

North Coast valleys 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 heavy rain led to several large flood events on the North Coast between February and May 2022.
- The heavy rains kept water storage levels high throughout the year.
- NSW Fisheries investigated 2 fish death reports in January 2022 at Arrawarra Creek and Darlington Park.
- Flooding was the main driver of water quality in the North Coast catchment. The water quality index indicated that of the 13 sites in the catchment, 3 were rated as good, 2 as moderate and 8 as poor. Of the 13 monitoring sites, 5 sites had poorer water quality in 2021–2022 than the previous year.
- Heavy rainfall and flooding brought freshwater inflows to the Richmond, Clarence and Macleay River tidal pools which kept electrical conductivity low.
- Red alerts for blue-green algae occurred at Toonumbar Dam and further downstream (December to March). Lake Ainsworth recorded red alerts for recreational use during October and November 2022.

The water quality data used in this report is collected on a monthly frequency at 13 sites in the North Coast valleys 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 North Coast valleys from July 2021 to June 2022. The location of monitoring sites is shown in Figure 1.

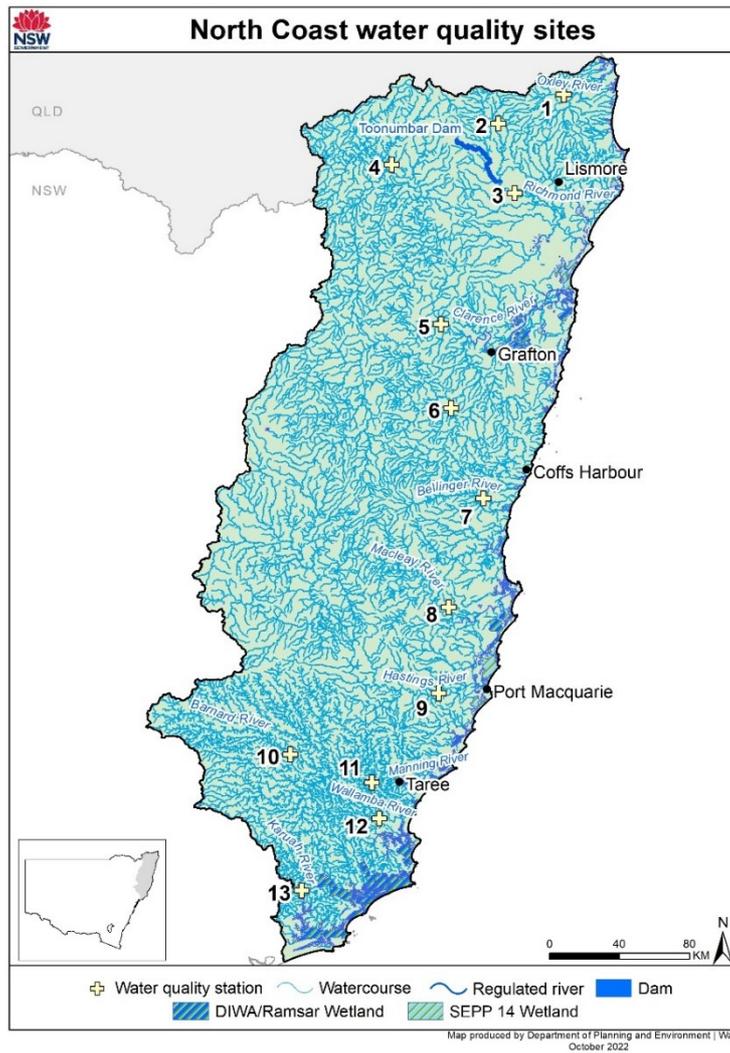


Figure 1: Location of routine water quality monitoring sites in the North Coast valleys

Table 1: Site information for each monitoring site in the North Coast catchments. Refer to Figure 1 and site numbers for location of each site

Site number	Site name	Water Quality Zone	Station number
1	Oxley River near Eungella	Far North Coast lowlands	20110017
2	Richmond River at Wiangaree	Far North Coast lowlands	203005
3	Richmond River at Casino	Far North Coast regulated	203004
4	Clarence River at Paddy’s Flat	North Coast uplands	204051
5	Clarence River at Lillydale	North Coast lowlands	20410043
6	Nymboida River at Nymboida	North Coast uplands	204001
7	Bellinger River at Bellingen	North Coast lowlands	20510051
8	Macleay River at Turners Flat	North Coast lowlands	206011
9	Hastings River at Kooree Island Road	Lower North Coast lowlands	20710002
10	Barnard River at Mackay	Lower North Coast uplands	208011
11	Manning River at Killawarra	Lower North Coast lowlands	208004
12	Wallamba River at Dargaville Road Crossing	Lower North Coast lowlands	20910017
13	Karuah River at Booral	Lower North Coast lowlands	209003

Catchment description

The North Coast catchment covers an area greater than 27,000 km², extending from the Queensland border to the Hunter Catchment in the south, with the Border Rivers, Gwydir and Namoi catchments to the west. Rugged mountainous areas often characterise the headwaters of North Coast river catchments, which then flow onto large flat coastal floodplains. Many of the rivers on the North Coast are recognised as having high biodiversity and ecological value. The Great Lakes also fall within the North Coast area and include Wallis, Smith and Myall Lakes.

The North Coast catchment contains several river basins which flow east into the Pacific Ocean including the Tweed and Richmond Rivers in the far north coast, the Clarence, Hastings, Bellinger and Macleay Rivers in the mid-north coast, and the Manning and Karuah Rivers on the lower north coast.

Several large towns are present on the North Coast including Port Macquarie, Grafton, Lismore, Ballina and Coffs Harbour. Water use is generally for town water supply with some irrigation present. Major instream storages include Clarrie Hall Dam on the Tweed River and Toonumbar Dam, Rocky Creek Dam and Emigrant Creek Dam on the Richmond River, several smaller weirs and off-stream dams are also present throughout the North Coast.

Catchment conditions during 2021-2022

Flow during 2021–2022 was characterised by extremely heavy rain falling across much of the catchment from October 2021 through to May 2022 (Figure 2A). This heavy rain led to several large flood events on the North Coast between February and May 2022 (Figure 2C). During this period discharge reached almost 200,000 ML/day on the Macleay River at Turners Flat on 9 March 2022. Similarly, the Manning River at Killawarra peaked at over 159,000 ML/d as did the Richmond River at Casino reaching almost 100,000 ML/d (Figure 2C).

Toonumbar Dam started and ended the 2021–2022 period at 100% capacity (11GL), dropping to slightly below 95% in early November 2021 (Figure 2B).

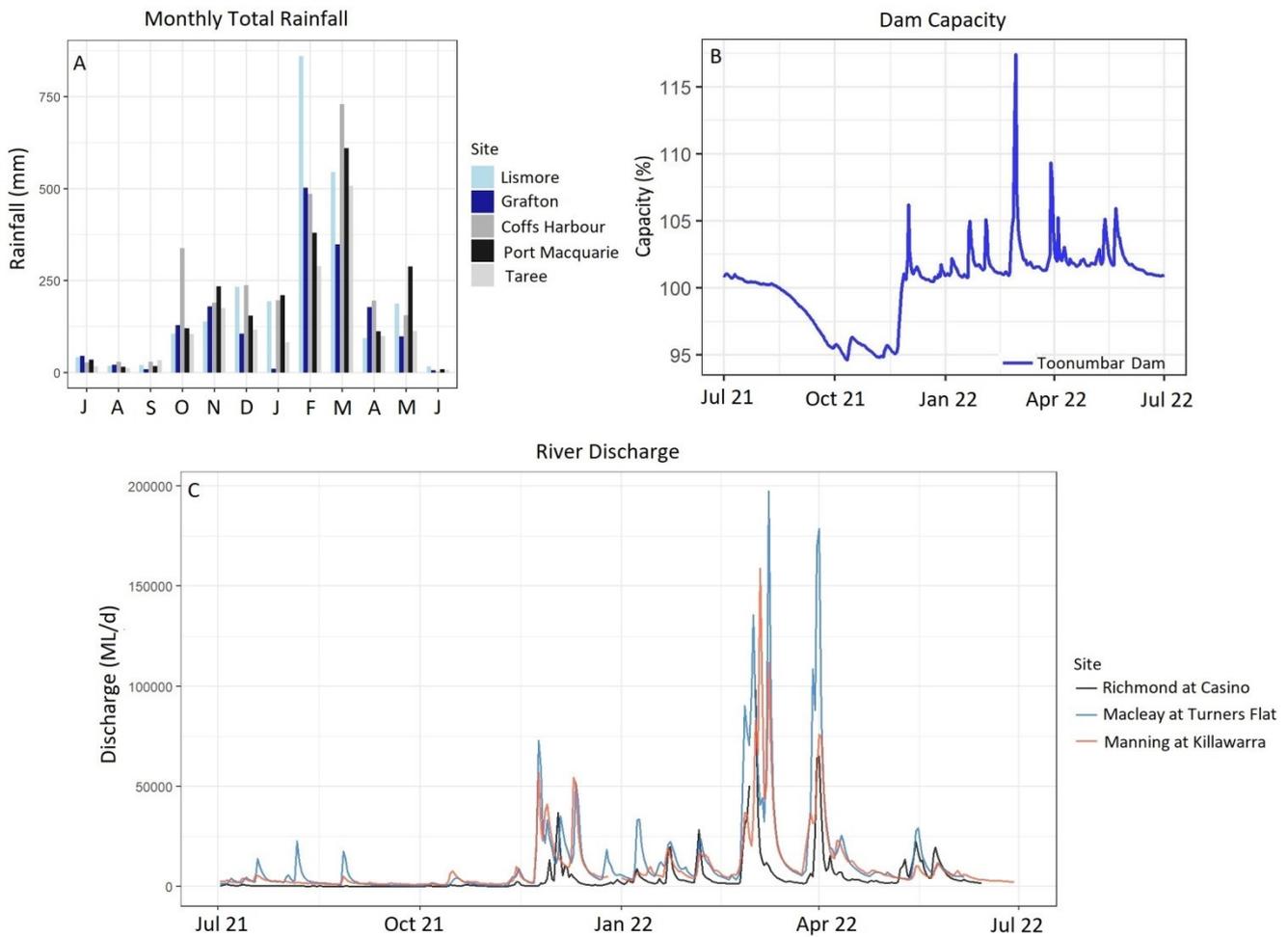


Figure 2: Catchment conditions for selected stations in the North Coast catchment from July 2021 to June 2022 for A: Monthly total rainfall (mm) B: Dam capacity (%) and C: River discharge (ML/day).

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. Up or down arrows indicate the score has changed by more than 5 points.

The Oxley River near Eungella, Bellinger River at Bellingen and Hastings River at Kooree Island Road were the only sites on the North Coast to be rated as good. The Nymboida River at Nymboida and Barnard River at Mackay were rated as moderate with the remaining 8 sites rated as poor.

Compared to the 2020 to 2021 results, 2 sites (Hastings River at Kooree Island Road and Wallamba River at Dargaville Road Crossing) showed an improvement in water quality index score. Increased nutrient and sediment loads caused by flooding resulted in a decline in index score at 5 sites while the remaining 6 sites showed minimal change in water quality compared to last year.

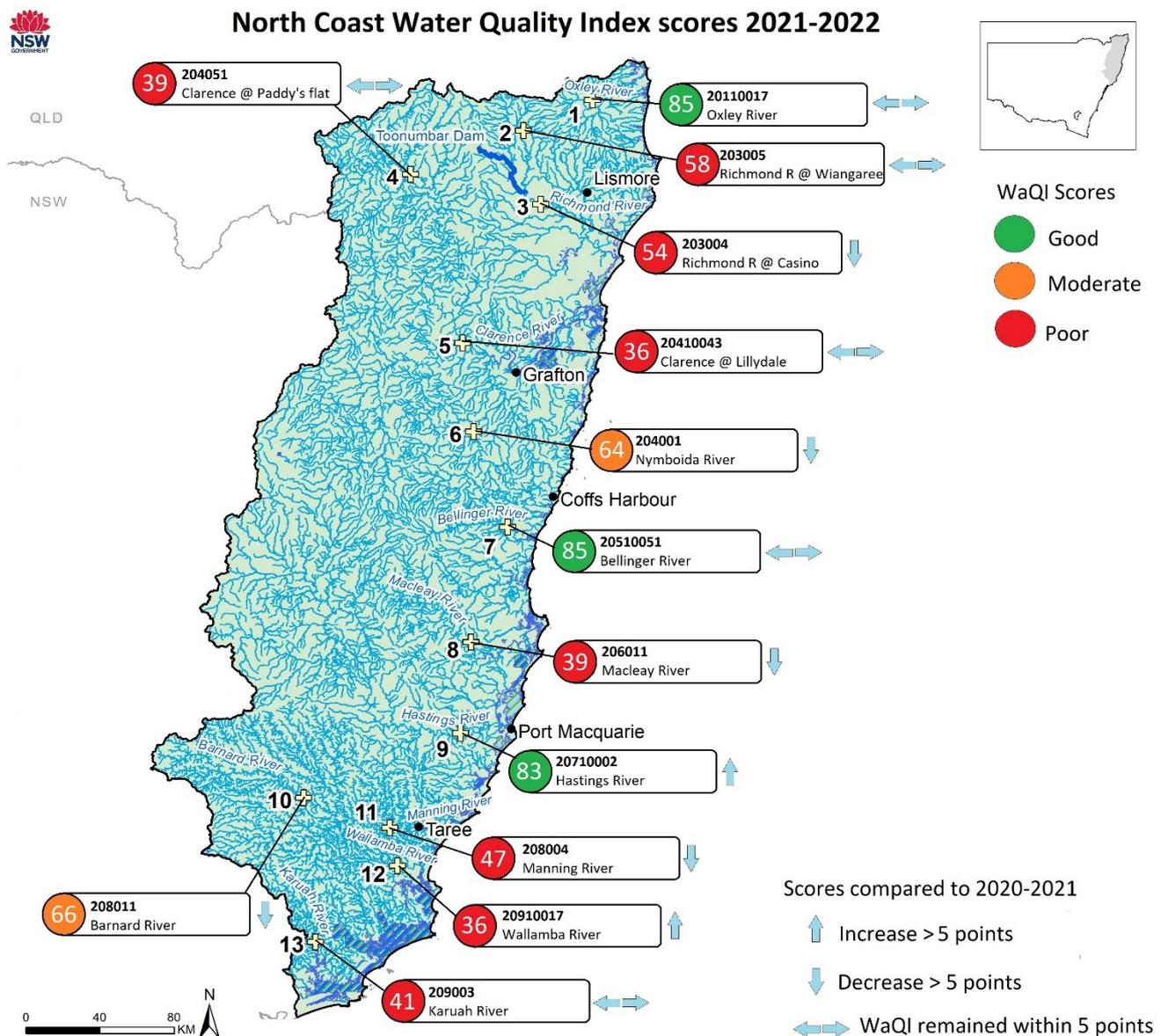


Figure 3: Water quality index scores for the North Coast valleys

The majority of the monitoring sites on the North Coast are located in the lower catchment where the quality of the water is impacted by the cumulative effects of land use, soil and vegetation disturbance and human activity occurring in the catchment.

There was some variability in pH results between the North Coast valleys, though the median results were all between 7 and 8, which is safe for water-dependent ecosystems.

Major flooding in the Richmond catchment resulted in the highest turbidity and nutrient concentrations detected at the Casino monitoring site. The Macleay River at Turners Flat also had elevated turbidity and nutrient concentrations. High concentrations of pollutants may have been present in other rivers, however safety concerns during major flooding events limited sampling during very high flows.

Hypoxic, or low oxygen blackwater is a feature of Australian lowland river systems and occurs when organic material, such as sticks, leaves, bark, grass or crops are broken down in 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. Despite the flooding, dissolved oxygen levels were relatively stable across most sites, with median levels close to 100% saturation. Dissolved oxygen was lower in the Karuah and Wallamba rivers but remained above the critical threshold for fish health.

Electrical conductivity is low across all the North Coast catchments and would not impact on agricultural use or aquatic ecosystems. The highest readings were in Wallamba Creek. The Wallamba Creek monitoring site is located close to the upper tidal limit, which can result in increased electrical conductivity during periods of very low flows and high tides.

Summary statistics for the key water quality parameters at each monitoring site on the North Coast 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.

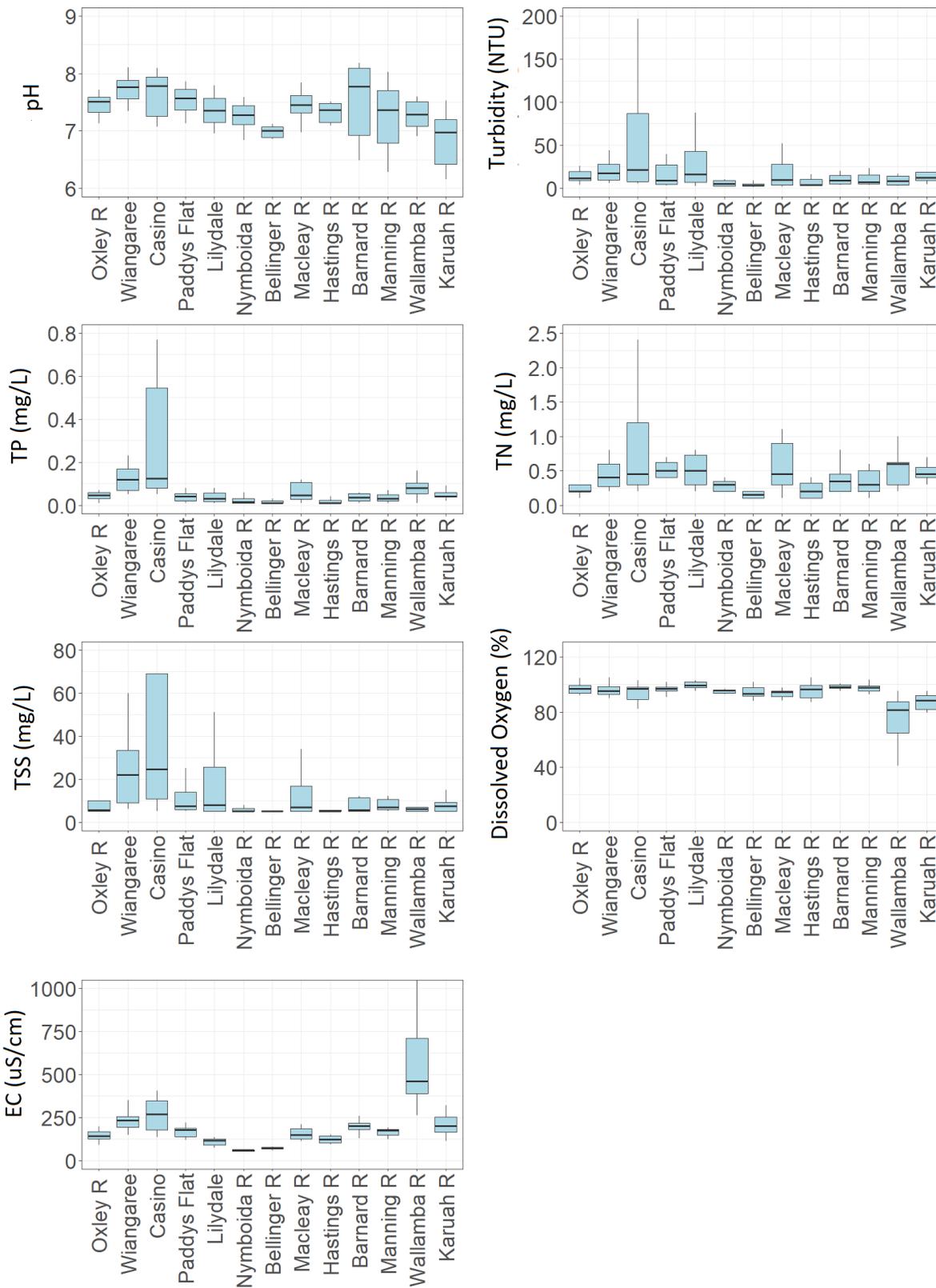


Figure 4: Water quality data for water quality parameters by site

Irrigation and salinity

During periods of low flow in the Richmond, Clarence and Macleay rivers, salt water from the sea is able to push further up the estuaries where it can impact water users. Monitoring in the Richmond, Clarence and Macleay tidal pools (Figure 5) shows electrical conductivity at Coraki, Grafton and Kempsey remained low throughout 2021–2022. Heavy rainfall and flooding brought freshwater inflows to these tidal pools which kept electrical conductivity at safe levels for agricultural use in the upper reaches of the tidal pool.

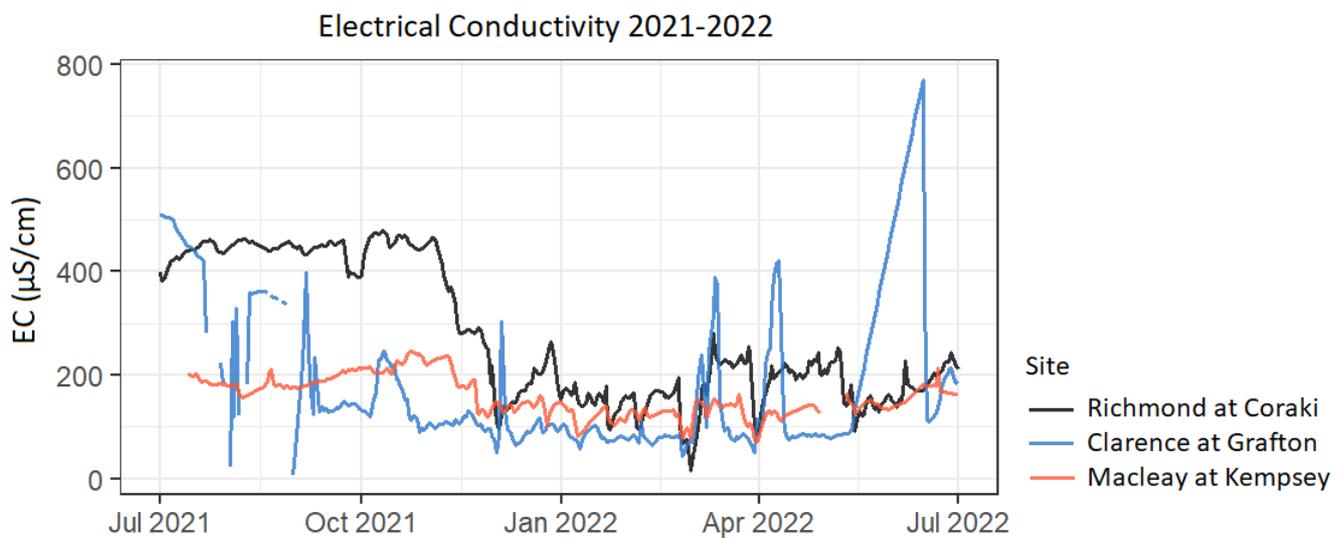


Figure 5: Electrical conductivity in the North Coast valleys

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](#)).

Blue-green algae have historically been a major issue in Toonumbar Dam during the high-risk summer period. Table 1 indicates the distribution of algal alerts during July 2021 to June 2021, highlighting that Toonumbar Dam and Toonumbar downstream were on red alert for recreational use during the summer months. Lake Ainsworth is also prone to algal blooms during summer due to high temperatures and extended dry periods. Due to heavy rainfall events, Lake Ainsworth only recorded red alerts for recreational use during October and November 2022.

Table 2: Distribution of algal alert levels in the North Coast valleys July 2021 to June 2022

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Clarrie Hall Dam	Green											
Emigrant Creek Dam	Nil	Nil	Nil	Nil	Amber	Amber	Green	Green	Green	Green	Green	Green
Lake Ainsworth	Nil	Nil	Nil	Green	Red	Red	Amber	Amber	Green	Green	Green	Green
Toonumbar Dam	Nil	Green	Green	Green	Green	Red	Red	Red	Red	Red	Amber	Amber
Toonumbar Downstream	Nil	Nil	Nil	Nil	Nil	Amber	Red	Red	Red	Red	Amber	Amber
Richmond River at Casino	Green											
Malpas Dam	Nil	Nil	Nil	Nil	Nil	Amber						

Key: * Nil/low alert Green alert Amber alert Red alert

Extreme water quality events

November 2021 was Australia’s wettest November since national records began in 1900 (BoM, 2022). It was also the wettest November on record for New South Wales. Further record flooding occurred in the Northern Rivers with increased rainfall over February 2022, and again in March, leading to flood levees being breached and areas such as Lismore and Ballina being evacuated.



Figure 5: Aerial shot of Lismore 2nd March 2022. Source: NSW EPA

With flooding on this scale came an increased risk of poor water quality events and a high risk of significant fish deaths.

NSW Fisheries investigated 2 fish kill reports on the North Coast in January 2022 and determined the cause was likely heavy rainfall that had washed organic material into creeks and waterways.

High amounts of decaying organic material, combined with high summer temperatures, reduced dissolved oxygen in the water below the thresholds needed for native fish to breathe and survive.

The 2 reports listed on the [Department of Primary Industries website](#) for 1 July 2021 - 30 June 2022 were:

- Arrawarra Creek, near Coffs Harbour (16 January) - Report of hundreds of dead fish. Species affected included juvenile Flathead and Bream.
- Darlington Park, Corindi near Coffs Harbour (17 January) - Report of thousands of dead fish. Species affected included Mullet and Bream.

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 2021 and 2022, flooding was the main water quality driver. Increased runoff carries high volumes of sediment and attached nutrients such as nitrogen and phosphorus into waterways. This resulted in 8 of the 13 water quality monitoring sites being rated as having poor water quality, 2 as moderate and 3 as good. Five sites returned a lower water quality index score in 2021-2022 than the previous year.

NSW Fisheries investigated reports of fish deaths in Arrawarra Creek and Darlington Park in January 2022. Although these hypoxic blackwater events may result in the loss of fish and other aquatic life, the impacts 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.

References and further information

Bureau of Meteorology (BoM) 2022. Special Climate Statement 75 – Australia's wettest November on record. Issued 14 February 2022: <http://www.bom.gov.au/climate/current/statements/scs75.pdf?20220214>

NSW EPA, 2022. Following the debris. <https://storymaps.arcgis.com/stories/b506ce07f1394c498f5830a4db1f2a03>