Drakes Brook – Waroona Drain

Drakes Brook starts on the Darling Plateau in the Dwellingup State Forest to the east of Waroona. The natural flow of the Brook has been modified by engineering works. There are two dams in the catchment: Drakes Brook Dam (Lake Moyanup) and Waroona Dam (Lake Navarino). When required discharge from Drakes Brook Dam is diverted, via Drakes Brook Drain, to service the north of the catchment.

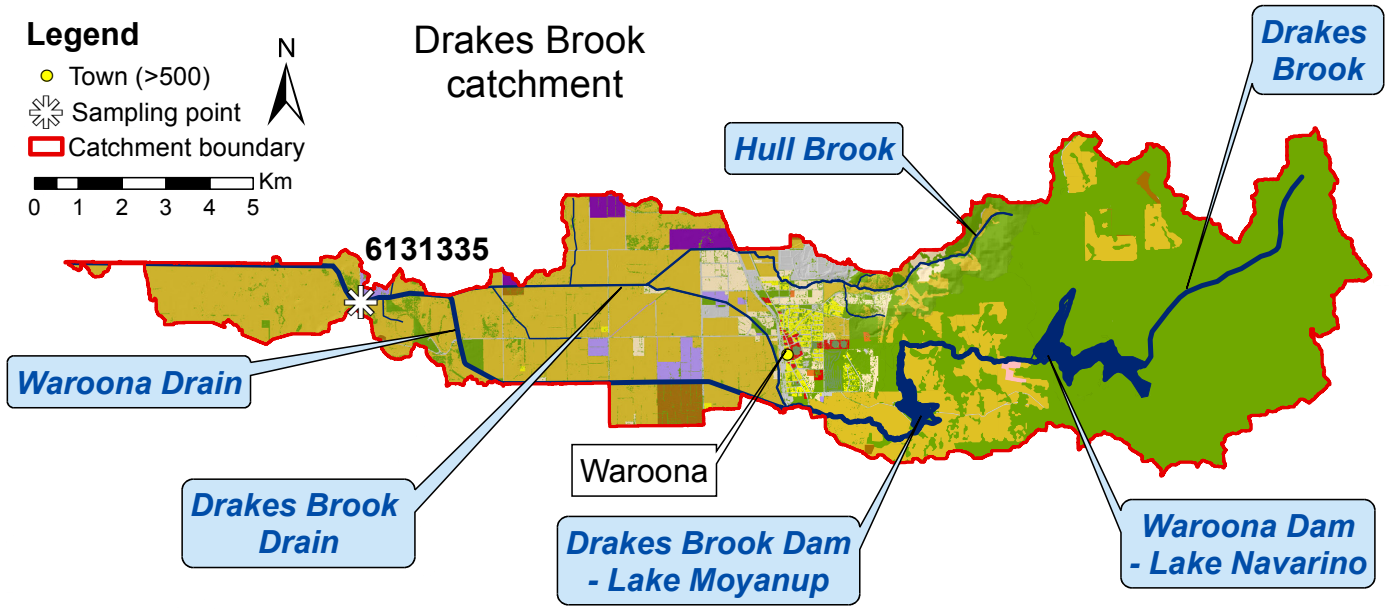
The monitoring site at Dorsett Road (6131335) on Waroona Drain, downstream of the confluence of Drakes Brook Drain and Waroona Drain, has been sampled for water quality since September 2006. There is no flow gauging station in the catchment. Waroona Drain discharges into the Harvey River, just upstream of the gauging station (613052).

Less than 3% of the Drakes Brook catchment is subject to seasonal inundation, while 11% of the catchment has a high or very high risk of phosphorus leaching to waterways.

The catchment consists of a variety of soil types, including massive rock outcrops with acid red earths, sandy acidic yellow mottled soils and dark porous loamy soils containing ironstone gravel.

To the east of the Darling Scarp the catchment remains relatively undisturbed. West of the scarp, the land has been cleared, mostly for agriculture such as stock grazing, as well as industry and lifestyle blocks.

Land use classification (2006)[1]	Area (km²)	Area (%)
Animal keeping – non-farming (horses)	0.06	0.06
Cattle for beef (predominantly)	39	37
Cattle for dairy	1.2	1.1
Conservation and natural	57	53
Horticulture	1.2	1.1
Industry, manufacturing and transport	3.1	2.9
Lifestyle block	2.6	2.4
Mixed grazing	1.1	1.0
Offices, commercial and education	0.23	0.22
Recreation	0.28	0.26
Residential	0.99	0.93
Viticulture	0.14	0.13
Total	**107**	**100**



Nutrient summary: median concentrations, loads and status classification at 6131335

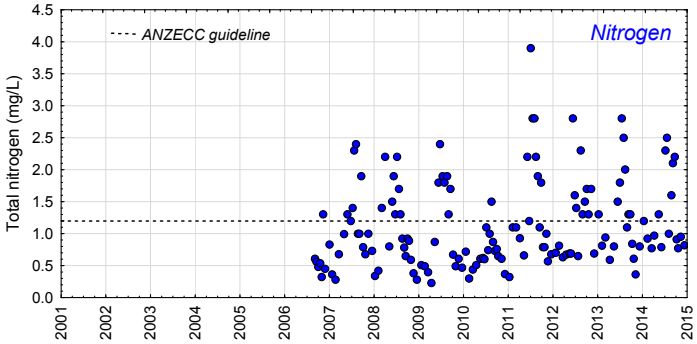
Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Annual flow (GL)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TN median (mg/L)	-	-	-	-	-	0.56	1.0	0.92	0.77	0.65	1.1	1.3	1.1	0.99
TP median (mg/L)	-	-	-	-	-	0.030	0.044	0.065	0.040	0.038	0.061	0.067	0.072	0.065
TN load (tonnes)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP load (tonnes)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

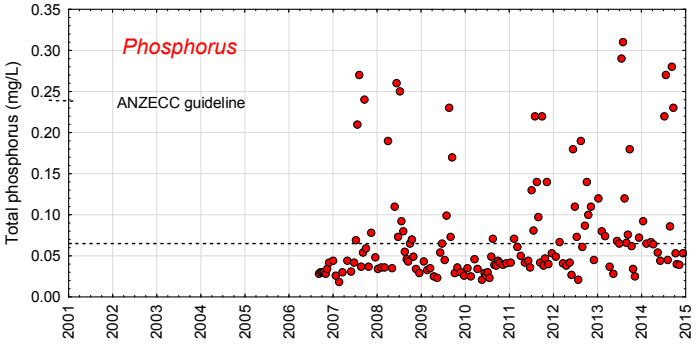
Status classification[2] Low Moderate High Very high

Status reported for three-year period end (i.e. 2012–14 reported in 2014)
TN = total nitrogen TP = total phosphorus

* Best estimate using available data
(- not applicable)

Total nitrogen (TN) and total phosphorus (TP) concentrations (2006–14) at 6131335





TN concentration:

Between 2006 and 2014, 36% of TN samples exceeded the ANZECC[3] guideline for lowland rivers (1.2 mg/L). The annual percentage of TN samples that exceeded the guideline ranged between 6% (2010) and 53% (2012).

The percentage of samples exceeding 1.2 mg/L increased slightly from 36% (2006–09) to 43% (2011–14).

TN trend:

Trend analysis[2] was not undertaken using data from 2010 to 2014 inclusive as 2010 was an atypical year.

Five years of continuously increasing, decreasing or relatively consistent concentrations are needed to calculate a trend.

TP concentration:

Between 2006 and 2014, an average of 37% of TP samples exceeded the ANZECC[3] guideline for lowland rivers (0.065 mg/L).

The annual percentage of samples that exceeded 0.065 mg/L ranged from 0% (2006) to 65% (2013). There was an increase in the percentage of exceedance from 29% (2006–09) to 51% (2011–14).

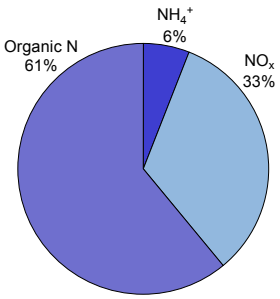
TP trend:

Trend analysis[2] was not undertaken using data from 2010 to 2014 inclusive as 2010 was an atypical year.

Five years of continuously increasing, decreasing or relatively consistent concentrations are needed to calculate a trend.

Upstream view of Waroona Drain at 6131335 – February 2008

Nutrient fractions (2010–14) at 6131335



Nitrogen:

Most of the nitrogen (N) was organic in nature. Organic N consists of both dissolved organic and particulate N. It is derived from degrading plant and animal matter and fertilisers. It often needs to be further broken down before it can be used by plants and algae.

The remaining N was dissolved inorganic N (DIN) such as ammonium (NH_4^+) and N oxides (NO_x).

DIN is also derived from animal wastes and fertilisers but is readily available to plants and algae.

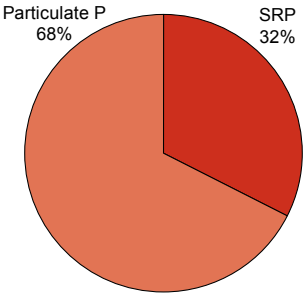
Waroona Drain had the highest percentage of NO_x of all the sampled sites. It also had the second-highest percentage of NH_4^+ (Samson North Drain to the south had the highest percentage at 10%).

Waroona Drain – February 2008

Phosphorus:

Just over two-thirds of the phosphorus (P) was present as particulate P which consists of sediment bound forms of P and organic waste materials.

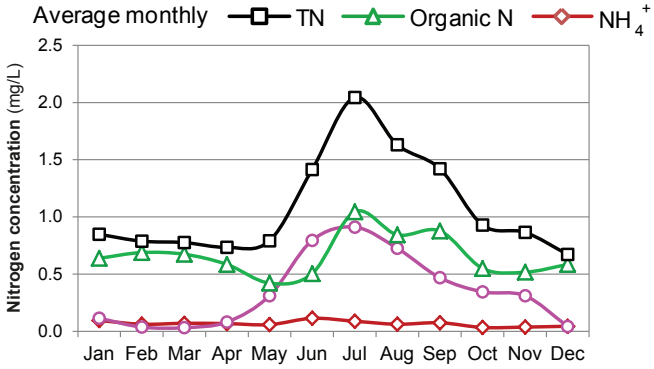
Particulate P is not readily available for uptake by plants and algae, but may become available over time as particles decompose or release bound P.

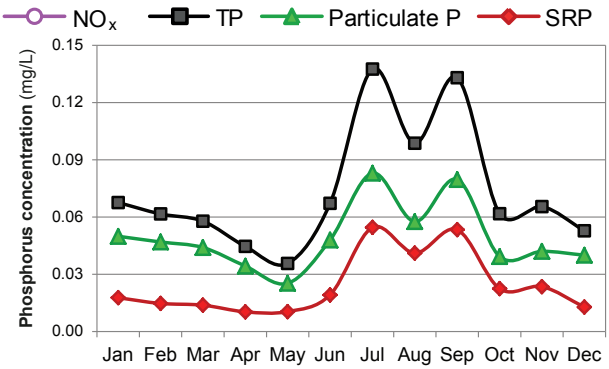


The remaining P was present as soluble reactive phosphorus (SRP). SRP is derived from fertilisers and animal wastes and is readily available for uptake by plants and algae.

Waroona Drain had the third-highest percentage of particulate P of the sampled sites. Mayfield Drain was slightly higher (70%) and South Dandalup River (which drains to the Peel Inlet instead of the Harvey Estuary) had the highest percentage at 74%.

Seasonal variation in nutrient concentrations and riverine flow (2010–14) at 6131335





Nitrogen:

Average monthly nitrogen concentrations were dominated by organic N throughout most of the year, while NO_x was dominant in June.

Average monthly concentrations of TN exceeded the ANZECC[3] guideline during winter, while average monthly NO_x concentrations exceeded the guideline for slightly longer (starting before and ending after winter).

Average monthly concentrations of NH_4^+ only exceeded the guideline occasionally.

	ANZECC 2000[3]	Months exceeded
TN	1.2 mg/L	Jun–Sept
NH_4^+	0.08 mg/L	Jan, Jun, July
NO_x	0.15 mg/L	May–Nov
TP	0.065 mg/L	Jan, Jun–Sept, Nov
SRP	0.04 mg/L	Jul–Sept

Phosphorus:

Average monthly phosphorus concentrations were dominated by particular P and were greatest during summer and winter. The decreases observed in August might be due to dilution if the two dams in the catchment overflow.

Average monthly TP concentrations exceeded the ANZECC[3] guideline during January, throughout winter and in November.

Average monthly SRP concentrations also exceeded the guideline concentrations during winter.

Erosion along Waroona Drain – October 2009

Ecological condition of Drakes Brook

Ecological condition was assessed across two reaches of Drakes Brook: between the Waroona Dam and Drakes Brook Dam (summer 2011), and below the Drakes Brook Dam (summer 2014). The assessments were made with the South West Index of River Condition using data collected at field sites and desktop data from the best available sources.

Three native freshwater fish and crayfish species were recorded in the system: western minnow, gilgie and marron (western minnow were not expected or found in the upper reach). Species were only found in low abundance which may reflect the poor condition of the fringing zone, reduced in-stream habitat and poor water quality. Expected species, such as western pygmy perch and nightfish, were not found. One exotic species, redfin perch (*Perca fluviatilis*) was recorded below the Drakes Brook Dam. This species is known to occur in large numbers in both the Drakes Brook and Waroona dams.

Drakes Brook: Between Waroona and Drakes Brook dams

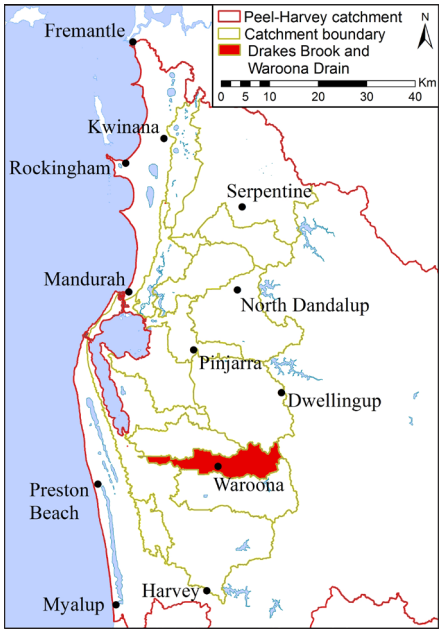
Drakes Brook: Below Drakes Brook Dam

Dissolved oxygen, temperature and salinity were within acceptable ranges at the field sites assessed.

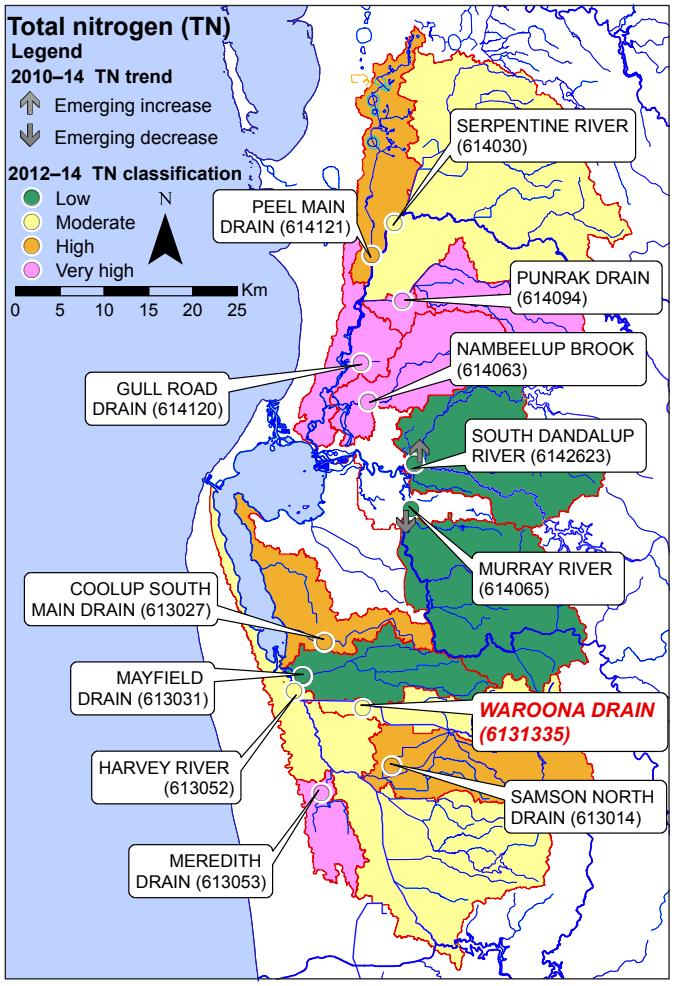
Fringing vegetation cover below the Drakes Brook Dam was low, with 12% of the reach length vegetated to an average width of 2.3 m. On the upstream reach (below the Waroona Dam), around 57% of the reach length was vegetated to an average width of 22 m. For both reaches, over 75% of the groundcover at field sites assessed was non-native. Erosion was observed across more than 50% of the bank length on the lower reach and less than 20% of the bank length on the upper reach.

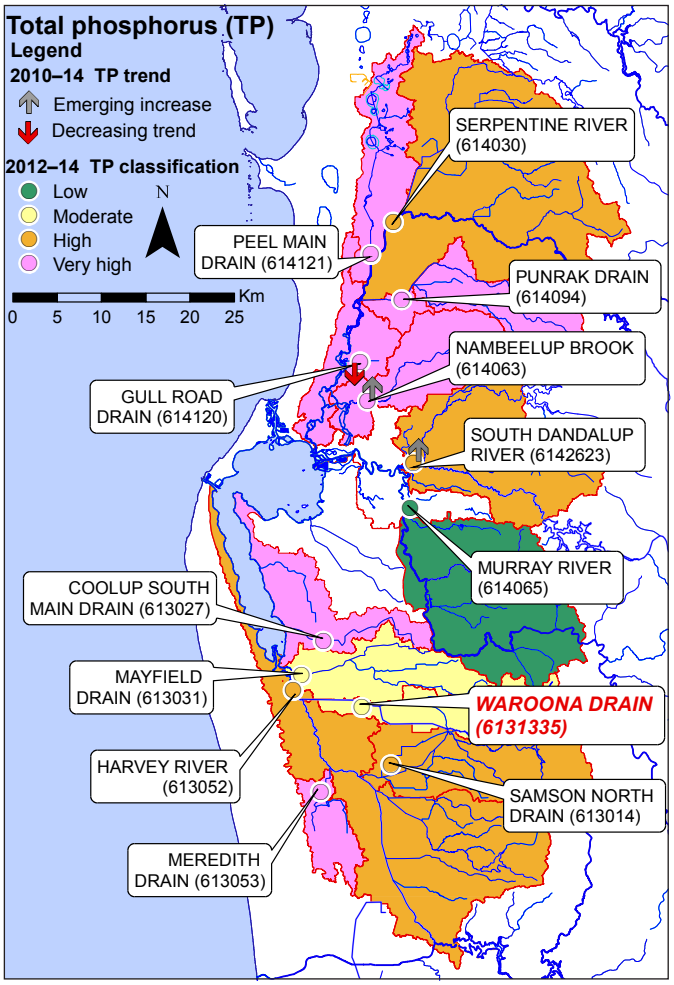
Lake Navarino: Waroona Dam

How Drakes Brook – Waroona Drain fits within the Peel-Harvey catchment: location and statistics



Catchment	Receiving waterbody	Sample site (AWRC)	Area (km²)	2014 Flow (GL)	2014 TN median (mg/L)	2014 TP median (mg/L)
Peel Main Drain	Serpentine River	614121	120	5.0	1.7	0.19
Upper Serpentine River	Serpentine River	614030	502	28	0.79	0.13
Dirk Brook – Punrak Drain	Serpentine River	614094	134	9.6	1.9	0.21
Nambeelup Brook	Serpentine River	614063	143	9.7	3.7	0.60
Lower Serpentine River - Gull Road Drain	Peel Inlet	614120	94	-	4.4	0.93
South Dandalup River	Murray River	6142623	243	-	1.1	0.11
Mid Murray River	Murray River	614065	293	153	0.57	0.01
Coolup South Main Drain	Harvey Estuary	613027	113	2.1	2.1	0.31
Mayfield Drain	Harvey Estuary	613031	119	15	0.73	0.03
Harvey River	Harvey Estuary	613052	408	98	1.4	0.15
Drakes Brook – Waroona Drain	**Harvey River**	**6131335**	**107**	**-**	**0.99**	**0.07**
Samson North Drain	Harvey River	613014	195	-	1.5	0.18
Meredith Drain	Harvey River	613053	56	-	2.8	0.38





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[1] Kelsey, P, Hall, J, Kretschmer, P, Quinton, B & Shakya, D 2010, *Hydrological and nutrient modelling of the Peel-Harvey catchment*, Water Science Technical Series, Report no. 33, Department of Water, Western Australia.

[2] Department of Water 2015, *Catchment nutrient reports* (methods for the analysis of status classification, loads and trends), <http://www.water.wa.gov.au/water-topics/waterways/assessing-waterway-health/catchment-nutirent-reports>.

[3] ANZECC & ARMCANZ 2000, *Australian guidelines for water quality monitoring and reporting*, National Water Quality Management Strategy, Paper no. 7, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

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