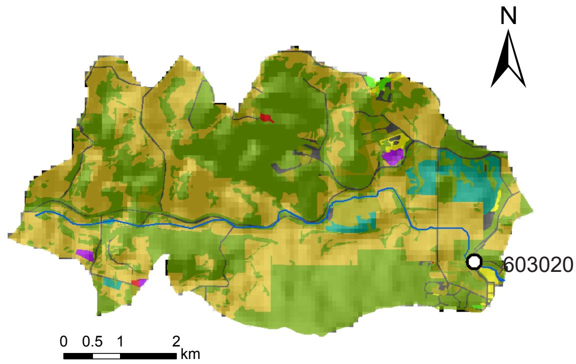
Little River

This data report provides a summary of the nutrients at the Little 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 enters the 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.



- ○ Sampling station
- Waterways

Landuse

- Beef / sheep
- Horticulture
- Industry, manufacturing & transport
- Lifestyle blocks and horses
- Native vegetation
- Recreation
- Timber plantation
- Urban
- Viticulture

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

About the catchment

Little River has a catchment area of about 32 km^2 which is largely cleared for agriculture. The dominant land uses in the catchment are beef cattle grazing (covering about 36 per cent of the catchment) and fragmented areas of native vegetation (which make up a little under half of the total catchment area). Also present are some lifestyle blocks near the lower end of the catchment. While there are no water-supply dams in the catchment, there are a few dams on Little River in the mid to upper catchment. The river flows into the western basin of Wilson Inlet in Ocean Beach.

Water quality is measured at site 603020, just upstream of Ocean Beach Road in Ocean Beach, about 1 km before the river discharges into Wilson Inlet.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) in Little River were low to moderate (nitrogen) and moderate to high (phosphorus). The nutrient loads were small (total nitrogen) to moderate (total phosphorus) compared with the other monitored catchments. However, because of the marginal nutrient concentrations and small catchment size, the loads per-unit area were moderate. Nutrient concentrations were influenced by the land use in the catchment.

Facts and figures

Sampling site code	603020
Rainfall at Denmark (2018)	776 mm
Catchment area	32 km^2
Per cent cleared area (2014)	51%
River flow	Flows year-round
Annual flow (2018)	5.5 GL
Main land use (2014)	Beef cattle grazing and native vegetation

Little River

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations fluctuated over the past 15 years in Little River. Most years had some samples over the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value; however, the annual median TN concentration has always been below the trigger value.

Compared with the other monitored sites in the Wilson Inlet catchment, TN concentrations were low.

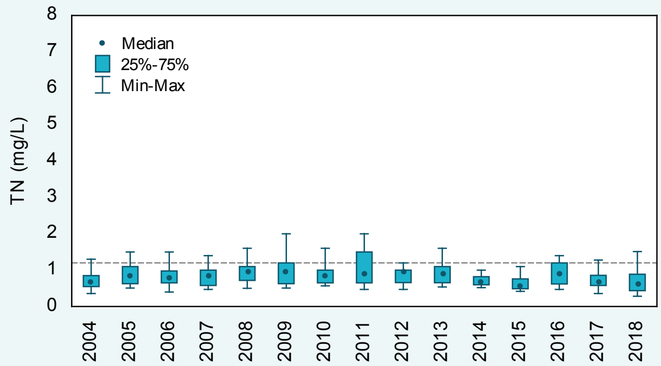
Trends

There were no trends in TN concentrations over either the short- (2014–18) or long-term (2004–18) in Little River.

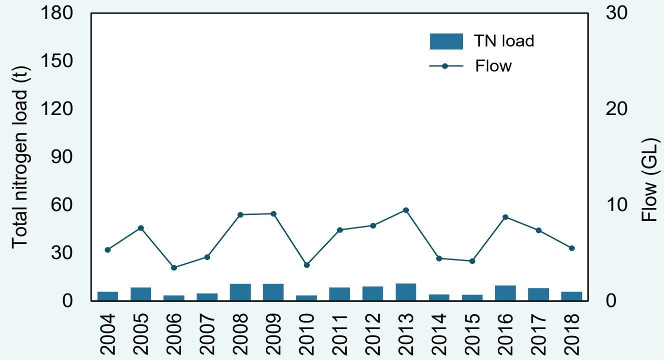
Estimated loads

Estimated TN loads at the Little River sampling site were relatively small. In 2018, the river had a TN load of 6 t; the second smallest load of the six monitored catchments of the Wilson Inlet (only Sunny Glen Creek had a smaller load of 2 t). However, it had the second largest TN load per unit area, 181 kg/km^2 in 2018 (Cuppup Creek had a load per unit area of 245 kg/km^2). Annual TN loads were closely related to flow volumes; years with high annual flow had large TN loads and vice versa.

Little River



Total nitrogen concentrations, 2004–18 at site 603020. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 603020.

Looking upstream from the sampling site during high flow, August 2017.

Nitrogen (2018)

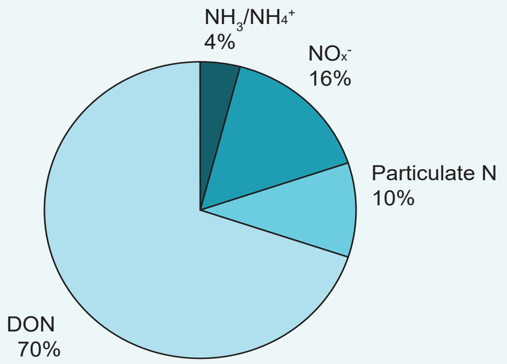
Types of nitrogen

Total N is made up of many different forms of N. In Little 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 detritus. 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. Of the monitored catchments, Little River had the largest portion of N present as oxides of nitrogen (NO_x^-). The portion of N present as ammonia N (NH_3/NH_4^+) was quite low. Together, NO_x^- and NH_3/NH_4^+ make up dissolved inorganic N which is bioavailable to plants and algae and, like some forms of DON, can be used to fuel rapid growth.

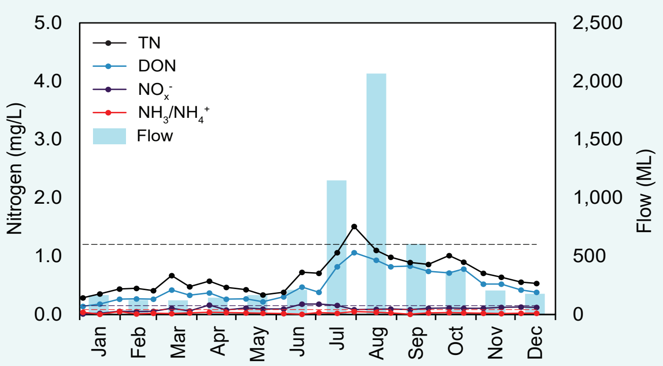
Concentrations

N concentrations varied throughout the year, with evidence of a seasonal pattern in TN and DON concentrations which were generally higher during winter when flow was greater. This suggests that most of the DON was entering the river via surface flows from surrounding land use at this time, with groundwater playing a greater role in the drier months when streamflow was less. In-stream sources contributed N year-round. Total oxidised nitrogen (NO_x^-—consisting of nitrite NO_2^- and nitrate NO_3^-) concentrations were fairly stable throughout the year, though there was a peak in NO_x^- concentrations in June/July, when flow volumes started to increase following the onset of winter rains.

Little River



2018 average nitrogen fractions at site 603020.



2018 nitrogen concentrations and monthly flow at 603020. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

Looking downstream from the sampling site during high flow, August 2017.

Phosphorus over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations fluctuated slightly over the past 15 years. The median TP concentration was above the ANZECC trigger value in more than half of the past 15 years and, with the exception of 2015, all years had some samples over the trigger value. The 2018 median TP concentration was moderate when compared with the other sites monitored in the Wilson Inlet catchment.

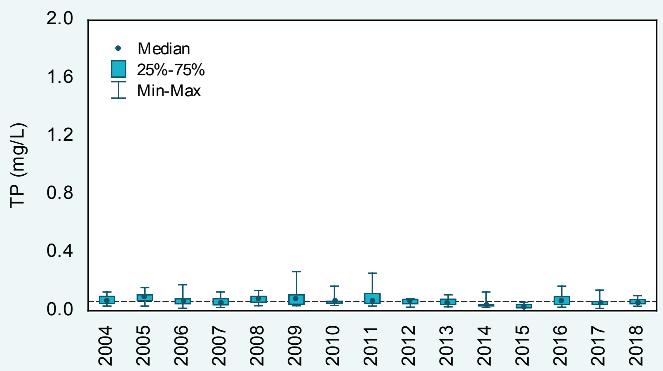
Trends

There was a small, increasing short-term (2014–18) trend in TP concentrations of 0.006 mg/L/year. This may be part of the natural fluctuations at this site or because of an increase in TP concentrations. Ongoing monitoring will help determine if water quality at this site is getting worse.

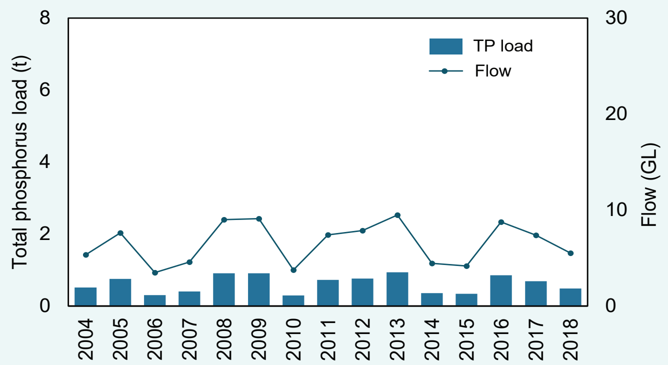
Estimated loads

Estimated TP loads at the Little River sampling site were moderate compared with the other Wilson Inlet catchments. Little River had a TP load of 0.49 t, the third largest TP load in 2018 (Cuppup Creek and the Sleeman River both had loads of 1.6 t). It had the third largest load per unit area in 2018 of 15 kg/km^2 (after Cuppup Creek with 22.9 kg/km^2 and the Sleeman River with 17 kg/km^2). Annual TP loads were closely related to flow volumes; years with high annual flow had large TP loads and vice versa.

Little River



Total phosphorus concentrations, 2004–18 at site 603020. The dashed line is the ANZECC trigger value for lowland rivers.



Total phosphorus loads and annual flow, 2004–18 at site 603020.

An old wooden bridge over the Little River in a Karri-dominated forest, July 2019.

Phosphorus (2018)

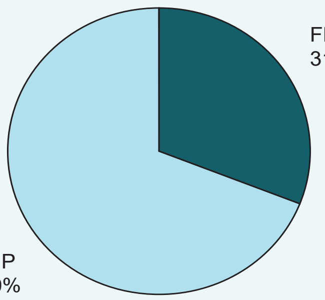
Types of phosphorus

Total P is made up of different types of P. In Little 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 likely 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.

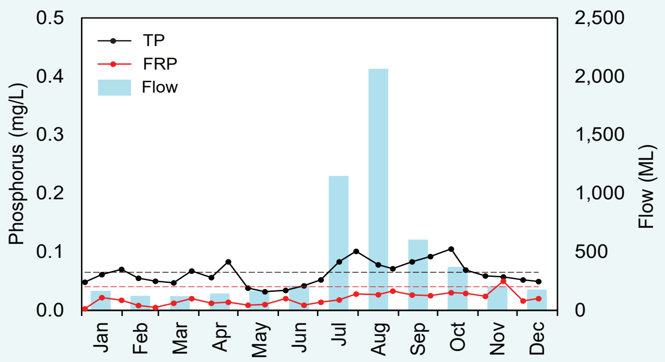
Concentrations

Both TP and FRP concentrations had a slight seasonal pattern in Little River, with the highest concentrations recorded in winter when rainfall and flow were greatest. There was also a peak in FRP concentrations in November. It is likely that most of the P is entering Little River through surface flows during the wetter months, with groundwater playing a more significant role during summer and spring. P was also coming from in-stream sources such as erosion year-round.

Little River



2018 average phosphorus fractions at site 603020.



2018 phosphorus concentrations and monthly flow at 603020. The dashed lines are the ANZECC trigger values for lowland rivers for the different P species.

The culverts under the bridge at the Little River sampling site, June 2017.

Little River

Total suspended solids over time (2004–18)

Concentrations

Total suspended solids (TSS) concentrations were high in Little River compared with the other Wilson Inlet catchment sites. Using the Statewide River Water Quality Assessment (SWRWQA) bands, the median TSS concentrations were classified as moderate for all years with the exception of 2005 (median was high) and 2007 (median was low). The 2018 median was the equal highest of all sites sampled (7 mg/L, the same as Cuppup Creek). Between 2010 and 2016, TSS was only collected sporadically so the data were not graphed.

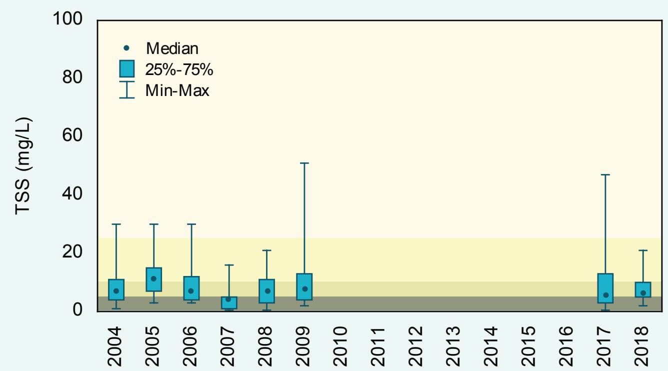
Trends

As TSS was only sporadically collected between 2010 and 2017, it was not possible to perform trend tests on the TSS data from Little River.

Estimated loads

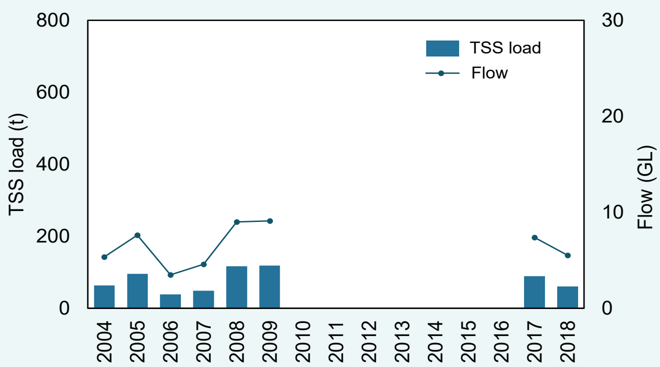
Estimated TSS loads at the sampling site on Little River were moderate compared with the other sites sampled in the Wilson Inlet catchment. In 2018, the catchment had the third largest TSS load of the six monitored catchments of the Wilson Inlet (61 t). The river had the second largest TSS load per unit area of 1,906 kg/km² (behind Cuppup Creek with 1,913 kg/km²), which was high when compared with the six other Wilson Inlet catchment sites. Annual TSS loads were closely related to flow volumes; years with high annual flow had large TSS loads and vice versa.

Little River



Total suspended solids concentrations, 2004–18 at site 603020. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low



Total suspended solids loads and annual flow, 2004–18 at site 603020.

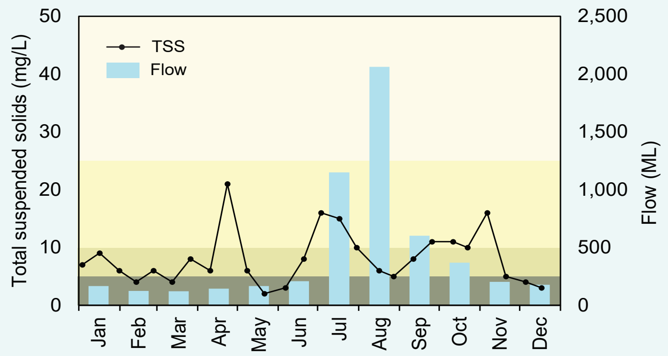
The Little River catchment. Cattle grazing is one of the dominant land uses in the catchment.

Total suspended solids (2018)

Concentrations

TSS did not show a clear seasonal pattern in Little River. The peak in April coincided with heavy rainfall the previous day which washed particulates into the river as well as mobilising particulates already present in the river. The increase in June—July was likely because of a first-flush effect where rainfall washed particulate matter from the surrounding catchment into the river. It is unclear why there was a peak in November. It is likely TSS was entering the river through surface runoff from surrounding land as well as from in-stream erosion throughout the year. While most of the river has been fenced to prevent stock access, the fringing vegetation is quite sparse along some sections which will allow particulates to runoff from surrounding cleared farmland into the river.

Little River



2018 total suspended solids concentrations and monthly flow at 603020. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

Little River at the sampling site. Note the dense fringing vegetation, August 2017.

pH over time (2004–18)

pH values

In the early part of the reporting period, all samples fell between the upper and lower ANZECC trigger values. Since 2008, most years had samples which were below the lower ANZECC trigger value. The pH values from 2016 and 2017 may have been recorded as lower than the actual in-stream pH (see comment under 'pH (2018)').

Trends

There were no trends present over either the short- (2014–18) or long-term (2004–18) in pH in Little River.

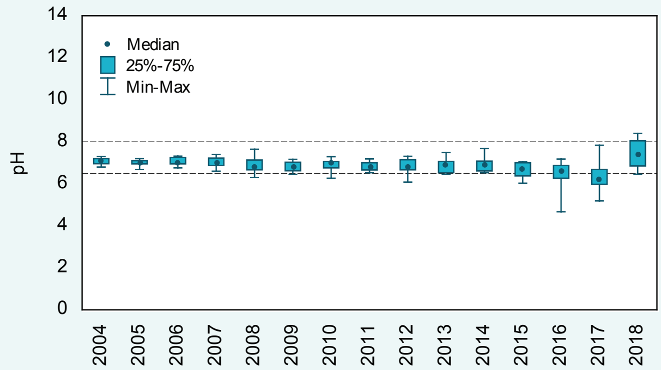
pH (2018)

pH values

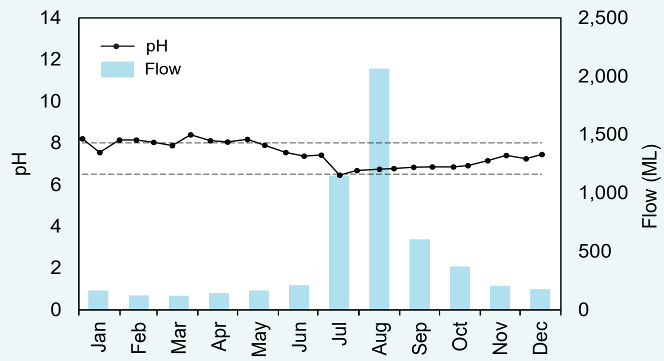
pH was highest in the first half of the year, decreasing from about May when the proportion of flow contributed by surface water runoff started to increase. This suggests the pH of the groundwater is higher than the surface water in the Little River catchment.

There is some concern that the probe used to collect the pH data from the catchments of Wilson Inlet (including the Little 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.

Little River



pH levels, 2004–18 at site 603020. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 603020. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Collecting discharge measurements using a StreamPro Acoustic Doppler Current Profiler, July 2016.

Salinity over time (2004–18)

Concentrations

Salinity in Little River was fresh, with all samples collected classified as fresh using the SWRWQA bands. In 2018, Little River had the lowest median salinity of the sites sampled (225 mg/L; Scotsdale Brook had the next lowest median of 275 mg/L).

Trends

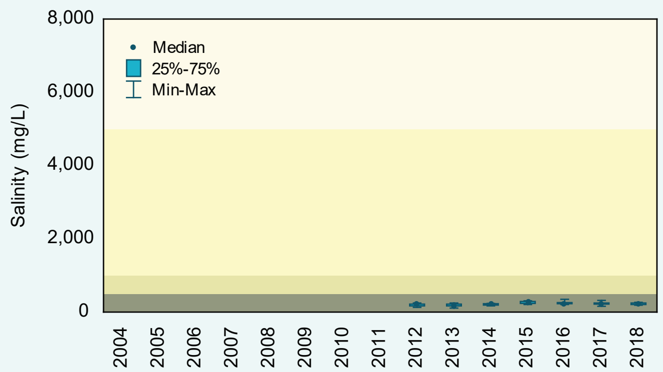
There was no short-term (2014–18) trend present in salinity in Little River.

Salinity (2018)

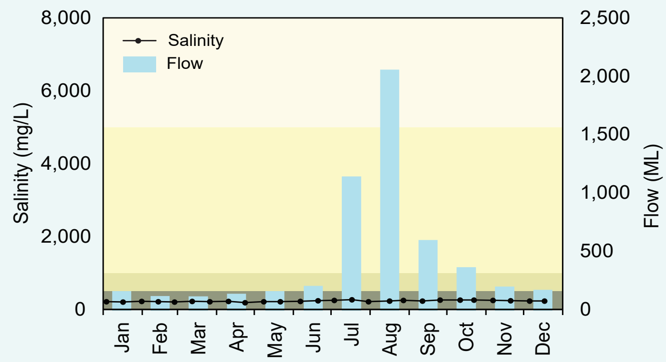
Concentrations

In 2018, all samples collected were classified as fresh. While the salinity varied a little over the year, there was no clear seasonal pattern present. It is likely salt was entering the river via surface flows as well as groundwater year-round.

Little River



Salinity concentrations, 2004–18 at site 603020. The shading refers to the SWRWQA classification bands..



2018 salinity concentrations and monthly flow at 603020. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

The culverts at the Little River sampling site during high flow, August 2018.

Little 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.

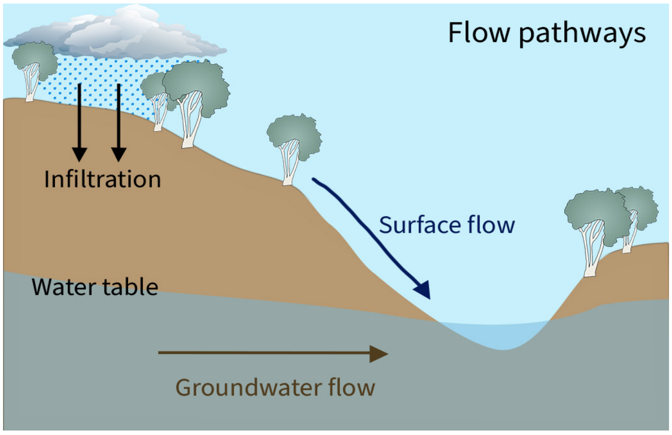
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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.



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