

Governor Broome

This data report provides a summary of the nutrients at the Governor Broome sampling site in 2018 as well as historical data from 2004–18. This report was produced as part of the Regional Estuaries Initiative. Downstream of this site, the stream discharges to the Scott River and subsequently the Hardy Inlet. Nutrients (nitrogen and phosphorus) are compounds that are important for plants to grow. Excess nutrients entering waterways from effluent, fertilisers and other sources can fuel algal growth, decrease oxygen levels in 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.

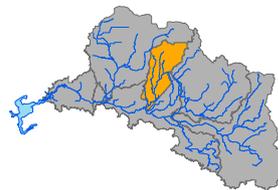
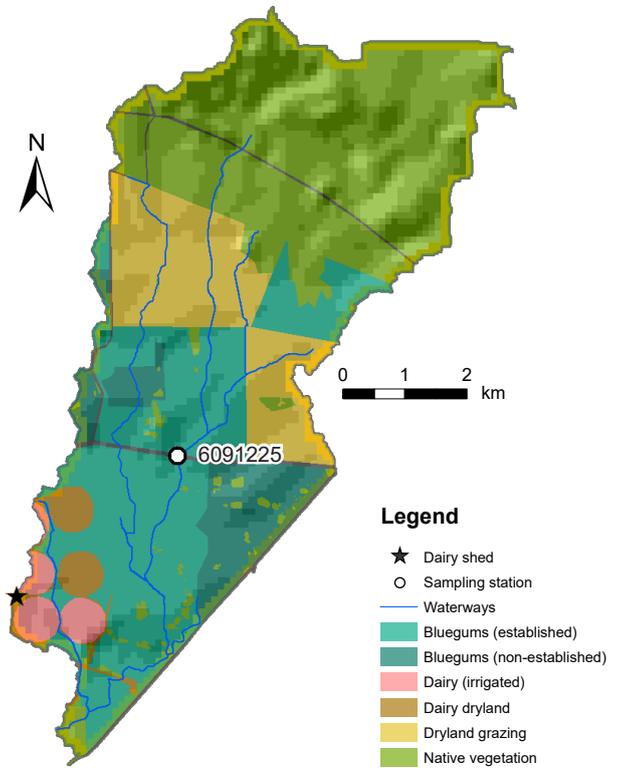
About the catchment

Governor Broome has a catchment area of about 46 km², about 40 per cent of which is covered in native vegetation, in the northern portion of the catchment. More than a third of the catchment is covered in bluegum plantations and there are large areas of dryland grazing. There is also dryland and irrigated dairy present as well as a dairy shed, though these are all downstream of the sampling site. In some areas, drains have been constructed to help reduce ponding in agricultural land. Much of the fringing vegetation has been lost along waterways in the agricultural areas.

Water quality is measured at site 6091225, Governor Broome Road, just downstream of where the waterway passes under the road. Upstream of the site are bluegum plantations and dryland grazing, with native vegetation further upstream.

Results summary

Nutrient concentrations (total nitrogen and, to a lesser extent, total phosphorus) at the Governor Broome Road sampling site in the Governor Broome catchment were high. Most of the nitrogen was present as dissolved organic nitrogen, indicating much of the nitrogen is being sourced from degrading plant and animal matter. This is typical of a site that has some agricultural land uses further upstream but no nearby point sources of nutrient pollution.



Location of Governor Broome catchment in the greater Scott River catchment.

Facts and figures

Sampling site code	6091225
Rainfall at Brennans Ford (2018)	850 mm
Catchment area	46 km ²
Per cent cleared area (2009)	59 per cent
River flow	Ephemeral
Main land use (2009)	Native vegetation, bluegum plantations and dryland grazing

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Nitrogen over time (2004–18)

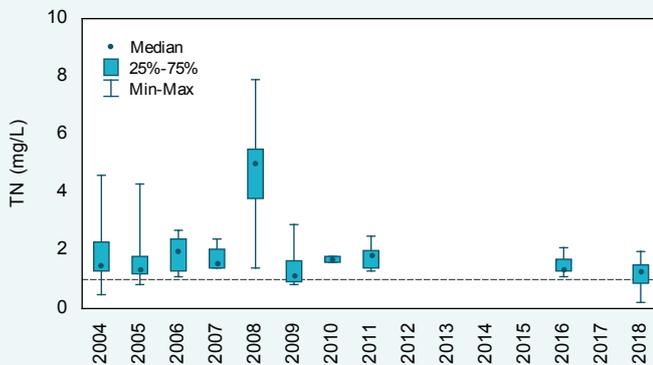
Concentrations

Total nitrogen (TN) concentrations at the Governor Broome Road sampling site were high, with the median in excess of the Water Quality Improvement Plan (WQIP) target every year for which there were sufficient data to calculate it. TN concentrations have fluctuated over the past 15 years, with 2018 appearing to have slightly lower TN concentrations than previous years. 2008 was an outlier, with TN concentrations much higher in this year. The reason for these high concentrations is unknown. One possibility is that fertiliser was applied to the upstream blue gum plantations during this year (though there is no proof this was the case).

Trends

Because of the gaps in the monitoring data between 2012–15 and in 2017, it was not possible to test for trends in TN concentrations at Governor Broome Road as a minimum of five years of data are required to test for trends.

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Total nitrogen concentrations, 2004–18 at site 6091225. The dashed line is the Scott River WQIP target for median TN concentrations.



The Governor Broome Road sampling site, dry in June.

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Nitrogen (2018)

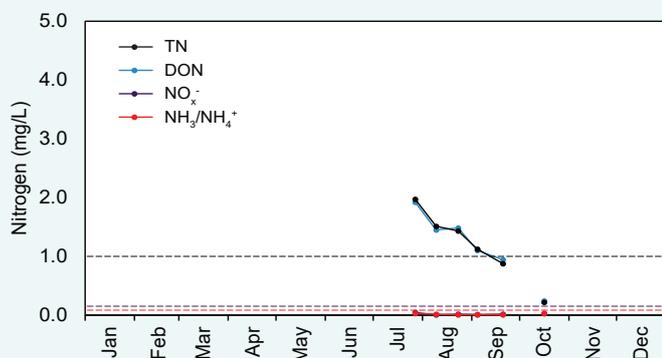
Concentrations

In 2018, TN and dissolved organic N (DON) concentrations peaked when the stream started flowing and then slowly decreased during the year. It is likely N was being washed into the stream following rainfall during the start of the flow year. Much of this N was organic N washing from soils and remnant wetlands where it had built up over the summer period. As the year progressed, the proportion of water coming from groundwater would have increased, suggesting groundwater concentrations were lower than what was present in the surface water. All the dissolved N concentrations (oxides of nitrogen, NO_x^- , and ammonia N, $\text{NH}_3/\text{NH}_4^+$) were low, below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger values for lowland rivers on each occasion the site was sampled.

Types of nitrogen

Total N is made up of many different forms of N. As more than half of the $\text{NH}_3/\text{NH}_4^+$ samples collected at this site were below the laboratory limit of reporting, a pie chart showing the nutrient fractions has not been constructed. It can be seen from the time-series graph, however, that the dominant form of N was DON. This form of N consists of plant and animal matter which needs to be further broken down before it becomes available to fuel plant and algal growth as well as more bioavailable forms. It is likely a lot of the N in this catchment is coming from plant and animal matter that is being washed or deposited into the stream. The highly bioavailable forms of N (NO_x^- and $\text{NH}_3/\text{NH}_4^+$) both contributed very little to the N present at this site; it is likely that NO_x^- is being denitrified in the watershed before it reaches the sampling location. The distribution of the N fractions at this site are typical of a site which receives some nutrient input from agricultural land use but has no significant point sources upstream of the sampling site.

Governor Broome Road



2018 nitrogen concentrations at 6091225. The black dashed line is the Scott River WQIP target for TN, the red and purple lines are the ANZECC trigger values for lowland rivers for $\text{NH}_3/\text{NH}_4^+$ and NO_x^- .



The Governor Broome Road sampling site, wet in August.

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Phosphorus over time (2004–18)

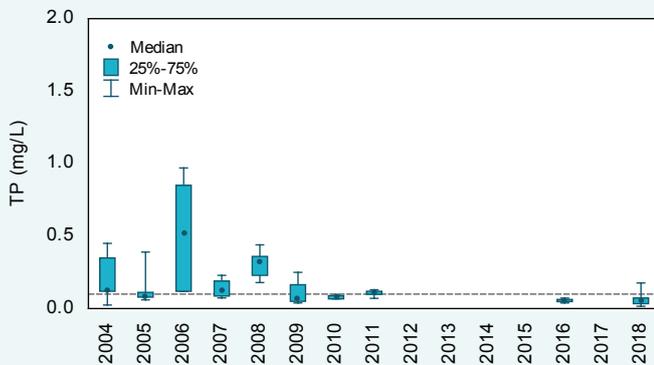
Concentrations

Over the past 15 years, TP concentrations at the Governor Broome Road sampling site fluctuated with some evidence they improved since 2009. The reason for this apparent improvement is unclear but may be because of land use change from grazing to bluegum plantations which is causing the P to run down from soil stores. In 2018, Governor Broome Road had the second lowest median TP concentration of the sites sampled in the Scott River catchment (0.062 mg/L, Four Acres Road, which has a catchment almost completely covered by native vegetation, had the lowest median of 0.003 mg/L). There were two years, 2006 and 2008, when all the samples collected were greater than the WQIP target. The reason for this is unknown. There was a corresponding peak in TN concentrations in 2008, which can possibly be attributed to fertiliser use in the bluegum plantations (though there is no proof that this was the case). The reason why 2006 had much higher TP concentrations than surrounding years is unknown.

Trends

Because of the gaps in the monitoring at this site (2012–15 and 2017) it was not possible to test for trends in TP concentrations as a minimum of five years of data are required to test for trends.

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Total phosphorus concentrations, 2004–18 at site 6091225. The dashed line is the Scott River WQIP target for median TP concentrations.



Bluegums in the Governor Broome catchment.

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Phosphorus (2018)

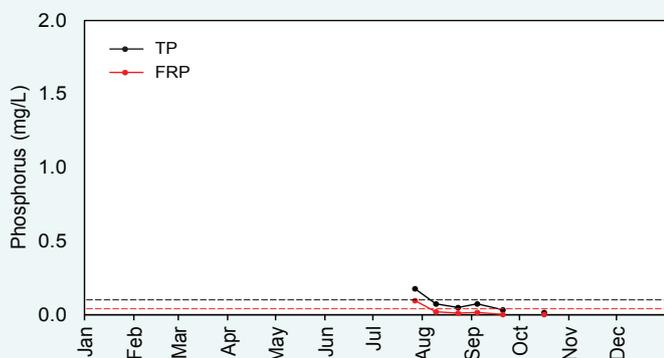
Concentrations

Both TP and FRP concentrations were relatively low at Governor Broome Road, with all samples collected below the WQIP TP target and ANZECC FRP trigger value for lowland rivers, with the exception of the first sample collected in July, when the stream started flowing. It is likely that this small peak is because of a first-flush effect where rainfall flushed P into the stream from surrounding land use as well as mobilising P that was already present on the stream bed. It is likely P is coming from in-stream sources as well as entering the stream via both surface flows and groundwater.

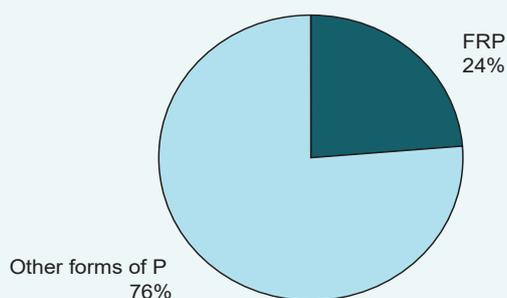
Types of phosphorus

Total P is made up of different types of P. Governor Broome Road had the lowest percentage of P present as FRP (24 per cent) of the sites in the Scott River catchment. This form of P is readily available for plants and algae to use to fuel growth. The remainder of the P was present as either particulate P or dissolved organic P. Particulate P generally needs to be broken down before becoming bioavailable to algae. The bioavailability of DOP varies and is poorly understood.

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2018 phosphorus concentrations at 6091225. The black dashed line is the Scott River WQIP target for TP, the red is the ANZECC trigger value for lowland rivers for FRP.



2018 average phosphorus fractions at site 6091225.



Collecting a water quality sample for laboratory analysis.

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Total suspended solids over time (2004–18)

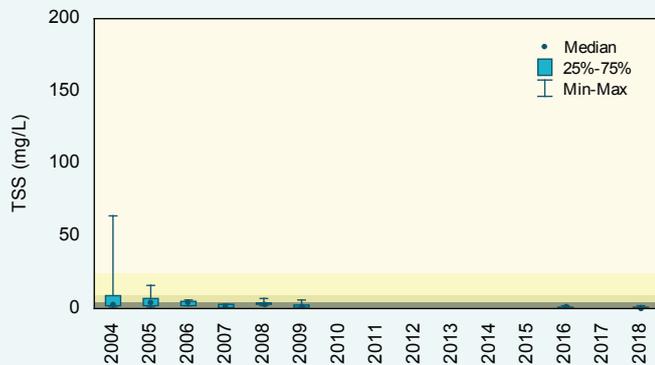
Concentrations

Total suspended solids (TSS) concentrations were low at the Governor Broome Road sampling site, with all available annual median concentrations over the past 15 years classified as low using the Statewide River Water Quality Assessment (SWRWQA) classification bands.

Trends

Because of the gaps in the monitoring at this site (2010–15 and 2017) it was not possible to test for trends in TSS concentrations as a minimum of five years of data are required to test for trends.

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Total suspended solids concentrations, 2004–18 at site 6091225. The shading refers to the SWRWQA classification bands.

very high high moderate low



Filamentous algae growing in the waterway in September.

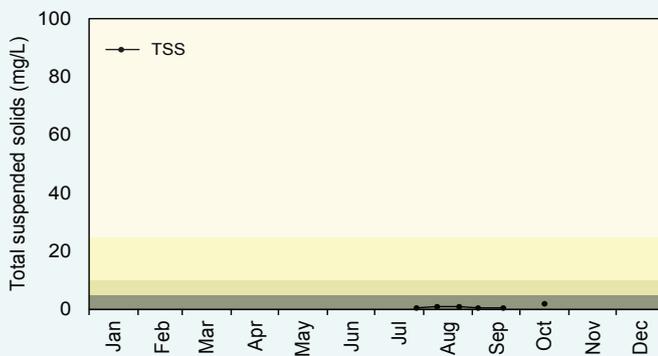
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Total suspended solids (2018)

Concentrations

In 2018, all of the TSS samples collected were classified as low. Half of the samples had TSS concentrations so low that they were below the laboratory limit of reporting. There was no evidence of a seasonal pattern in TSS concentrations. The sample collected in October was slightly higher than those collected earlier in the year but this is likely because of natural variability at the site. It is likely particulates were entering the stream via surface flows as well as from in-stream sources such as erosion.

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2018 total suspended solids concentrations at 6091225. The shading refers to the SWRWQA classification bands.

very high high moderate low



Bluegum plantation in the process of being logged in the Governor Broome catchment.

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pH over time (2004–18)

pH values

Over the past 15 years, pH at the Governor Broome Road sampling site fluctuated, though the median pH was between the upper and lower ANZECC trigger values for lowland rivers each year. There have been no samples with a pH below the lower ANZECC trigger value since 2005.

Trends

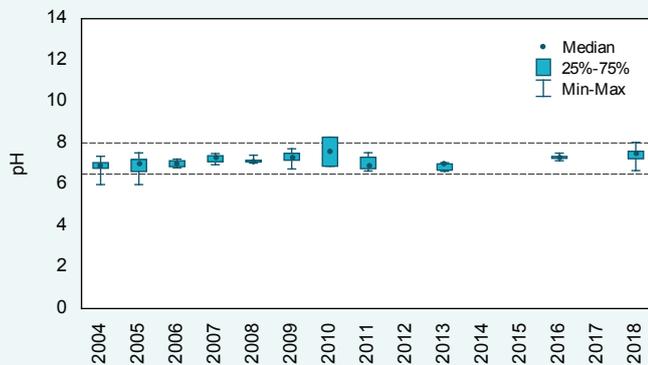
Because of the gaps in the monitoring at this site (2012, 2014–15 and 2017) it was not possible to test for trends in pH as a minimum of five years of data are required to test for trends.

pH (2018)

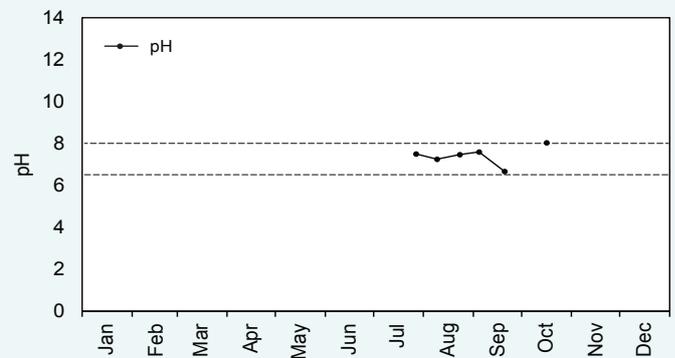
pH values

All but one of the samples collected in 2018 were between the upper and lower ANZECC trigger values. The past sample collected, in October, was just over the upper ANZECC trigger value.

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pH levels, 2004–18 at site 6091225. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels at 6091225. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



Young bluegum plantation in Governor Broome catchment.

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Salinity over time (2004–18)

Concentrations

The Governor Broome Road sampling site was fresh, with all samples collected over the past 15 years being classified as fresh using the SWRWQA classification bands. While salinity fluctuated slightly over the reporting period it does not appear to be changing. In 2018, Governor Broome Road had the second lowest median salinity of all the sites sampled in the Scott River catchment (160 mg/L, Four Acres Road, which has an upstream catchment that is almost entirely covered in native vegetation, had a median salinity of 110 mg/L).

Trends

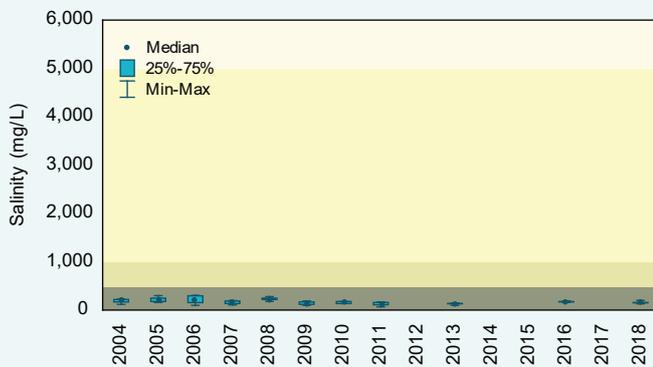
Because of the gaps in the monitoring at this site (2012, 2014–15 and 2017) it was not possible to test for trends in salinity as a minimum of five years of data are required to test for trends.

Salinity (2018)

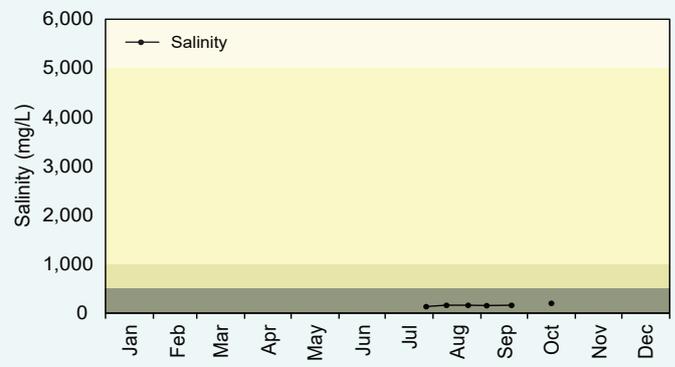
Concentrations

Salinity showed no seasonal pattern at the Governor Broome Road sampling site. All samples collected in 2018 were classified as fresh using the SWRWQA classification bands.

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Salinity concentrations, 2004–18 at site 6091225. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations at 6091225. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh



The waterway just downstream from the Governor Broome Road sampling site, September 2018.

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 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 Hardy Inlet at estuaries.dwer.wa.gov.au/estuary/hardy-inlet/

The Regional Estuaries Initiative partners with the Lower Blackwood Land Conservation District Committee (Lower Blackwood LCDC) 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 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

Total nitrogen and TP concentrations were compared with the Scott River WQIP targets. These targets represent the historical median winter concentration where *lyngbya* blooms were not observed in the upper Hardy Inlet. They were developed for use at Brennans Ford but have been used at all Scott River sites to allow for comparisons between sites. 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 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 concentrations 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.

