Chapter Eighteen

Water Resources

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GEOGRAPHIC BACKGROUND

Rainfall, or the lack of it, is the most important single factor determining land use and rural production in Australia. The chapter on Geography contains details on geographical and climatic features that determine the Australian water pattern. The scarcity of both surface and ground water resources, together with the low rates of precipitation which restrict agriculture (quite apart from economic factors), has led to extensive programs to regulate supplies by construction of dams, reservoirs, large tanks and other storages.

The major topographical feature affecting the rainfall and drainage patterns in Australia is the absence of high mountain barriers. Australia's topographical features range from sloping tablelands and uplands along the east coast Main Divide, through the low plain and marked depression in the interior to the Great Western Plateau.

Only one-third of the Australian land mass drains directly to the ocean, mainly on the coastal side of the Main Divide and inland with the Murray–Darling system. With the exception of the latter, most rivers draining to the ocean are comparatively short but account for the majority of the country's average annual discharge. Surface drainage is totally absent from some arid areas of low relief.

Australia's large area (7.7 million square kilometres) and latitudinal range (3,700 kilometres) have resulted in climatic conditions ranging from alpine to tropical. Two-thirds of the continent is arid or semi-arid, although good rainfalls (over 800 millimetres annually) occur in the northern monsoonal belt under the influence of the Australian–Asian monsoon, and along the eastern and southern highland regions under the influence of the great atmospheric depressions of the Southern Ocean. The effectiveness of the rainfall is greatly reduced by marked alternation of wet and dry seasons, unreliability from year to year, high temperatures and high potential evaporation.

The availability of water resources controls, to a large degree, the possibility and density of settlement; this in turn, influences the quality of the water through production and disposal of waste. Most early settlements were established on the basis of reliable surface water supplies and, as a result, Australia's population is concentrated along the coast, mainly in the comparatively fertile, well-watered east, south-east and far south-west.

As settlement spread into the dry inland grazing country, the value of reliable supplies of underground water was realised. Observations of the disappearance of large quantities of the rainfall precipitated on the coastal ranges of eastern Australia eventually led to the discovery of the Great Artesian Basin which has become a major asset to the pastoral industry. Development, however, has not been without costs. Significant environmental degradation and deterioration in water quality are becoming evident.

18.1 MAJOR GROUND WATER RESOURCES OF STATES/TERRITORIES

		Ground water resource (gigalitres)					
					Major divertible resource		*Abstraction during 1983–84*
State/Territory	*Area of aquifers (km^2)*	*Fresh*	*Marginal*	*Brackish*	*Saline*	*Total*	
New South Wales	595,900	881	564	431	304	2,180	242
Victoria	103,700	469	294	69	30	862	146
Queensland	1,174,800	1,760	683	255	144	2,840	962
South Australia	486,100	102	647	375	86	1,210	504
Western Australia	2,622,000	578	1,240	652	261	2,740	355
Tasmania	7,240	47	69	8	—	124	5
Northern Territory	236,700	994	3,380	43	10	4,420	24
Australia	**5,226,440**	**4,831**	**6,877**	**1,833**	**835**	**14,376**	**2,238**

Source: Australian Water Resources Council, 1987.

Permanent rivers and streams flow in only a small part of the continent. The average annual discharge of Australian rivers has been recently assessed at 397 teralitres of which 100 teralitres is now estimated to be exploitable for use on a sustained yield basis. This is small in comparison with river flows on other continents, as indicated in the following broad comparison of rainfall and run-off of the continents.

18.2 RAINFALL AND RUN-OFF OF THE CONTINENTS

Continent	*Area*	*Average yearly rainfall*	*Run-off*	*Run-off*	*Run-off*
	km^2	mm	mm	km^3	%
Africa	30,300,000	690	260	7,900	38
Asia	45,000,000	600	290	13,000	48
Australia	7,700,000	465	57	440	12
Europe	9,800,000	640	250	2,500	39
North America	20,700,000	660	340	6,900	52
South America	17,800,000	1,630	930	16,700	57

Source: Department of Resources and Energy, 1983.

In addition, there is a pronounced concentration of run-off in the summer months in northern Australia while the southern part of the continent has a distinct, if somewhat less marked, winter maximum.

Even in areas of high rainfall, large variability in flow means that, for local regional development, most streams must be regulated by surface storage. However, in many areas evaporation is so great that storage costs are high in terms of yield. Extreme floods also add greatly to the cost of water storage, because of the need for adequate spillway capacity.

The portion of run-off able to be diverted for use is very low compared with other continents, and results from the high variability of stream flow, high rates of evaporation and the lack of storage sites on many catchments. On an Australia-wide basis, only 21.5 per cent of the divertible resource has currently been developed for use; much of the remaining resource is available in remote regions where development is impractical and uneconomic. In areas such as the Murray–Darling Division, where water is scarce, there are few resources not yet developed, and management is focusing on greater efficiency in water use.

18.3 SURFACE WATER RESOURCES OF STATES/TERRITORIES

				Surface water resource (gigalitres)					
				Major divertible resource					
State/ Territory	*Area (km^2)*	*Mean annual run-off*	*Mean annual outflow*	*Fresh*	*Marginal*	*Brackish*	*Saline*	*Total*	*Developed resource*
NSW	802,000	42,400	37,200	17,300	—	—	—	16,900	7,970
Vic.	228,000	19,200	18,800	9,050	240	120	—	9,810	5,990
Qld	1,730,000	159,000	158,000	32,700	—	—	—	32,700	3,840
SA	984,000	2,120	1,250	193	109	59	20	384	124
WA	2,520,000	39,900	39,700	10,200	516	856	168	11,700	2,340
Tas.	68,200	52,900	52,900	10,800	—	—	—	10,900	1,020
NT	1,350,000	81,200	79,200	17,700	—	—	—	17,700	59
ACT	2,400	549	549	175	—	—	—	175	106
Total(a)	**7,680,000**	**397,000**	**387,600**	**98,100**	**865**	**1,040**	**190**	**100,000**	**21,500**

(a) Totals rounded.

Source: Australian Water Resources Council, 1987.

The resource is assessed within a framework comprising four levels:

- the **total water resource** is the volume of water present in the environment, measured as mean annual run-off for surface water, and mean annual recharge for ground water;
- the **divertible resource** is the portion of run-off and recharge which can be developed for use;
- the **developed resource** is the portion of the divertible resource which has been developed for use; and
- **resource utilisation** is a measure of the portion of the developed resource which is actually used.

Emphasis is given to the second level of assessment, the divertible resource, as the prime measure of the resource. The divertible resource is defined as 'the average annual volume of water which, using current technology, could be removed from developed or potential surface water or ground water sources on a sustained basis, without causing adverse effects or long-term depletion of storages'.

WATER MANAGEMENT

Australia's water resources are managed by a large number of resource management agencies, irrigation authorities, metropolitan water boards, local government councils and private individuals. State authorities dominate the assessment and control of water resources as, under the Commonwealth Constitution, primary responsibility for management of water rests with the individual State Governments. The Commonwealth Government is responsible for matters relating to its Territories, and participates indirectly through financial assistance or directly in the coordination or operation of interstate projects through bodies such as the Murray–Darling Basin Commission.

18.4 WATER-RELATED COMMONWEALTH PAYMENTS TO THE STATES AND TERRITORIES, 1987–88 TO 1991–92
($'000)

Type of payment	*1987–88*	*1988–89*	*1989–90*	*1990–91*	*1991–92*
Federal Water Resources Assistance Program					
Salinity mitigation	1,250	5,446	9,845	972	430
Murray–Darling Basin salinity mitigation	4,689	3,560	4,449	1,429	1,130
Flood plain management	5,607	6,910	8,101	7,161	7,804
Western Sydney flooding	—	—	—	—	970
Country Towns Water Supply Improvement Program	4,919	6,197	4,362	5,052	4,955
Agricultural water supply	20,500	6,150	4,728	3,381	—
Water conservation	125	190	445	1,270	1,272
Water planning	623	486	207	521	864
Urban and industrial water supply	6,164	5,750	5,250	5,250	3,500
Total	*43,877*	*34,689*	*37,387*	*25,036*	*20,925*
Murray–Darling Basin Initiative					
Administration	359	430	672	822	967
Community Advisory Committee	—	—	—	71	77
Salinity investigations	217	263	509	407	286
Investigations and construction	1,345	663	687	1,650	1,026
Salinity construction	—	1,710	2,881	1,325	1,998
MDB Drainage Program	—	—	—	4,278	5,509
National Resources Management Strategy (NRMS) interstate	—	—	886	1,224	1,850
NRMS intrastate	—	—	1,041	4,431	5,150
Total	*1,921*	*3,066*	*6,676*	*14,208*	*16,863*
Payments to Commonwealth authorities	437	398	183	206	260
Water research programs	6,182	7,300	7,017	2,376	—
Land and Water R&D Corporation	—	—	—	8,894	10,785
Sewerage research	—	—	200	—	—
Total water program	**52,417**	**45,453**	**51,463**	**50,720**	**48,833**

Source: Department of Primary Industries and Energy, 1992.

Financial assistance is provided primarily through the Federal Water Resources Assistance Program.

Australia's attitudes to water resources management have changed substantially over the last twenty years. Water management is no longer seen just in terms of storing water and regulating streams for consumption, but also in terms of conserving unregulated streams in an unmodified landscape for wildlife preservation or recreation purposes or for possible social or economic use by future generations. In addition, agricultural, industrial and urban development has led to greater attention being paid to water quality management.

The Prime Minister's Environment Statement in December 1992 allocated $30 million to the management of rural and urban catchments and their rivers, with high priority to the abatement of nutrient pollution, particularly in the Murray–Darling Basin.

$16 million has been allocated to the Country Towns Water Supply Improvement Program (COWSIP) to include waste water treatment in small rural communities.

Water quality monitoring programs will be funded at a cost of $10 million; and $2.3 million has been allocated to the assessment of ground water quality in key areas vulnerable to rising salt and nutrient levels.

In addition, a new Cooperative Research Centres (CRC) program for Freshwater Ecology providing an ecological basis for sustainable management of Australia's temperate surface waters will receive $12.8 million over seven years, with particular emphasis on the Murray–Darling Basin algal bloom problem.

The Australian Water Resources Council (AWRC), consisting of the Commonwealth, State and Territory Ministers with portfolio responsibilities for water resources, is the peak forum for the water industry. AWRC and the Australian and New Zealand Environment and Conservation Council (ANZECC) are working together to develop the National Water Quality Management Strategy. Included as part of the National Strategy will be matters for priority attention such as:

- development of a policy framework for water quality management;
- review of drinking water guidelines;
- management of sewerage systems;
- guidelines for ground water protection;
- water quality management in the rural enivronment; and
- guidelines for water quality including:
  - national criteria
  - effluent guidelines.

The water resource situation and arrangements in each State and Territory are described below.

Water resources research

The Department of Primary Industries and Energy is responsible for Commonwealth interests in water resource matters.

In July 1990, the Land and Water Resources Research and Development Corporation (LWRRDC) was established to provide leadership and national coordination of research and development of land, water and related issues. It is also responsible for determining national research priorities and in doing so consults its five 'representative organisations': the Australian Conservation Foundation; National Farmers' Federation; National Association of Forest Industries; Standing Committee on Soil Conservation; and the Standing Committee of the Australian Water Resources Council. Projects funded include research on salinity, ground water, stream ecology, waste water management, hydrology and water treatment and quality. Activities to effectively disseminate the results of research were also undertaken.

In 1991–92, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) spent approximately $21 million (of direct appropriation funds) on water research. Competitive research grants, consultancies, and collaborative research provided an additional amount of approximately $8.5 million for work of direct relevance to the Australian water industry.

The Division of Water Resources has a total staff of more than 230 with laboratories in Perth, Adelaide, Canberra and Griffith. The Division's task is to develop new and improved practices for the definition, use, and management of Australia's water resources.

The Division of Chemicals and Polymers, based at Clayton, Victoria, has significantly expanded its research on new methods of treating municipal water and waste water, and

cleaning up effluents from a wide range of manufacturing industries, resulting in some of the new technologies being marketed in the United Kingdom and China.

The Centre for Environmental Mechanics conducts research on soil-water processes, evapotranspiration and physical limnology with special emphasis on physical/biological interactions in lakes, weirs and streams.

The Division of Coal and Energy Technology carries out research aimed at assessing and controlling the impact on freshwater and marine systems of pollutants arising from the energy, minerals and other industries as well as from urban and rural sources. Research on soil-water processes and erosion is conducted by the CSIRO Division of Soils.

CSIRO is a partner with LWRRDC, the Murray–Darling Basin Commission, and the Albury–Wodonga Development Corporation in the Murray–Darling Freshwater Research Centre.

At the State level, water agencies have extensive laboratory facilities for water quality testing. However, most water related research is undertaken in research centres associated with agriculture, fisheries, forestry and environmental authorities. At the regional level, some of the larger authorities providing water supply and sewerage services undertake applied research on a very limited scale.

A significant proportion of Australian water research is undertaken by researchers in tertiary education institutions with the aid of either internal funding or grants from outside bodies, such as LWRRDC or the Australian Research Grants Committee. Water research is carried out within a range of disciplines, including the biological and social sciences and engineering.

New South Wales

Irrigation takes up the largest volume of consumption water use in New South Wales, on average 75 per cent, with urban water consumption in Newcastle, Sydney and Wollongong taking up the bulk of the remaining 25 per cent.

Major metropolitan urban water supplies are managed by central water boards at Newcastle and Sydney. Water sources for Sydney, Wollongong and the Blue Mountains are good quality rivers and associated storages on the Hawkesbury, and Shoalhaven Rivers and various streams in the Blue Mountains. Newcastle's water supply is taken from the Chichester and Grahamstown Reservoirs and from ground water in coastal sandbeds. Country towns develop their own water supply systems ranging from run-of-river pumping to ground water extractions, to dams built specifically for urban water supply. Metropolitan water authorities are increasingly managing urban water demand to reduce water consumption by a range of mechanisms including pricing and persuasion. Drought management and asset management are more recent areas of concern for metropolitan water utilities which are also increasing their interest in balanced environmental management of water supply catchments.

18.5 URBAN WATER USE IN NEW SOUTH WALES, 1990–91

Area/region	*Water use (ML(a)/year)*	*Population served*
Sydney	655,175	3,679,000
Hunter	84,640	423,400
Gosford/Wyong	36,100	234,000
Other towns	234,000	266,000

(a) Megalitres.
Source: New South Wales Water Resources Council, 1992.

The bulk of irrigation in New South Wales is within the Murray–Darling Basin, the centre of recent Commonwealth/State initiatives in land and water management to reduce salinity problems. Twenty-four storages, including four shared with Victoria and South Australia and one shared with Queensland, regulate water supplies in the Basin.

Two main irrigation arrangements exist State-wide. Licensed irrigation occurs where licensees take water from rivers, usually by pumping at their own cost. Around 1.5 million megalitres per annum is used in this way.

Irrigation Areas and Districts form the second type of irrigation. These are located on the three southern inland rivers — the Murray, Murrumbidgee and Lachlan and include over 6,300 farms and holdings covering nearly 1.4 million hectares. About a third of this area is usually irrigated using 1.4 million megalitres per annum. Extractions from licensed high-yielding bores now approach 300 gigalitres per annum.

The annual gross value of production in the Murray–Darling system is around $800 million, about 20 per cent of the State's total agricultural production. Nevertheless the growing extent of land degradation and salinisation in the Murray–Darling Basin is reducing productivity and increasing costs of production.

Ameliorating waterlogging and salinisation of farming lands is an environmental management priority for the Commonwealth and States, and New South Wales is pursuing this through a State funded SALTACTION initiative and through the Murray–Darling Basin Ministerial Council. For further information on salinisation, *see* the special article *Salinity — An Old Environmental Problem* in *Year Book Australia 1990*.

Water management is coordinated through the NSW Water Resources Council, composed of the heads of government agencies which have a role in water management along with representatives of major interest groups.

18.6 MAJOR WATER STORAGES, NEW SOUTH WALES, 1991–92

Storage name	*River basin*	*Purpose*	*Capacity (ML)*
Eucumbene Dam	Snowy River (NSW)	Hydro-electricity	4,807,000
Hume Dam	Upper Murray River (NSW)	Irrigation, Hydro-electricity	3,038,000
Warragamba Dam	Hawkesbury River	Public water supply, Hydro-electricity	2,091,800
Menindee Lakes Storage	Darling River	Irrigation	1,794,000
Blowering Dam	Murrumbidgee River	Irrigation, Hydro-electricity	1,628,000
Copeton Dam	Gwydir River	Irrigation	1,364,000
Wyangala Dam	Lachlan River	Irrigation	1,220,000
Burrendong Dam	Macquarie-Bogan Rivers	Irrigation, Flood control	1,190,110
Burrinjuck Dam	Murrumbidgee River	Irrigation, Hydro-electricity	1,026,000
Talbingo Dam	Murrumbidgee River	Hydro-electricity	920,550
Glenbawn Dam	Hunter River	Irrigation, Flood control	870,000
Jindabyne Dam	Snowy River (NSW)	Hydro-electricity	688,000
Lake Victoria	Lower Murray River (NSW)	Irrigation	680,200
Keepit Dam	Namoi River	Irrigation, Hydro-electricity	426,000
Split Rock Dam	Namoi River	Irrigation	372,000
Windamere Dam	Macquarie-Bogan Rivers	Irrigation	353,000
Glennies Creek Dam	Hunter River	Irrigation, Public water supply	284,000
Glenlyon Dam (Qld)	Border Rivers (NSW)	Irrigation	261,000
Tantangara Dam	Murrumbidgee River	Hydro-electricity	254,080
Avon Dam	Hawkesbury River	Public water supply	214,360
Mangrove Creek Dam	Hawkesbury River	Public water supply	176,000
Lake Brewster	Lachlan River	Irrigation	154,000
Liddell Dam	Hunter River	Public water supply	148,000
Grahamstown Dam	Hunter River	Public water supply	139,817
Googong Dam	Murrumbidgee River	Public water supply	125,000
Tallowa Dam	Shoalhaven River	Public water supply, Hydro-electricity	110,200

Source: New South Wales Water Resources Council, 1992.

Victoria

Water resources are administered by three major agencies, the Office of Water Resources (in the Department of Conservation and Environment), the Melbourne Metropolitan Board of Works, and the Rural Water Commission.

In an average year water consumption in Victoria is as follows:

- 77 per cent irrigated agriculture;
- 16 per cent urban; and
- 7 per cent rural stock and domestic.

18.7 MAJOR WATER STORAGES IN VICTORIA, 1991–92 (megalitres)

Reservoir	*Storage capacity*
Dartmouth	4,000,000
Eildon	3,390,000
Thomson	1,175,000
Waranga	411,000
Mokoan	365,000
Rocklands	348,000
Eppalock	312,000
Cardinia	289,000
Upper Yarra	207,000
Blue Rock	198,000
Glenmaggie	190,000
Cairn Curran	148,000
Yarrawonga	117,000
Toolondo	107,000
Winneke	100,000

Source: Department of Water Resources Victoria, 1992.

The main rural water supply systems are:

- **Goulburn–Campaspe–Loddon.** The main storage is Lake Eildon with a capacity of 3,390 gigalitres. The main products in these systems are dairy products, fruit, wool and fat lambs. Annual production of deciduous canning fruits in the eastern part of the system is about two-thirds of Australia's total.
- **Murray River System.** The Murray Valley Irrigation Area and the Torrumbarry Irrigation System are irrigated by water diverted at the Yarrawonga and Torrumbarry weirs respectively. These areas are devoted mainly to dairying, fat lambs, fruit, vineyards, orchards and market gardens. Downstream from Swan Hill, the First Mildura Irrigation Trust and four Commission Districts are supplied by pumping, and produce mainly dried vine fruits, citrus fruits and table and wine grapes.
- **Southern Systems.** The Macalister district, supplied from the Macalister River and regulated by Lake Glenmaggie, is devoted mainly to dairying.
- **Werribee and Bacchus Marsh.** These districts produce fresh fruit, vegetables and dairy products mainly for the local domestic market. Irrigation is supplied from the Werribee River system which is regulated by three main storages: Pykes Creek Reservoir, Melton Reservoir and Lake Merrimu.
- **Wimmera–Mallee Domestic and Stock Supply System.** Storages in the Grampian Ranges ensure farm water supplies for dry land, pastoral and cereal farming in the Wimmera and Mallee. There are small areas of irrigation supplied from this system near Horsham and Murtoa.

One of the main problems with water supply in the Wimmera–Mallee Region (as in other regions) is the volume of water lost from the distribution system through evaporation and seepage. In 1990 the average efficiency of the system varied from 70 per cent for irrigation to 35 per cent for domestic and stock deliveries, putting the overall delivery system efficiency at only 41 per cent.

18.8 WATER DISTRIBUTION LOSSES IN THE WIMMERA–MALLEE REGION, 1990 (megalitres per year)

Water use	*Total releases*	*Losses*	*Deliveries*
Farm dams	115,000	79,000	36,000
Rural Water Commission (RWC) urban authorities	30,600	17,500	13,100
Irrigation	27,000	8,000	19,000
Intensive farming	900	550	350
Recreation	2,000	1,250	750
Compensation flows	3,500	—	3,500
Total	**179,000**	**106,300**	**72,700**

Source: Department of Conservation and Environment, 1991.

Nine sub-regional salinity management plans are in various stages of preparation or completion. (Four salinity management plans: Shepparton, Goulburn dryland, Campaspe West and Tragowel Plains, have been accepted by the Government.) The plans are prepared by community based planning groups assisted by a technical committee made up of State

government officers. A lead State agency has been nominated for each management plan. Priority has been given to the Northern Victorian irrigation areas because of the size of their salinity problems and the relationship to the interstate River Murray issue.

Queensland

The management of surface and underground water is exercised by the Water Resources Commission.

18.9 MAJOR WATER STORAGES IN QUEENSLAND, 1991–92 (megalitres)

Storage name	*Storage capacity*
Burdekin Falls Dam	1,860,000
Fairbairn Dam	1,440,000
Fred Haigh Dam	586,000
Peter Faust Dam	497,500
Tinaroo Falls Dam	407,000
Glenlyon Dam	254,000
Boondooma Dam	212,000
Wuruma Dam	194,000
Eungella Dam	131,000
Julius Dam	127,000
Callide Dam	127,000
Bjelke-Petersen Dam	125,000
Leslie Dam	107,000
Beardmore Dam	101,000

Source: Queensland Water Resources Commission, 1992.

Approximately half of the area irrigated in Queensland now uses water from storages constructed by the Commission. The balance is irrigated from unsupplemented surface or ground water supplies spread widely throughout the State. Because of the predominance of irrigation by private diversion from streams, as opposed to channel systems delivering water to farms, most of the storages release water to maintain supplies downstream.

Approximately one-third of the area irrigated in Queensland each year is concentrated in eight Irrigation Areas constituted under the *Water Resources Act 1989* where the supply is generally reticulated by channel systems to the farms. Irrigation projects are schemes established under the Act, where water is released from storages to maintain supplies for pumping under licence to land adjacent to the streams. Details of the projects are set out in table 18.10.

The availability of underground water, particularly the Great Artesian Basin, has played a major part in the development of the pastoral industry in Queensland. Underground water is also used extensively for irrigation on individual farms, particularly along the coastal fringe, and for domestic purposes.

Some 45 per cent of the area irrigated in Queensland receives its supplies from underground sources. The predominant areas where water from this source is used for irrigation are the Burdekin Delta, Condamine Valley, Bundaberg, Lockyer Valley, Callide Valley and Pioneer Valley.

18.10 IRRIGATION PROJECTS IN QUEENSLAND, 1991–92

	Announced allocations(a)				*Actual use(a)*		
	Irrigation		*Other uses*				
	Outlets	*Allocation*	*Outlets*	*Allocation*	*Irrigation*	*Other uses*	*Area irrigated*
	no.	megalitres	no.	megalitres	megalitres	megalitres	hectares
Irrigation areas							
Bundaberg(a)	2,477	414,863	8	15,008	158,785	12,259	55,638
Burdekin River(a)	834	160,495	85	343	211,012	281	15,506
Dawson Valley	337	53,517	7	3,273	29,091	2,087	7,497
Emerald	263	195,122	201	20,239	128,884	19,733	17,948
Eton	639	76,443	41	9,041	54,314	9,956	16,930
Lower Mary River	189	17,634	—	—	10,258	—	4,553
Mareeba-Dimbulah	1,238	141,460	783	49,037	67,506	5,506	14,737
St George(b)	304	71,930	19	2,853	103,240	2,516	12,356
Total	**6,281**	**1,131,464**	**1,144**	**99,794**	**763,090**	**52,338**	**145,165**

(a) Includes ground water component. (b) Irrigation includes some water harvesting component.
Source: Queensland Water Resources Commission, 1992.

South Australia

All major water resources and most public water supply schemes are administered by the Engineering and Water Supply Department under various statutes.

Currently water diversions totalling more than 469,795 megalitres (supplying an area of 43,000 hectares) are made for government, cooperative and private irrigation schemes in the South Australian section of the River Murray.

Except for quantities held in various lock pools and natural lakes, no water from the Murray is stored within South Australia for irrigation purposes. In addition to irrigation direct from the River Murray there are considerable areas irrigated from underground sources.

In 1991–92, River Murray pipelines supplied 75,100 megalitres, which represents 42 per cent of the total intake to the Metropolitan Adelaide Water Supply System, compared with 48 per cent for the previous year. The principal sources of supply for the nine storages in the Mount Lofty Ranges are the Rivers Onkaparinga, Torrens, South Para, Myponga and Little Para. Total metropolitan consumption was 177,400 megalitres.

Average consumption per residential property for 1991–92 was down to 268 kilolitres compared to 300 kilolitres in 1990–91. This was partly due to more favourable weather conditions during the 1991–92 summer.

The following table shows the total water supplied (consumed) to the Adelaide metropolitan area over recent years.

18.11 SOUTH AUSTRALIAN METROPOLITAN WATER SUPPLY, 1986–87 TO 1990–91 (megalitres)

Water supply consumption	*1986–87*	*1987–88*	*1988–89*	*1989–90*	*1990–91*
Metropolitan	162,000	180,000	183,000	183,000	187,000
Highest daily	1,025	1,158	1,226	1,215	1,211
Average daily	444	524	532	532	548

Source: Engineering and Water Supply Department of South Australia, 1991.

Natural inflow from the principal catchments was 134,700 megalitres, up from 126,000 megalitres in 1990–91.

18.12 MAJOR WATER STORAGES IN SOUTH AUSTRALIA, 1991–92 (megalitres)

Reservoir	*Storage capacity*
South Para	51,300
Mount Bold	45,900
Myponga	26,800
Little Para Dam	20,800
Kangaroo Creek	19,000
Millbrook	16,500
Happy Valley	12,700
Todd River	11,300
Bundaleer	6,370
Baroota	6,120
Warren	4,770

Source: Engineering and Water Supply Department of South Australia.

A number of reservoirs in the Barossa Ranges and other local sources are augmented by the Morgan–Whyalla, Swan Reach–Stockwell and Tailem Bend–Keith pipelines which provide River Murray water to extensive country areas. Surface and underground resources have been developed to supply most country centres not covered by the larger schemes. Total country consumption was 73,777 megalitres.

The Murray–Darling Basin Ministerial Council and Commission administer the joint operation of the river system. The Commission is pursuing two main strategies to maintain and improve the quality of River Murray water and improve the management of associated lands. The first is, the Salinity and Drainage Strategy and the second, the Natural Resources Management Strategy (NRMS).

The Salinity and Drainage Strategy involves works to mitigate salinity in the lower reaches of the Murray combined with drainage proposals in the upper States, to rehabilitate waterlogged land. Under this strategy, the

Woolpunda Salt Interception Scheme was commissioned in November 1990. This will intercept up to 170 tonnes of salt per day. Construction of the Waikerie Salt Interception Scheme is proceeding and pumping will commence late in 1992. Investigations are continuing for other projects including Chowilla and Loxton.

The NRMS is the Murray–Darling Basin Ministerial Council's plan of action to improve the management of the natural resources of the basin. The principal objectives of the NRMS are:

- control of land degradation;
- maintaining and where possible, improving water quality; and
- conservation of the natural environment.

South Australia has undertaken a range of research and community projects since the commencement of the NRMS in 1990.

In August 1992, $10.8 million was allocated to a three year program to support rehabilitation of irrigation assets in South Australia's Riverland, the objectives being to make more efficient use of scarce water resources and reduce the impact of irrigation on the region's environment.

Western Australia

The Water Authority of Western Australia manages the majority of water-related services.

Western Australia has a great variation in the size and complexity of water supply schemes, which range from town schemes serving fewer than 50 people to the Perth metropolitan scheme serving a population of 1,200,000.

Considerable use is made of ground water by individual farmers, pastoralists, market gardeners, etc., and it is estimated that over 100,000 bores are in use in the State. Both artesian and non-artesian sources are used to supply or augment the supplies of numerous towns, including such major centres as Perth, Albany, Bunbury, Busselton, Carnarvon, Dampier, Esperance, Exmouth, Geraldton, Karratha and Port Hedland. In a number of mining towns in the north-west, mining companies are responsible for the provision of their own water supplies. Industries also use ground water in substantial quantities, particularly in the processing of titanium, iron and alumbAustralia, 1991.

Perth is supplied from a number of dams and pipeheads in the Darling Range and from ground water schemes located on the Swan Coastal Plain. Water gravitates or is pumped from these sources to service reservoirs and tanks located at high points over the metropolitan area for gravity feed to consumers.

The Water Authority is responsible for all town water supply schemes in the country towns of Western Australia, with the exception of the Bunbury and Busselton schemes which are run by local Water Boards. There are also a small number of town water supply schemes operated by mining companies. Individual water supplies serve railways, timber mill towns, isolated mines, pastoral properties, stock routes and agricultural areas, mainly from dams, tanks, wells and bores.

In country areas total control has been exercised on ground water usage in Broome, Gascoyne, Swan and South West Coastal Ground Water areas. The control of other areas has been tailored to the specific problems known to exist.

- **Goldfields and Agricultural Areas Water Supply.** This scheme provides water from Mundaring Weir to consumers in the Central Agricultural Areas and the Eastern Goldfields.
- **West Pilbara Water Supply Scheme**. The West Pilbara Water Supply serves the towns of Dampier, Karratha, Wickham, Point Samson and Roebourne as well as the industrial complexes at Dampier, the Burrup Peninsula and Cape Lambert. Water is supplied exclusively from the Millstream aquifer and the Harding Dam.
- **Geraldton Regional Water Supply Scheme**. The Geraldton Regional Water Supply serves consumers in the towns of Geraldton, Dongara, Port Denison, Mullewa, Walkaway, Eradu and Narngulu with water being drawn from the Wicherina, Allanooka and Wye Springs borefields.
- **Great Southern Towns Water Supply.** This scheme provides water to the coal mining town of Collie together with towns and farmlands in the Great Southern Area. Water is drawn from Harris Dam, which has a capacity of 71 gigalitres, and supplied to towns from Brookton and Kondinin in the north to Kojonup and Gnowangerup in the south and to Lake Grace in the east as well as 600,000 hectares of farmland.

- **Port Hedland Regional Water Supply Scheme.** The Port Hedland Regional Water Supply provides water for the consumers of Port Hedland and South Hedland from the complementary De Grey and Yule River borefields.
- **Lower Great Southern Towns Water Supply Scheme.** This scheme supplies the towns of Albany, Mt Barker and Kendenup. Water is drawn from three sources: Two Peoples Bay east of Albany (from which the water is treated for colour removal), Limeburner's Creek and bores which are located on the west of Princess Royal Harbour.
- **Mandurah Regional Water Supply Scheme.** This scheme provides water to the town of Mandurah and areas to the south and east. Approximately 90 per cent of the water consumed is supplied by gravity from the South Dandalup Dam with the remainder supplied from bores at Ravenswood.
- **Supplies to other country towns.** Nearly 150 towns are supplied with water from stream flow, dams, tanks, wells and bores, the schemes being administered under the provisions of the *Country Areas Water Supply Act 1947*.

The Water Authority is responsible for the provision and maintenance of tanks and wells as a source of cartage water for farmers and a number of small communities in gold mining and agricultural areas.

The Water Authority also undertakes design and construction of water services for Aboriginal communities on behalf of the Aboriginal and Torres Strait Islander Commission. The Authority under contract to the Aboriginal Affairs and Planning Agency assists communities in operating and maintaining schemes and training community operators.

The Water Authority is responsible for the operation and maintenance of seven irrigation and 15 drainage schemes throughout the State from Albany in the south to Kununurra in the north.

Irrigation schemes have been established by the State Government on the coastal plain south of Perth in the Waroona, Harvey, Collie River and Preston Valley Irrigation Districts between Waroona and Donnybrook, the water being channelled from dams in the adjacent Darling Range.

There is a thriving plantation industry situated at Carnarvon near the mouth of the Gascoyne River. This centre is one of the major producers in Western Australia of tomatoes, watermelons, pumpkins, cucumbers, capsicums and runner beans. Carnarvon also supplies capsicums, zucchinis and pumpkins to the eastern States. It produces over half the bananas consumed in Western Australia as well as limited supplies of citrus fruit, mangoes and avocados.

The rainfall at Carnarvon is extremely variable and averages little more than 230 millimetres per annum. Agricultural development has been made possible only by irrigation with ground water. Water is obtained from the growers' own irrigation pumping plants and from the government-controlled Carnarvon Groundwater Supply Scheme which is supplied from bores along the Gascoyne River.

The Ord Irrigation Project provides for the ultimate development of 72,000 hectares of clay soils and additional areas of sandy soils adjoining the clays. Water is currently supplied to 18,000 hectares.

Tasmania

The Hobart Regional Water Board, the Rivers and Water Supply Commission, the North-West Regional Water Authority, the Department of Resources and Energy, and the Hydro-Electric Commission all play responsive roles in the administration of water resources.

Contrary to popular belief, Tasmania is heavily dependent on water conservation in maintaining reliable sources of supply for irrigation, stock and domestic requirements, and urban and industrial water supplies. This is due to an annual summer drought between January and March, when most run-of-the-river flows only support ordinary riparian needs or very limited irrigation and many smaller streams cease to flow.

The total surface water usage for domestic, industrial, and agricultural purposes in Tasmania is only one per cent of the potential exploitable yield, compared with a national figure of about 13 per cent. Despite this, economic, environmental and social constraints are beginning to restrict further development of the total yield for these purposes.

Excluding power generation storages, the total capacity of water conservation dams in the State is about 150 gigalitres, almost half of which is in on-farm dams.

There is widespread use of farm dams for irrigation which is needed to maintain overall production because of the summer drought and the lack of pasture and crop growth in the State's cold winters.

The vast majority of the State's water resources are used for power generation, based on a large, integrated system of water storages. This system also benefits other water users by enabling greatly increased regulation of many streams. Table 18.13 shows the major dams and reservoirs in Tasmania.

The Rivers and Water Supply Commission is in charge of three major irrigation schemes, these being the Cressy–Longford Irrigation Scheme, the South East Irrigation Scheme, Stage I, both of which supply water via open channel, and the Winnaleah Irrigation Scheme which supplies water via pipelines.

18.13 MAJOR WATER STORAGES IN TASMANIA, 1991–92 (megalitres)

Reservoir	*Storage capacity*
Lake Gordon	12,450,000
Great Lake	3,179,000
Lake Pedder	2,960,000
Lake St Clair	2,000,000
Lake Burbury	1,065,000
Lake Mackintosh	914,000
Lake Echo	725,000
Lake Piemont	641,000
Lake King William	539,000
Arthur's Lake	511,000
Lake Barrington	180,000
Lake Rowallan	131,000
Lake Rosebury	124,000
Lake Cethana	109,000

Source: Hydro-Electric Commission, 1992.

Of the three schemes, Cressy–Longford is the largest (serving 88 properties) with 10,000 hectares being fit for irrigation. The Coal River Scheme is capable of serving 107 properties of which 3,800 hectares are fit for irrigation. The Winnaleah Scheme serves 1,500 hectares on 72 properties.

18.14 TOTAL WATER USAGE BY THE CRESSY–LONGFORD, SOUTH EAST DISTRICTS AND WINNALEAH IRRIGATION SCHEMES, 1989–90

Purpose	*Total water used*	*Area irrigated*
	ML	ha
Pasture	5,079	1,899
Processing potatoes	1,038	243
Canning peas	1,059	848
Other crops	1,382	1,090
Dam filling	519	—
Stock and domestic	139	—
Total	**9,216**	**4,080**

Source: Rivers and Water Supply Commission, 1990.

The majority of land irrigated in the State is watered by private schemes either by pumping directly from unregulated streams or from on-farm storages. Pasture still predominates as the major crop irrigated but vegetables and other crops now constitute 33 per cent of the total area irrigated.

Northern Territory

The Power and Water Authority is responsible for water resources.

Northern Territory water resources range from the abundance of northern coastal rivers to the harsh dry interior where surface water is rare and reliable supplies can only be found in ground water reserves. The streams of the northern quarter, or Top End, of the Territory are generally ephemeral, with flow dictated by wet and dry season climate under monsoonal influence. The total annual run-off to the northern coast is some 80 million megalitres. Of this total, 10.5 megalitres is potentially divertible after allowing for topographic and land use constraints, such as national parks. The developed surface water resource totals 0.6 million megalitres per annum. Rural, stock, domestic and private diversions account for 56 per cent (35 thousand megalitres per annum) of this, with the balance of 44 per cent (28 thousand megalitres per annum) used for urban supply.

The only significant surface water storage is the Darwin River Dam (259 gigalitres), approximately 60 kilometres south of Darwin. It forms part of the water supply headworks system for urban Darwin. Ground water from

McMinns Lagoon area is used to augment supply. Water supply to Katherine is from run of river with supplementation from ground water. Most other towns and communities, including Alice Springs, Tennant Creek, Jabiru and Nhulunbuy are supplied from ground water.

There are approximately 23,000 registered bores and wells in the Territory, of which 33 per cent serve urban and domestic supplies, 28 per cent are for pastoral use, 11 per cent are used for mining, 4 per cent for various miscellaneous uses and the remaining 24 per cent are investigation bores.

Estimates of theoretically divertible ground water resources are:

- Top End — 6 million megalitres (fresh and marginal); and
- Arid Zone — 2 million megalitres (fresh and marginal); and 1 million megalitres (brackish and saline).

Of the estimated 9 million megalitres of ground water available in the Territory, approximately 70 thousand megalitres per annum is extracted.

Irrigation in the Territory is expanding but is not extensive, being confined to Top End locations near Darwin, Adelaide River, Daly River and Katherine, and Ti Tree and Alice Springs in the arid zone. Irrigated agriculture includes fruit, vegetables, fodder crops, pastures and some dairying and most is carried out using bore water. There are no publicly owned/operated irrigation systems in the Territory.

12 per cent of total waste water is being used for irrigation purposes in Darwin, Katherine and Alice Springs.

Australian Capital Territory

The Electricity and Water Authority is responsible for the supply of water.

Surface water storages supplying the Australian Capital Territory (ACT) (population about 295,000) and the neighbouring city of Queanbeyan (population about 27,000) are located to the south-west and south-east. The storages to the south-west are in the heavily timbered, mountainous Cotter River catchment within the ACT, the storages being Corin Dam (75,500 megalitres), Bendora Dam (10,700 megalitres) and Cotter Dam (4,700 megalitres). The storage to the south-east in New South Wales in the Queanbeyan River catchment (over which the Commonwealth has permanent water rights) on the western slopes of the Great Dividing Range is the Googong Dam (125,000 megalitres).

The following table shows the total annual water consumption for the ACT and Queanbeyan. Variation in consumption can be accounted for by climatic variables such as temperature and rain days.

18.15 TOTAL WATER CONSUMPTION FOR THE AUSTRALIAN CAPITAL TERRITORY AND QUEANBEYAN, 1986–87 TO 1990–91 (megalitres)

Year	*Water consumption*
1986–87	65,939.7
1987–88	71,786.8
1988–89	62,448.7
1989–90	65,425.2
1990–91	77,260.7

Source: ACT Electricity and Water, 1992.

The existing storages on the Cotter and Queanbeyan Rivers have an ultimate combined capacity to serve 400,000 persons. Other potential storage sites exist on the Cotter, Paddy and Gudgenby Rivers which are likely to meet the needs of a population in excess of one million people.

Ground water has been used in the past by most primary producers to augment surface storage. Ground water production bores in the ACT have yields ranging between about 0.4 and 20 kilolitres per hour; 3 kilolitres per hour is about the average yield. However, many farm bores have fallen into disuse as a result of the Government's resumption of freehold land within the ACT, and because of the rapid expansion of urban growth. The Bureau of Mineral Resources has provided a bore-siting, ground water-quality and yield-prediction service in and around the ACT since the early 1950s and has maintained a network of observation bores which have been monitored regularly.

INTERNATIONAL ASPECTS AND NATIONAL AND INTERSTATE AGREEMENTS

For information on international aspects and for national and interstate agreements on the management of water resources *see Year Book Australia 1990*, pages 504–507.

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FOR MORE INFORMATION

The ABS has a far wider range of information on Australia than that contained in the *Year Book*. Information is available in the form of regular publications, electronic data services, special tables and from investigations of published and unpublished data.

For further information contact ABS Information Services at one of the addresses listed on the page facing the Introduction to the *Year Book*.