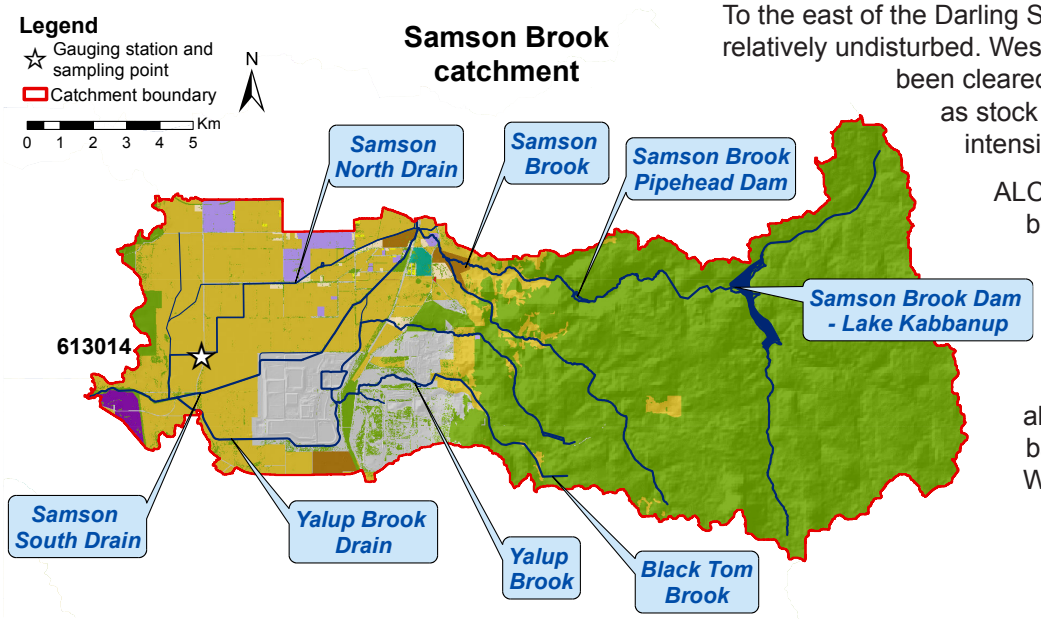
Samson North Drain

The Samson Brook catchment starts in the Dwellingup State Forrest on the Darling Plateau and drains west to the Harvey River. Samson Brook is dammed at Lake Kabbanup (Samson Brook Dam) which is used to supply the Waroona Irrigation District. Seven kilometres downstream of the Samson Brook Dam is the Samson Brook Pipehead Dam. Originally a pipehead weir constructed in 1962 it was upgraded to a dam in 2003 and feeds water into the state water supply grid.

Land use classification (2006)	Area (km²)	Area (%)
Cattle for beef (predominantly)	44.97	23
Cattle for dairy	1.77	0.91
Conservation and natural	125.44	64
Horticulture	2.74	1.4
Industry, manufacturing and transport	17.19	8.8
Lifestyle block	0.87	0.45
Mixed grazing	0.97	0.50
Offices, commercial and education	0.01	0.01
Plantation	0.39	0.20
Residential	0.16	0.08
Total	**195**	**100**



Downstream of the dams, engineering works divert Samson Brook to the south into Samson South Drain and Samson North Drain. Excessive flows may flow north but are prevented from flowing into Waroona Drain. Samson North Drain flows through the north west of the catchment and drains into Samson South Drain which in turn drains into the Harvey River downstream of Logue Brook.

The catchment's monitoring site on Samson North Drain is located adjacent to Somers Road (613014). The drain has been monitored for nutrients since 1990 while flow was measured from 1978 to 1999 and again between 2005 and early 2008. Samson North Drain flows year round.

Samson North Drain gauging station at Somers Road – March 2005

Only 2% of the Samson Brook catchment is subject to seasonal inundation while 8% of the catchment has a high or very high risk of phosphorus leaching to waterways.

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 more intensive land uses such as industry.

ALCOA's Wagerup refinery has been in operation since 1984 and was expanded in 2006. It covers 9% of the catchment and utilises the brooks and drains that flow through or adjacent to its holding. The alumina refinery processes bauxite from the nearby Willowdale bauxite mine.

Nutrient summary: median concentrations, loads and status classification at 613014

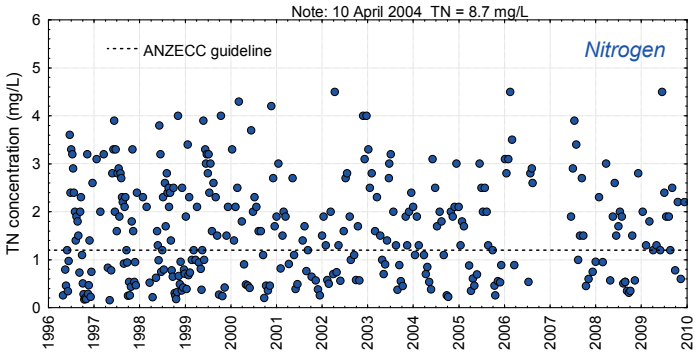
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Annual flow (GL)	8.2	5.1	4.6							5.6*	2.3	4.7*		
TN median (mg/L)	1.2	2.0	1.1	1.6	1.7	1.2	1.6	1.9	1.8	1.2	2.9	1.9	1.2	1.9
TP median (mg/L)	0.13	0.22	0.17	0.25	0.21	0.16	0.21	0.23	0.24	0.11	0.53	0.16	0.13	0.22
TN load (t/year)	20	12	11							14*	5.4	14*		
TP load (t/year)	2.4	1.4	1.3							1.7*	0.82	1.4*		

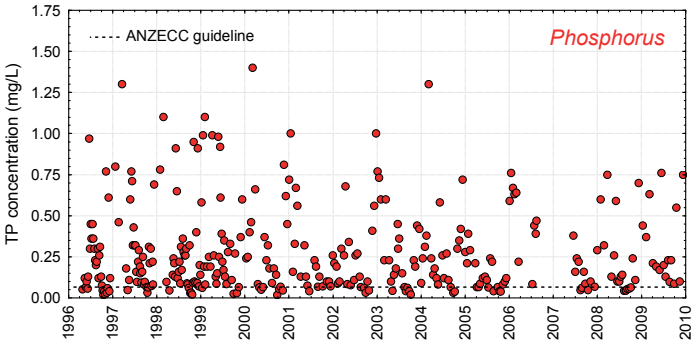
Status classification — Low — Moderate — High — Very high

Status reported for three-year period end (i.e. 1996 – 1998 reported in 1998)
TN = total nitrogen TP = total phosphorus

* best estimate using available data

Total nitrogen (TN) and total phosphorus (TP) concentrations (1996–2009)





TN concentration:

The annual percentage of TN samples that exceeded the ANZECC[1] guideline for lowland rivers (1.2 mg/L) ranged between 42% (2001) and 80% (2006) with an average of 57% (1996 – 2009).

Between 1996 and 2004, 56% of samples exceeded the guideline. This did not change significantly in the 2005 – 2009 period when 59% of samples exceeded the guideline.

TN trend:

Trend analysis was undertaken using data from 2005 to 2009 inclusive.

Once the data were adjusted for flow and seasonality an increasing trend (0.28 mg/L/year) was detected.

TP concentration:

The annual percentage of samples that exceeded the ANZECC[1] guideline for lowland rivers (0.065 mg/L) ranged between 67% (2005) and 100% (2006 and 2009) with an average of 83% (1996 – 2009).

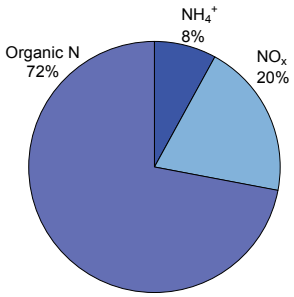
Between 1996 and 2004, 84% of samples exceeded the guideline, this decreased slightly to 79% for the period between 2005 and 2009.

TP trend:

Trend analysis was undertaken using data from 2005 to 2009 inclusive.

Once the data were adjusted for flow and seasonality an emerging increasing trend (0.008 mg/L/year) was detected.

Nutrient fractions (2005–2009)



Nitrogen:

Most of the nitrogen (N) was organic in nature. Organic N consists of both dissolved organic and particulate nitrogen. 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).

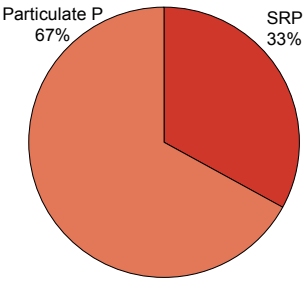
DIN is also derived from animal wastes and fertilisers but is readily available to plants and algae.

Samson North Drain had the highest percentage of NH_4^+ of all the sampled sites within the Peel-Harvey catchment and the second-highest percentage of DIN (Waroona Drain had the highest at 40%).

Phosphorus:

Over half 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 phosphate.

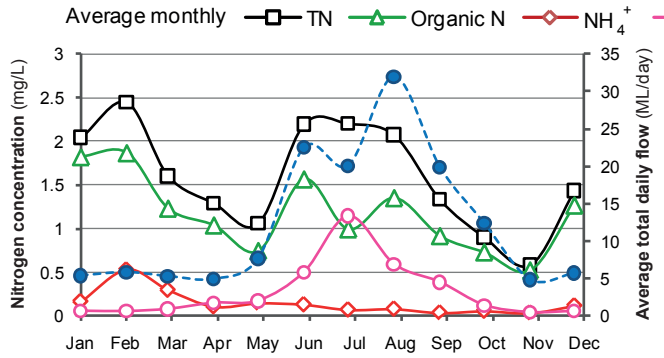


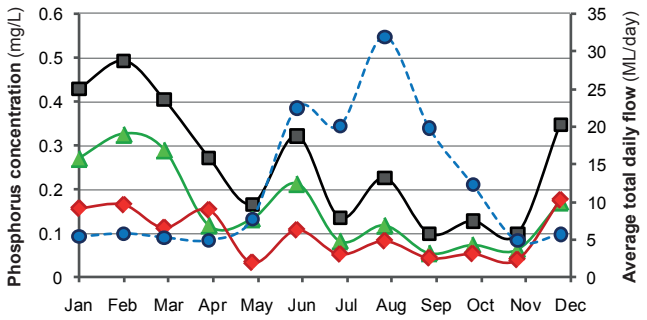
The remaining P was present as soluble reactive phosphorus (SRP). SRP is derived from fertilisers and animal wastes and is readily available for uptake by plants and algae.

Samson North Drain had the third-highest percentage of SRP of the catchments draining to the Harvey Estuary. The other five sites flowing towards the Estuary had percentages of SRP ranging between 28% (Waroona Drain) and 58% (Meredith Drain).

Samson North Drain at Somers Road – August 2005

Seasonal variation in nutrient concentrations and riverine flow (2005–2009)





Nitrogen:

Average monthly nitrogen concentrations were dominated by organic N throughout the year, except July when NO_x was at its highest. DIN was dominated by NH_4^+ in summer and NO_x in winter.

Average monthly concentrations of TN and NH_4^+ exceeded ANZECC[1] guidelines for most of the year, while NO_x only exceeded guidelines during winter.

Upstream view of Samson North Drain at Somers Road – May 2006

Phosphorus:

Average monthly phosphorus concentrations were greatest during the summer months peaking in February.

Average monthly particulate P concentrations were greater than SRP concentrations with the exception of April and December.

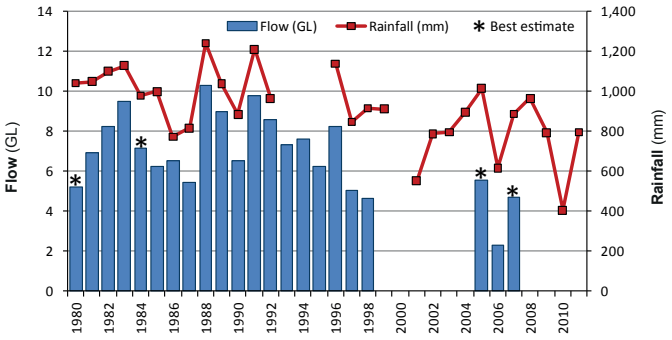
All average monthly TP concentrations exceeded ANZECC[1] guideline values. Average monthly SRP concentrations also exceeded guideline for most of the year except for May.

	ANZECC 2000	Months exceeded
TN	1.2 mg/L	Dec – Apr, Jun – Sept
NH_4^+	0.08 mg/L	Dec – Jun, Aug
NO_x	0.15 mg/L	May – Sept
TP	0.065 mg/L	All
SRP	0.04 mg/L	Jun – Apr

Long term flow and rainfall (1980 – 2011)

Flow was measured at Somers Road between March 1978 and October 2007, with a six year cessation between March 1999 and 2005. Samson North Drain flowed year-round.

The Bureau of Meteorology records daily rainfall at Yarloop (9624), to the south-east of the gauging station at Somers Road. Ongoing records are available from 1947, however data from 1993 and 1994 are unavailable and intermittent thereafter.



Both total annual flow and rainfall appear to be declining. Total annual flow ranged from 2.3 GL (2006) to 10 GL (1988). Total annual rainfall ranged from 405 mm (2010) to 1241 mm (1988).

Upstream view of Samson North Drain at Somers Road – November 2003

Samson North Drain – March 2005

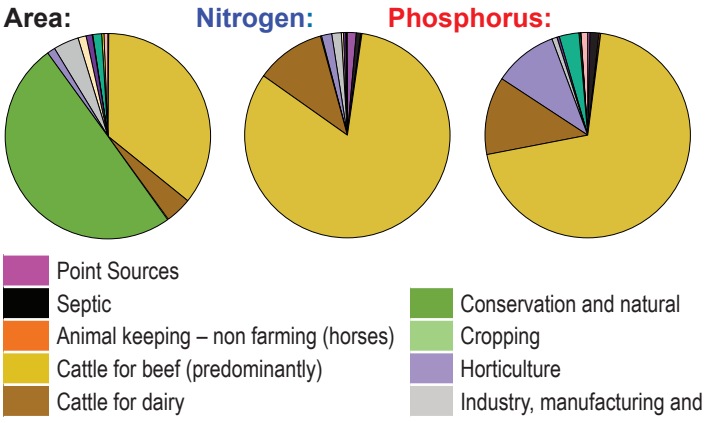
Samson North Drain – June 2005

Modelled results (1997–2007)[3]

This page reports results from the Streamflow Quality Affecting Rivers and Estuaries (SQUARE) model. It estimated flow, nitrogen and phosphorus loads at the outlets of the 13 sub-catchments of the Peel-Harvey estuary. Outputs for the Harvey catchment include the Harvey River, Samson Brook and Drakes Brook - Waroona Drain sub-catchments.

Nutrient sources

'Cattle for beef' followed by 'cattle for dairy' were the dominant nutrient sources in the Harvey catchments. While they only covered 42% of the catchment they contributed 94% of the total nitrogen and 83% of the total phosphorus load. 'Horticulture' contributed a substantial percent of the phosphorus load, despite its small area.



Annual exports to Peel Inlet

The Harvey catchment is 71% of the area that drains to the Harvey Estuary. On average it contributed to the Harvey Estuary:

- 76% of the flow (142 GL/year)
- 78% of the nitrogen load (259 tonnes/year)
- 57% of the phosphorus load (39 tonnes/year).

Values may differ to those on the front page due to different analysis techniques.

Remediation priority

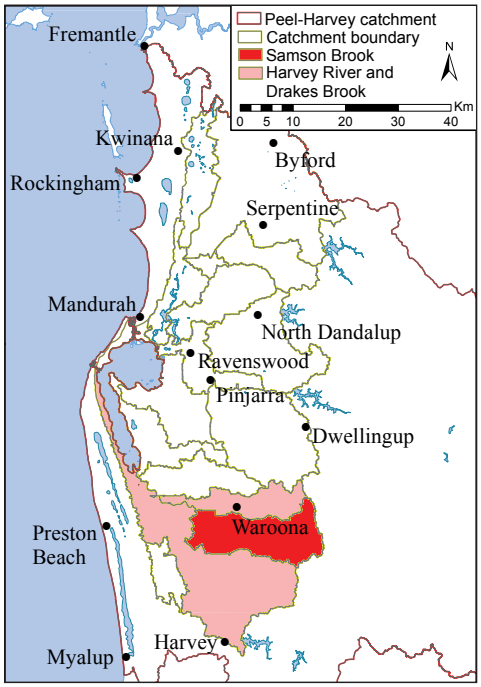
The SQUARE-modelled data indicated that based on nutrient loads per cleared area (kg/ha/year)[1]:

- Harvey catchment requires high-priority nitrogen and low-priority phosphorus remediation action

The Harvey catchment had the second-highest nitrogen load per cleared area of all the Peel-Harvey catchments.

It had the highest TP load (tonnes/year) however the load per cleared area was less than those for Coolup (Peel and Harvey) and Meredith Drain.

How Harvey fits within the Peel-Harvey catchment: location and statistics



Catchment draining to estuary	Area (km²)	Flow (GL)	TN load (tonnes/ year)	TN load per cleared area (kg/ha)	TP load (tonnes/ year)	TP load per cleared area (kg/ha)
Peel Main Drain	120	11	26	3.0	4.5	0.52
Upper Serpentine	502	55	106	3.8	21	0.75
Dirk Brook – Punrak Drain	134	18	51	7.5	5.6	0.82
Nambeelup	143	19	44	3.6	10.5	0.86
Lower Serpentine	94	6.2	9.7	1.6	2.9	0.49
Mandurah	24	3.0	7.9	5.0	1.3	0.84
Upper Murray	6 752	286	204	0.51	4.9	0.01
Lower Murray, Mid Murray and Dandalup	638	74	198	6.4	4.9	0.16
Coolup (Peel)	151	23	42	3.2	15	1.2
Subtotal Peel Inlet	**8 558**	**496**	**701**	**1.4**	**73**	**0.14**
Coolup (Harvey)	113	16	26	3.3	14	1.8
Mayfield Drain	119	19	33	3.1	7.1	0.67
Harvey	710	142	259	6.9	39	1.0
Meredith Drain	56	11	16	4.3	8.3	2.2
Subtotal Harvey Estuary	**998**	**188**	**334**	**5.6**	**69**	**1.2**
Total Peel-Harvey Estuary	**9 556**	**684**	**1 035**	**1.8**	**142**	**0.25**

References

[1] 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.

[2] Water and Rivers Commission 2002, *Samson Brook Catchment Area Water Source Protection Plan: Waroona and Hamel Town Water Supply and Integrated Water Supply Scheme,* Water Resource Protection Series, Report no. 50, Water and Rivers Commission, Western Australia.

[3] 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.

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