South Australia's River Murray Environmental Watering Report

2013-2014

Australian Government

MURRAY–DARLING BASIN AUTHORITY

Government of South Australia
Department of Environment, Water and Natural Resources

Acknowledgements

This is the sixth River Murray environmental watering report to be produced by the South Australian Government. It was prepared by staff in the Department of Environment, Water and Natural Resources (DEWNR). The following agencies and organisations are acknowledged for their important role in environmental water management:

- Commonwealth Environmental Water Office (CEWO);
- Commonwealth Department of Environment;
- Murray-Darling Basin Authority (MDBA) including The Living Murray program;
- Natural Resources South Australian Murray-Darling Basin (NRSAMDB);
- Local Action Planning Committees (LAP); and
- Nature Foundation South Australia (NFSA).

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Cover photos: Spoonbills, Ibis, Pelicans at Nikalapko, by C Nickolai

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1. Introduction

This report was compiled by officers within the Department of Environment, Water and Natural Resources (DEWNR). It describes the volumes and timing of environmental water delivered for environmental watering actions along the River Murray in South Australia during the 2013-14 water year and highlights some of the successful environmental outcomes achieved through that delivery. It is not a comprehensive summary; rather, it is a brief synopsis of some selected observations based on the limited available data and documentation.

The Murray-Darling Basin Plan (Basin Plan), adopted in November 2012, introduced significant requirements for Basin States with respect to environmental water planning and reporting. These requirements complement and reinforce the annual environmental water planning and reporting that has been undertaken in South Australia for the last decade. The requirements are set out in Chapter 8 (Environmental Watering Plan) and Schedule 12 of the Basin Plan, with additional guidance provided by the Schedule 12 Reporting Guideline (version 2.0 August 2014).

To meet the reporting requirements, DEWNR provided reports on consultation, held and planned environmental water, volumes, timing and sites where environmental watering was undertaken based on existing data, to the Murray-Darling Basin Authority (MDBA) by the end of October 2014. These reports are available on the MDBA website. This report draws on and builds on information provided to the MDBA in respect of those reporting requirements.

The report also meets the South Australian Government's commitment to the Council of Australian Governments (COAG) to publish an annual report for providing transparency and accountability for public information sharing of River Murray environmental water use in South Australia (National Water Initiative Policy Guidelines for Water Planning and Management 2010).

2. Environmental water types and sources

The planning, management, delivery, reporting and evaluation of environmental water is coordinated within DEWNR and undertaken in partnership with other government agencies including the MDBA and the Commonwealth Environmental Water Office (CEWO), research organisations and community groups.

During 2013-14, DEWNR successfully negotiated with the Commonwealth Environmental Water Holder (CEWH) and the MDBA The Living Murray Initiative (TLM) for over 746,000 megalitres (ML) of environmental water. The majority of the environmental water was delivered via the River Murray channel to the Lower Lakes, Coorong and Murray Mouth, an icon site under TLM and Ramsar site under the

Ramsar Convention. A small volume (500 ML) was used to inundate a number of localised wetland and floodplain areas.

Environmental water within South Australia falls into two broad categories, Held Environmental Water and Planned Environmental Water. A description of each follows.

2.1 Held Environmental Water

Held Environmental Water (HEW) is water held on licence for the purpose of achieving environmental outcomes. There are two major environmental water holders that provide HEW to South Australia:

- the CEWH holds 1,082,700 ML of water entitlements in the Southern Connected Basin for use in the Southern Connected Basin (as of September 2014); and
- TLM under the MDBA holds 479,975 ML of water entitlements for use at the six TLM icon sites in the Murray-Darling Basin.

Additional HEW for use in South Australia is available through:

- the South Australian Minister for Water and the River Murray's wetland licence and account, with 34,782 ML available for use at pool connected wetlands with regulators and also named on the site-use approval;
- the South Australian Minister for Water and the River Murray's desalination licence and account, with 17,100 ML available for use at any priority site during 2013-14;
- Banrock Station's licence and account, with 2,454 ML available for Banrock Station wetland;
- the South Australian Minister for Water and the River Murray's licence and account with 1,035 ML for Tolderol wetland; and
- the South Australian Minister for Water and the River Murray's licence and account with 1,233 ML for Loveday wetland.

2.2 Planned Environmental Water

Planned Environmental Water (PEW) is water that is committed by the Basin Plan or a water resource plan for a water resource plan area; or a plan or other instrument under State water law; for achieving environmental outcomes or other environmental purposes that are specified in the plan or the instrument, and cannot be taken or used for any other purpose.

PEW in the River Murray in South Australia consists of the unlicensed portion of 200,000 ML set aside in the South Australian River Murray Water Allocation Plan (Section 5.2) for pool connected wetlands. Of this volume, ~34.8 ML is on licence (see above section on held water), therefore 165,218 ML of PEW was available in 2013-14. This is the volume estimated as already used through evaporative losses by those wetlands connected at full supply level (normal weir pool level) and provided as part of the non-consumptive part of Entitlement Flow (EF). It is not additional water made available for allocation.

In addition there was ~120,000 ML unallocated water within the South Australian EF that was designated as PEW in 2013-14.

3. Environmental Water Planning

Each year DEWNR develops annual environmental watering priorities and an annual environmental watering plan to provide the environmental water holders (CEWH, TLM) with information regarding the environmental watering actions that have been agreed in South Australia and approved by the Minister for Water and the River Murray.

3.1 Development of Annual Priorities

As required under the Basin Plan, DEWNR officers identified annual priorities for the SA River Murray for the use of HEW and PEW. These are set out in table 1. These were provided to the MDBA by 31 May 2013 (for the 2013-14 water year) and an annual environmental watering plan, providing additional detail, was later published on the DEWNR website. Scenario-based planning (relating to likely water availability) is used in the development of the annual priorities and the annual environmental watering plan, with scenarios ranging from extreme dry to wet. For 2013-14, South Australia prepared for annual exceedance probabilities (see Appendix 3 for an explanation of this term) of 50% (median), 75% (median /dry) and 90% (dry). The actual conditions in 2013-14 were between 50% and 75%.

Table 1: 2013-14 Environmental watering priorities for the South Australian River Murray

Site ID	Site name	Estimated required volume
1	Lower Lakes, Coorong and Murray Mouth	517-953 GL depending on flow conditions. A significant proportion of this volume would be used concurrently for River Channel actions
2	River Channel	Up to 5 GL for weir pool raising
3	Evaporation Basins	~1.75 GL
4	Chowilla wetlands	4.5-4.9 GL
5	Milang Snipe sanctuary	0.043 GL
6	Temporary wetlands	1.5-5 GL

Sugarshack Wetland Photo by K Mason

4. Environmental water delivery

4.1 Delivery summary and selected outcomes

Good ecological outcomes were achieved from the program of environmental watering in 2013-14. During 2013-14, a total of 801,000 ML of HEW was delivered to priority sites identified within the South Australian River Murray annual environmental watering plan. The CEWH provided 579,200 ML (including 500 ML of water provided through Nature Foundation South Australia (NFSA)); TLM provided 159,900 ML; the Victorian Environmental Water Holder (VEWH) provided 7,000 ML, water held in South Australia on the Minister's environmental water licence provided 17,100 ML; water held on the Minister's wetland licence provided 34,782 ML; Banrock wetland licence provided 2,450 ML and private donations provided 3 ML. Appendices 1 and 2 provide details of sites receiving environmental water. Figure 1 is a hydrograph showing the total flow to South Australia. Flows above EF comprised unregulated flow (July to October 2013) and held environmental water from November 2013 to June 2014. South Australia did not receive any Additional Dilution Flow (ADF) during 2013-14. ADF may be delivered to South Australia from Menindee Lakes to help reduce salinity levels.

Shortly after the commencement of the 2013-14 water year, unregulated flows were received. Referring to Figure 1, from 19 July 2013 until 6 January 2014 flow to South Australia (QSA) continuously exceeded EF

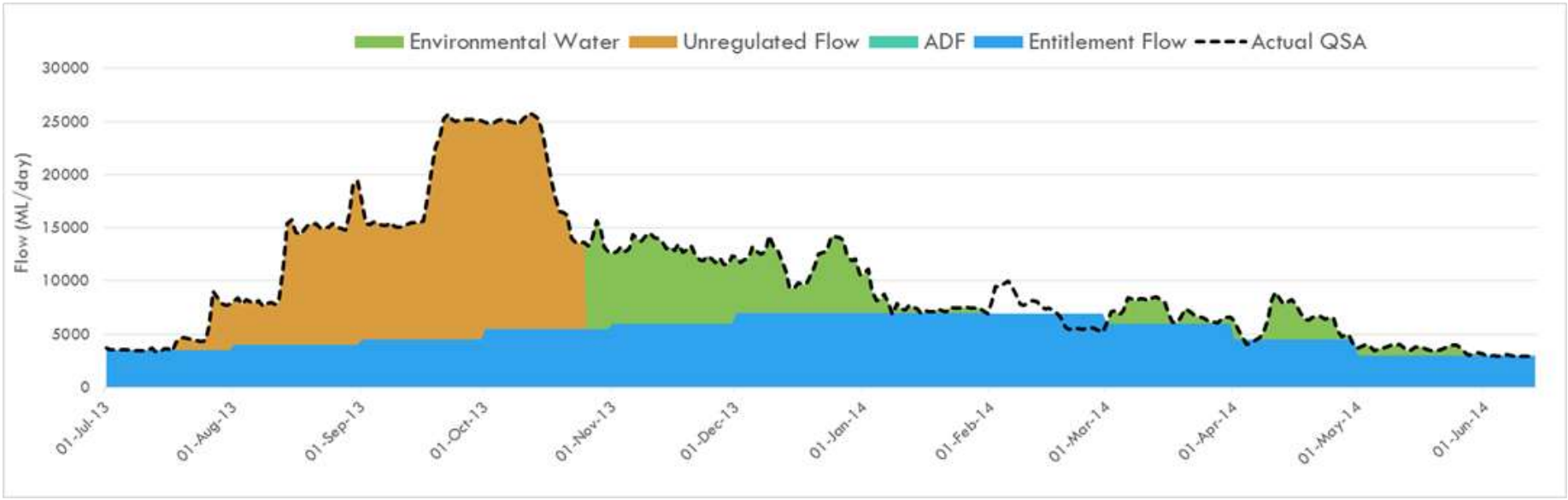

Figure 1: Flow to South Australia 1 July 2013-30 June 2014 showing components of flow (the 'white' peak shows the early delivery of EF due to works at Lake Victoria)

by at least 1,000 ML/day (in July EF is 3,500 ML/day). Flows peaked at 25,841 ML/day on 12 October 2013.

Flows remained around 25,000 ML/day for 24 days through late September and early October (24 September 2013 – 14 October 2013). The use of held environmental water during this period was considered; however, this could not occur as there were flow constraints associated with works being undertaken at Lock 2 and Lock 4, Yatco and Chowilla.

In mid-October 2013, as the unregulated flow began to reduce, the flow into South Australia receded steeply; this can be clearly seen in Figure 1. South Australia asked the MDBA for environmental water to be used to limit this steep recession; however, this was not possible as it was still an unregulated flow period – any environmental water delivered during this unregulated flow period would have been substituted for flows already crossing the South Australian border and therefore would not have increased flow. This is an unresolved policy issue that will be addressed in future years.

It was agreed by the South Australian Environmental Flows Reference Group (a sub group of the DEWNR River Murray Operations Working Group) that the best time for any additional environmental water delivery to South Australia is in late spring when the water temperature reaches approximately 20°C, as this can enhance the possibility of native fish breeding. This timing also aligns with ruppia breeding requirements in the Coorong. When the unregulated flow ended in late October, additional environmental water was delivered to South Australia. Two flow pulses were delivered in October as a result of return flows from environmental watering actions in the Goulburn River (upstream of the South Australian border) being traded into South Australia.

South Australia successfully negotiated with the MDBA for a pre-release of water from Lake Victoria followed by capture of the first Goulburn flow pulse in Lake Victoria to offset this pre-release This was undertaken to fill a low flow period in the hydrograph and which in turn would help maintain flow over the barrages and water levels in the Coorong to enable completion of the reproductive cycle for ruppia). Environmental water delivered to South Australia, together with releases from Lakes Alexandrina and Albert (enhanced by deliberately lowering water levels in these lakes) contributed to maintaining relatively high barrage releases during November and early December 2013. Initial data suggests that callop spawned and recruited at this time in response to the flow pulse and warmer water (Ye et al 2014).

Delivery and release of environmental water contributed to reducing the decline in Coorong South Lagoon water levels. A greater area of ruppia was inundated for a longer period of time during 2013-14 compared to 2012-13, increasing the reproductive output. A small increase in ruppia seed density was observed after the event (Paton and Bailey 2014b). Pumping to a number of temporary wetlands was also undertaken in spring-summer.

Work at Lake Victoria in the first half of 2014 reduced the ability to deliver both EF and environmental water. This led to a change in the pattern of EF delivery at that time. Following a high rainfall event, all of the weir pools were raised by 10 cm from March to May to store the water received through local rainfall run-off and to retain enough water to ensure flows of 2,500 ML/day over Lock 1 for the rest of the water year (this flow rate is considered important by river operations managers in South Australia).

The actions and ecological outcomes achieved from the program of environmental watering in 2013-14 are further summarised in Table 2. Some further assessment of the outcomes against the Environmental Water Requirements for selected sites is provided in section 4.3.

Table 2: Summary of environmental watering actions and preliminary outcomes for 2013-14

Site ID	Site name	Actions	Preliminary Outcomes
1	Lower Lakes, Coorong and Murray Mouth	1. To provide water to operate Lake levels between 0.5 and 0.8m AHD to enable continuous fishway releases and water fringing wetlands. 2. To provide water for continuous barrage releases (with majority of outflow between October and February targeting diadromous fish movement and recruitment. 3. To provide a spring pulse to the Coorong for ruppia to complete its life cycle.	1. Water levels maintained above 0.4m AHD. 2. Barrage releases maintained throughout the year although releases less than in the previous 3 years. 3. Majority of outflow occurred between August and January. 4. New recruits of congolli, sandy sprat, small-mouthed hardyhead, black bream, yellow-eye mullet, bony herring were recorded in the Coorong. 5. Completion of ruppia life cycle occurred with an increase in ruppia coverage in a number of locations in the Coorong. 6. Young and courting pelicans on North Pelican Island and crested terns on Teal Island were recorded. 7. ~79,000 waterbirds from 58 species were recorded in late Jan 2014 at the Lakes. 8. 230,000 waterbirds from 70 species recorded in Coorong. 9. There was recovery of macroinvertebrates based on higher number of species and increased abundances of individuals compared to 2013-14. 10. Food availability for birds was the highest recorded since 2004. 11. Abundance of congollis and galaxias was the highest ever sampled since 2006.
2	Channel	1. To provide water for a flow pulse in spring/summer to facilitate larval dispersal and recruitment success of native flow cued spawning fish i.e. for golden perch. 2. To provide water to manage the rate of recession to prevent bank slumping and stranding of aquatic fauna.	1. Golden perch larvae were detected following the flow pulse. 2. Rate of recession of unregulated flow partially managed – environmental water began on the decline of the peak but the decline in flow rate was greater than desired.

Site ID	Site name	Actions	Preliminary Outcomes
3	Evaporation Basins	1. To provide water to the basins to maintain habitat for Murray hardyhead.	1. Record number of Murray hardyhead recorded at Dishers Creek. 2. Low abundances of other native fish recorded. 3. Diverse bird populations recorded. 4. Six species of native frog recorded.
4	Chowilla	1. To pump water to six sites to maintain and improve condition of wetland sites previously watered.	1. Excellent frog and vegetation response to watering of six wetland sites.
5	Milang Snipe Sanctuary	1. To provide water all year round.	1. Water received through natural flow.
6	Temporary wetlands	To pump water to nine wetlands to: 1. prolong length of wetland inundation to maintain foraging habitat for birds; 2. freshen the wetlands; 3. provide a mosaic of habitats.	Outcomes based on results from Maize Island and Carpark Lagoons: 1. Excellent frog and vegetation response recorded. 2. Wetlands freshened – lower salinities recorded. 3. Fifteen species of waterbird recorded. 4. Three species of waterbird with young recorded. 5. Abundant growth of aquatic vegetation recorded. 6. Improvement in tree health recorded. 7. Waterbird and frog species of conservation significance observed.

4.2 Assessment of environmental water delivery against Environmental Water Requirements for selected sites

Each year there is an assessment of whether Environmental Water Requirements (EWRs) have been met for the floodplain, channel and Coorong, Lower Lakes and Murray Mouth. Based on this assessment, some further selected outcomes are as follows.

4.2.1 Floodplain and in-channel

As outlined in section 4.1, flows to South Australia peaked at approximately 25,000 ML/day as measured at the state border (QSA). Overbank flows are considered to commence at QSA of 40,000 ML/day when water starts to spread across the broader floodplain, and this is the indicative threshold for shifting from channel to floodplain EWRs. Therefore flow to South Australia (QSA) was not sufficient to generate out-of-channel (overbank) flows and therefore no floodplain EWRs were met in the 2013-14 water-year.

Channel EWRs have been described by Wallace (2014a). Only one of these EWRs was met during 2013-14 and this was the requirement to deliver a flow of 7,000-12,000 ML/d for 60 days during the preferred delivery period of September to March.

4.2.2 Coorong, Lower Lakes and Murray Mouth (CLLMM)

The EWRs for the CLLMM are described in Lester (2011a). Four of these EWRs were met in 2013-14 (see Table 3).

Table 3: Coorong, Lower Lakes and Murray Mouth Environmental Water Requirements met during 2013-14

Target	**Environmental Water Requirement**
Lower Lakes Maintain desired ecological character of Lower Lakes through managing water quality	Lake Alexandrina salinity <1,000 EC for 95% of all years Lake Alexandrina salinity <1,500 EC for all years
Coorong and Murray Mouth Maintain current frequency of ecosystem states associated with high flows	Barrage outflow 6,000 GL/year, 1 in 3 years Barrage outflow 10,000 GL/year 1 in 7 years

Barrage outflows

A comparison of approximate barrage outflows by year is shown in Table 4. These data show that the EWRs in Table 4 for barrage outflows have been met.

Table 4: Barrage Outflows for the last 4 years

Year	Estimated Annual Barrage Outflow Volume (GL)*
2013-14	1,300
2012-13	4,605
2011-12	7,000
2010-11	11,000

*modelled estimate only

Salinity

The Basin Plan specifies salinity targets for managing water flows at a number of sites along the River. These are set out in Table 6. The Basin Plan also identifies that *the levels of salinity at the reporting sites should not exceed the values set out in the table, 95% of the time.*

During 2013-14, the salinity was maintained below these targets for 100% of the time during as shown in Table 5.

Table 5: Basin Plan Targets for Reporting Sites - Salinity in 2013-14

Location	Target (EC)	Maximum (EC)	Minimum (EC)	Average (EC)
Lock 6	580	460	130	240
Morgan	800	650	180	360
Murray Bridge	830	670	210	390
Milang	1 000	800	550	680

4.3 Multi-Site Environmental Watering Event

The Living Murray (TLM) Initiative Business Plan states that available environmental water should be managed to maximise environmental outcomes by re-using it at multiple sites. Multi-site environmental watering events are an important element in the effort to achieve system wide outcomes such as longitudinal connectivity and arrest of environmental decline across the Murray-Darling Basin.

South Australia received a large percentage of its environmental water during 2013-14 as part of the multi-site environmental watering event that was developed by environmental water holders and coordinated by the MDBA through the Environmental Watering Group, Water Liaison Working Group and Operations Advisory Group. The event was a cooperative arrangement between environmental water holders and managers. The multi-site is further described in the report '2013-14 Large Scale Environmental Watering Event' (MDBA, July 2014), an extract from which is as follows:

'Large-scale environmental watering events have been implemented in the southern Basin in the past four water years. These events reuse environmental water at multiple sites throughout the southern connected Basin. Water used in this way has the potential to provide maximum environmental benefit, including supporting functional processes and values of the River Murray channel and other selected sites.

Large-scale environmental watering events can require an approval by the Basin Officials Committee (BOC) if actions have the potential to have a material impact on State water entitlements or are not consistent with the Objectives and Outcomes set by BOC. Large-scale environmental watering events have been called multi-site environmental watering trials (MSEWTs) because of the need to test new operating and accounting processes.'

BOC (Meeting 20, 14 February 2013) **agreed** *that the long-term objectives of MSEWTs are to work towards:*

a) incorporating environmental delivery into normal River Murray operations by identifying and analysing issues and potential changes to current operational practices and the enabling instruments, and

b) the resolution of unimplemented policy measures under the Basin Plan 2012.

Under section 7.15 (2) of the Basin Plan 2012, *unimplemented policy measure means an anticipated measure consisting of a policy to:*

a) Credit environmental return flows for downstream environmental use, or

b) Allow the call of held environmental water from storage during un-regulated flow events.'

The outcomes of this event for South Australia are reflected in the findings documented in sections 4.1 and 4.2 of this report, particularly as they relate to the channel and the Coorong, Lower Lakes and Murray Mouth.

5. Consultation

This section of the report describes how stakeholders were engaged during planning for environmental watering prior to the start of the 2013-14 water year as well as during the actual delivery of environmental water.

5.1 Consultation during planning for environmental water

Early in 2013, a workshop was held to begin discussing annual planning and environmental watering priorities for 2013-14. Key government stakeholders, environmental water holders and local scientific experts were invited to attend. Prior to this workshop, regional departmental staff sought input from Local Action Planning (LAP) officers and LAP committees regarding priority sites.

Input and feedback were sought from community groups and peak bodies that had been consulted on environmental watering priorities in previous years. These included the SA MDB NRM Board, the River Murray Operations Working Group, the River Murray Advisory Committee, LLCMM Community Advisory Panel, the LLCMM Scientific Advisory Group, Chowilla Community Reference Committee; the Community Action for the Rural Environment (CARE) committee, Local Action Planning Committees, the First Peoples of Murray and Mallee Region and the Ngarrindjeri Regional Authority (through the Kungan Ngarrindjeri Yunnan Agreement (KNYA) Taskforce and Yarluwar Ruwe Committee).

Presentations detailing objectives, required volumes, preferred timing of delivery, modelled outputs and associated monitoring were delivered at the regular (and specially-organised) group meetings, and written feedback was sought on priorities. The LLCMM Community Advisory Panel and Scientific Advisory Group are regularly engaged throughout the year to inform real-time management and water delivery decisions. This engagement enables connections to be strengthened. The engagement with these key groups is critical to lead to an improved understanding of the State and Basin environmental water planning processes and to gain feedback to inform modification and improvement of the process for the future.

Perons tree frog at Hogwash Bend South. Photo by C Nickolai

5.2 Consultation for delivery of environmental water

Once priorities for environmental watering had been agreed and approved within DEWNR, negotiations began with the environmental water holders (CEWH and MDBA). These negotiations were ongoing with regular MDBA committee meetings and CEWO teleconferences occurring throughout the year.

When agreement was reached with environmental water holders to provide environmental water, discussions were initiated for localised watering actions to determine optimum and most suitable timing of delivery of environmental water. Local groups were engaged through their regular meetings. The community was informed regarding potential forthcoming flow events through these committees and the DEWNR flow advice bulletins. Good communication ensured that local communities were aware of pending environmental watering actions and the ecological benefits. SA Water staff were regularly informed of the timing for environmental water delivery and there was regular flow advice information provided on the DEWNR website and via email.

Lignum flowers. Photo by E Hoffmann

6. Conclusion

This report describes the volumes and timing of environmental water delivered for environmental watering actions along the River Murray in South Australia during the 2013-14 water year and highlights some of the successful environmental outcomes achieved through that delivery. Selected outcomes have been presented based on available data only.

In 2013-14 construction activity continued to restrain opportunities for water delivery; as yet unresolved accounting issues prevented the addition of environmental water to unregulated flow peaks, and sudden drops in flow to South Australia prevented the completion of some frog and bird breeding cycles. Constraints to delivery of environmental water in summer due to river channel capacity remains an issue, especially for the Lower Lakes as this is a time when evaporation is high and this leads to increased salinities that affect biota.

However, the volumes of held environmental water delivered as described in section 4.1 enabled the creation of a 'within channel' flow pulse in spring. The benefits of this flow peak were greatly improved following a late decision to extend the duration of this peak to achieve enhanced ecological outcomes particularly for native fish populations.

The process of ecological recovery following drought has continued in 2013-14 for Lakes Alexandrina and Albert, the Murray Mouth and Coorong. While some species such as the diadromous congolli and common galaxias have shown a positive and immediate response to the return of flows, other species such as ruppia, pygmy perch, southern bell frog and black bream have still not recovered in terms of abundances and distribution recorded prior to the drought.

Continued recovery is dependent on future freshwater flows to the site. In addition to continuous flows through the fishways throughout the year to support connectivity, substantial barrage flows are required over spring and summer to facilitate appropriate water quality and water level conditions in the Coorong. These flows also allow for seasonal water level increases in the Lower Lakes, and extra inundation of fringing wetlands. Barrage flows are also required through the year to minimise sand accumulation in the Murray Mouth.

Carpark lagoons. Photo by T Steggles

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Appendix 1 Table of watering actions

During 2013-14, a total of 801,000 ML of HEW was delivered to priority sites identified within the South Australian River Murray annual environmental watering plan.

During 2013-14, the CEWH provided 586,200 ML including water provided through NFSA; TLM provided 159,900 ML; water held in South Australia against the Minister's environmental water licence provided 17,100 ML; water held against the Minister's wetland licence provided 34,782 ML; Banrock wetland licence provided 2,450 ML and private donations provided 3 ML.

Site	**Volume ML**	**Time period**	**Water Source**
SA River Murray channel	801,000 (total of all volumes delivered as outlined below)	Jul-June	TLM, CEWH, SA
LLCMM	770,000	Jul-Jun	TLM, CEWH, SA
Berri Evaporation Basin	1238	Nov-Jun	Minister's licence
Bookmark Creek	449	Nov-Jun	Minister's licence
Bunyip Reach	20	Apr	Minister's licence
Dishers Creek	100	Nov-Jun	Minister's licence
Other managed pool connected wetlands (see Appendix 2)	21,733	Nov-Jun	Minister's class 9
Brandybottle	97	Oct	TLM
Lake Littra	989	Oct-Nov	TLM
Werta Wert	748	Jan-Feb	TLM

Site	Volume ML	Time period	Water Source
Punkah Island Horseshoe	750	Jan	TLM
Gum Flat	1488	Nov-Dec	TLM
Chowilla Horseshoe	100	Feb-Mar	TLM
Markaranka floodrunners	14	Spring-Summer	Minister's licence
Markaranka Blackbox	6	Nov-Apr	Minister's licence
Gerard	0.2	Dec-Jun	Minister's licence
Overland Corner	98	Apr-May	CEWH
Maize Island	198	Dec-Apr	CEWH
Carpark Lagoons	240	Dec-Apr	CEWH
Morgan Conservation Park	267	Dec-Apr	CEWH
Weila Shedding	0.3	Spring-Summer	CEWH
Hogwash Bend North	31	Dec-Mar	CEWH
Hogwash Bend South	358	Jan-Apr	CEWH
Johnsons Waterhole	150	Jan	NFSA/CEWH
Clarks Floodplain	120	Feb	NFSA/CEWH

Site	Volume ML	Time period	Water Source
Rilli Reach	60	Feb	NFSA/CEWH
Loxton Riverside	50	Mar-Apr	NFSA/CEWH
Thieles Flat	17	Mar	NFSA/CEWH
Ramco River Terrace	20	Feb	NFSA/CEWH
Banrock Station Wetland	2454	Nov-Jun	Class 9

Appendix 2 Managed wetlands that received class 9 water

Sites	Delivery time
Brenda Park	Sep-Dec
Causeway Wetland Complex – Little Duck, Causeway Lagoon, Winding Creek	Jul –Jun
Devon Downs South	Jul-Jun
Hart Lagoon	Aug-Apr
Mussels Lagoons, Loveday North and South	Jul-Jun
Martins Bend	Jul-Jun
Morgan Lagoon CP	Jul-Jun
Morgans Lagoon LM	Jul-Jun
Murbpook Lagoon	Nov-Jun
Murkbo South	Jul-Mar
Narrung	Jul-Jun
Ngak Indau	Nov-Jun
Nigra Creek, Schillers lagoon Noonawirra	Oct-Jun Jul-Jun
Paiwalla	Jul-Aug
Pilby Wetland Complex - Pilby Creek, Pilby Lagoon, Lock 6 depression	Nov-Jun Jul-Jan
Ramco Lagoon	Aug-Mar
Reedy Creek	Jul-Jun
Riverglades	Jul-Jun
Slaney Billabong	Aug-Jun
Spectacle Lakes, Beldora Complex	Jul-Mar
Sugar Shack	Jul-Dec
Sweeneys Lagoon	Dec-May
Teringie	Nov-Jun
Schillers refill and Sugar Shack refill	Jan

A total of 21,733 ML was delivered across the sites listed in this table.

Appendix 3 Glossary

Term	Meaning
ADF – Additional Dilution Flow	Flow provided in addition to Entitlement Flow to help manage salinity in the River Murray
AHD- Australian Height Datum	Height above sea level
Annual exceedance probabilities (AEP)	A 90% AEP reflects that 90% of the historical records for annual river flow indicate that this flow rate was achieved; therefore there is a 90% chance of receiving at least this flow in any year
EC	A measure of water salinity
EF – Entitlement Flow	The flow South Australia is entitled to receive under the Murray-Darling Basin Agreement
Longitudinal connectivity	Water is allowed to travel the full length of the river and is not captured in storages – this allows distribution of seeds, fish and nutrients down the length of the river
ML/d	Megalitres per day
Ramsar Convention	An international convention that recognises important wetlands that meet defined criteria
Unregulated flow	Water received in South Australia above legislative requirement and not traded