

Article

Water Sources of Upland Swamps in Eastern Australia: Implications for System Integrity with Aquifer Interference and a Changing Climate

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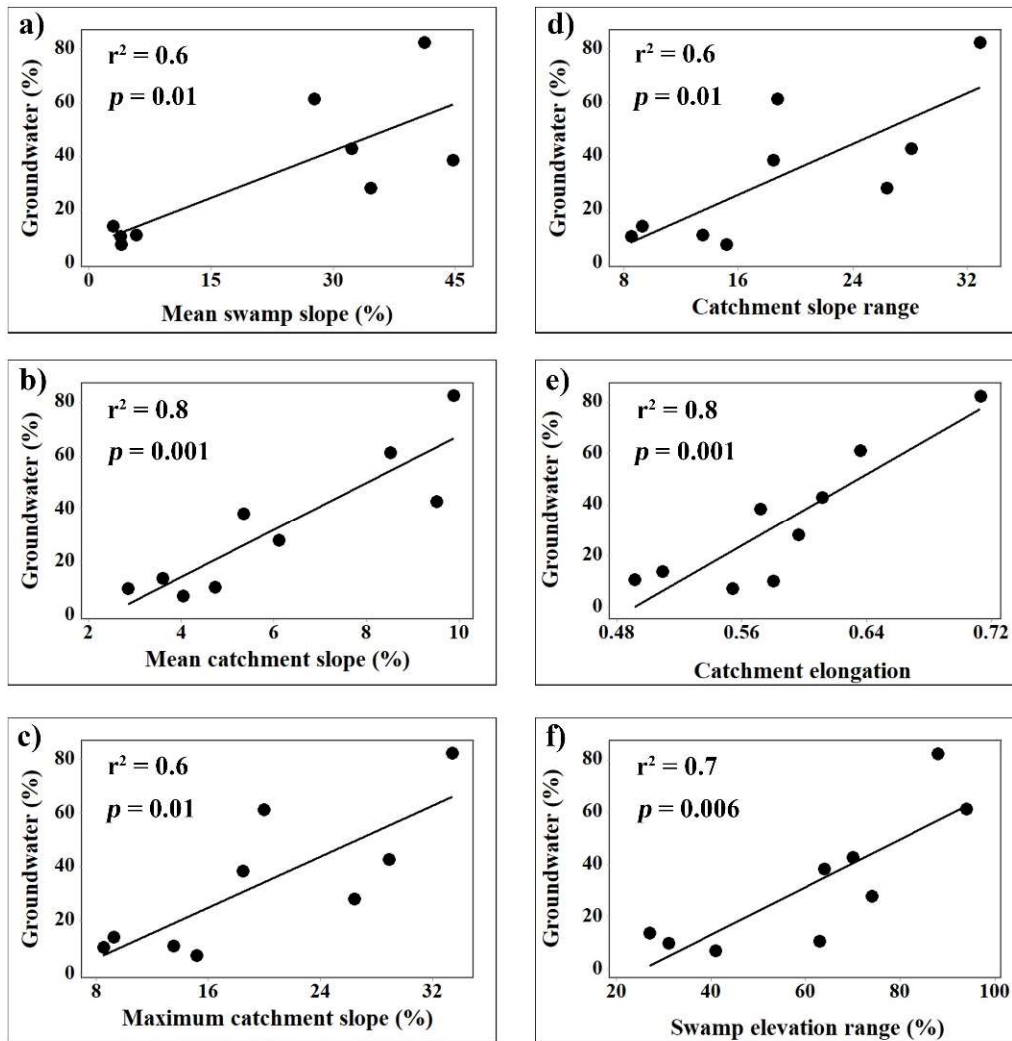


Figure S1. Regression plots showing correlations between groundwater connectivity and a subset of swamp-catchment morphometrics such as (a) Mean swamp slope, (b) Mean catchment slope, (c) Maximum catchment slope, (d) Catchment slope range, (e) Catchment elongation, (f) Swamp elevation range.

Table S1. Individual Radon and isotope sampling results for swamp water, groundwater, surface waters and rainwater.

Location	Piezometer/Borehole No.	Rn Concentration (Bq/L)	Rn Emanation (Bq/L)	$\delta^{18}\text{O}\text{‰}$	$\delta^2\text{H}\text{‰}$	$\delta^{18}\text{O}\text{‰}$	$\delta^2\text{H}\text{‰}$
				Winter	Winter	Summer	Summer
Walmer Crescent—Wentworth Falls	P1	4.255	0.083	-5.16	-24.6	-5.31	-25.6
	P2	NS	NS	-5.6	-27.7	-5.42	-26.5
	Surface water	BQL	NA	NS	NS	-5.39	-26.0
Mt Hay—Leura	P1	NS	NS	-5.5	-25.95	-5.65	-27.3
	P2	1.95	0.143	-6.01	-28.9	-5.71	-27.5
	Surface water	0.195	NA	NS	NS	-5.74	-28.6
Michael Eade—Katoomba	P1	1.02	0.001	-5.97	-30.15	-5.90	-29.9
	P2	NS	NS	-6.245	-32.5	-5.55	-27.3
	Surface water	0.52	NA	-5.89	-29.50	-5.94	-29.9
Grand Canyon—Medlow Bath	P1	1.63	0.067	-6	-30.3	-5.89	-29.3
	P2	NS	NS	-6.265	-32.45	-5.90	-29.4
	Surface water	0.48	NA	NS	NS	-6.00	-30.3
Perrys St—Blackheath	P1	NS	NS	-5.72	-28.3	-5.3	-25.151
	P2	3.04	0.173	-5.505	-26.8	-5.35	-25.3
	Surface water	0.4	NA	NS	NS	-5.70	-28.3
Katoomba groundwater bore (19 m bgl)		5.3/2.1*	NA	-5.87	-29.6	-6.04	-30.76
Wentworth Falls groundwater bore (50 m bgl)	GW058603	NA	NA	-6.215	-31.45	-5.81	-29.3
Wentworth Falls Rainwater		NA	NA	-6.28	-26.9	-4.31	-17.7
				-7.82	-41.7	-3.94	-12.7
Blackheath Rainwater		NA	NA	-6.92	-29.3	-5.99	-29.5
				-7.7	-42	-8.38	-51.9
						-9.47	-64.2
Butlers, East Kangaloon	75107	9.33	0.132	-5.49	-26.7	-6.55	-35.5
	75106	103*		-5.62	-28.3	-5.54	-28.2
	Surface water	3.37	NA	NS	NS	-3.72	-14.0
Horseshoe, East Kangaloon (Nepean River)	SCA-8	NS	NS	-6.25	-33.6	-3.10	-11.2
Little Guy, East Kangaloon (Nepean River)	SCA-9	NS	NS	-6.68	-37.9	-6.28	-34.6
	Surface water	NS	NS	-6.73	-37.5	NS	NS
Nepean River, East Kangaloon	Surface water	NS	NS	6.52	-35.3	4.98	-25.1

Stockyard, Mt Murray	P1	NS	NS	-6.1	-30.6	NS	NS
	Surface water	NS	NA	-6.26	-31.9	NS	NS
North Stockyard, Mt Murray	75210	1.65	0.132			-4.96	-22.9
	75211	NS	NS	-5.42	-26.1	-4.91	-22.4
	Surface water	0.16	NA	5.83	-29.6	-4.26	-17.2
Dudewaugh Creek, Mt Murray	Surface water	NS	NA	6.15	-31.1	-4.47	-17.9
North Pole, Mt Murray	NA	NS	NS	-6.46	-35.3	-4.34	-18.4
Powerlines Prickly, Mt Murray	NA	NS	NS	-5.64	-27.2	-6.02	-30.5
Jess and Jane, Knights Hill	NA	1.075	0.029	-6.03	-30.05	-4.37	-16.7
	Surface water	0.4	0.029	NS	NS	NS	NS
BNP4, Knights Hill	BNP4	NS	NS	-6.01	-28.1	-4.81	-20.2
BNP5, Knights Hill	BNP5	NS	NS	-5.94	-29.25	-5.68	-27.5
BNP1, Budderoo	BNP1	NS	NS	-5.44	-24.2	-4.49	-18.5
Wallaya, Budderoo	BNP2	1.635	0.029	-5.12	-23.2	-5.18	-23.7
	Surface water	1.5	NA	NS	NS	-4.17	-16.0
East Kangaloon Bedrock Aquifer	40970 (7 m bgl)	69.3	NA	-5.53	-27.9	-6.07	-31.8
East Kangaloon Bedrock Aquifer (90 m bgl)	40971 (90 m bgl)	17.7	NA	-5.585	-28.2	-5.77	-30.1
Mt Murray Groundwater bores (2005)	9m1s (27 m bgl)	NS	NS	NS	NS	-5.68	-28.5
	9m2s (36 m bgl)	NS	NS	NS	NS	-5.86	-29.2
	9m3s (18 m bgl)	NS	NS	NS	NS	-5.56	-27.7
	9m1d (45 m bgl)	NS	NS	NS	NS	-5.91	-30.2
Fitzroy Falls Rainwater (2015)	NA	NA	NA	-6.85	-39.60	NS	NS
Moss Vale Rainwater (2011)	NA	NA	NA	-10.87	-73.3	NS	NS
	NA	NA	NA	-10.98	-73.7	NS	NS
Bowral Rainwater (2015)	NA	NA	NA	NS	NS	-2.86	-1.4
	NA	NA	NA	NS	NS	-4.09	-16.2

BQL Result is below quantification limit of 0.05 Bq/L

* value not used in equations due to high level of uncertainty

NA – Not applicable

NS – Not sampled

Table S2. Groundwater mixing model results for swamp waters and surface waters for all swamps within the two study regions.

Location	Groundwater/swamp water mixing model (%)**	Swamp water/surface water mixing model (%)
Blue Mountains		
Walmer Crescent—Wentworth Falls	82 (6)	NA
Mt Hay—Leura	43 (3)	10 (3)
Michael Eade—North Katoomba	28 (2)	51 (1.8)
Grand Canyon—Medlow Bath	38 (2.7)	29 (2.5)
Perrys St—Blackheath	61 (4.3)	13 (4.4)
Southern Highlands		
Butlers, East Kangaloon	13.7 (1)	36 (0.7)
Horseshoe, East Kangaloon	NS	NS
Little Guy, East Kangaloon (Nepean River)	NS	NS
Stockyard, Mt Murray	NS	NA
North Stockyard, Mt Murray	10 (0.7)	10 (0.8)
North Pole, Mt Murray	NS	NS
Powerlines Prickly, Mt Murray	NS	NS
Jess and Jane, Knights Hill	7 (0.5)	37 (0.5)
BNP4, Knights Hill	NS	NS
BNP5, Knights Hill	NS	NS
BNP1, Budderoo	NS	NS
Wallaya, Budderoo	11 (0.8)	92 (0.7)

** Uncertainty (%) from error propagation equation

NS—Not sampled

Table S3. Statistics for $\delta^2\text{H}\text{‰}$, $\delta^{18}\text{O}\text{‰}$ and ^{222}Rn for swamp water, groundwater and surface water in the two regions.

Analyte	Water Body	Region	Min	Max	Mean
$\delta^2\text{H}\text{‰}$	Swamp water	Blue Mountains	-33.4	-24.3	-28.1 ± 2.3
		Southern Highlands	-38	-11.2	-26.7 ± 6.1
	Groundwater	Blue Mountains	-31.5	-29.3	-30.6 ± 0.9
		Southern Highlands	-34.7	-26.5	-29.5 ± 2.2
	Surface water	Blue Mountains	-30.3	-26	-28.9 ± 1.6
		Southern Highlands	-37.5	-14	-25.1 ± 7.9
	Rainwater	Blue Mountains	-64.2	-12.7	-35.1 ± 16.4
		Southern Highlands	-73.7	-1.4	-40.8 ± 33
$\delta^{18}\text{O}\text{‰}$	Swamp water	Blue Mountains	-6.3	-5.2	-5.7 ± 0.32
		Southern Highlands	-6.7	-3.1	-5.5 ± 0.77
	Groundwater	Blue Mountains	-6.2	-5.8	-6 ± 0.17
		Southern Highlands	-6.3	-5.5	-5.8 ± 0.24
	Surface water	Blue Mountains	-6	-5.4	-5.8 ± 0.2
		Southern Highlands	-6.7	-3.7	-5.1 ± 1
	Rainwater	Blue Mountains	-9.5	-3.9	-6.8 ± 1.8
		Southern Highlands	-11	-2.9	-7.1 ± 3.8
^{222}Rn (Bq/L)	Swamp water	Blue Mountains	1.02	4.3	2.4 ± 1.3
		Southern Highlands	1.1	9.3	3.4 ± 3.9
	Groundwater	Blue Mountains	2.4	5.3	3.7 ± 2.2
		Southern Highlands (7m bgl)	69.3	69.3	69.3
		Southern Highlands (90m bgl)	17.7	17.7	17.7
	Surface water	Blue Mountains	0.03	0.5	0.3 ± 0.2
Southern Highlands		0.16	3.4	1.4 ± 1.5	