South Australian evaluation of environmental outcomes under the Basin Plan | 2024

South Australian Murray Region Water Resource Plan Area

SOUTH AUSTRALIA

Government of South Australia

Department for Environment and Water

Acknowledgment of Country

We acknowledge and respect the Traditional Custodians whose ancestral lands we live and work upon and we pay our respects to their Elders past and present. We acknowledge and respect their deep spiritual connection and the relationship that Aboriginal and Torres Strait Islanders people have to Country.

We also pay our respects to the cultural authority of Aboriginal and Torres Strait Islander people and their nations in South Australia, as well as those across Australia.

Acknowledgement of partners

Many individuals and staff from South Australian government agencies, including SA Department for Environment and Water, the Northern and Yorke, and Murraylands and Riverland Landscape Boards have contributed, data, information, reports, expert input and review at all stages of this evaluation. This work has relied on monitoring data and information from flow monitoring data captured by the South Australian flow monitoring network and the Bureau of Meteorology rainfall monitoring network, along with data and information from the South Australian Environment Protection Authority and the Australian Bureau of Meteorology. This evaluation report is the product of a collaborative effort, and the authors thank all contributors and reviewers.

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Synopsis

The *South Australian evaluation of environmental outcomes under the Basin Plan: 2024 South Australian Murray Region Water Resource Plan Area* is one in a suite of reports submitted every five years by South Australia to meet our obligations under the Basin Plan.

The South Australian Government remains committed to ensuring that the Basin Plan's commitments are met to ensure that we have a sustainable, healthy, working Basin for future generations. Monitoring and evaluation are critical to underpin adaptive management and the resultant management improvements to achieve the Basin Plan's intended environmental outcomes.

This evaluation draws together current evidence from the SA Murray Region Water Resource Plan Area (WRPA) to provide a summary of progress made towards the achievement of environmental outcomes.

This report comes at an important time in the implementation of the Basin Plan. It will support the continued work towards full implementation of our Basin Plan obligations and inform the upcoming review of the Basin Plan in 2026.

In undertaking this evaluation, we have worked closely with technical experts and key stakeholders to evaluate the following questions:

- To what extent have outcomes been achieved?
- If outcomes were not achieved, why not?
- To what extent did the Basin Plan contribute to achieving outcomes?
- Have there been any unanticipated outcomes?

Key messages

This evaluation demonstrates that:

- Baseflows into the permanent pools of Burra Gorge were near perennial throughout the assessment and have been sustained since 2019, helping to maintain aquatic ecosystem condition.
- Freshes have occurred every year since 2009–10 and remain stable over the assessment period.
- Although there have been improvements in the higher bankfull and overbank flows, the frequency of these flows required to support aquatic ecosystems were not met at times, due to a lack of rainfall producing sufficient runoff events.
- The key factors that have affected the achievement of environmental outcomes for baseflows and higher flows to permanent pools in Burra Gorge are rainfall, surface water and groundwater extraction and dam development levels; however, the relative impact of these drivers is currently a knowledge gap.

This report summarises our assessment and evaluation in a simple and accessible format. It communicates environmental outcomes achieved to date and what is still to be done. This report begins with a description of the SA Murray Region WRPA and the Northern Mount Lofty Ranges Priority Environmental Asset (PEA), followed by evaluation findings for key indicators (i.e. environmental water requirement measures) in the form of environmental outcome assessments. This report is supported by a more detailed technical report.

Based on this evaluation, to achieve ongoing environmental improvements it is important that we seek to:

- Ensure that Planned Environmental Water (PEW) is preserved for achieving environmental outcomes
- Further investigate the levels of water resource development in the Burra creek catchment and Northern Mount Lofty Ranges (i.e. dam and groundwater development and use)
- Monitor the ecological health of the permanent pools of Burra creek to determine the impacts of current levels of water resource development and a drying climate.


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South Australian Murray Region Water Resource Plan Area

The South Australian Murray Region Water Resource Plan Area (WRPA) covers an area of approximately 63,509 km^2 and includes all surface and groundwater resources in this area (Figure 1). The SA Murray Region WRPA covers most of the Murray–Darling Basin in SA from the state border in the east, to the edge of the plains of the Mount Lofty Ranges in the west and south-east to the coast.

In the Basin Plan, the SA Murray Region also includes the Coorong; however, the evaluation of environmental outcomes for the Coorong is undertaken as part of the South Australian River Murray evaluation. This is because the SA River Murray Long-term Watering Plan (LTWP) includes objectives, targets and Environmental Water Requirements for this asset in recognition of the intrinsic connection between the River Murray and Coorong

The SA Murray Region is not part of a connected river system and, therefore, there is a limited ability to manage environmental water. There is no Held Environmental Water in the SA Murray Region and limited instances of Planned Environmental Water (PEW), which are not actively managed. However, statutory water planning instruments ensure that PEW is provided and protects ecosystem functions.

Within the SA Murray Region WRPA, the Northern Mount Lofty Ranges Watercourses (NMLRW) are the identified PEA. These watercourses provide critical refuge habitats for aquatic biota in the form of permanent pools and have PEW which is protected for the environment. These watercourses drain onto flat mallee country and very rarely reach the SA River Murray. Of these watercourses, Burra Creek is considered critical (and is the focus of this assessment and evaluation of outcomes), as it has the most important permanent refuge pools of the region, with few other examples elsewhere in the SA Murray Region WRPA.

For more information about the SA Murray Region please see the SA Murray Region Long-term Environmental Watering Plan.

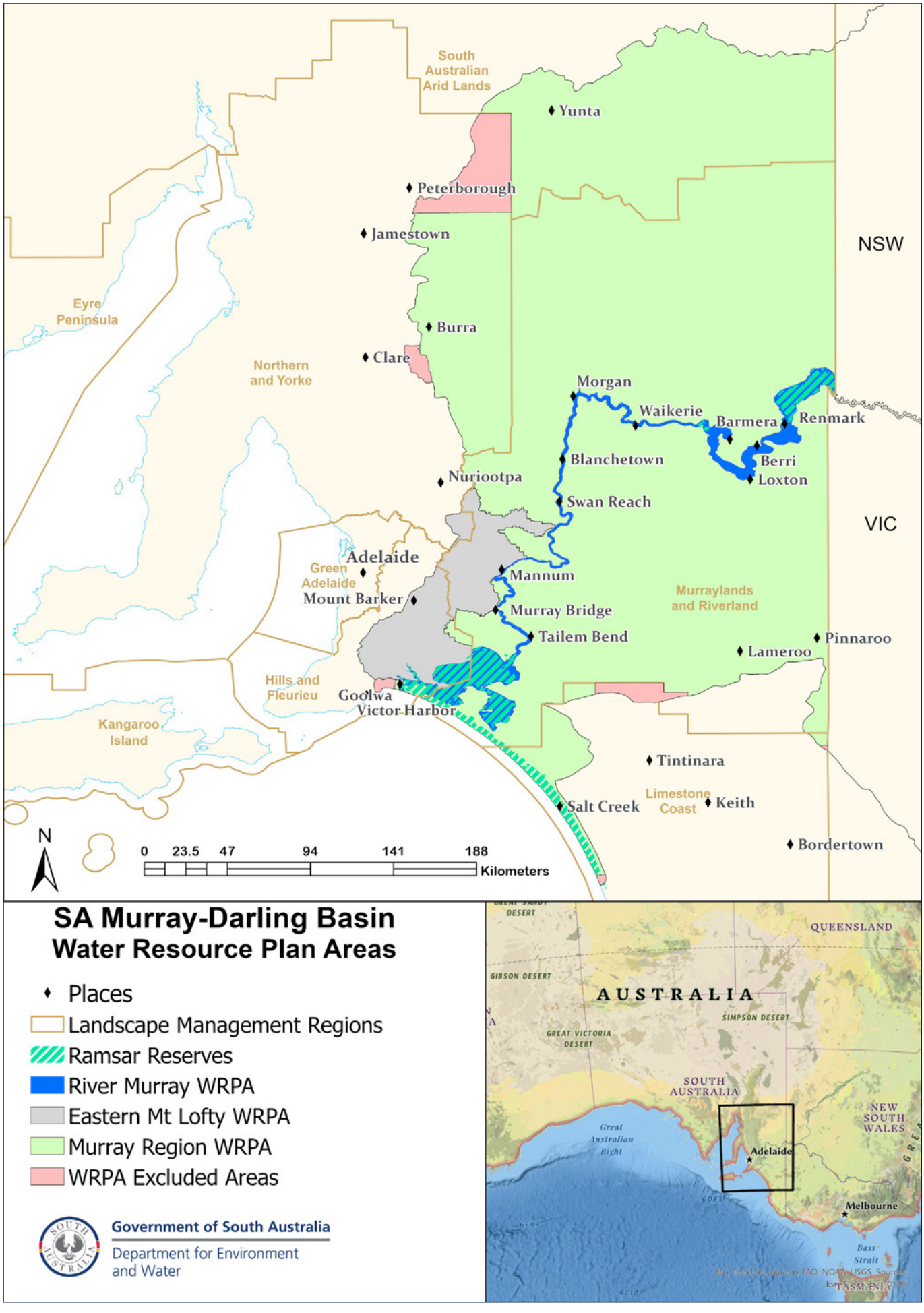


Figure 1. Extent of the South Australian Murray Region Water Resource Plan Area (WRPA).

Priority Environmental Asset: Northern Mount Lofty Ranges PEA - Burra Creek catchment

The Burra Creek catchment is found in the north-west section of the SA Murray Region WRPA and Burra Creek is the only tributary from within the SA Murray Region considered connected to the River Murray (Figure 2).

The headwaters of the catchment originate to the north of Mt Bryan before flowing east to Burra Creek where a short reach (~17 km) of baseflow creek with large deep permanent refuge pools occur in the vicinity of Burra/Worlds End Gorge. This flow is primarily from groundwater baseflows. Further to the east, flow becomes discontinuous and permanent waterholes are irregularly located before Burra Creek becomes poorly defined and is essentially a floodplain with braided and discontinuous drainage lines. Flows generally disappear underground in the lower reaches of the creek but have occasionally extended to the River Murray (east of Morgan) during exceptional flooding periods in the past.

The permanent refuge pools in the vicinity of Burra/Worlds End Gorge that are sustained by groundwater are unique and provide refugia and habitats for macroinvertebrates, frogs, waterbirds and aquatic plants, including several vulnerable and threatened plant species. The pools are moderately saline (3,000–5,000 EC), strongly influencing the ecology and limiting the range of possible species that can persist. The riparian vegetation of Burra Creek is characterised by river red gum, native and introduced grasses and aquatic plants such as water buttons and arrowgrass.

Water-resource development of both ground and surface waters, as well as the recharge of groundwater from rainfall, all directly impact the water availability within the catchment.

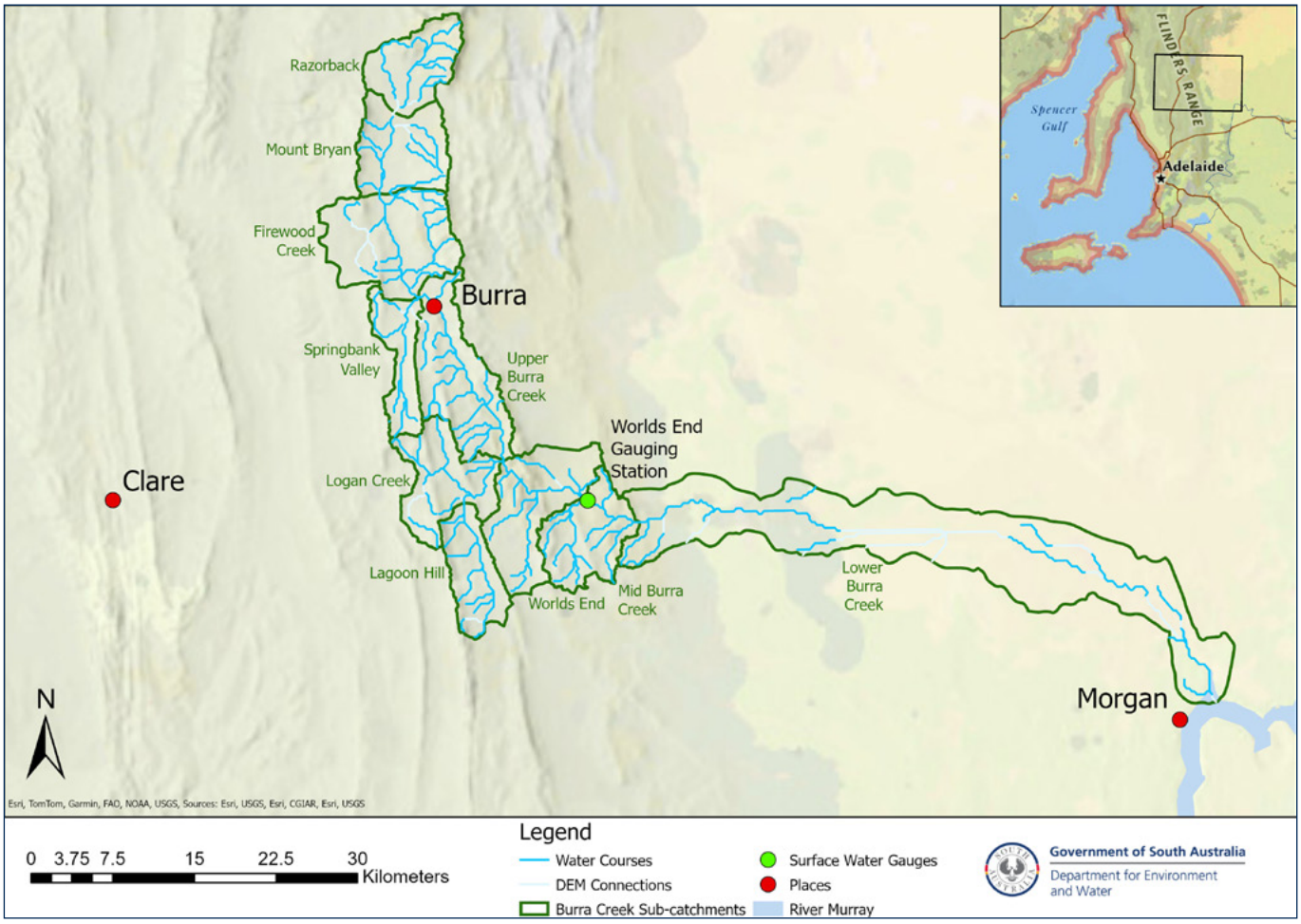


Figure 2: Location of the Burra Catchment and sub-catchments with respect to the Burra Township, Worlds End gauging station and the River Murray.

Northern Mount Lofty Ranges Watercourses (NMLRW) ecosystem drivers and pressures

Drivers

Rainfall in the region is generally more variable than the southern Mount Lofty Ranges and runoff is unpredictable. Rainfall is often localised and at times heavy where the annual rainfall can fall in a single event. The high variability and extreme events influence the amount of water, water regime and groundwater recharge within the system as well as sustaining local conditions.

Surface water is highly variable in nature and many watercourses are temporary. When surface flows occur, they support various permanent pools in Burra Creek but tend to terminate underground at Worlds End as they fan out across the plains. The seasonality, frequency, water level and duration of the flow regime is dependent on surface water flows and groundwater discharge.

Groundwater flows fed through fractured rock aquifers in the hills flow towards the River Murray under low hydraulic gradients, a focus point for groundwater discharge. The presence of permanent pools in the Burra Gorge and the baseflow supporting these pools is linked to a complex system of groundwater and surface water interaction in the catchment upstream.

Watercourses begin in the hills near Burra and meander through Burra Gorge before converging on Worlds End. The surface water catchments drain onto flat mallee country and into groundwater, but rarely reach the River Murray.

Water usage for irrigation, industry and urban consumption reduces flows, leading to lower river levels and degraded water quality with an increase in concentration of salts and pollutants. The alteration of natural flow regimes also disrupts the lifecycle of native fish and other water-dependent species.

Pressures

Changes in climate and climate extremes have influenced rainfall, temperatures, groundwater and surface water regime. Extreme weather events including droughts and floods pose challenges for infrastructure, communities and industries as well as influencing the availability of surface and groundwater.

The region's climate makes it particularly vulnerable to fluctuations in water availability. Increased demand from agriculture, urban development and industry exacerbates the strain on the system, leading to concerns about reduced river flows and negative impacts on aquatic ecosystems.

Problematic native reed species such as *Typha domingensis* and *Phragmites australis* favour stable, low flow environments, increasing in abundance and impacting flow and outcompeting other native species.

Stormwater and wastewater discharge, discharge from industry and saline discharge from local and regional groundwater resulting in water quality changes and sedimentation.

How we evaluated environmental outcomes

This report provides our five-year evaluation of progress towards achieving environmental outcomes under the Basin Plan in South Australia. South Australia is required to report on the achievement of environmental outcomes at the asset scale every five years in accordance with Schedule 12 of the Basin Plan

Our approach for the SA Murray Region is underpinned by the ecological objective in the SA Murray Region Long-term Environmental Watering Plan '*aquatic fauna and flora supported within permanent pools*' and an assessment and evaluation of outcomes associated with measures of the environmental water requirements (i.e. flow levels required for different durations) that are considered to maintain water-dependent ecosystems at a low level of risk.

What have we assessed?

Our report evaluates environmental outcomes in the Northern Mount Lofty Ranges PEA – Burra Creek catchment. Specifically, an assessment and evaluation of environmental outcomes utilises the achievement of environmental water requirements to support the permanent pools of the gorge section of the catchment.

Environmental Water Requirements

Requirements to maintain the water-dependent ecosystems and ecosystem functions:

- maintenance of existing baseflow to permanent pools: Permanent flow >0.05 ML/day in each year
- maintenance of occasional higher (bankfull) flows and overbank flows to scour and maintain pool depths and assist in managing salinity levels.

The LTWP recommends various flow bands to meet these environmental water requirements:

- *Freshes: Flow >3 ML/day 1–3 times per year*
- *Bankfull: Flow >33 ML/day every 1–2 years*
- *Overbank: Flows >220 ML/day every 4–6 years*

Northern Mount Lofty Ranges Watercourses PEA - Burra Creek Catchment

Environmental Outcomes report

Trend

The change over time, calculated using all available data for an indicator across the assessment period.

↗	Trend **Improved**	**Improved:** The indicator has improved over the period of assessment.
–	Trend **Stable**	**Stable:** The indicator has neither improved nor declined over the period of assessment.
↙	Trend **Declined**	**Declined:** The indicator has declined over the period of assessment.
NA	Trend **Not Applicable**	**Not Applicable:** Data were not sufficient to determine any trend in the status of the indicator.

Summary of outcomes at an asset scale

The assessment of environmental outcomes presents the trend for each measure along with an evaluation of the following:

- Did we achieve what we expected we would achieve?
- If not, why not?
- How did the Basin Plan contribute to the achievement of environmental outcomes?

For further information on the evaluation please see the more detailed technical report.

Theme	Indicator	Trend	Key findings
Flow & Ecosystem Function 	Base flows	NA Trend **Not Applicable**	Baseflows to permanent pools have improved, with no cease to flow events since 2019.
	Higher flows: Freshes	— Trend **Stable**	Freshes were observed every year since 2009–10, but this did not meet the flow requirement (all years).
	Higher flows: Bankfull	↗ Trend **Improved**	Bankfull flows have improved, but requirements have not been met in 3 of the last 5 years.
Information reliability* Reliability **Fair**	Higher flows: Overbank	↗ Trend **Improved**	Overbank flow requirements have been met across the assessment period, with flows detected across 2 of the last 6 years.

*Information reliability is only scored once as it is derived from a single data source for each indicator

Expected outcome report: Flow & Ecosystem Function

Flows

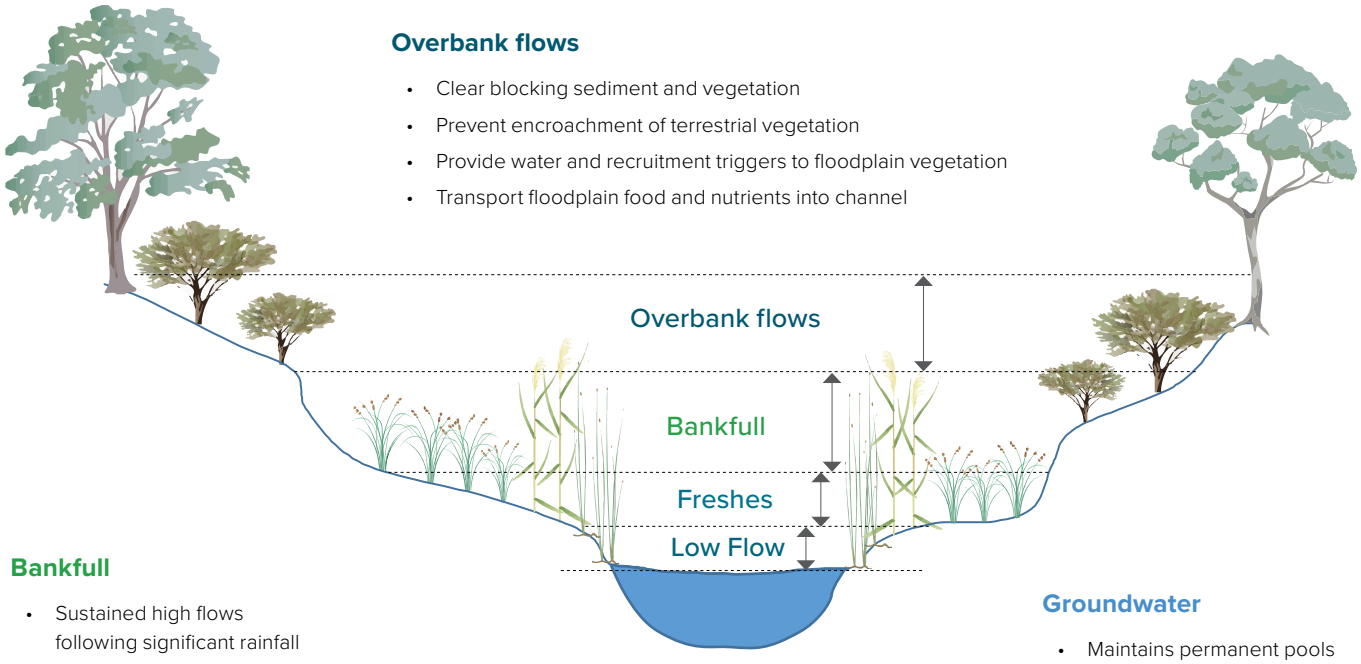
What are we trying to achieve?

The SA Murray Region Long-term Environmental Watering Plan objective is *"aquatic fauna and flora supported within permanent pools"* and environmental water requirements for the *"maintenance of the existing baseflow to permanent pools"* and the "*maintenance of occasional overbank and higher flows to scour and maintain pool depths and assist in maintaining salinity levels"*.

Why are the different flow requirements important?

Baseflows through the permanent pools of Burra Gorge are important because they maintain the permanency and connection of freshwater habitats, along with critical refuges that support aquatic flora and fauna that would be otherwise unable to persist.

Higher flows, including freshes, bankfull and overbank flows, are important as they increase pool water levels and water conditions through reducing salinity and flushing out accumulated sediment and nutrients. They also provide aquatic habitats and productivity to support aquatic plants and animals, including native fish species (Figure 3).



Overbank flows

- Clear blocking sediment and vegetation
- Prevent encroachment of terrestrial vegetation
- Provide water and recruitment triggers to floodplain vegetation
- Transport floodplain food and nutrients into channel

Bankfull

- Sustained high flows following significant rainfall
- Provide water to riparian vegetation
- Moves silt and debris from channel and pools
- Provides breeding and migration triggers

Freshes

- Pulse of flow following rainfall event
- Top up and freshen permanent pools
- Provide water to riparian vegetation

Low Flow

- Refill pools with fresh water
- Link pools together
- Enables aquatic fauna movement

Groundwater

- Maintains permanent pools
- Groundwater driven flow (baseflow)
- Maintains refuge habitat over cease-to-flow period

Figure 3: Flow requirements (Source: Eastern Mount Lofty Ranges Water Allocation Plan). Note: baseflow (not shown) is the lowest, detectable flow band (0.05 ML/day) and is groundwater dependent.

What is the trend and current status of the flow requirements?

Baseflows into the permanent pools of Burra Gorge improved and were near perennial between 2008 and 2023. There were three occasions (2008–09, 2017–18 and 2018–19) when no baseflow occurred, resulting in a total of 95 days of no baseflow across the assessment period (2008–09 to 2022–23). The most significant cease to flow event was in 2017–18, when no flow was recorded for 55 days. However, baseflow has been perennial since 2019.

Freshes flows have been recorded every year since 2009–10 and have remained stable between 2008–2023. Nine of the 12 years had low numbers of days with freshes flows (i.e. six or less), with the most significant freshes flow having occurred in 2014–15 (264 days). There were 26 days of freshes flows recorded in the most recent year of (2022–23; Table 1).

Bankfull flows have improved between 2008–09 and 2022–23. However, requirements have not been met in 3 of the last 5 years – with the most recent year of 2022–23 recording 8 days of flows >33 ML/day. Bankfull flows were also recorded between 2013–14 and 2017–18, ranging from a single day in 2013–14 to 12 days in 2017–18. All other years across the assessment period did not record any days with bankfull flow volumes (Figure 4). Overall, overbank flows between 2008–09 and 2022–23 have improved. Overbank flows were recorded at a single day in the years 2010–11, 2014–15 and 2015–16 and recorded during two days in 2016–17. The highest number of days recorded with overbank flows was in 2017–18, with 10 days. Most recently in 2022–23 a total of 3 days were recorded with overbank flows.

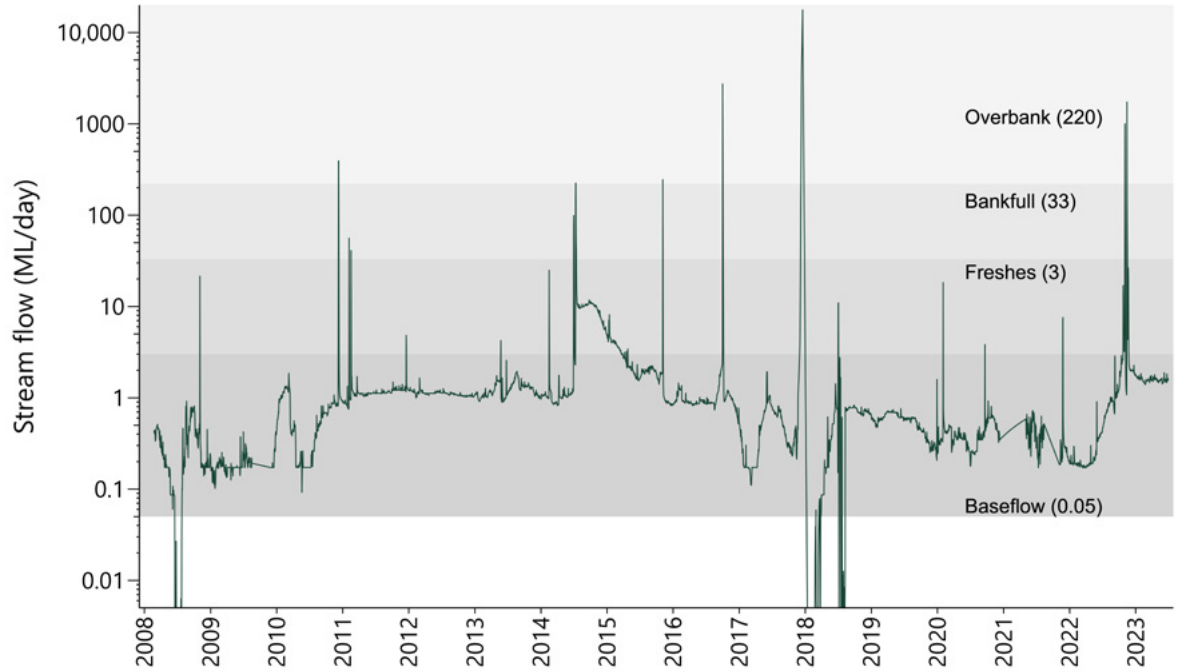


Figure 4. Daily surface flow at Worlds End station (A4261148), transformed with log10 for improved visualisation. The y-axis is truncated at 10,000 ML/day, removing three consecutive days in December 2017 of very high flow (10,619, 13,118 and 17,713 ML/day), as well when stream flow is zero due to the logarithm transformation.

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Have we achieved our outcomes?

The environmental outcome for continuous baseflow to the permanent pools has not been achieved between 2008–09 and 2022–23, with three years having no recorded baseflow during the water year. Despite the environmental outcome not being achieved in all years, since 2019 there have been no cease to flow events recorded and the baseflow requirements have been met.

The freshes flow requirements (1-3 pulses per year) were achieved in all but one year (2008–09) between 2008–09 and 2022–23. Bankfull flow requirements were not achieved in four years across the 15-year assessment period. The required frequency of bankfull flows has been achieved except for between 2019–20 and 2021–22, which did not meet the requirement of these flows occurring every 1–2 years.

Overbank flow requirements have been achieved, with overbank flows recorded in 2010–11, between 2014–15 and 2017–18 and in 2022–23, meeting the required occurrence of every 4-6 years (Table 1).

Have there been any unanticipated outcomes?

While not unanticipated in results, the updated flow gauge began operation in 2008 and this has improved capability of detecting low flows. This improved capability has meant that there is little alignment with the historical dataset to enable comparison but it does provide greater confidence of the flow volumes recorded across the flow regime.

Table 1. Number of days per water year of high flow bands since 2008–09.

Year	Freshes flows (1–3 per year)		Bankfull flows (every 1–2 years)		Overbank flows (every 4–6 years)	
	Days	Flow requirement achieved	Days	Flow requirement achieved	Days	Flow requirement achieved
2008–09	1	Yes	0	NA*	0	NA*
2009–10	0	No	0	No	0	NA*
2010–11	8	Yes	4	Yes	1	Yes
2011–12	2	Yes	0	Yes	0	Yes
2012–13	1	Yes	0	No	0	Yes
2013–14	3	Yes	1	Yes	0	Yes
2014–15	264	Yes	7	Yes	1	Yes
2015–16	3	Yes	2	Yes	1	Yes
2016–17	6	Yes	3	Yes	2	Yes
2017–18	17	Yes	12	Yes	10	Yes
2018–19	2	Yes	0	Yes	0	Yes
2019–20	1	Yes	0	No	0	Yes
2020–21	1	Yes	0	No	0	Yes
2021–22	2	Yes	0	No	0	Yes
2022–23	26	Yes	8	Yes	3	Yes

Why are we seeing these results?

Improvement in bankfull and overbank flows to permanent pools in Burra Creek improved over the assessment period (2008–09 and 2022–23). However, it is recognised that the start of this period coincided with the Millennium Drought (1996–2010) which resulted in prolonged dry conditions in the region and across the southern Basin more broadly, significantly reducing flows in those catchments.

The achievement of environmental outcomes of continuous baseflows and higher flows was primarily influenced by rainfall. Annual rainfall is highly variable and despite the recent trend between 2008–09 and 2022–23 being relatively stable, variability in rainfall between years is high (Figure 5). Cease to flow events, like those in 2018, were associated with below average rainfall. Surface water runoff in the catchment is highly variable and driven by extreme rainfall events, e.g. the high flow events recorded in 2017–18 and 2022–23 coincided with years of above average rainfall, including extreme daily rainfall events. Increased groundwater depth can also be driven by annual rainfall, which can influence the permanent pools of Burra Creek.

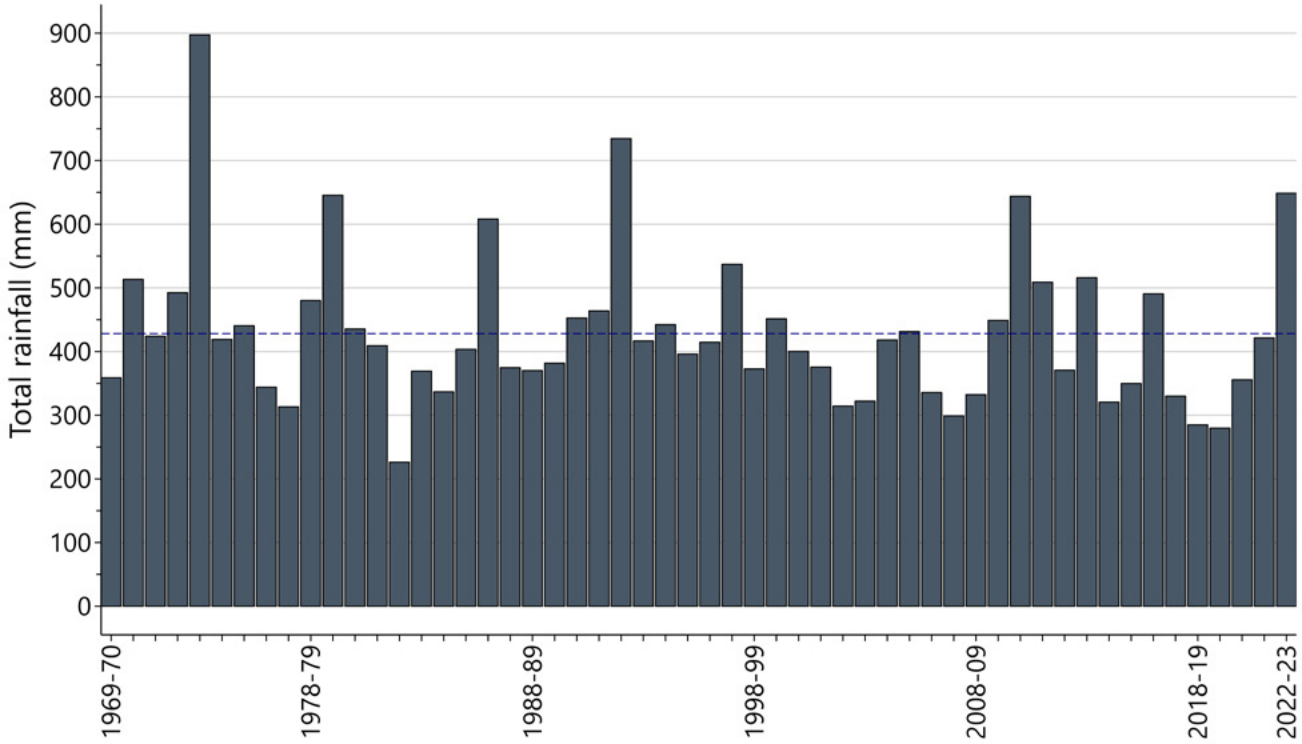

Figure 5. Annual rainfall (mm) per water year from the Burra Community School monitoring location (station 21077, BOM 2023). Blue line represents long term mean rainfall from 1970–2023.

Other influences on flow outcomes in the SA Murray Region include:

- ***Surface water and groundwater usage:*** Surface water extraction is permitted in the area and is primarily used for stock and domestic purposes. Groundwater has an important influence on baseflows, as rainfall in the upper catchment recharges the aquifer. The level of groundwater development is likely to have localised impacts with no new increase in groundwater development having been recorded since 2008.
- ***Water resource (dam) development levels:*** Farm dams are the most prominent form of water resource development in the Burra Creek catchment. The impacts of diverting surface water into dams are likely most significant during low-rainfall years. Bankfull and overbank flows are generally not impacted by water resource development, as dams fill during high rain conditions and then subsequently quickly spill following these events.
- ***Land use***, such as livestock access to watercourses and limited riparian vegetation that provides minimal buffer protection from catchment land uses, can impact on the condition of permanent pools and their capacity to support aquatic plants and animals. In late 2023, a 1,000-hectare parcel of land containing several permanent pools in the Burra Gorge was gifted to the Department for Environment and Water for a new national park and improved protection of the existing ecological values.

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How has Basin Plan contributed?

Implementation of the Basin Plan has provided the mechanism for the development of Water Resource Plans, including that for the SA Murray Region. The Water Resource Plan documents the controls and policies to ensure water extraction and use remains within the Sustainable Diversion Limits set under the Basin Plan. The Water Resource Plan identifies the rules that provide the protection to the PEA (the Northern Mount Lofty Ranges Watercourses) and ecosystems functions, together with the rules for the protection of planned environmental water within the SA Murray Region.

What is still to be done?

The level of water resource development in the Burra Creek catchment was identified in the South Australian Water Resource Plan Area Risk Assessment as warranting further investigation as to whether it has an impact on the water-dependent ecosystems like those within the Burra Creek catchment. Ecological monitoring of the permanent pools of Burra Creek could ascertain whether current levels of water resource development under a drying climate are impacting these water-dependent ecosystems.

Further investigations into levels of ground and surface water usage and dam development within the Burra Creek catchment and others within the Northern Mount Lofty Ranges Watercourses would assist in ascertaining how these activities impact flows and ecological condition.

What do we expect to see in the future?

The maintenance of various flows bands through Burra Gorge will be highly dependent on climatic conditions such as temperature and rainfall. However, continuing to manage ground and surface water extractions, as well as future dam development, will contribute to improvements in baseflows and higher flows.

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Abbreviations:

LTWP – Long-term Watering Plan

NMLRW – Northern Mount Lofty Rangers Watercourses

PEA – Priority Environmental Asset

PEW – Planned Environmental Water

WRPA – Water Resource Plan Area

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Glossary of terms

Aquatic plants	Plant species that grow partly or wholly within aquatic environments.
Bankfull flows	Flows that fill the channel but do not spill on to the floodplain (can occur any time but more commonly associated with High Flow Season). Defined in the LTWP for the Murray Region as flows between 33 and 220 ML/day.
Baseflow	Minimum flows within a perennial waterbody. Defined in the LTWP for the Murray Region as flows between 0 and 3 ML/day. Due to gauging accuracy limits, for the purpose of this evaluation, minimum baseflow was defined at 0.05 ML/day.
Basin Plan	Adopted in 2012, the Basin Plan is a partnership, across governments, to share water between all users and the environment in a sustainable way.
Biota	A grouping of animals, plants, fungi and other organisms that all share the same geographical region.
Cease-to-flow or zero flows	No flows are recorded in the channel and during these periods, the stream may contract to a series of pools or ponds, or may dry completely.
Ecosystem	A group of living organisms that live in and interact with each other in a specific environment.
Environmental Water	Environmental water is 'held' or 'planned' environmental water, defined in the Water Act 2007. Held environmental water is available under a water access right for the purposes of achieving environmental outcomes; planned environmental water is committed to environmental outcomes and cannot be used for any other purpose unless required in emergency circumstances.
Freshes or fresh flows	Flows greater than base flow but less than Bankfull, defined in the LTWP for the Murray Region as flows between 3 and 33 ML/day.
Murray–Darling Basin	An area of about 1 million km^2 in the south east of Australia, it is almost 1,400 km long and about 800 km wide.
Overbank flows	Higher flows that spill out of the channel on to the floodplain (can occur any time but more commonly associated with High Flow Season). Defined in the LTWP for the Murray Region as flows between 220 and 1,500 ML/day.
Riparian vegetation	Vegetation that grows in the transition zone between the aquatic and upland areas.

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