Nambeelup Brook

This data report provides a summary of the nutrients at the Nambeelup Brook sampling site in 2018 as well as historical data from 2004–18. This report was produced as part of the Regional Estuaries Initiative. Downstream of the site, the brook flows into Black Lake, which continues into Goegrup Lake (one of the Serpentine Lakes) before entering the Serpentine River which discharges to the Peel Inlet. Nutrients (nitrogen and phosphorus) are compounds that are important for plants to grow. Excess nutrients entering waterways from effluent, fertilisers and other sources can fuel algal growth, decrease oxygen levels in water and harm fish and other species. Total suspended solids, pH and salinity data are also presented as they help us better understand the processes occurring in the catchment.

About the catchment

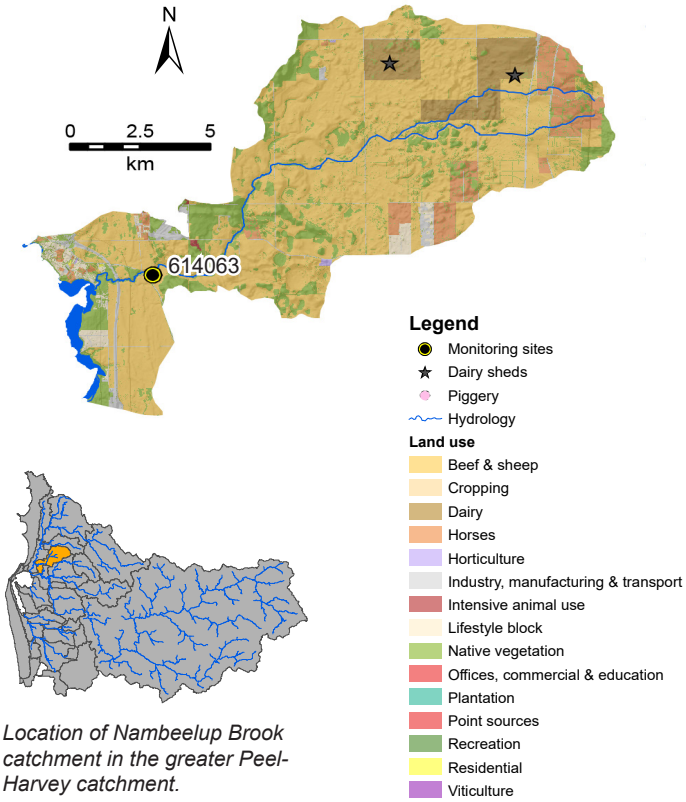
Nambeelup Brook has a catchment area of about 139 km^2, more than three-quarters of which has been cleared for agriculture, predominantly beef and sheep grazing. Two dairy sheds are present in the upper catchment. While the brook itself retains its natural form, much of the fringing vegetation has been lost or degraded and there are numerous drains constructed to quickly remove water from agricultural land and drain it to the brook.

Most of the catchment soils have a low phosphorus-binding capacity. This is often so poor that any phosphorus applied to them can be quickly washed into drains and other waterways.

Water quality is monitored at site 614063, Patterson Road–Kielman, upstream of where Nambeelup Brook passes under Patterson Road in Nambeelup. The catchment area upstream of the sampling site is about 112 km^2.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Nambeelup Brook sampling site were very high. Annual nutrient loads were moderate compared with the other Peel-Harvey catchment sites and the load per square kilometre was large. The combination of agricultural land use, lack of fringing vegetation and the construction of drains to reduce surface water ponding means large amounts of nutrients can be washed from soils to waterways and then transported downstream quickly rather than being assimilated.



Location of Nambeelup Brook catchment in the greater Peel-Harvey catchment.

Facts and figures

Sampling site code	614063
Catchment area	139 km^2
Per cent cleared area (2015)	79 per cent
River flow	Ephemeral, dries over summer
Annual flow (2018)	16 GL
Main land use (2015)	Beef and sheep grazing

Nambeelup Brook

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations at the Nambeelup Brook sampling site were very high with only one sample in the past 15 years below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value. Concentrations fluctuated over the reporting period but remained consistently high. Nambeelup Brook had one of the highest TN concentrations of the 13 sites sampled in the Peel-Harvey catchment, with the 2018 median (2.8 mg/L) being the second highest (after the Gull Road Drain site which had a median of 4.2 mg/L).

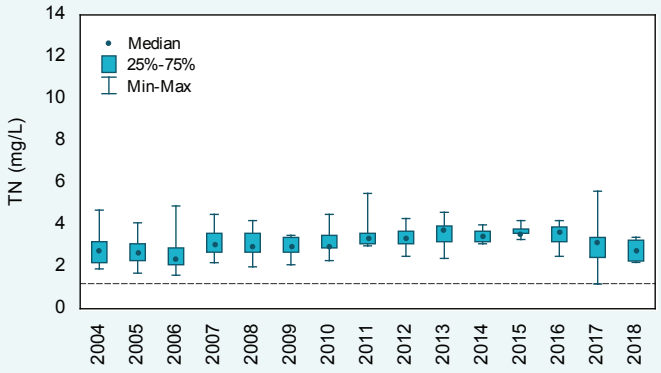
Trends

There was a short-term (2014–18) decreasing trend in TN concentrations of 0.18 mg/L/yr. This may be because of natural fluctuations at this site or an actual decrease in TN concentrations. Ongoing monitoring will help determine if the water quality is getting better at this site. There was no long-term (2004–18) trend present.

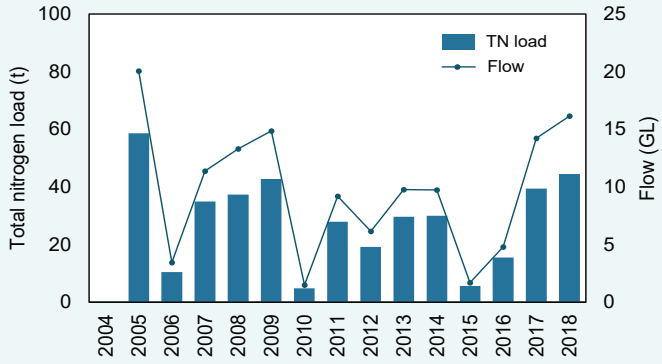
Estimated loads

Estimated TN loads at the Nambeelup Brook sampling site were moderate compared with the other 10 sites where it was possible to calculate loads in the Peel-Harvey catchment. In 2018, Nambeelup Brook had an estimated TN load of 45 t, similar to Mayfield Drain which had a load of 41 t. The load per unit area was moderate to large, at 397 kg/km^2 in 2018, similar to Mayfield Drain at 366 kg/km^2. Only the Harvey River had a larger load per unit area of 624 kg/km^2. TN loads were closely related to flow volume, years with high annual flow having large TN loads and vice versa.

Nambeelup Brook



Total nitrogen concentrations, 2004–18 at site 614063. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 614063.

The weir at the Nambeelup Brook sampling site, October 2016.

Nitrogen (2018)

Types of nitrogen

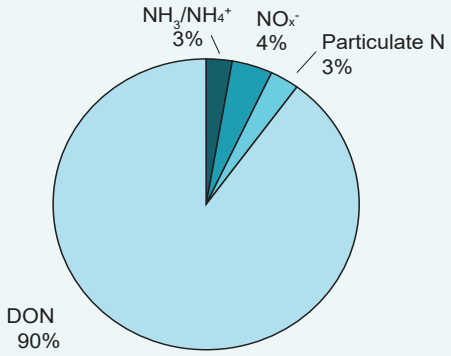
Total N is made up of many different types of N. At the Nambeelup Brook sampling site, most of the N was present as dissolved organic N (DON) which consists mainly of degrading plant and animal matter but may also include other forms. Most forms of DON need to be further broken down to become available to plants and algae, though some forms are readily bioavailable. Only a very small portion of N was present as dissolved inorganic N (DIN—consisting of oxides of N, NO_x^- and ammonia N, NH_3/NH_4^+).

Concentrations

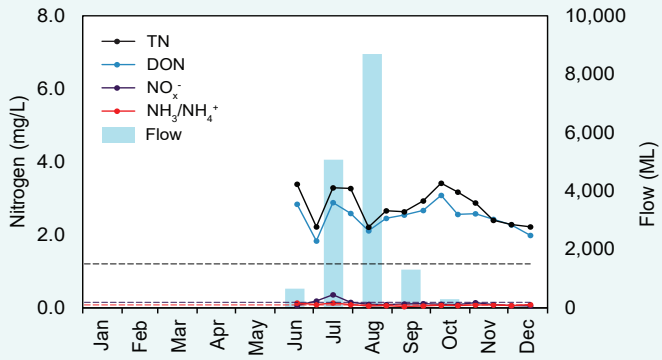
Total N and DON did not show a strong seasonal pattern in 2018, fluctuating through the year. TN was consistently over the ANZECC trigger value whereas both NH_3/NH_4^+ and NO_x^- only exceeded their trigger values a few times during the year. NO_x^- showed a seasonal pattern, peaking in July after rainfall and flow had increased. It is likely much of the NO_x^- was the result of mineralisation of organic N in soils and drains over the summer period as well as runoff of high-concentrations waters from agricultural land which builds up with fertiliser and animal waste over the summer. Much of the N present was organic (as DON) and likely washed from rewetting remnant wetlands in the catchment.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



2018 average nitrogen fractions at site 614063.



2018 nitrogen concentrations and monthly flow at 614065. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

Nambeelup Brook completely dry at the sampling site, March 2011.

Nambeelup Brook

Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations were very high at the Nambeelup Brook sampling site, with all samples collected during the reporting period over the Peel-Harvey WQIP target. Concentrations fluctuated over the reporting period with, some evidence they may be improving (see 'Trends' section below).

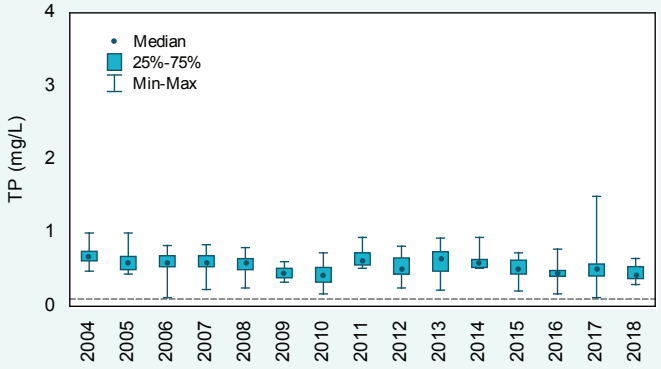
Trends

There was a short-term (2014–18) decreasing trend in TP concentrations of 0.03 mg/L/yr, and a long-term (2004–18) decreasing trend of 0.01 mg/L/yr. These trends may be because of climate change.

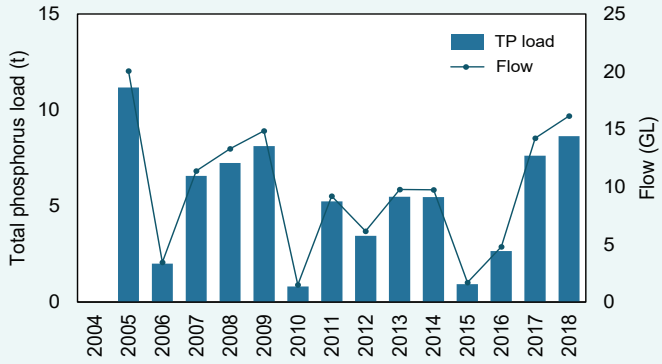
Estimated loads

Estimated TP loads at the Nambeelup Brook sampling site were moderate compared with the other 10 sites where it was possible to calculate loads in the Peel-Harvey catchment. In 2018, the site had an estimated TP load of 8.6 t, similar to the Middle Murray site which had a load of 8.3 t. The load per unit area of 77 kg/km^2 was the second largest of the Peel-Harvey sites. Only the Harvey River had a larger load of 83 kg/km^2. TP loads were closely related to flow volume, years with high annual flow having large TP loads and vice versa.

Nambeelup Brook



Total phosphorus concentrations, 2004–18 at site 614063. The dashed line is the Peel-Harvey WQIP target for winter median TP concentrations.



Total phosphorus loads and annual flow, 2004–18 at site 614063.

High nutrient concentrations contribute to excess algal growth like that shown in this photograph in Nambeelup Brook, November 2017.

Nambeelup Brook

Phosphorus (2018)

Types of phosphorus

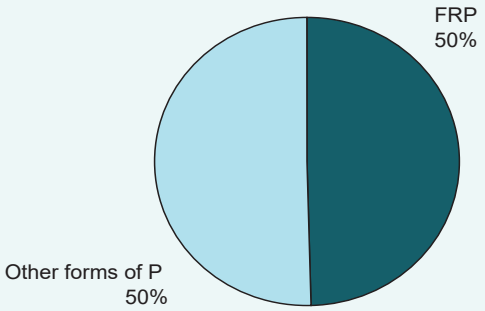
Total P is made up of different types of P. At the Nambeelup Brook sampling site, half of the P was present as highly bioavailable filterable reactive P (FRP). This form of P is readily used by plants and algae to fuel growth and is likely sourced from fertilisers and animal waste as well as natural sources. The remaining P was present as either particulate P or dissolved organic P (DOP) or both. Particulate P generally needs to be broken down before becoming bioavailable to algae. The bioavailability of DOP varies and is poorly understood.

Concentrations

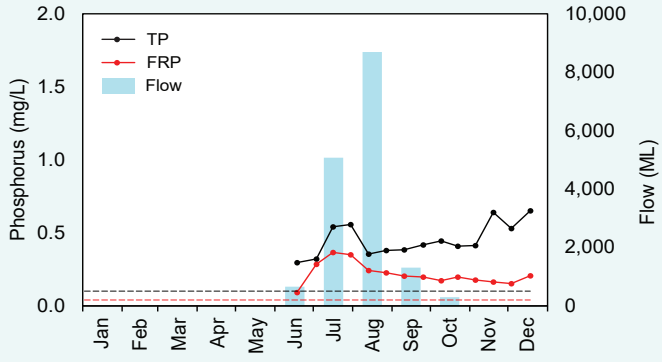
Both TP and FRP concentrations showed some evidence of a seasonal response, increasing from June to July, as rainfall and flow increased. This suggests P was being washed into the brook at this time via surface flows from waterlogged paddocks, as well as any P present in the brook, after it dried over the warmer months, being mobilised. After the peak in July, FRP concentrations fell during the rest of the year whereas TP fell and then slowly increased again. The rise later in the year was possibly because of greater inflows of nutrients from lower semi-rural reaches of the catchment. Most of the P at this time was either particulate P or DOP, though it is not possible to determine what proportion of each was present.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



2018 average phosphorus fractions at site 614063.



2018 phosphorus concentrations and monthly flow at 614063. The dashed black line is the Peel-Harvey WQIP target, the red line is the ANZECC trigger values for lowland rivers.

Paperbark trees along Nambeelup Brook, July 2019.

Nambeelup Brook

Dissolved organic carbon over time (2004–18)

Concentrations

There were only four years with sufficient dissolved organic carbon (DOC) data to graph. Using the Statewide River Water Quality Assessment (SWRWQA) bands, all annual medians were classified as very high. While DOC appears to have decreased over the past three years, it is not yet possible to test if this is a trend (see 'Trends' section, below). Compared with the other sites in the Peel-Harvey catchment, DOC was very high at Nambeelup Brook with the 2018 median being the second highest of the 13 sites sampled (49 mg/L, only the Gull Road Drain site had a higher median of 112 mg/L).

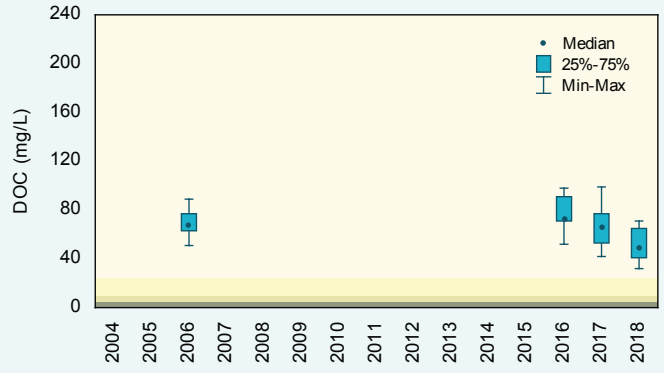
Trends

It was not possible to calculate trends in DOC concentrations at the Nambeelup Brook site as there were only three consecutive years of data present. A minimum of five consecutive years of data are required to test for trends.

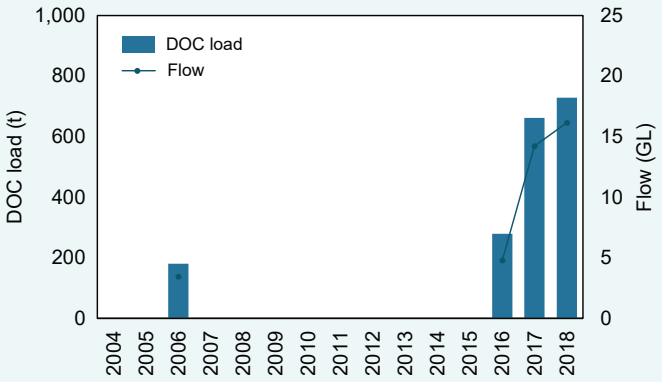
Estimated loads

Estimated DOC loads at the Nambeelup Brook sampling site were moderate compared with the other 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. In 2018, the estimated DOC load was 728 t. The load per unit area of 6,504 kg/km^2 was large compared with the other Peel-Harvey catchment sites, with only the Harvey River having a larger load per unit area of 6,933 kg/km^2. DOC loads were closely related to flow volume, years with high annual flow having large DOC loads and vice versa.

Nambeelup Brook



Dissolved organic carbon concentrations, 2004–18 at site 614063. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2004–18 at site 614063.

very high high moderate low

Grazing pasture in the Nambeelup Brook catchment. Beef and sheep grazing is the dominant land use in this catchment, July 2003.

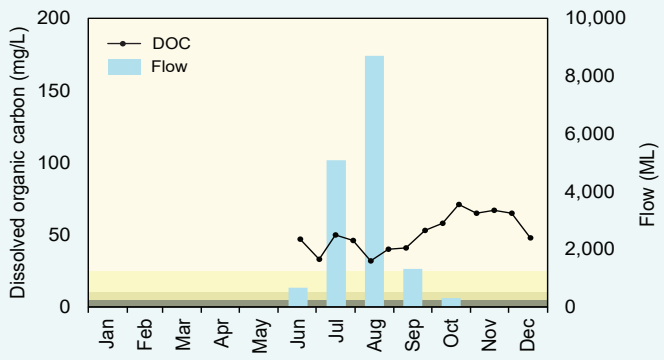
Dissolved organic carbon (2018)

Concentrations

In 2018, all DOC samples collected were classified as very high using the SWRWQA. There were initial peaks in DOC in June and again in July, suggesting early rainfall and flow flushed DOC into the brook from surrounding land use as well as mobilising DOC already present in the dry brook. Concentrations then fell slightly before increasing again from September to October. This pattern reflects the wetting up of the lower catchment, which is dominated by the same soils that generate high DOC concentrations at the Gull Road Drain site. DOC is sourced mainly from degrading plant and animal matter, including natural organic matter in soils and wetlands, with many wetlands on deep sands typically generating high DOC concentrations. It varies widely in its bioavailability.

Where there are no data shown on the graph, the drain was not flowing.

Nambeelup Brook



2018 dissolved organic carbon concentrations and monthly flow at 614063. The shading refers to the SWRWQA classification bands.

very high high moderate low

Nambeelup Brook dries over summer. Here there is only a small pool of water left near the sampling site, March 2015.

Nambeelup Brook

Total suspended solids over time (2004–18)

Concentrations

Total suspended solids (TSS) concentrations at the Nambeelup Brook sampling site fluctuated over the reporting period. They were generally low however, with most annual medians classified as low using the SWRWQA bands. There were only two samples that fell in the very high band (one in 2006 and one in 2010) but, in both instances, they only just fell into this band.

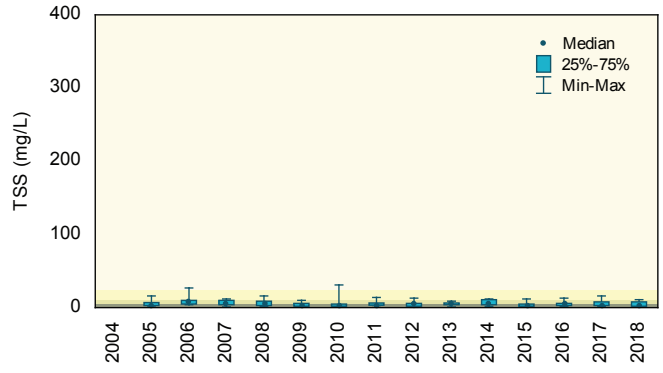
Trends

There was no trend in TSS concentrations at Nambeelup Brook over either the short- (2014–18) or long-term (2005–18).

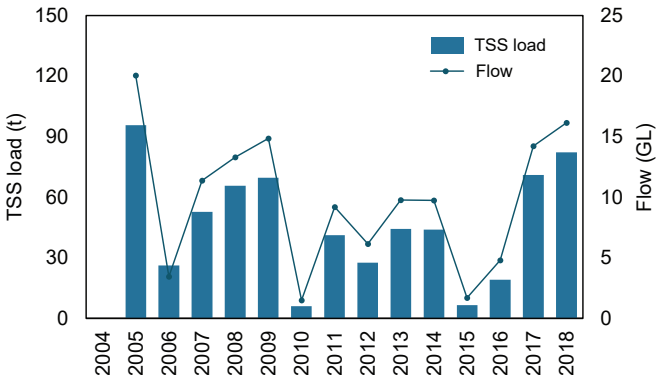
Estimated loads

Estimated TSS loads at the Nambeelup Brook sampling site were small to moderate compared with the other 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. In 2018, the estimated TSS load at this site was 82 t. The load per unit area of 734 kg/km^2 was moderate compared with the other Peel-Harvey catchment sites. TSS loads were closely related to flow volume, years with high annual flow having large TSS loads and vice versa.

Nambeelup Brook



Total suspended solids concentrations, 2004–18 at site 614063. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2004–18 at site 614063.

very high high moderate low

Taking flow measurements at the Nambeelup Brook sampling site, September 2011.

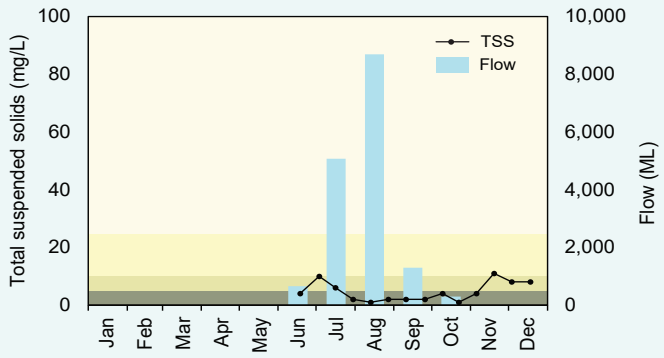
Total suspended solids (2018)

Concentrations

Total suspended solids concentrations showed a slight seasonal pattern, peaking early and late in the flow year. This suggests the onset of winter rains washed particulate matter into the brook from surrounding land use as well as mobilising any that had been deposited into the brook over the drier months when the brook was not flowing. Concentrations then decreased as flow increased before increasing again in November, when the brook started to dry out. This increase could be because of evapoconcentration of particulate matter in the brook at this time, algal growth, or stock accessing the brook upstream of the sampling site.

Where there are no data shown on the graph the brook was not flowing.

Nambeelup Brook



2018 total suspended solids concentrations and monthly flow at 614063. The shading refers to the SWRWQA classification bands.

very high high moderate low

Placing fish and crayfish traps as part of a river health assessment in Nambeelup Brook, November 2017.

Nambeelup Brook

pH over time (2004–18)

pH values

pH at the Nambeelup Brook sampling site fluctuated over the reporting period. All annual medians fell within the upper and lower ANZECC trigger values. The reason why the range in pH was so much larger in 2013 than other years is unknown.

Trends

There was no trend in pH at Nambeelup Brook over either the short- (2014–18) or long-term (2004–18).

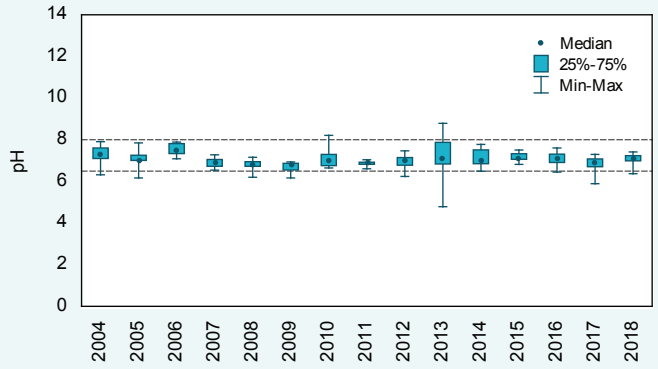
pH (2018)

pH values

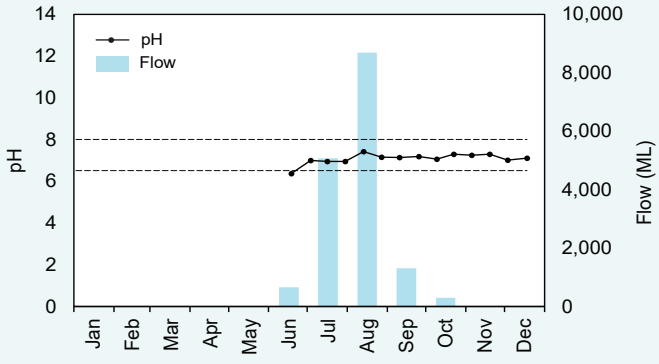
In 2018, all but one sample fell within the upper and lower ANZECC trigger values. There was no clear evidence of a seasonal pattern in pH values.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



pH levels, 2004–18 at site 614063. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 614063. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Nambeelup Brook at the sampling site during high flows, August 2018.

Nambeelup Brook

Salinity over time (2004–18)

Concentrations

Salinity at the Nambeelup Brook sampling site was low. While salinity fluctuated over the reporting period, all annual medians were classified as low using the SWRWQA bands and only a few samples fell in the marginal band.

Trends

There was no trend in salinity at Nambeelup Brook over either the short- (2014–18) or long-term (2004–18).

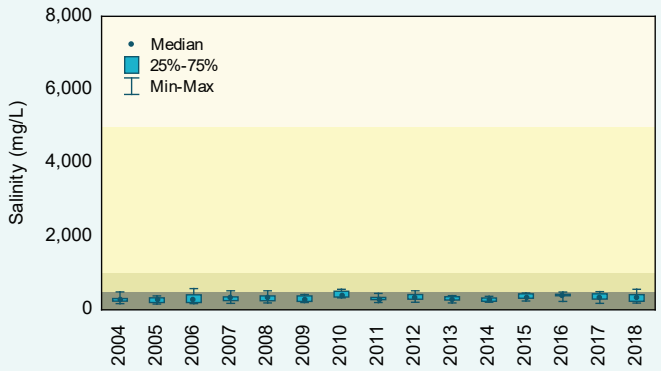
Salinity (2018)

Concentrations

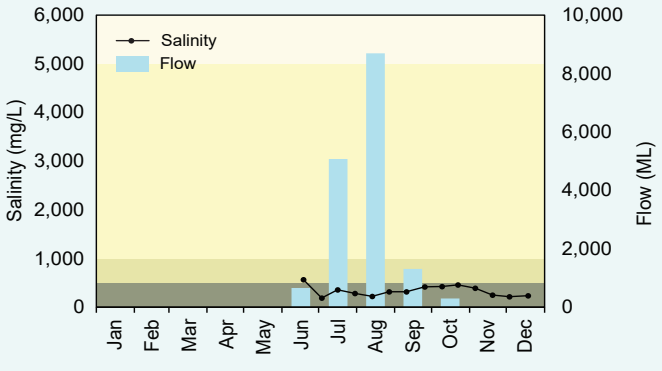
Salinity did not show a seasonal pattern in 2018 at the Nambeelup Brook sampling site, with concentrations fluctuating during the year. Except for the first sample collected in mid-June which fell in the marginal band, all samples were classified as low using the SWRWQA bands. It is likely most of the salt is entering the brook via surface flow, with groundwater contributing proportionally less.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



Salinity concentrations, 2004–18 at site 614063. The shading refers to the SWRWQA classification bands..



2018 salinity concentrations and monthly flow at 614063. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

Bushland in the Nambeelup Brook catchment, July 2003.

Naubeelup Brook

Background

The Regional Estuaries Initiative is a State Government program to improve the health of waterways and estuaries in the south-west of Western Australia. Healthy Estuaries WA is a Royalties for Regions program launched in 2020 and will build on the work of the Regional Estuaries Initiative. Collecting and reporting water quality data, such as in this report, helps build understanding of the whole system. By understanding the whole system, we can direct investment towards the most effective actions in the catchments to protect and restore the health of our waterways.

You can find the latest data on the condition of Peel-Harvey estuary at estuaries.dwer.wa.gov.au/estuary/peel-harvey-estuary/

The Regional Estuaries Initiative partners with the Peel-Harvey Catchment Council to fund best-practice fertilisers, dairy effluent and watercourse management on farms.

- To find out how you can be involved visit estuaries.dwer.wa.gov.au/participate
- To find out more about the Peel-Harvey Catchment Council go to peel-harvey.org.au
- To find out more about the health of the rivers in the Peel-Harvey Catchment go to rivers.dwer.wa.gov.au/assessments/results

Methods

Total phosphorus concentrations were compared with the Peel-Harvey WQIP target. This target represents the median winter concentration that is required for each of the subcatchments to meet their load reduction target. Where possible, other parameters were compared with the ANZECC trigger values for lowland rivers in south-west Australia. These values provide a value above which there may be a risk of adverse effect. For pH there is both an upper and lower trigger value which represent the acceptable pH range. Where there were no ANZECC trigger values available (for DOC, TSS and salinity) the SWRWQA classification bands were used to allow samples and sites to be classified and compared.

Trend testing was carried out using either the Mann or Seasonal Kendall tests as appropriate. Where there were flow data available and there was a flow-concentration relationship, the data were flow-adjusted before trend analysis.

Annual loads were calculated by multiplying daily flow with daily nutrient concentrations and aggregating over the year. Measured daily concentrations were not available as samples were collected fortnightly at best, so daily concentration data were calculated using the locally estimated scatterplot smoothing algorithm (LOESS).

Glossary

Bioavailable: bioavailable nutrients refers to those nutrients which plants and algae can take up from the water and use straight away for growth.

Concentration: the amount of a substance present in the water.

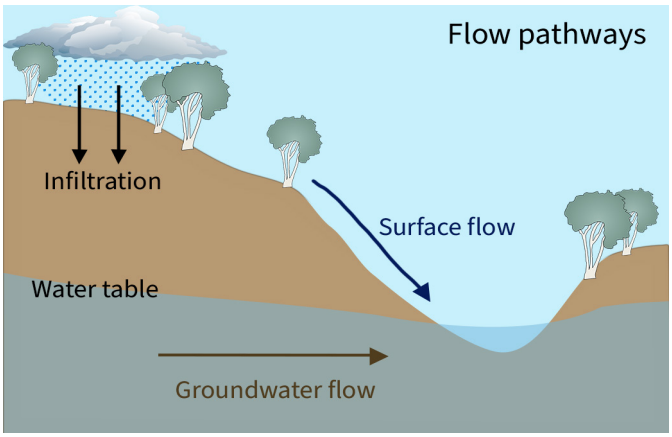
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

Laboratory limit of reporting: this is the lowest concentration (or amount) of an analyte that can be reported by a laboratory.

Load: the total mass of a substance passing a certain point.

Load per unit area: the load at the sampling site divided by the entire catchment area upstream of the sampling site.

The schematic below shows the main flow pathways which may contribute nutrients, particulates and salts to the waterways. Connection between surface water and groundwater depends on the location in the catchment, geology and the time of year.



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