# RIVER MURRAY PWC

## Surface Water Status Report

## 2010-11

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# PURPOSE AND CONTEXT

This status report provides a snapshot of the surface water resources in the River Murray Prescribed Watercourse (PWC) for the financial year 2010-11. Surface water status reports are limited to reporting on the 'hydrological status' of the PWC. Available data on climate, streamflow, salinity and water use are summarised and compared with recent and long-term data to provide an indication of the hydrological status of its water resources. Each element is discussed with reference to recent or more long-term trends where they are present in these data. 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 system. Implementation of the NRM State and Condition Reporting Framework seeks to include an assessment of state and condition of natural resources through the development of Report Cards. The Department of Environment, Water and Natural Resources (DEWNR) in consultation with key stakeholders is 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 compared to status of water resources, visit the NR Connect site's NRM Reporting page: http://www.nrconnect.sa.gov.au/NRM-Reporting

# RIVER MURRAY PWC

The River Murray PWC extends from South Australia's eastern border to Lake Alexandrina and Lake Albert (Lower Lakes) (Figure 1). Surface water (including within watercourses) in the PWC have been prescribed under South Australia's *Natural Resources Management Act 2004*. Following prescription, a Water Allocation Plan (WAP) was developed by the South Australian Murray-Darling Basin NRM Board in 2009, which seeks to provide for the sustainable management of water resources.

The River Murray and its tributaries, all within the Murray-Darling Basin, originates in Queensland, New South Wales, Victoria and South Australia and is the most important water resource within South Australia (SAMDBNRMB 2009). Flows within the PWC are regulated by releases of water from Lake Victoria, Menindee Lakes, Hume Weir and Dartmouth Dam (SAMDBNRMB 2009). Major towns along the PWC include Berri, Morgan, Blanchetown, Swan Reach, Mannum, Murray Bridge and Tailem Bend. The rainfall of the PWC varies from around 250 mm average annual rainfall at the border to over 450 mm at the Lower Lakes. River regulation in the form of locks, weirs, storage reservoirs and dams have kept river water levels relatively constant, resulting in a now predominantly lacustrine (lake-like) ecosystem (SAMDBNRMB 2009). The natural flow regime of the River Murray prior to regulation was highly variable, with peak flows in South Australia usually in spring and early summer, reflecting the travel time for winter-spring runoff and snow melt in the headwaters of the catchment (SAMDBNRMB 2009).

Water authorised to be taken from the PWC is used for irrigation, industrial, stock, domestic, commercial, Metropolitan Adelaide and country town water supplies. Major pipelines from the River Murray distribute water to various regions of South Australia including Metropolitan Adelaide, the Barossa Valley, the Yorke Peninsula, the Lower North, Port Augusta, Whyalla, Iron Knob, Woomera and the Upper South East.

The major ecosystems that depend on water from the PWC include the Lower Lakes, the Coorong, the channel of the River Murray, wetlands and the floodplains. The Lower Lakes are the largest permanent lakes in South Australia, impounded by the barrages. The barrages also maintain a variety of permanent and temporary wetlands of international significance and are listed on the Ramsar register as important habitats for migratory birds that fly between Australia and Asia. There are more than 1100 wetlands in 250 complexes along the River Murray valley, including the Ramsar-listed Chowilla wetland complex (SAMDBNRMB 2009).

# SUMMARY 2010-11

## STATUS 2010-11

"No adverse hydrological trends, indicating a stable or improving situation"

This hydrological status is supported by:

- above average streamflow
- above average rainfall
- freshening salinity
- negligible water use.

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 when assigning the hydrological status for 2010-11. The section titled 'water dependent ecosystems' provides a brief overview of the water dependent ecosystems in the PWC.

(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.

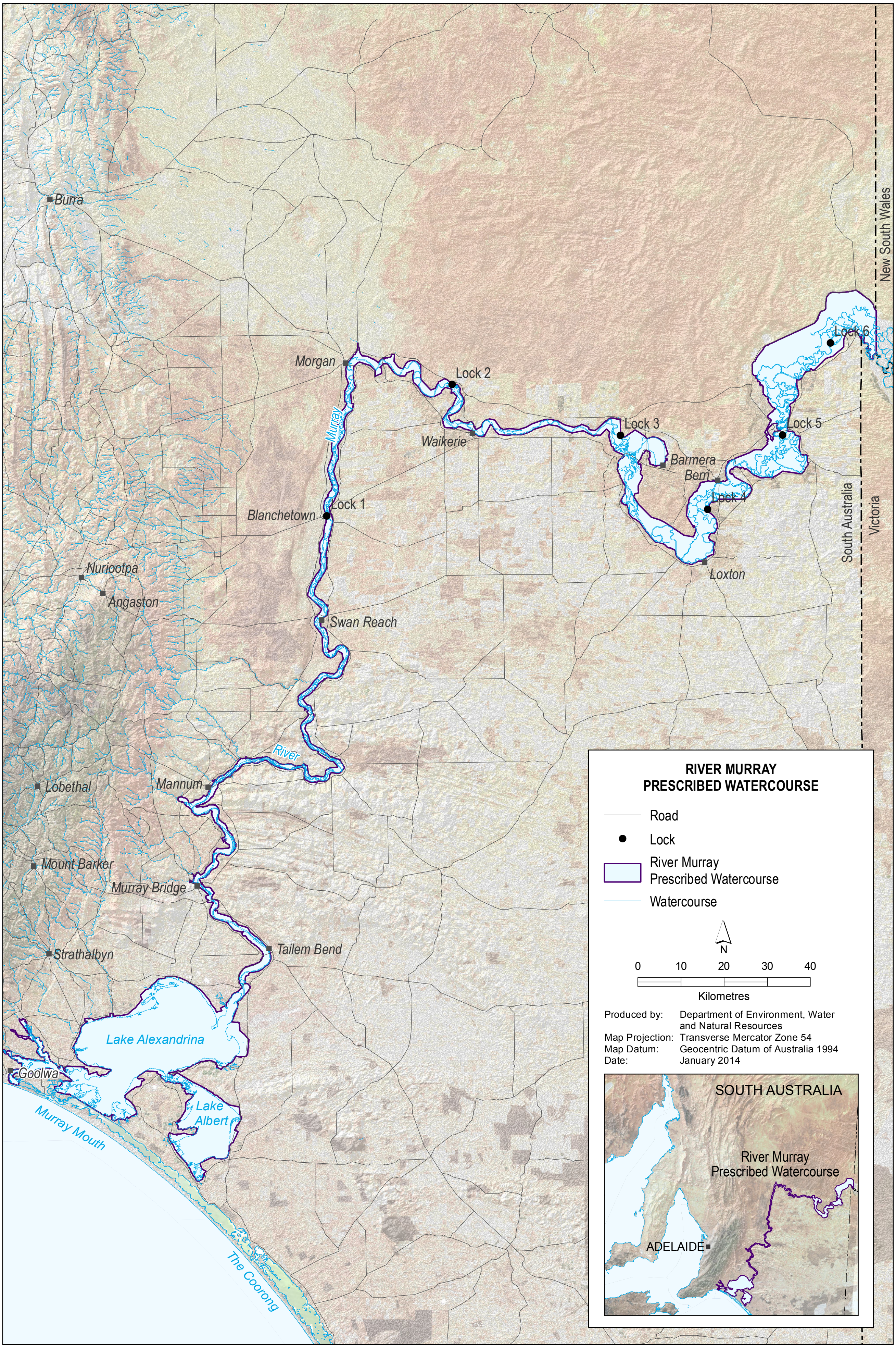



Figure 1. River Murray PWC and surrounding region

# RAINFALL

| Status | Degree of confidence | Comments on recent historical context |
|---|---|---|
| Above average rainfall across the region | High: good coverage of rainfall stations representing the rainfall variation across the region | Second year of above average rainfall in a row recorded at Overland Corner and Murray Bridge after two and three years of below average rainfall respectively. Third year of above average rainfall at Meningie after two years of below average rainfall. |

Rainfall in the River Murray PWC varies from 250 mm at the border to over 450 mm around the Lower Lakes. Rainfall stations along the River Murray are shown in Figure 5. Data from three of these stations, Overland Corner (M024012), Murray Bridge (M024521) and Meningie (M024518) were chosen for analysis of rainfall trends. Rainfall data have been sourced from SILO and are Patched Point Data. Further information on SILO climate data is available at: http://www.longpaddock.qld.gov.au/silo/index.html. As some of the stations have longer data sets, all data are summarised over the period from 1889 to June 2011 to ensure a consistent reporting period. It should be noted that the majority of flow in the PWC is generated from rainfall runoff in the headwater catchments outside of South Australia, whereas, a trend in local rainfall is the most relevant influence on extractions from the resource, for example irrigation demands.

The Overland Corner BoM rainfall station is located at Overland Corner. The long-term average annual rainfall (1889–2010) is 248 mm at Overland Corner. The Murray Bridge BoM rainfall station, located in the township of Murray Bridge, has a long-term average annual rainfall (1889–2010) of 349 mm. The Meningie BoM rainfall station is located on the edge of Lake Albert in the township of Meningie and has a long-term average annual rainfall (1889–2010) of 462 mm.

# RECENT RAINFALL

During 2010–11, large rainfall events were experienced during the warmer summer months at all stations (Figures 2 to 4). The rainfall recorded in these months raised the rainfall totals to well above the long-term averages. Overland Corner BoM rainfall station received 549 mm in 2010–11. Nine months of the year received above average rainfall with the months of September through to March receiving more than double the monthly average rainfall (Figure 2).

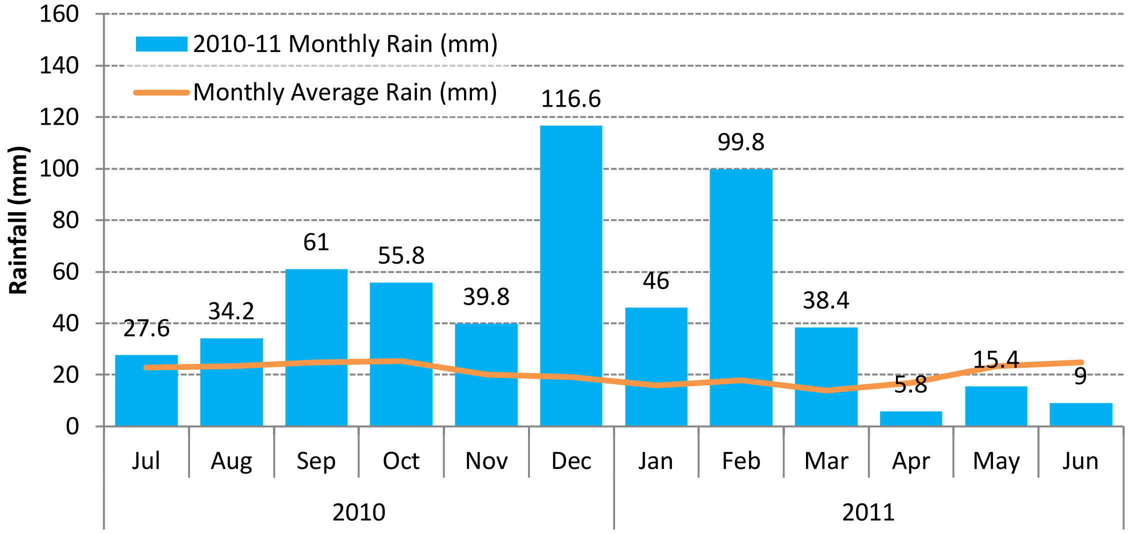



Figure 2. Monthly rainfalls at Overland Corner (M024012)

The Murray Bridge BoM rainfall station received 573 mm in 2010–11. Seven months of the year received above average rainfall with September, December, February and March receiving well above average rainfall (Figure 3).

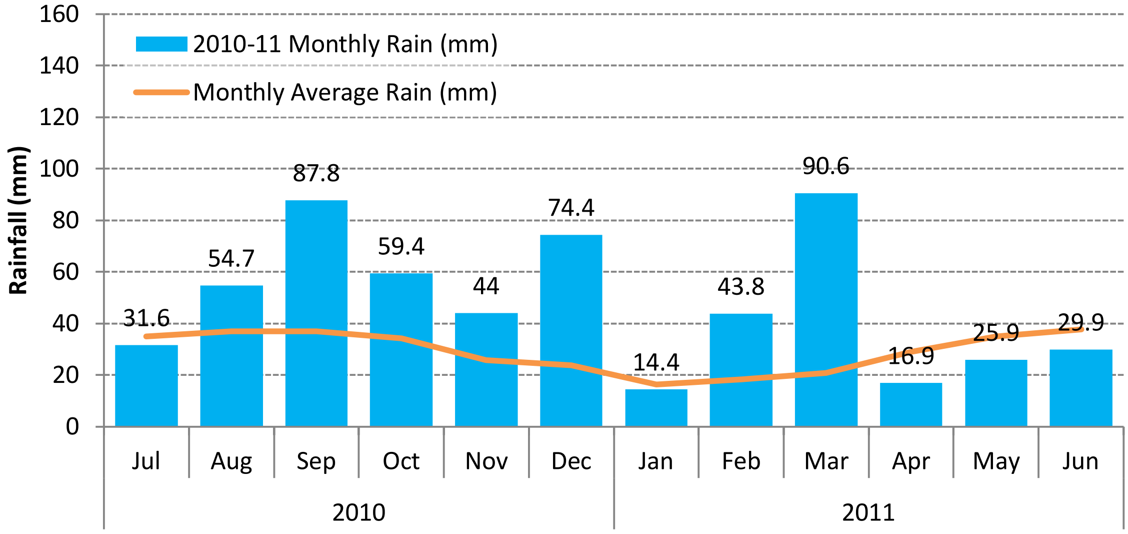



Figure 3. Monthly rainfalls at Murray Bridge (M024521)

The Meningie BoM rainfall station received 667 mm in 2010–11. Eight months of the year received above average rainfall with August, December and February receiving well above average rainfall (Figure 4).

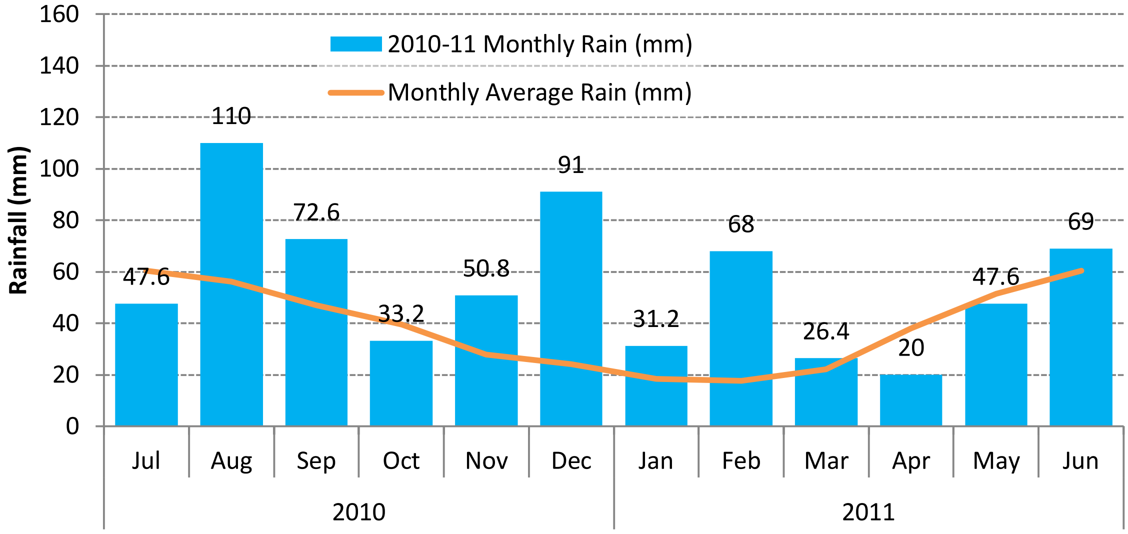



Figure 4. Monthly rainfalls at Meningie (M024518)

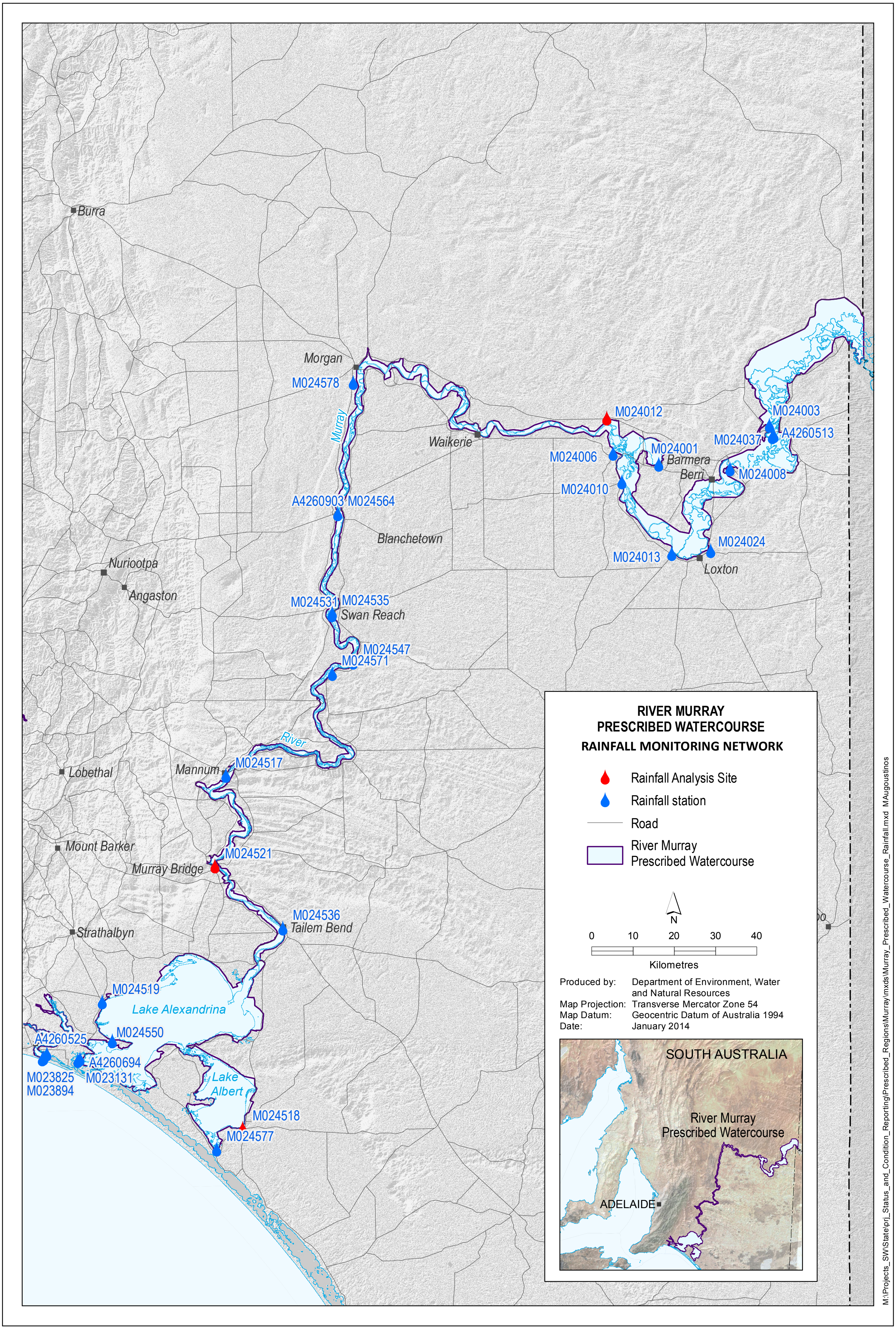



Figure 5. Location of rainfall monitoring sites in the River Murray PWC

# LONG AND SHORT-TERM TRENDS

Figure 6 shows the spatial distribution of rainfall over the River Murray PWC and surrounding areas for the:

1. long-term average annual rainfall from 1900–2010
2. short-term average of the previous 10 years (2001–10)
3. annual rainfall for 2010

The three panels of Figure 6, indicates that over much of the surrounding area, rainfall for the year 2010 (Panel 3) was above the long and short-term averages (Panel 1 and Panel 2). Panel 2 shows the average rainfall for the years 2001–10 and this shows a largely similar rainfall pattern to the long-term average but indicates slightly lower rainfall across the northern and southern parts of the surrounding area.

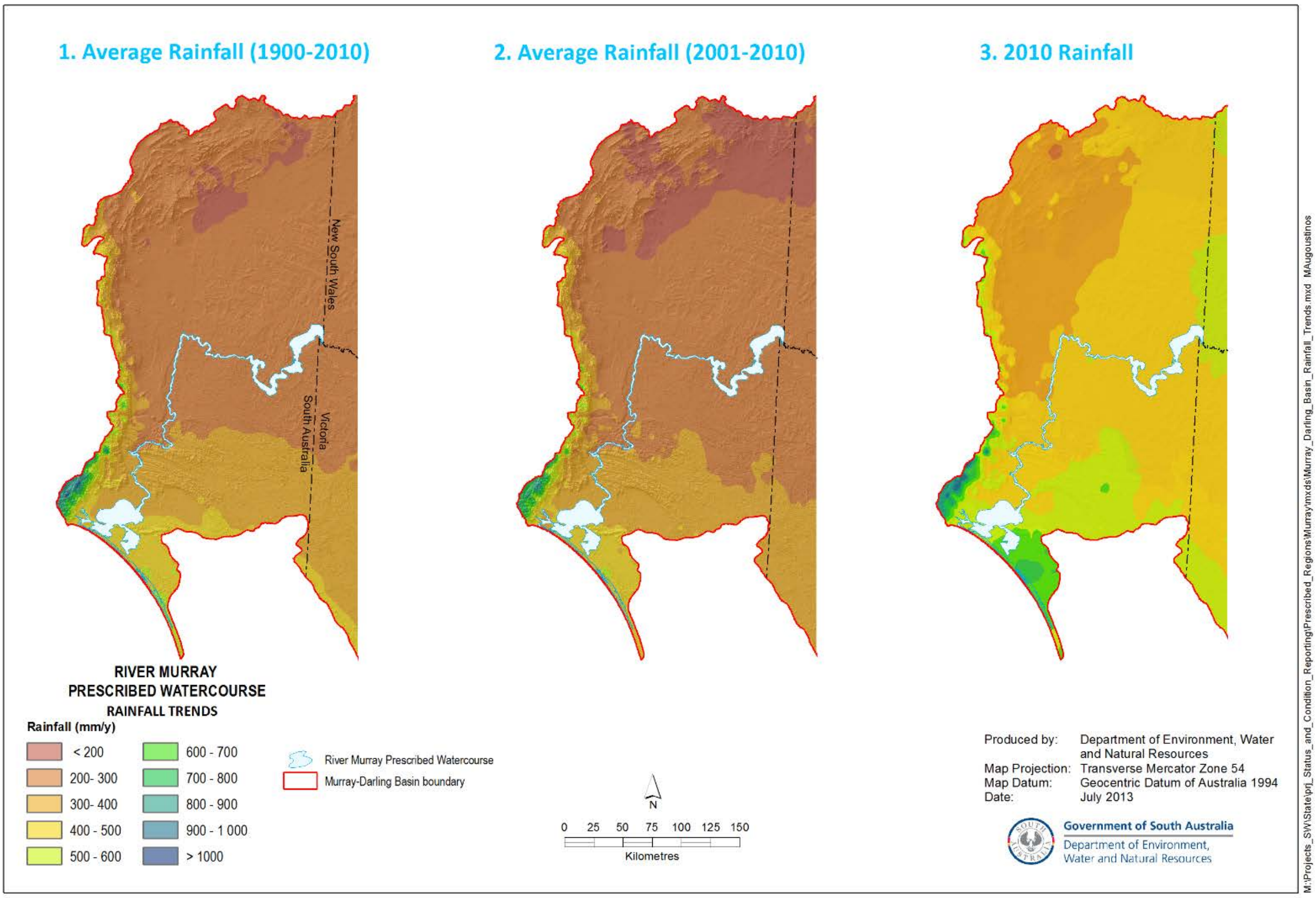



Figure 6. Annual rainfall distributions for the River Murray PWC and surrounding region

To identify periods of above or below average trends, the cumulative deviation from average annual rainfall (residual mass curve) is plotted in orange on Figure 7 to 9. An upward slope indicates a period of above average rainfall, while a downward slope indicates a period of below average rainfall.

Cumulative deviation data from Overland Corner show a slightly upward trend in annual rainfall between 1889 and the early 1920s (Figure 7). From the early 1920s to around 1950, the rainfall trend is in a sharp decline with predominantly below average rainfall throughout this period, then levelling out to around average rainfall until the early 1990s. Since the early 1990s, rainfall at Overland Corner shows a slightly increasing trend in annual rainfall.

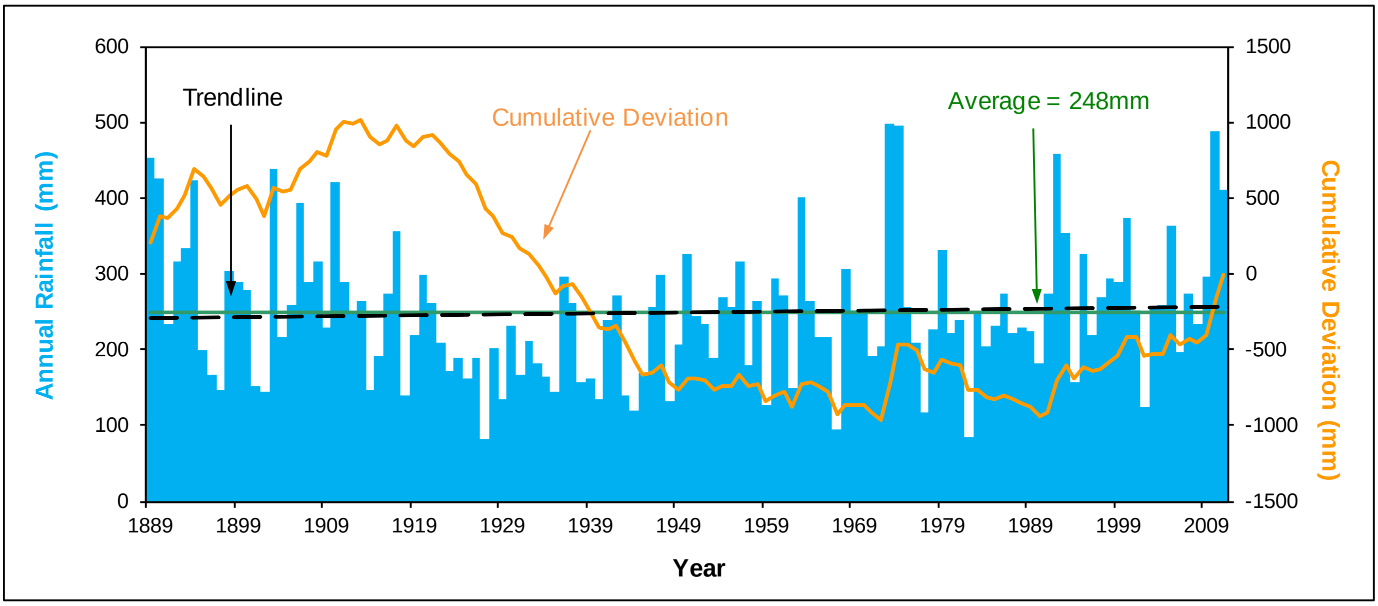



Figure 7. Overland Corner annual rainfall showing long-term trend and cumulative deviation

The rainfall trend at Murray Bridge shows a similar broad pattern to that of Overland Corner (Figure 8). From 1889 to around 1910 there was an overall upward trend in annual rainfall before a predominantly declining period in annual rainfall trend to the late 1960s. Since the late 1960s rainfall at Murray Bridge shows a predominantly increasing trend in annual rainfall.

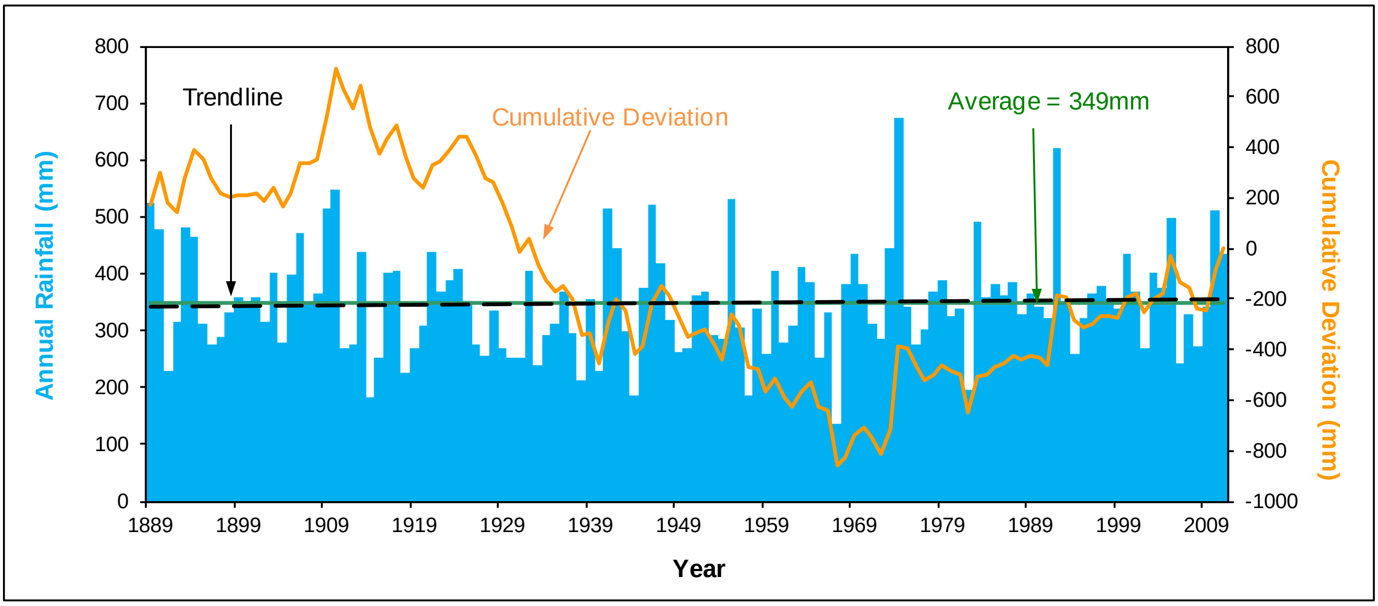



Figure 8. Murray Bridge annual rainfall showing long-term trend and cumulative deviation

Meningie received variable above and below average rainfall from 1889 to the late 1920s before a sharp declining trend in annual rainfall to the mid 1940s (Figure 9). A predominantly inclining trend in annual rainfall is shown between the mid 1940s and mid 1980s. Since the mid 1980s rainfall at Meningie shows a predominantly declining trend in annual rainfall.

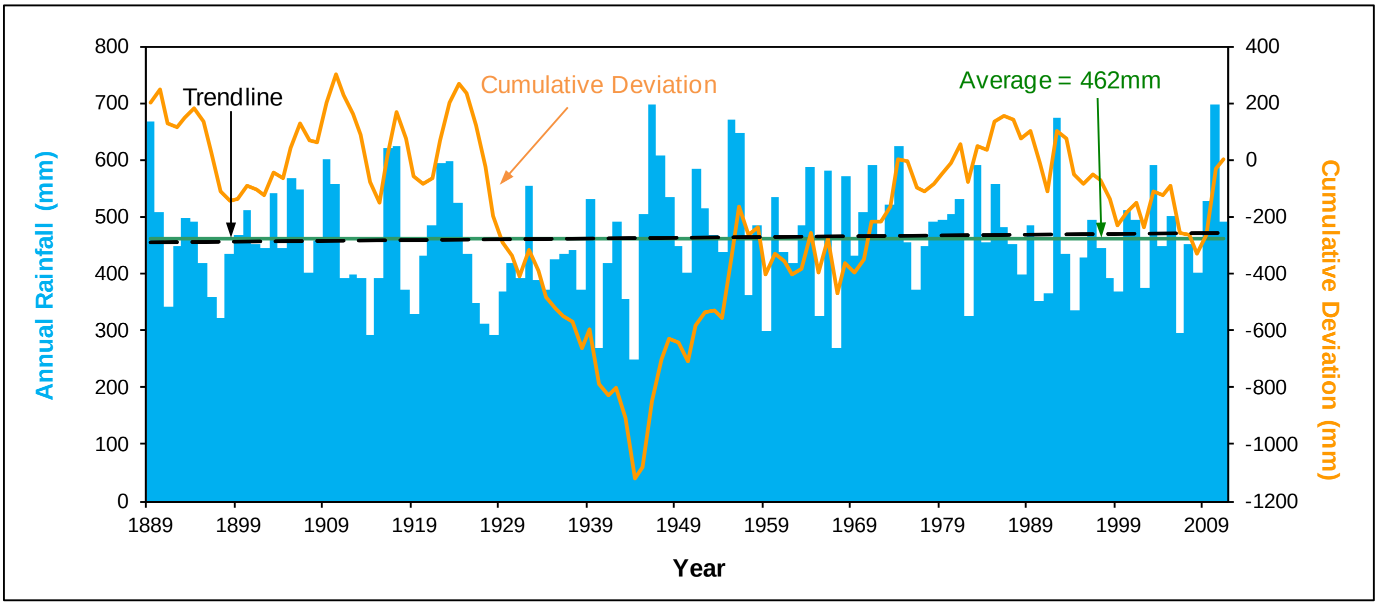



Figure 9. Meningie annual rainfall showing long-term trend and cumulative deviation

# STREAMFLOW

| Status | Degree of confidence | Comments on recent historical context |
|---|---|---|
| Above average | High – data derived from long-term monitoring stations | Above average streamflow was observed in the PWC for the first time since 2000–01 |

The monitoring network for the PWC is shown in Figures 10 and 11. Among the parameters recorded at the monitoring sites are water level, flow and salinity. As the number of monitoring sites in the PWC is numerous, for the purpose of this report, streamflow is summarised as flow to South Australia and flow at the barrages. Streamflow data are available via WaterConnect: http://www.waterconnect.sa.gov.au.

Flow to South Australia is calculated based on flow recorded at River Murray D/S (downstream) Rufus River gauging station (A4260200), plus flow in the anabranch that goes around this station at Mullaroo Creek gauging station (A4140211). Monitoring the flow to South Australia is a requirement of the WAP for the River Murray PWC, to assess the capacity of the resource under the *Natural Resources Management Act 2004*. Mean annual flow to South Australia is 5430 GL for the period 1978–2010. The majority of streamflow in the PWC is generated in the headwater catchments of the Murray-Darling Basin in New South Wales and Victoria. Streamflow is also regulated by releases of water from Lake Victoria, Menindee Lakes, Hume Weir, and Dartmouth Dam (SAMDBNRMB 2009).

The Lower Lakes are the largest permanent lakes in South Australia. Lake Alexandrina is the larger of the two lakes, connected to Lake Albert via a narrow channel. The Lower Lakes are impounded by a series of barrages that artificially separate the Lower Lakes from the Coorong, a long shallow lagoonal system. The Barrages also limit reverse flows of seawater into the Lower Lakes. The barrages, constructed between 1935 and 1940, maintain the river level between the Lower Lakes and Lock 1 at Blanchetown, as water in this reach is drawn upon to distribute water supplies to various regions of South Australia. To control the river level, stop logs and radial gates are used. In periods of low streamflow, stop logs and gates are set to completely stop flow from exiting the Lower Lakes to assist in maintaining river and lake levels. During times of upstream flooding, stop logs are removed and gates are opened to pass water into the Coorong and out to sea (MDBA 2014).

Streamflow at the barrages has been calculated based on the number of gates open at stations A4260526 (Mundoo Barrage), A4260570 (Boundary Creek Barrage), A4260571 (Ewe Island Barrage), A4261005 (Goolwa Barrage) and A4261006 (Tauwitchere Barrage) (Figure 11).

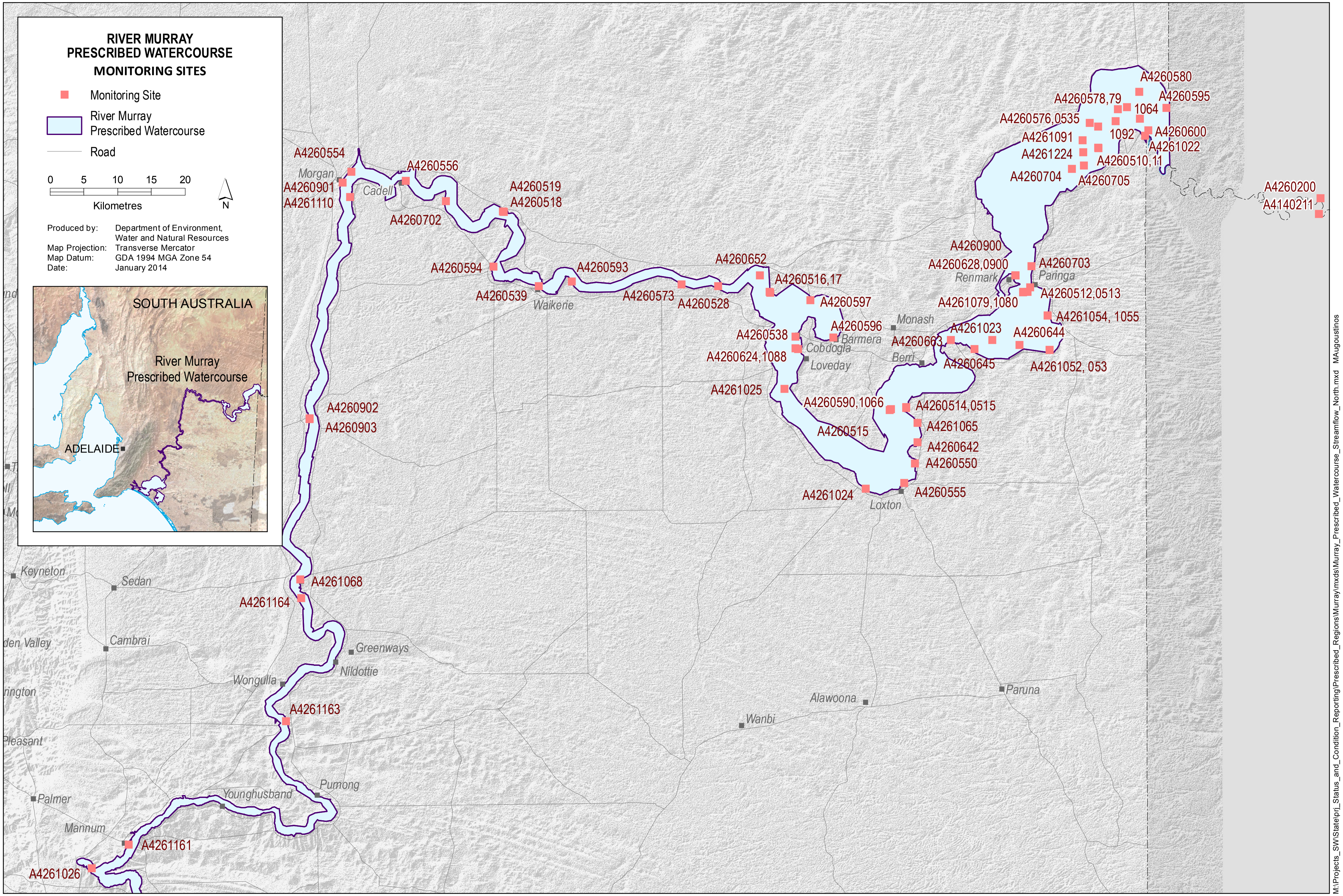



Figure 10. Location of streamflow and salinity monitoring sites in the River Murray PWC (north)

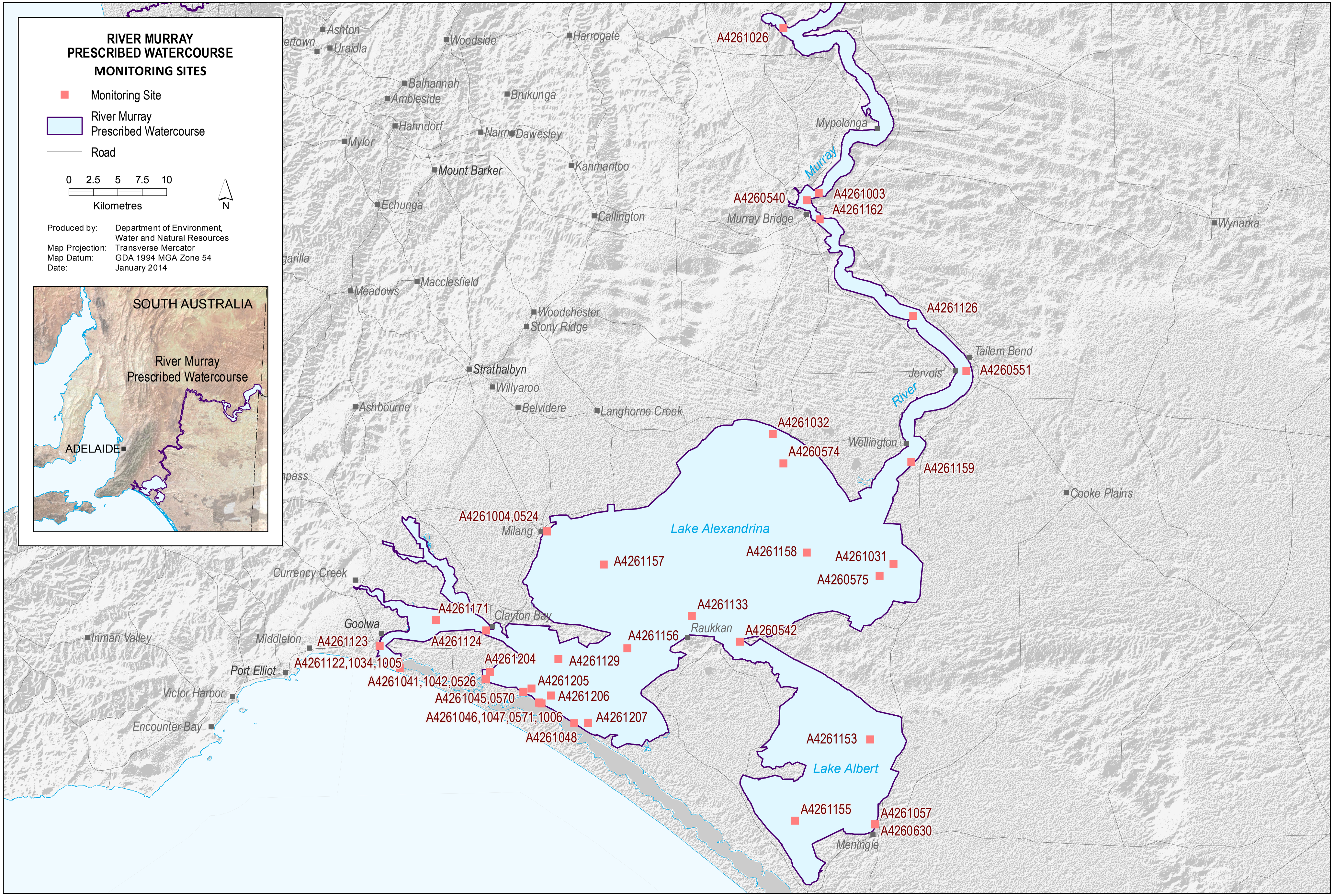
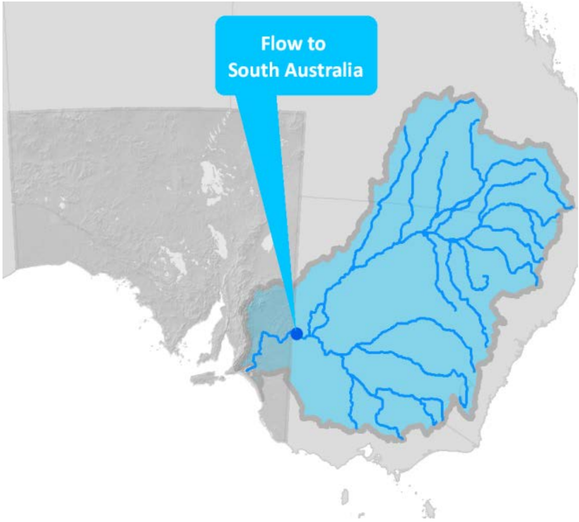



Figure 11. Location of streamflow and salinity monitoring sites in the River Murray PWC (south)

# STREAMFLOW DATA – TO SOUTH AUSTRALIA




Flow to South Australia is calculated based on the station River Murray D/S Rufus River (A4260200) and the flow in Mullaroo Creek (A4140211). The calculated flow is reported as the Flow to South Australia (A4261001). The flow for 2010–11 was above average, as highlighted in green in Figure 12. The 15 140 GL total was considerably higher than the 5430 GL long-term average. Prior to above average flows in 2010–11, flow to South Australia has been below average since 2001–02. The average annual streamflow between 1978–79 and 2000–01 was 6875 GL, much higher than the average annual streamflow between 2001–02 and 2009–10, which was 1745 GL.

The monthly breakdown of streamflow for 2010–11 (Figure 13) highlights that the months of November to June received well above average streamflows. This reflects the travel time for winter-spring runoff and snow melt in the headwaters of the catchment to travel downstream, as well as tropical events from the North of the Murray-Darling Basin arriving in late summer (see adjacent image). The warmer months of December to April contributed 70% of the annual streamflow total with February, March and April receiving more than eight times the average for those months. Streamflow recorded between July and October was below average.

At the commencement of 2010–11, it should be noted that South Australia was experiencing the fifth consecutive year with access to less than the Entitlement Flow of 1850 GL, due to the prolonged period of low flows. The volume of water available to South Australia at the start of 2010–11 was 1384 GL (MDBA 2012a). The significant improvement of streamflow in 2010–11 resulted in South Australia receiving the full Entitlement Flow of 1850 GL.

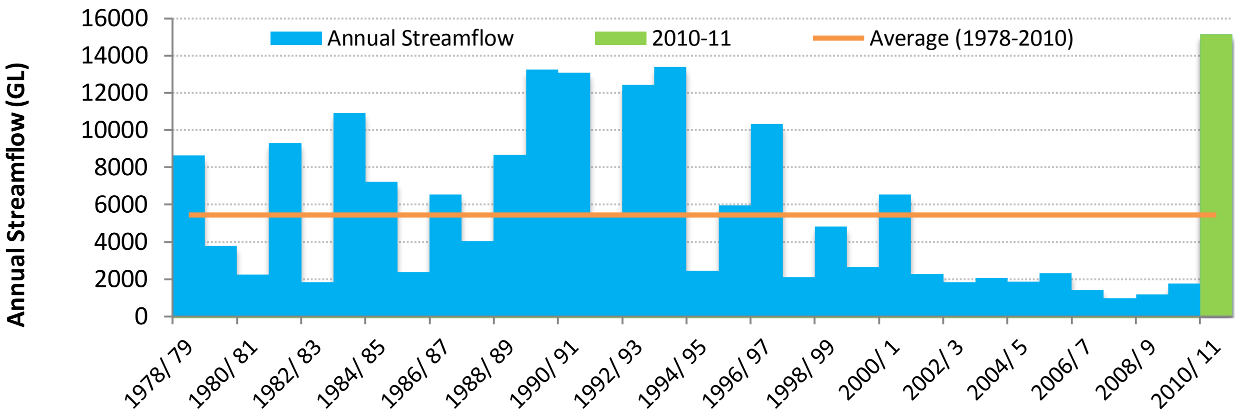



Figure 12. Flow to South Australia annual streamflow (GL)

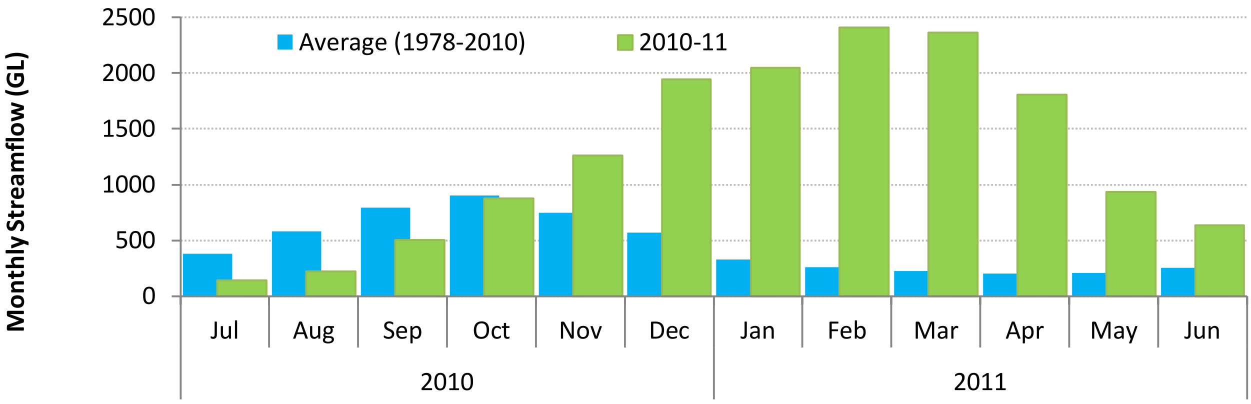
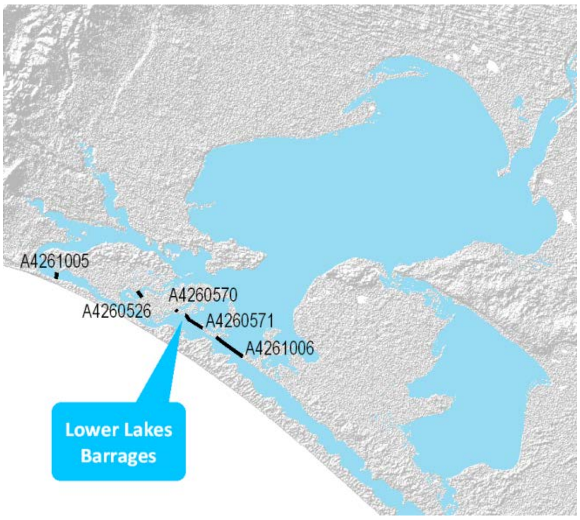



Figure 13. Flow to South Australia monthly streamflow (GL)

# STREAMFLOW DATA – AT THE BARRAGES

Streamflow estimated at the barrages was above average for 2010–11, as highlighted in green in Figure 14. The 15 250 GL total was approximately five times the 3060 GL long-term average (1982–2010). Prior to 2010–11, streamflow at the barrages has been below average since 1997–98. No streamflow occurred in 2002–03 and 2007–10.

The monthly breakdown of streamflow at the barrages for 2010–11 (Figure 15) highlights that the months of November to June received well above average streamflows. The majority of the annual total occurred in these months. No streamflow occurred in July and August, while September and October were below average.



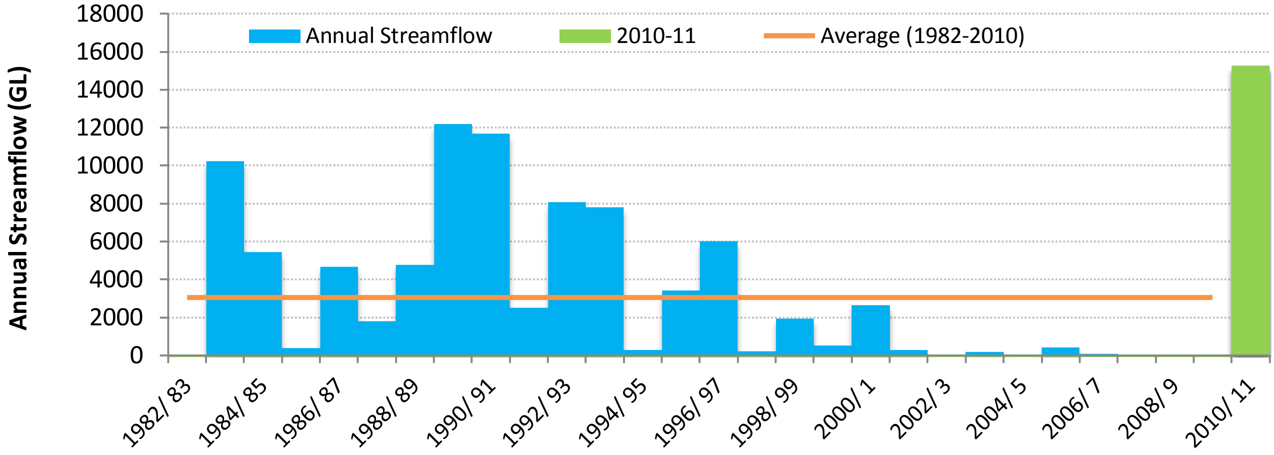




Figure 14. Flow at the barrages annual streamflow (GL)

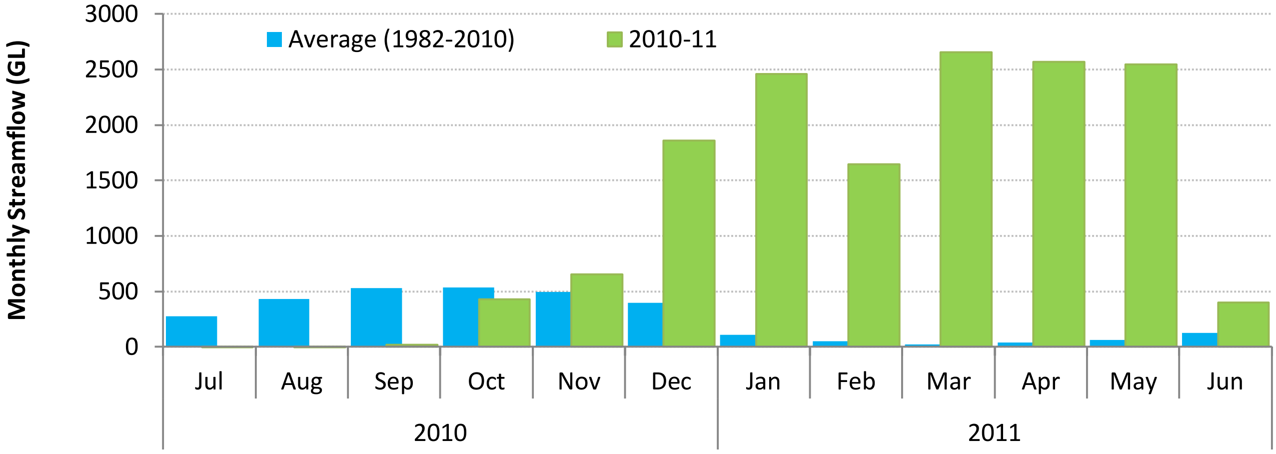



Figure 15. Flow at the barrages monthly streamflow (GL)

# SALINITY

| Status | Degree of confidence | Comments on recent historical context |
|---|---|---|
| Freshening | High: data derived from long-term salinity monitoring | Salinity levels prior to 2010–11 were higher due to the reduced levels of streamflow in the PWC |

## MORGAN AND MURRAY BRIDGE

South Australia depends heavily on the River Murray to meet its water requirements. Water is transported from the River Murray to many regions of South Australia through major pipelines from Morgan, Swan Reach, Mannum, Murray Bridge and Tailem Bend. Target salinity levels of less than 800 EC (µs/cm) at Morgan and less than 830 EC (µs/cm) at Murray Bridge for 95% of the time are set in the Basin Plan (MDBA 2012). Salinity at Morgan (A4260554) and Murray Bridge (A4261003) improved during 2010–11 as a result of increased streamflows to South Australia, with most salinity data below 400 EC. Prior to 2010–11, salinity levels at Morgan and Murray Bridge were higher due to lower streamflows in the River Murray. From 2001 to 2011, salinity at Morgan has exceeded 800 EC only once in 2001 (0.03% of total days). Over the same period, salinity at Murray Bridge has exceeded 830 EC for one event of ninety–three days in 2008 (2.43% of total days).

Salinity data are available via WaterConnect: http://www.waterconnect.sa.gov.au

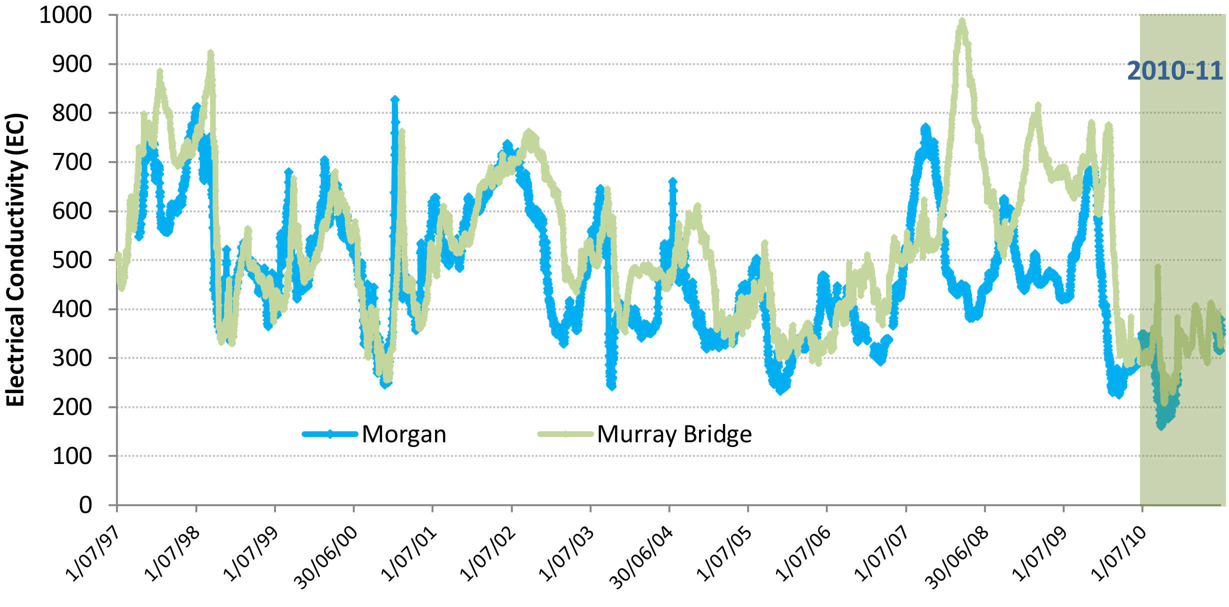



Figure 16. Salinity data at Morgan and Murray Bridge from 1997-2011

# LOWER LAKES

Salt from the entire Murray-Darling system is naturally exported to the ocean through the Murray Mouth. Salt build up in the Lower Lakes can be attributed to low freshwater flows to the site, reduced flow at the barrages and increased evaporation due to high temperatures (DEWNR 2014). Although salinity levels remain high in Lake Albert, salinity is freshening due to increased flows that have allowed some salt to be exported from Lake Albert through the Narrows to Lake Alexandrina, which is then washed to sea through the Murray Mouth. The Basin Plan includes a salinity target for Milang (Lake Alexandrina) of less than 1000 EC 95% of the time. This can be compared to the calculated Lake Alexandria salinity that was less than 1000 EC 9% of the time from 2002–11. During 2002–07, salinity levels at the Lower Lakes were generally between 1000–2500 EC (µs/cm). From 2007, salinity levels started to increase more rapidly and at an even greater rate in Lake Albert. In 2009, the Narrung Bund was built to disconnect Lake Albert from Lake Alexandrina in response to the impacts of prolonged drought and the threat of acidification in Lake Albert (DEWNR 2014a). In July 2011, the Narrung Bund was removed to fully reconnect Lake Alexandrina and Lake Albert as result of improved flows to the Lower Lakes. Improved flows have contributed to the reduced levels of salinity in the Lower Lakes.

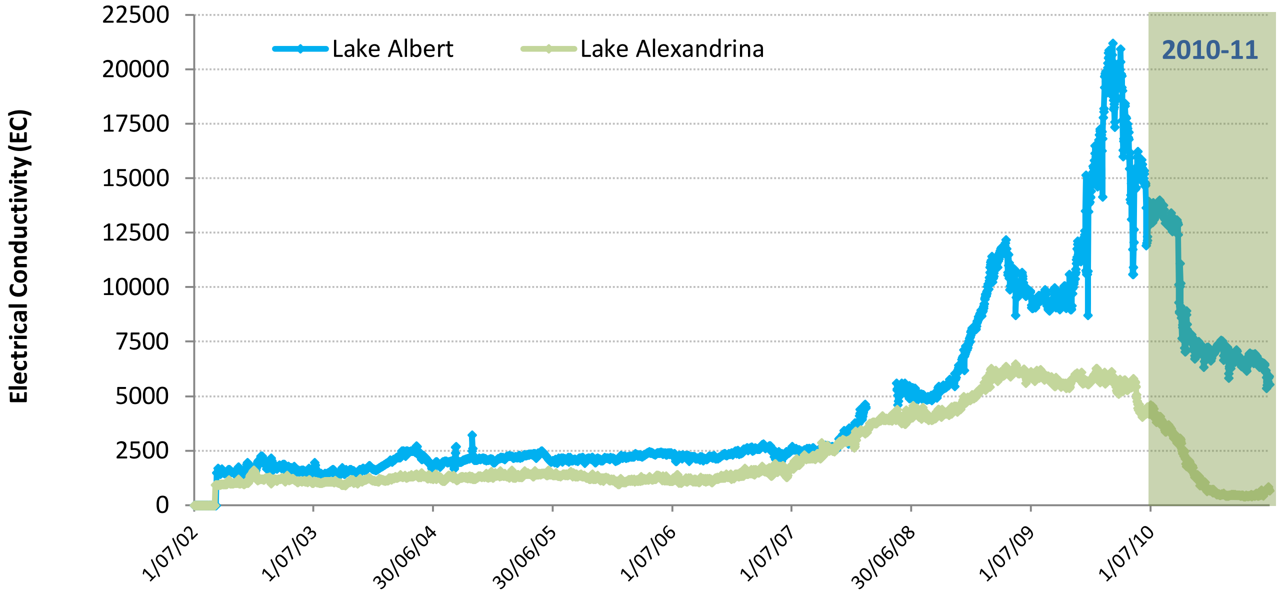



Figure 17. Salinity data at the Lower Lakes from 2002-11

# SURFACE WATER USE

| Status | Degree of Confidence | Comments on recent historical context |
|---|---|---|
| Negligible use<br>2% use/volume ratio | High – data from MDBA Water Audit Monitoring Report | Water use decreased in 2010-11 in comparison to use reported in 2008-09 (485 GL; 50% of total streamflow) and 2009-10 (480 GL; 31% of total streamflow) |

Total water use, as water diverted for consumptive use from the watercourse, is reported by the Murray-Darling Basin Authority (MDBA) via Water Audit Monitoring Reports released each year. For South Australia, water use is summarised as Metropolitan Adelaide and Associated Country Areas, Lower Murray Swamps, Country Towns and All Other Purposes. A summary of the environmental water delivered has also been provided, however environmental water use and outcomes are not the focus of this surface water status report.

## SURFACE WATER USE 2010-11

In 2010–11 total use (diversions) from the River Murray PWC was 362 GL, less than the 480 GL diverted in 2009–10 (MDBA 2012a) (Figure 18). The diversions for 2010-11 comprised of:

- 56.4 GL for Metropolitan Adelaide and Associated Country Areas
- 34.1 GL for Country Towns
- 13.6 GL for the Lower Murray Swamps (including Environmental Land Management Allocation)
- 257.9 GL for All Other Purposes (metered and non-metered consumption).

Water for Metropolitan Adelaide and Associated Country Areas is primarily sourced from natural catchment inflows to the Mount Lofty Ranges storages, water diverted from the River Murray and more recently, the Adelaide desalination plant (MDBA 2012a). The 56.4 GL diverted from the River Murray in 2010–11 is slightly less than the 56.9 GL diverted in 2009–10.

In terms of supply to Country Towns, the 34.1 GL diverted from the River Murray in 2010–11 is less than the 37.6 GL diverted in 2009–10.

The Lower Murray Swamps consists of reclaimed irrigation areas located between Mannum and Wellington that were formerly wetlands connected to the River Murray (MDBA 2012a). The 13.6 GL diverted from the River Murray in 2010–11 is less than the 14.3 GL diverted in 2009–10.

All Other Purposes consists of metered and non-metered diversions for irrigation, industrial, recreation, stock and domestic use. The 244.2 GL diverted from the River Murray for metered consumption in 2010–11 is considerably less than the 350.6 GL diverted in 2009–10. It is likely that this is primarily due to the above average rainfall conditions experienced in and adjacent the PWC during the main growing season (spring to summer) (Figures 2-4). The 13.7 GL diverted from the River Murray for non-metered consumption in 2010–11 is less than the 21 GL diverted in 2009–10.

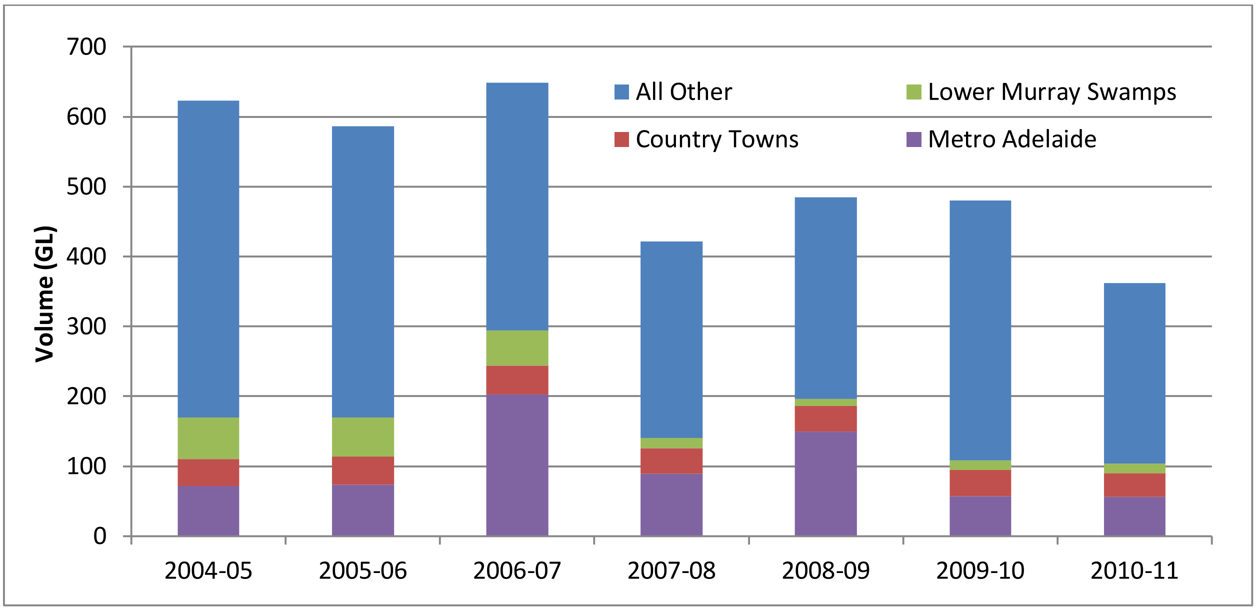



Figure 18. Surface water diversions from the River Murray PWC from 2004–2011

### Environmental Water

During 2010–11, 306 GL of environmental water formally allocated was received in addition to unregulated streamflow (MDBA 2012a). High volumes of unregulated streamflow have a range of positive environmental outcomes in the PWC including, but not limited to, the maintenance or rehabilitation of aquatic or riparian ecosystems. Formally allocated environmental water was provided to wetlands, floodplains, the Lower Lakes, the Coorong and the Murray Mouth. The water came from a variety of sources including the MDBA, Commonwealth Environmental Water Holder, private donations and return flows from Victorian environmental watering actions. In addition to this, 0.56 GL was delivered as part of the 2010–11 multi-site environmental watering trial and South Australia provided 92 GL of water that was saved under the River Murray Drought Water Allocation Framework for Lakes Alexandrina and Albert (MDBA 2012a). Environmental water is largely used by water dependent ecosystems in the PWC, hence haven't been included in Figure 18, which shows surface water diversions from the PWC.

# USE RATING

An assessment of use was carried out using a rating from 1 to 6 to indicate the estimated percentage of the year's surface water resources used for diversion. This annual approach is slightly different to that used in the State's NRM Plan 2006, where water allocation and management guidelines stipulate that 25% of median annual adjusted runoff is considered to be an indicator of sustainable use limits, outside prescribed areas, until additional information becomes available. This is to protect the needs of downstream users, including water dependent ecosystems. In prescribed areas, use limits are defined in the various WAP's developed by NRM Boards and currently range between 15–30% and are generally based on long–term average values. The 25% rule is consistent with peer-reviewed independent scientific studies in south-eastern Australia (SKM 2003, RMCWMB 2003). As such, Table 1 was developed whereby 25% of streamflow used is considered moderate (21–30%). Any percentage of streamflow greater than 30% is considered high, very high or extreme and therefore above use limit guidelines.

Recorded streamflow for the River Murray PWC in 2010–11 (at River Murray D/S Rufus River) was approximately 15 000 GL, with approximately 360 GL (excluding environmental water) recorded or estimated as being diverted from the PWC. As such it is estimated that 2% was diverted for use, much lower than the 31% in 2009–10 and 50% in 2008–09. In terms of the rating system described in Table 1, the River Murray PWC has been assigned a use rating of 1 (Negligible use) for 2010–11.

Table 1. Use Rating System

| Rating | % of streamflow used in current year | Description |
|---|---|---|
| 1 | 0 – 10 % | Negligible use |
| 2 | 11 – 20 % | Low use |
| 3 | 21 – 30 % | Moderate use |
| 4 | 31 – 40 % | High use |
| 5 | 41 – 50 % | Very high use |
| 6 | Greater than 50 % | Extremely high use |

# WATER DEPENDENT ECOSYSTEMS

This status report for the River Murray PWC 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. The River Murray is the longest river in Australia. It is a regulated river system with multiple weirs and barrages controlling the flow of water along the watercourse. Extraction and regulation activities have resulted in an altered aquatic ecosystem (SAMDBNRMB 2009). The PWC encompasses ecologically significant ecosystems including floodplains, wetlands, lakes and estuarine habitats.

Given the high profile nature and importance of the Murray-Darling Basin for Australia, multiple monitoring programs were active throughout 2010-11 and include:

- The River Murray Water Quality Program; also inclusive of some biological monitoring (http://www.mdba.gov.au/what-we-do/mon-eval-reporting/water-quality-program)
- The Living Murray environmental monitoring (http://www.mdba.gov.au/what-we-do/mon-eval-reporting/TLM-environmental-monitoring)
- Sustainable Rivers Audit (http://www.mdba.gov.au/what-we-do/mon-eval-reporting/sustainable-rivers-audit)
- Murray-Darling Freshwater Research Centre's Macroinvertebrate Monitoring Program (http://www.mdfrc.org.au/projects/featured/murraymacro.asp)
- River Murray Environmental Watering Program (http://www.environment.sa.gov.au/managing-natural-resources/river-murray), and
- Numerous community monitoring programs (Local Action Plans)

The programs listed above monitor diverse aspects of the PWC and associated ecosystems and below is a summary of the major findings of these programs.

The aquatic vegetation of the PWC has shown improvement due to the increased water levels and fresher water provided by the large rainfall events in late 2010. The increased water levels inundated floodplain vegetation causing large scale recruitment of aquatic vegetation from the seed bank and increases in overall plant health. Increased water levels also removed encroaching terrestrial vegetation in both floodplain and Lower Lakes areas (Gehrig *et al.* 2012). Lower salinity levels in the Lower Lakes resulted in an increase in submerged vegetation (Gehrig *et al.* 2012).

Macroinvertebrate populations also responded positively to increased water levels and fresher water. Inundated floodplain habitat provided opportunities for large scale breeding of aquatic macroinvertebrates (EPA 2011). The decreased salinity levels in the river and Lower Lakes also resulted in an increase of macroinvertebrate species (EPA 2011).

The fish community within the PWC is a complex mix of native and exotic fish. There has been a documented increase in the population of carp since the end of the drought with large breeding events reported (Bice *et al.* 2011). While the numbers of fish are still dominated by natives, the biomass is dominated by exotics with many of the large bodied native fish being rare. The abundant native species are small bodied hardy species such as the Murray River Rainbow Fish, while European Carp is the most abundant exotic and is responsible for reductions in aquatic vegetation and increased turbidity (Bice *et al.* 2011).

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