CLARE PWRA

SURFACE WATER STATUS AND CONDITION REPORT

2010–11

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

PURPOSE AND CONTEXT

This status report provides a snapshot of the surface water resources in the Clare Prescribed Water Resources Area (PWRA) for the financial year 2010–11. Available data on climate, streamflow, salinity, water use and environmental water requirements are summarised and compared with recent and long term data to provide an indication of the status of its water resources. Each element is discussed with reference to recent or more long-term trends where, if at all, they are present in the data. This will enable resource managers and those that are responsible or reliant on the resource to make more informed management decisions.

A similar separate report has been released previously for the groundwater resources of this PWRA. This surface water report is in a format consistent with that already adopted for the groundwater report. These status reports seek to support informed management decisions by resource managers and those responsible for, or reliant on, the water resources.

CLARE PRESCRIBED WATER RESOURCES AREA

The Clare PWRA is located approximately 100 km north of Adelaide and is part of the Broughton River, Wakefield River and Diamond Lake Catchments (Figure 1). It is a regional-scale resource for which surface water and groundwater have been prescribed since 2001 under South Australia's *Natural Resources Management Act 2004*. A Water Allocation Plan (WAP) has been developed for the Clare PWRA by the Northern and Yorke Natural Resources Management (NRM) Board, which seeks to provide for sustainable management of water resources.

The Clare PWRA covers an area of 700 km^2 with the major towns being Clare, Auburn, Mintaro and Watervale. The topography, characterised by hills and valleys, essentially divides the area into a northern half, comprising part of the Broughton River Catchment that drains to Spencer Gulf and a southern half, comprising part of the Wakefield River Catchment that drains to Gulf St Vincent. A small area on the Western edge of the PWRA is part of the Diamond Lake Catchment. This part of the PWRA is not discussed in this report due to a lack of information. The climate of the Clare PWRA is characterised by hot, dry summers and cool to cold, wet winters, with rainfall in the region varying from over 600 mm in the central region around the township of Clare to as low as 500 mm in the south-east and south-west. The main watercourses that drain to the north are the Hill and Hutt Rivers (Figure 8), while Eyre Creek, Skillogalee Creek and Wakefield River are the major watercourses that drain to the south. The average annual runoff varies from around 30 mm in the higher rainfall areas around Clare and Auburn, to around 10 mm in the drier parts in the North and South.

Surface water use for irrigation, commercial, stock and domestic purposes comes from a variety of sources, including pumping from streams and rivers, interception and storage by farm dams, groundwater pumping and, since 2006, imported water from the SA Water Clare Valley Water Supply Scheme.

SUMMARY 2010–11

The Clare PWRA has been assigned a green status for 2010–11:

STATUS 2010–11  "No adverse trends, indicating a stable or improving situation"

This status is supported by:

- A return to average rainfall for this year following a recent dry spell
- Average or above average streamflow
- A low ratio of water use to streamflow
- Average salinity levels in the Wakefield catchment
- 100% of the Environmental Water Requirements criteria at three sites outlined in the WAP were met.

Trends indicate that following the recent drier than average climate and runoff conditions, licensed water use remains stable and good streamflow has contributed to an improved expected condition for the beneficial use of the resource.

 No adverse trends, indicating a stable or improving situation

Trends are either stable (no significant change), or have improved over the reporting period, indicating that there is insignificant risk of impact to the beneficial use of the resource.

 Adverse trends indicating low risk to the resource in the short term (1 to 3 years)

Observed adverse trends are gradual and if continued, are unlikely to lead to a change in the current beneficial uses of the surface water resource in the short term.

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

Observed adverse trends are significant and if continued, moderately likely to lead to a change in the current beneficial uses of the surface water resource in the short term.

 Adverse trends indicating high risk to the resource within the short term

Trends indicate degradation of the resource is occurring. Degradation will very likely result in a change in the beneficial use (e.g. reduced ability to access surface water entitlements and/or decline in the condition of environmental assets).

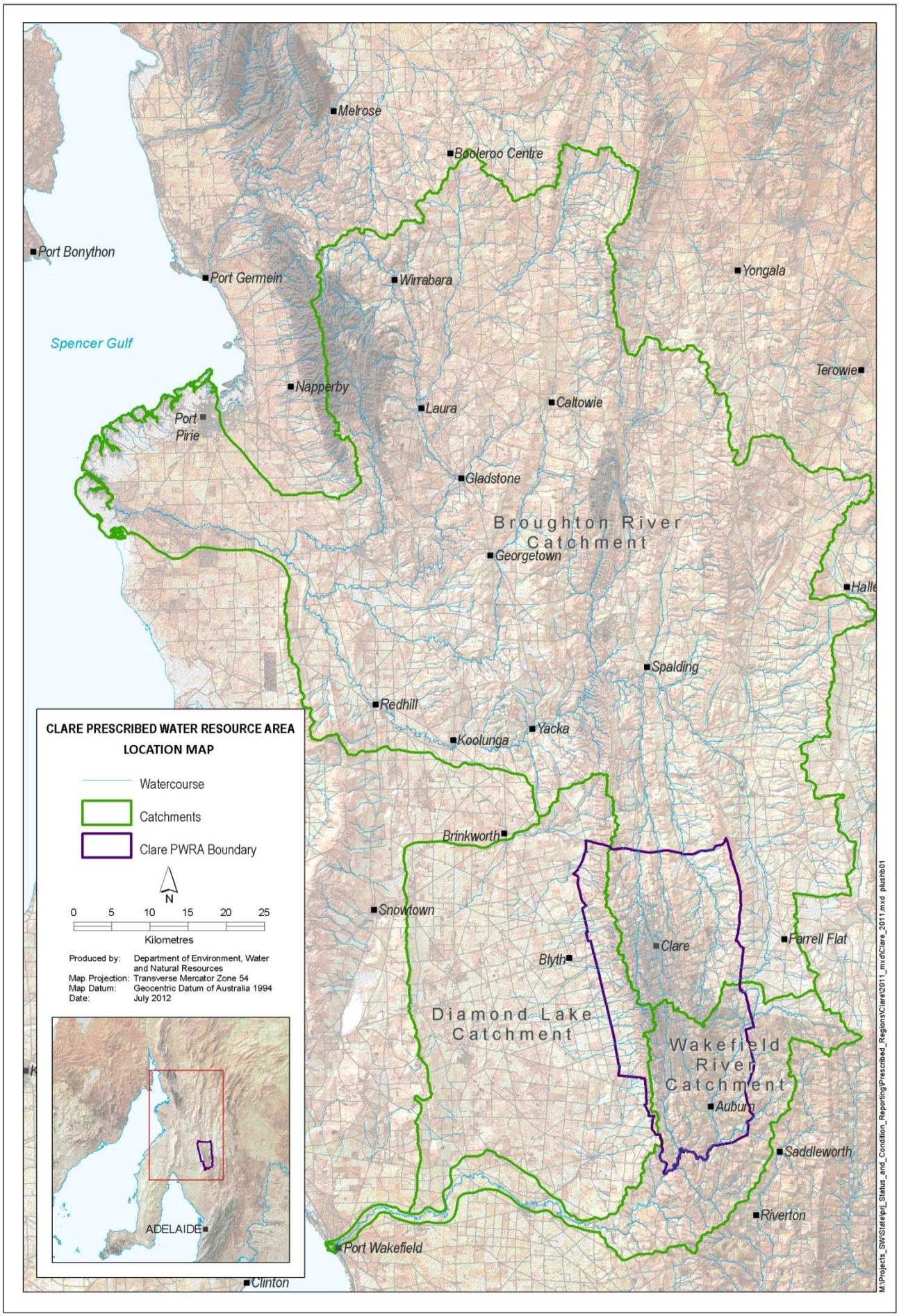


Figure 1. Clare PWRA and the Broughton, Wakefield and Diamond Lake Catchments

RAINFALL

Status	Degree of confidence	Comments on recent historical context
Above average rainfall across most of the region.	High: good coverage of rainfall stations representing the rainfall variation across the region.	The second year of average or above average rainfall.

The climate of the Clare PWRA is characterised by hot, dry summers and cool to cold, wet winters. Rainfall in the region varies from over 600 mm in the central region around the township of Clare to as low as 500 mm in the south-east and south-west. There are 16 rainfall stations across the PWRA (Figure 4). Data from two of those stations, Clare (Calcannia) (M021075) and Watervale (M021054) were chosen for analysis of rainfall trends. Clare (Calcannia) represents the northern part of the PWRA while Watervale represents the central and southern part. Long term annual average rainfall (from 1889 to 2010) is 542 mm at Clare (Calcannia) and 653 mm at Watervale. The highest rainfall corresponds to areas of higher elevation in the central and southern portions of the PWRA.

RECENT RAINFALL

The rainfall in 2010–11, 794 mm at Watervale and 733 mm at Clare, was well above the long-term average (1889–2010) with heavier than average falls in August through to December 2010 and February and March 2011 (Figure 2 and Figure 3). These months were able to push the rainfall totals well above the average whilst the other months were below the long term averages. Values in Figures 2–3 are 2010–11 monthly rainfall.

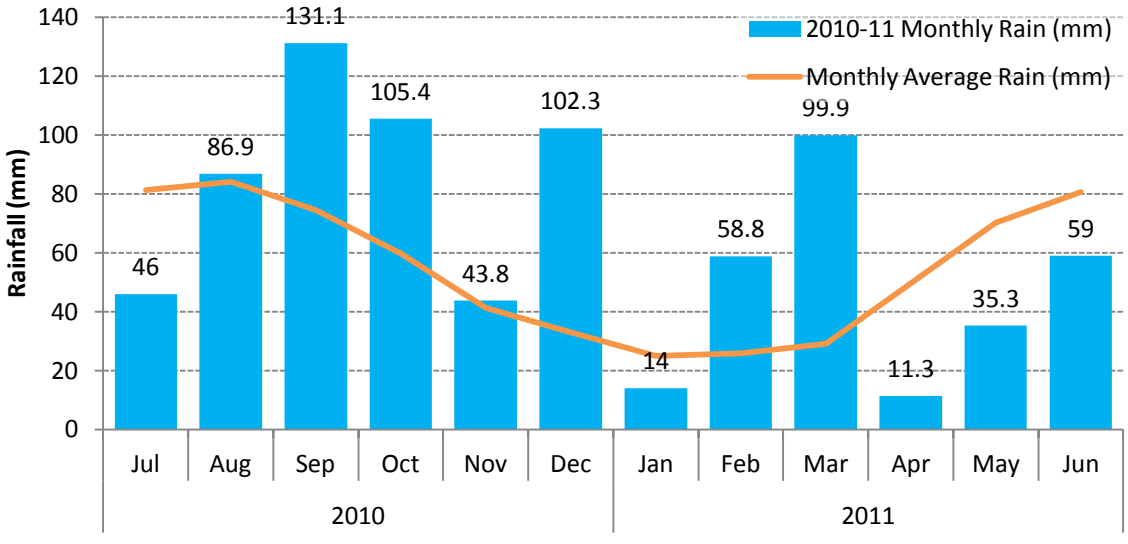


Figure 2. Monthly rainfalls at Watervale

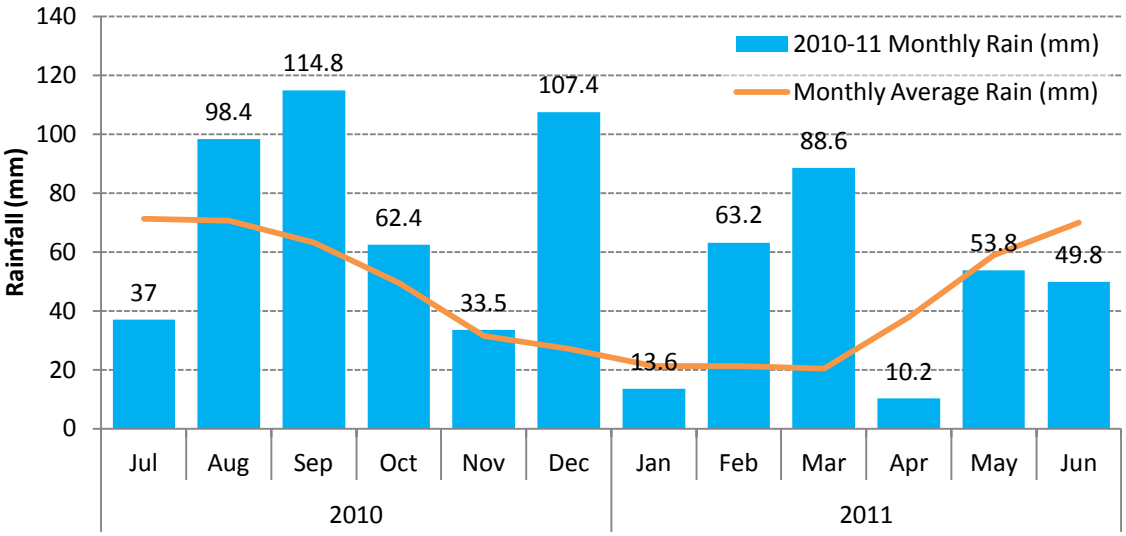


Figure 3. Monthly rainfalls at Clare (Calcannia)

LONG AND SHORT TERM TRENDS

Figure 5 shows the spatial distribution of rainfall over the Clare PWRA for the:

1. long term average annual rainfall from 1900–2010
2. annual rainfall for 2010
3. short term average of the previous 10 years (2001–2010).

The three panels of Figure 5 indicate that over much of the PWRA, rainfall for the year 2010 (panel 2) was above the long term average (panel 1). Panel 3 shows the average rainfall for the years 2001–10 and this shows a drier period during the last ten years compared to the long term average shown in Panel 1, indicating that despite a strong rainfall year the rainfall over this period is still lower than the long term average.

The cumulative deviation from average annual rainfall (residual mass curve) is plotted in orange in Figures 6 and 7 to identify periods of above or below average trends. An upward slope indicates a period of above average rainfall, while a downward slope indicates a period of below average rainfall. Clare (Calcannia) shows variable above and below average trends lasting between 15 and 25 years. Since 1981 there has been predominantly below average rainfall, apart from wet periods in 1992–93 and 2000–03.

The period of record at Watervale displays a different trend to that of Clare (Calcannia) and indicates an above average rainfall period between 1881 and 1924, with a few dry periods in between. The next 30 year period shows 15 years of below average rainfall followed by 15 years of rainfall above average. Since 1956 there has clearly been an extensive period of below average rainfall, with some slightly above average rainfall periods in between.

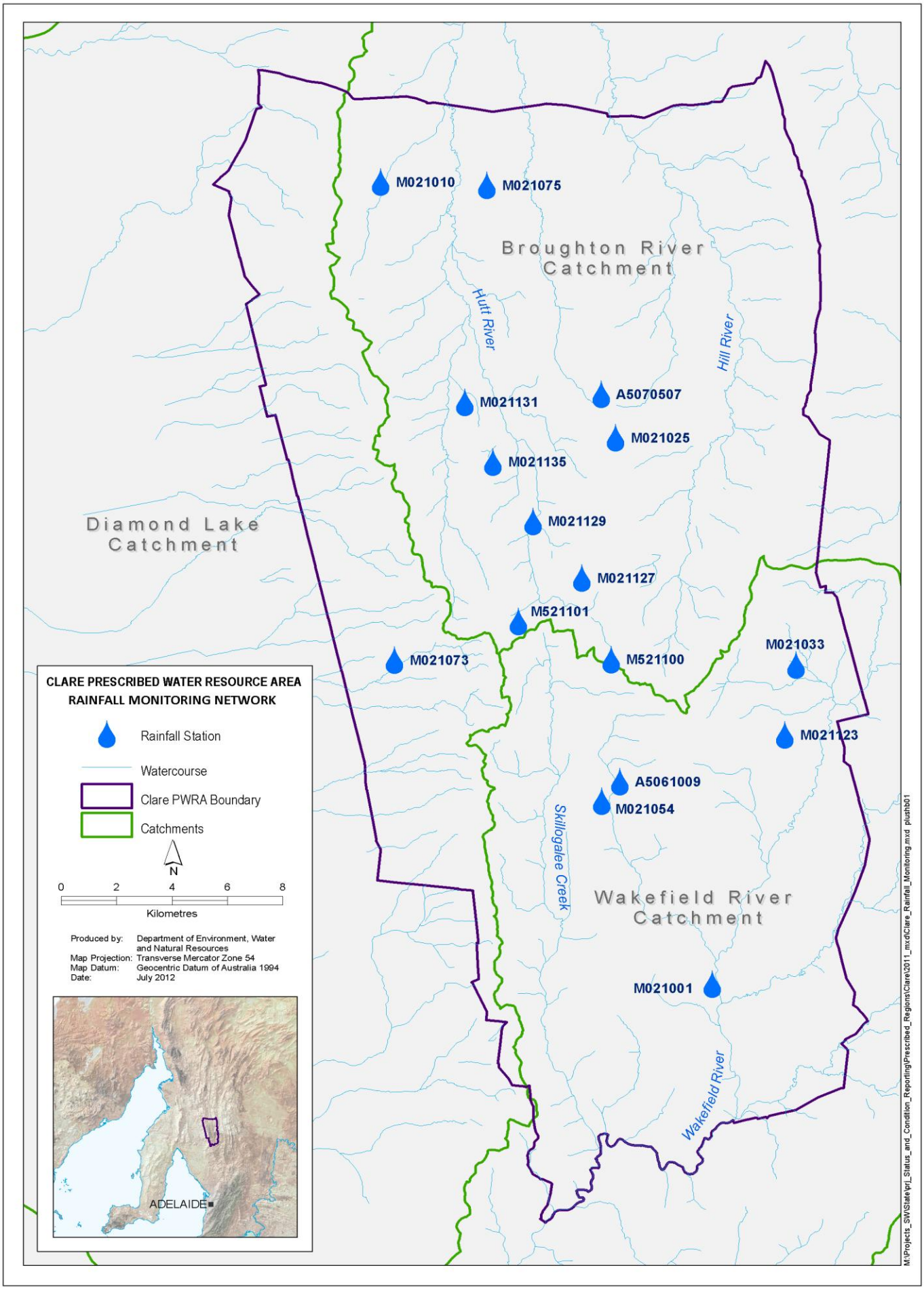


Figure 4. Location of rainfall monitoring sites in the Clare PWRA

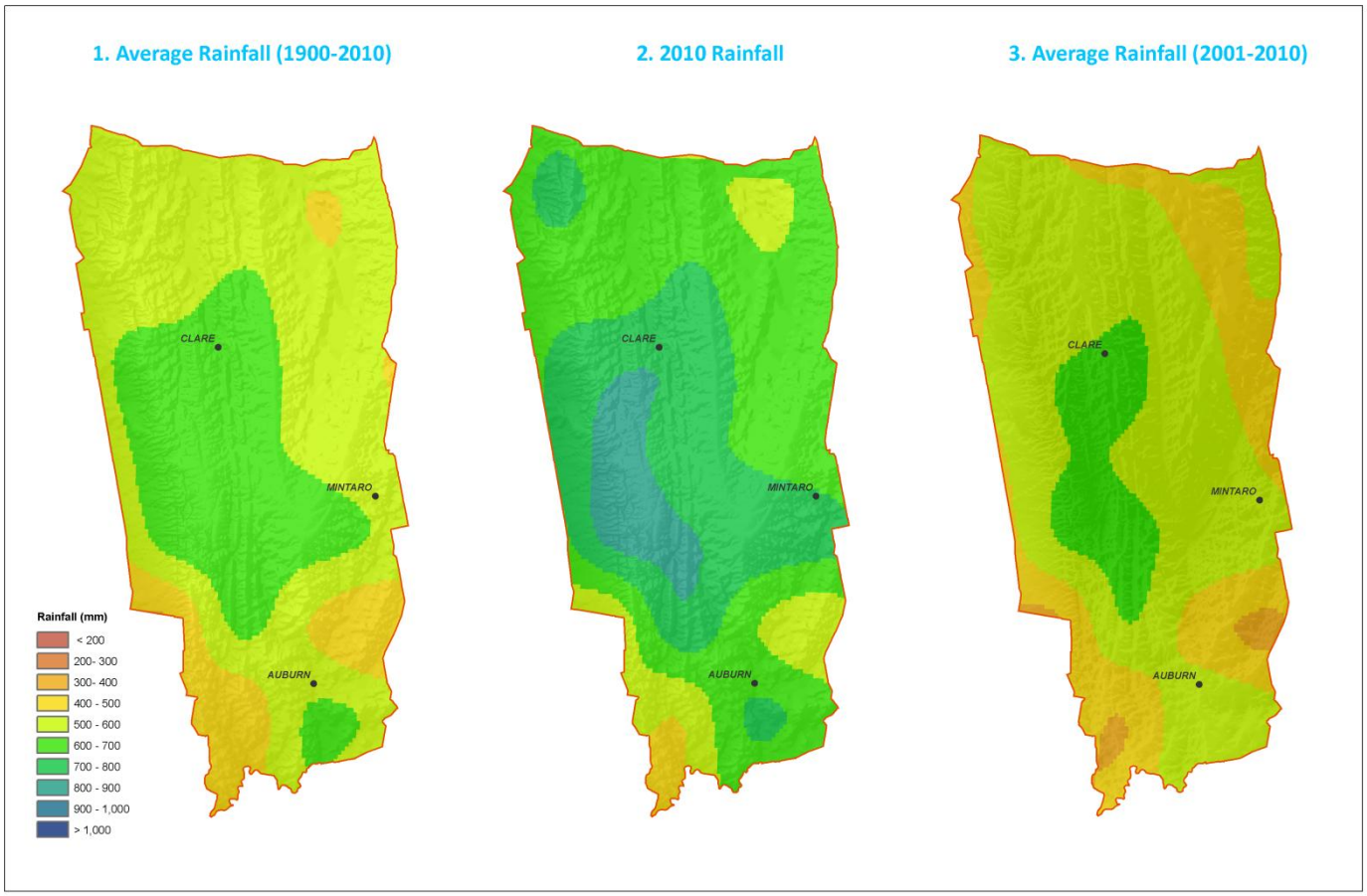


Figure 5. Annual rainfall distributions for the Clare PWRA

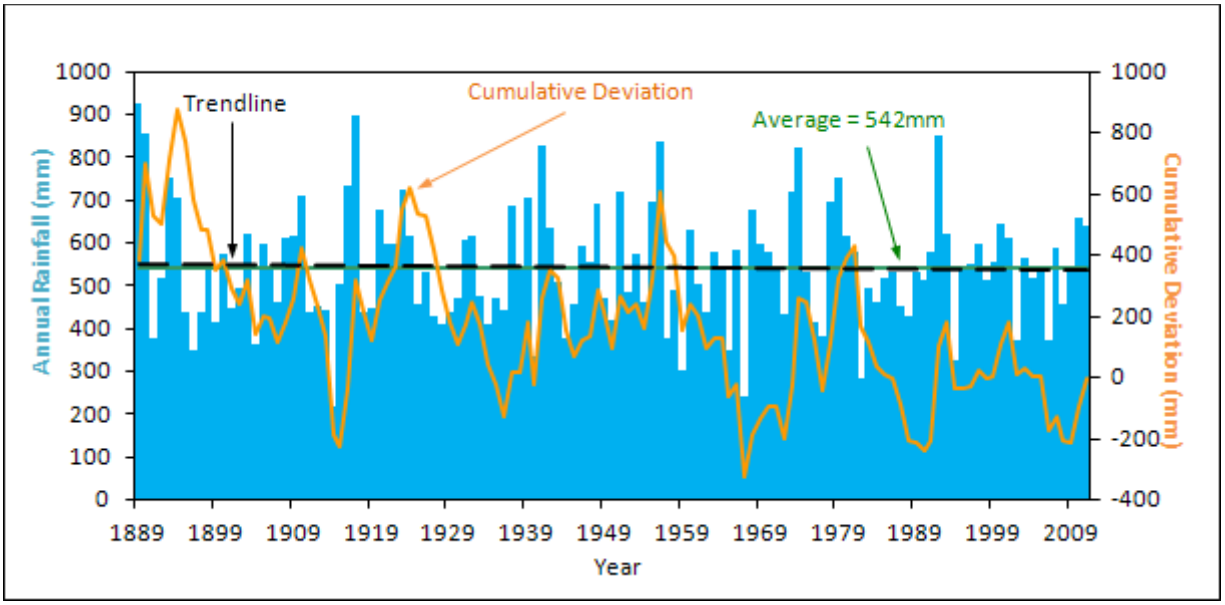


Figure 6. Clare (Calcannia) annual rainfall showing long term trend and cumulative deviation

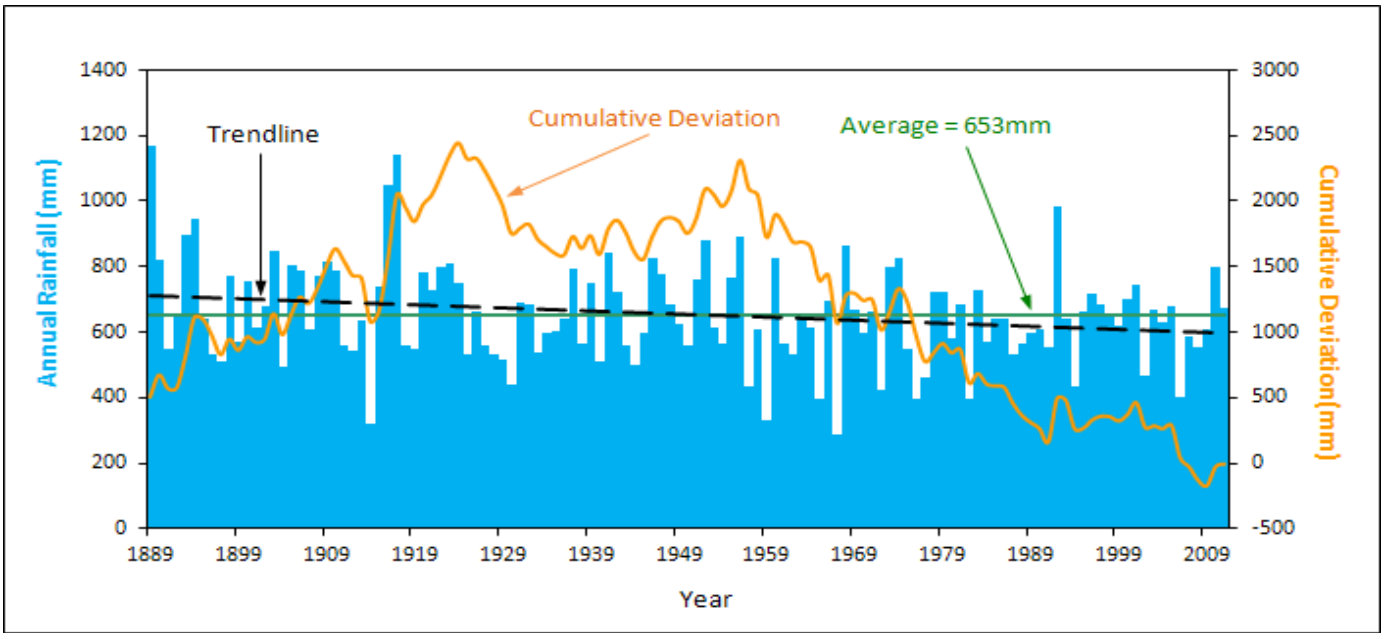


Figure 7. Watervale annual rainfall showing long term trend and cumulative deviation

STREAMFLOW

Status	Degree of confidence	Comments on recent historical context
Above average streamflow.	High-Medium: data derived from long-term streamflow stations for both the Broughton and Wakefield catchments.	Streamflow has shown a recovery this year in response to higher than average rainfall.

The Clare PWRA can be divided into a northern half that is part of the Broughton River Catchment and a southern half that is part of the Wakefield River Catchment (Figure 1). The streamflow monitoring network for the Clare PWRA and surrounding area is shown in Figure 8. Parameters recorded at these sites include both streamflow and salinity.

Broughton River Catchment

Streamflow gauging stations of the Broughton River section are located outside the PWRA boundary, meaning flow records taken at these locations include contributions from between the PWRA boundary and the gauging stations. The Hutt River gauging station (A5070501), which is approximately 20 km downstream of the PWRA boundary, has a mean annual flow of 5900 ML from 1969–10. The Hill River gauging station (A5070500), which is approximately 12 km downstream of the PWRA boundary, has a mean annual flow of 4030 ML for the same period. The average annual rainfall for the contributing catchment area to the Hill River gauging station is slightly less than that of the Hutt River station and also has less contributing catchment area overall, resulting in a lower mean annual flow. Salinity measurements have only been collected sporadically over the period for the two stations, with continuous conductivity probes being installed in October 2010 at both sites. It is expected that these instruments will allow the measurement and detection of salinity trends to be established in future years.

Wakefield River Catchment

The Wakefield River section of the PWRA has four active gauging stations located within the PWRA boundary. The main gauging station for the Wakefield section is Wakefield River near Rhynie (A5060500). This station is downstream of the Skillogalee and Eyre Creek gauging stations, so its total recorded data includes those stations upstream. The Wakefield River station also has a large catchment area outside of the PWRA that contributes to the flow record of the station. Time-series flow data for this station have been recorded since 1941 and has a mean annual flow of 6750 ML from 1969 to 2010, to correspond with the time period used to summarize the Broughton River gauging stations.

Table 1. Summary of gauging stations in the Clare PWRA and surrounding area

Gauging station	Station No.	Period of streamflow	Average annual streamflow	
			ML	mm
Hutt River	A5070501	1969-2010	5900	21
Hill River	A5070500	1969-2010	4030	17
Wakefield River	A5060500	1969-2010	6750	16
Eyre Creek at Watervale	A5060501	1995-2009	150	14
Eyre Creek at Auburn	A5060502	1995-2009	280	9
Skillogalee Creek	A5061008	1995-2009	345	6

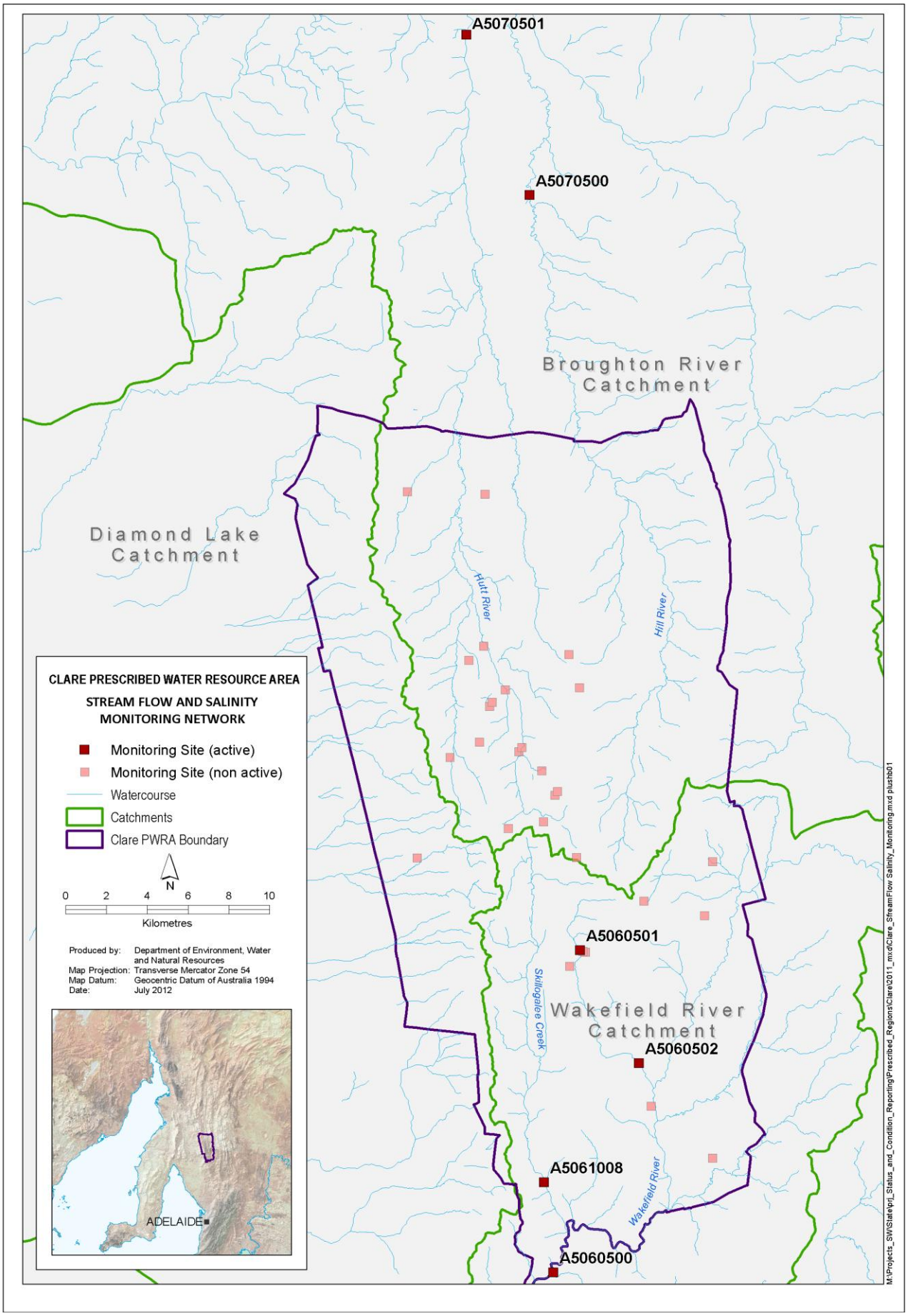
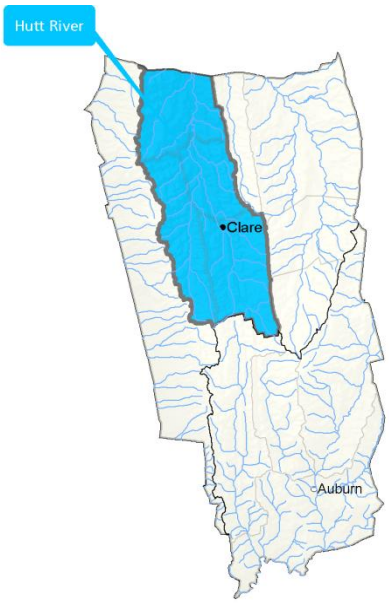


Figure 8. Location of streamflow and salinity monitoring sites in the Clare PWRA

STREAMFLOW DATA – BROUGHTON RIVER



HUTT RIVER

Hutt River experienced an above average annual streamflow for 2010–11, as highlighted in green in Figure 9. The 8840 ML total was 50% higher than the 5900 ML long term average. Since 2002–03, Hutt River has experienced significantly below average streamflow, with 2008–09 recording no streamflow at all. The monthly breakdown of streamflow for 2010–11 (Figure 10) highlights that September, November, December and March to May had totals above the average. Extremely high flows in September 2010 followed a slow start to the year. 2011 flows remained at around average levels.

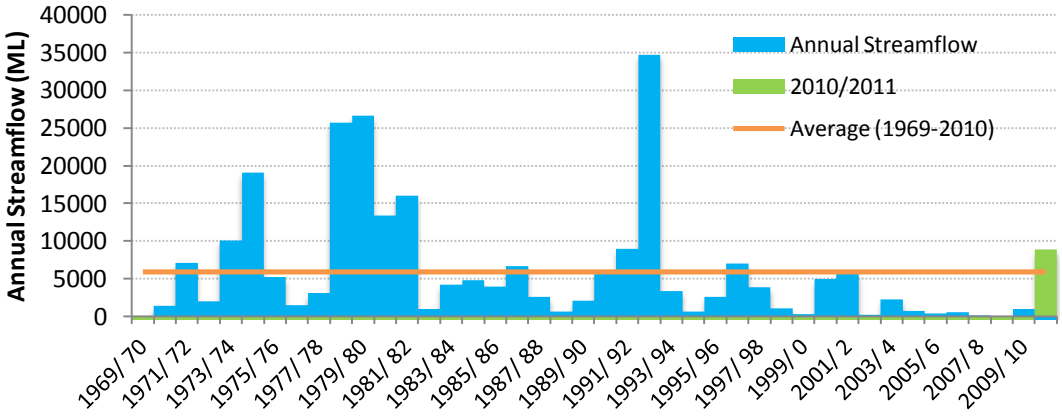


Figure 9. Hutt River annual streamflow (ML)

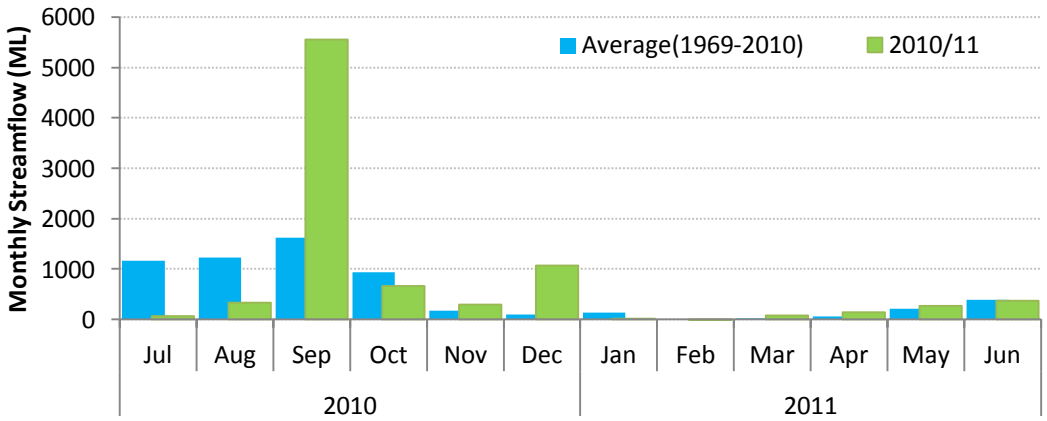


Figure 10 Hutt River monthly streamflow (ML)

HILL RIVER

Hill River experienced an above average annual streamflow for 2010–11, as highlighted in green in Figure 11. The 6140 ML total was 52% higher than the 4030 ML long term average. Since 2002–03, Hill River has experienced significantly below average streamflow, with 2008–09 producing no recorded streamflow at all. This replicates the conditions experienced on the Hutt River. The monthly breakdown of streamflow for 2010–11 (Figure 12) highlights those seven months with totals above the average. Extremely high flows in September 2010 followed a slow start to the year. 2011 flows continued at slightly above average levels.

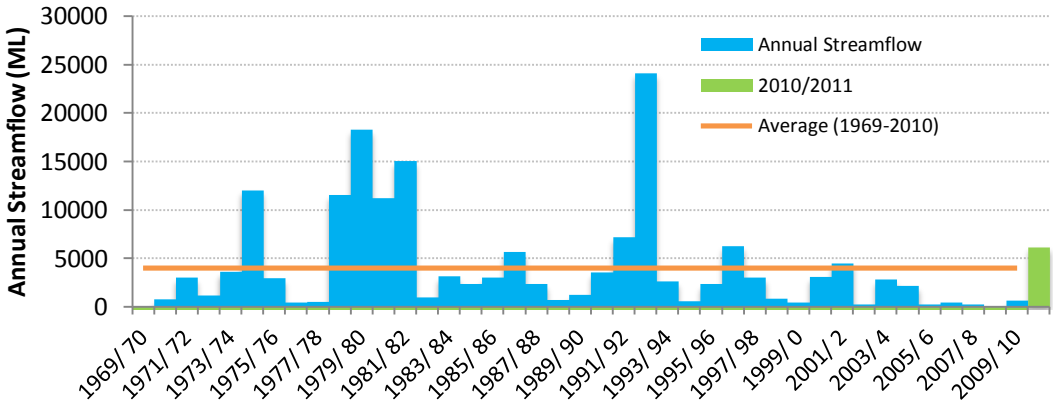


Figure 11. Hill River annual streamflow (ML)

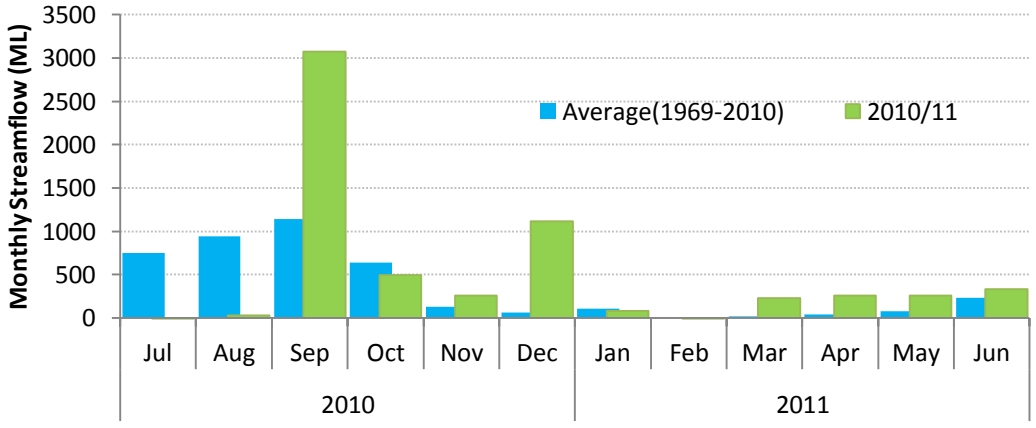
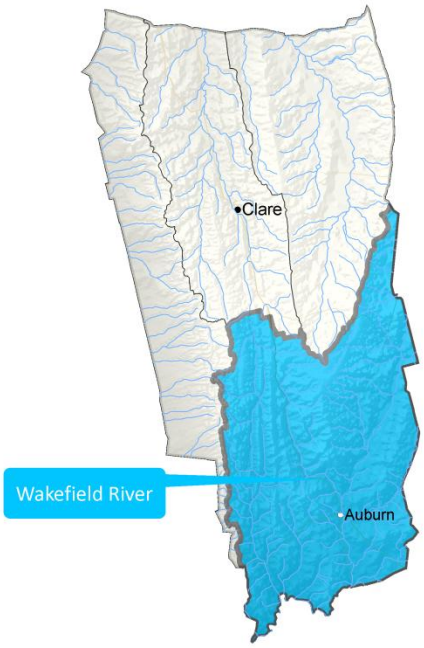


Figure 12. Hill River monthly streamflow (ML)

STREAMFLOW DATA - WAKEFIELD RIVER

Wakefield River experienced above average annual streamflow for 2010–11, as highlighted in green in Figure 13. The 12,250 ML total is more than 80% higher than the 6,750 ML long term average. Since 2002–03, Wakefield River has experienced below average streamflow. This period of below average flows coincides with the stations mentioned previously over the same period. The monthly distribution of streamflow for 2010–11 (Figure 14) highlights the highly variable nature of this part of the catchment. Extreme flow events in September and December made up over 96% of the total flow for the 2010-11 period.



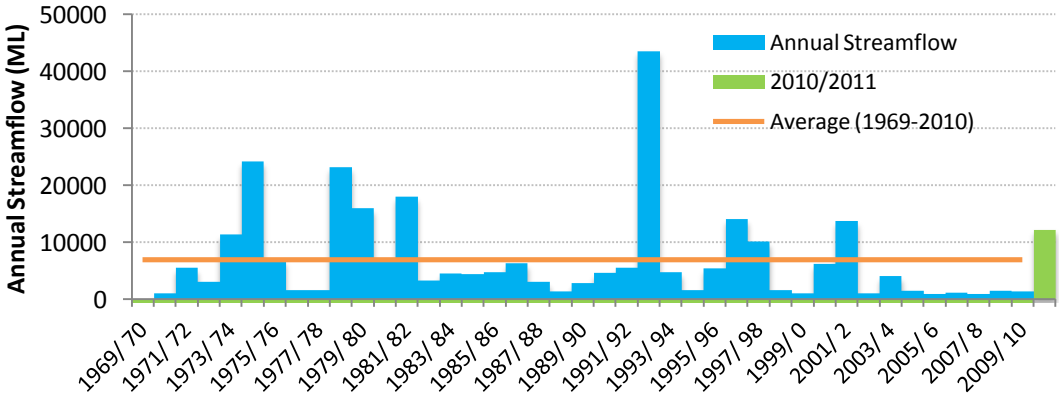


Figure 13. Wakefield River annual streamflow (ML)

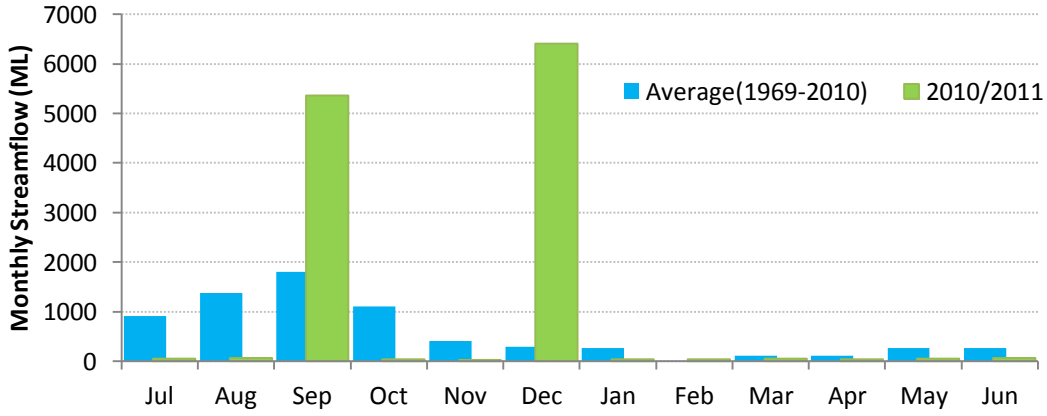
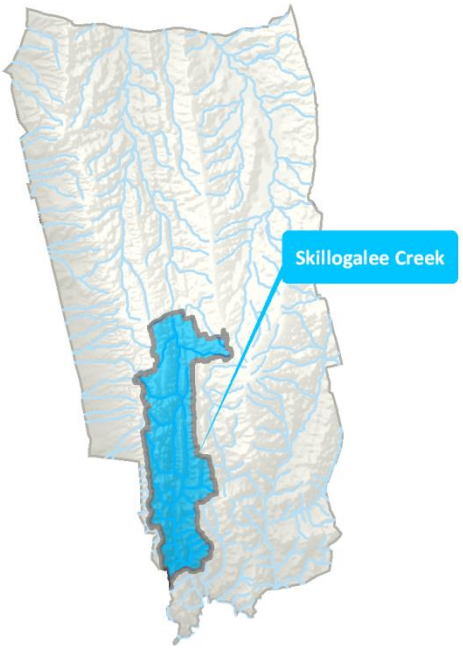


Figure 14. Wakefield River monthly streamflow (ML)

Status	Degree of confidence	Comments on recent historical context
Around average or freshening.	Medium; data representative for the Wakefield catchment only.	Salinities have fallen, mostly due to increased flows observed this year.

SKILLOGALEE CREEK



Salinity data has been recorded at the Skillogalee Creek (A5061008) monitoring station since June 2003. Despite some data gaps with no recorded information, the station provides a good indication of salinity in the creek over the past seven years.

The station drains 62.4 km^2 of the upper Wakefield Catchment area. 66% of the recorded data is rated as good or fair quality, 4% at poor quality and 30% as either missing or outside the recordable range. This data is shown in Figure 15 below.

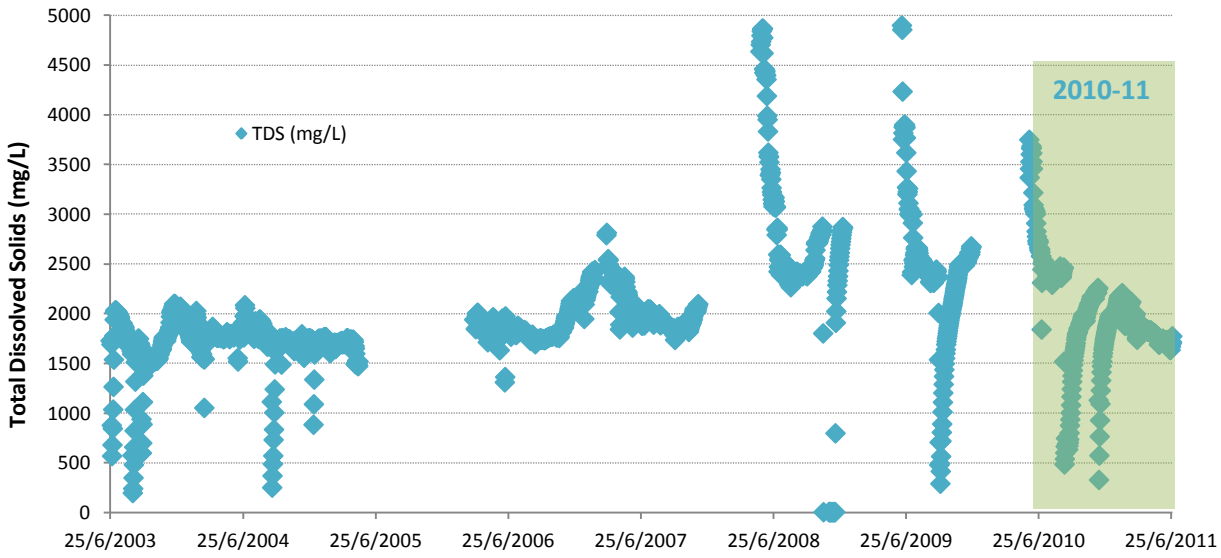


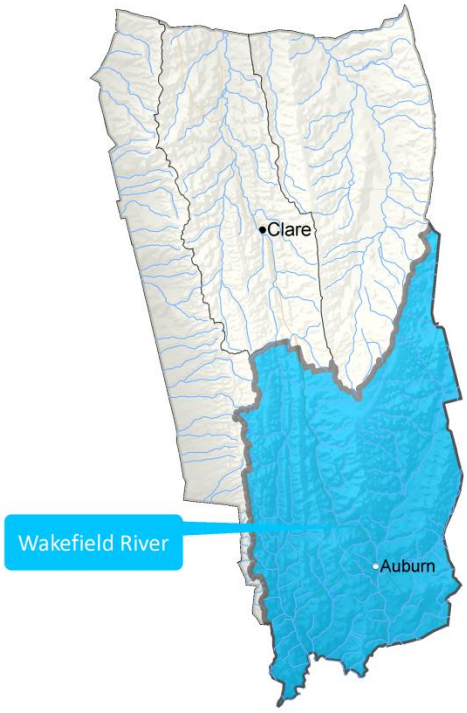
Figure 15. Salinity data at Skillogalee Creek from 2003–11

Years 2003 to 2007 all showed high-flow season (winter) daily salinities of less than 2000 mg/L and summer peaks of less than 3000 mg/L. During the following three years, seasonal winter salinities were in excess of 2000 mg/L while the summer peaks in salinity were much higher than previously recorded. Due to higher streamflow, salinities at this station have decreased to the levels of 2003 and 2004.

WAKEFIELD RIVER NEAR RHYNIE

Salinity data has been recorded at the station since 1970 as point measurements and has been upgraded to a continuous record from July 2006. Figure 16 shows continuously recorded salinity record at the station. Even though some data gaps are present in the continuous record, the period of record is long enough to provide a general trend of salinity in the river.

There seems no obvious trends of increase or decrease in salinity. More than 70% of the data lies between 2000-4000 mg/L and most of the remaining data is scattered between 1000–5000 mg/L.



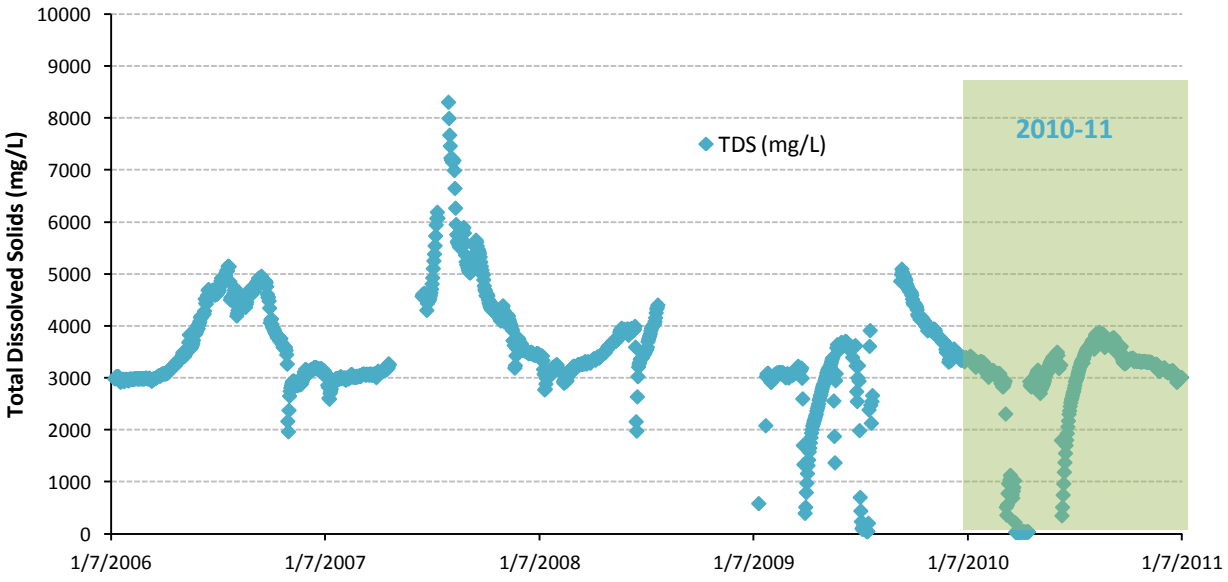


Figure 16. Salinity data at Wakefield River from 2006–11

SURFACE WATER DEVELOPMENT AND USE

Status	Degree of confidence	Comments on recent historical context
Around long-term average use. High usage compared to runoff.	High: meter readings are taken twice a year.	Imported water use has fallen, whilst extractions from farm dams and streams remains around average levels.

This section includes description and estimates of the type and distribution of surface water development and use in the Clare PWRA. Groundwater use is described in the Groundwater Status Report available for this region on the WaterConnect website: http://www.waterconnect.sa.gov.au/GSR/

Water use for irrigation, commercial, stock and domestic purposes comes from a variety of sources including pumping from streams and rivers, interception and storage by farm dams, groundwater pumping and, since 2006, imported water from the SA Water Clare Valley Water Supply Scheme. Water use is controlled by the Clare Valley WAP which is administered by the Northern and Yorke NRM Board.

FARM DAMS

The Clare Water Allocation Plan 2009 states there are 1435 farm dams within the Clare PWRA, with an estimated capacity of 6451 ML. A breakdown of farm dam statistics is given in Table 2 below.

Table 2. Summary of farm dams in the Clare PWRA

Major sub-catchment	Count			Volume (ML)		
	Total	Licensed	Non-Licensed	Licensed	Non-Licensed	Total Vol
Wakefield	411	59	352	1358	527	1885
Hutt	669	117	552	1385	959	2344
Hill	260	20	240	1250	871	2121
Clare Valley West	95	1	94	4	97	101
Total	1435	197	1238	3997	2454	6451

As water levels in farm dams are not currently monitored, this report cannot indicate the status of farm dam storage volumes from year to year. The status of water levels in farm dams in this area is contingent on many factors including:

- the amount in storage from the previous year
- the demand (extraction) placed on the dam over the irrigation season
- the amount of inflows to the dam
- any other inflows including groundwater pumping or imported water
- other losses from seepage and/or evaporation.

As irrigated water use is metered from those dams and watercourse pumps with meters, those numbers are reported in the following section on metered water use.

Estimated Non-licensed water demand

A further estimate on the water use for stock and domestic (non-licensed) purposes across the area is made in the 2009 WAP. This estimates approximately 750 to 1000 ML per year for stock water with an additional 350 ML for domestic purposes. The divide between surface water and groundwater demand is not stated. Assuming 50% of this demand comes from surface water sources and using the upper estimate, the estimate is 675 ML. This equates to approximately 30% of the existing stock and domestic dam capacity. The estimated irrigation demand from surface water (farm dams) for this period for irrigation was 712 ML (Clare Water Allocation Plan 2009), which is around 18% of the total capacity of farm dams licensed for irrigation.

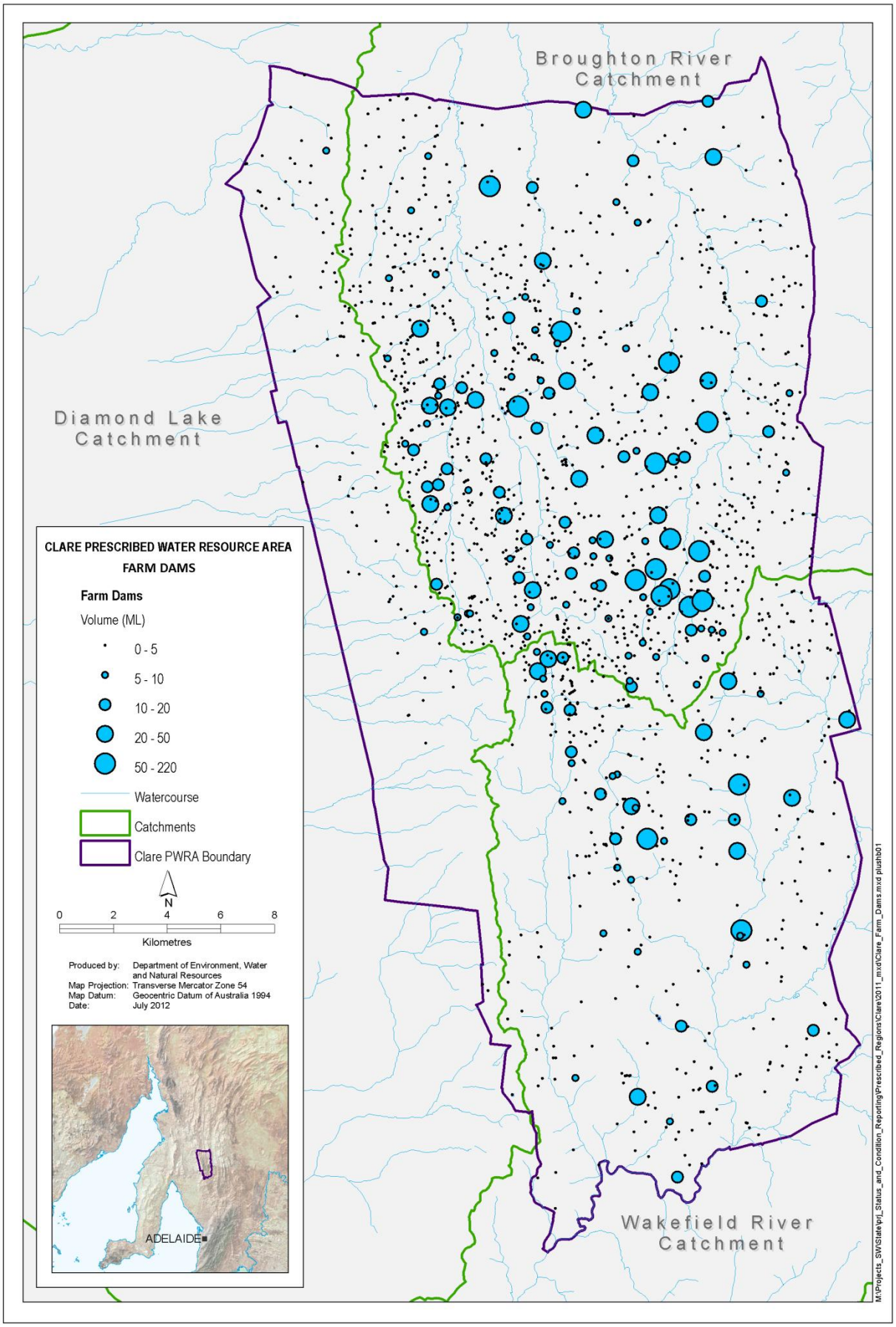


Figure 17. Licensed and non-licensed farm dam distribution of the Clare PWRA

METERED WATER USE 2010–11

The distribution of metered water use (Figure 18) includes imported water, irrigated water use from dams and streams and estimated stock and domestic demand from farm dams. Surface water usage in the early part of the decade coupled with farm dams was the main source of water in the region. SA Water resources being pumped to the region, beginning in 2006, immediately reduced usage from surface water and farm dams compared to early in the decade. The last three years has seen a slight increase in usage from streams.

Table 3. Summary of water use in the Clare PWRA

Clare PWRA water resources (ML)	Watercourse extractions	477
	Dam extractions	714
	Total licensed extractions	**1191**
	Estimated Stock and Domestic Demand	675
Clare Valley Water Supply Scheme (ML)	CVWSS	141
	3rd Party Transportation	427
Total water extractions		2434

Water usage from licensed surface water sources in 2010–11 totalled approximately 1,191 ML (Table 3). This is up from the previous year's total of 1,029 ML. Water use from the CVSS is down to 568 ML from the previous year's total of 1,185 ML. The distribution of water use across the area is shown in Figure 18.

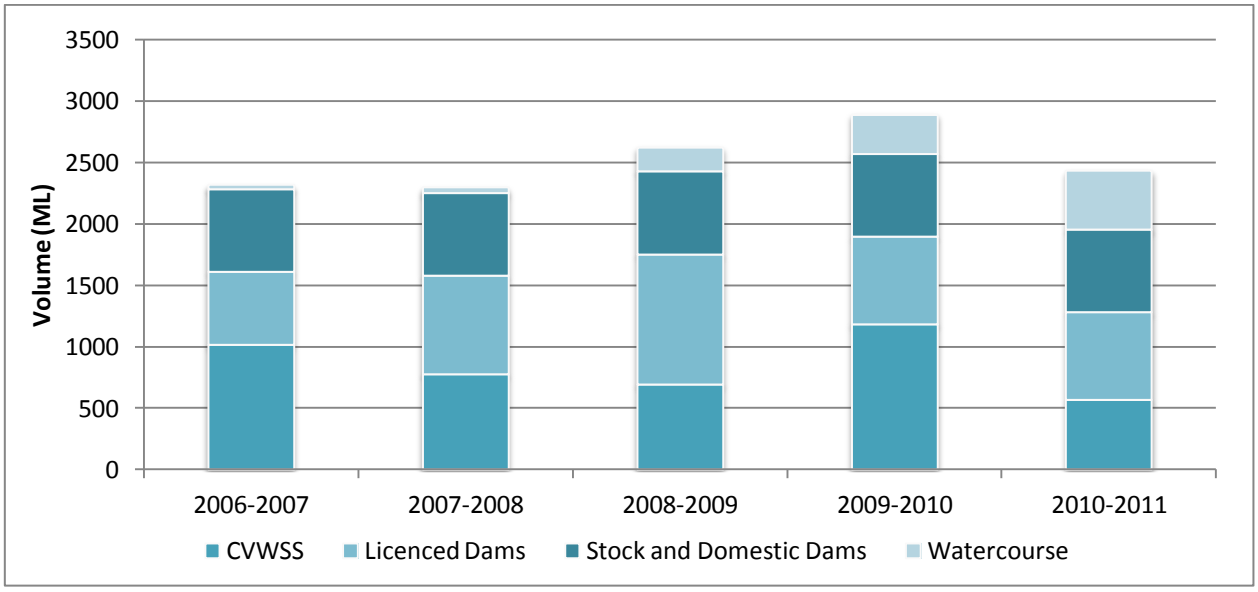


Figure 18. Surface water use in the Clare PWRA from 2006 to 2010–11

DEVELOPMENT AND USE RATING

An assessment of development and use was carried out using a rating from 1 to 6 to indicate the estimated percentage of the year's surface water resources used for irrigation, commercial, or stock or domestic purposes.

As reported in earlier sections, water resources in the Clare PWRA provide high value irrigation to the wine and other industries. The year 2010–11 was an above average rainfall year, which produced above average runoff to the rivers of the Wakefield and Broughton River catchments. In order to determine the impact of water extractions, from farm dams and watercourse, a comparison of recorded streamflow and recorded and estimated water use is useful.

Recorded streamflow for the Clare PWRA in 2010–11 was approximately 20,500 ML, with approximately 1866 ML recorded or estimated as being extracted. As such, of the 2010–11 total estimated Clare PWRA streamflow volume (not including evaporation from farm dams) (20,500 +1866 = 22,366 ML), it is estimated that 8% was extracted for use. In terms of the rating system described by the adjacent table, the Clare PWRA has been assigned a development and use rating of 1 (Negligible/development) for 2010–11.

Table 4. Development and Use Rating System

Rating	% of surface water used in current year	Description
1	0 – 10 %	Negligible use/development
2	10 – 20 %	Low use/development
3	20 – 30 %	Moderate use/development
4	30 – 40 %	High use/development
5	40 – 50 %	Very high use/development
6	Greater than 50 %	Extremely high use/development

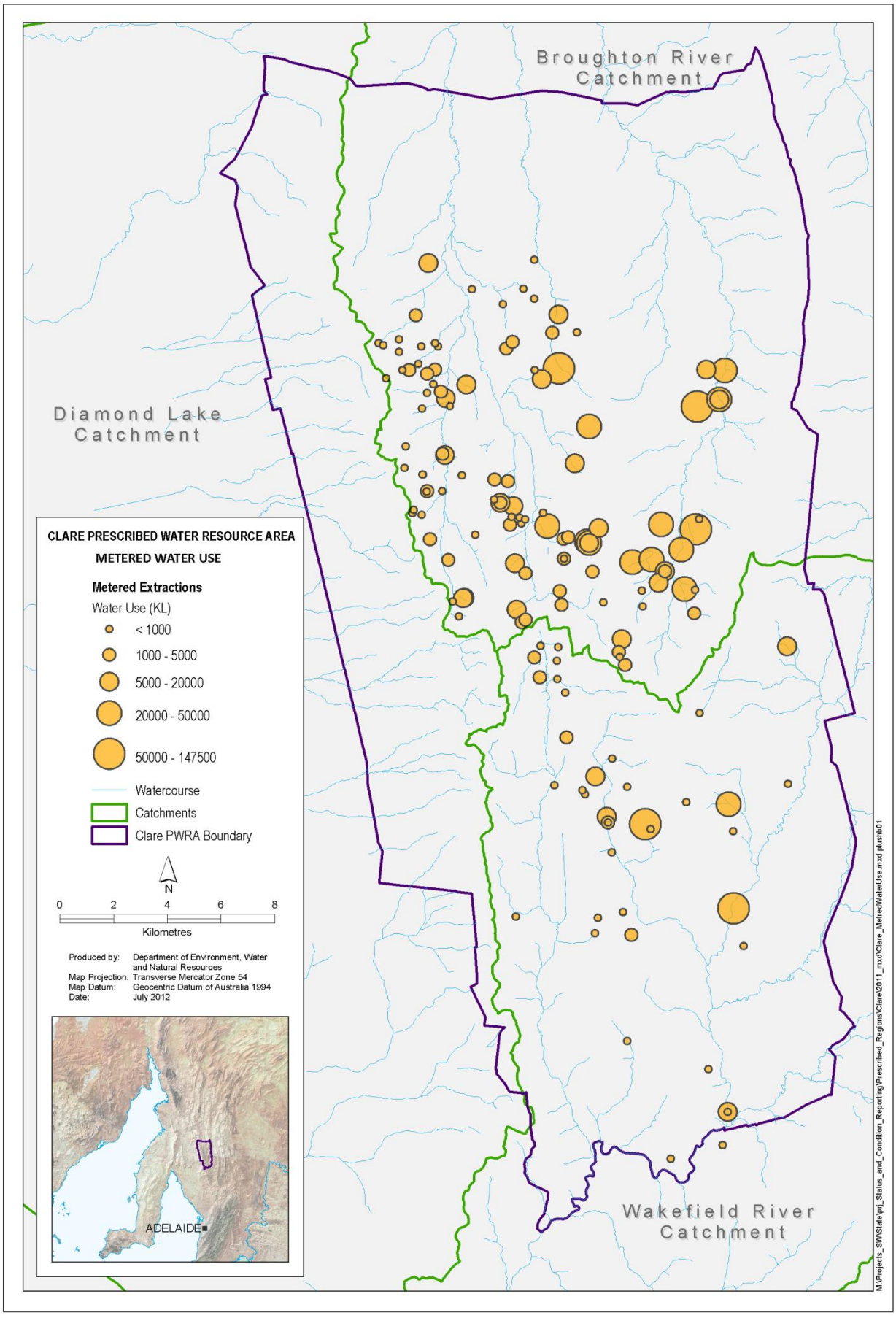


Figure 19. Metered water extractions in the Clare PWRA for 2010–11

STATUS OF WATER DEPENDENT ECOSYSTEMS IN THE CLARE VALLEY PWRA

Status	Degree of confidence	Comments on recent historical context
Stress likelihood: Low.	Medium: assessment based on analysis of streamflow data and environmental water requirements.	A return to above average streamflow following two years of good rainfall has contributed to a return to the required flow regime.

INTRODUCTION

Water dependent ecosystems are defined as those parts of the environment, such as species composition and natural ecological processes, which are determined by the permanent or temporary presence of flowing or standing water (ARMCANZ & ANZECC 1996). This section assesses the extent to which flows derived from runoff in the Clare PWRA deliver the environmental water requirements (EWRs) that have been determined for water dependent ecosystems. From this assessment, a rating of ecological stress has been undertaken that indicates the likelihood of regional scale impacts over the reporting period caused by deviations from EWRs. This ecological stress rating serves as one of the indicators of the status of the surface water resources for the Clare PWRA.

DELIVERY OF ENVIRONMENTAL WATER REQUIREMENTS

The 2009 Clare Valley PWRA WAP established EWRs for the Broughton and Wakefield River catchments on the basis of Favier et al (2004), Favier et al (2000), Lloyd (2000) and Cresswell (2000). These requirements are expressed as 'flow bands', which describe the magnitude, duration, seasonality and frequency of the flow events necessary to maintain key ecological functions. Typically, 6 to 7 flow bands have been identified for each EWR reference site with each band being linked to a particular set of ecological outcomes.

Time series of flow data are available from three gauging stations. Figure 20 shows that two of these stations (A5070500 and A5070501) are located on the Hill and Hutt Rivers respectively in the Broughton River catchment, while the remaining site (A5060500) is located on the Wakefield River. While these gauging stations are located outside the prescribed area, the collective data from these stations are assumed to indicate flow regimes affected by rainfall, water use and underground water interactions within the Clare PWRA.

To determine the delivery of EWRs, flow data from the three available gauging stations have been analysed using criteria derived from the EWRs determined for reaches lying immediately upstream of these stations. These criteria are presented in Table 5. Note that the flow bands outlined by each row of Table 5 have been chosen on the basis that they support equivalent ecological functions for both the Broughton River and Wakefield River catchments. Furthermore, these criteria specifically address flow bands derived predominantly from surface runoff and not those derived from underground water.

Table 5. Criteria for assessment of environmental water requirements (after Northern and Yorke Natural Resources Management Board 2009)

Broughton River Catchment				Wakefield River Catchment		
Flow band		**A5070500 Hill River**	**A5070501 Hutt River**	**Flow band**		**A5060500 Wakefield River**
Overbank flow	Flow	7.5 m^3/s	20 m^3/s	**Floodplain**	Flow	40 m^3/s
	Duration	1 day	1 day		Duration	1 day
	Frequency	1 in 3 years	1 in 5 years		Frequency	1 in 20 years
High flow	Flow	6.5 m^3/s	7.5 m^3/s	**High flow**	Flow	15 m^3/s
	Duration	2 days	2 days		Duration	1 day
	Frequency	1 in 3 years	1 in 3 years		Frequency	1 in 6 years
Mid flow	Flow	1.5 m^3/s	2 m^3/s	**Migration flow**	Flow	3 m^3/s
	Duration	4 days	4 days		Duration	7 days
	Frequency	1 in 3 years	1 in 3 years		Frequency	Annual
Seasonal low flow	Flow	0.025 m^3/s	0.5 m^3/s	**Habitat connection flow**	Flow	1 m^3/s
	Duration	2 weeks	4 weeks		Duration	4 days
	Frequency	Annual	Annual		Frequency	3 per year

For this 2010-11 report, each of the flow bands outlined in Table 5 was assessed using the time-series flow data for the relevant site ending in June 2011. The length of the time series analysed depended on the sustainable frequency outlined by the criteria in Table 5. For example, an assessment of the 'overbank flow' flow band for the Hill River involved analysis of flow data from station A5070500 over the period 2008 to 2011, as this time window enables determination of occurrence at the required sustainable frequency of at least once in three years.

Table 6 summarises the results of the analysis by showing the presence or absence of site/flow band combinations observed for the reporting period. It was found that all of the 12 assessed flow bands were graded as having met the EWRs outlined in Table 6.

Table 6. Achievement of environmental water requirements over reporting period

Site	Hill River (A5070500)	Hutt River (A5070501)	Wakefield River (A5060500)
Overbank flow	✓	✓	✓
High flow	✓	✓	✓
Mid flow	✓	✓	✓
Seasonal low flow	✓	✓	✓

ASSESSMENT OF ECOSYSTEM STRESS

Table 7 outlines an ecosystem stress likelihood rating system to be applied at the prescribed area scale. According to this system, regional-scale water dependent ecosystem degradation is more likely when:

- a greater proportion of flow bands are not observed and/or
- specific flow bands are not delivered for a high proportion of sites.

The second criterion above indicates the extent to which a specific ecological function could be impaired at a regional scale. Note that for the purposes of this rating system, all flow bands are assumed to be equally important in their contribution to the wellbeing of water dependent ecosystems. Also, note that the ecosystem stress rating only indicates the likely patterns of degradation, not the severity of degradation events.

Table 7. Criteria for regional ecosystem stress likelihood rating

Ecosystem stress likelihood	Criteria
Low	All metrics passed
Moderate	10 or 11 metrics passed
High	7 to 9 metrics passed OR 2 sites failed for a single metric
Almost certain	0 to 6 metrics observed OR 3 sites failed for a single metric

With all EWRs delivered, the ecosystem stress likelihood rating as defined by the flow regime for the Clare PWRA (Table 7) was graded as 'low' during the reporting period.

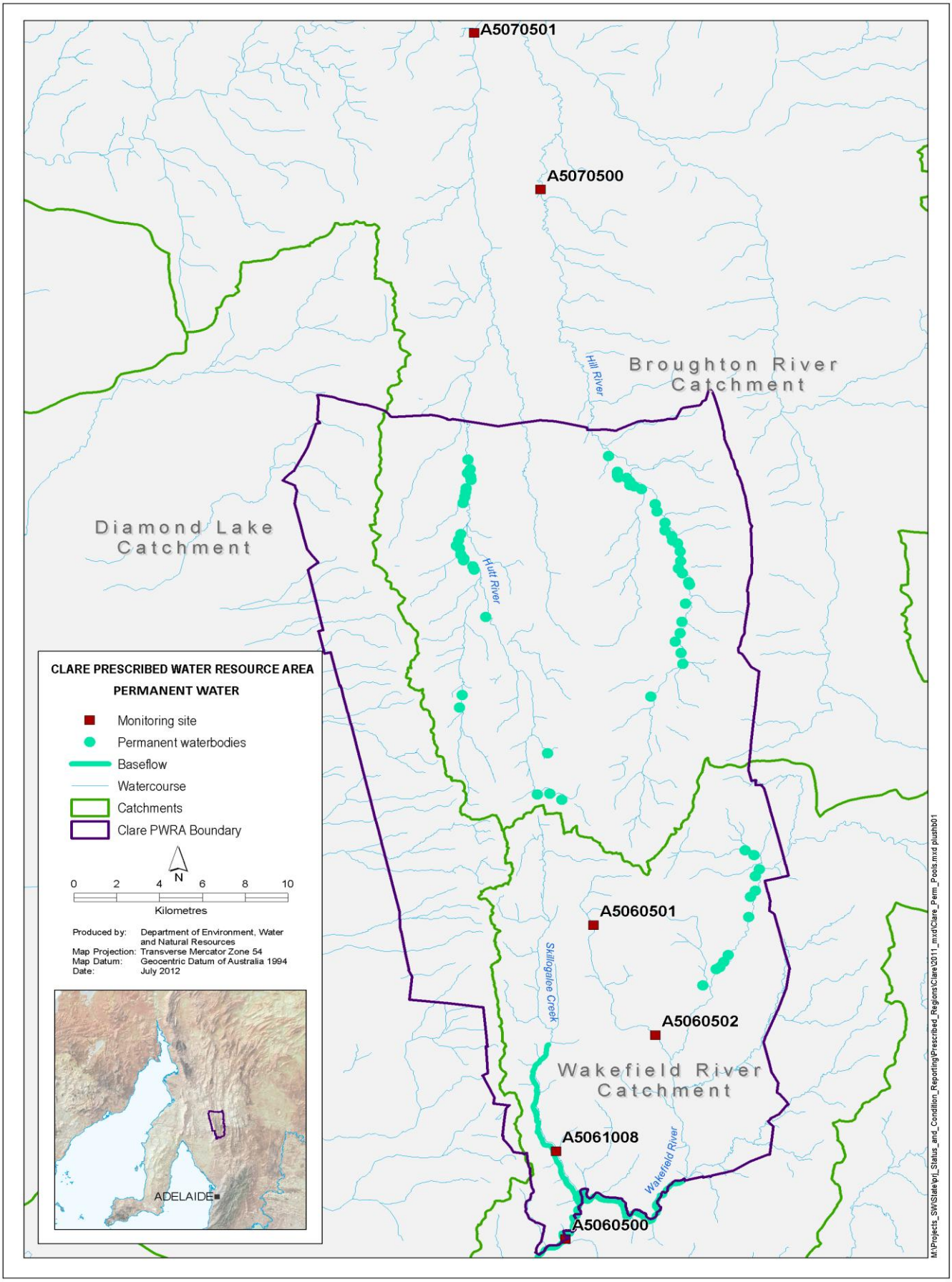


Figure 20. Areas with permanent water in the Clare PWRA

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