The Department of
Water, Land and
Biodiversity
Conservation

Noora Prescribed Wells Area Groundwater Monitoring Status Report 2002

Report DWLBC 2002/08

Government of South Australia

The Department of
Water, Land and
Biodiversity
Conservation

Noora Prescribed Wells Area groundwater monitoring status report 2002

Zoe E. Marsden

Groundwater Assessment
Department of Water, Land and Biodiversity Conservation

August 2002

Report DWLBC 2002/08

Government
of South Australia

Resource Assessment Division
Department of Water, Land and Biodiversity Conservation
Level 11, 25 Grenfell Street, Adelaide
GPO Box 2834, Adelaide SA 5001

Telephone	National	(08) 8463 6967
	International	+61 8 8463 6967
Fax	National	(08) 8463 6999
	International	+61 8 8463 6999
Website	www.dwlbc.sa.gov.au	

Disclaimer

Department of Water, Land and Biodiversity Conservation and its employees do not warrant or make any representation regarding the use, or results of the use, of the information contained herein as regards to its correctness, accuracy, reliability, currency or otherwise. The Department of Water, Land and Biodiversity Conservation and its employees expressly disclaims all liability or responsibility to any person using the information or advice.

Marsden, Z.E., 2002. Noora Prescribed Wells Area groundwater monitoring status report 2002. *South Australia. Department of Water, Land and Biodiversity Conservation. Report,* DWLBC 2002/08.

Foreword

South Australia's natural resources are fundamental to the economic and social wellbeing of the State. One of the State's most precious natural resources, water is a basic requirement of all living organisms and is one of the essential elements ensuring biological diversity of life at all levels. In pristine or undeveloped situations, the condition of water resources reflects the equilibrium between rainfall, vegetation and other physical parameters. Development of these resources changes the natural balance and may cause degradation. If degradation is small, and the resource retains its utility, the community may assess these changes as being acceptable. However, significant stress will impact on the ability of a resource to continue to meet the needs of users and the environment. Understanding the cause and effect relationship between the various stresses imposed on the natural resources is paramount to developing effective management strategies. Reports of investigations into the availability and quality of water supplies throughout the State aim to build upon the existing knowledge base enabling the community to make informed decisions concerning the future management of the natural resources thus ensuring conservation of biological diversity.

Bryan Harris
Director, Resource Assessment Division
Department of Water, Land and Biodiversity Conservation

CONTENTS

List of Tables

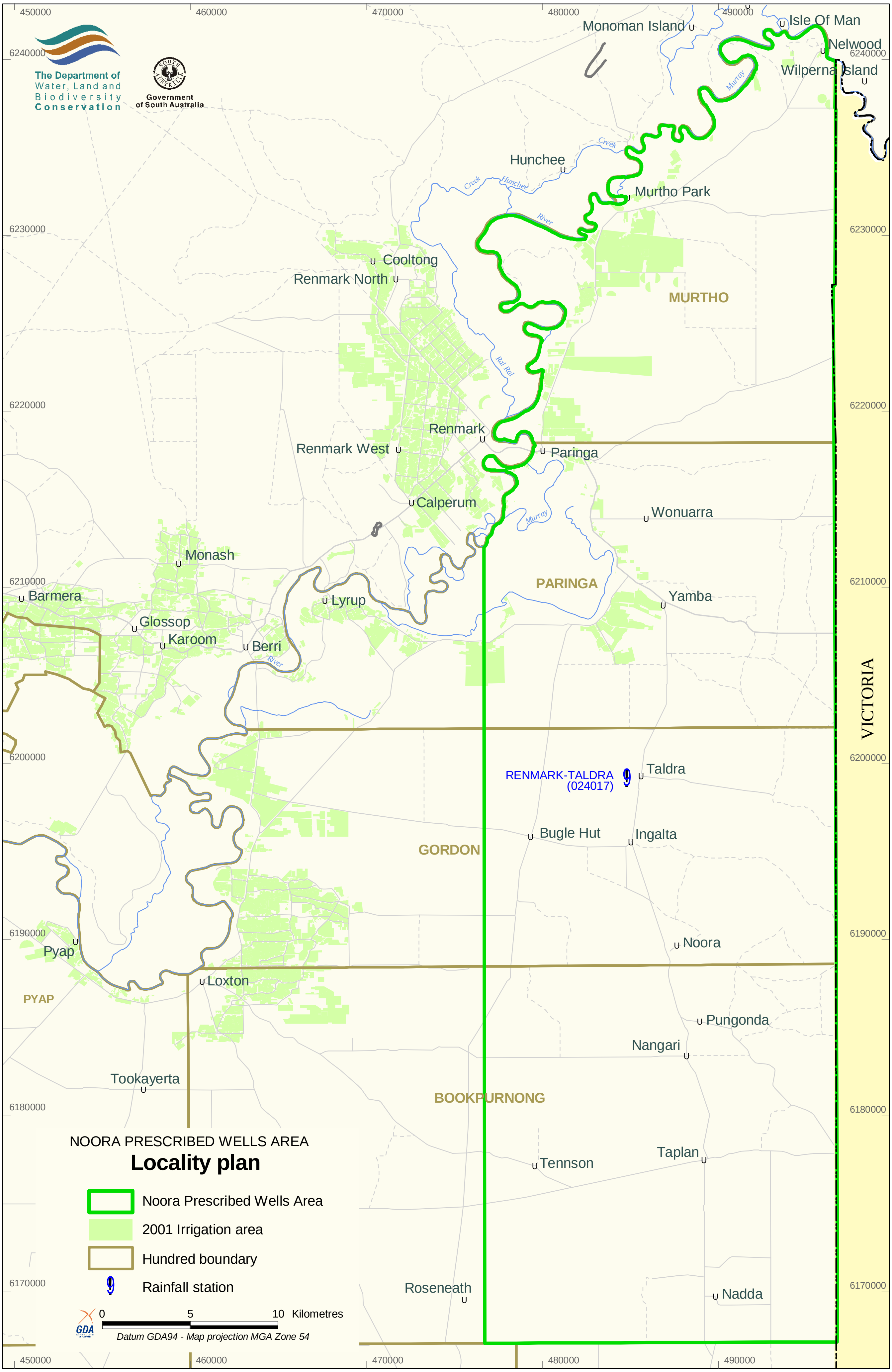
List of Figures

INTRODUCTION

The Noora Prescribed Wells Area (PWA) lies over the deepest part of the Murray Basin in the far eastern boundary of South Australia (Fig. 1). It is bordered to the north by the River Murray, to the east by the South Australia – Victoria border, to the south by the southern border of the Hundred of Bookpurnong and the west by a line parallel to and 20 km west from the South Australia – Victoria border.

Two aquifers are monitored in the Noora PWA: the Pliocene Sands Aquifer (topmost and unconfined) and the confined Murray Group Limestone Aquifer. Both aquifers contain mostly poor quality water with current limited use only for stock, but with potential uses for mining and industry. Groundwater flows in a westerly direction in each aquifer towards the River Murray. A third aquifer underlies the Murray Group Limestone Aquifer: the Renmark Group Aquifer. No current water level data is available for this aquifer system in the Noora PWA and it was therefore omitted from this monitoring report.

There have been three main impacts of human settlement on the Noora PWA: land clearance, irrigation and the construction of the Noora Disposal Basin. All three have altered the hydrogeological balance in the Noora PWA by causing a rise in the watertable (Barnett, 1992).



NOORA PRESCRIBED WELLS AREA
Locality plan
Noora Prescribed Wells Area
2001 Irrigation area
Hundred boundary
Rainfall station
0
5
10 Kilometres
Datum GDA94 - Map projection MGA Zone 54
The Department of Water, Land and Biodiversity Conservation
Government of South Australia
450000
460000
470000
480000
490000
6240000
6230000
6220000
6210000
6200000
6190000
6180000
6170000
Monoman Island
Isle Of Man
Nelwood
Wilperna Island
Hunchee
Murtho Park
Cooltong
Renmark North
MURTHO
Renmark
Renmark West
Paringa
Calperum
Wonuarra
Monash
Barmera
Glossop
Karoom
Berri
Lyrup
PARINGA
Yamba
RENMARK-TALDRA
(024017)
Taldra
Bugle Hut
Ingalta
GORDON
Noora
Pyap
PYAP
Loxton
Pungonda
Nangari
Tookayerta
BOOKPURNONG
Tennson
Taplan
Roseneath
Nadda
VICTORIA
River
Murray
Creek
Hunchee
Ral Ral

Figure 1

CLIMATE

Noora is located within a temperate climate with low annual rainfall. Rainfall is winter dominant, with the monthly averages for the Renmark (Taldra) rain gauging station shown in Table 1. The annual average is 266 mm/y.

Table 1. Monthly average rainfall for Taldra rain gauging station (mm)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
16	17	15	18	28	26	27	28	29	27	20	18

Because most of the summer rainfall is lost by evaporation before it has a chance to percolate down to the watertable, only winter rainfall (April–October) is considered to be effective in contributing to the water balance.

Time series graphs display monthly rainfall data between 1909 and 2002, recorded at the Renmark (Taldra) rain gauging station (Fig. 2). Cumulative deviation is graphed to highlight periods of above average rainfall. In this case it highlights a possible dry period spaning for over 30 years, from 1941–73.

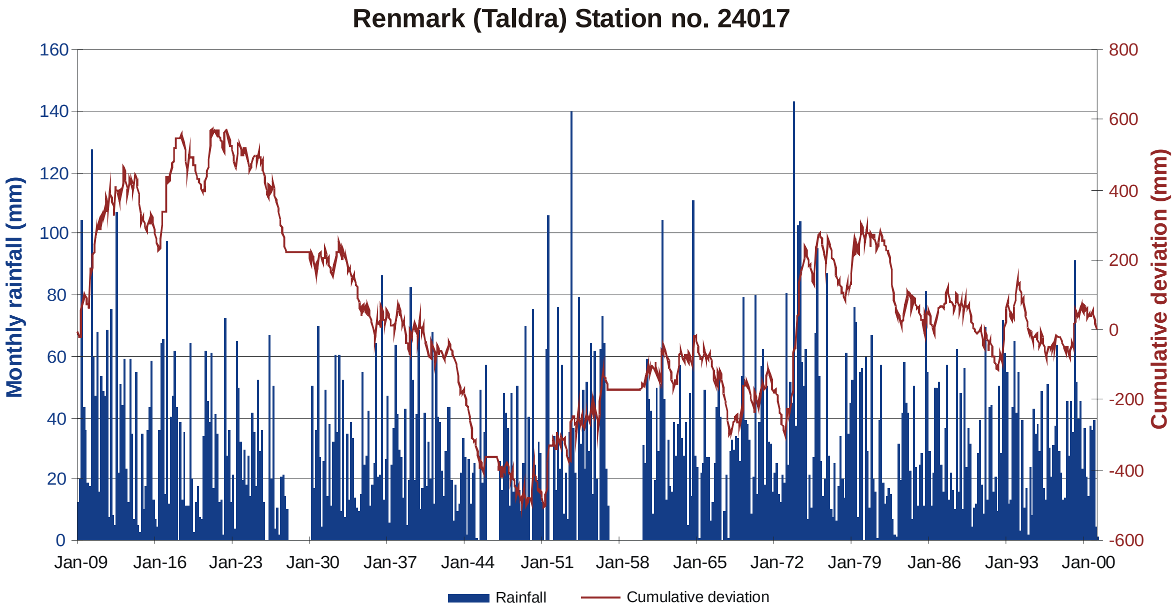


Figure 2 Monthly rainfall and cumulative deviation

201526_002

HYDROGEOLOGY

The Murray Basin contains marine and non-marine sequences which have been deposited over the last 65 million years to form three main aquifer systems: the unconfined Pliocene Sands Aquifer (shallowest), the Murray Group Limestone Aquifer and the Renmark Group Aquifer (deepest). These aquifers are separated by clay and marl confining layers. Table 2 summaries the hydrogeological units within Noora.

Potentiometric surface maps were created for the Pliocene Sands and the confined Murray Group Limestone Aquifers to indicate the likely direction of groundwater flow within them. Data used to compile the plots was based on combined October–December 2001 and January–March 2002 reduced standing water levels. Summer and winter months were combined as there was minimal difference in water levels between the two seasons.

Groundwater flow in the Pliocene Sands Aquifer is toward the River Murray from the east and south under low gradients (Fig. 3). Slight variations in groundwater flow result from the effects of the Disposal Basin. Groundwater flow in the Murray Group Limestone Aquifer is from the north-east and south-east towards the river (Fig. 4) at a rate between 0.6 and 1 m/y (Sibenaler, 1988).

As the Noora Disposal Basin is in the lowest part of the Murray Basin at 18 m AHD, evaporative discharge of groundwater from the shallow watertable in the Pliocene Sands Aquifer plays a major role in the groundwater processes arising in the area (Barnett, 1992).

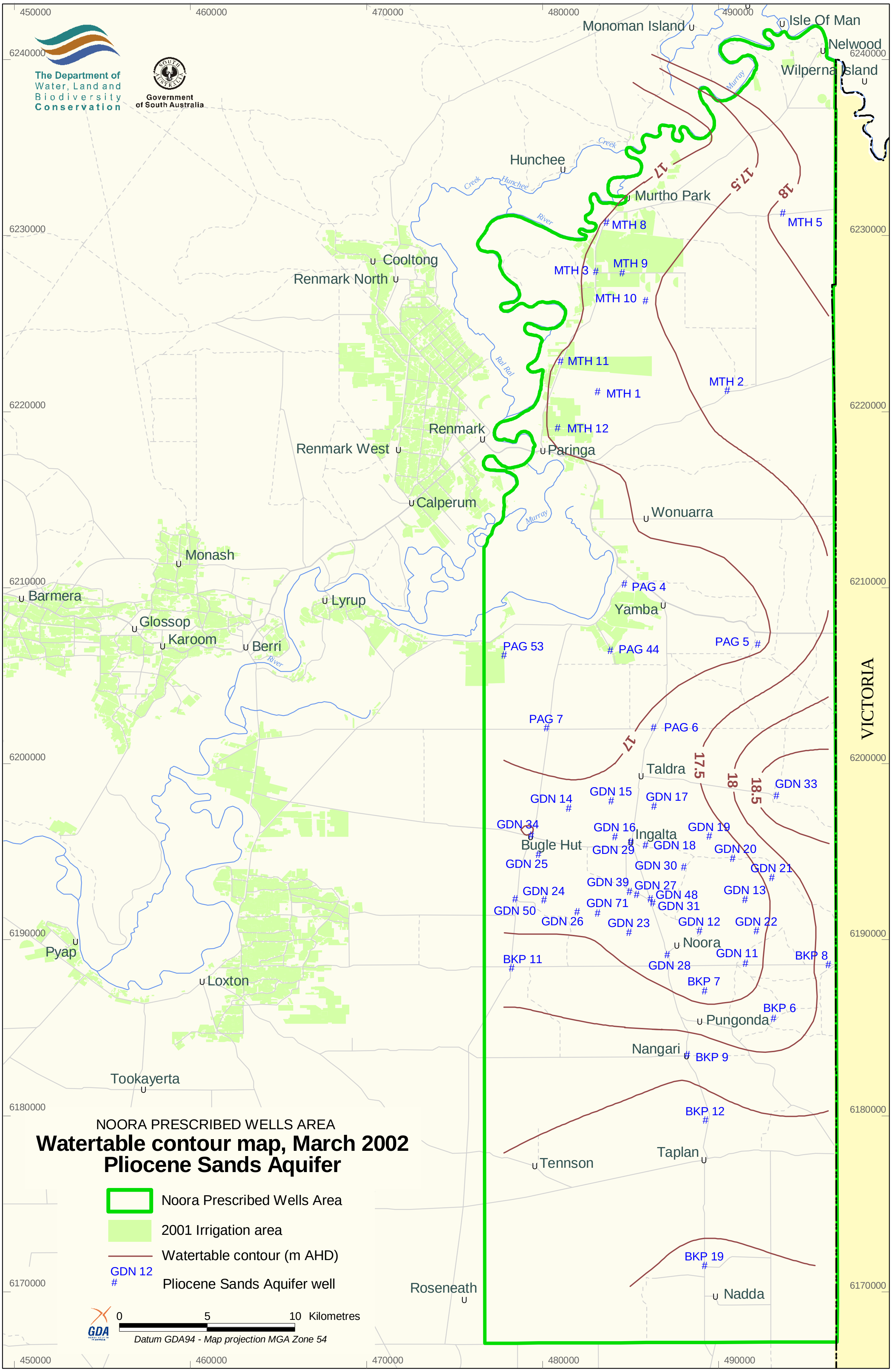


Figure 3

PIRSA Publishing Services AV:201526_003

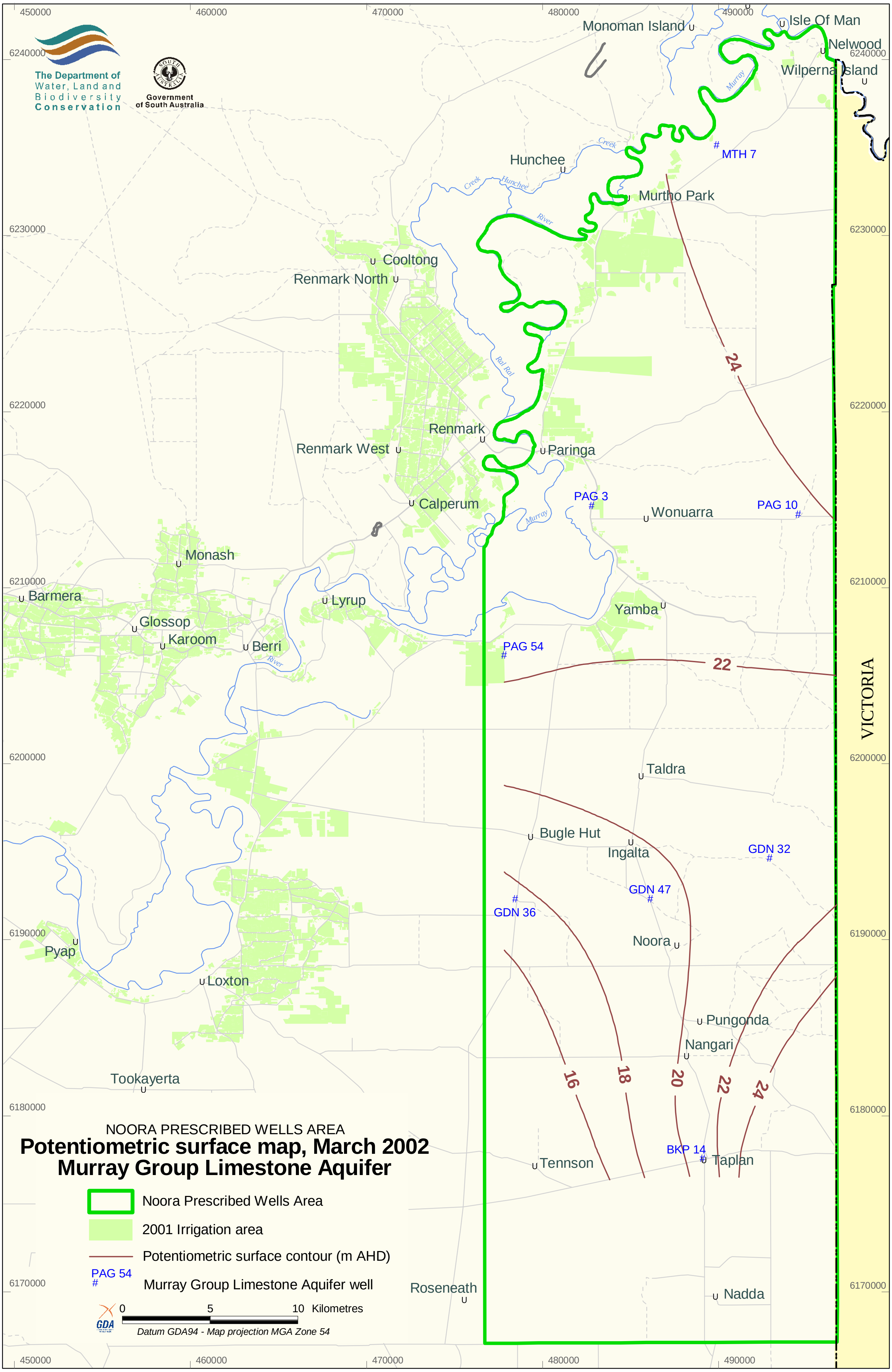


Figure 4

PIRSA Publishing Services AV:201526_004

Table 2. Stratigraphic units within the Noora PWA (after Barnett, 1992)

Age	Stratigraphic unit	Symbol	Lithology	Thickness (m)	Comments
Quaternary	Monoman Sands	Qam	Light brown and grey, sandy clays and sands. Micaceous in parts.	1–6	–
Quaternary	Blanchetown Clay	TpQlb	Silty clay, dark red to grey.	0–15	Responsible for the perched watertable beneath irrigation areas.
Pliocene	Loxton Parilla Sands	Tpp	Fine to coarse sands, clayey in part. Red–orange to grey.	20–50	Unconfined Pliocene Sands aquifer. Contains the shallow watertable and discharges to the river and saline discharge areas.
Mio-Pliocene	Bookpurnong Beds	Tpb	Grey–green fossiliferous silts and clay. Glauconitic.	10–25	Confining layer.
Miocene	Murray Group Limestone	Ty	Grey to off-white fossiliferous limestone.	150	Confined aquifer with yields of up to 1200 m^3/d.
Oligocene	Ettrick Formation	Toe	Grey-green glauconitic marl.	20–40	Confining layer.
Eocene	Renmark Group	Tr	Brown and grey clays with fine to medium sand interlayers; some siltstone and lignite.	100–300	Confined aquifer with groundwater flow to the west. Yields of up to 2000 m^3/d have been obtained.

MONITORING

The Noora PWA was prescribed in 1986. Monitoring has been conducted on a regular basis around the Noora Disposal Basin since 1982; and the irrigation areas adjacent to the River Murray since 1969. The current groundwater monitoring network comprises of four bores in the Murray Group Limestone Aquifer (located in the north, south and central part of the area) and ~30 bores monitoring the Pliocene Sands Aquifer (Fig. 5). It is expected that these present monitoring arrangements will be maintained, but could be expanded for future developments as required.

Current usage of groundwater is restricted to several stock and domestic bores extracting water from the confined Murray Group Limestone Aquifer in the southern part of the area. Extraction rates are low, with a low level of impact on the aquifers at a distance no greater than 100 m from the bore (RMCWMB, 2001).

Dryland farming rather than irrigation, is expected to remain the dominant land use as the high salinities of the Noora PWA groundwater result in a low development potential. There may be possible development of groundwater for special ventures such as mineral sand mining or brine production (RMCWMB, 2001).

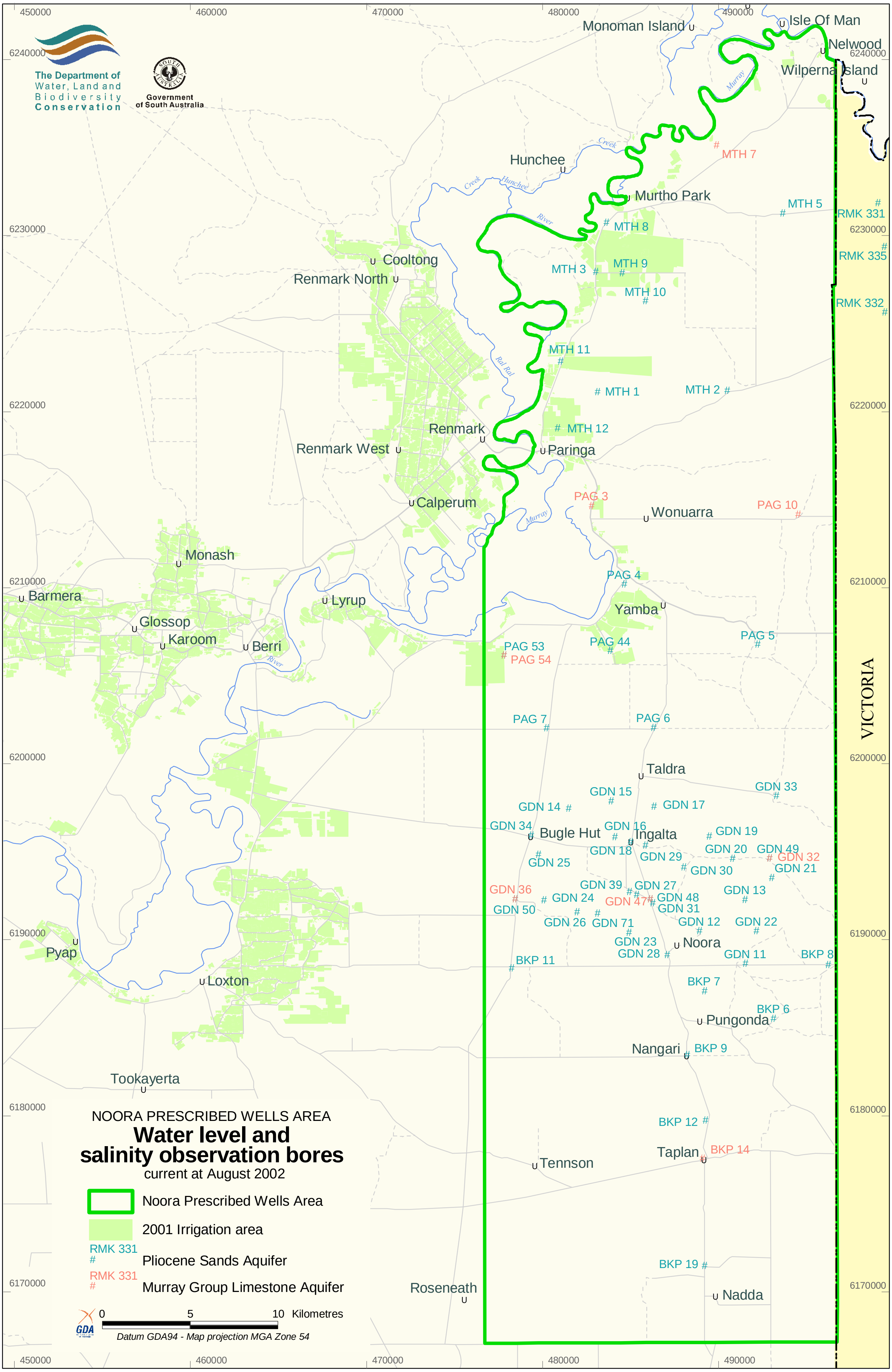


Figure 5

PIRSA Publishing Services AV:201526_005

WATER LEVEL ANALYSIS

Hydrographs have been produced to examine the effects of land clearance, irrigation and the construction of the Noora Disposal Basin on the hydrogeology of the Noora area. Figure 6 shows the impact land clearance has on the water levels. The rise in watertable is caused by the clearance of deep-rooted native vegetation and replacement by shallow-rooted crops. This results in an increase in recharge, and therefore, a rise in the watertable. BKP 11 (unit number 7029-33) shows an increase of 20 mm/y since 1973, while the water level in bore BKP 9 (7029-34) has not shown any significant increase since monitoring began in 1974. This well is close to the discharge area and also has a shallow depth to water. Therefore, the amount of recharge it receives is counteracted by discharge through evapotranspiration (hence, there is virtually no change in water levels).

Irrigation processes lead to accessions of drainage water to the watertable. Figure 7 demonstrates this effectively with MTH 3 (7029-17) showing a water level increase of 20 mm/y since 1973.

In an attempt to remove irrigation drainage from disposal basins on the river floodplain at Berri and Renmark, the Noora Drainage Disposal Scheme was constructed in 1982. The disposal of drainage water has contributed to a rise in the watertable of 10 mm/y in well GDN 26 (7029-699) and 20 mm/y in well GDN 16 (7029-689) since 1982 (Fig. 8). The layer increase in GDN 16 is due to its closer proximity to the basin.

Figure 9 shows hydrographs for the wells GDN 36, GDN 32 and PAG 3 (7029-625, 7029-624, 7029-626) and GDN 47 (7029-1151) completed in the confined Murray Group Limestone Aquifer below and downgradient of the Noora Disposal Basin. Although there is potential for downward leakage to occur from the Pliocene Sands Aquifer as a result of the high salinities (30 000–90 000 mg/L) in the overlying Pliocene Sands Aquifer (Barnett, 1992), the rises in the Murray Group Limestone Aquifer pressures (Fig. 9) are more likely caused by an increase in the load of the overlying Pliocene Sands Aquifer (due to an increase in recharge and storage; Barnett, 1995). This additional load compresses the elastic confined aquifer and increases the hydrostatic pressure (thus increasing the water level).

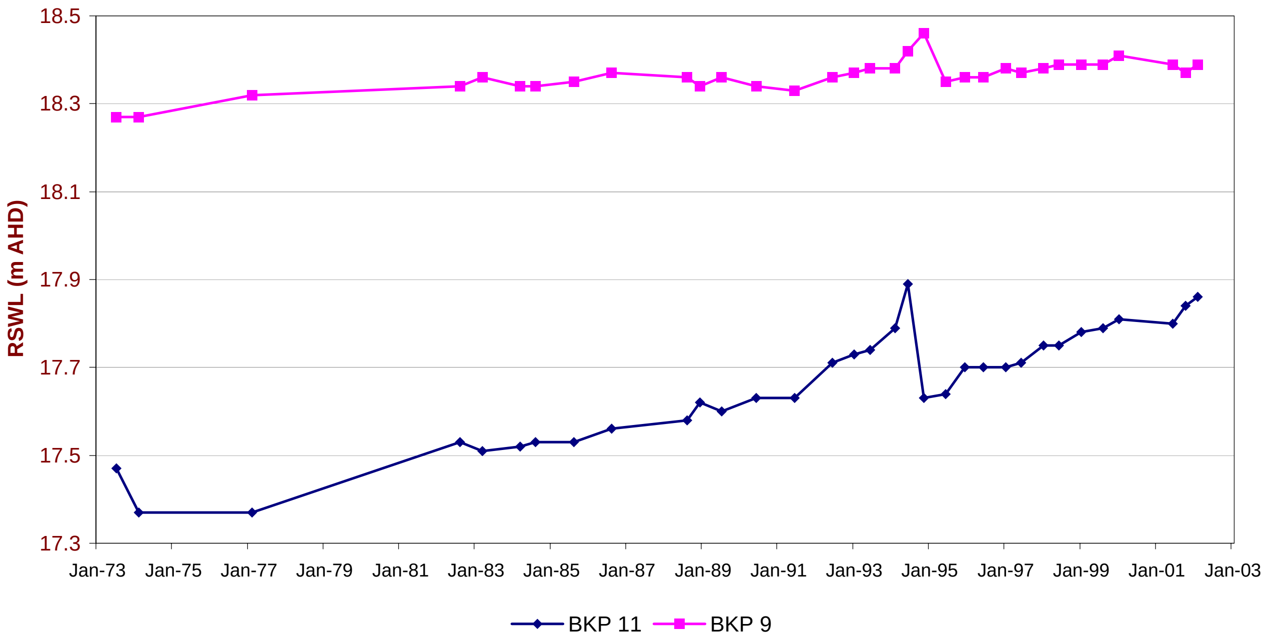


Figure 6 Hydrographs showing the impact of land clearance on Pliocene Sands Aquifer

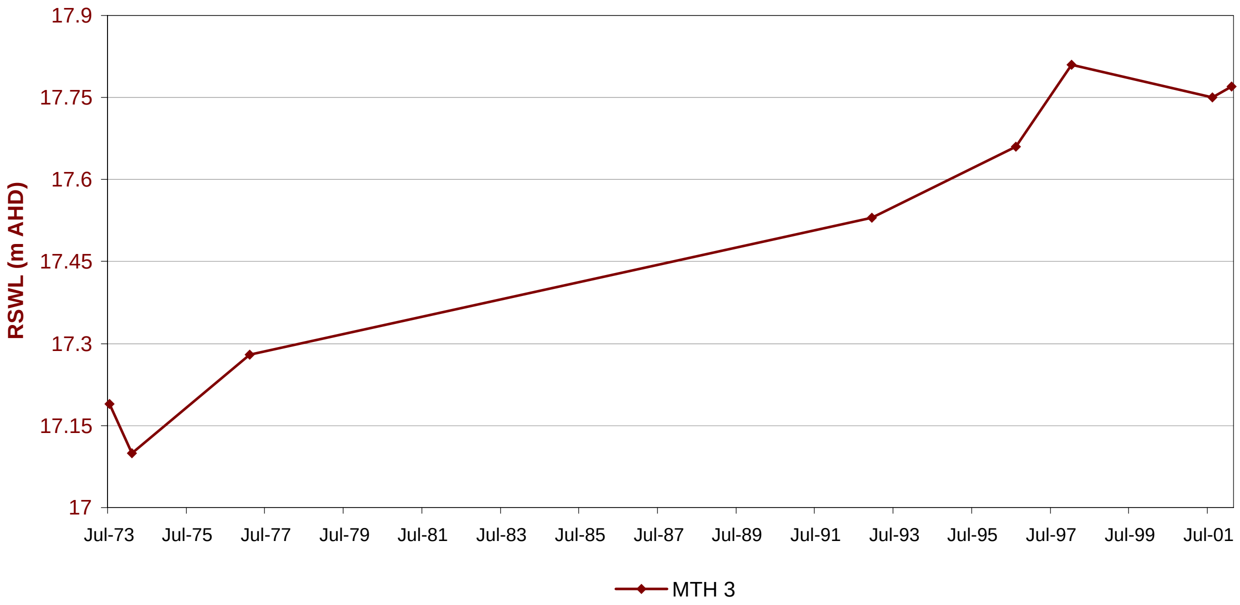


Figure 7 Hydrograph showing the impact of irrigation on Pliocene Sands Aquifer

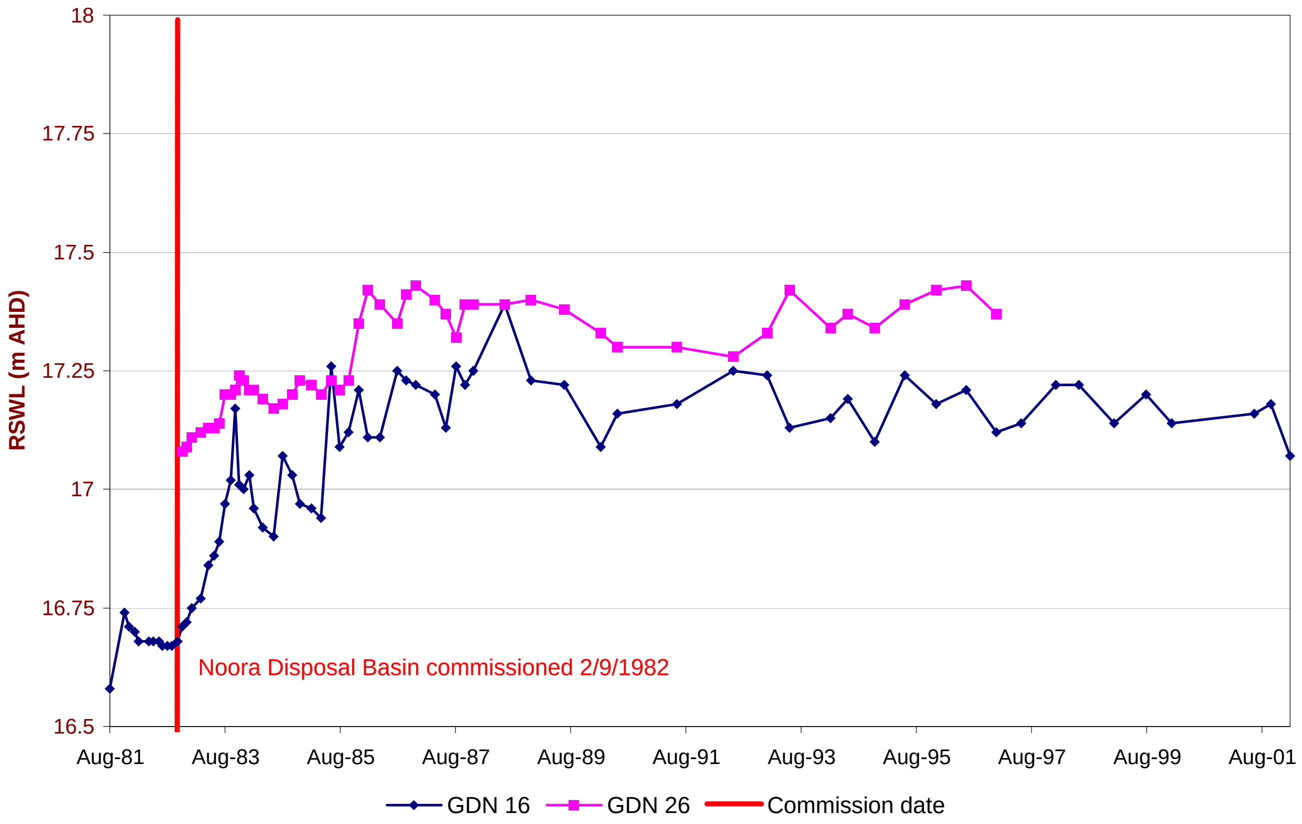


Figure 8 Hydrographs showing the impact of the Noora Disposal Basin on Pliocene Sands Aquifer

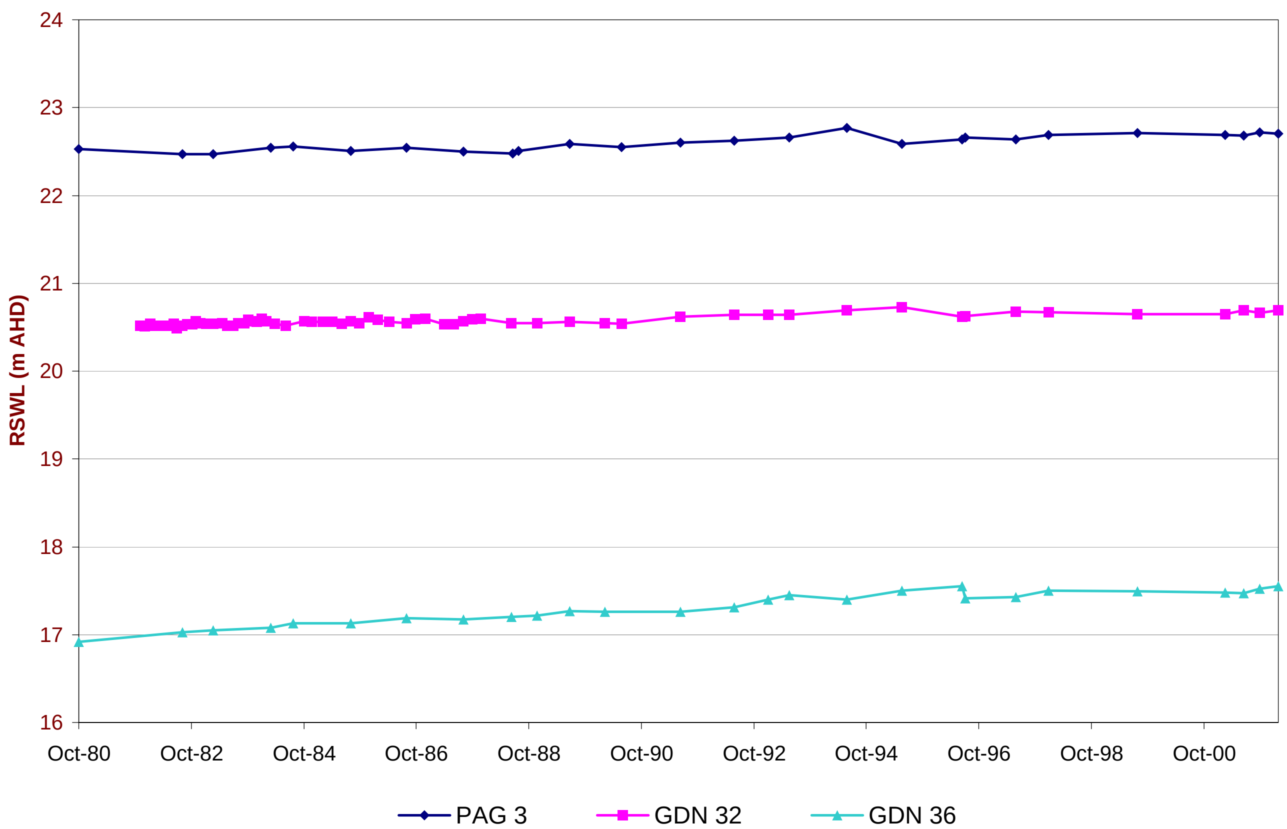


Figure 9 Hydrographs demonstrating increasing water levels in the Murray Group Limestone Aquifer due to increases in the hydrostatic pressure

SALINITY

Data from observation wells was used to construct salinity plots for the Pliocene Sands and the Murray Group Limestone Aquifers (Figs 10, 11). Although most of the data is not current, it is believed to be representative of the current salinities of the aquifers. The salinity range in the Pliocene Sands Aquifer is from ~12 000 mg/L (near the river) to ~93 000 mg/L (around the disposal basin). Salinity values around the disposal basin generally fall within the range 25 000–50 000 mg/L. Barnett (1992) has found that values >35 000 mg/L in the Pliocene Sands Aquifer are associated with the subdued topography below 40 mAHD and evaporative discharge from the watertable.

Salinities in the Murray Group Limestone Aquifer range from ~13 000 mg/L in the southern part of the PWA to up to ~92 000 mg/L in the floodplains. High salinities are also found beneath and downgradient from the Noora Saline Disposal Basin (33 000–62 000 mg/L), resulting from downward leakage from the overlying Pliocene Sands Aquifer.

As there has not been any regular monitoring of salinity levels in any of the aquifer wells since construction, no trends can be given, but no significant changes are expected.

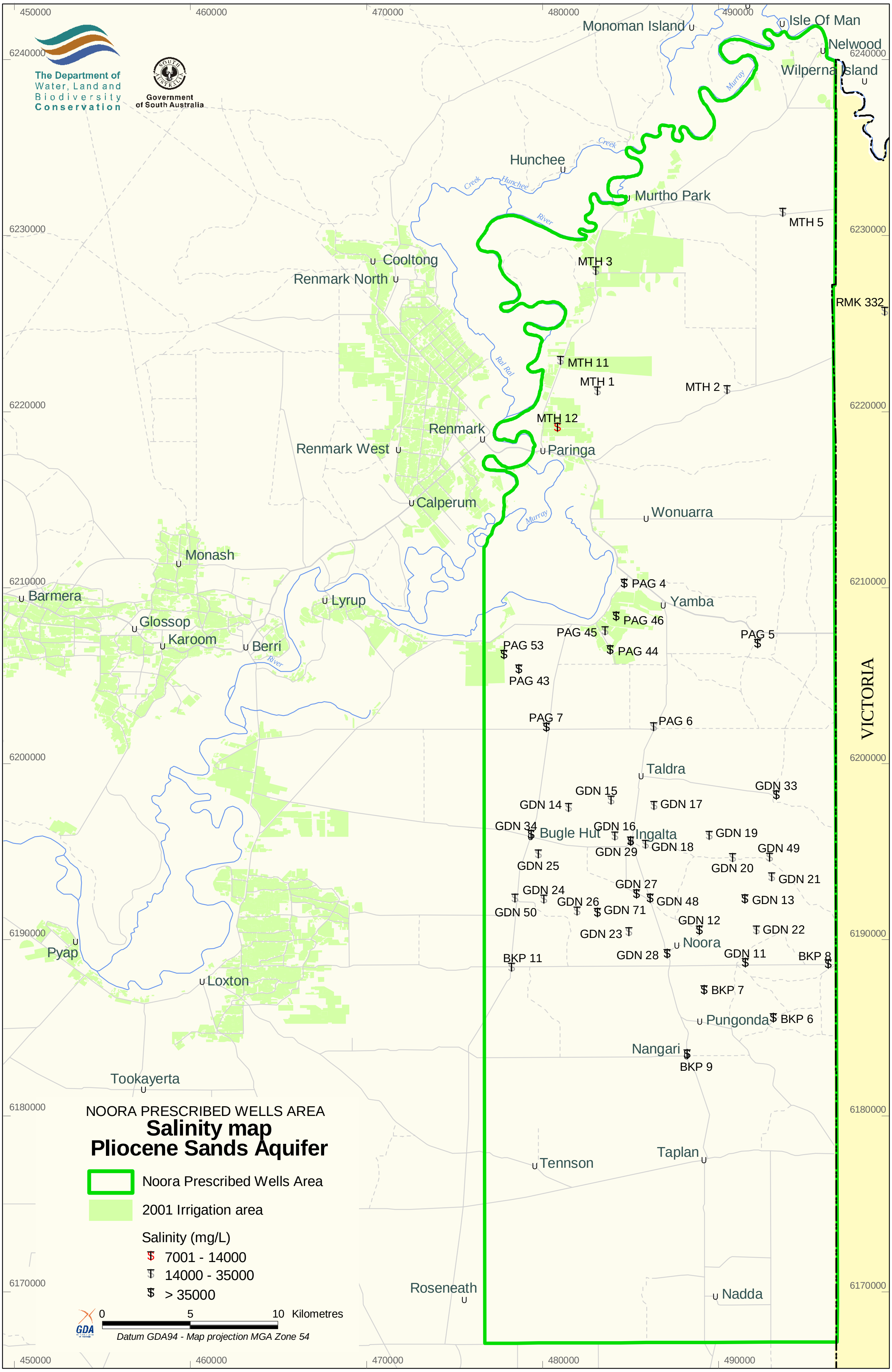


Figure 10

PIRSA Publishing Services AV:201526_001

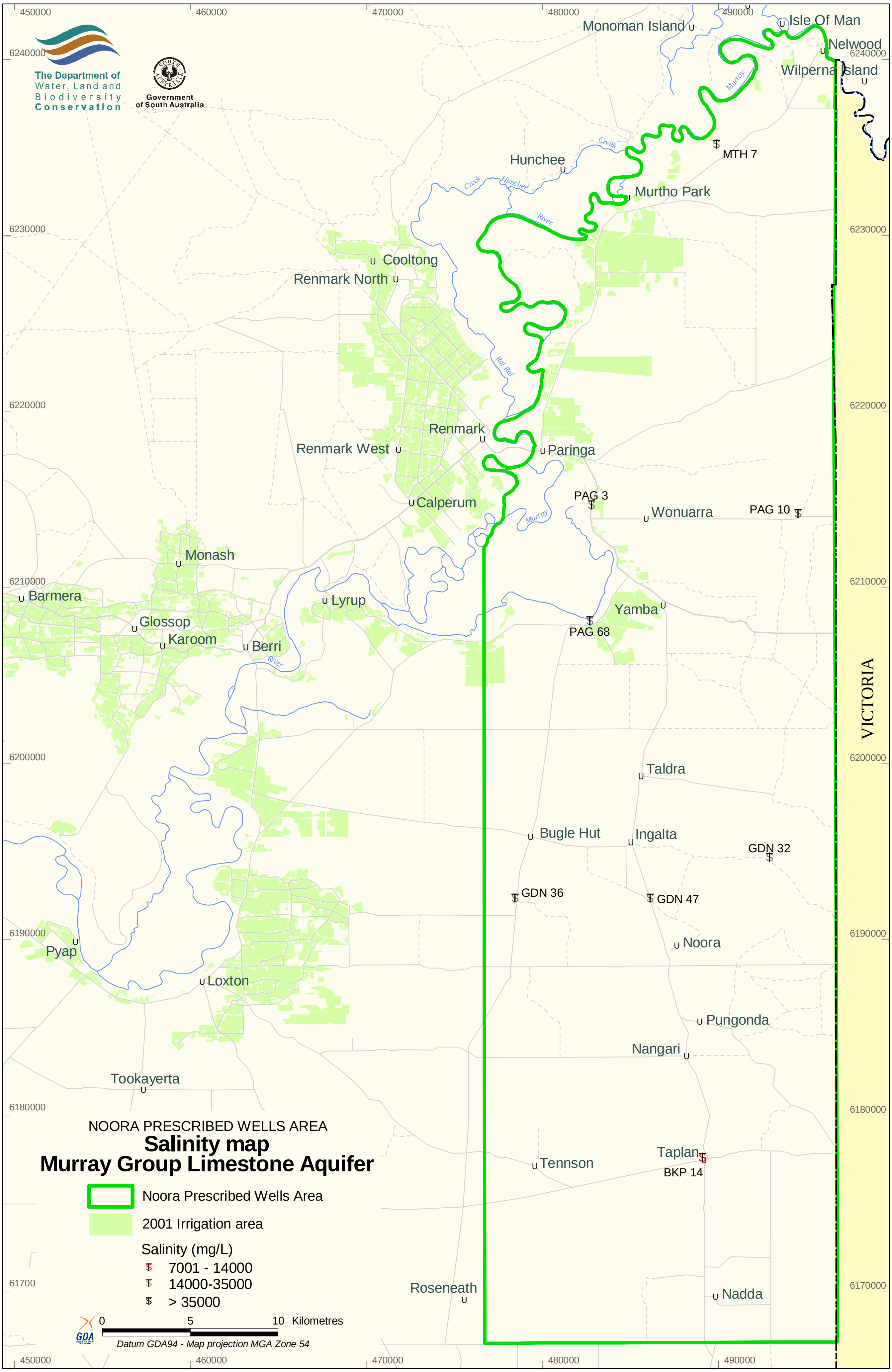


Figure 11

PIRSA Publishing Services AV:201526_001

SUMMARY

There are two main monitored aquifers systems that underlie the Noora PWA. The upper aquifer is the unconfined Pliocene Sands Aquifer, which contains groundwater with salinities generally in the range of 12 000–93 000 mg/L. Underlying this aquifer is the Murray Group Limestone confined aquifer with groundwater of 13 000–92 000 mg/L. Downward leakage arises directly beneath or downgradient from groundwater discharge zones in the overlying Pliocene Sands Aquifer. Groundwater flow in both aquifers is generally in the west direction towards the River Murray.

Groundwater watertable trends show a slight increase around the land clearance areas (up to 20 mm/y), irrigation areas (~20 mm/y) and the Noora Disposal Basin (~20 mm/y).

SHORTENED FORMS

Measurement

Name of unit	Symbol	Definition in terms of other metric units	
Day	d		time interval
Gram	g		mass
Kilometre	km	10^3 m	length
Litre	L	10^{-3} m^3	volume
Metre	m		length
Cubic metres per day	m^3/d		
Milligram	mg	10^{-3} g	mass
Milligrams per litre	mg/L		
Millimetre	mm	10^{-3} m	length
Millimetres per year	mm/y		
Year	y		time interval

General

Shortened form	Description
AHD	Australian height datum
DWLBC	Department of Water, Land and Biodiversity Conservation
PWA	prescribed wells area
RSWL	reduced standing water level
RMCWMB	River Murray Catchment Water Management Board

REFERENCES

Barnett, S.R., 1992. Regional hydrogeology of the Loxton–Noora area, Murray Basin, South Australia. *South Australia. Department of Mines and Energy. Report Book*, 92/15.

Barnett, S.R., 1995. The rise and rise of confined aquifer pressures — why? Murray-Darling Workshop, Wagga Wagga, September. *Australian Geological Survey Organisation. Extended Abstracts,* 1995/61.

RMCWMB, 2001. Water Allocation Plan for the Noora Prescribed Wells Area. *South Australia*. *River Murray Catchment Water Management Board*. *Report* (unpublished).

Sibenaler, X.P., 1988. Woolpunda Groundwater Interception Scheme — Phase 4: Drilling and well discharge testing program. *South Australia*. *Department of Mines and Energy. Report Book*, 88/88.