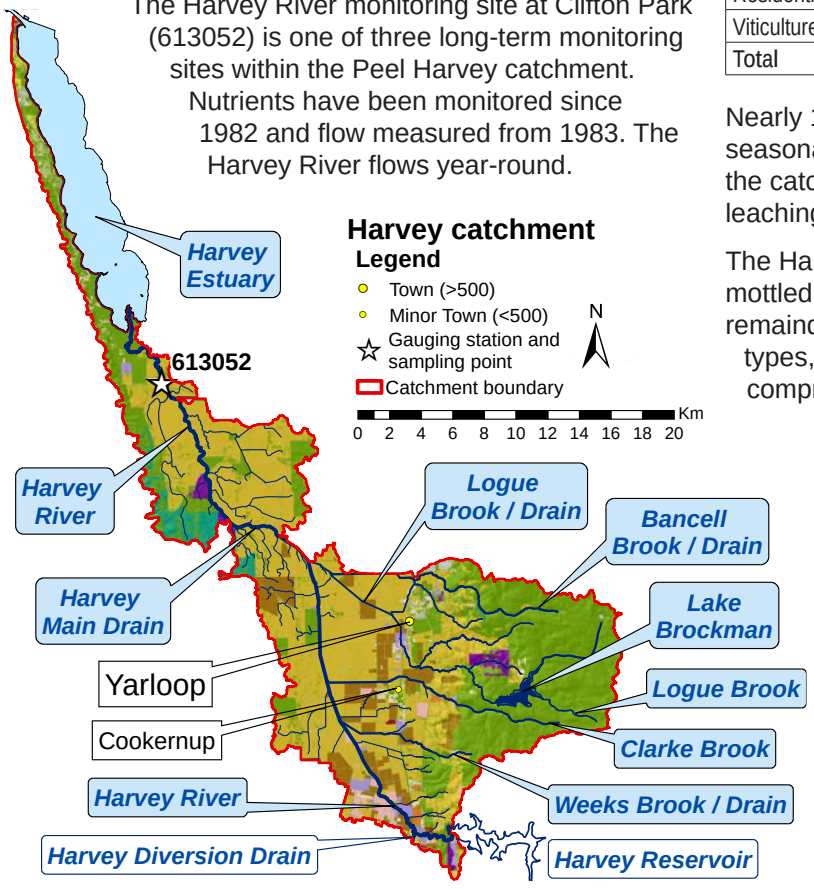
Harvey River

The Harvey River flows north-easterly from the Harvey Reservoir to its discharge point at the southern end of the Harvey Estuary. Many of the waterways within the catchment have been modified and these portions of the rivers and brooks have been re-named as drains. Just downstream of the Harvey Reservoir the Harvey Diversion Drain carries water directly to the ocean.

The headwaters of Logue Brook are located on the Darling Plateau in the Dwellingup State Forest. The Brook flows into Lake Brockman, the reservoir formed by Logue Brook Dam, before continuing through the coastal plain to its confluence with Harvey Main Drain. Bancell Brook flows into Logue Brook while both Clarke Brook and Weeks Brook discharge into Harvey Main Drain, upstream of Logue Brook.

The Harvey River monitoring site at Clifton Park (613052) is one of three long-term monitoring sites within the Peel Harvey catchment. Nutrients have been monitored since 1982 and flow measured from 1983. The Harvey River flows year-round.



Land use classification (2006)		Area (km²)	Area (%)
Animal keeping – non farming (horses)		1.1	0.26
Cattle for beef (predominantly)		169	41
Cattle for dairy		27	6.5
Conservation and natural		172	42
Cropping		<0.01	<0.01
Horticulture		5.3	1.3
Industry, manufacturing and transport		8.1	2.0
Intensive animal use		0.15	0.04
Lifestyle block		5.6	1.4
Mixed grazing		4.9	1.2
Offices, commercial and education		0.54	0.13
Plantation		9.5	2.3
Recreation		0.10	0.02
Residential		1.3	0.31
Viticulture		4.3	1.1
Total		408	100

Nearly 10% of the Harvey catchment is subject to seasonal inundation (9.4%) and more than a quarter of the catchment has a high or very high risk of phosphorus leaching to waterways (27%).

The Harvey River flows through sandy acidic yellow mottled soils, some containing ironstone gravel. The remainder of the catchment consists of a variety of soil types, including leached sands and poorly drained flats comprising of black and grey cracking clays.

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 piggeries and turf farms.

Harvey River – July 2004

Nutrient summary: median concentrations, loads and status classification at 613052

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Annual flow (GL)	209	128	217	196	208	57	106	105*	103*	143	38	84	107	95
TN median (mg/L)	0.90	1.2	0.96	0.98	1.0	0.90	1.0	1.0	1.0	0.88	1.0	1.3	1.3	0.85
TP median (mg/L)	0.14	0.17	0.16	0.19	0.14	0.16	0.15	0.15	0.12	0.14	0.13	0.15	0.20	0.11
TN load (t/year)	411	232	504	374	388	81	189	198*	191*	273	71	190	199	201
TP load (t/year)	62	31	57	54	58	11	27	29*	27*	42	9.4	24	27	26

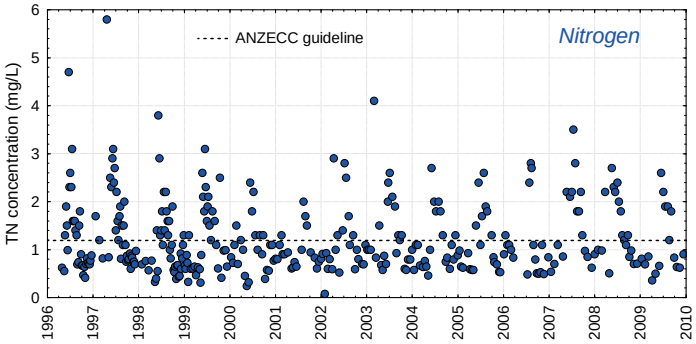
Status classification — Low — Moderate — High — Very high

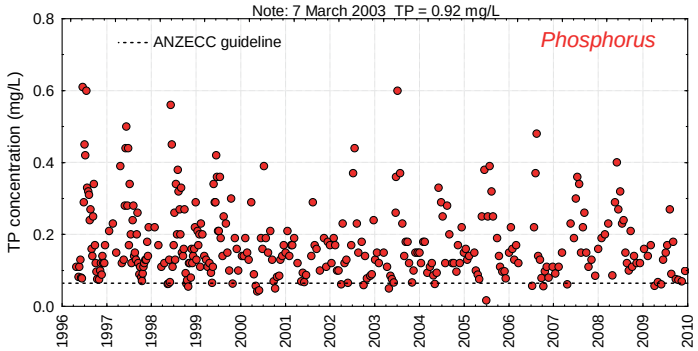
Status reported for three-year period end (i.e. 1996 – 1998 reported in 1998)

* best estimate using available data

TN = total nitrogen TP = total phosphorus

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 21% (2001) and 53% (2007).

Between 1996 and 2004, 37% of samples exceeded the guideline. This did not change in the 2005 to 2009 period when 38% 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 no trend was detected.

Sedimentation and in-stream plant growth at Clifton Park – June 2005

TP concentration:

Between 1996 and 2009, 94% of TP samples exceeded the ANZECC[1] guideline for lowland rivers (0.065 mg/L).

The annual percentage of samples that exceeded the guideline ranged from 83% (2000) to 100% (1996, 1997, 2001 and 2008).

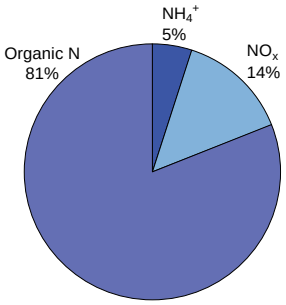
In addition an average of 57% of samples exceeded 0.13 mg/L, twice the ANZECC guideline. Annual percentages of samples exceeding 0.13 mg/L ranged from 44% (2009) to 68% (2008).

TP trend:

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

Once the data were adjusted for flow and seasonality no trend 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.

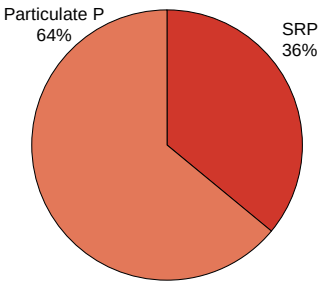
The Harvey River had the fourth-highest percentage of NO_x of all the sampled sites. Two of the three sites with higher percentages were directly upstream, Waroona Drain (33%) and Samson North Drain (20%). The other was on the Murray River (20%).

Clifton Park at the Old Bunbury Road – December 2009

Phosphorus:

Over half of the phosphorus (P) was present as particulate P which consists of sediment bound forms of P and organic waste materials.

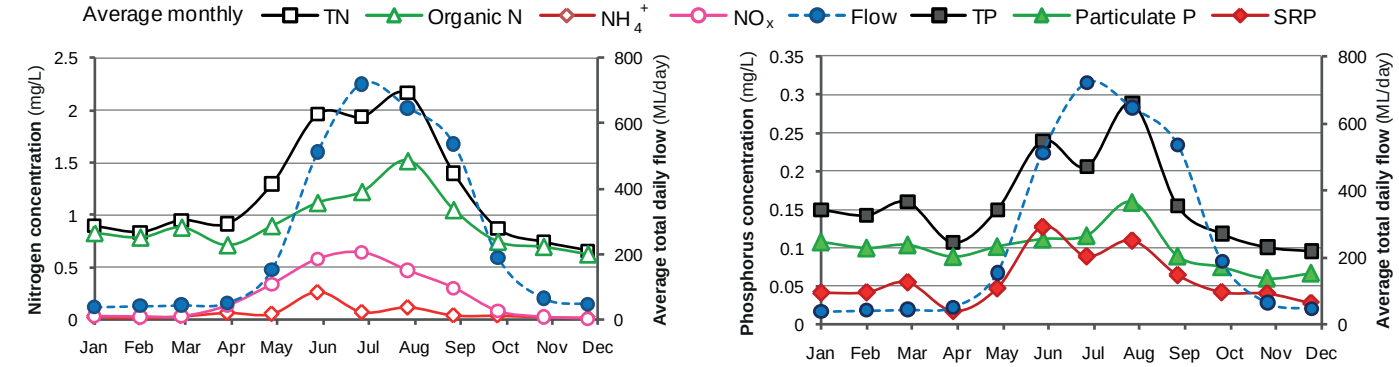
Particulate P is not readily available for uptake by plants and algae, but may become available over time as particles decompose or release bound phosphate.



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.

The Harvey River had the second-highest percentage of SRP of the six sub-catchments draining to the Harvey Estuary (Meredith Drain had the highest, 58%). The other four catchments had SRP percentages ranging between 28% (Waroona Drain) and 40% (South Coolup Main Drain).

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



Nitrogen:

Average monthly nitrogen concentrations were dominated by organic N throughout the year, while DIN was dominated by NO_x.

Concentrations were related to flow with maximum average concentrations occuring in winter. The greatest average monthly NH_4^+ concentration occurred first in June, followed by NO_x in July and finally organic N (and TN) in August.

Average monthly concentrations of TN and NO_x exceeded ANZECC[1] guidelines between May and September, while average monthly NH_4^+ concentrations had a slightly shorter period of exceeding the guideline.

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

Phosphorus:

Average monthly phosphorus concentrations were greatest during winter however peak flows in July appeared to temporarily dilute TN and SRP concentrations.

Average monthly particulate P concentrations were greater than SRP concentrations with the exception of June.

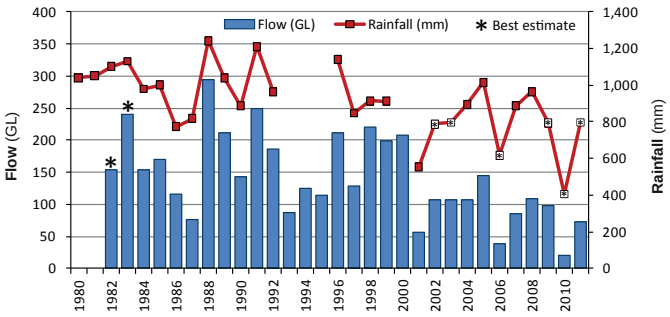
All average monthly TP concentrations exceeded the ANZECC[1] guideline. Average monthly SRP concentrations also exceeded the guideline for most of the year but were below it during April and December.

Clifton Park at the Old Bunbury Road Bridge – August 2005

Long term flow and rainfall (1980 – 2011)

Flow has been measured at Clifton Park since May 1982, with a brief cessation between December 1982 and March 1983. The Harvey River flows year-round.

The Bureau of Meteorology records daily rainfall at Yarloop (9624), to the south-east of the Clifton Park gauging station. 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 20 GL (2010) to 220 GL (1988). Total annual rainfall ranged from 405 mm (2010) to 1241 mm (1988).

Ecological health of Logue Brook[2]

In response to the drying climate environmental water provisions to many south-west river systems were temporarily reduced in late 2010. Logue Brook was one of the systems affected, with a 50% reduction in environmental water release between December 2010 and March 2011.

An investigation into the impact of reduced environmental water releases on the ecological health of Logue Brook determined that while ecosystem health was maintained in the short term, the long-term resilience of the ecosystem under an ongoing regime of reduced releases was of concern.

Logue Brook – March 2011

Roadworks

In December 2006 maintenance work was undertaken on the Old Bunbury Road Bridge where the Harvey River gauging station is located. This involved in-stream disturbances with additional sand being imported.

Construction of the Forrest Highway approximately 350 m upstream of Old Bunbury Road was initiated in May 2007. The highway was completed in early 2009. River stabilisation and restoration was then undertaken and continues to some degree between the Forrest Highway and the Clifton park gauging station.

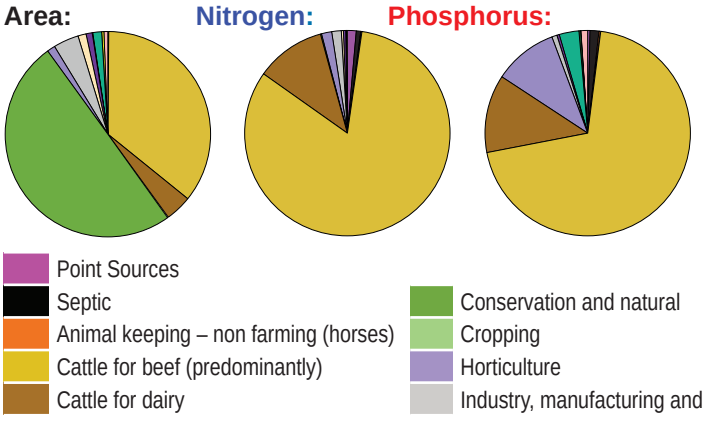
Increases in median TN concentrations were observed in 2007 and in both median TN and TP concentrations in 2008, however these were not extreme when compared to historical data.

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 Harvey Estuary

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

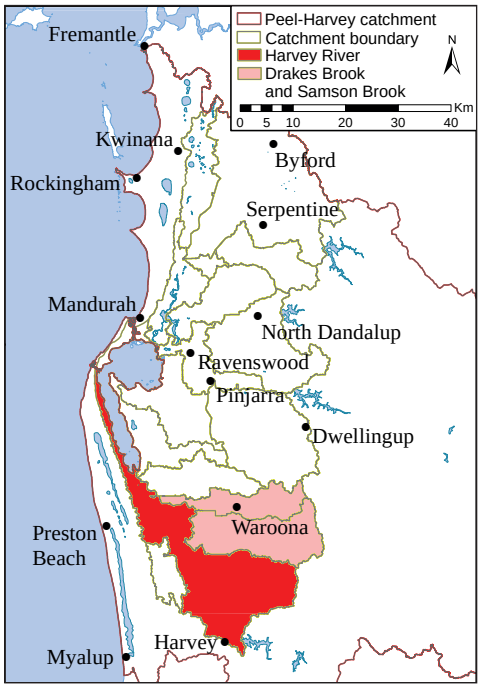
The SQUARE-modelled data indicated that based on nutrient loads per cleared area (kg/ha/year)[1]:

- 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] White G & Storer T 2012, *Assessment of ecological health and environmental water provisions in the Logue Brook, February to May 2011*, Water Science Technical Series, Report no. 43, Department of Water, 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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