bnhcrc.com.au

A TYPOLOGY OF DISASTER RESILIENCE IN AUSTRALIA

Annual Project Report, 2018-19

Melissa Parsons, Ian Reeve, James McGregor, Sonya Glavac, Richard Stayner, Judith McNeill, Peter Hastings, Graham Marshall and Phil Morley
University of New England

Version	Release history	Date
1.0	Initial release of document	11/06/2020

Publisher:
Bushfire and Natural Hazards CRC

June 2020

Citation: Parsons M, Reeve I, McGregor J, Glavac S, Stayner R, McNeill J, Hastings P, Marshall G & Morley P (2020) A typology of disaster resilience in Australia - annual report 2018-19, Bushfire and Natural Hazards CRC, Melbourne.

Cover: Source: Kassandra Hunt, UNE. Austock image 000042057, Jamestown SA, under licence.

CONTENTS

ACKNOWLEDGMENTS

The Australian Natural Disaster Resilience Index has been co-designed by project end-users. We thank the many end-users and other supporters who have contributed their thoughts, time and expertise to the project so far:

- Sandra Barber, Tasmania Fire Service
- Gwynne Brennan, Country Fire Authority Victoria
- Trent Curtin, Metropolitan Fire Brigade, Melbourne
- Karen Enbom, Country Fire Authority Victoria
- Tony Jarrett – NSW Rural Fire Service
- Paul Fletcher – Metropolitan Fire Service, SA
- Suellen Flint – Department of Fire and Emergency Services WA
- Holly Foster – Emergency Management Victoria
- Tamara Beckett – Department of Environment, Land, Water and Planning, VIC
- Andrew Richards – State Emergency Service, NSW
- Nicole Hogan – State Emergency Service, NSW
- Colleen Ridge - State Emergency Service, Tasmania
- Amanda Leck – Australian Institute of Disater Resilience
- Members of the AFAC Community Engagement Technical Group
- Anthony Bradstreet – NSW Rural Fire Service
- Rachel Armstrong – Department of Fire and Emergency Services, WA
- Stef Russell – Country Fire Authority, Victoria
- Mark Edwards – Geoscience Australia
- Fyowna Naughten – Emergency Management Victoria
- Danny Rey Conde – Emergency Management Victoria

And many others who have contributed through Research Advisory Forum workshops and the AFAC Community Engagement Technical Group.

EXECUTIVE SUMMARY

The themes that influence disaster resilience in different locations in Australia are summarised using a typology. A typology identifies SA2s (Statistical Area 2 divisions of the ABS) that have similar characteristic patterns of theme sub-index values, and places these SA2s together into groups. Thus, the SA2s within a group are similar to each other, but each group has a different disaster resilience profile. The profile associated with each group can then be used to understand disaster resilience in local communities and the strengths and opportunities for enhancing or improving disaster resilience.

Cluster analysis revealed five disaster resilience profiles in Australia. The SA2s within a group all have a similar profile – that is, they have similar disaster resilience strengths and constraints. Most SA2s fall into Group 4, and these are largely in metropolitan Australia. In comparison to other groups, areas within Group 4 are best placed overall to cope with and adapt to complex change associated with natural hazards. Areas in Group 3 are largely in regional and remote areas. Areas with this disaster resilience profile have an enhanced pro-social setting, but face constraints from economic capital, planning and the built environment, emergency services, information access and governance and leadership. Areas with the Groups 1 and the Group 5 disaster resilience profile are constrained by community capital and social character. Areas with the Group 2 disaster resilience profile are largely inner regional areas with reduced access to information and telecommunications services. Variation in the strengths and constraints on disaster resilience suggests that place-based strategies need to be applied to support the different dimensions of disaster resilience.

Summary of disaster resilience profiles in Australia

	Typology group				
	Group 1	**Group 2**	**Group 3**	**Group 4**	**Group 5**
Disaster resilience strengths	Emergency services Economic capital Planning and the built environment Information access Governance and leadership	Social character Community capital Social and community engagement Economic capital Planning and the built environment Emergency services Governance and leadership	Social character Community capital Social and community engagement	Economic capital Information access Governance and leadership Social character Planning and the built environment Emergency services Community capital Social and community engagement	Planning and the built environment Governance and leadership Economic capital Emergency services Information access Social and community engagement
Barriers to disaster resilience	Community capital Social and community engagement Social character	Information access	Economic capital Planning and the built environment Emergency services Information access Governance and leadership		Social character Community capital
Population*#	3,567,512	3,266,777	3,156,814	7,474,525	6,337,995
% population	15.0	13.7	13.3	31.4	26.6
Land area (km²)^	10,399	405,546	7,211,800	10,689	6,328
% land area^	0.1	5.3	94.3	0.1	0.1
Number of SA2s+	308	389	447	572	368
Metropolitan SA2s$	158 (13%)	125 (10%)	70 (6%)	495 (41%)	355 (30%)
Inner regional SA2s$	70 (15%)	204 (43%)	133 (28%)	59 (12%)	10 (2%)
Outer regional SA2s$	73 (24%)	55 (18%)	161 (52%)	17 (6%)	3 (1%)
Remote SA2s$	6 (13%)	4 (8%)	37 (77%)	1 (2%)	0 (0%)
Very remote SA2s$	1 (2%)	1 (2%)	46 (96%)	0 (0%)	0 (0%)

* Computed using ABS Estimated Resident population as of 30th June 2015.
# Excludes SA2s not used in the index. The population in SA2s used in the index is 23,803,623 people. The population in SA2s not used in the index is a further 12,372 people.
^ Excludes SA2s not used in the index. The land area of SA2s used in the index is 7,644,763km². The land area of SA2s not used in the index is a further 43,047km².
+ Excludes SA2s not used in the index. Of the 2214 SA2s in the ASGS 2011, 2084 were used in the index and 130 excluded.
$ ABS remoteness categories, ASGS 2011.

END-USER PROJECT IMPACT STATEMENT

Dr Holly Foster, *Research Coordination and Innovation, Emergency Management Victoria*

The work of the emergency management sector fundamentally contributes to fostering and supporting resilient communities. How emergency management organisations understand and respond to the plethora of variables influencing resilience across the broader, macro environment is complex and can be overwhelming. The Australian Natural Disaster Resilience Index (ANDRI) is a tool that assists to identify and understand the multifaceted dynamics at play across the broader social system. Moreover, it offers a way of scaling this nuanced data across States, regions and townships. The ANDRI tools offer a leading-edge approach to plan and resource activities that further enhance resilience, across planning, response and recovery activities. Moreover, we are already starting to see the critical and timely influence of this research with many organisations embedding the key principles and frameworks of the ANDRI into their doctrine and planning processes.

The ANDRI is a must-read for any organisation working toward resilience outcomes.

INTRODUCTION

Natural hazard management policy directions in Australia – and indeed internationally – are increasingly being aligned to ideas of resilience. However, the definition and conceptualization of resilience in relation to natural hazards is keenly contested within academic literature (Klein et al., 2003; Wisner et al., 2004; Boin et al., 2010; Tierney, 2014). Broadly speaking, resilience to natural hazards is the ability of individuals and communities to cope with disturbances or changes and to maintain adaptive behaviour (Maguire and Cartwright, 2008). Building resilience to natural hazards requires the capacity to cope with the event and its aftermath, as well as the capacity to learn about hazard risks, change behaviour, transform institutions and adapt to a changing environment (Maguire and Cartwright, 2008).

However, an assessment of the current of resilience is needed to able identify problems and plan future resilience building actions. There are two principal approaches to assessing disaster resilience. Bottom-up approaches are locally based and locally driven and are qualitative self-assessments of disaster resilience (Committee on Measures of Community Resilience, 2015). Bottom-up approaches survey individuals or communities using a scorecard consisting of indicators of disaster resilience such as preparation, exposure to specific hazards, community resources and communication (e.g. Arbon, 2014). In contrast, top-down approaches are often intended for use at broad scales by an oversight body (Committee on Measures of Community Resilience, 2015) and use secondary spatial sources such as census data to quantitatively derive indicators that describe the inherent characteristics of a community that contribute to disaster resilience (Cutter et al., 2010).

The Australian Natural Disaster Resilience Index will be a tool for assessing the resilience of communities to natural hazards at a large scale. Using a top down approach, the assessment will provide input to macro-level policy, strategic planning, community planning and community engagement activities at National, State and local government levels. First, it is a snapshot of the current state of natural hazard resilience at a national scale. Second, it is a layer of information for use in strategic policy development and planning. Third, it provides a benchmark against which to assess future change in resilience to natural hazards. Understanding resilience strengths and weaknesses will help communities, governments and organizations to build the capacities needed for living with natural hazards.

BACKGROUND

The Australian Natural Disaster Resilience Index is the first national assessment of disaster resilience. An index was created (see Parsons et al. 2019a) using a hierarchical design with sub-indices of coping and adaptive capacity, and the eight themes of disaster resilience (Figure 1). The index was subsequently used to undertake an assessment of the State of Disaster Resilience in Australia (Parsons et al. 2019a). Many of the indicators used in the construction of the Australian Natural Disaster Resilience Index have well-understood spatial relationships. This suggests that, if the eight theme sub-indices are considered, aeas with similar disaster resilience profiles can be determined.

The themes that influence disaster resilience in different locations in Australia are summarised using a typology. A typology identifies SA2s (Statistical Area 2 divisions of the ABS) that have similar characteristic patterns of theme sub-index values, and places these SA2s together into groups. Thus, the SA2s within a group are similar to each other, but each group has a different disaster resilience profile. The profile associated with each group can then be used to understand disaster resilience in local communities and the strengths and opportunities for enhancing or improving disaster resilience.

This report presents the typology of disaster resilience in Australia.

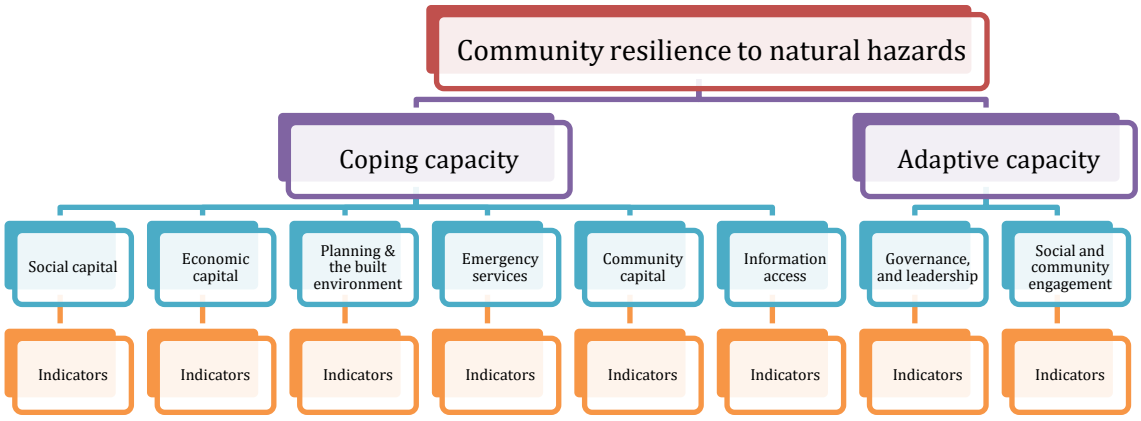


Figure 1. The hierarchical structure of the Australian Natural Disaster Resilience Index.

RESEARCH APPROACH

METHODS

Cluster analysis was used to extract groups of SA2s with unique disaster resilience profiles. Four different methods of cluster analysis were used to examine the cluster structure using the eight theme dimensions: hierarchical agglomerative cluster analysis; k-means analysis; partitioning around medoids; and, latent profile analysis. The choice of number of clusters was guided by the scree-type plots appropriate to each method. The agglomerative hierarchical scree plot suggested nine, five or three clusters. The k-means scree plot gave no guidance. The silhouette coefficient plot for partitioning around medoids suggested three clusters, but the low value of the silhouette coefficient for all the cluster solutions indicated that cluster structure was very weak. The plot of BIC against the number of profiles for latent profile analysis gave little guidance.

It was concluded that there is support for a three, five or nine cluster solution for the eight theme sub-indices, although the cluster structure is weak. The five cluster solution using partitioning around medoids was chosen on simple communication grounds to support further interpretive visualisation of the Australian Natural Disaster Resilience Index using a heat-map. A nine cluster solution would overly complicate the interpretation, while a three cluster solution would be unnecessarily parsimonious. External validation of the five cluster solution using a measure of remoteness showed there were significant differences in remoteness among the five groups. This lent support for the decision to present interpretative visualisations of the Australian Natural Disaster Resilience Index as a five-group typology. When mapped, the five groups of SA2s tended to form cohesive regions, rather than being scattered randomly, further supporting the view that, although cluster structure is weak, it is nonetheless spatially meaningful. A full description of the derivation of the typology is provided in Parsons et al. (2019b).

The disaster resilience profile associated with each of the cluster groups was determined using a three step process. First, percentiles were calculated using all 2084 SA2s within a theme to set the classes of high (>75th percentile), moderate (25th to 75th percentile) and low (<25th percentile) disaster resilience. Second, the median index values for each cluster group and theme were used to identify groups as belonging to the high, moderate or low disaster resilience band. Third, the bands were narrated using the relationships of individual indicators to the distribution of theme sub-index values (see Parsons et al. 2019b). Summary statistics were also used to show the relationships between cluster groups and population, land area and remoteness, and the relationships between groups and the resilience, coping and adaptive capacity index values.

THE TYPOLOGY GROUPS

Cluster analysis revealed five groups of SA2s, each with a different disaster resilience profile (Figure 2). High and low theme sub-index values were associated with each group (Figure 2). For example, Group 4 has high economic capital theme sub-index values while Group 3 has much lower economic capital theme sub-index values. Based on median values, each group could then be placed into a band of high, moderate or low disaster resilience (Table 1). For example, Group 4 falls into the high band for economic capital while Group 3 falls into the low band (Table 1). These bands have an associated narration (Table 2), forming the basis for interpreting the typology. Groups also have characteristic associations with population, land area and remoteness classes and with the overall Australian Natural Disaster Resilience Index values.

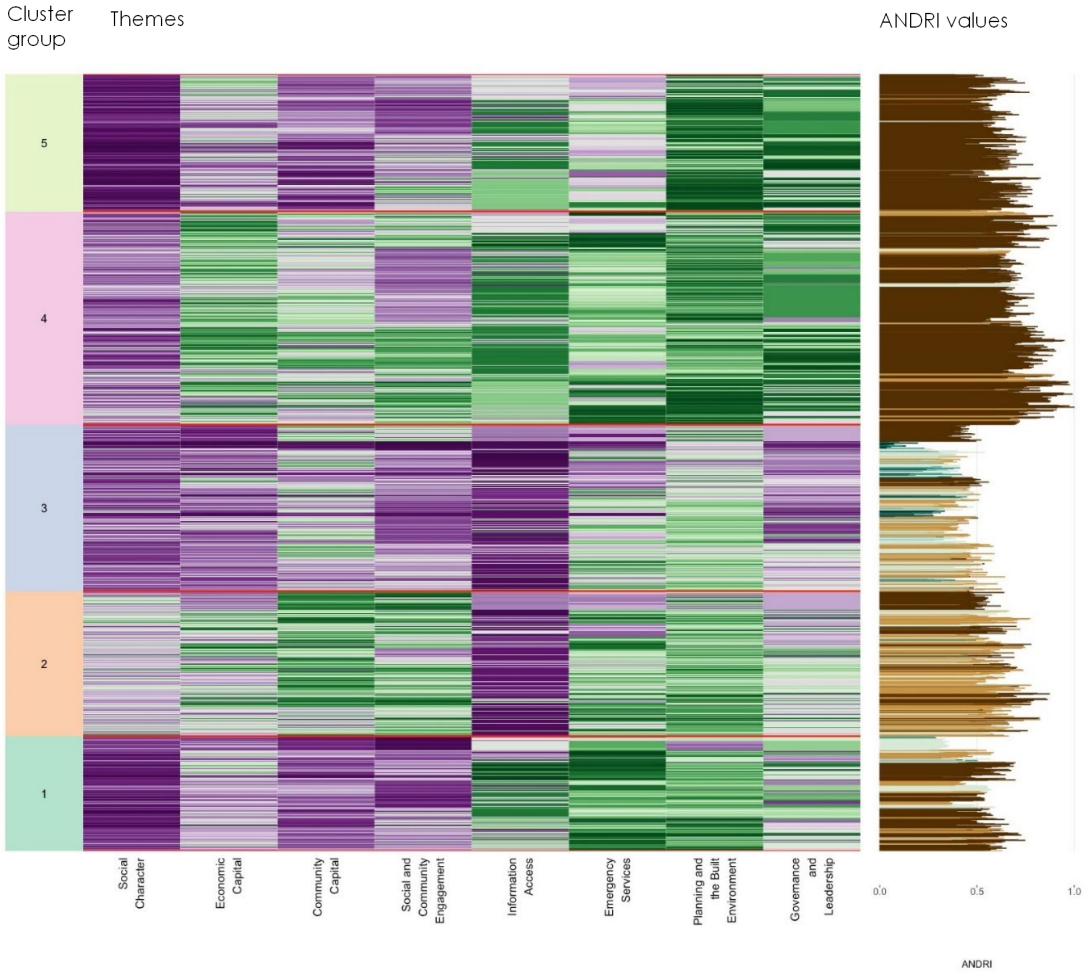


Figure 2. Overall results of the cluster analysis to extract groups of SA2s with similar disaster resilience profiles. The five groups extracted from the cluster analysis are shown on the left. Associated with each group is a set of SA2s (thin lines) with a sub-index value for each theme. These are colour coded as purple (lower sub-index values) and green (higher sub-index values). On the right, the overall Australian Natural Disaster Resilience Index value for each SA2 is shown, ranging from 0 (lower disaster resilience) to 1 (higher disaster resilience). These are colour coded by remoteness, with brown being metropolitan and blue being remote and very remote SA2s.

Table 1: Classification of typology groups into classes of high (H), moderate (M) and low (L) capacity for each disaster resilience theme. Low = median <25th percentile of overall theme index value, moderate = median in 50th – 75th percentile of overall theme index value, high = median >75th percentile of overall theme index value. Cases marked with * have a median that falls on or very close to the boundary between two classes.

Theme	Typology group				
	1	2	3	4	5
Social character	M*	H	M	M	L
Economic capital	M	M	L	H	M
Emergency services	H	M	L*	M	M
Planning and the built environment	M	M	L*	M	H
Community capital	L	H	M	M	L
Information access	M	L	L	H*	M
Social and community engagement	L	H	M	M	M
Governance and leadership	M	M	L	H*	H

Table 2. Description of high, moderate and low classes applied to typology groups.

Theme	Class	Description
Social character 	**High**	These communities have social and demographic characteristics that should enhance the capacity to prepare for, respond to and recover from natural hazard events. In general, enhanced capacity comes from higher levels of education, employment and English language proficiency and a somewhat lower need for assistance.
	Moderate	These communities have some social and demographic characteristics that support the capacity to prepare for, respond to and recover from natural hazard events, but may also have some social and demographic characteristics that constrain this capacity. The combination of supporting and constraining social and demographic characteristics will vary across SA2s within the group, but it is likely that communities will have mid-range levels of education, employment and English language proficiency.
	Low	These communities have social and demographic characteristics that may constrain their capacity to prepare for, respond to and recover from natural hazard events. The circumstances limiting this capacity will vary, but it is likely that many of these communities will have lower levels of education, employment and English language proficiency. Further constraints on capacity may come from a higher need for assistance and a relatively higher proportion of the working population in occupations other than management and professional occupations.
Economic capital 	**High**	These communities have economic characteristics that should enhance the capacity to prepare for, respond to and recover from natural hazard events. The enhanced capacity of these communities arises through access by individuals and households to greater economic resources. This will occur where fewer households are paying rent, and income levels are higher. Enhanced capacity also derives from a diversified economy.
	Moderate	These communities have some economic characteristics that support the capacity to prepare for, respond to and recover from natural hazard events, but may also have some economic characteristics that constrain this capacity. The combination of supporting and constraining economic characteristics will vary across SA2s within the group, but it is likely that communities will have mid-range proportions of renters and mid-range income levels. Their economies are likely to be only moderately diversified.
	Low	These communities have economic characteristics that may constrain their capacity to prepare for, respond to and recover from natural hazard events. The circumstances limiting this capacity will vary, but it is likely that these communities will have relatively high proportions of rental households and low income households, resulting in a limited capacity to buffer external financial shocks. In many cases this will be exacerbated by an economy dominated by a single industry sector.

Table 2 (cont.)

Theme	Class	Description
Emergency services 	**High**	The presence, capability and resourcing of emergency services should enhance the capacity of these communities to respond to natural hazard events. While the combination of emergency services characteristics will vary across SA2s within the group, it is likely that most of these communities will have relatively high levels of emergency service volunteers, well-resourced ambulance services and good access to medical services.
	Moderate	Some characteristics of emergency services supports the capacity of these communities to respond to natural hazard events, while other emergency services characteristics may constrain this capacity. The combination of supporting and constraining emergency services characteristics will vary across SA2s within this group, but most communities are likely have high levels of emergency services volunteers and well-resourced ambulance organisations. Capacity to respond to natural hazard events may be constrained by poorer access to medical services.
	Low	These communities have emergency services characteristics that may constrain their capacity to respond to natural hazard events. Constraint largely arises because of remoteness, which limits the availability of emergency and other services. Due to other sources of disadvantage, these communities may have a greater presence of welfare support workers and police, but these positive aspects of response capacity are offset by their very limited access to medical services.
Planning and the built environment 	**High**	Planning systems and the character of the built environment should enhance the capacity of these communities to prepare for natural hazard events using strategies of mitigation, planning or risk management. While the combination of planning and built environment characteristics may vary across SA2s within the group, most of these communities are likely to have newer residential and commercial or industrial buildings, and high standards of emergency and other planning systems. Many of these communities will also be in well-resourced local government areas.
	Moderate	These communities have some planning system and built environment characteristics that support their capacity to prepare for, respond to and recover from natural hazard events using strategies of mitigation, planning or risk management. However, there may also be some planning system and built environment characteristics that constrain this capacity. The combination of supporting and constraining planning and the built environment characteristics will vary across SA2s in the group, but it is likely that many communities will have a significant proportion of older buildings. Others with fewer older buildings may be constrained instead by emergency and other planning systems that could be improved to a higher standard.
	Low	Planning systems and the character of the built environment may constrain the capacity of these communities to prepare for natural hazard events using strategies of mitigation, planning or risk management. While the characteristics constraining this capacity will vary across SA2s in the group, most communities are likely to have a predominance of older building stock and relatively more people residing in caravans or improvised dwellings.

Table 2 (cont.)

Theme	Class	Description
Community capital 	**High**	The cohesion and connectedness of these communities should enhance the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. These communities are likely to have low crime rates, and be safe, supportive and relatively well-off neighbourhoods with significant levels of community participation activity such as volunteering.
	Moderate	The cohesion and connectedness of these communities supports the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. However, there may be some community capital characteristics that constrain this capacity. The combination of supporting and constraining circumstances will vary across SA2s in the group, but capacity may be constrained by mid-range crime rates, slightly less supportive and well-off neighbourhoods and lower levels of volunteering.
	Low	The cohesion and connectedness of these communities may constrain the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. The circumstances constraining this capacity will vary across SA2s in the group but are likely to arise from a high incidence of crime, low community safety and other factors that limit social support and community participation. The level of volunteering activity is also likely to be low.
Information access 	**High**	These communities have enhanced capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. Generally this enhanced capacity will be associated with good telecommunications access and, to a lesser extent, engagement in hazard education.
	Moderate	These communities have some capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. There may be some constraints on capacity arising from less than universal telecommunications access.
	Low	These communities have constrained capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. The main characteristic contributing to reduced capacity is limited telecommunications access.

Table 2 (cont.)

Theme	Class	Description
Social and community engagement 	**High**	These communities have enhanced capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards. The enhanced capacity of these communities for learning and transformation may arise through high levels of past participation in education, high life satisfaction and a stable population.
	Moderate	These communities have some capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards, but may also face some constraints on this capacity. While the characteristics supporting and constraining capacity will vary across SA2s in the group, but these communities can be expected to have mid-range levels of in and out migration, suggesting a slightly less stable population.
	Low	These communities have constrained capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards. The characteristics constraining capacity will vary across SA2s in the group, but are most likely to arise from low levels of past and present participation in education. Some communities may also be constrained by high levels of population turnover.
Governance and leadership 	**High**	These communities are associated with a governance environment that should enhance the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. Enhanced capacity may be contributed by the presence of research organisations and innovative commercial firms, and an emergency services sector with a capacity for agility, flexibility and adaptation.
	Moderate	These communities are associated with a governance environment that supports the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. However, the governance environment may also face some constraints on this capacity, associated with the need for improvement in research presence, innovation or agency agility, flexibility and adaptation.
	Low	These communities are associated with a governance environment that may be limited by the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. The characteristics constraining capacity will vary across SA2s in the group, but it is likely that these communities do not have the benefit of research organisation presence and innovative commercial firms. Levels of local economic development support may also be limited.

TYPOLOGY GROUP 1

The disaster resilience strengths associated with communities with the Typology Group 1 disaster resilience profile are emergency services, economic capital, planning and the built environment, information access and governance and leadership (Table 3). Thus, these communities are generally well- supported by government services that enhance disaster preparation, response and recovery, identify and mitigate risk and guide organisations through complex change.

Constraints to disaster resilience arise from community capital, social and community engagement and social character (Table 3). Thus, there are opportunities for building disaster resilience in these communities through improved attention to vulnerable groups, community cohesion and enhancing community capacity to adjust to complex change.

All States and Territories have SA2s with this disaster resilience profile, with the exception of the ACT. SA2s with this disaster resilience profile are located across a mix of areas: metropolitan, inner regional, outer regional and remote.

Typology Group 1 corresponds to 0.1% of Australia's land area. Approximately 15% of the population, or 3.6 million people, live in areas with this disaster resilience profile. There are 308 SA2s across Australia with this disaster resilience profile, or 15% of all 2,084 SA2s assessed.

Maps of the typology groups are given in Appendix 1.

Table 3. Overview of the disaster resilience profile of Typology Group 1. Maps of the distribution of Typology Group 1 are given in Appendix 1.

Typology group	Group 1
Number of SA2s	308
Mean ANDRI value	0.4787
Approximate population and proportion of total	3.6 million 15%
Land area and proportion of total	10,399 km^2 0.1%
Location	SA2s in Typology Group 1 are located across a mix of areas: metropolitan, inner regional, outer regional and remote (Table 4.3). Table 4.6 lists the SA2s within typology Group 1.
Disaster resilience strengths 	**Emergency services (High)** The presence, capability and resourcing of emergency services should enhance the capacity of these communities to respond to natural hazard events. While the combination of emergency services characteristics will vary across SA2s within the group, it is likely that most of these communities will have relatively high levels of emergency service volunteers, well-resourced ambulance services and good access to medical services.
	Economic capital (Moderate) These communities have some economic characteristics that support the capacity to prepare for, respond to and recover from natural hazard events, but may also have some economic characteristics that constrain this capacity. The combination of supporting and constraining economic characteristics will vary across SA2s within the group, but it is likely that communities will have mid-range proportions of renters and mid-range income levels. Their economies are likely to be only moderately diversified
	Planning and the built environment (Moderate) These communities have some planning system and built environment characteristics that support their capacity to prepare for, respond to and recover from natural hazard events using strategies of mitigation, planning or risk management. However, there may also be some planning system and built environment characteristics that constrain this capacity. The combination of supporting and constraining planning and the built environment characteristics will vary across SA2s in the group, but it is likely that many communities will have a significant proportion of older buildings. Others with fewer older buildings may be constrained instead by emergency and other planning systems that could be improved to a higher standard.
	Information access (Moderate) These communities have some capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. There may be some constraints on capacity arising from less than universal telecommunications access
	Governance and leadership (Moderate) These communities are associated with a governance environment that supports the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. However, the governance environment may also face some constraints on this capacity, associated with the need for improvement in research presence, innovation or agency agility, flexibility and adaptation.

Table 3 (cont.)

Barriers to disaster resilience 	**Community capital (Low)** The cohesion and connectedness of these communities may constrain the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. The circumstances constraining this capacity will vary across SA2s in the group but are likely to arise from a high incidence of crime, low community safety and other factors that limit social support and community participation. The level of volunteering activity is also likely to be low.
	Social and community engagement (Low) These communities have constrained capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards. The characteristics constraining capacity will vary across SA2s in the group, but are most likely to arise from low levels of past and present participation in education. Some communities may also be constrained by high levels of population turnover.
	Social character (Low) These communities have social and demographic characteristics that may constrain their capacity to prepare for, respond to and recover from natural hazard events. The circumstances limiting this capacity will vary, but it is likely that many of these communities will have lower levels of education, employment and English language proficiency. Further constraints on capacity may come from a higher need for assistance and a relatively higher proportion of the working population in occupations other than management and professional occupations.

TYPOLOGY GROUP 2

The disaster resilience strengths associated with communities with the Typology Group 2 disaster resilience profile are social character, community capital, social and community engagement, economic capital, planning and the built environment, emergency services and governance and leadership (Table 4). Thus, the disaster resilience of these communities is contributed by social cohesion, economic resources, well-resourced government services that enhance disaster preparation, response and recovery, identify and mitigate risk and guide organisations through complex change.

Constraints to disaster resilience arise from information access (Table 4). Thus there are opportunities for building resilience through improving access to telecommunications and increasing the engagement of communities with natural hazard information before, during and after natural hazard events.

All States and Territories have SA2s with this disaster resilience profile, with the exception of the NT. SA2s with this disaster resilience profile are predominantly inner regional, but also contain a moderate proportion of outer regional and metropolitan SA2s.

Typology Group 2 corresponds to 5.3% of Australia's land area. Approximately 14% of the population, or 3.3 million people, live in areas with this disaster resilience profile. There are 389 SA2s across Australia with this disaster resilience profile, or 19% of all 2,084 SA2s assessed.

Maps of the typology groups are given in Appendix 1.

Table 4. Overview of the disaster resilience profile of Typology Group 2. Maps of the distribution of Typology Group 2 are given in Appendix 1.

Typology group	Group 2
Number of SA2s	389
Mean ANDRI value	0.5731
Approximate population and proportion of total	3.3 million 14%
Land area and proportion of total	405,546 km^2 5.3%
Location	SA2s in Typology Group 2 are predominantly inner regional, but also contain a moderate proportion of outer regional and metropolitan SA2s (Table 4.3). Table 4.8 lists the SA2s within Typology Group 2.
Disaster resilience strengths 	**Social character (High)** These communities have social and demographic characteristics that should enhance the capacity to prepare for, respond to and recover from natural hazard events. In general, enhanced capacity comes from higher levels of education, employment and English language proficiency and a somewhat lower need for assistance.
	Community capital (High) The cohesion and connectedness of these communities should enhance the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. These communities are likely to have low crime rates, and be safe, supportive and relatively well-off neighbourhoods with significant levels of community participation activity such as volunteering.
	Social and community engagement (High) These communities have enhanced capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards. The enhanced capacity of these communities for learning and transformation may arise through high levels of past participation in education, high life satisfaction and a stable population.
	Economic capital (Moderate) These communities have some economic characteristics that support the capacity to prepare for, respond to and recover from natural hazard events, but may also have some economic characteristics that constrain this capacity. The combination of supporting and constraining economic characteristics will vary across SA2s within the group, but it is likely that communities will have mid-range proportions of renters and mid-range income levels. Their economies are likely to be only moderately diversified.
	Planning and the built environment (Moderate) These communities have some planning system and built environment characteristics that support their capacity to prepare for, respond to and recover from natural hazard events using strategies of mitigation, planning or risk management. However, there may also be some planning system and built environment characteristics that constrain this capacity. The combination of supporting and constraining planning and the built environment characteristics will vary across SA2s in the group, but it is likely that many communities will have a significant proportion of older buildings. Others with fewer older buildings may be constrained instead by emergency and other planning systems that could be improved to a higher standard.

Table 4 (cont.)

Disaster resilience strengths (cont.)	**Emergency services (Moderate)** Some characteristics of emergency services supports the capacity of these communities to respond to natural hazard events, while other emergency services characteristics may constrain this capacity. The combination of supporting and constraining emergency services characteristics will vary across SA2s within this group, but most communities are likely have high levels of emergency services volunteers and well resourced ambulance organisations. Capacity to respond to natural hazard events may be constrained by poorer access to medical services.
	Governance and leadership (Moderate) These communities are associated with a governance environment that supports the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. However, the governance environment may also face some constraints on this capacity, associated with the need for improvement in research presence, innovation or agency agility, flexibility and adaptation.
Barriers to disaster resilience	**Information access (Low)** These communities have constrained capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. The main characteristic contributing to reduced capacity is limited telecommunications access.

TYPOLOGY GROUP 4

The disaster resilience strengths associated with communities with the typology Group 3 disaster resilience profile are social character, community capital and social and community engagement (Table 5). Thus, the disaster resilience of these communities is contributed by a strong pro-social setting characterised by community coherence, community capital and capacity for communities to adapt to complex change. Although these factors were classed as moderate (Table 5) they suggest the potential for community as a resource and asset to prepare for, respond to and recover from disasters, and to adapt to complex change.

Communities with the group 3 disaster resilience profile face the greatest structural constraints to disaster resilience, in comparison to the other profiles. Constraints to disaster resilience arise from economic capital, planning and the built environment, emergency services, information access and governance and leadership (Table 5). Thus there are many factors that could be addressed to improve disaster resilience in these communities, usually sitting outside community control. These include improving economic prosperity, systems of planning for hazards, access to telecommunications and access to and provisioning of emergency services.

All States and Territories have SA2s with this disaster resilience profile. The majority of remote and very remote SA2s have this disaster resilience profile, but there are also many outer regional and inner regional SA2s with this disaster resilience profile, and a few metropolitan SA2s.

Typology Group 3 corresponds to 94.3% of Australia's land area. Approximately 13% of the population, or 3.2 million people, live in areas with this disaster resilience profile. There are 447 SA2s across Australia with this disaster resilience profile, or 21% of all 2,084 SA2s assessed.

Maps of the typology groups are given in Appendix 1.

Table 5. Overview of the disaster resilience profile of Typology Group 3. Maps of the distribution of Typology Group 3 are given in Appendix 1.

Typology group	Group 3
Number of SA2s	447
Mean ANDRI value	0.3717
Approximate population and proportion of total	3.2 million 13%
Land area and proportion of total	7,211,800 km^2 94.3%
Location	Most of the SA2s in Typology Group 3 are inner regional and outer regional (Table 4.3). Typology Group 3 also contains the majority (96%) of remote and very remote SA2s (Table 4.3). Table 4.10 lists the SA2s within Typology Group 3.
Disaster resilience strengths 	**Social character (Moderate)** These communities have some social and demographic characteristics that support the capacity to prepare for, respond to and recover from natural hazard events, but may also have some social and demographic characteristics that constrain this capacity. The combination of supporting and constraining social and demographic characteristics will vary across SA2s within the group, but it is likely that communities will have mid-range levels of education, employment and English language proficiency.
	Community capital (Moderate) The cohesion and connectedness of these communities supports the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. However, there may be some community capital characteristics that constrain this capacity. The combination of supporting and constraining circumstances will vary across SA2s in the group, but capacity may be constrained by mid-range crime rates, slightly less supportive and well-off neighbourhoods and lower levels of volunteering.
	Social and community engagement (Moderate) These communities have some capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards, but may also face some constraints on this capacity. While the characteristics supporting and constraining capacity will vary across SA2s in the group, but these communities can be expected to have mid-range levels of in and out migration, suggesting a slightly less stable population.
Barriers to disaster resilience 	**Economic capital (Low)** These communities have economic characteristics that may constrain their capacity to prepare for, respond to and recover from natural hazard events. The circumstances limiting this capacity will vary, but it is likely that these communities will have relatively high proportions of rental households and low income households, resulting in a limited capacity to buffer external financial shocks. In many cases this will be exacerbated by an economy dominated by a single industry sector.
	Planning and the built environment (Low) Planning systems and the character of the built environment may constrain the capacity of these communities to prepare for natural hazard events using strategies of mitigation, planning or risk management. While the characteristics constraining this capacity will vary across SA2s in the group, most communities are likely to have a predominance of older building stock and relatively more people residing in caravans or improvised dwellings.

Table 5 (cont.)

Barriers to disaster resilience (cont.)	**Emergency services (Low)** These communities have emergency services characteristics that may constrain their capacity to respond to natural hazard events. Constraint largely arises because of remoteness, which limits the availability of emergency and other services. Due to other sources of disadvantage, these communities may have a greater presence of welfare support workers and police, but these positive aspects of response capacity are offset by their very limited access to medical services.
	Information access (Low) These communities have constrained capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. The main characteristic contributing to reduced capacity is limited telecommunications access.
	Governance and leadership (Low) These communities are associated with a governance environment that may be limited by the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. The characteristics constraining capacity will vary across SA2s in the group, but it is likely that these communities do not have the benefit of research organisation presence and innovative commercial firms. Levels of local economic development support may also be limited.

TYPOLOGY GROUP 4

SA2s with this disaster resilience profile are best placed overall to cope with and adapt to complex change associated with natural hazards. The disaster resilience strengths associated with communities with the Typology Group 4 disaster resilience profile are economic capital, information access, governance and leadership, which all correspond to high disaster resilience, and social character, planning and the built environment, emergency services, community capital and social and community engagement, which all correspond to moderate disaster resilience (Table 6). Thus, communities with this disaster resilience profile are socially cohesive, economically well-resourced, well-supported by government services and able to adapt to complex change.

This disaster resilience profile is not characterised by any apparent constraints to disaster resilience, in comparison to the other profiles. All eight themes of disaster resilience were classified as corresponding to moderate or high disaster resilience (Table 6).

All States have SA2s with this disaster resilience profile, but the ACT or the NT does not have any SA2s with this disaster resilience profile. SA2s with this disaster resilience profile are predominantly metropolitan, but also contain a small proportion of inner regional SA2s.

Typology Group 4 corresponds to 0.1% of Australia's land area. Approximately 31% of the population, or 7.5 million people, live in areas with this disaster resilience profile. There are 572 SA2s across Australia with this disaster resilience profile, or 27% of all 2,084 SA2s assessed.

Maps of the typology groups are given in Appendix 1.

Table 6. Overview of the disaster resilience profile of Typology Group 4. Maps of the distribution of Typology Group 4 are given in Appendix 1.

Typology group	Group 4
Number of SA2s	572
Mean ANDRI value	0.7020
Approximate population and proportion of total	7.5 million 31%
Land area and proportion of total	10,689 km^2 0.1%
Location	SA2s in group 4 are predominantly metropolitan, but also contain a small proportion of inner regional SA2s (Table 4.3). Table 4.12 lists the SA2s within Typology Group 4.
Disaster resilience strengths 	**Economic capital (High)** These communities have economic characteristics that should enhance the capacity to prepare for, respond to and recover from natural hazard events. The enhanced capacity of these communities arises through access by individuals and households to greater economic resources. This will occur where fewer households are paying rent, and income levels are higher. Enhanced capacity also derives from a diversified economy. **Information access (High)** These communities have enhanced capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. Generally this enhanced capacity will be associated with good telecommunications access and, to a lesser extent, engagement in hazard education. **Governance and leadership (High)** These communities are associated with a governance environment that should enhance the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. Enhanced capacity may be contributed by the presence of research organisations and innovative commercial firms, and an emergency services sector with a capacity for agility, flexibility and adaptation. **Social character (Moderate)** These communities have some social and demographic characteristics that support the capacity to prepare for, respond to and recover from natural hazard events, but may also have some social and demographic characteristics that constrain this capacity. The combination of supporting and constraining social and demographic characteristics will vary across SA2s within the group, but it is likely that communities will have mid-range levels of education, employment and English language proficiency. **Planning and the built environment (Moderate)** These communities have some planning system and built environment characteristics that support their capacity to prepare for, respond to and recover from natural hazard events using strategies of mitigation, planning or risk management. However, there may also be some planning system and built environment characteristics that constrain this capacity. The combination of supporting and constraining planning and the built environment characteristics will vary across SA2s in the group, but it is likely that many communities will have a significant proportion of older buildings. Others with fewer older buildings may be constrained instead by emergency and other planning systems that could be improved to a higher standard.

Table 6 (cont.)

Disaster resilience strengths (cont.)	**Emergency services (Moderate)** Some characteristics of emergency services supports the capacity of these communities to respond to natural hazard events, while other emergency services characteristics may constrain this capacity. The combination of supporting and constraining emergency services characteristics will vary across SA2s within this group, but most communities are likely have high levels of emergency services volunteers and well-resourced ambulance organisations. Capacity to respond to natural hazard events may be constrained by poorer access to medical services.
	Community capital (Moderate) The cohesion and connectedness of these communities supports the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. However, there may be some community capital characteristics that constrain this capacity. The combination of supporting and constraining circumstances will vary across SA2s in the group, but capacity may be constrained by mid-range crime rates, slightly less supportive and well-off neighbourhoods and lower levels of volunteering.
	Social and community engagement (Moderate) These communities have some capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards, but may also face some constraints on this capacity. While the characteristics supporting and constraining capacity will vary across SA2s in the group, but these communities can be expected to have mid-range levels of in and out migration, suggesting a slightly less stable population.
Barriers to disaster resilience	No themes classed as low

TYPOLOGY GROUP 5

The disaster resilience strengths associated with communities with the typology Group 5 disaster resilience profile are planning and the built environment, governance and leadership, economic capital, emergency services, information access, and social and community engagement (Table 7). Thus, these communities are economically prosperous, and are generally well-supported by government services that enhance disaster preparation, response and recovery, and identify and mitigate risk. Communities and organisations are also well-placed to adapt to complex change.

Constraints to disaster resilience arise from social character and community capital (Table 7). Thus, there are opportunities for building disaster resilience in these communities through improved attention to vulnerable groups and community cohesion.

Five of the eight States and Territories have SA2s with this disaster resilience profile, with the exception of SA, TAS and the NT. The majority of SA2s with this disaster resilience profile are located in metropolitan areas.

Typology Group 5 corresponds to 0.1% of Australia's land area. Approximately 27% of the population, or 6.3 million people, live in areas with this disaster resilience profile. There are 368 SA2s across Australia with this disaster resilience profile, or 18% of all 2,084 SA2s assessed.

Maps of the typology groups are given in Appendix 1.

Table 7. Overview of the disaster resilience profile of Typology Group 5. Maps of the distribution of Typology Group 5 are given in Appendix 1.

Typology group	Group 5
Number of SA2s	368
Mean ANDRI value	0.5731
Approximate population and proportion of total	6.3 million 27%
Land area and proportion of total	6,328 km^2 0.1%
Location	The majority of SA2s in Typology Group 5 are located in metropolitan areas (Table 4.3). Table 4.14 lists the SA2s within Typology Group 5.
Disaster resilience strengths 	**Planning and the built environment (High)** Planning systems and the character of the built environment should enhance the capacity of these communities to prepare for natural hazard events using strategies of mitigation, planning or risk management. While the combination of planning and built environment characteristics may vary across SA2s within the group, most of these communities are likely to have newer residential and commercial or industrial buildings, and high standards of emergency and other planning systems. Many of these communities will also be in well-resourced local government areas.
	Governance and leadership (High) These communities are associated with a governance environment that should enhance the capacity of organisations to adaptively learn, transform and adjust to complex change, including that related to natural hazards. Enhanced capacity may be contributed by the presence of research organisations and innovative commercial firms, and an emergency services sector with a capacity for agility, flexibility and adaptation.
	Economic capital (Moderate) These communities have some economic characteristics that support the capacity to prepare for, respond to and recover from natural hazard events, but may also have some economic characteristics that constrain this capacity. The combination of supporting and constraining economic characteristics will vary across SA2s within the group, but it is likely that communities will have mid-range proportions of renters and mid-range income levels. Their economies are likely to be only moderately diversified.
	Emergency services (Moderate) Some characteristics of emergency services supports the capacity of these communities to respond to natural hazard events, while other emergency services characteristics may constrain this capacity. The combination of supporting and constraining emergency services characteristics will vary across SA2s within this group, but most communities are likely have high levels of emergency services volunteers and well-resourced ambulance organisations. Capacity to respond to natural hazard events may be constrained by poorer access to medical services.
	Information access (Moderate) These communities have some capacity to engage with natural hazard information and to access knowledge associated with natural hazard preparation, self-reliance and response. There may be some constraints on capacity arising from less than universal telecommunications access.

Table 7 (cont.)

Disaster resilience strengths (cont.)	**Social and community engagement (Moderate)** These communities have some capacity to adaptively learn and transform in response to complex change, including that associated with natural hazards, but may also face some constraints on this capacity. While the characteristics supporting and constraining capacity will vary across SA2s in the group, but these communities can be expected to have mid-range levels of in and out migration, suggesting a slightly less stable population.
Barriers to disaster resilience 	**Social character (Low)** These communities have social and demographic characteristics that may constrain their capacity to prepare for, respond to and recover from natural hazard events. The circumstances limiting this capacity will vary, but it is likely that many of these communities will have lower levels of education, employment and English language proficiency. Further constraints on capacity may come from a higher need for assistance and a relatively higher proportion of the working population in occupations other than management and professional occupations.
	Community capital (Low) The cohesion and connectedness of these communities may constrain the capacity to coordinate and cooperate for mutual benefit, including preparing for, responding to and recovering from natural hazard events. The circumstances constraining this capacity will vary across SA2s in the group but are likely to arise from a high incidence of crime, low community safety and other factors that limit social support and community participation. The level of volunteering activity is also likely to be low.

KEY MILESTONES

Key project milestones and activities completed during the 2018-2019 year include:

- Computation of the final Australian Natural Disater Resilience Index, and review of index values;
- Sensitivity and uncertainty analysis associated with the Australian Natural Disater Resilience Index;
- Completion of two major reports on the Australian Natural Disaster Resilience Index:
    - Volume I – State of Disaster Resilience Report

      Assesses the state of disaster resilience in Australia, using the Australian Natural Disaster Resilience Index. Volume I gives a brief overview of the design and computation of the index, then assesses the state of disaster resilience in Australia at different levels: overall disaster resilience, coping and adaptive capacity, and the eight themes of disaster resilience. Volume I also presents a typology of disaster resilience that groups areas across Australia that have similar disaster resilience profiles.
    - Volume II – Index design and computation

      Describes in detail the computation of the Australian Natural Disaster Resilience Index. This includes resilience concepts, literature review, index structure, data collection, indicators, statistical methods, detailed statistical outputs, sensitivity analysis and uncertainty analyses.
- Commencement of development of a dashboard to allow easy access to, and use of, the Australian Natural Disaster Resilience Index data. The choice to develop a centralised web platform will enhance adoption efficiency and create a consistent product.
- Utilisation activities as detailed in the following section.

UTILISATION AND IMPACT

SUMMARY

There are three major outputs this year and into the upcoming year for the Australian Natural Disaster Resilience Index project.

- Australian Natural Disaster Resilience Index Volume I – State of Disaster Resilience Report. Status: completed and awaiting release.
- Australian Natural Disaster Resilience Index Volume II – Technical Report. Status: completed and awaiting release.
- Australian Natural Disaster Resilience Index Dashboard. Status: Phase 1 of development underway (design of the dashboard).

To date, utilization has focused on applying the conceptual framework used in the Australian Natural Disaster Resilience Index. Utilisation and impact will increase with the release of the reports and the development of the dashboard, and the socialization of the index results with agencies.

AUSTRALIAN NATURAL DISASTER RESILIENCE INDEX VOLUME I – STATE OF DISASTER RESILIENCE REPORT

Output Description

Volume I assesses the state of disaster resilience in Australia, using the Australian Natural Disaster Resilience Index. Volume I gives a brief overview of the design and computation of the index, then assesses the state of disaster resilience in Australia at different levels: overall disaster resilience, coping and adaptive capacity, and the eight themes of disaster resilience. Volume I also presents a typology of disaster resilience that groups areas across Australia that have similar disaster resilience profiles.

Readers interested in the results of the assessment of disaster resilience in Australia should focus on Volume I.

Extent of Use

- Not released yet as of August 2019.
- Results have been presented in several different forums.
- Smaller excerpts from the research report are being developed (e.g. an overall short but high impact summary piece).

Utilisation Potential

- High. This report details the state of disaster resilience in Australia, setting out the performance of the system of capacities for disaster resilience and the spatial distribution of those capacities.

Utilisation Impact

- When released, impacts will be in the areas of policy development, strategic planning, program development, community engagement.

AUSTRALIAN NATURAL DISASTER RESILIENCE INDEX VOLUME II – TECHNICAL VOLUME

Output Description

Volume II describes in detail the computation of the Australian Natural Disaster Resilience Index. This includes resilience concepts, literature review, index structure, data collection, indicators, statistical methods, detailed statistical outputs, sensitivity analysis and uncertainty analyses.

Readers interested in the technical aspects of the Australian Natural Disaster Resilience Index should also consider Volume II. Volume II is comprised of six chapters:

1) Design of the Australian Natural Disaster Resilience Index
2) Indicators
3) Computation of the Australian Natural Disaster Resilience Index
4) Statistical outputs: ANDRI, coping capacity and adaptive capacity
5) Statistical outputs: disaster resilience themes
6) Uncertainty and sensitivity analysis

Extent of Use

- Not released yet as of August 2019.
- The technical report will be used by parties interested in the methods sitting behind the Australian Natural Disaster Resilience Index. The readership of this Volume is likely to be less than for Volume I. However, an additional audience exists for Volume II in that is presents a new, and leading edge, way of deriving a composite index.

Utilisation Potential

- Moderate. This report will only be of interest to some end users. Research and academic interest will be high because it details the methods used to construct the Australian Natural Disaster Resilience Index.

Utilisation Impact

- When released, impacts will be in the academic areas of index design and computation. The method for the index is also being written as a paper.

AUSTRALIAN NATURAL DISASTER RESILIENCE INDEX DASHBOARD

Output Description

Now that we have the final results for the Australian Natural Disaster Resilience Index, utilisation activities are ramping up. One of our major activities is to build a dashboard to allow easy access to, and use of, the ANDRI data. The choice to develop a centralised web platform will enhance adoption efficiency and create a consistent product.

As part of Phase I (design) a workshop was held in Melbourne on the 16 August 2019 to scope the required elements of and use cases for the ANDRI dashboard. At the time of writing this, the workshop is only a few days old so the next steps are to produce a 'prototype' dashboard structure based on information gained in the workshop about needs and use cases. We will then seek feedback on the design.

Phase II (software development) makes the dashboard itself. It uses an agile software development methodology where users 'trial' the dashboard at various stages to test outputs and user friendliness. The dashboard is expected to be finalised in 2020.

The workshop also recommended that agency end-users require access to the ANDRI data for their existing systems. An API (Application Programming Interface) will also be developed as part of the project.

Extent of Use

- In development as of August 2019.

Utilisation Potential

- High. Interest is from different groups including research groups, government departments, emergency service agencies, AIDR and local governments.

Utilisation Impact

- High. This is the first time that this information will be available at a nationally standardized level to policy makers, engagement teams, local governments and communities.

Utilisation and Impact Evidence

1. Parsons, M. and Morley, P. 2017. The Australian Natural Disaster Resilience Index. Australian Journal of Emergency Management, 32: 20-22.
2. Bushfire and Natural Hazards CRC. 2016. What is disaster resilience and how can it be measured? Bushfire and Natural Hazards CRC Hazard Note, June, 2016. BNHCRC, Melbourne, Australia.

3. Parsons, M., Foster, H. and Redlich, S. (2018). Case study: the Victorian Emergency Management Community Resilience Index. Australian Journal of Emergency Management, 33: 21-22.

NEXT STEPS

At the time of writing (August 2019) the next steps for the Australian Natural Disaster Resilience Index include:

1) Release of the State of Disaster Resilience Report
2) Release of the Technical Volume
3) Preparation of small, targeted excerpts from the State of Disaster Resilience Report
4) Development of the Australian Natural Disaster Resilience Index Dashboard, which will display trends and allow users to interact with and extract results
5) Ongoing alignment of the Australian Natural Disaster Resilience Index findings into agency activities including community engagement, planning, program development and policy development.

PUBLICATIONS LIST

PEER REVIEWED JOURNAL ARTICLES

1. Parsons, M., Glavac, S., Hastings, P., Marshall, G., McGregor, J., McNeill, J., Morley, P., Reeve, I. and Stayner, R. (2016) Top-down assessment of disaster resilience: a conceptual framework using coping and adaptive capacities. *International Journal of Disaster Risk Reduction*, 19: 1-11.
2. Parsons, M. (2019). Extreme floods and river values: a social-ecological perspective. River Research and Applications, In Press.
3. Parsons, M. and Thoms, M.C. 2018. From academic to applied: Operationalizing resilience in river systems. Geomorphology, 305: 242-251.

Submitted

McGregor, J., Parsons, M. and Glavac, S. Local government capacity and land use planning for natural hazards: A comparative evaluation of Australian local government areas. Planning Practice and Research.

CONFERENCE PAPERS

1 Morley, P., Parsons, M., Glavac, S., Hastings, P., Marshall, G., McGregor, J., McNeill, J., Reeve, I., Stayner, R. and Thoms, M. (2015) The Australian Natural Disaster Resilience Index: A system for assessing the resilience of Australian communities to natural hazards. Proceedings of the Bushfire and Natural Hazards CRC and Australasian Fire and Emergency Service Authorities Council Annual Meeting, Wellington, New Zealand, September 2-5, 2014

TECHNICAL REPORTS

1. Parsons, M., Reeve, I., McGregor, J., Marshall, G., Stayner, R., McNeill, J., Hastings, P., Glavac, S. and Morley, P. 2019a. The Australian Natural Disater Resilience Index: Volume I – State of Disaster Resilience Report. Bushfire and Natural Hazards CRC, Melbourne.
2. Parsons, M., Reeve, I., McGregor, J., Marshall, G., Stayner, R., McNeill, J., Hastings, P., Glavac, S. and Morley, P. 2019b. The Australian Natural Disater Resilience Index: Volume I – State of Disaster Resilience Report. Bushfire and Natural Hazards CRC, Melbourne.
3. Melissa Parsons, Phil Morley, James McGregor, Peter Hastings, Sonya Glavac, Graham Marshall, Ian Reeve, Richard Stayner and Judith McNeill. 2016. Overview of Indicators: The Australian Natural Disaster Resilience Index. Bushfire and Natural Hazards Cooperative Research Centre, Melbourne, Australia.
4. Parsons, M., Morley, P., Marshall, G., Hastings, P., Glavac, S., McGregor, J., Stayner, R., McNeill, J. and Reeve, I. (2015). The Australian Natural Disaster Resilience Index: Conceptual framework and indicator approach. Bushfire and Natural Hazards Cooperative Research Centre, Melbourne, Australia.

OTHER

4. Parsons, M. and Morley, P. 2017. The Australian Natural Disaster Resilience Index. Australian Journal of Emergency Management, 32: 20-22.

5. Bushfire and Natural Hazards CRC. 2016. What is disaster resilience and how can it be measured? Bushfire and Natural Hazards CRC Hazard Note, June, 2016. BNHCRC, Melbourne, Australia.
6. Parsons, M., Foster, H. and Redlich, S. (2018). Case study: the Victorian Emergency Management Community Resilience Index. Australian Journal of Emergency Management, 33: 21-22.

TEAM MEMBERS

RESEARCH TEAM

- Dr Melissa Parsons, University of New England
- Dr Ian Reeve, University of New England
- Dr James McGregor, University of New England
- Dr Peter Hastings, University of New England
- Dr Richard Stayner, University of New England
- Dr Graham Marshall, University of New England
- Dr Judith McNeill, University of New England
- Dr Phil Morley, University of New England (until 2017)

END-USERS

- Gwynne Brennan, Country Fire Authority Victoria (until 2018)
- Trent Curtin, Metropolitan Fire Brigade, Melbourne
- Karen Enbom, Country Fire Authority Victoria
- Tony Jarrett – NSW Rural Fire Service
- Paul Fletcher – Metropolitan Fire Service, SA (until 2017)
- Suellen Flint – Department of Fire and Emergency Services WA (until 2018)
- Holly Foster – Emergency Management Victoria
- Tamara Beckett – Department of Environment, Land, Water and Planning, VIC
- Andrew Richards – State Emergency Service, NSW (until 2018)
- Nicole Hogan – State Emergency Service, NSW
- Colleen Ridge - State Emergency Service, Tasmania
- Amanda Leck – Australian Institute of Disater Resilience
- Members of the AFAC Community Engagement Technical Group
- Anthony Bradstreet – NSW Rural Fire Service
- Rachel Armstrong – Department of Fire and Emergency Services, WA
- Sandra Barber, Tasmania Fire Service

REFERENCES

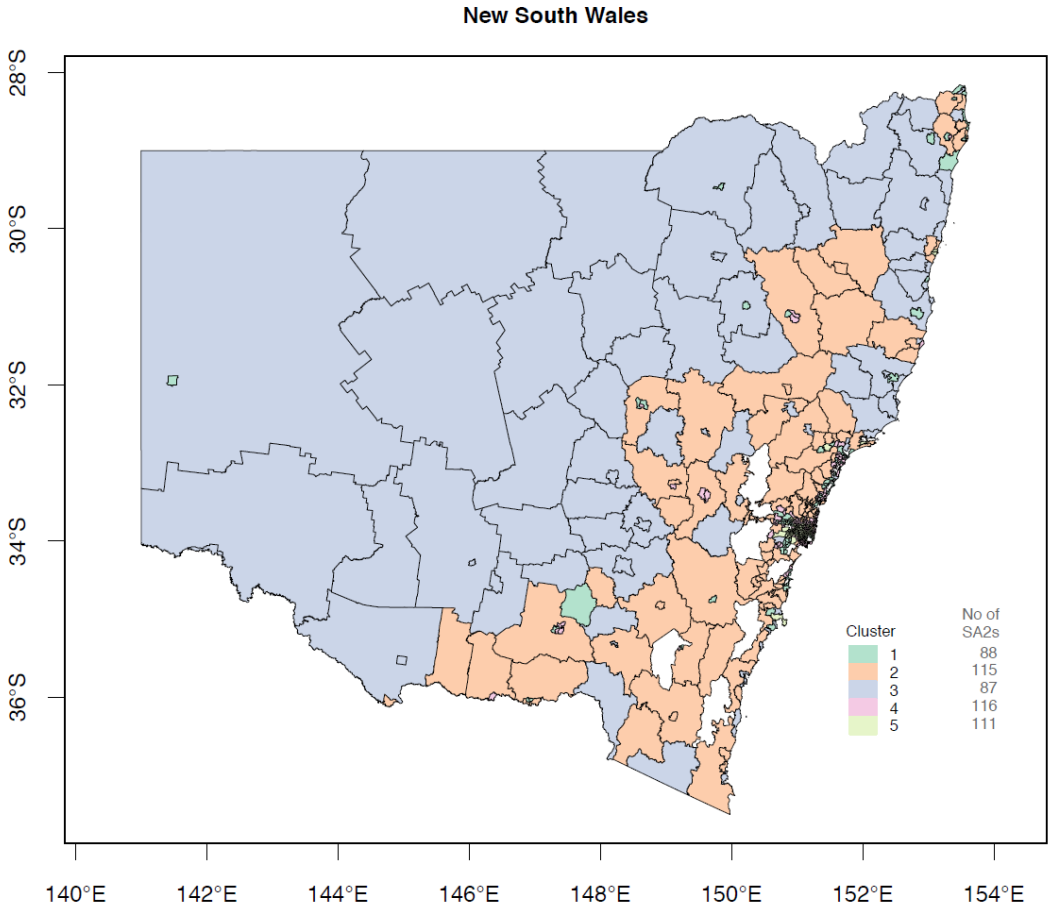
1. Arbon, P. 2014. Developing a model and tool to measure community disaster resilience. Australian Journal of Emergency Management, 29: 12-16.
2. Boin, A. 2010. Designing resilience: Leadership challenges in complex administrative systems. In: Comfort, L.K., Boin, A. and Demchak, C.C. (Editors) Designing Resilience: Preparing for extreme events. University of Pittsburgh Press, Pittsburgh, PA. Pages 129-142.
3. Committee on Measures of Community Resilience. 2015. Developing a framework for measuring community resilience: summary of a workshop. The National Academies Press, Washington DC.
4. Cutter, S.L., Burton, C.G., and Emrich, C.T. 2010. Disaster resilience indicators for benchmarking baseline conditions. Journal of Homeland Security and Emergency Management, 7: Issue 1, Article 51. DOI: 10.2202/1547-7355.1732
5. Klein, R.J.T., Nicholls, R.J. and Thomalla, F. 2003. Resilience to natural hazards: How useful is this concept? Environmental Hazards, 5: 35-45.
6. Maguire, B. and Cartwright, S. 2008. Assessing a community's capacity to manage change: A resilience approach to social assessment. Australian Government, Bureau of Rural Sciences, Canberra.
7. Parsons, M., Reeve, I., McGregor, J., Marshall, G., Stayner, R., McNeill, J., Hastings, P., Glavac, S. and Morley, P. 2019a. The Australian Natural Disater Resilience Index: Volume I – State of Disaster Resilience Report. Bushfire and Natural Hazards CRC, Melbourne.
8. Parsons, M., Reeve, I., McGregor, J., Marshall, G., Stayner, R., McNeill, J., Hastings, P., Glavac, S. and Morley, P. 2019b. The Australian Natural Disater Resilience Index: Volume I – State of Disaster Resilience Report. Bushfire and Natural Hazards CRC, Melbourne.
9. Tierney, K. 2014. The social roots of risk. Stanford University Press, California.
10. Wisner, B., Blaikie, P., Cannon, T. and Davis, I. 2004. At risk: Natural hazards, people's vulnerability and disasters. Routledge, London.

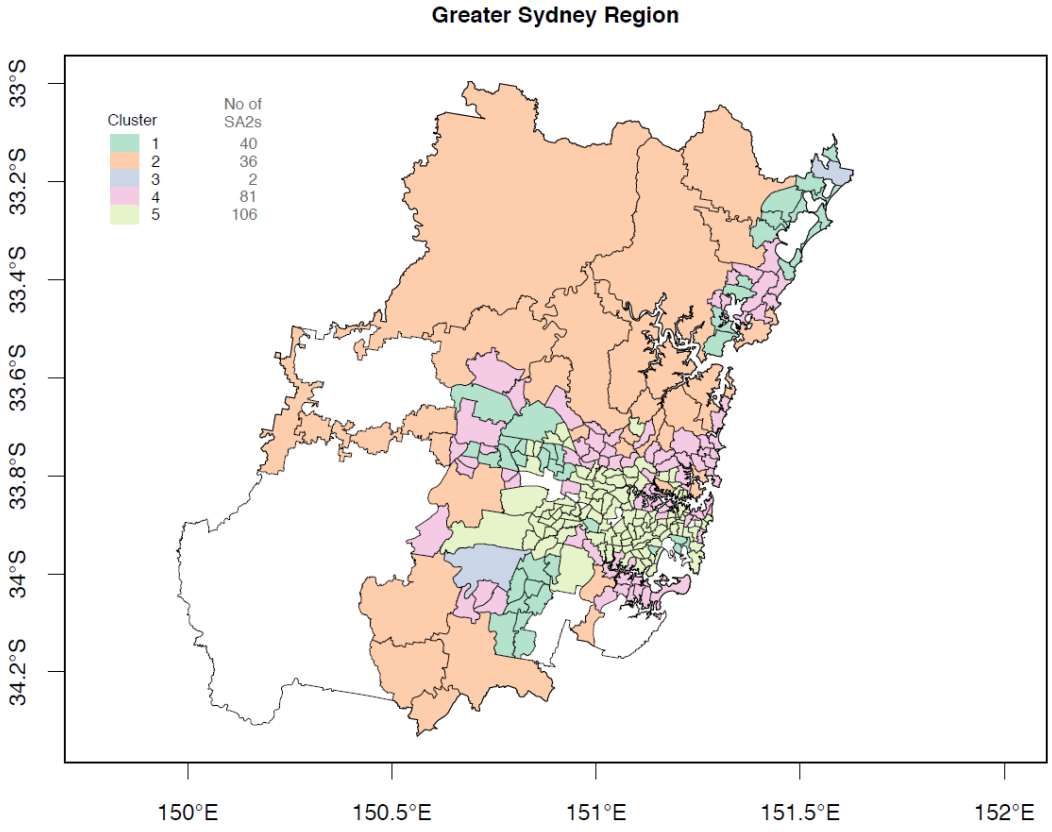
APPENDIX 1

MAPS: TYPOLOGY GROUPS

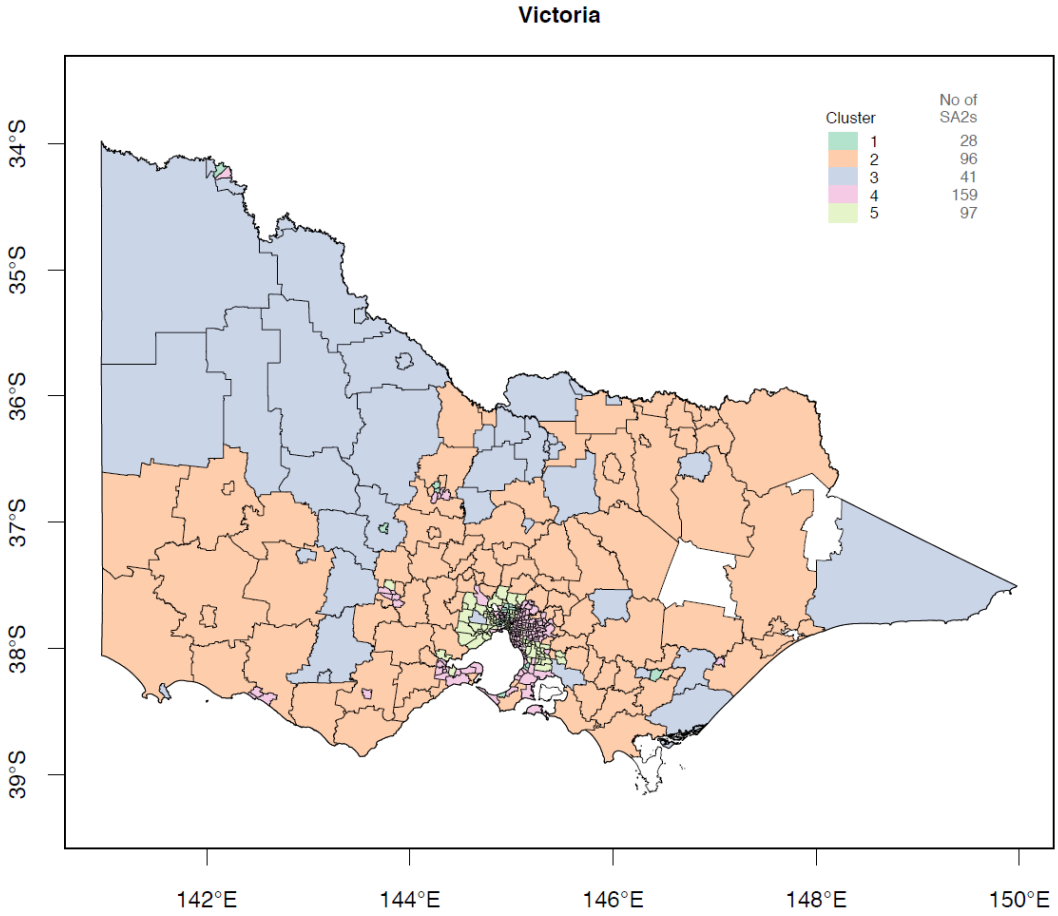
Appendix 1 maps the typology groups at the resolution of individual States and Territories, and major metropolitan areas.

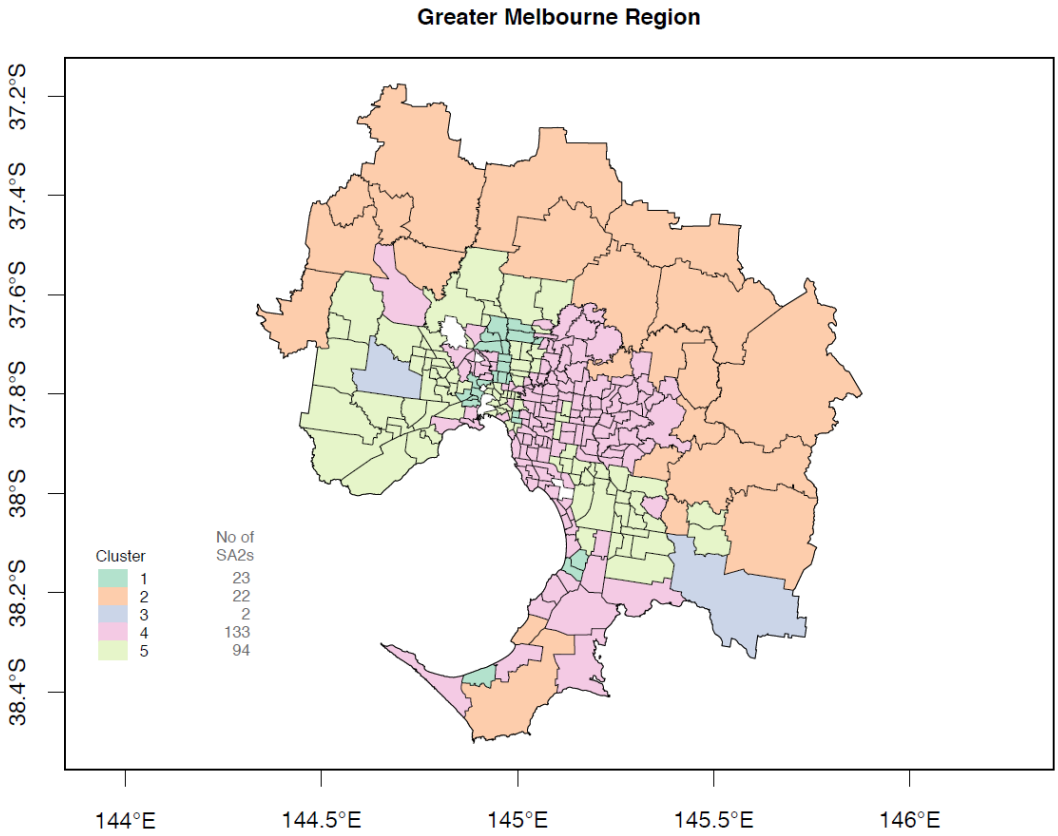
Appendix 1. Typology groups, NSW.



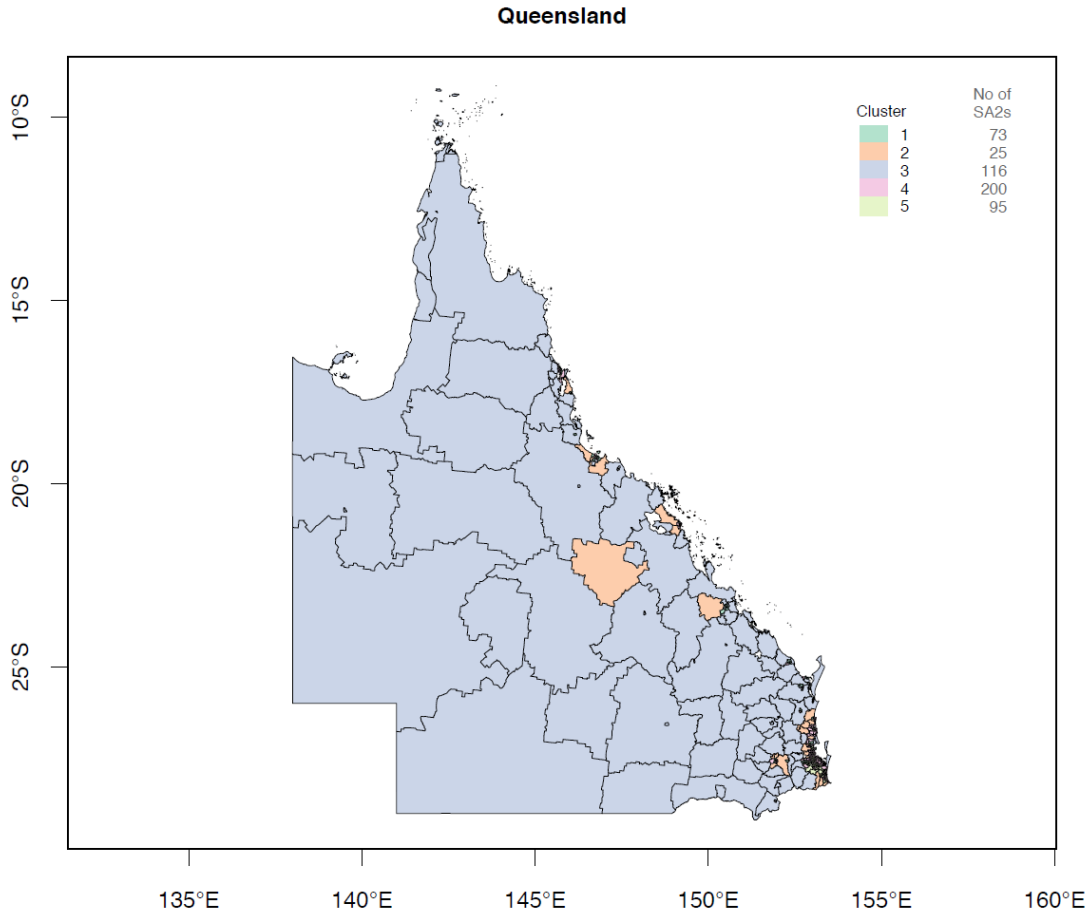


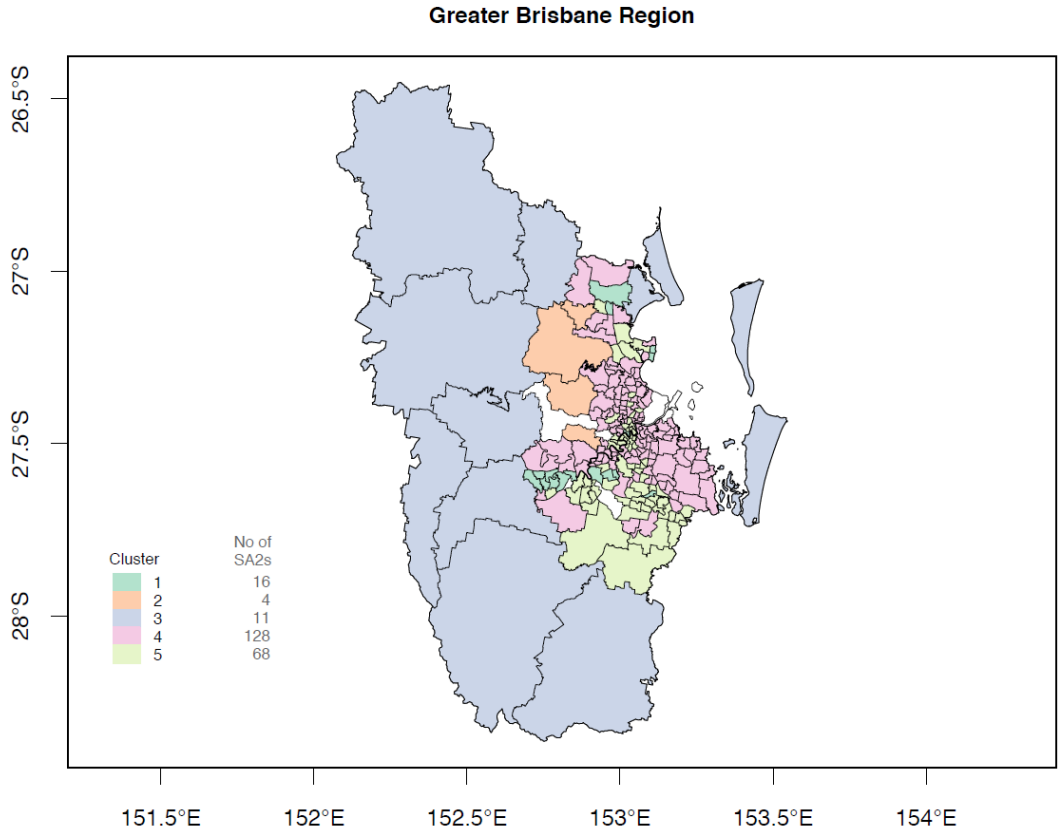
Appendix 1. Typology groups, VIC.



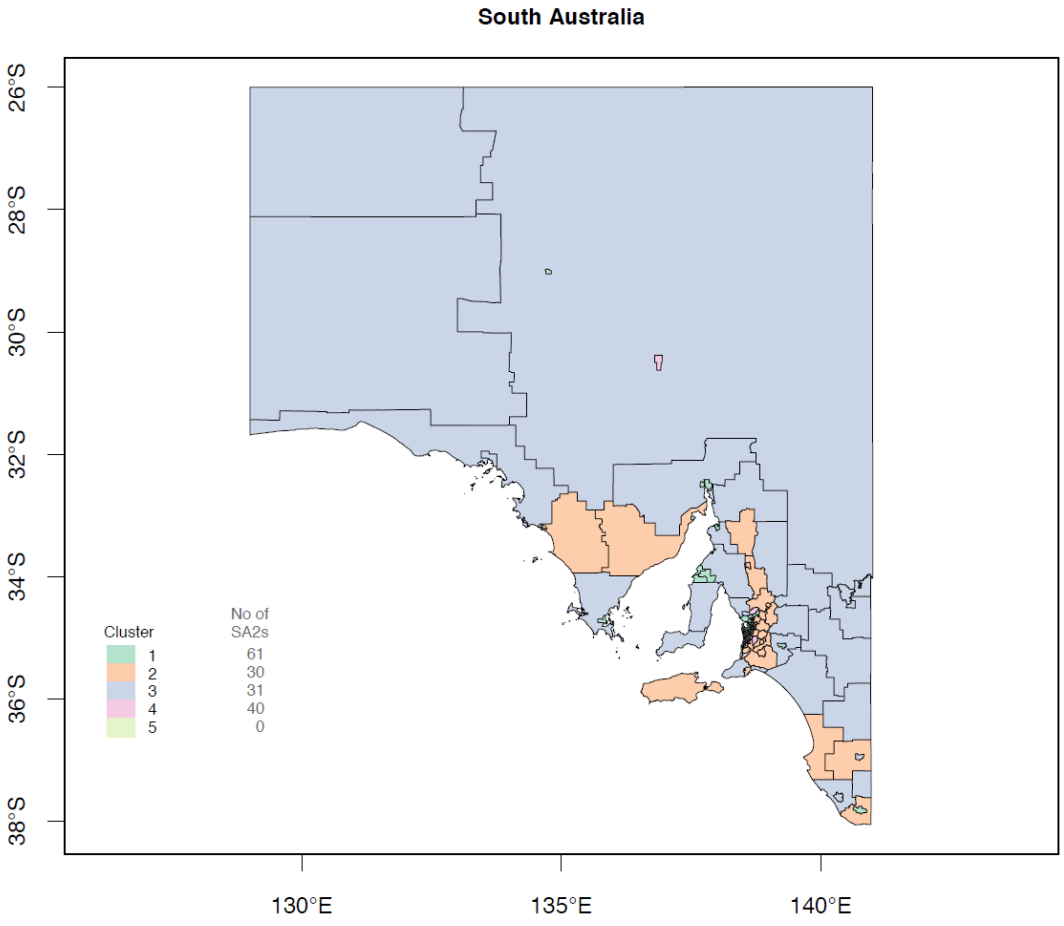


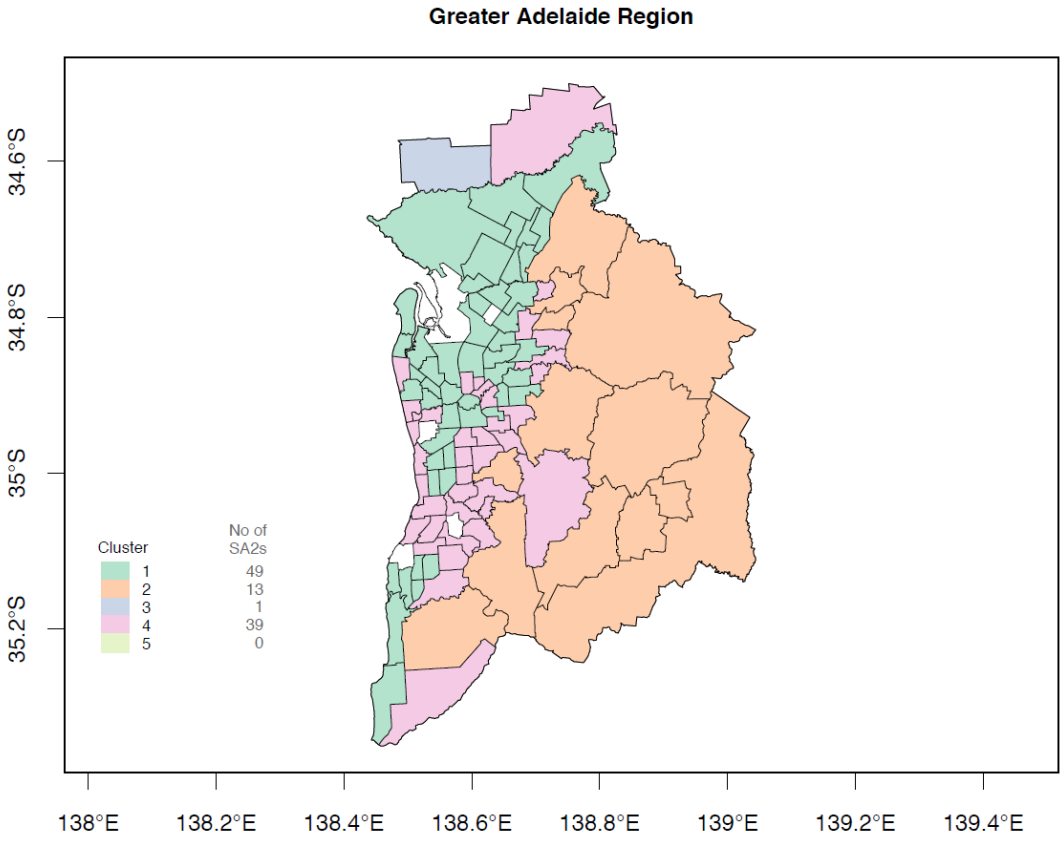
Appendix 1. Typology groups, QLD.



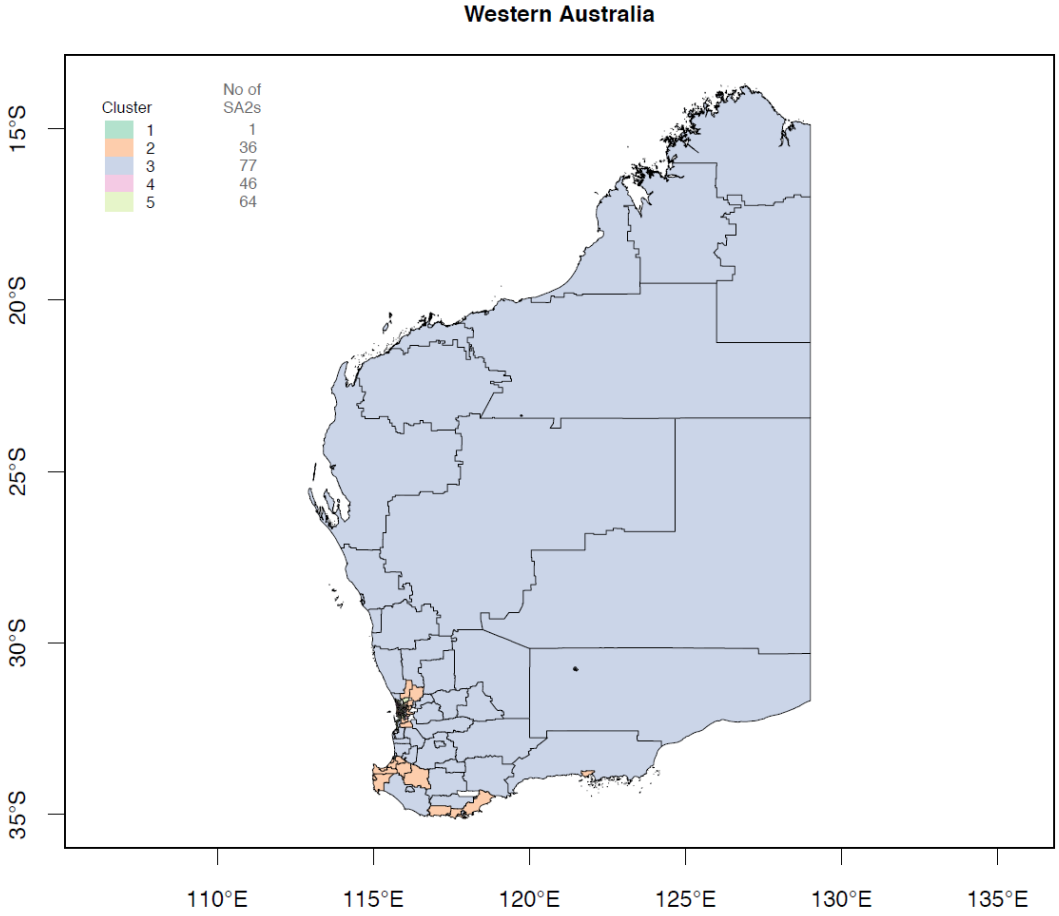


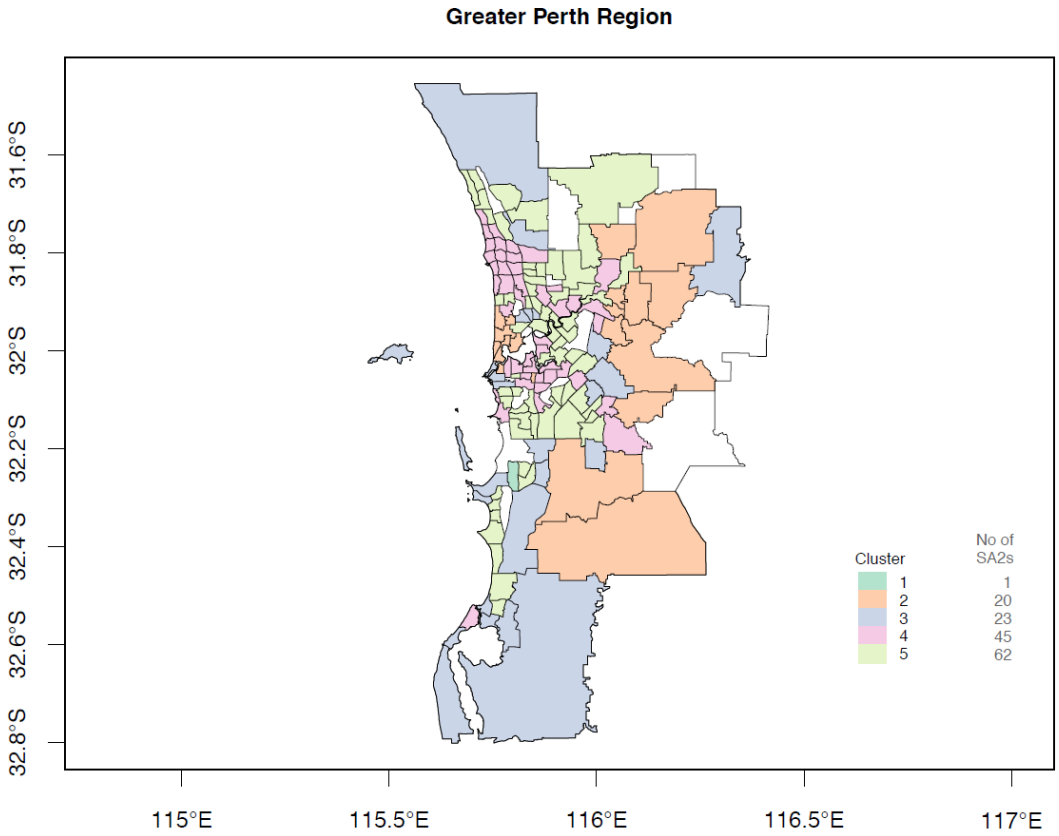
Appendix 1. Typology groups, SA.



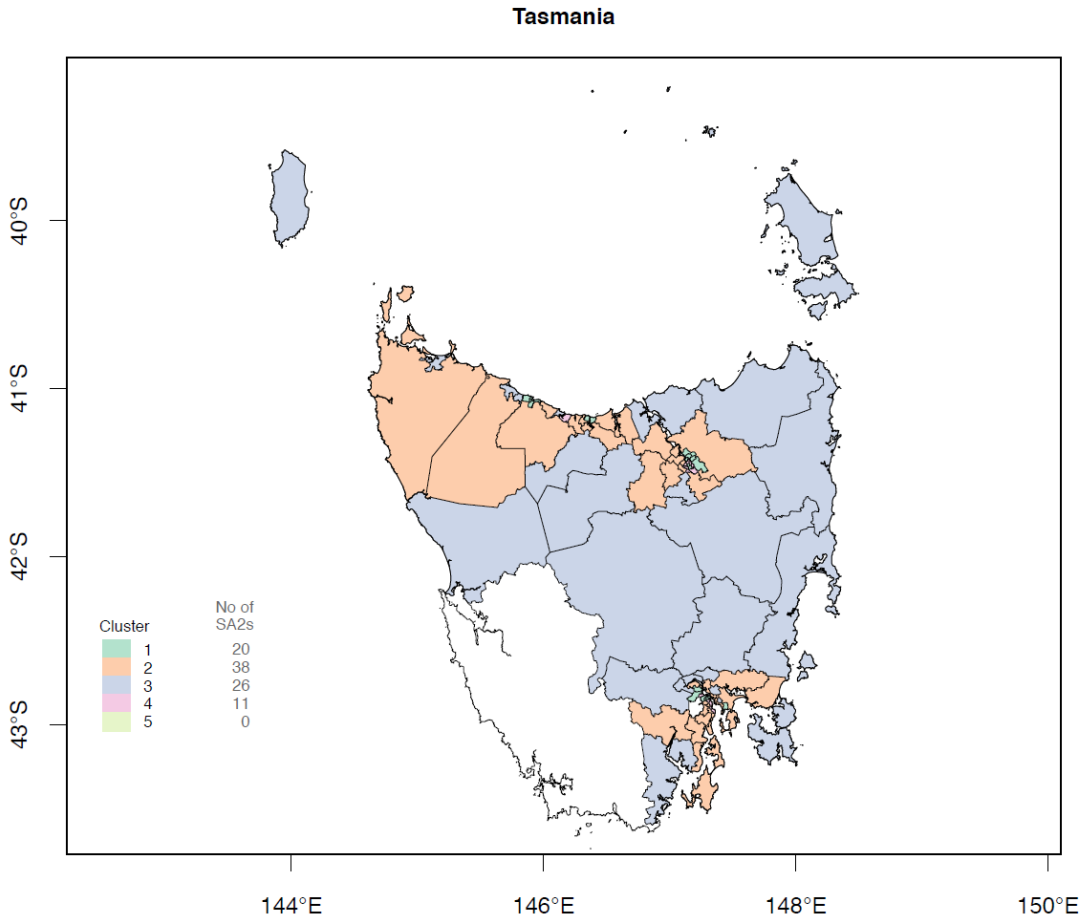


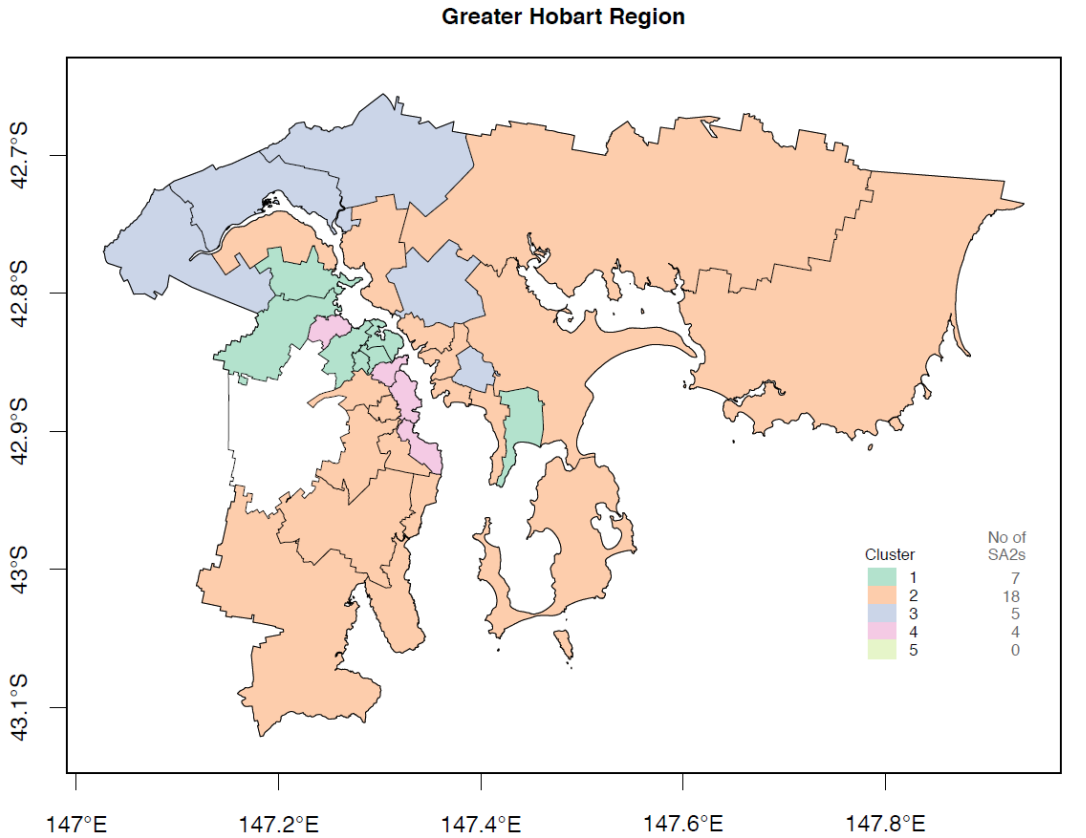
Appendix 1. Typology groups, WA.



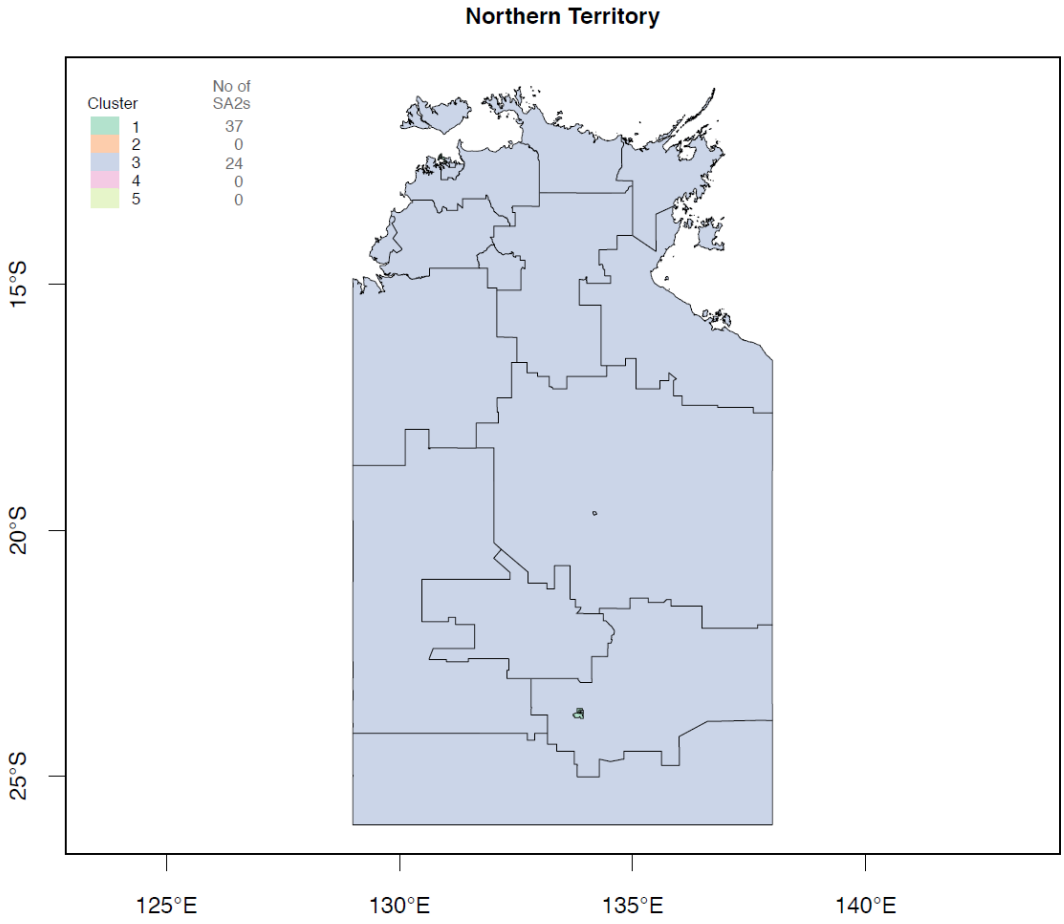


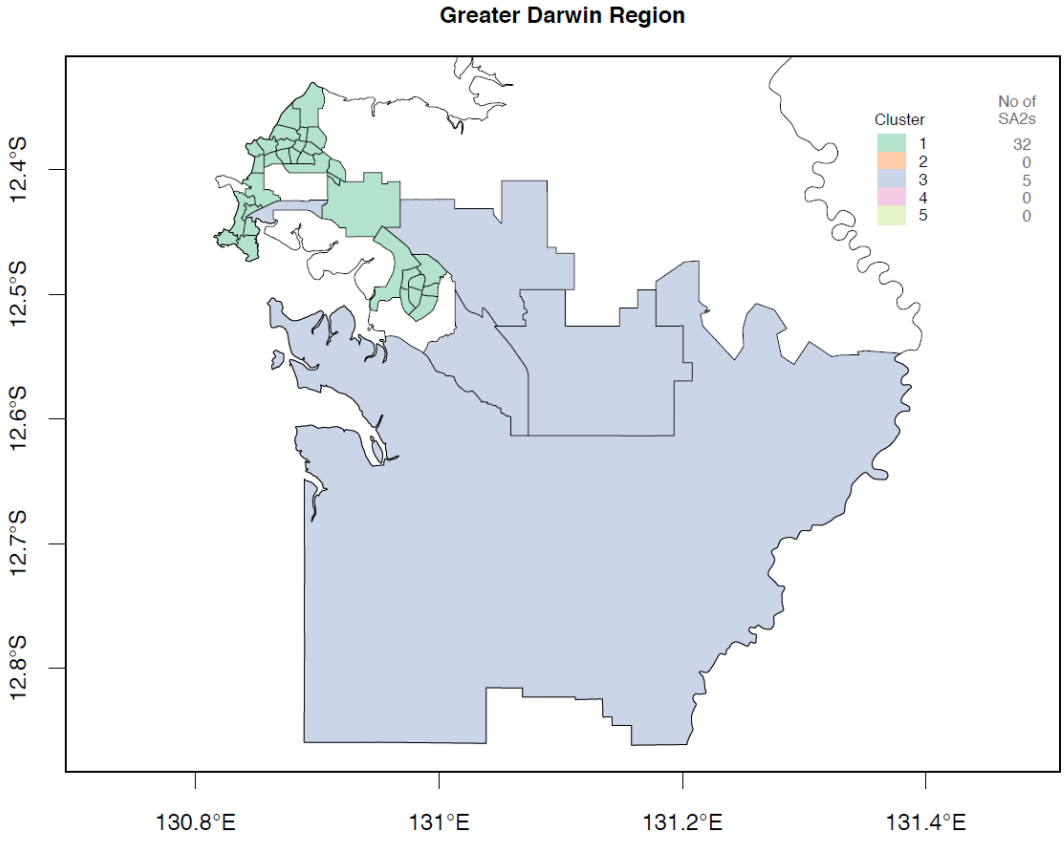
Appendix 1. Typology groups, TAS.





Appendix 1. Typology groups, NT.





Appendix 1. Typology groups, ACT.