Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**

GOVERNMENT OF WESTERN AUSTRALIA

Peel-Harvey catchment

HEALTHY ESTUARIES WA

Nutrient report 2023

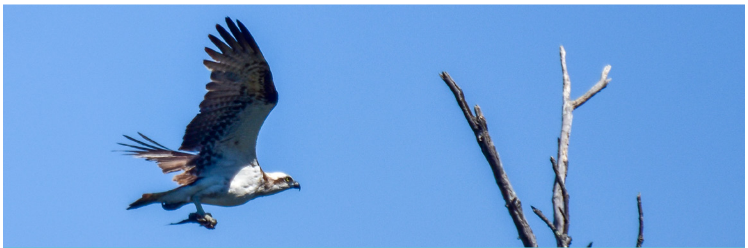
This data report provides a summary of nutrients in the waterways of the Peel-Harvey estuary catchment in 2023. Excess nutrients are one of the most significant pressures on our waterways and estuaries, and can lead to algal blooms and fish kills.

About the catchment

The Peel-Harvey estuary (Bindjareb Djilba) has a catchment area of about 9,390 km^2, about 57 per cent of which has been cleared, mostly for livestock grazing and cropping. Some rivers have been partially modified to allow better drainage. Drains have also been constructed in some areas to help speed up water removal from the landscape. These modifications to the landscape change the hydrological pathways (which determine how much and when water flows into the estuary), increase the concentrations of nutrients in the waterways and, together with climate change, put pressure on the Peel-Harvey estuary. Soil types also influence nutrient concentrations (especially phosphorus) as some soils bind phosphorus, preventing it from entering waterways, better than others.

Three rivers provide most of the flow into the estuary. The Serpentine and Murray rivers flow from the north and east into the Peel Inlet. The Harvey River flows from the south-east into the Harvey Estuary. Several smaller waterways and drains also flow into the estuary, but their contribution to the total flow volume entering the estuary is small.

Fortnightly monitoring is conducted at thirteen sites across thirteen subcatchments, with most sites located near the bottom of each subcatchment.



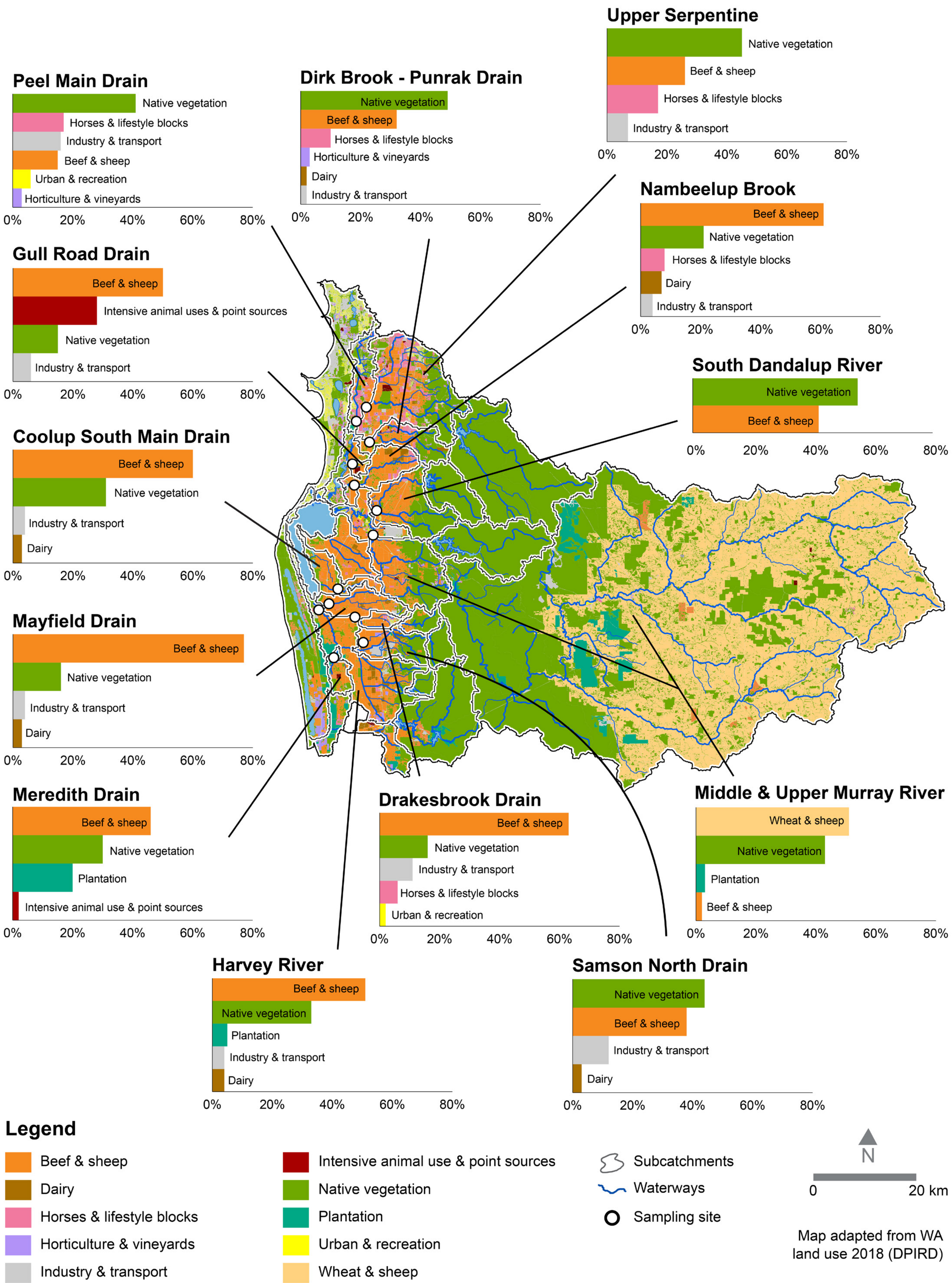
Key points:

- High nutrient concentrations are due to a combination of agricultural land uses, the construction of drains to reduce surface water ponding, and (for phosphorus) the presence of soils that bind phosphorus poorly.
- All subcatchments require nutrient reduction measures to comply with the Water Quality Objectives. Priority subcatchments for nutrient reduction actions are Gull Road Drain, Harvey River, Nambeelup Brook and Samson North Drain.

Facts and figures

Catchment area	9,390 km^2
Per cent cleared area (2018)	57 per cent
Main rivers flowing into Peel-Harvey estuary	Serpentine, Murray and Harvey rivers
River flow to Peel-Harvey estuary (2023)	250 GL
Main land use (2018)	Native vegetation, cropping, and beef and sheep grazing

Peel-Harvey estuary 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.

Coolup South Main Drain

Coolup South Main Drain did not meet our phosphorus or nitrogen water quality objectives, which are nutrient concentrations we aim to achieve for healthy waterways. While the nutrient loads were small, due to the small flow volume, nutrient concentrations were high.

Dirk Brook – Punrak Drain

Dirk Brook did not meet our phosphorus or nitrogen water quality objectives. A large portion of the nitrogen was present as nitrate, which can cause excess plant growth, algal blooms and fish kills.

Drakesbrook Drain

While Drakesbrook Drain met our phosphorus water quality objective it did not meet the objective for nitrogen. Further, of the sites sampled, it had the largest proportion of nitrogen present as nitrate, which can cause excess plant growth, algal blooms and fish kills.

Gull Road Drain

Gull Road Drain is a priority for nutrient management. Water quality was poor with the site recording the highest median phosphorus and nitrogen concentrations. It did not meet our water quality objectives and had the largest proportion of phosphorus present as phosphate, which can cause excess plant growth, algal blooms and fish kills.

Harvey River

The Harvey River is a high priority for nutrient management. It did not meet our water quality objectives for phosphorus or nitrogen. It contributed the largest nutrient loads, both as a total load and as a per square kilometre load, of all subcatchments.

Mayfield Drain

Water quality in Mayfield Drain was poor; the site did not meet either our phosphorus or nitrogen water quality objectives. However, the proportion of nitrogen present as nitrate and ammonia, two forms which can cause excess plant growth, algal blooms and fish kills, was small.

Meredith Drain

Meredith Drain did not meet either our phosphorus or nitrogen water quality objectives. The proportion of phosphorus present as phosphate, which can cause excess plant growth, algal blooms and fish kills, was large. The nutrient loads per square kilometre were also some of the largest.

Middle Murray River

Water quality in the Middle Murray River was good, with the site meeting both our water quality objectives – the only site to do so. This was driven by the low nutrient concentration water entering the Middle Murray subcatchment from the Upper Murray subcatchment. Taken in isolation, the Middle Murray River subcatchment contributes a considerable amount of nutrients.

Nambeelup Brook

Nambeelup Brook is a priority for nutrient management. Water quality was poor, with one of the highest median phosphorus and nitrogen concentrations. The site did not meet our water quality objectives, and it had some of the largest nutrient loads per square kilometre of the sites sampled.

Peel Main Drain

Water quality in Peel Main Drain was poor. The site did not meet our water quality objectives for phosphorus or nitrogen.

Samson North Drain

Samson North Drain is a high priority for nutrient management. Water quality was poor and did not meet either of our water quality objectives and the nutrient concentrations were amongst the highest in 2023. Further, the proportion of nitrogen present as nitrate, which can cause excess plant growth, algal blooms and fish kills, was large.

South Dandalup River

Water quality in the South Dandalup River was amongst the best in 2023. It met our nitrogen but not our phosphorus water quality objectives.

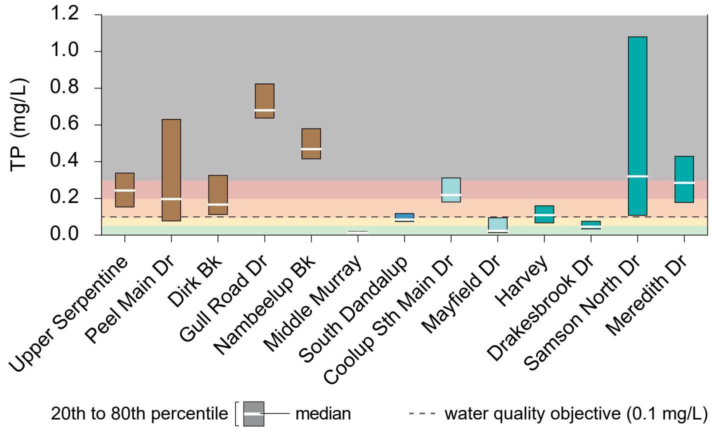
Upper Serpentine River

Water quality in the Upper Serpentine River was poor, and it did not meet either our phosphorus or nitrogen water quality objectives. The nutrient loads per square kilometre were moderate when compared to other subcatchments. Downstream of our catchment monitoring site, water quality in the estuarine Serpentine River deteriorates further.

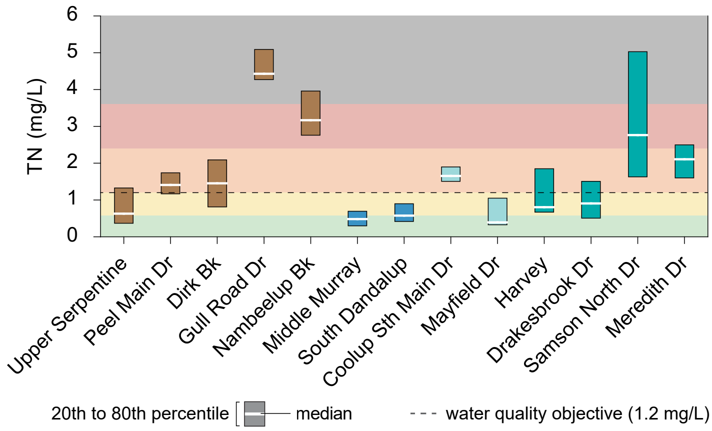
Nutrient concentrations (2023)

Nutrient concentrations varied significantly between the monitored sites. Gull Road Drain had the highest phosphorus and nitrogen concentrations, likely caused by a point source of intensive animal use just upstream of the sampling site. The Middle Murray site had the lowest concentrations of both phosphorus and nitrogen. While the land use in the Middle Murray catchment is quite intensive and produces a large amount of nutrients, these are diluted by the lower nutrient concentration water from the Upper Murray catchment.

The generally high nutrient concentrations in the Peel-Harvey catchment are due to the combination of intensive agricultural land use in the monitored subcatchments, the construction of drains to reduce surface water ponding, and (for phosphorus) the presence of soils that have a low ability to bind phosphorus applied to them. Drains tend to have elevated nutrient concentrations as they are designed to quickly remove water from the landscape, allowing minimal time for nutrient assimilation. This issue is exacerbated by the lack of vegetation along drains, which would otherwise help absorb and filter nutrients.



2023 Total phosphorus concentrations



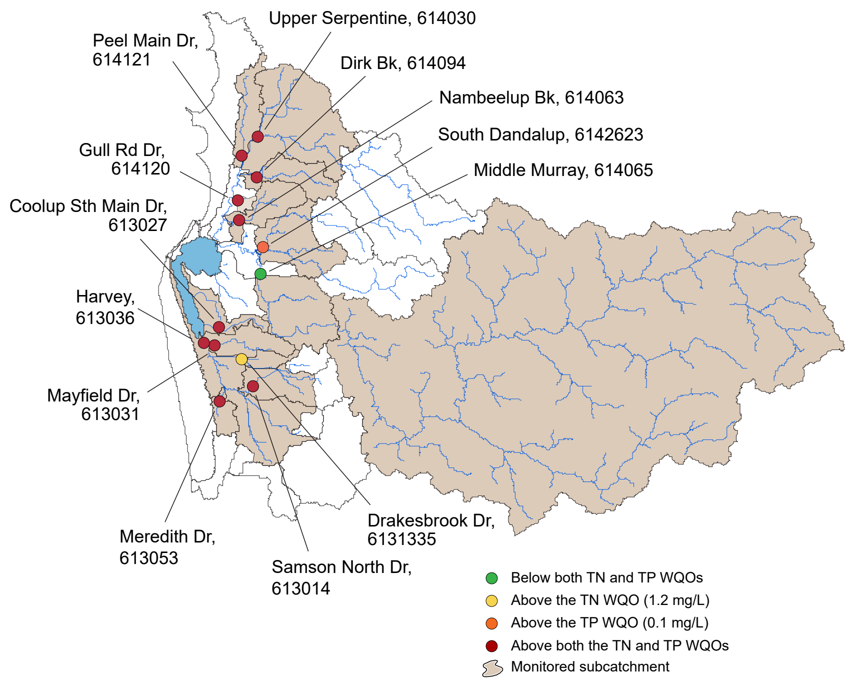
2023 Total nitrogen concentrations

low | moderate | high | very high | extreme

Performance against water quality objectives (2021–23)

Water quality objectives (WQOs) are the nutrient concentrations we aim for to protect the health of the estuary. For the Peel-Harvey estuary, the WQOs were developed as part of the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan (DWER 2020). 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.

Only one site, the Middle Murray, was meeting both the total phosphorus (0.1 mg/L) and total nitrogen (1.2 mg/L) WQOs. South Dandalup met the total nitrogen but not the total phosphorus WQO whereas Drakesbrook Drain met the total phosphorus but not the total nitrogen WQO. All other sites did not meet either the total nitrogen or the total phosphorus WQOs.



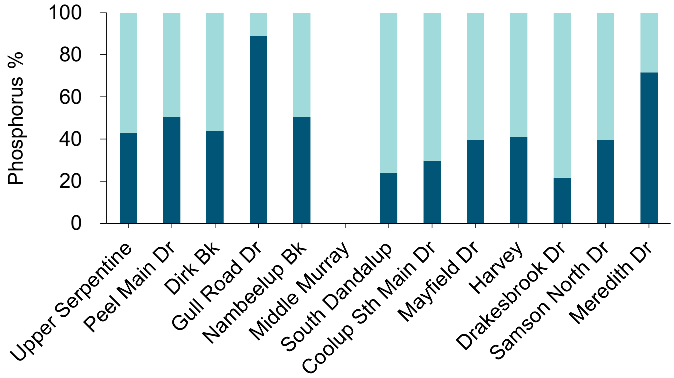
How each site performed against the TN (1.2 mg/L) and TP (0.1 mg/L) water quality objectives in 2021–23

Note: the graphs above show all data (January to December inclusive) collected in 2023, whereas performance against the WQOs were calculated using three-year (2021–23) wet months (June to October) medians. We use a three-year median as it reduces the impact of natural variation between years. This is why a median may be below the WQO in the graphs, yet the site may be shown as being above the WQO in the map, as is the case for nitrogen concentrations in the Upper Serpentine.

Wet month nutrient forms (2023)

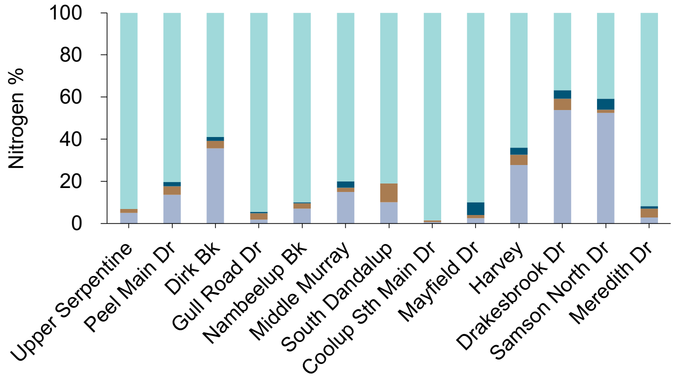
Gull Road Drain and Meredith Drain had the largest proportion of phosphorus present as **phosphate**, which can lead to algal blooms and fish kills. The soils along the waterways in both subcatchments tend to bind phosphorus poorly. These soils, in conjunction with agricultural land uses in these subcatchments and the presence of intensive animal land uses such as piggeries, are the reason for the large proportion of phosphate present.

Dissolved organic nitrogen was the most common form of nitrogen measured in the wet months at almost all sites. The proportion of nitrogen present as **nitrate**, which can lead to algal blooms and fish kills, was highest in Drakesbrook Drain and Samson North Drain (though the actual concentrations of nitrate were much higher in Samson North Drain than Drakesbrook Drain). This was likely due to nitrate entering the drains from the surrounding agricultural land uses following rainfall.



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

phosphate   other forms of P



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

nitrate   total ammonia   particulate N
dissolved organic N

NOTE: where there is no data shown for a site, it means that a large proportion of the collected samples were below the laboratory limit of reporting.

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.

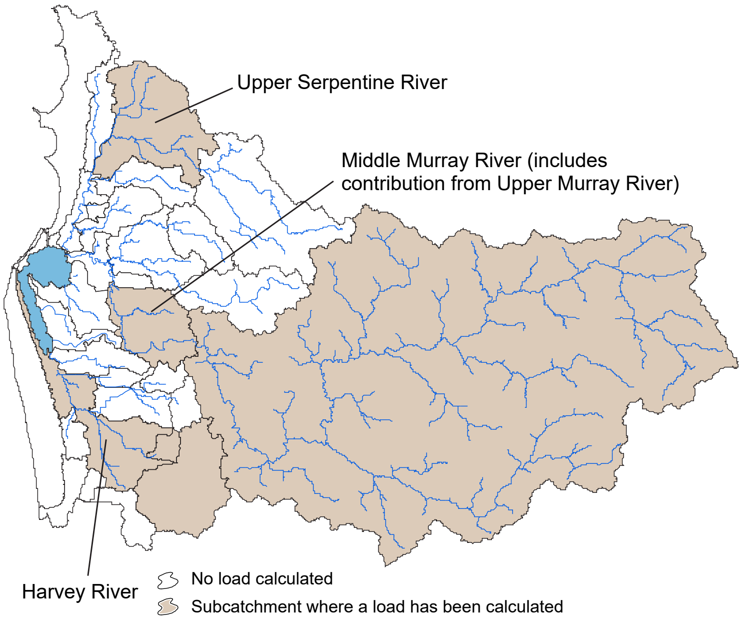
Dissolved inorganic nitrogen (**nitrate** and **total ammonia**) is readily used by plants and algae and can cause excess plant growth, algal blooms and fish kills. These nitrogen forms are typically at their highest levels when waterways begin to flow after autumn or winter rains. This is because, during 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 estuary (2023)

The Murray River contributed by far the largest flow volume (60 per cent) of the three largest waterways that flow into the Peel-Harvey estuary, followed by the Harvey (29 per cent) and the Serpentine (11 per cent). While it is possible to calculate loads for some of the other subcatchments, these have not been presented here as the loads they contribute are relatively small.

As nutrient loads are calculated by multiplying the flow at a site by the nutrient concentration, we generally see a close relationship between flow volumes and loads. That is, catchments with large flow volumes have large nutrient loads and vice versa. This pattern was not observed in 2023. The Harvey River in particular delivered a disproportionately large share of both phosphorus and nitrogen loads relative to its flow volume. This is because of the agricultural land use in the catchment driving high nutrient concentrations. This subcatchment also receives irrigation excess, leading to larger flows and higher nutrient concentrations during the summer months than the Murray River* and Upper Serpentine subcatchments. While these flows are still small compared to winter flows, they do contribute to the overall nutrient load.

The relatively small nutrient loads from the Murray River, compared to its flow volume, are because of the low nutrient concentrations at this site. The Middle Murray receives a significant amount of flow from the Upper Murray subcatchment. As the largest subcatchment, the Upper Murray generates substantial flow. However, nutrient concentrations

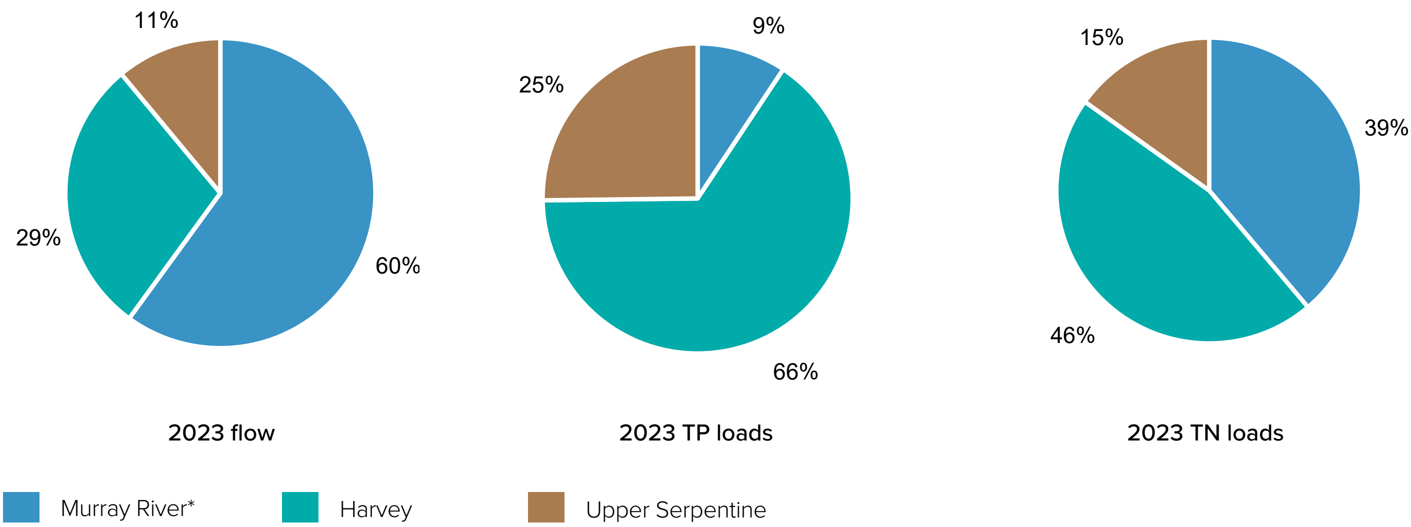


Subcatchments for which a load entering the estuary has been calculated

there are much lower than those measured in the Middle Murray. This difference is largely due to land use: the Upper Murray is dominated by wheat and sheep grazing, which typically produce less nutrients, while the Middle Murray has more beef and sheep grazing, which generate more nutrients.

The Upper Serpentine subcatchment had the smallest nitrogen load but the second largest phosphorus load. The large phosphorus load was caused by the comparatively high total phosphorus concentrations. In 2023, this site had the highest total phosphorus concentrations among the three sites with reported 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 are not included in the data presented here.

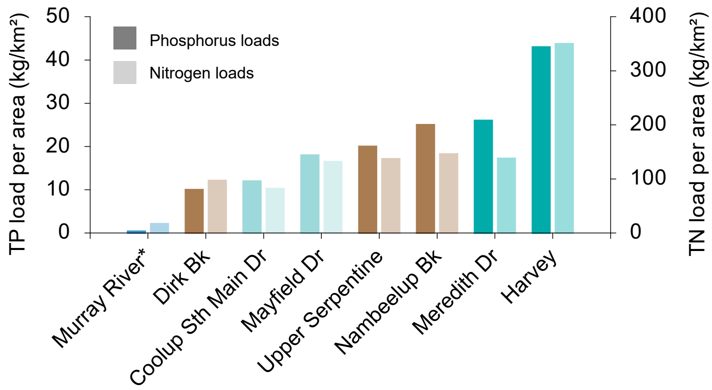


* Combined Middle and Upper Murray River subcatchments

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 unit area. This helps prioritise subcatchments for nutrient management actions as it allows us to identify where efforts are likely to have the biggest impact. Looking at the data in this way, we can see that the Harvey River has the largest load per square kilometre and should be a priority for management.

It is important to note several limitations in this reporting. First, nutrients entering waterways downstream of our sampling sites are not included in this data. Second, subcatchments without flow data are excluded from load calculations, e.g. Gull Road Drain, which has high nutrient concentrations. Finally, the load per square kilometre for the Murray River is calculated from the combined area of the Middle and Upper Murray subcatchments, which significantly underestimates the loads per square kilometre from the Middle Murray subcatchment.

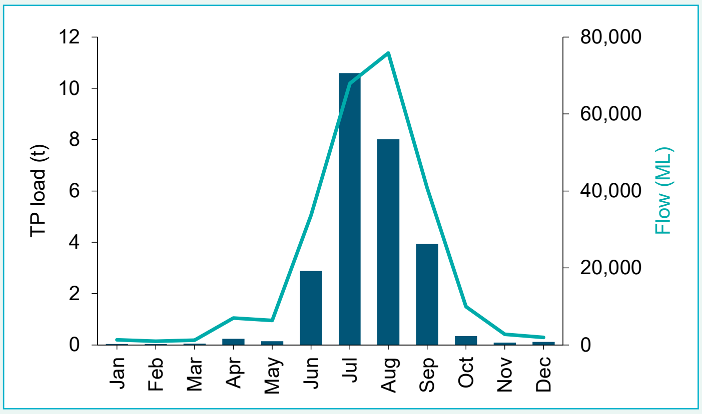


2023 loads per square kilometre for TP (dark columns, left hand axis) and TN (paler columns, right hand axis).

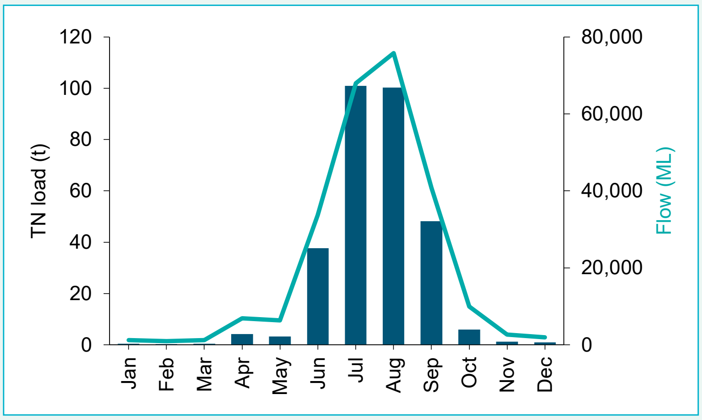
Monthly loads to the inlet (2023)

In 2023, the largest nitrogen and phosphorus loads left the subcatchments in July and August, because of their large flow volumes. 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 (June to October inclusive), which is when most of the nutrients are entering estuarine rivers and then the estuary. Flow volumes strongly influence what happens to the nutrients when they enter the estuarine rivers. In high-flow years, nutrients may be transported through them, and into the estuary where they may be diluted or lost to the ocean. In low-flow years, nutrients tend to remain in the estuarine rivers and the estuary for longer, as their loss to the ocean by tidal exchange is slower. Excess nutrients, especially when they are bioavailable, can lead to algal blooms and fish kills.



2023 monthly TP loads (columns) and flow (line) for the three subcatchments that contribute most of the flow.



2023 monthly TN loads (columns) and flow (line) for the three subcatchments that contribute most of the flow.

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 estuary. 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 the Peel-Harvey estuary at estuaries.dwer.wa.gov.au/estuary/peel-harvey-estuary

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

To find out more about:

- How to get involved: estuaries.dwer.wa.gov.au/participate
- The Peel-Harvey Catchment Council go to peel-harvey.org.au
- Dairy effluent management visit westerndairy.com.au/healthy-estuaries-wa/
- The health of the rivers in the Peel-Harvey 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 thirteen sites sampled in the Peel-Harvey catchment, see the list below. The number next to the site name is the unique Australian Water Resource Council code for that site.

Serpentine River

- Upper Serpentine, 614030
- Peel Main Dr, 614121
- Dirk Bk, 614094
- Gull Rd Dr, 614120
- Nambeelup Bk, 614063

Murray River

- Middle Murray, 614065
- South Dandalup, 6142623

Coolup South Main Drain

- Coolup Sth Main Dr, 613027

Mayfield Drain

- Mayfield Dr, 613031

Harvey River

- Harvey, 613036
- Drakesbrook Dr, 6131335
- Samson North Dr, 613014
- Meredith Dr, 613053

Want more?

If you would like to access the data used in the analyses in these reports, please visit: 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.

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