# Willyung Creek

This data report provides a summary of the nutrients at the Willyung Creek 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 creek flows into the King River which then discharges to Oyster Harbour. 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

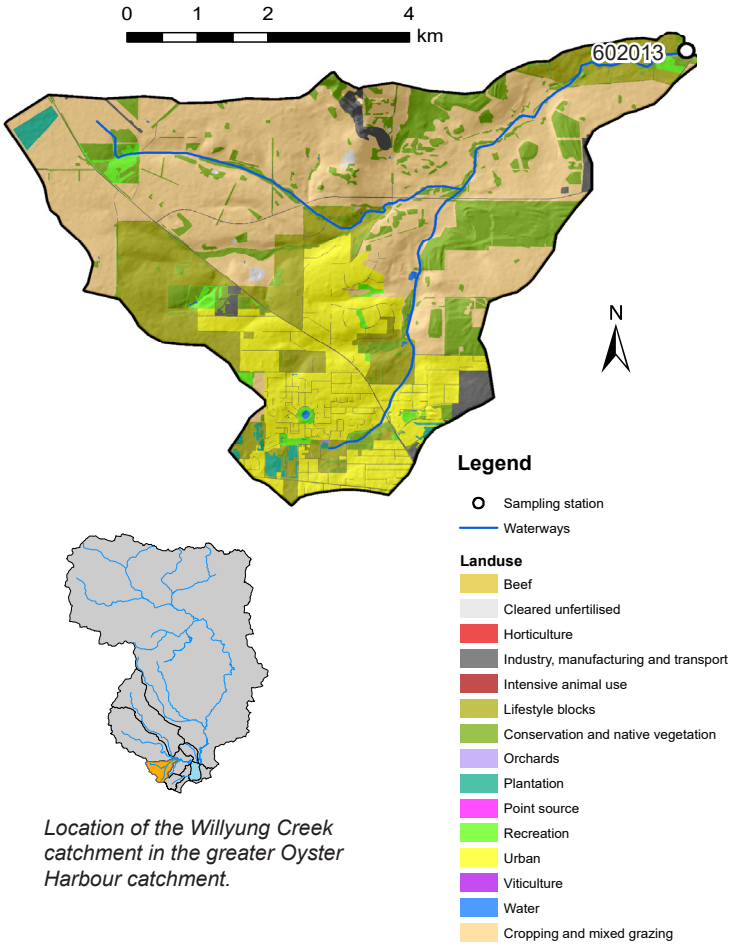
Willyung Creek has a catchment area of about 35 km² which has been almost entirely cleared. The dominant land use is cropping and mixed grazing which covers nearly half of the catchment. The western edge of the suburbs of Albany fall in the southern portion of the catchment along with a large number of lifestyle blocks. In the agricultural areas, waterways mostly retain their natural form whereas they have been converted to drains in the urban areas. Fringing vegetation is missing or poor in most of the catchment.

Most of the catchment has soils with a high phosphorus-binding capacity, though there are areas of soils near the creek with a low phosphorus-binding capacity. In these areas, any phosphorus applied to the soils can be quickly washed into drains and other waterways.

Water quality is measured at site 602013, Willyung, just upstream of where the creek flows into the King River in Willyung.

## Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Willyung Creek sampling site were moderate (total nitrogen) to high (total phosphorus). The proportion of nitrogen present in a form that is readily used by plants and algae was large. The combination of agricultural and urban land use in the catchment coupled with the modification to the waterways and poor quality frigning vegetation will all be contributing to the nutrient concentrations observed.




*Location of the Willyung Creek catchment in the greater Oyster Harbour catchment.*

## Facts and figures

| | |
|---|---|
| Sampling site code | 602013 |
| Catchment area | 35 km² |
| Per cent cleared area (2018) | 97% |
| River flow | Permanent |
| Main land use (2018) | Cropping and mixed grazing |

# Willyung Creek

## Nitrogen over time (2004–18)

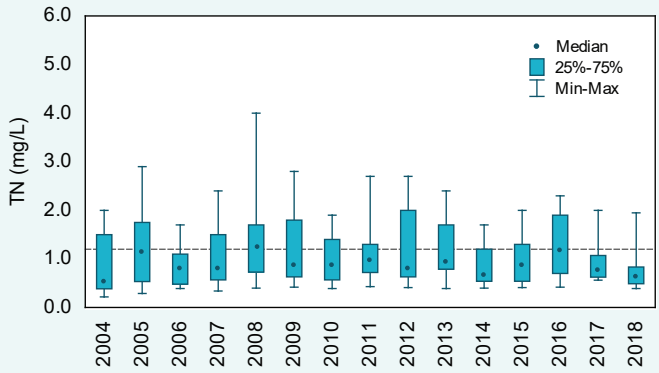
### Concentrations

Total nitrogen (TN) concentrations at the Willyung Creek sampling site were moderate compared with the other five Oyster Harbour catchment sites and fluctuated over the reporting period. With the exception of 2008, all annual medians were below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value; however, each year had some samples which were above the trigger value.

### Trends

There was a short-term (2014–18) decreasing trend in TN concentrations at the Willyung Creek sampling site of 0.05 mg/L/yr). Ongoing monitoring will help determine if this is because of natural fluctuations at the site or an actual improvement in water quality. There was no long-term (2004–18) trend present.

## Willyung Creek




*Total nitrogen concentrations, 2004–18 at site 602013. The dashed line is the ANZECC trigger value for lowland rivers.*

*The Willyung Creek sampling site, February 2019.*

# Willyung Creek

## Nitrogen (2018)

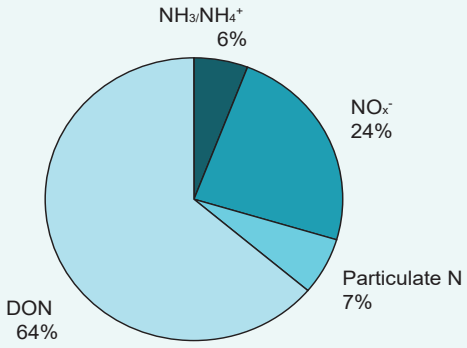
### Types of nitrogen

Total N is made up of different forms of N. Nearly a third of N was present as dissolved inorganic N (ammonia N – $NH_3/NH_4^+$ and total oxides of nitrogen – $NO_x^-$), the second largest proportion of the six Oyster Harbour catchment sites. This form of N is readily bioavailable to plants and algae and is likely sourced from fertilisers and animal wastes. Dissolved organic N (DON) was the dominant form of N and consists mainly of degrading plant and animal matter but may also include other forms. The bioavailability of DON varies depending on its form, some are highly bioavailable whereas others, like degrading plant and animal matter, often need to be further broken down.

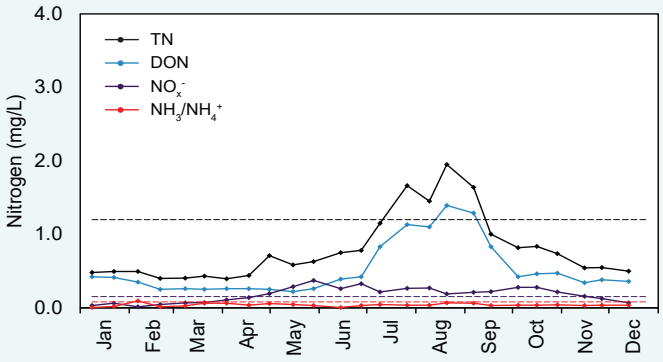
### Concentrations

Total N and DON concentrations showed a seasonal pattern in 2018 at Willyung Creek, increasing in July as rainfall and flow increased, peaking in August and then falling again. $NO_x^-$ also showed a seasonal response; however, it peaked in late May. This suggests a first-flush effect, where $NO_x^-$ was washed from farmland where fertilisers and animal wastes had built up over the summer period as well as mineralisation of organic N in soils and drains over the same time period. It is likely that much of the N was entering the creek via surface runoff, with groundwater contributing proportionally less. N was also coming from in-stream sources.

## Willyung Creek




*2018 average nitrogen fractions at site 602013.*




*2018 nitrogen concentrations at 602013. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.*

*Willyung Creek near the sampling site. The fringing vegetation here is made up almost entirely of exotic species, November 2017.*

## Phosphorus over time (2004–18)

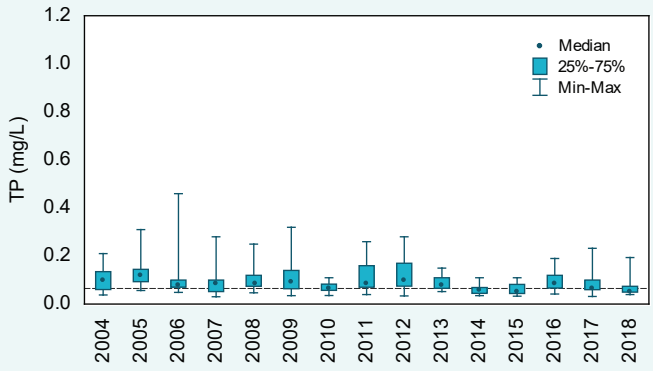
### Concentrations

Total phosphorus (TP) concentrations fluctuated over the reporting period at the Willyung Creek sampling site. Compared with the other five sites sampled in the Oyster Harbour catchment, TP concentrations were high and all but three of the annual medians were over the ANZECC trigger value.

### Trends

There was neither a short- (2014–18) or long-term (2004–18) trend present in TP concentrations at the Willyung Creek sampling site.

## Willyung Creek




*Total phosphorus concentrations, 2004–18 at site 602013. The dashed line is the ANZECC trigger value for lowland rivers.*

*A riffle in Willyung Creek. Rock riffles like this can increase oxygen levels in the water, October 2006.*

## Phosphorus (2018)

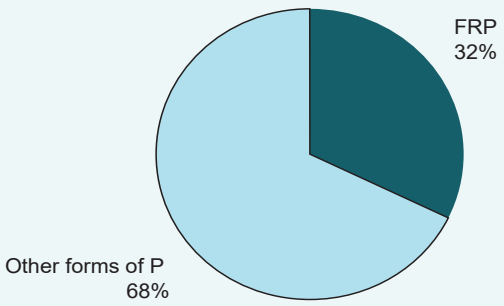
### Types of phosphorus

Total P is made up of different forms of P. At the Willyung Creek sampling site, about two-thirds of the P was present as either particulate P or dissolved organic P (DOP) or both (shown as 'Other forms of P' in the chart below). Particulate P generally needs to be broken down before becoming bioavailable to algae. The bioavailability of DOP varies and is poorly understood. The remainder of the P was present as filterable reactive phosphorus (FRP) which is readily bioavailable, meaning that plants and algae can use it to fuel rapid growth. The FRP was probably derived from animal waste and fertilisers as well as natural sources.

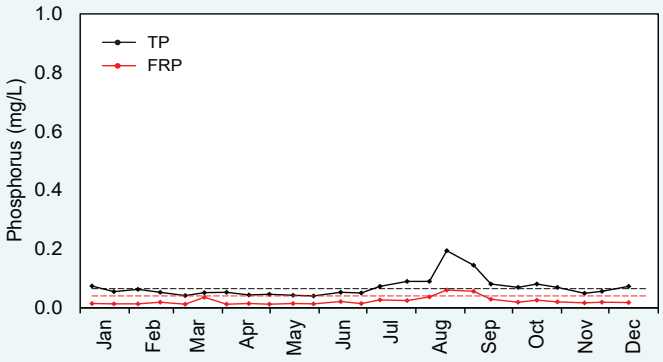
### Concentrations

Total P and FRP showed a seasonal pattern in 2018 at the Willyung Creek sampling site. Concentrations peaked in August when flow would have been at its highest. It is likely that most of the P at this site was entering the brook via surface flows from surrounding land use, with groundwater contributing proportionally less. In-stream sources were also contributing P.

## Willyung Creek




*2018 average phosphorus fractions at site 602013.*




*2018 phosphorus concentrations at 602013. The dashed lines are the ANZECC trigger values for the different P species in lowland rivers.*

*Wilyung Creek in a rural residential area. The fringing vegetation consists mainly of exotic grasses and remnant trees, September 2006.*

## Total suspended solids over time (2004–18)

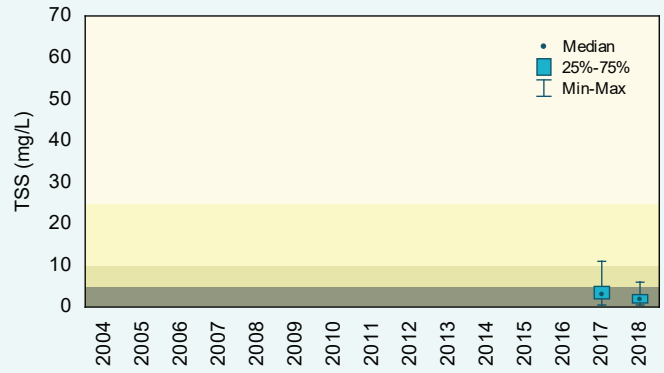
### Concentrations

There were only two years with sufficient total suspended solids (TSS) data to graph at the Willyung Creek sampling site. Both annual medians fell into the low band of the Statewide River Water Quality Assessment (SWRWQA) classification bands.

### Trends

As there were only two years of data, it was not possible to calculate trends in TSS concentrations at the Willyung Creek sampling site. A minimum of five consecutive years of data are required to test for trends.

## Willyung Creek




*Total suspended solids concentrations, 2004–18 at site 602013. The shading refers to the SWRWQA classification bands.*

very high high moderate low

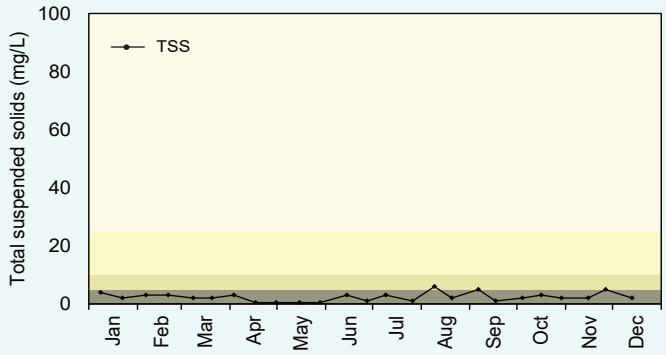
*Willyung Creek upstream of the sampling site. The fringing vegetation along the far bank is in good condition at this location, September 2006.*

## Total suspended solids (2018)

### Concentrations

In 2018 TSS concentrations fluctuated throughout the year without evidence of a clear seasonal pattern. Almost all the samples collected fell into the low band of the SWRWQA bands. It is likely that particulate matter at this site was being washed into the creek via surface flows as well as coming from in-stream sources such as erosion.

## Willyung Creek




*2018 total suspended solids concentrations at 602013. The shading refers to the SWRWQA classification bands.*

very high high moderate low

*One of the staff gauges, used to measure water height, at Willyung Creek, October 2006.*

# Willyung Creek

## pH over time (2004–18)

### pH values

pH at the Willyung Creek sampling site fluctuated over the reporting period. All annual medians fell within the upper and lower ANZECC trigger values.

There is some concern that the probe used to collect the pH data from the catchments of Oyster Harbour (including the Willyung Creek site) from about October 2016 to October 2017 was not functioning correctly. This may have caused lower-than-actual pH values to be recorded. From October 2017, a new probe was used. Although there is no way of verifying the 2016 and 2017 pH data, they have still been presented here.

### Trends

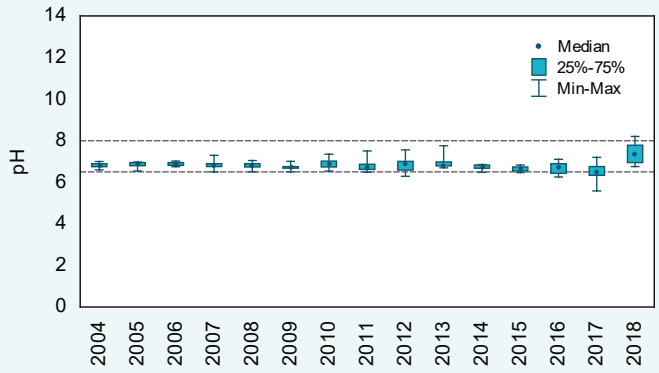
There was no trend in pH at the Willyung Creek sampling site over either the short- (2014–18) or long-term (2004–18).

## pH (2018)

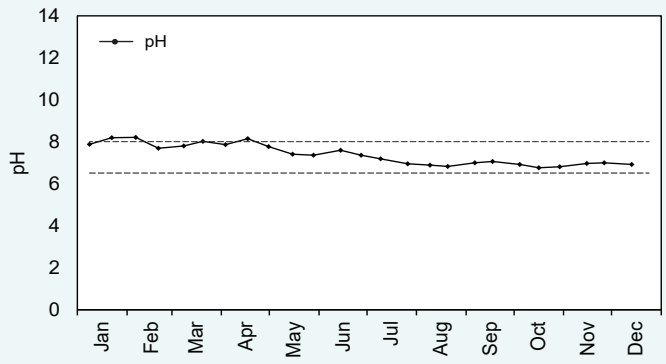
### pH values

In 2018, pH values were highest at the start of the year and then fell during the year. In the first part of the year there were a number of samples over the upper ANZECC trigger value but, after mid-April, all samples fell within the upper and lower ANZECC trigger values.

## Willyung Creek




*pH levels, 2004–18 at site 602013. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.*




*2018 pH levels at 602013. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.*

*Willyung Creek, near the sampling site at Dymesbury Lodge, October 2006.*

# Willyung Creek

## Salinity over time (2004–18)

### Concentrations

The Willyung Creek sampling site was fresh, with all samples collected falling into the fresh band of the SWRWQA classification bands.

### Trends

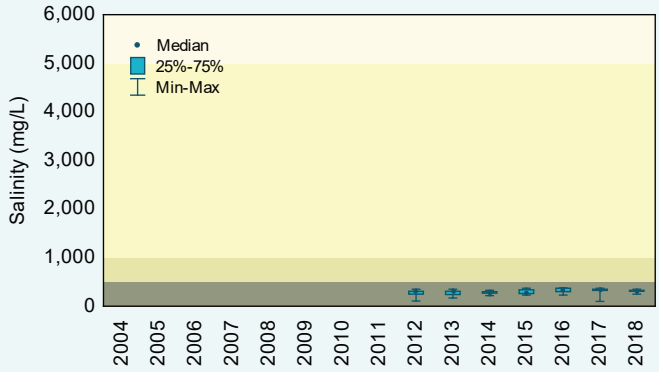
There was no short-term (2014–18) trend present in salinity concentrations at the Willyung Creek sampling site.

## Salinity (2018)

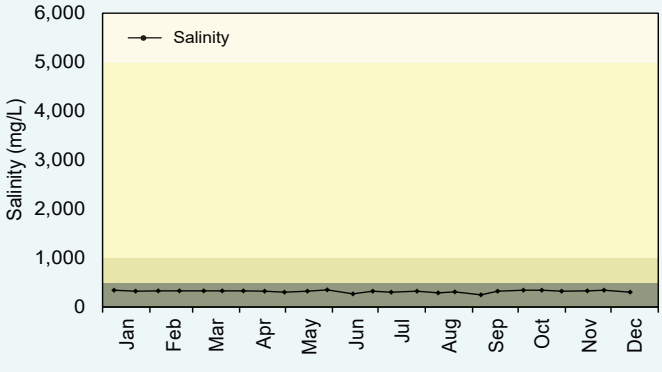
### Concentrations

In 2018, salinity fluctuated slightly at the Willyung Creek sampling site, with no evidence of a seasonal trend. It is likely that salt at this site was coming from both surface water runoff and groundwater.

## Willyung Creek




*Salinity concentrations, 2004–18 at site 602013 The shading refers to the SWRWQA classification bands.*




*2018 salinity concentrations at site 602013. The shading refers to the SWRWQA classification bands.*

saline brackish marginal fresh

*Willyung Creek at the sampling site at Dymesbury Lodge, December 2020.*

# Willyung Creek

## 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 Oyster Harbour at estuaries.dwer.wa.gov.au/estuary/oyster-harbour/

The Regional Estuaries Initiative partners with the Oyster Harbour Catchment Group to fund best-practice fertiliser, 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 Oyster Harbour Catchment Group go to ohcg.org.au
- To find out more about the health of the rivers in the Oyster Harbour catchment go to rivers.dwer.wa.gov.au/assessments/results

## Methods

Where possible, 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 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.

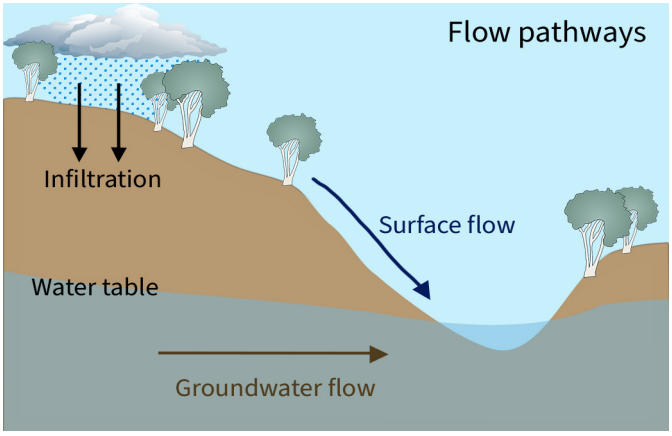
**Evapoconcentration**: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

**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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