TECHNICAL NOTE 2008/23

Department of Water, Land and Biodiversity Conservation

CAPACITY OF THE SURFACE WATER RESOURCE OF THE EASTERN MOUNT LOFTY RANGES

Mark Alcorn, Kumar Savadamuthu, and Bruce Murdoch

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Knowledge and Information Division

25 Grenfell Street, Adelaide

GPO Box 2834, Adelaide SA 5001

Telephone	National	(08) 8463 6946
	International	+61 8 8463 6946
Fax	National	(08) 8463 6999
	International	+61 8 8463 6999
Website	www.dwlbc.sa.gov.au	

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AIM

This technical note describes the methodology and results of the investigation to determine the capacity of the surface water resource of the *Eastern Mount Lofty Ranges Prescribed Water Resources Area* (EMLR PWRA) (Fig. 1). The investigation was done by the Department of Water, Land and Biodiversity Conservation, as part of the *Water Allocation Planning* process, undertaken by the South Australian Murray–Darling Basin Natural Resources Management Board. The results presented in this note will form an important technical foundation for allocating surface water in the area.

BACKGROUND

Surface water use in the highlands, and ground water use in the plains, are vital to the economics of the Eastern Mount Lofty Ranges (EMLR) region. The rapid development of farm dams over the last two decades in the EMLR has raised considerable concern in regard to the sustainability of water resources, and the impacts seen on the ecosystems dependent upon them. Preliminary investigations indicated that farm dam development, in the high rainfall areas of a number of catchments in the EMLR, have either reached or exceeded allowable levels of development, as defined in the Catchment Water Management Plan for the River Murray in South Australia ("RMCWMP"). (River Murray Catchment Water Management Board (RMCWMB), 2003).

To prevent further resource decline, and to provide security to all water users, the State Government, on 16 October 2003 declared two Notices of Prohibition. One Notice on the taking of surface water and water from watercourses — the other Notice on the taking of water from wells in the EMLR catchments. A Notice of Intent to prescribe the surface water, watercourses and wells of the EMLR catchments was also issued under section 8 of the Water Resources Act 1997. Following the consultation period the State Government prescribed the surface water, watercourses, and wells in the EMLR, on 8 September 2005.

The South Australian Murray-Darling Basin Natural Resources Management Board (SAMDB NRMB), established under the *Natural Resources Management Act* 2004, is responsible for protection of the water resources and associated ecosystems in the River Murray Catchment in the State of South Australia. The Catchment Water Management Plan (RMCWMP2003) (prepared by the RMCWMB), has set limits for development on a regional basis for the entire Eastern Mount Lofty Ranges ("EMLR").

The DWLBC, under its initiative "The Mt Lofty Ranges Water Resources Assessment Program" has been carrying out detailed technical studies to quantify and assess the condition, of surface and groundwater resources of the Mt Lofty Ranges. This study was carried out as part of the "Eastern Mount Lofty Ranges Water Resources Management Program", a joint program of the DWLBC and the RMCWMB. This study, along with studies carried out for the other catchments in the EMLR, will form an important technical foundation. They will be a basis for consideration, when policy decisions are made on future management of water resources in the region.

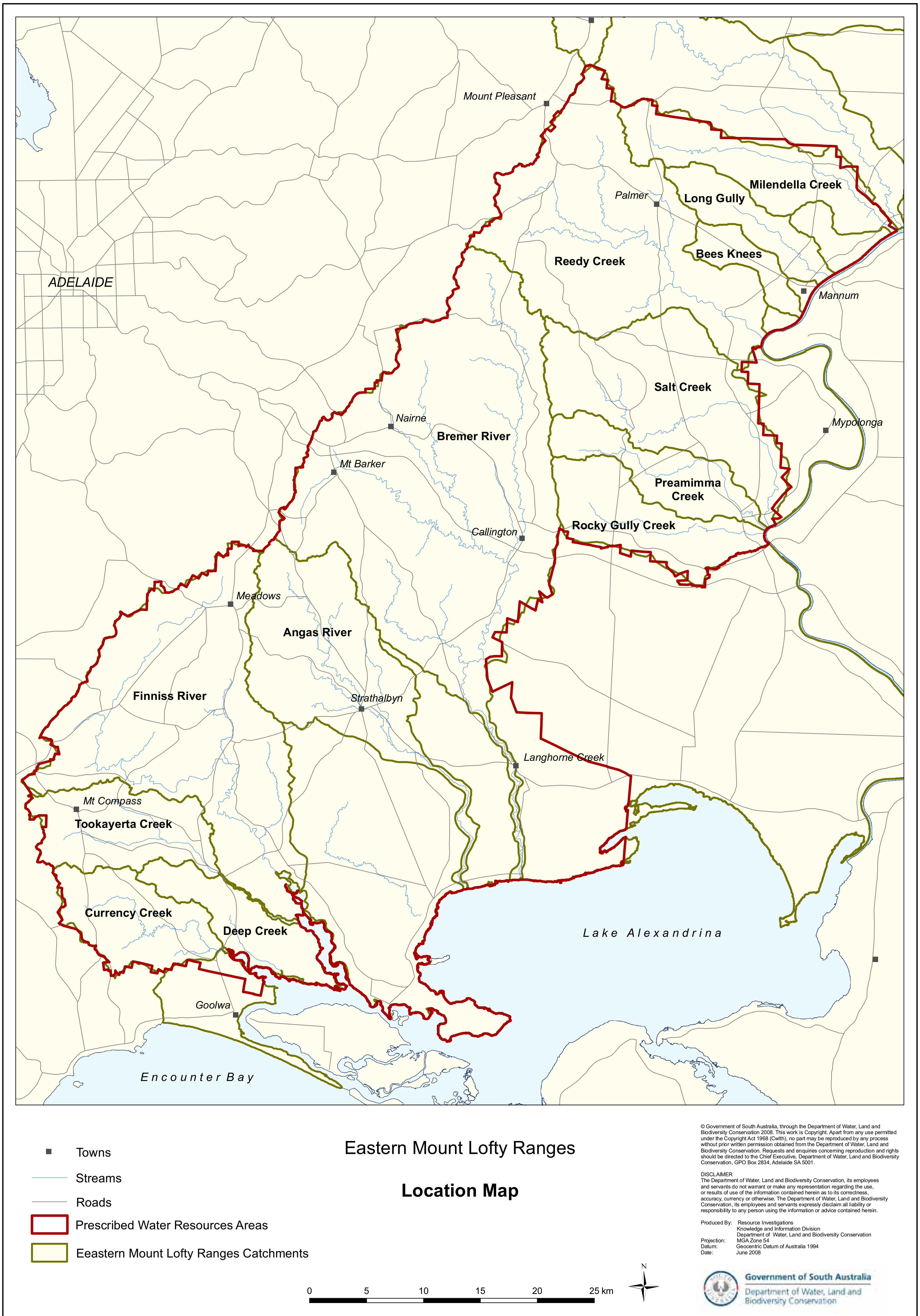


Figure 1. Location map of the EMLR PWRA

INTRODUCTION

This report expands on the results of detailed hydrological modelling conducted for catchments in the EMLR. It is based on the best available data at the time of the investigation. Previous modelling was conducted over the last seven years, and these results, were based on the data available at the time of investigation. This investigation seeks to produce a set of data that are consistent, in time scales and data currency.

The main aim of all technical investigations to date has been to quantify the effect of farm dams on the surface water resources of the various catchments in the EMLR. Farm dams are thought to be one of the main contributing factors to reductions in streamflow for the predominantly rural catchments that exist in the region. To this end, the most up to date climate and farm dam data were obtained for each catchment and applied to existing hydrological models. The models were recalibrated where required, and then run for a defined reference period, 1974–2003, and the results analysed. This enabled us to get a clear picture of the state of the surface water resources across the extent of the region.

The main output of this investigation is to define the "capacity of the surface water resource" in the EMLR. This describes the mean winter runoff (May–November inclusive), with the impact of farm dams removed from the catchment. The data will be used to determine the current level of development, and thus provide guidance in the future allocation of surface water, as required under the WAP.

Detailed reports on the hydrological modelling process can be found in the list below.

HYDROLOGICAL MODELLING REPORTS FOR THE EASTERN MOUNT LOFTY RANGES

Bremer River catchment

Surface water assessment of the Bremer River catchment. Report DWLBC 2008/13
http://www.dwlbc.sa.gov.au/assets/files/dwlbc_report_2008_13_web.pdf

Angas River catchment

Surface water assessment of the Upper Angas sub-catchment, Report DWLBC 2006/09
http://www.dwlbc.sa.gov.au/assets/files/ki_dwlbc_report_2006_09.pdf

Finniss River catchment

Streamflow in the Upper Finniss Catchment, Report DWLBC 2003/18
http://www.dwlbc.sa.gov.au/assets/files/finniss_report.pdf

Tookayerta Creek catchment

Surface water assessment of the Tookayerta Catchment, Report DWLBC 2004/23
http://www.dwlbc.sa.gov.au/assets/files/took_report1.pdf

Currency Creek catchment

Surface water assessment of the Currency Creek catchment, Report DWLBC 2006/07
http://www.dwlbc.sa.gov.au/assets/files/ki_dwlbc_report_2006_07.pdf

CLIMATE DATA

Updated rainfall and evaporation data were obtained from the Department of Natural Resources (Qld) rainfall database, SILO. The data are part of the Patched Point Dataset (PPD), which has been disaggregated and infilled using the methods described in Jeffrey et al. (2001).

It should be noted that using rainfall and evaporation data exclusively from the SILO database is a departure from previous technical investigations. Previously, various methods of infilling and disaggregation were used within the department to ensure a consistent and continuous rainfall record. The decision was made to migrate to, using this dataset in an effort to maintain consistency of data time scales and currency, and to align with an increasing number of external projects covering the entire River Murray Basin using the SILO data.

To determine the spatial distribution of rainfall, across catchments and between stations, a rainfall grid with resolution of 0.01 degrees (~1 km^2) was developed by the Bureau of Meteorology (Fawcett et al. 2006), for DWLBC. This data–set, used a total of ~800 rainfall stations in south-eastern South Australia, to determine rainfall averages at a monthly and annual time step, for the period 1971–2000. These averages were then used to create the smoothed rainfall grid. Estimation of mean rainfall, for the sub-catchments of the EMLR, was calculated by using a weighted area mean of the rainfall grid within the particular sub-catchment area. As the rainfall grid describes the mean rainfall for the period 1971–2000, an adjustment was made to the rainfall to reflect the mean for the study period (1974–2003). For most of the rainfall stations, this adjustment factor was less than +/- 1%, as the means for the two periods are similar.

Table 1. Climate data used for hydrological modelling

Station number	**Station name**	**Mean annual rain** (mm)*	**Mean winter rain** (mm)**	**Mean annual pan evaporation** (mm)
23701	ASHBOURNE	664	505	1530
23714	RIVERLEA	495	370	1556
23722	HARROGATE	575	431	1582
23724	KANMANTOO	528	394	1485
23725	KEYNETON	492	371	1554
23728	MACCLESFIELD	616	460	1385
23733	MOUNT BARKER	741	570	1332
23735	MOUNT COMPASS	779	614	1455
23739	NAIRNE	669	519	1335
23747	STRATHALBYN	494	363	1544
23818	KUITPO FOREST HQ	838	653	1431
23823	FERNBROOK	635	489	1361
24508	CALLINGTON	404	288	1563
24525	PALMER	401	293	1525
24529	SANDERSTON	399	287	1640
24533	TEPKO	370	264	1578

* Annual data for period 1974-2003

** Winter data is accumulated rainfall from 1 May to 30 November for period 1974–2003

The spatial distribution of rainfall can be seen in Figure 2.

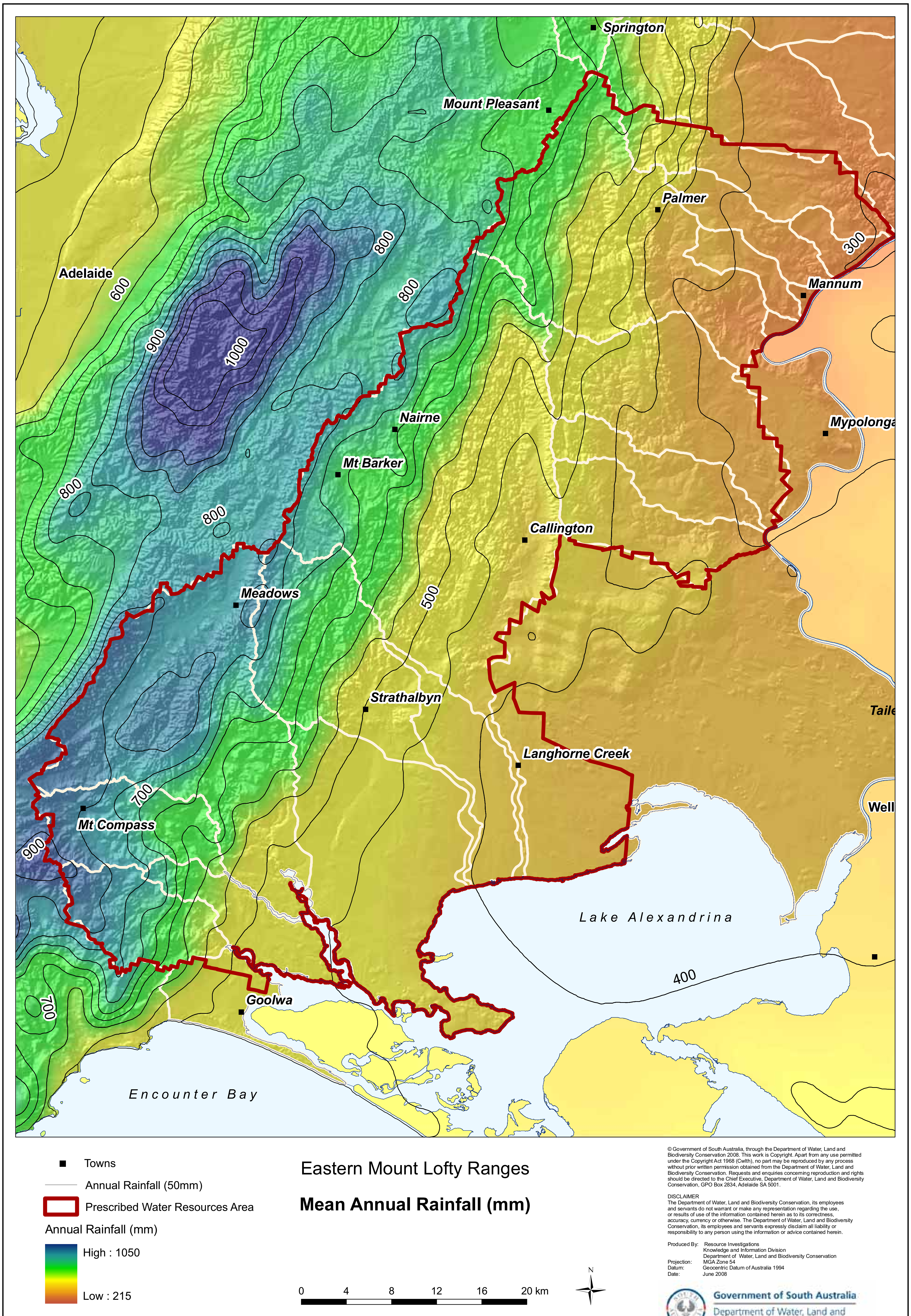


Figure 2. Spatial distribution of rainfall across the EMLR PWRA

FARM DAM DATA

Existing farm dam information (spatial datasets) were reviewed and updated where appropriate. This involved using aerial photography flown in 2003 and 2005. The 2003 dataset coverage extends over the entire EMLR and formed the basis for a dataset, used in the land–use survey carried out in 2004 (Daley and Dwyer, 2004). The 2005 dataset covers only the western edge, of the upper catchments, however this area carries the highest density of farm dam development. So its inclusion here is not trivial. Both datasets were used, to derive the updated spatial coverage of farm dams studied in this investigation (Fig. 3).

The 2005 dataset covers only 12% of the area however farm dams in that area make up 38% of the total volume of the EMLR.

Farm dam volumes were estimated using the following means in order of preference:

1. Actual surveyed volume as appearing in the Land and Water Use Surveys undertaken as part of the prescription process.
2. Rapid Assessment volume estimate (Equation 1) calculated from wall height and dam surface area.
3. Other agreed method as appearing on dam authorisations.
4. Surface Area–to–Volume relationship (Equation 2) (McMurray 2004b).

<u>Equation 1.</u>

Dam Capacity (ML) = 0.4 * Surface area (m^2)* Wall height (m)

<u>Equation 2.</u>

For surface area <15 000 m^2:

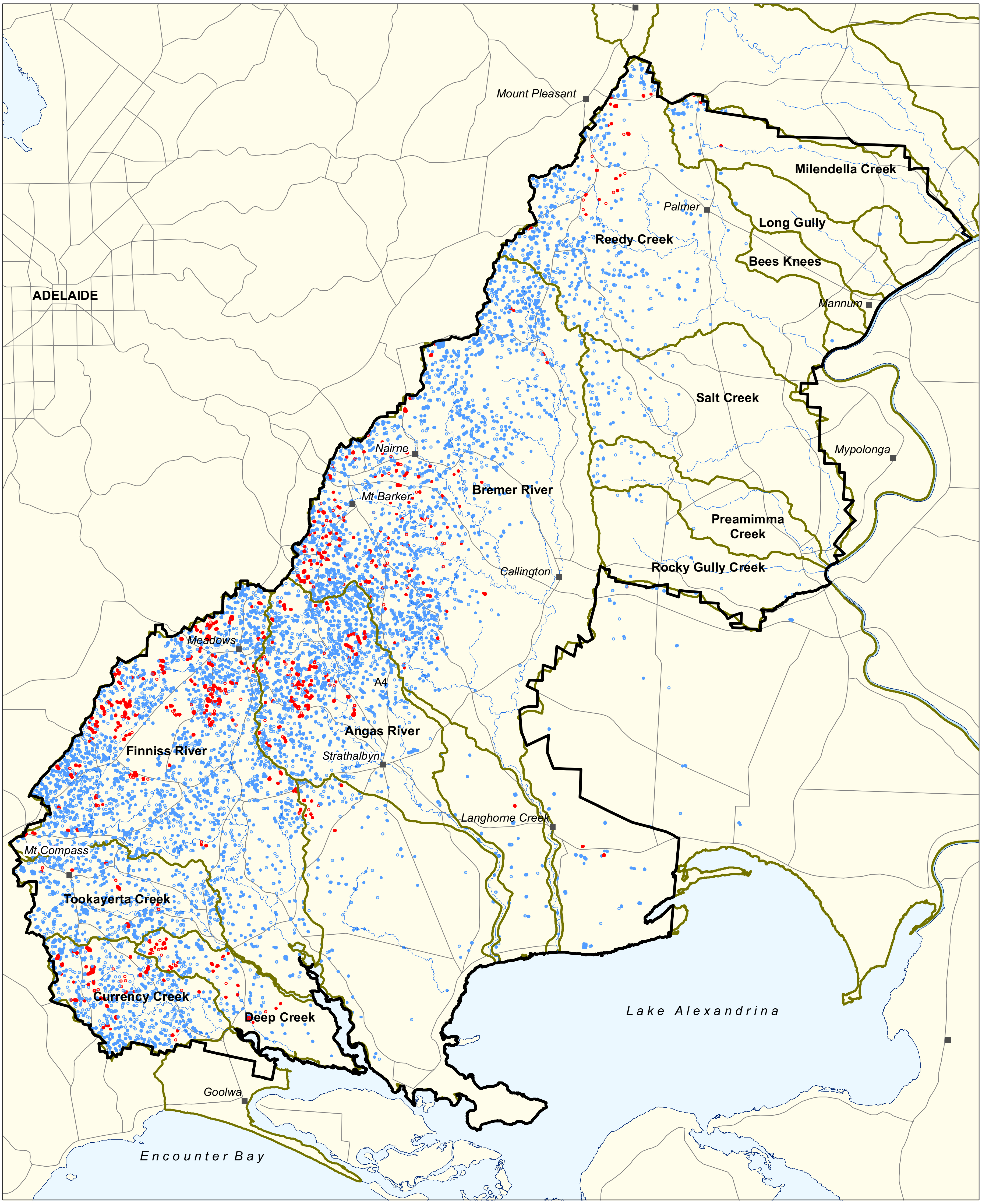
$$\text{Dam capacity (ML)} = 0.0002 \times \text{Surface area}^{1.25}$$

For surface area ≥15 000 m^2:

$$\text{Dam capacity (ML)} = 0.0022 \times \text{Surface area}$$

In total there were 7140 dams counted within the EMLR PWRA, with a combined estimated volume of around 17 500 ML.

Table 2 shows the count and volume of farm dams for each catchment in the EMLR sorted by volume. The data indicates that the largest proportion of farm dams, are in the higher rainfall catchments. Figures 4a and 4b show the distribution of farm dams based on volume and count.



Towns
Streams
Roads

FARM DAMS
Dam Type
Irrigation
Stock and Domestic
Prescribed Water Resources Area
Eastern Mount Lofty Ranges Catchments

Eastern Mount Lofty Ranges

Farm Dam Distribution

0 5 10 15 20 25 km

N

Produced By: Resource Investigations
Knowledge and Information Division
Department of Water, Land and Biodiversity Conservation
Projection: MGA Zone 54
Datum: Geocentric Datum of Australia 1994
Date: June 2008

Government of South Australia
Department of Water, Land and Biodiversity Conservation

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Figure 3. Spatial distribution of farm dams in the EMLR PWRA

Table 2. **Farm dam details of EMLR catchments**

Catchment	Total capacity (ML)	Count
Finniss River	5 244.0	2 076
Bremer River	4 547.0	1 884
Angas River	3 110.0	1 054
Currency Creek	1 295.0	558
Tookayerta Creek	1 115.0	543
Reedy Creek	873.0	473
Deep Creek	430.0	166
Ferries–McDonald	318.0	59
Sandergrove Plains	193.0	122
Angas Plains	128.0	33
Milendella Creek	70.0	38
Salt Creek	47.0	64
Long Gully	45.0	4
Preamimma Creek	16.0	22
Rocky Gully Creek	13.0	15
Underwood Hill	8.0	2
Baseby	2.0	1
Mypolonga Flat	0.4	1
Totals	**17 454.0**	**7 115**

Figure 4a. Distribution of EMLR farm dams by volume (% of total volume)

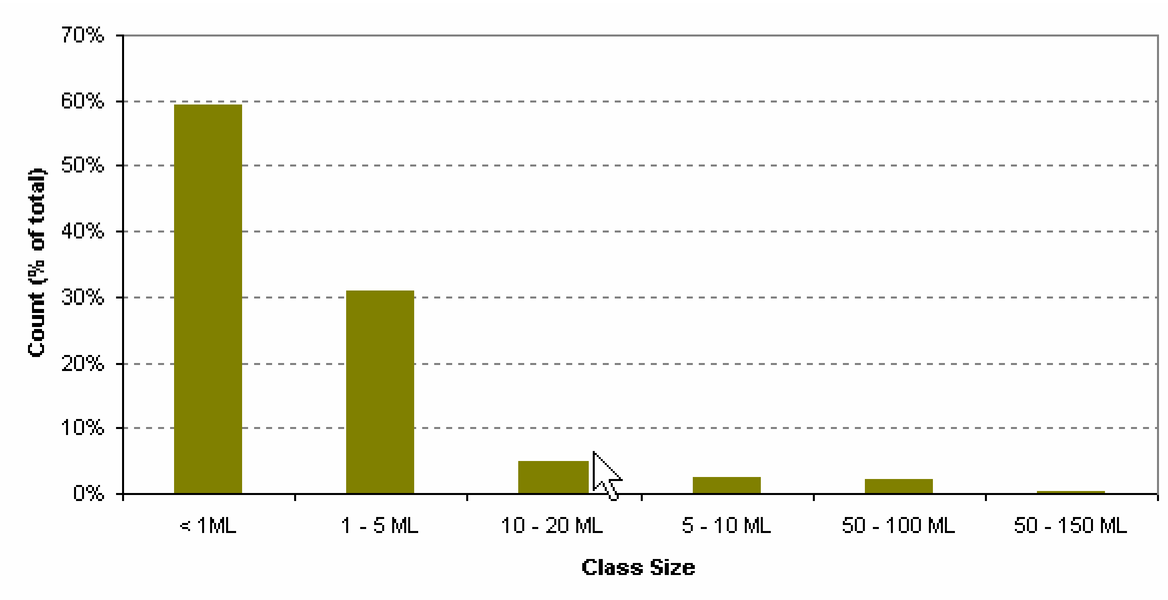

Figure 4b. Distribution of EMLR Farm Dams by number (% of total count)

WATER USE FROM FARM DAMS

Information collected through the Land and Water Use Surveys by DWLBC's Resource Allocation Division was obtained for use in this study, in order to differentiate between different types of water use – irrigation use or stock and domestic use. As the surveys are ongoing, it was necessary to accept a final data set only up to a certain point in time and work from that.

Only data available up to June 2007 was used in this study. It is acknowledged that the data collection process is ongoing and as such was incomplete at the time of recalibrating the models. However, it is thought that the data set provides a reasonable representation of water use through the EMLR.

The land and water use survey collects information only about irrigated land use throughout the EMLR, and includes such data as:

- crop type
- area of irrigated crop
- size, type and location of irrigation source.

Using this data, the type of use was assigned to dams. Water use from individual or grouped farm dams within the model was assigned a value based on whether the dam was considered to be used for irrigation or stock and domestic purposes. Stock and domestic dams were assigned an annual demand of 30% (McMurray 2004a) of the dam volume in the distribution pattern as shown in Figure 5. This pattern follows the monthly distribution of evaporation, which assumes a higher demand during the warmer summer months. Demand from irrigation was assumed to be higher and is set at 50% of the dam capacity, with water being demanded over the months of October to March inclusive.

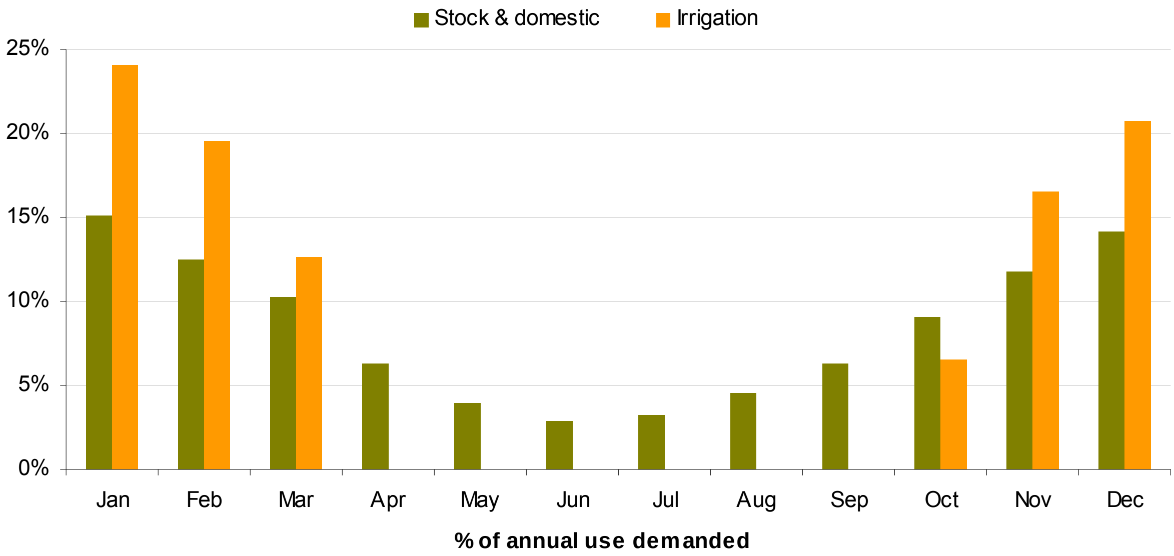

Figure 5. Demand distribution pattern for irrigation or stock and domestic dams for the EMLR models

Factors affecting the ability of the dam to supply the maximum demand include:

- storage held in the dam prior to the irrigation season
- inflows from catchment drainage above
- the local climate during the season (rainfall, evaporation, etc.).

The actual volume taken from the dam(s) will therefore vary from year to year.

The limitations of these assumptions are acknowledged, and it is noted that actual on-ground use may vary greatly from that modelled for this investigation. However, in the absence of metered water use from farm dams collected over a number of seasons, it is expected that these figures provide a reasonable initial estimate.

RAINFALL–RUNOFF MODELLING

GAUGED CATCHMENTS

The updated data described so far was input to the five existing Rainfall-Runoff models (Bremer River, Angas River, Finniss River, Tookayerta Creek, and Currency Creek).

Some of the existing models initially used a monthly distribution of evaporation based on the Mount Bold pan evaporation data, so the inclusion of derived daily data is a departure for those models. Also, most existing models have used an assumed farm dam demand of 30% for all farm dams. As this investigation assumed an increased demand from irrigation dams, modelled demand will thus be higher than previously estimated.

Following update of the models, recalibration was necessary to ensure that modelled flows were as close as possible to measured flows at calibration locations. For details of the calibration procedure, refer to the individual assessments for each catchment as listed in the “Hydrological Modelling Reports for the Eastern Mount Lofty Ranges” section of this note.

UNGAUGED CATCHMENTS

Hydrological data and models were used for the five gauged catchments, (Angas, Bremer, Finniss, Tookayerta and Currency Creek) producing the most runoff. Estimation of the capacity of the surface water resource in the remaining catchments was carried out using rainfall–runoff relationships. Since there were no suitable streamflow records available for these catchments, four sets of regionalised tanh (App. A) parameters were developed from other gauged catchments, to estimate the mean winter runoff. This was done by comparing rainfall–runoff relationships from nearby and hydrologically similar catchments, to find the best matching relationship. Four rainfall–runoff relationships were developed for the ungauged catchments. The rainfall–runoff (tanh) parameters for the model and the station from which they were derived are described in Table 3 below.

Table 3. Details of the four rainfall-runoff (tanh) relationships used for the ungauged catchments

	Curve 1
L	130
F	550
Curve derived from:	A4260529 Marne River @ U/S Cambrai
Catchments	Millendella Creek, Reedy Creek, Salt Creek, Preamimma Creek, Rocky Gully
Sub-catchments	Lr1,Lr2,Lr3, Rr2, Nr1,P1, G1
	Curve 2
L	155
F	545
Curve derived from:	A4260558, Dawesley Creek @ Dawesley
Catchments	Reedy Creek
Sub-catchments	Rr1
	Curve 3
L	145
F	340
Curve derived from:	A4260503 Upper Angas
Catchments	Sandergrove Plains
Sub-catchments	Er1, Er2
	Curve 4
L	140
F	565
Curve derived from:	A4260530, Currency Creek @ near Higgins
Catchments	Deep Creek
Sub-catchments	Dr1, Dr2

The topography of the ungauged catchments exhibits two distinct zones. The first zone is commonly referred to as the “hills zone” and runs across the higher elevation and steeper slopes on the western side of the catchments. The second zone is referred to as the “plains zone” and comprises of flat terrain with lower rainfall. The watercourse in this zone is generally just a channel or conduit draining water in an easterly direction across the plains. It is generally accepted that the plains zones of the EMLR provide little surface water runoff to the channel, and the watercourses are generally described as “losing” reaches. This means that, although significant flows might be generated in the “hills zone”, all of them may not necessarily reach the outlet of the catchment at the River Murray (or the Lakes) in a given year.

Taking this into consideration, the ungauged catchments were divided into two zones. The red line in Figure 6 shows this division. To the east of the red line, it was considered that there would be no surface water runoff available. This division was based on topography and rainfall. The tanh relationship used to derive runoff for the ungauged catchments is considered to be realistic only for wetter catchments and is only used for the hills zones of each catchment.

This is a reasonable assumption and is confirmed by the situation on the ground in the plains zones. Where surface water resources are available, they are generally captured by farm dams as they flow over the land and into watercourses. Such farm dam development is not evident in the plains zones with most of these parts of the catchments exhibiting very low farm dam densities when compared with the hills zones. Plotting farm dam development against runoff from other catchments (Fig. 7) confirms this assumption. The higher runoff producing catchments also exhibit higher farm dam development.

CAPACITY OF THE SURFACE WATER RESOURCE

Results of the investigation are presented here on catchment and sub-catchment scales (Tables 4–5, Figs 8–9). Sub-catchment reporting is done with reference to the sub-catchments as they appeared in the RMCWMP (RMCWMB, 2003). Except for some of the ungauged catchments, which were reclassified, based on factors described in the previous section.

- All results are reported for the reference period 1Jan 1974–31 Dec 2003.
- “Winter” refers to the period 1 May–30 November.

Table 4. Explanation of reporting at the zone scale (Column headings of Table 5)

Column Heading	Description
Catchment/Subcat/Zone	Refer to Figure 8. for location of reporting areas
Subcat Area (k m^2)	Area of the sub-catchment in square kilometres
Annual Rain (mm)	Mean annual rainfall averaged over the zone
Winter Rain (mm)	Mean winter rainfall averaged over the zone
Annual Runoff (ML)	Mean annual modelled surface runoff for the zone in megalitres
Winter Runoff (ML)	Mean winter modelled surface runoff for the zone in megalitres
Annual Runoff (mm)	Mean annual modelled surface runoff depth for the zone in millimetres
Annual Runoff "No Dams” (ML)	As for annual runoff, with the impact of dams removed
Winter Runoff "No Dams" (ML)	As for winter annual runoff, with the impact of dams removed
Winter Runoff "No Dams" (mm)	As above in millimetres
Annual RO Coeff.	Mean annual runoff divided by mean annual rainfall
Winter RO Coeff. "No Dams"	As above, winter period, dam impacts removed
Subcat Dam Volume (ML)	The estimated dam volume within the zone

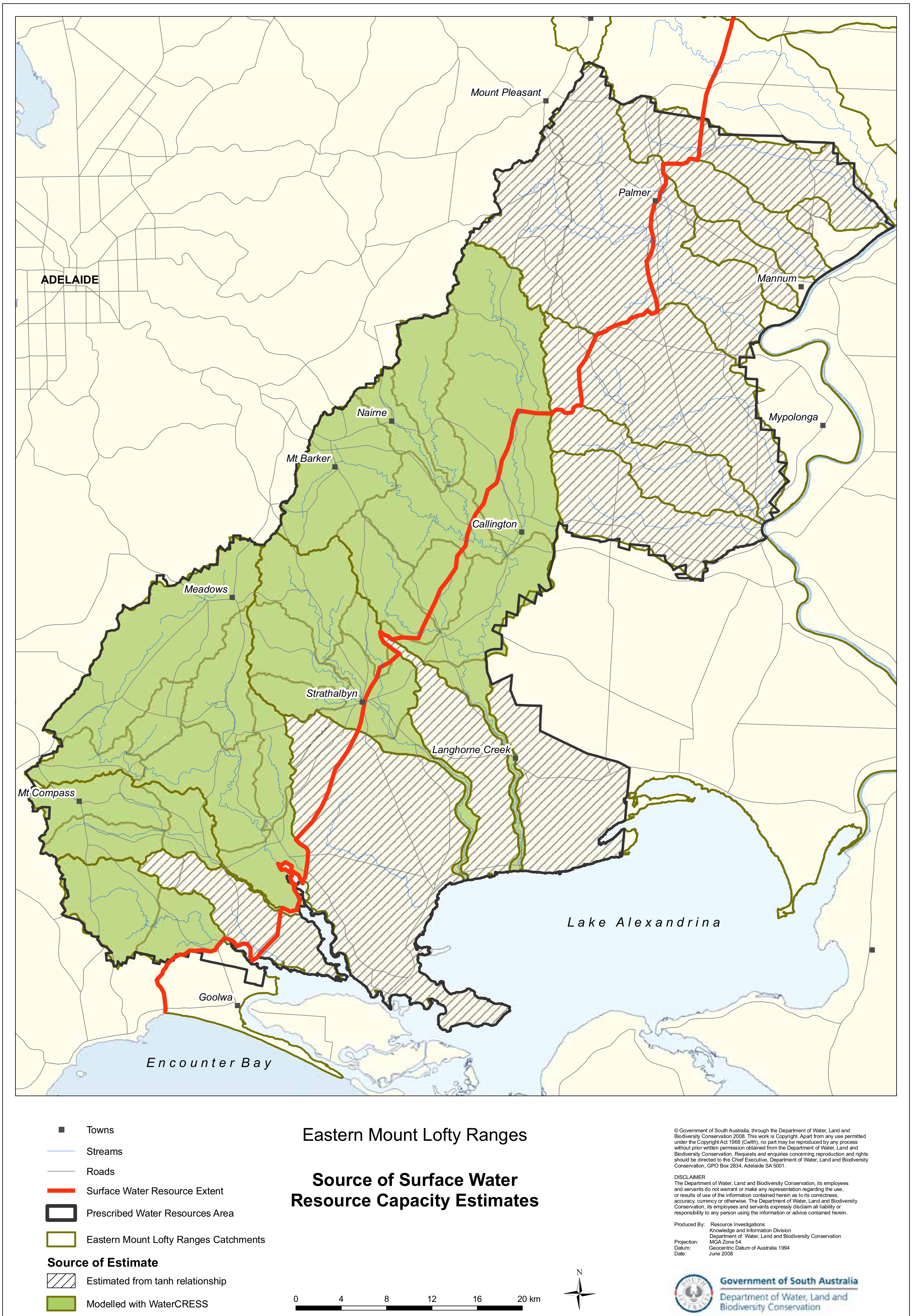

Figure 6. Source of estimates of the capacity of the surface water resources of the EMLR PWRA

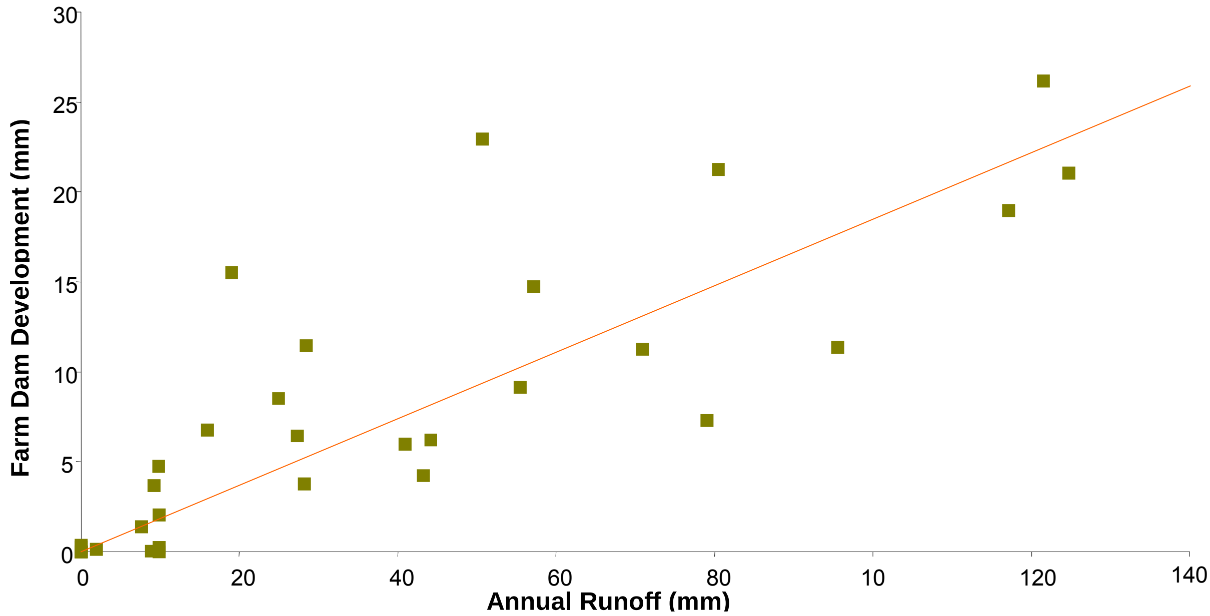

Figure 7. **Farm dam development (mm) against runoff (mm) for sub–catchments in the EMLR**

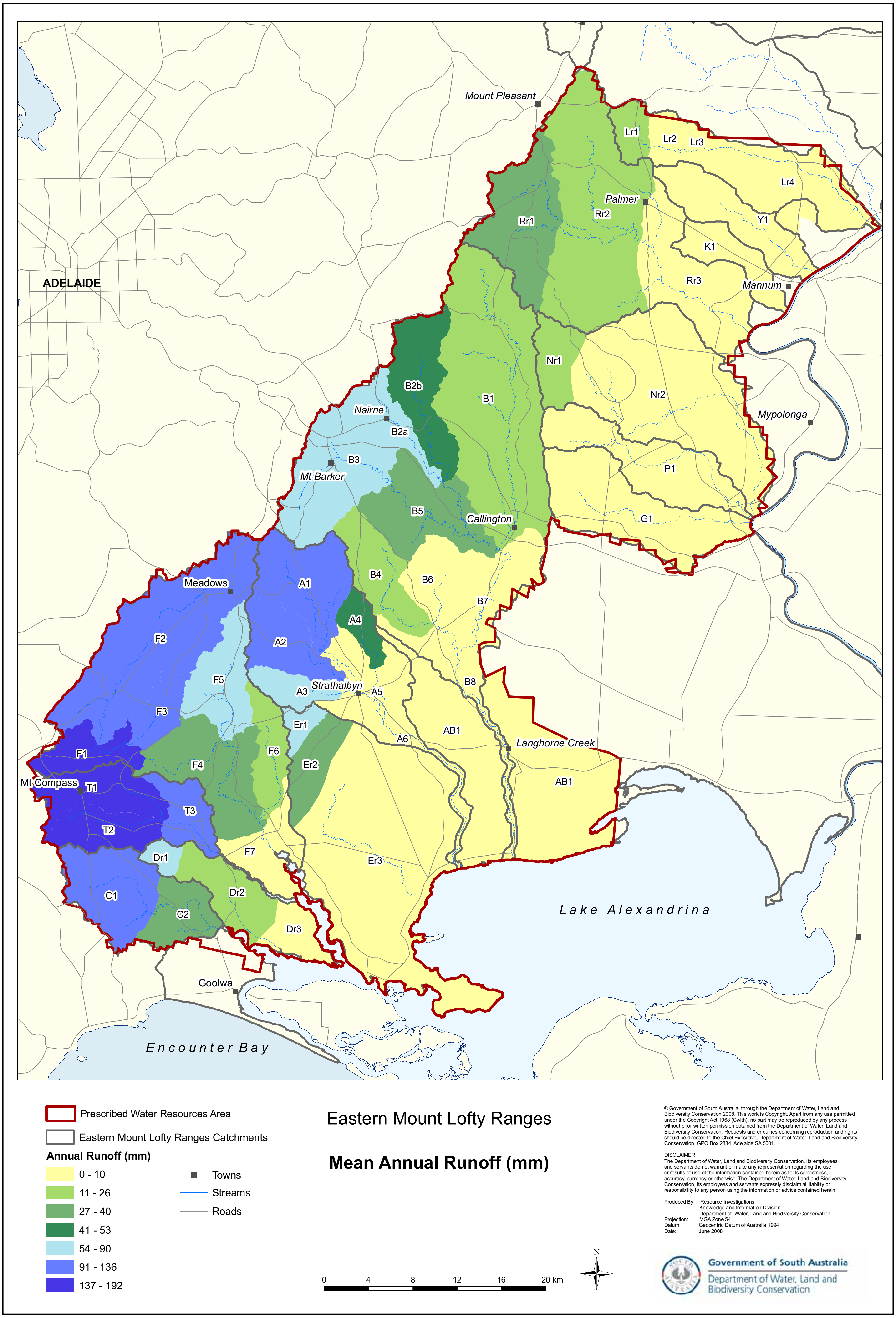

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Figure 8. Mean annual runoff for the subcatchments of the EMLR PWRA

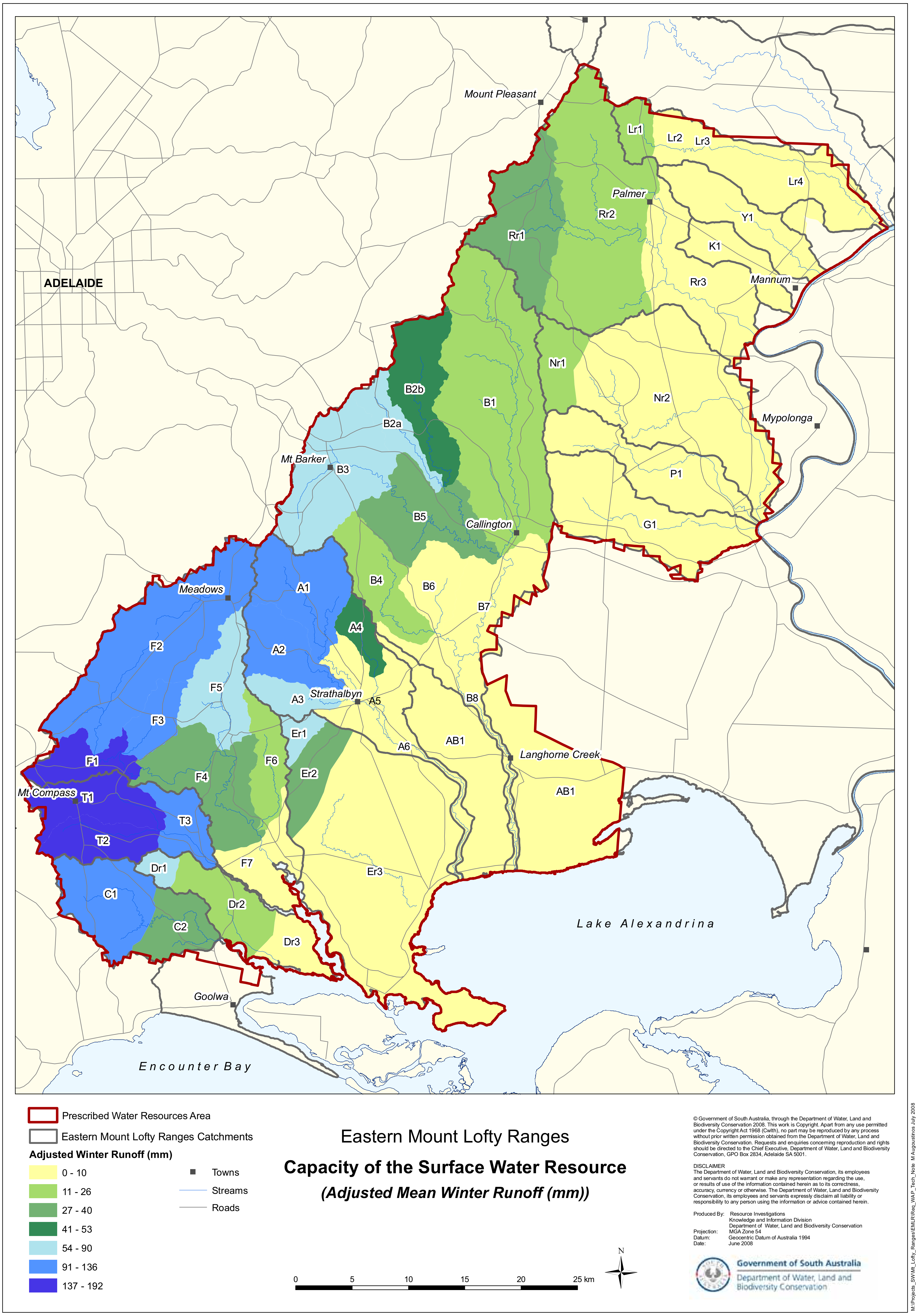

Figure 9. Mean winter (May–November) runoff with the effect of dams removed for sub-catchments of the EMLR PWRA

Table 5. Surface water capacity of catchments in the Eastern Mount Lofty Ranges prescribed area

Catchment	Sub-catchment	Zone	Subcat area (km^2)	Annual rain (mm)	Winter rain (mm)	Annual runoff (ML)	Annual runoff (mm)	Annual runoff "No Dams" (ML)	Winter runoff "No Dams" (ML)	Winter runoff "No Dams" (mm)	Annual RO Coeff.	Winter RO Coeff. "No Dams"	30% Mean winter "No Dams" runoff	Subcat dam volume (ML)
Angas Bremer Plains	Angas Bremer Plains	*AB1*	202	395	294	*0*	*0*	*0*	*0*	*0*	0	0	0	0
Angas River	Upper Angas River	A1	62	688	526	6 305	102	7 534	6 578	106	15%	20%	1 973	1 622
	Burslem Creek	A2	39	683	523	4 171	107	4 863	4 247	109	16%	21%	1 274	821
	Dawson Creek	A3	20	626	479	1 804	90	1 911	1 736	87	14%	18%	521	227
	Burnside Creek	A4	16	541	414	767	48	887	789	49	9%	12%	237	146
	Lower Angas River	A5	44	485	371	349	8	433	360	8	2%	2%	108	209
	Angas Plains	A6	18	425	306	0	0	0	0	0	0%	0%	0	0
Bees Knees	Bees Knees	K1	33	337	238	0	0	0	0	0	0%	0%	0	0
Bremer River	Upper Bremer River	B1	195	517	388	5 107	26	5 511	4 738	24	5%	6%	1 421	734
	Nairne Creek	B2a	23	675	527	1 538	66	1 661	1 416	60	10%	11%	425	264
	Dawesley Creek	B2b	56	664	511	2 941	53	3 192	2 779	50	8%	10%	834	824
	Upper Mount Barker Creek	B3	86	741	570	5 968	70	6 903	5 987	70	9%	12%	1 796	1 822
	Rodwell Creek	B4	45	584	433	976	22	1 274	1 084	24	4%	6%	325	512
	Lower Mount Barker Creek	B5	65	540	400	2 625	40	2 803	2 421	37	7%	9%	726	274
	Red Creek	B6	29	490	354	207	7	225	155	5	1%	1%	46	41
	Lower Bremer River	B7	68	430	304	130	2	133	91	1	0%	0%	27	9
	Bremer Plains	B8	23	404	287	0	0	0	0	0	0%	0%	0	0
Currency Creek	Upper Currency Creek	C1	58	818	640	5 974	103	6 786	6 008	104	13%	16%	1 802	1 100
	Lower Currency Creek	C2	32	612	473	1 137	36	1 298	1 148	36	6%	8%	344	190
Deep Creek	Upper Deep Creek	Dr1	8	739	581	653	77	N/A	618	73	10%	13%	185	96
	Middle Deep Creek	Dr2	39	533	406	775	20	N/A	712	18	4%	5%	214	319
	Lower Deep Creek	Dr3	21	465	343	2	0	N/A	0	0	0%	0%	0	5
Finniss River	Finniss River	F1	28	843	665	4 349	155	4 593	4 287	153	18%	23%	1 286	400
	Meadows Creek	F2	142	833	650	17 221	121	19 983	18 600	131	15%	20%	5 580	3 494
	Blackfellow Creek	F3	23	843	654	3 121	136	3 283	3 058	133	16%	20%	918	255
	Finniss River	F4	71	648	490	2 869	40	3 137	2 859	40	6%	8%	858	442
	Bull Creek	F5	46	746	579	3 403	74	3 637	3 301	72	10%	12%	990	335
	Wattle Flat	F6	29	592	447	656	23	792	731	25	4%	6%	219	187
	Lower Finniss River	F7	36	493	369	251	7	331	302	8	1%	2%	91	132
Long Gully	Long Gully	Y1	58	339	240	0	0	N/A	0	0	0%	0%	0	51
Milendella Creek	Milendella 1	Lr1	16	526	406	369	23	N/A	343	21	4%	5%	103	67
	Milendella 2	Lr2	16	456	335	169	10	N/A	150	9	2%	3%	45	2
	Milendella 3	Lr3	3	374	268	0	0	N/A	0	0	0%	0%	0	0
	Milendella Plains	Lr4	78	324	229	1	0	N/A	0	0	0%	0%	0	1
Preamimma Creek	Preamimma Creek	P1	75	389	278	1	0	N/A	0	0	0%	0%	0	16
Reedy Creek	Dairy Creek	Rr1	74	644	491	2 797	38	N/A	2 569	35	6%	7%	771	539
	Harrison Creek	Rr2	160	513	384	2 955	18	N/A	2 665	17	4%	4%	800	332
	Loxton Creek	Rr3	80	338	241	0	0	N/A	0	0	0%	0%	0	2
Rocky Gully Creek	Rocky Gully Creek	G1	100	395	281	2	0	N/A	0	0	0%	0%	0	13
Salt Creek	Upper Salt Creek	Nr1	27	507	371	434	16	N/A	382	14	3%	4%	115	38
	Lower Salt Creek	Nr2	172	370	264	2	0	N/A	0	0	0%	0%	0	9
Sandergrove Plains	Upper Sandergrove Plains	Er1	10	603	454	701	71	N/A	636	64	12%	14%	191	84
	Middle Sandergrove Plains	Er2	29	520	387	1 077	38	N/A	966	34	7%	9%	290	23
	Lower Sandergrove Plains	Er3	246	434	316	11	0	N/A	0	0	0%	0%	0	79
Tookayerta Creek	Nangkita Creek	T1	42	802	636	8 071	192	8 384	7 200	171	24%	27%	2 160	489
	Cleland Gully	T2	32	810	645	5 703	178	6 026	5 171	162	22%	25%	1 551	521
	Lower Tookayerta Creek	T3	27	650	505	3 539	131	3 525	3 060	113	20%	22%	918	103

APPENDICES

A. TANH CURVES

The tanh function is a standard hyperbolic function that was used by Boughton (1966) as a simple rainfall–runoff relationship.

Calculation

$$Q = (P - L) - F \times \tanh[(P - L)/F]$$

where: Q = runoff (mm)

P = rainfall (mm)

L = notional loss (mm)

F = notional infiltration (mm).

The equation can be applied to any data but should be used for data where average storage of soil water is approximately constant (i.e. where the notional loss and infiltration might be expected to be similar). Annual data satisfies this requirement but monthly data will need to be separated into data for each month, or at least for each season, and a different L and F derived for each month's (or season's) set.

Determination of F and L

The values of the notional loss (L) and notional infiltration (F) are determined by plotting monthly, seasonal or annual flow sets against the associated rainfall. A preliminary value of L is chosen from the data and F fitted either by trial and error, or with a curve–fitting technique. Similarly, the preliminary estimate of L can be changed to improve the fit. It is often simplest to plot the data in a spreadsheet and visually fit the parameters.

B. LOCATION OF WORKING DATA

Working data for this project is stored in the following locations (DWLBC staff use only):

Project Data:

P:\Projects_SW\Mt_Lofty_Ranges\426_3EasternStreams\EMLR_WAP_SW_Resource

GIS Data:

M:\Data\Covers\Surfacewater\HYDRO.EMLR_Rainfall_Runoff.shp\HYDRO.EMLR_Rainfall_Runoff.shp

M:\Projects_SW\Mt_Lofty_Ranges\EMLR\Prj_Management_Zones\spatial_data\EMLR_SWZones.gdb\SWZones\EMLR_Tanh_Parameters

REFERENCES

Alcorn, M 2006, ‘Surface water assessment of the Bremer River Catchment, Report’ DWLBC 2008/13, Department of Water, Land and Biodiversity Conservation, Adelaide.

Alcorn, M 2006, Surface water assessment of the Currency Creek Catchment, Report DWLBC, 2006/07, Department of Water, Land and Biodiversity Conservation, Adelaide.

Daley, S & Dwyer, T 2004, ‘Eastern Mt Lofty Ranges land use survey classification and field survey methodology’, internal technical report, Department of Water, Land and Biodiversity Conservation, Adelaide.

Fawcett, RJB, Jones, DA & Shitaye, B 2006, Climatological rainfall analyses for Southeast South Australia, National Climate Centre, Australian Bureau of Meteorology, Adelaide.

Jeffrey, SJ, Carter, JO, Moodie, KB & Beswick, AR 2001, ‘Using spatial interpolation to construct a comprehensive archive of Australian climate data’. Environmental Modelling & Software, 16(4), pp.309–330.

McMurray, D 2004a, Assessment of water use from farm dams in the Mount Lofty Ranges, South Australia, Report DWLBC 2004/02, Department of Water, Land and Biodiversity Conservation, Adelaide.

McMurray, D 2004b, Farm dam volume estimations from simple geometric relationships, Report DWLBC 2004/48, Department of Water, Land and Biodiversity Conservation, Adelaide.

RMCWMB 2003, Catchment water management plan for the River Murray in South Australia, 2003–2008, River Murray Catchment Water Management Board, Berri, South Australia.

Savadamuthu, K 2003, Streamflow in the Upper Finniss Catchment, Report DWLBC 2003/18, Department of Water, Land and Biodiversity Conservation, Adelaide.

Savadamuthu, K 2004, Surface water assessment of the Tookayerta Catchment, South Australia, Report DWLBC 2004/23, Department of Water, Land and Biodiversity Conservation, Adelaide.

Savadamuthu, K 2006, Surface water assessment of the Upper Angas sub-catchment, Report DWLBC 2006/09, Department of Water, Land and Biodiversity Conservation, Adelaide.