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Supplementary material

A trickle, not a flood: environmental watering in the Murray–Darling Basin, Australia

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Table S1. Volume (ML) of environmental water delivered (in-channel, overbank flows and wetland watering) by valley, from 2012–13 to 2017–18, showing contributions from Commonwealth Environmental Water Office (CEWO), States and other sources, including The Living Murray Program, environmental water allocations accrued under water sharing plans (NSW), and water diverted from the Snowy Hydro Scheme as 'River Murray Increased Flows'

Notes: 2012–13 CEWO data from CEWO (2013). 2013–14 CEWH data from CEWO (2015). 2013–14 State & Others data for NSW valleys and NSW Lower Murray Sites from OEH (2014) pp. 6, 10, 14, 18, 23. 2014–15 CEWO data from LTIM reports: Gawne *et al*. (2016) appendix A therein. 2015–16 CEWO data from Gawne *et al*. (2017) appendix A therein. 2016–17 CEWO data from Hale *et al*. (2018) appendix A therein. 2017–18 CEWO data from Hale *et al*. (2019) appendix A therein. 2018–19 CEWO data from Hale *et al*. (2020) appendix A therein. 2012–13 CEWO freshing flows of 300 000 ML for Murray split 50:50 between Central and Lower Murray (CEWO 2013, appendix C therein). 2015–16 CEWO freshing flows of 7640 ML from Mungindi to Menindee split 50:50 between Barwon-Darling and Lower Darling (Gawne *et al*. 2017, appendix A therein). 2017–18 NSW data from OEH (2018). Hale *et al*. (2018) state CEWO delivered 142 444 ML to the Goulburn in 2016–17, but VEWH (2017) report 182 253 ML. Some 28 600 ML was released in the Gwydir Catchment (10 600 from CEWO, 18 000 from NSW) of which 15 350 ML reached the Barwon, so split accordingly (OEH 2020). Hale *et al*. (2020) state CEWO delivered 45 722 ML to the Macquarie in 2018–19 but OEH (2020) reported 52 071 ML. For net total use, CEWO, figures on 'water delivered' by CEWO 2012–13 to 2018–19, reported by DAWE (n.d.), represent net total use and are lower than those reported as the CEWO total in LTIM reports (by an average of 26%; range 16–37%) because the former represents the volume of environmental water actually released, whereas the LTIM figures include return flows from River Murray tributaries that are available for re-use after they enter the Murray

	2012–13			2013–14			2014–15			2015–16			2016–17			2017–18			2018–19		
	CEWO	State	Others	CEWO	State	Others	CEWO	State	Others	CEWO	State	Others	CEWO	State	Others	CEWO	State	Others	CEWO	State	Others
Paroo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Warrego	0	0	0	506	0	0	2542	0	0	859	0	0	26980	0	0	3347	0	0	15738	0	0
Condamine–Balonne	64946	0	0	22282	0	0	17389	0	0	10453	0	0	45762	0	0	3985	0	0	0	0	0
Moonie	1415	0	0	1000	0	0	1415	0	0	201	0	0	1415	0	0	2323	0	0	1022	0	0
Border Rivers	2558	4000	0	4000	12907	0	1812	25080	0	1047	0	0	23526	0	0	9116	0	0	7400	0	0
Gwydir	27709	20365	3074	31915	0	1000	56639	0	29895	8400	100	4750	22847	3000	21000	28290	15748	3000	58150	8338	52000
Namoi	7727	0	0	0	0	0	0	0	0	0	0	0	9109	0	0	5357	0	0	5500	0	0
Macquarie–Castlereagh	100000	37718	128063	10000	10985	43675	10000	6037	17745	14239	4422	36393	54520	8258	26373	50660	19485	64232	45722	24434	51072
Barwon–Darling	25616	0	0	13000	0	0	1761	0	0	3820	0	0	26796	0	0	10600	18000	0	6940	9662	0
Lower Darling	0	0	0	47000	8243	0	0	0	0	3820	180	0	160453	46330	47980	2738	0	23072	0	0	0
Lachlan	51283	15373	0	22794	329	0	5000	1471	0	36022	12092	0	29492	6250	5084	35188	2986	17295	18173	8687	9271
Murrumbidgee	156000	18204	26787	133280	11144	106398	152560	68661	74603	108327	15954	103613	241465	45367	243592	179249	16148	74602	62296	117524	16100
Central Murray	186351	34871	5452	117031	90297	92853	63062	32332	13955	424513	43740	91737	349177	127286	13118	392996	20358	2044	135611	22311	76998
Ovens	20	0	0	20	0	0	70	0	0	70	0	0	70	0	0	123	0	0	123	39	0
Goulburn–Broken	242378	3986	50344	255000	33349	64000	244007	31454	54349	220083	13019	27689	182253	27500	20000	299211	42650	77559	227705	26480	26468
Campaspe	6821	6660	3406	7000	6280	1788	5791	22805	2574	3289	10336	889	0	5551	0	6594	17940	5300	3611	16522	3104
Loddon	2746	10654	0	2775	6593	0	2870	11658	0	1477	7235	0	1579	13086	0	3054	15815	0	2636	13703	0
Wimmera–Avoca	0	319	0	0	19797	16	19875	18271	0	0	5000	0	0	10843	0	3108	16639	13	5838	9825	0
Lower Murray	786918	53238	289103	579200	89082	230951	626096	86515	180555	821589	58932	146087	650649	143879	552614	909800	92700	84479	12342	51958	96739
Total	1662488	143305	375092	1246803	289006	540681	1210887	304284	373676	1658208	171010	411158	1826093	437350	929761	1945739	278469	351596	1158227	309483	33175
Grand total			2374105			2076490			1888847			2240376			3193204			2575804			1799462
Net total use CEWO	1272000			982000			1014000			1049000			1453000			1270000			853000		
Grand total, net total use			1983617			1811687			1691960			1631168			2820111			1900065			1494235

Sources of data used in Table S1

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Table S2. Major wetlands in the Murray–Darling Basin and sources of managed environmental water delivered as flood events (wetland watering or overbank flows plus bankfull or freshing flows to terminal wetlands), from 2014–15 to 2018–19

CEWO, Commonwealth Environmental Water Holder; EWA, environmental water allowances (NSW); NSW, New South Wales Office of Environment and Heritage; TLM, The Living Murray Program; VIC, Victorian Environmental Water Holder. Wetland status: EEC, contains an Endangered Ecological Community, listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (1999) or the NSW *Threatened Species Conservation Act* (1995); HIS, hydrological indicator site; I, Indigenous Protected Area; N, wetland of national significance; R, Ramsar wetland; S, wetland of State importance. BP outcomes?, whether the wetland is subject of expected ecological outcomes under the Basin Plan and Basin-wide Environmental Watering Strategy (MDBA 2014, 2019) and environmental water requirements have been assessed (MDBA 2011, 2012). CEWO priority (flood), whether the wetland is included for priority environmental objectives in CEWO annual portfolio management plans (from 2018–19). N/A, not applicable

River valley & wetland	Wetland status	BP outcomes?	CEWO priority (flood)	Wetland area (ha)	Source of environmental water delivered as flood events
Paroo					
Currawinya Lakes (Numalla & Wyara)	R	No	No	151300	N/A
Paroo River Wetlands (Paroo Overflow Lakes)	N	No	No	138304	N/A
Warrego					
Warrego River Waterholes	N	No	No	500	N/A
Western Floodplain (Toorale)	N	No	Yes	8800	CEWO
Yantabulla Swamp (Cuttaburra Basin)	N	No	No	37200	N/A
Condamine–Balonne					
Lower Balonne Floodplain	HIS, N	Yes	Yes	1988000	Nil
Narran Lakes	HIS, R	Yes	Yes	26480	CEWO
Moonie					
Moonie River Waterholes (Thallon Waterholes and Swamp)	S	No	Yes	200	CEWO
Border Rivers					
Lower Macintyre Floodplain Wetlands	S	Yes	Yes	5000	Nil
Morella Watercourse/Boobera Lagoon/Pungbougal Lagoon	N	Yes	Yes	460	Nil
Gwydir					
Mallowa Wetlands & Ballin Boora Wetlands	EEC, S	Yes	Yes	7043	CEWO, NSW
Gwydir Wetlands: Gingham and Lower Gwydir Watercourses	EEC, HIS, R	Yes	Yes	102120	CEWO, NSW, EWA
Namoi					
Barwon Nature Reserve	EEC, S	Yes	No	4132	Nil
Lake Goran	N	No	No	6385	Nil
Lower Namoi Wetlands	EEC, S	Yes	Yes	7000	Nil
Macquarie–Castlereagh					
Macquarie Marshes	HIS, R	Yes	Yes	200000	CEWO, NSW, EWA
Barwon–Darling					
Talyawalka Anabranch and Teryawinya Creek	N	Yes	No	170000	Nil
Lower Darling					
Darling Anabranch Lakes	HIS, N	Yes	No	630000	Nil
Lower Darling River Floodplain	HIS, N	Yes	No	1400000	NSW
Menindee Lakes	HIS, N	Yes	Yes	45000	CEWO
Lachlan					
Booligal Swamp	HIS, N	Yes	Yes	10000	CEWO, NSW, EWA
Great Cumbung Swamp	HIS, N	Yes	Yes	16000	CEWO, NSW
Lachlan Swamps	HIS, N	Yes	Yes	30000	CEWO, NSW
Lake Brewster	N	No	Yes	6140	CEWO, NSW
Merrowie Creek Wetlands	N	No	Yes	2500	CEWO, NSW
Murrumbidgil Swamp	N	No	Yes	300	CEWO, NSW
Murrumbidgee					
Fivebough and Tuckerbill swamps	R	Yes	Yes	620	CEWO, EWA
Ginini Flats Wetlands Complex	R	No	No	343	N/A
Lower Murrumbidgee Floodplain (incl. Junction Wetlands)	HIS, N	Yes	Yes	300000	CEWO, NSW, EWA
Mid-Murrumbidgee Wetlands	HIS, N	Yes	Yes	5816	CEWO, NSW, EWA
Paika Lake	S	No	No	450	CEWO, TLM, EWA
Toogimbie IPA Wetlands	I	Yes	Yes	1000	CEWO, NSW
Wanganella Swamp	S	Yes	Yes	3190	CEWO, EWA
Western Lakes	S	Yes	Yes	3459	CEWO, NSW
Central Murray					
Barmah Forest	HIS, R	Yes	Yes	29457	CEWO, VIC, TLM
Edward–Wakool River System	HIS	Yes	Yes	100000	CEWO, NSW
Gulpa Creek Wetlands	R	Yes	Yes	1400	CEWO, NSW
Gunbower Forest	HIS, R	Yes	Yes	19931	CEWO, VIC, TLM

River valley & wetland	Wetland status	BP outcomes?	CEWO priority (flood)	Wetland area (ha)	Source of environmental water delivered as flood events
Kerang Wetlands	R	Yes	No	9419	VIC
Koondrook–Perricoota Forests	HIS, N	Yes	Yes	31150	CEWO[A], NSW, TLM
Millewa Forest	HIS, R	Yes	Yes	36543	CEWO, NSW, TLM
Nyah and Vinifera Forests	S	No	No	1125	VIC
Werai Forest	I, R	Yes	Yes	11400	NSW
Ovens					
Lower King River	S	No	Yes	3445	CEWO, VIC
Lower Ovens Floodplain Wetlands	N	No	Yes	3750	CEWO
Goulburn–Broken					
Broken River Floodplain	N	Yes	No	2500	VIC
Lower Broken Creek	N	Yes	Yes	1268	CEWO*
Lower Goulburn River Floodplain	HIS, N	Yes	Yes	13500	CEWO*, VIC, TLM
Reedy & Gaynor swamps	N	No	No	600	VIC
Upper Broken Creek & Moodies Swamp	S	No	Yes	182	CEWO
Campaspe					
Coliban River	S	No	No	700	VIC
Lower Campaspe Floodplain	S	Yes	Yes	1000	VIC, CEWO, TLM
Loddon					
Lake Boort Wetlands	S	No	No	580	VIC
Lower Loddon Floodplain Lakes	S	Yes	No	2500	VIC
Mid-Loddon Wetlands	S	Yes	No	1200	VIC
Wimmera–Avoca					
Avoca Floodplain	S	Yes	No	1306	Nil
Lake Albacutya	HIS, R	Yes	No	5731	VIC
Lake Hindmarsh	HIS, N	Yes	No	15000	VIC
Lower Murray (SA, NSW, VIC)					
Angas–Bremer Floodplain	S	No	No	800	N/A
Banrock Station	R	No	Yes	1375	CEWO, SA
Coorong, Lakes Alexandrina and Albert Wetland	HIS, R	Yes	Yes	140500	CEWO, NSW, VIC, TLM, SA
Hattah Lakes	HIS, R	Yes	Yes	13000	CEWO, VIC, TLM
Lindsay–Mulcra–Walpolla Islands	HIS, R	Yes	Yes	37450	CEWO, NSW*, VIC
Pike River complex	S	No	Yes	2166	CEWO
Riverland–Chowilla Floodplain	HIS, R	Yes	Yes	30640	CEWO, NSW*, VIC*, TLM
Total area				5827360	

[A]Not targeted for wetland watering: floods occurred as overbank flows during in-channel delivery or, for the Lower Murray, as return flows from NSW and VIC.

Sources of data used in Table S2

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Table S3. Volume of Commonwealth environmental water delivered to wetlands in the Murray–Darling Basin, from 2014–15 to 2018–19, as overbank flows and wetland watering, plus bankfull or freshing flows to terminal wetlands (Macquarie Marshes, Narran Lakes, Great Cumbung Swamp and Booligal Wetlands)

Data from Gawne *et al*. (2016, 2016), Hale *et al*. (2018, 2019, 2020). Notes on flows to terminal wetlands: 2015/16: 14239 ML of CEWO water was recorded as freshing flows to Macquarie Marshes (Gawne *et al*. 2017, appendix A), which flooded ca. 10,150 ha (Stewardson and Guarino 2017, p. 35). 24059 ML of CEWO water was recorded as freshing flows to Great Cumbung Swamp (Gawne *et al*. 2017, appendix A therein), which flooded ~9000 ha (OEH 2017, p. 17). 2584 ML of CEWO water was recorded as freshing flows to Booligal Wetlands (Gawne *et al*. 2017, appendix A therein), which flooded an estimated 517 ha 2016/17: 28870 ML of CEWO water was recorded as bankfull flows to the Lower Balonne floodplain (Hale *et al*. 2018, appendix A therein), of which 18000 reached Narran Lakes, flooding an area of 1500 ha (CEWO n.d., History–Northern Unregulated Rivers, Condamine–Balonne Catchment, 2016–17; see https://www.environment.gov.au/water/cewo/catchment/northern-unregulated-rivers/history#barwon-16, accessed 7 October 2020). 28168 ML of CEWO water was recorded as freshing flows to Lachlan River (Hale *et al*. 2018, appendix A therein), which flooded an estimated area of 5634 ha of Great Cumbung Swamp

	Latitude	Longitude	Wetland area (ha)	2014–15 (ML)	2015–16 (ML)	2016–17 (ML)	2017–18 (ML)	2018–19 (ML)
Warrego								
Western Floodplain (Toorale)	–30.384	145.361	8800	0	0	9702	0	0
Condamine–Balonne								
Narran Lakes	–29.843	147.326	26480	0	0	18000	0	0
Gwydir								
Gwydir Wetlands	–29.361	149.353	102120	30000	1350	9000	4000	30000
Mallowa wetlands	–29.662	149.326	6400	9667	3486	7496	0	16950
Ballin Boora Creek	–29.499	149.151	643	0	0	0	0	600
Macquarie–Castlereagh								
Macquarie Marshes	–30.679	147.531	200000	10000	14239	24289	48421	45052
Lachlan								
Booligal Swamp	–33.782	144.857	10000	0	2584	1324	0	0
Great Cumbung Swamp	–34.287	144.026	16000	0	24059	28116	0	5338
Yarrabandai Lagoon	–33.179	147.546	351	0	0	0	0	412
Murrumbidgee								
Campbells Swamp, McCaugheys Lagoon	–34.631	146.394	306	0	0	0	0	1594
Coonancoocabil Lagoon	–34.607	146.273	85	0	0	0	900	0
Darlington Lagoon	–34.569	146.023	38	0	0	0	0	397
Fivebough Swamp	–34.532	146.435	342	0	0	0	0	794
Gooragool Lagoon	–34.582	146.087	290	0	0	0	0	83
Juanbung	–34.216	143.931	376	5688	10000	0	2176	0
Lowbidgee Floodplain	–34.592	143.655	70712	0	0	15507	0	0
Manie Swamp	–34.644	143.118	173	0	0	0	0	2000
Mid-Murrumbidgee wetlands	–34.529	145.739	5000	0	0	0	159283	0
Mid-north Redbank	–34.375	143.784	515	40000	0	0	0	0
Nimmie Caira	–34.498	144.108	98138	0	18000	0	5000	1505
Nimmie–Caira: Eulimbah	–34.462	144.146	456	0	0	2320	0	0
Nimmie–Caira: Is-Y-Coed	–34.567	143.736	604	0	0	5000	0	0
Nimmie–Caira: Nap Nap – Wagourah	–34.447	144.184	140	0	9557	630	0	0
Nimmie–Caira: Telephone Bank	–34.518	144.019	339	0	0	5425	0	0
North Redbank: Tori Lignum Swamp	–34.375	143.784	376	0		844	5528	6500
Oak Creek	–34.782	146.651	38	0	0	0	620	0
Paika Lake	–34.468	143.586	450	8498	0	0	0	0
Redbank	–34.382	143.784	5000	0	25000	0	0	0
Sandy Creek	–34.962	146.796	44	250	105	0	400	400
Toogimbie IPA Wetlands	–34.551	144.490	1000	0	933	998	1000	900
Tuckerbill Swamp	–34.290	146.210	620	0	0	0	600	610
Upper North Redbank	–34.372	143.802	1386	20000	0	0	0	0
Waldaira Wetlands	–34.667	143.244	267	0	2000	0	1500	1700
Wanganella Swamp	–35.283	144.883	3190	0	0	5000	0	0
Western Lakes	–34.715	143.620	3459	0	0	5060	0	0
Yanco Creek	–35.153	145.807	1354	2460	18263	0	0	0
Yanga National Park	–34.419	143.755	1258	74512	10000	2155	0	40500
Yarrada Lagoon	–34.579	145.815	88	1150	1394	0	504	2014
Central Murray								
Barham Lake	–35.637	144.138	8	0	115	0	102	0
Barmah–Millewa Forest	–36.016	144.961	71100	0	94800	39170	3344	38527
Carrs, Capitts and Bunberoo Creek System	–34.174	141.532	409	0	950	0	0	0
Gulpa Creek and Reed Beds Swamp	–35.757	144.943	1400	0	8000	0	0	0
Pollack Swamp	–35.569	144.153	220	0	0	0	0	2000
River Murray channel riparian zone	–35.856	144.991	25000	0	172600	0	289606	39984
Goulburn–Broken								
Upper Broken Ck. & Moodies Swamp	–36.226	145.791	182	250	0	0	498	0
Lower Murray (SA)								
Akuna Wetland	–34.182	140.055	6	125	0	0	0	0
Banrock Station Banrock Bend	–34.196	140.337	607	0	16	0	24	0
Banrock Station Eastern Lagoon	–34.196	140.337	10	0	1340	0	1429	0
Banrock Station Herons Bend	–34.196	140.337	75	0	20	0	24	0
Banrock Station – Herons & Banrock Flats Bend flats	–34.196	140.337	100	0	0	0	132	0
Berri Evaporation Basin	–34.299	140.613	100	1241	1255	707	1262	1007
Bookmark Creek	–34.159	140.753	45	0	424	239	448	386
Cadell Wetlands	–34.031	139.759	70	0	0	0	0	323
Calperum Station	–34.054	140.740	361	276	837	1277	3894	854
Carparks Lagoon	–34.408	140.539	246	0	229	0	0	0

	Latitude	Longitude	Wetland area (ha)	2014–15 (ML)	2015–16 (ML)	2016–17 (ML)	2017–18 (ML)	2018–19 (ML)
Clarks Floodplain	–34.360	140.579	271	201	105	0	13	8
Cobdogla	–34.244	140.404	169	2	0	0	0	0
Disher Creek	–34.260	140.698	17	0	0	0	50	78
Duck Hole	–34.212	140.782	15	220	271	0	0	0
Gerard Wetlands	–34.375	140.454	40	0	0	0	0	147
Greenways Landing	–34.662	139.656	14	0	39	0	20	40
Greigers at Sugar Shack	–34.567	139.601	7	0	59	0	0	0
Hogwash Bend	–34.065	139.849	34	0	448	0	0	543
Inner Mundic Creek	–34.202	140.777	3	0	42	0	0	49
Johnsons Waterhole	–34.141	140.752	8	162	117	0	0	0
Kroehns Landing	–34.693	139.596	96	0	0	3	0	0
Lescheid Pikes	–34.200	140.808	3	0	19	0	0	0
Lock 2 Qualco	–34.079	139.929	154	0	0	0	335	0
Lock 5 Paringa	–34.187	140.765	62	0	0	0	1266	0
Lock 7 Rufus River	–34.067	141.247	48	0	0	0	409	0
Lock 8 Neds Corner	–34.129	141.396	52	0	0	0	409	0
Lock 9 Cullulleraine	–34.192	141.596	36	0	0	0	409	0
Lock 15 Euston	–34.599	142.758	51	0	0	0	409	0
Loxton Riverfront Reserve	–34.452	140.552	50	39	19	32	0	31
Lyrup Lagoon – Gurra Gurra Wetlands	–34.265	140.631	505	0	284	111	297	0
Maize Island Lagoon	–34.167	140.017	9	0	213	0	0	150
Milang Snipe Sanctuary	–34.410	138.972	10	0	0	0	4	13
Markaranka	–34.067	139.930	80	2252	0	0	0	1916
Martins Bend	–34.288	140.624	142	0	56	0	0	0
Molo Flat	–34.057	139.802	62	703	105	0	0	740
Morgan Conservation Park	–34.035	139.673	82	0	306	0	0	336
Morgan East	–34.035	139.672	40	0	200	0	0	200
Mundic Wetland	–34.203	140.781	23	0	104	0	0	38
Murtho	–34.193	140.808	5	0	0	0	0	4
Nikalapko	–34.037	139.813	46	800	0	0	0	1036
Old Parcoola (West)	–34.178	140.296	223	0	353	0	0	0
Overland Corner Wetlands	–34.147	140.333	68	842	0	0	0	1045
Piggy Creek	–34.356	140.542	33	201	201	0	0	0
Pike River complex	–34.254	140.759	2166	0	0	5	19	71
Plush's Bend	–34.212	140.756	16	0	0	0	0	76
Qualco Lagoon	–34.088	139.868	150	0	0	0	0	885
Ramco River Terrace	–34.155	139.916	15	8	0	3	5	0
Renmark Wetlands – Site 5	–34.205	140.732	9	0	0	0	48	60
Renmark Wetlands – Site 8	–34.121	140.734	31	0	0	0	158	72
Renmark Wetlands – Site 9	–34.219	140.745	22	0	0	0	58	39
Renmark Wetlands – Site 14	–34.161	140.757	5	0	0	0	53	45
Renmark Wetlands – Site 15	–34.126	140.745	46	0	0	0	22	27
Rilli Reach (Stanitzki's)	–34.375	140.596	11	25	27	0	9	5
Rilli Reserve	–34.375	140.596	11	0	2	0	0	3
Rillis Lagoons	–34.375	140.596	3	0	0	35	0	0
Riversleigh	–34.075	139.913	90	0	569	180	650	237
South Teringie	–35.537	139.101	70	136	79	0	0	500
Templeton	–34.055	140.816	8	0	0	0	0	38
Thiele Flat	–34.438	140.574	105	33	43	0	0	0
Thieles Lagoon	–34.438	140.574	10	0	0	11	0	0
Waikerie Ferry	–34.175	139.987	32	0	6	0	0	0
Warnoch Lescheid	–34.200	140.808	3	0	32	0	0	0
Weila	–34.032	140.846	7	255	375	0	0	596
Westbrooks	–34.374	140.600	10	0	14	0	0	2
Whirlpool Corner Wetland	–34.104	140.777	30	90	0	0	0	22
Wigley Reach	–34.196	140.337	20	310	625	0	375	983
Woolenook Bend	–34.072	140.745	56	0	0	0	33	0
Yabby Creek	–34.438	140.558	67	0	1290	0	0	0
Yarra Creek	–34.173	140.119	81	0	593	0	0	0
Lower Murray (VIC, NSW)								
Brickworks Billabong	–34.141	142.037	16	100	200	0	0	0
Bridge Creek	–34.798	143.318	26	233	0	0	0	0
Bullock Creek	–34.436	142.336	70	300	0	0	0	0
Burra Creek South	–34.971	143.308	220	315	0	0	0	0
Cardross Lakes	–34.307	142.104	156	288	477	0	0	0
Cowanna Billabong	–34.129	142.031	15	0	125	0	0	0
Hattah Lakes	–34.756	142.347	11025	34239	5348	0	32145	0
Lucerne Day	–34.142	141.424	7	0	0	0	82	0
Mulcra Island	–34.121	141.357	3000	3761	0	0	0	0
Psyche Bend	–34.264	142.234	418	418	0	0	0	0
Wingillie Station	–34.123	141.392	65	0	192	0	1459	59
Woorlong Wetlands	–34.276	142.213	172	334	0	0	0	0
Total			687268	248204	436545	182685	569432	250004

Sources of data on wetland areas used in Tables S2 and S3

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Murray, P. A. (2006) Wetlands of the Murrumbidgee River Catchment, New South Wales. In: Taylor, I.R., Murray, P.A. and Taylor, S.G. (eds.) Wetlands of the Murrumbidgee River Catchment: Practical Management in an Altered Environment. Fivebough and Tuckerbill Wetlands Trust, Leeton, pp. 4–11.

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Table S4. Average calculated depth of ten flood events, from 2014–15 to 2018–19, where the flooded area was provided, for four Ramsar wetlands (Macquarie Marshes, Gwydir Wetlands, Narran Lakes, and Gunbower Forest) and two wetlands of national importance (Great Cumbung Swamp and Mallowa Wetlands)

References cited are listed above under 'Sources of data used in Table S2'. Total areas of wetlands from Table S3

	Source of water and volume (ML)							
	CEWO	State	Other	Total	Area flooded (ha)	Percentage of total area	Calculated mean depth (m)	References
2014–15								
Macquarie Marshes	10000	6037	17745	33782	9323	4.7	0.36	OEH (2015), p 11
Gwydir Wetlands	30000		29895	59895	6740	6.6	0.89	Gawne *et al*. (2016), p. 15
2015–16								
Great Cumbung Swamp	24058	8020		32078	9000	56.3	0.36	OEH (2017), p. 17
Barmah–Millewa Forest	84700		53110	137810	10000	15.2	1.38	Gawne *et al*. (2017), p. 13
2016–17								
Narran Lakes	16892			16892	1500	5.7	1.13	Hale *et al*. (2018), p. 13
2017–18								
Macquarie Marshes	50660	19485	64232	134377	23000	11.5	0.58	OEH (2018)[A]; Hale *et al*. (2019), p. 22
2018–19								
Gwydir Wetlands	30000	30000		60000	7000	6.9	0.86	OEH (2020)
Mallowa Creek	16950			16950	2000	28.4	0.85	OEH (2020)
Macquarie Marshes	51401	24004	48402	123807	15000	7.5	0.83	OEH (2020)
Gunbower Forest		30987	10824	41811	4500	22.6	0.93	VEWH (2019), p. 83
Average							**0.82**	

[A]OEH (2018) gives a figure of 19000 ha flooded, giving a calculated mean depth of 0.71 m.

Table S5. Volume of Commonwealth water (ML) delivered as flood events (wetland watering or overbank flows plus bankfull or freshing flows to terminal wetlands), from 2014–15 to 2018–19, as a proportion of the total volume of Commonwealth environmental water delivered in each river valley of the Murray–Darling Basin

Total volume delivered: from Table S1; volume delivered as flood events: from Table S3

	2014–15			2015–16			2016–17			2017–18			2018–19		
	Total delivered (ML)	Flood events (ML)	Flood events as a percentage of total	Total delivered (ML)	Flood events (ML)	Flood events as a percentage of total	Total delivered (ML)	Flood events (ML)	Flood events as a percentage of total	Total delivered (ML)	Flood events (ML)	Flood events as a percentage of total	Total delivered (ML)	Flood events (ML)	Flood events as a percentage of total
Paroo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Warrego	2542	0	0	859	0	0	26,980	9,702	36	3347	0	0	15738	0	0
Condamine-Balonne	17389	0	0	10453	0	0	45,762	18,000	39.3	3985	0	0	0	0	0
Moonie	1415	0	0	201	0	0	1,415	0	0	2323	0	0	1022	0	0
Border Rivers	1812	0	0	1047	0	0	23,526	0	0	9116	0	0	7400	0	0
Gwydir	56639	39667	70	8400	4836	57.6	22,847	16,496	72.2	28290	4000	14.1	58150	46950	80.7
Namoi	0	0	0	0	0	0	9,109	0	0	5357	0	0	5500	0	0
Macquarie-Castlereagh	10000	10000	100	14239	14239	100	54,520	24,289	44.6	50660	48421	95.6	45722	45052	98.5
Barwon-Darling	1761	0	0	3820	0	0	26,796	0	0	10600	0	0	6940	0	0
Lower Darling	0	0	0	3820	0	0	160,453	0	0	2738	0	0	0	0	0
Lachlan	5000	0	0	36022	2584	7.2	29,492	1,324	4.5	35188	0	0	18173	0	0
Murrumbidgee	152558	152558	100	108327	95252	87.9	241,465	42,939	17.8	179249	177511	99	62296	56883	91.3
Central Murray	63062	0	0	424513	276465	65.1	349,177	39,170	11.2	392996	293052	74.6	135611	80511	59.4
Ovens	70	0	0	70	0	0	70	0	0	123	0	0	123	0	0
Goulburn-Broken	244007	250	0.1	220083	0	0	182,253	0	0	299211	498	0.2	227705	0	0
Campaspe	5791	0	0	3289	0	0	0	0	0	6594	0	0	3611	0	0
Loddon	2870	0	0	1477	0	0	1,579	0	0	3054	0	0	2636	0	0
Wimmera-Avoca	19875	0	0	0	0	0	0	0	0	3108	0	0	5838	0	0
Lower Murray	626096	45729	7.3	821589	19111	2.3	650,649	2,597	0.4	909800	45950	5.1	561762	12664	2.3
Total	1210887	248204	18.4	1658208	436545	26.3	1,826,093	1,826,851	10	1945739	569432	29.3	1158227777	250004	21.6

Table S8. Duration and seasonal occurrence of overbank flows and wetland watering events plus bankfull or freshing flows to terminal wetlands [in brackets], intended for vegetation outcomes, from 2014–15 to 2018–19

Note: duration refers to period of flood rise, not flood rise and recession. Data on flow components, volume and dates from Gawne *et al*. 2016, 2017; Hale *et al*. 2018, 2019, 2020

		Volume (ML)	Flow component	Start date	Finish date	Duration (days)	Rate of fill (ML day^{-1})	Season
	2014–15							
Gwydir	Gwydir Wetlands	30000	Wetland	17/09/2014	07/03/2015	171	175	Spring to Autumn
	Mallowa Wetlands	9667	Wetland	17/09/2014	07/03/2015	171	57	Spring to Autumn
Macquarie	Macquarie Marshes	10000	Fresh [Wetland]	13/10/2014	12/12/2014	60	167	Spring–Summer
Murrumbidgee	Juanbung	5688	Wetland	4/05/2015	29/06/2015	56	102	Autumn–Winter
	Mid-north Redbank	40000	Wetland	12/08/2014	20/01/2015	161	248	Winter to Summer
	Paika Lake	8498	Wetland	25/05/2015	27/06/2015	33	258	Autumn–Winter
	Sandy Creek	250	Wetland	22/03/2015	1/04/2015	10	25	Autumn
	Upper North Redbank	20000	Wetland	1/10/2014	25/03/2015	175	114	Spring–Summer
	Yanco Creek	2460	Wetland	23/06/2015	30/06/2015	7	351	Winter
	Yanga National Park	74512	Wetland	23/10/2014	10/04/2015	169	441	Spring to Autumn
	Yarradda Lagoon	1150	Wetland	4/12/2014	22/01/2015	49	23	Summer
Goulburn	Moodies Swamp	250	Wetland	6/10/2014	02/12/2014	57	4	Spring–Summer
Lower Murray	Akuna	125	Wetland	26/11/2014	4/12/2015	373	0.3	Summer
	Banrock Station – Wigley Reach	310	Wetland	13/11/2014	23/01/2015	71	4	Summer
	Clarks Floodplain	201	Wetland	27/10/2014	15/06/2015	231	1	Spring to Winter
	Calperum Station	276	Wetland	5/11/2014	15/06/2015	222	1	Spring to Winter
	Cobdogla	2	Wetland	4/03/2015	10/03/2015	6	0.3	Autumn
	Duck Hole	220	Wetland	13/11/2014	7/12/2014	24	9	Spring–Summer
	Johnsons Waterhole	162	Wetland	2/09/2014	15/06/2015	286	1	Spring to Winter
	Loxton Riverfront Reserve	39	Wetland	25/09/2014	15/06/2015	263	0.1	Spring to Winter
	Markaranka South	1652	Wetland	1/12/2014	7/06/2015	188	9	Summer to Winter
	Markaranka East	600	Wetland	6/01/2015	24/02/2015	49	12	Summer
	Molo Flats	703	Wetland	3/12/2014	2/04/2015	120	6	Summer–Autumn
	Nikalapko	800	Wetland	10/11/2014	28/11/2014	18	44	Spring
	Overland Corner	842	Wetland	17/12/2014	15/05/2015	149	6	Summer–Autumn
	Piggy Creek	201	Wetland	11/11/2014	21/11/2014	10	20	Spring
	Ramco River Terrace	8	Wetland	6/11/2014	30/04/2015	175	0.05	Spring to Autumn
	Rilli Reach	25	Wetland	19/11/2014	30/04/2015	162	0.2	Spring to Autumn
	South Teringie	136	Wetland	25/11/2014	30/05/2015	186	1	Spring to Autumn
	Thiele Flat	33	Wetland	2/09/2014	30/04/2015	240	0.1	Spring to Autumn
	Weila	255	Wetland	12/11/2014	21/02/2015	101	3	Spring–Summer
	Whirlpool	90	Wetland	2/12/2014	24/03/2015	112	1	Summer–Autumn
	Hattah Lakes	34239	Wetland	26/05/2014	17/01/2015	236	145	Autumn to Summer
	Mulcra Island	3761	Wetland	12/08/2014	22/12/2014	132	28	Winter to Summer
	2015–16							
Gwydir	Gwydir Wetlands	1350	Overbank	9/01/2016	11/02/2016	33	41	Summer
	Mallowa Wetlands	3486	Overbank	9/11/2015	5/02/2016	88	40	Spring–Summer
Macquarie	Macquarie Marshes	12114	Fresh [Wetland]	6/08/2015	17/10/2015	72	168	Winter–Spring
	Macquarie Marshes	2125	Fresh [Wetland]	25/06/2016	30/06/2016	5	425	Winter
Lachlan	Booligal Swamp	1088	Fresh [Wetland]	2/09/2015	29/10/2015	57	19	Spring
	Great Cumbung Swamp	24059	Fresh [Wetland]	9/08/2015	15/10/2015	67	359	Winter–Spring
Murrumbidgee	Juanbung	10000	Wetland	4/11/2015	17/02/2016	105	95	Spring–Summer
	Nap Nap – Wagourah	7000	Wetland	6/05/2016	30/06/2016	55	127	Autumn–Winter
	Nap Nap – Wagourah	2557	Wetland	6/05/2016	30/06/2016	55	46	Autumn–Winter

		Volume (ML)	Flow component	Start date	Finish date	Duration (days)	Rate of fill (ML day^{-1})	Season
	Redbank	25000	Wetland	21/10/2015	10/02/2016	112	223	Spring–Summer
	Toogimbie IPA	933	Wetland	15/03/2016	1/05/2016	47	20	Autumn
	Waldaira Wetlands	2000	Wetland	9/02/2016	30/06/2016	142	14	Summer to Winter
	Yanco Creek	18263	Wetland	21/07/2015	13/08/2015	23	794	Winter
	Yarradda Lagoon	1394	Wetland	2/09/2015	20/12/2015	109	13	Spring–Summer
Central Murray	Barham Lake	115	Wetland	19/01/2016	7/03/2016	48	2	Summer
	Carrs, Capitts & Bunberoo cks.	950	Wetland	4/04/2016	16/05/2016	42	23	Autumn–Winter
	Gulpa Creek, Reed Beds Swamp	8000	Overbank	11/11/2015	10/02/2016	91	88	Spring–Summer
	River Murray riparian zone	172600	Overbank	25/07/2015	10/09/2015	47	3,672	Winter–Spring
	River Murray, Barmah & Millewa	63900	Overbank	11/09/2015	3/10/2015	22	2,905	Spring
	River Murray Barmah & Millewa	30900	Overbank	4/10/2015	31/10/2015	27	1,144	Spring
	Wingillie Station	192	Wetland	9/10/2015	17/10/2015	8	24	Spring
Lower Murray	Banrock Station – Banrock Bend	16	Wetland	3/12/2015	18/12/2015	15	1	Summer
	Banrock Station – Eastern Lagoon	1340	Wetland	17/11/2015	11/03/2016	115	12	Spring to Autumn
	Banrock Station – Herons Bend	20	Wetland	10/11/2015	27/11/2015	17	1	Spring
	Banrock Station – Wigley Reach Central	53	Wetland	20/01/2016	1/02/2016	12	4	Summer
	Banrock Station – Wigley Reach Depression	572	Wetland	10/11/2015	18/01/2016	69	8	Spring–Summer
	Bookmark Creek	424	Wetland	25/08/2015	30/06/2016	310	1	Spring to Winter
	Calperum Station	837	Wetland	1/11/2015	30/06/2016	242	3	Spring to Winter
	Carparks Lagoons	229	Wetland	21/10/2015	31/01/2016	102	2	Spring–Summer
	Clarks Floodplain	105	Wetland	1/08/2015	30/03/2016	242	0.4	Winter to Autumn
	Duck Hole	271	Wetland	1/10/2015	30/11/2016	426	1	Spring
	Greigers at Sugar Shack	59	Wetland	1/12/2015	30/04/2016	151	0.4	Summer–Autumn
	Greenways	39	Wetland	1/02/2016	30/03/2016	58	1	Summer–Autumn
	Hogwash Bend North	28	Wetland	14/01/2016	6/04/2016	83	0.3	Summer–Autumn
	Hogwash Bend South	420	Wetland	20/01/2016	18/02/2016	29	14	Summer
	Inner Mundic Creek	42	Wetland	1/11/2015	30/11/2015	29	1	Spring
	Johnsons Waterhole	117	Wetland	1/09/2015	30/04/2016	242	0.5	Spring to Autumn
	Lescheid Pikes	19	Wetland	1/12/2015	30/12/2015	29	1	Summer
	Loxton Riverfront Reserve	19	Wetland	1/08/2015	30/05/2016	303	0.1	Winter to Autumn
	Lyrup Lagoon	284	Wetland	1/09/2015	30/01/2016	151	2	Spring–Summer
	Maize Island Conservation Park	213	Wetland	4/02/2016	24/04/2016	80	3	Summer–Autumn
	Martin Bend	56	Wetland	31/08/2015	3/09/2015	3	19	Spring
	Molo Flat	105	Wetland	8/10/2015	21/10/2015	13	8	Spring
	Morgan Conservation Park	306	Wetland	11/01/2016	29/04/2016	109	3	Summer–Autumn
	Morgan East	200	Wetland	12/11/2015	30/01/2016	79	3	Spring–Summer
	Mundic Wetland	104	Wetland	1/10/2015	30/11/2015	60	2	Spring
	Old Parcoola (West)	353	Wetland	30/09/2015	28/11/2015	59	6	Spring
	Piggy Creek	201	Wetland	20/10/2015	5/11/2015	16	13	Spring
	Rilli Reach – Stanitzkis	27	Wetland	1/11/2015	30/05/2016	211	0.1	Spring to Autumn
	Rilli Reserve	2	Wetland	1/08/2015	30/09/2015	60	0.03	Winter–Spring
	Riversleigh	569	Wetland	1/01/2016	30/06/2016	181	3	Summer to Winter
	South Teringie	79	Wetland	1/12/2015	30/05/2016	181	0.4	Summer–Autumn
	Thiele Flat	43	Wetland	1/08/2015	30/03/2016	242	0.2	Winter to Autumn
	Waikerie Ferry	6	Wetland	1/12/2015	30/01/2016	60	0.1	Summer
	Warnoch Lescheid	32	Wetland	1/02/2016	30/03/2016	58	1	Summer–Autumn
	Weila	375	Wetland	4/11/2015	11/12/2015	37	10	Spring–Summer
	Westbrooks	14	Wetland	1/10/2015	30/04/2016	212	0.1	Spring–Autumn
	Yabby Creek	1290	Wetland	10/03/2016	18/05/2016	69	19	Autumn
	Yarra Creek	593	Wetland	1/10/2015	30/01/2016	121	5	Spring–Summer
	Brickworks Billabong	200	Wetland	1/10/2015	30/11/2015	60	3	Spring

		Volume (ML)	Flow component	Start date	Finish date	Duration (days)	Rate of fill (ML day^{-1})	Season
	Cardross Wetlands	477	Wetland	9/09/2015	24/12/2015	106	4	Spring–Summer
	Cowanna Billabong	125	Wetland	10/06/2015	30/11/2015	173	1	Winter–Spring
	Hattah Lakes	5348	Wetland	12/10/2015	23/10/2015	11	486	Spring
	2016–17							
Warrego	Toorale Western Floodplain	5023	Wetland	19/07/2016	12/09/2016	55	91	Winter
	Toorale Western Floodplain	4697	Wetland	12/09/2016	20/09/2016	8	587	Winter
Condamine	Narran Lakes	18000	Overbank	21/09/2016	2/10/2016	12	1,500	Winter–Spring
Gwydir	Gwydir Wetlands	9000	Wetland	27/12/2016	28/02/2017	63	143	Summer
	Mallowa Wetlands	7496	Wetland	13/01/2017	1/04/2017	78	96	Summer–Autumn
Macquarie	Macquarie Marshes	17039	Wetland	24/01/2017	18/02/2017	25	682	Summer
	Macquarie Marshes	3000	Wetland	24/07/2016	30/07/2016	6	500	Winter
	Macquarie Marshes	3500	Wetland	6/09/2016	13/09/2016	7	500	Spring
	Macquarie Marshes	750	Wetland	19/12/2016	21/12/2016	2	375	Summer
Murrumbidgee	Lower Murrumbidgee Floodplain	15507	Wetland	4/08/2016	3/09/2016	30	517	Winter–Spring
	Nimmie-Caira: Eulimbah	2320	Wetland	28/11/2016	3/03/2017	95	24	Spring–Summer
	Nimmie-Caira: Is-Y-Coed	5000	Wetland	10/02/2017	20/03/2017	38	132	Summer
	Nimmie-Caira: Nap Nap	630	Wetland	3/01/2017	7/01/2017	4	158	Summer
	Nimmie-Caira: Telephone Bank	5425	Wetland	24/11/2016	20/03/2017	116	47	Spring to Autumn
	North Redbank	844	Wetland	27/10/2016	13/02/2017	109	8	Spring–Summer
	Toogimbie IPA Wetlands	998	Wetland	18/03/2017	4/04/2017	17	59	Autumn
	Wanganella Swamp	5000	Wetland	19/11/2016	4/01/2017	46	109	Spring–Summer
	Western Lakes	5060	Wetland	7/11/2016	19/12/2016	42	120	Spring–Summer
	Yanga National Park	2155	Wetland	29/10/2016	13/02/2017	107	20	Spring–Summer
Central Murray	Barmah-Millewa Forest	39170	Overbank	22/06/2016	31/12/2016	192	204	Winter to Summer
Lower Murray	Bookmark Creek	239	Wetland	1/01/2017	30/06/2017	180	1	Summer to Winter
	Calperum Station	1277	Wetland	1/06/2016	1/06/2017	365	4	Winter to Winter
	Gurra Gurra Lyrup Lagoon	111	Wetland	1/04/2017	1/06/2017	61	2	Autumn–Winter
	Kroehns Landing	3	Wetland	1/06/2017	30/06/2017	29	0.1	Winter
	Loxton Riverfront Reserve	32	Wetland	1/04/2017	1/06/2017	61	0.5	Autumn–Winter
	Pike River complex	5	Wetland	1/11/2016	1/06/2017	212	0.03	Spring to Winter
	Ramco River Terrace	3	Wetland	1/05/2016	1/06/2017	396	0.01	Autumn–Winter
	Rillis Lagoons	35	Wetland	1/04/2017	1/06/2017	61	0.6	Autumn–Winter
	Riversleigh Lagoon	180	Wetland	1/04/2017	1/06/2017	61	3	Autumn–Winter
	Thieles Lagoon	11	Wetland	1/04/2017	1/06/2017	61	0.2	Autumn–Winter
	2017–18							
Gwydir	Gwydir Wetlands	4000	Wetland	19/12/2017	17/01/2018	29	138	Summer
Macquarie	Macquarie Marshes	48421	Fresh, Wetland	15/08/2017	12/11/2017	89	544	Winter–Spring
Murrumbidgee	Coonancoocabil Lagoon	900	Wetland	11/12/2017	2/01/2018	22	41	Summer
	Gooragool Lagoon	1426	Wetland	18/07/2017	11/08/2017	24	59	Winter
	Gooragool Lagoon	750	Wetland	1/06/2018	30/06/2018	29	26	Winter
	Mid-Murrumbidgee wetlands	159283	Fresh, Wetland	24/07/2017	1/09/2017	39	4,084	Winter–Spring
	Nimmie-Caira	5000	Wetland	15/04/2018	28/05/2018	43	116	Autumn
	North Redbank	5528	Wetland	9/10/2017	19/10/2017	10	553	Spring
	Oak Creek	620	Wetland	28/12/2017	2/01/2018	5	124	Summer
	Sandy Creek	400	Wetland	17/02/2018	23/04/2018	65	6	Summer–Autumn
	Tuckerbill Swamp	600	Wetland	9/04/2018	16/04/2018	7	86	Autumn
	Yarradda Lagoon	326	Wetland	4/07/2017	24/07/2017	20	16	Winter
	Yarradda Lagoon	178	Wetland	20/11/2017	25/11/2017	5	36	Spring
Central Murray	Barham Lake	102	Wetland	23/01/2018	23/03/2018	59	2	Summer–Autumn
	Hattah Lakes	32145	Wetland	3/07/2017	31/10/2017	120	268	Winter–Spring
	River Murray	289606	Fresh, Overbank	1/07/2017	31/12/2017	183	1,583	Winter to Summer

		Volume (ML)	Flow component	Start date	Finish date	Duration (days)	Rate of fill (ML day^{-1})	Season
Goulburn	Broken Creek & Moodie Swamp	498	Fresh, Wetland	18/04/2018	7/06/2018	50	10	Autumn
Lower Murray	Lock 2	335	Overbank	15/08/2017	15/10/2017	61	5	Winter–Spring
	Lock 5	1266	Overbank	1/08/2017	15/11/2017	106	12	Winter–Spring
	Lock 7	409	Overbank	8/09/2017	10/12/2017	93	4	Spring–Summer
	Lock 8	409	Overbank	10/09/2017	6/12/2017	87	5	Spring–Summer
	Lock 9	409	Overbank	30/08/2017	9/10/2017	40	10	Winter–Spring
	Lock 15	409	Overbank	5/09/2017	26/11/2017	82	5	Spring
	Lucerne Day	82	Wetland	28/09/2017	28/09/2017	1	82	Spring
	Wingillie Station	1459	Wetland	28/09/2017	20/04/2018	204	7	Spring to Autumn
	Banrock Stn. Banrock Bend	24	Wetland	11/12/2017	27/12/2017	16	2	Summer
	Banrock Stn. Eastern Lagoon	1429	Wetland	11/12/2017	23/05/2018	163	9	Summer–Autumn
	Herons & Banrock flats	132	Wetland	16/05/2018	13/06/2018	28	5	Autumn–Winter
	Banrock Stn., Herons Bend	24	Wetland	11/12/2017	27/12/2017	16	2	Summer
	Banrock Stn., Wigley Reach Depression	396	Wetland	11/12/2017	10/02/2018	61	7	Summer
	Bookmark Creek	448	Wetland	11/08/2017	30/06/2018	323	1	Winter to Winter
	Calperum Station	3894	Wetland	10/10/17	2/04/2018	174	22	Spring to Autumn
	Clarkes Floodplain	13	Wetland	22/03/2018	1/06/2018	71	0.2	Autumn–Winter
	Greenways Landing	20	Wetland	1/04/2018	30/04/2018	29	1	Autumn
	Gurra Gurra Lyrup Lagoon	297	Wetland	12/12/2017	15/02/2018	65	5	Summer
	Milang Snipe Sanctuary	4	Wetland	2/03/2018	21/03/2018	19	0.2	Autumn
	Pike River	19	Wetland	1/04/2018	27/04/2018	26	1	Autumn
	Ramco River Terrace	5	Wetland	1/04/2018	1/06/2018	61	0.1	Autumn–Winter
	Renmark Wetlands Site 5	48	Wetland	26/03/2018	27/05/2018	62	1	Autumn
	Renmark Wetlands Site 8	158	Wetland	9/04/2018	31/05/2018	52	3	Autumn
	Renmark Wetlands Site 9	58	Wetland	26/03/2018	31/05/2018	66	1	Autumn
	Renmark Wetlands Site 14	53	Wetland	1/08/2017	28/05/2018	300	0.2	Winter to Autumn
	Renmark Wetlands Site 15	22	Wetland	1/07/2017	10/10/2017	101	0.2	Winter–Spring
	Rilli Reach	9	Wetland	10/09/2017	10/06/2018	273	0.05	Spring to Winter
	Riversleigh Lagoon	650	Wetland	1/10/17	4/02/2018	126	5	Spring–Summer
	2018–19							
Gwydir	Ballin Boora	600	Wetland	12/12/2018	31/01/19	50	12	Summer
	Gwydir Wetlands	30000	Fresh, wetland	18/07/2018	7/02/19	204	147	Winter to Summer
	Mallowa Wetlands	16950	Fresh, wetland	20/09/2018	14/02/19	147	115	Spring–Summer
Macquarie	Macquarie Marshes	45052	Wetland	25/08/2018	11/12/18	108	417	Winter to Summer
Lachlan	Great Cumbung Swamp	5338	Wetland	9/06/2019	28/06/19	19	281	Winter
	Yarrabandai Lagoon	412	Wetland	18/03/2019	29/05/19	72	6	Autumn
Murrumbidgee	Campbells Swamp	1594	Wetland	8/11/2018	18/02/19	102	16	Spring–Summer
	Mainie Swamp	2000	Wetland	10/10/2018	25/02/19	138	14	Spring–Summer
	Darlington Lagoon	397	Wetland	20/12/2018	1/05/19	132	3	Summer–Autumn
	North Redbank	500	Wetland	18/09/2018	19/11/18	62	8	Spring
	North Redbank	6000	Wetland	17/12/2018	18/01/19	32	188	Summer
	Sandy Creek	400	Wetland	29/09/2018	12/01/19	105	4	Spring–Summer
	Toogimbie IPA	900	Wetland	15/10/2018	22/03/19	158	6	Spring to Autumn
	Yanga National Park	10500	Wetland	20/08/2018	31/01/19	164	64	Spring–Summer
	Yanga National Park	30000	Wetland	17/09/2018	25/01/19	130	231	Spring–Summer
	Yarradda Lagoon	2014	Wetland	16/11/2018	18/01/19	63	32	Spring–Summer
Central Murray	Barmah-Millewa Forest	38527	Overbank	7/11/2018	3/01/19	57	676	Spring–Summer
	Pollack Swamp	2000	Wetland	8/10/2018	25/01/19	109	18	Spring–Summer
	River Murray Channel	24975	Fresh, overbank	6/07/2018	31/07/18	25	999	Winter
Lower Murray	Wigley Reach Depression	570	Wetland	19/11/2018	7/05/19	169	3.4	Spring to Autumn
	Bookmark Creek	386	Wetland	2/10/2018	30/06/19	271	1.4	Spring to Winter

	Volume (ML)	Flow component	Start date	Finish date	Duration (days)	Rate of fill (ML day^{-1})	Season
Cadell Wetlands	73	Wetland	3/05/2019	16/05/19	13	5.7	Autumn
Cadell Wetlands	250	Wetland	23/11/2018	18/02/19	87	2.9	Spring–Summer
Calperum Station	175	Wetland	16/05/2019	3/06/19	18	9.7	Autumn–Winter
Calperum Station	6	Wetland	8/05/2019	11/06/19	34	0.2	Autumn–Winter
Calperum Station	331	Wetland	18/04/2019	21/05/19	33	10	Autumn
Calperum Station	69	Wetland	9/05/2019	3/06/19	25	2.8	Autumn–Winter
Calperum Station	274	Wetland	15/04/2019	8/05/19	23	12	Autumn
Clarks Floodplain	5	Wetland	7/09/2018	26/02/19	172	0.03	Spring–Summer
Clarks Floodplain	2	Wetland	26/02/2019	31/05/19	94	0.02	Summer–Autumn
Disher Creek	24	Wetland	27/11/2018	29/11/18	2	12	Spring
Gerard Wetlands	147	Wetland	22/11/2018	23/04/19	152	1	Spring to Autumn
Greenways Landing	40	Wetland	26/10/2018	7/11/18	12	3	Spring
Hogwash Bend	22	Wetland	19/11/2018	11/12/18	22	1	Spring–Summer
Hogwash Bend	523	Wetland	10/11/2018	8/02/19	90	6	Spring–Summer
Loxton Floodplain lagoons	30	Wetland	1/04/2019	20/05/19	49	0.6	Autumn
Loxton Floodplain lagoons	1	Wetland	1/04/2019	31/05/19	60	0.01	Autumn
Maize Island	150	Wetland	11/12/2018	11/02/19	62	2.4	Summer
Markaranka Flat	1916	Wetland	14/11/2018	8/02/19	86	22	Spring–Summer
Milang Snipe Sanctuary	13	Wetland	13/11/2018	15/03/19	122	0.1	Spring to Autumn
Molo Flat	740	Wetland	5/11/2018	12/02/19	99	8	Spring–Summer
Morgan East	200	Wetland	24/10/2018	11/02/19	110	2	Spring–Summer
Morgan North Lagoon	290	Wetland	29/11/2018	21/02/19	84	3.5	Spring–Summer
Morgan South Lagoon	46	Wetland	7/01/2019	23/02/19	47	1	Summer
Murtho	4	Wetland	12/10/2018	19/11/18	38	0.1	Spring
Nikalapko Wetland	1036	Wetland	26/11/2018	23/02/19	89	12	Spring–Summer
Overland Corner	1045	Wetland	9/10/2018	22/04/19	195	5.4	Spring to Autumn
Pike Lagoon	31	Wetland	10/05/2019	15/05/19	5	6.2	Autumn
Pike River	40	Wetland	22/11/2018	4/03/19	102	0.4	Spring to Autumn
Mundic Wetland	49	Wetland	30/04/2019	6/05/19	6	8	Autumn
Mundic Wetland	38	Wetland	14/05/2019	21/05/19	7	5.4	Autumn
Plushs Bend	76	Wetland	11/10/2018	19/02/19	131	0.6	Spring–Summer
Qualco	503	Wetland	7/09/2018	3/05/19	238	2	Spring to Autumn
Qualco	59	Wetland	7/09/2018	17/04/19	222	0.3	Spring to Autumn
Renmark Wetlands	60	Wetland	16/08/2018	30/05/19	287	0.2	Winter to Autumn
Renmark Wetlands	27	Wetland	17/07/2018	22/09/18	67	0.4	Winter–Spring
Renmark Wetlands	39	Wetland	15/08/2018	23/09/18	39	1	Winter–Spring
Renmark Wetlands	72	Wetland	20/07/2018	16/10/18	88	0.8	Winter–Spring
Renmark Wetlands	45	Wetland	16/08/2018	30/05/19	287	0.2	Winter to Autumn
Rilli Lagoons	2	Wetland	11/09/2018	26/11/18	76	0.03	Spring
Riversleigh Lagoon	37	Wetland	3/12/2018	10/01/19	38	1	Summer
Riversleigh Lagoon	200	Wetland	7/09/2018	13/11/18	67	3	Spring
Stanitzkis	5	Wetland	21/01/2019	21/02/19	31	0.2	Summer
Templeton	38	Wetland	10/10/2018	19/11/18	40	1	Spring
Teringie South	500	Wetland	1/03/2019	31/03/19	30	16.7	Autumn
Westbrooks	2	Wetland	21/01/2019	31/05/19	130	0.02	Summer–Autumn
Whirlpool Corner	22	Wetland	10/10/2018	19/11/18	40	0.6	Spring
Weila	596	Wetland	29/11/2018	5/02/19	68	9	Spring–Summer
Wigley Reach	413	Wetland	3/12/2018	27/02/19	86	5	Summer
Wingillie Station	59	Wetland	16/11/2018	28/12/18	42	1.4	Summer

Table S6. Basin-wide areas (ha) of woody wetland vegetation communities (sum of all river valleys) that received Commonwealth water as overbank or wetland watering plus bankfull or freshing flows to terminal wetlands, from 2014–15 to 2018–19, expressed as a proportion of total area estimated for each vegetation type in each year

Data from Brooks 2016, 2017, 2018, 2019, annexes C and D therein; Brooks 2020, appendices 3 and 4 therein). Means are based on the latter 3 years, when estimates of extent of each community are consistent. Note: total areas of each vegetation community vary between years because of the variation in accuracy between river valleys in assessing ecosystem types in the interim Australian National Aquatic Ecosystem Classification (ANAE; Brooks 2016, p. 14, 2017, p. 23). Also there were differences between years in methods used to calculate flood extent; cf. Brooks 2019, pp. 3–8 for updates on ANAO mapping and pp. 15–19 for a cumulative Basin-scale evaluation (2014–15 to 2017–18) of ecosystem types and details of variation in assessment of vegetation communities that received Commonwealth water. The total areas of vegetation communities presented by Brooks (2020, tables 8 and 10 therein) differ from the means presented above, as follows: river red gum forest: 713 743 ha; river red gum woodland: 325 221 ha; black box woodland: 839 911; coolibah woodland: 1 223 997 ha; lignum shrubland: 193 842 ha

	2014–15			2015–16			2016–17		
	Total area	Flooded area	%	Total area	Flooded area	%	Total area	Flooded area	%
River red gum forest	343964	20221	5.9	344045	46887	13.6	649619	14038	2.2
River red gum woodland	228356	4626	2	227641	5756	2.5	317188	1238	0.4
Black box woodland	450934	2652	0.6	440693	5947	1.4	885068	1190	0.1
Coolibah woodland	1813804	1223	0.1	1813812	672	0.04	427507	949	0.2
Lignum shrubland	247462	660	0.3	240364	6911	3.6	192868	13592	7.1
Total	3084520	29382	1	3066555	66173	2.2	2472250	31007	1.3
	2017–18			2018–19			Mean 2016–17 to 2018–19		
	Total area	Flooded area	%	Total area	Flooded area	%	Total area	Flooded area	%
River red gum forest	649786	25707	4	653085	53198	8.2	650830	32010	4.9
River red gum woodland	319242	39756	12.5	318133	1213	0.4	318188	10518	3.3
Black box woodland	885229	2234	0.3	883084	1388	0.2	884460	2682	0.3
Coolibah woodland	1217140	1335	0.1	1222563	2301	0.2	955737	1296	0.1
Lignum shrubland	188555	1920	1	188341	1541	0.8	189921	5771	3
Total	3259952	70952	2.2	3265206	59641	1.8	2999136	52277	1.7

Table S7. Water regimes for the four vegetation types based on water requirements for maintenance and regeneration (from Roberts and Marston 2011)

Note: more recent research of flooding requirements for river red gum suggests managers may have more flexibility over frequency, with flooding of 1-in-5 years being sufficient to maintain forest communities (Doody *et al*. 2015)

Maintenance	River red gum forest	River red gum woodland	Black box woodland	Coolibah woodland	Lignum shrubland
Frequency of flooding	Every 1–3 years	Every 2–4 years	Every 3–7 years	Every 10–20 years	Every 1–3 years for large shrubs; 3–5 years for healthy shrubs, 7–10 years for small shrubs
Depth of flooding	Not critical	Not critical	Not critical	Not critical	Not critical (<1 m)
Duration	5–7 months	2–4 months	2–6 months	Not known	3–7 months for vigorous canopy
Timing	Spring-summer		Natural timing for site	Not critical	Not critical
Regeneration					
Timing of flood recession	Spring	Spring	Spring-summer	Not critical	Autumn-winter
Requirements for seedling establishment	Follow-up flood in same year as germination or following year; shallow flood of 4–6 weeks		Additional moisture in 1st or 2nd year improves establishment	Additional rainfall or shallow flood in 1st or 2nd year	2–3 shallow (5–15 cm) spring-summer floods of 4–6 weeks in first 3 years

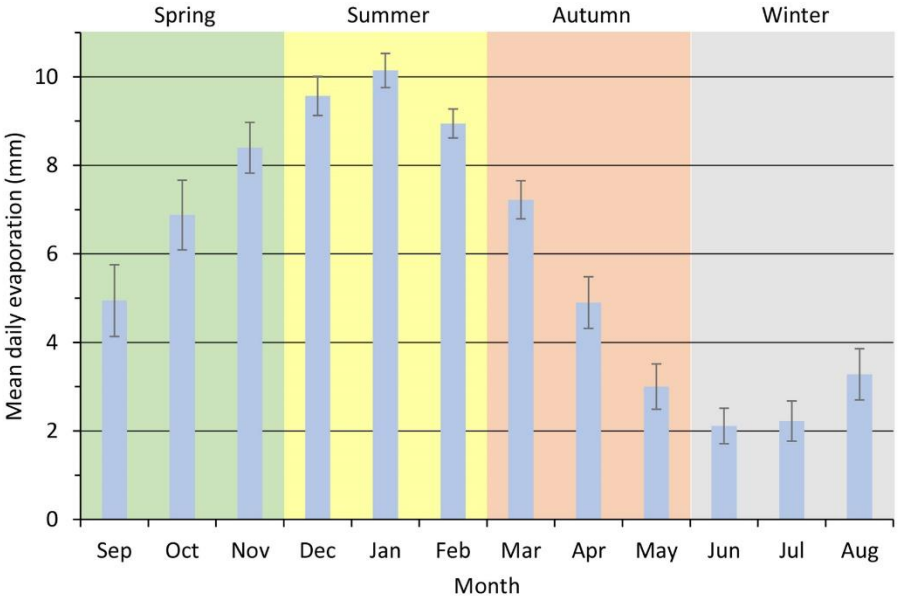

Figure S1. Mean actual evaporation (mm day^{-1}), expressed monthly, averaged from ten weather stations in the Murray–Darling Basin (1991–2018), showing seasonal differences. Data from Bureau of Meteorology. Error bars = 95% confidence intervals. Weather stations: Bourke Post Office 048013; Charleville Aero 044021; Cobar MO 048027; Deniliquin Visitor Information Centre 074128; Loxton Research Centre 024024; Mildura Aero 076031; Moree Aero 053115; Roma Airport 043091; Trangie Research Station AWS 051049 Wagga Wagga AMO 072150; see Fig. 1 for locations.

Questions used in semi-structured interviews

Objectives and outcomes

What do you think about current environmental water delivery?

What successful outcomes have resulted from environmental watering activities?

Is the current environmental watering plan efficient/sufficient to support the ecological functions of the wetlands? Why/Why not?

Social and economic constraints

What are the physical and operational constraints that affect environmental watering? And what are the priority constraints that need to be addressed urgently?

To what degree do current constraints affect the contribution of environmental watering?

What conflicts exist when delivering environmental water?

Policy and management

Given constraints on available water, how do you make decisions to overcome current constraints? And what are the trade-offs that you typically deal with?

How could you achieve most benefit with least water delivered to targeted places in your area?

What are the potential strategies or policy instruments that you plan to improve to address current uncertainties and to reconcile the conflicts?

Climate change

How do you think that climate change will affect adaptive management for the Basin or your area?

What strategies will you use to manage climate change and drought, and still deliver water for expected outcomes? (for environmental water managers only)

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