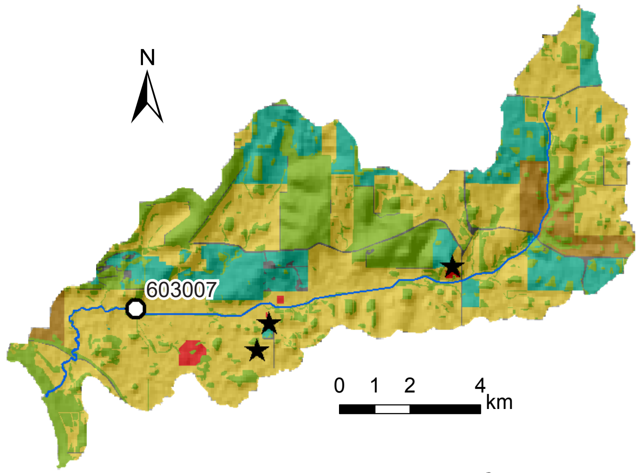
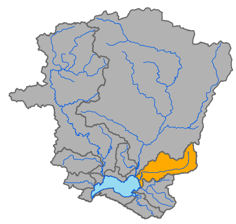
Sleeman River

This data report provides a summary of the nutrients at the Sleeman River 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 this site, the river discharges to Wilson 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 the water and harm fish and other species. Total suspended solids, pH and salinity data are also presented as these help us better understand the processes occurring in the catchment.





Location of Sleeman River catchment in the greater Wilson Inlet catchment.

About the catchment

The Sleeman River has a catchment area of about 92 km^2, almost three-quarters of which has been cleared for agriculture and plantations. The dominant land use is beef cattle grazing, which covers just over half the catchment. Other land uses in the catchment include dairy farms and potato growing areas. While the Sleeman River is a natural system, portions of it have been modified into drains to remove water from the surrounding agricultural areas. The combination of clearing native vegetation and straightening the river has increased the speed at which the water moves through the landscape, reducing the opportunity for nutrient processing.

The Sleeman River flows year-round and discharges into the eastern side of Wilson Inlet in Youngs Siding, between the discharge points of the Hay River and Cuppup Creek.

Water quality is measured at site 603007, where the river crosses Sleeman Road in Youngs Siding.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) in the Sleeman River were moderate (nitrogen) to high (phosphorus). The nutrient loads were large, as were the loads per square kilometre. The large loads were because of the high nutrient concentrations, caused by the intensive land use in the catchment, widescale clearing of native vegetation, the lack of fringing vegetation along much of the river, and the straightening of large sections of the river into drains.

Facts and figures

Sampling site code	603007
Rainfall at Denmark (2018)	776 mm
Catchment area	92 km^2
Per cent cleared area (2014)	74%
River flow	Flows year-round
Annual flow (2018)	6.4 GL
Main land use (2014)	Beef cattle grazing, native vegetation and plantation

Nitrogen over time (2004–18)

Concentrations

While the median total nitrogen (TN) concentrations were relatively low in the Sleeman River (most of the medians over the past 15 years were below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value), the annual range in concentrations was large, with a number of samples over the ANZECC trigger value each year. TN fluctuated over the reporting period.

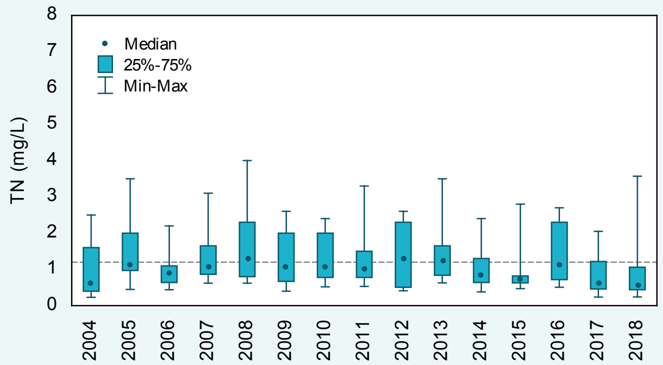
Trends

There was a short-term decreasing trend in TN concentrations of 0.09 mg/L/yr (2014–18). This may be part of the natural fluctuations at this site or because of an actual decrease in TN concentrations. Ongoing monitoring will help determine if water quality is improving at this site. There was no long-term (2004–18) trend.

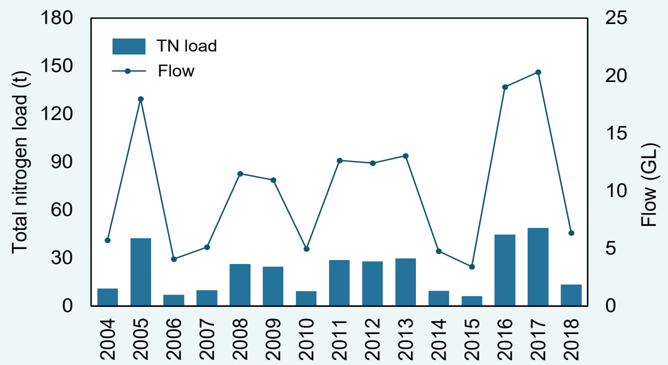
Estimated loads

Estimated TN loads at the Sleeman River sampling site were large compared with the other sites in the Wilson Inlet catchment. In 2018, the river had a load of 13 t, the third largest TN load of the six monitored catchments of the Wilson Inlet. It also had the third largest load per unit area of 146 kg/km^2. The combination of intensive land use, widescale clearing of native vegetation and the straightening of large sections of the river all contributed to the large loads and loads per unit area from the Sleeman River. Annual TN loads were closely related to flow volumes; years with high annual flow had large TN loads and vice versa.

Sleeman River



Total nitrogen concentrations, 2004–18 at site 603007. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 603007.

Sand deposit in the centre of the channel at the Sleeman River sampling site, November 2018.

Sleeman River

Nitrogen (2018)

Types of nitrogen

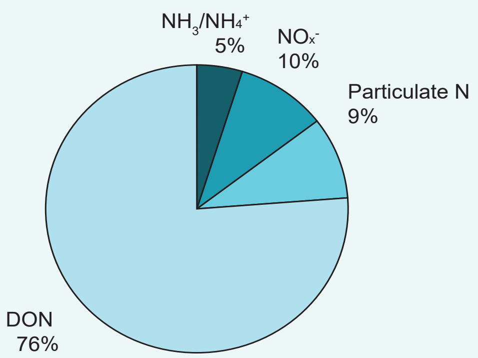
Total N is made up of many different types of N. In the Sleeman River, most of the N was present as dissolved organic N (DON) which consists mainly of degrading plant and animal matter but may include other, bioavailable, forms. Particulate N is composed of plant and animal matter. Most forms of particulate N and DON need to be further broken down to become available to plants and algae, though some DON forms are readily bioavailable. Only a small proportion of N was present as dissolved inorganic N (ammonia N – NH_3/NH_4^+ and oxides of nitrogen – NO_x^-), which is bioavailable to plants and algae and, like some forms of DON, can be used to fuel rapid growth.

Concentrations

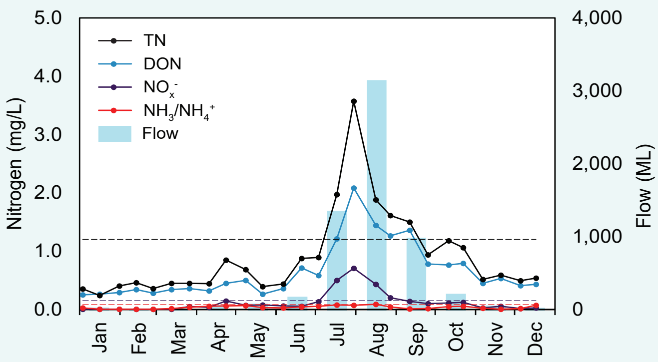
Nitrogen concentrations varied throughout the year, with evidence of a seasonal pattern in all forms of N which increased as rainfall and flow increased before decreasing again near the end of the year as rainfall and flow eased. This suggests N was entering the river via a number of pathways such as groundwater, surface flows and in-stream sources. It is likely the main sources changed during the year, with groundwater being more important in the drier months and surface flows being more important when the catchment was wet.

Because lengthy sections of the river have been straightened and there is a lack of fringing vegetation, any N entering the river is rapidly transported downstream. This reduces the opportunity of it being assimilated within the river compared with a more natural system.

Sleeman River



2018 average nitrogen fractions at site 603007.



2018 nitrogen concentrations and monthly flow at 603007. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

Removing the sand deposit in the weir pool at the Sleeman River sampling site, February 2019. This was done to improve the gauging station's ability to measure flow.

Sleeman River

Phosphorus over time (2004–18)

Concentrations

Over the past 15 years, total phosphorus (TP) concentrations fluctuated slightly. A large proportion of the samples were above the ANZECC trigger value each year; in fact, the Sleeman River had some of the highest TP concentrations of the sites sampled in the Wilson Inlet catchment. The 2018 median TP concentration in the Sleeman River (0.066 mg/L) was the third highest of the nine sites monitored. However, the median was still substantially lower than the two sites with higher medians, Sunny Glen Creek (0.268 mg/L) and Cuppup Creek (0.34 mg/L).

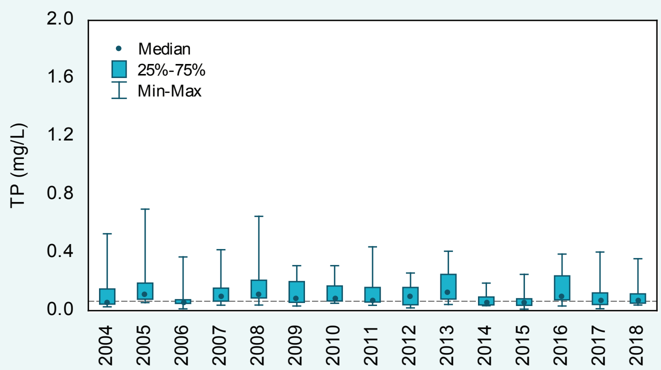
Trends

There were no short- (2014–18) or long-term (2004–18) trends present in the TP data.

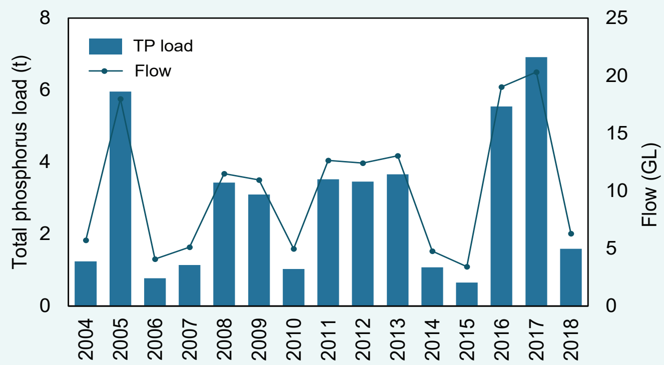
Estimated loads

Estimated TP loads at the Sleeman River sampling site were large. In 2018, the river had a TP load of 1.6 t, the equal largest P load of the six monitored catchments of the Wilson Inlet, along with Cuppup Creek. It had the second largest load per unit area, 17.3 kg/km^2 in 2018. Cuppup Creek, which had the largest load per unit area, had a load of 22.9 kg/km^2 in 2018. The combination of intensive land use, widescale clearing of native vegetation and the straightening of large sections of the river all contributed to the large loads and loads per unit area from the Sleeman River. Annual TP loads were closely related to flow volumes; years with high annual flow had large TP loads and vice versa.

Sleeman River



Total phosphorus concentrations, 2004–18 at site 603007. The dashed line is the ANZECC trigger value for lowland rivers.



Total phosphorus loads and annual flow, 2004–18 at site 603007.

The gauging station at the Sleeman River sampling site during very high flows, August 2017.

Sleeman River

Phosphorus (2018)

Types of phosphorus

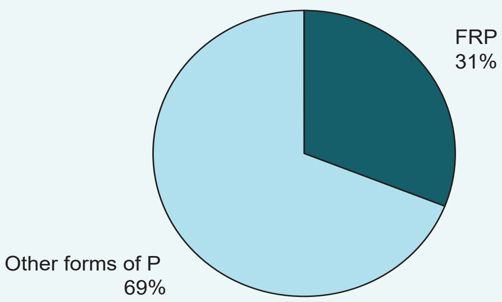
Total P is made up of different types of P. In the Sleeman River, about a third of the P was present as filterable reactive phosphorus (FRP), which is readily bioavailable, meaning plants and algae can use it to fuel rapid growth. FRP was probably derived from animal waste and fertilisers as well as 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

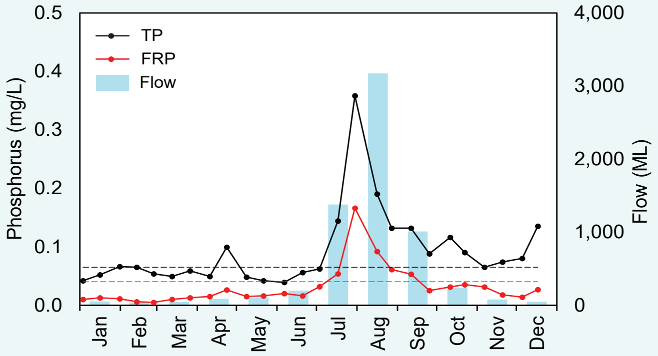
Both TP and FRP concentrations varied seasonally in the Sleeman River, with the highest concentrations recorded during the wettest months. P concentrations increased after the onset of winter rains. As the river levels fell again, P concentrations reduced. The reason for the peak in TP in December is unclear. The peak in April is likely related to heavy rainfall the previous day washing particulate P into the river and increasing in-stream erosion. P was likely entering the river via a number of pathways, with groundwater dominant in the drier months and surface flows, groundwater and in-stream sources all contributing during the wetter months.

Because lengthy sections of the river have been straightened and there is a lack of fringing vegetation, any P entering the river is rapidly transported downstream. This reduces the opportunity of it being assimilated within the river compared with a more natural system.

Sleeman River



2018 average phosphorus fractions at site 603007.



2018 phosphorus concentrations and monthly flow at 603007. The dashed lines are the ANZECC trigger values for lowland rivers for the different P species.

A flooded paddock in Sleeman River catchment, August 2017.

Sleeman River

Total suspended solids over time (2004–18)

Concentrations

Total suspended solids (TSS) concentrations were moderate in the Sleeman River compared with the other monitored sites. Using the Statewide River Water Quality Assessment (SWRWQA) bands, median TSS concentrations were moderate from 2003–07. In 2008–09 and 2017–18 they were low. Between 2010 and 2016, TSS was collected sporadically so the data have not been graphed.

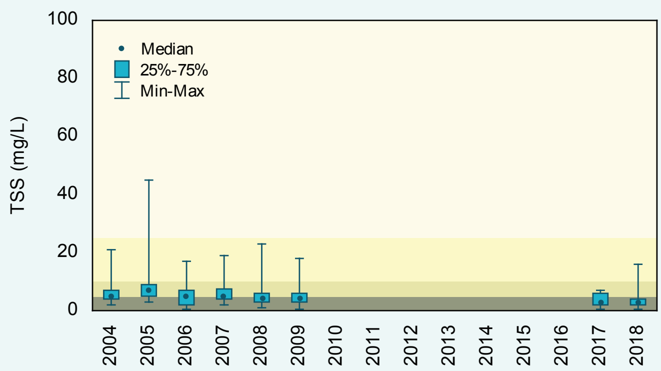
Trends

As TSS was sporadically collected between 2010 and 2016, it was not possible to perform trend tests on the data.

Estimated loads

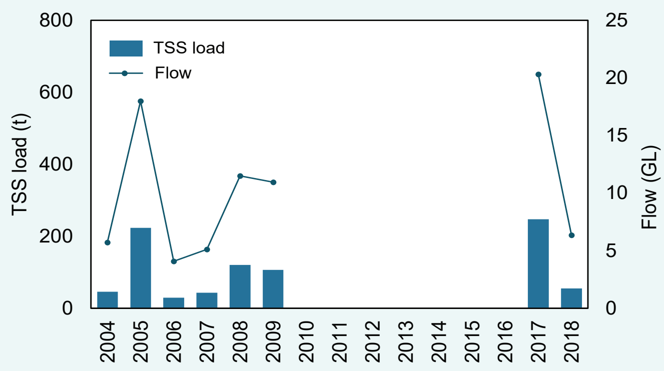
The estimated TSS loads at the Sleeman River sampling site were moderate compared with the other Wilson Inlet catchment sites. The Sleeman River had the third smallest TSS load of the monitored Wilson Inlet catchments in 2018 (55 t). It had a moderate load per unit area, 598 kg/km^2 in 2018. Annual TSS loads were closely related to flow volumes; years with high annual flow had large TSS loads and vice versa.

Sleeman River



Total suspended solids concentrations, 2004–18 at site 603007. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low



Total suspended solids loads and annual flow, 2004–18 at site 603007.

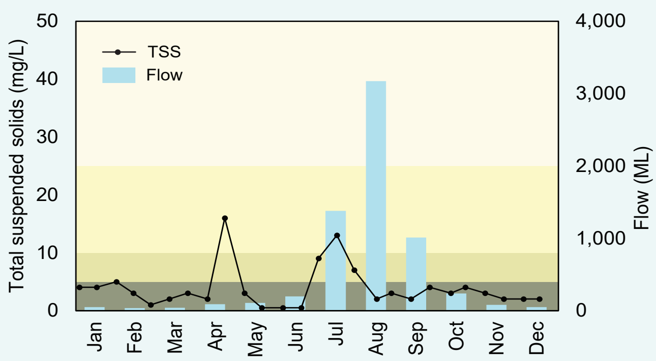
Examining bank undercutting along the Sleeman River, April 2018. This undercutting is caused by erosion which occurs because of a lack of fringing vegetation which helps stabilise banks.

Total suspended solids (2018)

Concentrations

In 2018, most of the samples fell in the low band. There was a seasonal relationship present, with TSS concentrations increasing in July, following the onset of winter rains, when particulate matter was being washed into the river from the surrounding catchment before reducing again. The peak in April was most likely because of heavy rainfall the day before sampling occurred, which washed particulate matter into the river as well as mobilising particulates through erosion. Stock accessing the river may have exacerbated erosion as they trample the bed and banks of the river.

Sleeman River



2018 total suspended solids concentrations and monthly flow at 603007. The shading refers to the SWRWQA classification bands.

very high   high   moderate   low

The weir at the Sleeman River sampling site during low flows, December 2017.

Sleeman River

pH over time (2004–18)

pH values

pH has fluctuated in the Sleeman River over the past 15 years. The river tends to be slightly acidic, with almost all years having some values below the lower ANZECC trigger value for lowland rivers. In 2018, all samples were within the ANZECC trigger values. The low values in 2016 and 2017 may have been because of an issue with the sampling probe (see comment under 'pH (2018)').

Trends

There was no short- (2014–18) or long-term (2004–18) trends present in pH.

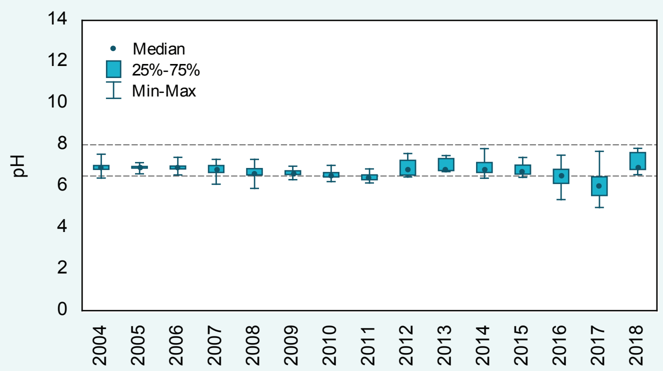
pH (2018)

pH values

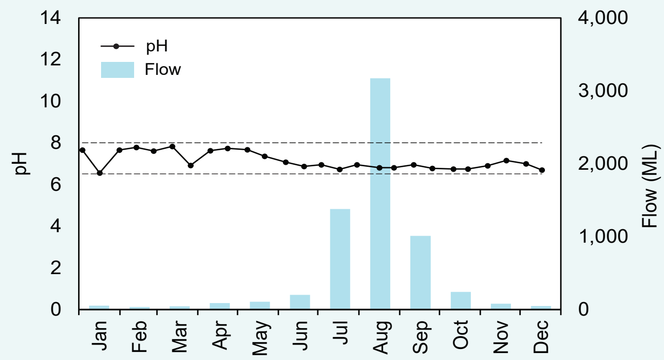
In 2018, pH values fluctuated more in the first half of the year before reducing around May and then remaining steady.

There is some concern that the probe used to collect the pH data from the catchments of Wilson Inlet (including the Sleeman River site) from about October 2016 to October 2017 was not functioning correctly. This may have caused the low pH values shown in the graphs below. After October, 2017 a new probe was used and the pH values increased and stabilised. Although there is no way of verifying the 2016–17 pH data, they have still been presented here.

Sleeman River



pH levels, 2004–18 at site 603007. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 603007. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Flooding in the Sleeman River catchment, August 2017.

Sleeman River

Salinity over time (2004–18)

Concentrations

Salinity in the Sleeman River was marginal, with the median salinity classified as marginal using the SWRWQA classification bands in all years. In 2018, salinity was moderate compared with the other Wilson Inlet catchment sites with a median of 670 mg/L. Only the Hay River (median of 4,140 mg/L) and the upper Hay River sites (median of 5,060 mg/L) had higher median salinity concentrations. Salinity was not measured from 2003–11.

Trends

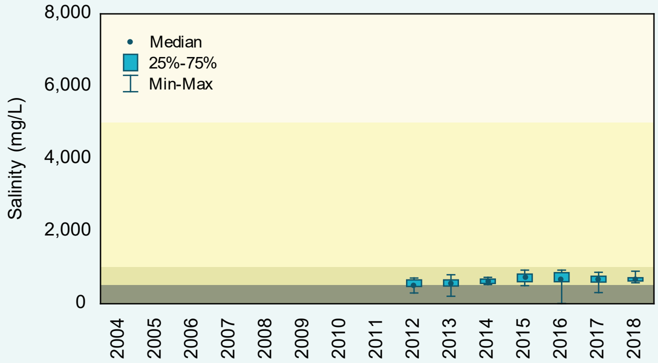
There was no short-term (2014–18) trend in salinity in the Sleeman River.

Salinity (2018)

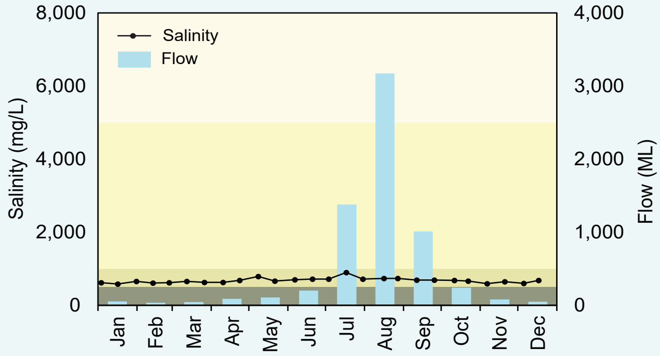
Concentrations

Salinity was constant over the year, with only very small fluctuations in concentrations. In 2018, all of the samples fell into the marginal band. It is likely salts are being transported to the river via groundwater and surface flows.

Sleeman River



Salinity concentrations, 2004–18 at site 603007. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations and monthly flow at 603007. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

The Sleeman River sampling site after the sedimentation was removed from the channel and the banks were stabilised using matting which was planted out with native species, October 2019.

Sleeman River

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 Wilson Inlet at estuaries.dwer.wa.gov.au/estuary/wilson-inlet/

The Regional Estuaries Initiative partners with the Wilson Inlet Catchment Committee 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 Wilson Inlet Catchment Committee go to wicc.org.au
- To find out more about the health of the rivers in the Wilson Inlet 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.

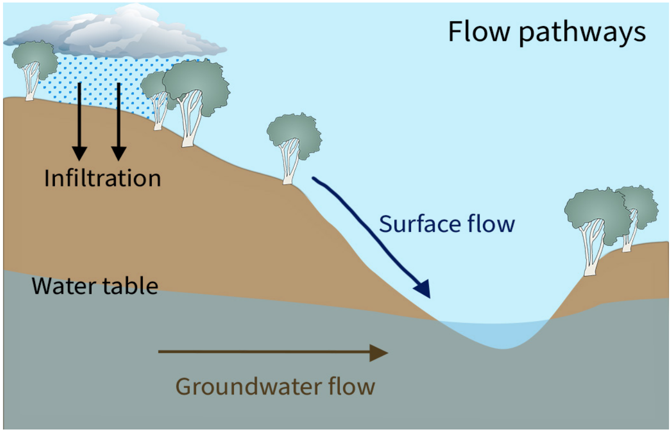
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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.



Sleeman River Issue 1
Publication date: May 2021
ISSN: 2209–6779 (online only)