NON-PRESCRIBED SURFACE WATER RESOURCES ASSESSMENT

KANGAROO ISLAND NATURAL RESOURCES MANAGEMENT REGION

2013

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

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DEPARTMENT OF ENVIRONMENT, WATER AND NATURAL RESOURCES

JUNE 2013

DEWNR TECHNICAL REPORT 2013/07

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ISBN 978-1-921923-79-1

Preferred way to cite this publication
DEWNR, 2013, *Non-prescribed Surface Water Resources Assessment – Kangaroo Island Natural Resources Management Region,* Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide

Download this document at: http://www.waterconnect.sa.gov.au

Foreword

The Department of Environment, Water and Natural Resources (DEWNR) is responsible for the management of the State's natural resources, ranging from policy leadership to on-ground delivery in consultation with government, industry and communities.

High-quality science and effective monitoring provides the foundation for the successful management of our environment and natural resources. This is achieved through undertaking appropriate research, investigations, assessments, monitoring and evaluation.

DEWNR's strong partnerships with educational and research institutions, industries, government agencies, Natural Resources Management Boards and the community ensures that there is continual capacity building across the sector and that the best skills and expertise are used to inform decision making.

Allan Holmes
CHIEF EXECUTIVE
DEPARTMENT OF ENVIRONMENT, WATER AND NATURAL RESOURCES

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1. Introduction

In an environment where water resources are increasingly scarce, a better understanding of water resource capacity and a more proactive approach to management is required. The Government of South Australia (2009) in its *Water for Good* plan acknowledged the importance of establishing a baseline understanding of South Australia's (the State's) resources. The status and condition of resources and their regular assessment is important to enhance sustainable development opportunities, to avoid overuse and to act proactively to any significant quantitative changes in the condition of these resources. *Water for Good* supports this through an action to expand monitoring networks and increase the regularity of assessments for status and condition reporting of resources.

The Department of Environment, Water and Natural Resources (DEWNR) has the lead-agency responsibility for ensuring the sustainable management of groundwater and surface water resources of the State. As such, DEWNR has developed a program to fulfil responsibilities under the *Natural Resources Management Act 2004* and in response to water security issues facing the State. This report presents findings of the sub-program *Non-prescribed surface water resources assessment – Kangaroo Island Natural Resources Management Region*.

The understanding of surface water resources in most non-prescribed region's across the State is limited. Current knowledge gaps regarding the quantity and quality of surface water resources present significant barriers to the management and potential future development of surface water systems. Addressing these gaps is especially important due to anticipated increases in demand for water, changes in land use and potential impacts associated with a changing climate.

This report aims to provide an overview of the available surface water information for the Kangaroo Island Natural Resources Management Region (region). This includes collating and presenting existing data and information about the non-prescribed surface water resources of the region. The region is one of eight Natural Resources Management (NRM) regions of the State (Figure 1) established under the *NRM Act 2004*. It is recommended this report be read in conjunction with reports available on groundwater and environmental water requirements of the region, to gain a broader understanding of the water resources in the region.

1.1. OBJECTIVE

Water resources are important for sustaining agri-business, industry, mining and rural townships, but non-prescribed regions have traditionally been poorly understood due to limited monitoring and investigation programs. A better understanding of water resources can assist with development of plans and policies for sustainable resource development in the region.

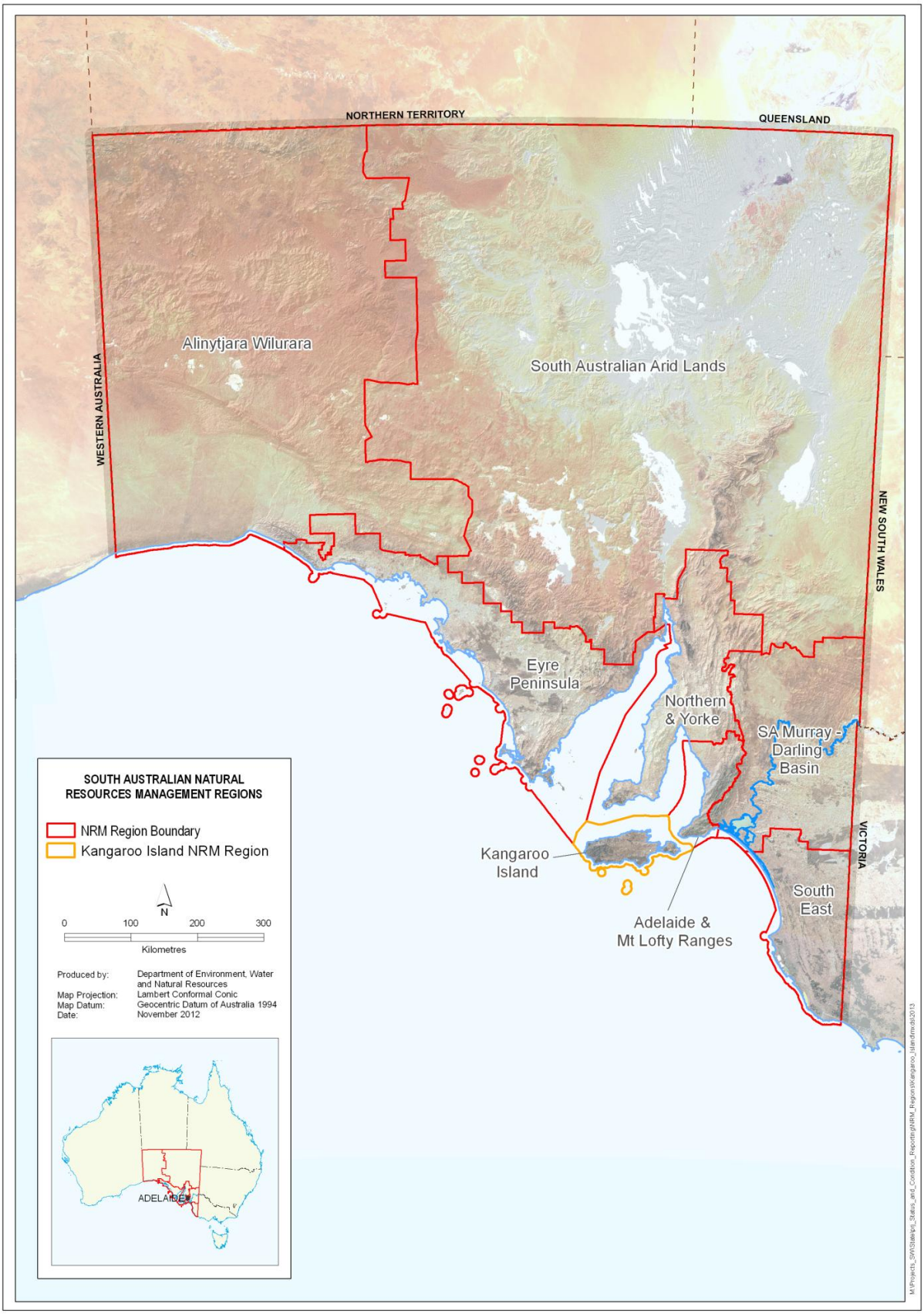

Figure 1. Location of the Kangaroo Island NRM Region

1.2. EARLIER STUDIES

Numerous studies have previously been undertaken for the region on topics such as climate change, monitoring reviews, ecological assessments and water management plans. Some of the more recent surface water reports for the region are highlighted below.

The Nilsen (2006) report was prepared for the Kangaroo Island NRM Board (the Board) following community concerns over deteriorating conditions of water resources of the region. The report describes the condition of surface water and groundwater resources and provides a baseline technical background on the condition of freshwater resources. The focus catchments investigated were Rocky River, Cygnet River, Middle River, Harriet River, Timber Creek and Willson River.

The Kangaroo Island NRM Plan (the Plan) (KINRMB 2009) is a comprehensive document describing land use, threats to natural resources, soils and landscapes, water resources, terrestrial and aquatic ecosystems, coastal estuarine and marine ecosystems, and geological features. The purpose of the Plan is to provide strategic direction, a policy and investment framework, and vision for natural resource management in the region. The Plan sets numerous regional and Board targets relating to the management and protection of water resources in the region. Implemented in September 2009, the Plan included the introduction of Water Affecting Activity Permits and establishment of provisions for the development of farm dams and forestry within Sustainable Use Limits. State legislation has been passed but is yet to be enacted to allow the requirement of forestry developments to receive permit approval. The Plan contains five volumes; State of the Region Report, 10 year Strategic Plan, Regulatory and Operational Policy Implementation, a three year Business Plan, and the MERLIN Framework (Monitoring, Evaluation, Reporting, Learning, and Improving Natural Resources Management).

A report by SA Water (2009) considered current and projected potable water demand and supply for Kangaroo Island. The condition of water resources from where potable supplies are sourced and options to ensure future demands could be met were also addressed.

Fawcett et al. (2006) includes the analysis of rainfall for Kangaroo Island on monthly, seasonal and annual time scales. A report by DENR (2010) contains a synthesis of information detailing region specific global climatic models to assess the impact of climate change scenarios on the region. Models were developed to produce outputs based on 2030 and 2070 time horizons and high, medium and low greenhouse gas emission scenarios.

Banks (2010) provides an assessment of the 'pristine' Rocky River catchment. The report aims to inform decision-making on the allocation of groundwater resources in fractured rock aquifers, by understanding the mechanisms of catchment-scale processes and the connectivity between surface water and groundwater.

The AGT (2010) report was prepared for the former Department for Water and reviewed the groundwater, surface water, ecological and dryland salinity monitoring networks within the region. This report seeks to identify whether the existing networks and frequency of monitoring are adequate to reliably report on the state and condition of the water resources.

The Board has assembled a Water Resources Taskforce. The objectives of the Taskforce are to:

- Facilitate communications with, and involvement of those Regional partners involved in water resources management;
- Provide policy advice and recommendations to the Board on issues and programs relating to water resources management in the region; and
- Assist the Board with the implementation of the recommended actions resulting from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) review of the Plan's water resources management policies, by providing advice and recommendations in relation to the development of new methods for determining Sustainable Use Limits for catchments in the region as required.

Regarding the dot points above, the Board engaged CSIRO to conduct an independent review of water resources policies contained in the Plan. The findings of this review are contained in Aryal (2011). Results of the review have led the Board to commence working towards the development of new methods to determine Sustainable Use Limits for catchments in the region.

Other surface water related investigations undertaken for the region include:

- A Risk Assessment of the Impact of Farm Dams on Streamflow in Catchments on Kangaroo Island (McMurray 2007)
- Environmental Water Requirements of native fishes in the Middle River catchment, Kangaroo Island, South Australia (McNeil and Fredberg 2011)
- Kangaroo Island Plan, A volume of the South Australian Planning Strategy (Department of Planning and Local Government 2011)

2. Characterising the region's surface water hydrology

2.1. CLIMATE

The Kangaroo Island climate is temperate with dry warm summers and cool wet winters. The region has several distinct zones and includes the western side from Cape Borda to Parndana, the eastern side from Parndana to Cape Willoughby and the area around Kingscote (Figure 2). Average rainfall decreases across these areas respectively.

The Bureau of Meteorology (BoM) website (2012) provides temperature statistics for the region. Cape Borda is located on the region's west coast and has a mean summer (December to February) maximum temperature of 24.4°C and a mean monthly minimum temperature during the winter months (June to August) of 9.1°C. Kingscote, on the region's north coast, has a mean summer maximum temperature of 23.7°C and a mean monthly minimum temperature during the winter months of 8.3°C. Cape Willoughby is located on the region's east coast and has a mean summer maximum temperature of 21.8°C and a mean monthly minimum temperature during the winter months of 9.6°C. Long term temperature data are not available for the central part of the region. Maximum temperatures have risen faster in the State compared to other States of Australia, but a slower rise has been observed with minimum temperatures (Suppiah *et al.* 2006). There is currently no evaporation monitoring in the region since BoM station M022814 located at Parndana was closed in 1984. Banks (2010) states mean potential annual evaporation for Kangaroo Island is 1400 mm/y.

Based on BoM rainfall data from 1900-2010, higher annual rainfall is recorded on the western side of the region, generally between 600-900 mm. The eastern side of the region is drier, averaging 400-700 mm per annum. The spatial distribution of rainfall over the region is shown in Figure 3 for:

1. long term average annual rainfall for the period 1900-2010

2. short term average annual rainfall for the period 2001-10.

The average annual rainfall for the period 2001-10 shows similarities with the long term average but a wider distribution of lower rainfall (between 400-500mm) can be seen on the eastern side of the region, from Emu Bay down to D'Estrees Bay. This is in contrast to the western side of the region where distinct zones received slightly higher rainfall in the past 10 years compared to the long term average. The Independent Scientific Review of the Kangaroo Island Natural Resources Management Plan Water Resources Management Policy report (Aryal 2011) also includes a detailed analysis of rainfall trends across the region.

Climate change annual projections for 2030 and 2070 show an increase in temperature and a decrease in rainfall (DENR 2010). The Regional Climate Change Projections report states "by 2030, the 50th percentile (best estimate) under medium emissions is for annual temperatures to increase by 0.8˚C and 1.8˚C by 2070. The best estimate for annual rainfall under medium emissions is a reduction of 3% by 2030 and a reduction of 8% by 2070" (DENR 2010).

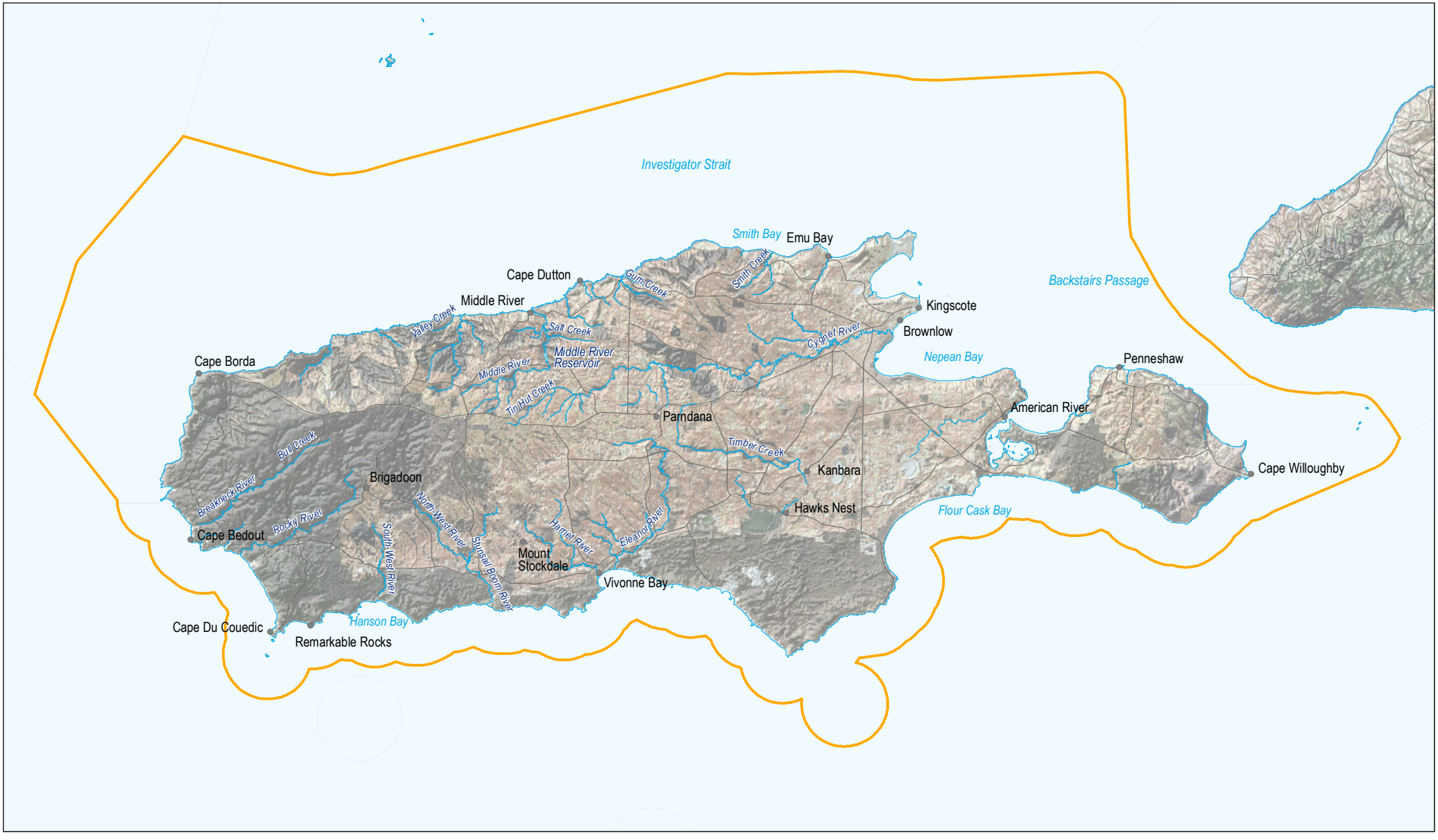

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Figure 2. Detailed map of the Kangaroo Island NRM Region

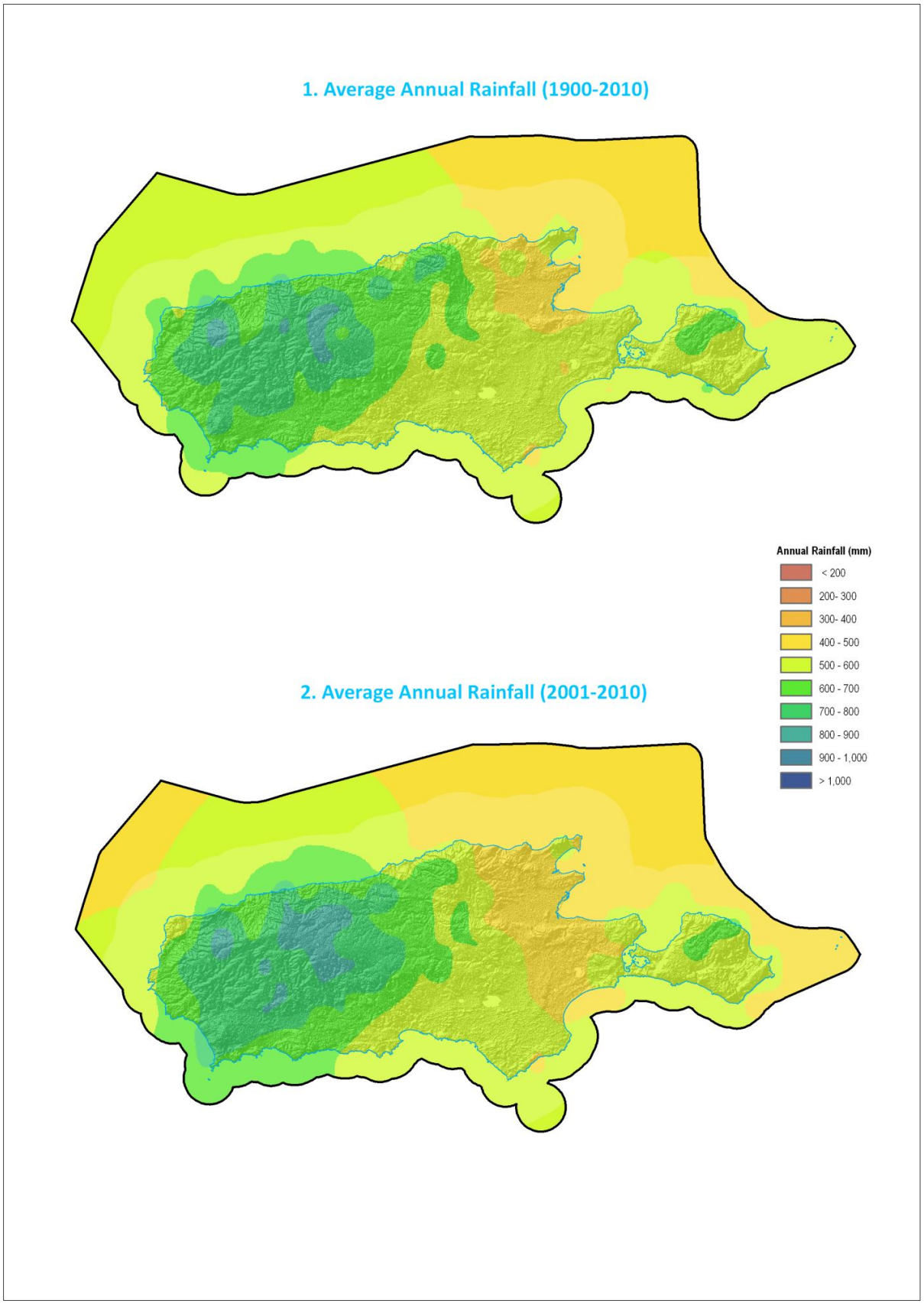


Figure 3. Annual rainfall distributions over the Kangaroo Island NRM Region

2.2. TOPOGRAPHY

Kangaroo Island is Australia's third largest island with an area of 4370 km^2 and around 510 km of coastline. It stretches 155 km from east to west, with a highest altitude of around 310 m (KINRMB 2010). The NRM region for Kangaroo Island also takes in parts of the surrounding marine waters. The topography of the coastline is characterised by steep cliffs, gentle rises and low lying salt marshes. The southern coastline is generally dominated by sand dunes and calcareous sediments. Inland topography is a dissected lateritic plateau from west to east with many incised valleys formed by watercourses flowing north-south (Nilsen 2006).

The topography is highlighted by higher elevated areas in the northern and central part of the region as well as around Penneshaw and Cape du Couedic. Lower elevated areas are in the south. The region has a number of protected areas, the largest being the Flinders Chase National Park. Others include Cape Gantheaume Conservation Park, Kelly Hill Conservation Park, Vivonne Bay Conservation Park and Western River Conservation Park.

Streams tend to begin in the central part of the region before flowing out to sea. Some of the larger streams include Cygnet River, Stunsail Boom River, Rocky River, Elenoar River, Harriet River and Middle River.

2.3. DRAINAGE DIVISIONS, RIVER BASINS AND CATCHMENTS

Australia's twelve drainage divisions and 246 river basins were defined by the Australian Water Resources Council in the early 1960s (Figure 4). Drainage divisions were defined both by major topographic features and major climatic zones to give broadly homogeneous hydrologic regions. Kangaroo Island is part of the South Australian Gulf drainage division. Drainage divisions were further defined into river basins, which were further defined into major watersheds. Kangaroo Island is classed as one whole river basin.

The region is defined by 53 catchments, which comprises 20 major catchments and numerous smaller catchments (Figure 4). Of the region's 53 surface water catchments, all but five drain to the coast. Approximately 5700 km of watercourses move surface water across the region. The majority of watercourses drain the higher elevated Gosse Ritchie plateau in the west to the coast (KINRMB 2009).

Major watercourses include Cygnet River, Rocky River, Stunsail Boom River, Middle River, and Timber Creek. Watercourses of the larger catchments tend to terminate in estuaries at the coastline (e.g. Stunsail Boom River, Middle River, Cygnet River), with others terminating at inland lakes and lagoons (e.g. Timber Creek) (KINRMB 2009). Most watercourses in the region are ephemeral, with the majority of flow occurring during the winter months, while during the summer months a large proportion of streams are reduced to dry river beds with isolated pools. Kangaroo Island also has a number of permanent flowing streams which is unusual for South Australia.

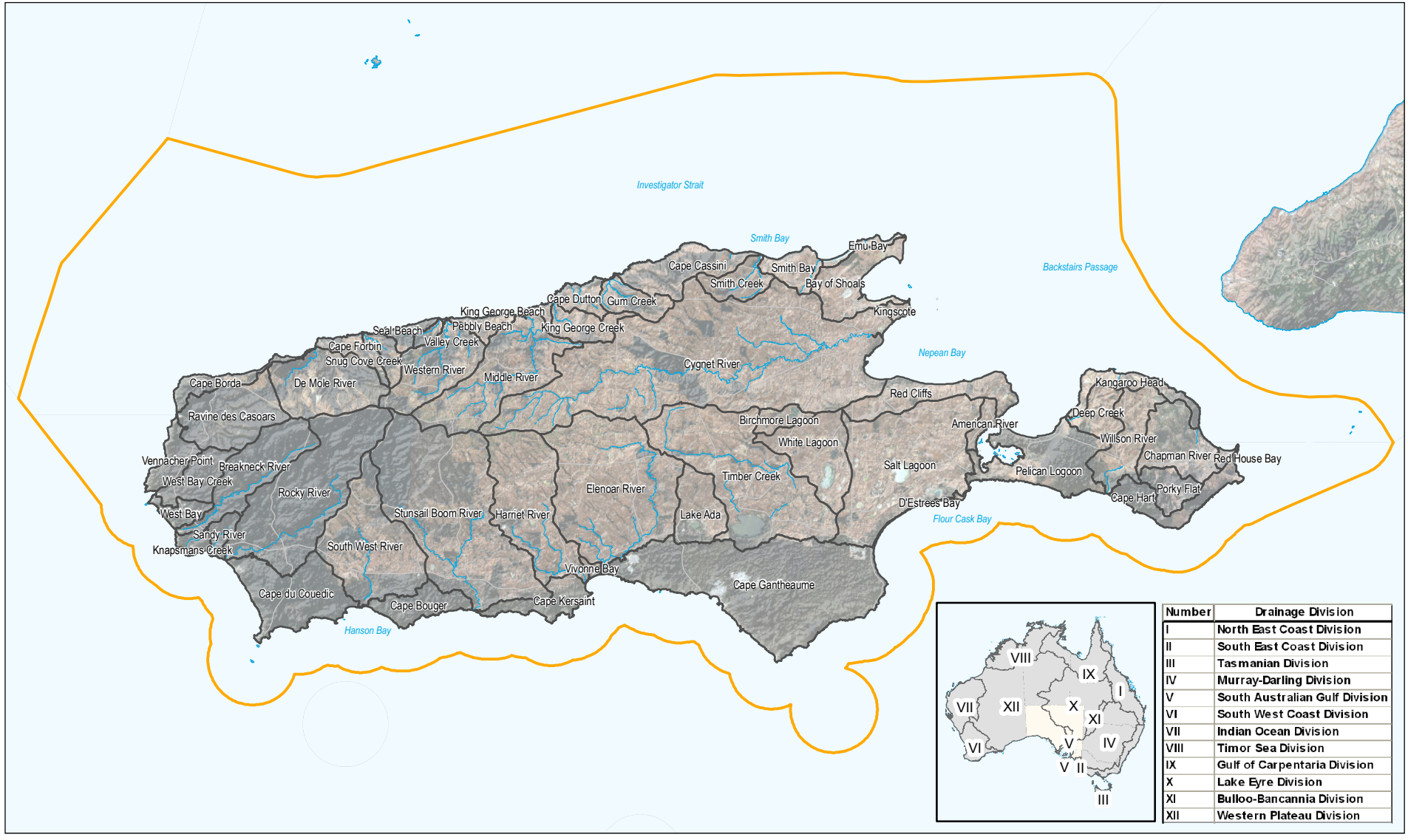
Cygnet River flows from the west to east, is bounded between the Gosse Ritchie plateau and north coast hills and is the largest catchment in the region, draining approximately 12% of the total surface area (KINRMB 2009). Cygnet River is known to be a larger saline watercourse in the region. Rocky River and Middle River are noted by Wen (2005) as the major freshwater watercourses in the region, with Middle River supplying the Middle River Reservoir. Lower Cygnet River, Lower Chapman River, Flinders Chase rivers and Lower South West River are listed as being of national significance in the Australian Directory of Important Wetlands (Environment Australia 2001).

Surface water in watercourses and lagoons in the higher rainfall part of the region's west tend to become increasingly saline in the summer months when they are confined to semi-permanent creeks and waterholes, until they are flushed by early winter rainfall

becoming fresh and plentiful (KINRMB 2009). Surface waters of the eastern side of the region are saline all year round due to lower rainfall and also geology, soils and groundwater. The lakes and lagoons of the region range from being inundated by water year-round or on a seasonal basis, with swampy wetlands being found where upwelling groundwater saturates the soil, typically in the headwaters of catchments (KINRMB 2009).

The region (particularly Flinders Chase) has a number of catchments that remain largely in pre-European settlement condition, and as a result significant in conservation and ecological values. The two most notable 'natural' catchments are associated with Rocky River and Breakneck River.

A summary of the key features associated with the main river systems of the region follows.



Number	Drainage Division
I	North East Coast Division
II	South East Coast Division
III	Tasmanian Division
IV	Murray-Darling Division
V	South Australian Gulf Division
VI	South West Coast Division
VII	Indian Ocean Division
VIII	Timor Sea Division
IX	Gulf of Carpentaria Division
X	Lake Eyre Division
XI	Bulloo-Bancannia Division
XII	Western Plateau Division

Road
Watercourse
Catchment Boundary
NRM Region Boundary

N

0 5 10 15 20 25
Kilometres

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Figure 4. Drainage divisions and surface water catchments of the Kangaroo Island NRM Region

2.3.1. Rocky River catchment

The Rocky River catchment is located about 100 km west of Penneshaw and flows in a south-westerly direction to discharge into the Southern Ocean at Maupertuis Bay (Figure 5). The catchment is bound to the north by the Playford Highway. Topography varies in the catchment, with elevations of 300 m above sea level in the north of the catchment. The catchment is essentially a 'disconnected' catchment, meaning there are no significant connections between the surface water system and the underlying fractured rock aquifer system (Green 2010).

The catchment is one of few in the State still predominantly covered by native vegetation and not subject to land clearing (Banks 2010).

Based on BoM rainfall data for the period 1900-2010, the average annual rainfall across the catchment ranges between 600 mm near the coast to 800 mm in the north of the catchment. The central part of the catchment is predominantly between 700-800 mm.

Runoff from the catchment is relatively low due to the fully vegetated condition (Nilsen 2006). Reduced runoff is due to the dense vegetation cover increasing interception rates and evapotranspiration. Surface water flows cease for short periods (e.g. 4-6 weeks) in most years during summer, resulting in long sections of dry riverbed with isolated pools.

Currently, there is one active streamflow monitoring station in the Rocky River catchment. The station, Rocky River u/s Gorge Falls, has been measuring streamflow since the 1970s.

Table 1. Catchment characteristics of the Rocky River catchment

Catchment Area	215 km^2
Rainfall	600-800 mm
Topography	0-300 m
Monitoring	2 active rainfall monitoring stations 1 active streamflow monitoring station – Rocky River u/s Gorge Falls (A5130501)

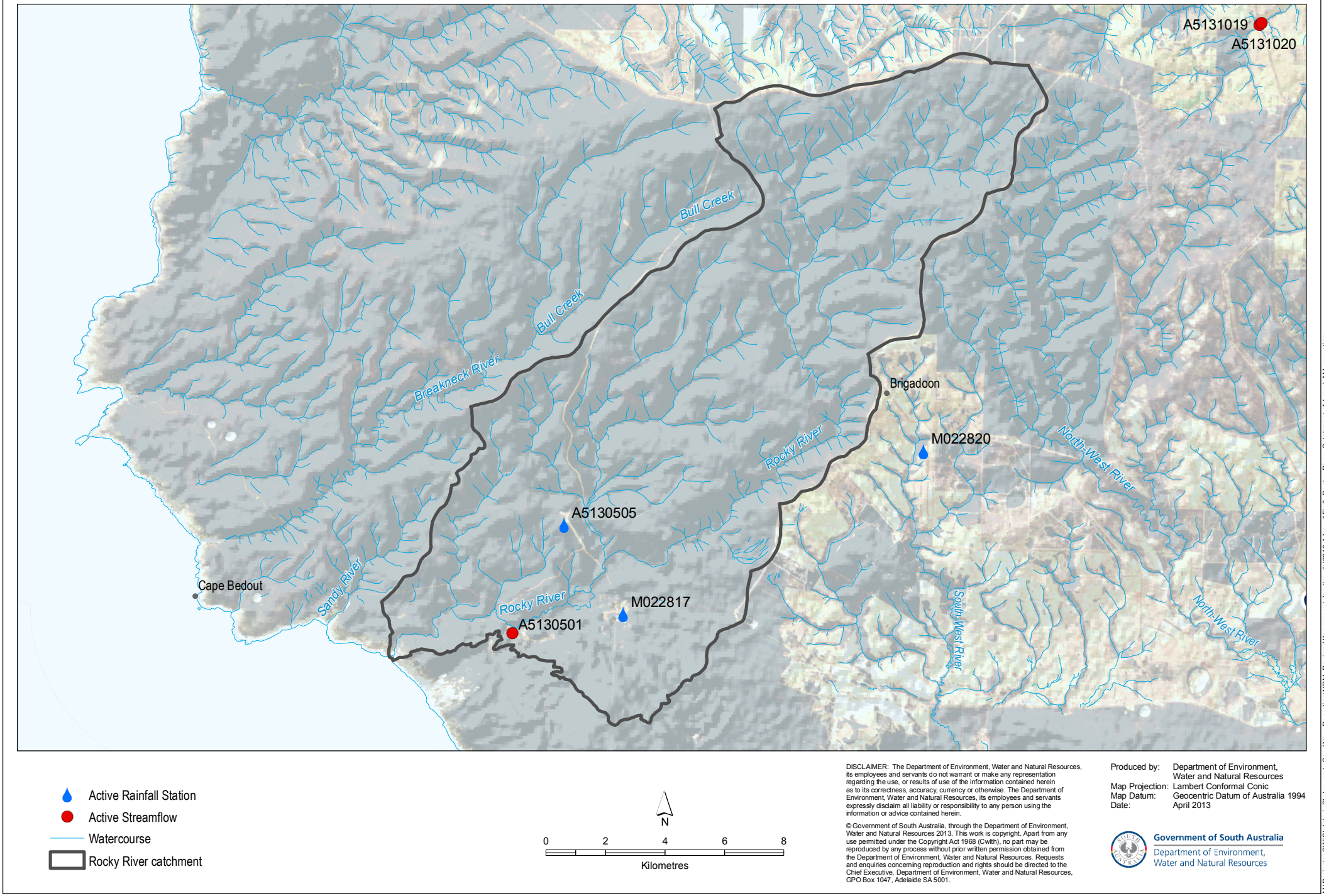

Figure 5. Detailed map of the Rocky River catchment

2.3.2. Cygnet River catchment

The Cygnet River catchment is the largest catchment in the region (Figure 6). The catchment is located about 35 km west of Penneshaw and flows in an easterly direction to discharge into Nepean Bay (Figure 6). Towns in the catchment include Parndana, Cygnet River and Brownlow.

Based on BoM rainfall data for the period 1900-2010, average annual rainfall across the catchment ranges between 400-800 mm. Rainfall is variable across the catchment, decreasing from west to east. The western half of the catchment predominantly experiences 600-800mm, while the eastern half experiences 400-600 mm.

The Cygnet River commences in the higher elevation areas in the west of the catchment and flows east into a tidal estuary system with a clearly defined delta of sediment deposition at Western Cove (Nilsen 2006). The Cygnet River ceases to flow in most years. Tributaries to the Cygnet River include Branch Creek, Brown Creek, Gum Creek, Tin Hut Creek and Snaky Creek.

Currently, there are two active streamflow monitoring stations in the Cygnet River catchment at Huxtable Forest and u/s Koala Lodge. The two monitoring sites have been measuring streamflow since 2004 and 2002 respectively.

Table 2. Catchment characteristics of the Cygnet River catchment

Catchment Area	605 km^2
Rainfall	400-800 mm
Topography	0-260 m
Monitoring	3 active rainfall monitoring stations 2 active streamflow monitoring stations – Cygnet River at Huxtable Forest (A5131001) and Cygnet River u/s Koala Lodge (A5131014)

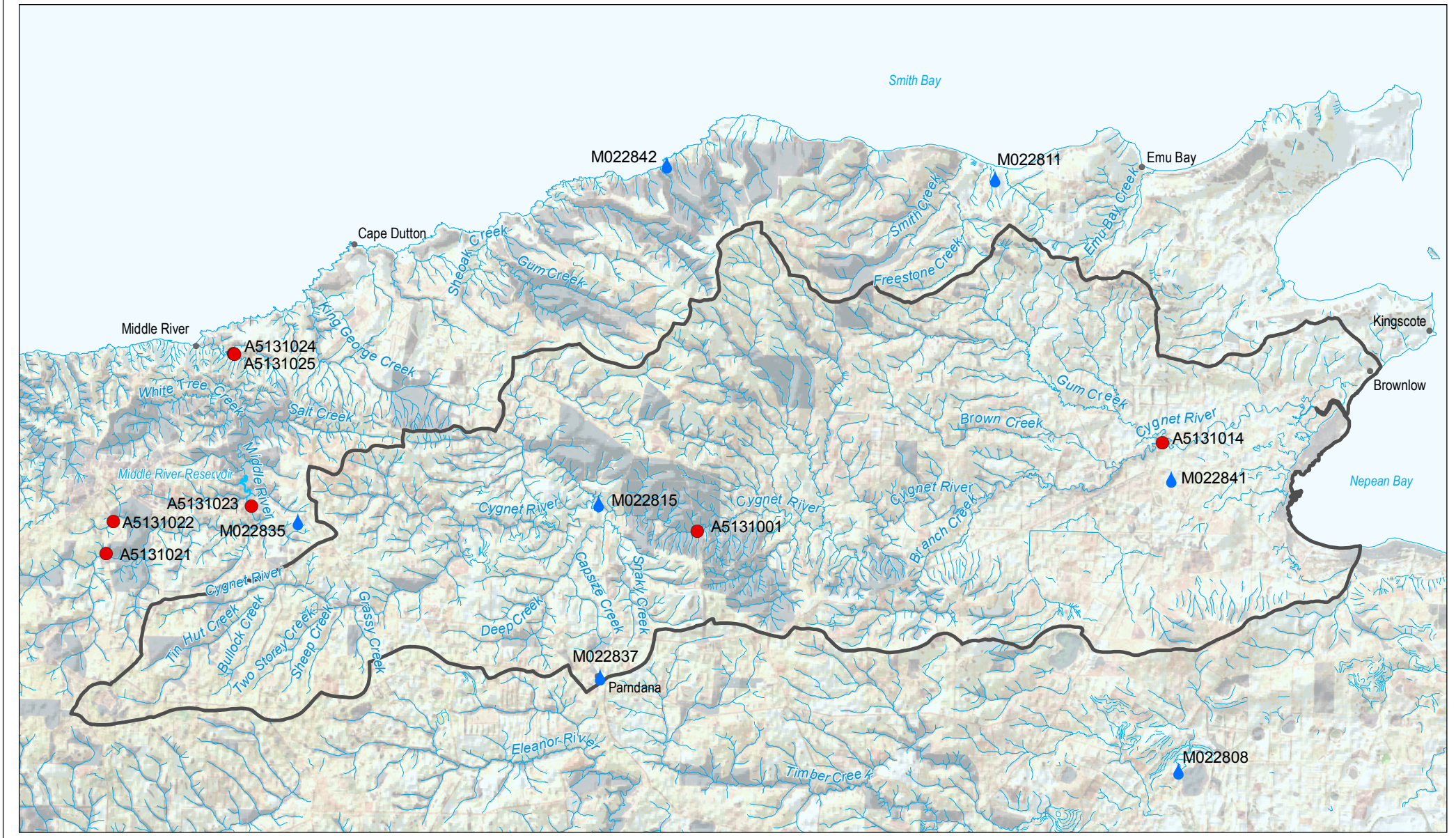

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Figure 6. Detailed map of the Cygnet River catchment

2.3.3. Timber Creek catchment

The Timber Creek catchment is located about 40 km south-west of Penneshaw. Timber Creek starts near Parndana and flows east to its mid point where it turns south to discharge into Murray Lagoon (Figure 7). Murray Lagoon is the largest inland lake in the region. The catchment is one of few that do not drain to the sea. The catchment is bound to the north by the Playford Highway.

Based on BoM rainfall data for the period 1900-2010, average annual rainfall across the catchment ranges between 600-700 mm in a small area at the north of the catchment and around 500-600 mm in the rest of the catchment.

According to Nilsen (2006), numerous surface water drainage lines have been constructed to alleviate excessive water logging. This has resulted in additional inflows to Murray Lagoon. Major tributaries of Timber Creek include Little Timber Creek and Curley Creek.

Topography of the Timber Creek catchment has lower elevations compared to others in the region, reaching heights of only about 170 m above sea level in the north of the catchment. The elevation around Murray Lagoon is as low as 10 m above sea level.

Currently, there is one active streamflow monitoring station in the Timber Creek catchment. The station, Timber Creek at South Coast Road, has been measuring streamflow since 2004.

Table 3. Catchment characteristics of the Timber Creek catchment

Catchment Area	245 km^2
Rainfall	500-700 mm
Topography	10-170 m
Monitoring	1 active rainfall monitoring station 1 active streamflow monitoring station – Timber Creek at South Coast Road (A5131002)

Figure 7. Detailed map of the Timber Creek catchment

2.3.4. Stunsail Boom River catchment

The Stunsail Boom River catchment is located about 90 km west of Penneshaw and flows in a southerly direction to discharge into the Southern Ocean (Figure 8). The catchment is one of the more developed on the western side of the region but still contains large areas of native vegetation and natural environments.

Based on BoM rainfall data for the period 1900-2010, the average annual rainfall across the catchment ranges between 700-900 mm in the northern half of the catchment to 500-700 mm in the southern half of the catchment. Average rainfall decreases towards the coast.

The western side of the catchment is drained by the North-West River while the eastern side is drained by the North-East River. These rivers meet approximately 10 km from the coast to form Stunsail Boom River. The majority of stream reaches in the catchment have low levels of stream flow extraction (McMurray 2007).

Topography in the catchment falls from north to south with elevations of 300 m above sea level in the north of the catchment, reducing to sea level where Stunsail Boom River drains to sea. The undulating hills in the north of the catchment become less prevalent in the lower part of the catchment.

Currently, there is one active streamflow monitoring station in the Stunsail Boom River catchment. The station, Stunsail Boom River at South Coast Road Bridge, has been measuring streamflow since 2010.

Table 4. Catchment characteristics of the Stunsail Boom River catchment

Catchment Area	325 km^2
Rainfall	500-900 mm
Topography	0-300 m
Monitoring	1 active rainfall monitoring station 1 active streamflow monitoring station – Stunsail Boom River at South Coast Road Bridge (A5131007)

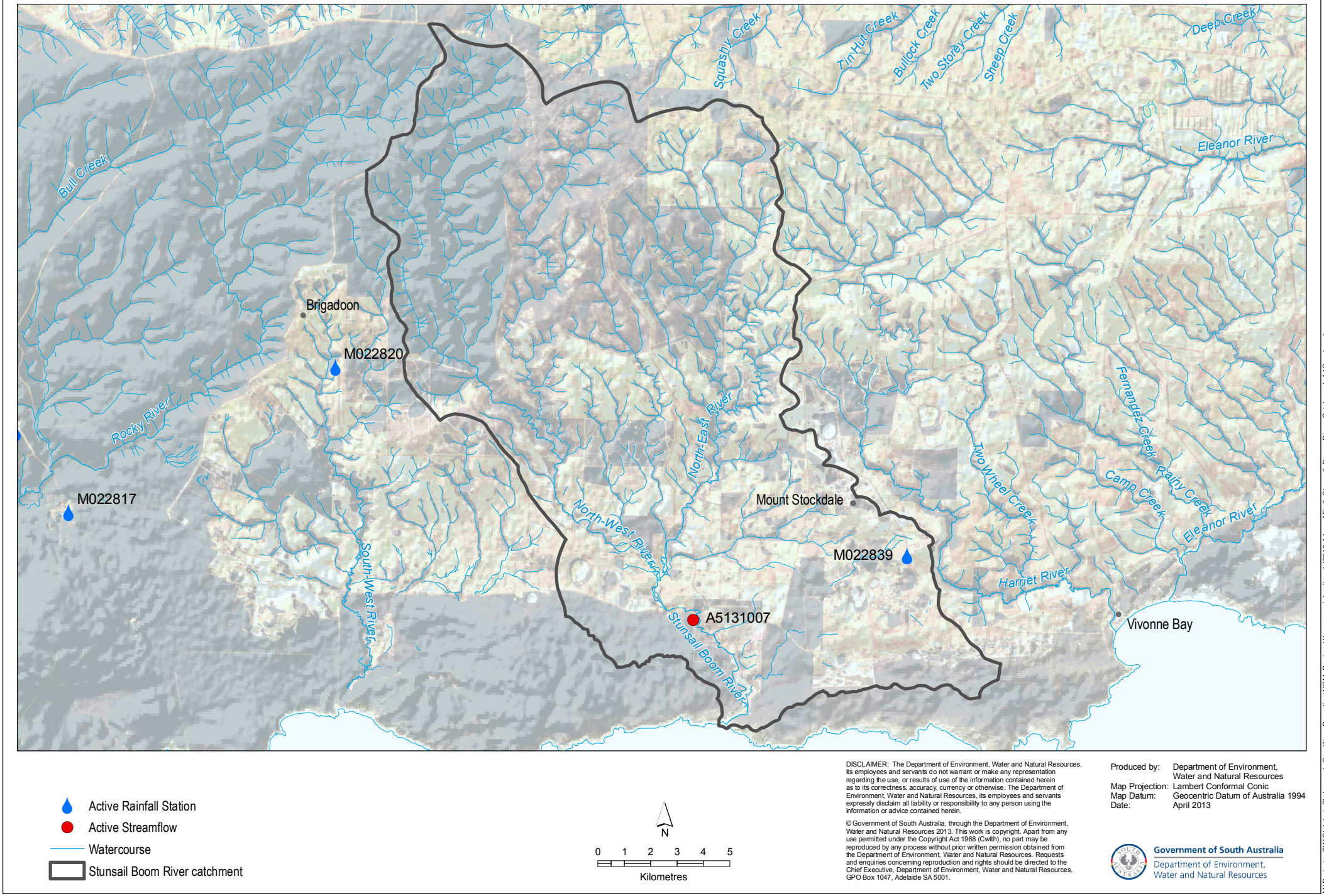

Figure 8. Detailed map of the Stunsail Boom River catchment

2.3.5. Middle River catchment

The Middle River catchment is located about 80 km west of Penneshaw and flows in a north-easterly direction to discharge into Investigator Straight at Snelling Beach (Figure 9). The catchment is bound to the south by the Gosse plateau. The Middle River Reservoir is the major water storage area in the region with a storage capacity of 540 ML (SA Water 2009).

Based on BoM rainfall data for the period 1900-2010, the average annual rainfall across the catchment ranges between 600-900 mm. In the south of the catchment, rainfall is as high as 900 mm, reducing to 600 mm near the coast.

Middle River is approximately 30 km in length. Many large permanent pools are located along the Middle River and tributaries, often in reaches with impermeable rock (Nilsen 2006). The water captured by the Middle River Reservoir is a critical supply to the people of the region. However, as with most reservoirs, the water withheld during low flow periods prolongs stress for the downstream aquatic ecosystems that have become isolated in pools (Nilsen 2006). Tributaries to the Middle River include Starvation Creek, Squashy Creek, Christmas Creek, White Tree Creek, Goat Hill Creek and Salt Creek.

Topography varies in the catchment with elevations of 280 m above sea level in the south of the catchment. Middle River Reservoir is located approximately 150 m above sea level.

Currently, there are seven active streamflow monitoring stations in the Middle River catchment. All stations began recording data during 2011. Monitoring stations A5131019 and A5131020 in the south of the catchment and A5131024 and A5131025 in the north are individual monitoring stations. (Figure 9). Stations A5131019 and A5131025 monitor water level to calibrate a Middle River flow model. Station A5131020 and A5131024 monitor water level and salinity, as these sites have been identified as key refuge pools for the native and endangered Glossy Black Cockatoos (Beasley & Mangeruca 2011).

Table 5. Catchment characteristics of the Middle River catchment

Catchment Area	145 km^2
Rainfall	600-900 mm
Topography	0-280 m
Monitoring	1 active rainfall monitoring station 7 active streamflow monitoring stations – Middle River @ North Coast Rd Crossing (upper reach) (A5131019), Middle River d/s North Coast Rd Crossing (upper reach) (A5131020), Middle River @ Coopers Rd Crossing (A5131021), Unknown Tributary @ Coopers Rd Crossing (A5131022), Middle River d/s ETSA track (A5131023), Middle River u/s North Coast Rd Crossing (near mouth) (A5131024) and Middle River @ North Coast Rd Crossing (near mouth) (A5131025)

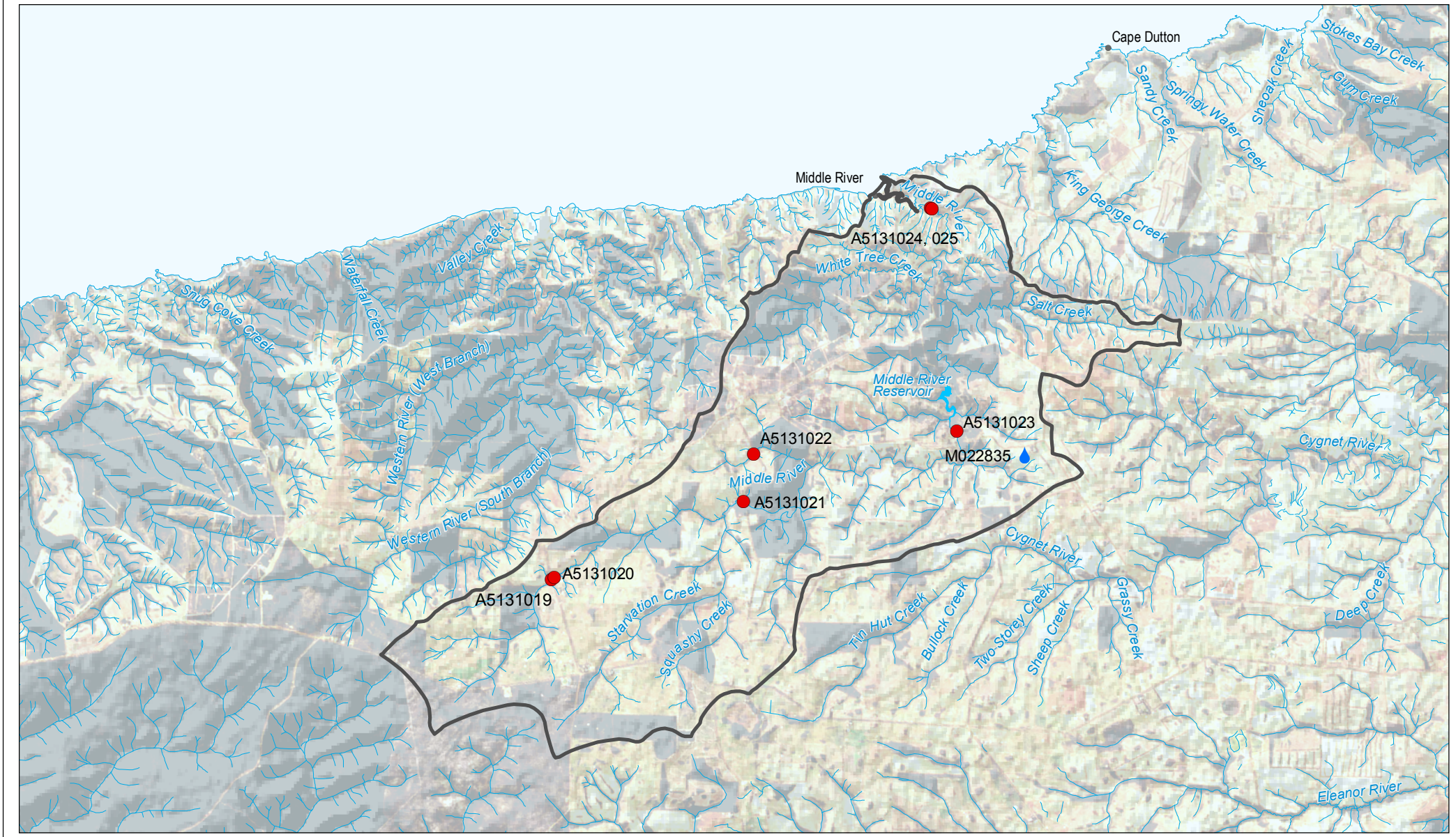

Figure 9. Detailed map of the Middle River catchment

2.4. LAND USE

The predominant land uses across the region are conservation/natural environments and dryland agriculture (Table 6). Much of the eastern side of the region has been cleared for agriculture, but 30% of the region's total area is reserved under the *National Parks and Wildlife Act 1972* and the *Wilderness Protection Act 1992* (Department of Planning and Local Government 2011). The west of the region and sections of the southern coast are largely classified as conservation areas and include Flinders Chase National Park, Kelly Hill Conservation Park, Cape Gantheaume Wilderness Protection Area, and Seal Bay Conservation Park (Figure 10).

A broad description of the soils in the region is provided in the State of the Region Report (KINRMB 2009a).

The major enterprises of dryland and irrigated agriculture are sheep for wool and prime lamb. Cropping has increased since 1990 from 8000 ha to more than 23 000 ha in 2003 (KINRMB 2009a). Hardwood forestry is the next largest land use based on area. A major trend in land use change for the period 2000-08 was the conversion of approximately 17 000 ha of land from agriculture to forestry (KINRMB 2009a). Orchards, viticulture, olives, essential oils and seed potatoes are emerging primary industries. Fisheries, aquaculture and tourism are other important industries for the region's current and future economic prospects. The NRM region boundary also includes 610 000 ha of the surrounding ocean.

Table 6. Land use summary of the Kangaroo Island NRM Region (KINRMB 2009a)

Land use	**Area (ha)**	**%**
Conservation and natural environments	215 970	49
Hardwood forestry production	18 637	4
Softwood forestry production	5257	1
Dryland agriculture	183 363	42
Irrigated agriculture	611	<1
Intensive uses (includes urban and commercial)	8805	2
Wetlands – marshes	2019	<1
Wetlands – open water	5175	1
TOTAL	**439 837**	

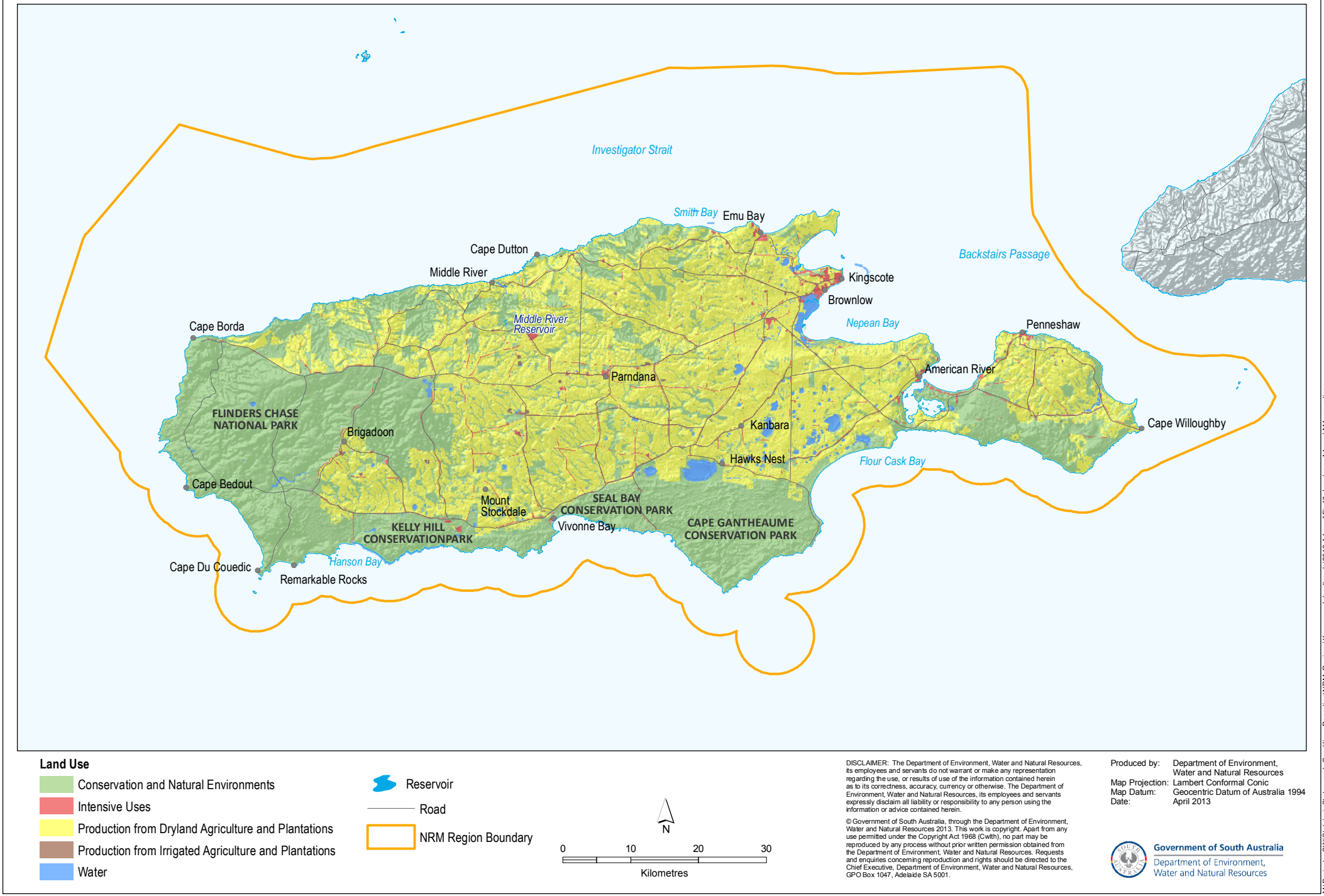

Figure 10. Land use map of the Kangaroo Island NRM Region

2.5. DEMAND FOR WATER RESOURCES

2.5.1. Towns

Surface water is the major water resource to the region with groundwater use minimal in comparison. Water was historically sourced from surface water catchments across the region. The Cygnet River scheme supplied the township of Kingscote from 1938. Prior to this, a 200 kL government tank, fed from a small catchment, was used to supplement residents rainwater tanks (SA Water 2009). Water Supply Systems (WSS) at Middle River and Penneshaw now provide potable water to parts of the region. Water sourced from Middle River Reservoir is used at the Middle River WSS and supplies Kingscote, Brownlow, Parndana and surrounding rural areas. Surface water outtakes from the reservoir to supply the WSS (Table 7) have gradually reduced since 2007-08, before a rise in 2011-12.

Table 7. Surface water outtakes from Middle River Reservoir (data provided by SA Water)

Year	2007-08	2008-09	2009-10	2010-11	2011-12
Volume (ML)	601	600	575	471	523

Penneshaw WSS supplies water to the township of Penneshaw with water sourced from a sea water desalination plant. The desalination plant was commissioned in 1999 and produces up to 100 ML/y. Prior to this, water for Penneshaw's WSS was sourced from privately owned farm dams. The water was often poor quality and eventually became insufficient to meet the required water demand (SA Water 2009). Many households in the region are not connected to the WSS's and must rely on other means such as rainwater tanks and farm dams for potable and non-potable water supply. Sources of non-potable water in the region include farm dams, stormwater harvesting and wastewater reuse that is used for applications such as stock watering or irrigation of parks and gardens.

2.5.2. Agriculture and Forestry

Agriculture, fisheries and forestry are the region's largest employers, accounting for almost a quarter of all jobs (Department of Planning and Local Government 2011). Agriculture and forestry are also two of the largest users of surface water in the region and predicted reductions in rainfall will have a direct affect on water availability for these industries. Agriculture in the region includes wool, sheep, and cattle production, and cropping of canola, wheat, barley, and oats. There is also an expanding viticulture industry on Kangaroo Island (Department of Planning and Local Government 2011).

Farm dams are the primary means of intercepting runoff and storing water for stock, domestic and irrigation purposes during the drier summer months. Farm dams are prominent across the region in all areas except conservation and national parks.

Applications for permits pursuant to the *Natural Resources Management Act 2004* are available for water affecting activities such as building a dam or making alterations to a watercourse which can affect other users and ecosystems that rely on water

resources. A total of 14 water affecting activities were assessed during 2011-12 (KINRMB 2012). Applications for 13 water affecting activities were assessed in 2010-11 and 12 in 2009-10.

Plantation and farm forestry has become established generally on the western side of the region. Plantation forests are purposely planted for harvesting, while farm forestry is the planting and growing of trees to complement agricultural systems (PIRSA 2012). Although still a relatively small portion of land use in the region (refer to Table 6), forestry has almost tripled in the region in the past 15 years (Department of Planning and Local Government 2011) and as of 2011, forestry included 14800 ha of *Eucalyptus globulus*, 4500 ha of *Pinus radiata* and 1100 ha of other eucalypt hardwood species (PIRSA 2013).

Plantation forests intercept rainfall and therefore reduce runoff. While there has been some debate regarding the extent of this runoff reduction, there is strong evidence that the runoff reduction (including groundwater recharge) due to plantation forests is in the order of 70 – 100%. The exact extent of this reduction varies among specific locations, and is likely to be higher in lower rainfall than in higher rainfall catchments. A state wide policy framework was developed to articulate the South Australian Government position on the management of the water resources impacts of plantation forests. The framework adopts the position that plantation forests, regardless of species, can be assumed to reduce runoff (including groundwater recharge) by 85% (Government of South Australia 2009a).

2.5.3. Mining

The Exploration Spatial Dataset (DEWNR 2012) shows numerous mining production tenements exist across the region, in addition to a few exploration licenses and exploration license applications. The exploration licences and applications are for gold, copper, zinc and lead. There are numerous small-scale mining developments across the region. These are mostly pits and quarries for non-mineral commodities (e.g. sand, sandstone, slate, limestone, shale and basalt) used for construction materials.

2.5.4. Balancing demand and supply

DEWNR has commenced developing Regional Demand and Supply Statements for each NRM Region of the State. So far, these have been released for the Eyre Peninsula NRM Region (DFW 2011a) and the Northern and Yorke NRM Region (DFW 2011). A Regional Demand and Supply Statement for Kangaroo Island is scheduled for release in the near future. Regional Demand and Supply Statements ensure that long-term water security solutions for each region are based on a thorough understanding of the state of all local water resources, the demand for these resources and the likely future pressures. Regional Demand and Supply Statements provide demand and supply projections for the scenarios of high and low population growth and high and low greenhouse gas emission. Two projection sets address the demand and supply for (1) drinking quality water only and (2) for all water sources and human demands.

The KI NRM Plan defines the current policies for water resources management in the region. These policies define Sustainable Use Limit's (SUL) for catchments and subcatchments. When a catchment or subcatchment SUL is reached, any water affecting activity will become on-merit and no further permits will generally be issued. Applications for permits may however be considered if it can be demonstrated the activity is in the broader public interest in terms of social, economic and environmental outcomes for NRM (KINRMB 2009b). Data provided by the KINRMB for January 2013 outlines 21 subcatchments are exceeding their current NRM Plan-defined SUL. All of these subcatchments except two are classed as Zone A and coincide with the high rainfall areas on the western side of the region. Two catchments in the region are also currently closed to further interception of surface water via farm dams (Western River catchment and Middle River catchment).

CSIRO (Aryal 2011) reviewed the current surface water management policies for the region and made the following recommendations (inter alia):

- [The Board should consider] stipulating larger thresholds for and a lower upper cap on, the diversion from streams. This will have implications for farm dam intake and plantations.
- [The Board should consider] setting plans for monitoring and evaluation. This policy should set out the principles and framework to be used to monitor and evaluate the effectiveness of the Plan in achieving its objectives including SUL provisions.
- SULs should be reviewed after every few years to reflect the changed rainfall and runoff regime in catchments as it is a requirement for the Plan to be reviewed every five years.
- Given the variation in rainfall trends during recent years along the east west direction of the Island, it is suggested to establish a meteorological monitoring station measuring evaporation.
- [The Board should] carry out detailed modelling of the rivers of Kangaroo Island to derive the past streamflow data so that a detailed statistical analysis can be done to determine minimum flow threshold and other flow caps.

In response to the CSIRO review, the Board is currently reviewing the water management policies in the Plan, with a view to appropriately addressing the CSIRO recommendations in the next revision of the overall NRM Plan.

SA Water's annual review of water demand projections for the region (SA Water 2012) shows a recent decline in consumption. Water demand projections indicate Penneshaw has sufficient capacity to meet demand until at least 2030. Middle River has sufficient capacity to meet demand until at least 2026-27 under average conditions and 2019-20 in drought conditions. Recent trends in surface water outtakes from Middle River Reservoir are provided in Table 7. To meet increasing demand in the future, SA Water has looked at a number of options to further enhance the existing network including upgrading the Middle River Water Treatment Plant and utilising existing storage tanks at Kingscote.

Considerable growth of the mining sector is expected in the State over the next 40 years (Government of South Australia 2011; RESIC 2010). Mining operations often require significant volumes of water, but can typically be of a lower quality than is required for stock or irrigation. Although mining is less prominent in the Kangaroo Island region compared to other parts of the State, it is important that associated water resource demands are considered, planned for and managed, while balancing this against environmental and social requirements.

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3. Data summary

3.1. RAINFALL

Rain tends to fall predominantly in the winter months across the region. The higher magnitude of rain tends to fall across the western part of the region. The central northern part of the region experiences the least amount of rainfall. Rainfall across the eastern part of the region varies between 500-700 mm. Around the townships of Emu Bay and Kingscote, rainfall varies between 400-500 mm on average. The western part of the region, approximately half of the islands total area, experiences between 600-800 mm. Rainfall in the central southern part of the region varies between 500-600mm on average.

The distribution of rainfall monitoring stations in the region varies, with two thirds (13) of the total number of active stations (19) on the eastern half of the region. Length of data available from these sites varies, with nine rainfall stations established post 1960. Six rainfall stations have more than 100 years of data. The oldest station is the Cape Willoughby BoM rainfall station, which was established in 1881.

3.1.1. Spatial and Temporal Variation

To analyse the spatial variation of rainfall in the region, three stations were selected to represent the rainfall patterns and trends across the region. These stations are highlighted as red raindrops in Figure 11. The stations are located on the western half of the region at Flinders Chase, the central northern part of the region at Kingscote and the eastern coast at Cape Willoughby. The selected stations have well over 120 years of data and show low, medium and high rainfall areas representative of the region. The period of record at each station has been summarised from 1889-2012 to ensure a consistent comparison of years (Table 8).

Table 8. Selected rainfall analysis sites in the Kangaroo Island NRM Region

Rainfall Station	Station No.	Period of Record	Average Annual Rainfall (mm)
Flinders Chase (Rocky River)	M022817	1889-2012	704
Cape Willoughby	M022803	1889-2012	544
Kingscote Aero	M022841	1889-2012	472

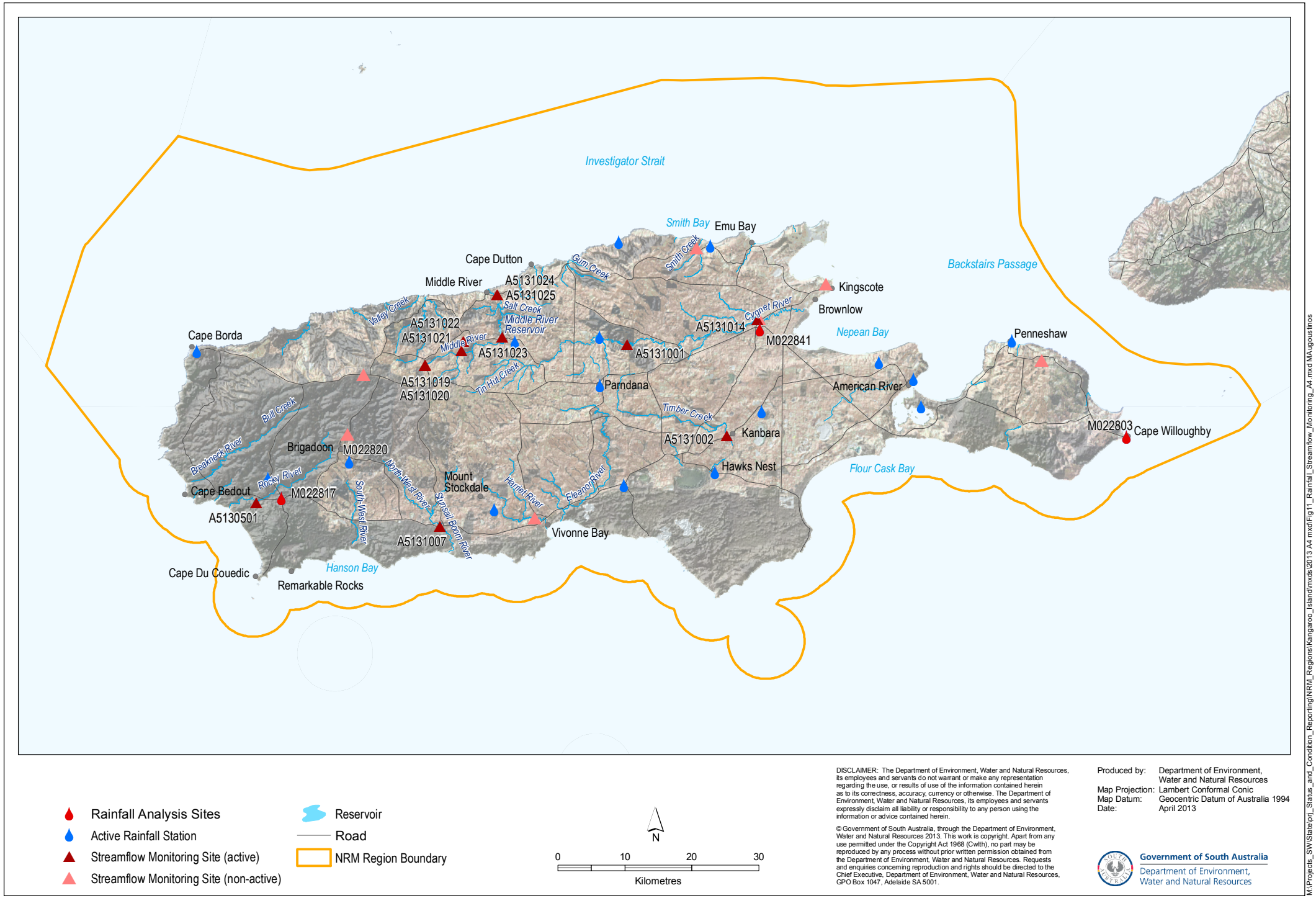


Figure 11. Rainfall and streamflow monitoring in the Kangaroo Island NRM Region

Annual rainfall records show varying trends when comparing the three rainfall sites. The cumulative deviation from mean annual rainfall (residual mass curve) identifies periods of above and below average trends. An upward slope in a residual mass curve indicates a period of wetter-than-average rainfall, while a downward slope indicates a period of drier-than-average rainfall.

Data from Flinders Chase BoM rainfall station (M022817) are summarised for the period 1889 to the end of 2012 in Figure 12. The 124 years of data have an average annual rainfall of 704 mm. A simple linear trend analysis indicates that there is a slightly increasing trend in annual rainfall across the period of record. Distinct wetter-than-average and drier-than-average rainfall periods can be seen. From 1889 to the mid 1950s, Flinders Chase experienced drier-than-average rainfall with limited years above the long term average. From the mid 1950s to around 1990 rainfall was wetter-than-average. From 1990, the trend for Flinders Chase is still increasing but at a slower rate. The period from 1993 to 1999 was below average. The recent drought period experienced in the 2000's appears to have had little impact on the annual rainfall at Flinders Chase. The distribution of monthly rainfall at Flinders Chase illustrates the regional characteristics of rainfall being highest during the winter months (Figure 13).

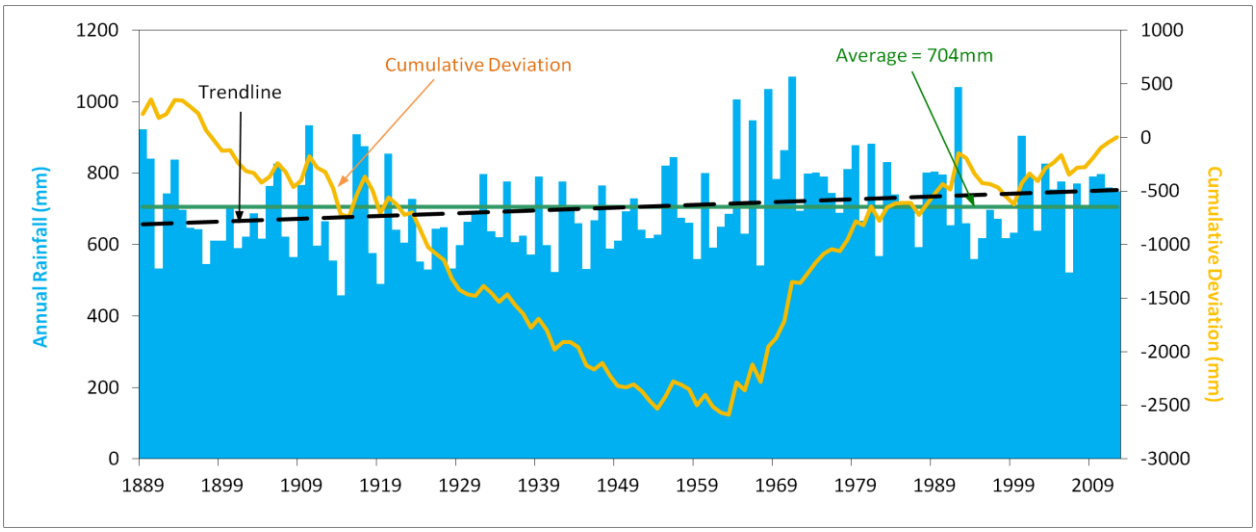


Figure 12. Annual rainfall: Flinders Chase BoM rainfall station

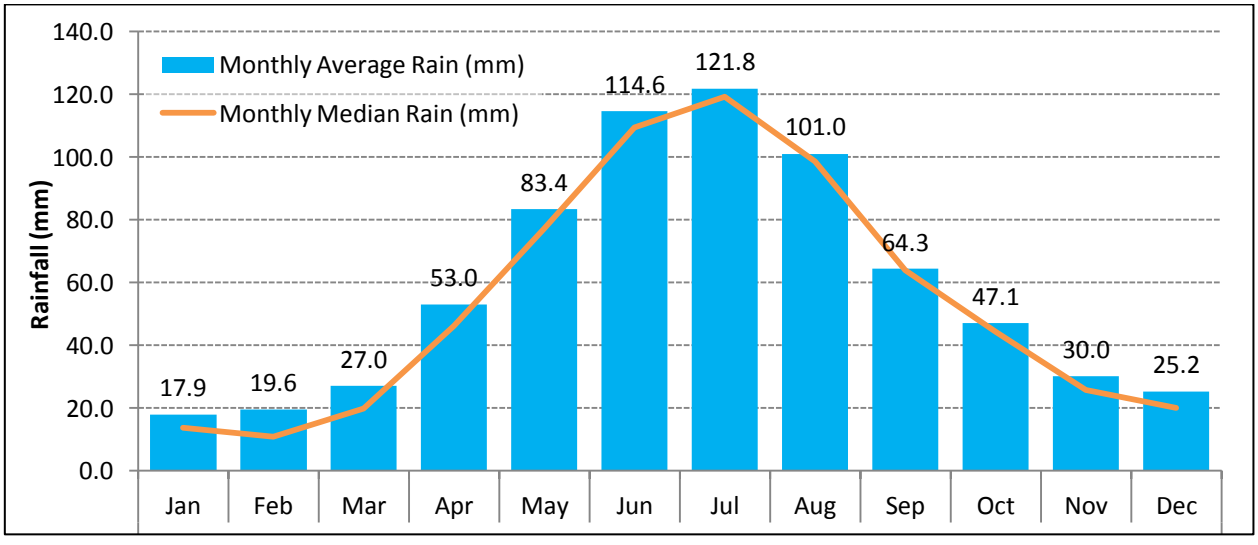


Figure 13. Mean and Median monthly rainfall: Flinders Chase BoM rainfall station

Data from Cape Willoughby BoM rainfall station (M022803) are summarised for the period 1889 to the end of 2012 in Figure 14. The 124 years of data have an average annual rainfall of 544 mm. A simple linear trend analysis indicates that there is a slightly increasing trend in annual rainfall across the period of record. In comparison to Rocky River, Cape Willoughby is located on the opposite side of the region on the east coast and experiences lower average rainfall. After a series of drier-than-average years between 1890 and 1910, Cape Willoughby experienced around 40 years of average rainfall to the late 1940s. From the late 1940s to the mid 1970s, rainfall was wetter-than-average, followed by another period of average rainfall to around 2000. Rainfall since 2000 has been drier-than-average and coincides with drought conditions experienced in many parts of south eastern Australia during that decade. The distribution of monthly rainfall at Cape Willoughby is presented in Figure 15. The monthly average in all months except January is lower than those at Flinders Chase.

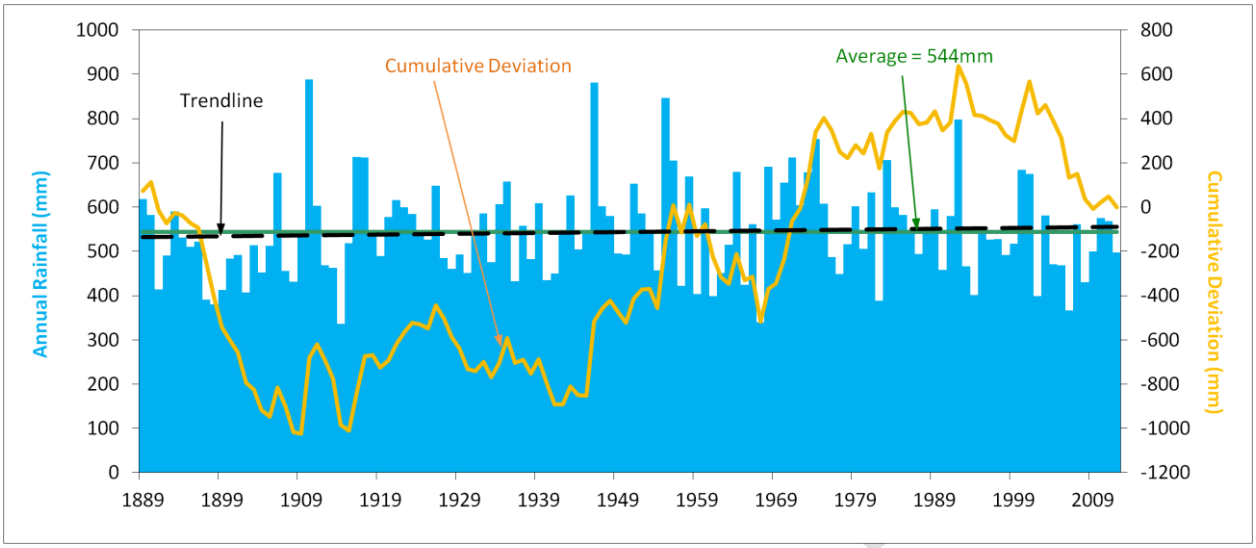


Figure 14. Annual rainfall: Cape Willoughby BoM rainfall station

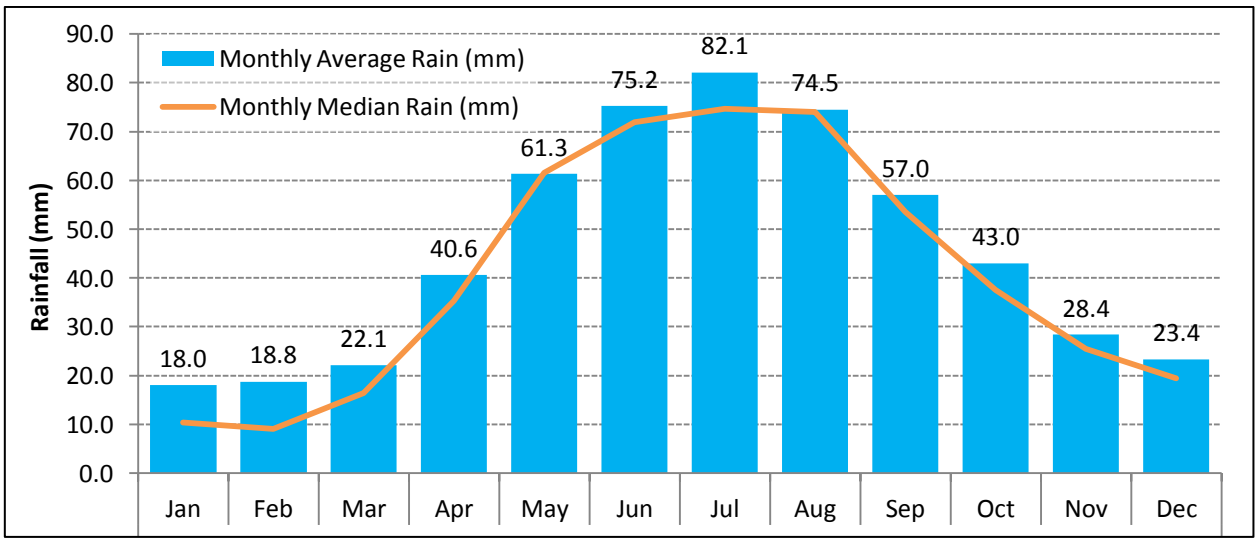


Figure 15. Mean and Median monthly rainfall: Cape Willoughby BoM rainfall station

Data from Kingscote Aero BoM rainfall station (M022841) are summarised for the period 1889 to the end of 2012 in Figure 16. The 124 years of data have an average annual rainfall of 472 mm. A simple linear trend analysis indicates that there is a slightly decreasing trend in annual rainfall across the period of record. In comparison to Flinders Chase and Cape Willoughby, Kingscote Aero is located in a lower average rainfall area. After a decade of drier-than-average years between 1894 and 1904 and wetter-than-average years between 1905 and 1911, Kingscote Aero experienced around 30 years of average rainfall to the early 1940s. From the early 1940s to the late 1950s, rainfall was wetter-than-average, followed by another period of average rainfall to the late 1970s. Since the late 1970s, rainfall has predominantly been drier-than-average, with the exception of a few years. From 2004-10, rainfall at Kingscote Aero was below average and coincided with drought conditions experienced in the State during this time. The distribution of monthly rainfall at Kingscote Aero shows rainfall predominantly during the winter months (Figure 17). The monthly average in all months is lower than those at Cape Willoughby.

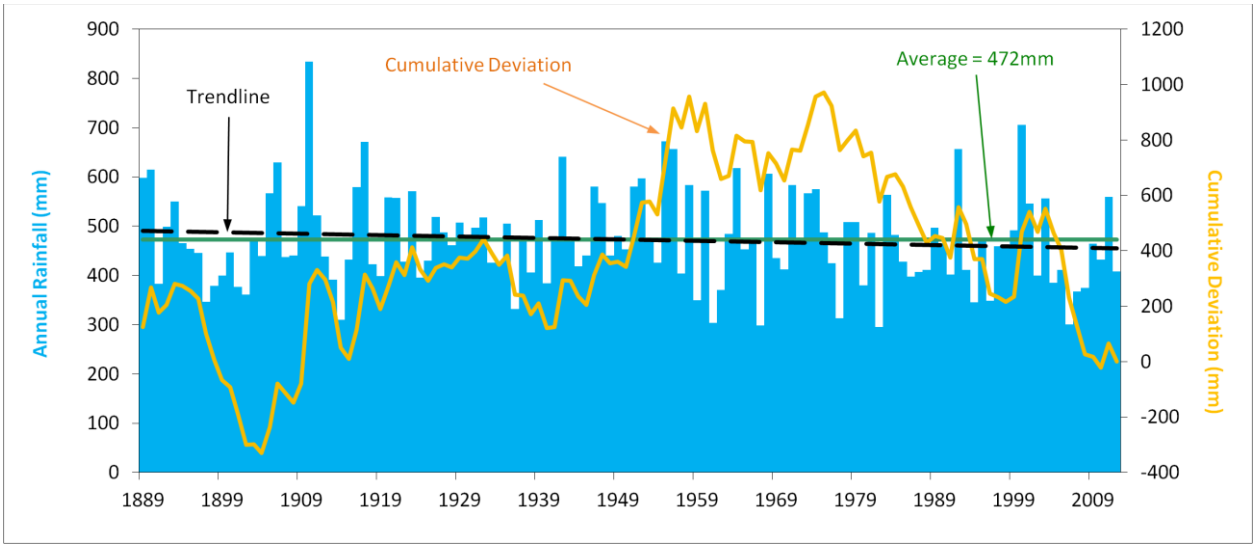


Figure 16. Annual rainfall: Kingscote Aero BoM rainfall station

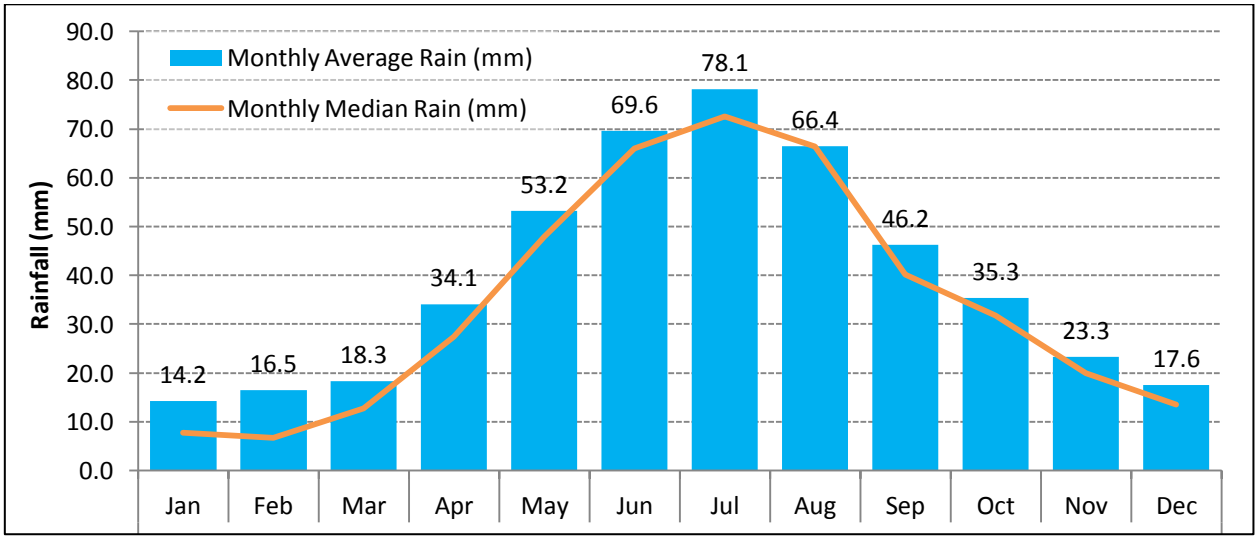


Figure 17. Mean and Median monthly rainfall: Kingscote Aero BoM rainfall station

3.2. STREAMFLOW

Streamflow monitoring across the region is limited to 12 active monitoring stations (Table 9 and Figure 11). Along with average annual streamflow for stations presented in Table 9, median streamflow and coefficient of variation is also given. The average coefficient of variation for streams in Australia is 0.70 (Grayson et al. 1996). One streamflow monitoring station is located on each of Rocky River, Timber Creek and Stunsail Boom River catchments, while Cygnet River catchment has two. Middle River catchment has seven streamflow monitoring stations, but each only have one year of low quality data. Average annual streamflow is summarised where possible for each station below based on the period of record available. For monitoring stations with limited years of flow data, the average annual streamflow is unlikely to be a true representation of long term flow conditions in the catchment.

Table 9. Active streamflow gauging stations in the Kangaroo Island NRM Region

Gauging Station	Station No.	Catchment Area km^2	Period of Record	Average Annual Streamflow		Median Streamflow (ML)	Coefficient of Variation (C_v)
				ML	mm		
Rocky River u/s Gorge Falls	A5130501	189	1974-2012	13 450	71	11 330	0.70
Cygnet River @ Huxtable Forest	A5131001	217	2004-12	*	*	-	-
Timber Creek @ South Coast Road	A5131002	126	2004-12	9230	73	10 835	0.64
Stunsail Boom River @ South Coast Road Bridge	A5131007	188	2010-12	*	*	-	-
Cygnet River u/s Koala Lodge	A5131014	480	2003-12	37 230	78	33 420	0.69
Middle River @ North Coast Rd Crossing (upper reach)	A5131019	-	2011-12	**	**	-	-
Middle River d/s North Coast Rd Crossing	A5131020	-	2011-12	**	**	-	-
Middle River @ Coopers Rd Crossing	A5131021	-	2011-12	**	**	-	-
Unknown Tributary @ Coopers Rd Crossing	A5131022	-	2011-12	**	**	-	-

Gauging Station	Station No.	Catchment Area km^2	Period of Record	Average Annual Streamflow		Median Streamflow (ML)	Coefficient of Variation (C_v)
				ML	mm		
Middle River d/s ETSA track	A5131023	-	2011-12	**	**	-	-
Middle River u/s North Coast Rd Crossing (near mouth)	A5131024	-	2011-12	**	**	-	-
Middle River @ North Coast Rd Crossing (near mouth)	A5131025	-	2011-12	**	**	-	-

*No average is given due to the extremely limited dataset and missing data

**Site has been active for one year only and has large periods of missing data

The long-term average annual streamflow (1974-2012) for Rocky River is 13 450 ML (Figure 18). Records date back to 1970, but include large periods of missing data. Records from 1974 are more reliable with limited days of data missing. For the purpose of this assessment, "Years with Missing Data" (green columns in Figures 18 to 22) are those with more than 30 days of data missing during winter, when the majority of flow occurs. Years with the whole period missing will appear blank. Some of the larger streamflow years for Rocky River includes 35 490 ML in 1981 and 44 760 ML in 1992, with both years far exceeding the long-term average streamflow. The lowest streamflow of 1910 ML was recorded in 2002. From 1974-96, Rocky River recorded variable above and below average streamflows, with an average of 16 800 ML. This is in contrast to an average streamflow of 8600 ML from 1997-2012 where 13 of those 16 years were below the long term average. The CSIRO review (Aryal 2011) postulates that reduced streamflow may be the result of vegetation lowering groundwater levels in the period of below average rainfall from 1993 to 1999, thereby causing a disconnection between surface water and groundwater in the catchment.

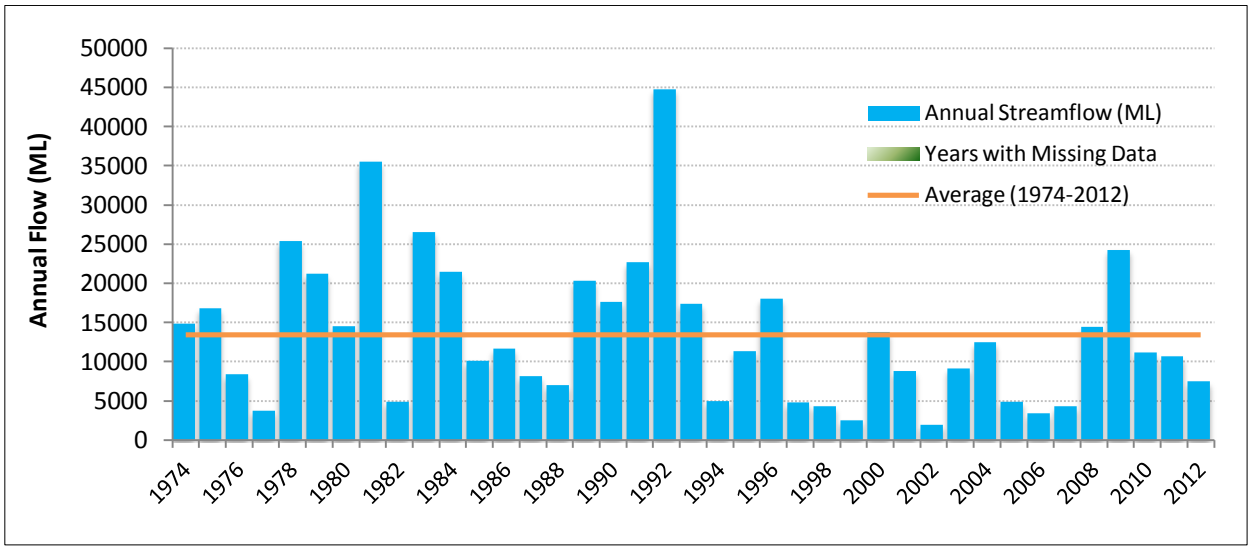


Figure 18. Annual streamflow record for Rocky River

Cygnet River at Huxtable Forest has annual streamflow data for 2004-12 (Figure 19). Streamflow data excludes years 2005-08, as no data were available for this period. The highest streamflow in this limited dataset was 38 630 ML in 2009. The lowest streamflow year of 930 ML was recorded in 2011, but this year was missing the winter month's data where the majority of streamflow is generated. No average has been shown in Figure 19 due to the extremely limited dataset and missing data in five out of nine years.

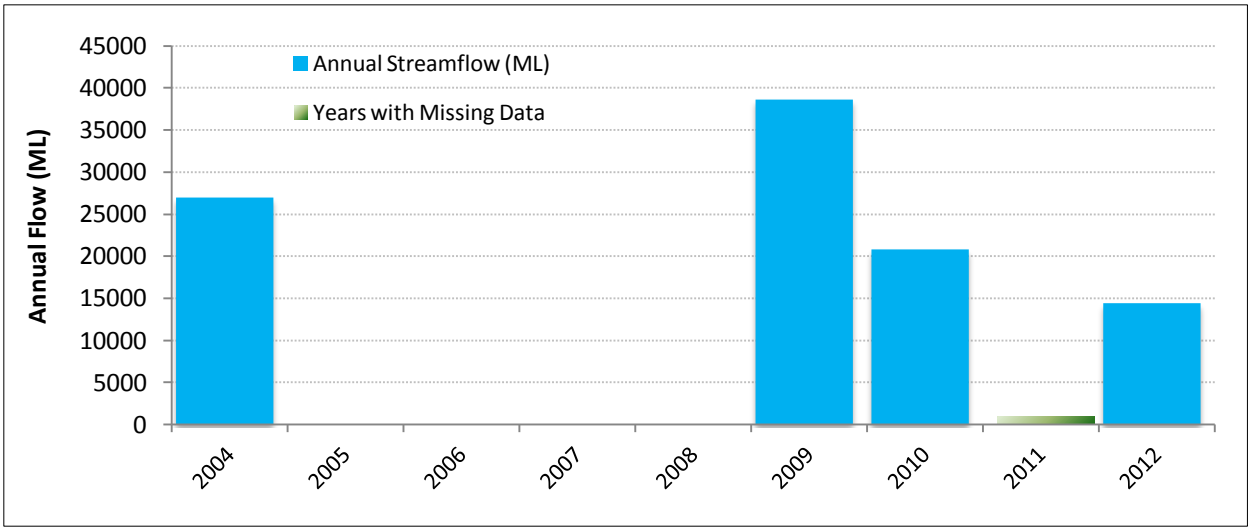


Figure 19. Annual streamflow record for Cygnet River at Huxtable Forest

Cygnet River u/s Koala Lodge has annual streamflow data from 2003-12 with an average streamflow of 37 230 ML (Figure 20). This average excludes 2008, as a large proportion of the record was missing for this year. The largest streamflow of 77 260 ML was recorded in 2003 and the lowest of 2455 ML in 2006. This station is located downstream of Cygnet River at Huxtable Forest.

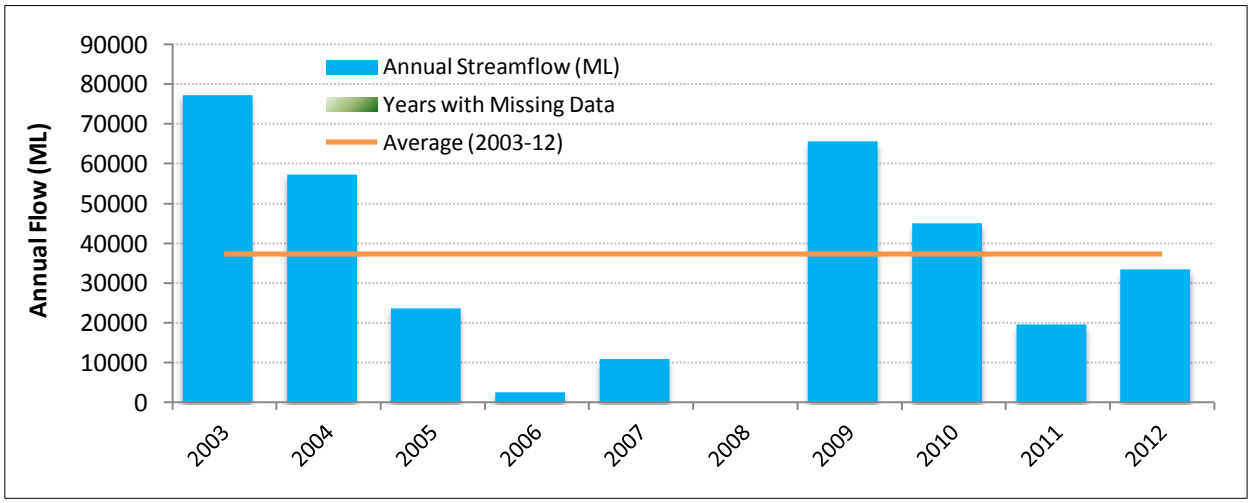


Figure 20. Annual streamflow record for the Cygnet River u/s Koala Lodge

Timber Creek has annual streamflow data for 2004-12 with an average streamflow of 9230 ML (Figure 21). The average excludes 2008 as all data for this year was missing. Larger streamflow events to occur during the period include 13 390 ML in 2010 and 17 230 ML in 2009. The lowest streamflow recorded was 950 ML in 2006. The 10 490 ML recorded in 2004 also included 45 days of missing data during the winter months. The years 2005-07 show consecutive years of well below average streamflow.

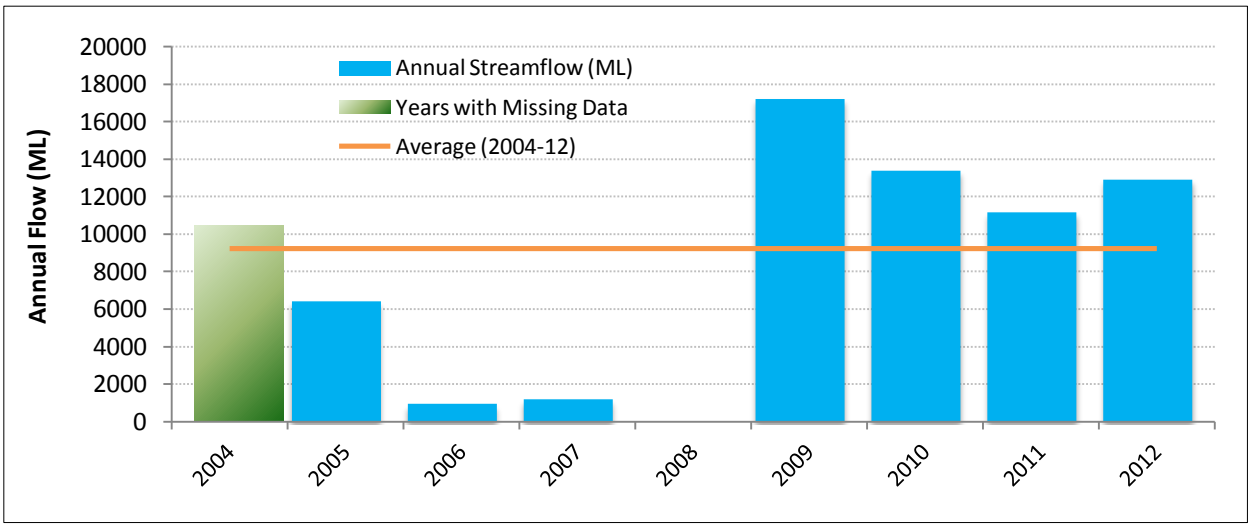


Figure 21. Annual streamflow record for Timber Creek

Stunsail Boom River has annual streamflow data for 2010-12 (Figure 22), but there are large periods of missing winter streamflow in 2010 and 2011, which compromises the flow record at this station. The largest streamflow event to occur in the short history of this station was 14 730 ML in 2012. The lowest recorded streamflow of 880 ML was in 2010 (with missing data). No average has been shown in Figure 22 due to the extremely limited dataset and missing data in two out of three available data years.

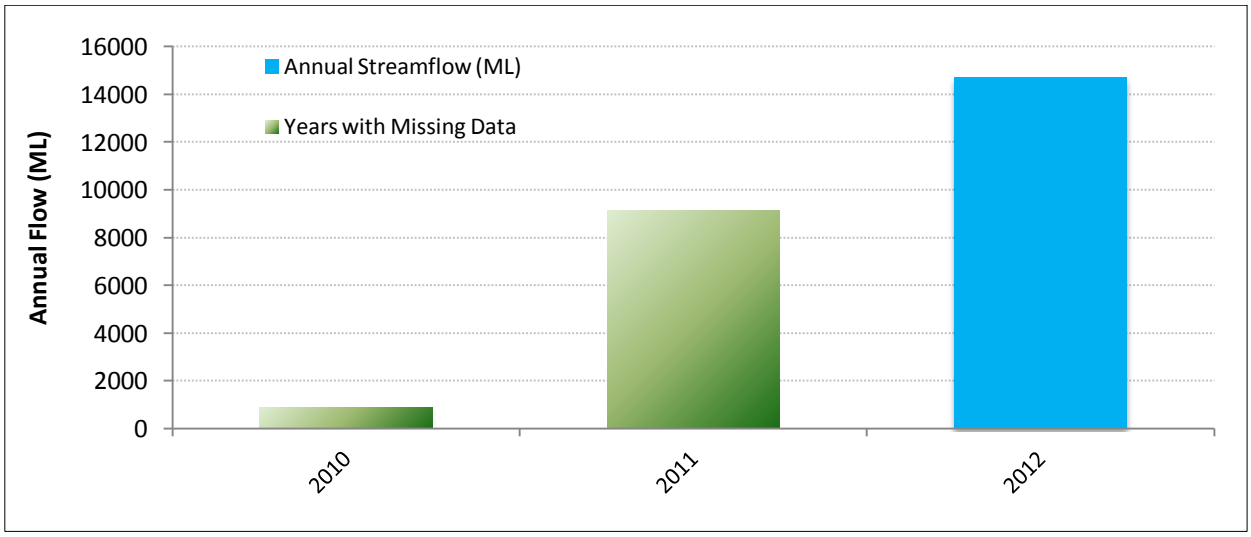


Figure 22. Annual streamflow record for Stunsail Boom River

3.3. WATER QUALITY

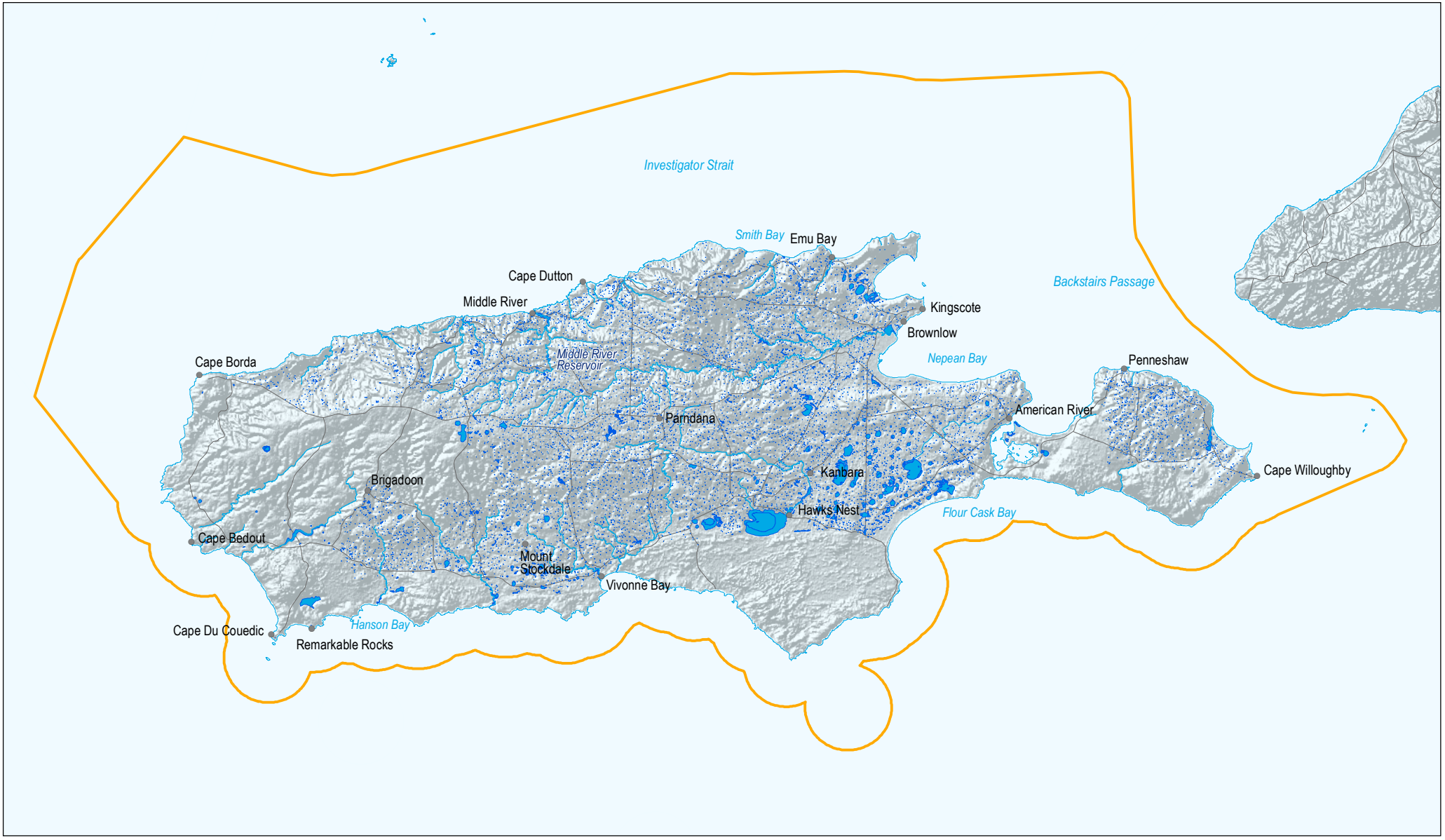
Water quality in the region's rivers is known to vary greatly, both spatially and seasonally, and there is currently a significant lack of baseline water quality data. In response to this the Board commenced a monthly water quality monitoring program at all streamflow gauging stations in January 2011 (KINRMB 2013, Pers. Comm., 6 June). Composite samplers have also been installed at the two Cygnet River gauging stations to collect weekly water quality data. Data collected will seek to support an improved understanding of seasonal variations of water quality experienced in streams across the region. Wetland water quality and invertebrate monitoring is occurring quarterly at Grassdale, Murray and Lashmar Lagoons.

3.4. SURFACE WATER STORAGES AND WETLANDS

Surface water storage in the region is largely farm dams, small lakes and reservoir storage (Figure 23). In 2011, the Board financed the capture of new aerial imagery across the region. This allowed an up-to-date estimation of dam development levels to be calculated. From 2001 to 2011, the number of farm dams in the region has increased from 9150 to 10 991. The estimated capacity of farm dams in 2011 was 18 496 ML. The estimated 2011 farm dam capacity is lower than the estimated 19 124 ML capacity in 2001, as aerial imagery from 2011 was of better quality than 2001, and thus the depiction of surface areas of dams has improved. The method for calculating dam volumes is based on a volume–area relationship developed from studies of farm dams in the Mount Lofty Ranges (McMurray 2004).

Construction of Middle River Reservoir was completed in 1968 with a design capacity of 470 ML and a catchment area of 100 km^2. The capacity of the reservoir has since been temporarily increased to 540 ML after the installation of a raised spillway to help offset the recent drought period. The reservoir is the main water supply to the Middle River WSS, which supplies Kingscote, Brownlow, Parndana and surrounding rural areas. Water level data have been collected at the reservoir since 1977. In that time, the reservoir has reached the approximate spillway height of 9.65 m and subsequently spilled in every year.

In addition to the streams listed as nationally significant in the Australian Directory of Important Wetlands (Environment Australia 2001), the directory also includes 15 wetland systems across the region. These include Murray Lagoon, Birchmore Lagoon, D'Estrees Bay, Lake Ada, Cygnet Estuary and American River wetland system. Numerous small lakes in the region can contain water year round or be more seasonal. Dryland salinity is driving increasing wetland salinisation and is a major threat to wetlands across the region (KINRMB 2009a). Swampy wetlands, where upwelling groundwater saturates the soil, can be more often found in headwater catchments.



Produced by: Department of Environment, Water and Natural Resources
Map Projection: Lambert Conformal Conic
Map Datum: Geocentric Datum of Australia 1994
Date: April 2013

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

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Figure 23. Waterbodies of the Kangaroo Island NRM Region

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4. Investment opportunities

This report has collated surface water information for the region and presents a summary of recorded rainfall and streamflow data from the non-prescribed surface water resources of the region. Hydrological data have been compiled with particular attention given to the major surface water catchments in the region.

In preparing this report, a number of opportunities have been identified to enhance surface water knowledge and data in the region, to inform decisions by water resource managers. These opportunities are detailed below to inform future investment planning:

1. In accordance with the recommendations of the CSIRO review (Aryal 2011), undertake fit-for-purpose eco-hydrological science investigations to inform a revision of existing sustainable use limit policies.

2. Evaporation data is a key input to understanding the local water cycle. The apparent absence of industry-standard evaporation monitoring on Kangaroo Island appears to be a gap in terms of monitoring local impacts of, and planning responses to climate change and variability (this is also in accordance with the recommendations of the CSIRO review (Aryal 2011).

3. Maintain current monitoring stations in accordance with the State Water Monitoring Operational Framework. Continuous and long term data (and its subsequent surveillance) are important to calibrate and validate hydrological models and condition assessment frameworks used to inform water management and policy decision making. Such monitoring will also support surveillance of the impacts of land-use change and climate change on Kangaroo Island.

4. There are currently considerable limitations in the understanding of the scale and processes of surface water – groundwater interaction in the region, which are critical in sustaining water supply to water dependent ecosystems (and potentially some farm dams) during dry periods. Targeted investigations to build this understanding would assist in refining estimates of resource capacity.

5. Farm dam volumes used in the Kangaroo Island NRM Plan were derived from volume-area relationships developed for the Mount Lofty Ranges. Should the Board find that there is evidence these volume-area relationships differ significantly on Kangaroo Island, investigations could be undertaken to develop tailored farm dam volume-area relationships for Kangaroo Island.

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5. Summary

Some of the challenges associated with managing the State's natural resources include the increasing demand for resources, climate change impacts and making well-informed decisions with existing data. It is important to ensure access to sufficient and reliable fit-for-purpose water that can be used to support food and wine production, mining expansion, liveability in our towns and cities and the health of the environment. Our use of water resources must be sustainable for the long-term.

As such, this report has collated existing climate and surface water hydrology data in a consolidated and accessible manner, which seeks to support a broad understanding of non-prescribed surface water resources on Kangaroo Island to underpin informed decision making on water resources management.

On Kangaroo Island, surface water resources are essential in maintaining the social fabric and economic viability of the region. This includes sustaining agriculture, industry and rural townships. Many properties in the region rely on surface water held in farm dams for irrigation of agriculture and stock water supply, and the Middle River Reservoir or desalination for town water supplies. The water supply system at Penneshaw has sufficient capacity to meet demand until at least 2030. Middle River has sufficient capacity to meet demand until at least 2026-27 under average conditions and 2019-20 in drought conditions.

Climate change projections indicate a reduction in rainfall and increase in temperature for the region (DENR 2010). Rain tends to fall predominantly in winter with the higher magnitude of rain falling across the western part of the region. A reduction in rainfall and ultimately runoff would impact the water supply to the Middle River Reservoir and the numerous farm dams in the region, directly influencing the users of water resources. At the regional scale, the drivers of increasing water demand may include expansion of population, livestock numbers, agriculture, plantation forestry and tourism.

The formulation of this report has highlighted the following potential investment opportunities for the Regional NRM Board to consider when planning for the sustainable management of surface water resources to underpin social and economic prosperity on Kangaroo Island:

- Appropriate responses to the recent CSIRO review of existing sustainable use limit policies.
- Monitor evaporation on Kangaroo Island to assess the impacts of, and support planning for climate change and variability.
- Maintain a strategic and high quality network of hydrological monitoring stations on Kangaroo Island to assess the impacts of, and support planning for climate change and variability. Such monitoring will also support surveillance of the impacts of land-use change on Kangaroo Island.
- Building an enhanced understanding of Kangaroo Island surface water-groundwater interactions and farm dam area-volume relationships.

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Units of measurement

Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol	Definition in terms of other metric units	Quantity
day	d	24 h	time interval
gigalitre	GL	10^6 m^3	volume
gram	g	10^{-3} kg	mass
hectare	ha	10^4 m^2	area
hour	h	60 min	time interval
kilogram	kg	base unit	mass
kilolitre	kL	1 m^3	volume
kilometre	km	10^3 m	length
litre	L	10^{-3} m^3	volume
megalitre	ML	10^3 m^3	volume
metre	m	base unit	length
microgram	μg	10^{-6} g	mass
microlitre	μL	10^{-9} m^3	volume
milligram	mg	10^{-3} g	mass
millilitre	mL	10^{-6} m^3	volume
millimetre	mm	10^{-3} m	length
minute	min	60 s	time interval
second	s	base unit	time interval
tonne	t	1000 kg	mass
year	y	365 or 366 days	time interval

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Glossary

Act (the) — In this document, refers to the *Natural Resources Management (SA) Act 2004,* which supersedes the *Water Resources (SA) Act 1997*

Annual adjusted catchment yield — Annual catchment yield with the impact of dams removed

Aquatic ecosystem — The stream channel, lake or estuary bed, water and/or biotic communities and the habitat features that occur therein

Aquifer — An underground layer of rock or sediment that holds water

Arid lands — In South Australia, arid lands are usually considered to be areas with an average annual rainfall of less than 250 mm and support pastoral activities instead of broadacre cropping

Baseflow — The water in a stream that results from groundwater discharge to the stream; often maintains streamflows during seasonal dry periods and has important ecological functions

Basin — The area drained by a major river and its tributaries

Biodiversity — The number and variety of organisms found within a specified geographic region

BoM — Bureau of Meteorology, Australia

Catchment — That area of land determined by topographic features within which rainfall will contribute to run-off at a particular point

Dams, off-stream dam — A dam, wall or other structure that is not constructed across a watercourse or drainage path and is designed to hold water diverted or pumped from a watercourse, a drainage path, an aquifer or from another source; may capture a limited volume of surface water from the catchment above the dam

Dams, on-stream dam — A dam, wall or other structure placed or constructed on, in or across a watercourse or drainage path for the purpose of holding and storing the natural streamflow of that watercourse or the surface water

Dams, turkey nest dam — An off-stream dam that does not capture any surface water from the catchment above the dam

DENR – former Department of Environment and Natural Resources

DEWNR — Department of Environment, Water and Natural Resources (Government of South Australia)

DFW — former Department for Water (Government of South Australia)

d/s — Downstream

DWLBC — former Department of Water, Land and Biodiversity Conservation (Government of South Australia)

Ecology — The study of the relationships between living organisms and their environment

Ecosystem — Any system in which there is an interdependence upon, and interaction between, living organisms and their immediate physical, chemical and biological environment

Environmental water requirements — The water regimes needed to sustain the ecological values of aquatic ecosystems, including their processes and biological diversity, at a low level of risk

EPA — Environment Protection Authority (Government of South Australia)

Ephemeral streams or wetlands — Those streams or wetlands that usually contain water only on an occasional basis after rainfall events. Many arid zone streams and wetlands are ephemeral.

Flow regime — The character of the timing and amount of streamflow in a stream

GIS – Geographical Information System; computer software linking geographic data (for example land parcels) to textual data (soil type, land value, ownership). It allows for a range of features, from simple map production to complex data analysis

Groundwater — Water occurring naturally below ground level or water pumped, diverted and released into a well for storage underground

Hydrology — The study of the characteristics, occurrence, movement and utilisation of water on and below the Earth's surface and within its atmosphere

Irrigation — Watering land by any means for the purpose of growing plants

KINRM – Kangaroo Island Natural Resources Management (region)

Lake — A natural lake, pond, lagoon, wetland or spring (whether modified or not) that includes part of a lake and a body of water declared by regulation to be a lake. A reference to a lake is a reference to the bed, banks and shores of the lake or the water for the time being held by the bed, banks and shores of the lake, or both, depending on the context.

Land — Whether under water or not, and includes an interest in land and any building or structure fixed to the land

m AHD — Defines elevation in metres (m) according to the Australian Height Datum (AHD)

Model — A conceptual or mathematical means of understanding elements of the real world that allows for predictions of outcomes given certain conditions. Examples include estimating catchment run-off, assessing the impacts of dams or predicting ecological response to environmental change

Natural resources — Soil, water and marine resources, geological features and landscapes, native vegetation, native animals and other native organisms and ecosystems

NRM — Natural Resources Management; caring for our natural resources – balancing people's needs with those of nature

Pasture — Grassland used for the production of grazing animals such as sheep and cattle

Perennial streams — Permanently inundated watercourses. These watercourses flow throughout the year except in years of infrequent drought.

Population — For the purposes of natural resources planning, the set of individuals of the same species that occurs within the natural resource of interest

Potable water — Water suitable for human consumption such as drinking or cooking water

Prescribed water resource — A water resource declared by the Governor to be prescribed under the Act. Prescription of a water resource requires that future management of the resource be regulated via a licensing system.

SA Water — South Australian Water Corporation (Government of South Australia)

Stock use — The taking of water to provide drinking water for stock other than stock subject to intensive farming (as defined by the Act)

Sub-catchment — The area of land determined by topographical features within which rainfall will contribute to run-off at a particular point. A number of sub-catchments form a catchment.

Surface water — (a) water flowing over land (except in a watercourse), (i) after having fallen as rain or hail or having precipitated in any another manner, (ii) or after rising to the surface naturally from underground; (b) water of the kind referred to in paragraph (a) that has been collected in a dam or reservoir

Sustainable Use Limit – consult NRM plan for definition

Tributary — A river or creek that flows into a larger river

u/s — Upstream

WAP — Water Allocation Plan; a plan prepared by a NRM Board or water resources planning committee and adopted by the Minister in accordance with the Act

Water body — Includes watercourses, riparian zones, floodplains, wetlands, estuaries, lakes and groundwater aquifers

Watercourse — A river, creek or other natural watercourse (whether modified or not) and includes: a dam or reservoir that collects water flowing in a watercourse; a lake through which water streamflows; a channel (but not a channel declared by regulation to be excluded from the this definition) into which the water of a watercourse has been diverted; and part of a watercourse

Water dependent ecosystems — Those parts of the environment, the species composition and natural ecological processes, that are determined by the permanent or temporary presence of flowing or standing water, above or below ground; the in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries and lakes are all water-dependent ecosystems

Water plans — The State Water Plan, NRM plans, water allocation plans and local water management plans prepared under Part 7 of the Act

WDE — Water dependent ecosystem

Wetlands — Defined by the Act as a swamp or marsh and includes any land that is seasonally inundated with water. This definition encompasses a number of concepts that are more specifically described in the definition used in the Ramsar Convention on Wetlands of International Importance. This describes wetlands as areas of permanent or periodic to intermittent inundation, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tides does not exceed six metres.

WSS – Water Supply System

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