Water Allocation Plan

South East Catchment Water Management Board

Supported By
Government of South Australia

COMAUM-CAROLINE PRESCRIBED WELLS AREA

Water Resources Act 1997

Water Allocation Plan

for the

Comaum-Caroline Prescribed Wells Area

I, Mark Brindal, Minister for Water Resources, hereby certify that this plan is the Water Allocation Plan for the Comaum-Caroline Prescribed Wells Area adopted by me on 29 June 2001 and amended pursuant to section 118 of the *Water Resources Act 1997*.

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Hon Mark Brindal MP
Minister for Water Resources

Date: 4/10/01

Prepared by

South East Catchment Water Management Board

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1 The Comaum-Caroline Prescribed Wells Area

This document is the Water Allocation Plan for the Comaum-Caroline Prescribed Wells Area, pursuant to Part 7, Division 3 of the *Water Resources Act 1997.* This Water Allocation Plan replaces the Comaum-Caroline *Water Allocation Plan* as varied by the Plan published in the Government Gazette on 27 July 2000, for the Comaum-Caroline Prescribed Wells Area.

The Comaum-Caroline Proclaimed Region was gazetted on 9 January 1986 under the provisions of the *Water Resources Act 1976*. Upon the introduction of the *Water Resources Act 1997* the Comaum-Caroline Proclaimed Region became known as the Comaum-Caroline Prescribed Wells Area.

The Comaum-Caroline Prescribed Wells Area (PWA) covers an area of approximately 1900 km^2 and comprises the Hundreds of Caroline, Gambier, Mingbool, Nangwarry, Penola, Comaum and the eastern portion of the Hundreds of Killanoola, Monbulla, Grey, Young, Blanche and MacDonnell. The western boundary of the Comaum-Caroline PWA is denoted by the western edge of the Designated Border Area (*Groundwater (Border Agreement) Act 1985),* which extends twenty kilometres west from the South Australian/Victorian Border. The PWA includes the zones 1A, 2A, 3A and the southern part of Zone 4A of the Designated Border Area. It also incorporates the City of Mount Gambier, the townships of Tarpeena, Nangwarry, Penola, Coonawarra, Donovans and the localities of Comaum, Millel, Yahl and Rennick (see Figure 1.1).

The climate in the Comaum-Caroline PWA is typical of the South East with hot, dry summers and cool, wet winters. The mean annual rainfall in Mount Gambier is 778 mm per annum (Mount Gambier Post Office, 1860-1975). Mean annual rainfall decreases northwards to 658 mm per annum at Penola (Penola Post Office, 1961 to present). The annual potential evapotranspiration is approximately 1400 mm in the south of the PWA increasing to more than 1500 mm in the northern portion of the PWA.

A total of 14,518 hectares of irrigated crops were grown in the Comaum-Caroline PWAs in 1998/99, representing 8% of the total land area in the PWA. Land use in the Comaum–Caroline PWA is mainly open pastures and forestry plantations (softwood and blue gum). Irrigated crop types have generally remained unchanged since the mid-1980s. Major underground water users include irrigated pasture for dairying and other grazing (6430 ha) in the southern portion of the PWA, viticulture in the Coonawarra area (5094 ha) (Zone 3A and Part Zone 4A) and potato growing (794 ha).

The Comaum–Caroline PWA generally consists of a low-lying coastal plain that gently rises from the coast in the south to ~70 m above sea level in the north of the area. In the north-eastern portion of the PWA the Kanawinka Fault separates the coastal plain from the elevated Naracoorte Ranges which rise 30 to 40 m above the elevation of the plain. To the south of Mount Gambier city is the topographic high of the Blue Lake and further south is Mount Schank which together are the two most prominent examples of the Mount Gambier Volcanic Complex in the area.

The Prescribed Resource

The prescribed water resources of the Comaum-Caroline Prescribed Wells Area consist of two distinct underground water aquifer systems. The first of these is the unconfined Tertiary Limestone Aquifer system (known generally as the unconfined aquifer), and the second is the lower Tertiary Confined Sand Aquifer (known generally as the confined aquifer).

Unconfined Aquifer

The unconfined aquifer is a multi-lithological system, which is hydraulically continuous throughout the PWA. Underground water flow in the aquifer is mainly through the Gambier Limestone Formation in both the Naracoorte Ranges and coastal plain. On the plain significant underground water flow occurs through the Padthaway and Bridgewater Formations where they are present. Underground water flow radiates out from the Nangwarry-Tarpeena area in a northerly, westerly, and southerly direction in the Comaum-Caroline PWA. Generally, underground water flow is in the south to south westerly direction.

The unconfined aquifer can be as little as ~10 m thick in the Nangwarry-Tarpeena-Glencoe area (Figure 1.2), increasing to more than 300 m thick south of Mount Gambier. The depth to water varies relative to topography. Generally the depth to water is less than 5 m on the plain and up to 20 m in the Ranges. The unconfined aquifer contains water of a high quality throughout the area as salinities vary between <500 and 1500 mg/L TDS (Total Dissolved Solids).

A well developed secondary porosity in the limestone in the southern portion of the PWA has resulted in the development of numerous karst (dissolution) features such as Ewens Ponds and Piccaninnie Ponds.

Confined Aquifer

In the Comaum–Caroline PWA the unconfined and confined aquifers are separated by a low permeability clay aquitard and the depth to the confined aquifer is generally more than 75 metres. However in the Nangwarry-Tarpeena area the depth to the aquitard is relatively close to the ground surface (~10 metres) and it is thin (possibly absent in some areas.). The salinity of the Confined Aquifer within the Comaum-Caroline Prescribed Wells Area is generally of a high quality (<500 -1000 mg/L TDS).

The confined aquifer in the Nangwarry-Tarpeena area is effectively a dome structure, which deepens rapidly away from this area most distinctly southwards towards the coast. (Refer to Figure 1.2) The confined aquifer in the South East region is essentially a ‘hidden’ aquifer, that is, there are very few locations where the aquifer outcrops at the surface. The Nangwarry-Tarpeena area has been identified as one of the areas where the confined aquifer is close to the surface, and where recharge from rainfall could occur. The area is, however, extensively covered in radiata pine and blue gum forest plantations, which may preclude future recharge.

There are very few confined aquifer wells in the Comaum–Caroline PWA. The two main reasons for this are considered to be because of the availability of good supplies of quality water from the unconfined aquifer, and the prohibitive cost of drilling a well into the aquifer (especially in the southern portion of the PWA where the depth to the aquifer can be more than 300 metres).

2 Assessment of the Needs of Dependent Ecosystems

The needs of ecosystems include both the local influence of underground water within an ecosystem and the influence on receiving environments downstream.

Ecosystem Water Needs

In ecosystems dependent on underground water currently undisturbed by the taking and use of underground water, the current conditions (that account for natural patterns such as climate) can be considered as providing the water needs of the ecosystem in question. Where undisturbed water dependent ecosystems have been identified, the underground water data available during October 2000 has been interpreted as the Ecosystem Water Needs of these ecosystems (see Table 2.1). For ecosystems subject to changing underground water conditions, the data that describes the most recent steady state underground water conditions has been interpreted from available records and adopted as the Ecosystem Water Needs (Table 2.1).

Water needs were collectively described for ecosystems sharing common environments, termed land units, in which current underground water conditions and trends were consistent. Seven land units were identified within the Comaum-Caroline PWA (Figure 2.1). These land units are the:

- Naracoorte Ranges in the north east of the PWA;
- Penola Wetlands comprising the flats of the Penola and Coonawarra districts;
- Penola Forest;
- Dismal Swamp;
- Myora Caroline Forest; and
- the Gambier Limestone along the south coast.

The quantity of underground water which ecosystems need was described in terms of water table elevation and underground water quality. Underground water quality was described in terms of salinity and nitrate (where available) levels.

Ecosystems Dependent on Underground Water in the Comaum-Caroline PWA

Naracoorte Ranges Land Unit

The Naracoorte Ranges Land Unit is located in the area north east of the Kanawinka Fault, comprising the dune ridge of Bridgewater Formation and plateau of Gambier Limestone. The following water dependent ecosystems were identified as present, or are likely to be present within the Naracoorte Ranges Land Unit:

- Wetlands – Several wetlands lie in enclosed depressions at elevations close to the water table. Durr Swamp and a wetland at Windingi lie at elevations of 95 and 75 m respectively and may receive underground water discharge. The Naracoorte

Ranges Land Unit also includes a number of perched wetlands. Rule Swamp, a perched wetland near the Victorian Border, interacts with the underground water environment by draining to a runaway hole (or karst feature) at its perimeter.

- Phreatophytes – There are a number of native vegetation remnants throughout the land unit that are usually associated with shallow underground water tables and may be dependent on the unconfined aquifer. The associations likely to be dependent on underground water include *Eucalyptus ovata* / *E. viminalis* Woodland and *Eucalyptus camaldulensis* var. *camaldulensis* Woodland.

- Karst Systems – Apart from the runaway hole recorded near Rule Swamp, there is no further information available on the karst systems that may be present within this land unit. There are likely to be other karst systems in existence throughout this area, but their position, whether they intersect the underground water table or the nature of the biota they support remains unknown.

- Hypogean Ecosystems – These ecosystems, where present, occur underground within the water filled pore spaces of aquifer systems, and may consist of macro-invertebrates and micro-organisms. There are no records of such ecosystems within the Naracoorte Ranges Land Unit. However, these ecosystems are likely to exist within this area.

Penola Wetlands Land Unit

The Penola Wetlands Land Unit comprises the low lying area between the Naracoorte Ranges in the north and the Penola Forest in the south and west. The geology is characterised by the Padthaway Formation overlying Gambier Limestone The following ecosystems dependent on underground water were identified as present or are likely to be present within the Penola Wetlands Land Unit:

- Wetlands – There are numerous wetlands throughout the area, distributed to the east, south and west of Penola. These consist of shallow depressions which are generally unconnected by watercourses. A number of these systems are semi-permanent, including Sawpit Swamp and Horseshoe Paddock and lie within 1m of the water table. Water may be maintained in these wetlands through interaction with underground water through either discharge or reduced seepage.

- Phreatophytes – Scattered mature *Eucalyptus camaldulensis* occur throughout the area. These trees exceed 10 metres in height and are likely to be dependent on underground water, which lies less than 2 metres below the surface. Some intact remnants of *Eucalyptus camaldulensis* var. *camaldulensis* Woodland are also present, along with other communities which are likely to be underground water dependent including *Melaleuca halmaturorum* Tall Shrubland, *Typha domingensis* Closed Sedgeland, *Eucalyptus ovata* /*E. viminalis* Woodland and *Pteridium esculentum* Closed Fernland with emergent *Eucalyptus* species.

- Karsts – There are likely to be karst systems within this area, but it is not known where they exist, whether they intersect the underground water table or what biota they support.

- Hypogean Ecosystems – These macroinvertebrate and microbial ecosystems, where present, occur underground within the water filled pore spaces of aquifer systems. There are no records of such ecosystems within the Penola Wetlands Land Unit. However, these ecosystems are likely to exist within this area.

Penola Forest Land Unit

The geology of the Penola Forest Land Unit is Quaternary Molineax Sand overlying Padthaway Formation and Gambier Limestone. The following ecosystems dependent on underground water have been identified as present or are likely to be present within the Penola Forest Land Unit:

- Wetlands and Phreatophytes – The Penola Forest Land Unit contains several wetlands which have formed in small enclosed depressions, generally close to the water table. Examples include Paltridges Swamps, Mingbool Swamp, Island Swamp and Nangwarry Swamp. Most wetlands are semi-permanent and may interact with the water table by forming underground water mounds or receiving underground water discharge in spring. These wetlands are often associated with deep rooted phreatophytic vegetation including *Eucalyptus camaldulensis* and *E. ovata*.

- Karst Systems – There are likely to be karsts in this area, but it is not known where they exist, whether they intersect the underground water table or what biota they support.

- Hypogean Ecosystems – These macroinvertebrate and microbial ecosystems, where present, occur underground within the water filled pore spaces of aquifer systems. There are no records of such ecosystems within the Penola Forest Land Unit. However, these ecosystems are likely to exist within this area.

Dismal Swamp Land Unit

The geology of the Dismal Swamp Land Unit is Padthaway Formation underlain by Gambier Limestone. The following ecosystems dependent on underground water have been identified as present or are likely to be present within the Dismal Swamp Land Unit:

- Wetlands – The Dismal Swamp wetlands are characterised by a series of semi-permanent depressions. The wetlands are generally filled by local rainfall and drainage, but in very wet years, sheet flow can be generated across the landscape to the east. The proximity of the water table to the surface indicates that the wetlands are likely to interact with underground water by way of mounding, or that they may be a surface expression of the underground water when the water table is particularly high. These wetlands are generally vegetated with sedges and aquatic plants.

- Phreatophytes – Most of the landscape throughout this area has been cleared of its native vegetation. However, scattered individual trees of *Eucalyptus camaldulensis, E. ovata* and *E. viminalis* occur throughout the area. These trees are generally more than 10 metres tall and are likely to be dependent on underground water,

which lies less than 2 metres below the surface. Intact remnant communities of associations containing these species also occur.

- Karst Systems – There are likely to be karsts in this area, but it is not known where they exist, whether they intersect the underground water table or what biota they support.

- Hypogean Ecosystems – These ecosystems, where present, occur underground within the water filled pore spaces of aquifer systems, and may consist of macro-invertebrates and micro-organisms. There are no records of such ecosystems within the Dismal Swamp Land Unit. However, these ecosystems are likely to exist within this area.

Myora Caroline Forest Land Unit

The Myora Caroline Forest Land Unit consists of the relatively elevated complex of relict dunes and Quaternary sands in the south of the Hundred of Gambier and the north of the Hundred of Caroline. The geology of the area is predominantly Bridgewater formation underlain by Gambier Limestone. The Mount Gambier district features the Quaternary volcanic pyroclasts and basalt flows which make up the Blue Lake Crater and overlie the Gambier Limestone. The following water dependent ecosystems have been identified as present or are likely to be present within the Myora Caroline Forest Land Unit:

- Wetlands – The wetlands in the Myora Caroline Forest Land Unit are considered to be perched and independent of the regional unconfined aquifer. Leg of Mutton and Brownes Lakes in the volcanic craters of Mount Gambier, are shallow and frequently retain water at a higher elevation than the unconfined aquifer. Black Swamp, 5 kilometres east of Mil Lel, lies at 65m AHD over a water table of approximately 57metres AHD and is unlikely to be underground water dependent.

- Karst Systems – The ecosystems dependent on underground water present within the Volcanic crater lakes (eg. Blue Lake and Valley Lake) around Mount Gambier, bare many similarities to those found within the Limestone Karst systems also found throughout the region. Therefore, these ecosystems have been amalgamated for the purposes of this assessment.

  There are many karst systems throughout the Myora Caroline Land Unit, of which Sheathers Cave north of Mt Gambier, Engelbrechts Cave, Blue Lake and Valley Lake in Mount Gambier and Hell's Hole, Caveton Park Estate Cave, Bottlebrush Sinkhole, Caroline Sinkhole and Grundys Woodland south of Mt Gambier are noted for the underground water dependence of their ecosystems.

  The underground water that fills these systems supports aquatic stygobites that are endemic to the South East, including syncarids, amphipods and stromatolite communities. The Blue Lake has the largest stromatolite communities recorded in Australia (>10 metres). These structures in the Blue Lake extend from just below the surface to over 45 metres deep, the deepest stromatolites ever recorded. Caveton Park Estate Cave supports aquatic bacterial colonies which form in sheets. The biology of these colonies is yet to be studied, but they are likely to be endemic.

In a number of features, including Blue Lake, the surface opening is substantial and provides a lake habitat which supports benthic algae, phytoplankton, invertebrates, fish and birds. Hell's Hole is listed on the Register of National Estate for its biological significance, due in part to the presence of the endangered fern *Pteris tremula*, which may be dependent on the underground water fed lake environment.

The depth of the lakes in these features ranges from 4 metres at Caveton Park Estate Cave to over 77 metres in the Blue Lake. Rainfall and runoff contribute little to the aquatic environment created by these features.

- Phreatopytes – No vegetation types dependent on underground water have been identified in the Myora Caroline Forest Land Unit. The depth to underground water is generally considered to be too deep to support phreatophytic vegetation.

- Hypogean Ecosystems – These ecosystems, where present, occur underground within the water filled pore spaces of aquifer systems, and may consist of macro-invertebrates and micro-organisms. There are no records of such ecosystems within the Myora Caroline Forests Land Unit. However, these ecosystems are likely to exist within this area.

Gambier Limestone Land Unit

The geology of this area is predominantly Gambier Limestone, which forms a gently undulating landscape. Dunes of the Bridgewater Formation form rises of up to 20 metres AHD. The coastal area is overlain by Quaternary coastal St Kilda Formation sediments. The following water dependent ecosystems have been identified as present or are likely to be present within the Gambier Limestone Land Unit:

- Streams – The Glenelg River flows through the eastern part of this land unit, where a short reach of the river crosses the Victorian Border. The contribution of underground water flow to the river is likely to be minor in comparison to the substantial surface and underground water catchment which lies within Victoria and includes part of the Grampians high rainfall area. Furthermore, the water table in the vicinity of the Glenelg River lies in the Ewen Ponds – Mt Shank Trough and there is a low hydraulic gradient towards the river.

  Underground water discharge contributes substantially to the flow of a number of streams on the south coast including Eight Mile Creek, Deep Creek and Fifty Four Foot Pond Drain.

- Karst Features - Karst features in the Gambier Limestone land unit fall into two categories, caves and sinkholes, which lie inland, and rising springs near the coast. The following caves and sinkholes are noted for the underground water dependence of their ecosystems:

  - Horse and Cart Sinkhole;
  - Tea Tree Sinkhole;
  - Mushroom Cave; and
  - Hereford Stream Cave.

  All these features support stygobite communities. Hereford Stream Cave has over 250 metres of cave and eight permanent pools. At the southern end of the system water flows out through a permanent underground stream up to 1 metre deep. The

cave supports numerous stygobite aquatic invertebrates, including locally endemic syncarids. Mushroom cave provides habitat for syncarids in a permanent 3 metre deep pool at the base of the cave.

Rising springs are karstic cavities near the coast, which provide discharge points for the water table. The cavities themselves support important and well preserved habitats and also form underground water dependent surface habitats generally comprising a permanent lake, fringing wetland vegetation and a stream draining to the sea. Underground water is the most important source of water in these ecosystems, and small local catchments provide limited and intermittent surface runoff. The ecologically important sinkholes are:

- Pretty Pond which discharges to an artificial drain;
- Stratmans Pond which discharges to Deep Creek;
- Fifty Four Foot Pond which discharges to Fifty Four Foot Pond Drain;
- Unnamed Pond which discharges to an artificial drain;
- Ewens Pond which discharges to Eight Mile Creek;
- Spencers Pond;
- Bones Ponds;
- Crescent Pond;
- Hammerhead Pond;
- Piccaninnie Ponds;
- Tadpole Pond;
- Bugga Bush Pond; and
- Eel Pot Pond.

Ewens Ponds and Piccaninnie Ponds lie within Conservation Parks and provide well preserved examples of an integrated surface and sub-surface underground water dependent ecosystem. Both sites are listed on the Register of the National Estate for their biological significance.

The permanent discharge of underground water to the surface supports reed and sedge vegetation (*Phragmites australis/Typha orientalis*) on the fringes of pools and tea-tree fen closed scrub (*Leptospermum lanigerum/Melaleuca squarrosa*) in the wetland areas. The open water of the ponds supports aquatic biota including vascular plants (eg *Triglochin procerum*) algae and mosses and a variety of fauna including fish, tortoises, water birds and crustaceans.

The Endangered Swamp Antechinus (*Antechinus minimus*) has been recorded in Piccaninnie Ponds Conservation Park. Ewens Ponds provides habitat for rare fish species, the Australian Greyling (*Prototroctes maraena*), and the endemic Ewens Pigmy Perch (*Nannoperca varigata*). This is the most westerly record for the Greyling. The other rising springs are preserved to various degrees and have generally been degraded through drainage and land clearance.

The rising spring ecosystems also support several other threatened plants and animals. These include the Swamp Skink (*Egernia coventryi*) which is listed as Endangered in South Australia, the Olive Whistler (*Pachycephala olivaceae*) and Rufous Bristlebird (*Dasyornis broadbenti*) which are listed as Vulnerable in South Australia, and the Swamp Greenhood Orchid (*Pterostylis tenuissima*) which is listed

as Nationally threatened. These species rely on underground water either directly, or indirectly through plant associations that are directly dependent on underground water. These ecosystems rely on very specific environmental conditions, and appear to be highly susceptible to water level changes.

- Hypogean Ecosystems – These ecosystems, where present, occur underground within the water filled pore spaces of aquifer systems, and may consist of macro-invertebrates and micro-organisms. There are no records of such ecosystems within the Gambier Limestone Land Unit. However, these ecosystems are likely to exist within this area.

Water Needs of Identified Ecosystems Dependent on Underground Water

Table 2.1 sets out the quantity (elevation and annual range), quality (salinity and nitrate concentration where available) and timing (seasonality of maximum and seasonality of minimum) of water needed by the ecosystems identified in each of the seven land units defined within the Comaum-Caroline PWA. The current conditions (as at October 2000) within each land unit have been included to provide a comparison with the identified ecosystem water needs (most recent observed steady state conditions).

Table 2.1: Needs of Identified Ecosystems Dependent on Underground Water

Land Unit	Parameter	Current Conditions at October 2000	Ecosystem Water Needs	Most Recent Observed Steady State Period
Naracoorte Ranges	Salinity	no change	1000-2000 mg/L	1971-2000
	Elevation of water table	decreasing 0.1 m/yr since 1993	70-95 m AHD	1971-1993
	Annual Range	no change	0.1-0.3 m	1971-2000
	Seasonality of Maximum	no change	spring	1971-2000
	Seasonality of Minimum	no change	autumn	1971-2000
Penola Wetlands	Salinity	increasing 100 mg/l in irrigated areas, otherwise stable	200-1100 mg/L	1990
	Elevation of water table	no change	57 to 75 m AHD	1970-2000
	Annual Range	no change	1-2 m	1970-2000
	Seasonality of Maximum	no change	spring	1970-2000
	Seasonality of Minimum	no change	autumn	1970-2000
	Nitrate Concentration	2->20 mg/L	inferred as < 10 mg/L	no data
Penola Forest	Salinity	no change	500-1000 mg/L	1970-2000
	Elevation of water table	decreasing 0.1 to 0.3 m/yr since 1992	55-70 m AHD	1970-1992
	Annual Range	no change	1 m	1970-2000
	Seasonality of Maximum	no change	spring	1970-2000
	Seasonality of Minimum	no change	autumn	1970-2000
Dismal Swamp	Salinity	no change	500-800 mg/L	1970-2000
	Elevation of water table	decreasing 0.2 to 0.3 m/yr since 1993	65 m AHD	1970-1993
	Annual Range	no change	0.5-1.5 m	1970-2000
	Seasonality of Maximum	no change	spring	1970-2000
	Seasonality of Minimum	no change	autumn	1970-2000
Myora Caroline Forest	Salinity	no change	300-700	1980-2000
	Elevation of water table	decreasing 0.1 to 0.3 m/yr since 1993	10-55 m AHD	1970-1993
	Annual Range	no change	<0.2 m	1970-2000
	Seasonality of Maximum	no change	Spring	1970-200
	Seasonality of Minimum	no change	Autumn	1970-200
	Nitrate	> 20 mg/L near Allendale, Mt Gambier	inferred <10 mg/L	no data
Gambier Limestone	Salinity	refer to site records for ecosystems	refer to site records for ecosystems	1975-2000
	Elevation of water table	minor decrease	10-0 m AHD	1971-2000
	Annual Range	no change	<0.1 m	1971-2000
	Seasonality of Maximum	no change	n.a.	1971-2000
	Seasonality of Minimum	no change	n.a.	1971-2000

Glossary

Amphipod	A small (approximately 5mm long) aquatic crustacean found in fresh waters including cave environments.
Hydraulic gradient	Spatial variation in the effective elevation of the water table, which drives lateral flow in underground water.
Hypogean ecosystems	Macroinvertebrate and microbial communities that occur within the water filled pore spaces of the saturated zone.
Invertebrate	An organism with an external skeleton.
Karst Feature	Cavity or cave formed by the solution of limestone by naturally occurring acids.
Macroinvertebrate	An invertebrate greater than 0.5 mm in length.
Microbial	Bacteria, fungi etc. that are invisible to the naked eye.
Phreatophyte	A plant that is dependent on underground water.
Recharge	Water that replenishes the aquifer by infiltration from the land surface.
Saturated zone	The zone in which voids within soils and rocks are completely filled with water, also known as the phreatic zone.
Stromatolite	Layered deposits of calcium carbonate and various other minerals which have been created by the action of living organisms such as microscopic algae, bacteria and other microbes.
Stygobite	An organism which exclusively inhabits underground habitats, such as caves and subterranean waters.
Syncarid	A small (approximately 3 mm long) aquatic invertebrate belonging to an ancient order of crustaceans, the Syncaridae. Their form has changed little over millions of years, and they are sometimes referred to as a living fossil. They are usually found in underground environments and are generally rare.
Through-flow	Lateral passage of underground water, driven by a hydraulic gradient.
Unsaturated zone	Region above the water table through which recharge infiltrates, also known as the vadose zone.
Water table	Upper surface of saturation in the unconfined aquifer.

3 Assessment of Effects on Other Water Resources

Section 101 (4) (b) of the Act requires the Plan to contain an assessment of whether the taking of water will have a detrimental effect on the quality and quantity of water available from any other water resource.

Other water resources within the Comaum-Caroline PWA comprise the following:

- The Glenelg River, and
- Streams including Eight Mile Creek, Deep Creek and Fifty Four Foot Pond Drain; and
- Lakes, including the Blue Lake and Valley Lake; and
- Rising springs, as listed in section 2, including Piccaninnie Ponds and Ewens Ponds.

In addition, as indicated in section 2, there are numerous wetland areas in the Comaum-Caroline PWA

The potential detrimental impacts of taking, or using, water from the unconfined aquifer in the Comaum-Caroline PWA on the quantity or quality of water in the confined aquifer resource, and the impacts taking or using water from the confined aquifer may have on the quantity or quality of water in the unconfined aquifer resource, were also considered, as well as the impacts of taking and use of underground water from the Comaum-Caroline PWA on other water resources in adjacent PWAs.

Glenelg River

The Glenelg River flows through south eastern corner of the Comaum-Caroline PWA, where a short reach of the river crosses the Victorian Border. The contribution of underground water flow to the river is likely to be minor in comparison to the substantial surface and underground water catchment which lies within Victoria and includes part of the Grampians high rainfall area. Furthermore, the water table in the vicinity of the Glenelg River lies in the Ewen Ponds – Mt Shank Trough and there is a low hydraulic gradient towards the river, therefore taking and use are unlikely to have a detrimental impact on the Glenelg River.

Wetlands

Wetlands in the Comaum-Caroline PWA vary in terms of their relationship with, and reliance on, groundwater. While a number of wetlands are perched, ie Rule Swamp in the Naracoorte Ranges Land Unit and wetlands in the Myora Caroline Forest Land Unit, and therefore independent of groundwater, most of the wetlands in the Comaum-Caroline PWA lie at elevations close to the water table, and are likely to form groundwater mounds and receive underground water discharge, as well as surface water. The taking and use of underground water is unlikely to have a detrimental effect on these wetlands.

Streams,Lakes and Rising Springs

The streams, lakes and rising springs listed above are highly dependent on underground water, and underground water discharge contributes substantially to them. Regionally, the water table is declining in the Comaum-Caroline PWA, particularly in the southern part of the area. While the taking and use of underground water in the Comaum-Caroline PWA also contributes to declining water tables and declining through-flow at the coast, the cause of the decline is considered to be predominantly climate, as well as interception of rainfall recharge by plantations. Thus, the taking and use of underground water *alone* will not detrimentally affect the streams, lakes and rising springs in the Comaum-Caroline PWA.

Confined Aquifer

Generally the depth to the aquitard that separates the unconfined and confined aquifers is considerable (>250 m at the southern coast). The aquitard is also often more than 20 m thick and of very low permeability. It is therefore unlikely there would be any detrimental impact on the confined aquifer water resource caused by extraction in the unconfined aquifer. In the southern portion of the PWA the hydraulic head in the confined aquifer is higher than the unconfined aquifer. This means the vertical component of underground water flow is upwards. There is therefore very little possibility of downward leakage of underground water from the overlying unconfined aquifer to the confined aquifer.

In the Nangwarry–Tarpeena–Glencoe area the confining layer is thin or absent and the watertable is at a higher elevation than the confined aquifer's potentiometric surface. Here recharge to the confined aquifer could be affected by lowering of the watertable through extraction or reduction in rainfall recharge by land use changes, however, on the information available it is considered unlikely to have a detrimental impact on the confined aquifer, due to this recharge component constituting a small percentage of overall recharge to and throughflow within the confined aquifer.

Unconfined Aquifer

Due to the confined and unconfined aquifers being separated by a low permeability aquitard (confining bed) generally of the order of 20 metres thick, there is little likelihood that extraction from the confined aquifer could detrimentally impact on the unconfined aquifer water resource.

There is only a small possibility that if underground water were taken from the confined aquifer and applied to the unconfined aquifer that there may be a volumetric effect, due to the increased quantity of water applied to the unconfined aquifer, and possibly a quality effect due to the addition of salts. However the application of an additional volume of water is unlikely to have any detrimental effect on the unconfined aquifer in the Comaum–Caroline PWA. Studies have shown that there is only a minimal response in the aquifer when additional volumes of water are applied during point source recharge events. The salinity of the underground water in the confined aquifer is generally very low, hence it is unlikely that the additional salt load would detrimentally impact on the water quality of the unconfined aquifer.

Water Resources in Adjacent PWAs

The taking and use of water in the Comaum-Caroline PWA is not expected to detrimentally affect the water resources in adjacent PWAs.

4 Assessment of the Capacity of the Resource to Meet Demands

4.1 The Capacity of the Resource

The capacity of the underground water resources of the Comaum-Caroline PWA to meet demands on a continuing basis will depend on several factors. One of the main factors is the rate of extraction by underground water users. Systems for appropriately allocating underground water and managing its use are required for the protection of the long-term condition of the resource.

Permissible Annual Volume (PAV) as defined by the *Groundwater (Border Agreement) Act, 1985* in effect relates to the volume of water that can be allocated for licensed extraction within the Border Designated Area. In calculating the PAV for the Border Designated Area, stock and domestic use has been excluded, as a water licence is not required for these purposes.

It is now recognised that it is preferable to calculate the volume of water to allocate within the area covered by this Plan by making provision for stock and domestic use, along with the expansion of plantation forestry and the environment. For this reason, the concept Volume for Licensed Allocation (VLA) has been developed.

The VLA is the total quantity of water (in megalitres) available for licensed extraction on an annual basis within each management area. The VLA is calculated differently for each aquifer.

The Volume for Licensed Allocation in each management area for the unconfined aquifer is calculated as follows:

> The Permissible Annual Volume less provisions for the effect of forestry plantations on annual vertical recharge, stock, domestic and environmental demands, less a further 10% buffer in areas that were not fully allocated (or did not become fully allocated as a result of the buffer) at **date of adoption**.

The Volume for Licensed Allocation in each management area of the confined aquifer is calculated as follows:

> The Permissible Annual Volume less provision for the effect of leaking wells, stock, domestic and future urban (town) use.

4.2 The Unconfined Aquifer

4.2.1 The Capacity of the Resource

The annual rate of net removals of underground water from the unconfined aquifer should roughly equate to the estimated annual average vertical recharge to the water table. The principle behind this approach is that lateral through-flow is maintained in the aquifer, thereby allowing any salts accumulated during recharge to be flushed down-gradient.

The PAV has been estimated by calculating the annual average vertical recharge to the aquifer in accordance with the following formula:

PAV for all management areas (in ML per year) = (sum of $(A_n X R_n))X S_f$

Where:

- A_n is the land area (in square kms) of a defined recharge region within the individual management area;
- R_n is the annual average vertical recharge rate (in mm per year) of the defined recharge region A_n;
- S_f is the salinity factor adopted for the management area.

As shown in Figure 4.1, a management area can comprise one or more recharge regions, each of which is assigned an individual recharge rate. The recharge rate is determined by considering factors such as land use, soil type, depth to groundwater and seasonal groundwater level responses. The salinity factor is a proportional reduction of the total recharge in the management area, where the extraction of 100% of the annual average vertical recharge is expected to lead to unacceptable salinity impacts.

In 2000, the Department for Water Resources estimated the PAV for the Comaum-Caroline PWA to be 86,200 megalitres. The PAV for each management area within the Comaum-Caroline PWA is shown in Table 4.1.

The Comaum–Caroline PWA is divided in to 7 management sub-areas (Fig. 1.1). Border Zone 1A has recently been sub-divided into three separate sub-areas as part of a strategy to manage declining water levels in the aquifer around Mount Gambier. The PAV for management areas Myora, Glenburnie, and Donovans (Zone 1A) was formerly 71,000 megalitres. This value was calculated using a storage coefficient of 0.15. This has been reassessed using a **specific yield** of 0.1 to a combined total for the 3 sub-areas of 30,900 megalitres.

It is evident from Table 4.1 that the rainfall recharge is higher than the PAV in Zones 2A and 3A. It was decided not to increase the PAVs, however, to match the recharge values, as a number of monitoring wells were showing a possible increase in underground water salinity.

Table 4.1: Comaum–Caroline PWA unconfined aquifer PAVs and licensed allocations and estimated use for 1998-99 (all in ML)

Manage-ment area	PAV	Vertical Recharge	Licensed Allocations and Estimated Use 1998-99			
			Total Licensed Allocation	Irrigation Allocation	Industrial and Recreation Allocations	Estimated Licensed Use[1]
Myora	6,000					
Glenburnie	12,300					
Donovans	12,600	30,900[2]	25,377[2]	24,521[2]	856[2]	12,161[2]
Zone 2A	25,000	36,390	20,818	20,790	28	9744
Zone 3A	24,000	45,600	23,959	23,427	532	12,556
Glenroy	4,550		5,712	5,711	1	2,098
Comaum	1,750		2,227	2,219	8	757
Total	**86,200**		**78,093**	**76,668**	**1,425**	**37,316**

1 Use does not include unlicensed use of the resource, for stock, domestic, town water supply and environmental purposes.

[2] Combined figures for Myora, Glenburnie and Donovans (Zone 1A).

4.2.2 Historical Demand

The historic and current level of allocation and use in the Comaum-Caroline PWA gives a good indication of the present demands on the unconfined aquifer.

The demand for unconfined aquifer water, in terms of allocations, has been quite strong in the Comaum-Caroline PWA.

Allocations increased in Zone 1A from 8,816 ML in 1993/94 to 25,377 ML in 1998/99. Over the same period water use rose from 33 ML to 12,161 ML, which is about half the allocation. A similar trend is evident in Zone 2A, with allocations increasing from 9,236 ML in 1993/94 to 20,818 ML in 1998/99.

In Zone 3A the allocation increased steadily from 11,468 ML in 1984/85 to 23,579 ML in 1995/96 after which it has remained fairly stable. Similarly usage shows a steady increase before stabilising at about half the allocation volume.

Allocation in the Glenroy management area, following a steady increase from 1984/85 to 1992/93 has since stabilised at ~5,700 ML. Usage is now about a third of the total allocation. In the Comaum management area the level of allocation has increased steadily from 1,539 ML in 1984/85 to 2,227 ML in 1998/99. Again usage is about a third of the total allocation.

However, underground water usage must be interpreted carefully, due to the method in which use for irrigation purposes is calculated. Historically, allocation of water licences for irrigation have been based on area and the irrigated crop water use requirement relative to a reference crop. The water usage volume is then estimated from annual seasonal returns supplied by water users and correlation with aerial photography. The volume of water used by crops is calculated by converting the area of irrigated crops to megalitres, using crop area ratios. The irrigated crop water requirement method does

not reflect the actual volume of groundwater extracted from the aquifer, and estimation of the volume used by each licensee relies on the veracity of the water user and the irrigated crop requirement method. A suitable method of measuring actual underground water use is required.

In contrast, allocations of water licences for industrial & recreational purposes are issued volumetrically. However, there is no recorded usage of these allocations. Even though allocations exist and some wells are equipped with meters, there is no regular meter reading program.

4.2.3 Current Demand

General

The total annual underground water allocation for 1998/99 was 78,093 ML as shown in Table 4.1, which represents approximately 111% of the VLA. Licensed underground water usage for the same period was estimated to be 37,316 ML, which represents 48% of the total licensed allocation. Unlicensed use of the resource, for stock, domestic, town water supply and environmental purposes, has not been included in Table 4.1.

Irrigation

76,668 ML had been allocated in 1998/99 throughout the Comaum-Caroline PWA for the purpose of irrigation. Irrigation is by far the largest user of underground water in the PWA. Irrigated crop types have generally remained unchanged since the mid-1980s. Major irrigated crops/plants in 1998/99 included irrigated pasture for dairying and other grazing (6,430 ha) in the southern portion of the PWA, viticulture in the Coonawarra area (5,094 ha) (Zone 3A and Part Zone 4A) and potato growing (794 ha).

Industry and recreation

1,425 ML had been allocated in 1998/99 in the Comaum-Caroline PWA for both industrial and recreational use, combined. The licences in the recreation category are largely held by sporting clubs (for watering sports fields, greens and gardens) and Local Government (for the watering of parks and gardens.)

Forestry Commitments

There are significant areas of established *Pinus radiata* and to a lesser extent, bluegum (*Eucalyptus globulus)* plantations, within Zones 1A and 2A in the Comaum-Caroline PWA. The reduction in vertical recharge attributed to these plantations has been estimated, and taken into account in determining the PAV.

Stock and domestic

Total annual stock underground water use from the unconfined aquifer for the PWA is estimated to be 1,960 ML (as shown in Table 4.2). These figures are based on stock numbers for the 1996/97 season in the Comaum-Caroline PWA which were obtained from the Australian Bureau of Statistics, and multiplied by the average daily stock consumption figures from data supplied by the New South Wales Department of Agriculture. The stock underground water use estimates are to the nearest 5 ML.

Domestic use was estimated during the recent pro-rata roll out, as shown in Table 4.2. The demand for domestic use is 1,300 ML in the Glenburnie management area. This relates to the population in the city of Mount Gambier and surrounding peri-urban areas drawing on the unconfined aquifer for watering gardens, as well as household requirements in areas without access to a reticulated water supply. Domestic use has not been estimated for all management areas in the Comaum-Caroline PWA.

Town Use

Water supplied for Mount Gambier city and surrounds from the Blue Lake from July 1998 to June 1999 was 3,589 ML. The townships of Penola and Nangwarry also source their water from the unconfined aquifer. SA Water may soon be issued with water licences for extraction of water for town water supply purposes, therefore licensed town water supply use has been included in the column titled 'Total Licensed Allocations' in Table 4.2.

Table 4.2: Licensed and unlicensed demands for the unconfined aquifer in the Comaum–Caroline PWA (all in ML)

Management Area	PAV ML	Forestry Commit-ment ML	Stock Use ML	Domestic Use ML	Environ-ment ML	VLA[(a)] ML	Total Licensed Allocations at 23/05/01[(b)] ML
Myora	6,000	0	195	530	600	4,208	3,335
Glenburnie	12,300	0	295	1,300	1,230	9,475	15,253
Donovans	12,600	0	320	325	1,260	10,695	12,339
Zone 2A	25,000	0	550	307	2,500	21,643	20,453
Zone 3A	24,000	0	505	0	2,400	21,095	24,109
Glenroy	4,550	0	65	0	455	4,030	5,720
Comaum	1,750	0	30	0	175	1,545	1,883
Total	**86,200**	**0**	**1,960**	**2,462**	**8,620**	**72,691**	**83,092**

4.2.4 Future Demand

Irrigation

An increased demand for underground water in the southern portion of the PWA for crop use is considered unlikely. The climate in the southern portion of the PWA is generally unsuitable for grapes (and possibly other crop types). While the Glenburnie and Donovans management areas are fully allocated, there may be expansion in irrigation through the transfer of allocations, or as unused allocations are brought into production. However, in the southern dairying areas, the existing density of irrigation may restrict further development of irrigated pasture for dairying and other grazing.

The Coonawarra grape growing region is located in Zone 3A and part Zone 4A, which are fully allocated. However, there is the potential for grape growing to expand in areas of Zone 3A and Part Zone 4A with suitable soils, through the transfer of allocations, or as unused allocations are brought into production. However, the density of existing irrigation may restrict further development in certain areas.

Industry

No immediate significant future industrial users of underground water are known.

However, with the large expansion in bluegum planatations in recent years in the South East of South Australia and Western Victoria, the establishment of a world-class hardwood bleached kraft pulp mill, which could produce around 500,000 tonnes per annum, has been mooted for the region. This would enable on-shore value adding of the bluegum resource, of which approximately 16,000 ha (net planted area) is located in the South East of South Australia. An operational pulp mill would not be required until around 2008 or 2009, when a critical mass of the bluegum plantations reaches harvestable age. If located within the South East of South Australia, the two most likely PWAs are Comaum-Caroline or Lacepede Kongorong. Such a pulp mill would require around 20,000 to 25,000 ML of water per year, which represents 28-35% of the VLA for the unconfined aquifer for the whole of the Comaum-Caroline PWA.

Recreation

Recreational use of the underground water resource is expected to remain similar to current use.

Forestry Commitments

Plantation expansion can potentially have a significant impact on future demand. If the area under plantation were to expand then rainfall recharge to the unconfined aquifer would effectively be reduced. During the recent pro-rata roll out process, the expected reduction in vertical recharge due to forestry expansion was calculated for the Myora, Glenburnie and Donovans management areas, and Zone 2A. Forestry expansion was estimated by including any forestry proposal not yet commenced but which had an approval under a Local Government Development Plan and industry estimates of firm proposals for developments that had not yet obtained approval under a Local Government Development Plan. However, at this time, future forestry commitment in these management areas was considered to be nil. However, if in the future there was a dramatic increase in forestry development, it then becomes unclear how the PAV will be reduced to compensate for the reduction in rainfall recharge.

Environmental Commitments

During the recent pro-rata roll out, an allowance of 10% of the PAV was made for environmental requirements in the Comaum-Caroline PWA in management areas Myora, Glenburnie and Donovans, and Zone 2A, as shown in Table 4.2. An allowance of 10% for environmental commitments has also been made in the remaining management areas.

Stock and domestic

Annual fluctuations in stock and domestic use are anticipated to be small.

Town Use

SA Water consider Mount Gambier's water use has stabilised, and predict a maximum annual usage of 4,000 ML over the next five years. Penola and Nangwarry's water use is also considered to have stabilised, and the maximum annual usage from the unconfined aquifer over the next five years is estimated at 170 ML and 100 ML respectively. SA Water may soon be issued with water licences for extraction of water for town water supply purposes, therefore licensed town water supply use has been included in the column titled 'Total Licensed Allocations' in Table 4.2.

4.2.5 Current Status of the Water Resources

Underground water Flow

The regional flow direction is generally east to west. North of the Nangwarry-Tarpeena potentiometric high, underground water flow is mainly in a north-westerly direction. South of the potentiometric high, the flow direction is southward.

Water Level Trends

Hydrographs from the majority of wells in the Comaum-Caroline PWA initially show little change in the water table elevation, followed by a more recent decline since the end of 1992 (Only wells with more than five years of data and currently part of the monitoring network were included in the assessment). This is consistent with a period of below average annual rainfall over the same period.

There are however a number of hydrographs that do not follow this general pattern. In the Glenburnie Sub-area, the decline is more long term and is consistent with the expansion of forestry in the area. Observation well NAN019 in Zone 2A shows a ~5 metre rise in the water table following the 1983 bushfire reflecting an increase in rainfall recharge after that event.

Salinity Trends

Generally the aquifer salinity is very low, ranging between 300 and 1000 mg/L.

Regular salinity monitoring began in 1986, which gives up to 14 years of monitoring record. Underground water salinity has remained generally unchanged over the length of monitoring record. The two exceptions are increasing salinity trends in observation wells NAN009 (+25 mg/L/yr) and MIN023 (+13 mg/L/yr.), both located in Zone 2A. Both are probably related to the effects of the 1983 bushfire but a more thorough examination is required.

Water Balance

A water balance also helps to determine whether the capacity of the resource is sufficient to meet demand on a continuing basis.

Underground water flow in the unconfined aquifer is particularly complex in the Comaum–Caroline PWA. A simple steady state underground water flow model was constructed and calibrated against observed water table contours.

A generalised water balance for the Comaum–Caroline PWA is presented in Table 4.3.

In its most general form the water balance for any closed basin may be expressed as follows:

$\sum$(inputs) - $\sum$(outputs) = (change in storage)

A tentative water balance for the Comaum–Caroline PWA (in ML) is therefore as follows:

(131 605 ML) - (178 410 ML) = (-46 805 ML)

The change in storage is consistent with a decline in water level in the PWA since 1993, and the more noticeable long term decline in the southern areas of the PWA.

Table 4.3: Water Balance for the Comaum–Caroline PWA (in ML)

	Sub-area				
Inputs	**1A**	**2A**	**3A**	**4A**	**Totals**
Inflow	10 490	3860	2460	2300	
Rainfall Recharge	31 055	33 860	40 460	7120	
Total In					**131 605**
Outputs					
Outflow	25 050	30 830	35 040	9390	
Extraction (1998/99)	25 380	20 820	23 960	7940	
Total Out					**178 410**
Change in Storage					**-46 805**

Note: the rainfall recharge figures differ slightly from the vertical recharge values as used in Table 4.1, mainly due to the approximation of the grid dimensions used in the model.

Conclusion

With the exception of the Myora and Zone 2A management areas, the Comaum-Caroline PWA is fully allocated, and is over-allocated in the Glenburnie, Donovans, Zone 3A, Glenroy and Comaum management areas if all unlicensed uses (stock, domestic, forestry and environmental commitments) as well as licensed allocations, are taken into account. Of particular concern are the Glenburnie and Zone 3A management areas, which are over-allocated by ~5800 ML and ~3,000 ML respectively, if all bona fide unlicensed uses (stock, domestic,forestry and environmental commitments) as well as licensed allocations, are taken into account.

While the declining water levels in the Comaum-Caroline PWA are largely attributed to a period of below average rainfall, land use change, particularly forestry, is a major water management issue for the Comaum-Caroline PWA, given the effect plantations have on vertical recharge to the unconfined aquifer. The future expansion of blue gum plantations in the Comaum-Caroline PWA is of particular concern. The extraction and use of underground water at the current level is also considered to be contributing to declining water levels.

The capacity of the resource is considered sufficient to meet current demand on a continuing basis. However, if in the future allocations become fully utilised, the capacity of the resource may not be sufficient to meet demand on a continuing basis, particularly in the Glenburnie management area.

It would be also be extremely difficult to source water from the unconfined aquifer for the establishment of a world class pulp mill in the Comaum-Caroline PWA, given the large volume required, and the current level of allocation. While theoretically it would be possible if the pulp mill purchased existing allocations from licensees, the logistics and time involved in doing this would make this option unattractive. It is unlikely that a world class pulp mill could be accommodated within the Comaum-Caroline PWA without an alternative source of water being found and utilised.

4.3 Confined Aquifer

4.3.1 Capacity of the Resource

The PAV for the confined aquifer in the South East is the volume of underground water that can be used on an annual basis from the confined aquifer without causing significant adverse water level or water quality impacts to the underground water resource.

The PAV for each confined aquifer management area in the South East region was estimated by the Department for Water Resources in 2000 and is shown in Table 4.5, with the confined aquifer management areas shown in Figure 4.2.

Due to the confining layer (aquitard) the underground water in the confined aquifer is under pressure. Also, unlike the unconfined aquifer, the confined aquifer receives very little direct rainfall recharge. Therefore the proposed PAVs have been developed for each management zone for the confined aquifer using a combination of underground water throughflow determinations and computer flow modelling. Various extraction scenarios were modelled to examine the longer term change in aquifer pressure and changes in leakage between the confined & unconfined aquifers.

Other key considerations in determining the PAV included:

- Limiting the magnitude of head decline as a result of increased withdrawals from the confined aquifer, and the impacts to existing users of the confined aquifer;

- Ensuring that there is no reversal in potentiometric levels between the confined and unconfined aquifers, which could result in more saline water from the unconfined aquifer impacting on water quality in the confined aquifer through downward leakage;

- The impact on the unconfined aquifer of increased use of the confined aquifer for irrigation purposes (Confined aquifer water excess to crop requirements returns to the unconfined aquifer. This has the potential to increase salt accessions and water levels within the unconfined aquifer);

- Consideration of the impact of increased extractions from the confined aquifer on marine discharges. However, such impacts are difficult to assess given the lack of present understanding of these processes;

- Modelling limitations in terms of uncertainty in the levels of extraction from the aquifer, and limited extraction data in some areas; both affect calibration of the model.

After consideration of all the above factors, a precautionary approach to the specification of the management prescription for the Tertiary Confined Sand Aquifer has been taken. Limiting the water available for allocation to a proportion (0.75) of the groundwater throughflow volume would adequately allow for the current limited technical understanding of the resource and the lack of knowledge of the environmental significance of the marine discharges from the confined aquifer.

The South East Catchment Water Management Board considered the regional declines in potentiometric (pressure) levels across the aquifer that would be acceptable based on its consultation with the community. The Board considered that a decline in the potentiometric level of generally 2 metres in the next 20 years, with a limited area of 4 metres in the Kalangadoo management area, would be acceptable at this time.

The PAV has therefore been set at 50% of the upper limit of the proportion (0.75) of the groundwater throughflow to maintain recovered seasonal potentiometric levels within this acceptable range of 2 to 4 m, for all management areas except Kingston.

The management prescription recommended for the Kingston Management Area sets the PAV at the current level of allocation and use of water in this area. While this level of allocation is considered to be too high based on the current level of assessment and understanding of the resource, measures will be put in place to improve water use efficiency, and reduce underground water use, over the next five years. Such measures include introducing metering to gain a clear picture of extraction levels from the aquifer, and reducing water wastage through well rehabilitation. If after this time a review indicates that the level of allocation and use is not sustainable, then it is likely that the PAV for the Kingston management area will be reduced, and management strategies introduced to decrease allocations and use to the revised PAV, over the following five year period.

The management prescription for the confined aquifer in the South East is shown in Table 4.4.

Table 4.4: Management Prescription for the Confined Aquifer

AREA	MANAGEMENT PRESCRIPTION
Border Designated Area - Zones 1A-11A	PAV = 50 % x (0.75 x throughflow volumes)
Outside Border Designated Area	PAV = 50 % x (0.75 x throughflow volumes)
Kingston Management Area	PAV = 25,000 ML/annum

Table: 4.5 PAVs, VLAs and Licensed and Unlicensed Demands for the Confined Aquifer in South Australia (all in ML)

Management Area	PAV	Stock & Domestic Use	Future Town Use	Allowance for Leaking Wells	VLA (a)	Total Licensed Allocations at 23/05/01 (b)	Irrigation Extraction Factor (c)
Fairview	290	6	0	0	284	0	0
Kalangadoo	3,900	78	0	0	3,822	1,993	386
Keith	2,500	50	0	0	2,450	130	0
Kingston	25,000	500	360	1,761	22,379	19,755	2,935
Lucindale	3,600	72	90	0	3,438	1,325	123
Millicent	10,800	216	0	0	10,584	4,376	676
Taratap	330	7	0	0	323	16	3
Wirrega	960	19	0	0	941	300	0
Zone 1A	9,200	184	210	0	8,806	404	81
Zone 2A	2,900	58	0	0	2,842	50	0
Zone 3A	1,900	38	0	0	1,862	0	0
Zone 4A	710	14	0	0	696	280	56
Zone 5A	540	11	0	0	529	0	0
Zone 6A	360	7	0	0	353	0	0
Zone 7A	350	7	0	0	343	0	0
Zone 8A	340	7	0	0	333	0	0
Zone 9A	570	11	0	0	559	0	0
Total	**64,250**	**1,285**	**660**	**1,761**	**60,544**	**28,629**	**4,259**

Notes:

1. SA Water may soon be issued with water licences for extraction of water for town water supply purposes. However, SA Water did not apply for the full estimated maximum annual usage in some areas. Therefore 560 ML in the Kingston management area, 90 ML in the Lucindale management area and 210 ML in Zone 1A has been set aside in the column titled 'Future Town Use'. Licensed town water supply volumes are included in the column titled 'Total Licensed Allocations'.

2. Stock and domestic use has been estimated at 2% of PAV, across all confined aquifer management areas.

3. An allowance of 10% of total irrigation use (Ha IE irrigation licences converted to a volume using CARs plus the irrigation extraction factor) has been made for loss from confined aquifer leaking wells in the Kingston management area.

4. As area based HaIE licences represent the irrigated crop water requirement, and not the actual volume extracted from the aquifer, a further 20% of HaIE irrigation licences (converted to a volume using CARs) was considered to be extracted from the confined aquifer and recharged to the unconfined aquifer through irrigation root zone drainage, in the column titled 'Irrigation Extraction Factor'.

Historical & Present Demand

General

The historical and current levels of allocation and use in the Comaum-Caroline PWA give a good indication of the present demands on the confined aquifer. The confined aquifer management areas coincide with the management areas within the Border Designated Area.

Town Use

The confined aquifer is an important source of town water supply, due to its protected nature (which means it is less susceptible to contamination), and generally high water quality. There are a number of town water supply wells that use the confined aquifer in the Comaum-Caroline PWA. There are two confined aquifer wells at Tarpeena, and two back-up wells that are used periodically for the Mount Gambier water supply.

From 1991/92 to 1998/99 the total annual underground water use for Tarpeena town water supply ranged between 31 and 37 ML/yr.

Water use for the township of Tarpeena between July 1998 and June 1999 was 37 ML.

Irrigation and Industrial Use

At 23 May 2001, 404 ML had been allocated from the confined aquifer in Zone 1A and 280 ML allocated in Zone 4A, for the purpose of irrigation. No allocations have been issued for industrial purposes within the Comaum-Caroline PWA.

As area based HaIE licences represent the irrigated crop water use requirement, and not the actual volume extracted from the aquifer, a further 20% of HaIE irrigation licences (converted to a volume using Crop Area Ratios) was considered to be extracted from the confined aquifer and recharged to the unconfined aquifer through irrigation root zone drainage, under the Irrigation Extraction Factor in Table 4.5. Unlike the unconfined aquifer, where a portion of the excess irrigation water filters back down through the soil and back into the aquifer, no excess irrigation water extracted from the confined aquifer returns to the confined aquifer.

Stock and Domestic

Current stock and domestic use of the confined aquifer has been estimated at 2% of the PAV across all confined aquifer management areas.

Leaking Wells

There are no known leaking wells in the Comaum-Caroline PWA.

4.3.2 Future Demand

SA Water considers water use to have stabilised in Tarpeena, and predict a maximum annual usage of 50 ML/yr The maximum annual usage of the confined aquifer for Mount Gambier's two back-up water supply wells is estimated at 210 ML/yr. SA Water may soon be issued with water licences for extraction of water for town water supply

purposes. Therefore, 50 ML for Tarpeena's town water supply use has included in the column titled 'Total Licensed Allocations' in Table 4.5. The 210 ML for Mount Gambier's two back-up water supply wells has not been licensed, but this volume has been set aside in the column titled 'Future Town Use' in Table 4.5.

The availability of an ample supply of good quality water in the unconfined aquifer has meant there has been little need to utilise underground water from the confined aquifer. Even though the water quality in the confined aquifer is very good (generally less than 1000 mg/L) the cost/benefit of drilling to a greater depth, especially in the southern portion of the PWA, is marginal. There may be future demand on the confined aquifer water resource in the southern dairy belt if there is no available allocation in the unconfined aquifer. If this were to happen, monitoring wells would have to be established, preferably before any extraction occurred.

The water requirement to establish a world class pulp mill referred to in section 4.2.4 for the unconfined aquifer, would not be able to be accommodated from the confined aquifer in the Comaum-Caroline PWA. The confined aquifer PAV for Zones 1A, 2A & 3A is a total of 14,000 ML, while the pulp mill requirement would be in the order of 20,000 to 25,000 ML.

4.3.3 Current Status of the Water Resources

Underground water Flow

The underground water flow pattern in the confined aquifer is similar to that of the unconfined aquifer. The potentiometric head decreases from a high of ~45 m in the Nangwarry-Tarpeena area in a north-westward direction north of the area, and a south-westward direction, south of the area. At the coast the potentiometric head is ~20 m above AHD.

Water Level Trends

Water level trends are similar to those of the unconfined aquifer. Generally heads remained stable up until the end of 1992, since then they have shown a steady decline. The decline in hydraulic head in the confined aquifer is probably related to a reduction in overburden pressure consistent with the decline in water level in the unconfined aquifer. It is unlikely to be a result of extraction as there is very little occurring from the confined aquifer in this area.

Salinity Distribution

The salinity of the underground water in the confined aquifer ranges from ~500 mg/L to ~1400 mg/L. There is a general trend of increasing underground water salinity northwards. The last major sampling occurred in 1996, however the underground water salinity is not expected to change significantly over each five year sampling period.

The aquifer salinity is unlikely to change appreciably in those parts of the PWA where the confined hydraulic head is higher than the unconfined head. If there were an increase in underground water salinity in the overlying unconfined aquifer (or some other form of contamination) the confined aquifer salinity will remain unchanged as there is no potential for downward movement of the underground water.

In areas where the hydraulic head in the unconfined aquifer is higher than that of the confined aquifer there is the potential for downward leakage of underground water to the confined aquifer. Usually the depth to the aquifer and thickness of the aquitard means that any change in underground water quality in the unconfined aquifer would take a significant period of time to reach the confined aquifer. However, this assumes the recharge to the confined aquifer is via diffuse leakage through the aquitard. If the aquifer is receiving recharge via preferential flow paths, then any change in water quality in the unconfined aquifer may impact on the confined aquifer within a much shorter time period.

Salinity Trends

There is currently insufficient data to assess salinity trends in the confined aquifer.

Conclusion

The capacity of the confined aquifer in the Comaum-Caroline PWA is sufficient to meet demand on a continuing basis, except for a major development such as a world class pulp mill. The capacity of the confined aquifer in the Comaum-Caroline PWA would not be sufficient to meet demand for such a facility.

5 Definitions

Any terms used in this Plan that are defined in the *Water Resources Act 1997* have the definitions set out in that Act and in addition for the purposes of this Plan the following terms have the definitions set out below:

"Adjoins" or **"Adjoining"** means in relation to an allotment or management area that the allotment or management area, or any part of the allotment or management area, is contiguous with another allotment or management area and includes allotments or management areas that are separated only by a road, street, footpath, railway or thoroughfare.

"AHD" means the Australian Height Datum, which is the datum used for the determination of elevations in Australia. The determination used a national network of bench marks and tide gauges, and set mean sea level as zero elevation.

"Allotment" means:

(a) the whole of the land comprised in a certificate of title including a community or development lot or common property within the meaning of the *Community Titles Act 1996* or a unit or common property within the meaning of the *Strata Titles Act 1988*;

(b) the whole of the land comprised in a registered conveyance of land that has not been brought under the provisions of the *Real Property Act 1886*;

(c) a separately defined piece of land that is delineated on a public map and separately identified by a number or letter (not being a piece of land that is identified in a Treasury receipt, certificate or other document or instrument of title as being part only of an allotment);

(d) two or more separately defined pieces of land that are delineated on a public map and that are identified in a Treasury receipt, certificate or other document or instrument of title as forming one allotment for the purposes of the *Real Property Act 1886*;

(e) a separately defined piece of land delineated on a plan of division for the purpose of enabling the separate ownership in fee simple of that land;

(f) a separately defined piece of land identified as an allotment for the purposes of the Real Property Act in a plan prepared by the Registrar-General and accepted for filing in the Lands Titles Registration Office;

(g) where a primary plan of community division has been cancelled under Part 7 Division 3 of the *Community Titles Act 1996* or a strata plan has been cancelled under Part 2 Division 7 of the *Strata Titles Act 1988* – the land comprising the former community parcel or site shown on the plan.

"Aquaculture" means the propagating or keeping of stocks of any aquatic or marine organism.

"Aquifer storage and recovery" means the process of drainage or discharge of water directly or indirectly to a well for the purposes of refilling or replenishing the aquifer or storing water in the aquifer for subsequent extraction.

"Confined Aquifer" means the saturated sands and gravels of either the Dilwyn Formation or the Mepunga Formation in the Otway Basin, or the Renmark Group in the Murray Basin.

"Draw down" means the occasional, seasonal or permanent lowering of the water table or reduction in pressure (head) of an aquifer resulting from the extraction of underground water.

"Exceptional circumstances" means the death or serious illness of or serious injury to the licensee or, where the licence is held by a company, partnership or incorporated body, the death or serious illness or injury to a director, partner or office holder respectively, that prevents the licensee from using the allocation with the minimum of delay and in any case within 3 years of the date of the granting of the allocation.

"Flood irrigation" means irrigation where underground water is pumped or directed onto an irrigation bay or levelled land and flows uniformly across the bay or the land without the aid of sprinklers, drippers or other infrastructure.

"Imported water" means water which has been brought into a management area by means of a pipe or other channel, and the water (including surface water) has been extracted and piped, or directed into a channel, under licence or permit under the *Water Resources Act* 1997, or *Groundwater (Border Agreement) Act 1985* from the originating management area or zones within the border Designated Area.

"Industry" means the carrying on, in the course of a trade or business, of any purposes for, or incidental to:

(a) The making of any article (or part thereof); or

(b) The altering, repairing, ornamenting, finishing, assembling, cleaning, washing, packing, bottling, canning or adapting for sale, or the breaking up or demolition of any article; or

(c) The getting, dressing or treatment of materials.

"Management area" means for the unconfined aquifer, a part of a Prescribed Wells Area as shown in Figure 1.1 and for the confined aquifer, a part of a Prescribed Wells Area shown in Figure 4.2.

"Permissible Annual Volume (PAV)" means for the unconfined aquifer in the South East, the volume of water that can be sustainably used or assigned from the unconfined aquifer on an annual basis, in a particular management area. For the purpose of this definition, "assigned" means the volume set aside for environmental and future forestry commitments.

"Permissible Annual Volume (PAV)" for the confined aquifer in the South East is the volume of groundwater that can be used from the confined aquifer without causing significant adverse water level or water quality impacts to the groundwater resource, on an annual basis.

"Pollution" includes any solid, liquid, gas or heat (or any combination thereof) that directly or indirectly causes or has the potential to cause harm to the environment, structures, persons or organisms.

"Potentiometric level" means the level to which water rises in a well due to water pressure in the aquifer. May also be referred to as the "potentiometric surface" or the "potentiometric level".

"Public water supply" means the supply of water by reticulation primarily for domestic purposes.

"Recharged water" means water which has been drained or discharged directly or indirectly into a well in accordance with a permit granted under the *Water Resources Act 1997*.

"Recreational use" means the use of water for the irrigation of parks, gardens and sports grounds, whether publicly or privately owned.

"Rotational crop" means a crop or plantation of a species/cultivar that produces one harvest per planting and requires an inter-rotational break period of three years or greater from the date of the previous planting before the same crop or plantation can be replanted at the same location.

"Same ownership" means any allotment or allotments where the registered proprietor is, or proprietors are, a member of the same family. For the purpose of this definition, "same family" includes a company where the director, directors or shareholders are members of the family or a trustee of a trust where the beneficiaries of that trust are one or more members of that family.

"Specific Yield" means the ratio of the volume of water a rock or soil will yield by gravity drainage, to the volume of the rock or soil.

"Unconfined Aquifer" means the saturated sequence of rocks occurring above the aquitard on top of the Dilwyn Formation or the Mepunga Formation in the Otway Basin, or the Renmark Group in the Murray Basin, whether occurring within the Gambier Limestone of the Otway Basin, the Murray Group Limestone of the Murray Basin, or some other younger geological unit.

"Volume for Licensed Allocation (VLA)" means the total quantity of water (in megalitres) available for licensed extraction on an annual basis within each management area (see tables A and B, annexed hereto).

The Volume for Licensed Allocation in each unconfined aquifer management area is calculated as follows:

> The Permissible Annual Volume less provisions for the effect of forestry plantations on annual vertical recharge, stock, domestic and environmental demands, less a further 10% buffer in areas that were not fully allocated (or did not become fully allocated as a result of the buffer) at **date of adoption**.

The Volume for Licensed Allocation for each confined aquifer management area is calculated as follows:

> The Permissible Annual Volume less provision for the effect of leaking wells, stock, domestic and future urban (town) use.

"Water use year" means a period of 12 months commencing on the 1 July in any year.

"Wild flooding" means flood irrigation where no adequate system such as land levelling, or irrigation bays is used to ensure uniform distribution of water.

6 Allocation Criteria – Unconfined Aquifer

The present and future needs for water by the occupiers of land in the Comaum-Caroline Prescribed Wells Area have been outlined in section 4. The present needs for water of the occupiers of land in the Comaum-Caroline Prescribed Wells Area are mainly irrigation, stock and domestic water use, town water supplies, and industrial use. Stock, domestic and town water use is expected to remain relatively stable. Irrigation is expected to remain the largest water use in the Comaum-Caroline Prescribed Wells Area, and it is likely to expand further in all management areas through the transfer of allocations, or as unused allocations are brought into production. Industrial and recreational uses are expected to remain steady.

An assessment of irrigated crop potential of the land in the Comaum-Caroline Prescribed Wells Area indicates that some areas have limitations for irrigation development. Such areas may remain dryland-farming areas, or may develop some other activity. Irrigation will tend to concentrate in areas that combine good quality water with suitable soils. The productive capacity of the land will also depend on land management practices and standards directed at avoiding land degradation issues such as erosion, water logging and land salinisation.

The overall capacity of the water resources in the Comaum-Caroline Prescribed Wells Area are considered to be sufficient to meet all existing demands, considering the capacity of the land. Locally, in areas that combine the availability of good water quality with suitable soils, the demand for water may exceed the capacity of the water resources. In some management areas demand has already exceeded the capacity of the water resources. However, improvements in irrigation efficiency (where allocations are expressed volumetrically) and more active use of trade of licensed water allocations, may accommodate further development of water-based enterprises in these areas.

Some of the policies contained within this plan may have potential impacts on land values. The policies with this potential generally relate to the protection of the resource from degradation through over allocation, the concentration of water extraction and use, or inappropriate water use and management. It is considered that any potential impacts on the value of land are outweighed by the benefits of protecting the condition of the resource, so that it may continue to be used on a sustainable basis.

Land suitable for irrigation in an area with good quality underground water will tend to have a higher value than land that is not suitable for irrigation, or land located in an area where access is limited to underground water which is low yielding, unsuitable, or marginal, for irrigation.

The SE Catchment Water Management Board has taken the above aspects into account in setting the policies and criteria within this plan.

6.1 Objectives

1. To ensure that underground water extractions remain within the sustainable limits of the unconfined aquifer by preventing over allocation of the resource at the local and management area scale and throughout the entire Prescribed Wells Area;

2. To protect the resource locally, throughout each management area and the entire Prescribed Wells Area, by ensuring that the taking and use of underground water does not cause a significant increase in the salinity of underground water, or cause a significant decrease in the elevation of the water table.

3. To provide flexibility and equity in access to the underground water resource of the unconfined aquifer;

4. To minimise constraints to economic activity throughout the region that result from the under use of water allocations;

5. To protect ecosystems dependent on underground water by ensuring that the taking and use of underground water from the unconfined aquifer does not cause significant degradation of the ecology and biodiversity of the region;

6. To protect the environment generally by ensuring that the taking and use of underground water from the unconfined aquifer does not cause significant degradation of any other resource such as soils or other water resources;

7. To manage the underground water resource of the unconfined aquifer so that it may continue to be utilised by future generations;

8. To encourage and expedite an active water market so that water allocations are readily available for future economic development;

9. To promote the active and efficient use of water allocations according to current industry best practice standards; and

10. To minimise the potential negative impacts of aquifer storage and recovery on underground water quality, and the integrity of the unconfined aquifer.

6.2 Principles

Limit to total allocation

1. Water shall not be allocated from the unconfined aquifer (by water (holding) or water (taking) allocation) where the allocation would cause the total amount allocated on all licences for the relevant management area to exceed the Volume for Licensed Allocation (VLA) for the relevant management area (see Table A), except where:

   (a) Water is to be allocated to existing non-licensed users in accordance with principles 6.2.2 and 6.2.3 (Unlicensed pre-existing water use);

   (b) A water allocation is to be taken from another management area in accordance with principles 6.2.30 (Crop rotations) or 7.2.14 (Applications to transfer water (taking) allocations – Destinations); or

   (c) Water is allocated above the VLA in the relevant management area at the **date of adoption,** in which case the taking of water will not cause significant adverse impacts on the unconfined aquifer within the relevant management area, and provided that where water is allocated above the VLA, the total

amount allocated on all licences within the relevant management area does not exceed the PAV for that management area (see Table A). Where water is allocated above the VLA within the relevant management area at the **date of adoption,** no further water shall be allocated, except where principles 6.2.1 (a) & (b) apply.

Unlicensed pre-existing water use

2. Water may be allocated to existing non-licensed water users where:

   (a) It can be demonstrated that the water use in its present form at the date of application, was also in existence during the year prior to 10 April 1997;

   (b) Water is used for the following:

   - Operation of a dairy licensed by the Dairy Authority of South Australia at the date of application, (including wash down, washing up and milk cooling);
   - Intensive animal keeping;
   - An intensive plant production system such as greenhouses, hydroponics or nurseries;
   - Industry; or
   - Recreation;

   (c) The source aquifer nominated on the application is the aquifer from which the unlicensed water was being taken at 12th February 2001; and

   (d) An application for a water allocation is received no earlier than 5p.m. on 30th June 2002 and no later than 5 p.m. on the 31st July 2002.

3. Water shall be allocated for unlicensed pre-existing water use in the following manner:

   (a) Where water remains available, or becomes available for allocation within a management area, up to 200ML shall be reserved for the purposes of allocation to unlicensed pre-existing water use, subject to 6.2.2 and 6.2.3 (b) – (d), until 5 p.m. on the 31 July 2002;

   (b) The water allocation shall meet the applicant's reasonable requirements up to 10 megalitres per annum, except for dairies which milk in excess of 300 cows in which case the allocation shall meet the applicant's reasonable requirements;

   (c) In the case of dairies, the water allocation shall be calculated as whichever is the greater of the reasonable requirements of the water user at the time of application, or the average of the annual reasonable requirements over the preceding three year period; and

(d) Allocations granted under section 6.2.2 are exempt from sections 6.2.4 (Unallocated water), 6.2.11 (Quantity for allocation), 6.2.14 to 6.2.18 (Active and expeditious use of water), and 6.2.19 to 6.2.23 (Hydrogeological effects).

Where the 200ML set aside in accordance with this principle has not been allocated then any remaining water shall be available for allocation in accordance with this Plan.

Unallocated water

4. Water may be allocated in the following manner:

(a) All applications for a water licence and/or a water (taking) allocation (not including any application that involves the surrender of a water licence, water (taking) allocation or part thereof) received by the Minister after 5.00p.m. on **adoption date,** will be given a serial number and dealt with in the following manner:

(i) Applications from the same management area will be accumulated together;

(ii) At 5.00p.m. on the last Friday of each month, all applications received for that month will by anonymously given a random rank number for that management area;

(iii) After any application for an allocation under 6.2.4 (b), (c) & (d) received in that month have been determined, the Minister will consider and determine applications for each management area by commencing with the lowest rank number within each management area first, and then in order of increasing rank number until all applications received in that month have been determined;

(iv) Any applications received in successive months will be dealt with in the same manner;

(v) Only one application per allotment for each management area will be determined by the Minister in each month; and

(vi) Where, in any month, more than one application is made in relation to the same allotment, if one of those applicants is the registered proprietor of the land, then that proprietor shall have his or her application determined before any other applicant, regardless of the rank number of his or her application.

(b) Where a confined aquifer licence endorsed with a water (taking) allocation or the whole or part of a confined aquifer water (taking) allocation is surrendered by the licensee to the Minister under section 31 of the *Water Resources Act 1997* after 5p.m. **adoption date**, then an unconfined aquifer water (taking) allocation and/or water licence may be granted to that licensee within the unconfined aquifer management area that corresponds with the relevant confined aquifer management area, in accordance with the provisions of this Plan, except that the provisions of principles 6.2.10 & 6.2.11 (Quantity of allocation) and 6.2.14 – 6.2.18 (Active and expeditious use) shall not apply to such an allocation and/or licence.

(c) Where a confined aquifer licence is endorsed with a water (taking) allocation or the whole or part of a confined aquifer water (taking) allocation held within the Kingston confined aquifer management area is surrendered by the licensee to the Minister under section 31 of the *Water Resources Act 1997* after 5p.m. **adoption date**, then an unconfined aquifer water (taking) allocation and/or licence may be granted to that licensee within any management area that lies within the Comaum-Caroline PWA in accordance with the provisions of this Plan, except that the provisions of principles 6.2.10 & 6.2.11 (Quantity of allocation) and 6.2.14 – 6.2.18 (Active and expeditious use) shall not apply to such an allocation and/or licence.

(d) Where a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, originates from a management area adjoining a zone within the border Designated Area, but is taken and used in a zone within the border Designated Area on an allotment divided by a border Designated Area boundary, water may be allocated in the zone within the border Designated Area to the applicant provided that a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation is surrendered by the licensee to the Minister under section 31 of the *Water Resources Act 1997* in the originating management area. Such allocations shall be in accordance with the provisions of this Plan, except that the provisions of principles 6.2.10 & 6.2.11 (Quantity of allocation) and 6.2.14 – 6.2.18 (Active and expeditious use) shall not apply to such an allocation and/or licence.

Underground Water Resource condition

5. The taking and use of water shall not cause, or be likely to cause:

(a) A mean (arithmetic) increase in salinity of the underground water resource of greater than 10 mg/L per year (measured over the preceding 5 years) within the vicinity of the point of use (including neighbouring properties and the nearest salinity monitoring wells), or within the relevant management area;

(b) A mean (arithmetic) decrease in underground water levels within the vicinity of the point of taking (including neighbouring properties and the nearest underground water level monitoring wells), or within the relevant management area of greater than 0.1 metres per year (measured over the preceding 5 years), except where the taking and use of water is for the purposes of industry or energy generation;

(c) A decline in underground water levels over a period of greater than 3 years within the vicinity of the point of taking (including neighbouring properties and the nearest underground water level monitoring wells), or within the relevant management area, before a new stable equilibrium water level is achieved, where the taking and use of water is for the purpose of industry or energy generation.

Water (holding) allocations

6. No water (holding) allocation shall be endorsed on a licence after **adoption date** except where a water (taking) allocation, either in whole or part, endorsed on a licence is converted to a water (holding) allocation with the exception that any water (taking) allocation on a licence that is subject to a condition or conditions requiring the expeditious use of water (including a requirement that the equipment, or land by which or on which the water is used be developed in a certain time) shall not be converted to a water (holding) allocation if that condition has, or conditions have, not been satisfied.

Basis of allocation

7. Allocations of water granted after 5.00 p.m. on adoption date will be expressed volumetrically except for:

   (a) Allocations granted in accordance with principles 6.2.4 (b) – (d), which shall be expressed in the same units of measure as those on the water licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation surrendered to the Minister under section 31 of the *Water Resources Act 1997*.

   (b) Allocations that have been obtained through transfers, which shall be expressed in the same units of measure as those used prior to the transfer;

   (c) Allocations varied through conversion from a water (taking) allocation to a water (holding) allocation, which shall remain expressed in the same units of measure as those used prior to conversion; and

   (d) Allocations varied through conversion from a water (holding) allocation to a water (taking) allocation, which shall remain expressed in the same units of measure as those used prior to conversion.

Purpose of use

8. Water shall not be taken and used for the purpose of wild flooding.

9. Water shall not be taken from the unconfined aquifer and used for the purpose of aquaculture unless:

   (a) The volume of tail water produced for disposal does not exceed an amount reasonably produced according to current best industry practice;

   (b) The disposal of tail water does not result in an increase (above seasonal fluctuations) in underground water levels in the unconfined or confined aquifers at the boundary of the allotment where the tail water is disposed of or, at the boundary of any adjoining allotment held by the same owner, whichever is the greater distance from the point of disposal;

   (c) Disposal of tail water does not result in an accelerated increase in salinity of the unconfined or confined aquifers, or result in pollution of these aquifers by any other substance; and

(d) The ponds, tanks, vessels or other places for the keeping of any water for the aquaculture process have no significant hydraulic connection with the unconfined or confined aquifers.

Quantity of allocation

10. Where water is to be used for irrigation purposes, the allocation shall not exceed the amount reasonably required to irrigate the area of the particular crop type, on the dominant soil type and given the local average meteorological conditions applicable to the relevant allotment.

11. Where water is to be used for purposes other than irrigation, the allocation shall not exceed the amount reasonably required (applying current industry best practice standards) for the purpose proposed.

Efficient use of water

12. Water shall be used and applied using water efficient technologies and techniques appropriate for the particular purpose and circumstance for and in which the water is to be used in accordance with current industry best practice standards.

13. For the purposes of principle 6.2.12 the particular circumstances for the use of water for irrigation include (but are not limited to):

    (a) The plant type;

    (b) The climate, dominant soil type and topography of the allotment;

    (c) The location of remnant native vegetation and/or other permanent structures such as powerlines, which may limit the method of application of water; and

    (d) The salinity of the water to be used.

Active and expeditious use of water

14. All water (taking) allocations granted on or after **adoption date**, excluding allocations which have been obtained through transfers, shall be used with the minimum of delay and in any case within 3 years of the granting of the allocation.

15. All water (taking) allocations granted **before adoption date**, with a condition requiring active and expeditious use, shall be used with the minimum of delay and in any case within 3 years of the granting of the allocation.

16. All water (taking) allocations granted **after 5pm 1 September 2000**, resulting from the conversion of a water (holding) allocation, shall be used with the minimum of delay and in any case within 3 years of the granting of the allocation.

17. For the purposes of principles 6.2.14, 6.2.15 and 6.2.16, the use of an allocation includes the development of the land and equipment upon or by which the water is used, to a capacity that enables the water (taking) allocation to be utilised at its maximum lawful rate.

18. Without in any other way affecting the operation of principles 6.2.14, 6.2.15 and 6.2.16, where **exceptional circumstances** apply to the licensee, the maximum period may be increased to 4 years from the granting of the allocation.

Hydrogeological effects

19. The taking of water for industrial, energy generation or public water supply purposes shall not adversely affect to a significant extent:

    (a) The quality of water in the unconfined aquifer by (including but not limited to) an increase in salinity by exceeding the rate specified in principle 6.2.5 (a);

    (b) The water level of the unconfined aquifer by causing or contributing to a long term decline in underground water levels by exceeding the rate specified in principle 6.2.5 (c) for industrial or energy generation use, or 6.2.5 (b) for public water supply use; and

    (c) The structural integrity of the aquifer.

20. The taking of water for all purposes other than those mentioned in principle 6.2.19 shall comply with the 4 kilometre square test and the taking and use of water shall not adversely affect to a significant extent:

    (a) The quality of water in the unconfined aquifer by (including but not limited to) an increase in salinity by exceeding the rate specified in principle 6.2.5 (a);

    (b) The water level of the unconfined aquifer by causing or contributing to a long term decline in underground water levels by exceeding the rate specified in principle 6.2.5 (b);

    (c) The structural integrity of the aquifer;

    (d) Any other water resource (including but not limited to the confined aquifer, or any relevant surface water resource), both within and beyond the Comaum-Caroline Prescribed Wells Area; and

    (e) Ecosystems dependent on underground water, by contravening principle 6.2.24.

21. The **"4 kilometre square test"** requires that the granting of a water (taking) allocation shall not cause the total volume of water (taking) allocations within a square with 4 kilometre long sides to exceed 1.25 times the amount of annual vertical recharge for the management area.

22. The 4 kilometre square shall be centred on the specified point of taking of the water or, where the precise point of taking is not specified, the 4 kilometre square shall be centred on the centremost point of the nominated allotment involved in the application. Where the point of taking of the water is not specified the well shall be constructed for the taking of the water within a 1 kilometre radius of the centremost point of the nominated allotment.

23. For the purposes of the 4 kilometre square test, the amount of annual vertical recharge is whichever is the lesser of:

    (a) The recharge sub area delineated on General Registry Office Plan 395/00 multiplied by 16km^2; or

    (b) The amount determined by the following formula **– Specific yield within the 4 kilometre square multiplied by long term seasonal underground water level fluctuation.**

Ecosystems dependent on underground water

24. Water shall not be taken and used if to do so may create a significant adverse affect on ecosystems that depend on the underground water by causing:

    (a) The mean water table elevation within the vicinity of the point of taking or within the relevant land unit (see Figure 2.1) to drop below that identified for the relevant land unit as specified in Table 2.1;

    (b) The seasonal water table range within the vicinity of the point of taking or within the relevant land unit (see Figure 2.1) to exceed the range identified for the relevant land unit as specified in Table 2.1;

    (c) The seasonality of the minimum or maximum water table level within the vicinity of the point of taking or the relevant land unit (see Figure 2.1) to vary from that identified for the relevant land unit as specified in Table 2.1; and

    (d) Salinity of underground water within the vicinity of the point of use or within the relevant land unit (see Figure 2.1) to exceed the range identified for the relevant land unit as specified in Table 2.1.

25. Factors that will be considered in assessing the likelihood of significant adverse impacts include, but are not limited to the:

    (a) Distance of the proposed extraction point from ecosystems that depend on the underground water; and

    (b) Local hydrogeology.

Piping of water more than 2km

26. Where water is to be taken from one point and transported by pipe or other means to be used at another point at least 2 kilometres from the point of taking, both the taking and use of water shall comply with principles 6.2.19 – 6.2.20.The 4 kilometre square test shall only apply at the point of taking.

Divided allotments

27. Where an allotment is, or two or more adjoining allotments held by the same owner are, divided by a management area or prescribed wells area boundary, but a water allocation is held in only one of the management areas or prescribed wells areas, the allocation may be taken and used anywhere throughout the allotment or adjoining allotments, provided that:

(a) The taking and use of water meets the hydrogeological criteria defined in principles 6.2.19 – 6.2.23 (Hydrogeological effects);

(b) The point of extraction and/or use is not moved more than 2 kilometres into an adjacent management area or prescribed wells area unless it can be demonstrated that the allocation (or part thereof) was being extracted at the current location in an adjacent management area or prescribed wells area prior to **adoption date**;

(c) An allocation from another management area is not taken in a zone within the area designated under the *Groundwater (Border Agreement) Act 1985* unless it can be demonstrated that the allocation (or part thereof) was being taken at the current location in a zone within the border Designated Area prior to **adoption date**;

(d) The allocation remains referenced to, and accounted for in the originating management area and prescribed wells area; and

(e) The allocation will not be available for further transfer within the receiving management area and prescribed wells area.

Crop rotations

28. Subject to principles 6.2.29 to 6.2.30, an allocation of water from a management area may be taken from another management area ("the receiving management area") for the purposes of irrigating a **rotational crop** for a maximum period of 5 years (from the date that the application to take the allocation of water from a receiving management area is approved) provided the taking of water from the receiving management area complies with section 6.2.18 (Hydrogeological effects) of this Plan.

29. For the purposes of principle 6.2.28, water may not be taken from another unconfined aquifer management area for the purposes of irrigating a rotational crop, where a receiving management area lies within the Padthaway Prescribed Wells Area. An allocation granted for the purposes of irrigating a rotational crop after **adoption date**, may not be taken from a receiving unconfined aquifer management area that lies in a zone within the area designated under the *Groundwater (Border Agreement) Act, 1985.*

30. Where the receiving management area is fully allocated on **adoption date**, or the sum of the amount of water proposed to be taken in the receiving management area and the amount allocated in the receiving management area at the date of application, exceeds the Volume for Licensed Allocation (VLA) for the receiving management area, the allocation of water may only be taken provided that:

(a) The taking and use of water in the receiving management area complies with section 6.2.20 (Hydrogeological effects) of this Plan; and

(b) The level of water use in the year preceding the year ending 30 June did not exceed 90% of the VLA of the receiving management area.

The Allocation of Recharged Imported water from Aquifer Storage and Recovery Schemes

Principle 6.2.31 applies to the allocation of **imported water recharged** for the purpose of **aquifer storage and recovery**, pursuant to a permit under section 9(3)(c) of the *Water Resources Act 1997*

31. Imported **water** that is **recharged** within a management area that lies in a zone within the area designated under the *Groundwater (Border Agreement) Act, 1985* will not be available for allocation.

7 Transfer Criteria – Unconfined Aquifer

7.1 Objectives

1. To protect ecosystems dependent on underground water by ensuring that the taking and use of underground water from the unconfined aquifer does not degrade the ecology and biodiversity of the region;
2. To protect the environment generally by ensuring that the taking and use of underground water from the unconfined aquifer does not significantly degrade any other resource such as soils or other water resources;
3. To provide flexibility and equity in access to the underground water resource of the unconfined aquifer;
4. To encourage and expedite an active water market so that water allocations are readily available for future economic development;
5. To promote the active and efficient use of water according to industry best practice standards;
6. To manage the underground water resource of the unconfined aquifer so that it may continue to be utilised by future generations;
7. To ensure that extractions remain within the sustainable limits of the unconfined aquifer by limiting the concentration of underground water use from the unconfined aquifer that may result through the transfer of water allocations; and
8. To minimise constraints to economic activity throughout the region that result from the under use of water allocations.

7.2 Principles

Transfers of water (holding) allocations

1. A licence endorsed with a water (holding) allocation, or the whole or part of a water (holding) allocation may be transferred to any person or legal entity, but will continue to be recognised as being held from the same management area from which the allocation was originally granted.

Transfer of water (taking) allocations

2. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation from the unconfined aquifer, may not be transferred to the confined aquifer.

Applications to transfer water (taking) allocations – Purpose of use

3. Transfer of a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation will not be granted where water is to be taken and used for wild flooding.

4. Transfer of a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation that is to be used for the purpose of aquaculture will not be granted unless:

   (a) The volume of tail water produced for disposal does not exceed an amount reasonably produced according to current best industry practice;

   (b) Disposal of tail water does not result in an increase above seasonal fluctuations in underground water levels in the unconfined or confined aquifers at the boundary of the allotment or, at the boundary of any adjoining allotment held by the same owner, whichever is the greater distance from the point of disposal;

   (c) Disposal of tail water does not result in an accelerated increase in salinity of the unconfined or confined aquifers, or result in pollution of these aquifers by any other substance; and

   (d) The ponds, tanks, vessels or other places for the keeping of any water for the aquaculture process have no significant hydraulic connection with the unconfined or confined aquifers.

Applications to transfer water (taking) allocations – Efficient use of water

5. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation shall only be transferred where the water shall be used and applied using water efficient technologies and techniques appropriate for the particular purpose and circumstances for, and in which the water is to be used in accordance with current industry best practice standards.

6. For the purposes of principle 7.2.5, the relevant circumstances for the use of water for irrigation include (but are not limited to) the:

   (a) Plant type;

   (b) Climate, dominant soil type and topography of the allotment;

   (c) Location of remnant native vegetation and/or other permanent structures such as powerlines, which may limit the method of application of water; and

   (d) Salinity of the water to be used.

Applications to transfer water (taking) allocations – Hydrogeological effects

7. The taking of water for industrial, energy generation or public water supply use shall not adversely affect to a significant extent:

   (a) The quality of water in the unconfined aquifer by (including but not limited to) an increase in salinity by exceeding the rate specified in principle 6.2.5 (a);

   (b) The water level of the unconfined aquifer by causing or contributing to a long term decline in underground water levels by exceeding the rate specified in principle 6.2.5 (c) for industrial or energy generation use, or 6.2.5 (b) for public water supply use; and

   (c) The structural integrity of the aquifer.

8. Subject to principle 7.2.9, a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, that is to be used for all purposes other than those mentioned in principle 7.2.7 shall only be transferred where the taking of water complies with the 4 kilometre square test (as defined in principles 6.2.21 to 6.2.23) and the taking and use of water shall not adversely affect to a significant extent:

   (a) The quality of water in the unconfined aquifer by (including but not limited to) an increase in salinity by exceeding the rate specified in principle 6.2.5 (a);

   (b) The water level of the unconfined aquifer by causing or contributing to a long term decline in underground water levels by exceeding the rate specified in principle 6.2.5 (b);

   (c) The structural integrity of the aquifer;

   (d) Any other water resource (including but not limited to the confined aquifer, or any relevant surface water resource), both within and beyond the Comaum-Caroline Prescribed Wells Area; and

   (e) Ecosystems dependent on underground water, by contravening principle 7.2.10.

9. A transfer application shall be deemed to have complied with the 4 kilometre square test (as defined in sections 6.2.21 to 6.2.23) without further assessment, where:

   (a) A licence endorsed with a water (taking) allocation, or the whole or a part of a water (taking) allocation is to be transferred but will continue to be taken from the same well, or is replaced by a new well within 1km of the original well, and is to be used on the same allotment or allotments; or

   (b) An application to renew a temporary transfer (of the same quantity) that proposes taking the water allocation from the same well (or a well that replaces the original well, but lies within 1 kilometre of the original well), and the use of the allocation on the same allotment or allotments, is received and processed prior to the date and time of expiry of the original temporary transfer.

Ecosystems dependent on underground water

10. Transfer of a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation will not be granted if to do so will create a significant adverse effect on ecosystems that depend on the underground water by causing the:

    (a) Mean water table elevation within the vicinity of the point of taking or within the relevant land unit (see Figure 2.1) to drop below that identified for the relevant land unit as specified in Table 2.1;

    (b) Seasonal water table range within the vicinity of the point of taking or within the relevant land unit (see Figure 2.1) to exceed the range identified for the relevant land unit as specified in Table 2.1;

(c) Seasonality of the minimum or maximum water table level within the vicinity of the point of taking or the relevant land unit (see Figure 2.1)to vary from that identified for the relevant land unit as specified in Table 2.1; and

(d) Salinity of underground water within the vicinity of the point of use or within the relevant land unit (see Figure 2.1) to exceed the range identified for the relevant land unit as specified in Table 2.1.

11. Factors that will be considered in assessing the likelihood of significant adverse impacts include, but are not limited to the:

(a) Distance of the proposed extraction point from ecosystems that depend on the underground water; and

(b) Local hydrogeology.

Applications to transfer water (taking) allocations – piping of water more than 2km

12. Where a transfer application proposes the taking of water from one point and transporting it by pipe or other means to be used at another point at least 2 kilometres from the point of taking, both the taking and use of water shall comply with principles 7.2.7- 7.2.9 (Hydrogeological effects). The 4 kilometre square test shall only apply at the point of taking. Where the proposed point of taking and point of use is the same as those being utilised prior to transfer, the proposed transfer of water shall be deemed to have complied with the 4 kilometre square test at both the extraction and discharge sites without further assessment.

Applications to transfer water (taking) allocations – Destinations

13. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, may be transferred either permanently or temporarily where the proposed location of the point of extraction lies within the same management area as the existing location of the point of extraction from which the allocation may lawfully be taken.

14. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, may be transferred from a management area to an adjacent management area, where the proposed point of extraction and use is less than or equal to a maximum of 2 kilometres inside that adjacent management area, on an allotment which adjoins the management area boundary, consistent with the following criteria:

(a) The maximum period of transfer shall be 5 years;

(b) The provisions of this clause shall not apply where the receiving management area lies within the area designated under the *Groundwater (Border Agreement) Act 1985;*

(c) The allocation shall continue to be deemed to be taken from and accounted for in the management area of its origin;

(d) Water transferred for extraction and use up to a maximum of 2 kilometres into an adjacent management area will not then be available for subsequent transfer elsewhere in the receiving management area except to other allotments adjoining the same management area boundary and where the proposed point

of extraction and use lies less than or equal to a distance of 2km from the boundary of the original management area;

(e) Use and extraction shall be consistent with the relevant Water Allocation Plan for the receiving management area.

(f) The transfer of a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, up to 2 kilometres into an adjacent management area shall not cause the total allocations that may be used in the receiving management area to exceed 110% of its Volume for Licensed Allocation (VLA). An application to transfer a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation up to 2 kilometres into an adjacent management area, which would cause the total allocations that may be used in that adjacent management area to exceed 110 % of its VLA, shall not be permitted and subsequent applications to transfer a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, up to 2 kilometres into that adjacent management area, shall not be permitted unless and until the total allocations that may be used in that management area become less than or equal to 105 % of its VLA.

(g) The transfer shall be subject to principles 7.2.2 (Transfers of water (taking) allocations), 7.2.3 & 7.2.4 (Purpose of use), 7.2.5 and 7.2.6 (Efficient use of water), 7.2.7 - 7.2.9 (Hydrogeological effects), 7.2.10 & 7.2.11 (Ecosystems dependent on underground water*)* and 7.2.15 (Development of allocation before transfer).

For the purposes of this principle, an "adjacent management area" includes all management areas that adjoin the management area from which the allocation and/or licence was initially granted, including those that may lie within an adjoining prescribed wells area.

Applications to transfer water (taking) allocations – Development of allocation before transfer

15. For licences granted by the Minister with a condition or conditions imposed requiring the expeditious use of water (including a requirement that the equipment, or land by which or on which the water is used be developed in a certain time), the following applies:

(a) The allocation (or part thereof), or licence may be transferred where the equipment or land has been fully developed to allow use of the water at its maximum lawful rate;

(b) Where the expeditious use conditions have not been fully satisfied, only the portion of the allocation that may be used in accordance with the extent of development at the date of receipt of the application to transfer by the Minister may be transferred; or

(c) Where the licence or allocation is to be transferred in its entirety, but will be taken and used on the same allotment, it may be transferred whether or not the land or equipment has been fully developed in accordance with the condition(s), provided that the new landholder fully develops the land and equipment to allow use of the allocation at its maximum lawful rate, in accordance with the original conditions.

8 Allocation Criteria - Confined Aquifer

8.1 Objectives

1. To ensure that underground water extractions remain within the sustainable limits of the confined aquifer by preventing over allocation of the underground water resource at the local, and management area scale and throughout the entire Prescribed Wells Area;

2. To protect the resource locally, throughout each management area and the entire Prescribed Wells Area, by ensuring that the taking and use of underground water does not cause a significant decrease in the elevation of the potentiometric level of the confined aquifer.

3. To cautiously manage the confined aquifer, due to it being an ancient resource, with limited recharge;

4. To ensure that underground water from the unconfined aquifer is allocated and used in precedence to underground water from the confined aquifer;

5. To protect ecosystems dependent on underground water by ensuring that the taking and use of underground water from the confined aquifer does not significantly degrade the ecology and biodiversity of the region;

6. To protect the environment generally by ensuring that the taking and use of underground water from the confined aquifer does not significantly degrade any other resource, such as soils or other water resources;

7. To manage the confined aquifer underground water resource so that it may continue to be utilised by future generations;

8. To encourage and expedite an active water market so that water allocations are readily available for future economic development; and

9. To promote the efficient use of water according to industry best practice standards.

8.2 Principles

Except where otherwise expressly stated, all of the following principles apply to the allocation of water (taking) allocations from the confined aquifer.

Limit to total allocation

1. Water shall not be allocated from the confined aquifer where the allocation would cause the total amount allocated on all licences for the relevant management area plus the Irrigation extraction Factor, to exceed the Volume for Licensed Allocations (VLA) for the relevant management area (as shown in Figure 4.2), except where:

   (a) Water is to be allocated to existing unlicensed users in accordance with principles 8.2.2 and 8.2.3 (Unlicensed pre-existing water use); or

   (b) The total amount allocated on all licences plus the Irrigation Extraction Factor exceeds the VLA in the relevant management area at the **date of adoption,** in

which case the taking of the water will not cause significant adverse impacts on the confined aquifer within the relevant management area and provided that where the total amount allocated on all licences plus the Irrigation extraction Factor exceeds the VLA, the total amount allocated on all licenses plus the Irrigation Extraction Factor within the relevant management area does not exceed the PAV for that management area (see Table B).

Unlicensed pre-existing use

2. Water may be allocated to existing non-licensed water users where:

   (a) It can be demonstrated that the water use in its present form at the date of application, was also in existence during the year prior to 10 April 1997;

   (b) Water is used for the following:

   - Operation of a dairy licensed by the Dairy Authority of South Australia at date of application, (including wash down, washing up and milk cooling);
   - Intensive animal keeping;
   - An intensive plant production system such as greenhouses, hydroponics or nurseries;
   - Industry; or
   - Recreation;

   (c) The source aquifer nominated on the application is the aquifer from which the unlicensed water was taken at 12th February 2001; and

   (d) Applications for a water allocation are received by no earlier than 5p.m. on 30th June 2002 and no later than 31st July 2002.

3. Water shall be allocated for unlicensed pre-existing use in the following manner:

   (a) The water allocation shall meet the applicant's reasonable requirements up to 10 megalitres per annum, except for dairies which milk in excess of 300 cows in which case the allocation shall meet the applicant's reasonable requirements;

   (b) In the case of dairies, the water allocation shall be calculated as whichever is the greater of, the reasonable requirements of the water user at the time of application, or the average of the reasonable requirements over the preceding three year period;

   (c) Allocations granted under principles 8.2.2 and 8.2.3 are exempt from sections 8.2.4 & 8.2.5 (Taking and Use of water), 8.2.13 (Quantity of allocation), 8.2.16 to 8.2.20 (Active and expeditious use of water) and 8.2.21 to 8.2.23 (Hydrogeological effects).

Taking and Use of Water

4. Up to 50% of the volume available for allocation in the 1A, 2A and 3A confined aquifer management areas at **adoption date** may be allocated for the purposes of industry.

5. Subject to principle 8.2.4, there shall be no further allocations of confined aquifer water in the Comaum-Caroline PWA, except:

   (a) Where principles 8.2.2 and 8.2.3 (Unlicensed pre-existing water use) apply; or

   (b) Where an allocation is permanently transferred into Zone 1A in accordance with principle 9.2.6 (Transfer of water (taking) allocations) of this Plan; or

   (c) For the purpose of public water supply.

Underground Water Resource condition

6. The taking and use of water shall not cause or be likely to cause a mean (arithmetic) decrease in the potentiometric level of the confined aquifer within the vicinity of the point of taking (including neighbouring properties and the nearest potentiometric level monitoring wells), or within the relevant confined aquifer management area, of greater than 0.1 metres per year (measured over the preceding 5 years).

Water (holding) allocations

7. No water (holding) allocation shall be endorsed on a licence after **adoption date** except where a water (taking) allocation, either in whole or part, endorsed on a licence, is converted to a water (holding) allocation with the exception that any water (taking) allocation on a licence that is subject to a condition or conditions requiring the expeditious use of water (including a requirement that the equipment, or land by which or on which the water is used be developed in a certain time), shall not be converted to a water (holding) allocation if that condition has, or conditions have, not been satisfied.

Basis of allocation

8. Allocations of confined aquifer water granted after 5 pm on **adoption date** will be expressed volumetrically, except for:

   (a) Allocations that have been obtained through transfers, which shall be expressed in the same units of measure as those used prior to transfer;

   (b) Allocations varied through conversion from a water (taking) allocation to a water (holding) allocation, which shall remain expressed in the same units of measure as those used prior to conversion; and

   (c) Allocations varied through conversion from a water (holding) allocation to a water (taking) allocation, which shall remain expressed in the same units of measure as those used prior to conversion.

9. All allocations of confined aquifer water will be expressed volumetrically by 1 January 2005.

Purpose of use

10. Water shall not be taken and used for the purposes of wild flooding.

11. Water shall not be taken from the confined aquifer and used for the purpose of aquaculture unless:

    (a) The volume of tail water produced for disposal does not exceed an amount reasonably produced according to current industry best practice;

    (b) Disposal of tail water will not result in an increase (above seasonal fluctuations) in underground water levels in the unconfined or confined aquifers at the boundary of the allotment where the tail water is disposed of or, at the boundary of any adjoining allotment held by the same owner, whichever is the greater distance from the point of disposal;

    (c) Disposal of tail water will not result in an accelerated increase in salinity of the unconfined or confined aquifers, or result in pollution of these aquifers by any other substance; and

    (d) The ponds, tanks, vessels, or other places for the keeping of any water for the aquaculture process have no significant hydraulic connection with the unconfined or confined aquifers.

Quantity of allocation

12. Where water is to be used for irrigation purposes, the allocation shall not exceed the amount reasonably required to irrigate the area of the particular crop type, on the dominant soil type and given the local average meteorological conditions applicable to the relevant allotment.

13. Where water is to be used for purposes other than irrigation, the allocation shall not exceed the amount reasonably required (applying current industry best practice standards) for the purpose proposed.

Efficient use of water

14. Water shall be used and applied using water efficient technologies and techniques appropriate for the particular purpose and circumstances for and in which the water is to be used in accordance with current industry best practice standards.

15. For the purposes of principle 8.2.14, the relevant circumstances for the use of water for irrigation include (but are not limited to):

    (a) The plant type;

    (b) The climate, dominant soil type and topography of the allotment;

    (c) The location of remnant native vegetation and/or other permanent structures such as powerlines, which may limit the method of application of water; and

    (d) The salinity of the water to be used.

Active and expeditious use of water

16. All water (taking) allocations granted after adoption date, excluding allocations which have been obtained through transfers shall be used with the minimum of delay and in any case within 3 years of the granting of the allocation.

17. All water (taking) allocations granted before **adoption date**, with a condition requiring active and expeditious use, shall be used with the minimum of delay and in any case within 3 years of the granting of the allocation.

18. All water (taking) allocations granted after **adoption date**, resulting from the conversion of a water (holding) allocation, shall be used with the minimum of delay and in any case within 3 years of the granting of the allocation.

19. For the purposes of principles 8.2.16, 8.2.17 and 8.2.18 the use of an allocation includes the development of the land and equipment upon or by which the water is used, to a capacity that enables the water (taking) allocation to be utilised at its maximum lawful rate.

20. Without in any other way affecting the operation of principles 8.2.16, 8.2.17 and 8.2.18, where exceptional circumstances apply to the licensee, the maximum period may be increased to 4 years from the granting of the allocation.

Hydrogeological effects

21. The taking and use of water shall not adversely affect to a significant extent:

    (a) The quality of water in the confined aquifer by (including but not limited to) an increase in salinity;

    (b) The potentiometric level of the confined aquifer by causing or contributing to a long term decline in the potentiometric level by exceeding the rate specified in principle 8.2.6;

    (c) The structural integrity of the aquifer;

    (d) Any other water resource (including but not limited to the unconfined aquifer, or any relevant surface water resource), both within and outside the Comaum-Caroline Prescribed Wells Area; and

    (e) Ecosystems dependent on underground water.

22. The taking of water from the confined aquifer shall not cause a seasonal draw-down at any point beyond the 2 km radius from the proposed well(s) of greater than 2.0 metres, except where water is taken to be used for the purpose of public water supply by SA Water Corporation or a Local Government Authority and that Corporation or Authority had supplied the public with water from the well(s) on or before **adoption date**.

23. The taking of water from the confined aquifer shall not occur if it is likely to cause the potentiometric level in the confined aquifer to permanently fall below the potentiometric level in the unconfined aquifer in areas where the existing potentiometric level of the confined aquifer is greater than the potentiometric level of the unconfined aquifer.

Piping of water more than 2km

24. Where water is to be taken from one point and transported by pipe or other closed vessel to be used at another point at least 2 kilometres from the point of taking, the taking of water shall comply with principles 8.2.21 to 8.2.23 and use of the water shall comply with principle 8.2.21.

25. Confined aquifer water (taking) allocations granted after **adoption date** shall not be transported from the point of taking by means of an open channel.

9 Transfer Criteria – Confined Aquifer

9.1 Objectives

1. To protect ecosystems dependent on underground water by ensuring that the taking and use of underground water from the confined aquifer does not degrade the ecology and biodiversity of the region;

2. To protect the environment generally by ensuring that the taking and use of underground water from the confined aquifer does not significantly degrade any other resource, such as soils or other water resources;

3. To promote the efficient use of water according to industry best practice standards;

4. To manage the underground water resource of the confined aquifer so that it may continue to be utilised by future generations;

5. To ensure that extractions remain within the sustainable limits of the confined aquifer by limiting the concentration of water use that may result through the transfer of water allocations;

6. To encourage permanent transfers out of the Kingston confined aquifer management area, into Zones 1A.

9.2 Principles

Except where otherwise expressly stated, all the following principles apply to the transfer of a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation from the confined aquifer.

Transfers of water (holding) allocations

1. A licence endorsed with a water (holding) allocation, or the whole or a part of a water (holding) allocation may be transferred to any person or legal entity, but will continue to be recognised as being held from the same management area from which the allocation was originally granted.

Transfer of Water (Taking) Allocations – Purpose of Use

2. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, shall not be transferred where water is to be taken and used for wild flooding.

3. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation may only be transferred for the purpose of flood irrigation where the water will continue to be taken from the same well (or a well that replaces the original well, but lies within 1 kilometre of the original well) and is to be used on the same allotment or allotments.

4. The transfer of a licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation that is to be taken from the confined aquifer for the purpose of aquaculture will not be granted unless:

(a) The volume of tail water produced for disposal does not exceed an amount reasonably produced according to current industry best practice;

(b) Disposal of tail water will not result in an increase (above seasonal fluctuations) in underground water levels in the unconfined or confined aquifers at the boundary of the allotment where the tail water is disposed of, or, at the boundary of any adjoining allotment held by the same owner, whichever is the greater distance from the point of disposal;

(c) Disposal of tail water will not result in an accelerated increase in salinity of the unconfined or confined aquifers, or result in pollution of these aquifers by any other substance; and

(d) The ponds, tanks, vessels, or other places for the keeping of any water for the aquaculture process have no significant hydraulic connection with the unconfined or confined aquifers.

Transfer of water (taking) allocations

5. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation from the confined aquifer may be transferred either permanently or temporarily only where the proposed point of extraction is in the same confined aquifer management area as the existing point of extraction from which the allocation may lawfully be taken.

6. Existing water (taking) allocations which may lawfully be taken from the confined aquifer in the Kingston confined aquifer management area may be permanently but not temporarily transferred into Zone 1A confined aquifer management area, where the transfer will not cause the VLA in the receiving management area to be exceeded.

Applications to transfer water (taking) allocations – Efficient use of water

7. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation shall only be transferred where the water shall be used and applied using water efficient technologies and techniques appropriate for the particular purpose and circumstances for and in which the water is to be used in accordance with current industry best practice standards.

8. For the purposes of principle 9.2.7, the relevant circumstances for the use of water for irrigation include (but are not limited to):

   (a) The plant type;

   (b) The climate, dominant soil type and topography of the allotment;

   (c) The location of remnant native vegetation and/or other permanent structures such as powerlines, which may limit the method of application of water; and

   (d) The salinity of the water to be used.

Applications to transfer water (taking) allocations – Hydrogeological effects

9. A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation, shall only be transferred where the taking and use of water shall not adversely affect to a significant extent:

   (a) The quality of water in the confined aquifer by (including but not limited to) an increase in salinity;

   (b) The potentiometric level of the confined aquifer by causing or contributing to a long term decline in the potentiometric level by exceeding the rate specified in principle 8.2.6;

   (c) The structural integrity of the aquifer;

   (d) Any other water resource (including but not limited to the unconfined aquifer, or any relevant surface water resource), both within and outside the Comaum-Caroline Prescribed Wells Area;

   (e) Ecosystems dependent on underground water.

10. The transfer shall not cause the taking of water from the confined aquifer from the proposed well(s) of extraction to result in a seasonal draw-down at any point beyond the 2 km radius from the proposed well(s) of greater than 2.0 metres..

11. The transfer shall not occur where the taking of water from the confined aquifer from the proposed well(s) of extraction is likely to cause the potentiometric level in the confined aquifer to permanently fall below the potentiometric level in the unconfined aquifer in areas where the existing potentiometric level of the confined aquifer is greater than the potentiometric level of the unconfined aquifer.

12. A transfer application shall be deemed to have complied with principles 9.2.10 and 9.2.11 without further assessment where:

   (a) A licence endorsed with a water (taking) allocation, or the whole or part of a water (taking) allocation is to be transferred but will continue to be taken from the same well or is replaced by a new well within 1 kilometre of the original well and is to be used on the same allotment or allotments; or

   (b) An application to renew a temporary transfer (of the same quantity) that proposes taking the water allocation from the same well (or a well that replaces the original well, but lies within 1 kilometre of the original well), and use of the allocation on the same allotment or allotments, is received and processed prior to the date and time of expiry of the original temporary transfer.

Applications to transfer water (taking) allocations –Piping of water more than 2km

13. Where an application to transfer water proposes taking water from one point and transporting it by pipe or other closed vessel to be used at another point at least 2 kilometres from the point of taking, the taking of water shall comply with principles 9.2.9 , 9.2.10 and 9.2.11, and use of the water shall comply with principle 9.2.9.

14. Transfer applications that propose transporting confined aquifer water from the point of taking by means of an open channel shall not granted.

Applications to transfer water (taking) allocations – Development of allocation before transfer

15. Licences from the confined aquifer, with a condition or conditions imposed requiring the expeditious use of water (including a requirement that the equipment, or land by which or on which the water is used be developed in a certain time):

    (a) The allocation (or part thereof), or the licence may be transferred where the equipment or land has been fully developed to allow use of the water at its maximum lawful rate;

    (b) Where the allocation has not been fully developed, only the portion of the allocation that may be used in accordance with the extent of development at the date of receipt of the application to transfer by the Minister may be transferred; or

    (c) Where the licence or allocation is to be transferred in its entirety, but will be taken and used on the same allotment, it may be transferred whether or not the land or equipment has been fully developed in accordance with the condition(s), provided that the new landholder fully develops the land and equipment to allow use of the allocation at its maximum lawful rate, in accordance with the original conditions.

10 Permits

10.1 Wells

The following objectives and principles apply to permits for activities pursuant to section 9(3)(a) & (b) of the *Water Resources Act 1997* comprising drilling, plugging, backfilling or sealing a well and the repairing, replacing or altering the casing, lining, or screen of a well.

10.1.1 Objectives

1. To ensure the drilling, plugging, backfilling or sealing of a well occurs in a manner that will protect the quality of underground water resources.
2. To minimise the impact of repair, replacement or alteration of the casing, lining or screen of wells on the underground water resources.
3. To protect the underground water resources from pollution, deterioration and undue depletion.
4. To ensure the integrity of the headworks of wells are maintained.
5. To ensure that wells are constructed in the correct aquifer system.

10.1.2 Principles

Impact of well works on water quality & integrity of the aquifer

1. The equipment, materials and method used in the drilling, plugging, backfilling or sealing of a well, or the replacement or alteration of the casing, lining or screen of a well, shall not adversely affect the quality of the underground water resource.
2. Aquifers shall be protected during the drilling, plugging, backfilling or sealing of a well, or the replacement or alteration of the casing, lining or screen of a well, to prevent adverse impacts upon the integrity of an aquifer.

Seals between aquifers

3. Where a well passes, or will pass through two or more aquifers, an impervious seal shall be made and maintained between such aquifers.

Design of headworks

4. The headworks of a well from which a licensed allocation is to be taken shall be constructed so that the extraction of water from the well can be metered without interference.

Wells for artificial recharge

5. The headworks of a well for the draining or discharge of recharged water shall be constructed so that recharge and draining or discharge operations can be metered without interference.

Minimum distance between licensed wells and the border between South Australia and Victoria

6. Wells in the Border Designated Area must be located a distance greater than one kilometre from the border between the State of South Australia and the State of Victoria, unless the Border Groundwaters Review committee has first considered the matter and determined that such application may be granted.

10.2 Draining or Discharging of Imported Water into a Well – Artificial Recharge

10.2.1 Objective

To provide for the draining or discharging of imported water directly or indirectly into a well in a manner that does not adversely affect the underground water quality, the aquifer or any ecosystem that depends on that water.

10.2.2 Principles

The following principles apply to permits, pursuant to section 9 (3) (c) of the Act, for the activity of draining and discharging of imported water directly into a well.

1. Imported water may be drained or discharged into the confined or unconfined aquifers.

2. Subject to principles 10.2.2.4 and 10.2.2.5 imported water may be drained or discharged into a well for the purpose of aquifer storage and recovery where the concentrations, levels or amounts of the substances, materials or characteristics set out in principle 10.2.2.4 below, in the water to be drained or discharged, do not exceed the concentrations, levels or amounts of those substances, materials or characteristics in the native underground water.

3. For the purposes of principles 10.2.2.2, 10.2.2.4 and 10.2.2.5, the relevant concentrations, levels or amounts shall be measured by sufficient representative samples of:

   (a) The water to be drained or discharged, collected either from an existing dam or directly from the source; and

   (b) Native underground water collected from the proposed point of injection, or as near as possible to the proposed point of injection, and from the same aquifer as that in which storage is proposed.

   "Sufficient representative samples" means suitable samples, collected with equipment appropriate for the substance, material or characteristic to be measured and taken at suitable locations and times to accurately represent the quality of the relevant water.

4. Imported water may be drained or discharged directly or indirectly into a well (despite principle 10.2.2.2) where the concentrations, levels and amounts of the substances, materials or characteristics of, or in the water set out in principle 10.2.2.6 are not sufficient to degrade the ecosystems dependent upon underground

water within the prescribed water resource or to reduce the suitability of the underground water for other purposes for which it might reasonably be used.

5. The draining or discharge of imported water directly or indirectly into a well may not be granted (despite principles 10.2.2.2 and 10.2.2.4) where the cumulative effects of the discharge of water to the aquifer are considered sufficient to degrade the ecosystems dependent upon underground water within the prescribed water resource, or to reduce the suitability of the underground water for other purposes for which it might reasonably be used.

6. For the purposes of principles 10.2.2.2, 10.2.2.4 and 10.2.2.5 above, the list of substances, materials and characteristics comprises substances, materials and characteristics that may reasonably be expected to be present in the imported water to be drained or discharged and have the potential to degrade the native underground water and the ecosystems that depend upon the native underground water, including where relevant (but not limited to):

   (a) pH, TDS, turbidity, ammonia, nitrate, nitrite, total phosphorus, sodium, chloride, sulphate, calcium, magnesium, bicarbonate, iron, total arsenic, total boron, total cadmium, total chromium, total lead, total manganese, total zinc, total coliforms and faecal coliforms; and

   (b) Pesticides, *Giardia, Cryptosporidium*, volatile organic compounds and petroleum hydrocarbons (including but not limited to water from land used for intensive agriculture or industrial purposes) those substances, materials and characteristics likely to be present in the source of the water; and

   (c) trihalomethanes where the water to be drained or discharged has been treated by chlorination.

7. The draining or discharging of imported water directly or indirectly to a well must not detrimentally affect the ability of other persons to lawfully take from that underground water or damage any ecosystem that depends on the underground water.

8. Draining or discharging imported water directly or indirectly into a well may only occur where:

   (a) the headworks of the well are constructed such that both recharge and recovery operations can be metered without interference;

   (b) continued recharge of water at the site will not result in detrimental impacts on water quality or on the integrity of the aquifer, for example, but not limited to:

      (i) unacceptable interference with the water supply from neighbouring wells constructed to current industry standards;

      (ii) an increase in salinity of the underground water;

      (iii) secondary water quality issues such as increased susceptibility to dryland salinity;

(iv) increased secondary porosity, which may affect the stability of the aquifer and result in land subsidence;

(v) perched water tables; or

(vi) waterlogging.

9. For the purposes of this plan the term "native underground water" means the underground water (as that term is defined in the *Water Resources Act 1997*) that exists in the relevant aquifer absent any such water drained or discharged to that aquifer by artificial means.

10. Licence or permit holders draining or discharging imported water into a well will be required to implement an ongoing water quality monitoring program, with the following minimum analysis of the water to be drained or discharged into the well:

    (a) minimum of four (4) samples per season during which the drainage or discharge to the well occurs; and

    (b) at least one sample per ten (10) megalitres of water drained or discharged to the well.

    Parameters to be analysed will be determined after assessment of the quality of the water to be drained or discharged directly or indirectly into the well and of the underground water into which the drainage or discharge is to occur, as undertaken at 10.2.2.6.

10.3 Importation of Water

Except for the purpose of public water supply, a permit is required for the activity prescribed by the Regulations pursuant to section 9(4)(k) of the *Water Resources Act 1997* comprising using water in the course of carrying on a business at a rate that exceeds 1 megalitre/annum where the water has been brought into a management area by means of a pipe or other channel ("use of imported water").

10.3.1 Relevant Authority

The relevant authority for determining a permit application for the activity of using water in the course of carrying on a business at a rate that exceeds 1 megalitre per annum where the water has been brought into the management area by means of a pipe or other channel is the Minister responsible for the administration of the *Water Resources Act 1997*.

The following objectives and principles apply to the use of imported water:

10.3.2 Objective

To ensure that the use of imported water occurs in a manner that does not adversely affect the prescribed underground water resource, or ecosystems dependent on underground water.

10.3.3 Principles

1. Use of imported water shall not cause a rise in the underground water levels that detrimentally affects a structure or ecosystem.
2. For the purposes of principle 10.3.3.1, “structure” is defined as, but is not limited to, a building, fence or wall.
3. Use of imported water shall not adversely affect the quality of the prescribed underground water resource.
4. Use of imported water shall not adversely affect the productive capacity of the land by causing salinity, waterlogging or perched watertables or other such impacts.
5. The salinity of imported water shall not exceed native background underground water salinity levels or 1500 mg/L, which ever is the lower.

11 Monitoring

Section 101 (4) (e) of the Act requires the Plan to assess the capacity of the resource to meet the demands for water on a continuing basis and provide for regular monitoring of the capacity of the resource to meet those demands.

11.1 Monitoring the capacity of the underground water resource - The Water Level and Salinity Monitoring Network

The water level monitoring network in the Comaum–Caroline PWA has been in operation for more than 30 years. Over this period, the network has been upgraded and expanded to match the agricultural development in the PWA.

Unconfined Aquifer

There are currently 104 wells in the water level monitoring network. The majority of these wells are measured quarterly by the Department for Water Resources. There is a fairly even distribution of observation wells over the PWA. The highest concentration of wells are centred around Mount Gambier City and are part of the water level and salinity monitoring program for the Blue Lake.

The network has recently been expanded in a number of areas. These include observation wells in and around blue gum developments, an investigation in to lateral groundwater inflow to the Blue Lake, and south of Mount Gambier additional wells in the intensely irrigated dairying area.

There are currently 49 wells in the Comaum– Caroline salinity monitoring network, which are sampled quarterly. The network has recently been expanded to meet increased development in the area (see above section).

Confined Aquifer

There are currently 10 confined aquifer water level monitoring wells in the Comaum–Caroline PWA. All the wells are part of the network that monitors confined aquifer water levels in the Designated Border zone.

Salinity monitoring of the ten confined aquifer wells in the Comaum–Caroline PWA is undertaken every five years as part of the *Border Agreement Ac*t. None of the wells have sufficient record lengths to interpret trends.

Table 11.1: Underground water monitoring

What	Where	When
Underground water levels in the unconfined aquifer	Unconfined aquifer water level monitoring network locations in the Prescribed Wells Area	Quarterly
Underground water salinity in the unconfined aquifer	Unconfined aquifer salinity monitoring network locations in the Prescribed Wells Area	Quarterly
Underground water level/pressure in the confined aquifer	Confined aquifer water level/pressure monitoring network locations in the Prescribed Wells Area	Every six months
Underground water salinity in the confined aquifer	Confined aquifer salinity monitoring network locations in the Prescribed Wells Area	Every five years

11.2 The strategy for regular monitoring of the demands placed on the underground water resource

The strategy for regular monitoring of the demands placed on the underground water resource is provided below. The monitoring program will include:

11.2.1 Annual Water Use Report

An Annual Water Use Report is to be prepared by each licensee and submitted to the Department for Water Resources, Mount Gambier office, on or by 5 pm 31 July each year. Each licensee will provide the following information in the Annual Water Use Report:

(a) The volume of water and/or HaIE allocated on the licence;

(b) For licences expressed volumetrically, the volume of water actually used by the licensee and recorded on each meter during the water-use year (i.e. opening and closing meter readings);

(c) The period of water use (eg. from 12 November to 30 April);

(d) The purpose for which water has been taken;

(e) The salinity reading, date and bore number of any underground water salinity measurements taken during the Water Use Year;

(f) The total amount of imported water recharged for each meter for the purpose of Aquifer Storage and Recovery in the water-use year (where applicable); and

(g) Where the water taken by the licensee is used for irrigation:

(i) the area of each crop type irrigated;

(ii) An estimate of the quantity of water taken from each licensed well (in megalitres) and a description of the method used to calculate extraction(s);

(iii) a sketch plan of the area irrigated, the plant type, and how many hectares were irrigated;

(iv) the number of irrigations;

(v) the irrigation method; and

(vi) the nature of services used to schedule when irrigation is required (eg. neutron probes, external irrigation scheduling service, tensiometer etc).

Table 11.2: Monitoring the use of underground water

What	Where	When
Underground water use and extraction	The wells used by all licensed users by way of an annual water use report	Submitted by 5.00pm 31 July each year
The salinity of underground water	The wells used by all licensed users by way of an annual water use report	Submitted by 5.00pm 31 July each year

11.2.2 Monitoring of the Water Needs of Ecosystems Dependent on Underground Water

The water needs of ecosystems dependent on underground water are described in Table 2.1. Monitoring arrangements must be established to evaluate whether the policies in this Plan protect the water needs that have been identified.

This requires monitoring of critical hydrogeological and ecosystem parameters that can be used for this evaluation. These parameters include:

- Mean underground water levels;
- Seasonal underground water fluctuations;
- Underground water salinity;
- Species composition and abundance;
- Species recruitment; and
- Specific vegetation health measures such as canopy density.

A detailed program to monitor the parameters listed above will be formulated and implemented through the investigations program detailed in the Catchment Water Management Plan.

12 Miscellaneous

The preparing the policy, the Board has had regard to the issues set out in section 6 (2) of the *Water Resources Act 1997,* the *Groundwater (Border Agreement) Act 1995* and the *South Easter Water Conservation and Drainage Act 1992*.

The Plan also shows relevant benefits of consistency with the following plans and policies as listed in Section 101(9) of the Act:

(a) Relevant management plans under the *Coast Protection Act 1972*;

(b) Relevant Development Plans under the *Development Act 1993*;

(c) Relevant environment protection policies under the *Environment Protection Act 1993*;

(d) Relevant plans of management under the *National Parks and Wildlife Act 1972*;

(e) Relevant district plans under the *Soil Conservation and Land Care Act 1989*;

(f) Guidelines relating to the management of native vegetation adopted by the Native Vegetation Council under the *Native Vegetation Act 1991*;

(g) State Water Plan.

Table A: Volume for licensed allocation (VLA) for the unconfined aquifer management areas of the Comaum-Caroline Prescribed Wells Area

Management Area	PAV ML	VLA[(a)] ML	Total Licensed Allocations at 23/05/01[(b)] ML	Difference (a - b) ML	Volume Reserved for Allocation to Unlicensed Pre-Existing Uses ML	Volume Available for Allocation to other uses at 23/05/01 ML
Myora	6,000	4,208	3,335	873	200	0
Glenburnie	12,300	9,475	15,253	-5,778	0	0
Donovans	12,600	10,695	12,339	-1,644	0	0
Zone 2A	25,000	21,643	20,453	1,190	200	990
Zone 3A	24,000	21,095	24,109	-3,014	0	0
Glenroy	4,550	4,030	5,720	-1,690	0	0
Comaum	1,750	1,545	1,883	-338	0	0
Total	**86,200**	**72,691**	**83,092**	**N/A**	**400**	990

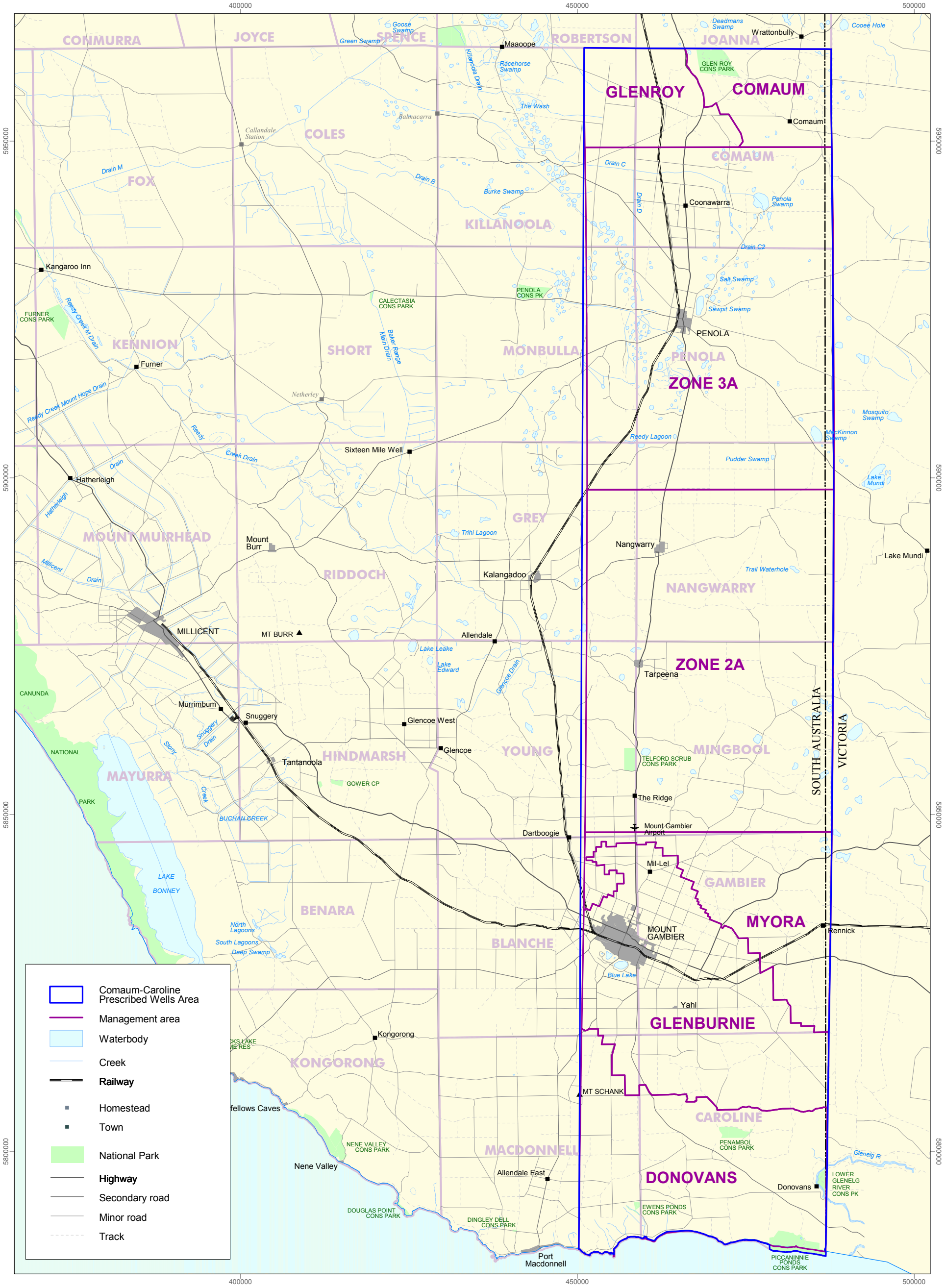
Note: Total Licensed Allocations within Zone 1A (incorporating the Myora, Donovans and Glenburnie management areas) can not exceed the PAV for Zone 1A set by the Border Groundwaters Review Committee under the *Groundwater (Border Agreement Act) 1985*. Therefore, under this Plan, no further water will be allocated from the Myora management area, except for unlicensed pre-existing uses.

Please Note: At **date of adoption** the PAV and VLA figures in this table cannot be altered during the life of this Plan. The figures shown in the columns titled 'Total Allocations', 'Difference' and 'Volume Available for Allocation' may change during the life of this Plan.

Table B: Volume for Licensed Allocation (VLA) for the confined aquifer management areas in South Australia (all in ML)

Management Area	PAV	VLA (a)	Total Licensed Allocations at 23/05/01 (b)	Irrigation Extraction Factor (c)	Difference (a)-(b)-(c)	Volume available for allocation at 23/05/01
Fairview	290	284	0	0	284	284
Kalangadoo	3,900	3,822	1,993	386	1,443	1,443
Keith	2,500	2,450	130	0	2,320	2,320
Kingston	25,000	22,379	19,755	2,935	-311	0
Lucindale	3,600	3,438	1,325	123	1,990	1,990
Millicent	10,800	10,584	4,376	676	5,532	5,532
Taratap	330	323	16	3	304	304
Wirrega	960	941	300	0	641	641
Zone 1A	9,200	8,806	404	81	8,321	8,321
Zone 2A	2,900	2,842	50	0	2,792	2,792
Zone 3A	1,900	1,862	0	0	1,862	1,862
Zone 4A	710	696	280	56	360	360
Zone 5A	540	529	0	0	529	529
Zone 6A	360	353	0	0	353	353
Zone 7A	350	343	0	0	343	343
Zone 8A	340	333	0	0	333	333
Zone 9A	570	559	0	0	559	559
Total	**64,250**	**60,544**	**28,629**	**4,259**	**N/A**	**27,967**

Figures



COMAUM-CAROLINE PRESCRIBED WELLS AREA

UNDERGROUND WATER MANAGEMENT AREAS FOR THE UNCONFINED AQUIFER

Water Search Groundwater & Geological Consultants

Department for Water Resources

PRIMARY INDUSTRIES AND RESOURCES SA

GDA Geocentric Datum of Australia

Government of South Australia

AV3: 200454_048

Figure 1.1

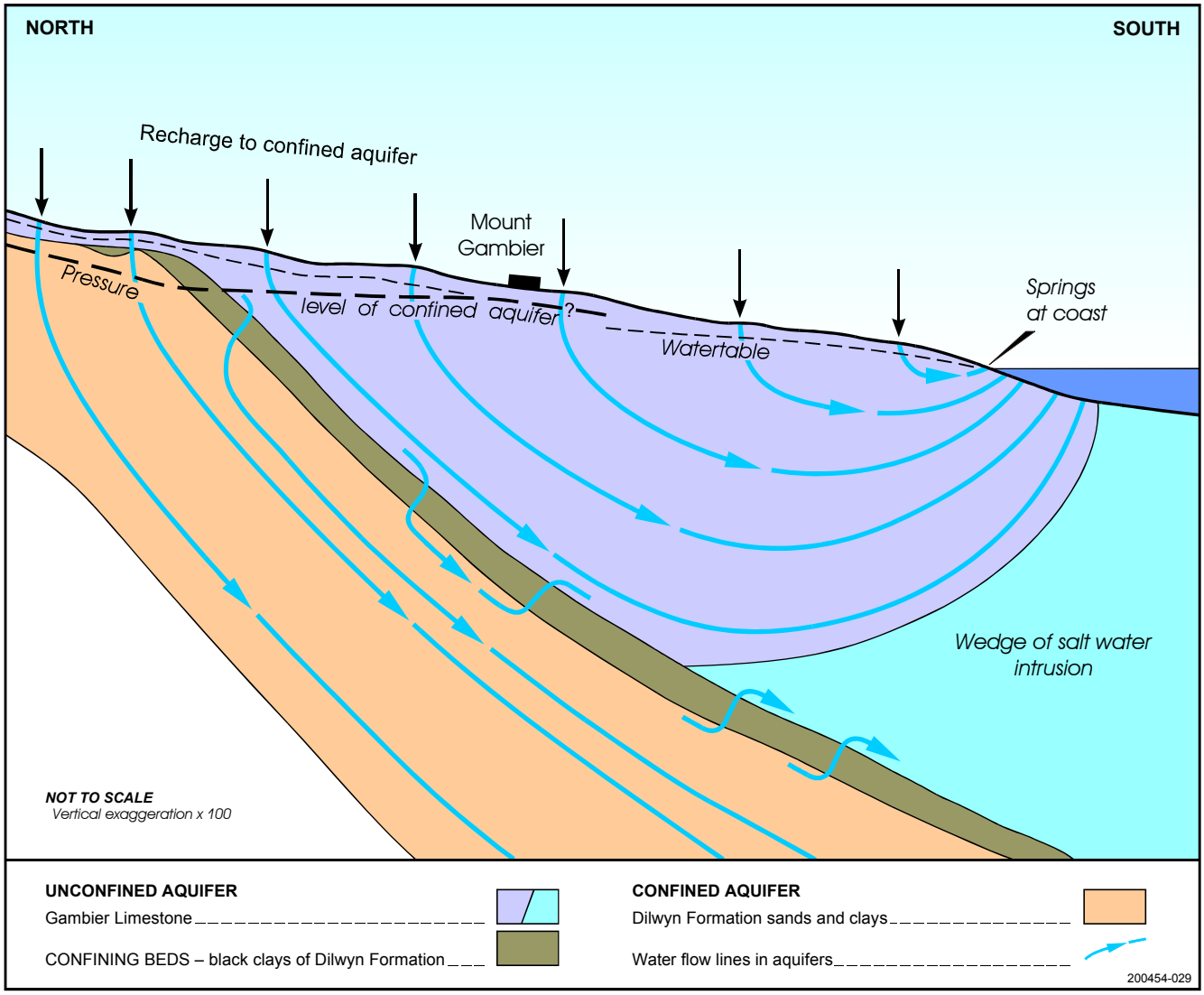


Figure 1.2 *Schematic north-south geological cross section of the Comaum-Caroline PWA.*

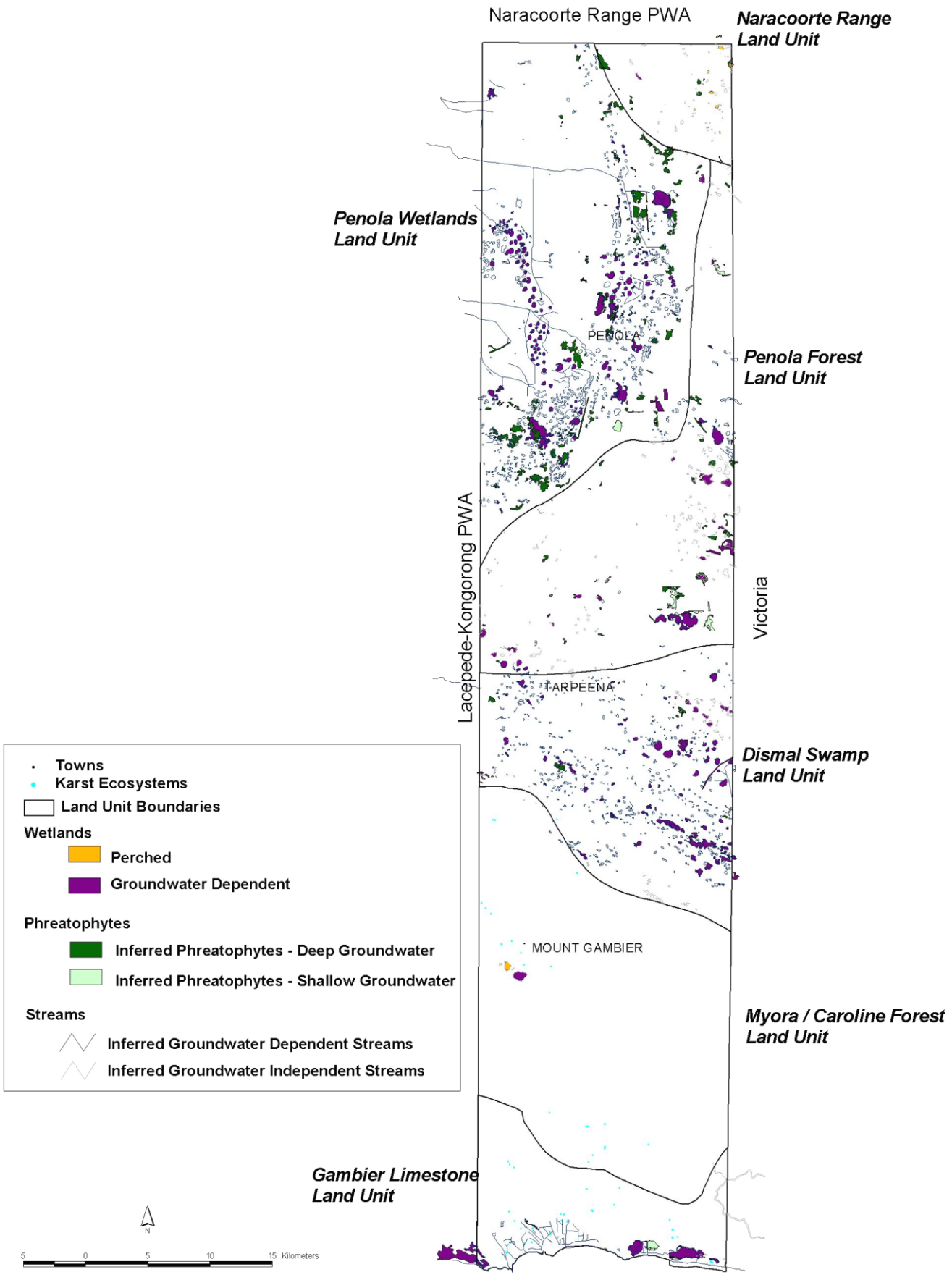
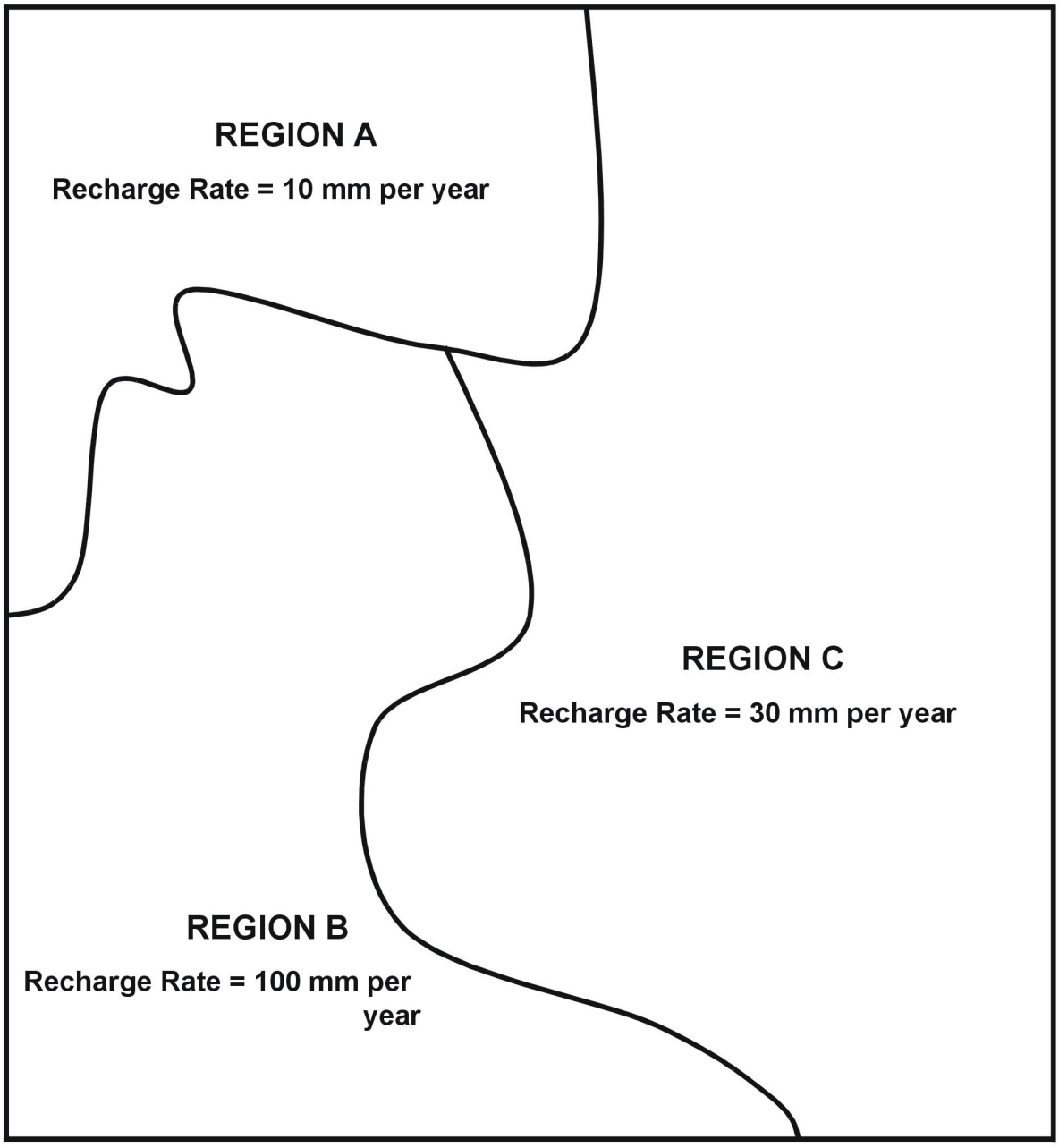


Figure 2.1: Ecosystems Dependent on Underground Water Comaum-Caroline PWA

Figure 4.1: Example Determination of Permissible Annual Volume (PAV) for the Unconfined Aquifer in an Example Management Area

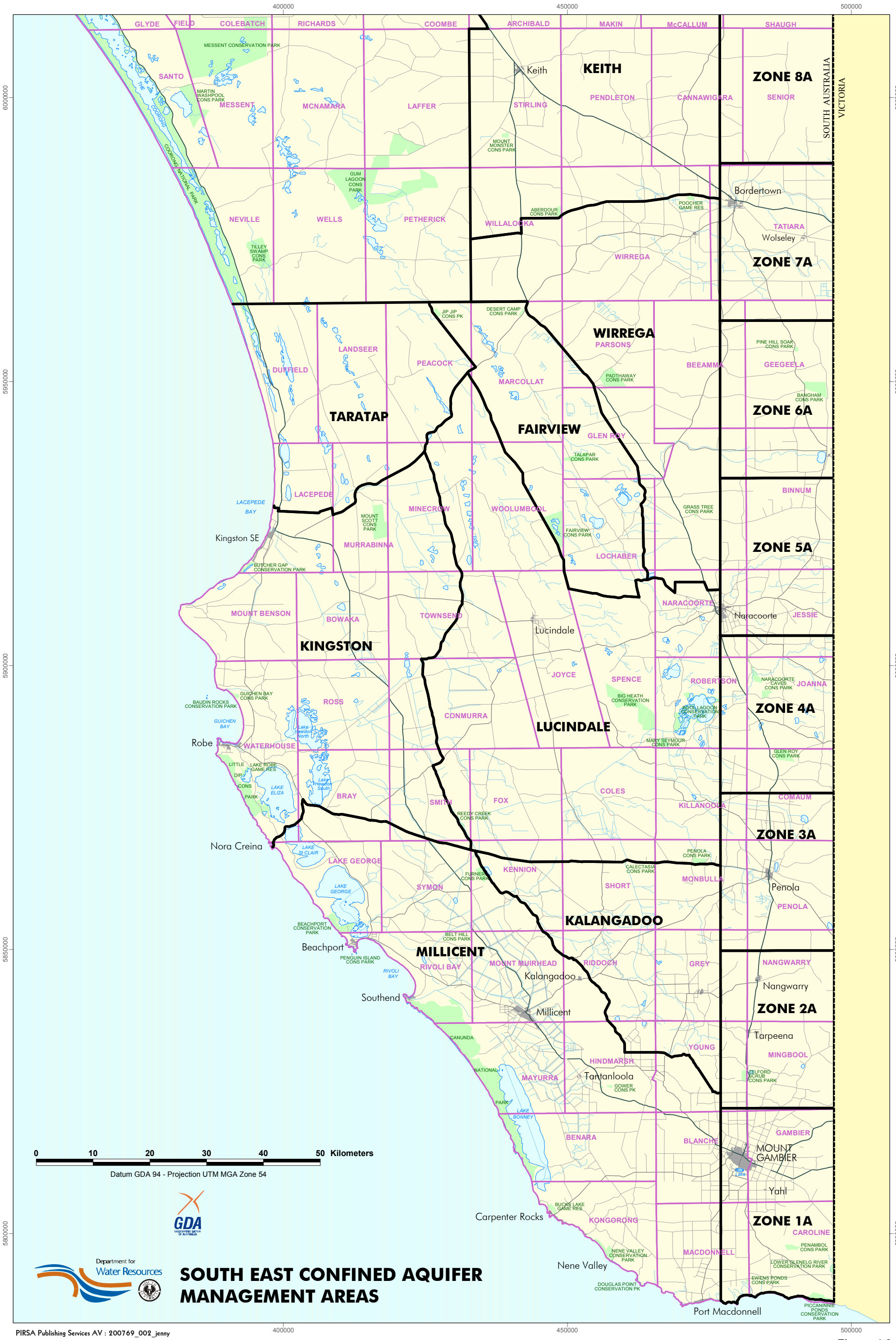


PAV (in ML per year)

= (Sum of all recharge in regions A, B and C) x Salinity factor

= ((Land area of A (km^2) x 10) + (Land area of B (km^2) x 100)

+ (Land area of C (km^2) x 30)) X Salinity Factor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SANTO
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MESSENT
MCNAMARA
LAFFER
STIRLING
Keith
KEITH
PENDLETON
CANNAWIGARA
ZONE 8A
SENIOR
SOUTH AUSTRALIA
VICTORIA
THE COORONG
COORONG NATIONAL PARK
MOUNT MONSTER CONS PARK
GUM LAGOON CONS PARK
Bordertown
POOCHER GAME RES
ABERDOUR CONS PARK
NEVILLE
WELLS
PETHERICK
WILLALOOKA
TATIARA
Wolseley
TILLEY SWAMP CONS PARK
WIRREGA
ZONE 7A
JIP JIP CONS PK
DESERT CAMP CONS PARK
WIRREGA
PARSONS
LANDSEER
PEACOCK
DUFFIELD
MARCOLLAT
PINE HILL SOAK CONS PARK
BEEAMMA
GEEGEELA
PADTHAWAY CONS PARK
BANGHAM CONS PARK
ZONE 6A
TARATAP
FAIRVIEW
GLEN ROY
TALAPAR CONS PARK
LACEPEDE
LACEPEDE BAY
MINECROW
WOOLUMBOOL
MOUNT SCOTT CONS PARK
GRASS TREE CONS PARK
FAIRVIEW CONS PARK
BINNUM
Kingston SE
MURRABINNA
LOCHABER
ZONE 5A
BUTCHER GAP CONSERVATION PARK
NARACOORTE
Naracoorte
JESSIE
MOUNT BENSON
BOWAKA
TOWNSEND
Lucindale
KINGSTON
JOYCE
SPENCE
ROBERTSON
NARACOORTE CAVES CONS PARK
JOANNA
GUICHEN BAY CONS PARK
BAUDIN ROCKS CONSERVATION PARK
ROSS
CONMURRA
LUCINDALE
BIG HEATH CONSERVATION PARK
BOOL LAGOON CONSERVATION PARK
ZONE 4A
GUICHEN BAY
Lake Hawdon North
Robe
WATERHOUSE
MARY SEYMOUR CONS PARK
GLEN ROY CONS PARK
LITTLE DIP CONS PARK
LAKE ROBE GAME RES
LAKE ELIZA
Lake Hawdon South
BRAY
SMITH
FOX
COLES
KILLANOOLA
COMAUM
REEDY CREEK CONS PARK
ZONE 3A
Nora Creina
LAKE St CLAIR
LAKE GEORGE
KENNION
CALECTASIA CONS PARK
PENOLA CONS PARK
FURNER CONS PARK
SYMON
SHORT
MONBULLA
Penola
PENOLA
KALANGADOO
BEACHPORT CONSERVATION PARK
BELT HILL CONS PARK
Beachport
PENGUIN ISLAND CONS PARK
MILLICENT
RIVOLI BAY
MOUNT MUIRHEAD
RIDDOCH
GREY
NANGWARRY
Kalangadoo
Nangwarry
Southend
Millicent
ZONE 2A
CANUNDA
Tarpeena
YOUNG
MINGBOOL
HINDMARSH
NATIONAL PARK
MAYURRA
Tantanloola
TELFORD SCRUB CONS PARK
GOWER CONS PK
LAKE BONNEY
BENARA
BLANCHE
GAMBIER
MOUNT GAMBIER
Yahl
BUCKS LAKE GAME RES
Carpenter Rocks
KONGORONG
ZONE 1A
CAROLINE
PENAMBOL CONS PARK
NENE VALLEY CONSERVATION PARK
MACDONNELL
LOWER SLENELG RIVER CONSERVATION PARK
Nene Valley
EWENS PONDS CONS PARK
DOUGLAS POINT CONSERVATION PK
Port Macdonnell
PICCANINNIE PONDS CONSERVATION PARK
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GEOCENTRIC DATUM OF AUSTRALIA
Department for Water Resources
SOUTH EAST CONFINED AQUIFER MANAGEMENT AREAS
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Figure 4.2