WESTERN MOUNT LOFTY RANGES PWRA

Groundwater Level and Salinity Status Report

2011

Government of South Australia
Department of Environment, Water and Natural Resources

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2011 SUMMARY

The Western Mount Lofty Ranges Prescribed Water Resources Area (PWRA) covers an area of approximately 2750 km^2 stretching from Cape Jervis on the south coast, to Gawler in the north. It is a regional-scale prescribed water resource for which groundwater is managed under South Australia's *Natural Resources Management Act 2004*.

There are two different types of aquifers in the Western Mount Lofty Ranges PWRA—fractured rock and sedimentary aquifers. Recharge to both aquifers occurs directly from the portion of rainfall that percolates down to the water table through the soil profile.

The fractured rock aquifers of the Western Mount Lofty Ranges PWRA are comprised of three geological units: the Barossa Complex, Adelaidean sediments and the Kanmantoo Group. Generally, the Adelaidean sedimentary rocks are more favourable in terms of recharge, salinity and yields, while the Barossa Complex and Kanmantoo Group rocks provide groundwater of poorer quality at low yields.

There are three types of sedimentary aquifers in the Western Mount Lofty Ranges PWRA: Permian sand, Tertiary limestone and Quaternary sediments. Tertiary limestone aquifers provide good quality water and high yields, while the Permian sand aquifers display a wide variation in characteristics.

Groundwater flow within the fractured rock aquifers generally follows the topography and moves from higher points towards the lowest areas, where it eventually discharges into rivers and streams.

Generally, groundwater levels in the Adelaidean fractured rock aquifer of the Central Hills region reveal a good correlation with rainfall. In 2011, groundwater levels have continued to rise despite slightly below-average rainfall recorded for 2011 and are likely attributed to the unusually wet summer of 2010–11.

In the Myponga Basin, four of seven observation wells monitoring the Permian sand aquifer recorded an increase in the maximum recovered groundwater level of up to 0.3 m in September 2011 when compared to the same time the previous year; two observation wells recorded a decline of up to 0.2 m and one observation well recorded no change.

In September 2011, the two observation wells monitoring the Permian sand aquifer of the Hindmarsh Tiers Basin recorded an increase of 0.05 m and a decline of 0.03 m in the maximum recovered groundwater level when compared to the same time the previous year.

The majority of observation wells in the Tertiary limestone aquifer of the Hindmarsh Tiers Basin recorded an increase in the maximum recovered water level of around 2 m in September 2011 when compared to the same time the previous year and are likely attributed to the unusually wet summer of 2010–11.

Seven of the nine observation wells monitoring the Tertiary limestone aquifer of the Myponga Basin recorded a decline in the maximum recovered groundwater level of up to 0.2 m. Although the decline in levels is relatively small, they have occurred in unusually wet conditions which may indicate extraction is the possible cause.

The large majority of observation wells in the Adelaidean fractured rock aquifer of the Central Hills region recorded an improvement in salinity in 2011. At the Inverbrackie Creek catchment, observation wells recorded very small increases in salinity in 2011.

Salinities within the Tertiary limestone aquifers are generally below 1000 mg/L and have been quite stable since 2007.

ASSESSMENT OF STATUS

FRACTURED ROCK AQUIFERS

The fractured rock aquifers of the central hills region of the Western Mount Lofty Ranges PWRA have been assigned a green status for 2011:

2011 STATUS

"No adverse trends, indicating negligible risk to the resource"

This means that the groundwater status was observed to be stable (i.e. no significant change) or improving over the reporting period. Continuation of these trends favours a very low likelihood of negative impacts on beneficial uses such as drinking water, irrigation or stock watering. The 2011 status for the fractured rock aquifers is supported by:

- the reduced rate of decline, stabilisation or increase in groundwater levels
- an overall decline in salinity.

PERMIAN SAND AQUIFERS

Hindmarsh Tiers and Myponga Basins

The Permian sand aquifers of the Hindmarsh Tiers and Myponga Basins have been assigned a yellow status for 2011:

2011 STATUS

"Gradual adverse trends, indicating low risk to the resource in the medium term"

This means that gradual adverse trends in the resource status have been observed over the reporting period. Continuation of these trends is unlikely to negatively impact the beneficial use of the resource for at least 15 years. The 2011 status for the Permian sand aquifers is supported by:

- gradual decline in recovered groundwater levels since 1993 in the Hindmarsh Tiers Basin, in response to below-average rainfall
- gradual decline in recovered groundwater levels since 2001 in the Myponga Basin, in response to below-average rainfall.

Although the observed groundwater level trends of 2011 are showing a slight recovery from previous years, this is attributed to the unusually wet summer of 2010–11. Ongoing monitoring is essential to determine if the groundwater level declines will be persistent and present a threat to the sustainability of the Permian sand aquifers.

TERTIARY LIMESTONE AQUIFERS

Hindmarsh Tiers and Myponga Basins

The Tertiary limestone aquifers of the Hindmarsh Tiers and Myponga Basins have been assigned a yellow status for 2011:

2011 STATUS

"Gradual adverse trends, indicating low risk to the resource in the medium term"

This means that gradual adverse trends in the resource status have been observed over the reporting period. Continuation of these trends is unlikely to negatively impact the beneficial use of the resource for at least 15 years. The 2011 status for the Tertiary limestone aquifers of the Hindmarsh Tiers and Myponga Basins is supported by:

- gradual decline in recovered groundwater levels since 1975 in the Hindmarsh Tiers Basin
- lower-than-average groundwater levels between 2005 and 2009 in the Myponga Basin in response to below-average rainfall.

There has been some recovery in groundwater levels since 2009. This is consistent with an incidence of wetter conditions in South Australia in the 2009 to 2011 period, which included the unusually wet summer of 2010–11. However, the overall long-term decline in levels in the Hindmarsh Tiers Basin and declines in 2011 in the Myponga Basin despite unusually wet conditions suggest another driver, most likely extraction, is also affecting levels. Ongoing monitoring is essential to determine if the groundwater level declines will be persistent and present a threat to the sustainability of the Tertiary limestone aquifers.

No adverse trends, indicating negligible risk to the resource
Groundwater status was observed to be stable, i.e. no significant change or improving, over the reporting period. Continuation of these trends favours a very low likelihood of negative impacts on beneficial uses such as drinking water, irrigation or stock watering.

Gradual adverse trends indicating low risk to the resource in the medium term
Gradual adverse trends in the resource status have been observed over the reporting period. Continuation of these trends is unlikely to negatively impact the beneficial use of the resource for at least 15 years.

Significant adverse trends indicating high risk to the resource in the short to medium term
Significant adverse trends in the resource status have been observed over the reporting period. Continuation of these trends will likely lead to negative impacts on the beneficial use of the resource within 5 to 10 years.

Substantial adverse trends indicating extreme risk to the resource in the short term
Very significant adverse trends in the resource status have been observed over the reporting period. Continuation of these trends will most certainly lead to negative impacts on the beneficial use of the resource within 5 years.

BACKGROUND

The Western Mount Lofty Ranges Prescribed Water Resources Area (PWRA) covers an area of approximately 2750 km^2 stretching from Cape Jervis on the south-east coast, across to Middleton and up to Gawler in the north (Fig. 1). It falls within the Adelaide and Mount Lofty Ranges Natural Resources Management Region and is a regional-scale prescribed water resource for which groundwater is managed under South Australia's Natural Resources Management Act 2004. A water allocation plan provides for the sustainable use of groundwater resources.

The McLaren Vale Prescribed Wells Area (PWA) is located wholly within the boundaries of the Western Mount Lofty Ranges PWRA and separate groundwater level and salinity status reports have been prepared for the area and can be found on the WaterConnect website. The McLaren Vale PWA divides the Western Mount Lofty Ranges PWRA into two regions—the Central Hills and Fleurieu Peninsula (Fig. 1).

HYDROGEOLOGY

There are two different types of aquifers in the Western Mount Lofty Ranges PWRA. The fractured rock aquifers occur where groundwater is stored and moves through joints and fractures in the basement rocks. Sedimentary aquifers occur in the valleys where groundwater flows through the pore spaces within the sediments. Recharge to both of these aquifers occurs directly from the portion of rainfall that percolates down to the water table through the soil profile or, in the case of the sedimentary aquifers, indirectly by throughflow from adjacent aquifers.

Fractured Rock Aquifers

The fractured rock aquifers of the Western Mount Lofty Ranges PWRA are comprised of three geological units—the Barossa Complex, Adelaidean sediments and the Kanmantoo Group (Fig. 2). Generally, the Adelaidean sedimentary rocks are more favourable in terms of recharge, salinity and yields, while the Barossa Complex and Kanmantoo Group rocks provide groundwater of poorer quality at low yields.

Barossa Complex (Lb)

The Palaeoproterozoic-aged Barossa Complex is generally considered to be a poor aquifer from which irrigation supplies are usually not obtained. These basement rocks are generally tight and impermeable, with few open systems of fractures and joints in which groundwater is stored and transmitted. Clayey weathered materials have infilled joints and fractures and soluble components of these materials can dissolve and raise the salinity of the groundwater. The clays can also restrict the infiltration of rainwater.

Adelaidean sediments (N)

These Neoproterozoic-aged sediments consist mainly of sandstone, siltstone, shale and slate, with minor beds of quartzite. As the Adelaidean sedimentary rocks have not been subjected to the heat and pressure of metamorphism, they are considered reasonably good aquifers because the joints and fractures are open and permeable, resulting in relatively high yields. In addition, these sediments occur in the west of the region where the rainfall is higher, resulting in higher recharge and lower salinities.

Kanmantoo Group (Ek)

Like the Barossa Complex, the Cambrian-aged Kanmantoo Group is generally considered to be a poor aquifer. While isolated instances of low salinity can occur, lower rainfall to the east reduces recharge and flushing in this aquifer, resulting in higher salinities. Yields are also low and as such, the groundwater development potential for this aquifer is considered low.

Sedimentary aquifers

There are three types of sedimentary aquifers in the Western Mount Lofty Ranges PWRA—Permian sand, Tertiary limestone and Quaternary sediments (Fig. 2). Tertiary limestone aquifers provide good quality water and high yields, while the Permian sand aquifers display a wide variation in characteristics.

Permian sand (P)

The Permian sediments consist of unconsolidated sands, silts and clays with occasional gravel beds that are known as the Cape Jervis Formation. The Permian sand aquifers generally provide good yields at low salinity levels, but can have high clay contents in some areas leading to lower yields and higher salinities.

In the Myponga Basin, the Permian sand aquifer is used for irrigation purposes where the Tertiary limestone is absent around the basin margin and to the north-east toward Pages Flat.

Tertiary limestone (T)

The Tertiary limestone aquifer is restricted in extent to isolated basins, such as Myponga and Hindmarsh Tiers. The Tertiary limestone aquifer is an important source of water where it contains good quality groundwater and is confined by the overlying Quaternary clays, which may cause seasonal artesian conditions. This aquifer is widely developed for irrigation, primarily of dairy pasture in the Myponga and Hindmarsh Tiers Basins.

A geological cross-section of the Myponga Basin shows the Tertiary limestone aquifer reaching thicknesses of 200 m and being contained within the Permian sands (which are up to 300 m thick). A cross-section through the Hindmarsh Tiers Basin depicts the Tertiary limestone attaining a thickness of over 100 m and being confined by Quaternary alluvium and partly contained by Permian sands.

Quaternary sediments (Q)

Quaternary sediments are found at the lowest points in the catchments adjacent to drainage lines and consist of dark grey silts and clays with a high organic content and some reworked Permian sand. Significant thicknesses of peat occur in some places.

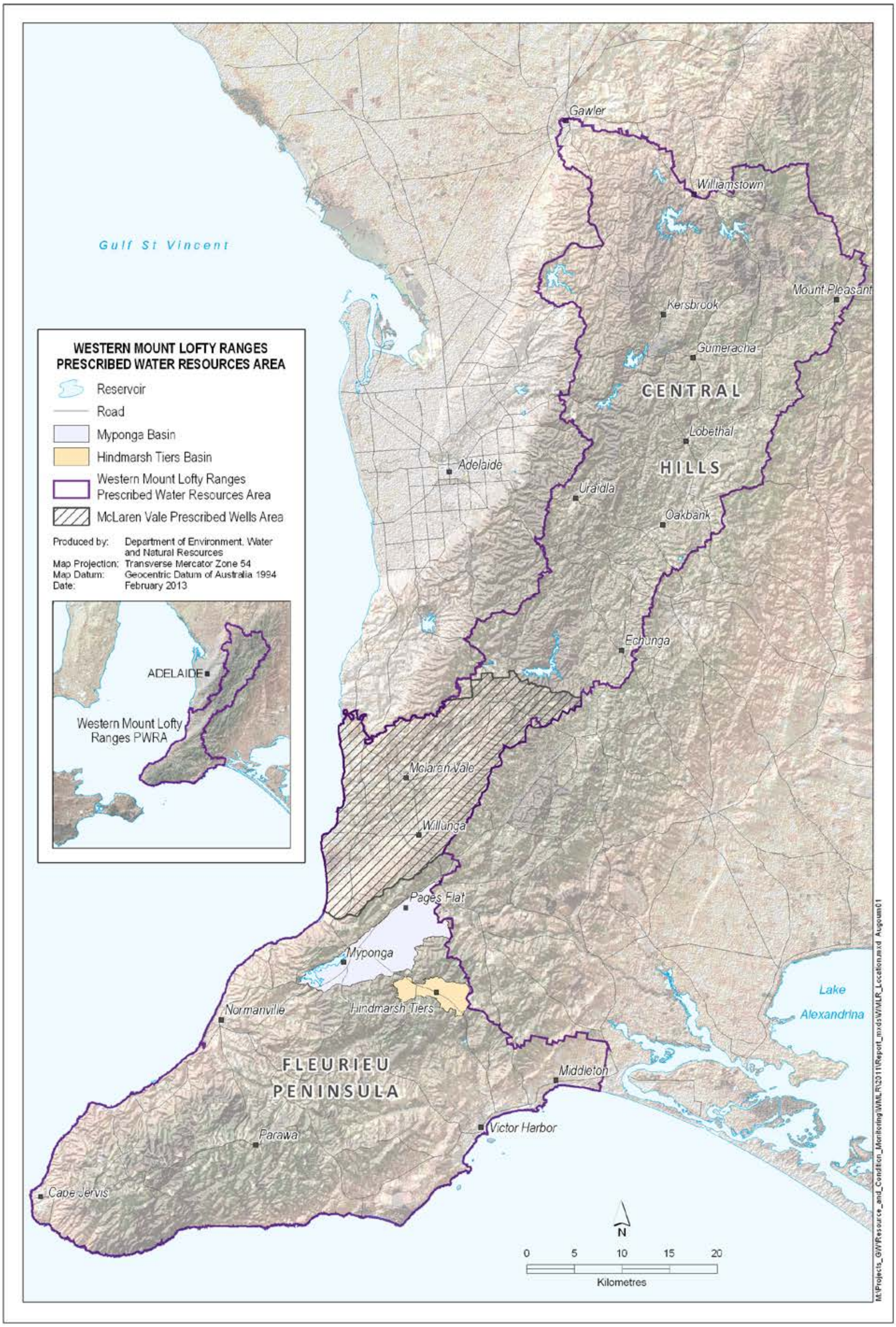

Figure 1. The Western Mount Lofty Ranges Prescribed Water Resources Area

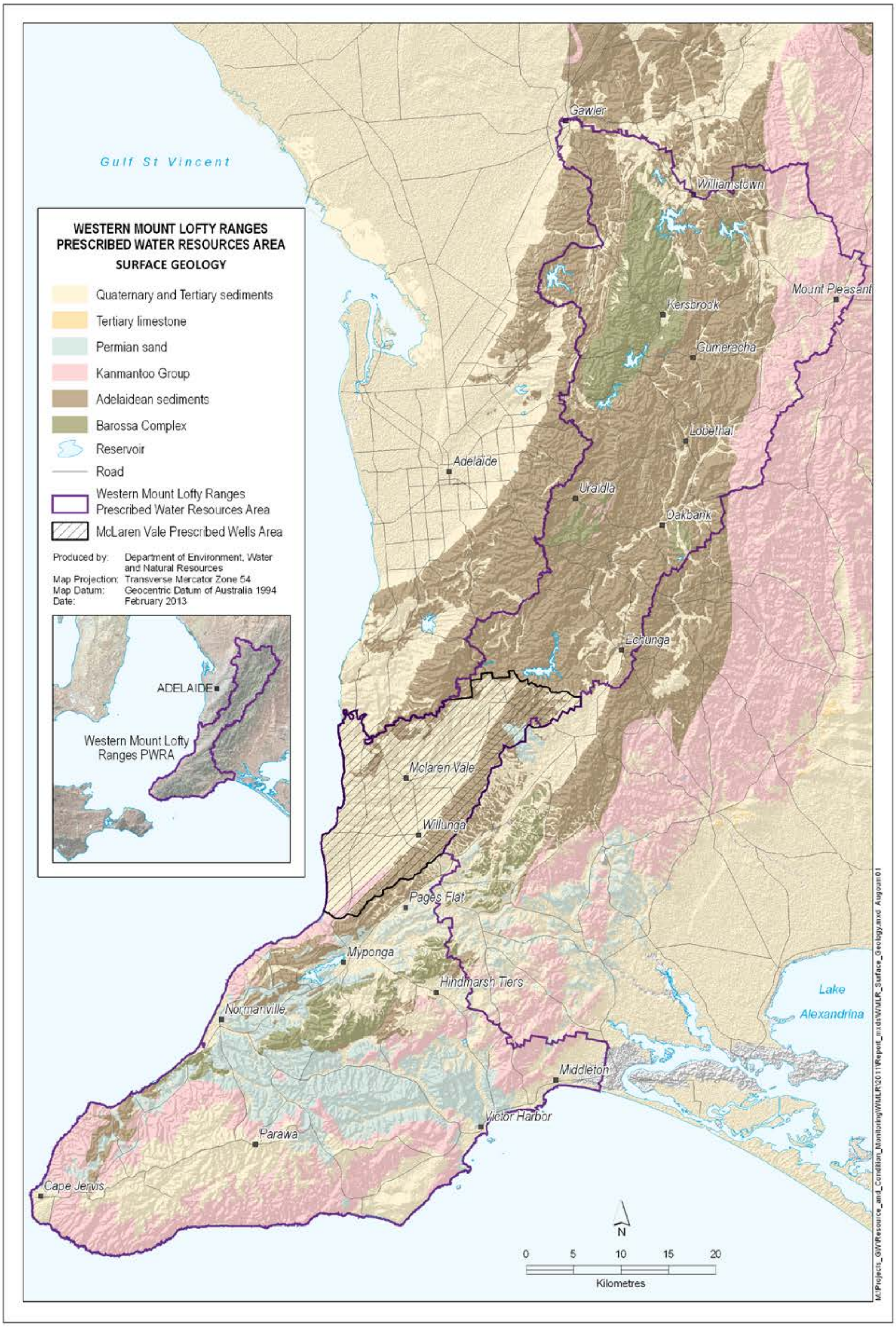

Figure 2. Surface geology of the Western Mount Lofty Ranges Prescribed Water Resources Area

GROUNDWATER FLOW AND SALINITY

Groundwater flow within the fractured rock aquifers generally follows the topography and moves from higher points towards the lowest areas, where it eventually discharges into rivers and streams.

Central Hills

All three major types of fractured rock aquifers occur in the Central Hills region. In general, the Kanmantoo Group dominates the eastern part of the region. The Kanmantoo Group typically has poor water quality and yields. Adelaidean sediments generally have better recharge levels, lower salinity and higher yields. Therefore, salinities within the fractured rock aquifer are highly variable, with values ranging from less than 200 mg/L near Uraidla to nearly 3000 mg/L at Echunga (Fig. 3). Sedimentary aquifers in the Central Hills region consist of Quaternary sediments.

Fleurieu Peninsula

The three types of fractured rock aquifers are also found on the Fleurieu Peninsula. The Barossa Complex is generally considered to be a poor aquifer from which irrigation supplies are usually not obtained. The Kanmantoo Group is also generally considered to be a poor aquifer, with higher salinities in the range 1500–3000 mg/L due to the lower rainfall to the east resulting in reduced recharge and flushing to this aquifer. However, isolated instances of low salinity still occur. Yields are also low, mostly below 5 L/s. The Adelaidean sedimentary rocks are considered reasonably good aquifers as they occur to the west of the region where the rainfall is higher, resulting in higher recharge and low salinities with relatively high yields.

The Permian sand aquifer is generally not highly productive, except in the northern Myponga Basin where the Tertiary limestone is absent. Although yields are generally low, the quality is very good, mostly below 500 mg/L. The Tertiary limestone is the most productive aquifer with high yields of up to 60 L/s and salinities generally below 1000 mg/L (Fig. 4). Groundwater movement is from the Permian sand recharge areas in the southern and eastern parts of the catchment where the salinities are lowest (below 500 mg/L), toward the Myponga Reservoir in the north-west of the catchment.

Groundwater salinities are also low in the Hindmarsh Tiers Basin, being mostly below 1000 mg/L (Fig. 4). Yields of up to 55 L/s can be obtained from wells completed into the Tertiary limestone aquifer. Groundwater flows from the Permian sand recharge areas in the west of the catchment, toward the east where it discharges from the aquifer system by evapotranspiration and baseflow into the Hindmarsh River. Groundwater flow out of the area through the basement fractured rock aquifer is likely to be small due to their low permeability. Aquifer tests performed on the Tertiary limestone aquifer found high values of hydraulic conductivity suggesting flow through the aquifer in the Hindmarsh Tiers Bain may be controlled by solution cavities.

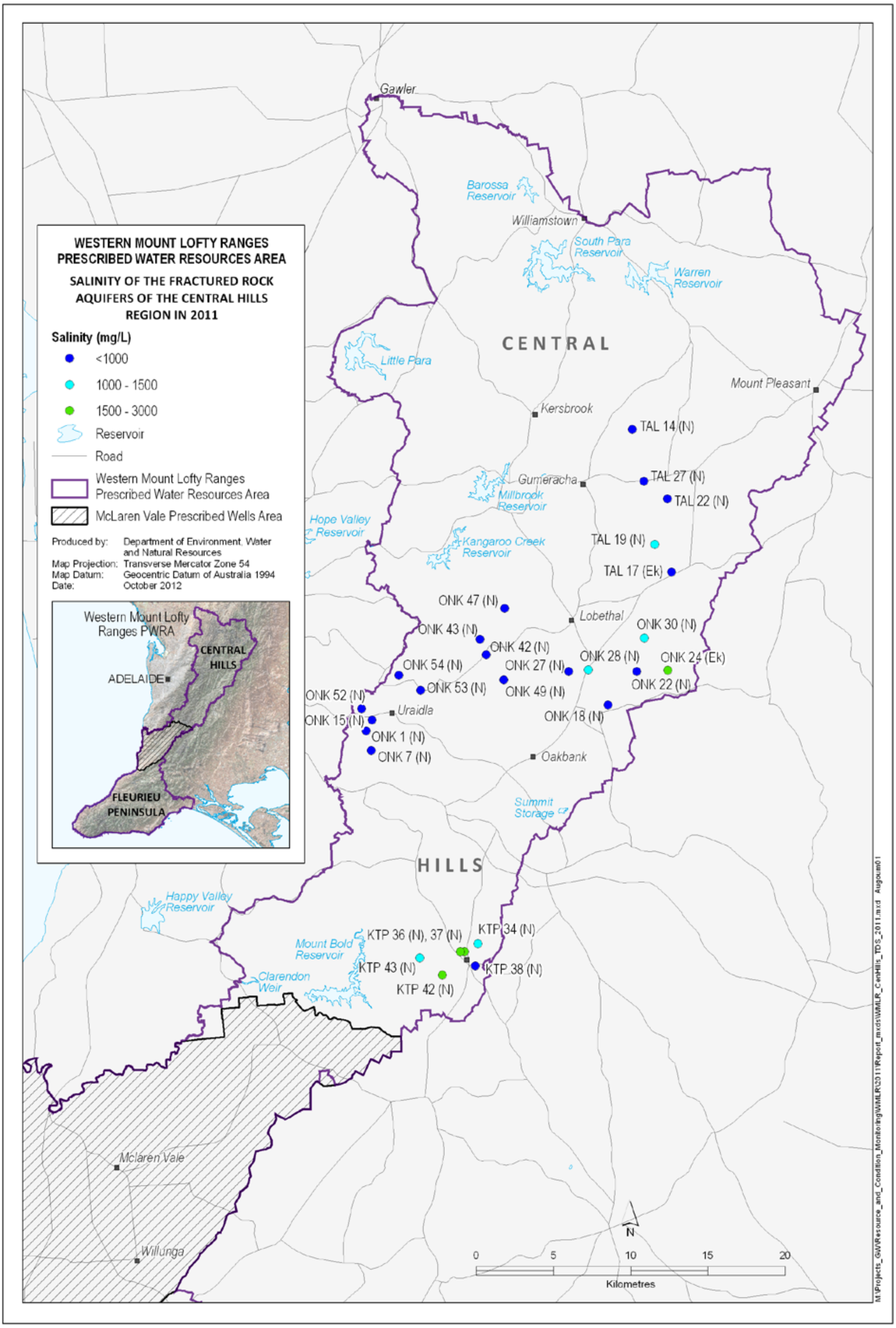

Figure 3. 2011 salinity distribution of the fractured rock aquifers in the Central Hills region of the Western Mount Lofty Ranges Prescribed Water Resources Area

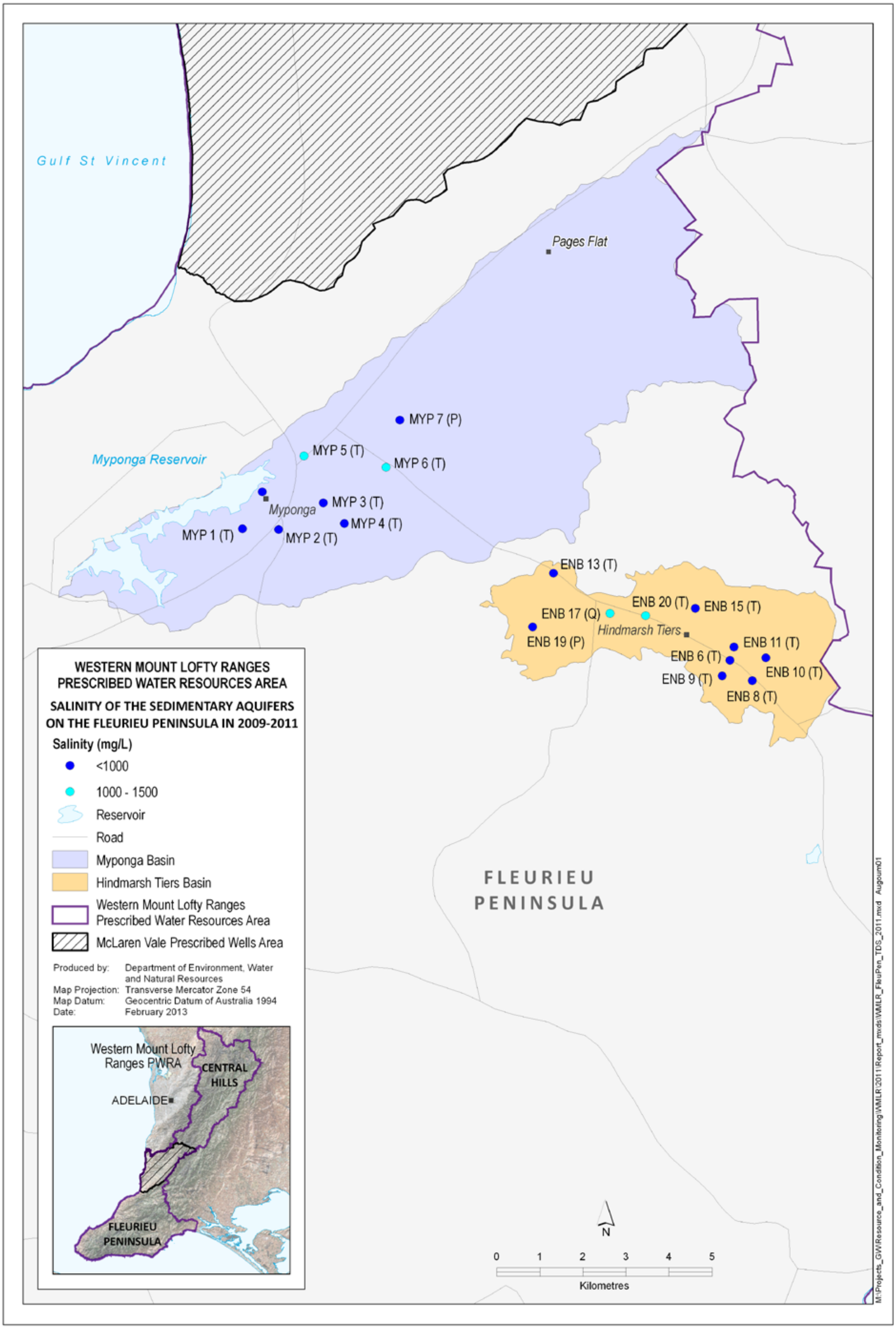

Figure 4. 2009–2011 salinity distribution of the sedimentary aquifers on the Fleurieu Peninsula of the Western Mount Lofty Ranges Prescribed Water Resources Area

GROUNDWATER-DEPENDENT ECOSYSTEMS

Whilst groundwater-dependent ecosystems (GDEs) have not been considered in the assessment of the annual status of the groundwater resources, it is important to note the presence and ecological characteristics of the GDEs found in the Western Mount Lofty Ranges PWRA. Groundwater-dependent ecosystems can be defined as ecosystems where groundwater provides all or part of the water quantity, chemistry or temperature requirements, either permanently, seasonally or intermittently. It is generally considered that shallow water tables less than 10 m below the surface are more likely to support GDEs than deeper water tables. Shallow water tables are more susceptible to changes in groundwater levels, which can affect the connectivity to GDEs and the ecological value of sites. The exception to this is stygofauna (animals that inhabit water-filled cracks and pools below the ground), which can be found at greater depths.

There is strong connectivity between surface water and groundwater resources in the catchments of the Western Mount Lofty Ranges (WMLR). The contribution of groundwater to surface ecosystems prolongs the existence of aquatic habitats that act as important refugia for aquatic biota during dry periods. These persistent aquatic habitats exist across the WMLR (Fig. 5) and include baseflow, in-stream pools, wetlands and terrestrial vegetation (phreatophytes), which support diverse populations of aquatic plants, aquatic macroinvertebrates and fish.

Many wetlands have been mapped across the WMLR, with the majority found on the Fleurieu Peninsula. A portion of these wetlands that typically exist lower in the catchment have water requirements that are at least partially met through groundwater discharge from either fractured rock (largely Kanmantoo Group) or sedimentary (Permian sand) aquifers. These wetlands are known to support a wide diversity of plants and animals, many of which have conservation status at the state and national scale.

Swamps of the Fleurieu Peninsula are a subset of wetland that are recognised as a critically endangered ecological community and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

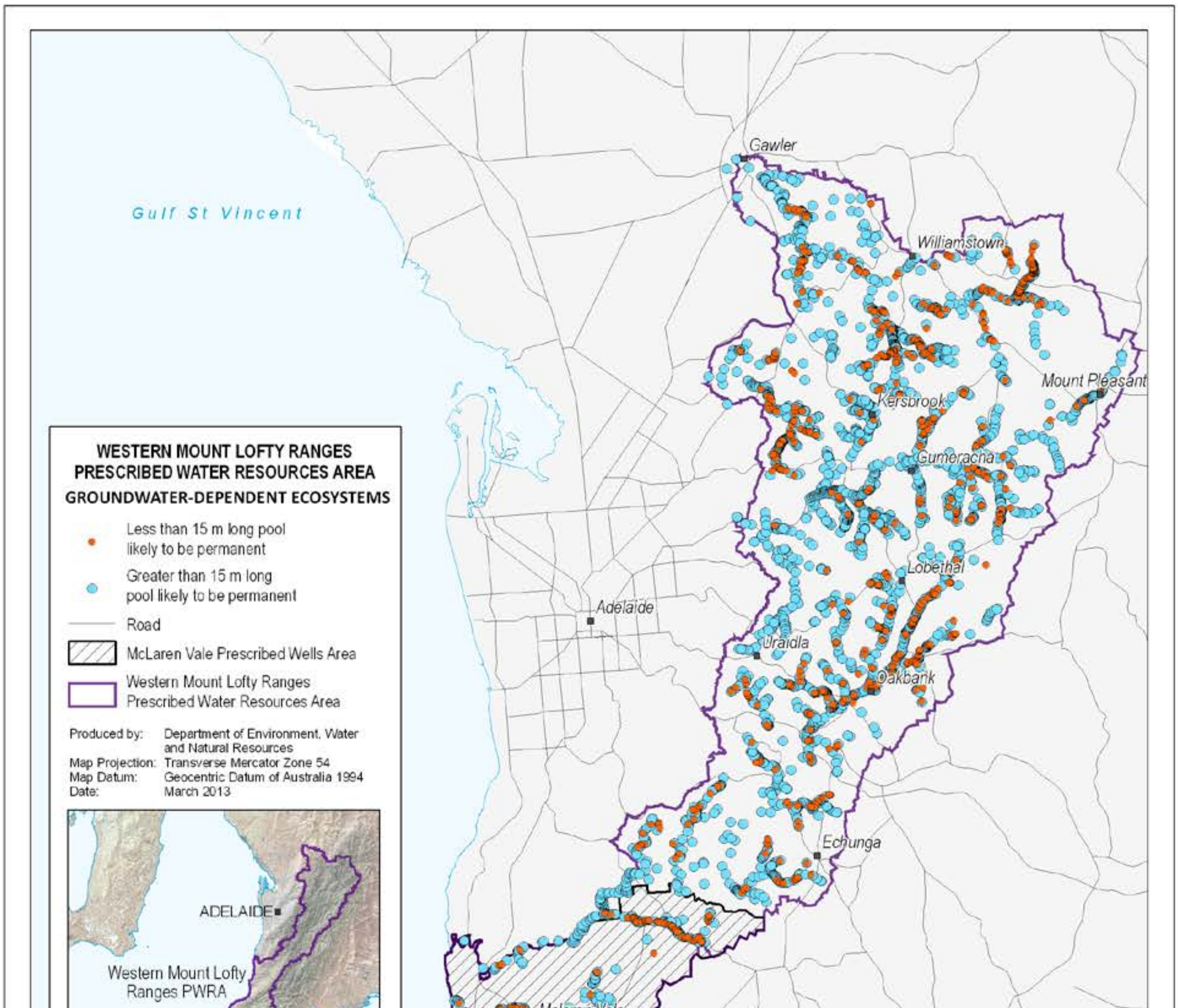

Figure 5. Groundwater-dependent ecosystems of the Western Mount Lofty Ranges Prescribed Water Resources Area

RAINFALL

In the Central Hills, the average annual rainfall ranges from less than 500 mm at Gawler in the north, around 800 mm at Gumeracha, to more than 1000 mm at Uraidla (Fig. 6). On the Fleurieu Peninsula, the average annual rainfall ranges from around 500 mm at Normanville and Middleton, up to more than 800 mm at Hindmarsh Tiers and nearly 950 mm at Parawa (Fig. 6).

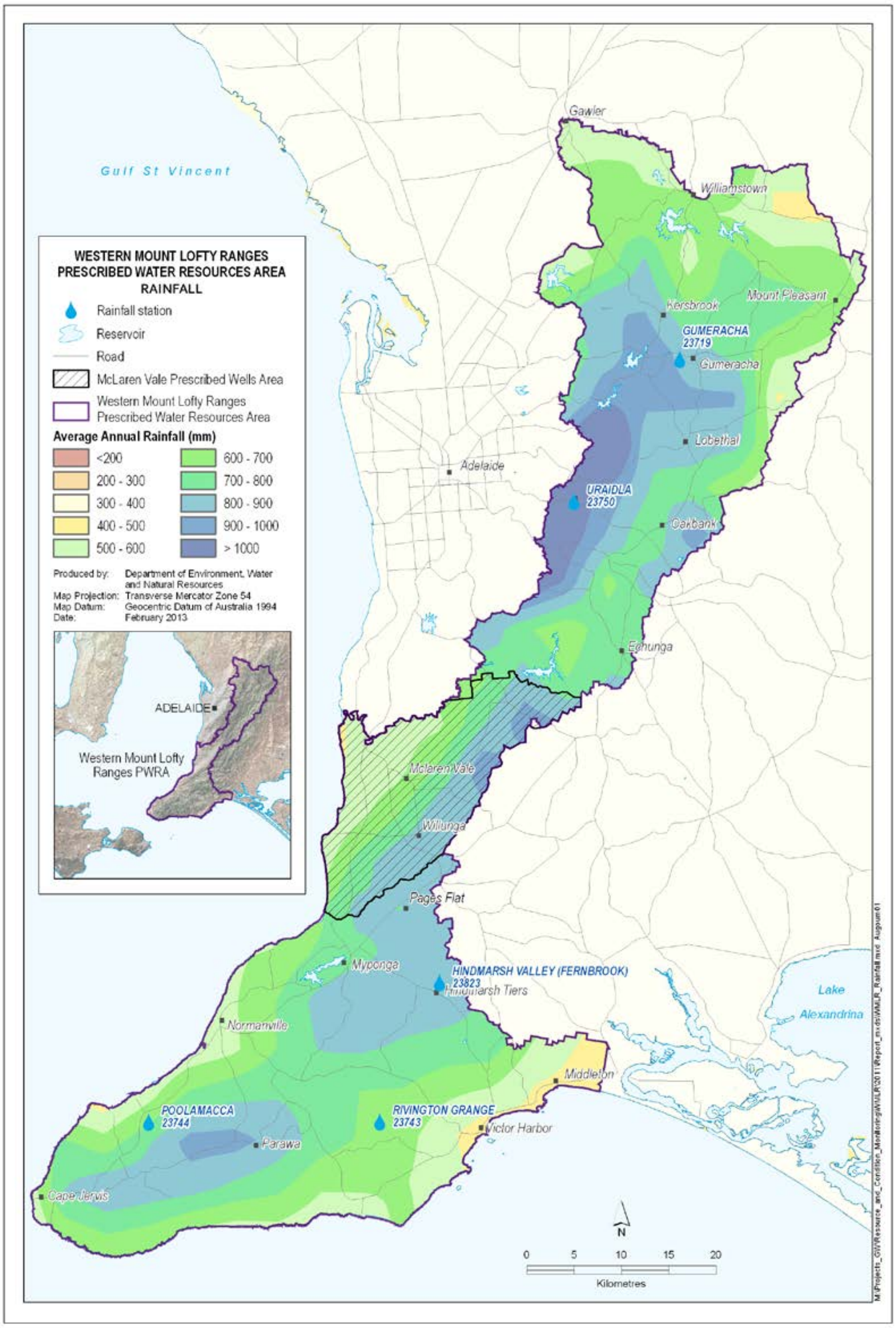

Figure 6. Average rainfall of the Western Mount Lofty Ranges Prescribed Water Resources Area

Five rainfall stations, Gumeracha, Uraidla, Hindmarsh Valley, Rivington Grange and Poolamacca (Fig. 6), were chosen to examine rainfall trends, with their average annual rainfall over the last 40 years plotted along with the cumulative deviation (Figs. 7–11). The cumulative deviation calculates the difference between the actual measured annual rainfall and the long-term average annual rainfall. An upward trend in the cumulative deviation indicates periods where the rainfall was above average and conversely, a downward trend indicates periods of below-average rainfall.

Gumeracha displays an overall long-term trend of below-average rainfall, although there are a number of years that received above-average rainfall in this period, particularly 1981 and 1992 (Fig. 7). At Uraidla the dominant long-term trend is similarly below average, with 1992 a particularly wet year also (Fig. 8). The Hindmarsh Valley rainfall record reveals a predominantly above-average trend until 2001, after which the trend reverses with only three of the next ten years recording above-average rainfall and even then, only slightly above the average (Fig. 9) At Rivington Grange, the rainfall is quite variable between 1971 and 1983 although the majority of years received above-average rainfall. The years 1984 to 1991 were average to slightly below average and were followed by the high-rainfall year of 1992, after which the trend is predominantly of below-average rainfall (Fig. 10). Neither trend dominates at Poolamacca from 1971 to 1981 but the next decade displays a dominant below-average trend in rainfall (Fig. 11). Unlike the other stations, 1992 was not a particularly wet year, though it does lead into a decade of overall above-average rainfall. The following decade is quite stable. In 2011, Gumeracha, Uraidla, Hindmarsh Valley and Rivington Grange received below-average rainfall, while Poolamacca received slightly above-average rainfall.

It is worth noting an incidence of wetter conditions in South Australia in the 2009 to 2011 period. The state experienced its third wettest summer on record in 2010–11, with many individual locations in the Mount Lofty Ranges and Fleurieu Peninsula setting summer and daily rainfall records. High summer rainfall is particularly relevant as it may lead to significantly reduced demand from groundwater users and thus lower drawdown of the aquifer over the dry months of the year.

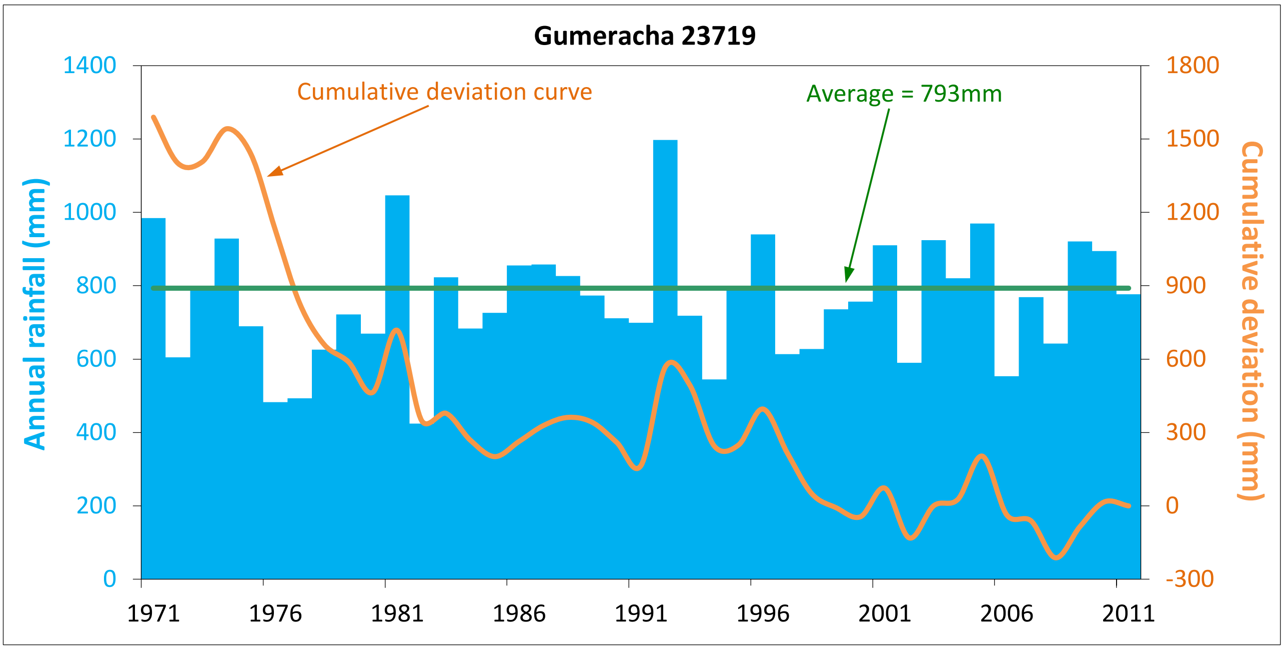

Figure 7. Annual rainfall and the cumulative deviation from average annual rainfall for the Gumeracha rainfall station (number 23719)

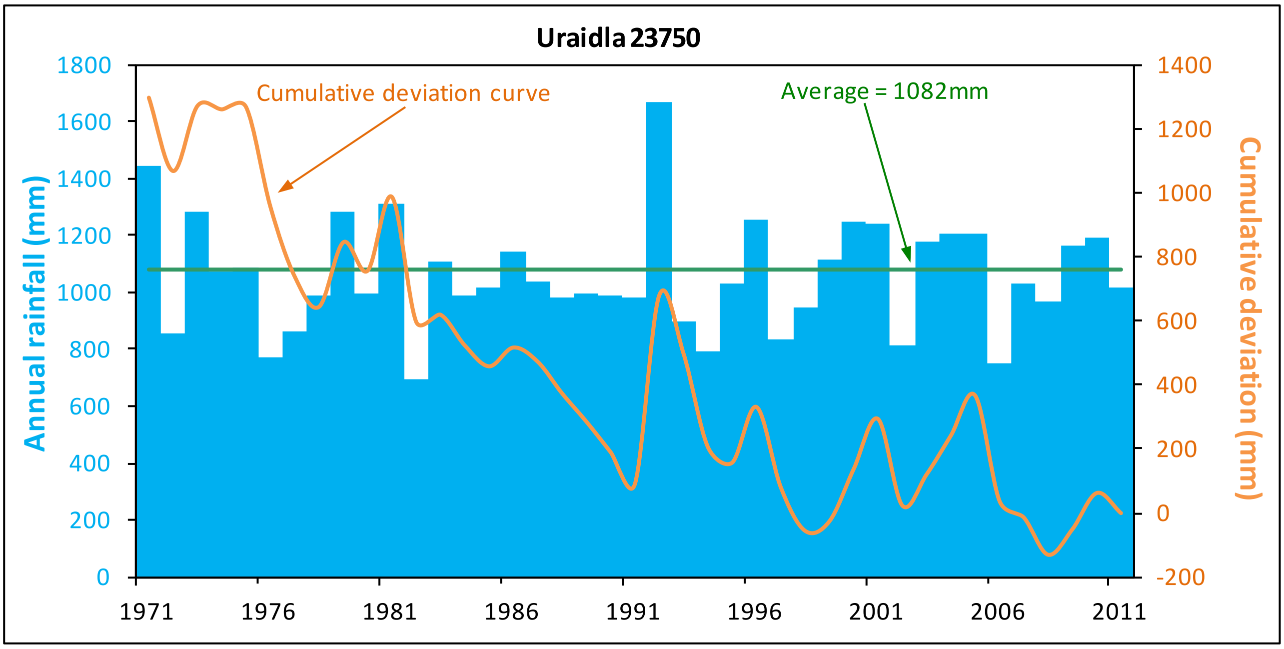

Figure 8. Annual rainfall and the cumulative deviation from average annual rainfall for the Uraidla rainfall station (number 23750)

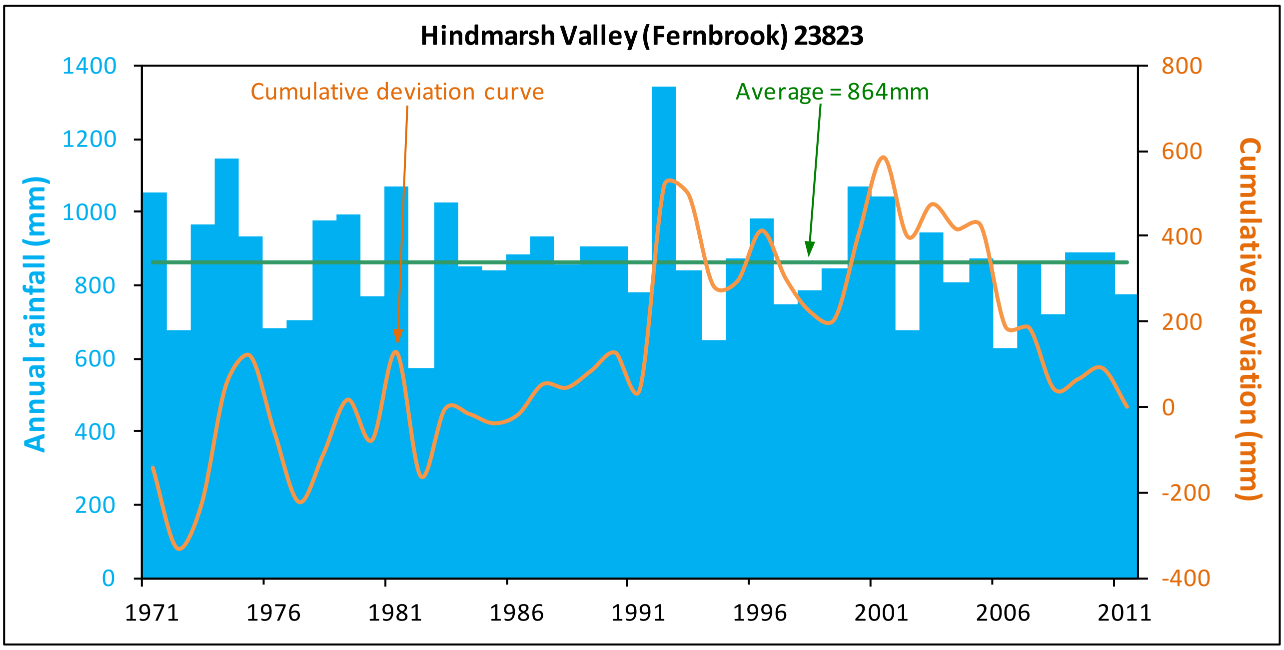

Figure 9. Annual rainfall and the cumulative deviation from average annual rainfall for the Hindmarsh Valley rainfall station (number 23823)

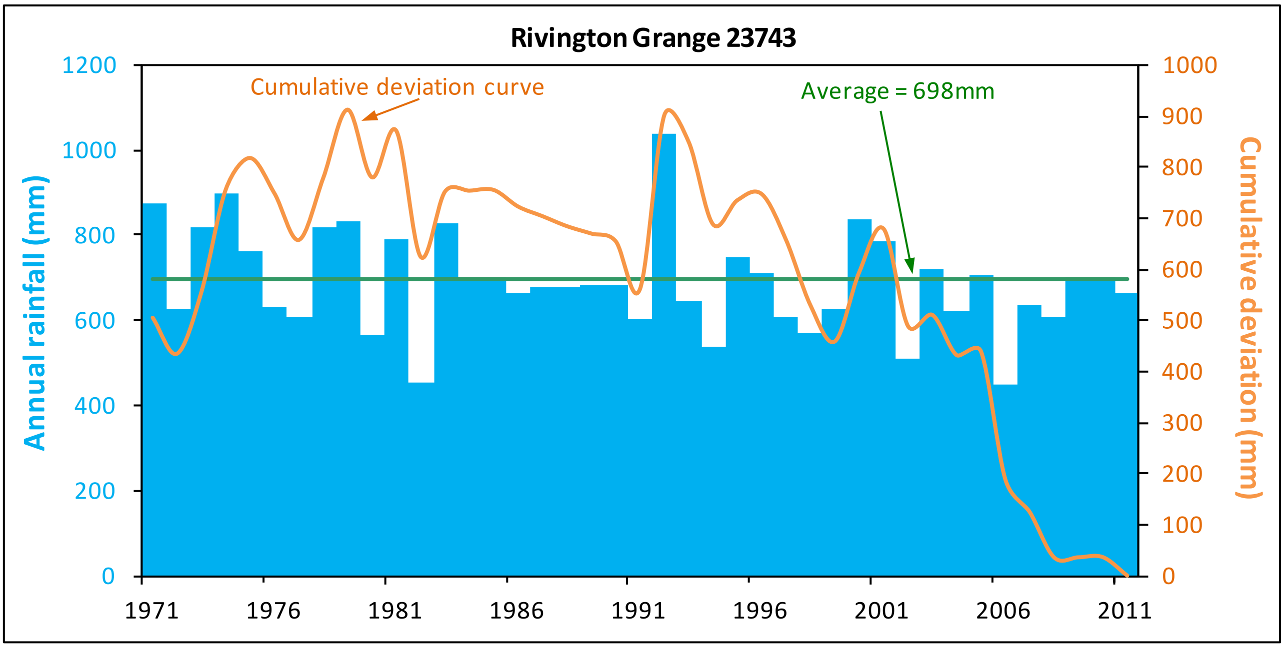

Figure 10. Annual rainfall and the cumulative deviation from average annual rainfall for the Rivington Grange rainfall station (number 23743)

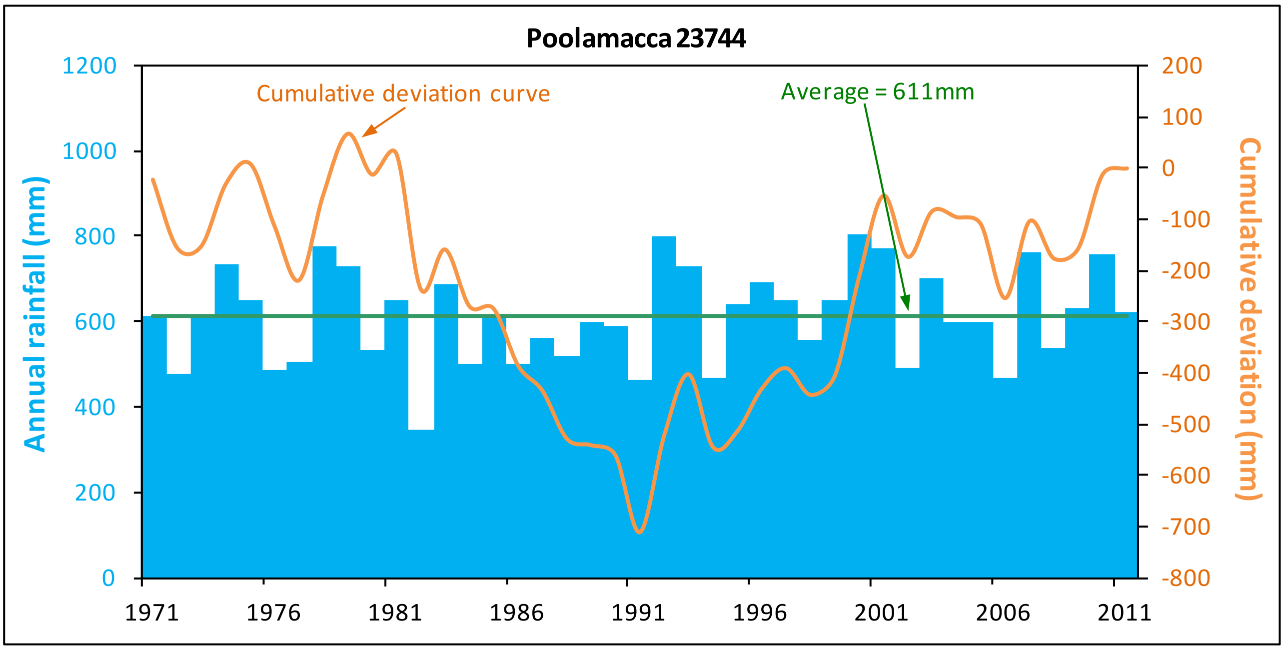

Figure 11. Annual rainfall and the cumulative deviation from average annual rainfall for the Poolamacca rainfall station (number 23744)

GROUNDWATER OBSERVATION NETWORKS

WATER LEVEL NETWORK

There are a number of water level observation networks within the WMLR PWRA (Table 1). The Central Hills (Fig. 12) contains the Charleston, Cock Creek, Inverbrackie, Echunga, Piccadilly Valley and Torrens River networks. Seven of the 16 wells in the One Tree Hill network are located in the north-west of the WMLR PWRA, with the remaining wells in the adjacent Central Adelaide PWA (Fig. 13). The MLR groundwater recharge investigation network includes 41 wells within the WMLR PWRA, as well as eight wells in the Eastern MLR PWRA and four wells in the Marne–Saunders PWRA. The Myponga and Hindmarsh Tiers networks are located on the Fleurieu Peninsula (Fig. 14).

Table 1. Groundwater level observation networks of the Western Mount Lofty Ranges Prescribed Water Resources Area

Monitoring network	Aquifer	Number of wells	Monitoring frequency
Charleston	Adelaidean sediments	11	Three-monthly
Cock Creek	Adelaidean sediments	12	Three-monthly
Echunga	Adelaidean sediments	9	Three-monthly
Inverbrackie	Adelaidean sediments Kanmantoo Group	9 1	Three-monthly
Piccadilly Valley	Adelaidean sediments	12	Six-monthly
Torrens River	Adelaidean sediments Kanmantoo Group Quaternary sediments	2 9 2	Three-monthly
One Tree Hill	Adelaidean sediments	16	Six-monthly
MLR GW recharge investigation sites	Adelaidean sediments Kanmantoo Group Unknown	32 4 17	Three-monthly
Hindmarsh Tiers	Kanmantoo Group Kanmantoo Group + Tertiary limestone Permian sand Permian sand + Tertiary limestone Tertiary limestone Quaternary sediments	1 1 2 1 9 2	Six-monthly
Myponga	Permian sand Tertiary limestone Quaternary sediments	8 9 1	Six-monthly

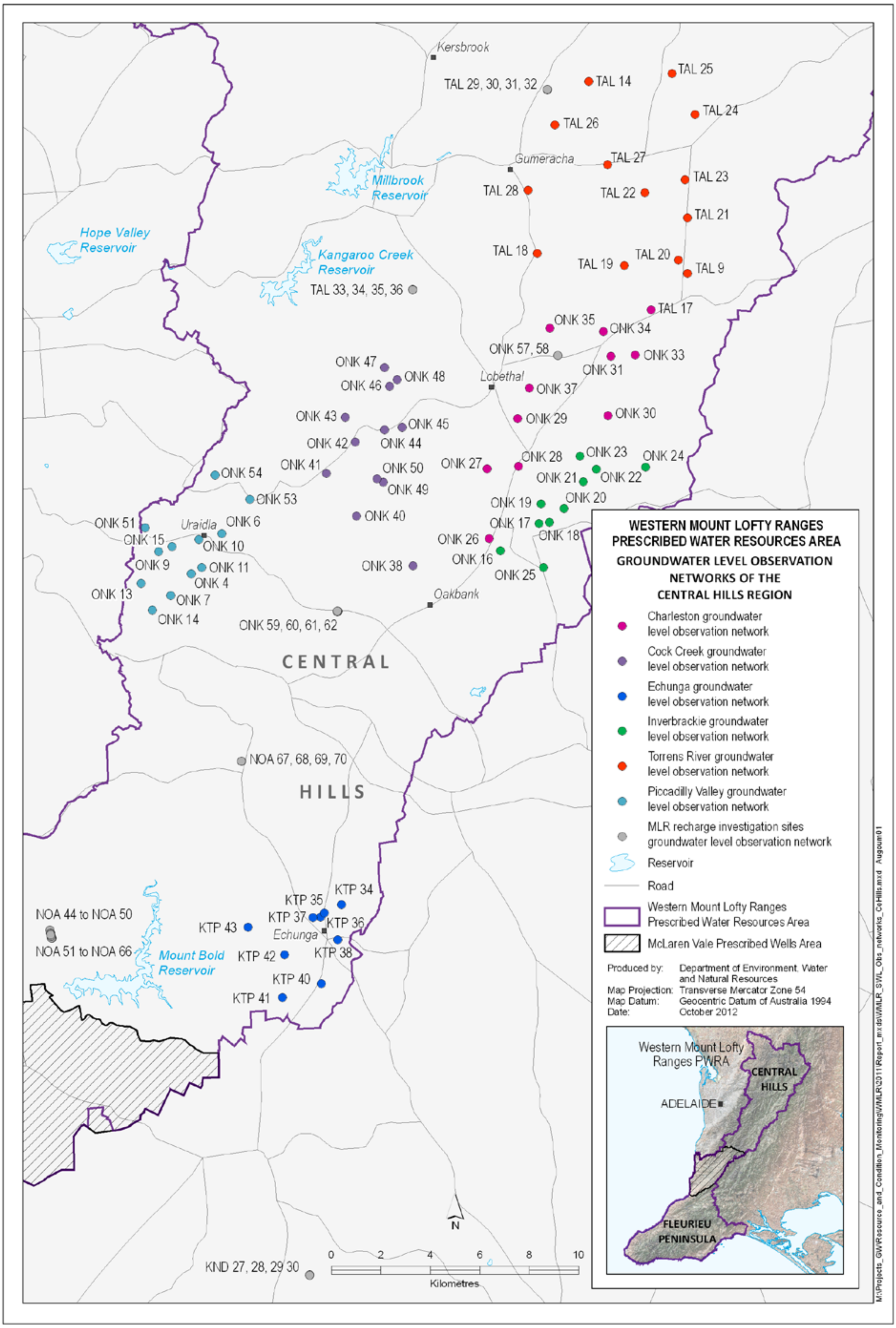

Figure 12. Location of groundwater level observation wells in the Central Hills region of the Western Mount Lofty Ranges Prescribed Water Resources Area

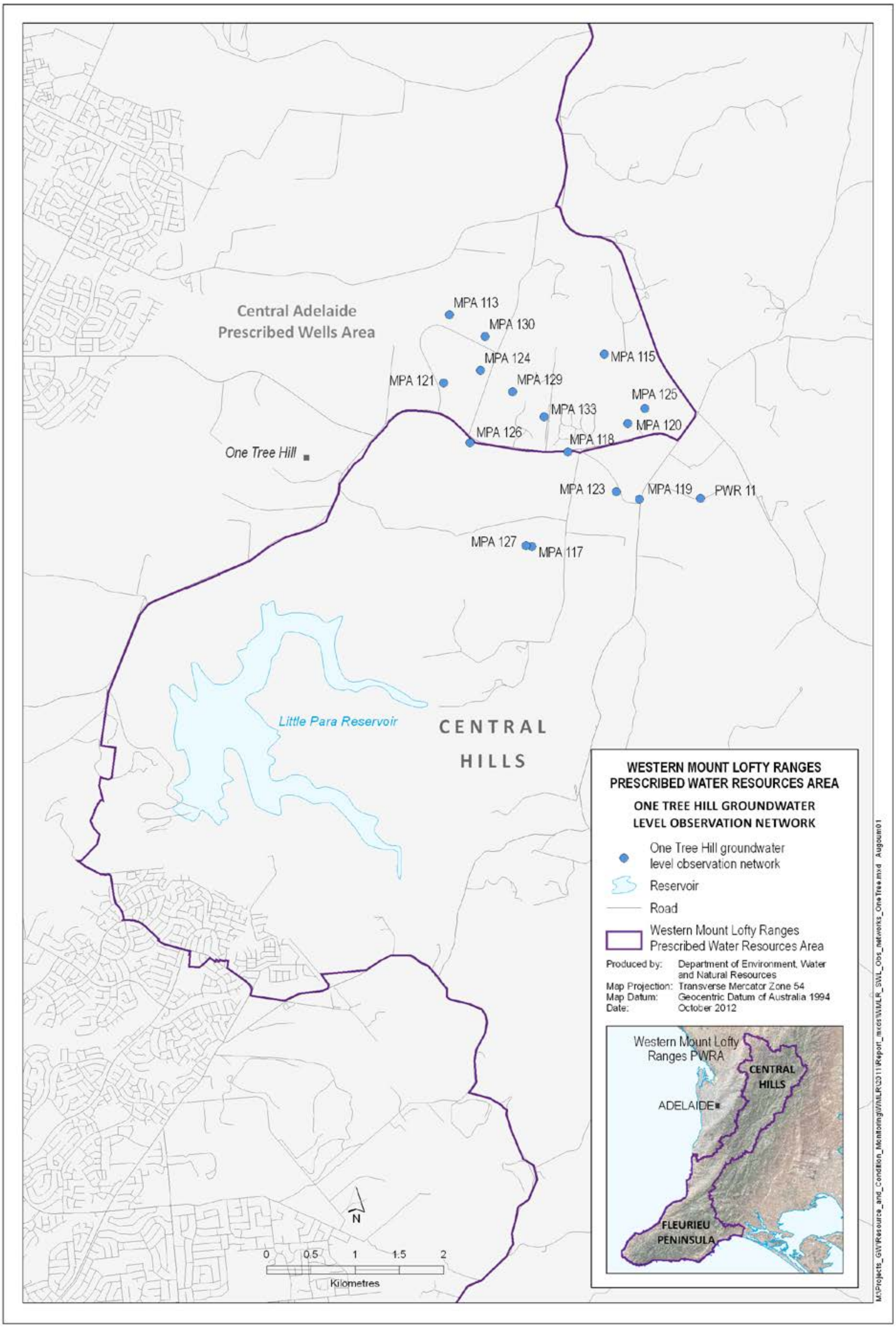

Figure 13. Location of the One Tree Hill groundwater level observation network in the Central Hills region of the Western Mount Lofty Ranges Prescribed Water Resources Area

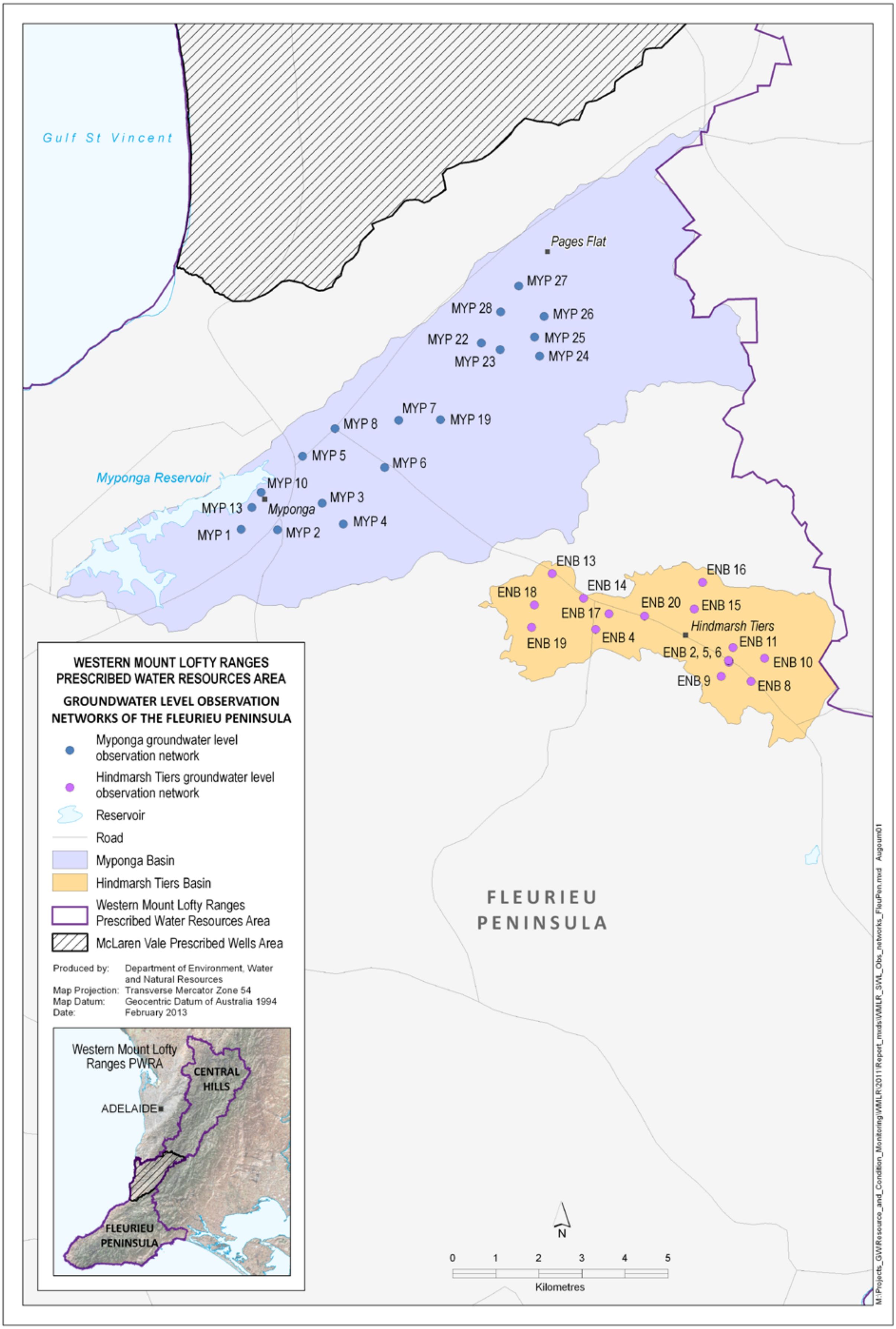

Figure 14. Location of groundwater level observation wells on the Fleurieu Peninsula of the Western Mount Lofty Ranges Prescribed Water Resources Area

SALINITY NETWORK

There are a number of salinity observation networks within the WMLR (Table 2). The Central Hills (Fig. 15) contains the Charleston, Cock Creek, Echunga, Inverbrackie, Piccadilly Valley and Torrens River networks. The Myponga and Hindmarsh Tiers networks are located on the Fleurieu Peninsula (Fig. 16).

Table 2. Groundwater salinity observation networks of the Western Mount Lofty Ranges Prescribed Water Resources Area

Monitoring network	Aquifer	Number of wells	Monitoring frequency
Charleston	Adelaidean sediments	6	Yearly
Cock Creek	Adelaidean sediments	9	Yearly
Echunga	Adelaidean sediments	8	Yearly
Inverbrackie	Adelaidean sediments Kanmantoo Group	5 1	Yearly
Piccadilly Valley	Adelaidean sediments	8	Yearly
Torrens River	Adelaidean sediments Kanmantoo Group Quaternary sediments	7 1 2	Yearly
Hindmarsh Tiers	Kanmantoo Group Kanmantoo Group + Tertiary limestone Permian sand Permian sand + Tertiary limestone Tertiary limestone Quaternary sediments	1 1 1 1 8 1	Yearly
Myponga	Permian sand Tertiary limestone	1 7	Yearly

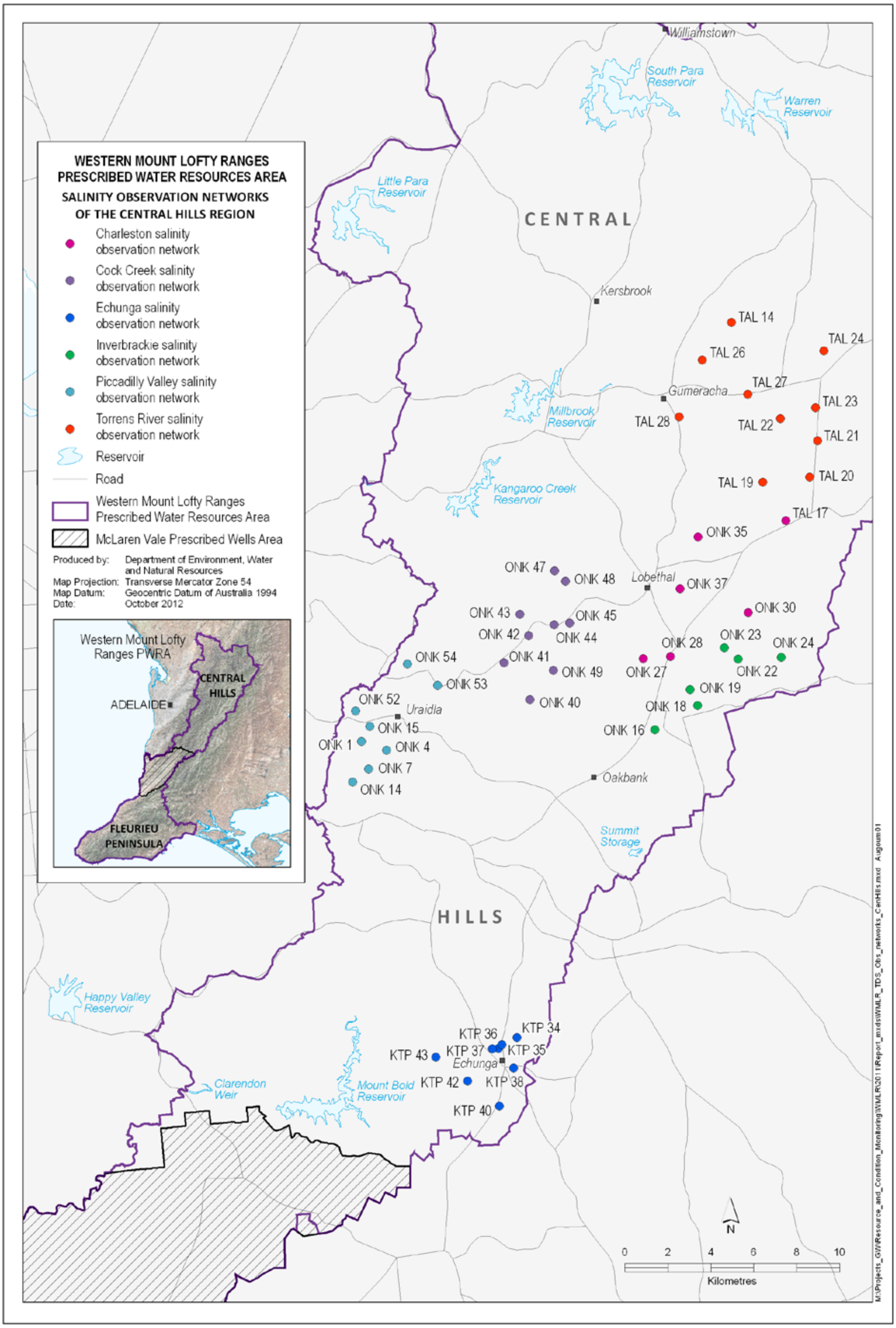

Figure 15. Location of groundwater salinity observation wells in the Central Hills region of the Western Mount Lofty Ranges Prescribed Water Resources Area

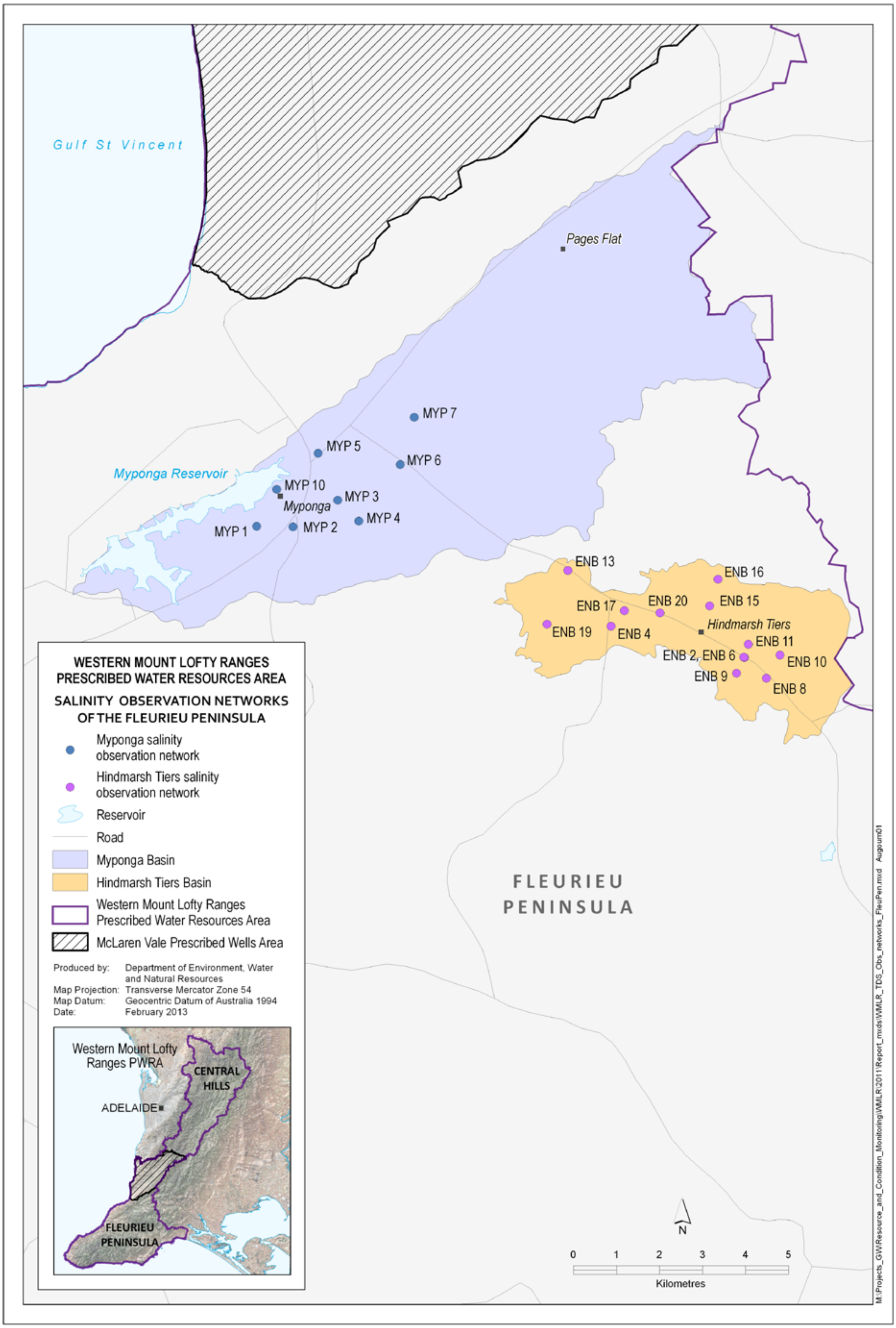

Figure 16. Location of groundwater salinity observation wells on the Fleurieu Peninsula of the Western Mount Lofty Ranges Prescribed Water Resources Area

GROUNDWATER LEVEL TRENDS

Adelaidean Fractured Rock

Groundwater levels in the Adelaidean fractured rock aquifers of the Central Hills region monitored by the One Tree Hill observation network reveal a good correlation between groundwater levels and rainfall (Fig. 17). Recently, below-average rainfall and a decline groundwater levels from 2006 was followed by above-average rainfall and a recovery of groundwater levels in 2009 and 2010. In 2011, groundwater levels have continued to rise and are likely attributed to the unusually wet summer of 2010–11.

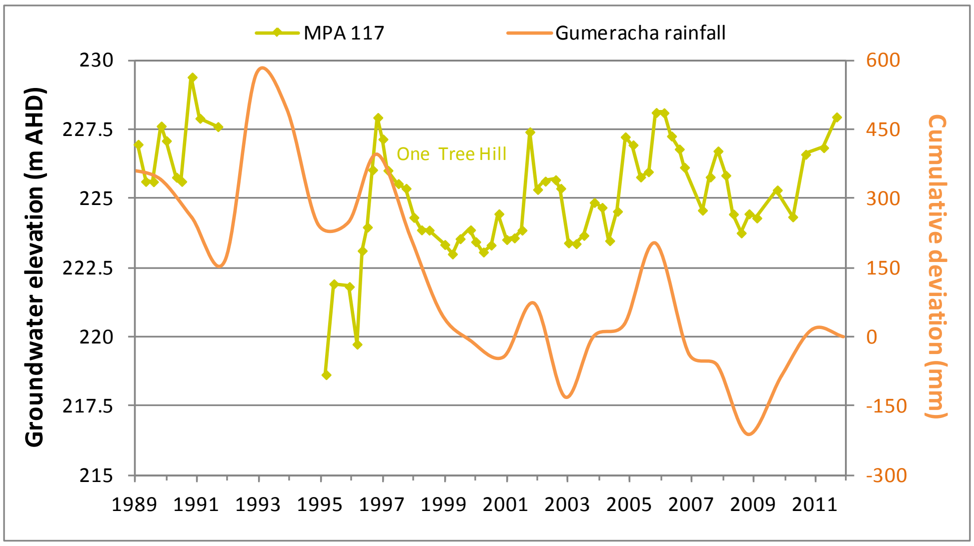

Figure 17. Groundwater level trends within Adelaidean fractured rock aquifers, One Tree Hill observation network, Central Hills region, Western Mount Lofty Ranges Prescribed Water Resources Area

Groundwater levels monitored by the Piccadilly Valley observation network display large seasonal variations and also reveal a good correlation with rainfall (Fig. 18). Similarly, below-average rainfall and a decline groundwater levels from 2006 was followed by above-average rainfall and a recovery of groundwater levels in 2009 and 2010. In 2011, groundwater levels have continued to rise despite the slightly below-average rainfall recorded in 2011 and are likely attributed to the unusually wet summer of 2010–11.

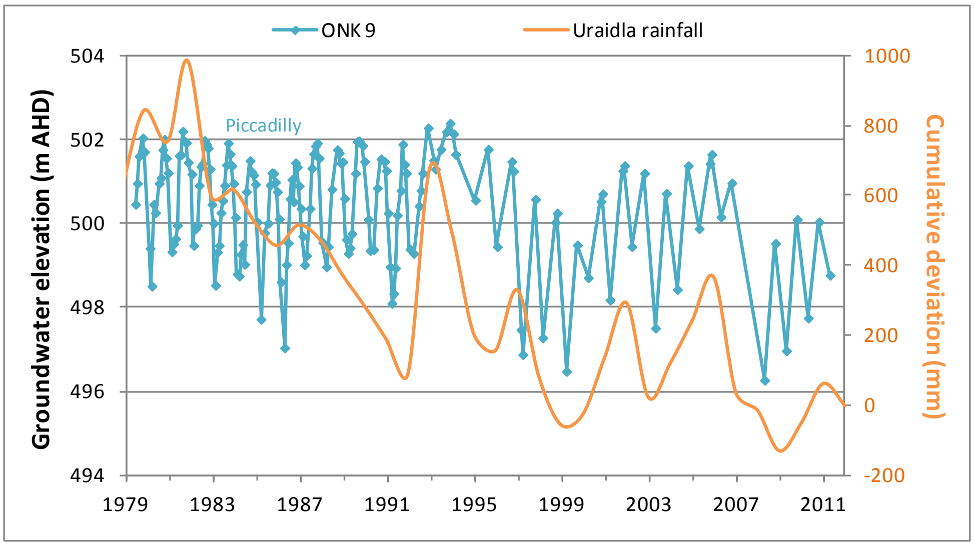

Figure 18. Groundwater level trends within Adelaidean fractured rock aquifers, Piccadilly Valley observation network, Central Hills region, Western Mount Lofty Ranges Prescribed Water Resources Area

In general, groundwater level trends monitored by the Cock Creek, Torrens River, Inverbrackie, Charleston and Echunga observation networks have been relatively stable over the past ten years (e.g. ONK 50 and KTP 34 in Fig. 19). Many wells in these networks also reveal a correlation with above or below-average rainfall trends (e.g. ONK 20 in Fig. 19). Observation well ONK 34 from Charleston reveals a singular trend of continuous rise since mid-2005 (Fig. 19). Since 2009, most observation wells show stabilisation, reduced rate of decline or increase in groundwater levels. In 2011, groundwater levels have continued this trend despite the slightly below-average rainfall recorded in 2011 and are likely attributed to the unusually wet summer of 2010–11.

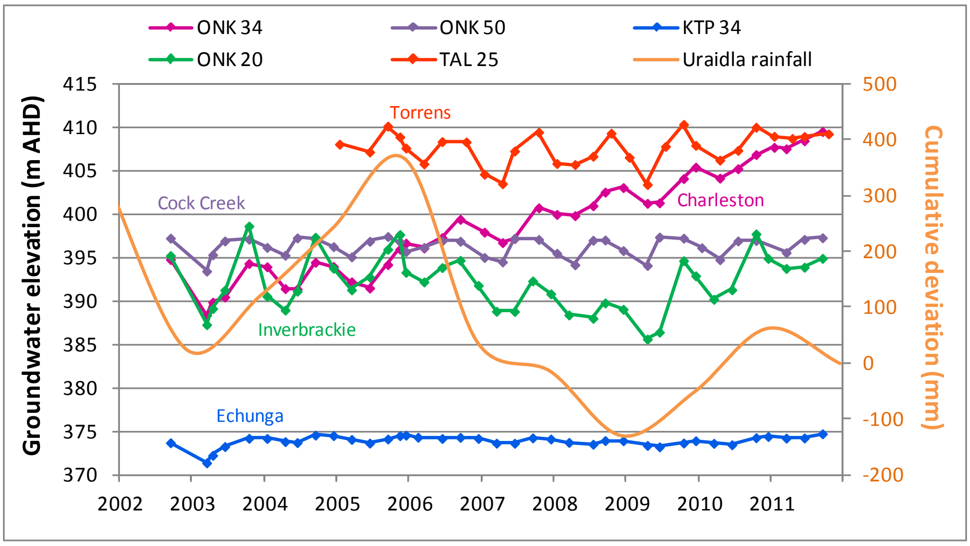

Figure 19. Groundwater level trends within Adelaidean fractured rock aquifers, Central Hills region, Western Mount Lofty Ranges Prescribed Water Resources Area

Groundwater levels in the MLR recharge investigation observation network have generally remained quite stable since monitoring began in 2006. All wells have recorded a rise in the groundwater level of varying degrees in late 2009 and late 2010 which is likely due to the above-average rainfall recorded in these years (Fig. 20). The majority of wells have also recorded a slight rise in groundwater levels in 2011 despite the slightly below-average rainfall recorded in 2011 and are likely attributed to the unusually wet summer of 2010–11. The groundwater level in observation well ONK 57 has risen steadily since early 2010 suggesting that particular geological unit, the Saddleworth Formation, is more responsive to recharge.

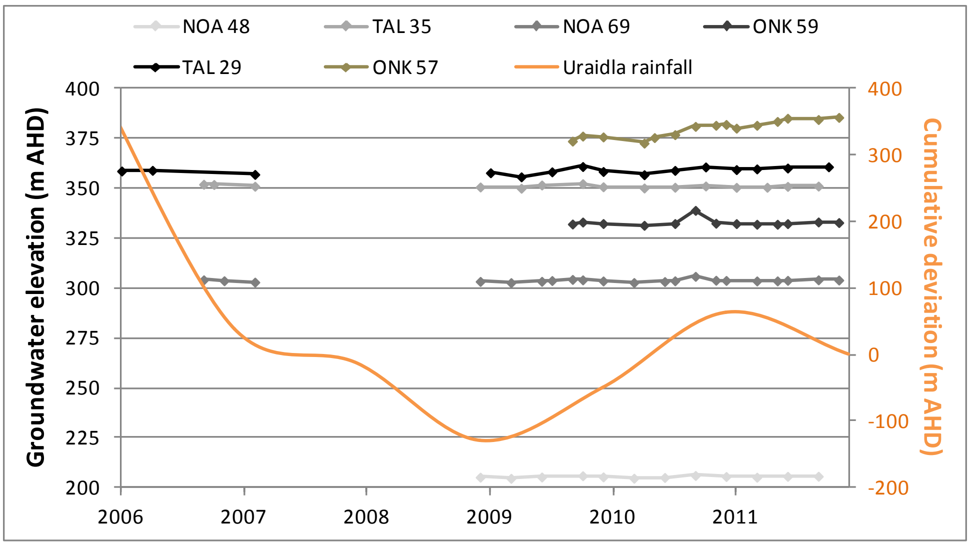

Figure 20. Groundwater level trends within Adelaidean fractured rock aquifers, MLR Recharge Investigation observation network, Central Hills region, Western Mount Lofty Ranges

Permian sand

The Permian sand aquifer displays large seasonal variations in groundwater levels in both the Myponga and Hindmarsh Tiers Basins (Figs. 21 & 22). Groundwater levels in the Myponga Basin were relatively stable between 1975 and 1995. Since 2001, groundwater levels have declined by up to two metres (Fig. 21). This decline since 2001 correlates well with the dominant below-average rainfall trend recorded over this period. This is likely to have reduced recharge to the aquifer and increased demand from groundwater users because of the dry conditions.

In 2011, four of the observation wells monitoring the Permian sand aquifer of the Myponga Basin recorded an increase in the maximum recovered groundwater level of up to 0.3 m when compared to the same time the previous year; two observation wells recorded a decline of up to 0.2 m and one observation well recorded no change. The overall increase in the groundwater level may be attributed to the unusually wet summer of 2010–11 reducing demand from groundwater users.

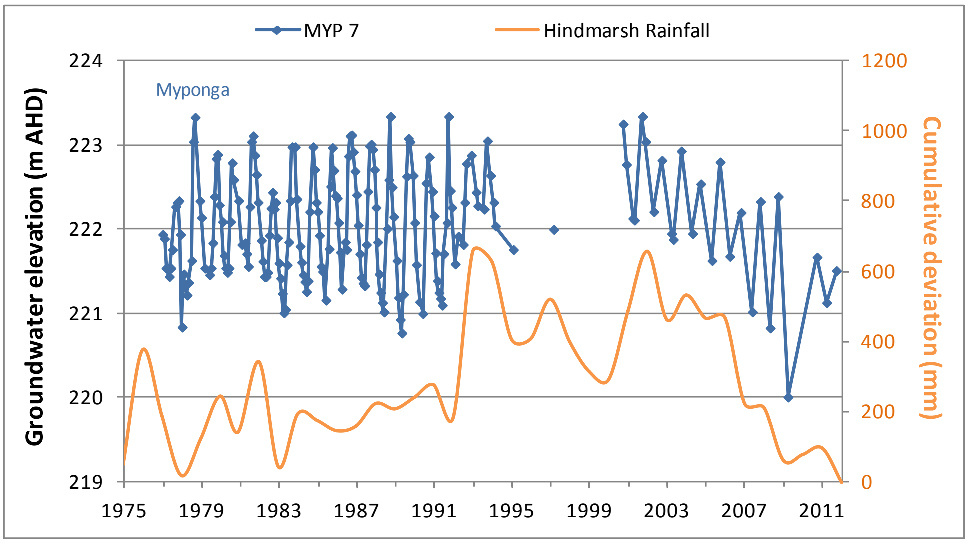

Figure 21. Groundwater level trends of the Permian sand aquifer within the Myponga Basin on the Fleurieu Peninsula, Western Mount Lofty Ranges Prescribed Water Resources Area

In the Hindmarsh Tiers Basin, groundwater levels rose slightly between 1983 and 1993. Between 1993 and 1999, there is a gap in the data but levels declined by around two metres in this time. Levels were relatively stable between 1999 and 2004, after which they have declined slightly, with a small recovery from 2009 to 2011. These trends in the groundwater level are similar to the trends in rainfall recorded over the same period and may be attributed to the aquifer receiving recharge where the overlying Tertiary and Quaternary sediments are absent and fluctuations in demand.

In September 2011, the two observation wells monitoring the Permian sand aquifer of the Hindmarsh Tiers Basin recorded an increase of 0.05 m and a decline of 0.03 m in the maximum recovered groundwater level when compared to the same time the previous year.

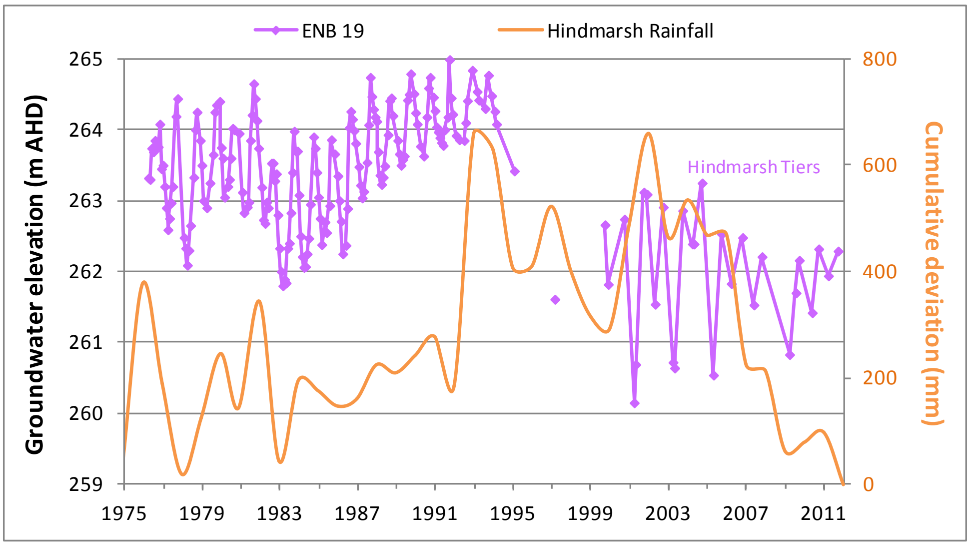

Figure 22. Groundwater level trends of the Permian sand aquifer within the Hindmarsh Tiers Basin on the Fleurieu Peninsula, Western Mount Lofty Ranges Prescribed Water Resources Area

Tertiary limestone

Groundwater levels in the Tertiary limestone within the Myponga and Hindmarsh Tiers Basins also display large seasonal variations due to groundwater extractions from the aquifer (Fig. 23).

In the Hindmarsh Tiers Basin, the maximum recovered groundwater level has declined steadily in seven out of nine observation wells since 1975 and in all nine wells since 2001. However, from 2009 to 2011, the same seven wells have recorded an increase in the maximum recovered groundwater level. In 2011, the increase was around 2 m; the other two observation wells recorded a decline of up to 0.5 m. The increase in groundwater levels may be attributed to the wetter conditions in the 2009 to 2011 period, particularly the unusually wet summer of 2010–11. As mentioned previously, high summer rainfall may lead to significantly reduced demand from groundwater users and thus lower drawdown of the aquifer over the dry months of the year. While fluctuations in the groundwater level show a correlation with trends in rainfall, the overall long-term decline in levels suggest another driver, most likely extraction, is also affecting levels in the basin.

Groundwater levels in the Myponga Basin have remained stable since monitoring began in 1975, with a period of lower-than-average levels between 2005 and 2009. There has also been some recovery in groundwater levels since 2009. However, in 2011, seven of the nine observation wells monitoring the Tertiary limestone aquifer of the Myponga Basin recorded a decline in the maximum recovered groundwater level of up to 0.2 m in September 2011 when compared to the same time the previous year; the other two observation wells recorded an increase of up to 0.06 m. Although the decline in levels recorded in 2011 are relatively small, they have occurred in unusually wet conditions which may indicate extraction from the aquifer is the possible cause of the decline.

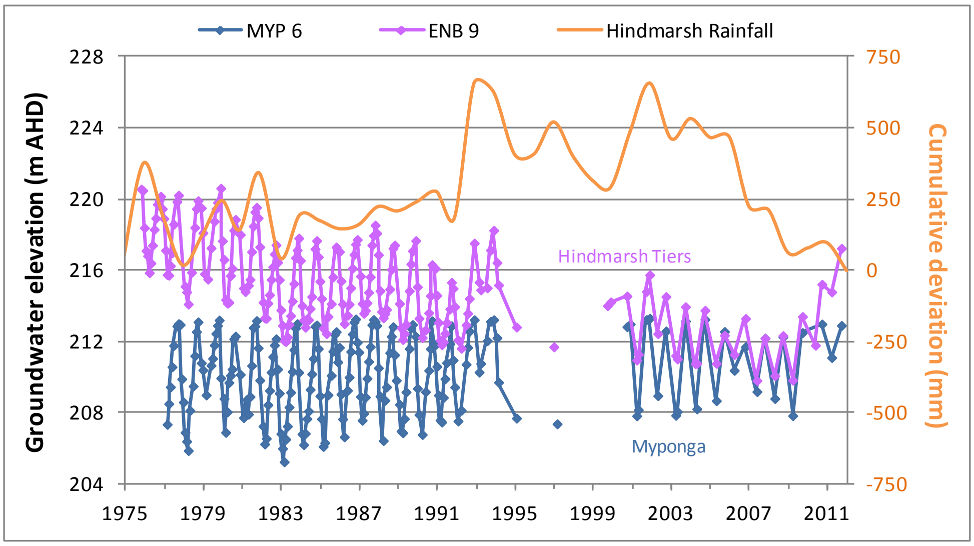

Figure 23. Groundwater level trends of the Tertiary limestone aquifers within the Myponga and Hindmarsh Tiers Basins on the Fleurieu Peninsula, Western Mount Lofty Ranges Prescribed Water Resources Area

GROUNDWATER SALINITY TRENDS

Adelaidean Fractured Rock

Between 1978 and 1998, groundwater salinities in the Adelaidean fractured rock aquifer monitored by the Piccadilly observation network have been relatively stable (Fig. 24). The next reading taken in 2005 recorded a drop in salinity in two out of three observation wells. Since 2005, all wells bar one have recorded a slight rise in salinity in 2006 and 2009. All observation wells recorded a decrease in salinity in 2011.

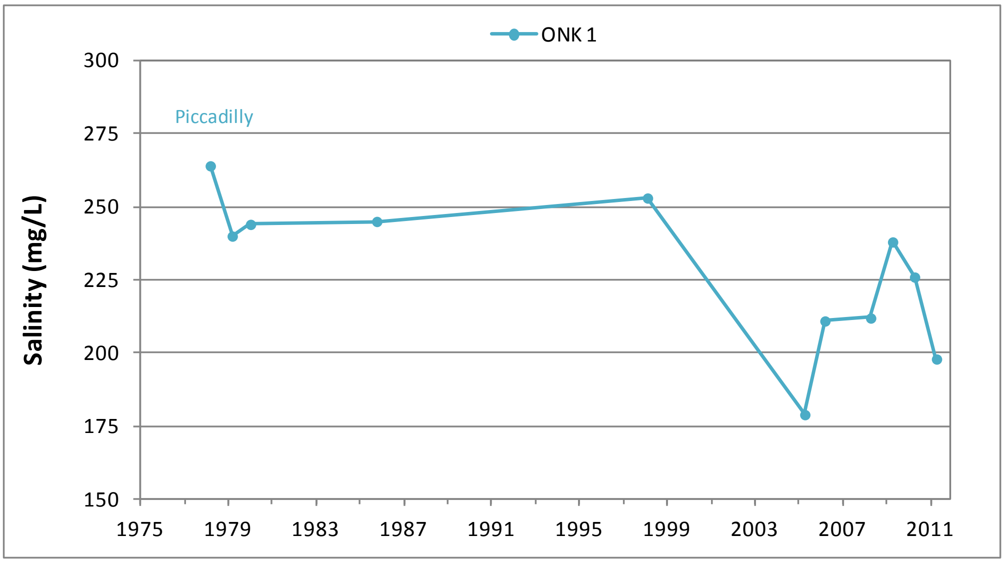

Figure 24. Salinity trends within Adelaidean fractured rock aquifers, Piccadilly Valley observation network of the Central Hills region, Western Mount Lofty Ranges Prescribed Water Resources Area

Groundwater salinities within the Adelaidean fractured rock aquifers of the Central Hills region have been quite stable over the last ten years (Fig. 25). At Charleston, groundwater salinity rose slightly between 2004 and 2005/2006, but returned to 2003 levels in 2007 before increasing slightly in 2008. At Cock Creek, a slight rise in groundwater salinity was recorded before a drop in 2008 followed by another rise in 2009. Salinity at Echunga has been varied with most wells' salinity quite stable but a couple of wells displaying an overall increase in salinity. Salinity at Inverbrackie has been quite stable with only minor variations including very small increases in 2011. Salinity at Torrens River has risen slightly since 2006 with a peak in 2009. In 2011, with the exception of Inverbrackie, all monitoring networks recorded lower salinities than those recorded in 2010.

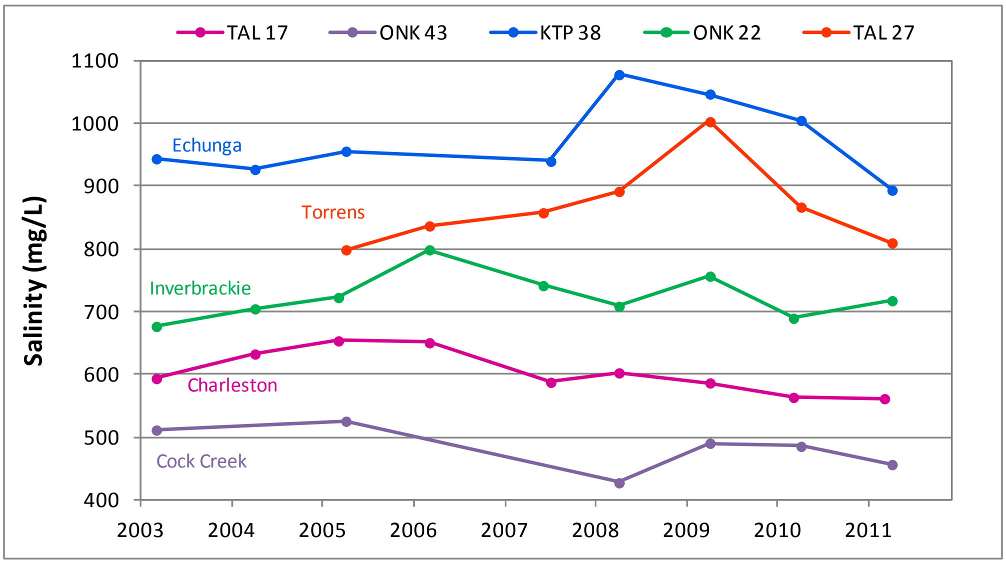

Figure 25. Salinity trends within Adelaidean fractured rock aquifers as monitored by the Cock Creek, Torrens River, Inverbrackie, Charleston and Echunga observation networks of the Central Hills region in the Western Mount Lofty Ranges Prescribed Water Resources Area

Permian sand

In the Myponga Basin, the Permian sand aquifer is used for irrigation purposes where the Tertiary limestone is absent around the basin margin and to the north-east toward Pages Flat. However, most of the groundwater in the Myponga and Hindmarsh Tiers Basins is extracted from the Tertiary limestone aquifer. As such, little salinity monitoring of the Permian sand aquifer occurs, although salinity is known to be generally of good quality—typically less than 500 mg/L in the Hindmarsh Tiers Basin and less than 1000 mg/L in the Myponga Basin.

Tertiary limestone

Groundwater salinities within the Tertiary limestone aquifer are generally below 1000 mg/L and have been quite stable since 2007 (Fig. 26). Observation wells in the Myponga Basin recorded a rise in salinity in 1989 but levels have returned to historical levels since then. Observation well MYP 10 in the Myponga Basin recorded a decrease in salinity in 2011 (Fig. 26).

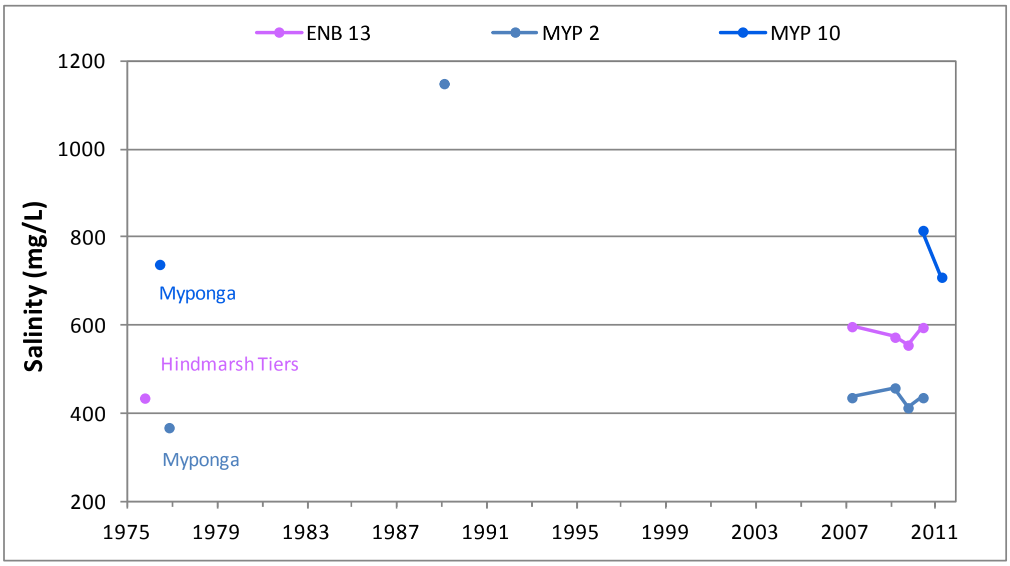

Figure 26. Salinity trends of the Tertiary limestone aquifers within the Myponga and Hindmarsh Tiers Basins on the Fleurieu Peninsula in the Western Mount Lofty Ranges Prescribed Water Resources Area