Dennis

This data report provides a summary of the nutrients at the Dennis 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 stream discharges into the Scott River and subsequently the Hardy Inlet.

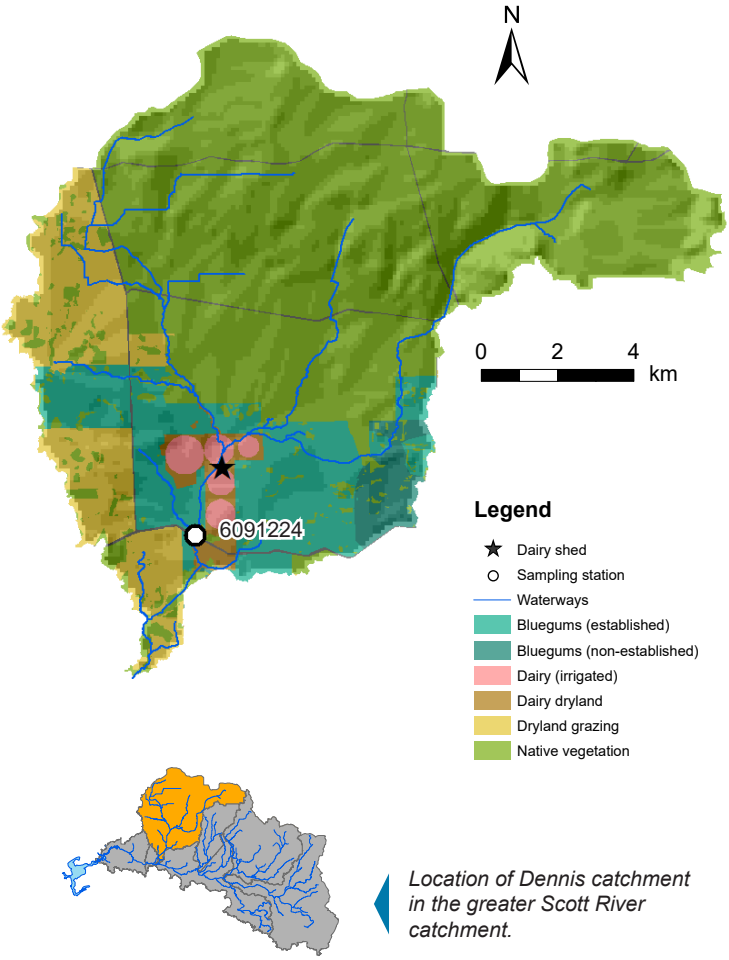
About the catchment

Dennis has a catchment area of about 145 km^2, more than two-thirds of which is covered by native vegetation, mostly in the northern portion of the catchment. Bluegum plantations and dryland grazing are the two dominant land uses and there is one dairy shed in the catchment. Drains have been constructed to help reduce surface water ponding in agricultural land. Much of the fringing vegetation has been lost where the waterways run through farmland.

Most of the soils in the cleared portion of the catchment have 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.

The Dennis catchment tributary discharges to the Scott River, roughly 2 km upstream of the Brennans Ford gauging station.

Water quality is measured at site 6091224, Coonack Downs, downstream of the culverts where the tributary passes under Governor Broome Road. Just upstream of the sampling site is an irrigated dairy.



Location of Dennis catchment in the greater Scott River catchment.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Coonack Downs sampling site in the Dennis catchment were higher in 2019 than 2018 with both nitrogen and phosphorus being classified as high for the first time. The proportion of nitrogen present as total ammonia was large, suggesting effluent from the upstream dairy shed is entering the waterway. The lack of fringing vegetation along waterways in farmland areas and the construction of drains to reduce surface water ponding means nutrients can be washed from soils to waterways and are transported downstream quickly rather than being assimilated.

Facts and figures

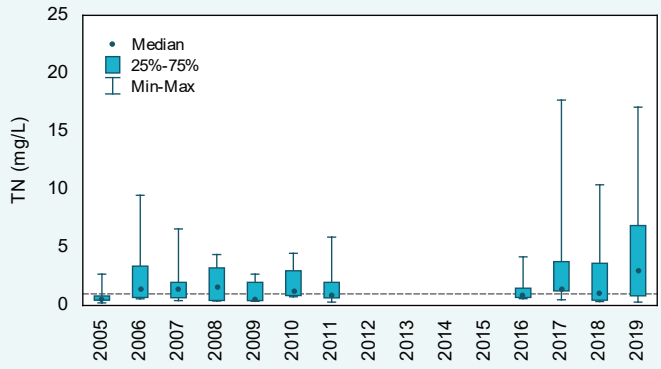
Sampling site code	6091224 (Coonack Downs)
Catchment area	145 km^2
Per cent cleared area (2009)	33 per cent
River flow	Ephemeral
Main land use (2009)	Native vegetation, bluegum plantations and dryland grazing

Nitrogen over time (2005–19)

Concentrations

TN concentrations fluctuated over the reporting period at Coonack Downs. Using the State Wide River Water Quality Assessment (SWRWQA) methodology, TN was classified as low from 2005–07, then moderate until 2018; in 2019 it was classified as high. In 2017 and 2019, the maximum concentrations (17.7 mg/L and 17.1 mg/L respectively), were extremely high for a waterway in the south-west of Western Australia. Land use in the catchment likely contributed to the high TN concentrations recorded, especially the irrigated dairy and dryland beef upstream of the sampling site. It is likely that pulses of nutrients were released from these land uses following periodic fertiliser application or after heavy rain events which flushed nutrients from paddocks and drains.

Coonack Down



Total nitrogen concentrations, 2005–19 at site 6091224. The dashed line is the Scott River WQIP target for median TN concentrations.

The water can be quite turbid at the sampling site early in the flow year. This photograph was taken in February.

Nitrogen (2019)

Types of nitrogen

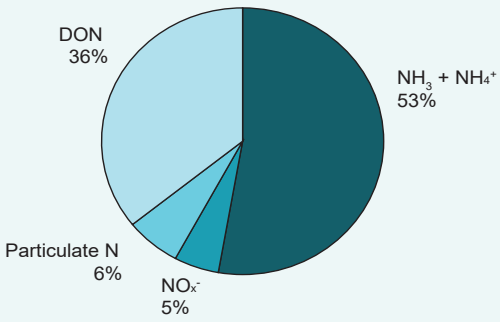
Total N is made up of different types of N. Coonack Downs had the second highest percentage of N present as total ammonia (NH_3 + NH_4^+) of the nine sites sampled in the Scott River catchment (53 per cent). This is a much higher proportion than is found in pristine waterways. This type of N is bioavailable to plants and algae and is used to fuel rapid growth. It is likely the total ammonia is coming from the dairy farm upstream as it is found in high concentrations in animal waste. The percentage of N present as dissolved organic N (DON) was the second lowest of the Scott River sites. 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.

Concentrations

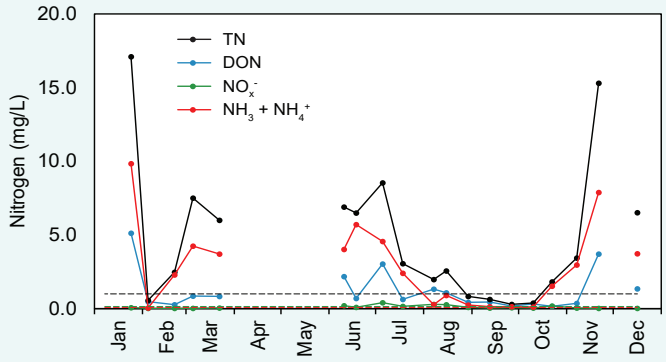
N concentrations varied throughout the year. Concentrations were very high at the start and end of the year, likely a result of irrigation returns or dairy effluent entering the waterway as there would have been very little flow from other sources at this time. The very high N concentrations when the waterway started to flow in June and July were likely because of a first flush effect where N was mobilised following heavy rainfall. Much of this N was likely to be the result of mineralisation of organic N in soils and drains over the summer period, and runoff of high-concentration waters from irrigated pasture, which builds up with fertiliser and animal waste over the summer periods. Concentrations were relatively low in the first part of spring, possibly because of dilution of point sources by rainfall runoff.

Where there are no data in the graph, the waterway was not flowing. In 2018, the site was not visited before the end of May and may have been flowing before this.

Coonack Downs



2019 average nitrogen fractions at site 6091224.



2019 nitrogen concentrations at 6091224. The black dashed line is the Scott River WQIP target for TN, the red and green lines are the ANZECC trigger values for total ammonia and nitrate.

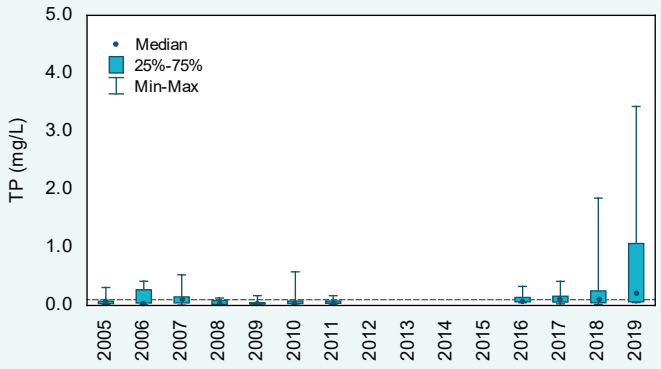
Cattle with unrestricted access to waterways. They contribute nutrients, destroy fringing vegetation and cause erosion.

Phosphorus over time (2005–19)

Concentrations

Total phosphorus (TP) concentrations were classified as moderate using the SWRWQA methodology for all years except 2019 which was classified as high. The annual median concentrations were below the Water Quality Improvement Plan (WQIP) TP target before 2017. Since 2017, the annual medians have been above the WQIP target. TP concentrations fluctuated before the break in monitoring but appear to be increasing since then, with the maximum concentration steadily increasing.

Coonack Downs



Total phosphorus concentrations, 2005–19 at site 6091224. The dashed line is the Scott River WQIP target for median TP concentrations.

Much of the natural fringing vegetation has been lost and replaced with weeds along the waterways in the Dennis catchment.

Phosphorus (2019)

Types of phosphorus

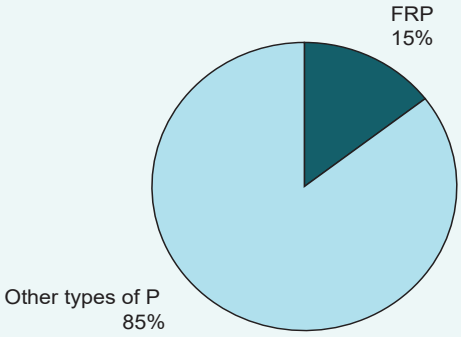
Total P is made up of different types of P. At Coonack Downs, 85 per cent of the P was present as either particulate P or dissolved organic P (DOP) or both (shown as 'Other types of P' in the pie chart below). Particulate P generally needs to be broken down before becoming bioavailable. The bioavailability of DOP varies and is poorly understood. The remainder of the P was present as phosphate; measured as filterable reactive phosphorus (FRP), in surface waters this is mainly present as phosphate (PO_4^{3-}) species and is readily bioavailable. Phosphate was probably derived from animal waste and fertilisers as well as natural sources. While the average proportion of P present as phosphate was relatively low, there were a number of sampling occasions when phosphate was well above its Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value.

Concentrations

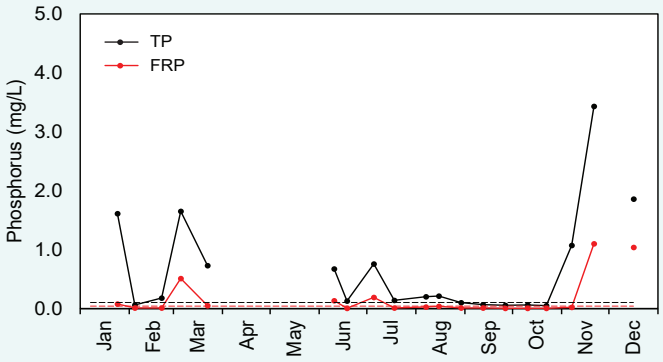
TP and, to a slightly lesser extent, phosphate concentrations showed a reverse seasonal pattern, being higher early and late in the year and lower in the middle. Early and late in the year, when P concentrations were highest, there was less water present so any irrigation returns or dairy effluent entering the waterway was not being diluted by the lower concentrations found in catchment runoff. It is likely that much of the P at this site is coming from irrigation returns and dairy effluent, with other catchment sources contributing less.

Where there are no data in the graph, the waterway was not flowing. In 2018, the site was not visited before the end of May and may have been flowing before this.

Coonack Downs



2019 average phosphorus fractions at site 6091224.



2019 phosphorus concentrations at 6091224. The black dashed line is the Scott River WQIP target for TP, the red is the ANZECC trigger value for phosphate.

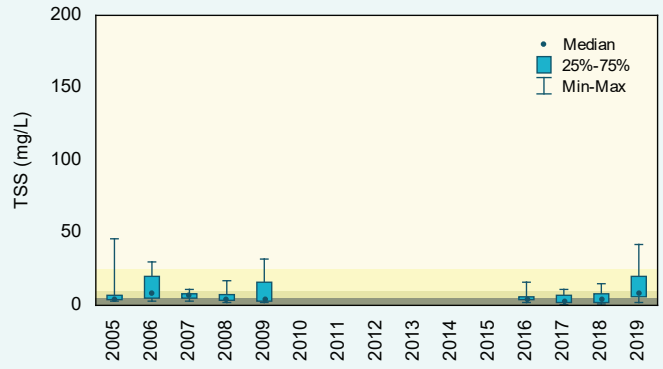
High water levels in September. The bluegum plantations in the background are one of the dominant land uses in the Dennis catchment.

Total suspended solids over time (2005–19)

Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Using the SWRWQA methodology, annual TSS concentrations were classified as low before the break in monitoring and moderate afterwards. Like with TN and TP, TSS concentrations appear to be increasing from 2016–19, though they are still within the range experienced before the break in monitoring. High TSS concentrations can have an unfavourable impact on aquatic biota as it may smother their gills. It can also reduce available habitat by settling out, reducing the complexity of the habitat available to them.

Coonack Downs



Total suspended solids concentrations, 2005–19 at site 6091224. The shading refers to the SWRWQA classification bands.

low moderate high very high

The Coonack Downs sampling site in August. Water levels are typically high at this time of the year.

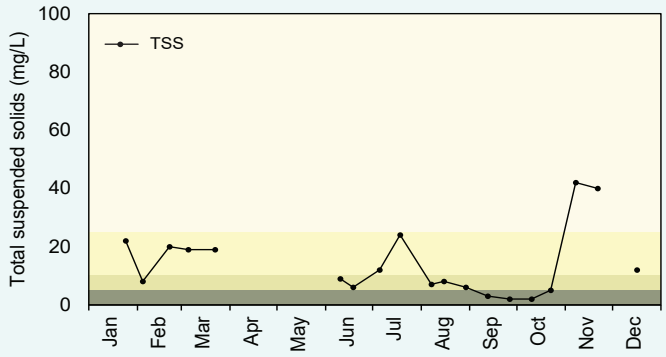
Total suspended solids (2019)

Concentrations

In 2019, TSS concentrations followed a similar pattern to TN and TP, being higher at the beginning and end of the year as well as peaking in July. The high concentrations in the beginning and end of the year are likely from irrigation returns and dairy effluent as well as possibly livestock accessing the waterway for water.

Where there are no data in the graph, the waterway was not flowing. In 2018, the site was not visited before the end of May and may have been flowing before this.

Coonack Downs



2019 total suspended solids concentrations at 6091224. The shading refers to the SWRWQA classification bands.

low moderate high very high

The Coonack Downs sampling site in December. The site has ceased to flow, with only a stagnant pool present. This site often dries completely over summer and autumn.

pH over time (2005–19)

pH values

pH at Coonack Downs fluctuated over the reporting period, with some low pH values recorded; well below the lower ANZECC trigger value. In all years, except 2015 when it was below the lower trigger value, the median pH has been within the upper and lower ANZECC trigger values. pH values below the lower ANZECC trigger values indicate that the water is acidic and may have negative impacts on the biota at the site.

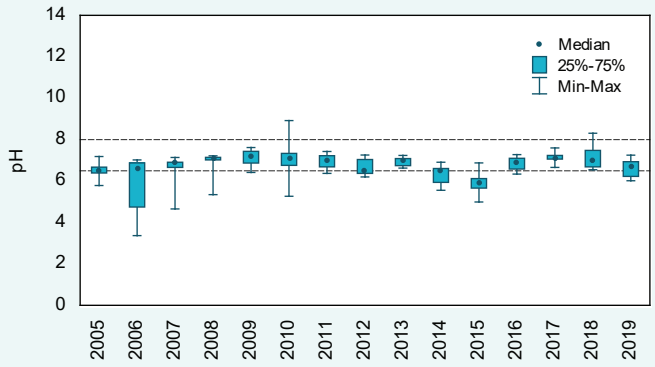
pH (2019)

pH values

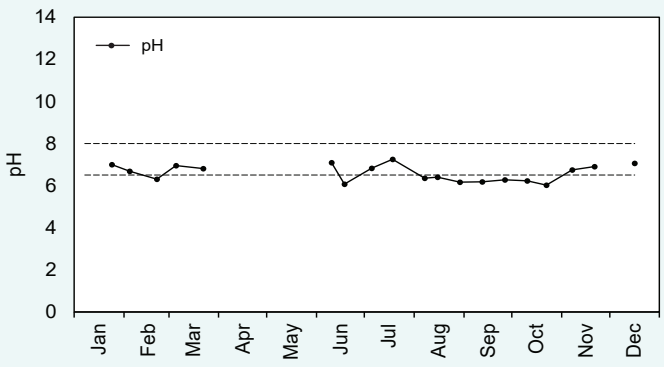
There was no evidence of a seasonal pattern in pH at Coonack Downs, with values fluctuating throughout the year. Nearly half of the samples collected in 2019 were below the lower ANZECC trigger value.

Where there are no data in the graph, the waterway was not flowing. In 2018, the site was not visited before the end of May and may have been flowing before this.

Coonack Downs



pH levels, 2005–19 at site 6091224. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels at 6091224. The dashed lines are the upper and lower ANZECC trigger values.

Algae growing in a stagnant pool at the Coonack Downs sampling site in November.

Salinity over time (2005–19)

Concentrations

Salinity fluctuated over the reporting period at Coonack Downs. Using the Water Resources Inventory 2014 salinity ranges, all years were classified as fresh (note the 2018 nutrient report used the SWRWQA bands).

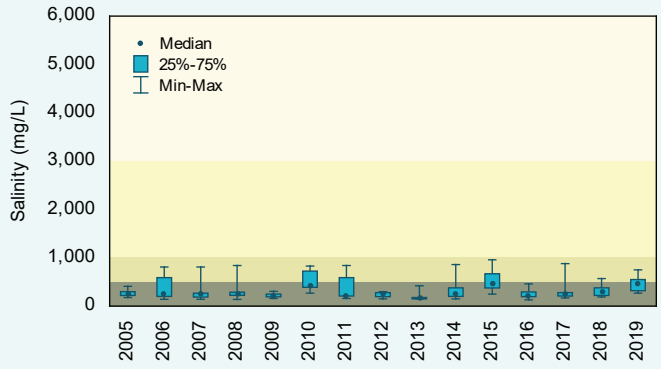
Salinity (2019)

Concentrations

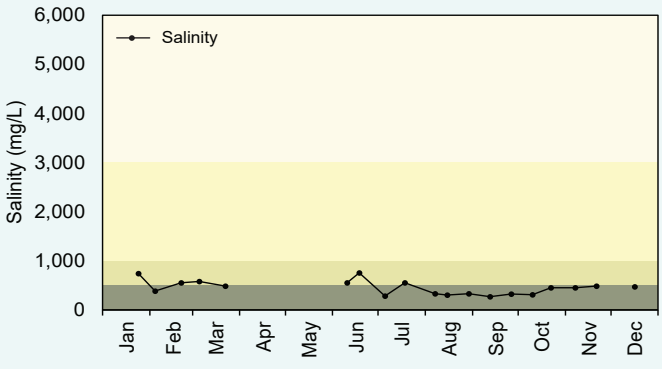
Salinity showed a slight inverse relationship to flow. That is, when flow volumes were larger, salinity levels were lower and vice versa. The small peaks in January and June were likely related to either salts left behind by evaporation as the stream dried over summer and then again in autumn being dissolved following rainfall or salts being washed into the waterway from the catchment. The increase in concentrations later in the year coincided with water in the stream drying up. At this time, more of the water present is groundwater, irrigation returns and dairy effluent and there is also evapoconcentration occurring, which suggests the slightly elevated salinity is because of one (or more) of these sources.

Where there are no data in the graph, the waterway was not flowing. In 2018, the site was not visited before the end of May and may have been flowing before this.

Coonack Downs



Salinity concentrations, 2005–19 at site 6091224. The shading refers to the Water Resources inventory 2014 salinity ranges.



2019 salinity concentrations at 6091224. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

Paperbarks overhanging a waterway in the Dennis catchment. These provide shading as well as a natural carbon source to the waterway.

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; both the catchment and estuary. 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 more information on the condition of Hardy Inlet at estuaries.dwer.wa.gov.au/estuary/hardy-inlet/

Healthy Estuaries WA partners with the Lower Blackwood Land Conservation District Committee (Lower Blackwood LCDC) 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 Lower Blackwood LCDC go to lowerblackwood.com.au
- To find out more about the health of the rivers in the Hardy Inlet catchment go to rivers.dwer.wa.gov.au/assessments/results

Methods

Variables were compared with the Scott River WQIP targets or ANZECC trigger values where available, or the SWRWQA bands or 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 in the 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.

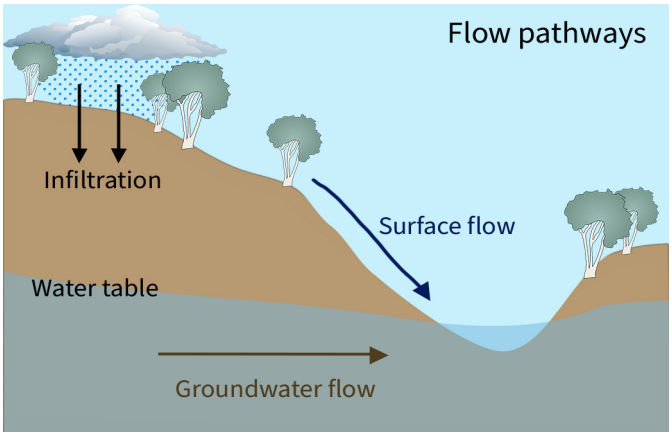
Laboratory limit of reporting: this is the lowest concentration (or amount) of an analyte that can be reported by a laboratory.

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

Load per 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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