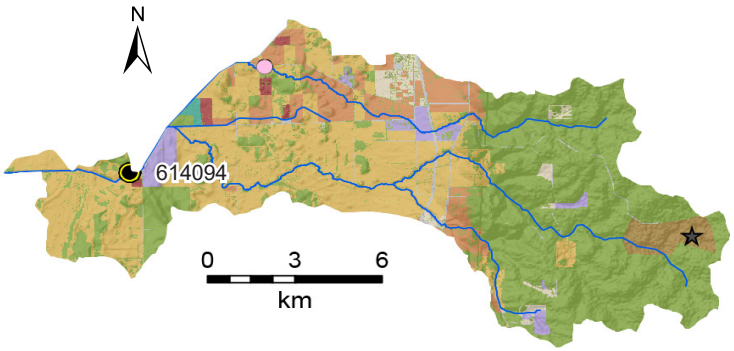
Dirk Brook–Punrak Drain

This data report provides a summary of the nutrients at the Punrak 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 this site the drain enters Lake Amarillo, before flowing into the Serpentine River and, from there, into the Peel Inlet.



About the catchment

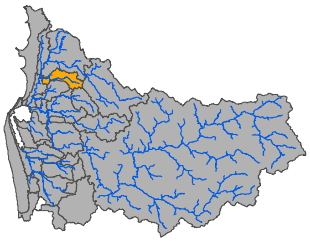
The Dirk Brook–Punrak Drain catchment has a total area of about 140 km^2 while the area upstream of the sampling site is about 125 km^2. There are two main waterways in the catchment, Karnet Brook and Dirk Brook, which combine to become Punrak Drain. While much of the brooks retain their natural form, there are many straight, man-made drains present and Punrak Drain itself is a highly modified, straight drain. Fringing vegetation is missing or highly modified along much of the waterways, particularly on the coastal plain.

The western portion of the catchment, which is on the coastal plain, has been extensively cleared for agriculture, predominantly beef and sheep grazing. This part of the catchment has soils with a low capacity to bind phosphorus, which is often so poor that any phosphorus applied to them can be quickly washed or leached into drains and other waterways. A piggery, dairy shed and turf farm are also present in the catchment.

Water quality is sampled at site 614094, Yangedi Swamp, on Punrak Drain. This site is about 600 m downstream of the Punrak Road Bridge in Keysbrook.

Legend
- Monitoring sites
- Dairy sheds
- Piggery
- Hydrology

Land use
- Beef & sheep
- Cropping
- Dairy
- Horses
- Horticulture
- Industry, manufacturing & transport
- Intensive animal use
- Lifestyle block
- Native vegetation
- Offices, commercial & education
- Plantation
- Point sources
- Recreation
- Residential
- Viticulture



Location of Dirk Brook catchment in the greater Peel-Harvey catchment.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Punrak Drain sampling site were classified as very high. The nutrient loads were moderate compared with the other monitored catchments, as were the loads per square kilometre. It is likely that the shallow groundwater close to the monitoring site had high nutrient concentrations and was one of the main drivers of the high nutrient concentrations recorded at this site because concentrations were highest in the drier, first half of the year.

Facts and figures

Sampling site code	614094
Catchment area	140 km^2
Per cent cleared area (2015)	51 per cent
River flow	Permanent
Main land use (2015)	Native vegetation and beef and sheep grazing

Estimated loads and flow at Punrak Drain

614094	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)			15	15	18	6.8	12	5.5	11	9.6	2.0	6.3	13	17	4.8
TN load (t)			32	32	39	12	24	10	22	18	3.5	11	28	36	8.0
TP load (t)			3.72	3.80	4.67	1.33	2.74	1.09	2.42	2.02	0.37	1.19	3.50	4.17	0.85

Dirk Brook–Punrak Drain

Nitrogen over time (2005–19)

Concentrations

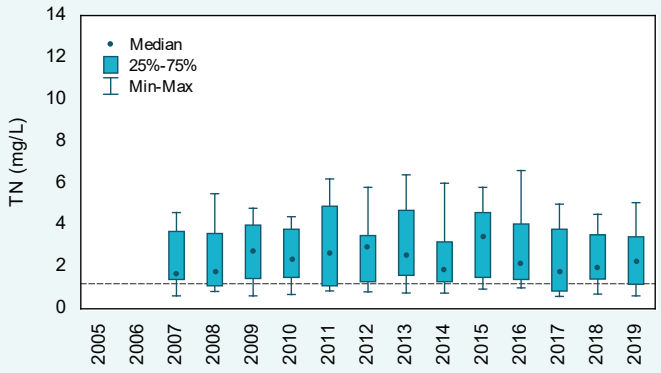
Total nitrogen (TN) concentrations fluctuated over the reporting period. Using the State Wide River Water Quality Assessment (SWRWQA) methodology, annual TN concentrations were classified as high up to 2012 and very high since then. Further, more than three-quarters of the samples collected each year were over the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan water quality target for TN concentrations.

In 2019, the Punrak Drain sampling site had the third highest median of the 13 sites in the Peel-Harvey catchment (2.3 mg/L).

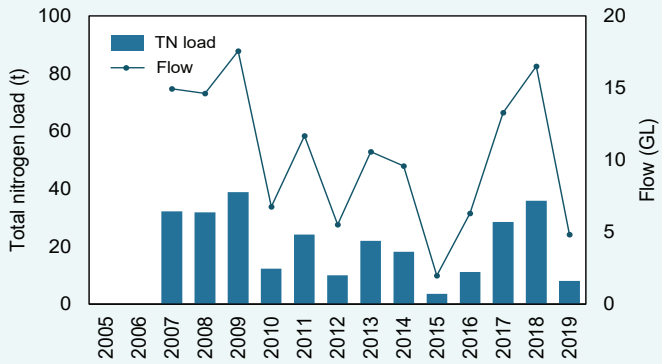
Estimated loads

Estimated TN loads at the Punrak Drain sampling site were moderate compared with the other sites in the Peel-Harvey catchment. In 2019, Punrak Drain had an estimated TN load of 8.0 t. The load per square kilometre was also moderate, at 65 kg/km^2. TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

Punrak Drain



Total nitrogen concentrations, 2005–19 at site 614094. The dashed line is the protection plan TN target.



Total nitrogen loads and annual flow, 2005–19 at site 614094.

Looking upstream during high flows at the Punrak Drain sampling site, August 2009.

Dirk Brook–Punrak Drain

Nitrogen (2019)

Types of nitrogen

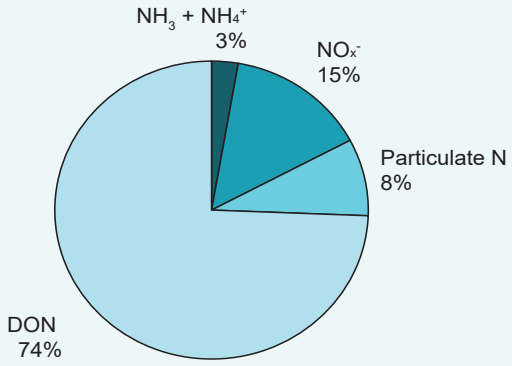
Total N is made up of different types of N. Dissolved organic N (DON) was the dominant type at the Punrak Drain sampling site. This type of N consists of degrading plant and animal matter which needs to be further broken down before it becomes available to plants and algae, as well as more bioavailable types. The percentage of N present as dissolved inorganic N (total ammonia, NH_3 + NH_4^+ and nitrate, NO_x^-) was lower than in 2019, though this is most likely because of annual variation rather than an actual shift in nutrient composition at this site. Further monitoring will help confirm this. Likely sources of these kinds of N include fertilisers and animal wastes.

Concentrations

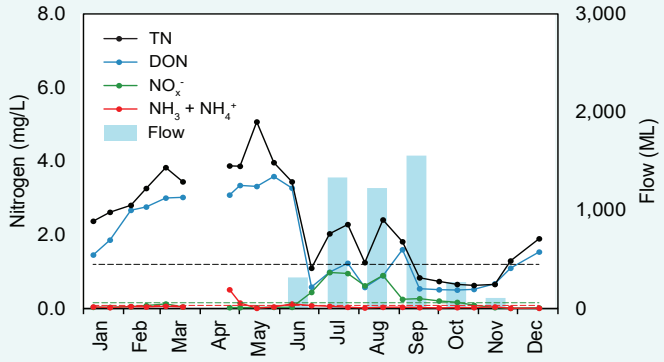
Total N and DON concentrations were highest early in the year, when flow was at its lowest. Likely sources of DON at this time were shallow groundwater (which was contributing most of the flow at this time), possibly decaying plant matter in the drain (it sometimes gets choked with aquatic vegetation) and algal blooms. Nitrate concentrations showed a first flush response, peaking in early July when N was mobilised by heavy rainfall. Much of this N was probably the result of mineralisation of organic N in soils and drains over the summer period, and runoff of high-concentration water from intensive land uses adjacent to the drain, which build up with fertiliser and animal waste over the summer. The dip in TN, DON and nitrate in August was probably the result of a dry spell which caused parts of the catchment to dry out, therefore no longer contributing nutrients. This dip was present at many of the Peel-Harvey catchment sites in both N and phosphorus concentrations.

Where there was no data in April, the site was not flowing.

Punrak Drain



2019 average nitrogen fractions at site 614094.



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.

Looking upstream during low flows at the Punrak Drain sampling site, March 2011.

Dirk Brook–Punrak Drain

Phosphorus over time (2005–19)

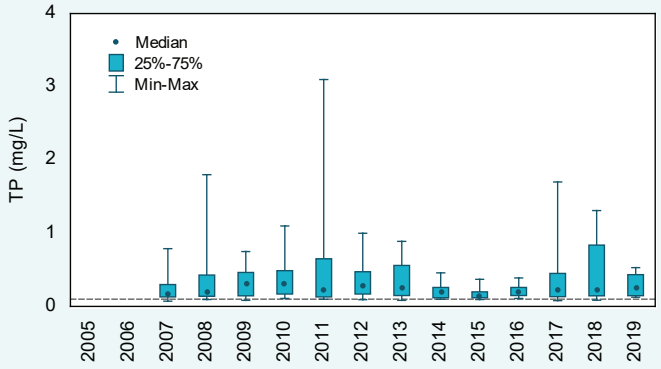
Concentrations

Annual total phosphorus (TP) concentrations at the Punrak Drain sampling site were classified as very high using the SWRWQA methodology and fluctuated over the reporting period. The majority of the samples, and all the medians, were above the protection plan water quality target for TP concentrations. Why the range in TP concentrations was much larger in 2011 than other years is unclear.

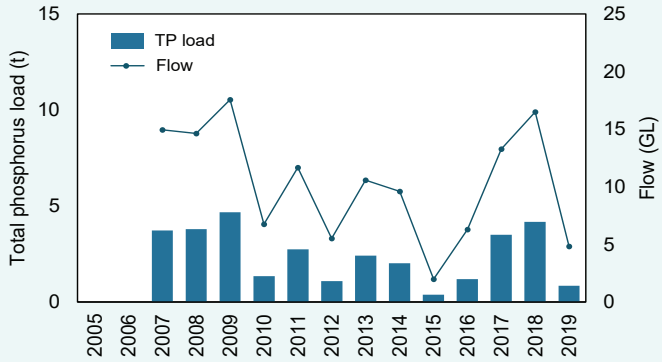
Estimated loads

Estimated TP loads at the Punrak Drain sampling site were moderate compared with the other sites in the Peel-Harvey catchment. In 2019, the site had an estimated TP load of 0.85 t. The load per square kilometre of 6.8 kg/km^2 was small 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.

Punrak Drain



Total phosphorus concentrations, 2005–19 at site 614094. The dashed line is the protection plan TP target.



Total phosphorus loads and annual flow, 2005–19 at site 614094.

High nutrient concentrations support plant growth. Here the drain is almost completely covered in vegetation, October 2010.

Dirk Brook–Punrak Drain

Phosphorus (2019)

Types of phosphorus

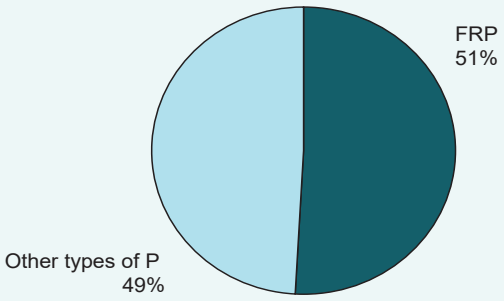
Total P is made up of different types of P. The proportion of P present as phosphate was large, the third largest of the 13 sites in the Peel-Harvey catchment. Phosphate is measured as filterable reactive phosphorus (FRP) which in surface waters is mainly present as phosphate (PO_4^{3-}). Phosphate is mainly sourced from animal waste and fertiliser and is readily bioavailable. The remainder 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.

Concentrations

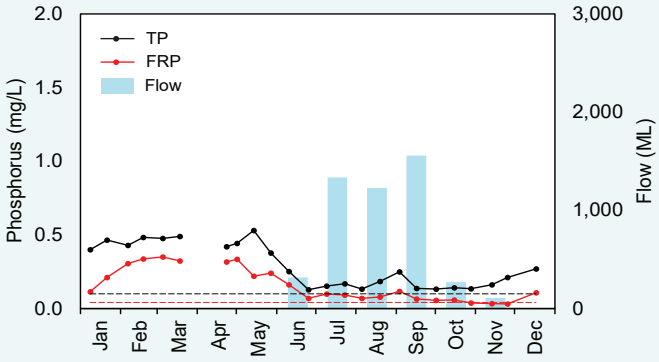
Total P and phosphate concentrations were highest in the first part of the year, when the relative proportion of groundwater in the stream was largest and there was little or no surface flow. This suggests phosphate was entering the drain via shallow groundwater and that concentrations in the groundwater were high. This was most likely because of a land use activity close to the measurement site, as phosphate is typically rapidly used by algae in slow-flowing waters. After the onset of winter rains, the concentrations of both TP and phosphate fell quickly. This suggests the P-rich groundwater was being diluted by surface flows which had lower P concentrations.

Where there was no data present in April, the site was not flowing.

Punrak Drain



2019 average phosphorus fractions at site 614094.



2019 phosphorus concentrations and monthly flow at 614094. The dashed black line is the protection plan TP target, the red is the ANZECC trigger value for lowland rivers for phosphate.

Aerial view of a drainage water treatment trial site in Punrak Drain. Phosphorus-binding clay is being added to the drain to remove phosphorus from the water, October 2017.

Dissolved organic carbon over time (2005–19)

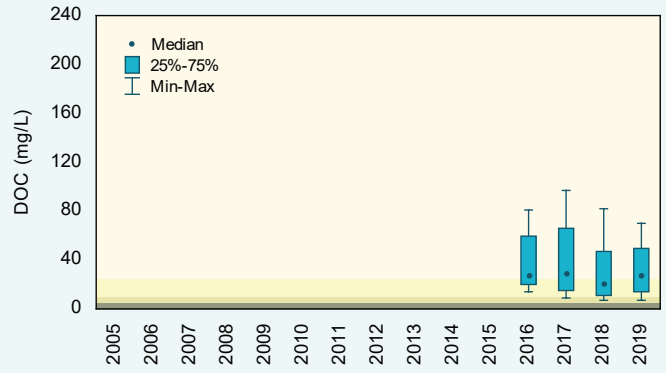
Concentrations

There were only four years with sufficient dissolved organic carbon (DOC) data available to graph at the Punrak Drain sampling site. Using the SWRWQA methodology, all years were classified as having very high DOC concentrations. Compared with the other sites sampled in the Peel-Harvey catchment, the annual range in DOC concentrations was large.

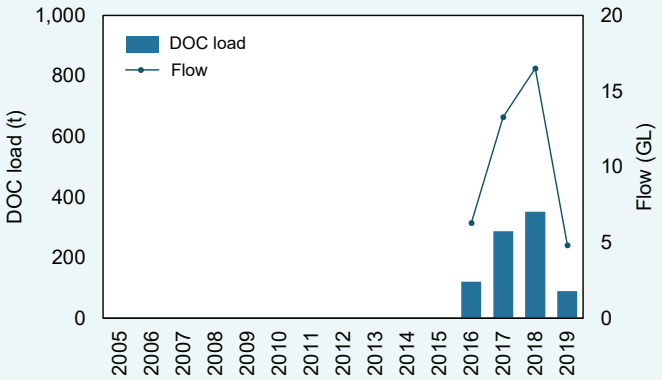
Estimated loads

Estimated DOC loads at the Punrak Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2019, the estimated DOC load was 89 t. The load per square kilometre of 722 kg/km^2 was also small 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.

Punrak Drain



Dissolved organic carbon concentrations, 2005–19 at site 614094. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2005–19 at site 614094.

low moderate high very high

The Punrak Drain sampling site. Note the presence of almost entirely exotic species growing along the drain, December 2005.

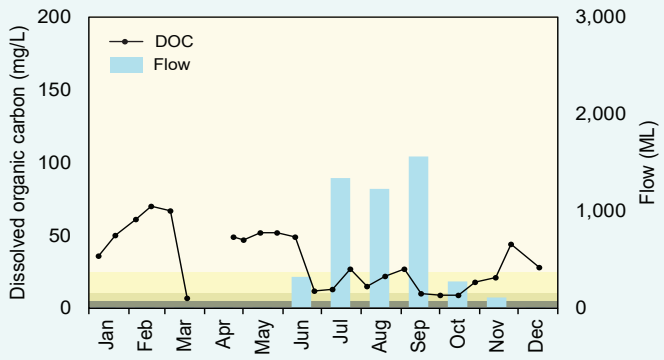
Dissolved organic carbon (2019)

Concentrations

With the exception of the low data point in March, DOC showed a similar seasonal pattern to N and P. Concentrations were higher in the first five months of the year, when flow was at its lowest. When rainfall and flow increased in June, DOC concentrations dropped. DOC is sourced mainly from degrading plant and animal matter including from agricultural land and natural organic matter in soils and wetlands, with many wetlands on deep sands typically generating high DOC concentrations. It varies widely in its bioavailability. The peak in the drier months suggests DOC was entering the drain via groundwater, with surface flows and in-stream sources contributing less. When surface flow increased, it diluted the DOC present in the groundwater at this site.

Where there was no data present in April, the site was not flowing.

Punrak Drain



2019 dissolved organic carbon concentrations and monthly flow at 614094. The shading refers to the SWRWQA classification bands.

low moderate high very high

An excavator removing excess plant growth from the drain close to the sampling site, May 2020.

Dirk Brook–Punrak Drain

Total suspended solids over time (2005–19)

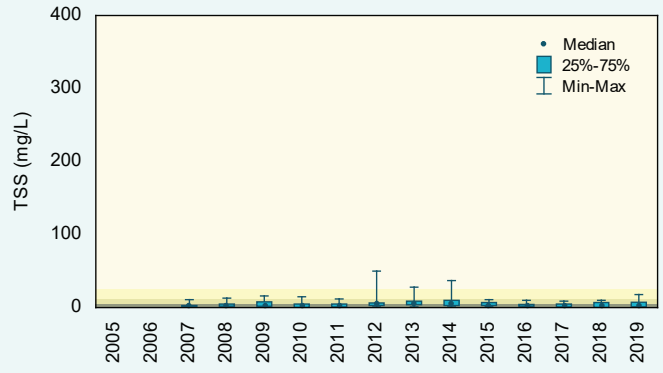
Concentrations

While total suspended solids (TSS) concentrations fluctuated over the reporting period they were generally low compared with the other Peel-Harvey catchment sites. Using the SWRWQA methodology, all annual TSS concentrations were classified as low, with the exception of 2014 and 2015 which were classified as having moderate TSS concentrations.

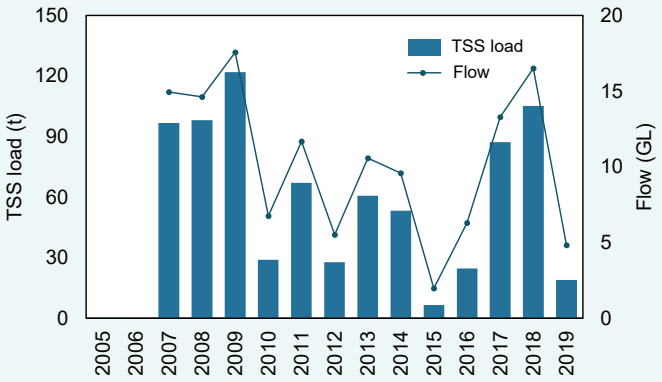
Estimated loads

Estimated TSS loads at the Punrak 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 19 t. The load per square kilometre of 153 kg/km^2 was moderate 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.

Punrak Drain



Total suspended solids concentrations, 2005–19 at site 614094. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 614094.

low moderate high very high

A Western Minnow, collected as part of a river health assessment carried out in the Punrak Drain, November 2017.

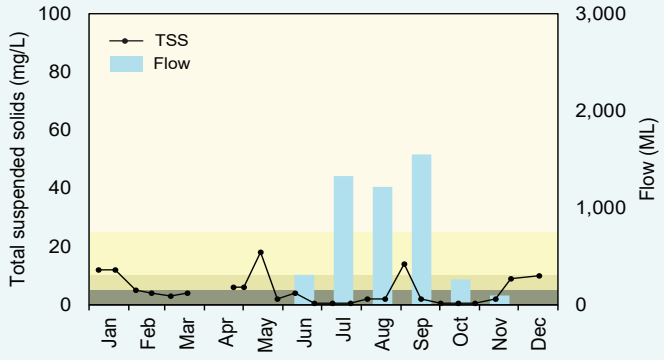
Total suspended solids (2019)

Concentrations

TSS concentrations fluctuated in 2019, though they were generally highest from about January to June, with a small peak in September and again later in the year. The higher TSS concentrations at these times was possibly because of a number of factors, including evapoconcentration and particulate matter accumulating on in-stream vegetation which may be disturbed at the time of sampling. Most of the samples collected fell into the low band, though there were a number that fell into the high band.

Where there was no data present in April, the site was not flowing.

Punrak Drain



2019 total suspended solids concentrations and monthly flow at 614094. The shading refers to the SWRWQA classification bands.

low moderate high very high

Freshwater mussels collected as part of a river health assessment carried out in the Punrak Drain, November 2017.

Dirk Brook–Punrak Drain

pH over time (2005–19)

pH values

pH fluctuated over the reporting period. The annual median pH was between the upper and lower Australian and New Zealand Environment and Conservation Council (ANZECC) trigger values, though many years had some samples which were below the lower ANZECC trigger value.

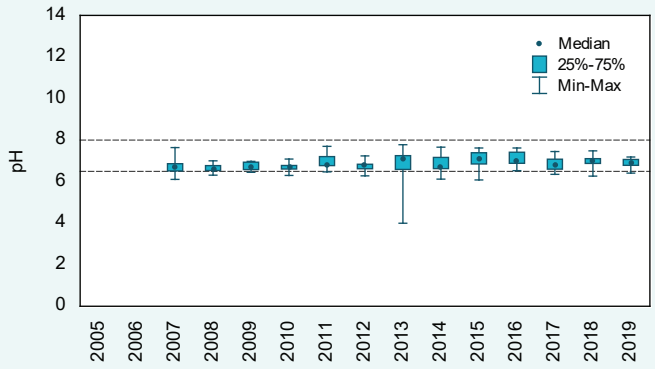
pH (2019)

pH values

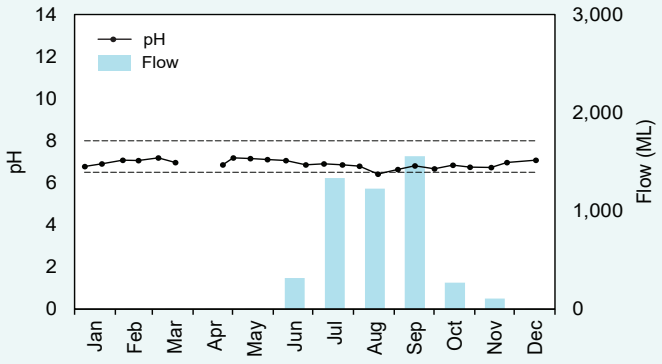
There was no clear seasonal pattern in pH at the Punrak Drain sampling site in 2019. Levels fluctuated, and dipped below the lower ANZECC trigger value in August on one sampling occasion. All other samples were between the upper and lower ANZECC trigger values.

Where there was no data present in April, the site was not flowing.

Punrak Drain



pH levels, 2005–19 at site 614094. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 614094. The dashed lines are the upper and lower ANZECC trigger values.

A sand deposit in Punrak Drain, downstream of the sampling site. Sand like this often comes from erosion along the drain and reduces the habitat available for aquatic animals, November 2017.

Dirk Brook–Punrak Drain

Salinity over time (2005–19)

Concentrations

Salinity fluctuated over the reporting period at Punrak Drain. Using the Water Resources Inventory 2014 salinity ranges, all years were classified as fresh. The annual range in data was large, however, with some samples falling into the brackish band each year (note the 2018 nutrient report used the SWRWQA bands).

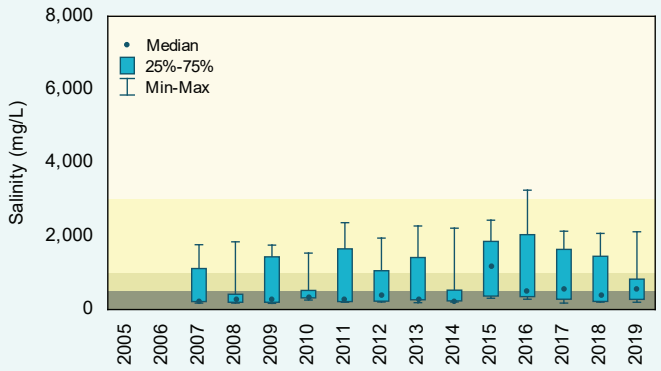
Salinity (2019)

Concentrations

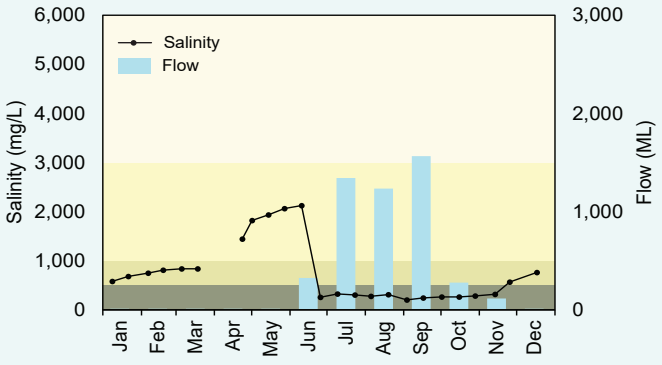
Salinity showed a similar pattern to TN, DON, TP and phosphate in Punrak Drain. Concentrations were highest (marginal or brackish) at the start of the year when the relative proportion of groundwater was at its highest. After the onset of winter rains, when surface flow diluted the groundwater in the drain, salinity dropped rapidly and was then fresh until late November, when it increased to marginal. This suggests that the groundwater near this site is brackish as well as being high in nutrients and that salinity gradually concentrates with evaporation during summer-autumn.

Where there was no data present in April, the site was not flowing.

Punrak Drain



Salinity concentrations, 2005–19 at site 614094. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations and monthly flow at site 614094. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

The rock weir used for gauging at the Punrak Drain sampling site under construction, March 2006.

Dirk Brook–Punrak 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 the latest data 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.

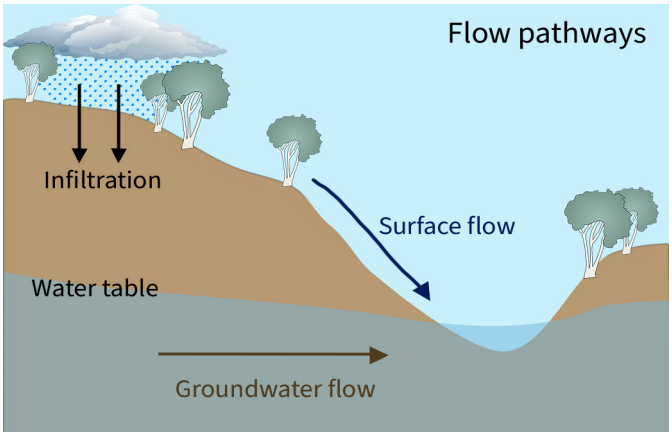
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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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