

# Lake Illawarra Catchment Water Quality Monitoring Program

## December 2021- April 2024

### What was the aim of the program?

- The primary aim of this monitoring program was to provide Wollongong City and Shellharbour City Councils with a robust baseline of waterway conditions for making data driven management decisions.

### What was the sampling program?

- Sampling was conducted at 21 sites across 14 waterways within the Lake Illawarra catchment, including Mullet Creek, Macquarie Rivulet and adjoining tributaries.
- Sample sites were located downstream of major representative land uses likely to influence ecological condition which included urban, urban release, agricultural and forested areas.
- Water quality monitoring was undertaken on 25 occasions across a two-year period, with 14 dry weather events and 11 wet weather events.

### Water quality parameters sampled:

- ▶ Electrical conductivity ( $\mu\text{s}/\text{cm}$ )
- ▶ Dissolved oxygen (%)
- ▶ Turbidity (NTU)
- ▶ Ammonia (mg/L)
- ▶ Total Nitrogen (mg/L)
- ▶ Reactive Phosphorous (mg/L)
- ▶ Enterococci (CFU/100 mL)
- ▶ Temperature ( $^{\circ}\text{C}$ )
- ▶ pH
- ▶ Total Suspended Solids (TSS)
- ▶ Nitrite and Nitrate (mg/L)
- ▶ Total Phosphorous (mg/L)
- ▶ Chlorophyll-*a* (mg/L)

### Microbial Source Tracking (MST) analysis using Bacteroides:

Analysis of bacteroides was used to differentiate between sources of faecal contamination. This included human bacteroides, which can reflect human faecal contamination such as sewage leaks and stormwater, ruminant bacteroides (which are herbivorous mammals with more than one stomach such as cows, sheep and deer), and animal bacteroides (animals such as dogs, horses, kangaroos and wallabies). This information is useful to better understand the potential sources of contamination occurring within a catchment.

Bacteroides were assessed during 2 events (a dry and wet weather event) at 10 targeted sites throughout the catchment.

### Analysis of data

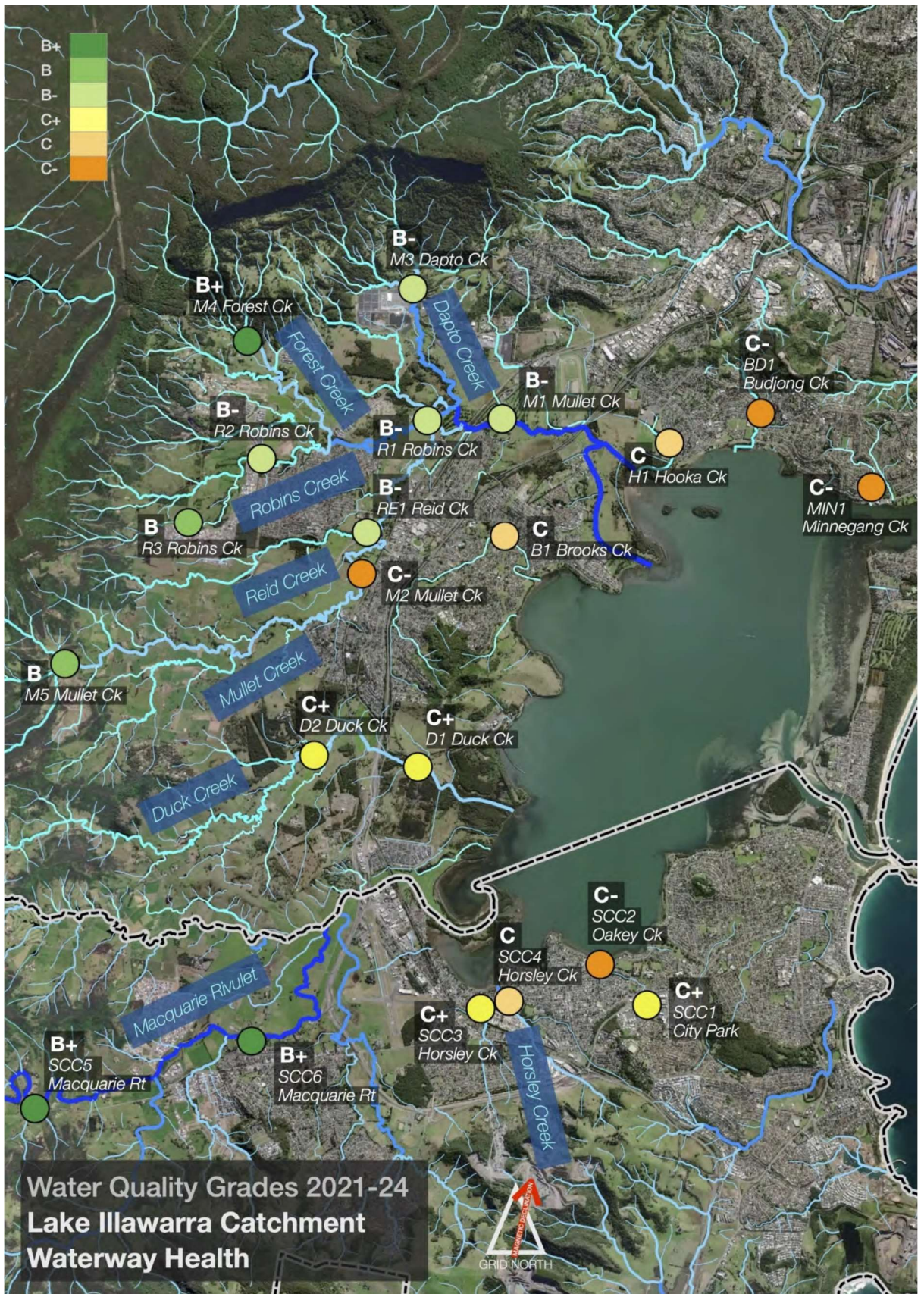
- Water quality data, including the median for each catchment, was also compared with the ANZECC (2000) guidelines for Aquatic Ecosystems (Lowland River in south-eastern Australia), and compared between dry and wet weather events.
- Waterway Health Grades for each site was calculated based on the South East Queensland Healthy Waterways Program methodology.



## Key Results:

- Waterway health grades ranged from Good (B+) to Fair (C-), with most sites experiencing 'fair' water quality. A longitudinal trend was evident, with the relatively healthy scores experienced by waterways that are influenced by naturally vegetated areas present at the headwaters of streams that flow into Lake Illawarra. Moving downstream, land use becomes more intense, shifting from bushland to farmland to the urban environment, corresponding to a reduction in water quality. However, sites within the upper regions of the Lake Illawarra catchment still experience impacted water quality due to rural land use pressures and the presence of stock near waterways, with elevated nutrients and biological indicators such as *Enterococci*.
- Increased levels of nutrients above the ANZECC (2000) water quality guidelines were recorded at the majority of sites. Median total nitrogen was compliant only 3 sites during dry weather monitoring, and only one of the 21 sites during wet weather, suggesting waterways across the whole catchment pose a significant source of nitrogen to the lake.
- The more bioavailable forms of nitrogen such as ammonia and NO<sub>x</sub> (nitrite and nitrate) were also largely non-compliant with the ANZECC guidelines. Median ammonia and NO<sub>x</sub> concentrations were compliant at only 5 sites during dry weather sampling. Only 3 sites has median ammonium values compliant during wet weather sampling, and median NO<sub>x</sub> concentrations did not comply with the ANZECC (2000) guideline at all 21 sites, indicating high levels of bioavailable nitrogen in the system.
- It was a similar situation with phosphorus, with median total phosphorous compliant at only six sites during dry weather, and only two sites during wet weather. However, median phosphate concentrations was low across all sites, with 20 sites meeting the ANZECC guidelines. During wet weather monitoring, median phosphate was non-compliant at eight out of 21 sites.
- Median chlorophyll-*a* levels did not comply with the ANZECC (2000) guidelines for all 21 sites across both dry and wet weather monitoring events and were consistently elevated.
- Median turbidity was compliant with the ANZECC (2000) guidelines at all sites on all occasions (during both wet and dry weather monitoring). The guideline though reflects a wide range of turbidity values (6-50 NTU), and all sites did experience events where turbidity was elevated. No ANZECC (2000) guidelines are currently available for total suspended solids (TSS). However, TSS values were high at a number of sites across the Lake Illawarra catchment, which indicates an increased risk of siltation.
- Monitoring sites also frequently exceeded the ANZECC (2000) primary and secondary contact guidelines for *Enterococci*. During dry weather monitoring, only one site (RE1) was compliant with the guidelines, 17 sites recorded *Enterococci* that exceeded the ANZECC (2000) primary contact guideline, and three sites exceeded the secondary contact guideline. The highest median *Enterococci* values during wet weather monitoring were at Hooka Creek (4000 CFU/100 mL), Horsley Creek (2100 CFU/100 mL), and Budjong Creek (1600 CFU/100 mL). This highlights the link between rainfall events, stormwater impacts, and elevated *Enterococci* concentrations. Maximum values of all sites ranged from 520 up to 78,000 CFU/mL though.





Waterway Health Grades for each site

### Results of Bacteroides analysis:

- Human bacteroides were generally low across the ten sites sampled, typically being <0.4 copies/mL. The highest level of human bacteroides was detected at Reid Creek with 29 copies/mL and at upper Macquarie Rivulet (SCC5) (10.0 copies/mL). Sources of human bacteroides include potential sewage leaks and stormwater runoff into waterways.
- Conversely, the majority of sites had higher levels of animal bacteroides (all animals excluding ruminants). The highest animal bacteroides levels occurred at upper Macquarie Rivulet SCC5 (37,000 copies/mL) and Robins Creek (25,000 copies/mL) and at upper Mullet Creek (M5) (2,300 copies/mL). These levels can be attributed to horses, dogs and kangaroos, and were also detected at lower levels across the urban catchments.
- High ruminant (such as cows and deer) bacteroides value were also found at upper Macquarie Rivulet, Mullet Creek and Robins Creek (25,000, 16,000 and 12,000 copies/mL respectively). The occurrence of ruminant bacteroides across all sites highlights the presence of cattle and feral deer within the Lake Illawarra catchment, even in the upper forested areas, and the ability for them to be transported throughout the catchment to lower areas.

### Summary

Degraded water quality reflects the pressures that urbanisation and industrialisation exert on waterways. The “urban stream syndrome” is used to describe the multiple environmental problems which typify the degradation of urban streams. These symptoms include increased intensity of flow after rainfall, erosion, sedimentation, stream bed and bank scouring, and degraded water quality; all of which apply to waterways within the Lake Illawarra catchment. The driver of the urban stream syndrome is the proportion of catchment covered by impervious surfaces, such as roads, roofs, and car parks.

For each catchment there was an overall trend of a reduction in water quality moving downstream. However, sites in the upper reaches of each catchment all showed non-compliance with ANZECC (2000) guidelines. For example, within the Mullet Creek catchment median pH and NO<sub>x</sub> were highest in the upper reaches, and in Macquarie Rivulet median NO<sub>x</sub> was highest in the upper reaches. These 2 sites also had the highest ruminant bacteroides values; in line with agricultural use and stock access to creeks, and possibly feral deer, even in the upper catchments.

Overall, these findings highlight that whilst urban areas reflect a significant contribution of contaminants to the sites in the lower region of the catchment, sites in the upper reaches of the catchment that experience rural land use and poor land management also are high sources of degraded water quality.

For the full technical Final Report visit [Lake Illawarra | City of Wollongong \(nsw.gov.au\)](https://www.nsw.gov.au/lake-illawarra)

### What's next?

- Water quality monitoring at 17 sites will continue till June 2026.
- Macroinvertebrate and benthic diatom trophic index sampling and analysis will also occur to give an indication of the ecological condition of the waterways.