REPORT

ASSESSMENT OF THE NEEDS OF WATER DEPENDENT ECOSYSTEMS FOR THE MALLEE PRESCRIBED WELLS AREA

Government of South Australia
Department for Water

ASSESSMENT OF THE NEEDS OF WATER DEPENDENT ECOSYSTEMS FOR THE MALLEE PRESCRIBED WELLS AREA

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Under delegation of the Minister for Sustainability, Environment and Conservation pursuant to Section 164N(4) of the *Natural Resources Management Act 2004*

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FOREWORD

South Australia's Department for Water leads the management of our most valuable resource—water.

Water is fundamental to our health, our way of life and our environment. It underpins growth in population and our economy—and these are critical to South Australia's future prosperity.

High quality science and monitoring of our State's natural water resources is central to the work that we do. This will ensure we have a better understanding of our surface and groundwater resources so that there is sustainable allocation of water between communities, industry and the environment.

Department for Water scientific and technical staff continue to expand their knowledge of our water resources through undertaking investigations, technical reviews and resource modelling.

Scott Ashby
CHIEF EXECUTIVE
DEPARTMENT FOR WATER

CONTENTS

LIST OF FIGURES

SUMMARY

In accordance with Section 164N(4) of the *Natural Resources Management Act 2004*, before determining the capacity of a prescribed water resource, the Minister responsible for the administration of that Act must prepare a report assessing the needs of ecosystems that depend on the prescribed resource.

The majority of underground water extraction in the Mallee PWA is from two main aquifer systems; the Murray Group Limestone and the Renmark Group Confined Aquifers. Overlying these is the Parilla Sands Aquifer (technically called the Pliocene Sands Aquifer). Extraction from the unconfined Parilla Sands is limited to a small number of stock bores due to its highly saline nature (Barnett and Osei-bonsu, 2006).

The unconfined watertable within the Mallee Prescribed Wells Area (PWA) is sufficiently deep (~40 m) to preclude the existence of the majority of groundwater dependent ecosystems. However, survey work has discovered the presence of stygofauna (an Oligochaete worm), which appears to be widespread across South Australia. Stygofauna populations in the Mallee PWA are expected to be very low due to the depth of groundwater and high salinity levels. Very little is known of the environmental water requirements of stygofauna and so an assessment of risk due to changes in the groundwater regime, due to extraction, cannot be made.

A number of perched groundwater aquifers support ephemeral wetland ecosystems in the PWA. These systems appear to be largely restricted to the Ngarkat Conservation Park and immediate surrounds and are not likely to have any connection to the deeper unconfined Parilla Sands Aquifer. There are no extractions from these perched aquifers.

Due to the deep unconfined water table, high salinity levels and the paucity of groundwater dependent ecosystems, it is expected that groundwater extractions will have minimal to no impact upon aquatic environments within the Mallee PWA.

1. INTRODUCTION

In accordance with Section 164N(4) of the *Natural Resources Management Act 2004* (the Act), before the capacity of a water resource can be determined, the Minister responsible for the administration of the Act must prepare a report to assess the needs of ecosystems that depend on the water resource.

This report outlines the current knowledge on water dependent ecosystems within the Mallee Prescribed Wells Area.

1.1. LOCATION

The Mallee Prescribed Wells Area (Mallee PWA) is located approximately 150 km east of Adelaide and covers the underground water resources in a large portion of the Murraylands area of South Australia (Figure 1). The Mallee PWA incorporates the Hundreds of McGorrery, Kekwick, Allen, Mindarie, Chesson, McPherson, Auld, Billiatt, Kingsford, Peebinga, Pinnaroo, Parilla, Bews, Cotton, Molineux, Price, Allenby, Day, Quirke, Fisk, Bandon, Vincent, Wilson, Hooper, Marmon Jabuk and a portion of the Out of Hundreds area. It also comprises three border designated areas along a 20 km strip of the South Australian/Victorian border, which are regulated by the *Border (Groundwater Agreement) Act 1985*.

The Mallee PWA is a gently undulating plain with soils ranging from deep sands to heavy soils such as clays and clay loams. Areas of remnant vegetation are primarily confined to several large State reserves protected under the *National Parks and Wildlife Act 1972* and the *Wilderness Protection Act 1992*, with the remainder of the region having experience widespread clearance. Due to the low rainfall (300–450 mm), high evaporation (1700–2200 mm) and well drained sandy soils, there are almost no surface water resources and the region is wholly dependent on water from the Murray Group Limestone Aquifer for stock, domestic and town water supplies.

1.2. MANAGEMENT OF WATER IN THE MALLEE PRESCRIBED WELLS AREA

The underground water resources of the Mallee PWA were first protected through proclamation of the Mallee Proclaimed Region in 1983 under the *Water Resources Act 1976*. The prescription of the Mallee Proclaimed Region was varied in 1986 pursuant to the same Act. Protection of the resource occurred due to concerns raised about its future sustainability following the use of underground water supplies for irrigation. In 2005, the Mallee Proclaimed Region was renamed the 'Mallee Prescribed Wells Area' pursuant to the *Natural Resources Management Act 2004*.

The South Australian Murray-Darling Basin Natural Resources Management Board (the Board) is required, under the Act, to prepare a water allocation plan (WAP) for the Mallee PWA. The aim of the WAP is to ensure the sustainable use of the available underground water resources. A WAP for the Mallee PWA currently exists (adopted 21 December 2000 under the *Water Resources Act 1976*).

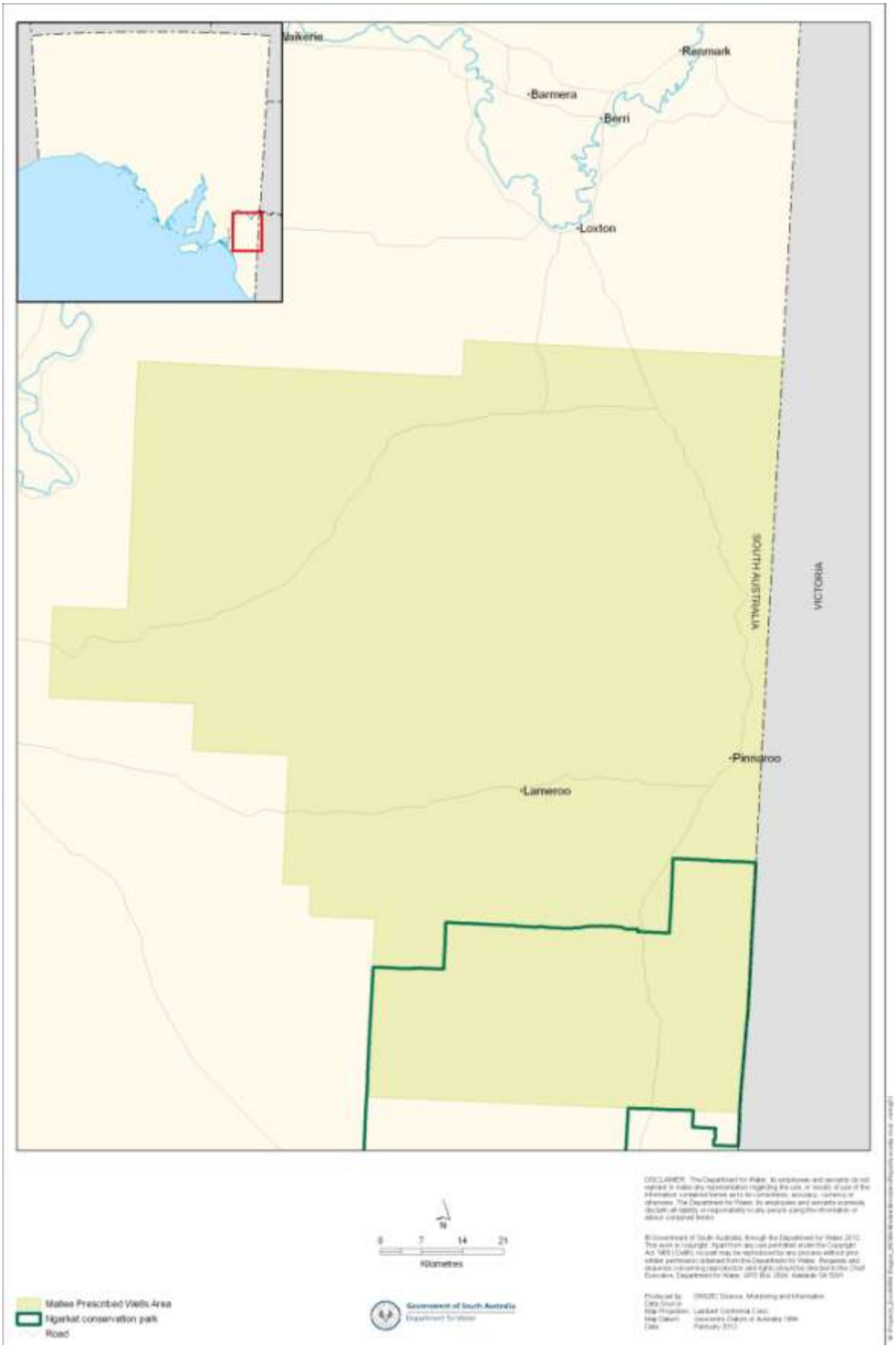

Figure 1: Mallee Prescribed Wells Area

2. GROUNDWATER

The underground water prescribed within the areas added to the Mallee PWA in 2005 is considered to be the same water resource throughout the Mallee PWA. As such, information provided about the water resource reflects the Mallee PWA as a whole.

The Mallee PWA sits within the Murray Basin, which extends from the Mount Lofty Ranges eastward to the Great Dividing Range. The Murray Basin consists of sand, clay and limestone sedimentary layers, which lay horizontally and are relatively uniform in thickness (maximum thickness of 300 m). These layers were deposited 30 million years ago during the Tertiary period when an ocean inundated the area, during the separation of Australia and Antarctica by continental drift. There are three main aquifer systems in the Mallee PWA; the unconfined Parilla Sand Aquifer, the Murray Group Limestone Aquifer which is predominantly confined and the confined Renmark Group Aquifer. The average depth to the watertable within the Mallee PWA is 40 m.

Groundwater contributes to aquatic ecosystems through supporting hypogean biota (animals that live below the ground surface), providing a subsurface water supply for vegetation (phreatophytic vegetation), or through surface expressions (e.g. springs, river baseflow). These processes are driven through unconfined aquifers. In the Mallee PWA, a shallow sand aquifer locally known as the Parilla Sands Aquifer (but technically called the Pliocene Sands Aquifer) overlies the main source of water for the Mallee PWA, the Murray Group Limestone Aquifer. The aquifer consists of unconsolidated to weakly cemented fine to course sand and is generally more than 50 m in thickness. It is generally unconfined and is saturated mostly in Victoria. The average depth to the unconfined watertable across the PWA is 40 m, from which a limited number of stock bores extract a small amount of water due to its highly saline nature (Barnett and Osei-Bonsu, 2006).

3. WATER DEPENDENT ECOSYSTEMS

It is generally considered that shallow watertables (those less than 10 m below the surface), are more likely to support GDEs than deeper watertables. The exception to this is stygofauna (animals that inhabit water filled cracks and pools below the ground) which can be found at greater depths.

The typical depth to the watertable in the Mallee PWA is around 40 metres and as such, this aquifer is not expected to provide surface expression of groundwater, or be sufficiently shallow to support phreatophytic (groundwater dependent) vegetation. A few small water bodies have been identified within the Mallee PWA, however, evidence suggests that these are often saline ephemeral depressions that collect surface runoff after heavy rain. Due to the watertable of this aquifer being so deep the only underground water interaction with these water bodies is expected to be with localised perched aquifers. Most of these waterbodies exist within the Ngarkat Conservation Park in the south-eastern corner of the PWA and despite their ephemeral nature, a number of these water bodies are likely to support the aquatic biodiversity values recorded from the park such as frogs, birds and plants (Department for Environment and Heritage 2004), Pers. comm. R. Pudney, DENR Senior Ranger Murray Mallee 2012).

These ephemeral and potentially perched groundwater dependent ecosystems can be impacted due to extraction from the perched aquifers or through salinisation resulting from close proximity irrigation from deeper groundwater sources.

Stygofauna and stygomicrobes are small aquatic invertebrates that inhabit underground aquifers and caves. In August 2008 sampling of a number of wells within the Mallee PWA (including the additional areas) was undertaken in an effort to find evidence of stygofauna (Leijs & Mitchell, 2008). Of the 16 wells sampled in the area only one bore, 12 km north of Peebinga, showed evidence of stygofauna (Oligochaete worms) (Leijs & Mitchell, 2009; R. Leijs, (Flinders University) 2010, pers. comm., 24 February). These results are typical of samples collected from underground water 50 metres or more below the surface where stygofauna densities are generally very low (R. Leijs, 2010, pers. comm.). It should be noted that the sampling undertaken thus far is not considered comprehensive. Given that the depth to the Murray Group Limestone Aquifer is greater than 50 m and that the saline water of the Parilla Sands aquifer is not an ideal environment for stygofauna, it is not expected that further sampling would find significant populations of stygofauna within the Mallee PWA.

The Murray Group Limestone and Renmark Group Confined aquifers contribute to the baseflow of the River Murray; however this discharge is mostly saline and is intercepted by salt interception schemes in some areas.

There are no groundwater dependent ecosystems that are dependent on the underground water from the Parilla Sands, Murray Group Limestone or Renmark Group Aquifers within the Mallee PWA, with the exception of stygofauna which are likely to be present in very low numbers.

4. ENVIRONMENTAL WATER REQUIREMENTS

Environmental water requirements are defined as “the water regime needed to sustain the ecological values of aquatic ecosystems, including their processes and biological diversity, at a low level of risk” (DWLBC 2006). Ecosystem requirements include both the local influence of underground water and the influence on receiving environments downstream.

A number of ephemeral wetlands/soaks exist within the PWA, but appear to be largely confined to Ngarkat Conservation Park. Persistence of water within these systems will be prolonged through interactions with localised perched aquifers. While very little is known about these systems, the ephemeral nature of these wetlands suggests a sensitivity to extensive changes in the water regime. Due to this paucity in information on the biotic and physical values and processes associated with these ecosystems the water requirements can only be stated in terms of current (assumed unimpacted) conditions. Therefore, the EWR for these systems is the water regime that they have historically experienced.

Oligochaete worm stygofauna were sampled from a single well in 2008 (Leijs and Mitchell 2009). Little is known about the water requirements of stygofauna apart from a requirement for the presence of water, therefore the influence of a changing groundwater regime upon this population cannot be stated.

Oligochaete worms appear to be widespread and were found in 32 separate wells during the sampling program across the Mount Lofty Ranges, South East, Flinders Ranges and Eyre Peninsula regions of South Australia. While the taxa does not appear to be endemic and unique, it is not clear what their true ecological significance is.

5. CONCLUSION

The only biota dependent upon water from the Parilla Sands, Murray Group Limestone and Renmark Group Aquifers found within the Mallee PWA is Oligochaete worm stygofauna (an invertebrate that lives within subsurface groundwater). Very little is known about the environmental water requirements of stygofauna; however, sampling of stygofauna across South Australia shows that Oligochaete worms appears to be widespread, reducing the risks to the taxa should impacts occur.

It is unlikely that other ecosystems reliant upon the Parilla Sands, Murray Group Limestone and Renmark Group Aquifers exist within the Mallee PWA given the depth to groundwater (~40 m across most of the region).

UNITS OF MEASUREMENT

Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol	Definition in terms of other metric units	Quantity
day	d	24 h	time interval
gigalitre	GL	10^6 m^3	volume
gram	g	10^{-3} kg	mass
hectare	ha	10^4 m^2	area
hour	h	60 min	time interval
kilogram	kg	base unit	mass
kilolitre	kL	1 m^3	volume
kilometre	km	10^3 m	length
litre	L	10^{-3} m^3	volume
megalitre	ML	10^3 m^3	volume
metre	m	base unit	length
microgram	µg	10^{-6} g	mass
microlitre	µL	10^{-9} m^3	volume
milligram	mg	10^{-3} g	mass
millilitre	mL	10^{-6} m^3	volume
millimetre	mm	10^{-3} m	length
minute	min	60 s	time interval
second	s	base unit	time interval
tonne	t	1000 kg	mass
year	y	365 or 366 days	time interval

GLOSSARY

Aquifer — A permeable zone of rock or sediment in which underground water is stored and moves.

Baseflow — The component of flow in a watercourse that is driven from the discharge of underground water.

Ecosystem — A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Environmental water requirement — The water regime needed to sustain the ecological values of aquatic ecosystems, including their processes and biological diversity, at a low level of risk.

Groundwater — Water occurring naturally below ground level or water pumped, diverted and released into a well for storage underground; see also 'underground water'

Phreatophytic — A plant (often deep-rooted) that obtains a significant portion of the water that it needs from the water table or other permanent ground supply.

Prescribed Area — The Mallee Prescribed Wells Area.

Stygofauna — Animals that live within groundwater systems, including caves and aquifers.

Surface water — As in Section 3(1) of the Natural Resources Management Act:

- water flowing over land (except in a watercourse)
- after having fallen as rain or hail or having precipitated in any other manner or
- after rising to the surface naturally from underground
- water of the kind referred to above that has been collected in a dam or reservoir
- water of the kind referred to in the first dot point above that is contained in any stormwater infrastructure (as that term is defined in the Act).

Watercourse — As in Section 3(1) of the Act, a river, creek or other natural watercourse (whether modified or not) in which water is contained or flows whether permanently or from time to time and includes:

- a dam or reservoir that collects water flowing in a watercourse
- a lake through which water flows
- a channel (but not a channel declared by regulation to be excluded from the ambit of this definition) into which the water of a watercourse has been diverted
- part of a watercourse
- an estuary through which water flows
- any other natural resource or class of natural resource, designated as a watercourse for the purposes of the Act by an NRM Plan.

Water dependent ecosystem(s) — Those parts of the environment, the species composition and natural ecological processes, which are determined by the permanent or temporary presence of flowing or standing water, above or below ground. The instream areas of rivers, riparian vegetation, springs, wetlands, permanent pools, floodplains, estuaries and lakes are all water dependent ecosystems.

Water resource — As in Section 3(1) of the Act –

- a watercourse or lake, surface water, underground water, stormwater (to the extent that it is not within a preceding item) and effluent
- an opening in the ground excavated for some other purpose but that gives access to underground water
- a natural opening in the ground that gives access to underground water.

GLOSSARY

Wetland — As in Section 3(1) of the Act, an area that comprises land that is permanently or periodically inundated with water (whether through a natural or artificial process) where the water may be static or flowing and may range from fresh water to saline water and where the inundation with water influences the biota or ecological processes (whether permanently or from time to time) and includes any other area designated as a wetland:

- by an NRM plan or
- by a Development Plan under the *Development Act 1993*.

For the purposes of this report, dams and well-defined, channelised watercourses are exempt from this definition.

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