CLARE
PWRA
GROUNDWATER STATUS REPORT

2009-10

Government of South Australia
Department for Water

SUMMARY 2009 - 10

The Clare Prescribed Water Resources Area (PWRA) is located approximately 130 km north of Adelaide within the Mount Lofty Ranges. It is a regional scale resource for which surface water and groundwater have been prescribed under South Australia's *Natural Resources Management Act 2004*.

Groundwater extractions in the Clare PWRA occur from a fractured rock aquifer. Metered extractions in 2009-10 totalled 975 ML, which represents a decrease of 9 % from the previous water use year, and is the lowest recorded use within the PWRA since metering commenced in the 2000-01 season. The decrease in extractions could be due to good rainfall in the growing season, and decreased yields from irrigation wells due to falling groundwater levels. Vines are by far receiving the greatest irrigation volume, 734 ML, followed by recreational irrigation (94 ML) and lucerne/pasture (30.5 ML).

Although total extractions have been generally decreasing over recent years, there has been significant localised increase in extractions since 2006 in the Armagh and Stanley Flat sub-catchments, and particularly to the north-east of Auburn where the highest extractions in the Clare PWRA occur.

After a prolonged period of declining water levels caused by below average rainfall, groundwater level trends over the past three years are showing some recovery in response to recent wet years for the higher rainfall area (600 mm/yr). Outside this area, water levels have shown little or no response to the recent higher rainfall, and levels remain at historical lows.

Salinity trends appear to be reflective of rainfall and water level trends. A decrease in salinity has been observed within the 600 mm isohyet, whilst outside of this area, groundwater salinity increases are evident especially near the Auburn and Mintaro townships, and in the Armagh and Stanley Flat sub-catchments. The largest rises in salinity occur to the north-east of Auburn.

Further monitoring is required to ascertain if the adverse trends observed are directly the result of localised over-extraction, or are due to climatic influences.

ASSESSMENT OF STATUS

The Clare PWRA has been assigned a status of yellow "Adverse trends indicating low risk to the resource in the medium term" based on current trends. This status is supported by;

- In lower rainfall areas of the Clare PWRA, gradual decline in water levels have continued since 2000, although elsewhere levels have recovered due to higher rainfall in 2009. These declines may not persist and are not expected to affect access to the resource by groundwater users over the next 10 – 20 years.
- Although most observation wells are showing decreasing salinity levels in response to higher rainfall in recent years, there are rising trends in some areas. At present, there is no evidence of salinity increases caused by groundwater over-extraction.

On-going monitoring is essential to determine if the groundwater level declines and salinity rises in the lower rainfall areas of the Clare PWRA will be persistent and present a threat to the sustainability of the groundwater resource in those areas.

STATUS

No adverse trends, indicating a stable or improving situation

Trends are either stable (no significant change), or improving (i.e. decreasing salinity or rising water levels).

Adverse trends indicating low risk to the resource in the medium term

Observed adverse trends are gradual and if continued, will not lead to a change in the current beneficial uses of the groundwater resource for at least 15 years. Beneficial uses may be drinking water, irrigation or stock watering.

Adverse trends indicating high risk to the resource eventuating in the short to medium term

Observed adverse trends are significant and if continued, will lead to a change in the current beneficial uses of the groundwater resource in about 10 years.

Degradation of the resource compromising present use within the short term

Trends indicate degradation of the resource is occurring, or will occur within 5 years. Degradation will result in a change in the beneficial use (i.e. no longer suitable for drinking or irrigation purposes) and may take the form of increasing groundwater salinities, or a fall in the groundwater levels such that extractions from the aquifer may not be possible.

BACKGROUND

The Clare PWRA is located approximately 130 km north of Adelaide within the Mount Lofty Ranges. It is a regional scale resource for which surface water and groundwater have been prescribed under South Australia's *Natural Resources Management Act 2004*. A Water Allocation Plan provides for sustainable management of the water resources.

HYDROGEOLOGY

There are two aquifer systems within the Clare Valley region; an alluvial Quaternary Aquifer occurring at shallow depths (<15 m) in valley floors, which is underlain by a substantial Fractured Rock Aquifer.

The Quaternary Aquifer is not extensive in the Clare PWRA and provides only a small portion of the groundwater resource (mainly in the vicinity of Stanley Flat). The main aquifer system developed within the Clare Valley PWRA is the Fractured Rock Aquifer which is composed of Proterozoic rocks of the Burra and Umberatanna Groups, consisting of siltstones, shales, dolomites and quartzites.

The major fractured rock units that provide groundwater for irrigation in the Clare region come from the Mintaro Shale, Saddleworth Formation, Undalya Quartzite, and the Skillogalee Dolomite. Within the Fractured Rock Aquifer, the fractures act as conduits for groundwater flow. The yield of groundwater from a particular well is dependent on the size and spacing between fractures and the orientation of fractures intercepted. Variations in supply from individual bores are likely to be the result of fracturing or other structural constraints rather than the rock type.

The fractured rock aquifer can be divided into two zones; a relatively permeable zone in the upper 20-40 m within which fractures are closely spaced (generally <0.5 m apart), and a deeper low permeability regional zone. The size and spacing of fractures tends to decrease with depth.

Groundwater levels are controlled by recharge to both Quaternary and Fractured Rock Aquifer systems from rainfall. Periods of above average rainfall should result in rising groundwater levels and decreasing groundwater salinity, while years of below average rainfall should result in declining groundwater levels and increasing groundwater salinity.

For further information on the hydrogeology, see the following brochure "Groundwater flow in the Clare Valley"
http://www.waterconnect.sa.gov.au/BusinessUnits/InformationUnit/Technical%20Publications/Groundwater%20flow%20in%20the%20Clare%20Valley.pdf

For further information on the geology of the Clare Valley,
http://www.pir.sa.gov.au/__data/assets/pdf_file/0017/10727/IS_M49_web_203968.pdf

To view the previous monitoring status report prepared in 2005,
http://www.waterconnect.sa.gov.au/BusinessUnits/InformationUnit/Technical%20Publications/ki_dwlbc_report_2005_18.pdf

GROUNDWATER DEPENDENT ECOSYSTEMS

Whilst groundwater dependent ecosystems (GDEs) have not been used in the assessment of the status of the resource, it is important to note the presence and ecological characteristics of the GDEs found in the Clare PWRA. Water Allocation Plans must include an assessment of the water required by ecosystems, including water from both surface water and groundwater resources. Groundwater dependent ecosystems can be defined as ecosystems where groundwater provides all or part of the water quantity, chemistry or temperature either permanently, seasonally or intermittently. It is generally considered that shallow watertables, i.e. those less than 10 m below the surface are more likely to support GDEs than deeper watertables. The exception to this is stygofauna (animals that inhabit water filled cracks and pools below the ground), which can be found at greater depths.

Permanent pools exist throughout the watercourses that flow through the Clare PWRA, most of which are expected to be maintained through groundwater contributions from the fractured rock aquifer. These permanent aquatic habitats are important refugia for aquatic biota, and are known to support diverse populations of macroinvertebrates and aquatic plants. Fish surveys have found native species inhabiting pools in the areas surrounding the Clare PWRA, and are likely to be present within the PWRA given the presence of suitable aquatic habitat.

Plants that have a dependence on groundwater also exist along the watercourses within the region, as well as below the flats to the east of the Clare Hills, particularly in the catchment of the Wakefield River downstream of Mintaro and the upper Hill River catchment. Largely consisting of River Redgum (*Eucalyptus camaldulensis*) and South Australian Bluegum (*E. leucoxylon*), the health of these vegetation communities can be influenced by reductions in groundwater levels.

Other possible GDEs in the Clare PWRA include stygofauna.

RAINFALL

Rainfall is a very important part of the groundwater balance because it is a source of replenishment or recharge to aquifers by infiltration through the soil or by percolation from streamflow in drainage lines.

The climate of the Clare region is characterised by hot, dry summers and cool to cold, wet winters. Two Bureau of Meteorology rainfall stations; Clare (Calcannia) (21075) and Watervale (21054) were chosen for analysis of rainfall trends (Fig. 1). Long term annual average rainfall (from 1938 to 2010) is 540 mm at Clare (Calcannia) and 626 mm at Watervale. The highest rainfall corresponds to areas of higher elevation in the central and southern portions of the region.

The cumulative deviation from mean monthly rainfall is graphed in blue in Figure 2 to identify periods where rainfall trends are above or below average. An upward slope indicates a period where the rainfall is greater than the average, while a downward slope indicates a period where the rainfall is below the average.

The Clare (Calcannia) station shows alternating above and below average trends lasting between 15 and 25 years. Significantly, there has been predominantly below average rainfall since 1981, apart from wet periods in 1992-93 and 2000-03.

The Watervale station has a much longer record and displays a different trend to the other station. It indicates quite a consistent period of below average rainfall prior to 1992, with some above average rainfall from 1992 till 2002. Since then, strongly below average rainfall conditions prevailed, especially since the 2006 drought. A slight rise has occurred in 2009.

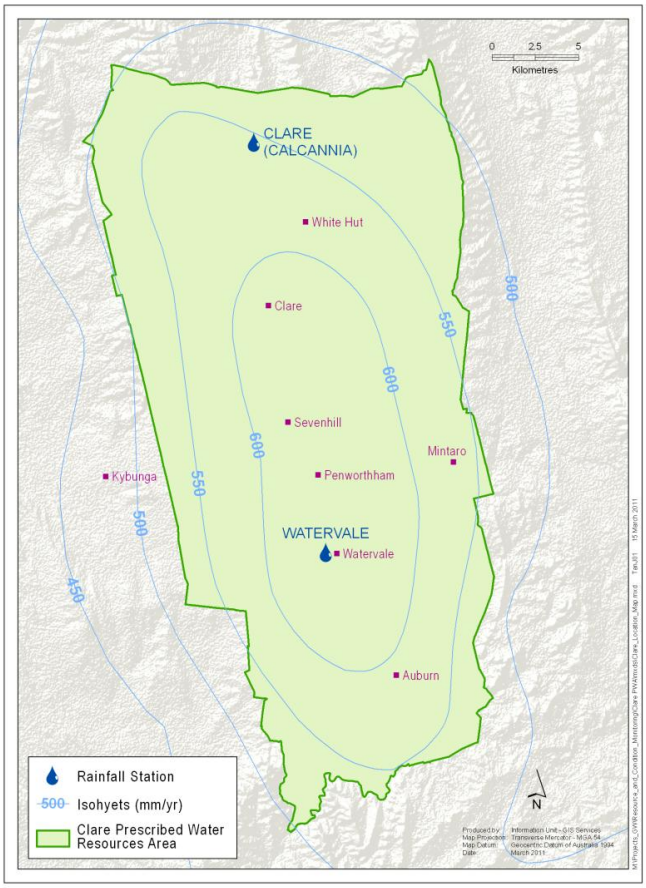
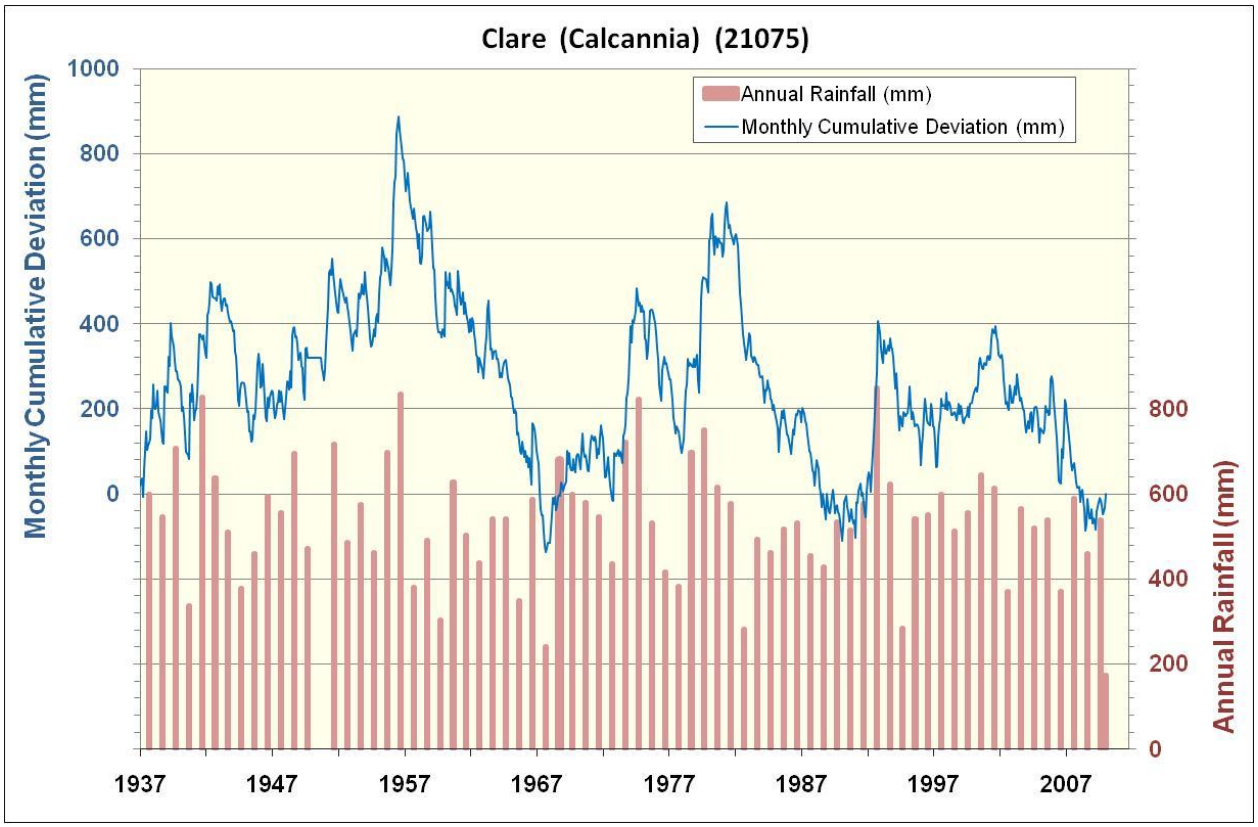


Figure 1. Location of rainfall stations in the Clare PWRA



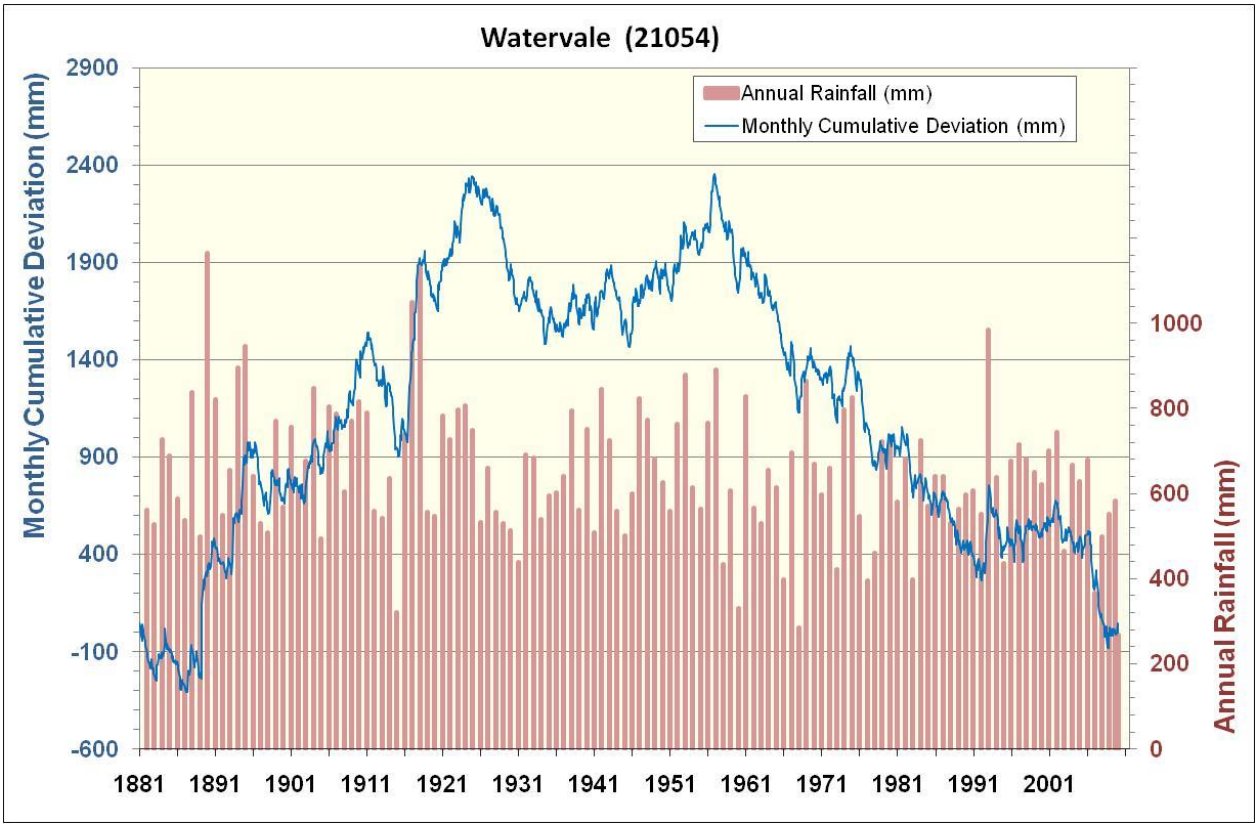


Figure 2. **Annual rainfall and cumulative deviation for mean monthly rainfall two rainfall stations in the Clare PWRA**

GROUNDWATER USE

Metered groundwater extractions in the Clare Valley PWRA for 2009-10 totalled 975 ML (Fig. 3). This extraction figure is the lowest recorded since metering commenced in the 2000-01 season. The large decrease in extractions since 2007-08 may be due to good rainfall in the growing season and decreased yields from irrigation wells due to falling groundwater levels. The significant decrease in extraction observed in 2004-05 was due to the availability of imported water from the River Murray. Over the 2009-10 season, vines were the biggest user of groundwater receiving 734 ML, followed by recreation (94 ML) and lucerne/pasture (30.5 ML) as shown in Figure 4. A spatial distribution of extraction from each licensed well in the Clare PWRA is shown in Figure 5.

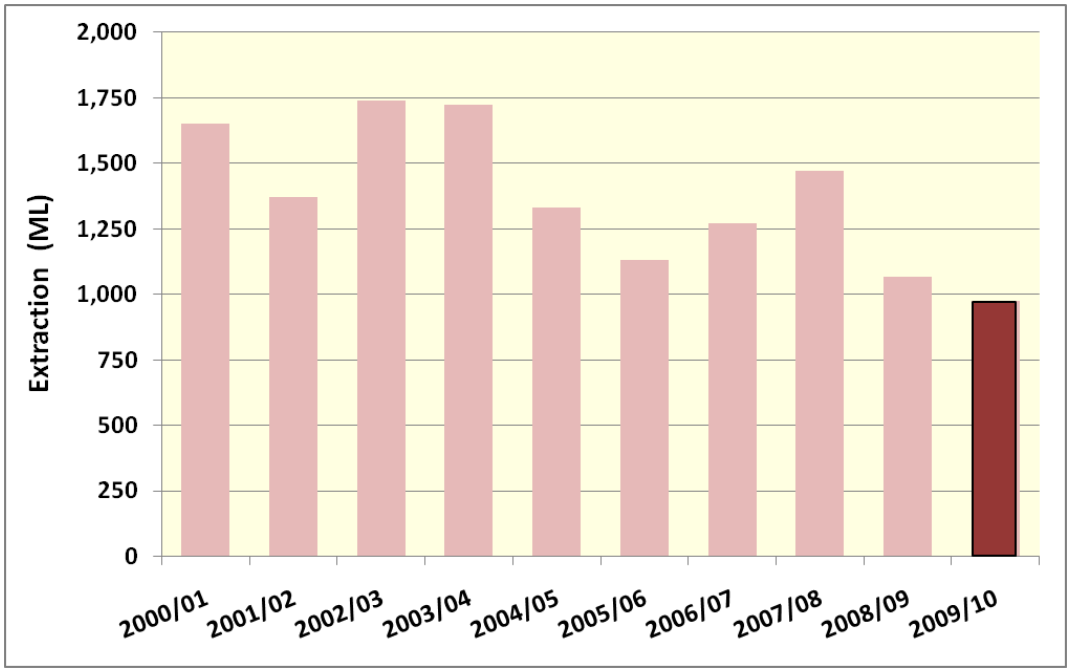


Figure 3. **Historical licensed groundwater use for the Clare PWRA**

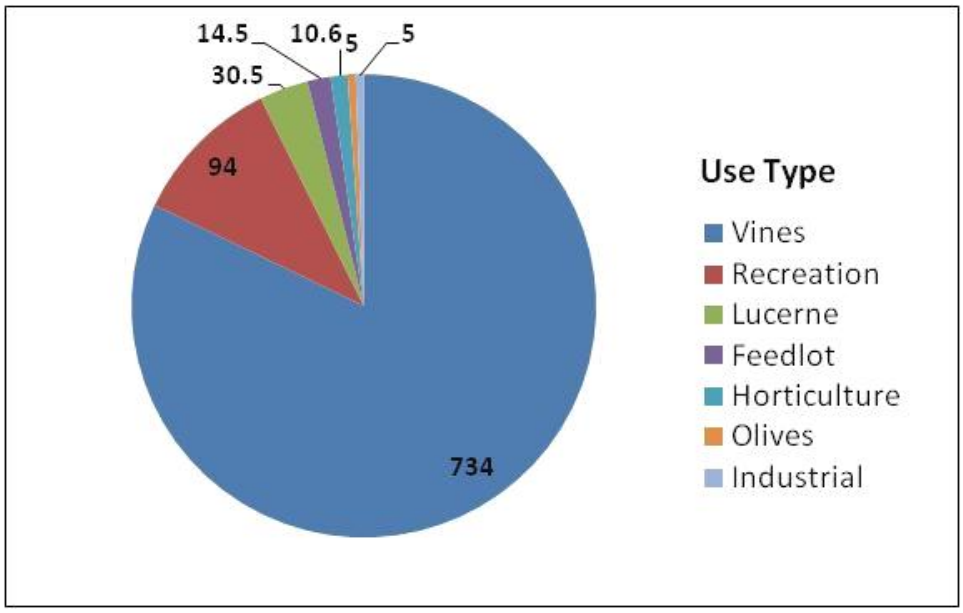


Figure 4. **Groundwater volumes extracted per type of use for the 2009/10 season (ML)**

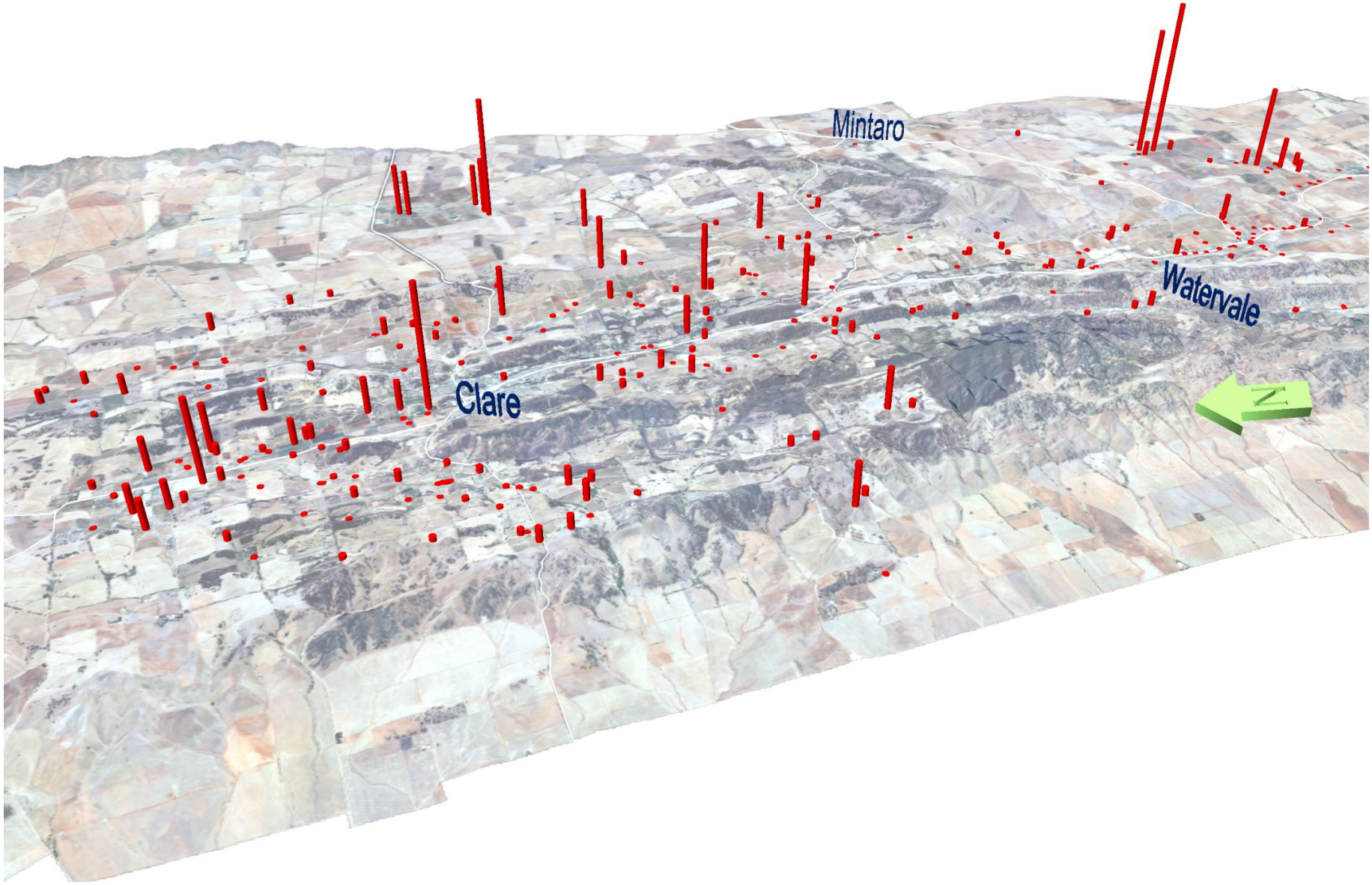


Figure 5. Spatial distribution of groundwater extraction in the Clare PWRA in 2009-10

WATER LEVEL NETWORK

The water level observation network for the Clare Valley PWRA is shown in Figure 6. Groundwater monitoring of the Clare Valley began in 1987, and there are currently 110 wells monitoring water levels. Of these, 14 are known to monitor the shallow Quaternary sediments. Most of these wells are monitored on a quarterly basis to enable assessment of both the long-term and short-term health of the groundwater resource.

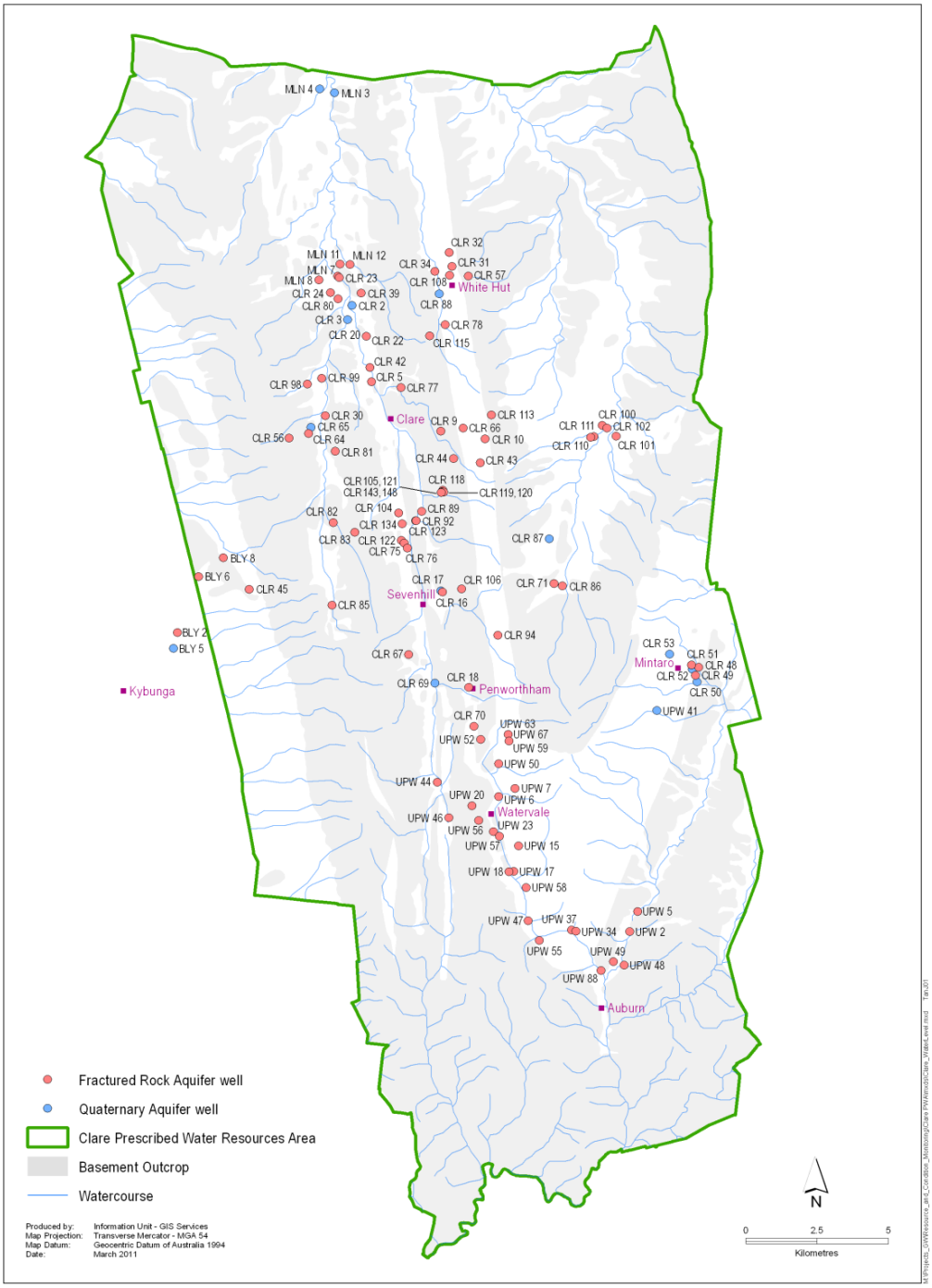


Figure 6. Location of groundwater level observation wells in the Clare PWRA

SALINITY NETWORK

The salinity observation network for the Clare Valley PWRA is shown in Figure 7. There are currently 34 wells monitoring salinity at six monthly intervals. Of these, eight are known to monitor the shallow Quaternary sediments.

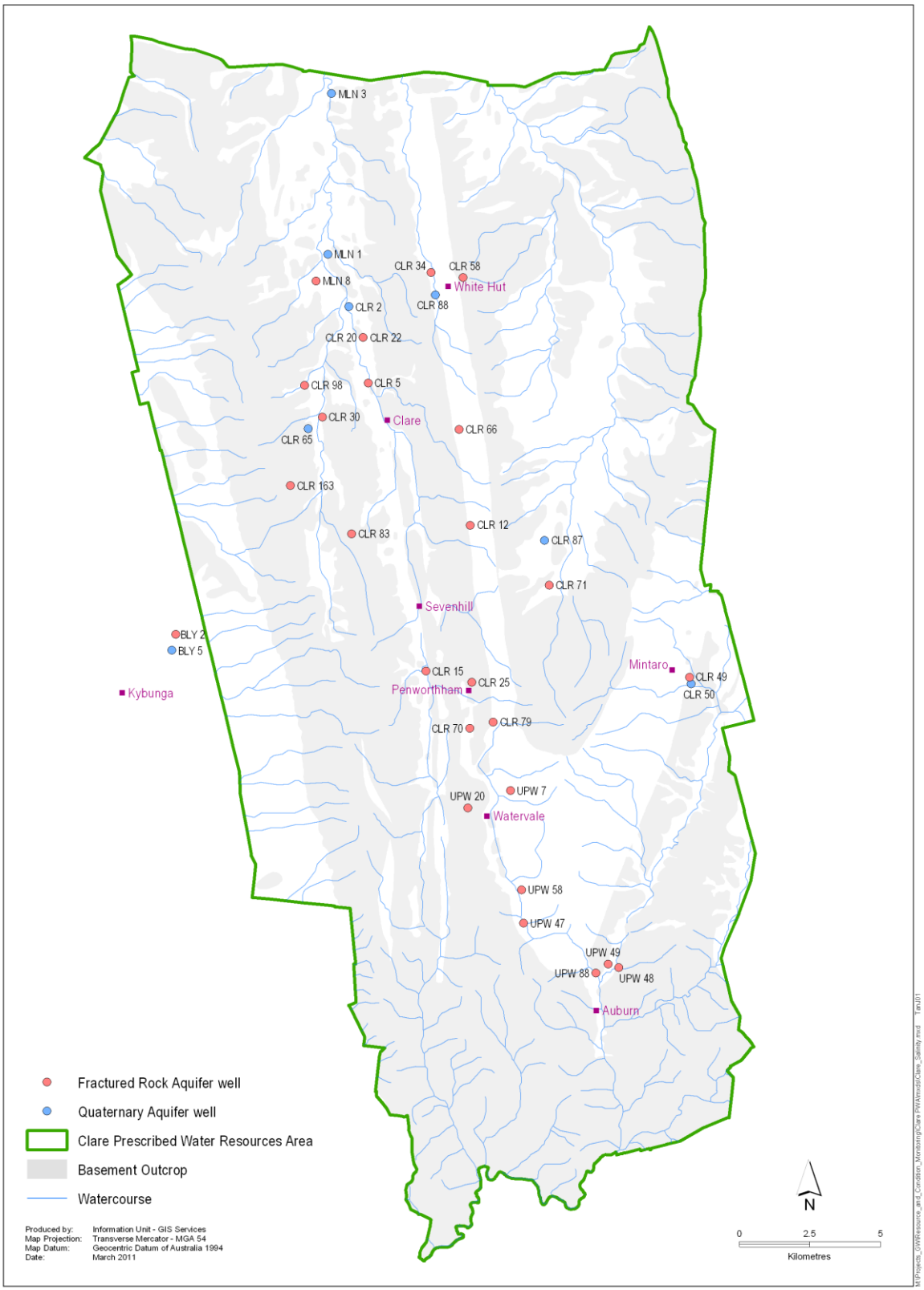


Figure 7. Location of groundwater salinity observation wells in Clare PWRA

GROUNDWATER LEVEL TRENDS

Because the aquifers in the Clare PWRA are recharged from rainfall, the groundwater levels generally follow rainfall trends (i.e. they rise in wet years and decline in below average years). The observed water level trends have been analysed for the fractured rock aquifer for both a short and long term perspective.

LONG TERM TRENDS

Long term water level trends are presented as hydrographs of representative observation wells from various regions within the Clare PWRA.

The hydrographs in Figure 8 are from observation wells located within the high rainfall area and are characterised by a strong response to the wetter period during 2009.

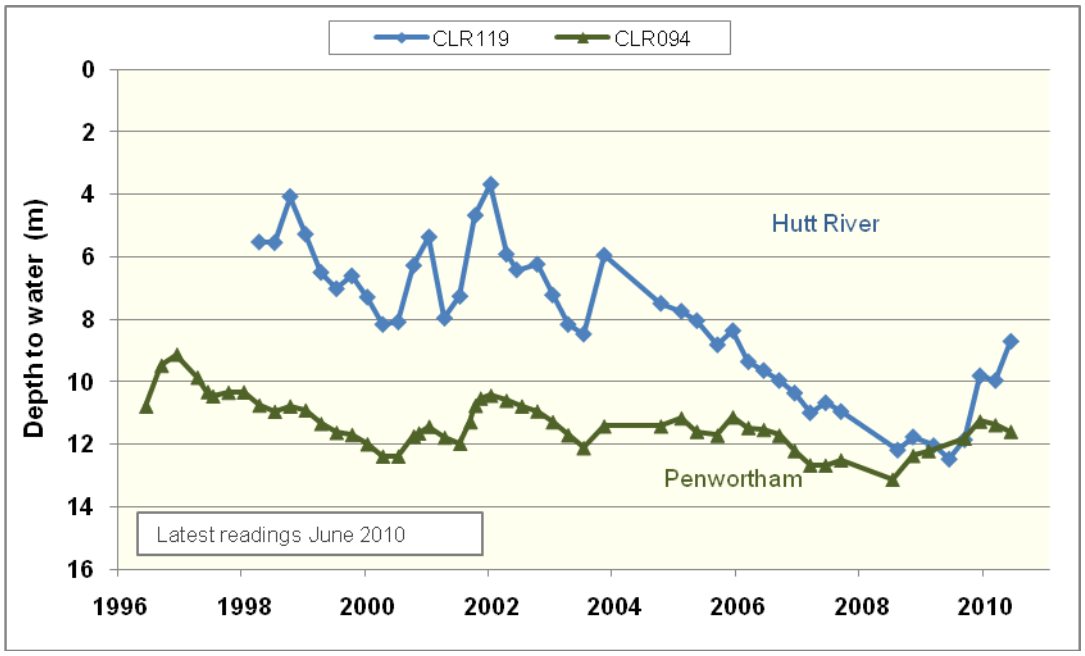


Figure 8. Groundwater level trends for Hutt River and Penwortham in the Clare PWRA

The hydrographs in Figure 9 are located to the north and west of Clare township in a lower rainfall area and show little response to the higher rainfall in 2009. Water levels are at, or close to, historically low levels. There has been a significant increase in extractions since 2006 in the Armagh and Stanley Flat sub-catchments.

The hydrographs in Figure 10 are similarly located in a lower rainfall area along the eastern side of the Clare PWRA and show a slight response to the higher rainfall in 2009. Water levels are at, or close to, historically low levels. The highest extractions in the Clare PWRA occur to the northeast of Auburn as can be seen in the significant seasonal drawdowns due to pumping in observation well UPW 48. This increase in extraction is most likely due to a reduction in the imported River Murray allocations due to drought.

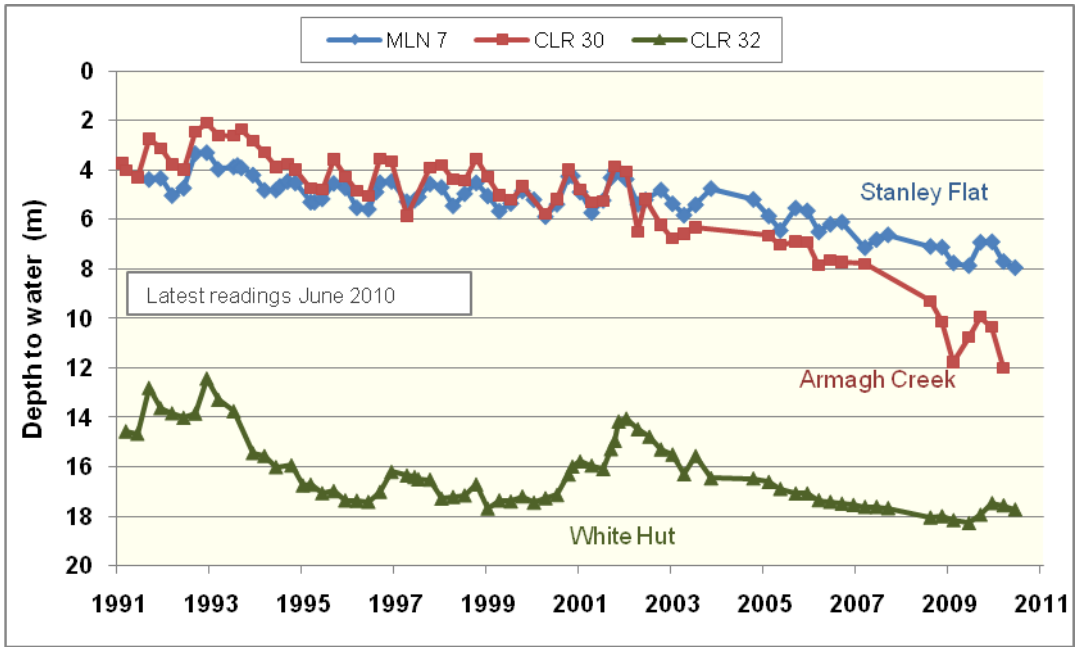


Figure 9. **Groundwater level trends for Stanley Flat, White Hut and Armagh Creek in the Clare PWRA**

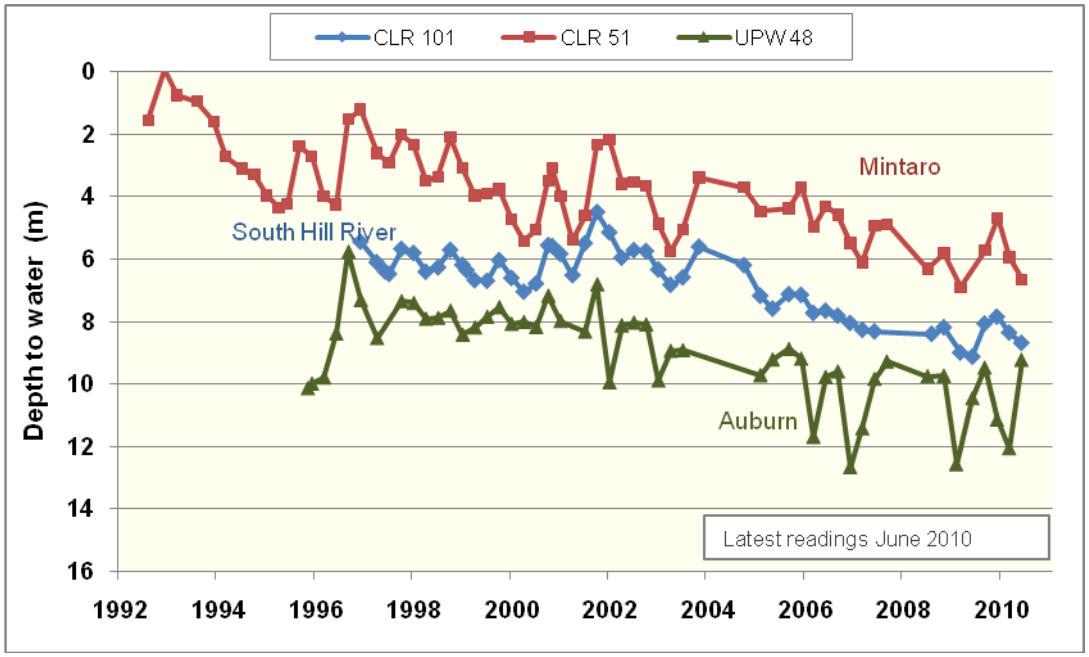


Figure 10. **Groundwater level trends for Mintaro, Auburn and South Hill River in the Clare PWRA**

SHORT TERM TRENDS

Figure 11 shows the observed water level trend over the last three years for each observation well in the fractured rock aquifer. At first glance, the distribution of trends seems quite varied, with most wells either rising or falling at a rate of up to 0.5 m/yr. However on closer examination, the blue rising trend arrows which are showing a response to recharge from a wetter year in 2009 after several years of below average rainfall, are predominantly located in the high rainfall areas within the 600 mm isohyet produced from long term average data.

Observation wells experiencing less rainfall outside the 600 mm isohyet are show a falling three year trend, indicating limited or no response to the wetter 2009 winter.

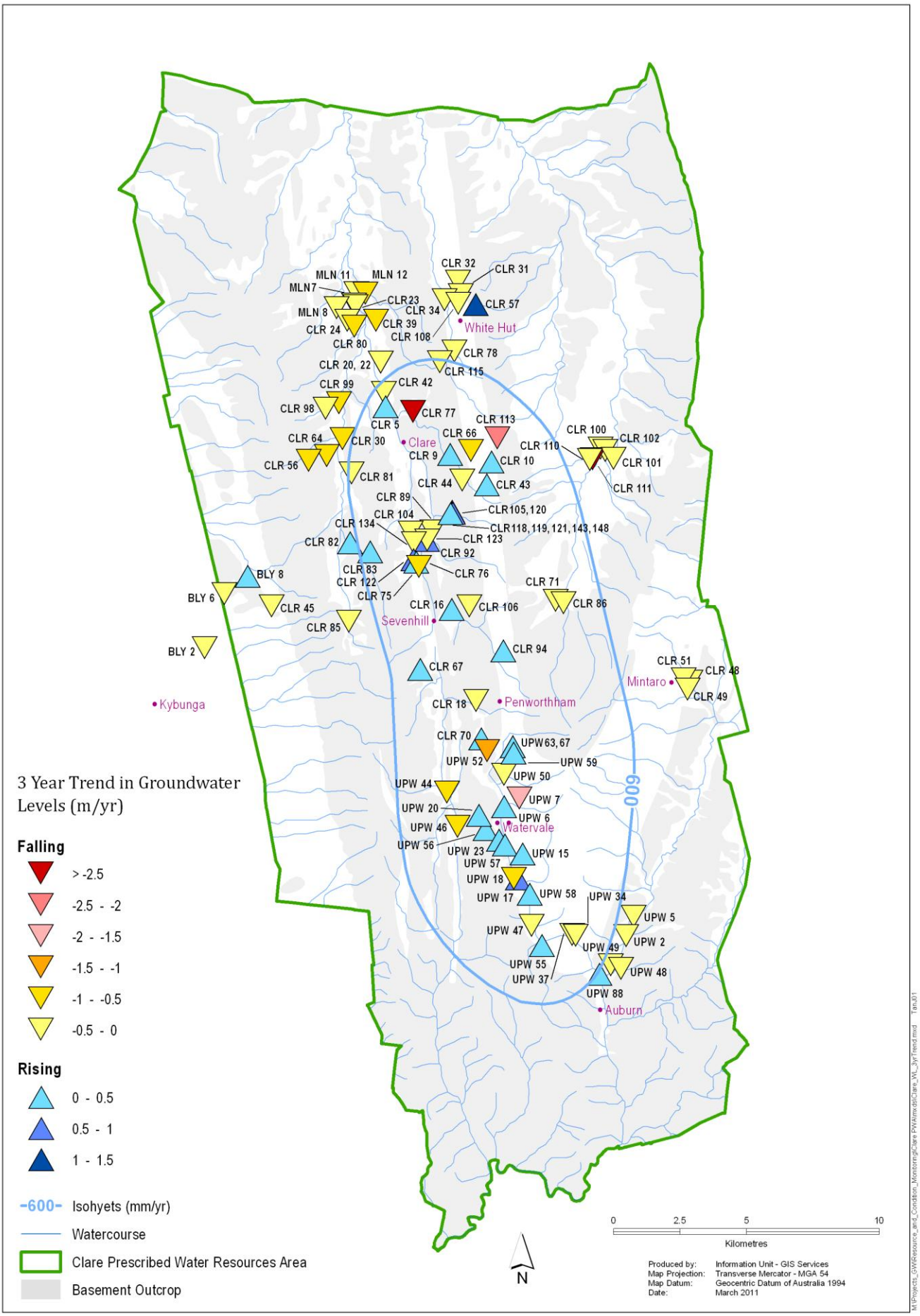


Figure 11. Three year groundwater level trends (March 2010) in the Clare PWRA

GROUNDWATER SALINITY TRENDS

The observed groundwater salinity trends have been analysed from both a short and long term perspective. Salinity trends broadly appear to be responsive to rainfall and consequently also reflect water level trends. There is no correlation with rising salinity trends associated with the use of River Murray imported water, which has the potential to cause groundwater salinisation.

LONG TERM TRENDS

In lower rainfall areas in the eastern part of the Clare PWRA, salinity trends are generally showing a rise in response to the recent years of below average rainfall, as shown below in Figure 12.

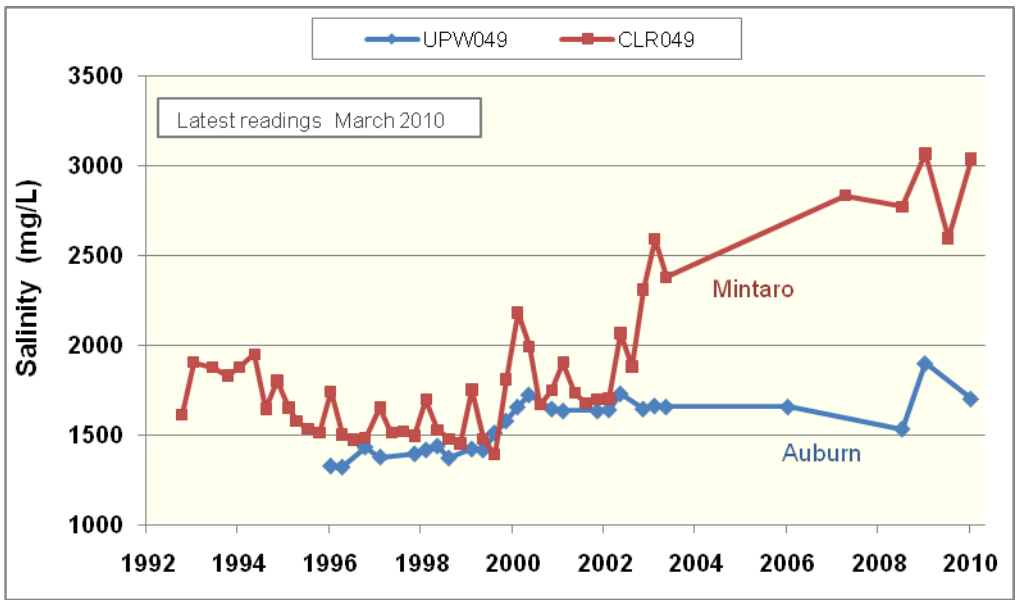


Figure 12. **Groundwater salinity trends for Mintaro and Auburn in the Clare PWRA**

Figure 13 indicates that within the higher rainfall area, salinity levels generally show a decreasing trend as observed in CLR 12 whilst UPW 7 indicates a return to historic salinity levels.

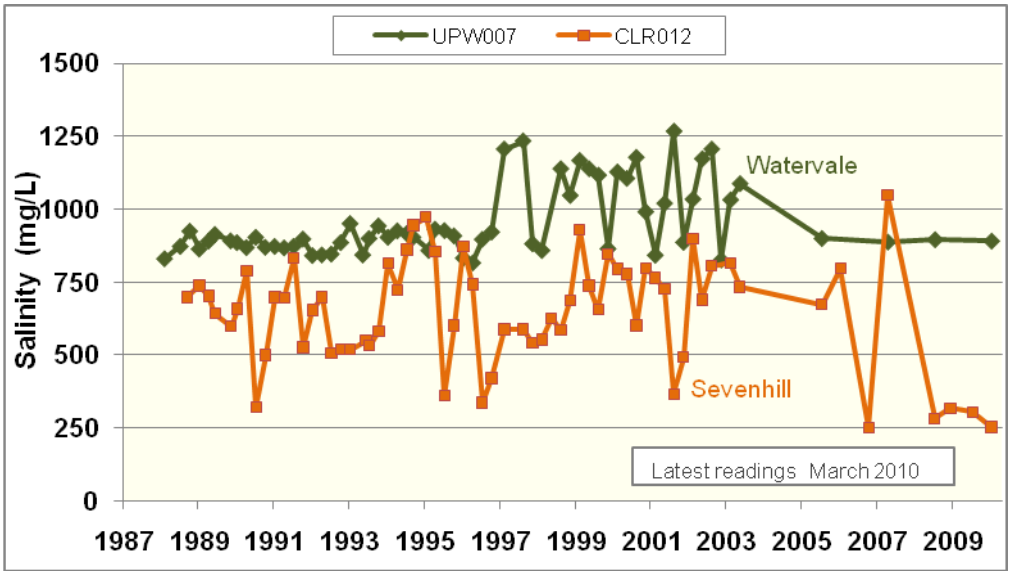


Figure 13. **Groundwater salinity trends for Sevenhill and Watervale in the Clare PWRA**

SHORT TERM TRENDS

Because of the generally slower response to change, and a less frequent monitoring interval than water levels, the short term regional salinity trends are reported over the last five years (Fig. 14).

A general decrease in salinity is obvious within the 600 mm isohyet high rainfall area. Outside of this area, especially in the Auburn and Mintaro townships, and the Armagh and Stanley Flat sub-catchments, groundwater salinity increases are evident. The largest rises in salinity correspond to the highest extractions in the Clare PWRA, occurring to the north-east of Auburn.

Whilst the application of imported water within the PWRA carries a risk of salinisation of groundwater, there does not appear to be any correlation between the observed rising salinity trends and application of this water.

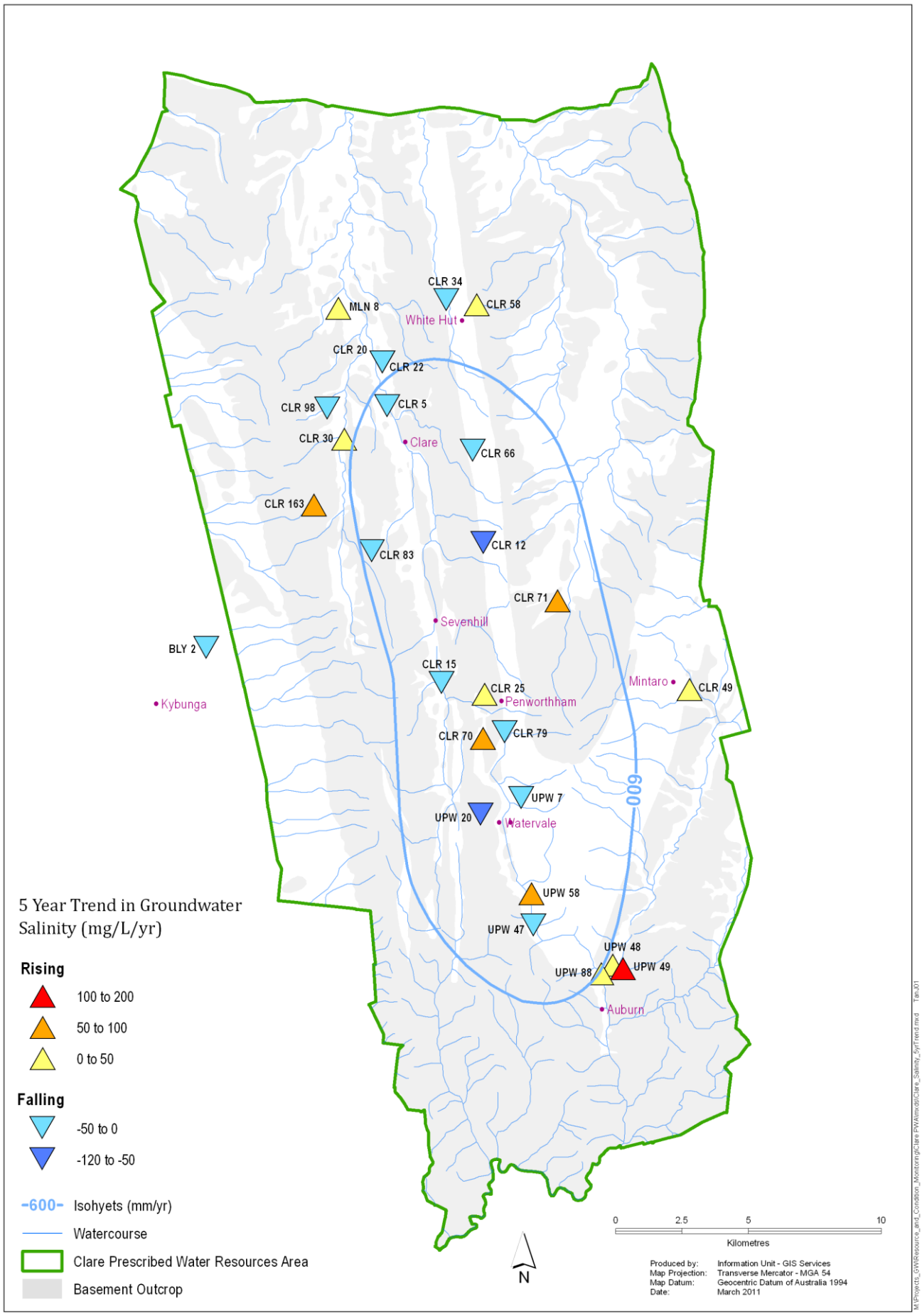


Figure 14. Five year regional groundwater salinity trend (March 2010) in the Clare PWRA