CHAPTER TWO

USER NEEDS AND REGIONALISATION

COURTESY OF NORTH EAST CMA, VICTORIA

CHAPTER 2 USER NEEDS AND REGIONALISATION

To maximise the utility of climate change projections, user needs should be considered while ensuring the projections are scientifically robust and regionally applicable. This chapter describes an assessment of user needs undertaken to inform the projections contained in this Report. The users consulted were primarily from the natural resource management (NRM) sector of Australia, due to the strong linkages between this work and regional NRM planning. This chapter also compares the results with similar international studies. The regionalisation used throughout this Report and associated products is described and explained here. This includes the eight clusters and additional sub-clusters.

2.1 ASSESSING USER NEEDS

Throughout its history of developing climate projections for Australia and elsewhere, CSIRO has worked closely with a variety of partners and end users to deliver climate projections information that can be used in planning and impact assessments. In the 1990s, reports and maps were suitable for awareness-raising and broad-scale general assessments that were prevalent at the time. Since then however, the requirements of end users of climate projections have progressively increased in complexity and sophistication.

This requirement for increasingly detailed projections information has led to a growth in demand from researchers, private sector entities, governments, and non-government organisations undertaking impact assessments, as well as long-term strategic planning exercises. These users require information about the likelihood and magnitude of future climate change for many variables of interest. Community level information is also often required to assist in building relevant knowledge and capability among constituents.

In response to the increasing needs of users, new products and services were required. A computer-based (and later, online) projections tool called *OzClim* (Page and Jones, 2001, Ricketts and Page, 2007) was developed to provide access to climate model data on a 25 km grid. The *Climate Change in Australia* website, underpinning the technical report and brochure of the same name (CSIRO and BOM, 2007), provided users with access to more detailed results. A climate projections liaison service was initiated in 2009 to deliver tailored projections information, advice and data.

Uptake of these products and services has increased over time. Users have undertaken impact assessments that range from simple to complex, with significant and varying data requirements. The ability to service these requests has evolved as methodologies, data sharing arrangements, data formatting and impact assessment options have matured. An increasing need for both climate change data (*i.e.* the projected change values from climate models) and also application-ready data (*i.e.* 'synthetic' future climate information that is calculated by applying projected change values from climate models to observed climate data) has been identified.

Organisations that have a role in community engagement and education about future climate require more than data provision. Tailored regional messages, or narratives, about the projected changes are required for a range of different stakeholders. Local-scale approaches (within the limitations of the spatial scale of climate model output) are often well received, and assist in increasing the relevance of engagement and communication activities.

In 2011, stakeholder workshops were held in seven Australian capital cities to seek feedback on the utility of the projections published in 2007 (CSIRO and BOM, 2007) and identify needs for future projections. The feedback included a number of common user requirements:

- Ensure legitimacy, credibility and relevance;
- Provide information about climate model reliability;
- Convey information in ways that are easy to understand;
- Represent uncertainty and provide guidance on how to deal with it;
- Supply an appropriate level of spatial and temporal detail;
- Generate projections for 20-year periods centred on 2030, 2050, 2070 and 2090;
- Include information on year to year variability and extreme events;
- Provide easy access to data, support, guidance material and case studies;
- Supply information in different formats, *e.g.* text summaries, GIS data, tables, maps, graphs, PowerPoint slides, animations, etc.

This aligns well with the experience of others around the world. For example, in their evaluation of the United Kingdom Climate Impacts Program, Steynor *et al*. (2012) recognized the need to:

- Establish an understanding of user requirements;
- Manage tensions that exist between meeting user requirements and developing credible climate science;
- Help users incorporate inherent uncertainty into decision-making;
- Solicit a wide range of users' views about presentation and delivery, including projections themselves, delivery interface, guidance materials and training;
- Support sustained user engagement.

In addition to this, CSIRO collaborated with the Bureau of Meteorology to undertake a range of stakeholder engagement activities in Australia from 2012 to 2014. This engagement was primarily with the NRM sector, reflecting the Australian Government's alignment of projections research in assisting the sector to understand and plan for future climate change.

A major component of this engagement was the Climate Projections User Panel, comprised of key NRM stakeholders, which was established to enhance the two-way exchange of views about data and information needs, use and accessibility of online tools, guidance materials and training requirements. Stakeholder workshops and interviews were also conducted to delve into how users had previously interacted with climate change projections information and data, and to understand the future potential uses (referred to hereafter as Use Cases).

These interactions facilitated a shared understanding amongst scientists and stakeholders about what was needed and what could be delivered with the available resources while maintaining adequate scientific rigour.

The Use Cases revealed a number of common themes:

Simple exploration of the future climate involves basic searches for information, most often in map form, in responses to general queries about key variables within a location and time period, or under a certain emissions scenario.

Retrieval of data from a user-defined area or point involves accessing information regarding a specific region, or uploading data points, to facilitate impact studies associated with particular points within a landscape.

Selecting and downloading climate projection data describes accessing appropriate data file types for use in impact studies which match other systems (*e.g.* GIS formats), are suitable for batch download, and can be included in robust metadata.

Comparing historical climate information with projections describes linking climate projections with historical observation data, which can be compared through combined data sets and displayed graphically.

Quantitative exploration of future climate involves more detailed use of projection information in sophisticated mapping and tabular formats regarding climate thresholds, time series, extreme event occurrences, coastal impacts and the like.

The Use Cases also provided information about the objectives or motivations for projection information usage. These include:

Estimating future impacts – in plant productivity, plant mortality, species distributions, biodiversity and water supply by modelling or projecting plant growth (invasive, native and crop species), soil and sediment erosion, fire occurrences, sea levels, fresh and salt water interactions, drought and catchment water balance.

Identifying adaptation strategies – by working with different sectors (*e.g.* tourism, primary production, water) to develop plans. This involves identifying vulnerable sites or locations where crops and species will survive, considering alternative options regarding water supply or plant varieties, managing remnant vegetation and conservation planting, and deciding water allocations.

Communicating and educating about adaptation – by developing information materials to assist different sectors, strategies to change public water use attitudes and behaviours, guidance to help planners shift from a focus on mitigation and single scenarios, and advice to facilitate conversations between NRM groups and the community about climate change.

2.2 MEETING USER NEEDS

Projections are provided for many climate variables at national, regional and sub-regional scales in this Report and the companion Cluster Reports and brochures. Access to this information and associated datasets is also provided through the *Climate Change in Australia* website. Information regarding how to use these data in impact assessments is detailed in Chapter 9.

Specific products and services provided on the website to support users of these projections include:

- A decision tree to guide the selection of projection methods and products to use for different applications (*i.e.* fit for purpose);
- Guidance material, such as step-by-step guides to assist the appropriate use of the data;
- Online training;
- A service to assist users and respond to requests for data not readily obtainable from the reports or the website.

Important issues such as addressing uncertainty in projections (Section 6.1) and climate model reliability (Chapter 5) are addressed in this Report as well as on the website. NRM regional staff, researchers and members of local groups, societies and education facilities are tasked with the role of communicating climate change information to the broader community. To assist them, a range of useful and targeted resources and links to additional material are available on the *Climate Change in Australia* website. These resources include an extensive climate information site (called 'Climate Campus'), slide packs, a guide to communicating about climate change and access to informative graphics.

2.3 SUB-DIVIDING AUSTRALIA

For the purposes of this Report and associated products, Australia has been considered at three levels of detail to suit specific purposes.

The regionalisation scheme, developed in consultation with the Department of the Environment, defines eight natural resource management (NRM) clusters. This sub-division was informed by logical groupings of recent past climatic conditions (*e.g.* Stern *et al*. 2000), biophysical factors and expected broad patterns of climate change (*e.g.* CSIRO and BOM, 2007). Where possible, the cluster boundaries were aligned with existing boundaries of 56 NRM regions (Department of Agriculture, 2013, Department of the Environment, 2013) – these are described in Box 2.1. The clusters are shown in Figure 2.1 and a summary of selected characteristics of each cluster is provided in Table 2.1. There is a Cluster Report describing the climate change projections for each cluster available on the *Climate Change in Australia* website.

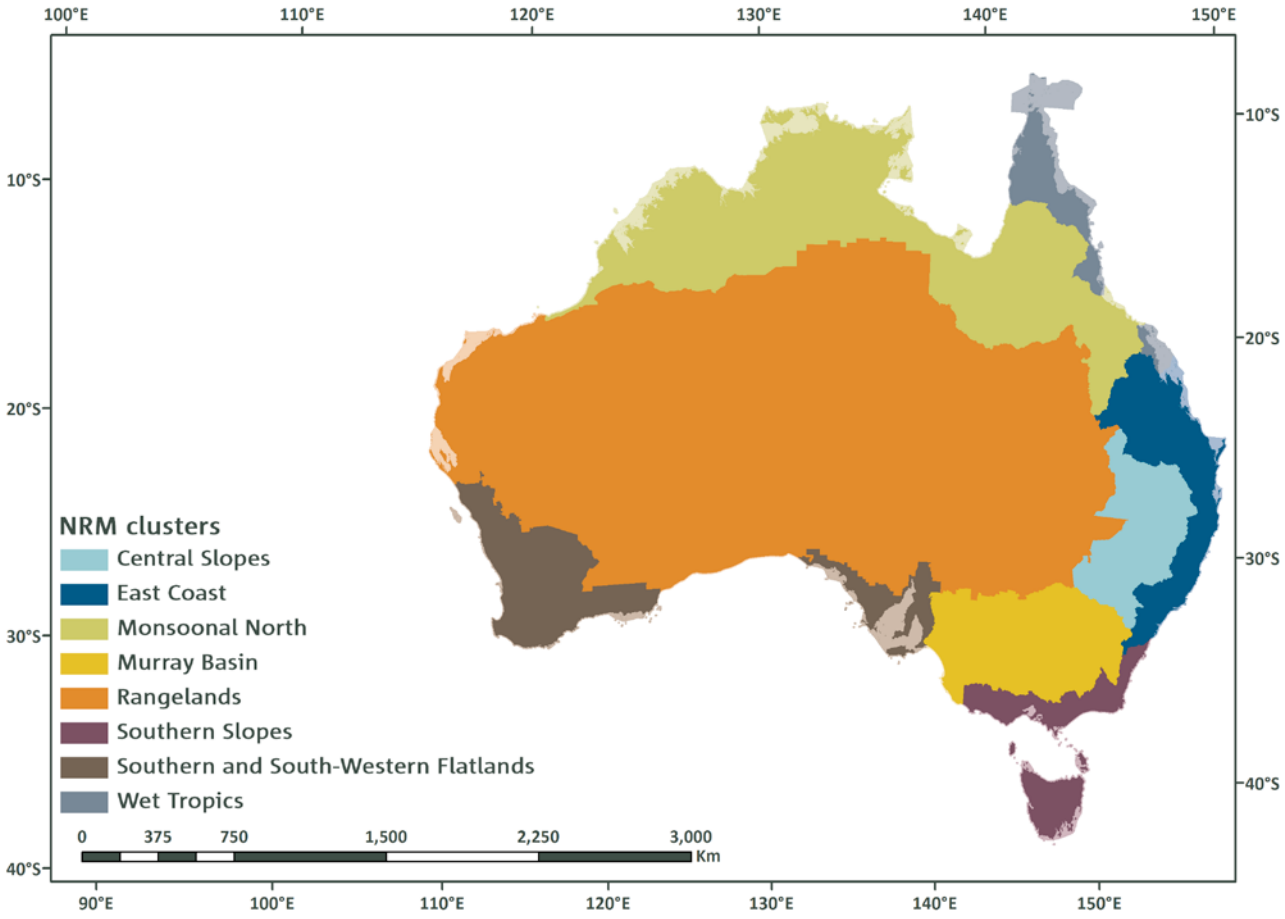

FIGURE 2.1: NATURAL RESOURCE MANAGEMENT (NRM) CLUSTERS (LIGHTER SHADES DENOTE COASTAL WATERS INCLUDED IN THE CLUSTERS TO ENCOMPASS OFFSHORE ISLANDS).

Recent studies (*e.g.* Grose *et al*. 2010) and preliminary analysis of the model results in the early stages of this work suggested further sub-division was needed in some cases to better capture the important patterns of projected change. In light of this, five of the eight clusters were sub-divided (Figure 2.2). Projections at this scale, called sub-clusters, are also more useful for impact assessment and adaptation planning.

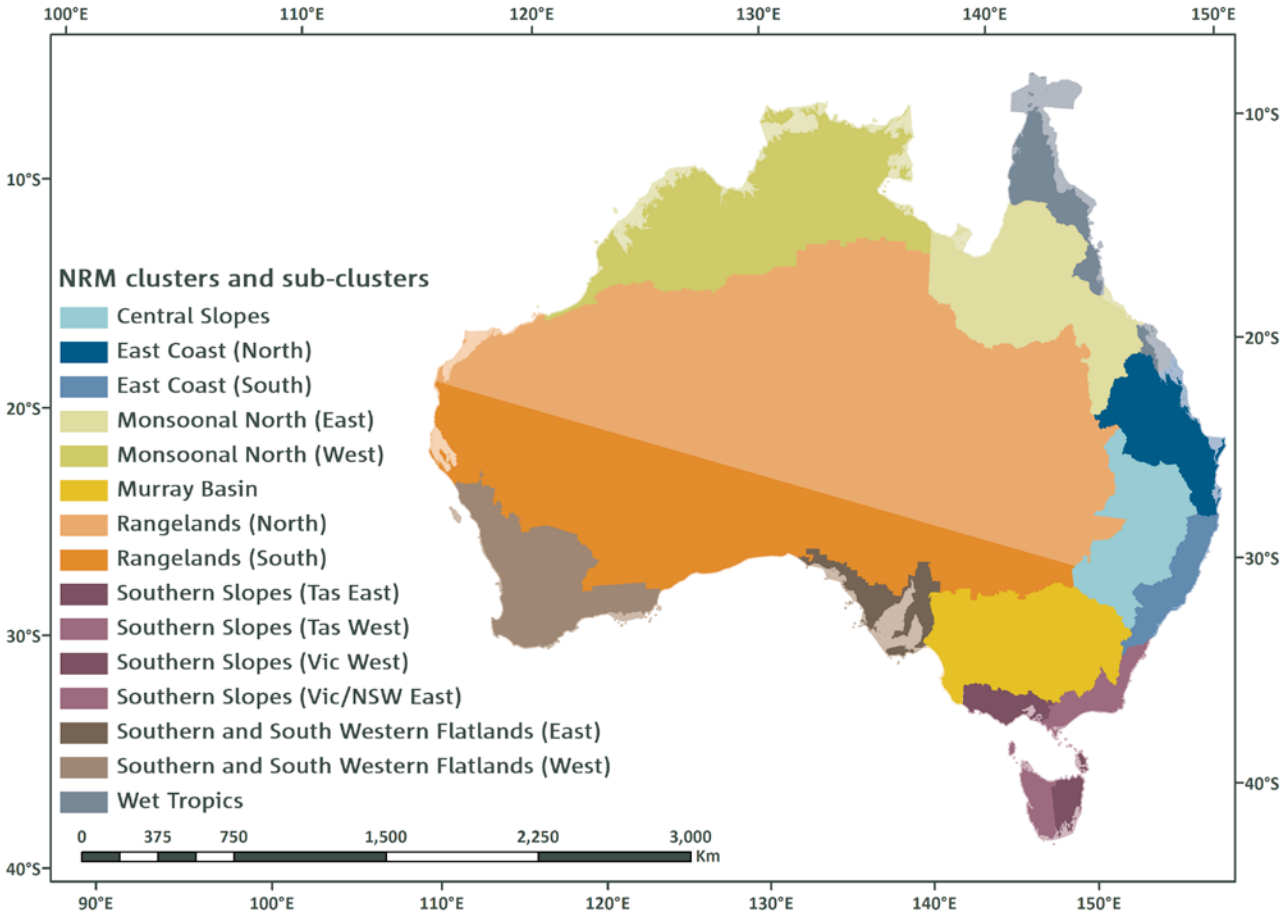

FIGURE 2.2: NRM CLUSTERS AND SUB-CLUSTERS (LIGHTER SHADES DENOTE COASTAL WATERS INCLUDED IN THE CLUSTERS TO ENCOMPASS OFFSHORE ISLANDS).

TABLE 2.1: CLIMATIC ZONES (STERN *ET AL*. 2000); ECOREGIONS (SEWPAC, 2013); APPROXIMATE AREA, POPULATION AND TOP THREE LAND USES BY AREA (AUSTRALIAN BUREAU OF STATISTICS, 2013) FOR THE EIGHT NRM CLUSTERS.

CLUSTER (APPROX. AREA 1000 KM²)	APPROX. POP. (X1000)	CLIMATIC ZONES (SEE NOTES)	ECOREGIONS (SEE NOTES)	MAIN LAND USES (% OF AREA)
CENTRAL SLOPES (372)	566	*A* (mainly north) *D* (south east) *E* (west)	4 (south east) 5 (west) 6 (north and central)	Agricultural (94) Parkland (5) Residential (0.5)
EAST COAST (395)	9,080	*C* (north) *D* (south)	4 (south) 6 (north)	Agricultural (79) Parkland (18) Residential (2)
MONSOONAL NORTH (1,906)	462	*B* (north) *C* (far east) *E* (south)	6	Agricultural (94) Parkland (5) Residential (0.2)
MURRAY BASIN (510)	1,557	*D* (south) *E* (north)	2 (west) 4 (east and south) 5 (central)	Agricultural (85) Parkland (14) Residential (0.6)
RANGELANDS (4,888)	226	*E* (scattered) *F* (majority)	1 (majority) 2 (south west & far south) 5 (east) 6 (north east)	Agricultural (95) Parkland (4) Residential (0.03)
SOUTHERN AND SOUTH-WESTERN FLATLANDS (754)	3,480	*C* (west coast) *D* (inland) *E* (coastal)	2	Agricultural (89) Parkland (9) Residential (0.6)
SOUTHERN SLOPES (200)	5,685	*D*	3 (patches) 4 (majority)	Agricultural (51) Parkland (45) Residential (2)
WET TROPICS (178)	390	*A* (north) *B* (north) *C* (south)	6 (northern) 7 (southern)	Agricultural (79) Parkland (20) Residential (<1)

CLIMATIC ZONES

A. Equatorial
B. Tropical
C. Subtropical
D. Temperate
E. Grassland
F. Desert

ECOREGIONS

1. Deserts and xeric shrublands.
2. Mediterranean forests, woodlands and scrubs.
3. Montane grasslands and shrublands.
4. Temperate broadleaf and mixed forests.
5. Temperate grasslands, savannas and shrublands.
6. Tropical and subtropical grasslands, savannahs and shrublands.
7. Tropical and subtropical moist broadleaf forests.

We have also developed a broad-scale regionalisation of Australia by amalgamating the NRM clusters into four super-clusters: Northern Australia, Eastern Australia, Southern Australia and Rangelands (Figure 2.3). This regionalisation is used within this Report (particularly in Chapter 7) to describe climate changes at national-scale while permitting representation of differing projected climate changes for the major climatic zones. The relationship between the three levels of sub-division is shown in Table 2.2.

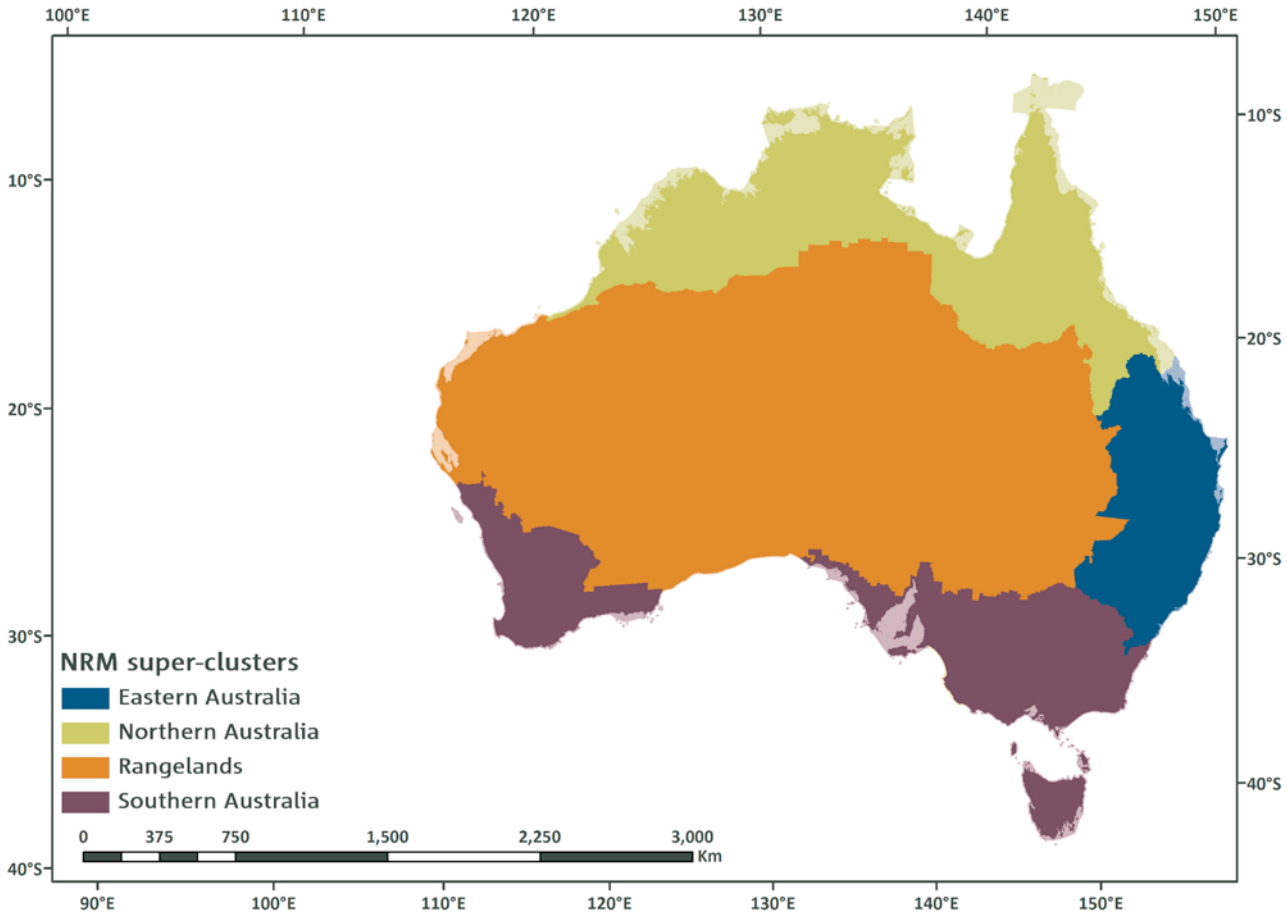

FIGURE 2.3: NRM SUPER-CLUSTERS (LIGHTER SHADES DENOTE COASTAL WATERS INCLUDED IN THE CLUSTERS TO ENCOMPASS OFFSHORE ISLANDS).

TABLE 2.2: THE SUPER-CLUSTERS, CLUSTERS AND SUB-CLUSTERS USED THROUGHOUT THIS REPORT.

SUPER-CLUSTER	CLUSTER(S)	SUB-CLUSTERS
EASTERN AUSTRALIA	East Coast	East Coast – North
		East Coast – South
	Central Slopes	Not subdivided
NORTHERN AUSTRALIA	Monsoonal North	Monsoonal North – East
		Monsoonal North – West
	Wet Tropics	Not subdivided
RANGELANDS	Rangelands	Rangelands – North
		Rangelands – South
SOUTHERN AUSTRALIA	Murray Basin	Not subdivided
	Southern & South Western Flatlands (SSWF)	SSWF – East
		SSWF – West
	Southern Slopes (SS)	SS – Tasmania East
		SS – Tasmania West
		SS – Victoria East
		SS – Victoria West

While a wide range of projections information has been provided as cluster, super-cluster and sub-cluster averages, finer scale data are available for users with a particular need. Chapter 9 gives a full explanation of the projections data available, the spatial scales, and notes on how to use them appropriately.

BOX 2.1: NRM REGIONS

Australia is divided up into 56 natural resource management (NRM) regions based on catchments or bioregions. These regions facilitate the development and implementation of strategic NRM plans, and regional bodies play a key role in delivery of government NRM programmes, including the National Landcare Programme. These regions are determined by the Commonwealth, State and Territory governments, with revisions from time to time.

For these projections, a regionalisation scheme using the NRM regional boundaries has been used. The main projections regions are called clusters. To allow time for the extensive analyses required to develop the results presented in this Report (and associated products) it was necessary to settle on the cluster boundaries and retain those boundaries for the life of the project. The boundaries were fixed on 1 January 2013. In early 2014, the New South Wales government realigned their NRM regional boundaries. This affects the East Coast, Southern Slopes and Murray Basin clusters, and to a lesser extent the Rangelands cluster (see the relevant Cluster Reports for details).

In most cases, the definition of clusters was based on NRM regional boundaries. However, the whole of the Northern Territory is a single NRM region as is northern Western Australia. It was important in the definition of cluster boundaries to recognise the distinct climatic and biophysical character of the far northern monsoonal areas. As such, the Northern Territory and northern Western Australia were split along their sub-regional boundaries delineating the Monsoonal North and the Rangelands clusters. In addition, the Cape York Cooperative Management Area was used to delineate part of the boundary between the Wet Tropics and Monsoonal North clusters. Figure B2.1 shows the NRM regions and other boundaries used as the basis for the regionalisation described in this chapter.

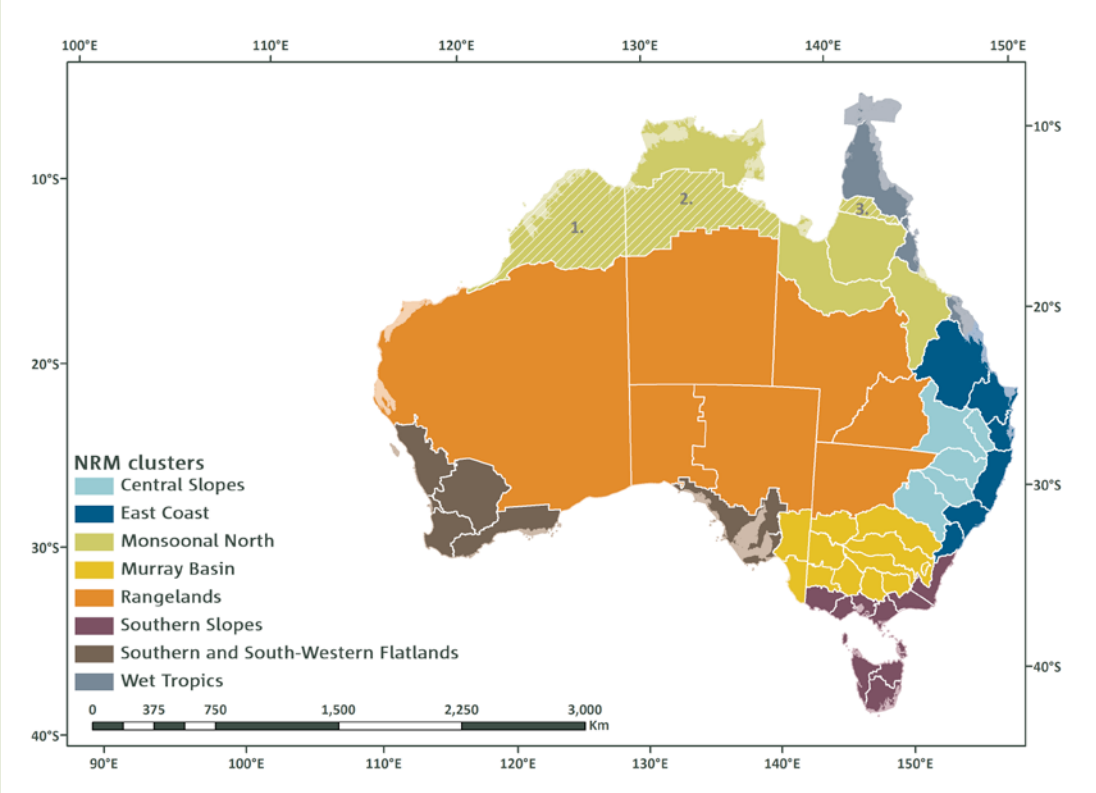

FIGURE B2.1 THE NRM REGIONS USED TO DEVELOP THE REGIONALISATION FOR THIS REPORT AND ASSOCIATED PRODUCTS, IN CONSULTATION WITH THE DEPARTMENT OF THE ENVIRONMENT. NOTE THAT SOME BOUNDARIES ARE DEFINED BY NRM SUB-REGIONS (1 AND 2), AND THE COOPERATIVE MANAGEMENT AREA ON CAPE YORK (3).

Note that NRM Regions are reviewed from time to time by the relevant State agencies (e.g. the NSW regions were revised in early 2014). To facilitate the extensive analyses required for this project, the boundaries were fixed on 1 January 2013.