Coolup South Main Drain

This data report provides a summary of the nutrients at the Coolup South Main Drain 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 drain discharges into the Harvey Estuary. 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

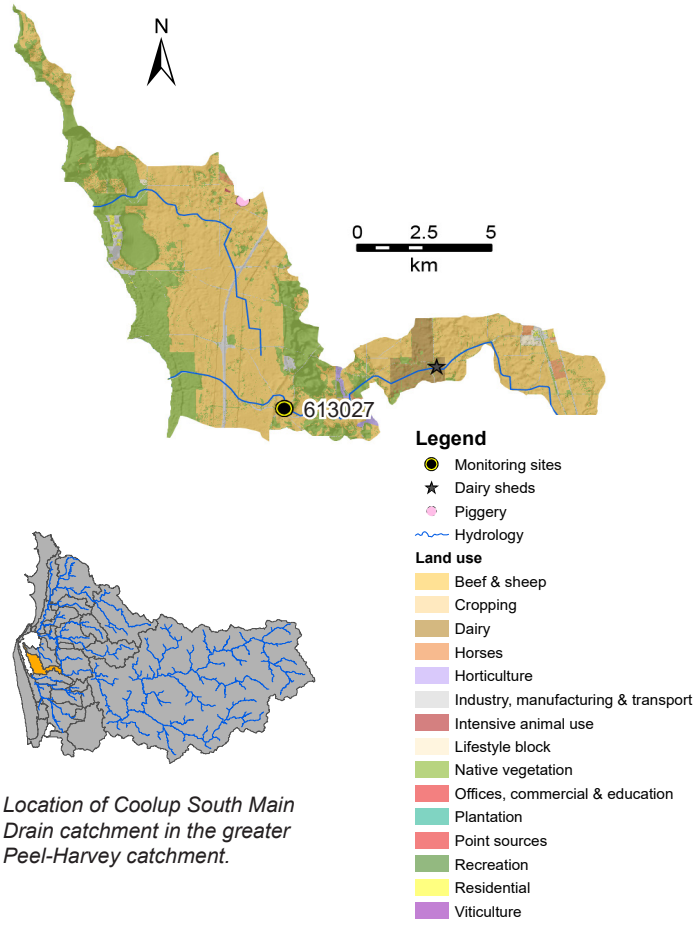
Coolup South Main Drain has a total catchment area of about 100 km^2, over half of which has been cleared for agriculture. The dominant land use in the catchment is beef cattle grazing (covering 60 per cent of the catchment). A dairy shed and a piggery are also present. There are two main waterways that drain the catchment to the Harvey Estuary, of which only the southern one (Coolup South Main Drain) is monitored. The catchment area upstream of the monitored site is 32 km^2. Both waterways are almost entirely artificial and consist of straight drains with many smaller drains constructed to remove water from surrounding agricultural land. There is little or no fringing vegetation present along the drains.

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

Water quality is measured at site 613027, Yackaboon Coolup Drain, where the drain passes under Old Bunbury Road in West Coolup.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Coolup South Main Drain sampling site were very high. The nutrient loads were small compared with the other monitored catchments, and the loads per square kilometre were moderate. The high nutrient concentrations were because of the agricultural land use in the catchment as well as the highly modified nature of Coolup South Main Drain and the drains that feed into it.



Location of Coolup South Main Drain catchment in the greater Peel-Harvey catchment.

Facts and figures

Sampling site code	613027
Catchment area	100 km^2
Per cent cleared area (2015)	68 per cent
River flow	Ephemeral, dries over summer
Annual flow (2018)	5.1 GL
Main land use (2015)	Beef cattle grazing

Coolup South Main Drain

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations in the Coolup South Main Drain were very high, with almost all samples collected over the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value. Concentrations fluctuated over the reporting period.

In 2018, Coolup South Main Drain had a median TN concentration of 2 mg/L, the same as the Punrak Drain sampling site. This was the equal fourth highest of the 13 sites sampled in the Peel-Harvey catchment.

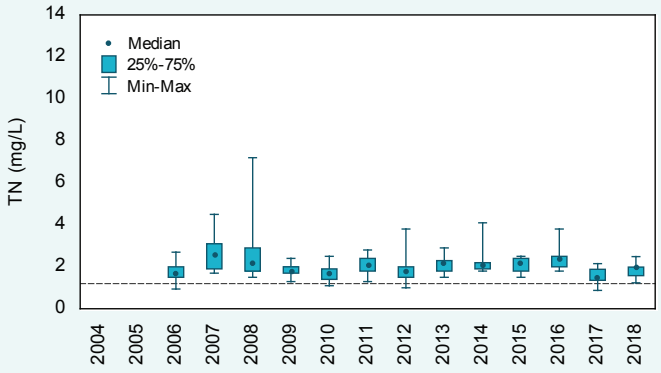
Trends

There was a short-term (2014–18) decreasing trend in TN concentrations of 0.07 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 (2006–18) trend present.

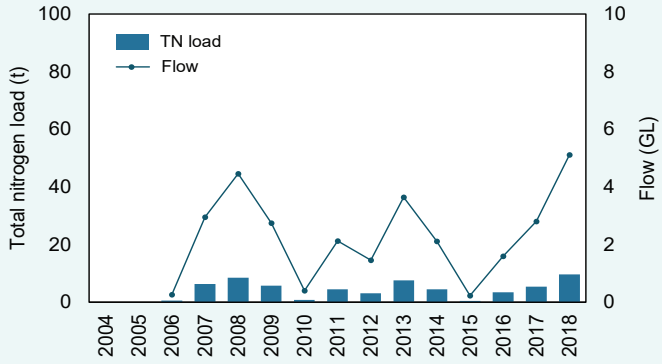
Estimated loads

Estimated TN loads at the Coolup South Main Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2018, Coolup South had an estimated TN load of 10 t, the second smallest of the 10 sites where it was possible to calculate loads. Only the site in the Gull Road Drain catchment had a smaller load of 1 t. The load per unit area was moderate, at 300 kg/km^2 in 2018, the fourth largest of the Peel-Harvey catchments. TN loads were closely related to flow volume, years with high annual flow having large TN loads and vice versa.

Coolup South Main Drain



Total nitrogen concentrations, 2004–18 at site 613027. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 613027.

The weir at the Coolup South Main Drain sampling site, September 2018.

Coolup South Main Drain

Nitrogen (2018)

Types of nitrogen

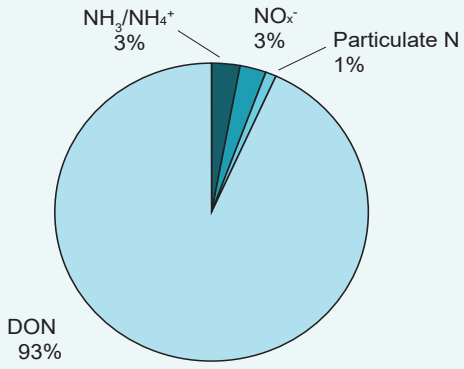
Total N is made up of different types of N. The dominant form of N in Coolup South Main Drain was dissolved organic N (DON); in fact this sampling site had the highest proportion of N present as DON of the 13 Peel-Harvey catchment sites. DON consists mainly of degrading plant and animal matter but may 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. The proportion of N present as bioavailable dissolved inorganic N (ammonia N - NH_3/NH_4^+ and total oxides of nitrogen - NO_x^-) was very low.

Concentrations

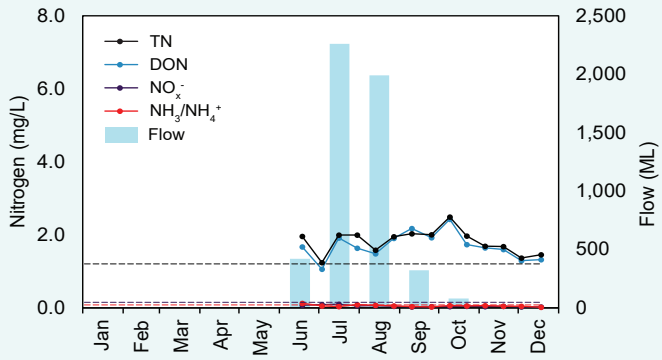
Total N and DON concentrations showed a slight seasonal pattern, increasing after the onset of winter rains and the resumption of flow, and then decreasing again from about October. As the catchment is prone to waterlogging it is likely that N is entering the drain via both shallow groundwater and surface flows throughout the flow year. NH_3/NH_4^+ and NO_x^- did not show a similar seasonal response, with concentrations being fairly steady throughout the year.

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

Coolup South Main Drain



2018 average nitrogen fractions at site 613027.



2018 nitrogen concentrations and monthly flow at 613027. The dashed lines are ANZECC trigger values for lowland rivers for the different N species.

The Coolup South Main Drain sampling site dry except for a small puddle of water downstream of the weir, May 2019.

Coolup South Main Drain

Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations fluctuated over the reporting period, though they were consistently high with almost all samples collected over the Peel-Harvey Water Quality Improvement Plan (WQIP) target for winter median TP concentrations.

In 2018, Coolup South Main Drain had the third highest median TP concentration (0.297 mg/L), though it was still significantly lower than the two sites with higher concentrations (Nambeelup Brook at 0.415 mg/L and Gull Road Drain in the Gull Road Drain catchment at 0.74 mg/L).

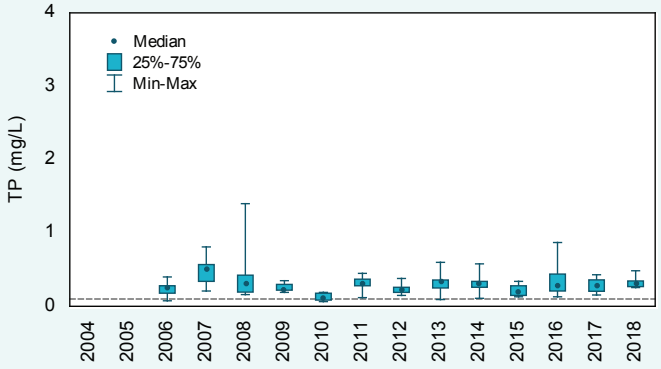
Trends

There was a short-term (2014–18) increasing trend in TP concentrations of 0.017 mg/L/yr. This may be because of natural fluctuations at this site or be because of an actual increase in TP concentrations. Ongoing monitoring will help determine if the water quality is getting better at this site. There was no long-term (2006–18) trend present.

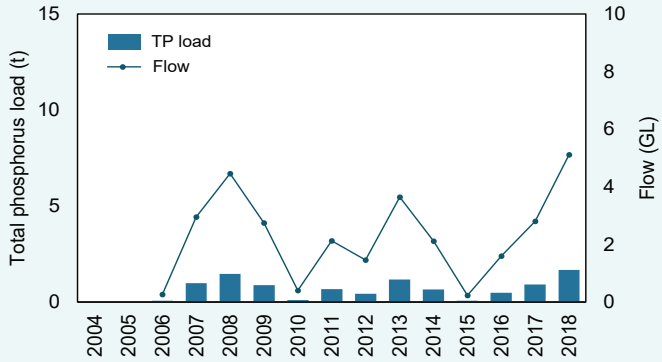
Estimated loads

Estimated TP loads at the Coolup South Main Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2018, the site had an estimated TP load of 1.7 t, the second smallest TP load of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per unit area of 52.2 kg/km^2 was moderate compared with the other Peel-Harvey sites. TP loads were closely related to flow volume, years with high annual flow having large TP loads and vice versa.

Coolup South Main Drain



Total phosphorus concentrations, 2004–18 at site 613027. The dashed line is the Peel-Harvey WQIP target for winter median TP concentrations.



Total phosphorus loads and annual flow, 2004–18 at site 613027.

High nutrient concentrations encourage macrophyte growth. Here the drain is completely covered by macrophytes, December 2014.

Coolup South Main Drain

Phosphorus (2018)

Types of phosphorus

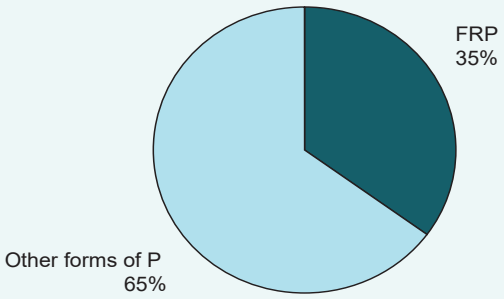
Total P is made up of different types of P. At the Coolup South Main Drain sampling site, about two-thirds of the P was present as either particulate P or dissolved organic P (DOP) or both (shown as 'Other forms of P' in the chart below). Particulate P generally needs to be broken down before becoming 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

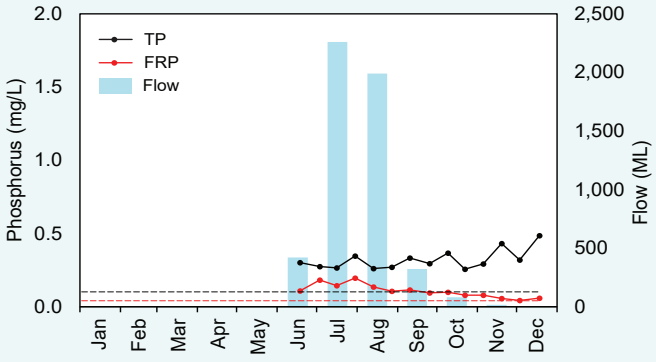
Total P and FRP concentrations behaved differently during the year. FRP was highest early in the flow year when flow volumes were at their greatest, whereas TP was fairly steady through the year before increasing from about November. It is possible that more FRP is entering the drain via surface water than groundwater, which is why it was highest when flow volumes were greatest and dropped later in the year when there was proportionally more groundwater in the drain. All FRP and TP values were over their respective WQIP target and ANZECC trigger value.

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

Coolup South Main Drain



2018 average phosphorus fractions at site 613027.



2018 phosphorus concentrations and monthly flow at 613027. The dashed black line is the Peel-Harvey WQIP target, the red line is the ANZECC trigger value for lowland rivers.

Looking downstream at the weir during high flows at the Coolup South Main Drain sampling site, August 2013.

Coolup South Main Drain

Dissolved organic carbon over time (2004–18)

Concentrations

There were only three years with sufficient dissolved organic carbon (DOC) data to graph at the Coolup South Main Drain sampling site. Using the Statewide River Water Quality Assessment (SWRWQA) classification bands, each annual median was classified as very high. There were only a few samples, collected in 2018, that were classified as high, the rest were all very high. DOC concentrations were high compared with the other Peel-Harvey catchment sites, with the 2018 annual median being the fourth highest of the 13 sites sampled.

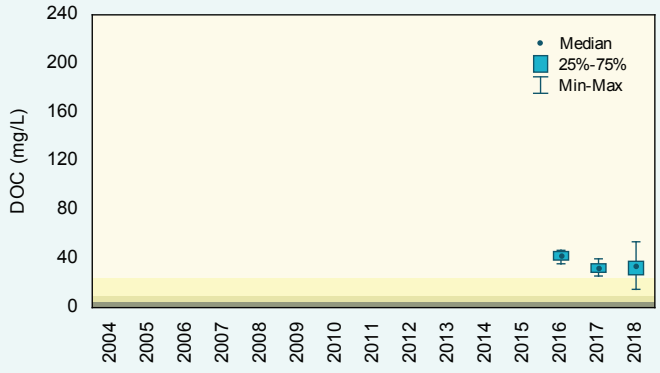
Trends

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

Estimated loads

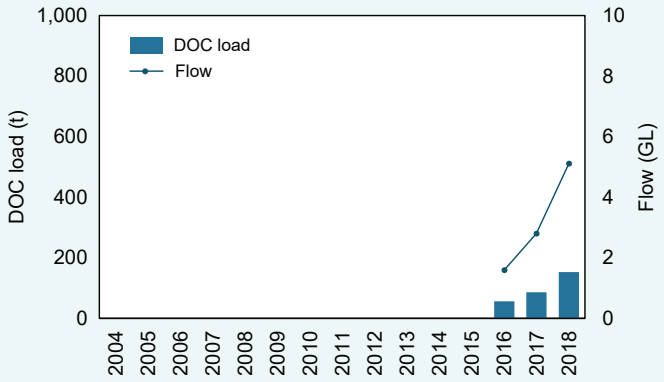
Estimated DOC loads at the Coolup South Main Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2018, the estimated DOC load was 153 t, the second smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per unit area of 4,768 kg/km^2 was moderate to large compared with the other Peel-Harvey catchment sites. DOC loads were closely related to flow volume, years with high annual flow having large DOC loads and vice versa.

Coolup South Main Drain



Dissolved organic carbon concentrations, 2004–18 at site 613027. The shading refers to the SWRWQA classification bands.

very high high moderate low



Dissolved organic carbon loads and annual flow, 2004–18 at site 613027.

The weir at the Coolup South Main Drain sampling site, August 2016.

Coolup South Main Drain

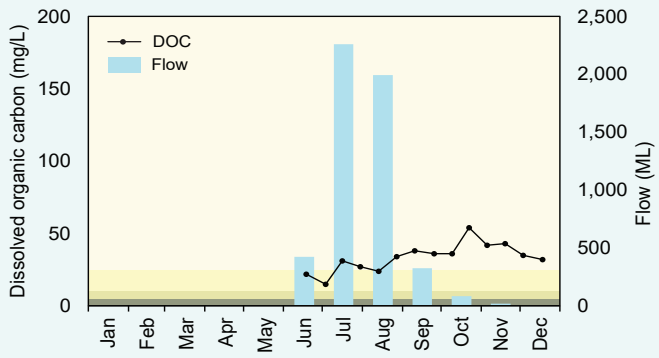
Dissolved organic carbon (2018)

Concentrations

In 2018, DOC concentrations increased during the year. At the start of the flow year, concentrations were slightly lower, classified as high using the SWRWQA classification bands, before increasing into the very high band. 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. At the Coolup South Main Drain sampling site, DOC was likely coming from surface flow and groundwater as well as in-stream sources.

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

Coolup South Main Drain



2018 dissolved organic carbon concentrations and monthly flow at 613027. The shading refers to the SWRWQA classification bands.

very high high moderate low

Coolup South Main Drain passing under the Old Bunbury Road Bridge, September 2018.

Coolup South Main Drain

Total suspended solids over time (2004–18)

Concentrations

Using the SWRWQA bands, the median total suspended solids (TSS) concentration at the Coolup South Main Drain sampling site was classified as moderate to high in the years where there were data. TSS concentrations fluctuated over the reporting period.

In 2018, the median TSS was 8 mg/L, which was high compared with the other 12 Peel-Harvey catchment sites. The only site with a higher median was Samson North Drain (13 mg/L).

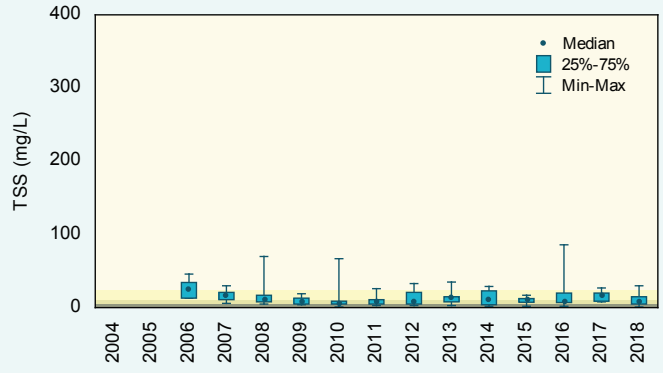
Trends

There was no trend in TSS concentrations at Coolup South Main Drain over either the short- (2014–18) or long-term (2006–18).

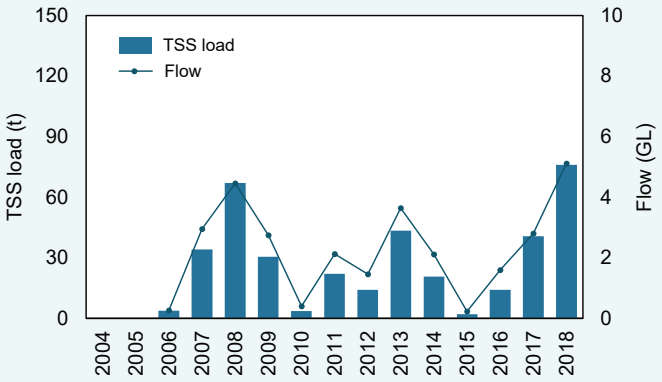
Estimated loads

Estimated TSS loads at the Coolup South Main Drain sampling site were small to moderate compared with the other sites in the Peel-Harvey catchment. In 2018, the estimated TSS load at this site was 76 t, the third smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per unit area of 2,373 kg/km^2 was moderate to large 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.

Coolup South Main Drain



Total suspended solids concentrations, 2004–18 at site 613027. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2004–18 at site 613027.

very high high moderate low

Collecting flow measurements at the Coolup South Main Drain sampling site, July 2018.

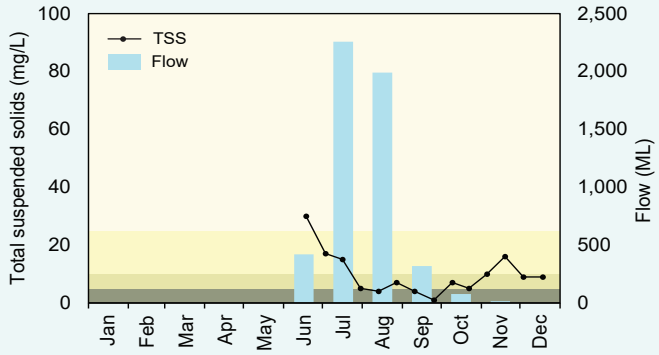
Total suspended solids (2018)

Concentrations

In 2018, there was a reverse seasonal pattern in TSS with concentrations highest when the drain started flowing in June before dropping in July to September. Concentrations increased again in October to November. This suggests that early winter rainfall washed particles into the drain as well as mobilising any that were present in the dry drain, including dead algal and plant material which may have grown over summer. After the initial mobilisation, the amount of particles entering the drain reduced. Why they increased again from October to November is unclear, although this could be because of particulate matter being dislodged from aquatic plants and algae, which thrive at this time of year, while sampling.

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

Coolup South Main Drain



2018 total suspended solids concentrations and monthly flow at 613027. The shading refers to the SWRWQA classification bands.

very high high moderate low

Waterlogging in a paddock adjacent to the Coolup South Main Drain, August 2013.

Coolup South Main Drain

pH over time (2004–18)

pH values

pH in the Coolup South Main Drain fluctuated over the reporting period. Almost all samples collected fell within the upper and lower ANZECC trigger values.

Trends

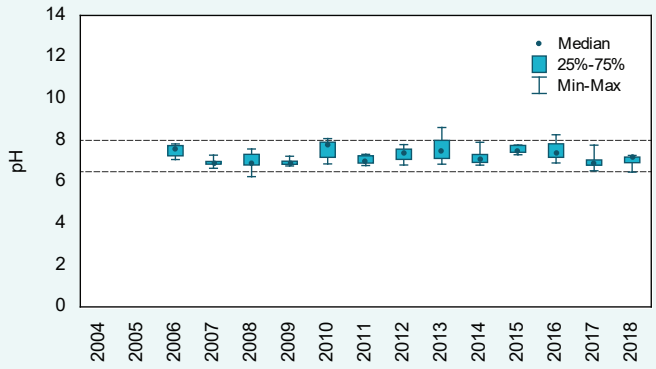
There was no trend in pH at Coolup South Main Drain over either the short- (2014–18) or long-term (2006–18).

pH (2018)

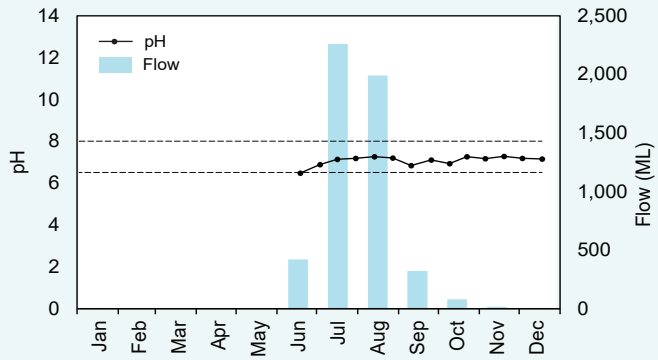
pH values

All but one of the samples collected in 2018 fell within the upper and lower ANZECC trigger values, the first sample collected after the drain started flowing fell just below the lower trigger value. While there was some fluctuation during the year, there was no clear seasonal pattern in pH values.

Coolup South Main Drain



pH levels, 2004–18 at site 613027. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 613027. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Looking upstream to the Coolup South Main Drain sampling site from the Old Bunbury Road Bridge, June 2014.

Coolup South Main Drain

Salinity over time (2004–18)

Concentrations

Salinity fluctuated during the reporting period at the Coolup South Main Drain sampling site. Using the SWRWQA classification bands, the median salinity was fresh every year except 2006, when it was marginal.

Trends

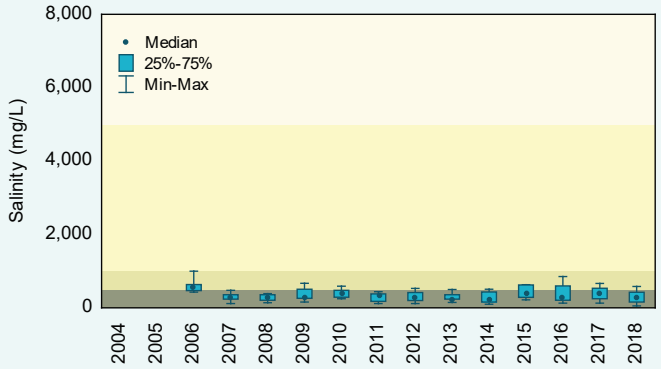
There was a short-term (2014–18) increasing trend in salinity of 14 mg/L/yr. This may be because of natural fluctuations at this site or an actual increase in salinity. Ongoing monitoring will help determine if this site is getting more salty.

Salinity (2018)

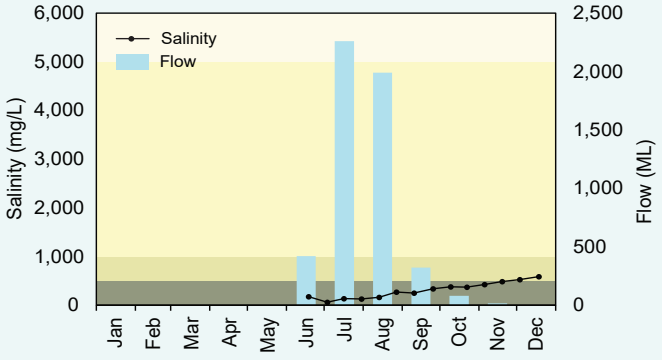
Concentrations

Salinity showed a slight seasonal response, being lowest when the drain first started flowing before slowly increasing through the year. It is possible that the gradual increase is because of either evapoconcentration of salts in the drain water or the groundwater in the area being more saline than the surface water. As rainfall eases and the water levels in the drain start to flow, the proportion of groundwater present increases.

Coolup South Main Drain



Salinity concentrations, 2004–18 at site 613027. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations and monthly flow at site 613027. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

Paddock next to Coolup South Main Drain sampling site, March 2005.

Coolup South Main Drain

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.

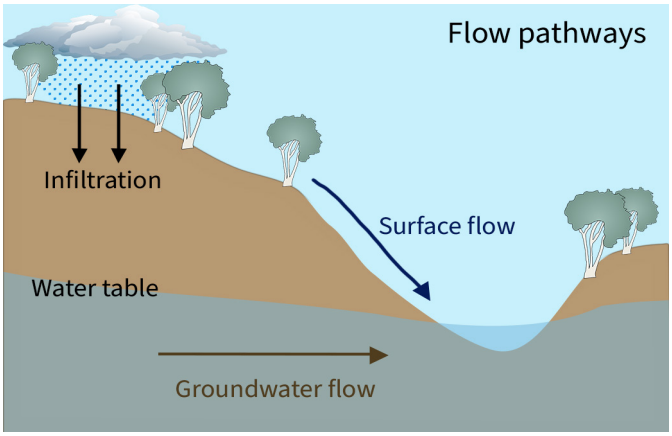
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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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