BAROOTA PWRA

Surface Water Status Report

2010-11

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Water and Natural Resources

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PURPOSE AND CONTEXT

This status report provides a snapshot of the surface water resources in the Baroota Prescribed Water Resources Area (PWRA) for the financial year 2010-11. Surface water status reports are limited to reporting on the 'hydrological status' of the PWRA. Available data on climate is discussed with reference to recent or more long-term trends where, if at all, they are present in the data.

A similar separate report has been released previously for the groundwater resources of this PWRA. This surface water report is in a format consistent with that already adopted for the groundwater report. These status reports seek to support informed management decisions by resource managers and those responsible for, or reliant on, the water resources.

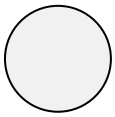
Development of the Natural Resource Management (NRM) State and Condition Reporting Framework (Government of South Australia 2012) was identified as a priority in the State NRM Plan (Government of South Australia 2012a) to strengthen the NRM management system. Implementation of the NRM State and Condition Reporting Framework seeks to include an assessment of state and condition through the development of Report Cards. Department of Environment, Water and Natural Resources (DEWNR) in consultation with key stakeholders is working towards developing the Report Card *"Trends in condition of rivers, streams, wetlands and drains"*, which assess resource condition and the Report Card "Proportion of SA's water resources managed within sustainable limits" which reports on management outcomes. For further information on the condition cf. status of water resources, visit the NR Connect site's NRM Reporting page http://www.nrconnect.sa.gov.au/NRM-Reporting/SitePages/Home.aspx.

BAROOTA PRESCRIBED WATER RESOURCES AREA

The Baroota PWRA is located approximately 25 km north of Port Pirie, on the coastal plains between the Flinders Ranges and Spencer Gulf in South Australia's Mid-North (Figure 1). Surface water and groundwater resources in the PWRA have been prescribed under South Australia's Natural Resources Management Act 2004. A Water Allocation Plan (WAP) is being developed by the Northern and Yorke NRM Board and will provide for sustainable management of water resources.

The Baroota PWRA covers an area of 130 km^2 with Port Germein being the nearest major town, just outside the PWRA boundary, on the coast. The topography is characterised by hills and valleys above the reservoir, with major stream flow contribution from the adjacent Flinders Ranges, which ultimately drains in a south westerly direction through the plains to Spencer Gulf. The climate of the Baroota PWRA is characterised by hot, dry summers and cool to cold, wet winters. Average annual rainfall varies from 200-300mm in the west to 500-600mm in the east (Figure 5). The main watercourse in the PWRA is Baroota Creek (Figure 4), which drains downstream of the Baroota Reservoir, but the watercourse has no current or historical streamflow gauging stations. Baroota Reservoir was completed in 1921 and is the major water storage in the PWRA, with a current capacity of 6,140ML. The reservoir was used as a balancing storage for River Murray pipeline water up until 1997, but has since been removed from the distribution network by SA Water due to water quality issues (Barnett 2009). The primary land uses in the region are broadacre cropping, grazing, irrigated horticulture and conservation reserves.

SUMMARY 2010-11

STATUS 2010-11  "Unclear"

Unlike other PWRA reports, this report is not able to provide a status on variables such as streamflow, salinity or water use, due to the absence of current monitoring data. As such, this report is not able to provide an overall status for the Baroota PWRA and has been assigned an "unclear" status for 2010-11.

However, it is noted that for 2010-11, there was above average rainfall across the region.

Rainfall, streamflow, salinity and water usage can be highly variable from year to year. It is therefore important to acknowledge that hydrological trend, and therefore the hydrological status can also vary greatly from year to year. However this does not necessarily translate to the variability in the condition of water dependent ecosystems. On this matter, environmental water requirements and condition of water dependent ecosystems have not been considered as part of assigning the hydrological status for 2010-11. The section titled 'water dependent ecosystems' provides a brief overview of the water dependent ecosystems in the PWRA.

(green) No adverse trends, indicating a stable or improving situation

Trends are either stable (no significant change), or have improved over the reporting period, indicating that there is insignificant risk of impact to the beneficial use of the resource.

(yellow) Adverse trends indicating low risk to the resource in the short term (1 to 3 years)

Observed adverse trends are gradual and if continued, are unlikely to lead to a change in the current beneficial uses of the surface water resource in the short term.

(amber) Adverse trends indicating medium risk to the resource eventuating in the short term

Observed adverse trends are significant and if continued, moderately likely to lead to a change in the current beneficial uses of the surface water resource in the short term.

(red) Adverse trends indicating high risk to the resource within the short term

Trends indicate degradation of the resource is occurring. Degradation will very likely result in a change in the beneficial use (e.g. reduced ability to access surface water entitlements and/or decline in the condition of environmental assets).

(grey) Unclear

Trends are unable to be determined due to a lack of adequate information on which to base a sound judgement of status.

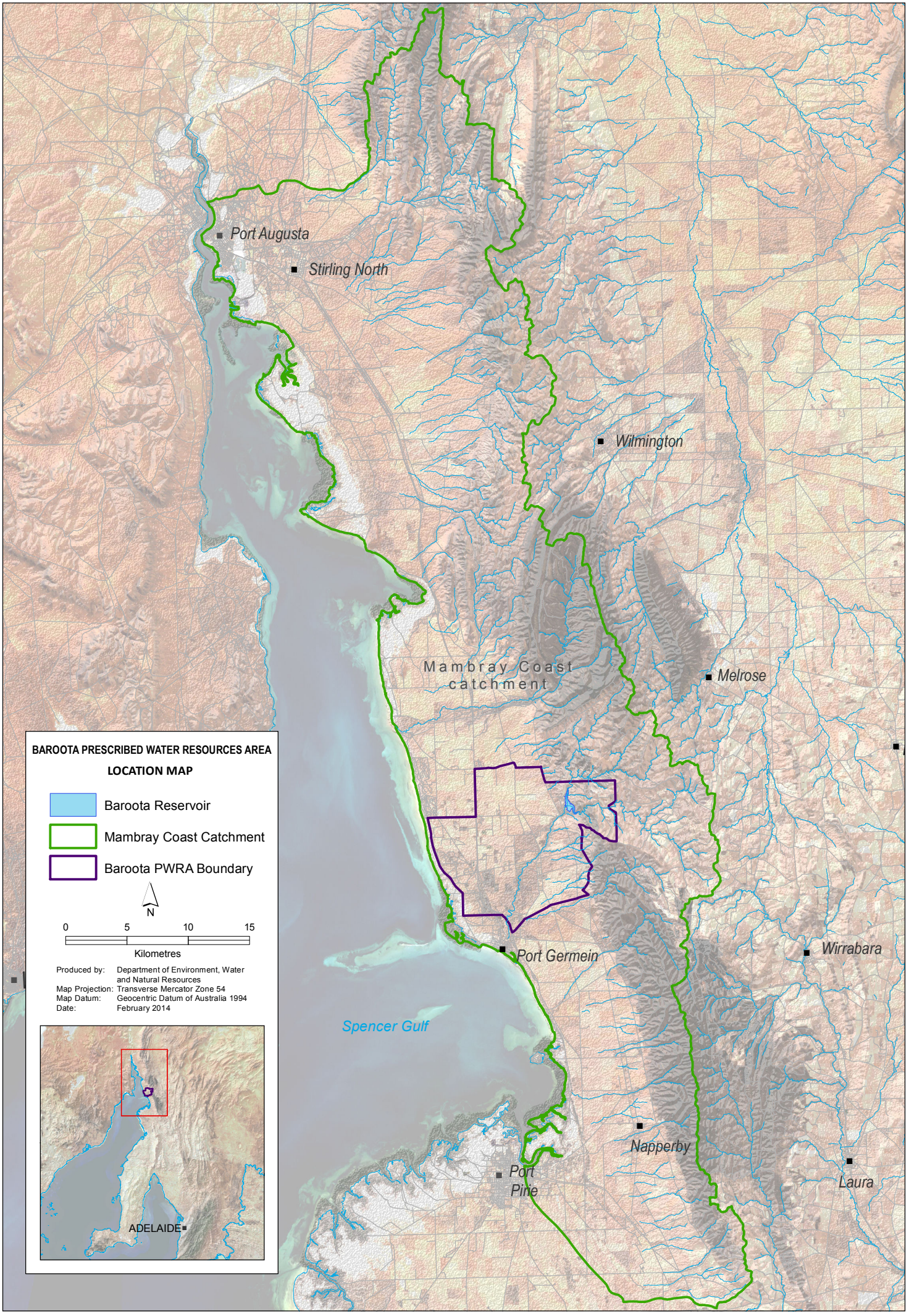


Figure 1. Baroota PWRA and the Mambray Coast catchment

RAINFALL

Status	Degree of Confidence	Comments on recent historical context
Above average rainfall across the region	Medium: limited coverage of monitoring stations representing the variation in rainfall across the region	Second year of average or above rainfall

The climate of the Baroota PWRA is characterised by hot, dry summers and cool to cold, wet winters. The average annual rainfall in the region varies from 200-300mm in the west to 500-600mm in the east (Figure 5). Data from two stations; Port Germein (M019037) and Baroota Reservoir Catchment Pluvio at Glenlossie (A5080504) (Figure 4), were chosen for analysis of rainfall trends. Rainfall data has been sourced from SILO and is Patched Point Data. Further information on SILO climate data is available at: http://www.longpaddock.qld.gov.au/silo/index.html

Port Germein was selected for analysis of rainfall trends on the plains and Baroota Reservoir Catchment Pluvio was chosen to show trends in the reservoir catchment. The long term annual average rainfall (1889 to 2010) is 324 mm at Port Germein, while the shorter data record at the Reservoir Catchment Pluvio (1990 to 2010) indicates an average of 511mm. The higher rainfall coincides with the higher elevations of the Flinders Ranges to the east and the average rainfall decreases towards the coast.

RECENT RAINFALL

The BoM rainfall station at Port Germein is located on the coast at the outlet of the Baroota PWRA. Rainfall in 2010-11 at Port Germein was 435mm, higher than the long term average of 324mm (1889-2010). Higher than average rainfall was recorded in all but five months of the year, with the warmer months of October, February and March experiencing considerably higher than average rainfall (Figure 2). The early winter months of May, June and July recorded lower than average monthly rainfall, as did January and April.

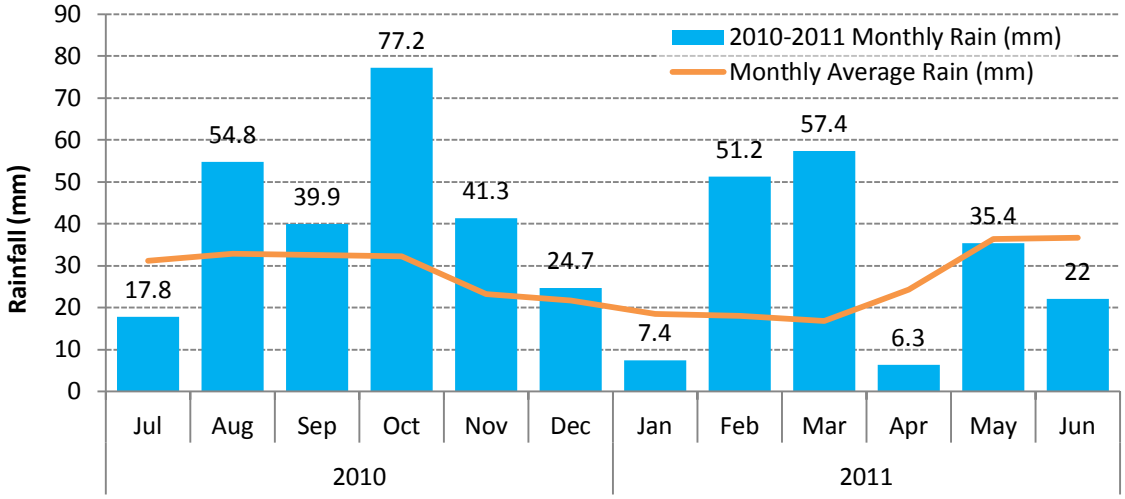


Figure 2. Monthly rainfalls at Port Germein

Baroota Reservoir Catchment Pluvio at Glenlossie is the highest elevated site of the two summarised. Rainfall in 2010-11 at Glenlossie was 669mm, higher than the long term average of 511mm (1990-2010). Higher than average rainfall was recorded for six months of the year, with October, February and March all receiving more than double the monthly average rain (Figure 3).

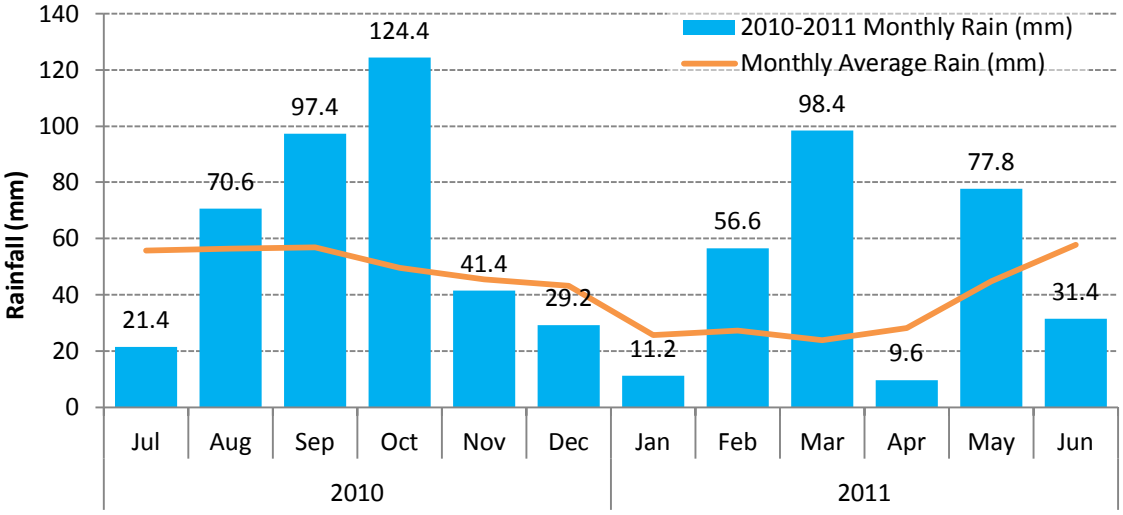


Figure 3. Monthly rainfalls at Baroota Reservoir Catchment Pluvio

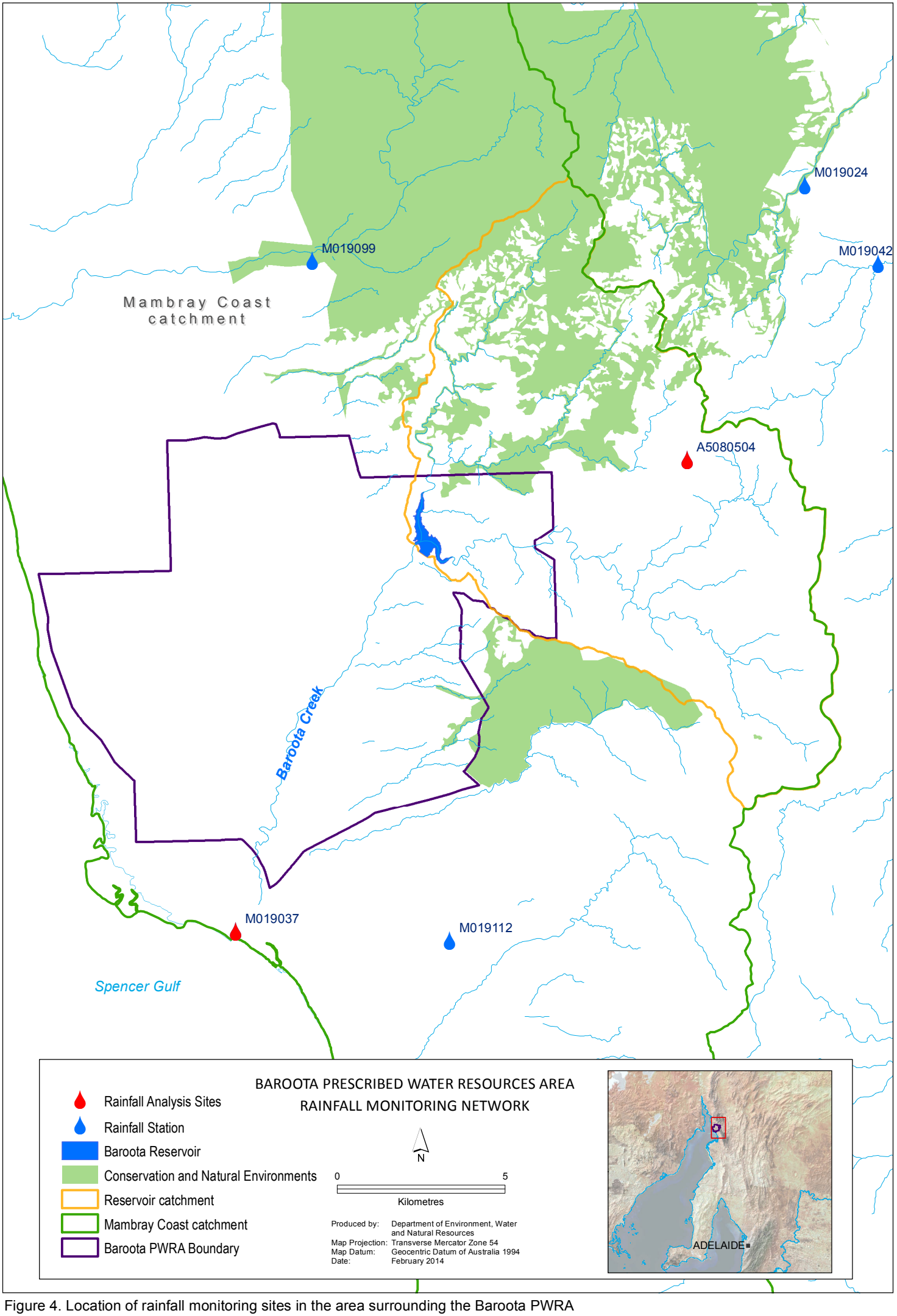


Figure 4. Location of rainfall monitoring sites in the area surrounding the Baroota PWRA

LONG AND SHORT TERM TRENDS

Figure 5 shows the spatial distribution of rainfall across the Baroota PWRA and surrounding region for the;

1. Long term average (1900-2010)

2. Short term average of the previous 10 years (2001-2010)

3. Annual rainfall for 2010

The three panels in Figure 5 indicate 2010 (Panel 3) was higher than average in comparison to the long-term (Panel 1) and short-term (Panel 2) annual rainfall averages across the region. Panel 2 indicates a wider distribution of lower than long-term average rainfall for 2001-2010 across the west of the region and also slightly lower than average in the east, which reflects the drought conditions in the early-late 2000's (State of the Environment Committee 2011).

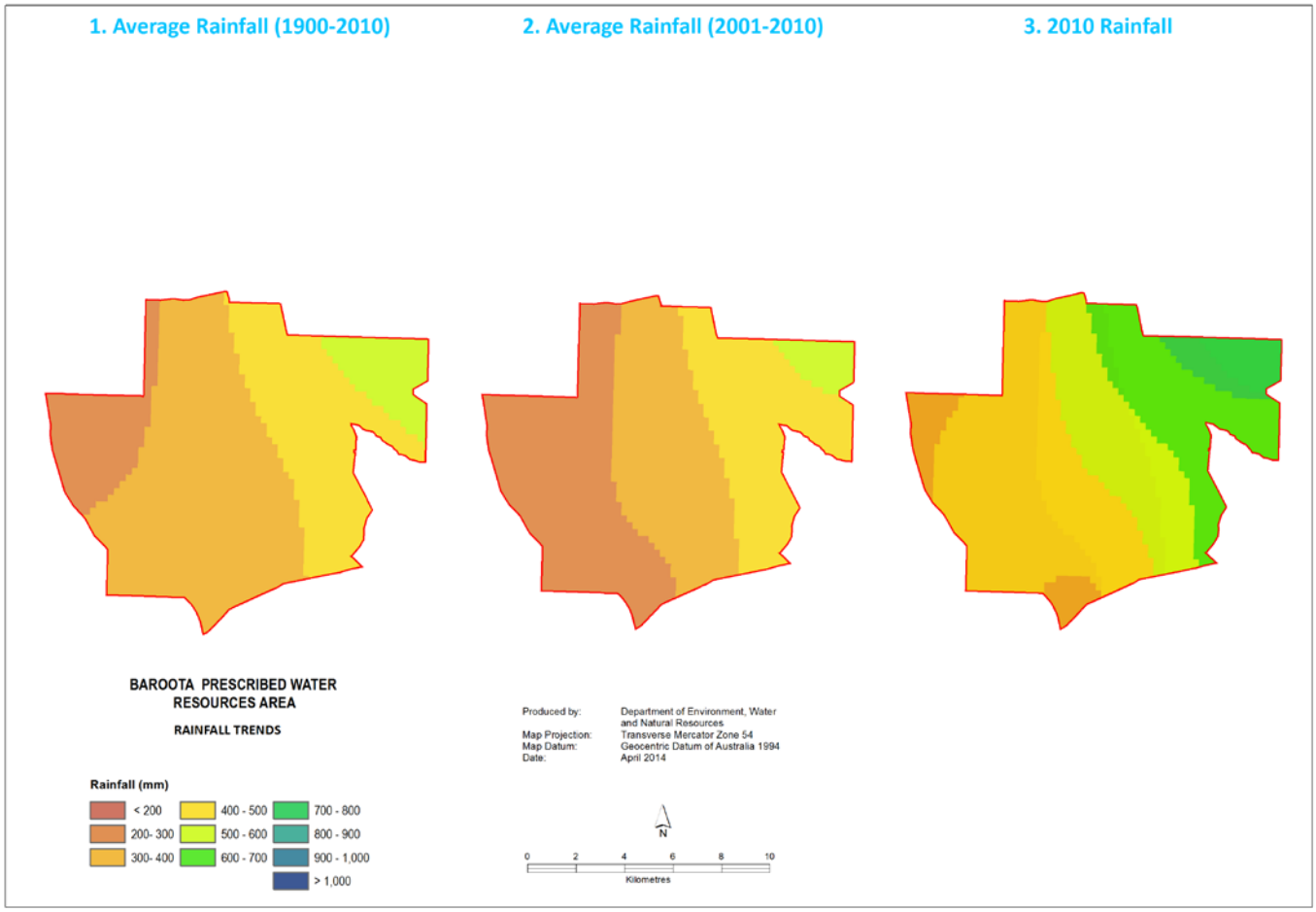


Figure 5. Annual rainfall distributions for the Baroota PWRA

The cumulative deviation from average annual rainfall (residual mass curve) is plotted in orange in Figures 6 - 8 to identify periods of above or below average trends. An upward slope indicates a period of above average rainfall, while a downward slope indicates a period of rainfall below average. Data presented for Port Germein (Figure 6) shows alternating periods of above and below average rainfall lasting between 5-10 years in the early part of the time series. A period of around average rainfall for 10 years occurred from 1930 before a period of 15 years with consistent above average rainfall. Since 2002 there has been below average rainfall that coincides with recent drought conditions until 2010 when above average rainfall was once again experienced.

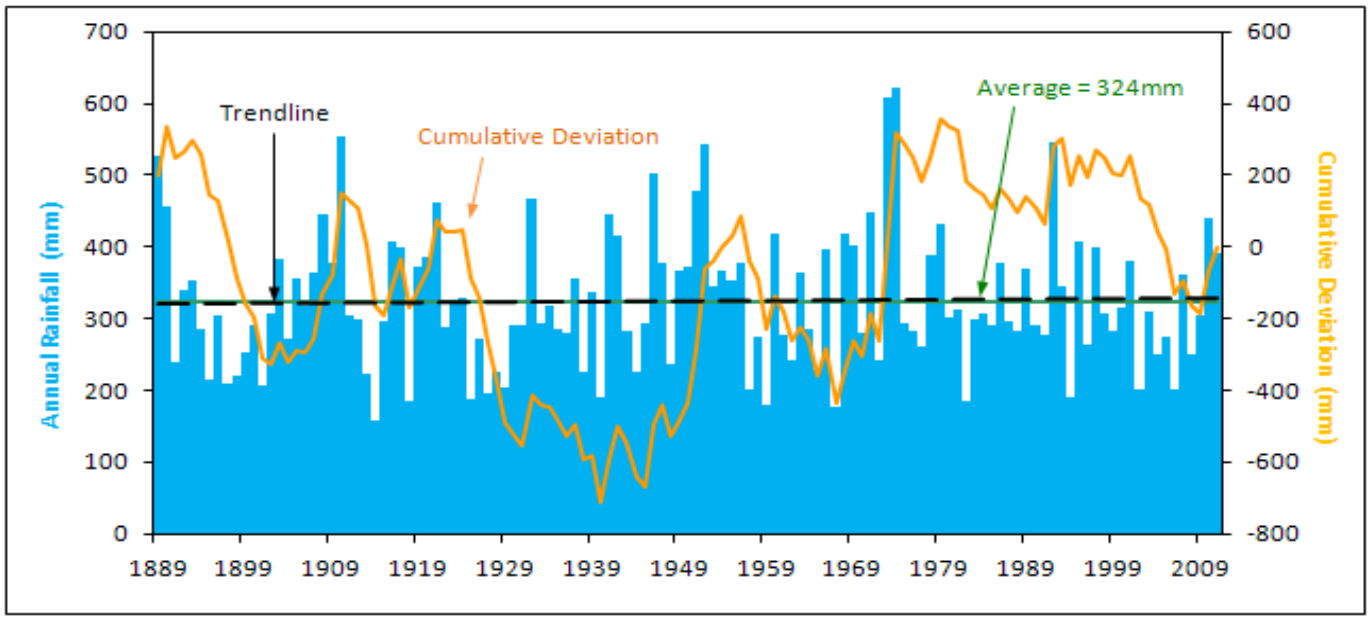


Figure 6. Port Germein annual rainfall showing long term trend and cumulative deviation (1889-2010)

Port Germein has the longest continuous rainfall record in the region and the data indicates a slightly increasing trend. Data from the Port Germein station is also plotted for the period 1990 to 2010 (Figure 7) for comparison with Baroota Reservoir Catchment Pluvio at Glenlossie records (Figure 8).

At both Port Germein and Glenlossie, a slightly decreasing rainfall trend can be seen over the last 20 years, with rainfall from 2002 to 2009 being predominantly below average after a few years of higher than average rainfall scattered between 1990 and 2001 (Figure 7 and 8). This trend is influenced by the extremely higher than average rainfall year of 1992. Removing this year from the record returns the trend to around average across the reporting period.

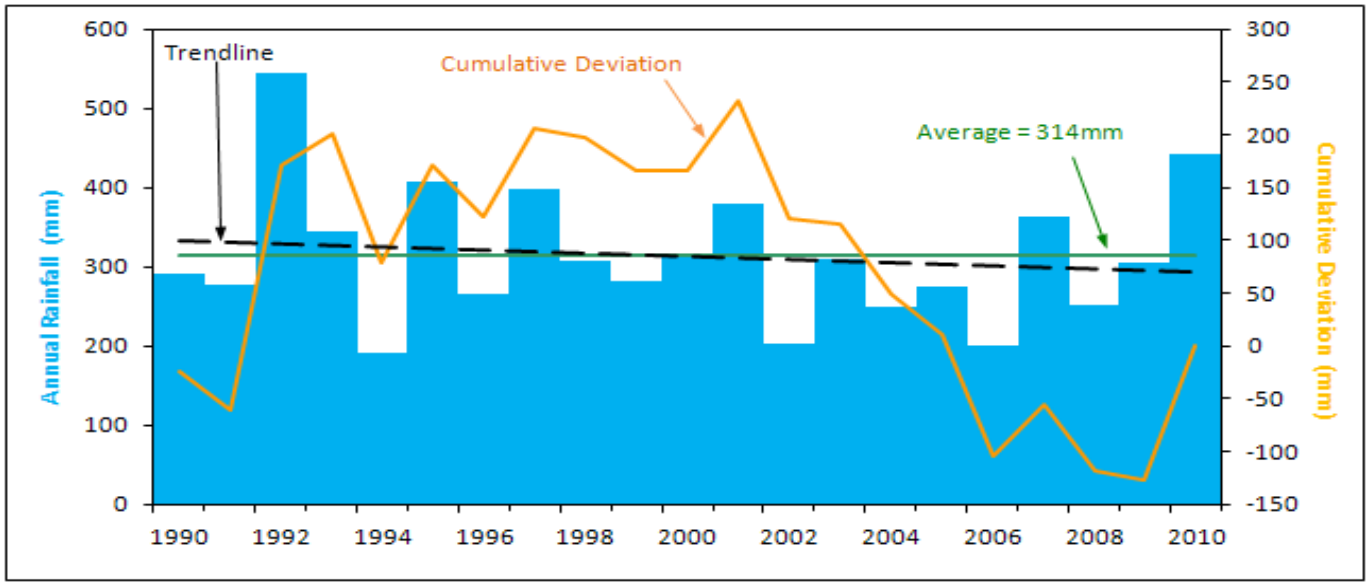


Figure 7. Port Germein annual rainfall for 1990-2010 and cumulative deviation

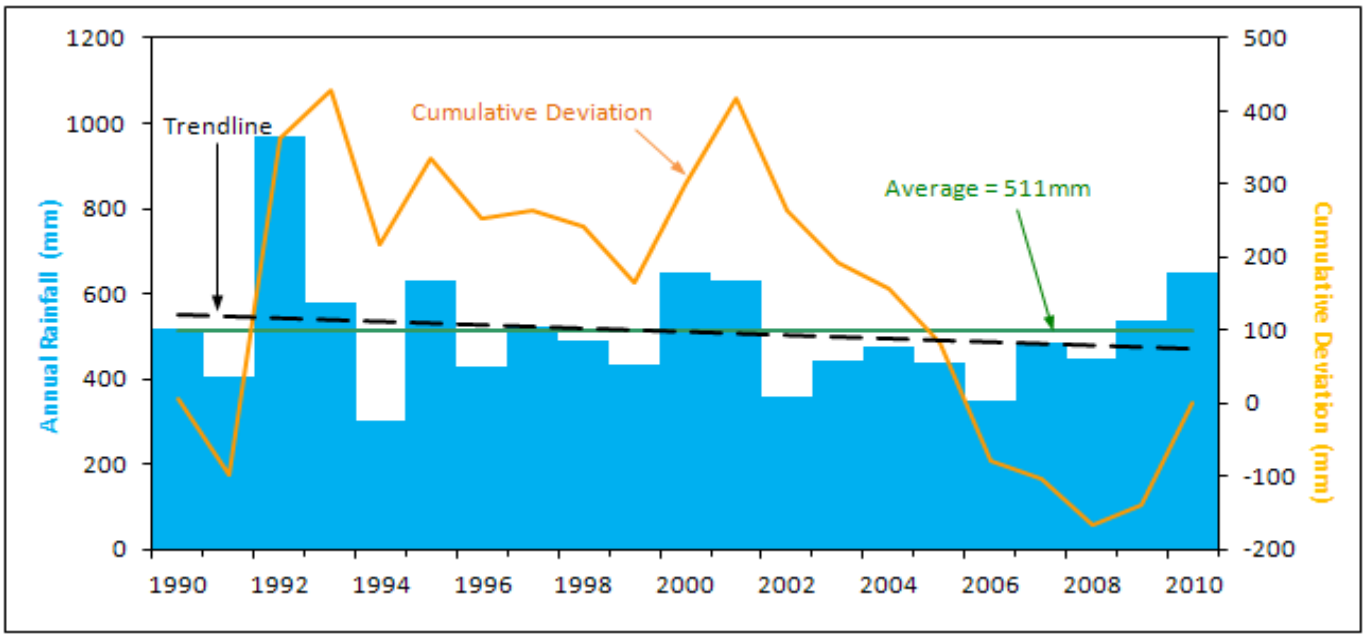


Figure 8. Baroota Reservoir Catchment Pluvio at Glenlossie annual rainfall for 1990-2010 and cumulative deviation

STREAMFLOW AND WATER STORAGE

Status	Degree of Confidence	Comments on recent historical context
Streamflow data in Baroota Creek is not available to make an assessment	N/A	N/A

The Baroota Creek catchment is the largest catchment on the western side of the Flinders Ranges between Port Pirie and Port Augusta. Streams in the region originate from the ranges in the east and flow through the lower elevation coastal plains in the west, and for those that actually reach the coast they drain into Spencer Gulf. Major streamflow gauging stations on Baroota Creek are non-existent. Gauging station A5080500 Baroota Creek at Baroota Reservoir has monitored reservoir storage levels and rainfall since 1978, but the station has since been decommissioned at the end of 2010. A report by Young (2001) refers to work completed by B.C. Tonkin & Associates (1999) and states that average inflows into the Baroota Reservoir were in the vicinity of 2950ML/yr, but the period over which this applies is not stated. A study by Clarke (1990) reports on a 1989 overflow event with flows of 100L/s observed 500m downstream of the reservoir reducing to flows of 20L/s a further 3.5km downstream. This study shows Baroota Creek downstream of the reservoir is a losing stream, where water volume gradually diminishes further down the creek.

Baroota Reservoir was constructed in 1921 with a capacity of 6,140ML. The reservoir construction is expected to have altered the hydrology of Baroota Creek downstream of the reservoir. DWLBC (2004) states that pre-reservoir stream hydrology would have been characterised by short duration flow events generated from the Flinders Ranges, which would flow across the coastal plains in winter and provide some recharge to the gravels and silts of the groundwater resource.

The reservoir catchment area of 130 km^2 is on the western side of the Flinders Ranges and a large proportion of this area is conservation and natural environments (Figure 4). The reservoir was used as a balancing storage for the reticulation of River Murray pipeline water up until 1997, but has since been removed from the distribution network by SA Water due to water quality issues (Barnett 2009). Its use as a balancing storage resulted in water levels being higher than those produced from local catchment runoff contributions. The removal from the distribution network has seen water levels consistently lower than before 1997 (Figure 9), apart from wet winters in 2000 and 2001. Water levels in the reservoir began to rise again in the latter part of the decade as result of higher than average winter rainfall in 2008 and 2009. Flow beneath the reservoir is known to contribute to groundwater recharge downstream of the reservoir as well as short periods of intensive recharge when the reservoir spills. Recharge is assisted by the geomorphology of the Baroota Creek with its highly permeable gravel beds. Reservoir storage and spill data presented in Figure 9 shows only six events that caused water levels to reach the spill level of 23m. Although the last event around 2002 reached the 23m spill level, it was of negligible quantity. The timing of the first five spill events can be matched to the reservoirs period of use as a balancing storage where levels were consistently higher. Baroota Reservoir is currently a stand-by water supply as part of SA Water's State Disaster and Emergency Management Plan (DEWNR 2013).

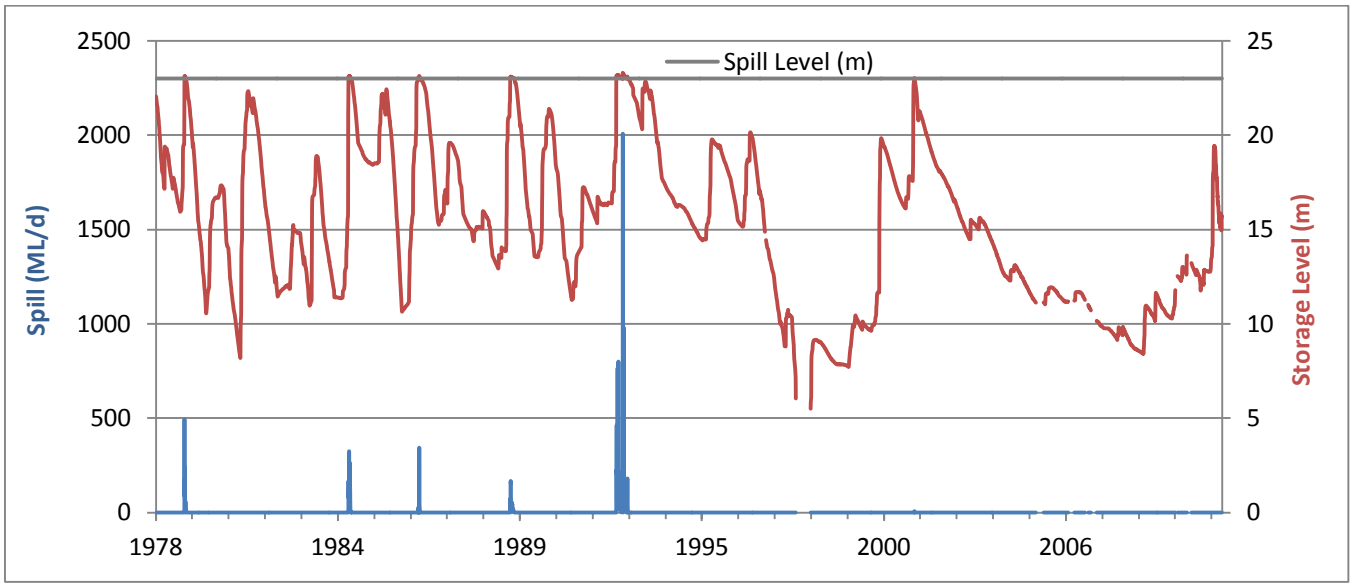


Figure 9. Baroota Reservoir storage and spill level

SALINITY

Status	Degree of Confidence	Comments on recent historical context
Salinity data in Baroota Creek is not available to make an assessment	N/A	N/A

No monitoring stations are established in the Baroota PWRA to monitor surface water salinity. An estimate of salinity in Baroota Reservoir varies between 800-1000mg/L TDS (CSIRO 2000).

Groundwater salinity is described in the Groundwater Status Report available for this region on the WaterConnect website: http://www.waterconnect.sa.gov.au/Systems/GSR/Pages/default.aspx

SURFACE WATER USE

Status	Degree of Confidence	Comments on recent historical context
Surface water usage data is not available to make an assessment	N/A	N/A

Water use in the Baroota PWRA will be controlled by the Baroota WAP, which is currently under development by the Northern and Yorke NRM Board in conjunction with the Department of Environment, Water and Natural Resources. Current metered water use is only available for groundwater. Groundwater use is described in the Groundwater Status Report available for this region on the WaterConnect website: http://www.waterconnect.sa.gov.au/Systems/GSR/Pages/default.aspx

FARM DAMS

A high level of development occurs within the Baroota Reservoir catchment (Figure 10). Dams within this region number around 100 with an estimated total storage capacity of 160 ML (Deane *et al.* 2005). The average dam size of 1.5 ML indicates that these are likely to be for stock and domestic purposes. Farm dams are limited within the PWRA with around 11 farm dams having an estimated storage capacity of 30ML. Based on information available for farm dams in the PWRA, it is not possible to distinguish between turkey nest dams and dams capturing surface water runoff. A turkey nest dam is a dam that, apart from rainfall falling directly into it, does not have its own upstream catchment directly supplying water to it (AMLRNRMB 2013).

As water levels in farm dams are not currently monitored, this report is unable to indicate the status of farm dam storage volumes from year to year. The status of water levels in farm dams in this area is contingent on many factors including;

- The amount in storage from the previous year
- The demand (extraction) placed on the dam
- The amount of inflows to the dam
- Any other inflows including groundwater pumping or imported water, and
- Other losses from seepage and/or evaporation.

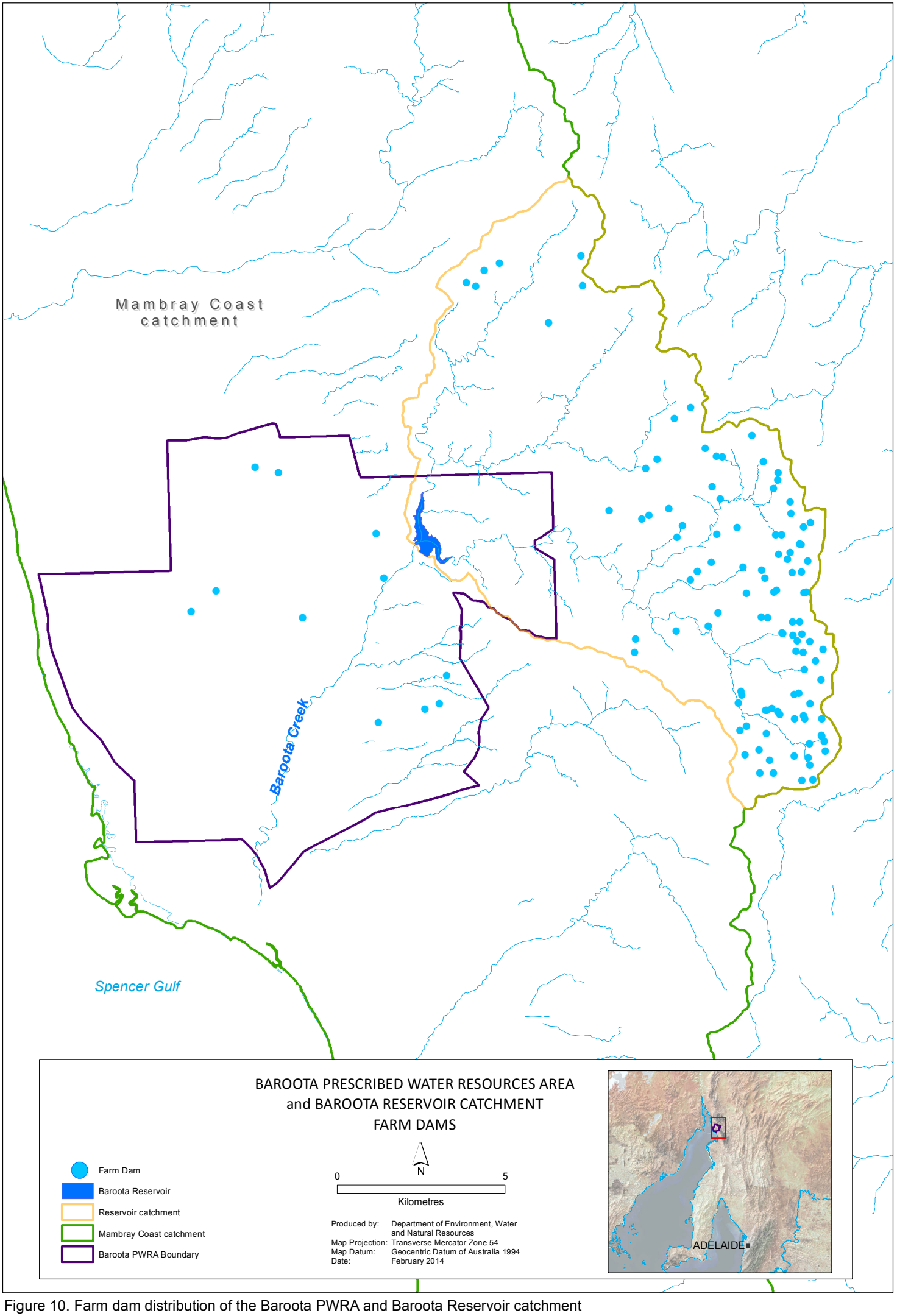


Figure 10. Farm dam distribution of the Baroota PWRA and Baroota Reservoir catchment

WATER DEPENDENT ECOSYSTEMS

This status report for the Baroota PWRA does not include an assessment of aquatic ecosystem condition and trend, however it is important to recognise the ecological components of the watercourses in the area. Baroota Creek is currently a highly modified ephemeral creek which has been altered through the construction of a large on-stream reservoir. This has resulted in highly reduced hydrological connectivity through the system (AWE 2012). Below is an examination of the current status of the aquatic ecosystems of the PWRA; no attempt is made to relate this to pre-reservoir conditions, as this is beyond the scope of this report.

River Red Gums (*Eucalyptus camaldulensis*) are key water dependant ecosystems in the PWRA, and they are primarily dependant on shallow groundwater. There has been no documented River Red Gum recruitment since the 1970s (Nicol, J 2013, pers. comm., 13 May). The health of the trees can be grouped into three categories based on their location within the PWRA viz., sections upstream of the reservoir, section immediately downstream of the reservoir and sections further downstream (around a kilometre) of the reservoir.

Recruitment of River Red Gums downstream of the reservoir is dependent on reservoir spills sufficient enough to wet the soil profile, recharge groundwater to limit watertable decline and remove competing vegetation (AWE 2012). AWE (2012) summarises the following on the health of the River Red Gums in the three sections mentioned earlier:

- All vegetation sampled upstream of Baroota reservoir at Waterfall Creek, including the River Red Gums, are in excellent condition including good vegetation health and recruitment.
- In sections immediately downstream of the reservoir, where reservoir leakage has been observed, the health of the trees is generally good, though some recent deaths had occurred with no evidence of recruitment.
- In sections further downstream of the reservoir, where the ground water levels are much deeper, the trees show signs of stress, recent death of mature trees and no evidence of recruitment. This poor health of River Red Gums in these sections is also documented in Deane *et al.* (2005) and Jensen (2011).

Storage levels have been consistently lower since the removal of the reservoir from the SA Water distribution network in 1997 (Barnett 2009). A reduction in the frequency of sufficient reservoir spills (Figure 9) and the affect of the recent drought period (AWE 2012) have influenced River Red Gum health. Deane *et al.* (2005) also notes that during dry periods, irrigation withdrawals may further increase the depth to the watertable.

Although there has been no known survey of the macroinvertebrate or fish communities in the PWRA, Fish Action Plan Data 2005 from the Biological Databases of South Australia lists Mosquito fish (Gambusia holbrooki) and Redfin Perch (*Perca fluviatilis*) in the reservoir and in the flowing section downstream of the reservoir. Both species are a noxious exotic species (Government of South Australia 2007). These are the only records of fish within the PWRA.

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