

Oyster Harbour catchment

HEALTHY
ESTUARIES
WA

Nutrient report 2023

This data report provides a summary of nutrients in the waterways of the Oyster Harbour catchment in 2023. Excess nutrients are one of the most significant pressures on our waterways and estuaries, and can lead to algal blooms and fish kills.

About the catchment

Oyster Harbour (Miaritch) has a catchment area of about 3,000 km², about 70 per cent of which has been cleared, mostly for livestock grazing and cropping. The modifications to the landscape change the hydrological pathways (which determine how much and when water flows into the harbour), increase the concentrations of nutrients in the waterways and, together with climate change, put pressure on Oyster Harbour. Soil types also influence nutrient concentrations (especially phosphorus) as some soil types bind phosphorus better than others, preventing it from entering waterways.

Of the three main rivers that flow into Oyster Harbour, the Kalgan River contributes the most flow. This river's catchment covers about three quarters of the Oyster Harbour catchment and contributes about two-thirds of the flow. The King River and Yakamia Creek are the other major rivers that flow into the harbour. A number of other smaller drains and waterways also enter the harbour but are not monitored.

Monitoring is carried out fortnightly at six sites in five subcatchments with most sites located near the bottom of the subcatchments.



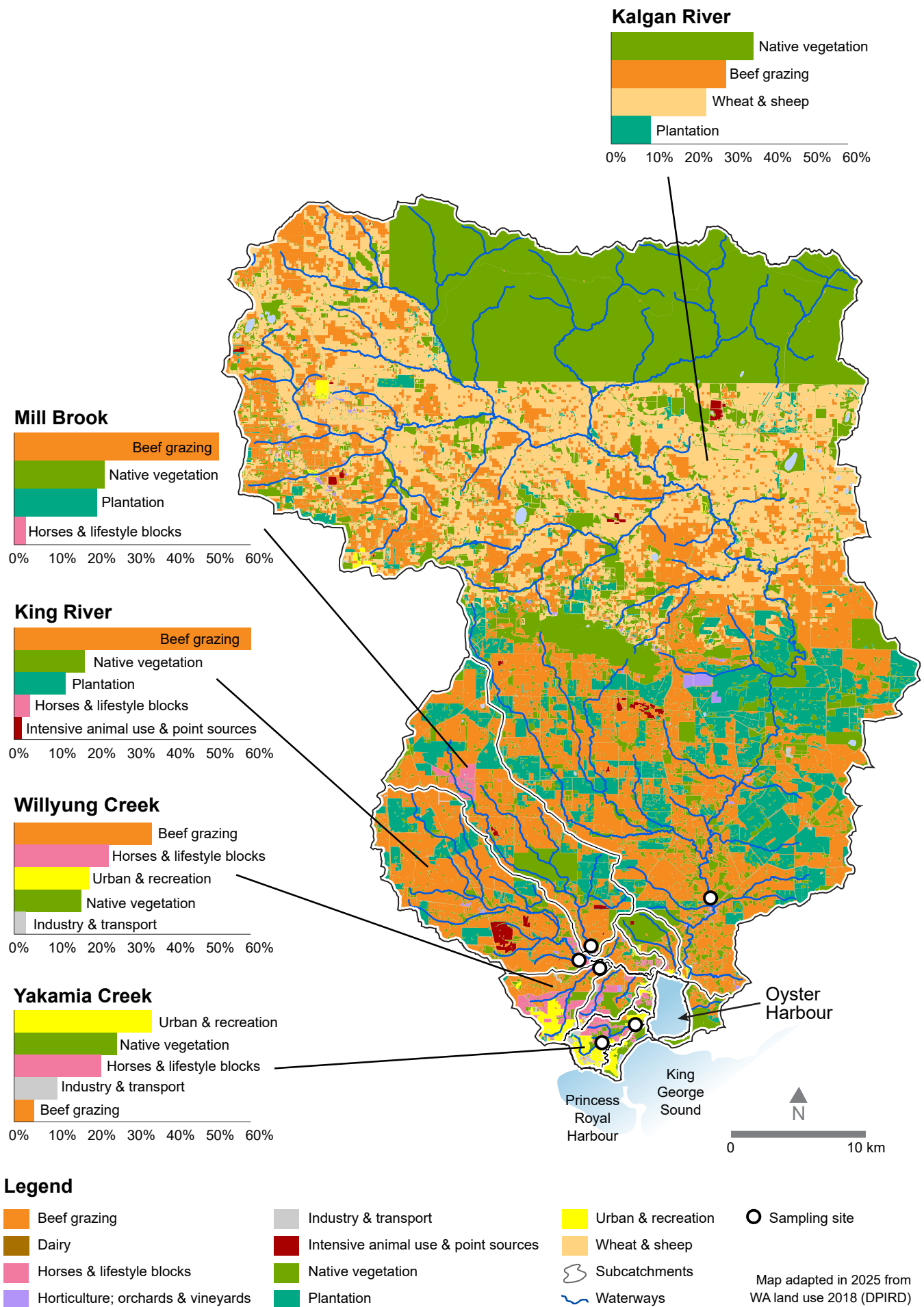
Key points:

- ⇒ The King River subcatchment is the highest priority for nutrient management.
- ⇒ Yakamia Creek had the largest nutrient loads per square kilometre.
- ⇒ Nitrogen concentrations in the Kalgan River were higher than normal, however, phosphorus concentrations remained low.

Facts and figures

Catchment area	3,000 km ²
Per cent cleared area (2018)	70 per cent
Main rivers flowing into Oyster Harbour	Kalgan and King rivers and Yakamia Creek
River flow to Oyster Harbour (2023)	70 GL
Main land use (2018)	Native vegetation, beef farming, and wheat & sheep

Oyster Harbour catchment land use map



The percentage land use graphs show the most common land use in each subcatchment. Graphs have only been prepared for the monitored subcatchments.

Subcatchment summaries (2023)

Subcatchments are smaller areas of water catchments where all the rain falling in the local area flows to the same waterway or waterways. **Water quality objectives** are the nutrient concentrations we aim to be below to protect waterway health.



Kalgan River

Nutrient concentrations in the Kalgan River met our total phosphorus but not our total nitrogen water quality objectives. As this site typically meets our nitrogen water quality objective, ongoing monitoring will help determine if nitrogen concentrations are increasing. The Kalgan River delivered the largest nutrient loads to the harbour due to its large catchment size and flow volume. However, the load per square kilometre of both nitrogen and phosphorus were small.



King River

The King River subcatchment is a priority for management. Nutrient concentrations in the river did not meet either of our water quality objectives. Further, it delivered one of the largest phosphorus loads to the harbour and had a large phosphorus load per square kilometre.



Mill Brook

Nutrient concentrations in the Mill Brook subcatchment did not meet either of our water quality objectives. However, the nutrient loads and the loads per square kilometre were both small. While this subcatchment would benefit from nutrient management actions, there are others that are a higher priority.



Willyung Creek

Like Mill Brook, nutrient concentrations in Willyung Creek did not meet either of our water quality objectives. We do not have flow data at Willyung Creek, so it was not possible to calculate loads. The relatively high nutrient concentrations in this subcatchment mean that it would benefit from nutrient management actions however there are other subcatchments that are a higher priority.



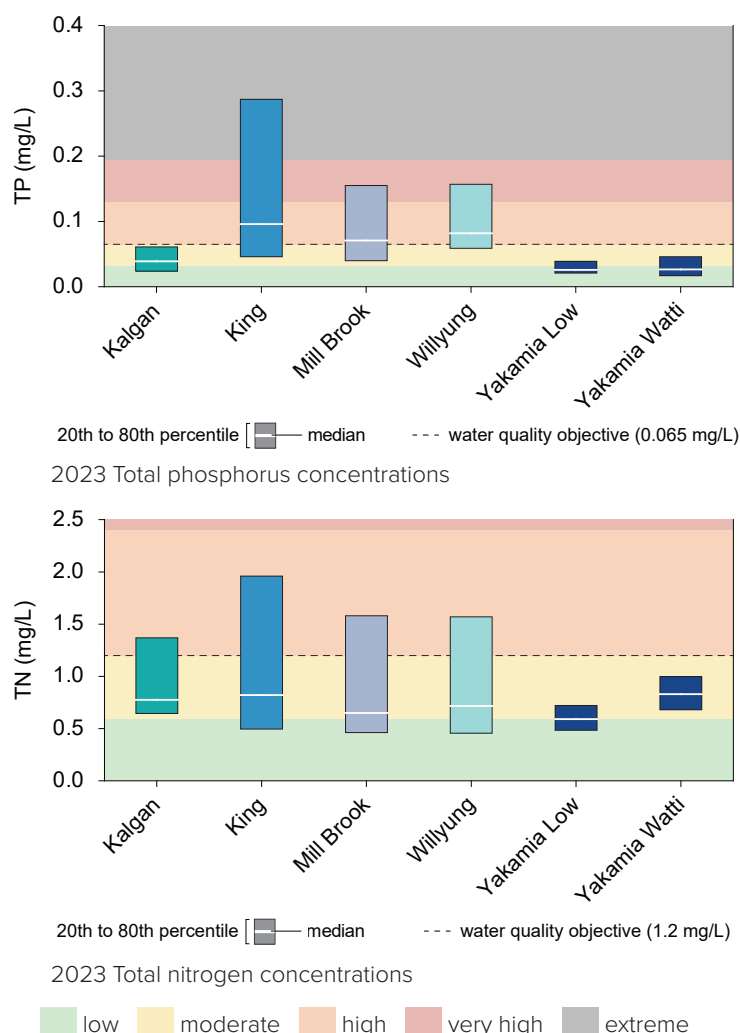
Yakamia Creek

Nutrient concentrations at both Yakamia Creek sites were low. The Yakamia Lower site met both our water quality objectives. We don't have enough years of data at Yakamia Watti to compare to our water quality objectives but will be able to do so in future reports. While nitrogen concentrations were low, the proportion of bioavailable dissolved inorganic nitrogen, and the loads per square kilometre of both phosphorus and nitrogen, were the largest at Yakamia Watti relative to all other sites. This means that this subcatchment would benefit from nutrient management actions.

Nutrient concentrations (2023)

Nutrient concentrations varied between the monitored sites. Median total phosphorus concentrations were highest in the King River, Mill Brook, and Willyung Creek. These sites also had the largest variation in concentrations across the year. The combination of high median concentrations and a broad range in concentrations is indicative of the land use and modification to waterways in these subcatchments. The presence of a point source of nutrients, located on soils with a poor capacity to bind phosphorus, in the King River subcatchment could also be contributing to this site having the largest variation and highest median of all sites.

Nitrogen concentrations were generally acceptable, with all 2023 medians falling in the moderate category apart from Yakamia Lower which fell in the low category. However, like with phosphorus concentrations, the range in nitrogen concentrations were largest in the King River, Mill Brook, and Willyung Creek, as well as the Kalgan River. Nitrogen concentrations were higher at the Yakamia Watti site than the Lower Yakamia Creek site, possibly due to the more intense land use in the upper catchment and/or assimilation of nitrogen between the two sites.



Performance against water quality objectives (2021–23)

Water quality objectives (WQOs) are the nutrient concentrations (total nitrogen and total phosphorus) we aim to be below to protect the health of Oyster Harbour. There are no WQOs developed specifically for Oyster Harbour, so we have used the ANZECC trigger values for lowland rivers as interim WQOs. Performance against the WQOs were calculated by comparing the three-year (2021–23) wet month (June to October inclusive) medians to the relevant water quality objective.

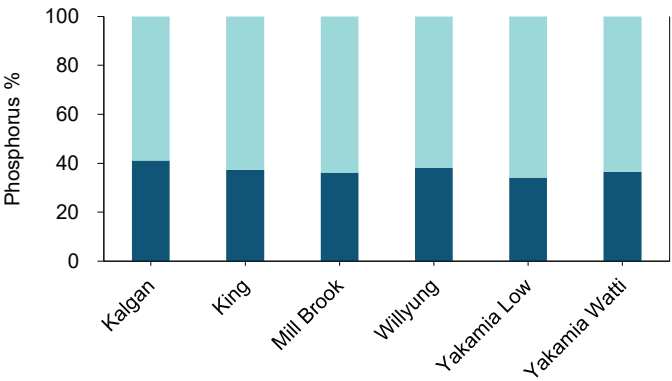
The Yakamia Lower site was the only one that met both of our WQO's in 2023 (we do not have enough data to compare the Yakamia Watti water quality to our WQO's yet). Mill Brook, King River, and Willyung Creek were all above both of our WQOs. The Kalgan River was below our phosphorus WQO but above our nitrogen WQO. While this site has been below both our WQO's in most years, there have been some years where it was above our nitrogen WQO. Ongoing monitoring will help us determine if nitrogen concentrations are increasing at this site. If nitrogen concentrations are indeed increasing, then this subcatchment may become a higher priority for management.



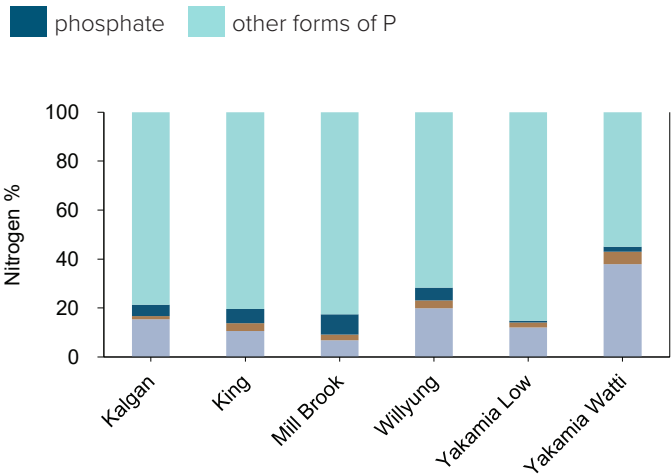
Wet month nutrient forms (2023)

The proportion of phosphorus present as **phosphate** which is readily used by plants and algae to fuel growth was very similar at all sites for the wet months (June to October). The phosphate is likely coming from the agricultural and urban land uses present in the Oyster Harbour catchment.

Dissolved organic nitrogen was the most common form of nitrogen during the wet months at all sites. The proportion of nitrogen present as dissolved inorganic nitrogen (**nitrate** and **total ammonia**) which is readily used by plants to fuel growth, was higher at the Yakamia Watti site than all other sites, where it is likely entering the creek from the upstream urban land use. In urban areas, nutrients that are applied as fertiliser tend to enter waterways quickly after rain as the presence of hard surfaces (such as roads and roofs) means that much of the rainwater flows directly to waterways rather than being absorbed by soils. There is also less opportunity for dissolved inorganic nitrogen to be assimilated in drains than in natural waterways.



Proportion of different forms of phosphorus in the wet months (June to October) of 2023



Proportion of different forms of nitrogen in the wet months (June to October) of 2023

Total phosphorus and total nitrogen are made up of different forms, or fractions, of phosphorus and nitrogen. Understanding which forms occur helps us to determine the likely sources of the nutrients, and better target management actions.

Phosphate is readily used by plants and algae and can cause excess plant growth, algal blooms and fish kills. It is mostly derived from animal waste and fertilisers and, to a smaller extent, from natural sources. **Other forms of phosphorus** include either particulate phosphorus, dissolved organic phosphorus, or both. Particulate phosphorus usually needs to be broken down before it can be used by plants and algae. The bioavailability of dissolved organic phosphorus varies and is poorly understood.

Dissolved organic nitrogen comes from both natural and human sources and consists of various compounds. Some, like urea (found in fertiliser and

animal urine), are bioavailable to algae. Others, like proteins and humic acids which mostly come from broken down pasture and manure as well as natural vegetation, need to be broken down further before plants and algae can use them. **Particulate nitrogen**, which comes from plant and animal matter, also generally needs to be broken down before it can be used by plants and algae.

Dissolved inorganic nitrogen (**nitrate** and **total ammonia**) is readily used by plants and algae and can cause excess plant growth, algal blooms and fish kills. These nitrogen forms are typically at their highest levels when waterways begin to flow after autumn or winter rains. This is because, during summer, organic nitrogen in the soil and dry waterways breaks down into nitrate and total ammonia. Additionally, fertilisers and animal waste accumulate on agricultural land. When the rainfall starts, it washes this nitrogen into the waterways.

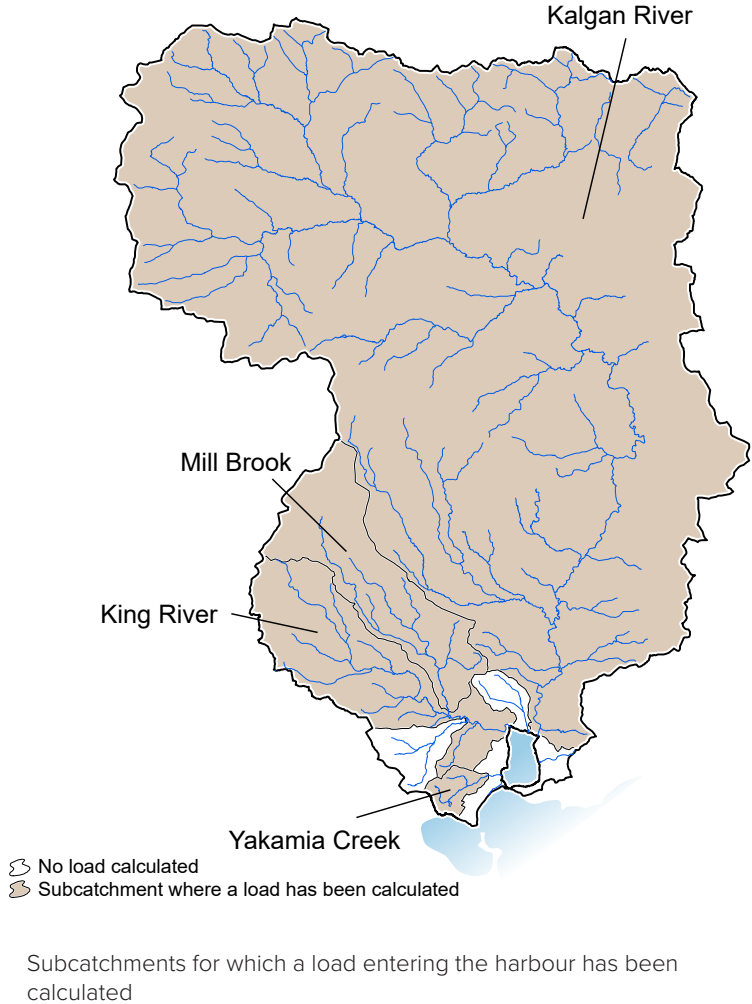
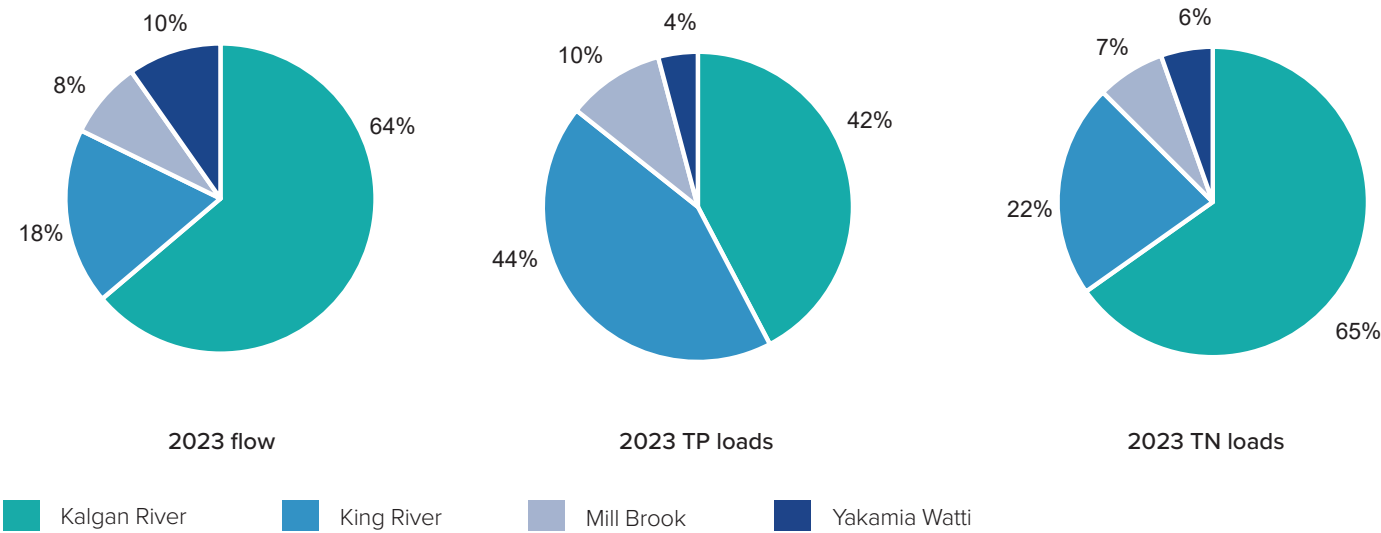
Flow and nutrient loads to the harbour (2023)

The Kalgan River had the largest flow volume to Oyster Harbour in 2023, contributing 64 per cent of the total flow. This was followed by the King River, with Mill Brook and Yakamia Watti contributing smaller amounts. Nutrient loads, which are the total amount of nutrients leaving a subcatchment each year, are calculated by multiplying the flow at a site by the nutrient concentration. This means that, in general, there is a close relationship between flow volumes and nutrient loads—subcatchments with large flows tend to have large nutrient loads and vice versa. However, if a subcatchment has high nutrient concentrations, it is possible for its nutrient loads to be disproportionately larger than its flow volume.

The majority of the phosphorus load was delivered by the Kalgan and King rivers which, together, contributed 85 per cent of the load. The phosphorus load contributed by the King River is large in comparison to the amount of flow it delivers. This is driven by the high phosphorus concentrations present in the King River.

Nitrogen loads showed a close link to flow volumes in 2023. The only exception to this was Yakamia Watti where the low nitrogen concentrations led to a smaller load than its flow volume would predict.

While nutrient loads can indicate which subcatchment contributes the most nutrients entering the harbour, they are strongly affected by changes in annual flow volumes. Concentrations, on the other hand, are less affected by flow variations



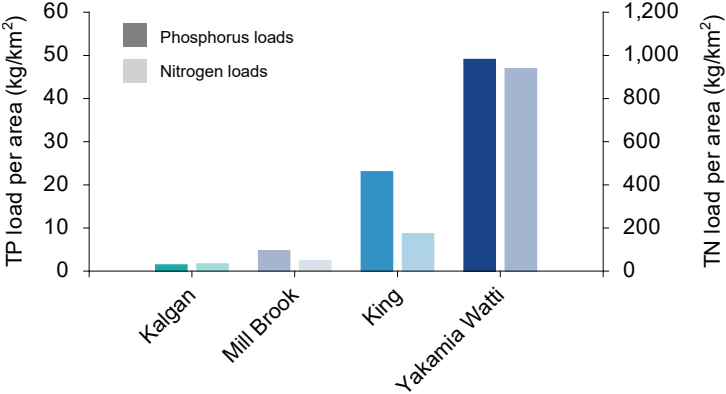
and therefore provide a better measurement for water quality objectives than loads.

It's important to note, these measurements are taken at the sampling sites, so any flow or nutrients entering the rivers downstream of these locations, or from waterways that are not monitored, are not included in the data presented here.

Nutrient loads per square kilometre (2023)

Another way to present load data is to divide the total annual load at a site by the area of land that contributes to that load, giving a load per square kilometre. This helps prioritise management actions as it allows us to identify those subcatchments where actions in the catchment to reduce nutrient losses are likely to have the biggest impact.

The Yakamia Watti site contributed the largest phosphorus, and nitrogen loads per square kilometre. This was driven by the large area of hard surfaces (such as roads and roofs) which caused any rainwater to quickly travel to the creek via drains, rather than being absorbed by the soil, as occurs in agricultural catchments. The King River had slightly smaller loads per square kilometre but the high nutrient concentrations at this site mean it is a priority for management as high nutrient concentrations can encourage algal growth in the harbour.

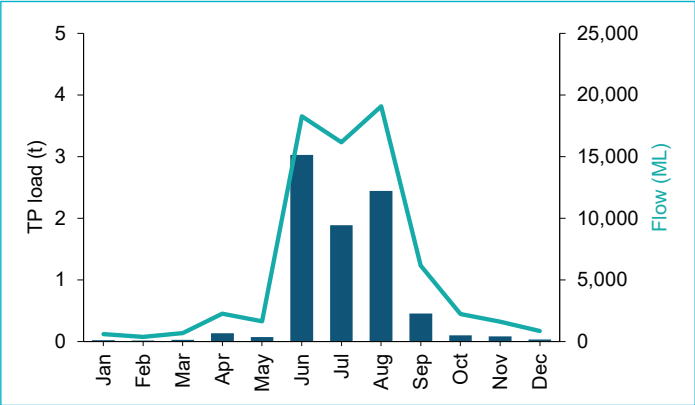


2023 loads per square kilometre for TP (dark columns, left hand axis) and TN (paler columns, right hand axis).

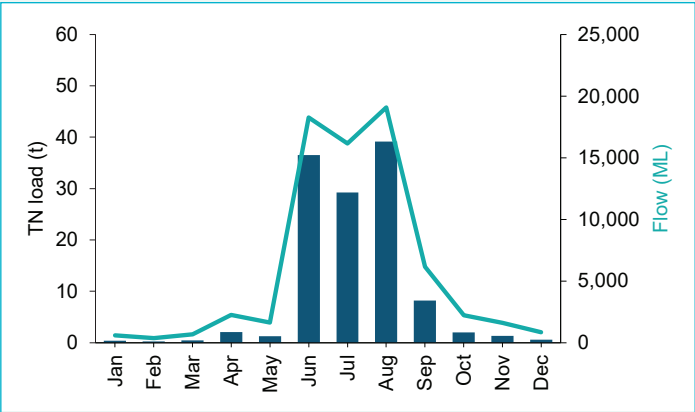
Monthly loads to the harbour (2023)

In 2023, the largest nitrogen and phosphorus loads entered Oyster Harbour during June and August, when the flow volumes were largest. As is clear from these graphs, loads are closely linked to flow so as the flow decreased, loads also decreased.

In a typical year, flow is largest during the wet months which is when most of the nutrients are entering the harbour. Once they reach the harbour, the fate of the nutrients leaving the catchment varies depending on the amount of catchment flow. When the flow volumes from the catchment are large (as is usually the case in the wet months), much of the river inflow, and the nutrients carried by it, quickly passes through Oyster Harbour as a thin layer of surface flow, and discharges into King George Sound. However, we still see local effects on water quality near the outflows of the King and Kalgan rivers, particularly during the wet months, when nutrient concentrations are much higher than in southern parts of the estuary. During the dry months, when flow volumes are smaller, river inflow spends a lot more time in the harbour, meaning that the seagrass, macroalgae and phytoplankton in the harbour have more time to take up these nutrients and use them for growth.



2023 monthly TP loads (columns) and flow (line).



2023 monthly TN loads (columns) and flow (line).

Background

Healthy Estuaries WA is a State Government program to protect and improve the health of our estuaries. Collecting and reporting water quality data, such as in this report, helps build understanding of the whole system, both the catchment and the harbour. This allows investment to be directed towards the most effective actions in the catchments to protect and restore the health of our rivers, creeks and estuaries.

Nutrients (phosphorus and nitrogen) are compounds that are important for plants to grow. Excess nutrients entering waterways from animal waste, fertilisers and other sources can fuel algal growth, decrease oxygen levels in the water and harm fish and other species.

You can find information on the condition of Oyster Harbour at estuaries.dwer.wa.gov.au/estuary/oyster-harbour/

Healthy Estuaries WA partners with the Oyster Harbour Catchment Group and industry groups to fund best-practice management of fertiliser, dairy effluent and watercourses on farms.

To find out more about:

- How you can be involved, visit estuaries.dwer.wa.gov.au/participate
- The Oyster Harbour Catchment Group, go to ohcg.org.au
- Dairy effluent management, visit westerndairy.com.au/healthy-estuaries-wa/
- The rivers in the Oyster Harbour catchment, go to rivers.dwer.wa.gov.au/assessments/results

Methods

Information on the methods used can be found here: estuaries.dwer.wa.gov.au/nutrient-reports/data-analysis

Sites sampled

There are six sites sampled in the Oyster Harbour catchment, as listed below. Only those sites marked with an * had flow data available in 2023. The number next to the site name is the unique Australian Water Resource Council code for that site.

Kalgan River

- Kalgan, 602004*

King River

- King River 602014*

Mill Brook

- Mill Brook, 602015*

Willyung Creek

- Willyung, 602013

Yakamia Creek

- Yakamia Lower, 602601
- Yakamia Wattli, 602012*

Want more?

If you would like to access the data used in these reports, please visit: [wa.gov.au/ service/natural-resources/water-resources/water-information-reporting](https://wa.gov.au/service/natural-resources/water-resources/water-information-reporting). The numerical AWRC codes listed above can be used to search for the available data.