Coolup South Main Drain

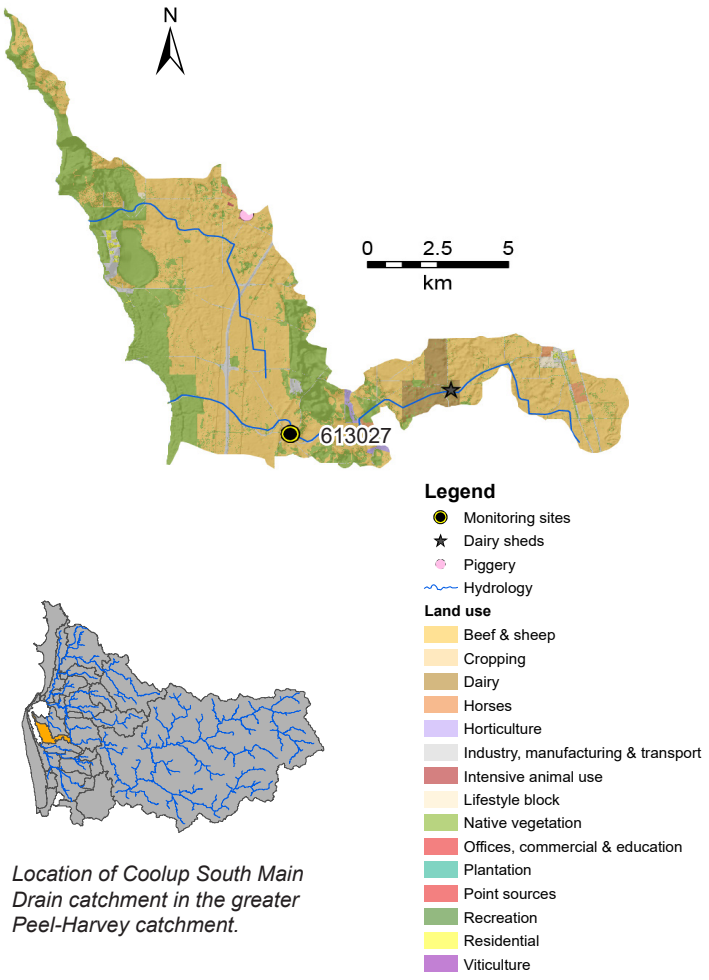
This data report provides a summary of the nutrients at the Coolup South Main Drain sampling site in 2019 as well as historical data from 2005–19. This report was produced as part of Healthy Estuaries WA. Downstream of the site, the drain discharges into the Harvey Estuary.

About the catchment

Coolup South Main Drain has a total catchment area of about 100 km^2, more than 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 or leached 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.



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

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Coolup South Main Drain sampling site were classified as high (nitrogen) and very high (phosphorus). The nutrient loads were small compared with the other monitored catchments, driven by the small flow volume at this site. 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.

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
Main land use (2015)	Beef cattle grazing

Estimated loads and flow at Coolup South Main Drain

613027	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)		0.3	3.0	4.5	2.7	0.4	2.1	1.5	3.6	2.1	0.2	1.6	2.8	5.1	1.5
TN load (t)		0.5	6.3	8.5	5.7	0.8	4.5	3.1	7.6	4.5	0.5	3.4	5.3	9.6	3.1
TP load (t)		0.07	0.98	1.47	0.88	0.11	0.68	0.43	1.18	0.65	0.06	0.47	0.91	1.67	0.45

Coolup South Main Drain

Nitrogen over time (2005–19)

Concentrations

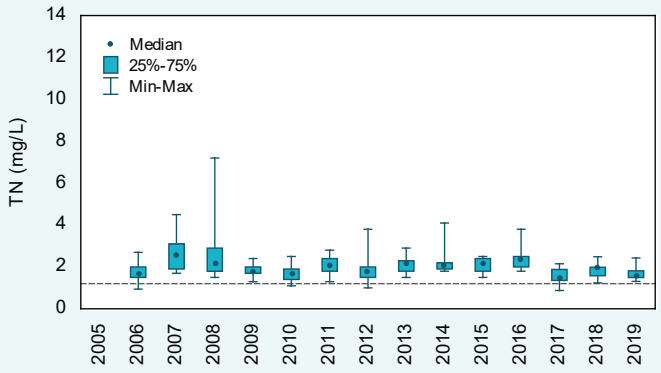
Annual total nitrogen (TN) concentrations in the Coolup South Main Drain were classified as high using the State Wide River Water Quality Assessment (SWRWQA) methodology, except for 2016 and 2017 which were classified as very high. Almost all samples collected were over the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan water quality target for TN concentrations. Concentrations fluctuated over the reporting period.

In 2019, Coolup South Main Drain had a median TN concentration of 1.6 mg/L, the same as the Samson North Drain sampling site. This was the equal fifth highest of the 13 sites sampled in the Peel-Harvey catchment.

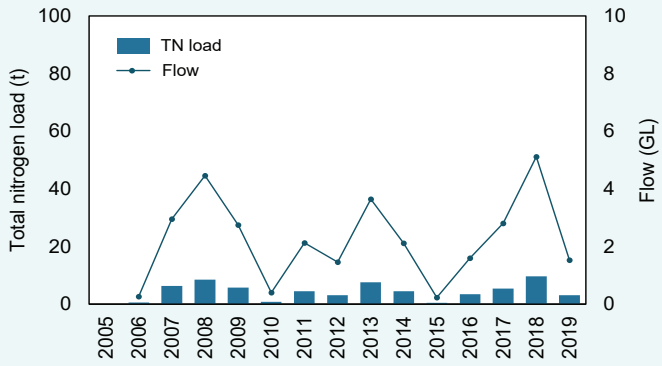
Estimated loads

Estimated TN loads at the Coolup South Main Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2019, Coolup South Main Drain had an estimated TN load of 3.1 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 0.3 t. Coolup South Main Drains small loads were driven by the small flow volumes at this site; TN concentrations were high. In 2019, Coolup South Main Drain had the third smallest flow volume of 1.5 GL, similar to Meredith Drain (1.4 GL). The load per square kilometre was moderate, at 98 kg/km^2 in 2019, the third largest of the Peel-Harvey catchments. TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

Coolup South Main Drain



Total nitrogen concentrations, 2005–19 at site 613027. The dashed line is the protection plan TN target.



Total nitrogen loads and annual flow, 2005–19 at site 613027.

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

Coolup South Main Drain

Nitrogen (2019)

Types of nitrogen

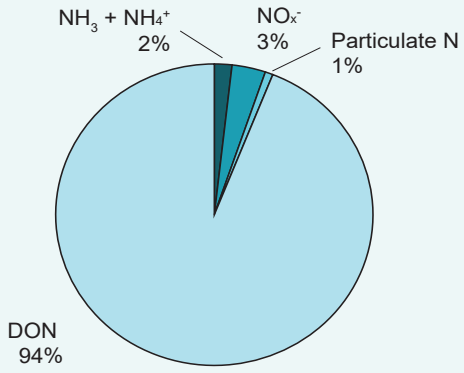
Total N is made up of different types of N. The dominant type of N in Coolup South Main Drain was dissolved organic N (DON); in fact this sampling site had the highest proportion of N present as DON of the 12 Peel-Harvey catchment sites where it was possible to construct average nitrogen fraction pie charts. DON consists mainly of degrading plant and animal matter but may also include other types. The bioavailability of DON varies depending on its type. 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 (total ammonia – NH_3 + NH_4^+ and nitrate – NO_x^-) was very small.

Concentrations

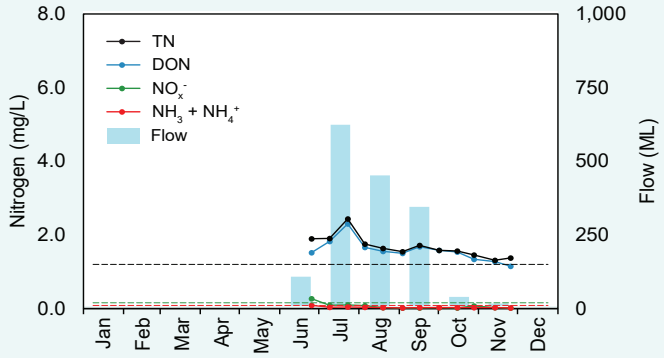
Total N and DON concentrations showed a seasonal pattern, increasing after the onset of winter rains and the resumption of flow, and then decreasing again. As the catchment is prone to waterlogging it is likely that N is entering the drain via both shallow groundwater and surface flows as well as in-stream sources throughout the flow year. Total ammonia and nitrate 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



2019 average nitrogen fractions at site 613027.



2019 nitrogen concentrations and monthly flow at 613027. The black dashed line is the protection plan TN target, the red and green lines are the ANZECC trigger values for total ammonia and nitrate.

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 (2005–19)

Concentrations

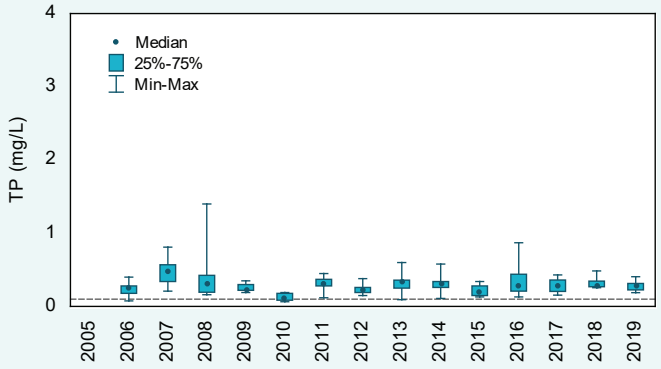
Total phosphorus (TP) concentrations fluctuated over the reporting period, though they were consistently classified as very high using the SWRWQA methodology. Further, almost all samples collected were over the protection plan water quality target for TP concentrations.

In 2019, Coolup South Main Drain had the fourth highest median TP concentration (0.280 mg/L).

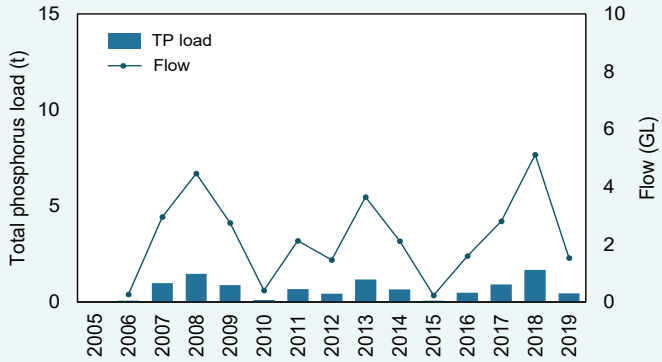
Estimated loads

Estimated TP loads at the Coolup South Main Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2019, the site had an estimated TP load of 0.45 t, the second smallest TP load of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The small loads were driven by the small flow volumes at this site; TP concentrations were very high. In 2019, Coolup South Main Drain had the third smallest flow volume of 1.5 GL, similar to Meredith Drain (1.4 GL). The load per square kilometre of 14.1 kg/km^2 was moderate compared with the other Peel-Harvey sites. TP loads were closely related to flow volume; years with large annual flow volumes had large TP loads and vice versa.

Coolup South Main Drain



Total phosphorus concentrations, 2005–19 at site 613027. The dashed line is the protection plan TP target.



Total phosphorus loads and annual flow, 2005–19 at site 613027.

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

Coolup South Main Drain

Phosphorus (2019)

Types of phosphorus

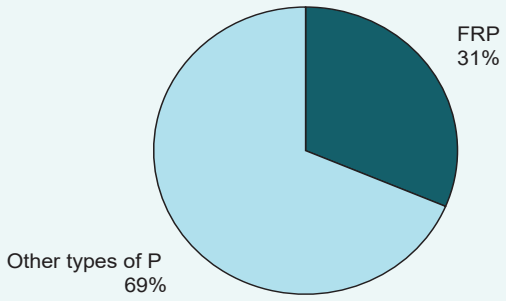
Total P is made up of different types of P. At the Coolup South Main Drain sampling site, about two-thirds of the P was present as either particulate P or dissolved organic P (DOP) or both (shown as 'Other types of P' in the chart below). Particulate P generally needs to be broken down before becoming bioavailable. The bioavailability of DOP varies and is poorly understood. The remainder of the P was present as phosphate. This is measured as filterable reactive phosphorus (FRP) which in surface waters is mainly present as phosphate (PO_4^{3-}) species and is readily bioavailable. The phosphate was probably derived from animal waste and fertilisers as well as natural sources.

Concentrations

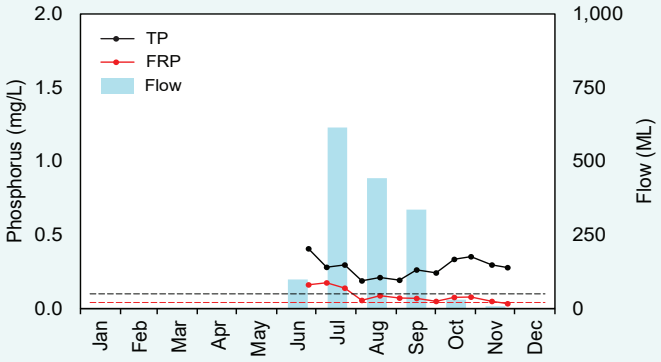
Total P and phosphate concentrations behaved similarly during the year. Concentrations were highest in June when the drain first started flowing, fell during the wetter months and then increased again from about late September when flow started to decrease. All TP and all but one phosphate value were over their respective protection plan water quality target and Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value. It is likely that P is entering the drain via both surface flows and groundwater as well as coming from in-stream sources.

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

Coolup South Main Drain



2019 average phosphorus fractions at site 613027.



2019 phosphorus concentrations and monthly flow at 613027. The dashed black line is the protection plan TP target, the red is the ANZECC trigger value for phosphate.

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 (2005–19)

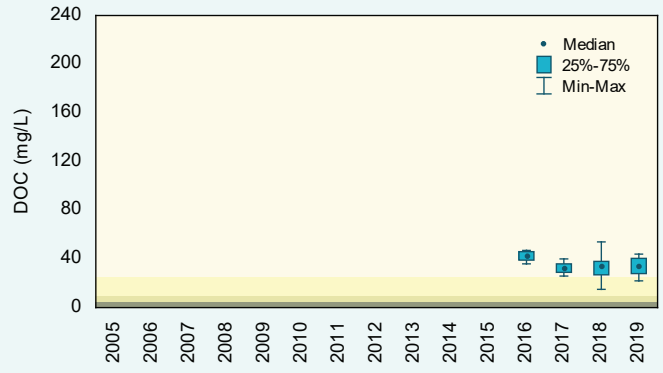
Concentrations

There were only four years with sufficient dissolved organic carbon (DOC) data to graph at the Coolup South Main Drain sampling site. Using the SWRWQA methodology, each year was classified as having very high DOC concentrations. DOC concentrations were also high compared with the other Peel-Harvey catchment sites, with the 2019 annual median being the fourth highest of the 13 sites sampled.

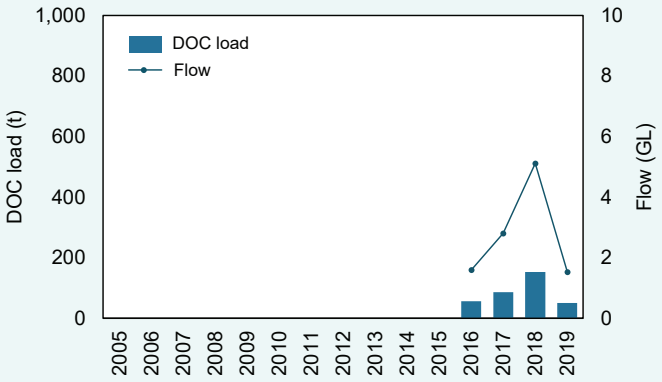
Estimated loads

Estimated DOC loads at the Coolup South Main Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2019, the estimated DOC load was 51 t, the second smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The small loads were driven by the small flow volumes at this site; DOC concentrations were very high. In 2019, Coolup South Main Drain had the third smallest flow volume of 1.5 GL, similar to Meredith Drain (1.4 GL). The load per square kilometre of 1,586 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 large annual flow volumes had large DOC loads and vice versa.

Coolup South Main Drain



Dissolved organic carbon concentrations, 2005–19 at site 613027. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2005–19 at site 613027.

low moderate high very high

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

Coolup South Main Drain

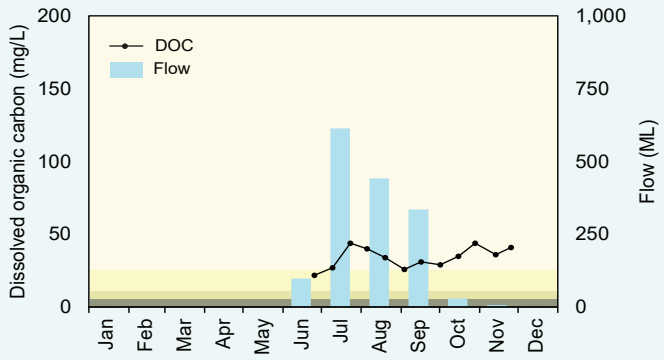
Dissolved organic carbon (2019)

Concentrations

In 2019, DOC concentrations increased during the year. At the start of the flow year, concentrations were slightly lower, falling in the high band of the SWRWQA, before increasing into the very high band. DOC is sourced mainly from degrading plant and animal matter, including from agricultural land and natural organic matter in soils and wetlands. It varies widely in its bioavailability. At the Coolup South Main Drain sampling site, DOC was likely entering the drain via surface flow and groundwater as well as coming from in-stream sources.

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

Coolup South Main Drain



2019 dissolved organic carbon concentrations and monthly flow at 613027. The shading refers to the SWRWQA classification bands.

low moderate high very high

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

Coolup South Main Drain

Total suspended solids over time (2005–19)

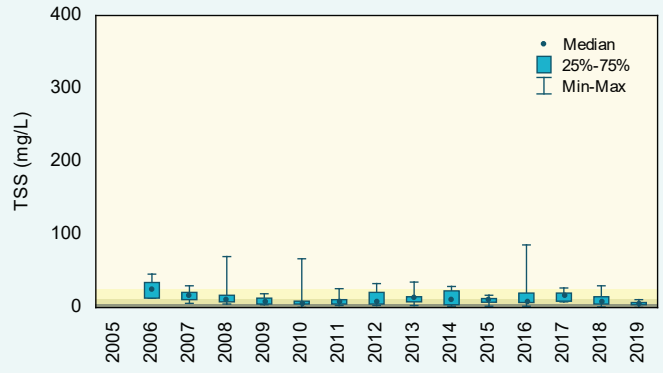
Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Using the SWRWQA methodology, 2007–09 were classified as having high TSS concentrations and all years from 2010 onwards were classified as having moderate TSS concentrations.

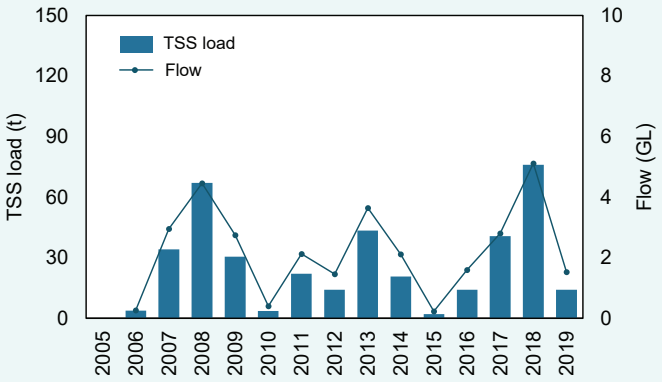
Estimated loads

Estimated TSS loads at the Coolup South Main Drain sampling site were moderate compared with the other sites in the Peel-Harvey catchment. In 2019, the estimated TSS load at this site was 14 t, the fourth smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per square kilometre of 439 kg/km^2 was large compared with the other Peel-Harvey catchment sites. TSS loads were closely related to flow volume; years with large annual flow volumes had large TSS loads and vice versa.

Coolup South Main Drain



Total suspended solids concentrations, 2005–19 at site 613027. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 613027.

low moderate high very high

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

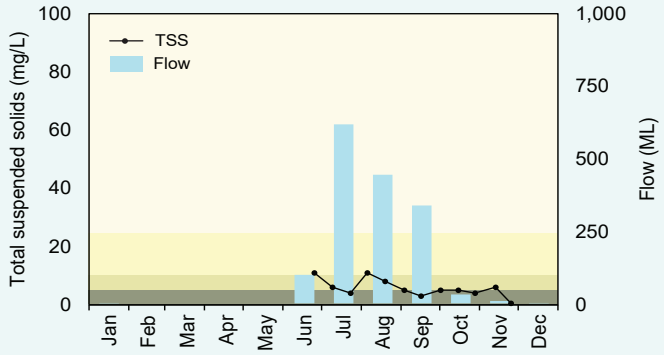
Total suspended solids (2019)

Concentrations

In 2019, TSS concentrations fluctuated. They were high when the drain first started flowing in June, and then peaked again in early August. This suggests that early winter rainfall washed particulate matter into the drain as well as mobilising any that was present in the dry drain, including dead algal and plant material which may have grown over summer. The reason for the peak in early August is unclear.

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

Coolup South Main Drain



2019 total suspended solids concentrations and monthly flow at 613027. The shading refers to the SWRWQA classification bands.

low moderate high very high

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

Coolup South Main Drain

pH over time (2005–19)

pH values

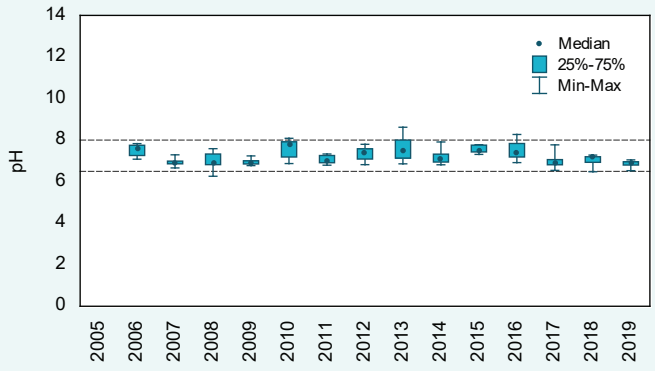
pH in the Coolup South Main Drain fluctuated over the reporting period. Almost all samples collected fell within the upper and lower ANZECC trigger values.

pH (2019)

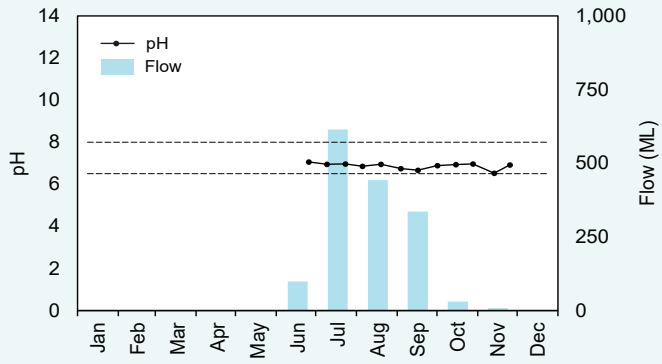
pH values

All of the samples collected in 2019 fell within the upper and lower ANZECC trigger values. While there was some fluctuation during the year, there was no clear seasonal pattern in pH values.

Coolup South Main Drain



pH levels, 2005–19 at site 613027. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 613027. The dashed lines are the upper and lower ANZECC trigger values.

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 (2005–19)

Concentrations

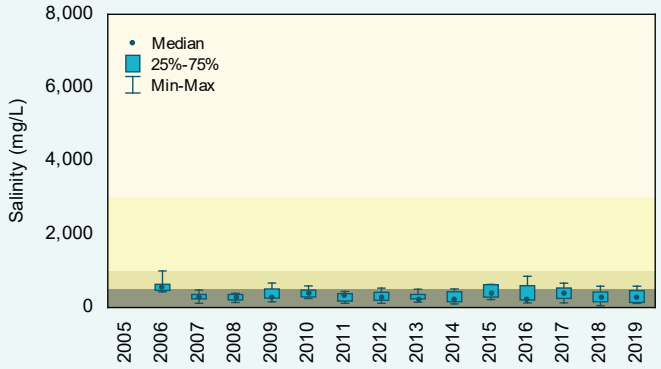
Salinity fluctuated during the reporting period at the Coolup South Main Drain sampling site. Using the Water Resources Inventory 2014 salinity ranges, all years were classified as fresh (note, the 2018 nutrient reports used the SWRWQA bands).

Salinity (2019)

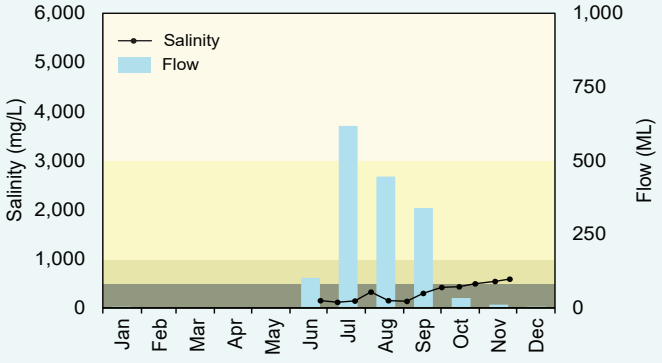
Concentrations

Salinity showed a slight seasonal response, being lowest when the drain first started flowing before slowly increasing later in 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 (or a combination of both). As rainfall eases and the water levels in the drain start to fall, the proportion of groundwater present increases. Why there was a small peak in salinity in early August is unclear. This peak coincides with the peak in TSS concentrations.

Coolup South Main Drain



Salinity concentrations, 2005–19 at site 613027. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations and monthly flow at site 613027. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

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

Coolup South Main Drain

Background

Healthy Estuaries WA is a State Government program launched in 2020 and builds 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.

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.

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

Healthy Estuaries WA partners with the Peel-Harvey Catchment Council to fund best-practice management of fertiliser, dairy effluent and watercourses 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

Variables were compared with the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan concentration targets or ANZECC trigger values where available, or the SWRWQA bands or the 2014 Water Resources Inventory ranges. They were classified using the SWRWQA methodology. Standard statistical tests were used to calculate trends and loads. For further information on the methods visit estuaries.dwer.wa.gov.au/nutrient-reports/data-analysis

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 per volume of water.

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

First flush: material washed into a waterway by the first rainfall after an extended dry period. The first flush is often associated with high concentrations of nutrients and particulate matter.

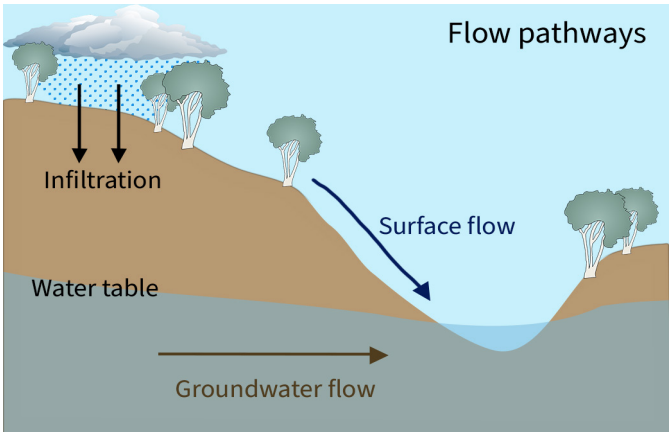
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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

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

Nitrate: The measurement for the nutrient nitrate actually measures both nitrate (NO_3^-) and nitrite (NO_2^-), which is reported as NO_x^-. We still refer to this as nitrate as in most surface waters nitrite is present in very low concentrations.

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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