

South Australian – Victorian Border Groundwaters Agreement Review Committee



Twenty- First Annual Report

To June 2006

Melbourne and Adelaide

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1. Groundwaters Agreement Designated Area

Along the Victorian/South Australian border, groundwater is the only reliable water source. There are two main aquifer systems comprising the 'Tertiary Confined Sand Aquifer'¹ and the 'Tertiary Limestone Aquifer'².

The Tertiary Limestone Aquifer is the principal source of groundwater for existing users. The use of the lower Tertiary Confined Sand Aquifer is generally limited to municipal supply, but there are increasing demands to use the aquifer where the Tertiary Limestone Aquifer is fully allocated.

In recognition of the need to cooperatively manage the groundwater resources along the border of South Australia and Victoria, the Border Groundwaters Agreement (the Agreement) was entered into in 1985. Following assent to the *Groundwater (Border Agreement) Act 1985* in each State, the Agreement came into force in January 1986.

The Agreement established a 40 km wide Designated Area centred on the border and divided into 22 paired management zones (Figure 1).

The Tertiary Limestone Aquifer is the most extensive aquifer in South Australia and is the prime source of water in the South Australian Mallee. It is the major water supply source for Mount Gambier and is used extensively for high value horticulture, small seed and viticulture irrigation.

In the extreme western area of Victoria there are extensive areas of good quality groundwater. The Glenelg River is the only readily available surface water supply in the region. All significant towns are dependent on groundwater for their water supply, from Portland on the coast, to Kaniva in the Wimmera and to Murrayville in the Sunset Country. Agricultural and pastoral activities likewise are dependent on the Tertiary Limestone Aquifer for groundwater.

In the Designated Area, the Tertiary Limestone Aquifer has been sub-divided into three hydrogeological provinces as shown in Figure 1 and described below:

Province 1 occurs largely in the Otway Basin and is characterised by Quaternary calcareous sandstone overlying the Gambier Limestone, forming one unconfined aquifer system;

Province 2 is located in the Murray Basin where the Murray Group Limestone is unconfined and either outcrops at the surface, or is overlain directly by the Pliocene Sands Aquifer; and

Province 3 is in an area of the Murray Basin where the Murray Group Limestone is confined by the Upper Tertiary Aquitard.

¹ The Tertiary Confined Sand Aquifer is the Dilwyn Formation in the Otway Basin and the Renmark Group in the Murray Basin.

² The Tertiary Limestone Aquifer is generally the Gambier Limestone in the Otway Basin and the Murray Group Limestone in the Murray Basin.

2. The Border Groundwaters Agreement

The Agreement operates in both States.

The Agreement establishes a Designated Area, which is a strip 40 km wide centred on the border and extending for its full length. It is divided into 22 zones, 11 in each State.

The Agreement provides that the available groundwater shall be shared equitably between the States and applies to all existing and future bores within the Designated Area, except domestic and stock bores.

The Agreement establishes the Border Groundwaters Agreement Review Committee (the Review Committee) with membership from both States, as the operating body for the effective implementation of the Border Groundwaters Agreement.

Extraction licences or permits may not be granted or renewed within the Designated Area other than in accordance with the management prescriptions set out in the Agreement. The prescriptions limit water use in a particular zone to that specified as the Permissible Annual Volume for total withdrawals from all aquifers, or to an average annual rate of lowering of potentiometric (water) levels as specified or a permissible level of salinity. The prescriptions also provide that, where appropriate, casing of new wells shall be sealed between aquifers to prevent inter-aquifer contamination.

The actual allocation of water is the responsibility of the licensing authorities in each State in accordance with the relevant groundwater management plan or allocation plan prepared under the respective States' water resources legislation.

The approach taken by the States in developing management plans has included objectives to better quantify the resource, to establish appropriate mechanisms of allocating the resource or if needed restrict the use of the resource. Plans are developed through consultative committees to maximise community involvement in the making and implementation of the arrangements.

Table 1 sets out the management areas relevant to the Designated Area. The locations of the areas are shown in Figure 2.

Table 1 Management areas relevant to the Designated Area

South Australia (Prescribed Wells Areas)	Victoria (Water Supply Protection Areas)
Lower Limestone Coast Tatiara Mallee Noora	Apsley Glenelg Kaniva Murrayville Neuarpur Telopea Downs

3. Border Groundwaters Agreement Review Committee

3.1 Establishment, membership and appointment

During the year membership of the Review Committee comprised:

from South Australia

Mr N A Power	member
Ms B Cohen	member
Mr S Mustafa	deputy member

from Victoria

Mr D J Baker	member (up to 31 January 2006)
Mr R Nott	member
Dr J Cooke	member (from 1 February 2006)
Mr M Burns	deputy member

Mr D. J. Baker was President up to 31 January 2006 and Mr N. A. Power President from 1 February 2006.

Ms D McKeown was secretary up to 31 January 2006 and Mr E Daniels secretary from 1 February 2006.

The Review Committee met five times during the year:

20 July 2005	Melbourne
14 September 2005	Adelaide
16 November 2005	Melbourne
15 February 2006	Adelaide
19 May 2006	Melbourne

3.2 Functions

The Agreement provides that the Review Committee:

- may from time to time coordinate, or cause to be carried out, surveys, investigations and studies concerning the use, control, protection, management or administration of the groundwater in the Designated Area.
- may make recommendations to the Contracting Governments or to any authority, agency or tribunal of the Contracting Governments concerning any matter which, in the opinion of the Review Committee, may in any way affect the investigations, use, control, protection, management or administration of the groundwater within the Designated Area;
- shall review at intervals of not more than five years:
 - the permissible distance from the border between the two States;
 - the Permissible Annual Volume of extraction – in relation to each zone;
 - the permissible rate of potentiometric surface lowering (drawdown); and

- the permissible levels of salinity if any such levels have been declared;
- review the Agreement and, if in its opinion, amendments thereto are necessary or desirable, make recommendations to the Contracting Governments accordingly.

3.3 Powers

The Agreement provides amongst other matters that the Review Committee shall have the power to:

- alter the permissible distance from the border between the two States; and/or the Permissible Annual Volume of extraction – in relation to each zone; and
- declare a period of restriction in relation to each zone.

3.4 Annual reports

The Agreement provides that as soon as practicable after 30 June each year the Review Committee shall prepare a report on its activities during the year ended on the preceding 30 June.

The Review Committee shall give a copy of each report to the Minister of each Contracting Government, who in turn under the *Groundwater (Border Agreement) Act 1985* must lay the report before each House of Parliament.

4. Prescriptions at 30 June 2006

4.1 Permissible Annual Volumes, allocations and use

Under the Agreement the term Permissible Annual Volume can only be applied to a whole zone of the Designated Area. Each zone may only have a single Permissible Annual Volume. This is a deficiency in the Agreement as it would be useful to divide a zone into sub-zones or into aquifers and set a separate Permissible Annual Volume for each sub-zone or aquifer, such as the case with the Tertiary Limestone Aquifer and the Tertiary Confined Sand Aquifer. For the time being, the term “Allowable Annual Volume” is being used for the individual volumes that can be extracted from each aquifer with the sum of these going to form the Permissible Annual Volume that is gazetted for a particular zone (Figure 3).

When the Agreement was made in 1985 the Permissible Annual Volumes were equal on both sides of the border. This reflected the limited understanding of the extent of the aquifers and the recharge of these aquifers at that time.

The Agreement empowers the Review Committee to amend the Permissible Annual Volumes. This has been done in the past in consultation with interested parties and the relevant agencies responsible for groundwater management in both States.

The Permissible Annual Volumes (and the Allowable Annual Volumes for the Tertiary Limestone Aquifer) have been adjusted, recognising the extent of development in each zone and taking into account the amount of recharge and the potential impacts groundwater extraction could have on drawdowns and groundwater salinisation.

A management framework for the Tertiary Confined Sand Aquifer was developed by the Review Committee in its 5-year management review (1996-2000) and adopted by both States to institute compatible management for the aquifer on a regional basis (Figure 4).

Table 2 sets out the Permissible Annual Volumes for each zone and the Allowable Annual Volumes for each aquifer of each zone for the year ending 30 June 2006. Tables 3 and 4 list the allocations and use for the Tertiary Limestone Aquifer and the Tertiary Confined Sand Aquifer respectively.

The zones for the Tertiary Limestone Aquifer along the Designated Area within South Australia are fully allocated (excluding Zone 2A) and transferable water entitlement systems operate in accordance with water allocation plans prepared by the South East Natural Resources Management Board and the South Australian Murray-Darling Basin Natural Resources Management Board. In Victoria a number of zones have become fully allocated and there is increasing demand for water allocations in other zones.

The South Australian Murray-Darling Basin Natural Resources Management Board and the South East Natural Resources Management Board are currently reviewing the Mallee, Tatiara and Limestone Coast Water Allocation Plans. Preparation of these plans has been extended to 30 June 2007.

South Australia has instituted programs to install water meters in the Mallee Prescribed Wells Area (part of Zone 9A, Zones 10A and 11A) and in the South East (Zones 1A to part of 9A). Meters have been installed in the Mallee on all bores used for licensed water allocations and volumetric measurements of water extraction are now available. Meters are progressively being installed in the South East, with approximately 65% installed by 30 June 2006.

Under the current allocation system South Australia is over-allocated in Zones 1A, 3A, 4A, 5A and 7A in the Tertiary Limestone Aquifer. Metered use in Zone 10A from the Tertiary Limestone Aquifer indicates that though water allocation under the crop area based system is within the Allowable Annual Volume, actual extraction may exceed this volume.

South Australia has instituted a program to convert crop area based water allocations to volumetric allocations in both the South East and the Mallee. Conversion methodologies in both areas are being developed to provide a transparent process for the conversion of individual licence allocations.

South Australia will address the over-allocation issues following the volumetric conversion process through the respective water allocation plans which will provide for the adjustment of allocation and use within permissible limits.

The allocations from the Tertiary Limestone Aquifer in the Victorian zones of the Designated Area are largely unchanged from the previous year. No groundwater has been allocated from the Tertiary Confined Sand Aquifer in Victoria in the year up to

30 June 2006.

The Permissible Annual Volumes and the Allowable Annual Volumes are critical for the management of groundwater in the Designated Area.

The Agreement does not apply to bores for domestic and stock purposes. The estimated number of stock and domestic bores for each zone is listed in Table 5. The list provides an indication of the important role groundwater plays for domestic and stock purposes.

Table 2 Permissible Annual Volumes and Allowable Annual Volumes at 30 June 2006

South Australia				Victoria			
AAV ³ Tertiary Limestone Aquifer (ML/y)	AAV Tertiary Confined Sand Aquifer (ML/y)	Permissible Annual Volume (ML/y)	Zones	Zones	AAV Tertiary Limestone Aquifer (ML/y)	AAV Tertiary Confined Sand Aquifer (ML/y)	Permissible Annual Volume (ML/y)
6861	0	6861	11A	11B	1823	0	1823
9400	320	9720	10A	10B	6720	560	7280
11595	570	12165	9A	9B	5960	630	6590
7700	340	8040	8A	8B	6760	330	7090
7500	350	7850	7A	7B	6600	350	6950
8850	360	9210	6A	6B	9838	360	10198
18500	540	19040	5A	5B	11949	570	12519
20000	710	20710	4A	4B	14000	300	14300
24000	1900	25900	3A	3B	16500	1000	17500
25000	2900	27900	2A	2B	25000	5100	30100
30900	9200	40100	1A	1B	45720	14500	60220

Table 3 Allowable Annual Volumes, allocations and metered use for Tertiary Limestone Aquifer at 30 June 2006

South Australia				Victoria					
Tertiary Limestone Aquifer				Zones	Zones	Tertiary Limestone Aquifer			
AAV ⁴ (ML/y)	Licensed Allocations					AAV (ML/y)	Licensed Allocations		
	Total No of Licences	Total Volume Allocated (ML)	Total Volume of Estimated Extractions ⁵ (ML)				Total No of Licences	Total Volume Allocated (ML)	Total Volume of Metered Extractions ⁶ (ML)
6861	17	6627	3322	11A	11B	1823	3	1600	342
9400	41	8624	13470	10A	10B	6720	14	6358	2524
11595	11	11437	2042	9A	9B	5960	2	5000	615
7700	42	4854	662	8A	8B	6760	4	2538	1994
7500	102	8244	5806	7A	7B	6600	13	5692	2940
8850	57	8758	6172	6A	6B	9838	13	9838	8197
18500	135	18999	10767	5A	5B	11949	36	11949	8268
20000	176	21898	11925	4A	4B	14000	5	2339	708
24000	247	24050	14327	3A	3B	16500	5	515	54
25000	120	20077	13182	2A	2B	25000	44	24893	4424
30900	357	31965	26058	1A	1B	45720	22	5812	3132

³ Allowable Annual Volume

⁴ Allowable Annual Volume

⁵ NA – The installation of meters is near completion in Zones 1A – 9 A . It is expected that South Australia will be in a position to provide estimates in the next Annual Report for these Zones.

⁶ The installation of meters is mostly complete.

Table 4 Allowable Annual Volumes, allocations and metered use for Tertiary Confined Sand Aquifer at 30 June 2006

South Australia				Victoria					
Tertiary Confined Sand Aquifer				Zones	Zones	Tertiary Confined Sand Aquifer			
AAV (ML/y)	Licensed Allocations					AAV (ML/y)	Licensed Allocations		
	Total No of Licences	Total Volume Allocated (ML)	Total Volume of Estimated Extractions (ML)	Total No of Licences	Total Volume Allocated (ML)		Total Volume Metered Extractions (ML)		
0	0	0	0	11A	11B	0	0	0	0
320	0	0	0	10A	10B	560	0	0	0
570	0	0	0	9A	9B	630	0	0	0
340	0	0	0	8A	8B	330	0	0	0
350	0	0	0	7A	7B	350	0	0	0
360	0	0	0	6A	6B	360	0	0	0
540	0	0	0	5A	5B	570	0	0	0
710	1	63	NA	4A	4B	300	0	0	0
1900	0	0	0	3A	3B	1000	0	0	0
2900	2	150	NA	2A	2B	5100	0	0	0
9200	3	1385	NA	1A	1B	14500	0	0	0

Table 5 Number of stock and domestic bores

South Australia		Victoria	
Number of Stock and Domestic Bores	Zones	Zones	Number of Stock and Domestic Bores
18	11A	11B	17
28	10A	10B	243
9	9A	9B	47
12	8A	8B	113
74	7A	7B	104
80	6A	6B	56
233	5A	5B	162
253	4A	4B	339
244	3A	3B	79
228	2A	2B	577
545	1A	1B	625

NOTE:

The numbers of stock and domestic bores are best estimates as made in 2004 based on State database records.

4.2 Permissible distance from the border

The permissible distance is the distance from the border within which all applications for a permit or licence must be forwarded to the Review Committee for approval. The Review Committee has the power to determine this distance. The Agreement only provides for a single distance to be set for any one zone. It does not allow for separate permissible distances to be set for each individual aquifer within a zone.

The radius of interference between pumping bores is greater in a confined aquifer than in an unconfined aquifer for a given discharge, as the water level drawdown in a confined aquifer is a pressure response.

The permissible distance for each of the zones as prescribed is shown in Table 6. As the Agreement only provides for one permissible distance for a zone, the States have adopted a recommendation of the Review Committee to administer applications in relation to the Tertiary Confined Sand Aquifer as if the permissible distance were 3 km.

The Review Committee considered no applications during the year up to 30 June 2006.

Table 6 Permissible distance at 30 June 2006

South Australia		Victoria	
Distance (km)	Zones	Zones	Distance (km)
3	11A	11B	3
3	10A	10B	3
1	9A	9B	1
1	8A	8B	1
1	7A	7B	1
1	6A	6B	1
1	5A	5B	1
1	4A	4B	1
1	3A	3B	1
1	2A	2B	1
1	1A	1B	1

4.3 Permissible rate of potentiometric surface lowering

The Agreement only provides for a single rate of potentiometric surface lowering to be set for any one zone. It does not allow for a separate rate of potentiometric surface lowering to be set for each individual aquifer or sub-zone.

A single simple rate of decline has meaning in the management of water levels in an unconfined aquifer. In the case of a confined aquifer this simple parameter is inadequate to describe the behaviour of the aquifer pressure response. Predictions of drawdowns using models have been used in such cases.

The Agreement originally provided that the permissible rate of potentiometric surface lowering is 0.05 m/y. On the recommendation of the Review Committee the Ministers of the Contracting Governments agreed to amend the rates for some zones in 2001 and 2003. The prescribed permissible rate of potentiometric surface lowering for each of the zones is shown in Table 7. Permissible rates have not been separately prescribed for the different aquifers. The 2002-03 annual report documented the Review Committee's view as to the rates that might apply to each aquifer for advice to the state water management authorities.

The Committee did not recommended any change to the permissible rates of potentiometric surface lowering this year.

The water level trends in the Designated Area are described in Appendix A of this report. The observed trends are within the permissible rates of potentiometric surface lowering.

Table 7 Permissible rate of potentiometric surface lowering at 30 June 2006

South Australia		Victoria	
Rate (m/y)	Zones	Zones	Rate (m/y)
0.65	11A	11B	0.65
0.65	10A	10B	0.65
0.65	9A	9B	0.65
0.05	8A	8B	0.65
0.05	7A	7B	0.05
0.05	6A	6B	0.05
0.25	5A	5B	0.25
0.25	4A	4B	0.25
0.25	3A	3B	0.25
0.25	2A	2B	0.25
0.25	1A	1B	0.25

5. Amendments to the Agreement

The Agreement provides for the Review Committee to make recommendations to the Contracting Governments regarding changes to the Agreement that it thinks necessary or desirable.

During the previous 5-year management review (1996–2000) the Review Committee identified that the current management prescriptions were drafted with only the Tertiary Limestone Aquifer in mind. They enabled only broad-based management to be applied. This has served well to date, but is no longer adequate due to the increased demand for groundwater resources and the need for more targeted management approaches that can be applied to specific circumstances, aquifer types, geologic and hydraulic conditions.

The Premiers of South Australia and Victoria entered into an Amending Agreement on 30 May 2006 to:

- distinguish between aquifers and enable sub-zones to be established for more effective local management;
- allow management prescriptions to be set for the different aquifers and sub-zones within a zone;
- revise the management prescriptions for potentiometric surface lowering and salinity increase so that they can be more effectively applied; and
- update references to other legislation.

Complementary legislation in each State is being pursued to give effect to the Amending Agreement. The Victorian Parliament passed amending legislation on 16 November 2005 to ratify the Amendment Agreement. Amending legislation was submitted to the South Australian Parliament on 31 May 2006.

6. Metering/volumetric conversion

The Review Committee in its previous 5-year management review recommended that water metering be adopted so that groundwater extraction can be more accurately determined for both assessment and management purposes.

The Review Committee notes that the current program by the South Australian Government to convert crop area based water allocations to volumetric allocations in both the Mallee and the South East including the Designated Area was originally scheduled for mid 2006. The program has been extended to 2007 to allow for further public consultation on the review of the water allocation plans for the prescribed wells areas.

7. Management areas

The Review Committee has extended observer status to the regional water resource planning and management authorities to maintain the participation of the agencies in the Review Committee's work. The Review Committee has provided technical liaison between the State agencies for the 5-year review of the groundwater resources in the Murrayville and Neuarpur Water Supply Protection Areas and in the prescribed wells areas in the Mallee and South East of South Australia.

In particular the Review Committee has also maintained an overview of groundwater levels in the Mallee (SA) and Murrayville (Victoria) areas in response to water extractions.

8. 5-year Management Review 2001 - 2005

The Review Committee has been actively involved in the preparation of its 5-year Management Review 2001-2005 as required by the Border Groundwaters Agreement. The Review Committee has conducted a technical review of the current status of the Tertiary Limestone Aquifer, groundwater level trends and salinity and its understanding of the hydrogeology of the regional aquifer systems.

In response to the current status of the resources and trends, the Review Committee is preparing recommendations to both States on the management prescriptions specified in the Border Groundwaters Agreement and other influences affecting the availability of groundwater within the Border Designated Area.

The Review Committee was also requested by the Victorian Minister for Water to review the appropriateness of the 20km wide boundaries of the Designated Area either side of the border. The Review Committee will provide its advice on this matter in the 5-year Management Review report.

9. Technical work program

The Review Committee identified a range of emerging issues that needed to be addressed in its 5-year management review (1996–2000). The key issues identified were:

- maintenance and enhancement of the metering, monitoring and review program;
- the impact of groundwater salinisation on the resource;
- the impact of forest plantations on recharge;
- the impact of climate change on recharge; and
- groundwater allocation for the environment.

A staged 5-year work plan program for the period July 2001 to June 2006 was developed in 2001-02 (BGARC, 2002) by the Review Committee in conjunction with the State agencies. Considerable progress was made during the year towards completing this program. The key technical reports that contributed to the assessment of the groundwater resources along the South Australia – Victoria border over the last 12 months are:

- Assessment of the impacts of climate variability and change to groundwater in Province 1 and 2 of the South Australian – Victorian Designated Area, Sinclair Knight Merz, April 2005;
- 5-year technical review of the Neuarpur WSPA Groundwater Management Plan, Sinclair Knight Merz, April 2005;
- Review of groundwater patterns and trends in the Designated Area, Border Groundwaters Agreement Review Committee. Report prepared by R. Nott and O. Juma Department of Sustainability and Environment, May 2005;
- 5-year technical review of the Murrayville WSPA Groundwater Management Plan, Nolan ITU, November 2004.

10. Condition of the resource

A recent review of groundwater water level trends based on the observation bore monitoring network (Figure 5) (a summary of which is contained in Appendix A) has identified:

- water level declines in two areas of the Tertiary Limestone Aquifer, (Zones 5A, 6A, 5B and 6B) and the southern region (Zones 1A, 2A, 3A, 1B, 2B and 3B);
- managed declines in groundwater levels in the Tertiary Limestone Aquifer in part of Zone 9A, Zones 10A, 10B and parts of Zones 11A and 11B; and
- stable groundwater levels in the remaining areas of the Tertiary Limestone Aquifer in the Designated Area. (Figures 6 and 7 illustrate the distribution of the water level trends for the Tertiary Limestone Aquifer and the Tertiary Confined Sand Aquifer, respectively.)

In the Mallee where the Tertiary Limestone Aquifer is confined, extraction results in a pressure response in the aquifer. The rate of recharge is very low and has been taken as zero, but the aquifer has a very large volume of groundwater in storage. The management prescription for the area provides for productive use of a small percentage of the resource. Numerical modelling predicted that with extraction groundwater levels would decline initially then flatten out over time. Monitoring of water levels shows that groundwater levels have stabilised since 2002 for the current level of extractions.

Groundwater declines in Zones 5A - 5B and part of 6A and 6B are caused by a combination of groundwater extraction and reduced groundwater recharge because of lower than average rainfall in recent years.

In the southern area there are three principal factors affecting water level decline: groundwater extraction, reduced rainfall and the effects of land use change, particularly the expansion of plantation forests.

All water use, other than stock and domestic, is metered in the Designated Area in Victoria.

In South Australia, water extractions are now fully metered in the Mallee (part of Zone 9A, 10A and 11A) and meters are progressively being installed in the South East (Zones 1A – Part of 9A).

The Review Committee is mindful of the declining trends in Zones 1A, 1B,2A,2B, western part of 3A and south western part of 3B, and Zones 5A, 5B, southern part of 6A and southern part of 6B and is considering their implications and will propose strategies to address the situation in its forthcoming 5-year management review. This will be done in collaboration with the water management authorities in each State.

11. Land use change and the groundwater budget

It is well established that land use changes can have a significant impact on groundwater recharge rates and hence the water budget of the aquifer. The most common impact is the clearing of native vegetation, leading to an increase in the recharge rate, which has in places resulted in rising groundwater levels. In some locations this has resulted in the mobilisation of salts stored in the soil profile being flushed down to the water table in Province 2.

Conversely the development of extensive plantation forests reduces the recharge compared to open pasture. The location where forest plantations will have a significant impact on groundwater supplies is in Province 1 where extensive plantation forests have been developed in this region over the last half-century.

The Review Committee is considering the matter of these changed recharge rates as part of its next 5-year Management Review 2001-2005.

12. Funding

In Victoria:

- the Department of Sustainability and Environment is responsible for the overarching management of the State's water resources and requirements to meet State priorities and interstate and national obligations. The Department undertakes investigations, groundwater monitoring and the State Water Inventory; and
- two water authorities in the Designated Area, Grampians Wimmera Mallee Water Authority and the Southern Rural Water Authority, are responsible for licensing of groundwater extractions and bore construction. The Authorities provide direct contact with groundwater users in allocating the resource, managing areas of intense development and resolving complaints.

In South Australia:

- investigation, monitoring, water allocation licensing and resource management are the responsibility of the Department of Water, Land and Biodiversity Conservation; and
- community based policy, management and water allocation planning is undertaken in South Australia by the South Australian Murray-Darling Basin Natural Resources Management Board and the South East Natural Resources Management Board.

Table 8 sets out the level of funding for 2005-2006.

The funding, as reported, broadly reflects the priorities of the Review Committee with the significant exception of the investigation into the salt accession processes in the Designated Area. National Action Plan for Salinity and Water Quality funding has been allocated for this project for Zones 4A, 5A and 6A in South Australia and Zone 2B in Victoria. Further funding is required particularly for Victoria in Zones 5B, 6B and 7B.

Table 8 Funding for 2005- 2006

State	Investigations	Monitoring	Resource Management	Agreement Management	Total
Victoria	\$100,880	\$54,539	\$79,720	\$53,539	\$288,678
South Australia	\$90,000	\$115,000	\$125,000	\$78,000	\$408,000
Totals	\$190,880	\$169,539	\$204,720	\$131,539	\$696,678

FIGURES

Figure 1 The Designated Area, zones and hydrogeological provinces

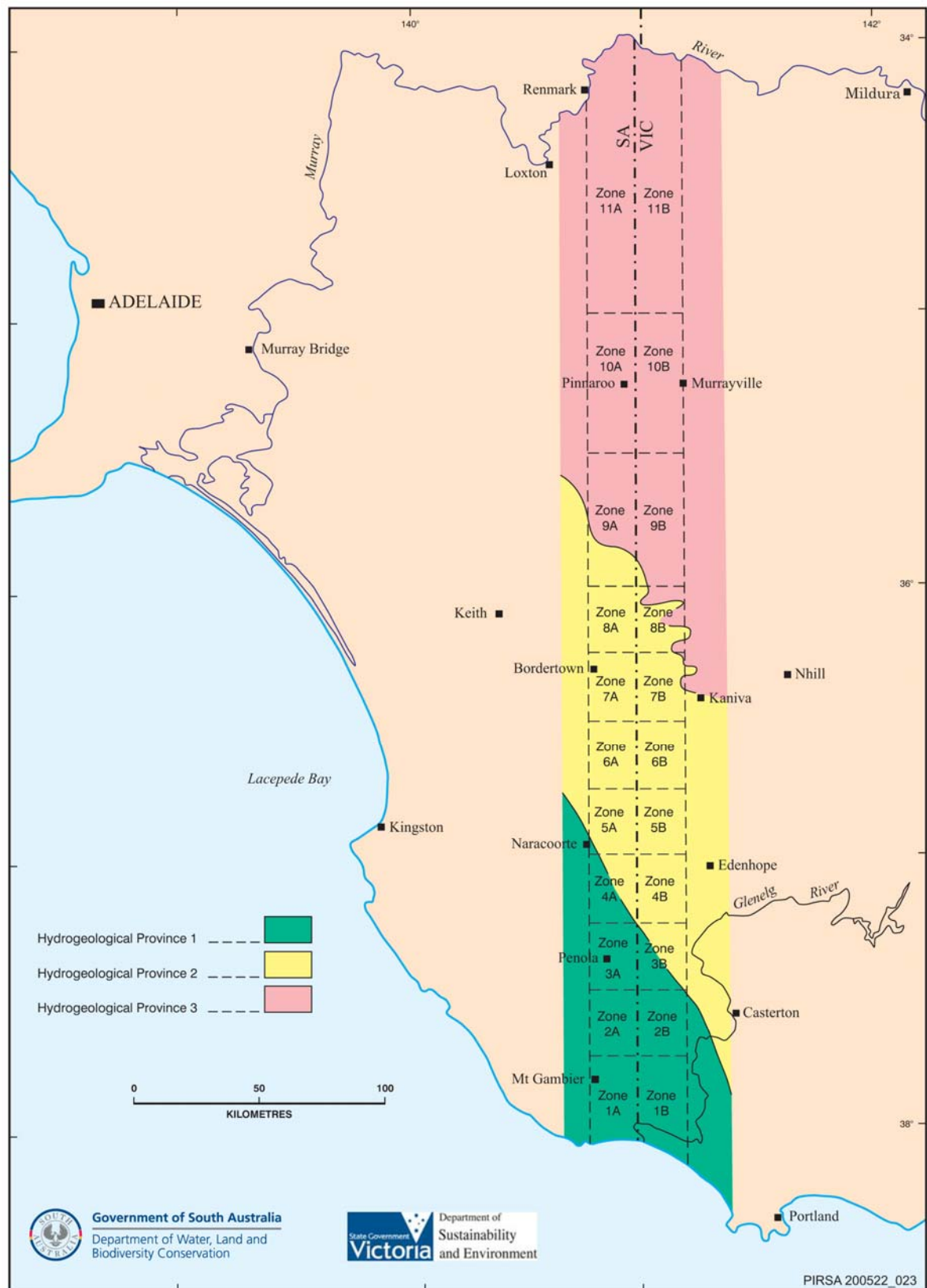


Figure 2 Relationship of other management areas in Victoria and South Australia to the Designated Area

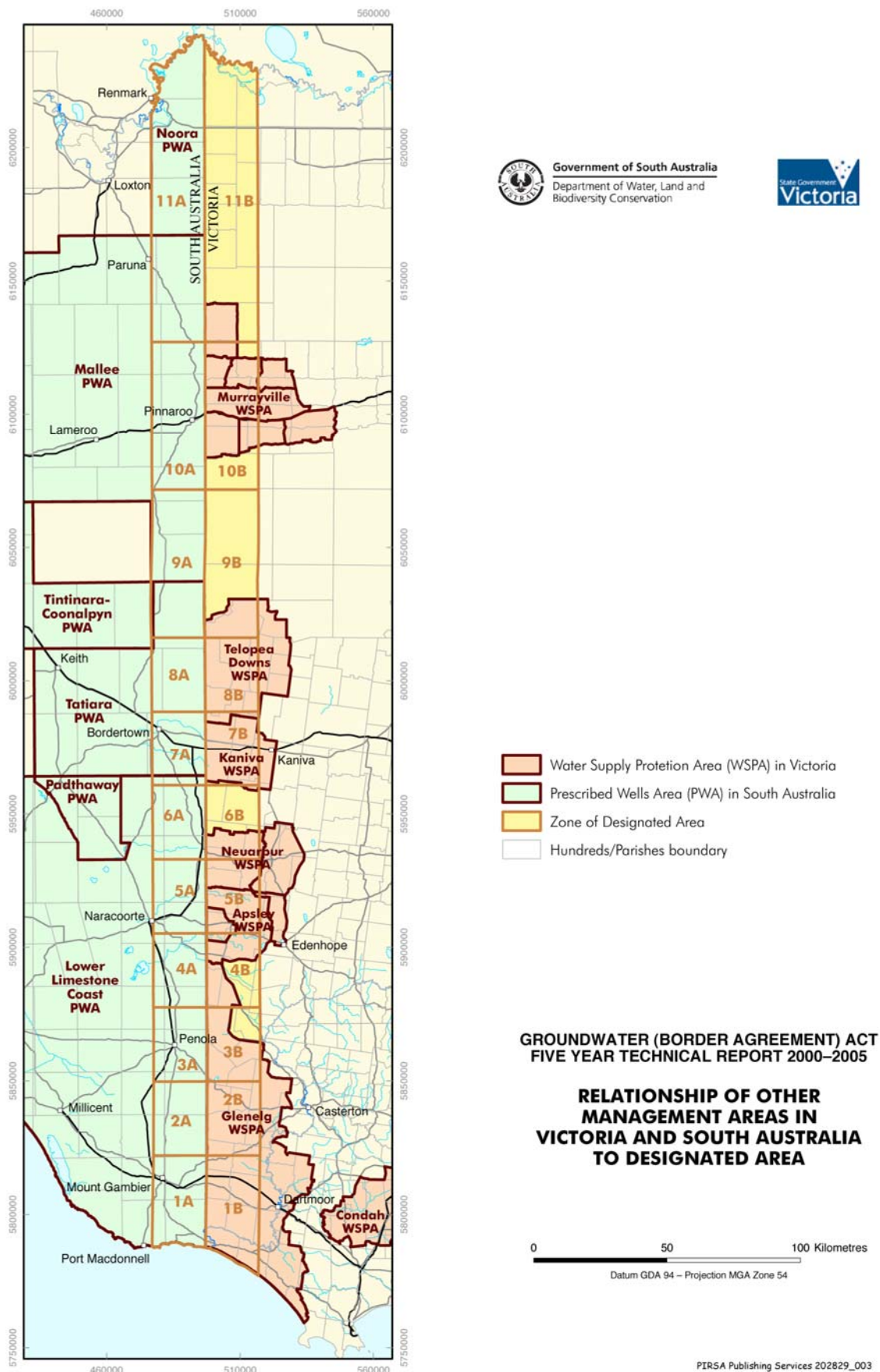


Figure 3 Schematic representation of relationship between Permissible Annual Volume and Allowable Annual Volume

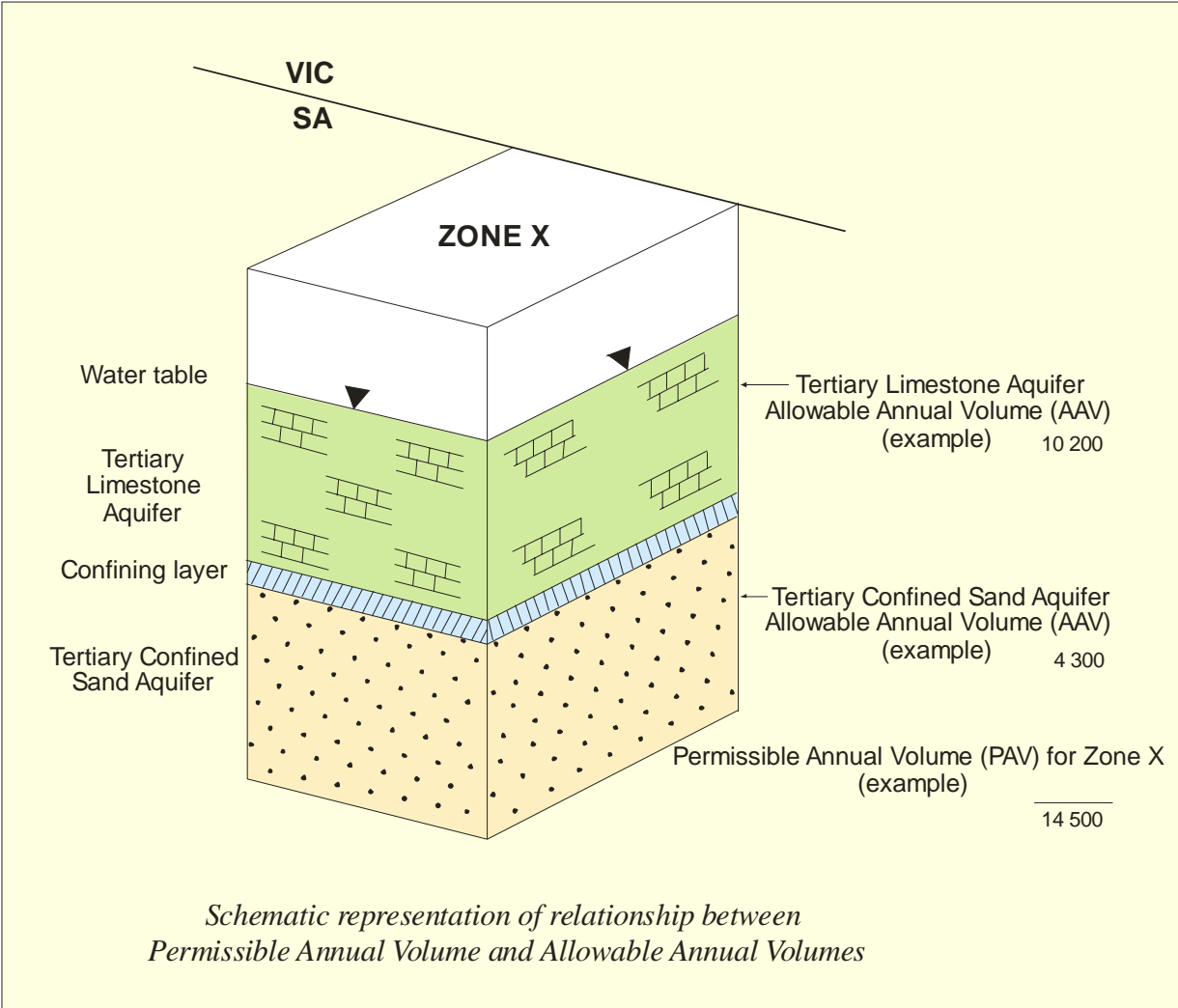


Figure 4 Tertiary Confined Sand Aquifer groundwater management Zones

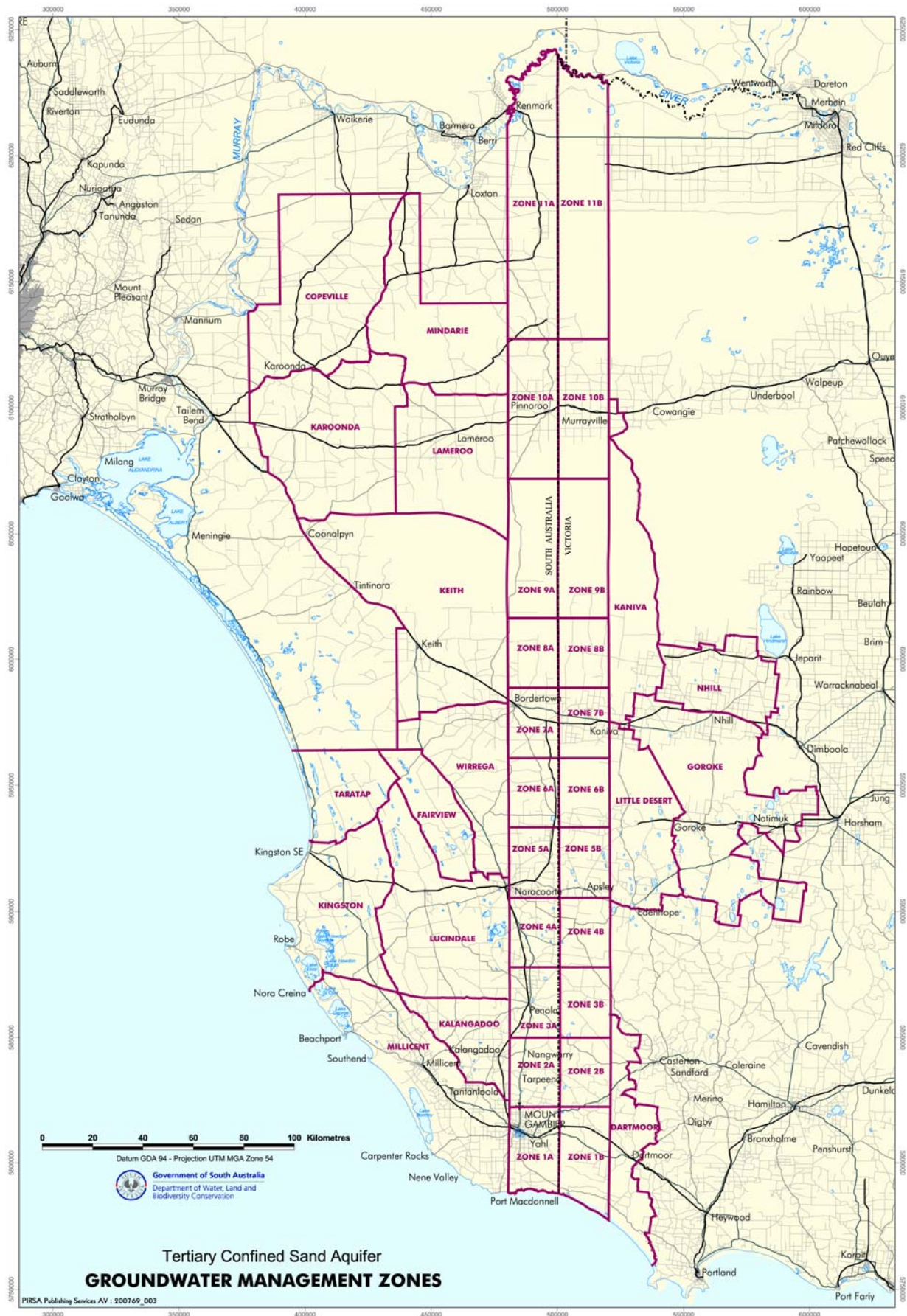
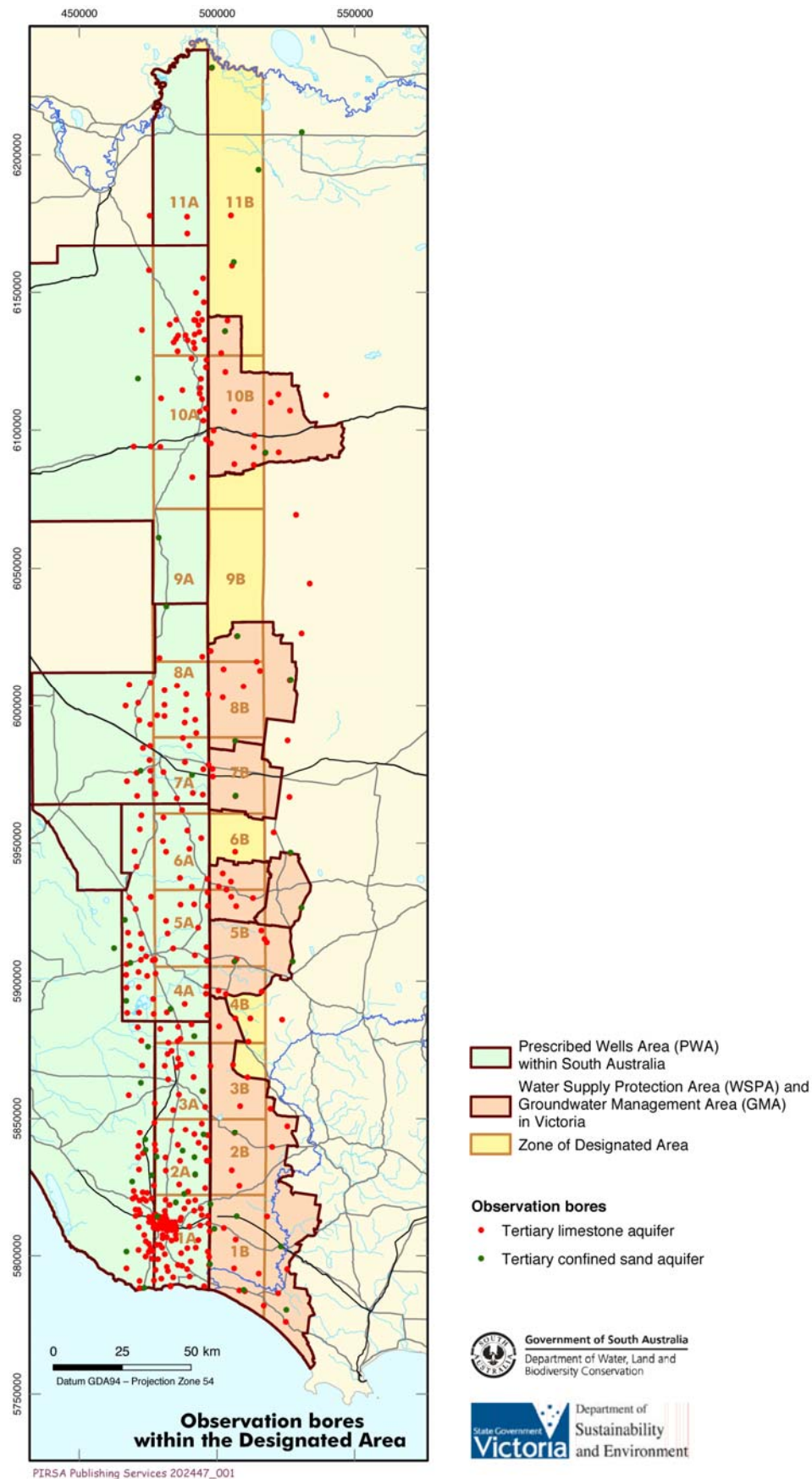


Figure 5 Observation bores within the Designated Area



GROUNDWATER (BORDER AGREEMENT) ACT

Figure 6 Map of groundwater level trends for the Tertiary Limestone Aquifer

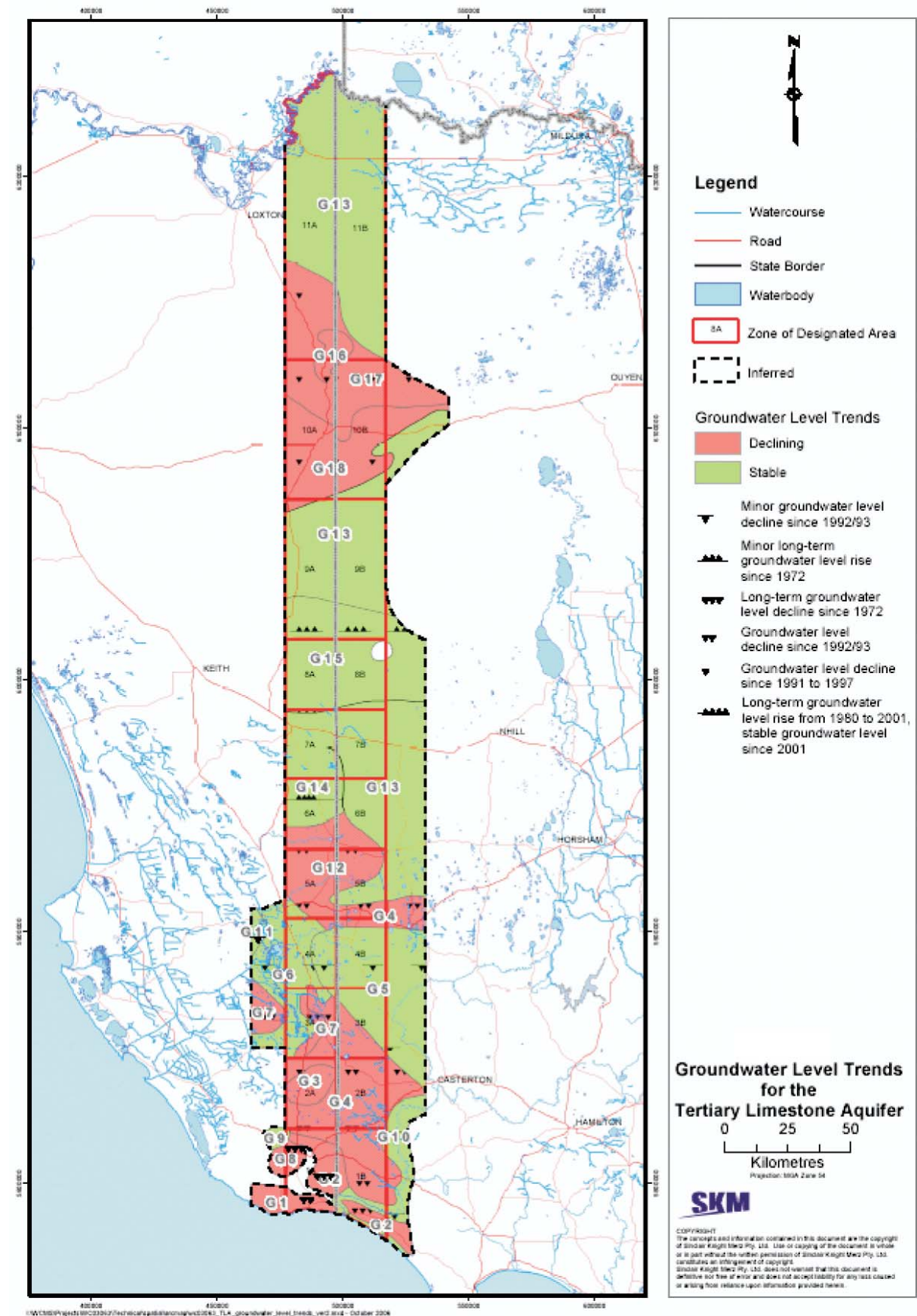


Figure 7 Map of groundwater level trends for the Tertiary Confined Sand Aquifer

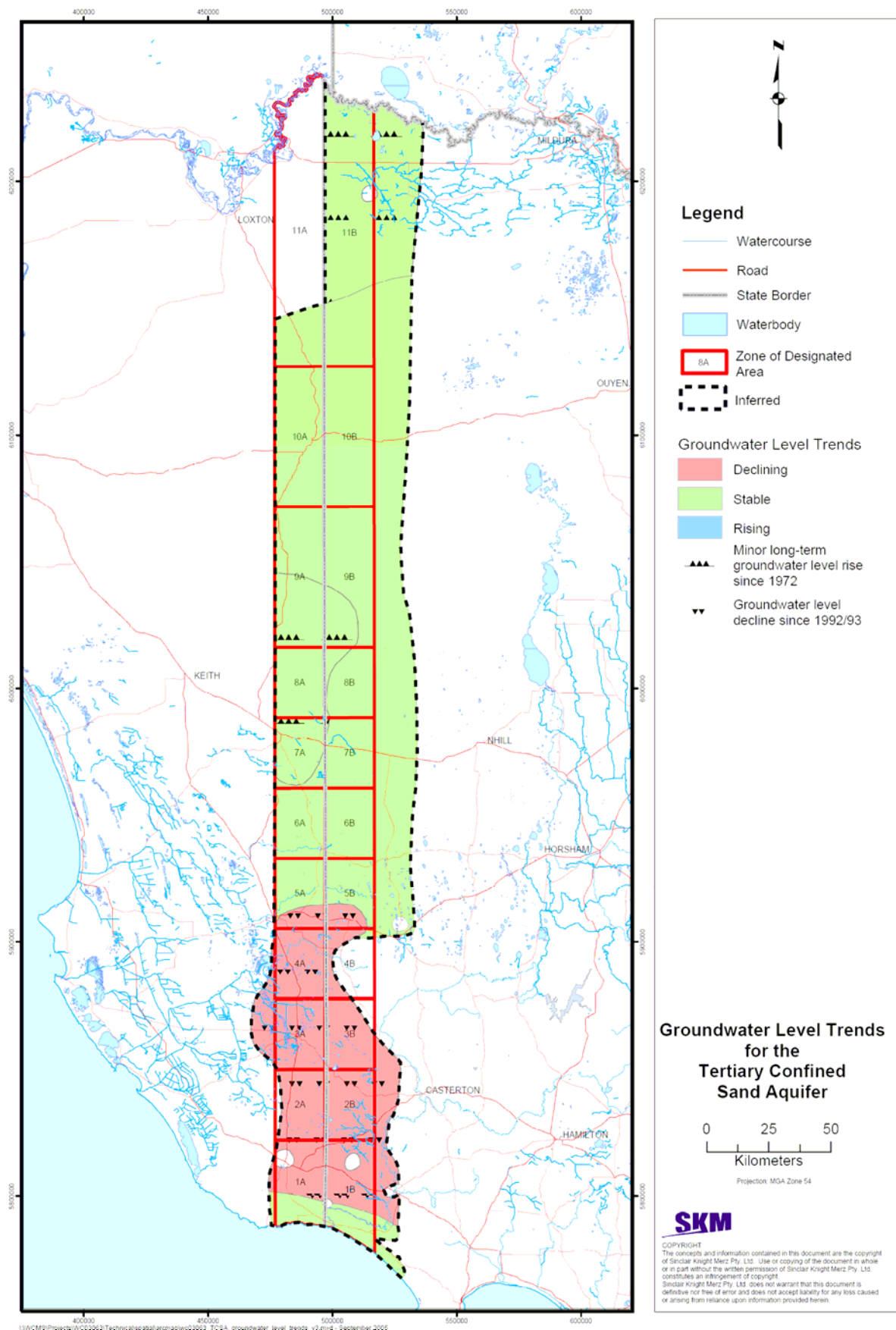
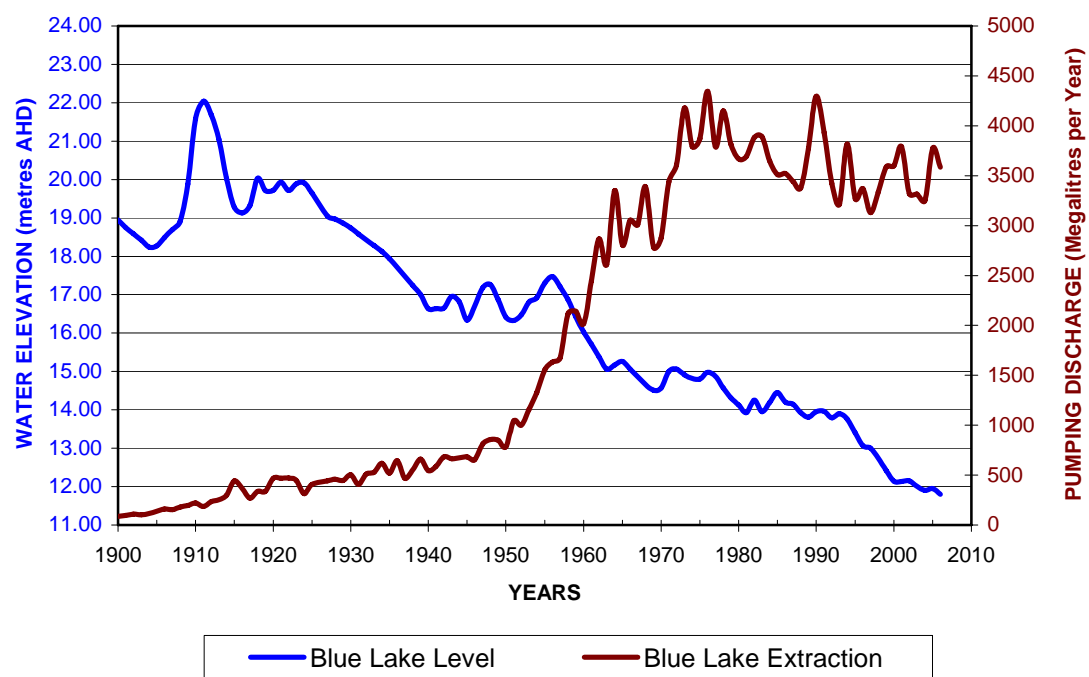


Figure 8 Water levels in Blue Lake, Mount Gambier, South Australia



Appendix A - Groundwater level trends

Groundwater level trends⁷ in the Designated Area are assessed annually as part of the Review Committee's work program. As part of the current 5-year review, a technical review of groundwater level trends was undertaken on all observation bores (~ 300, see Figure 5) in the Designated Area.

The assessments involved grouping bores of similar water level patterns and were sorted according to whether the long-term trends in recovered water levels were stable, declining or rising. Figures 6 and 7 illustrate the distribution of the water level trends for the Tertiary Limestone Aquifer and the Tertiary Confined Sand Aquifer, respectively.

The pertinent findings of the review are summarised below.

TERTIARY LIMESTONE AQUIFER

Stable water level trends (Shown in green on Figure 6)

Stable groundwater level trends occur over a significant portion of the Designated Area.

Where these areas occur in the Mallee (Zones 11B, 11A (the northern part), 8A, 8B, 7A, 7B and 6B (northern part) there is low groundwater extraction either because the groundwater quality is unsuitable or due to land use (eg National Parks - Sunset, Big Country and Little Desert).

In Zones 6A (northern part) and 7A groundwater levels rose by 2m during the period 1980 to 2001. The rise has been attributed to increased recharge following historic clearance of native vegetation (BGARC, 2004). Levels stabilised in 2001.

The area between Penola and Naracoorte in Zone 4A has stable water level trends but large seasonal drawdowns due to groundwater extraction. It is considered that groundwater use in this area is sustainable in respect to yields, as the long-term trends in recovered levels are stable.

Declining water level trends (Shown in red on Figure 6)

There are three regions where water levels have declined. These are:

- Zones 10A, 10B and 11A (southern part) of Province 3
- Zones 5A, 5B and 6A (southern part) and 6B (southern part) in Province 2; and
- Zones 1A, 1B, 2A, 2B, 3A (western part) and 3B (south western part) in Province 1.

⁷ "Water level/potentiometric level" - Throughout this review the term "water level" is used to mean potentiometric level either as a standing level, relative level or total hydraulic head. This has been done for convenience, noting that in:

- (i) confined aquifers it represents the level that water will rise in a bore; and
- (ii) in unconfined aquifers it is the water table.

The aquifer is confined in Province 3 and is distant from recharge areas. Consequently the aquifer does not respond to seasonal recharge from rainfall. The decline in groundwater level and the cone of depression that has formed in this region centred at Peebinga (eastern part of 10A), is an area of concentrated irrigation development.

The drawdown is a pressure response for which the Review Committee has established management targets documented in the 5-year management review (BGARC, 2001). Monitoring of water levels shows that groundwater levels have stabilised since 2002.

In Zones 5A, 5B, 6A (southern part) and 6B (southern part) in Province 2 water levels have declined in the order of 0.18m/y since 1992-93. The decline is attributed primarily to below average rainfall since the early 1990s and groundwater extraction. The aquifer is 100 m thick in this area providing a large groundwater storage volume.

Zones 1A, 1B, 2A, 2B, 3A (western part) and 3B (south western part) in Province 1.

There are a number of distinctive declining water levels trends across this region.

Long-term declining groundwater trends (30 years as observed by the hydrographs) occur in the eastern part of Zone 1A and the area south of the Glenelg River in Zone 1B. Since 1972 the total change in water level over that period is ~3.5m, which equates to a rate of decline of 0.11m/y. The seasonal fluctuation in water levels is negligible indicating little recharge from rainfall or seasonal extraction from groundwater extraction. These areas are located beneath plantation forests and are indicative of the impact that plantation forests have on rainfall recharge.

At Nangwarry (the eastern part of Zone 2A), water levels rose after the plantation forests were burnt during the 1983 bushfire (Stadter 1992). The water level information collated since then shows that groundwater levels are in decline under the plantations and a cone of depression is forming in response the re-establishment of the plantations.

In the Mount Gambier area (the north western part of Zone 1A) the groundwater levels have been in long-term decline since 1925, as observed by the water level in Blue Lake (Figure 8). The hydrographs for the bores show that the water levels have declined ~3.5m since 1972.

The declines at Mount Gambier have occurred even though over the interval 1925 to 1992 there have been periods of above average rainfall. Above average rainfall has not resulted in a long-term stabilisation of water levels.

The coastal area in South Australia (the southern part of Zone 1A) is the area south of Mount Gambier and includes sites of groundwater discharge such as Piccaninnie Ponds. The water levels in the coastal area were relatively stable up until 1997 with negligible seasonal fluctuation. Since 1997 groundwater levels have fluctuated seasonally. The seasonal drawdown is indicative of water level response to groundwater development and extraction. There is a small declining trend in recovered levels since 1997. It is considered that while the rate of decline in the recovered levels is low, the seasonal fluctuations are large and given the proximity to the coast and the potential risk of seawater intrusion, this warrants further investigation and should be given special attention.

The declining water level trends in Zones 2A (west and southern parts), 1B (parts north of the Glenelg River), 2B and 3B began in 1992-93 and since then have declined ~1.5 - 2m (0.12 - 0.16m/y). Prior to 1992 water levels were elevated and ~1m above the level of the previous period 1979-85. Consequently water levels at 2004 are ~1m lower than levels observed during the early 1980s.

TERTIARY CONFINED SAND AQUIFER

Stable water level trends (Shown in green on Figure 7)

Groundwater level trends in the Tertiary Confined Sand Aquifer have been stable throughout Province 2 and Province 3 of the Designated Area. There is negligible groundwater extraction from the Tertiary Confined Sand Aquifer in these provinces.

Groundwater levels have been stable in the coastal area in Province 1. This area is where the potentiometric level of the Tertiary Confined Sand Aquifer is higher than the water table of the Tertiary Limestone Aquifer.

Declining water level trends (Shown in red on Figure 7)

Declining water level trends began in Province 1 of the Tertiary Confined Sand Aquifer in 1993 and by 2004 water levels had fallen 2m. The water level trend in the Tertiary Confined Sand Aquifer is reflected by the declining trends in the Tertiary Limestone Aquifer.

The cause of the declining water level trends in the Tertiary Confined Sand Aquifer is of interest. There is negligible extraction in the Tertiary Confined Sand Aquifer. The declines are attributed to either a pressure response or a leakage response arising from reduced groundwater in storage in the overlying Tertiary Limestone Aquifer. The cause of the declines is being investigated.

The water level trends seem to have stabilised in five bores since 2000. However, there is uncertainty as three bores have continuing declining level trends.

GLOSSARY

Aquifer. A geological structure or formation or an artificial landfill permeated or capable of being permeated permanently or intermittently with water.

Allowable Annual Volume. The allowable volume of extraction, which is specified, for each aquifer within a zone of the Designated Area, which is a component of the Permissible Annual Volume for the zone. (Figure 3)

Designated Area. An area 40 km wide and centred on the South Australia - Victoria Border and is the area to which the *Groundwater (Border Agreement) Act 1985* applies.

Permissible Annual Volume. The Permissible Annual Volume of extraction that is prescribed for each zone of the Designated Area. It is the maximum volume that may be authorised for extraction.

Permissible distance. Is the distance from the South Australian/Victorian border within which all applications for licences must be referred to the Review Committee to determine whether the licence should be issued.

Permissible rate of potentiometric surface lowering. Means an average annual rate of lowering within a zone as prescribed under the Agreement or has been agreed by the Minister for each Contracting Government.

Permissible level of salinity. Means a certain level of salinity within a zone as has been agreed by the Minister for each Contracting Government.

Prescribed Wells Area. Means an area declared to be prescribed under the South Australian *Natural Resources Management Act 2004*. Prescription of a water resource requires that future management of the resource be regulated via a licensing system.

Tertiary Limestone Aquifer. Comprises aquifers in the Murray Group, Heytesbury Group, Coomandook Formation, Bridgewater Formation and Padthaway Formation, called collectively the Tertiary Limestone Aquifer, the base of which is identified as marl or black carbonaceous silt, sand or clay.

Tertiary Confined Sand Aquifer. Comprises aquifers in the Wangerrip Group and Renmark Group, below the Tertiary Limestone Aquifer.

Water Supply Protection Area. An area declared under the Victorian *Water Act 1989* to protect the area's groundwater or surface water resources through the development of a management plan, which aims for equitable management and long-term sustainability.

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