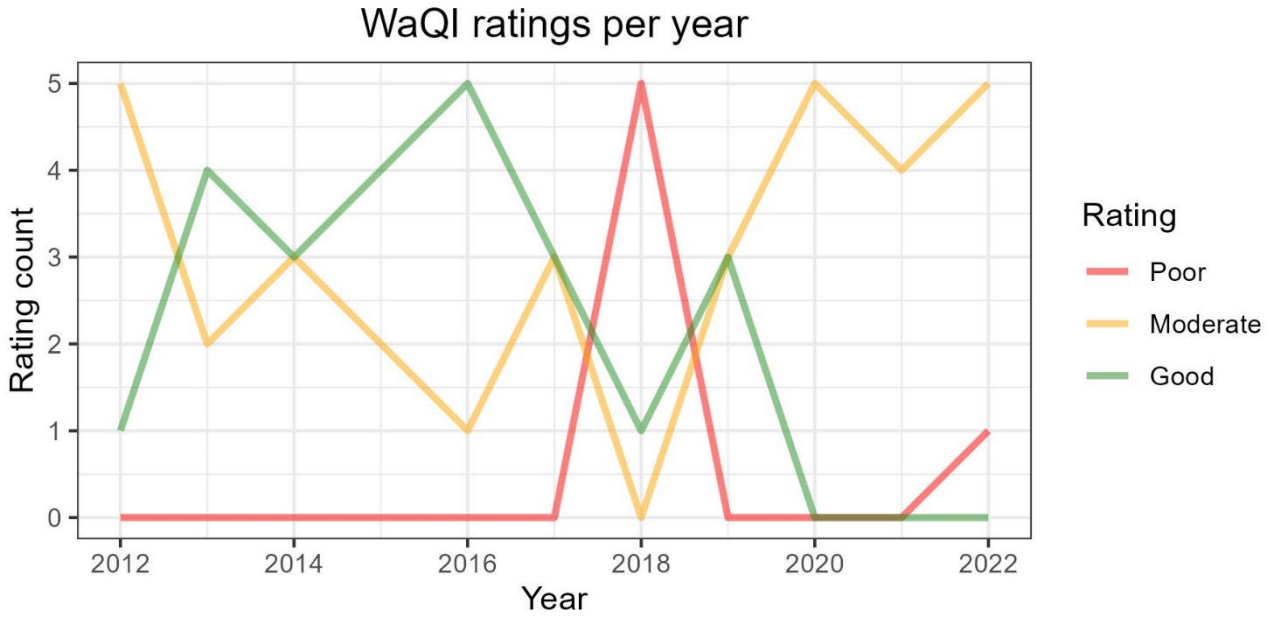

Figure 8: Graph summarising long-term water quality index ratings (2012–2013 to 2022–2023) for every site in the NSW Intersecting Streams by year

References and further information

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Fish kills in NSW: https://www.dpi.nsw.gov.au/fishing/habitat/threats/fish-kills

NSW DPE: Water for the environment: https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/other-regions/intersecting-streams-annual-environmental-water-priorities

MDBA Water Management: https://www.mdba.gov.au/water-management/catchments