Technical Review of the Alice Springs Water Strategy

February 2012

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For further information contact:
Department of Natural Resources, Environment, The Arts and Sport
PO Box 496, Palmerston, NT, 0831, Australia
Web: www.nt.gov.au/alicewaterplan

Cover photo: Todd River, 2010. Photo Anne Pye

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Introduction

The Alice Springs Water Resource Strategy was published in 2006 to regulate water resources in the Alice Springs Water Control District. For each management zone it set beneficial uses (allowable uses) and annual volumes that can be extracted for each use. A system of extraction licensing was established and individual water users are issued licenses that specify a maximum allowable volume of water that can be extracted. In specific cases licences require water usage and water levels to be monitored and the results submitted to the Controller of Water Resources. Water quality limits have not been specified in any licenses but some require water quality to be monitored.

For alluvial basin aquifers (Town, Inner and Outer Farm Basins) total extractions are based on average annual recharge. In the case of the Amadeus Basin aquifers (Roe Creek and Rocky Hill) total extraction over a period of no less than 320 years shall not exceed 80 per cent of the aquifer storage at the start of extraction or not more than 25 per cent of the storage every 100 years. The available storage is defined laterally by water quality limits (salinity less than 1000 mg/L) and vertically by the economic pumping depth (300 m.).

The Strategy flagged a number of actions to be undertaken in five yearly reviews. This report is part of the first review and it addresses two of the major actions:

- Assess monitor and report on regional rainfall, surface water flow, groundwater levels and water quality in each of the management zones. Review assessment methodology; and
- Assess sustainable yield in the Wanngardi Basin Management Zone.

The management zones include: Town Basin, Inner Farm Basin, Outer Farm Basin, Wanngardi Basin, Roe Creek and Rocky Hill / Ooraminna.

Rainfall

Like much of inland Australia Alice Springs is subject to long periods of drought interspersed with wet periods. One method of assessing the timing and length of these climate cycles is by graphing the cumulative annual rainfall's departure from the average (Figure 1). A rising trend indicates a period of above average rainfall, while prolonged periods with a negative slope indicate drought conditions. The most significant drought in the rainfall record occurred from the mid 1950s until the early 1970s. Drought conditions have also prevailed over the last decade (2002 - 2009). Above average rainfalls have occurred in the mid- 1970s and since 2010. These patterns are reflected in both the stream height and groundwater level records (Figure 2).

The region received below average rainfall from 2006 when the strategy was declared through to early 2010. Groundwater levels in the alluvial basins declined and stream flows reduced in frequency and height. During 2010 several major rainfall events occurred and Alice Springs received its highest recorded rainfall of 769 mm. This resulted in significant groundwater rises and increased stream flows. Note that the differences in the number of stream flow events in Roe Creek compared to the Todd River (Figure 2) are due to the different hydrologic characteristics of the two catchments. Stream flows are significant not so much from the point of view of available surface water resources but more because they represent potential groundwater recharge events. Stream bed seepage is considered to be the major recharge source in the shallow alluvial aquifers.

There are six management zones within the Alice Springs Water Control District. The performance of each is described below in terms of groundwater extraction, groundwater levels and water quality. Where possible the current situation is compared to that in 2006, the year that the strategy was released.

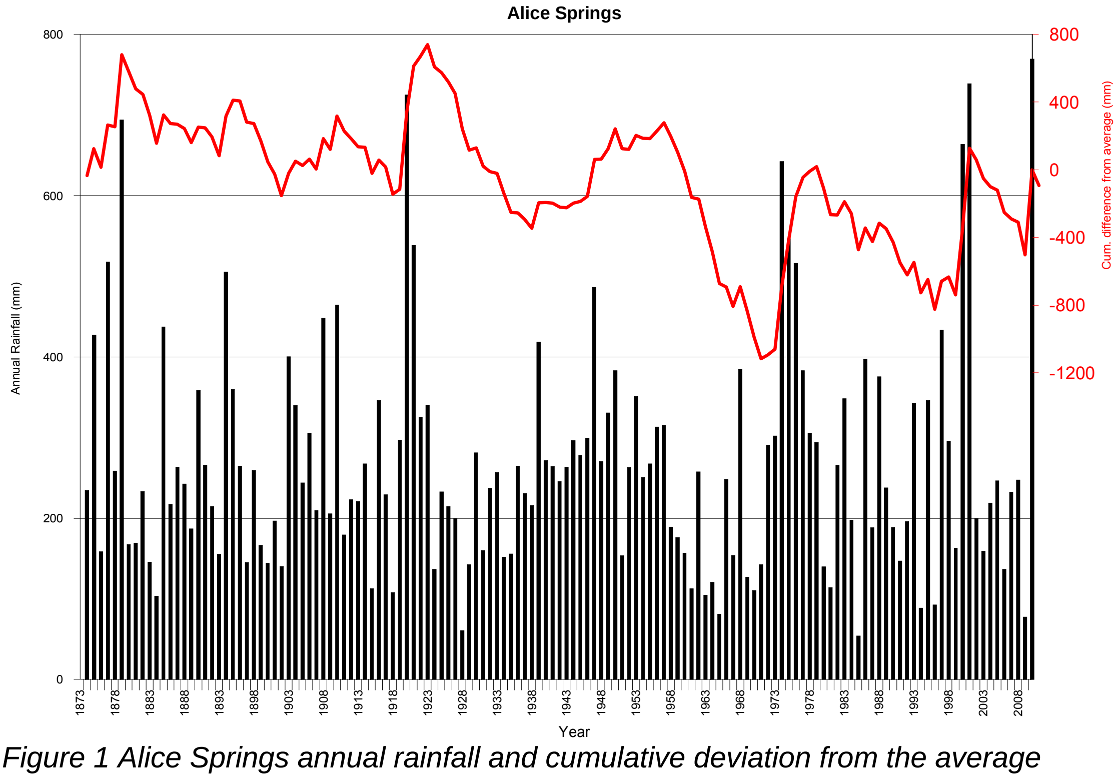

Figure 1 Alice Springs annual rainfall and cumulative deviation from the average

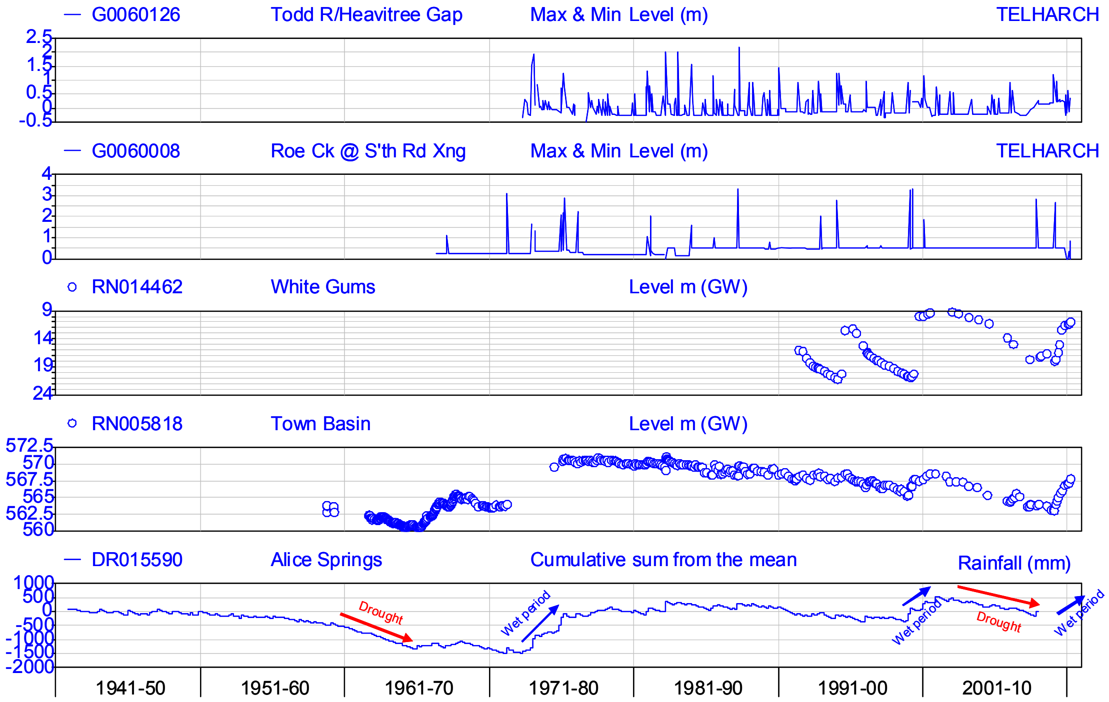

Figure 2 Stream heights, groundwater levels and rainfall

Town Basin

Hydrogeology

The Town Basin is a small alluvial basin associated with the Todd River. It extends upstream from Heavitree Gap, a natural constriction for the alluvial plain and underlies part of the town area and suburbs (Figure 3). The alluvium is mostly less than 20 m thick and comprises poorly consolidated clay, silt, sand and gravel. It overlies gneiss and granite. The location of the basin and monitoring bores are shown in Figure 3. Note that the basin boundary is generalised and only includes thicker sections of alluvium that are likely to contain aquifers.

Sand and gravel beds form aquifers within the alluvium. Individual beds tend to be discontinuous and variable in grainsize because of the nature of river deposits. There is sufficient overlap between beds to make a more or less continuous aquifer in the central part of the basin. Bore yields vary depending on the thickness of the sand beds and the amount of clay mixed with the sand. Bores can be capable of producing up to 30 L/sec but most yields range from 1 to 5 L/sec.

Groundwater flows in a general south-south-westerly direction towards Heavitree Gap. In the past five years water levels have varied from less than a meter below ground down to 10 m depending on location and local topography.

Groundwater Extraction

There are seven licensed bores in this zone managed by the Power Water Corporation (Figure 3) and which are currently licensed to extract a total of 800 ML/year. All bores are metered. The majority of usage is for watering sportsgrounds and parklands.

Groundwater Levels

The lowest recorded levels were in 1965, the end of an extended dry period. In the mid-1970s a series of above average rainfall years increased water levels substantially (Figure 4). Since then they have been gradually declining back towards pre-1971 levels when the Town Basin was Alice Spring's main source of water. Further rainfall events in early 2000 and especially in early 2010 again raised water levels but not to the levels attained in the mid-1970s. Current levels are generally higher than those of 2006.

The seven production bores managed by the Power Water Corporation have a condition on their license which requires that pumping must cease when water levels in specific monitoring bores reach trigger levels. The main purpose of this is to maintain the health of the river red gums by keeping water levels adjacent to the Todd River within eight metres of the bank level. The red gums are considered to be partially dependant on shallow groundwater.

Groundwater Quality

The groundwater in the Town Basin is generally unsuitable for human consumption due to contamination from urban and industrial sources. As the main use of the water is maintenance of the river red gums and irrigation of sports ovals and parks, the salinity of the water is its main water quality constraint. Both grasses and red gums are moderately salt tolerant but it is impractical to set water quality targets for these uses. There are numerous factors such as species of grass, soil type, watertable depth and climate which can affect salt tolerance. For the present it will suffice to check that salinities stay within the range of values observed historically.

General water quality parameters for the seven licensed production bores have been monitored annually since 2007 (Power Water Corporation, 2010a) as part of the license conditions. One showed no change in TDS, one showed a minor rise (28 mg/L) and five had decreases in TDS between 50 and 350 mg/L. Some of the bores vary in TDS by up to 550 mg/L. As the seasonal variations in TDS can be relatively large, longer term records than are currently available would be needed to see trends in water quality over time. The current regime of water quality testing should therefore continue. It would also be useful to determine the factors that cause some bores to vary so much over a year.

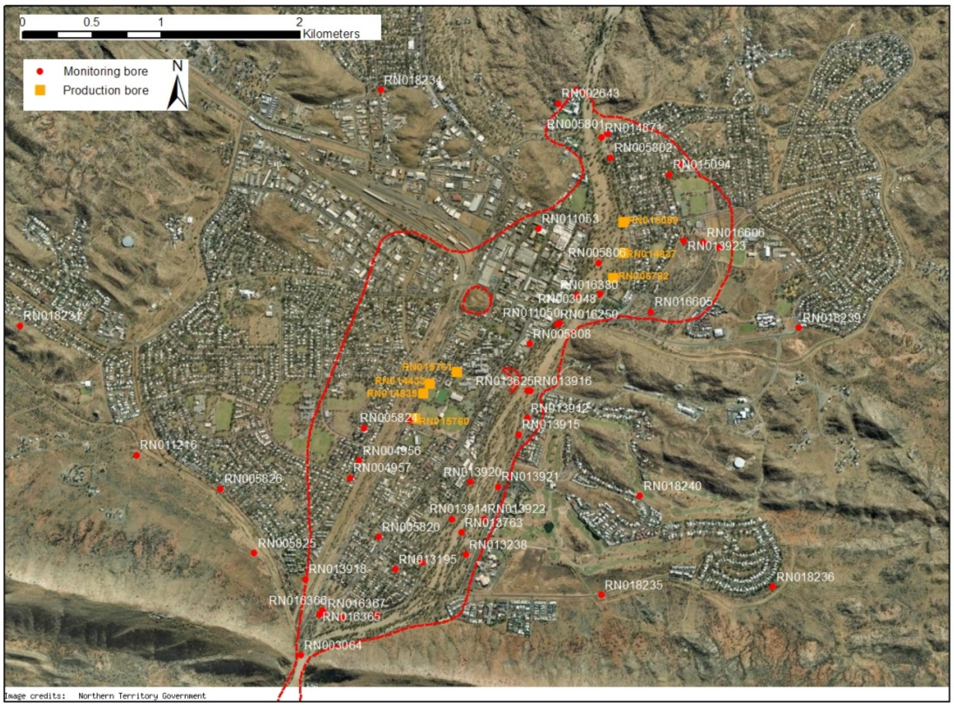

Figure 3 Town Basin extent, production bores and monitoring bores.

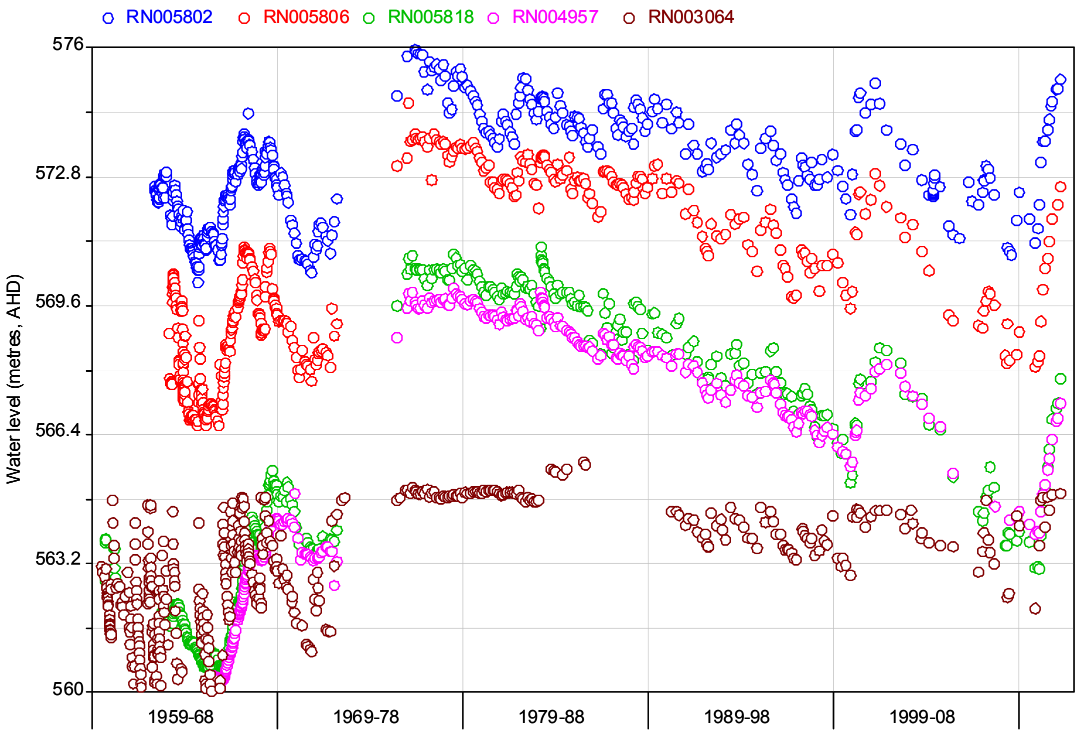

Figure 4 Groundwater levels from representative bores in the Town Basin

Inner Farm Basin

Hydrogeology

The Inner Farm Basin is also an alluvial basin associated with the Todd River. It extends from Heavitree Gap to the gap adjacent to Mt Blatherskite, 2.5 km to the south east (Figure 5). The alluvium is mostly less than 20 metres thick and comprises clay, silt, sand and gravel. The management area also includes aquifers beneath the basin. These comprise Neogene clays/sands, granite and sedimentary rocks of the Amadeus Basin.

Sand and gravel beds form aquifers within the alluvium. Individual beds tend to be discontinuous and variable in grainsize because of the nature of river deposits. There is sufficient overlap between beds to make a more or less continuous aquifer in the central part of the basin. Bore yields vary depending on the thickness of the sand beds and the amount of clay mixed with the sand. Bores can be capable of producing up to 5 L/sec.

Groundwater flows in a general south-easterly direction towards the gap near Mt Blatherskite. In the past five years water levels have varied from 1m below ground down to 10 m depending on location and local topography.

Groundwater Extraction

The total licensed volume for this zone is 83 ML/year. There are currently four licences issued in this area. There are also numerous registered but unlicensed domestic bores in this zone. The largest licensed user is now required to be metered and the remainder of licensees will have their licence conditions amended to require metering as their licences become due for renewal. The main usages are for domestic purposes, parkland watering and horticulture.

Groundwater Levels

Water levels show a similar trend to the Town Basin bores with an overall slow decline until the recharge event in January 2010 which caused water levels to rise mostly above 2006 levels (Figure 6).

Groundwater Quality

Water quality is not routinely tested in this zone.

Figure 5 Inner Farm Basin extent and monitoring bores.

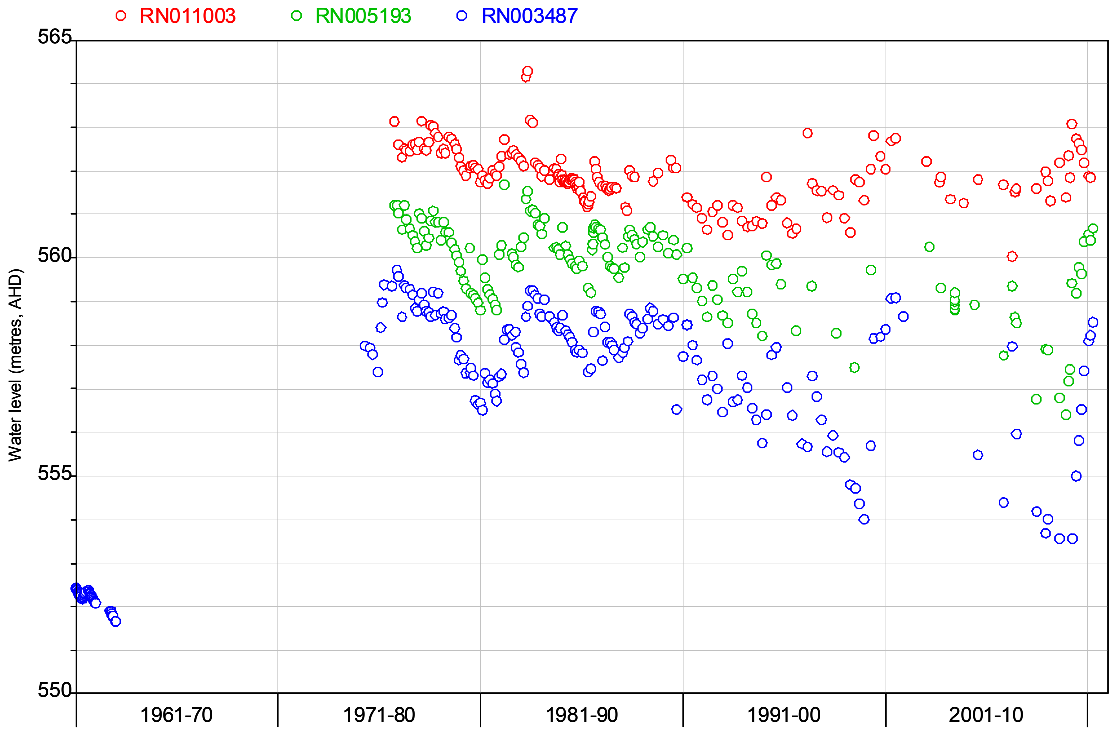

Figure 6 Groundwater levels from representative bores in the Inner Farm Basin

Outer Farm Basin

Hydrogeology

The Outer Farm Basin is also an alluvial basin associated with the Todd River. It extends downstream from the gap adjacent to Mt Blatherskite (Figure 7). The alluvium is mostly less than 20 m thick and comprises clay, silt, sand and gravel. The management area also includes aquifers beneath the basin. These comprise Neogene clays/sands and sedimentary rocks of the Amadeus Basin.

Sand and gravel beds form aquifers within the alluvium. Individual beds tend to be discontinuous and variable in grainsize because of the nature of river deposits. There is sufficient overlap between beds to make a more or less continuous aquifer in the central part of the basin. Bore yields vary depending on the thickness of the sand beds and the amount of clay mixed with the sand. Bores can be capable of producing up to 5 L/sec.

Groundwater flows in a general south-easterly direction. In the past five years water levels have varied from 8m below ground down to 35 m depending on location and local topography. Water levels tend to deepen in a downstream direction.

Groundwater Extraction

There are currently four licensed groundwater users with a total licensed volume of 88 ML/year. Only one of the four licensees is currently metered due to historic licensing conditions. (Requirements for metering will be considered as licences become due for renewal). Numerous registered but unlicensed domestic bores are also utilised in this zone. The main usages are for domestic purposes, parkland watering and horticulture.

Groundwater Levels

Since 2006 water levels generally declined until the heavy rains beginning in January 2010. Water levels show a similar trend to the Town and Inner Farm Basin bores with an overall decline until the recharge event in January 2010. In the upstream end of the basin where aquifers are shallower, water levels are now equal to or higher than 2006 levels. Further downstream levels have also risen but not to 2006 levels (RN017602, Figure 8).

Artificial Recharge

Since 2008 treated wastewater from the Alice Springs sewage treatment plant has been recharged into a shallow alluvial aquifer via recharge basins (Miotliński and others, 2010). This process is referred to as “Soil Aquifer Treatment” (SAT). Some 308 ML has infiltrated over 19 months. Regional water levels have not been noticeably affected but water quality testing has detected the plume of recharge water within 500 m of the basins (Knapton, pers.comm). Monitoring bore RN017936 (Figure 6) is located about a kilometre down-gradient of the pits.

Groundwater Quality

Water quality is currently monitored by the Power Water Corporation as a condition of their recharge license associated with the SAT trial. Selected bores in and around the recharge site are monitored for a specified range of water quality parameters (Power Water Corporation, 2009). The purpose of the monitoring is to ensure that aquifer is not polluted and to detect the movement of the recharge water.

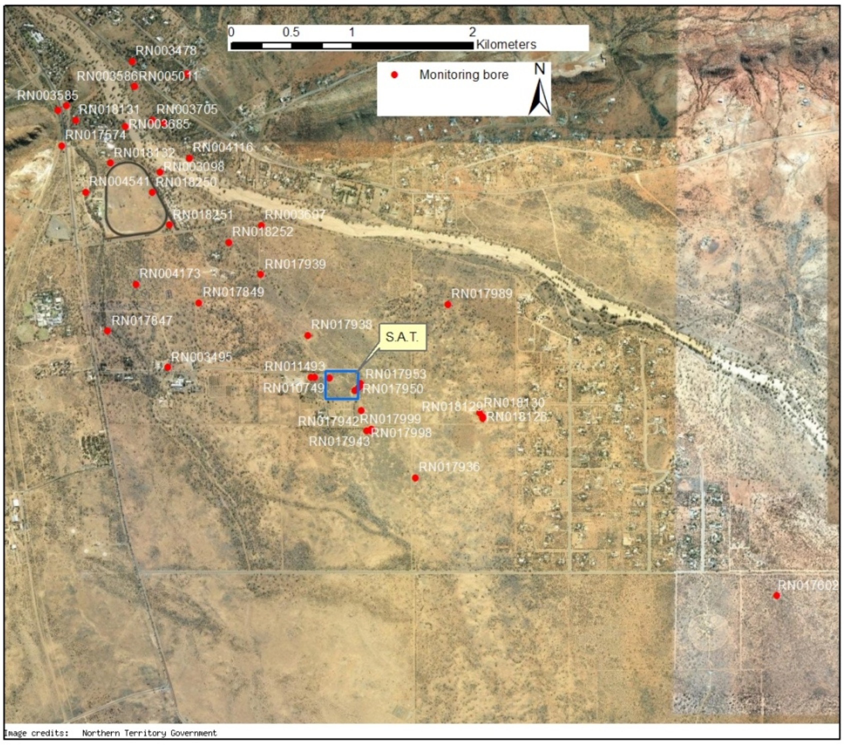

Figure 7 Outer Farm Basin monitoring bores and "Soil Aquifer Treatment" site.

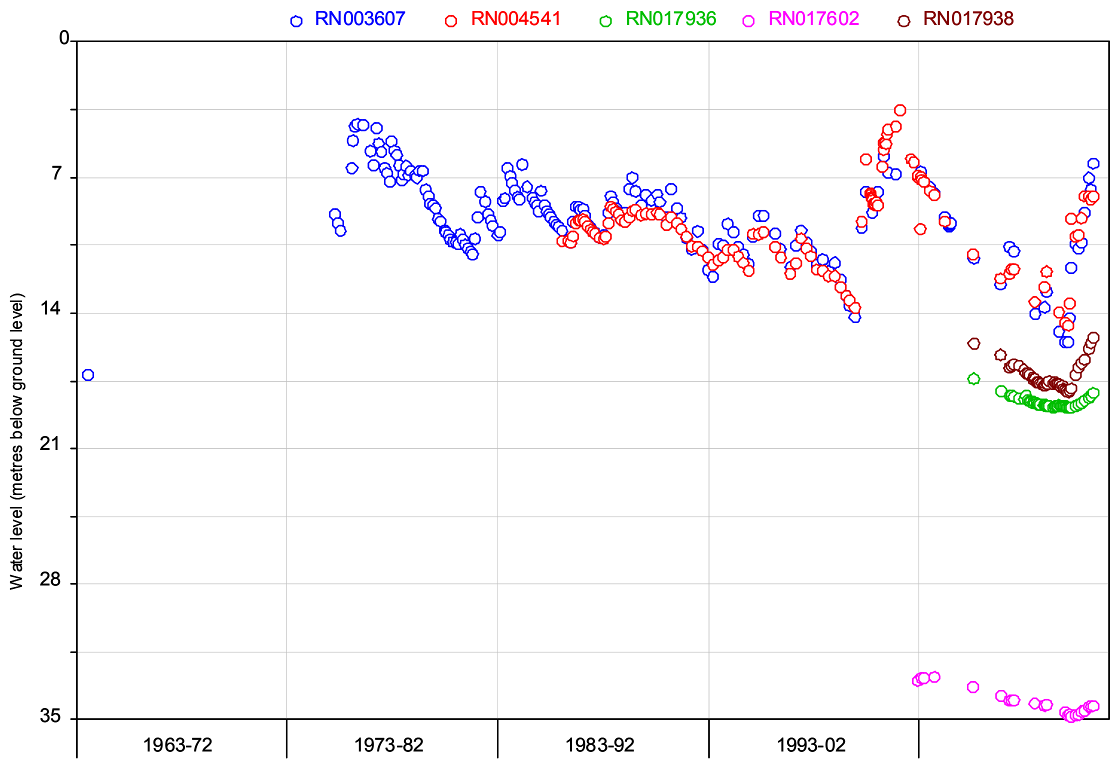

Figure 8 Groundwater levels from representative bores in the Outer Farm Basin

Wanngardi Basin

This is a shallow alluvial basin on Roe Creek situated 12 km south east of Alice Springs. The "basin" was delineated in the Water Resource Strategy as the alluvial flats between Honeymoon Gap and the unnamed range two kilometres downstream of the Temple Bar gap (Figure 9).One part of the area has been developed as a rural-residential subdivision known as White Gums. It comprises some 40 blocks, averaging eight hectares each. There is no reticulated water supply and the residents utilise bores and rainwater tanks. Elsewhere there are only sparse stock and domestic bores. For the purposes of this report only the White Gums area will be assessed. Elsewhere groundwater is only sparsely developed and unlikely to be stressed.

Geology

White Gums is located on an alluvial plain between two prominent ridges in the Macdonnell Ranges. Roe Creek cuts through the ranges approximately perpendicular to the strike. It has cut two prominent gaps in the range; Honeymoon Gap and Temple Bar which are respectively upstream and downstream of White Gums.

The ridges are formed from the resistant Heavitree Quartzite while the intervening areas comprise low hills formed on limestone and shale of the Bitter Springs Formation. The Alice Springs granite also occurs between the ridges where it is deeply weathered and shows low relief. Roe Creek has a narrow alluvial plain associated with it. The alluvium is locally over 30 m thick but is mostly less than 20 m thick. It comprises sand clay, silt and gravel.

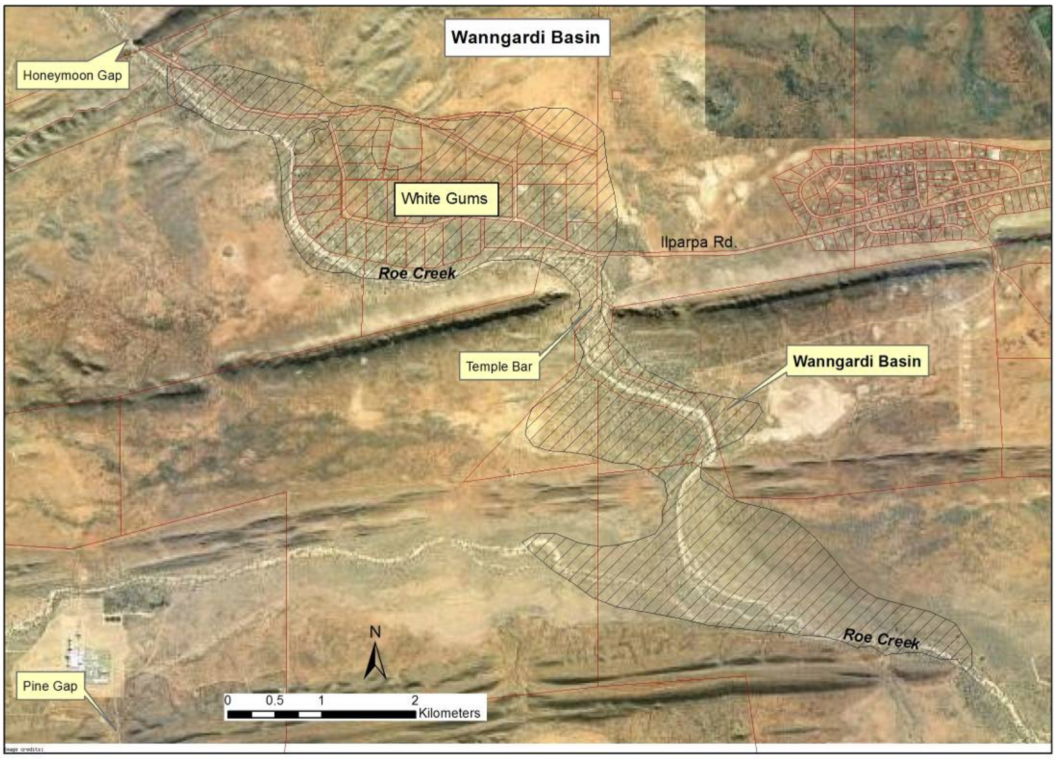

Figure 9 Wanngardi Basin locality map

Aquifers

In the White Gums area bores tap aquifers hosted in weathered granite and alluvium. Most aquifers are marginal, generally yielding less than 0.5 L/sec. Some bores are screened in both alluvium and weathered granite. The majority of bores tap the weathered zone of the granite. The weathered granite and the alluvium are likely in hydraulic connection and so could be considered to form a single aquifer. There is a high rate of unsuccessful bores. Some 14 per cent of registered bores failed to obtain an adequate domestic water supply. Limestone and shale of the Bitter Springs Formation occurs in the north west corner of the subdivision. A few bores tap that formation and yields can be up to 6 L/sec. where limestone is encountered. Downstream of the ridge of Arumbera Sandstone water levels progressively deepen and the alluvium is unsaturated. Aquifers in those areas are exclusively in bedrock formations.

Recharge

Since 1992 when water levels were first monitored, there have been three significant recharge events; January 1995, February 2000 and February 2010 (Figure 10). At least four lesser events have also been recorded. There are two possible recharge mechanisms for the Wanngardi Basin aquifer; direct infiltration of rainfall and seepage of surface water through the bed of Roe Creek. The distribution of chloride ions in the groundwater (Figure 11) shows a pattern of low values near the creek and higher values remote from the creek. This suggests that stream-bed seepage is the dominant type of recharge.

A stream gauging station, G0060008 located on Roe Creek some 8 km downstream of White Gums records stream heights and has been operating since 1967. The relationship between rainfall, stream flow and groundwater recharge is not straightforward. For example rainfall events of similar totals do not necessarily all result in stream flow. Complicating factors include the duration of the rainfall event and the time since previous rainfall events. These can affect soil moisture and so the ability of the catchment to yield runoff. Similarly not all stream flow events have equal effects on recharge. The duration of flow, prior flow history and stream height will all affect the potential for recharge to occur. In the absence of a rainfall/runoff/recharge model for the catchment only a very basic analysis can be done to determine the sustainable yield of the aquifer.

Groundwater Levels

Groundwater levels have been monitored in this management zone since 1992. Representative bore hydrographs are shown in Figure 12 to Figure 14. The locations of the monitoring bores are shown in Figure 15. North of the ridge of Arumbera Sandstone water levels show a pattern of irregular recharge events marked by sudden rises, separated by periods of no recharge up to eight years long in which levels gradually decline. As with the other shallow alluvial basins, water levels at White Gums have generally declined since 2006 until heavy rains in January 2010 raised them back to similar levels. The highest recorded levels were in 2002. Over the period of measurement there has been no obvious decline in the lowest water levels recorded just prior to each recharge event. Before the next review, the White Gum monitoring bores should be levelled so that a watertable elevation map can be drawn in order to determine flow directions.

Downstream of the ridge of Arumbera Sandstone water levels are deeper than 40 m (Figure 16) and aquifers are only developed in the various bedrock formations.

Water Quality

The main data available for the majority of bores are the water analyses carried out soon after bores were drilled. These indicate that the groundwaters are fresh to saline (TDS 179 to 7920 mg/L). The waters are soft to very hard (hardness 22 to 800 mg/L) and they are mostly neutral to slightly alkaline. The lower TDS waters have sodium and calcium as the dominant cations and bicarbonate as the dominant anion. With increasing TDS the waters tend to become sodium chloride dominant.

There has been no regular water quality monitoring. One bore, RN13729 located just south of Temple Bar was sampled in February 2011 and there was no significant change in the major ions since it was previously sampled in 1986 and 1983.

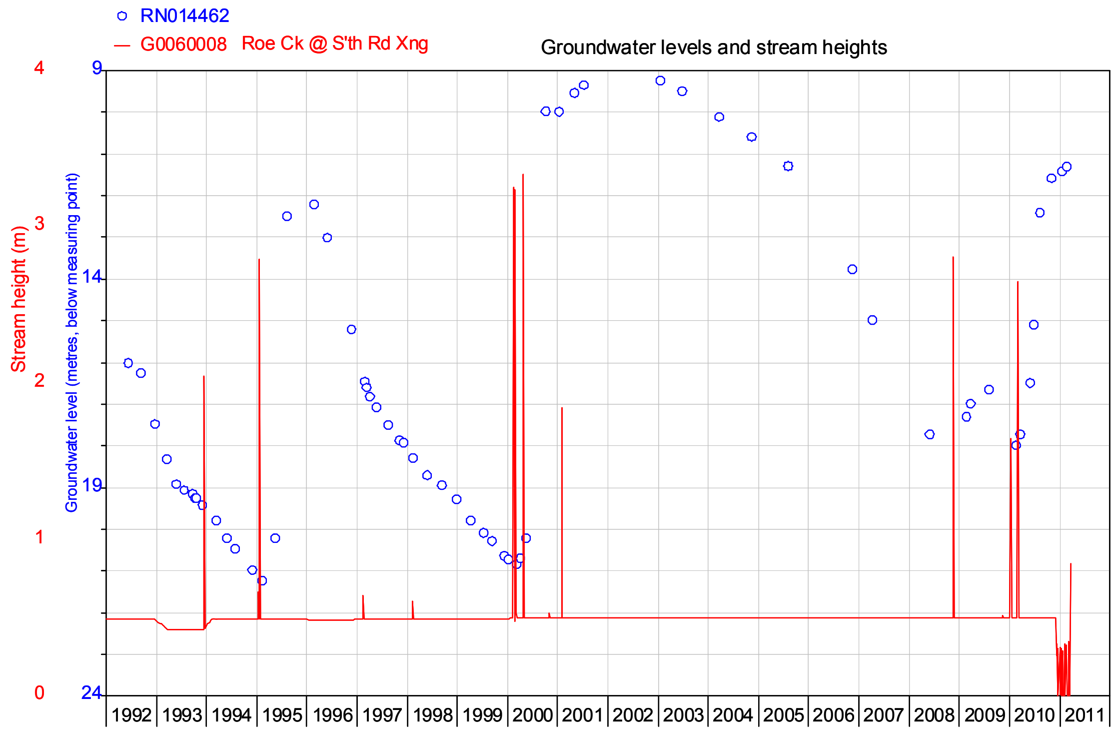

Figure 10 Groundwater levels at White Gums and Roe Creek stream height, see Fig. 15 for bore location

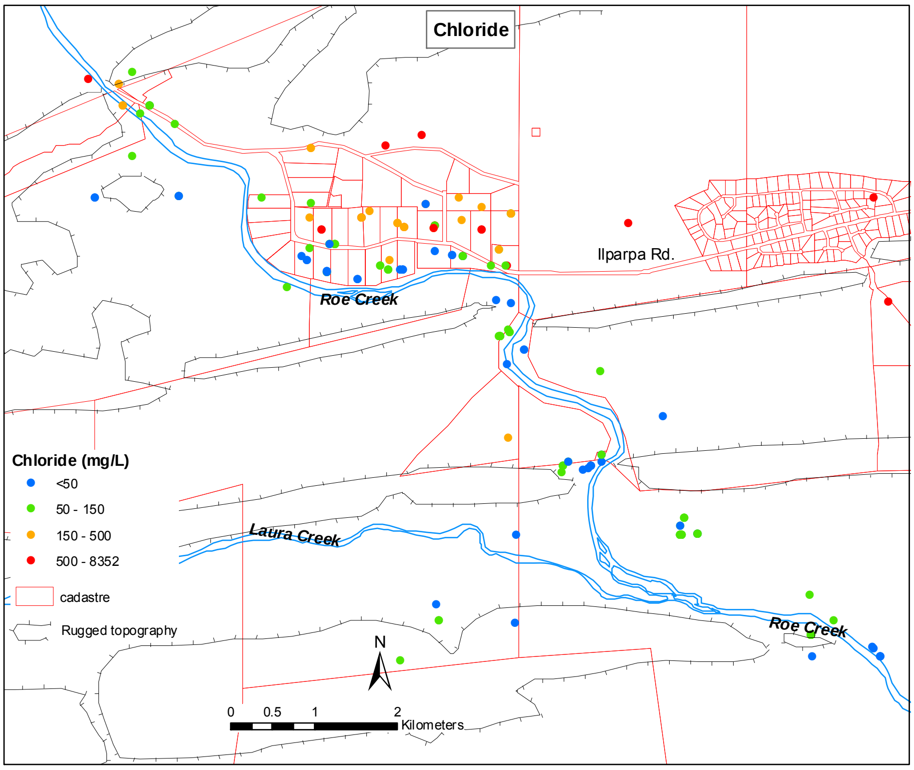

Figure 11 Chloride concentration in groundwater

Water Balance

Several main components of the hydrologic cycle must be accounted for in order to compile a water balance for the shallow alluvial/weathered granite aquifer. These include gains from water flowing into the area from the alluvial aquifer upstream of Honeymoon Gap and from episodic recharge from Roe Creek. Losses include extraction from bores, evapotranspiration and water flowing out of the area in the alluvial aquifer downstream of Temple Bar. The monitoring bores have not been levelled yet, so the flow of groundwater in and out of the area in the alluvial aquifer cannot be determined.

Groundwater Extraction

The groundwater usage in this zone is for two caravan parks, domestic and stock purposes. Only one of these bores is currently metered. Some usage figures for bores that supply the Temple Bar Caravan Park are reported to NRETAS by the owner. Those bores are located south of the Temple Bar Gap and tap a Bitter Springs Formation aquifer. Their licensed volume is 20 ML/year but actual usage is reported to be less than 10 per cent of that amount.

Domestic bores at White Gums are registered but not licensed or metered. Water use figures used in the recharge calculations below are based on the average Alice Springs household usage of 532 kL/y (Power Water Corporation, 2009). Some thirty three blocks have houses on them so the total water consumption for White Gums is estimated to be 17,600 m^3/y.

Evapotranspiration

Evapotranspiration is likely to be a significant part of the water balance. It was estimated here by applying figures for water use from Cook et. al. (2005) for red gum and mulga communities at Ti-Tree. In the case of red gums the average water use of 0.86 $m^3/y/m^2$ (for a tree density of 500 stems/ha) was used. For mulga 0.124 $m^3/y/m^2$ (for a tree density of 625 stems/ha) was used. The land unit mapping (Lennartz, 2000) was used to classify the area into vegetation types. That was then simplified into three categories; areas with red gums as the main upper stratum, areas with other trees as the main upper stratum (eg mulga, ironwood or corkwood) and finally areas lacking an upper stratum. Water use values of 0.86, 0.124 and nil were assigned to these categories respectively. An estimate of tree density for each zone was made using aerial photography and the water use of the vegetation type was scaled proportionately to the number of stems/ha compared to those at Ti-Tree. A total figure of 14,000 m^3/y was calculated for evapotranspiration.

Specific yield

The specific yield of an aquifer is the volume of water which will drain under gravity from a unit volume of aquifer. It can be estimated from the bore hydrographs and groundwater use. In turn it can be used to calculate recharge during specific recharge events. In the period between January 2003 and May 2008 no recharge was recorded and water levels declined steadily by an average of 5.6 m. The decline was due to pumping from bores and use of groundwater by vegetation, in particular by large riparian trees such as red gums. This event can be used to calculate the average specific yield of the aquifer. The zone in which alluvium is at least 10 m thick was the area used in the calculations. Using the following equation:

Specific yield = Volume extracted ÷ (Aquifer area x water level fall)
With an area of 538260 m^2, evapotranspiration of 14,000 m^3/y, groundwater pumping of 17,600 m^3/y, the period over which the water level dropped averaged 5.3 years and the average fall in water level of 5.6 m then the specific yield is 0.06.

Sustainable Yield

A simple water balance can be written as:
Recharge = Change in storage + groundwater pumping + evapotranspiration + lateral outflow – lateral inflow
The last two terms are unknown so will be assumed to be equal. The change in storage is equal to the specific yield times the rise in water level resulting from the recharge event. So the equation can be written as:
Recharge = (Specific yield x aquifer area x rise in water level) + groundwater pumping + evapotranspiration

In the case of the recharge event that occurred in February 2010 water levels rose on average 4.34 m over a nine month period. Groundwater pumping and evapotranspiration over that period were 33,000 and 14,000 m^3 respectively. The recharge was therefore 163,900 m^3.

The same method applied to recharge events that occurred in February 1995 and in March 2000 gave recharge amounts of 119,590 and 296,120 m^3 respectively. The total recharge since the beginning of water level records in 1992 is therefore 579,600 m^3. This averages 30,500 m^3/y, which is of a similar order to the licensed groundwater extraction of 33,000 m^3/y. This accords with the observation that water levels do not show a steady decline over that period.

Taking a longer term view, the subdivision has not yet experienced droughts such as those that occurred between 1924 and 1938 (15 years, average rainfall 196 mm/y) and between 1958 and 1971 (14 years, average rainfall 169 mm/y). Most bores were drilled in the 1980s. Groundwater levels were first monitored in the other shallow alluvial basins prior to 1971. The levels in that period were mostly deeper than those observed since 1972 when a major wet period began. By comparison the water levels at White Gums would most likely have been lower than those observed so far. There are a few records of water levels taken in the 1970s. For example the bore RN10627 had a standing water level of 22.9 m in March 1973, 21.3 m in May 1974, 14.4 m in July 1974 and 10.1 m in November 1980. Water levels in that area are currently between 6 and 13 m. Since 1973 the watertable has risen at least 10 m. In the event of a future dry period equivalent to that from 1958 to 1971 a fall of at least 10 m could be expected. Given that the aquifer is shallow and has low transmissivity, there would be a high likelihood that many of the bores could fail during an extended drought. As an example the bore RN13644 is 42 m deep with slots from 27 to 33 m. The water level in that area is presently at about 12 m. It was pump tested and had a drawdown of 5.5 m after 24 hours pumping at 0.3 L/sec. If an additional 10 m drop in water level were to occur the water level would be below the top of the slots and the bore would likely fail. Most bores have similar characteristics to that one.

Over the past twenty years extractions have been just balanced by recharge. The sustainable yield for that period is therefore of the order of 30,000 m^3/y. Over the past 60 years however the sustainable yield is likely to be much less than that figure. The current extraction rate would not be sustained under a period of extended drought.

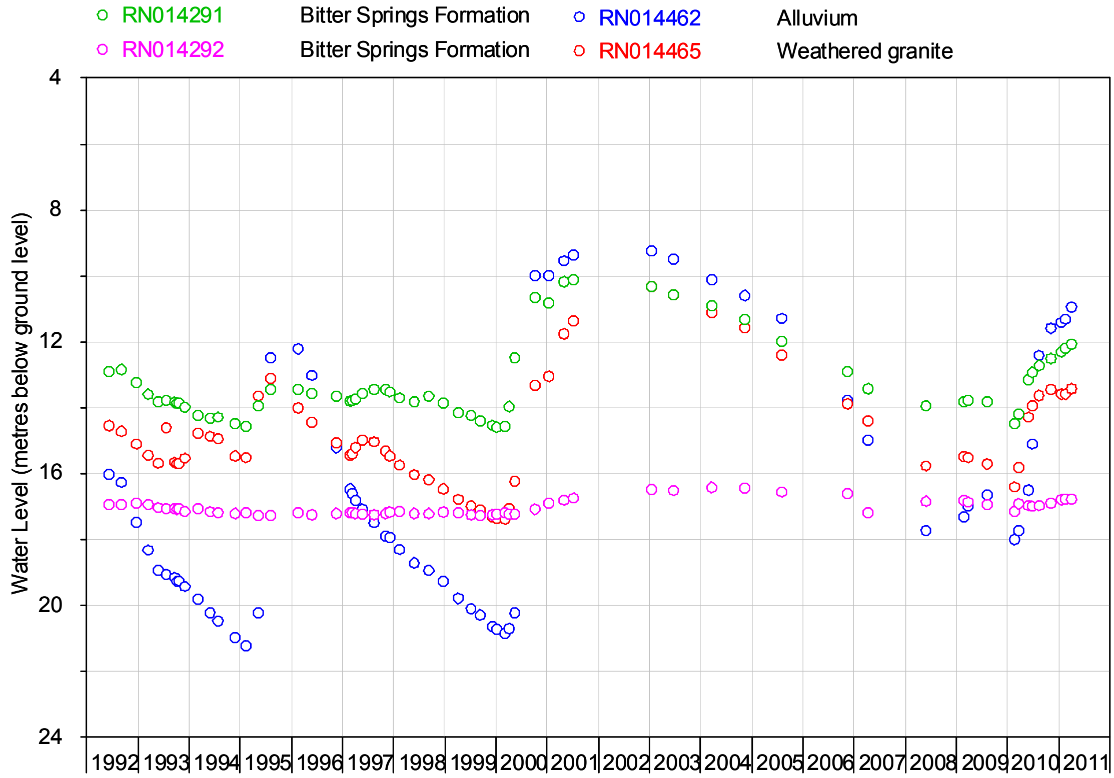

Figure 12 Groundwater levels, White Gums , see Fig.15 for bore locations

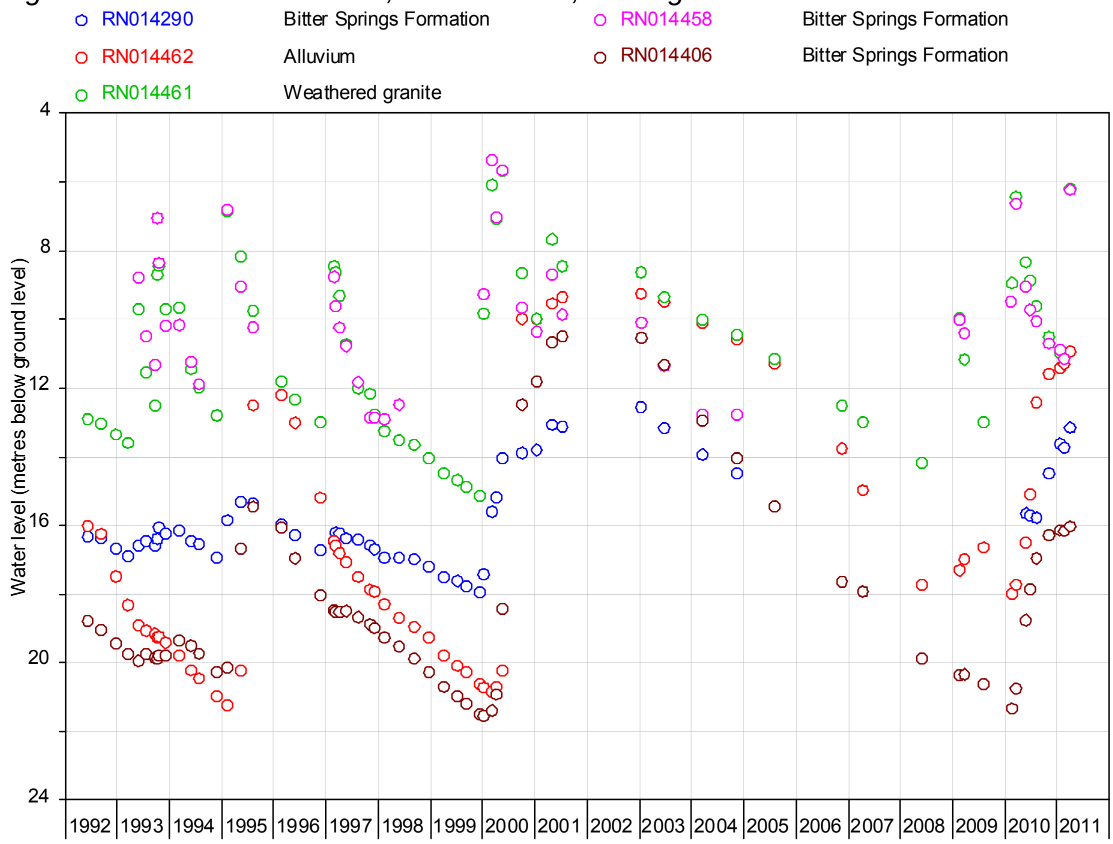

Figure 13 Groundwater levels, RN14290 downstream to RN14406, see Fig. 15 for bore locations

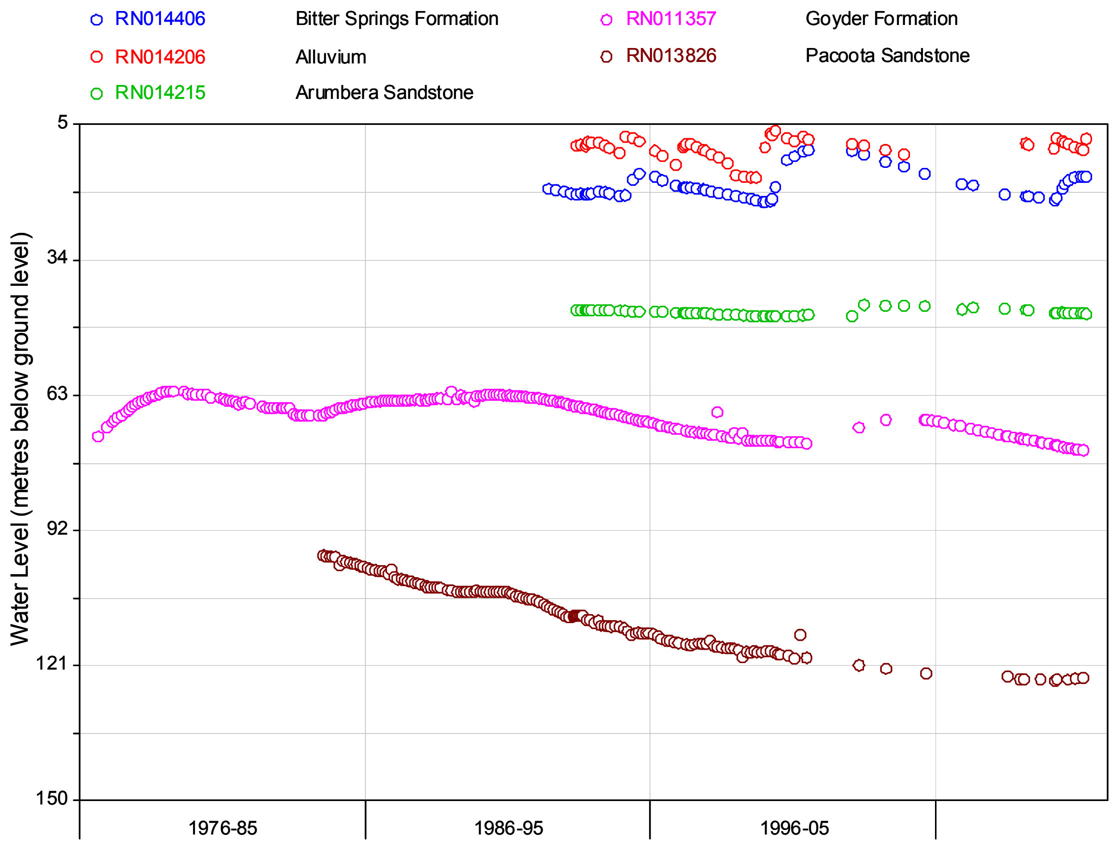

Figure 14 Groundwater levels, RN14406 downstream to RN13826 (note change of depth scale compared to previous two figures), see Fig. 15 for bore locations

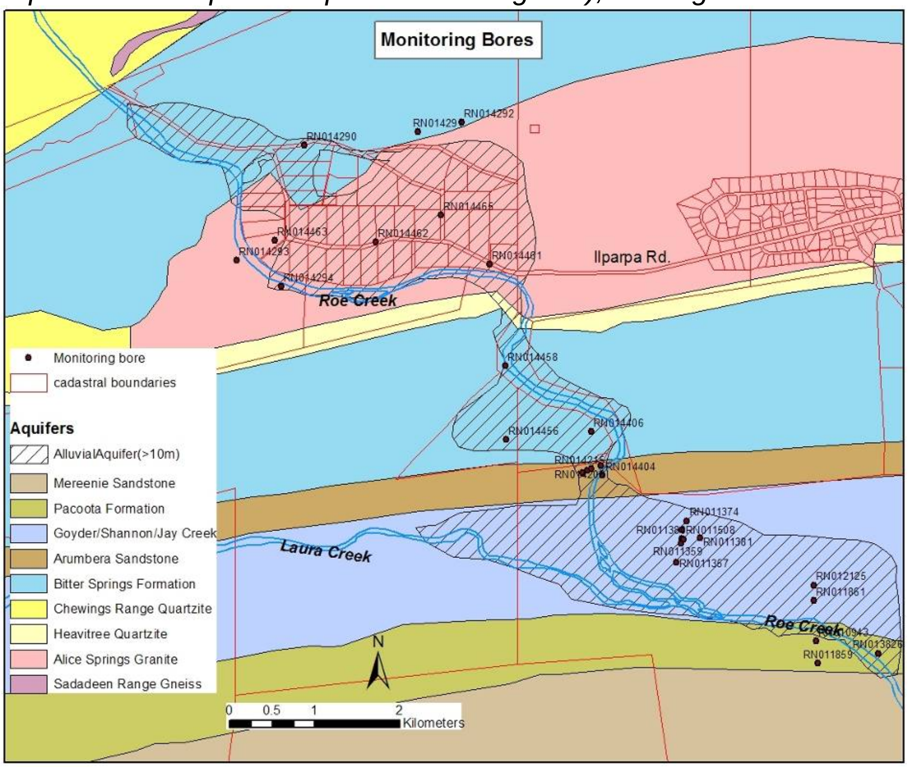

Figure 15 Monitoring bores and aquifers

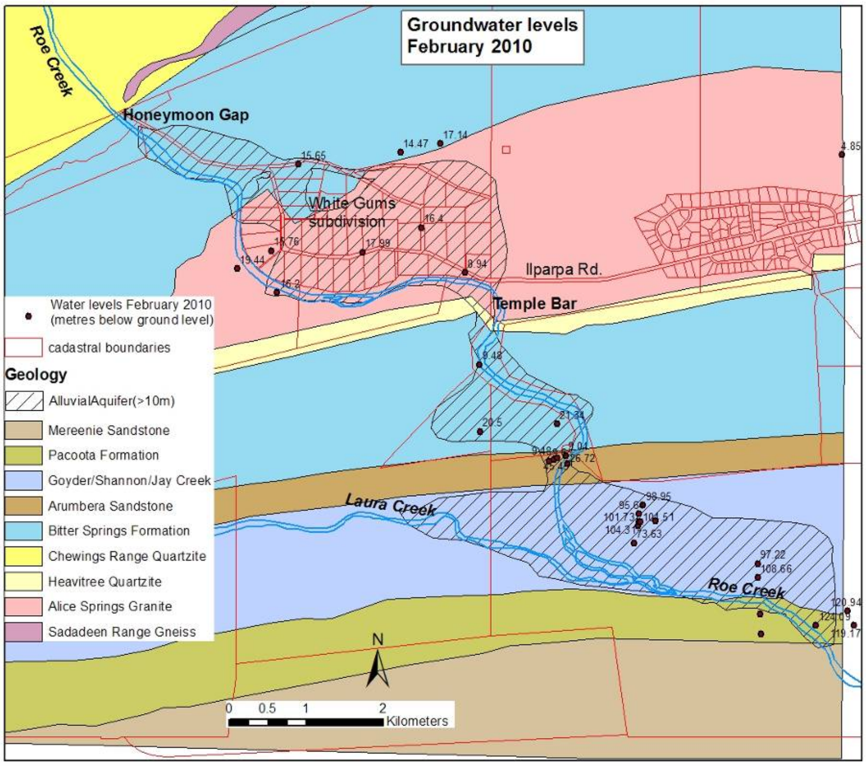

Figure 16 Groundwater levels February 2010 (depth below ground level, metres)

Roe Creek

Hydrogeology

The Roe Creek management zone is on the northern margin of the Amadeus Basin, a sequence of layered sedimentary rocks that have been folded. At Roe Creek they slope steeply to the south. Several of the layers form productive aquifers from which Alice Springs draws its water supplies. There are three main water bearing layers; the Mereenie, Pacoota and Shannon/Goyder aquifers. The Mereenie is the most productive of the three. It is sandstone with groundwater contained in fractures and in the pores between the sand grains.

The natural flow of groundwater prior to the commencement of pumping in 1964 was to the south. Continuous pumping has created a depression in the watertable centred on the borefield and water now flows towards the borefield from the surrounding areas. Water levels have dropped by up to 60 m and now stand at maximum of 150 m below ground level. The influence of pumping extends as far as the proposed Rocky Hill borefield 20 km to the south east.

Groundwater Extraction

The average annual groundwater extraction from all aquifers in the borefield was 9351 ML for the period 2006/2007 to 2009/2010. Some 79 per cent of this was taken from the Mereenie aquifer, 18 per cent from the Pacoota and 3 per cent from the Shannon. On average there has been a slight increase in extraction since 1996/1997 (Figure 17). The annual licensed volume from the Roe Creek borefield is 13,000 ML/y.

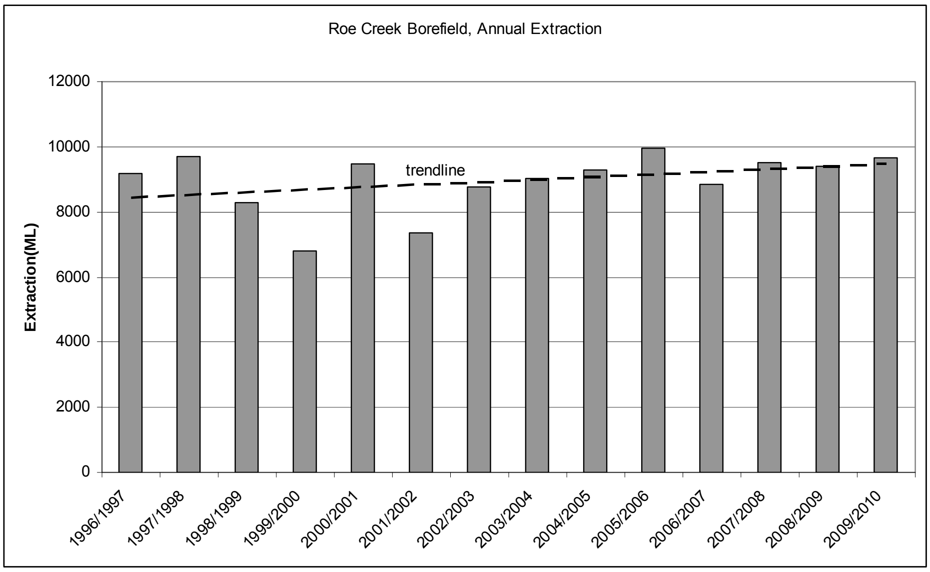

Figure 17 Annual extractions from all aquifers in the Roe Creek borefield

Groundwater Levels

Water levels have been declining as predicted by Jolly and others (2005) (Figure 18). Minor water level fluctuations are most likely related to a modification of the pumping regime. Changes due to recharge are relatively minor. Water level trends in the three main aquifers; the Mereenie, Pacoota and Shannon/Goyder are shown in Figure 19 to Figure 22. The Strategy does not set a specific rate of decline of the watertable as a management target but the water balance calculations set 300 m below ground level as the economic limit of pumping.

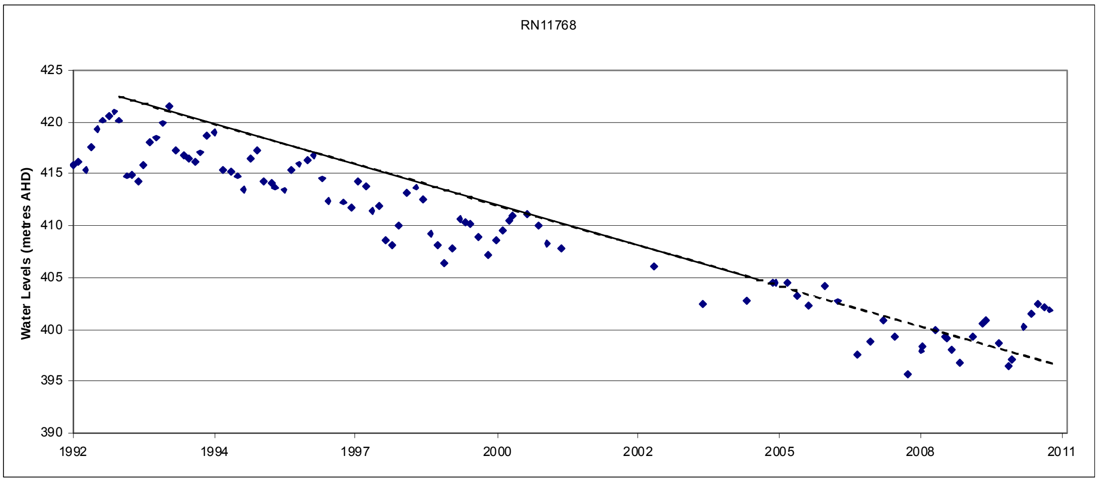

Figure 18 Water level in bore RN11768 with the trendline taken from Jolly and others, 2005.

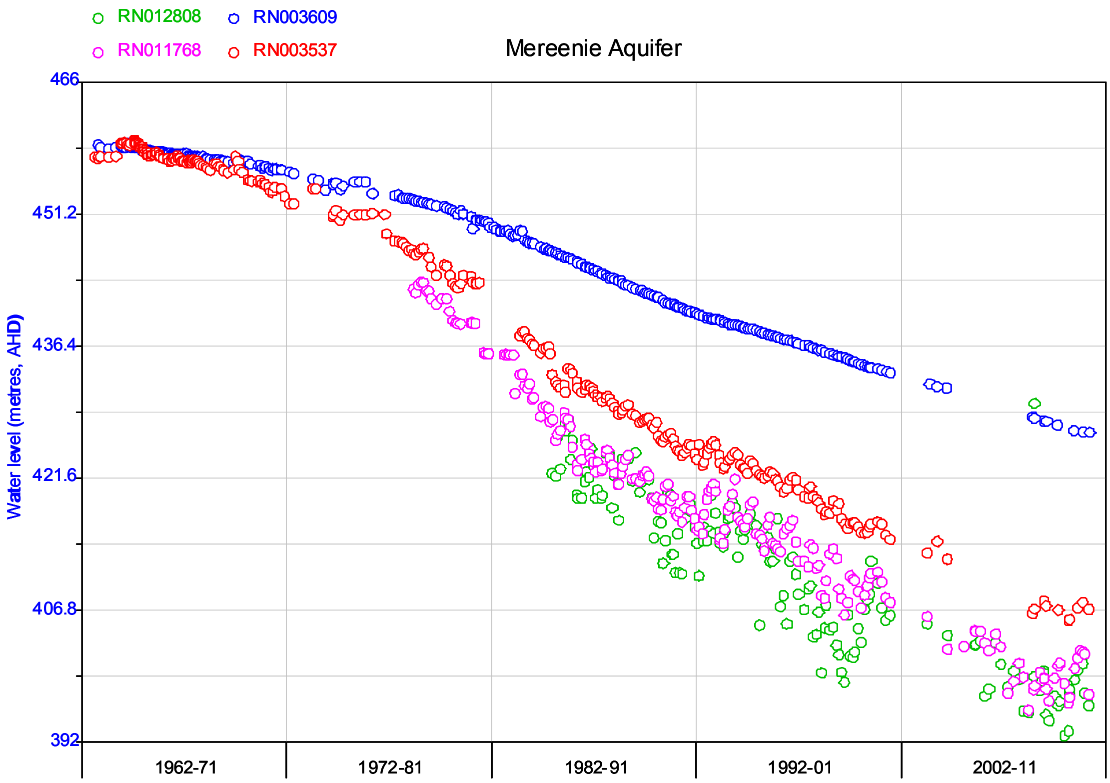

Figure 19 Mereenie aquifer water levels

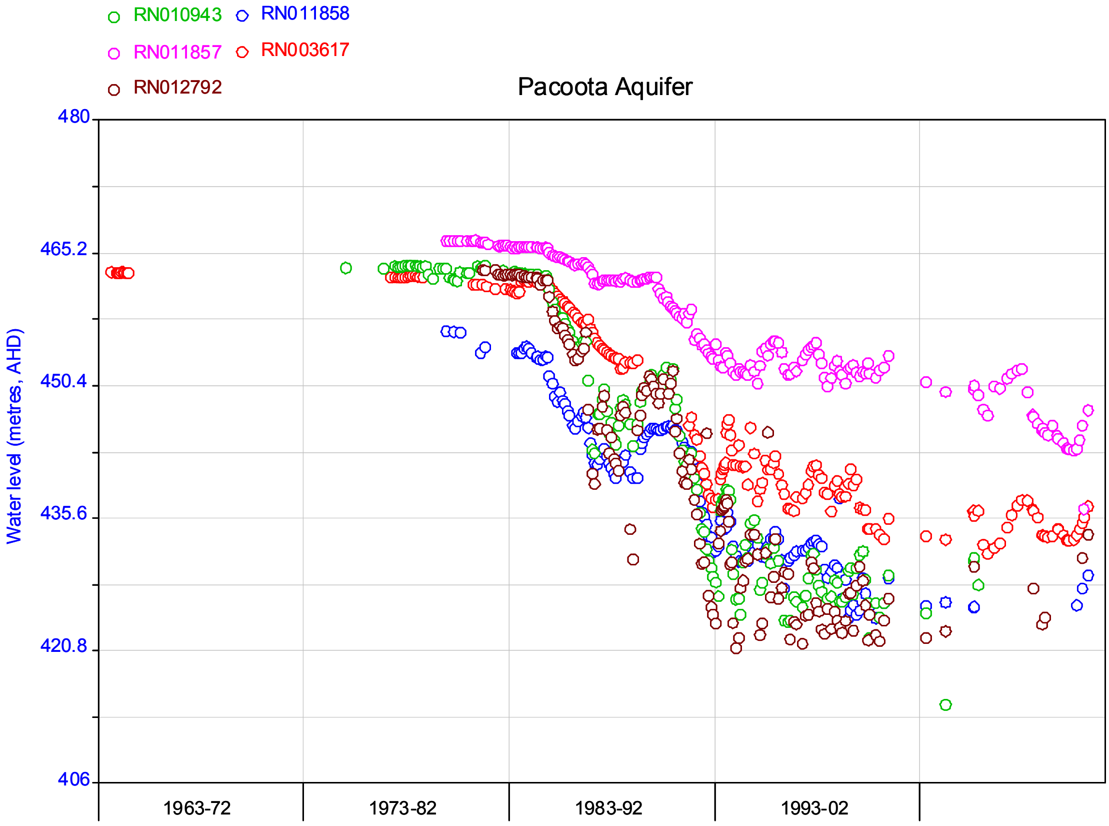

Figure 20 Pacoota aquifer water levels

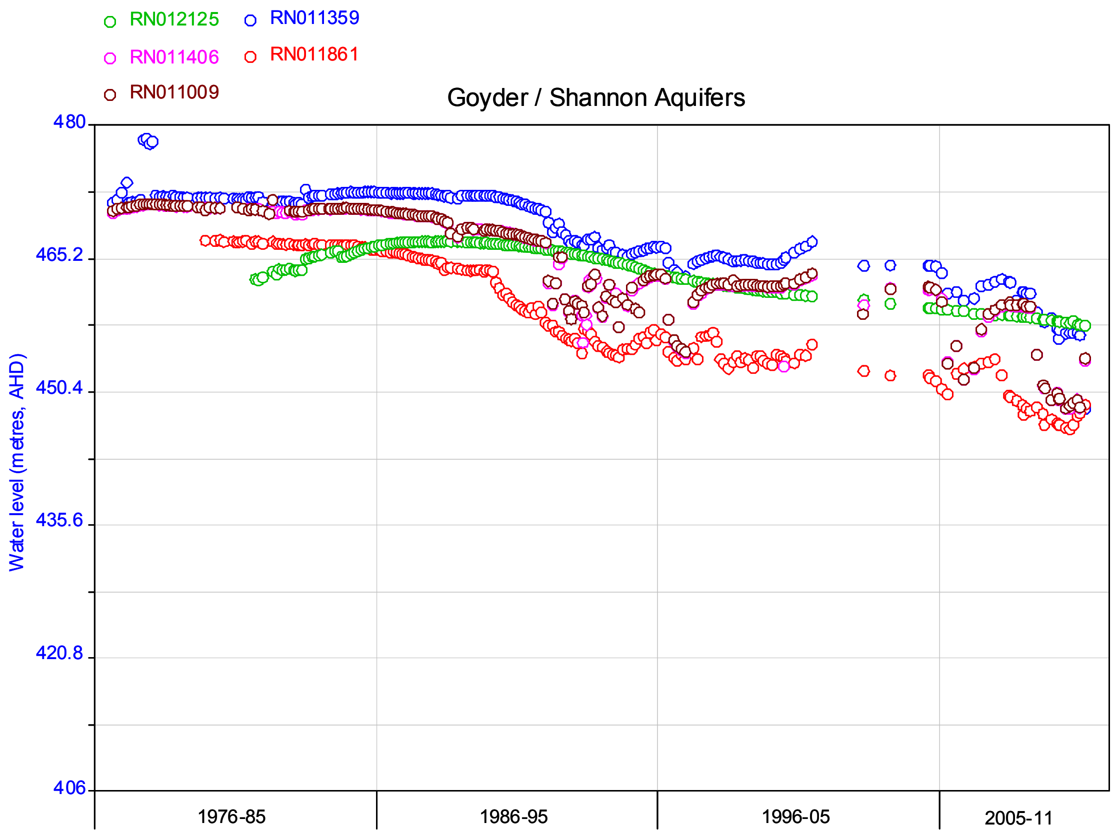

Figure 21 Goyder / Shannon aquifers water levels

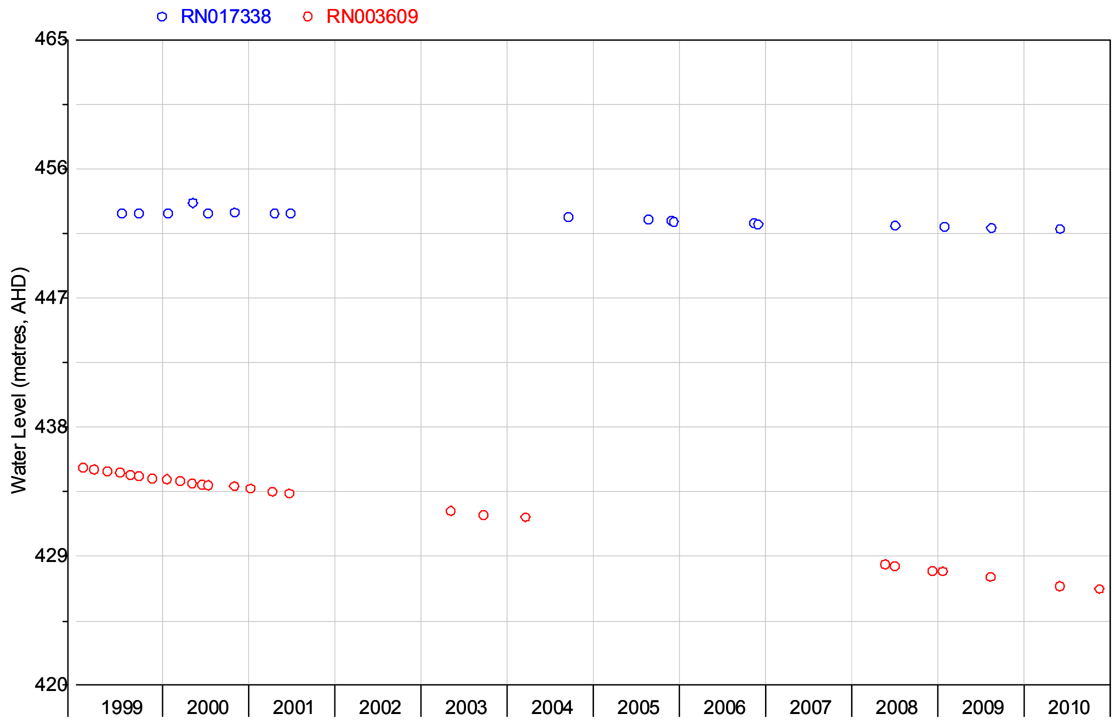

Figure 22 Groundwater levels, RN17338 is on the Rocky Hill agricultural block, RN3609 included for comparison is just south of the airport.

Groundwater Quality

General water quality parameters for eleven production bores have been analysed in 2008 and 2010 (Power Water Corporation, 2010b). Of those in the Mereenie aquifer, seven showed a rise in TDS averaging 26 mg/L. Three fell with an average fall of 22 mg/L. There was no clear trend in the ionic composition between the two dates. Only one bore in the Pacoota aquifer was tested at both dates and its TDS decreased by 70 mg/L. None were tested at both dates in the Shannon/Goyder aquifer.

Rocky Hill / Ooraminna

Hydrogeology

The same Amadeus Basin formations that form aquifers at Roe Creek are also present at Rocky Hill. The main difference is that the strata are more gently inclined in this zone (10^0 compared with 30^0 at Roe Creek). The porosity and permeability of the Mereenie aquifer appears to be lower at Rocky Hill. On the other hand the potential for recharge is higher because there is a greater outcrop area of the Mereenie Sandstone. Water levels are currently around 60 m below ground level.

Groundwater Extraction

There are five licensed groundwater users with a total licensed amount of 1205 ML/y. The average total extraction since 2004/2005 has been 442 ML/y. Horticulture is the main user of groundwater.

Groundwater Levels

The Rocky Hill area is within the zone of influence of pumping of the Roe Creek borefield. Water levels are declining steadily but at a lesser rate than in the vicinity of the borefield. Drawdown due to local pumping cannot readily be distinguished from that due to pumping at Roe Creek

Groundwater Quality

Water quality is not routinely tested in this zone. The Water Allocation Plan did not identify any issues related to water quality.

Discussion

The alluvial aquifers are recharged mainly from stream bed infiltration and so are dependent on rainfall and runoff. The lowest water levels recorded were those towards the end of the 1958 to 1971 dry period. If that situation were to be repeated many bore pumps may need to be lowered and some bores may be susceptible to failure (drawing the watertable below the top of the casing slots or screens). This is especially the case in low transmissivity aquifers such as in the Wanngardi Basin and very shallow aquifers. Over the past five years water levels have fluctuated with varying rainfall but are now generally similar to 2006 levels.

The water level records from all but the Wanngardi Basin extend to back prior to the extended wet period in the 1970s. They all show record high water levels peaking in the mid to late 1970s. A gradual decline has occurred since then, only interrupted by rises in 2000 and 2010 associated with above average rainfalls. Recharge in these aquifers replenishes storage relatively rapidly but under the current pumping regimes the storage takes much longer to deplete.

Most alluvial aquifers are shallower than 20 m and nearly all are shallower than 35 m. This can limit their pumping capacity, especially during extended dry periods or with high pumping rates. The Town Basin groundwater licenses currently accounts for this possibility by setting trigger values (water levels in specified monitoring bores) below which pumping must cease. This situation arose during two brief periods in late 2008 (Power Water Corporation, 2010a).

The aquifers in the Amadeus Basin on the other hand only receive minimal recharge. Groundwater that is pumped from the Roe Creek borefield was recharged thousands or tens of thousands of years ago. The water is being mined and water levels are largely unaffected by the present day climate. The rate of pumping is the factor which directly controls water levels. Minor fluctuations in water levels are caused by localised recoveries that occur when nearby pumps are turned off.

Recommendations

Town Basin

- The current extraction regime is not stressing the aquifer.
- There may be scope to reduce the number of monitoring bores. The network should be reviewed to determine the minimum number of bores necessary for the management of the basin. Measurements should continue on at least a quarterly basis.
- Two additional monitoring bores are needed to fill spatial gaps in the network in the vicinity of the rail yards and immediately south of Larapinta Drive.
- Monthly field water quality measurements (EC, ph and temperature) on the production bores would be useful to establish seasonal or shorter term variations. That would assist in optimising the timing of the annual sampling that is required under the extraction license.

Inner Farm Basin

- The current extraction regime is not stressing the aquifer.
- A more accurate estimate of groundwater extraction should be made. This can be done by metering the licensed bores, giving priority to those with the highest licensed amounts. Estimates of use by other bores could be achieved by fitting metres temporarily to representative bores. An alternative would be to measure pumping rates of representative bores and then logging their pumping hours.
- The network of monitoring bores should be maintained and measured at least quarterly.

Outer Farm Basin

- The current extraction regime is not stressing the aquifer.
- A more accurate estimate of groundwater extraction should be made. This can be done by metering all of the licensed bores, giving priority to those with the highest licensed amounts. Estimates of use by other bores could be achieved by fitting metres temporarily to representative bores. An alternative would be to measure pumping rates of representative bores and then logging their pumping hours.
- There may be scope to reduce the number of monitoring bores. The network should be reviewed to determine the minimum number of bores necessary for the management of the basin. Measurements should continue on at least a quarterly basis.
- The influence of the artificial recharge scheme should continue to be monitored in terms of water levels and water quality.

Wanngardi Basin

- The aquifer may be unable to maintain the current supply during drought periods. No additional bores should be drilled apart from those replacing existing ones.
- The network of monitoring bores should be maintained and measured at least quarterly.

- The volume of groundwater extracted is not well known at present. A survey of hours of pumping of representative bores would be useful to better estimate pumpage.
- Annual field water quality measurements (EC, ph and temperature) should be done on a few selected production bores.
- All of the monitoring bores need to be levelled in order to determine the flow directions and to calculate down valley flow.
- The flow record of Roe Creek together with bore hydrographs and rainfall records should be analysed to determine the long term frequency of recharge events.

Roe Creek

- Water levels are declining as predicted by Jolly and others (2005).
- The current monitoring of pumping, water levels and water quality is adequate for managing the resource.

Rocky Hill / Ooraminna

- The current extraction regime is having only minor effects on water levels
- The network of monitoring bores should be maintained and measured at least quarterly.
- Annual water quality testing (major ions) of irrigation bores would be useful for providing baseline data.

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