DWLBC REPORT

Mapping landscape values and perceived climate change risks for natural resources management: A study of the Southern Fleurieu Peninsula region, SA

2008/07

Government of South Australia
Department of Water, Land and Biodiversity Conservation

Mapping landscape values and perceived climate change risks for natural resources management: A study of the Southern Fleurieu Peninsula region, SA

Chris Raymond

Land and Biodiversity Services Division
Department of Water, Land and Biodiversity Conservation

April 2008

Report DWLBC 2008/07

Government of South Australia
Department of Water, Land and Biodiversity Conservation

Land and Biodiversity Services Division
Department of Water, Land and Biodiversity Conservation
Soil and Water Environs Centre, Urrbrae
GPO Box 2834, Adelaide SA 5001
Telephone National (08) 8463 6946
International +61 8 8463 6946
Fax National (08) 8463 6999
International +61 8 8463 6999
Website www.dwlbc.sa.gov.au

Disclaimer

The Department of Water, Land and Biodiversity Conservation and its employees do not warrant or make any representation regarding the use, or results of the use, of the information contained herein as regards to its correctness, accuracy, reliability, currency or otherwise. The Department of Water, Land and Biodiversity Conservation and its employees expressly disclaims all liability or responsibility to any person using the information or advice. Information contained in this document is correct at the time of writing.

ISBN 978-1-921218-90-3

Intended Audience

This report was prepared for Adelaide and Mount Lofty Natural Resources Management Board, Department of Water, Land, Biodiversity Conservation, the Australian Greenhouse Office, part of the Commonwealth Department of Climate Change, and the regional communities and survey respondents who participated in the study.

Preferred way to cite this publication

Raymond C 2008. *Mapping landscape values and perceived climate change risks for natural resources management: A study of the Southern Fleurieu Peninsula region,* SA, DWLBC Report 2008/07, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide.

FOREWORD

South Australia's unique and precious natural resources are fundamental to the economic and social wellbeing of the state. It is critical that these resources are managed in a sustainable manner to safeguard them both for current users and for future generations. The Department of Water, Land and Biodiversity Conservation (DWLBC) strives to ensure that our natural resources are managed so that they are available for all users.

The social dimension of natural resources management is crucial to the development of innovative and socially acceptable climate change responses. This requires systematic understanding of the values and aspirations of concerned citizens, state and regional agencies and scientific communities, and the development of new tools for integrating different values and belief systems into natural resources management policy, planning and program delivery. Improved understanding of the social dimension will support integrated management of natural resources and contribute towards improving the quality of life of all South Australians.

Rob Freeman
CHIEF EXECUTIVE
DEPARTMENT OF WATER, LAND AND BIODIVERSITY CONSERVATION

ACKNOWLEDGEMENTS

This work has been financially supported by the Department of Water, Land and Biodiversity Conservation, the Australian Greenhouse Office, part of the Commonwealth Department of Climate Change, and the Adelaide and Mount Lofty Ranges Natural Resources Management Board.

The author would like to acknowledge the assistance of a number of valuable contributors to this report:

1. Douglas Bardsley (former Senior Project Officer, Climate and Land Science, Department of Water, Land and Biodiversity Conservation) and Geoff Rogers (former Regional Liaison Officer, Adelaide and Mount Lofty Ranges NRM Board) who shared the vision for mapping the perceived landscape and assisted with project brief development.
2. Matthew Royal (Department for Environment and Heritage, South Australia), for the generation of the Southern Fleurieu Peninsula region map and access to GIS data sets, including cadastral, native vegetation and water body shapefiles.
3. Wendy Raymond for her efforts in helping the author collate and pack the necessary survey materials.
4. School students and teachers from Investigator College Goolwa, Mount Compass Area School, Victor Harbor High School and Yankalilla Area School. Your enthusiasm for the project and well-considered responses is greatly respected.
5. Adult survey respondents, many who completed the survey in their own time. Thanks for the wise and thought provoking responses.
6. Lisa Blake, Mary Crawford and Matthew Bonnett (Adelaide and Mount Lofty Ranges Natural Resources Management Board) for supporting the workshop process.
7. Staff within the Land Management and Revegetation Unit (Department of Water, Land and Biodiversity Conservation) who reviewed and revised multiple iterations of the postal and workshop surveys and reviewed this report.
8. Graciela Metternicht, former Professor of Geospatial Systems and Environmental Management (University of South Australia) for reviewing this report.
9. Kathy Vitkovsky for her precise data entry and support with survey mail-outs.
10. Finally, I wish to acknowledge the input of numerous individuals who I discussed ideas with during the creation of this document, many of whom are cited in the text.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

INTRODUCTION

This project was undertaken to provide information on community attitudes and values to assist natural resources management (NRM) decision-making and climate change adaptation in the Southern Fleurieu Peninsula region (Southern Fleurieu), South Australia. It is one of a number of studies for a larger project: 'A regional climate change decision framework for NRM'. The objective of this larger study has been to work within the Adelaide and Mount Lofty Ranges (AMLR) NRM region to undertake an assessment of key areas of NRM that are vulnerable to climate change, and develop and demonstrate methodologies for creating a regional framework for wider application in managing climate change risk and developing adaptation responses. The larger study is funded by Department of Water, Land and Biodiversity Conservation (DWLBC), the Adelaide and Mount Lofty Ranges Natural Resources Management (AMLR NRM) Board and the Australian Greenhouse Office (AGO), part of the Department of Climate Change (Commonwealth).

This sociological study was identified after an initial vulnerability analysis in the AMLR region (Bardsley 2006). Bardsley recommended participatory research on climate change so that adaptation responses can be informed by the knowledge and experience of local land managers. In response, this project further developed and applied a public survey technique known as the landscape values methodology (LVM) (Brown 2005) for systematically identifying landscape values (e.g. aesthetic, recreation, biodiversity, future and intrinsic), and, new to this approach, perceived climate change risks (e.g. biodiversity loss, land erosion and sea-level rise). In workshop or postal surveys, participants were asked to map their landscape values and perceived climate change risks by placing sticker dots on a map of the region. The mapped dots were digitised into a GIS and then overlaid with the spatially referenced conservation values and threats assessed by ecologists (Caton et al. 2007). To generate the value and threat indexes, it was assumed that the higher the density of perceived biodiversity value the higher the conservation value, and the higher the density of perceived biodiversity loss, the higher the conservation threat. In addition to the mapping, survey participants were asked about threats to their quality of life, their knowledge of climate change and level of concern, and their preferences for climate change adaptation. Attitudinal responses were examined across school student and adult sub-groups considering the paucity of information on young people's views toward climate change in the national and international literature. A 61% survey response rate was achieved for the postal survey.

OBJECTIVES OF STUDY

The objectives of this study as determined by the larger project were:

- Prepare a climate change presentation based on best available science.
- Identify, map and compare the perceived landscape values and climate change risks held by NRM stakeholders for the Southern Fleurieu.
- Compare and contrast public perceived landscape values and risks with those identified by ecologists (experts) in a recent conservation assessment along the Southern Fleurieu coast.

- Recommend strategies for future engagement of local communities in climate change adaptation.
- Create a report to assist the wider project build a framework for assessing climate change risk and adaptation responses in the AMLR NRM region.

KEY FINDINGS

- While school students stated that they had not paid as much attention to climate change as adults, they rated the phenomenon more highly as a threat to their Southern Fleurieu quality of life. Climate change was the highest ranked threat for students and third highest ranked threat for adults after biodiversity loss and new housing subdivisions.
- According to the value and risk maps, survey participants identified Deep Creek Conservation Park, Lower Murray and Coorong, Newland Head Conservation Park, Cox Scrub Conservation Park and Victor Harbor as priority areas for conservation activities, whereas the sub-region between Victor Harbor and the Coorong was identified as a priority area for managing sea-level rise, wave action and riparian flooding.
- Respondent mapping of biodiversity value is generally consistent with the conservation values identified by experts in a recent conservation assessment (Caton et al. 2007), with a few important differences. Survey participants did not assign high biodiversity value to two areas proposed by experts for protective buffering by zoning: the area from Deep Creek Conservation Park to Morgan Beach, and the area including King Head to Newland Head Conservation Park. Further, they identified Middleton, Goolwa and Second Valley as medium priorities for conservation in contrast to experts who identified them as low priorities.
- Survey respondents perceived the conservation values of Deep Creek and Newlands Head Conservation Parks to be moderately threatened by climate change, compared to experts who assessed both parks as low conservation threat. Adult survey respondents noted the potential for new diseases and weeds, the drying trend leading to more bushfires, and species loss associated with changing ecological niches.
- Experts identified the coastal strip between Cape Jervis and Second Valley to be of high conservation threat, whereas survey respondents identified this area as low to medium conservation threat.
- Survey participants were asked to suggest ways in which individuals could respond to climate change in the Southern Fleurieu region. Students frequently suggested: taking shorter showers, learning to live with less, minimising car usage, turning electrical equipment off at the switch and installing fluorescent/low emitting light globes. Adults frequently noted: installing rainwater tanks, planting more drought tolerant trees and shrubs, adjusting farming practices to cope with climate variability, investing in hybrid cars, switching to solar, wind or hot rock energy and educating self and others about climate change adaptation possibilities.
- Survey participants were also asked to recommend ways in which NRM agencies could respond to climate change. Students recommended the establishment of natural power sources (wind farms, solar, tidal and hot rock) and the development of committees to address climate change issues. Adults recommended tighter restrictions on water allocation and use, greater restrictions on the growth of water-loving crops such as rice and cotton, climate change education and awareness-raising programs, and the development of seamless planning guidelines between local councils, NRM boards and other coastal action groups to balance conservation and development interests.

CONCLUSIONS

This study has shown that authorities responsible for NRM and climate change planning should consider and act upon public perceptions of landscape value and climate change risk. Public perceived values and risks, as presented in this report, provide an important additional layer in climate change adaptation assessments. Soliciting these values early in the planning process may increase trust in decision-making and increase community support for and involvement in climate change adaptation responses. The values of quiet voices in society can also be recognised as part of this engagement process.

Both school students and adults were concerned about the projected impacts of climate change and acknowledged that tighter enforcement and incentive methods were needed to respond to climate change. Most of the participant concerns related to water use, water quality and water security in the Southern Fleurieu region, in recognition that a warming climate leads to reduced water availability. It is concluded that any enforcement or incentive method needs to be coupled with a strong education and awareness campaign at secondary and vocational levels. A number of school students, for example, had difficulties recognising the interdependencies between water, land and biodiversity systems and human impact upon them.

Public perceived values and climate change risks can also be overlaid with expert biophysical inventories for more integrated assessment of climate change adaptation priorities. Both survey participants and experts highly valued the conservation reserve systems in the Southern Fleurieu. This reflects positively on the efforts of authorities who manage reserve systems in the region. Some other areas, including the area between King Head and Newland Head Conservation Parks gave rise to differences between public and expert values and identified risks. The reasons for such value gaps should be discussed at follow up workshops, for example, whether access to proposed corridors influenced the intensity of valuation. Nonetheless, the value similarities and differences provide opportunities for improved understanding of public concerns and allow the appropriate targeting of adaptation responses.

This study used a consistent procedure for identifying value convergence or conflict, which could be replicated in other parts of the AMLR NRM region, SA or Australia:

- Identify the intensity of local and expert values or risks.
- Identify the location of these values or risks on the landscape.
- Determine the extent of spatial overlap with expert knowledge.
- Relate the areas of value gap or coincidence to existing or proposed NRM strategies.
- Use the resulting value and threat layers to facilitate workshops with NRM stakeholders, with the goal of obtaining further information about why those values and risks were important to survey participants.

The methods and results presented in this report have a number of implications for NRM planning across SA when considered in connection to a recent national NRM community capacity assessment (Fenton and Rickert 2008). The capacity assessment revealed that community engagement in NRM was consistently lower in SA than other states. One possible reason is that South Australian planning authorities continue to give preference to systematic collection of expert biophysical knowledge over public perceived knowledge in decision-making. This study has shown that, when collected using systematic sampling and

survey techniques, both local and expert knowledge systems can have an important role in NRM planning. This recognition requires a commitment to designing and implementing suite of tools for systematically integrating the values and aspirations of local people (NRM volunteers, rural landholders, industry groups, school students, urban residents) into the planning cycle and support for reporting processes that promote two-way knowledge and information exchange between local landholders and regional, state and federal agencies. It also provides a means for agencies to move from just 'listening and providing feedback' to looking for direct input and innovation from local groups in formulating solutions to NRM problems.

RECOMMENDATIONS

The study recommendations are as follows:

- DWLBC forward the report to NRM Council enabling it to consider the conclusions as part of a wider strategy to improve community engagement in NRM.
- NRM planning authorities responsible for climate change adaptation strategies use systematic social survey techniques, such as the LVM, to take into account public perceptions of climate change when designing NRM programs.
- Authorities engaged in establishing protective buffering by zoning (as recommended by Caton et al (2007) of the area including King Head to Newland Head Conservation Park note the need to promote the biodiversity value of the area in order to gain public support.
- Coastal planning authorities develop strategies to better understand why survey participants did not assign high conservation threat to the area between Cape Jervis and Normanville.
- Policy makers recognise public concern about freshwater security in the Southern Fleurieu and support the development of local adaptation strategies.
- Authorities responsible for communicating climate change issues continue to develop education and awareness-raising programs to increase public knowledge of the projected impacts of climate change across SA.
- NRM policy makers note the high conservation and climate change threat assigned by ecologists and survey respondents to the area between Victor Harbor and the Coorong.
- State NRM agencies consider the application of the LVM presented in this report to different land-use contexts and across different NRM issues, including the possibility of using a web-based approach to increase cost effectiveness.
- Local Government consider applying the LVM as part of their development planning and assessment processes.
- Researchers to develop new tools for understanding the connections between people and place at different geographic scales, and the relationships between place values and place meanings.

1. INTRODUCTION

1.1 PURPOSE OF THE STUDY

Climate change has the potential to significantly affect the sustainability of natural resources in South Australia and the prosperity of societies which depend upon them. Climate change scientists project a warming, drying trend for South Australia, as well as less reliable rainfall, later breaks in the winter growing season, more extreme weather events and hotter, longer hot spells (e.g. McInnes et al. 2003; Suppiah et al. 2006), leading to projected secondary risks such as more frequent and intense bushfires, sea-level rise and biodiversity loss (e.g. Bardsley 2006).

While biophysical assessment of climate change is crucial for NRM planning, the social dimension to climate change has been largely overlooked. Few studies, for example, have investigated community perceptions of change in South Australia, including those places on the landscape perceived vulnerable to change and how individuals and agencies can respond to perceived risks. In an initial integrated assessment of climate change in the AMLR, Bardsley (2006) recommended participatory research on climate change so that adaptation responses can be informed by the knowledge and experience of local land managers. The Intergovernmental Panel on Climate Change (IPCC) through Yohe et al. (2007) also asserts that local perceptions of climate change and community values of place have an important role in informing local and regional planning processes and for identifying new ideas for NRM in this state, particularly when the place-specific implications of climate change have not been systematically examined and remain uncertain. An understanding of community values and perceived risks is also important for developing responses relevant to people at the local scale.

To address these needs, this project was undertaken to provide information on community attitudes and values for the Southern Fleurieu region to inform climate change adaptation responses and NRM program development. The Southern Fleurieu study area was chosen because of the opportunities to compare and contrast public perceived values and threats to those assessed by ecologists in a recent conservation assessment along the Southern Fleurieu coast (Caton et al. 2007). Their assessment included climate change evaluation criteria.

This study is one of a number of case studies for a larger project: ‘A regional climate change decision framework for natural resources management’. The objective of this larger study has been to work within the AMLR NRM region to undertake an assessment of key areas of NRM that are vulnerable to climate change, and develop and demonstrate methodologies for creating a regional framework for wider application in managing climate change risk and developing adaptation responses.

The wider project has six case studies:

- Biodiversity and Invasive Species
- Groundwater — Resource and Environmental Management
- Olive and Wine Industry Rapid Risk Assessment

- Land-use Planning for the Apple and Pear Industry
- Land Management — Land Capability Projections
- Coastal Management — Mapping Landscape Values.

The focus of this report is on mapping the landscape values of NRM stakeholders along the Southern Fleurieu Coast to support climate change adaptation planning. It contributes to strategy 3.4.4 of the State NRM Plan: 'Seek and value the knowledge, skills and expertise of local people, including Aboriginal landholders, in planning and on-ground delivery' (DWLBC 2006, p.54) and an action under objective 2.1 of the South Australian Government's climate change strategy: 'Identify and address the adaptation needs of those communities where early adaptation is needed' (South Australian Government 2007, p.16).

The report frequently mentions the landscape values concept. It refers to the instrumental (tangible) or symbolic connections that develop between people and place. Two landscape value studies have been undertaken along the Southern Fleurieu Coast in recent years. A conservation priorities study eloquently summarised the conservation values and threats present in a series of landscape blocks along the Southern Fleurieu Coast (Caton et al. 2007), and a coastal values study systematically measured the importance of different sites along the Southern Fleurieu Coast from an aesthetic value perspective (Lothian 2005). However, few studies to date have spatially identified multiple perceived landscape values at the place-specific scale and examined their interaction with areas perceived to be vulnerable to climate change. Planning authorities could use this spatial information to:

- target climate change adaptation responses to places perceived by the local community to be of high social value and vulnerable to climate change
- develop new land management strategies that take into account locally perceived landscape values identified during the project
- use the mapped results as a catalyst for engaging local communities in the development of flexible climate change adaptation responses which are relevant to people at the local scale.

To spatially identify landscape values and climate change risks, this report presents a modified public survey technique to solicit perceived landscape values using a simple respondent mapping protocol developed by Brown (2005), referred to as the landscape values methodology (LVM).

The specific objectives of the study were:

- Prepare a climate change presentation based on best available science.
- Identify, map and compare the perceived landscape values and climate change risks held by NRM stakeholders for the Southern Fleurieu.
- Compare and contrast public perceived landscape values and risks with those identified by ecologists in a recent conservation assessment along the Southern Fleurieu coast.
- Recommend strategies for future engagement of local communities in climate change adaptation.
- Create a report to assist the wider project build a framework for assessing climate change risk and adaptation responses in the AMLR NRM region.

This report is divided into five chapters. The remainder of Chapter 1 outlines the study area and provides a short review of the 'sense of place' and climate change risk perception literature. Chapter 2 outlines the sampling methodology, workshop and postal survey instruments, and analysis methods. Chapter 3 presents the results, including survey population characteristics, student and adult attitudes toward climate change, and the landscape values and climate change risk analysis. Chapter 4 discusses the implications of the results for NRM planning and future directions for the enquiry. Chapter 5 recommends actions for NRM policy development or program implementation.

1.2 THE SOUTHERN FLEURIEU REGION AND CLIMATE CHANGE

The Southern Fleurieu Peninsula region, as defined in this study, is a plateau bordered by the townships of Mount Compass, Cape Jervis and Goolwa (Fig. 1). While the Goolwa, Hindmarsh Island and Coorong sub-regions are not formally part of the Southern Fleurieu, they were included considering the important NRM and climate change issues being experienced in these places. The area of the region is ~114 000 ha (DWLBC 2006). It has a wet and cool climate with predominantly winter rainfall. Rainfall varies from 500–800 mm (Caton et al. 2007).

The region has a mosaic of land uses. Farming activities comprise approximately 73% of the total land use, followed by conservation (21%) and residential living (6%) (DWLBC 2006). Residential development is undergoing major growth along the coastal fringe. The regional hub of Victor Harbor, for example, is amongst the fastest growing communities in the state, with an average growth in excess of 3% per annum for the past ten years and a population of 30 000 at peak tourist season from December to February (City of Victor Harbor 2007). A total of 13 individual conservation and recreation parks and reserves are encompassed by the study boundary. The most popular park in the region is Deep Creek Conservation Park with 32 104 visitors in 2003 (Urban and Regional Planning Solutions 2007).

The Southern Fleurieu region is an important area for biodiversity. The region contains 10.3% of its pre-European (pre-1788) vegetation cover, and 85% of the remaining vegetation is fragmented into patches of less than 1000 ha (National Land and Water Resources Audit 2001). The Fleurieu Peninsula swamps are rated as a nationally threatened plant community under the Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999 and are home to populations of the nationally endangered Mount Lofty Ranges Southern Emu-wren (Hill & Duffield 2002). Remnant vegetation is conserved in 13 conservation parks, SA Water land, ForestrySA Native Forest Reserves and private land.

Caton et al. (2007) undertook a coastal conservation assessment for the Southern Fleurieu coast between Sellicks Beach and Hindmarsh Island. The purpose of the report was to develop conservation priorities for places and areas within the region. They highlighted additional areas of high conservation value and high conservation threat: the beaches and lower slopes of Fishery Beach, Lands End, Cape Jervis and Morgan Beach; the cliffs and cliff tops from Newland Head to the Bluff; and the Normanville Dunes. As part of the regional adaptation to climate change, the authors recommended a regional 'coastlink' project to enhance the connectivity of coastal vegetation to include the revegetation of two areas adjacent to conservation parks: the area from Deep Creek Conservation Park to Morgan Beach, and the areas including King Head to Newland Head Conservation Park.

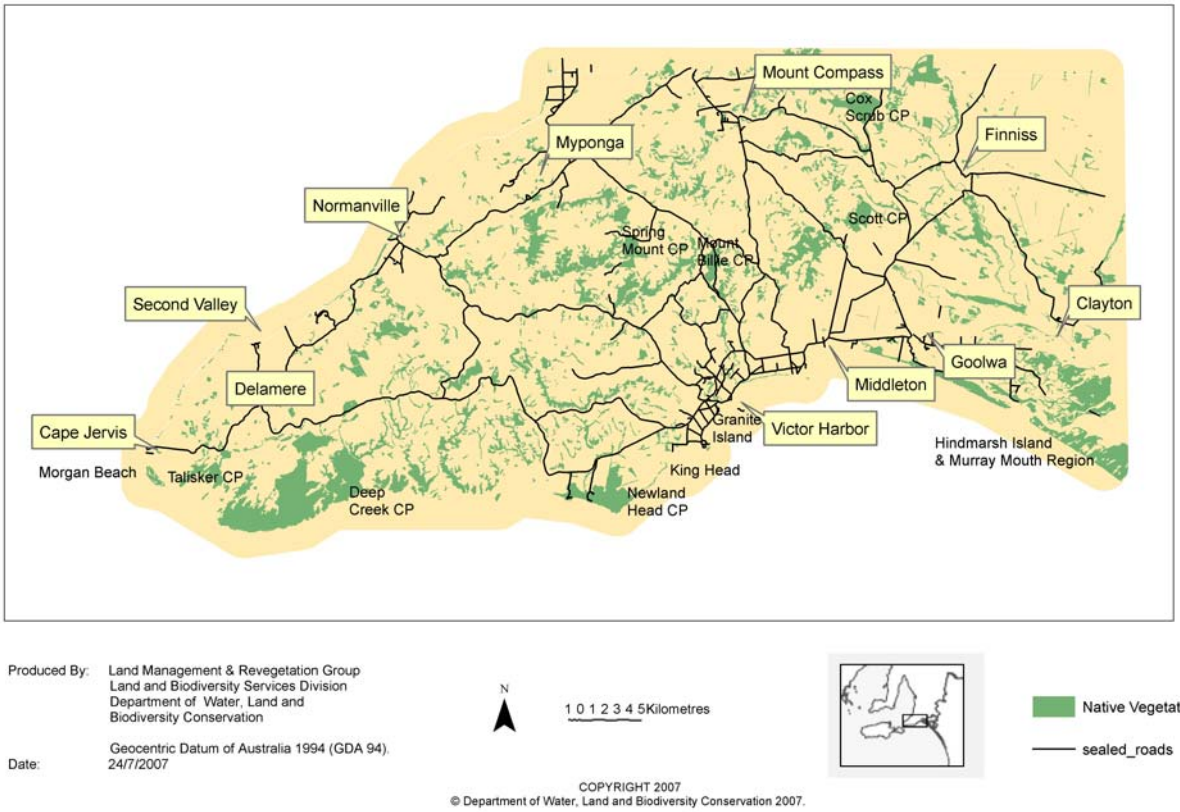


Figure 1. The Southern Fleurieu Peninsula Region (Southern Fleurieu) as defined in this study

1.2.1 'SENSE OF PLACE' AND NATURAL RESOURCES MANAGEMENT

Traditionally, the connections between individuals and place have not been considered directly relevant to NRM (Cheng, Kruger & Daniels 2003, Smaldon 2002, Stokowski 2002, Williams & Vaske 2003). Places have been viewed as commodities – policy makers have often presumed that public attitudes toward land management are dependent upon the objective landscape features and utilitarian values of the land. In contrast to this view, the 'sense of place' construct (referred to as sense of place) recognises that people hold deep meanings and values for places (e.g. Williams et al. 1992, Williams & Stewart 1998) which cannot be measured using conventional economic instruments alone. This section defines sense of place, outlines four approaches to sense of place, and reviews the relationship between landscape values and sense of place.

1.2.2 WHAT IS SENSE OF PLACE?

Sense of place reflects the entire suite of thoughts (cognitions) and emotional (affective) sentiments held regarding a particular geographic locale (Altman & Low 1992; Jorgensen & Stedman 2001) and the meanings one attributes to such areas (Relph 1976; Fishwick & Vining 1992; Kaltenborn 1998; Stedman 2003a, 2003b). It is a multifaceted topic with its conceptual basis derived from personal and interpersonal experiences and cultural values and shared meanings (Stedman, Beckley & Ambard 2004; Kyle & Chick 2007). Place is very different to the environment. Places involve meanings and values that assist connections

with particular geographic areas (Tuan 1977), whereas environment, as traditionally monitored and evaluated under the assets of water, land and biodiversity, refers to the biophysical components of the landscape that exist regardless of the types of human connections to them. The challenge for NRM is to move from a discourse where environmental assets are seen as separate from people to a place-based discourse where there are complex connections between people and the environment.

1.2.3 APPROACHES TO SENSE OF PLACE

Williams (In Press) defined four approaches to a sense of place in NRM. The first approach is to view 'place as an attitude object'. People have attitudes towards a geographic locale or resource, for example a person may hold attitudes towards an agency or how climate change may affect a particular region. The second approach involves recognising 'place as relationship and meaning'. The term meaning reflects a deeper notion than attitude by emphasising the relationship between a person or group and the place. It implies meanings that are hard to recognise and articulate, as well as the symbolic and goal-directed attachments that develop between people and place. They can be likened to stories about places rather than physical properties of places. The third approach, 'place as environmental philosophy', promotes the moral and ethical dimensions of place. Some components of place have timeless character which should be preserved at all costs. The fourth approach views 'place as a social-political process'. This approach examines the different meanings assigned to be place by constituencies and how they are contested over time. Often, claims on what belongs to a place are motivated by the need to assert power and authority over that place.

This report considers sense of place as 'a relationship and meaning' using the landscape values concept discussed below.

1.2.4 LANDSCAPE VALUES AND SENSE OF PLACE

Brown (2005) and colleagues further developed the concept of landscape values as an operational bridge between the geography of place and sense of place. The starting point for the selection of landscape values was work by Rolston and Coufal (1991) who identified ten basic landscape values: life support, economic, scientific, recreation, aesthetic, wildlife, biotic diversity, natural history, spiritual and intrinsic. The typology was modified to include subsistence, cultural and therapeutic values (Brown & Reed 2000). It has since been applied in eight natural resource applications in the United States (Brown 2005 – review of five applications; Alessa, Kliskey & Brown 2008; Beverly et al. 2008; Nielsen-Pincus In Review) and three resource management applications in Australia (Brown 2006; Raymond & Brown 2006; Pfueller et al. In Press). This study expands upon the typology by including perceived climate change risks.

Results from the first five United States applications of the LVM indicate that landscape values are not uniformly distributed across the landscape (not completely spatially random) and that spatial relationships exist between landscape values and points of residence (community) (Brown 2005). In a Chugach National Forest study, aesthetic and recreation values were more clustered than the other values. The study indicated that those Alaskan communities with strong place attachment tend to be more cohesive, enjoy a perceived higher quality of life, and tend to have more special places near their communities (Brown, Reed & Harris 2002).

The LVM has direct relevance for conservation planning. A study on Prince Williams Sound, Alaska, United States, compared locally perceived biodiversity values with expert perceived biodiversity values (Brown et al. 2004). The results indicated a moderate degree of spatial coincidence between local values and scientific assessment, with areas of agreement and disagreement identified. The analysis has since been expanded to identify geographic areas where both locally perceived and expert derived ecological values overlap, referred to as 'social-ecological hotspots' (Alessa, Kliskey & Brown 2008). The collected point data were used to produce a continuous density surface or hotspot surface for each value and were spatially cross-correlated with selected ecological map layers of vegetation cover and net primary productivity. Predictive modelling has also been used to prioritise sites for conservation. In the Otways region of Victoria, landscape values were used to differentiate between national park, state forest and private land (Raymond & Brown 2006). Predictive modelling (discriminate analysis) indicated moderate agreement between public perceived and expert-derived national park boundaries, suggesting the LVM is useful in reviewing public land classifications. Considering the paucity of data available on biodiversity in remote areas, it would be wise for land managers to incorporate both public values and expert assessment to determine conservation priorities.

There are a number of emerging methods for mapping perceived landscape values and meanings. A mapping tool was developed for local actors to identify a variety of experienced qualities of green areas in Helsinki, Finland, such as beautiful scenery or peace and quiet (Tyrväinen, Mäkinen & Schipperijn 2007); an in-depth interviewing technique was developed for comparing the relationships between place values and opportunity sets of activities, biophysical setting and social interaction in the United States (Black & Liljeblad 2005); and a web-based interactive mapping exercise is currently being developed to describe and locate place meanings at multiple geographic scales (Alan Watson, Aldo Leopold Wilderness Research Institute, pers. comm., 12 September 2007).

1.3 CLIMATE CHANGE AND RISK PERCEPTION

The climate change science community has an invaluable role in characterising system uncertainties, but value judgements about potential risks and individual perceptions of 'danger' are also important in the development of long-term policy (Lorenzoni, Pidgeon & O'Connor 2005; Botterill & Mazur 2004; Zahran et al. 2006). Researchers support inclusion of climate change value judgements in NRM planning to: 1) identify gaps in interpretations of climate change threat within local communities and between public, government and scientific community (Botterill & Mazur 2004) and 2) support local people to recognise and respond to environmental change (Bardsley & Edwards-Jones 2007). It is recognised that the best approach is to develop tools for identifying, measuring and empowering the values of multiple stakeholders and publics, with different response patterns and views (Lorenzoni et al. 2006).

Climate change is an issue of high concern, but it competes with other more pressing matters in people's lives. Studies in Australia (AGO 2003) and the United Kingdom (Poortinga & Pidgeon 2003) have shown that the public are somewhat ambivalent about climate change. Although people expressed high awareness and concern about the issue, it is often secondary to more pressing issues in people's lives. In the United Kingdom study, these issues included health, family, safety and finances. The Australian report cited more important environmental issues such as water supply/quality, pollution, salinity/land degradation and forests/tree clearing (AGO 2003). Nonetheless, the majority of Australian

respondents believed everyone had equal responsibility for addressing the change (59%). The most common activities undertaken in the six months prior to the study were washing clothes in cold water (83%), having the car serviced (79%), turning off unnecessary appliances at the power point (77%) and using fluorescent light globes (51%). Additionally, all respondents were asked what they thought the Commonwealth Government should be doing about climate change. The most common response was that the government should be educating/raising awareness (18%), followed by planting more trees (7%), ratifying the Kyoto Protocol (7%) and injecting financial resources into climate change (7%).

Undergraduate students have expressed different attitudes toward climate change than adults. While students in a United Kingdom study recognised climate change was a global problem with potentially catastrophic consequences, it did not translate into personal responsibility (Lowe 2007). They were unwilling to make changes themselves to reduce the impact of, or adapt to, climate change. Leiserowitz (2006) suggests some of these differences may be explained by the concept of 'interpretative communities', otherwise referred to as groups of individuals who share mutually compatible risk perceptions: 1) individuals who think that climate change is a low or non-existential risk; 2) individuals who perceive climate change as a real and high threat; and 3) people who confuse climate change with ozone layer depletion. Such divergent views create complexities for governments who have traditionally made policy judgements based on best available science. Initiatives calling for significant and short-term sacrifices may not be adopted if the measures conflict with the individual's perception of risk.

Other studies have emphasised the importance of socio-cultural influences on risk perception. Of particular interest to this study is the role of knowledge on risk appraisal. Early risk perception research suggested those who were more highly educated and had higher scientific training had lower risk perceptions than those who were less educated (Kraus, Malmros & Slovic 1992). However, more recent studies indicate that general beliefs, world views and environmental values strongly influence risk judgements (Slovic 1999; Stedman 2004; Leiserowitz 2006; David & Elise 2007).

A variety of methods have been used to explore and examine community perception of climate change and ecosystem risk. For example, Lazo et al. (1999) firstly explored expert and layperson perceptions of ecosystems and climate change risks using a mental modelling approach and content analysis, and in later studies applied psychometric scales developed by McDaniels, Axelrod and Slovic (1995) for characterising expert and lay perceptions of risks to ecosystems (Lazo, Kinnell & Fisher 2000). In the latter study, the ecological risk perceptions of professors and researchers with expertise in ecological sciences (experts) were compared to students and the public in Centre County, Pennsylvania (public). Both experts and public perceived climate change risks to ecosystems to be less avoidable and more acceptable than other risks like human health threat.

Although several studies have used psychometric scales to examine the differences between local people and scientific assessment of ecosystem risk (e.g; Kraus, Malmros & Slovic 1992; Slovic et al. 1995; Lazo et al. 1999; Herzon & Mikk 2007) and climate change risk (Stedman 2004; Lorezoni, Pidgeon & O'Connor 2005; Leiserowitz 2006), few studies have used spatial measures to understand the relationships between local perception and expert assessment of biological value and ecosystem risk. Spatially referenced information may help resource managers to identify place-specific priorities for climate change adaptation and may enable the development of locally relevant tools to engage the community in adaptation planning.

To address the knowledge gaps identified in the literature review, this report examines the spatial relationships between public perceived landscape values and climate change risks, with the goal of prioritising areas for climate change adaptation. Section 2 thoroughly explains the LVM further developed and applied in this study, with reference to the sampling method, survey instrument and analysis methods.

2. METHODOLOGY

2.1 SAMPLING

Two sampling techniques were used in this study – a snowball sampling technique (Minichiello et al. 1995) to identify workshop participants and a systematic random sampling technique to identify postal survey participants. In the snowball sampling technique, a list of key NRM organisations was obtained from the AMLR NRM Board. Organisations were clustered and then selected by interest (i.e. coastal development, education, conservation and primary production). Each organisation was invited to participate in the study through the chair or secretary. Additionally, the chair or secretary was asked to suggest names and contact details of other individuals and groups who may have been interested in being part of the study. If there was initial interest, a formal invitation was sent to the chair via email together with a workshop flyer that contained the proposed venue and date (App. 1).

Appendix 2 outlines a list of organisations and groups who participated in the study. Within the school student sample, only years 10–12 Geography and Society and Environment Studies were invited to participate because the LVM assumes skills in map reading, and the climate change concept requires some understanding of world climate systems. Across the adult and student workshop sample, there is some bias towards education, conservation and primary production interests. The snowball sample is not assumed to be representative of the Southern Fleurieu resident population; however, it does represent the major NRM interest groups in the region, all of who are critical to engage in climate change issues and adaptation responses, and the ongoing management of natural resources, especially biodiversity.

A random sample of Southern Fleurieu property owners was collected by examining the 2007 cadastral file (DEH 2007) which was cropped to the exact dimension of the study area. Property owners were randomly selected from 14 Southern Fleurieu communities. A census of property owners in Delamere and Clayton communities was attempted because a proportional sample of each community would have not yielded enough observations for statistical analysis. Secondly, all selections with company or trust names were removed from the database because the postal survey was tailored to individuals and their families. The sampling frame was representative of most residents over the age of 18; it discounted residential and commercial lessees whose details were omitted from the cadastral file.

2.2 SURVEY INSTRUMENT

2.2.1 WORKSHOP SURVEY

Between March and May 2007, 15 workshops were conducted with school students and adults residing in the Southern Fleurieu region. The number of participants involved in each workshop ranged from 5 to 30, with a median attendance of 17 people. The workshop survey contained questions in five sections: 1) familiarity with the Southern Fleurieu and threats to their quality of life; 2) climate change knowledge and level of concern; 3) preferred climate

change adaptation responses; 4) respondent characteristics (e.g. interest group, age, gender, level of formal education and employment category); and 5) identification of landscape values and climate change risks. The workshop survey appears in Appendix 3.

The following workshop facilitation process was repeated for each of the 15 workshops. To encourage attendance, the workshop facilitator delivered a 20 minute PowerPoint presentation divided into: 1) workshop purpose, objectives and sponsors; 2) international, national and state climate change trends using best available science; and 3) workshop survey activities. The presentation was followed by 10 minutes of question time. After conducting one workshop, the facilitator became aware that individual knowledge of climate change varied greatly. To partially address these differences, the facilitator opened his presentation with a few 'ice-breaker' questions such as: 'Can anybody in the room define the term climate change?' and 'Can anybody in the room explain the greenhouse effect in 2–3 sentences?'

In part 2, international climate change trends were distilled from the 2007 IPCC report (IPCC 2007), and the national and state trends from two Commonwealth Scientific and Industrial Research Organisation (CSIRO) reports (McInnes et al. 2003; Suppiah et al. 2006). The presentation focused on the exponential rise in carbon dioxide emissions over the last 100 years and the associated increase in global mean temperatures; the variability in carbon dioxide emissions and temperature over the past 400 000 years and the recent warming and drying trend; emission source at the household level; the warming trend leading to decreased northern hemisphere snow cover and sea-level rise; recent weather patterns in Australia; and climate projections for Australia and South Australia by 2030. The potential regional and local climate change risks and associated adaptation options were not discussed during the workshop as school students and adults were asked what could be done by individuals and NRM agencies to respond to projected climate change.

Following the PowerPoint presentation, workshop participants completed parts 1–4 of the survey individually within a 20 minute timeframe. Some participants, in particular school students, had questions about survey language. To avoid any confusion, common questions were answered in front of the whole group. Survey parts 1–4 consisted of a combination of Likert scales and open ended questions to encourage thoughtful consideration of climate change risks and responses. A ten minute break followed these four parts.

After the break, workshop participants were assigned approximately one hour to complete part five of the survey. In this section, they were asked to place mnemonically coded sticker dots representing eight different landscape values, up to six special place locations, two development preferences and six potential climate change risks (Fig. 2) on a 1:125 000 greyscale map of the Southern Fleurieu region (Royal 2007) provided with the survey. Broadly, the landscape values were divided into instrumental/goal-directed values (e.g. aesthetic, economic and learning) and symbolic values (e.g. intrinsic and future). The special places reflect other places of importance to respondents whereas the development preferences reflect multiple values. The six perceived climate change risks of biodiversity loss, land erosion, bushfire, riparian flooding, sea-level rise and wave action or storm surge were referred to in Bardsley's (2006) integrated assessment as possible risks to environmental assets in the AMLR region. An informal advisory group consisting of DWLBC Land Management and Revegetation Group representatives and two AMLR NRM Board representatives selected the final set of landscape values and climate change risks.

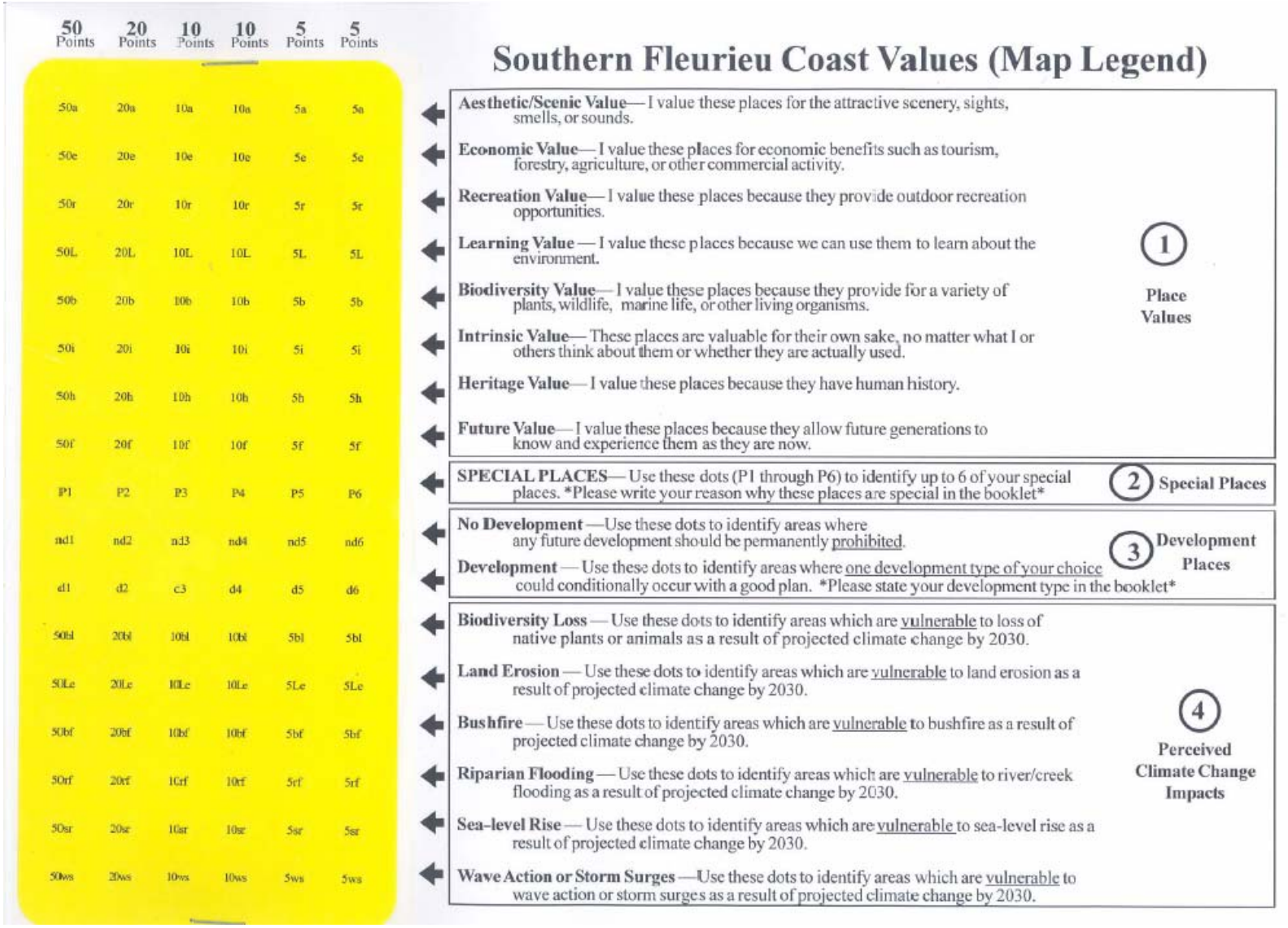


Figure 2. The landscape values typology, otherwise referred to as the 'map legend'

To aid the mapping component, an operational definition for each value and risk appeared adjacent to the respective row of sticker dots. Each value and risk was assigned six dots weighted from 50 to 5, with the larger numbers reflecting more of the landscape attribute, e.g. more scenic, more recreation value, higher biodiversity loss or higher bushfire threat. Additionally, workshop participants could identify places where development should be permanently prohibited ('no development') and places where a development type of their choice ('development') could conditionally occur with a good plan. Participants stated their preferred development type on page eight of the survey booklet.

The spatial data set used in the analysis consisted of 16 025 digitised points from 375 Southern Fleurieu school students and property owners. While this sticker dot approach identifies value intensities, it does not explain why a particular value is important to a respondent. For this reason, survey participants could explain why their 50 value dots were important to them in the survey booklet. Value explanation is a new element of the LVM.

2.2.2 POSTAL SURVEY

In May 2005, a postal survey of Southern Fleurieu property owners was conducted using a modified Total Design Method (Dillman 1978). Survey administration involved four mailings: 1) introductory letter informing of the purpose of the research; 2) complete survey packet; 3) handwritten reminder postcard; and 4) second complete survey packet to non-respondents from the first round. While handwriting over 150 postcards was a laborious task, it resulted in a significant increase in completed returns. Over 50 surveys were returned within three days of sending postcards.

The postal survey contained the same questions as the workshop survey, with the exception being the questions about length of residence (q1), interest group (q10) and community of residence (q11) (App. 4).

It is important to note that postal survey participants were not provided with a presentation on climate change and its impacts.

2.3 ANALYSIS METHODS

2.3.1 SURVEY DATA

Differences in attitudes toward climate change were determined using a combination of chi-square and t-tests performed in SPSS® V 15.0 software. Cross-tabulations with chi-square tests were used on categorical dependent variables such as 'participant knowledge of places in the Southern Fleurieu region'. Survey participants were asked to list additional threats to their quality of life, outline perceived past and future changes to climate change, and then suggest individual and NRM agency responses to climate change. Using MS Word, these open responses were categorised into themes and sub-themes by student and adult sub-groups.

2.3.2 SPATIAL DATA

This report applies three analysis techniques to the spatial data: 1) descriptive mapping; 2) proportionate analysis; and 3) simple raster modelling.

2.3.2.1 Descriptive mapping and hotspot analysis

Density analysis was used to show the spatial distribution and intensity of landscape values and perceived climate change risks in the Southern Fleurieu region. Density maps were generated in ArcGis® software by selecting a grid cell size (500 x 500 m) and search radius (3 km) around each grid cell. A 3 km search radius was chosen to allow for a dot diameter of 500 m (on the map) and error in dot placement by survey respondents. For each landscape value and climate change risk, the number of points falling inside the grid cell and cells within the search radius were totalled and then divided by the area contained within the grid cell. The density maps, created using a natural breaks (Jenks) classification, reveal varying intensities of landscape values and climate change risks. High point densities may be referred to as 'hotspots'.

2.3.2.2 Proportionate analysis

The relative proportions of landscape values and climate change risk dots within selected Southern Fleurieu townships and conservation parks were determined using cross-tabulations with a chi-square statistic. The statistic compares the amount of observed landscape values and climate change dots within selected townships and conservation parks to what would be expected by chance alone.

2.3.2.3 Simple raster modelling

Simple raster modelling was used to compare and contrast public perceived biodiversity values and climate change risks with expert derived conservation values and threats. The public perceived layers illustrate the number of biodiversity value or climate change threat points found within a 500 x 500 m grid cell and 3 km search radius. The resulting densities were collapsed into high, medium and low data ranges using a Jenks natural breaks classification. The conservation value and conservation threat summary maps generated by Caton et al. (2007) reflect a series of coastal cell polygons symbolised using highest, medium and lowest data ranges. The combined summarised value of each coastal cell was calculated by averaging the values of all of the 25 x 25 m grid cells within that coastal cell. The calculated values were divided into three data ranges and threat types (low, medium and high). The public perceived and expert assessed conservation value and threat outputs were overlaid and visually compared.

To generate the value and threat indexes, it was assumed that the higher the density of perceived biodiversity value the higher the conservation priority, and the higher the density of perceived climate change risk the higher the conservation threat. It must be emphasised that the conservation assessment was restricted to the coastal zone, whereas survey participants in this study were allowed to assign values and risks to the entire Southern Fleurieu region.

3. RESULTS

3.1 POPULATION CHARACTERISTICS

3.1.1 SURVEY RESPONSE RATE

Two surveys ran concurrently as part of the Southern Fleurieu study – a postal survey and a workshop survey. A total of 375 responses were received from both surveys, comprising 245 workshop responses (127 school students and 118 adults) and 130 postal responses (all adults).

A total of 210 postal surveys were sent to a random sample of Southern Fleurieu property owners for an overall response rate of 61%. Property owners were defined as people over the age of 18 who either lived in the Southern Fleurieu (n = 143) or owned a second property in the region (n = 57).

3.1.2 SOCIO-DEMOGRAPHIC PROFILE

It is important to examine the socio-demographic profile of survey respondents to determine the extent of sampling error and bias (Table 1). To assist comparisons with ABS data (ABS 2006), the adult survey population was separated into resident and non-resident sub-groups. There were more males (65.8%) in the resident sample compared to ABS statistics for the region (48%). The majority of resident survey respondents were over 40 years of age (53.6%) which is consistent with the region (61% ABS). However, there were proportionately fewer respondents 21–40 years of age (5.7% resident sample vs. 16.9% ABS) and proportionately more youth respondents less than 20 years of age (40.8% resident sample vs. 22.1% ABS). The high number of youth respondents is to be expected considering school students were targeted as part of the snowball sample.

The majority of the sample had completed either primary or secondary school (54.7%). Of the resident sample, 28.4% had completed secondary education, 14.5% tertiary education and 10.4% postgraduate education, all higher than the regional education profile. Non-residents were more educated than residents with 34.6% having completed tertiary and 32.7% postgraduate education.

Southern Fleurieu workshop participants were asked about their identification with interest groups. Non-residents were not asked this question, reflected in the lower response (n = 226). The majority of workshop participants either identified with education (32.3%), conservation (21.7%) or primary production (21.2%).

Overall, the demographic profile of respondents indicates that the sample was skewed towards male respondents who were better educated than the regional population and aligned with education, conservation or primary production interests.

Table 1. The socio-demographic profile of school student and adult survey respondents in comparison to the resident and non-resident survey population

Socio-demographic characteristics	N	Overall[1] (%)	Students (%)	Adults (%)	Resident overall (%)	Non-resident overall (%)
Sex						
Male	235	65.9	67.5	65.0	65.8	71.4
Female	118	34.1	32.5	35.0	34.2	28.6
Total	**353**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Age						
Younger than 20 years	127	34.6	100.0	0.0	40.8	2.0
21–40 years	21	5.7	0.0	8.8	5.6	2.0
41–60 years	114	31.1	0.0	47.5	26.3	57.1
60 years+	105	28.6	0.0	43.7	27.3	38.9
Total	**367**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Education Level						
Primary	97	27.8	0.0	6.7	30.9	8.2
Secondary	94	26.9	93.5	26.8	28.4	18.4
Vocational	40	11.6	0.0	17.2	12.5	6.1
Tertiary	60	17.3	0.0	27.2	14.5	34.6
Postgraduate	47	13.5	0.0	21.3	10.4	32.7
No response	10	2.9	6.5	0.8	3.3	0.0
Total	**348**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Interest Group						
Coastal Development	25	11.1	12.3	9.7	11.1	
Conservation	49	21.7	7.3	38.8	21.7	
Primary Production	48	21.2	8.1	36.9	21.2	
Recreation/Tourism	31	13.7	20.3	5.8	13.7	
Education	73	32.3	52.0	8.8	32.3	
Total	**226**	**100.0**	**100.0**	**100.0**	**100.0**	

1. Combined student and adult sample. Sex, age and education response totals do not sum to 375 due to question oversight.

3.1.3 ADULT AND STUDENT KNOWLEDGE OF THE SOUTHERN FLEURIEU REGION AND ATTENTION PAID TO CLIMATE CHANGE

An examination of perceived knowledge of the Southern Fleurieu region (Table 2) is important considering it influences the number of value dots mapped by survey respondents (Brown 2005). The majority of survey participants indicated good (54.4%) or fair (33.1%) knowledge of the Southern Fleurieu region. Although there were no significant differences in perceived individual knowledge between student and adult sub-groups, X^2 (3, N = 362) = 2.44, p >0.05, proportionately more adults (19.1%) than students (8.7%) felt they were more knowledgeable about the Southern Fleurieu region, X^2 (3, N = 362) = 10.90, p < 0.05, when they were asked to compare their knowledge of the region to other survey participants.

Table 2. School student and adult's perceived knowledge of the Southern Fleurieu region and level of attention paid to climate change issues

Variable	N	Overall[1] (%)	Students (%)	Adults (%)	X^2	p
Knowledge of Southern Fleurieu region						
Excellent	29	8.0	5.6	9.3	2.44	0.484
Good	197	54.4	58.7	52.1		
Fair	120	33.1	31.0	34.3		
Poor	16	4.4	4.8	4.2		
Total	**362**	**100.0**	**100.0**	**100.0**		
Knowledge compared to other survey participants						
More knowledgeable	56	15.5	8.7	19.1	10.90	0.012
About the same knowledge	180	49.7	59.5	44.5		
Less knowledgeable	97	26.8	26.2	27.1		
No opinion	29	8.0	5.6	9.3		
Total	**362**	**100.0**	**100.0**	**100.0**		
Attention paid to climate change						
None	13	3.6	8.0	1.3	45.39	0.000
Little	94	26.0	40.8	18.1		
Moderate	214	59.1	49.6	64.1		
Close and Constant	41	11.3	1.6	16.5		
Total	**362**	**100.0**	**100.0**	**100.0**		

1. Combined student and adult sample

Question five asked survey participants about the level of attention paid to climate change issues facing South Australia. Proportionately more adults than students responded that they had paid close and constant attention (16.5% vs. 1.6%) or moderate attention (64.1% vs. 49.6%) to climate change issues X^2 (3, N = 362) = 45.39, $p < 0.05$.

Overall, adults appear more knowledgeable about the Southern Fleurieu region than students and have paid significantly greater attention to climate change issues.

3.2 STUDENT AND ADULT ATTITUDES TOWARD CLIMATE CHANGE

3.2.1 POTENTIAL THREATS TO SOUTHERN FLEURIEU QUALITY OF LIFE

Adults and students were asked to respond to a list of potential threats to their Southern Fleurieu quality of life. The items were presented as statements. Respondents could indicate their level of agreement or disagreement on a 5-point Likert scale from '1 = Strongly Disagree' to '5 = Strongly Agree'. A response of '3' indicated neither agreement nor disagreement. The responses are listed in Tables 3a and 3b from largest to least perceived threat.

Table 3a. Extent to which climate change and development issues are a threat to school student quality of life in the Southern Fleurieu

Potential Threat	Students ($\bar{x}$)	Standard Deviation	Rank
Climate change	4.04	0.689	1
More frequent, intense and widespread bushfires	**3.84**	0.804	2
Biodiversity loss	**3.82**	0.919	3
Sea-level rise	**3.75**	0.954	4
Increased land erosion	3.67	0.765	5
New housing subdivisions	**3.49**	0.981	6
More frequent coastal storm surges	3.31	0.863	7
More frequent river/creek flooding	3.15	0.937	8

Table 3b. Extent to which climate change and development issues are a threat to adult quality of life in the Southern Fleurieu

Potential Threat	Adults ($\bar{x}$)	Standard Deviation	Rank
Biodiversity loss	**4.03**	0.854	1
New housing subdivisions	**3.92**	1.041	2
Climate change	3.90	0.884	3
Increased land erosion	3.81	0.901	4
More frequent, intense and widespread bushfires	**3.59**	0.991	5
Sea-level rise	**3.50**	1.034	6
More frequent coastal storm surges	3.46	0.925	7
More frequent river/creek flooding	3.12	0.993	8

Means were based on a scale where '1 = Strongly Disagree', '2 = Disagree', '3 = Neither Agree or Disagree', '4 = Agree' and '5 = Strongly Agree'. Bolded numbers indicate statistically significant differences between students and adults

Climate change is the largest perceived threat to school students ($\bar{x}$ = 4.04, Rank = 1), followed by bushfire ($\bar{x}$ = 3.84) and biodiversity loss ($\bar{x}$ = 3.82). From an adult perspective, the largest perceived threat is biodiversity loss ($\bar{x}$ = 4.03, Rank =1), followed by new housing subdivisions ($\bar{x}$ = 3.92) and climate change ($\bar{x}$ = 3.90). While all listed items were perceived to pose a threat ($\bar{x}$ >3), bushfire and sea-level rise were significantly greater threats for students and biodiversity loss and new housing divisions were significantly greater threats for adults ($t \geq 2.15$, $p < 0.05$).

3.2.1.1 Other threats

Survey participants were asked to identify another threat to their Southern Fleurieu quality of life. The most frequently mentioned threats for water, land, biodiversity and people themes are included in Table 4. The numbers reflect the frequency of threat identification. Both school students and adults believed drought, changed wind direction and population increase were threats to their quality of life. For adults, the most frequently noted perceived threats related to reduced rainfall, poor water quality, in particular effluent disposal into the Inmann River, the future sustainability of primary production enterprises and unchecked coastal

Table 4. Other threats to survey participant's quality of life in the Southern Fleurieu

Item and comments	Overall	Students	Adults
Water			
Quality of water – salinity or human waste disposal	6		6
Drought/reduced rainfall	8	3	5
Reduced surface water availability	5		5
Land			
Sustainability of primary production enterprises (e.g. Tasmanian blue gums)	4		4
Increased wind speeds	3		3
Changing wind direction (e.g. north winds)	2	1	1
Biodiversity			
Weed and pest invasion	3		3
Biodiversity loss	3		3
Development			
Unchecked coastal development (e.g. seven-storey hotels, marinas, Encounter Bay Shopping Centre)	6		6
People			
Population increase	5	2	3
Terrorism and war	3	3	

development. Fewer students than adults listed other threats. The most frequently noted threats for students generally related to activities outside of the NRM field, such as terrorism, war and population increase. See Appendix 5 for a comprehensive list of other threats.

3.2.2 IMPACT OF CLIMATE CHANGE ON THE SOUTHERN FLEURIEU COMMUNITY

Survey respondents were asked the extent to which climate change in the Southern Fleurieu will affect the quality of life for themselves, their families, the Southern Fleurieu community and the South Australian community on a scale where '1 = No Impact' and '5 = High Impact' (Table 5). Both students and adults indicated that climate change would have a low impact on themselves and their families; however, students believed climate change would have a significantly higher impact on the Southern Fleurieu community and South Australian community than adults ($t \geq 3.17$, $p < 0.05$).

Table 5. Impact of climate change on different community levels, as perceived by students and adults

Impact of climate change by 2030	Students ($\bar{x}$)	Adults ($\bar{x}$)	t	p
Yourself	2.56	2.44	1.30	0.195
Your family	2.71	2.55	1.76	0.079
Southern Fleurieu community	3.17	2.91	3.17	0.002
South Australian community	3.35	2.87	5.29	0.000

'1 = No Impact', '2 = Low Impact', '3 = Moderate Impact', 4= High Impact'

3.2.3 SUGGESTED ADAPTATION RESPONSES

Part 3 of the survey asked participants about actions that could be implemented by individuals and NRM agencies to reduce the impact of climate change by 2030. Tables 6 and 7 show the three most frequently mentioned adaptation responses by theme which could be implemented by individuals and NRM agencies, respectively. See Appendices 8 and 9 for the full list of responses.

3.2.3.1 Individual action

Both student and adults suggested individuals could increase the use of greywater around the home, minimise car usage by using alternative transport and promote reduced population growth (Table 6). The most frequently noted adaptation responses from students were taking shorter showers, decreasing affluence (learning to live with less), minimising car usage, turning electrical appliances off at switch, installing fluorescent light globes and switching to green energy – solar, wind, hot rock. Adults provided a greater range of responses. Most frequently noted adaptation strategies include installing rainwater tanks and other water capturing devices, planting more drought tolerant trees and shrubs, adjusting farming practices (e.g. stocking rates) to cope with climate variability, minimising car usage, and switching to green energy.

Table 6. School student and adult suggested individual responses to climate change

Item and Comments	Overall	Students	Adults
Water			
Install rainwater tanks and other water capturing devices	17	1	16
Take shorter showers	12	12	
Increase the use of greywater around the home	6	2	4
Land			
Plant more drought tolerant trees and shrubs (to enhance biodiversity, reduce water usage around the home, stabilise banks etc.)	16	2	14
Adjust farming practices to cope with climate variability (e.g. reduce stock numbers to maintain feed, buy more hay in good seasons to have adequate stores to survive lean seasons)	10		10
Grow own produce and invest in local trading	3		3
People			
Learn to live with less	8	8	
Educate self and others about climate change adaptation possibilities	5	1	4
Reduce population growth	4	3	1
Transport			
Minimise car usage (e.g. catch public transport, ride bike, be a one car family)	21	11	10
Invest in hybrid cars and other vehicles with cleaner emissions	4	3	1
Drive in a more conservative manner	1		1
Energy			
Switch to green energy – solar, wind, hot rock	18	3	15
Turn electrical equipment off at the switch when not in use	12	11	1
Install fluorescent/low emitting light bulbs	11	6	5

3.2.3.2 NRM agency action

Adults and students suggested a range of climate change adaptation actions for NRM agencies, with responses categorised under the themes of water, land, energy, people and development (Table 7). Both groups noted tighter restrictions on water allocation and usage, preventing the growth of water-loving crops, planting more drought tolerant trees, supporting education and awareness raising programs and supporting seamless planning mechanisms between local council, NRM boards and other groups and agencies.

Table 7. School student and adult suggested NRM agency responses to climate change

Item and Comments	Overall	Students	Adults
Water			
Impose tighter restrictions on water allocation and usage (includes buying back water licences).	6		6
Prevent the growth of water-loving crops, in particular rice, cotton and/or vines	5	1	4
Construct desalination plants along the SA coastline	4		4
Land			
Plant more drought tolerant trees	6	1	5
Support large-scale revegetation projects	4	1	3
Establish community groups to protect, monitor and regenerate remnant vegetation areas	2		2
Energy			
Establish natural power sources – wind farms, solar, tidal	3	2	1
Encourage car manufacturers to improve emission standards	1	1	
Encourage the establishment of large scale worm farms for recycling green waste	2		2
People			
Educate the general public about climate change, including how to adapt to a warmer climate	5		5
Provide up-front interest free loans to implement climate change adaptation strategies	2		2
Encourage federal government to provide Cities for Climate Protection funds to regional councils	2		2
Development			
Turnaround the mentality of ‘development at all costs’	3		3
Encourage seamless planning processes between local councils and NRM bodies	3		3
Encourage the building of display homes with more energy saving systems	1		1

3.3 LANDSCAPE VALUES AND CLIMATE CHANGE RISK ANALYSIS

An objective of this study was to identify, map and compare the perceived landscape values and climate change risks held by NRM stakeholders for the Southern Fleurieu region. Three techniques were used to address this objective: 1) descriptive mapping, 2) proportionate analysis, and 3) simple raster modelling.

3.3.1 DESCRIPTIVE MAPPING OF LANDSCAPE VALUES AND CLIMATE CHANGE RISKS

Landscape value maps for the Southern Fleurieu region were generated for each landscape value and perceived climate change risk (Apps 10–16) using density analysis, a GIS technique for determining the number of points within a specified grid cell and search radius. Density maps of biodiversity value and the six climate change risks are presented hereafter.

Firstly, the relationships between perceived biodiversity value and biodiversity loss are examined (Figs 3 and 4). There appears to be strong spatial alignment between those places of perceived high biodiversity value and high biodiversity loss. Biodiversity values and biodiversity loss risks are clustered at Deep Creek Conservation Park, Victor Harbor and the Coorong region.

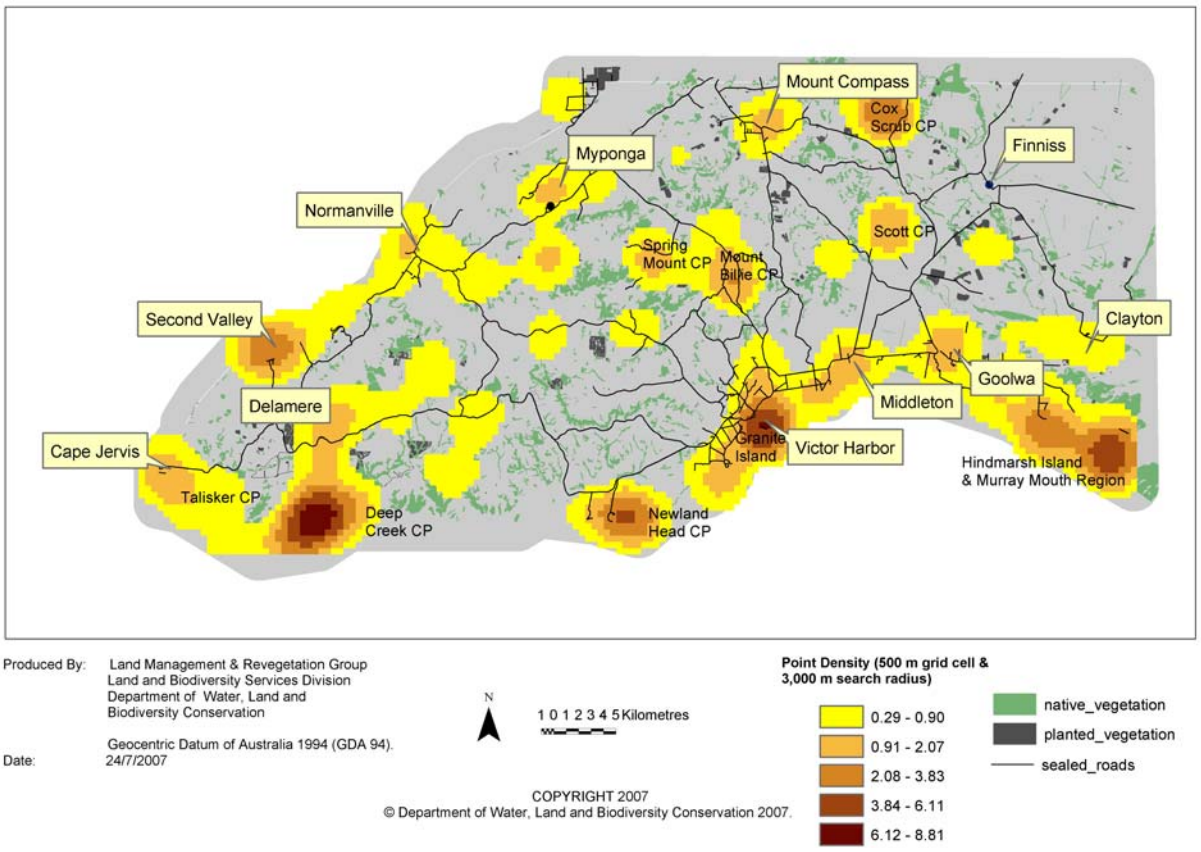


Figure 3. Density analysis of biodiversity value places, as perceived by survey respondents

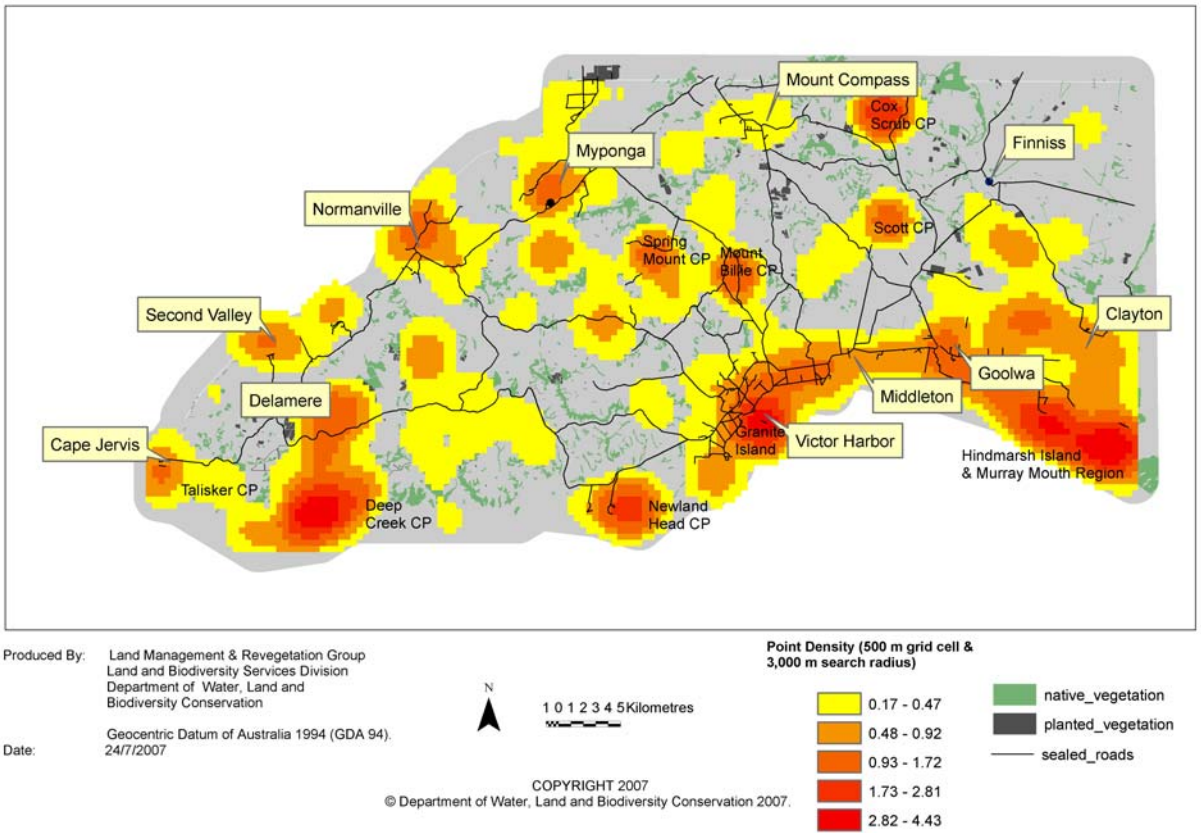


Figure 4. Density analysis of biodiversity loss places, as perceived by survey respondents

Those areas of high bushfire threat (Fig. 5) appear to be contained to conservation areas and planted vegetation reserves. Deep Creek Conservation Park, forestry reserves around Delamere and Cox Scrub Conservation Park were perceived to be highly vulnerable to bushfire. While the Coorong region was perceived to have high biodiversity value, it was not perceived to be vulnerable to bushfire.

There appears to be strong alignment between the perceived riparian flooding and sea-level rise risks (Figs 6–7). The townships of Victor Harbor and Goolwa were perceived to be most vulnerable to both risks.

The coastal dune systems around Normanville and between Victor Harbor and the Coorong were perceived to be most vulnerable to land erosion, with Victor Harbor, Middleton and Goolwa being hotspots (Fig. 8). Similarly, Victor Harbor and Middleton were perceived to be most vulnerable to wave action or storm surge (Fig. 9).

Overall, there is a public perception that conservation parks and reserves on the Southern Fleurieu are most vulnerable to biodiversity loss and bushfire, whereas the coastal strip beside Victor Harbor, Middleton and Goolwa was perceived to be most vulnerable to land erosion, riparian flooding and sea-level rise.

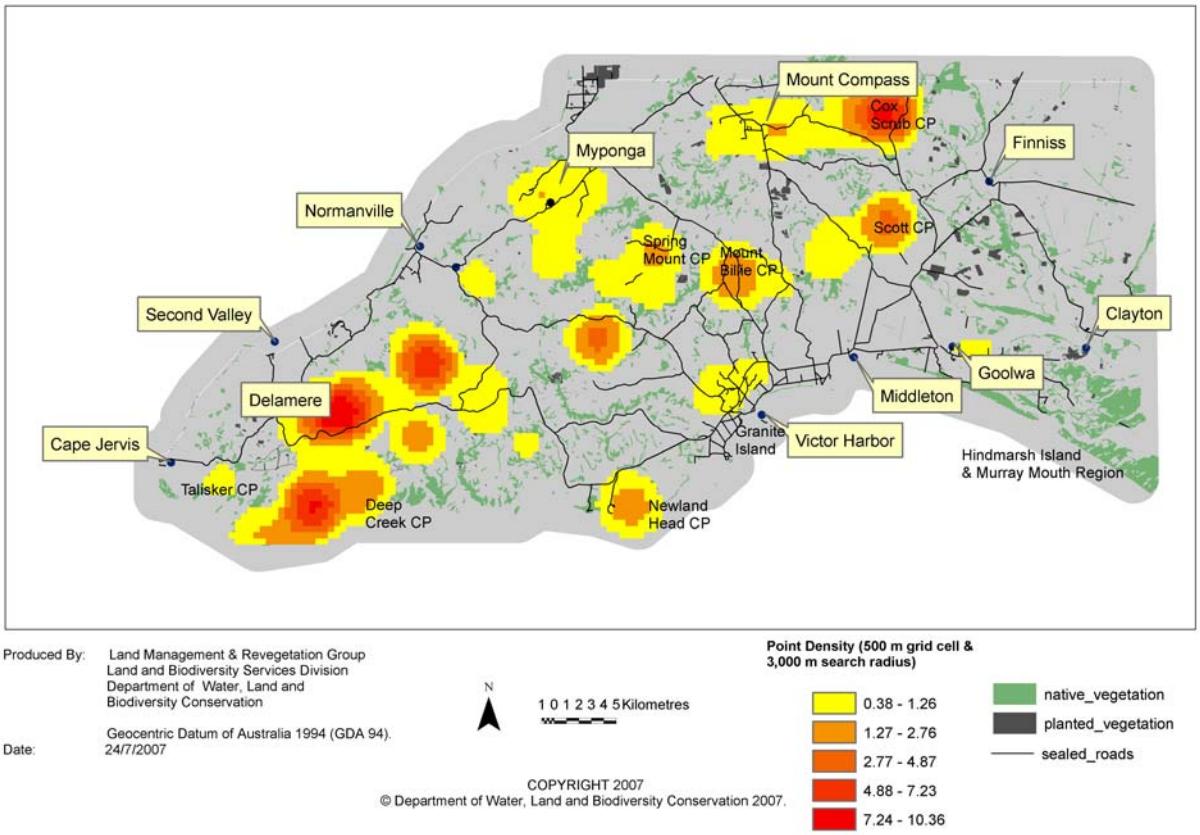


Figure 5. Density analysis of bushfire places, as perceived by survey respondents

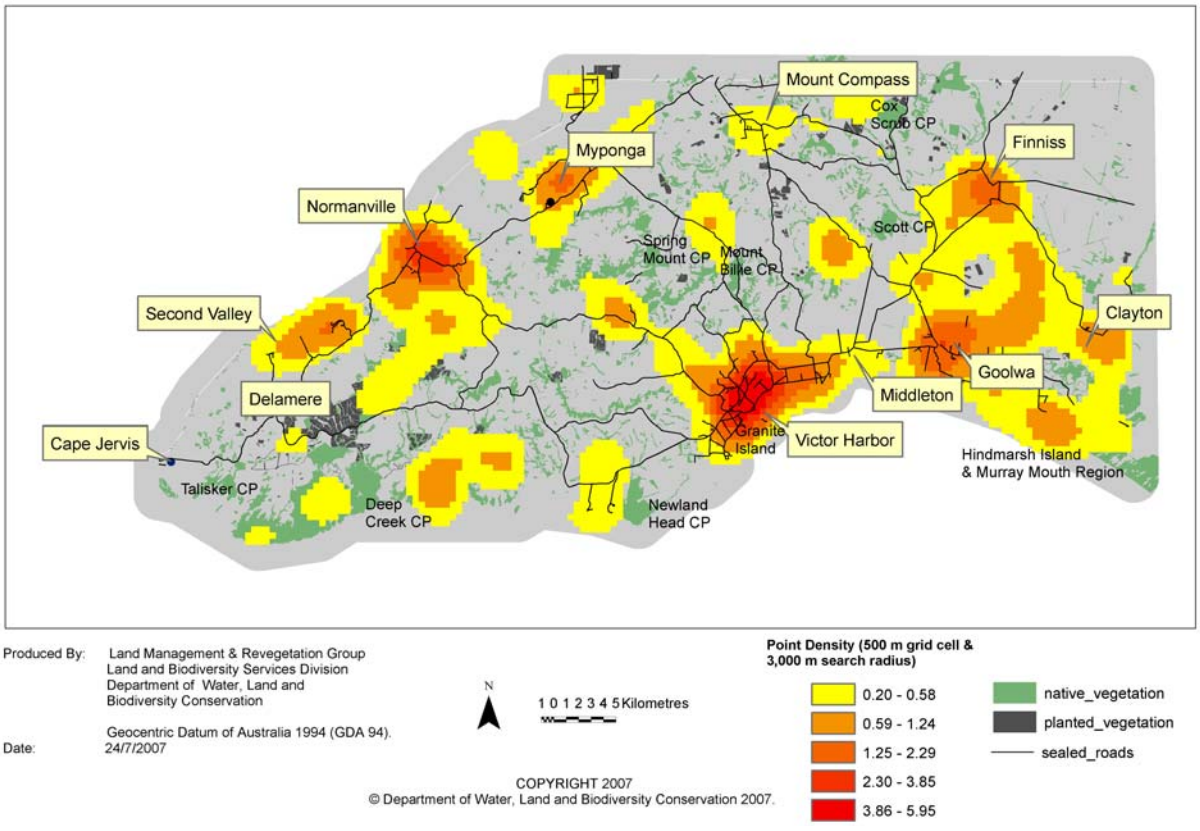


Figure 6. Density analysis riparian flooding places, as perceived by survey respondents

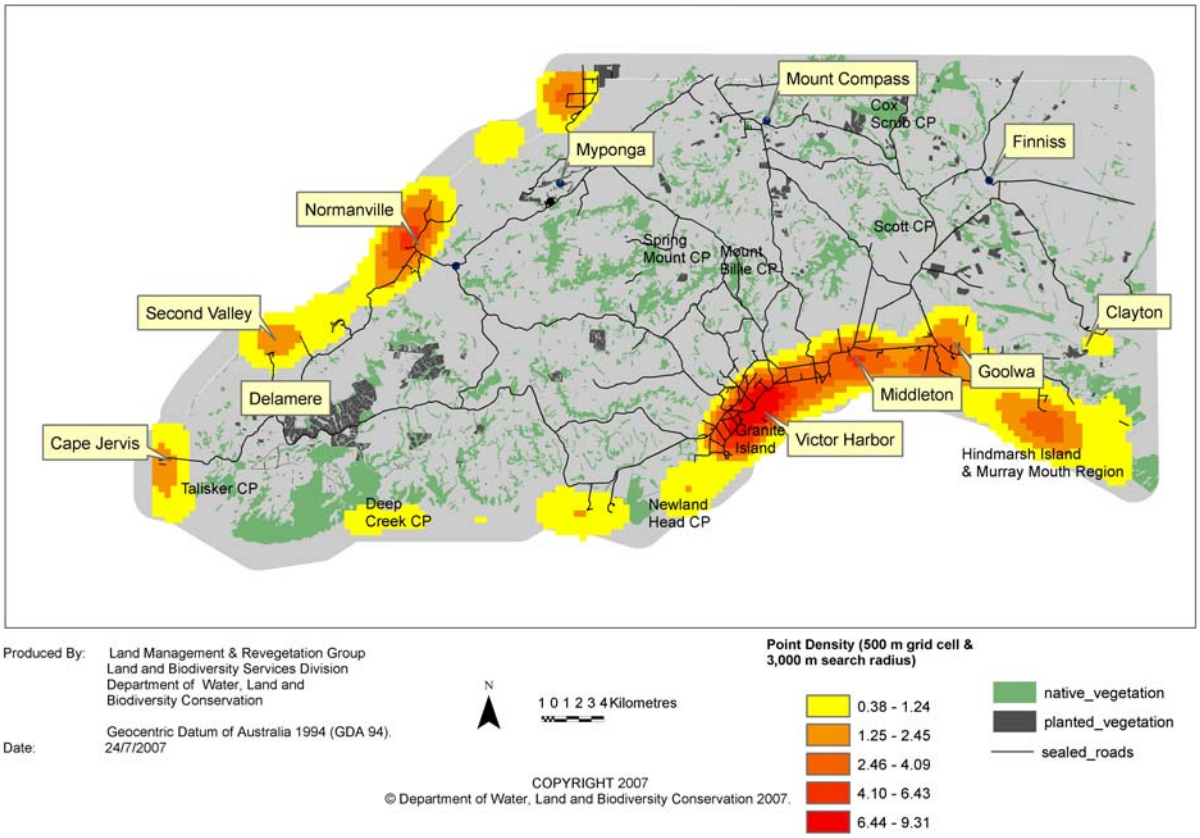


Figure 7. Density analysis of sea-level rise places, as perceived by survey respondents

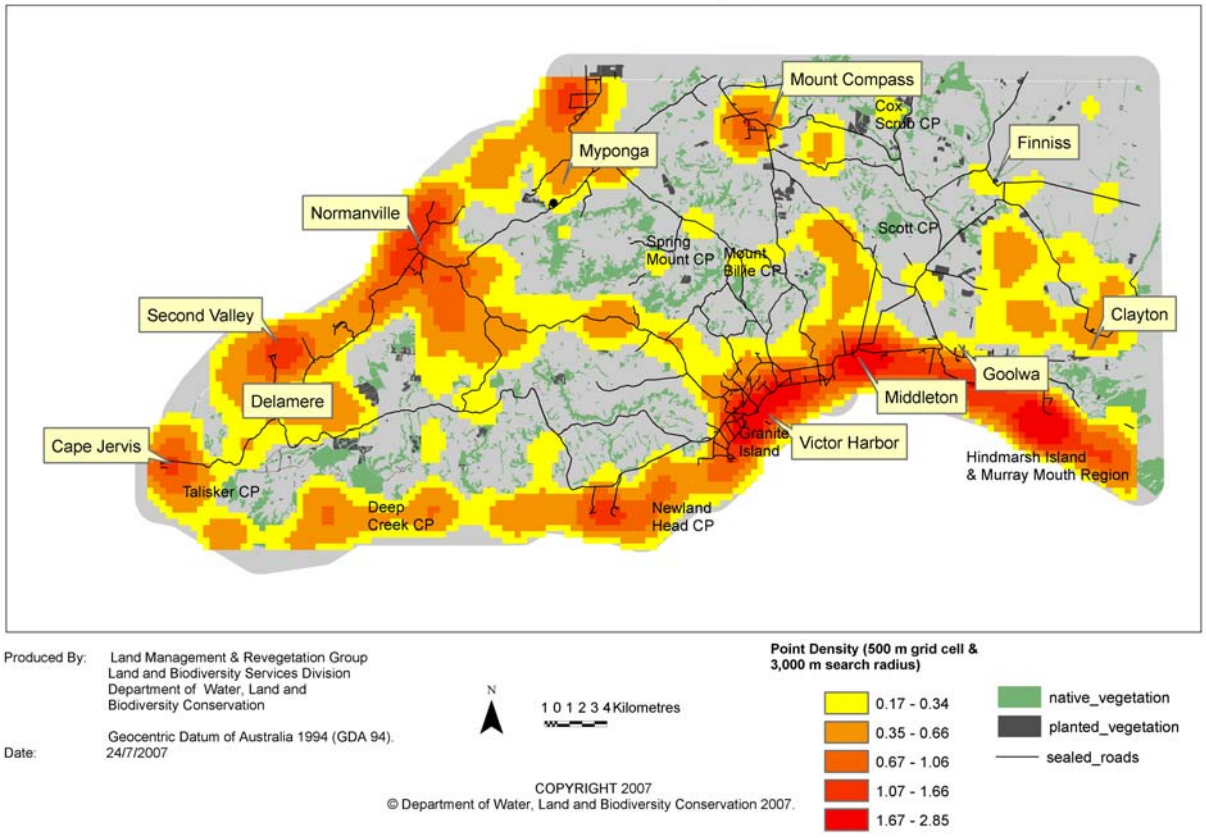


Figure 8. Density analysis of land erosion places, as perceived by survey respondents

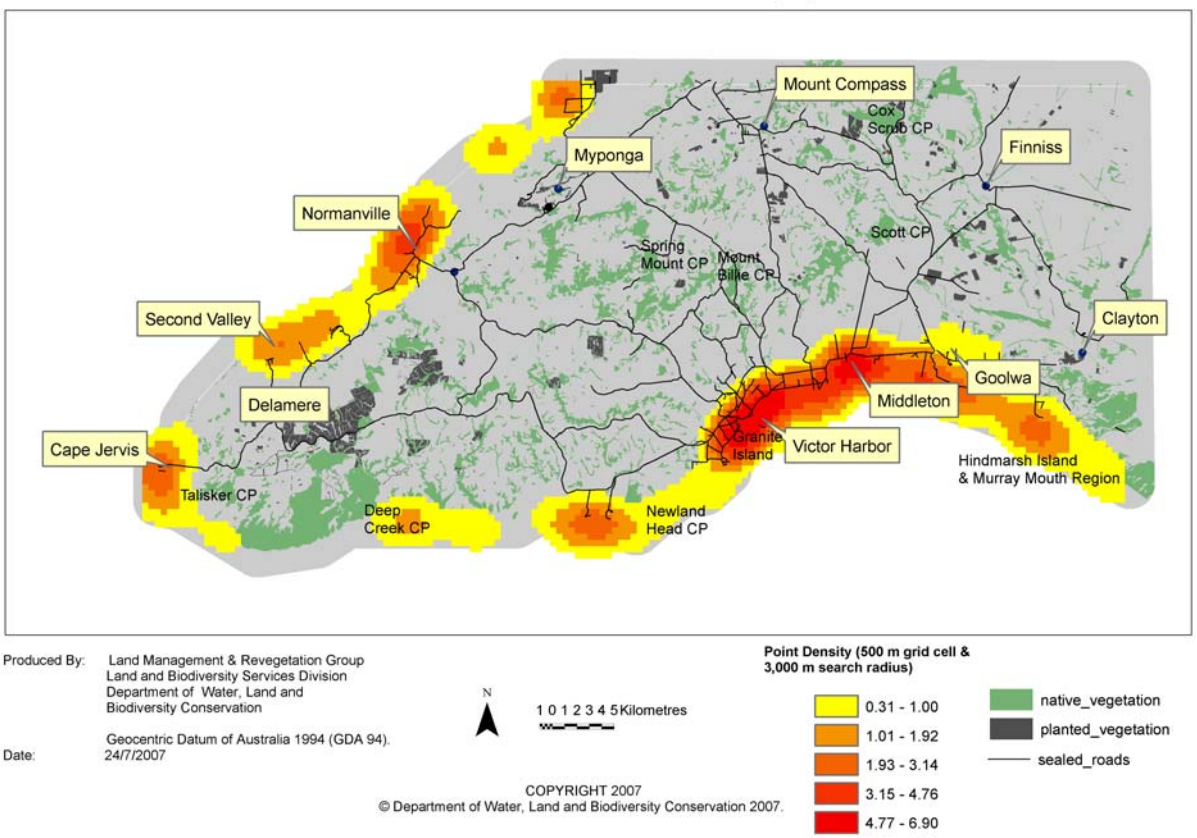


Figure 9. Density analysis of wave action places, as perceived by survey respondents

3.3.2 LANDSCAPE VALUES AND CLIMATE CHANGE RISKS IN SELECTED COMMUNITIES AND CONSERVATION PARKS

The previous section illustrated the spatial distribution and intensity of landscape values and perceived climate change risks on the landscape; however, it did not empirically show the differences within selected communities and conservation parks. This section uses descriptive statistics to determine the most frequently expressed values by community, and whether there are differences between student and adult values and risks. Explanations as to why the different places are important were compared and contrasted with a recent conservation priorities assessment (Caton et al. 2007) for improved understanding of 'expert' and 'public' views on place.

Six communities were included in the landscape value and climate change analysis. These were: Deep Creek Conservation Park, Victor Harbor, Goolwa, Lower Murray and Coorong, Normanville, and Mount Compass. Landscape value and climate change risk dots were selected within a 3 km radius of the identified township. In some instances the number of threat dots within the search radius was too small for statistical comparison. In this event, the search radius was increased until a minimum of 200 threat dots were selected.

3.3.2.1 Overall responses by community

Table 8 shows the proportional differences in survey respondent values and perceived climate change risks by community. The highest ranking values by community are as follows: biodiversity value for Deep Creek Conservation Park (23%) and Lower Murray and Coorong (18%); aesthetic value for Victor Harbor (19.8%) and Normanville and districts (21.4%); heritage value for Goolwa (24.5%); and economic value for Mount Compass and districts (19%).

Values appear to be assigned to communities based on direct and indirect use orientations. Deep Creek Conservation Park and the Lower Murray and Coorong region were frequently assigned indirect use values such as biodiversity value and learning value. Victor Harbor, Goolwa and Normanville were frequently assigned direct use values such as aesthetic, economic, or recreation value. Mount Compass and districts appears different to the other communities discussed in that respondents expressed a mix of direct and indirect use values. Economic values were ranked highest followed by learning and biodiversity value.

The distribution of perceived climate change risks follows a different pattern. The highest-ranking risks by community are as follows: bushfire for Deep Creek Conservation Park (54.8%) and Mount Compass and districts (60.5%); biodiversity loss for Lower Murray and Coorong (34.8%); and sea-level rise for Victor Harbor (31.4%), Goolwa (28%) and Normanville (26.6%).

3.3.2.2 Student and adult responses by community

This section examines the proportional differences in student and adult landscape values and perceived climate change risks by community, and the reasons why these places are important to them. It then compares the empirical results with a recent conservation assessment in the Southern Fleurieu (Caton et al. 2007). It is important to note that the conservation assessment only included areas within 500 m of the coast.

Deep Creek Conservation Park

Both students and adults assigned a high proportion of aesthetic (11.4% and 10.2%) and biodiversity values (15.6% and 16.9%) to Deep Creek Conservation Park (Table 9). When asked why Deep Creek was of most important aesthetic value, school students commented on the ‘awesome views’ of the peninsula from Deep Creek. Adults mentioned the wildlife-sea interface was aesthetically appealing, with one respondent noting: ‘the mixture of bush scrub, pines, blending into the sea, kangaroos and other wildlife is splendid’. Other aesthetically appealing features include the views of Backstairs Passage, the great walks, and the ‘unspoilt beauty’. From a biodiversity perspective, school students mentioned Deep Creek has a large variety of animal and plant life and it is ‘all natural’ and ‘peaceful’. Adults commented on the variety of plants and animals, the range of different geological environments, the free space, the coastal views, the inaccessibility and the unspoilt character.

Table 8. Relative proportion of landscape values and climate change risks assigned by survey respondents to particular communities or conservation parks in the Southern Fleurieu

Landscape values	Deep Creek Conservation Park		Lower Murray and Coorong		Victor Harbor		Goolwa		Normanville and districts		Mount Compass and districts	
	(%)		(%)		(%)		(%)		(%)		(%)	
Aesthetic	14.5		12.6		19.8	(1)	9.1		21.4	(1)	8.8	
Economic	5.2		6.7		18.1	(2)	19.3	(2)	14.6		19.0	(1)
Recreation	14.9	(3)	10.3		14.2	(3)	17.0	(3)	18.5	(2)	10.3	
Learning	16.2	(2)	14.4	(2)	9.4		11.0		9.8		17.5	(2)
Biodiversity	23.0	(1)	18.0	(1)	8.0		4.8		5.7		16.6	(3)
Intrinsic	9.6		14.4	(3)	7.8		6.2		6.3		9.4	
Heritage	2.0		9.8		12.1		24.5	(1)	14.4	(3)	7.6	
Future	14.5		13.7		10.6		7.9		9.3		10.9	
Total	**100.0**		**100.0**		**100.0**		**100.0**		**100.0**		**100.0**	
N	592		833		1058		481		583		331	
Climate change risks												
Biodiversity loss	33.9	(2)	34.8	(1)	12.7		9.8		9.2		16.5	(2)
Land erosion	4.8	(3)	17.5	(3)	11.1		12.4		20.5	(3)	11.0	(3)
Bushfire	54.8	(1)	3.5		1.0		3.6		3.5		60.5	(1)
Riparian flooding	3.5		13.4		18.3	(3)	19.2	(3)	19.1		8.0	
Sea-level rise	1.3		17.9	(2)	31.4	(1)	28.0	(1)	26.6	(1)	2.0	
Wave action	1.7		12.8		25.5	(2)	26.9	(2)	21.1	(2)	2.0	
Total	**100.0**		**100.0**		**100.0**		**100.0**		**100.0**		**100.0**	
N	230		514		487		200		346		200	

Number in parentheses indicates value or threat ranking

Table 9. Chi-square analysis of school student and adult values and perceived risks for Deep Creek Conservation Park

Deep Creek Conservation Park	**Value density** (%)	
	Students	*Adults*
	N = 292	*N = 825*
Higher values and risks for students		
Economic	6.3	2.8
Bushfire	18.6	14.1
Higher values and risks for adults		
Recreation	8.9	11.4
Learning	8.9	12.9
Intrinsic	4.6	7.9
Future	6.3	12.0
No significant differences between students and adults		
Aesthetic	11.4	10.2
Biodiversity	15.6	16.9
Heritage	2.1	1.2
Biodiversity loss	9.7	9.5
n/a		
Land erosion	3.4	0.5
Riparian flooding	3.0	0.2
Sea-level rise	0.4	0.3
Wave action	0.8	0.2

The high biodiversity value assigned to Deep Creek by students and adults is consistent with a recent conservation assessment (Caton et al. 2007). According to this assessment, Deep Creek has the second highest conservation rating in the region. It is based primarily on the status of the vegetation community, priority of sites with threatened flora, priority of vegetation assemblages containing a high proportion of endemic flora, the priority of habitat for reptiles and the Aboriginal sites of significance.

Both students and adults perceived biodiversity loss and bushfire to be the greatest risks to the area, whereas land erosion, riparian flooding, sea-level rise and wave actions were perceived as least threatening. When adults were asked why this park was at risk from biodiversity loss under climate change conditions, they noted: the potential for new diseases and weeds, each leading to the loss of vegetation and wildlife; the drying trend leading to more fire, loss of vegetation and native animals; and species loss related to changing ecological niches (including suitable foraging grounds) and the lack of area for species migration. In relation to bushfire, students commented on the ‘dry plant life and scrub’ and the large amount of undergrowth. Adults had similar concerns, in addition to the inaccessibility of the terrain, the heavy fire history (both natural and anthropogenic), and the high fuel loads attributed to the prohibition of controlled burns.

There are some noticeable differences in value assignment between students and adults. Adults assigned proportionately more recreation, learning and intrinsic values to the park, whereas students assigned more economic values. Recreational activities pursued in the

park include bushwalking, camping, surfing, fishing, bird-watching and swimming. Adults vividly described the recreational opportunities at Deep Creek. One respondent stated: it provides opportunities for 'rest, relaxation, bushwalking, socialising and keeping fit'.

Lower Murray and Coorong

In contrast to Deep Creek, there is a greater spread in the distribution of landscape values for the Lower Murray and Coorong (Table 10). Biodiversity, aesthetic, learning and future values all rank highly. Adults referred to the Coorong as a 'stunning place' and a 'classroom for ecology and learning about Indigenous people'. One respondent remarked: 'it is most at risk … urgent action is needed to ensure future generations can experience it'. From a biodiversity perspective, students remarked about the abundance of plants and animals and the perception that 'no one is living down there to destroy it'. Adults recognised the diverse ecosystems/habitats (marine, sand dune and tidal estuaries) which are critical for migratory birds, the salt and freshwater interface, the inaccessibility and habitat intactness; and the birdlife of international importance. It was also perceived as a 'finely balanced' ecosystem.

Table 10. Chi-square analysis of school student and adult values and perceived risks for the Lower Murray and Coorong

Lower Murray and Coorong	**Value density** (%)	
	Students	*Adults*
	N = 558	*N = 1262*
Higher values and risks for students		
Economic	6.3	3.1
Heritage	8.5	4.9
Bushfire	2.8	0.6
Riparian flooding	8.0	3.6
Higher values and risks for adults		
Recreation	4.6	7.3
Biodiversity	9.3	11.9
Intrinsic	7.6	9.6
Biodiversity loss	11.3	14.2
No significant differences between students and adults		
Aesthetic	7.2	8.2
Learning	8.0	9.4
Future	8.0	8.7
Land erosion	6.7	6.7
Sea-level rise	7.0	6.8
Wave action	4.6	5.1

While the conservation assessment did not include an analysis of the Coorong, there are some important similarities and differences between local and expert biodiversity values assigned to the Lower Murray. The assessment identified high scores for bird and butterfly habitat, remnant vegetation block size and connectivity, numbers of threatened species and species richness. While expressed differently, these views seem consistent with the student and adult value intensities and value explanations.

Both the conservation assessment and this study indicate the Lower Murray is perceived to be at moderate risk from biodiversity loss. The conservation assessment identified vegetation patch size, shape and isolation as major risks for the Murray Mouth and southern shore of Hindmarsh Island. In this study, adults commented on the salinity rise in the Coorong lagoons, the loss of bird and plant life, and lowering water levels connected to reduced runoff into the Murray-Darling system. They also mentioned the salinity and water level issues, with additional concerns being the lack of tidal flows, the regression of water from local wetlands and pollution from farming, and the 'already shocking signs of degradation'. Some feel the battle to save the Coorong from a biodiversity perspective has nearly been lost.

There are also differences between the conservation assessment and student and adults' perceptions of risk for this community. The conservation assessment suggests that sea-level will be an important issue for the area, however, students and adults only identified this as a moderate risk.

Victor Harbor

Both students and adults assigned a high proportion of aesthetic (14.8% and 12.6%) and economic values (14.2% and 10.7%) to Victor Harbor, but when examining variation within each group, students assigned proportionately more aesthetic and economic values than adults (Table 11). A number of students remarked that Victor Harbor is an enormous tourism asset, particularly Granite Island. They also recognised the hub of shops and the development boom occurring in the area. Adults commented on the sensational view of the township and foreshore when arriving into Victor Harbor by road, the economic return from tourism and the large shopping precinct, and the increasing employment opportunities in the area.

Students assigned almost twice the proportion of future values to Victor Harbor than adults (9.2% vs. 5.5%). For students, future value was considered from an economic viability perspective: they noted the township is still growing, the large schools and gyms, and the demand for new houses.

Both students and adults assigned a high proportion of sea-level rise dots to Victor Harbor (8.3% and 11.4%), but adults assigned almost three times the proportion of riparian flooding (8.1% vs. 3.1%) and two times the proportion of wave action risks to the community (10.6% vs. 5.2%) than students. Adults were concerned that Victor Harbor has two major riparian systems nearby, both of which are located on low-lying land perceived to be vulnerable to flooding. Respondents acknowledged that heavy summer downpours might cause flash flooding around the mouths of the Inmann and Hindmarsh Rivers, threatening existing infrastructure. While respondents were unsure about the specific effects of wave action changes, they again expressed concerns regarding the security of existing infrastructure and viability of new developments on low-lying land. These sentiments concur with the conservation assessment, with low parts of the coastal plain assessed to be subject to both flooding and erosion in the medium term. According to experts, rising sea levels will lead to increased foredune damage and recession. Changes in wave action will have an impact on the beaches and low dunes.

Table 11. Chi-square analysis of school student and adult values and perceived risks for Victor Harbor township

Victor Harbor	**Value density** (%)	
	Students	*Adults*
	N = 861	*N = 1125*
Higher values and risks for students		
Aesthetic	14.8	12.6
Economic	14.2	10.7
Learning	7.7	5.1
Future	9.2	5.5
Land erosion	4.1	2.9
Higher values and risks for adults		
Heritage	7.0	9.4
Riparian flooding	3.1	8.1
Sea-level rise	8.3	11.4
Wave action	5.2	10.6
No significant differences between students and adults		
Recreation	10.0	9.6
Biodiversity	5.6	5.2
Intrinsic	5.7	5.1
Biodiversity loss	4.5	3.6
n/a		
Bushfire	0.5	0.1

Goolwa

Both students and adults assigned a high proportion of economic, recreation and heritage values to Goolwa township (Table 12). In relation to recreation value, students remarked that Goolwa had great surfing beaches and sporting facilities. Adults believed that Goolwa was a great place for recreational flying, boating, bike riding, walking, fishing and bird watching. They assigned almost twice the proportion of heritage values to Goolwa than students (21.1% vs. 11.0%). Adults valued the wharves, steamers, railway museum and the Port Elliot rail corridor. Students valued the old buildings, paddle steamers and the old police station.

Riparian flooding and wave action were important risks to students (7.8% and 7.3%). Students assigned almost two times the amount of riparian flooding dots to this community than adults (7.8% vs. 4.2%). Students were concerned about the low elevation of the township and its close proximity to the sea. Some adults elaborated that it is a very exposed town and it would not take much to destroy the very thin dune system separating houses from the sea.

School student and adult comments concur with the conservation assessment. The assessment suggests that increasing aridity will slow natural recovery from damage to dune vegetation. Rising sea levels will see increased storm damage to foredunes.

Table 12. Chi-square analysis of school student and adult values and perceived risks for Goolwa township

Goolwa	**Value density** (%)	
	Students	*Adults*
	N = 295	*N = 598*
Higher values and risks for students		
Aesthetic	8.6	5.4
Biodiversity	4.5	2.8
Future	6.9	4.9
Riparian flooding	7.8	4.2
Higher values and risks for adults		
Heritage	11.0	21.1
Sea-level rise	6.5	8.9
No significant differences between students and adults		
Economic	14.3	13.6
Recreation	12.2	11.9
Learning	8.2	7.7
Intrinsic	4.1	4.7
Biodiversity loss	3.3	2.6
Land erosion	2.9	4.0
Wave action	7.3	8.0
n/a		
Bushfire	2.4	0.2

Normanville and districts

Both students and adults assigned a high proportion of aesthetic (14.1% and 12.8%) and recreation values (10.7% and 12.3%) to Normanville and Districts (Table 13). Students commented on the beautiful Normanville jetty and beach, the untouched coast and the sea breeze. Adults admired the village look, the sand dunes and the peaceful beach setting.

Students and adults perceived land erosion, sea level rise and riparian flooding to be the most important climate change risks for the community. Respondents remarked the farmland beside Yankalilla is vulnerable to slumping because it is steep and has little vegetation cover. Adults believed that Normanville Beach was vulnerable to sea-level rise and the low-lying land beside Bungala River to be vulnerable to riparian flooding. This view appears concordant with the conservation assessment which suggests rising sea levels will see increased storm damage to foredunes over the next 50 years (Caton et al. 2007).

Table 13. Chi-square analysis of school student and adult values and perceived risks for Normanville and districts

Normanville and districts	Value density (%)	
	Students	*Adults*
	N = 575	*N = 746*
Higher values and risks for students		
Aesthetic	14.1	12.8
Economic	10.9	7.4
Learning	7.7	4.5
Biodiversity	4.8	2.5
Future	7.1	4.7
Biodiversity loss	4.8	2.3
Higher values and risks for adults		
Recreation	10.7	12.3
Heritage	9.8	8.4
Riparian flooding	4.6	9.5
Sea-level rise	7.3	12.3
Wave action	5.2	10.3
No significant differences between students and adults		
Intrinsic	4.1	3.9
Land erosion	7.1	8.2
Bushfire	1.8	0.8

Mount Compass and Districts

Both students and adults assigned a high proportion of learning (12.1% and 9.3%) and biodiversity values (9.5% and 11.7%) to Mount Compass and districts (Table 14). Students believed Mount Compass is a great place to learn about the environment. One student remarked: 'it is home … it has a lot of farms, animals and wetlands'. The presence of Cox Scrub within this community is one reason for the high biodiversity value assignment. Both students and adults viewed Cox Scrub as a pristine area with high biodiversity. Additionally, students assigned over three times the proportion of aesthetic value dots to this community than adults and two times the proportion of intrinsic and recreation values.

Both students and adults assigned a very high proportion of bushfire risk dots to this area. Respondents believed Cox Scrub was highly vulnerable to bushfire because it experienced two recent fires. Adults noted that in the event of a large bushfire Cox Scrub's wildlife will be lost considering there are no corridors or escape passages.

Table 14. Chi-square analysis of school student and adult values and perceived risks **for Mount Compass and districts**

Mount Compass and districts	**Value density** (%)	
	Students	*Adults*
	N = 411	*N = 348*
Higher values and risks for students		
Aesthetic	7.3	2.8
Learning	12.1	9.3
Intrinsic	7.6	3.3
Future	6.0	7.9
Recreation	8.3	3.7
Higher values and risks for adults		
Economic	10.2	14.5
Biodiversity	9.5	11.7
Biodiversity loss	5.4	7.5
Bushfire	18.7	28.0
No significant differences between students and adults		
Heritage	4.8	4.7
Land erosion	4.1	4.2
Riparian flooding	3.5	2.3
n/a		
Sea-level rise	1.3	0.0
Wave action	1.3	0.0

3.3.3 MODELLING PUBLIC PERCEIVED AND EXPERT ASSESSED VALUES AND RISKS

This section compares and contrasts public perceived and expert assessed values and risks for the Southern Fleurieu region. The purpose is to show there are spatial similarities and differences between public perception and expert assessment of conservation value and threat. It is important to note that the conservation value and conservation threat summary maps generated by Caton et al. (2007) refer to the coastal strip or the area within 500 m of the shoreline. The layers representing expert assessment of conservation value and threat were generated using the total sum of means from a number of themes (see Caton et al. 2007 for detailed explanation). Conservation value themes included the condition of remnant vegetation communities (14 themes), significant or a diversity of flora and fauna (eight themes), sites of heritage significance (three themes), and sites of geological and geomorphic significance (three themes). Conservation threat themes included council provision for urban development, the level of visual amenity, the proximity of dump sites to sensitive areas, environmental weeds affecting the area, the stability of cliffs and dune areas, the presence of coastal acid sulfate soil, and projected climate change.

To assist comparison of expert assessed and layperson perception themes, it was assumed that the higher the density of perceived biodiversity value the higher the conservation priority,

the higher the density of perceived biodiversity loss the higher the conservation threat and the higher the density of perceived climate change risk the higher the climate change threat. It must be emphasised that the conservation assessment was restricted to the coastal zone, whereas survey participants in this study were allowed to assign values and risks to the entire Southern Fleurieu region.

The conservation values and risks of survey respondents and experts are overlaid in Figures 10–12. There is moderate alignment between locally perceived and expert derived conservation priorities for the Southern Fleurieu, with some important differences. Both survey participants and experts identified Deep Creek Conservation Park as a high priority for conservation (Fig. 10). Survey participants assigned higher conservation value to the coastal townships of Victor Harbor (high priority vs. medium priority) and Middleton (medium priority vs. low priority). The conservation assessment recommended the planting of corridors from Newland Head Conservation Park to Deep Creek Conservation Park and Morgan Beach to Newland Head; however, the public assigned low biodiversity value to these places.

There is also moderate alignment between public perceived biodiversity loss risk (conservation threat) and expert assessed conservation risks with some notable exceptions (Fig. 11). Survey respondents and experts identified the region between Victor Harbor and Goolwa to be medium or high conservation threat. Survey participants assigned higher conservation threat to Deep Creek (medium conservation threat vs. low conservation threat) and Newland Head Conservation Parks (medium conservation threat vs. low conservation threat). Conversely, experts assigned highest conservation threat to the area from Cape Jervis to Second Valley (high conservation threat vs. low conservation threat). Survey participants did not assign high conservation threat to two areas proposed by experts for protective buffering by zoning: the area from Deep Creek Conservation Park to Morgan Beach, and the area including King Head to Newland Head Conservation Park.

In addition to the conservation risks, a perceived climate change risk layer was generated to reflect the distribution and intensity of all six climate change risks (Fig. 12), as operationalised on the map legend. Areas that are priority for conservation are not always a priority for climate change adaptation. For example, survey participants assigned Deep Creek Conservation Park medium conservation threat but only low climate change threat. Conversely, survey participants perceived Middleton and districts to be medium conservation threat, but high climate change threat.

Figures 10–12 can inform climate change adaptation strategies. Those areas of high value and/or high threat are priorities for climate change adaptation. They include Deep Creek Conservation Park and the coastal strip between Victor Harbor and Goolwa. Awareness raising activities need to be targeted to the areas proposed for protective buffering by zoning and the area from Second Valley to Normanville where large gaps exist between expert assessment and public perceptions.

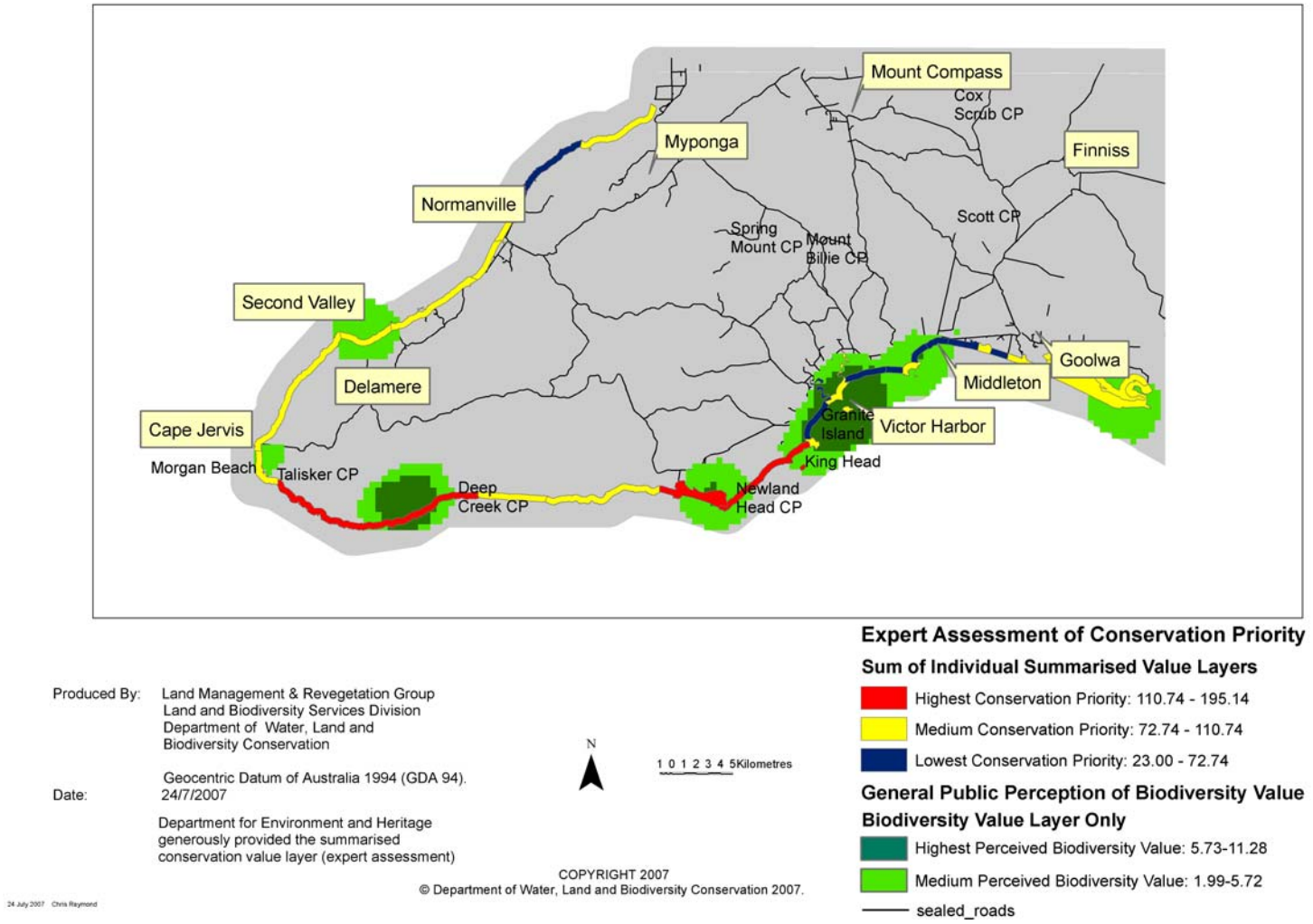


Figure 10. Comparison of expert assessment of conservation priority (Caton et al. 2007) and public perception of biodiversity value within 3 km of the coastline

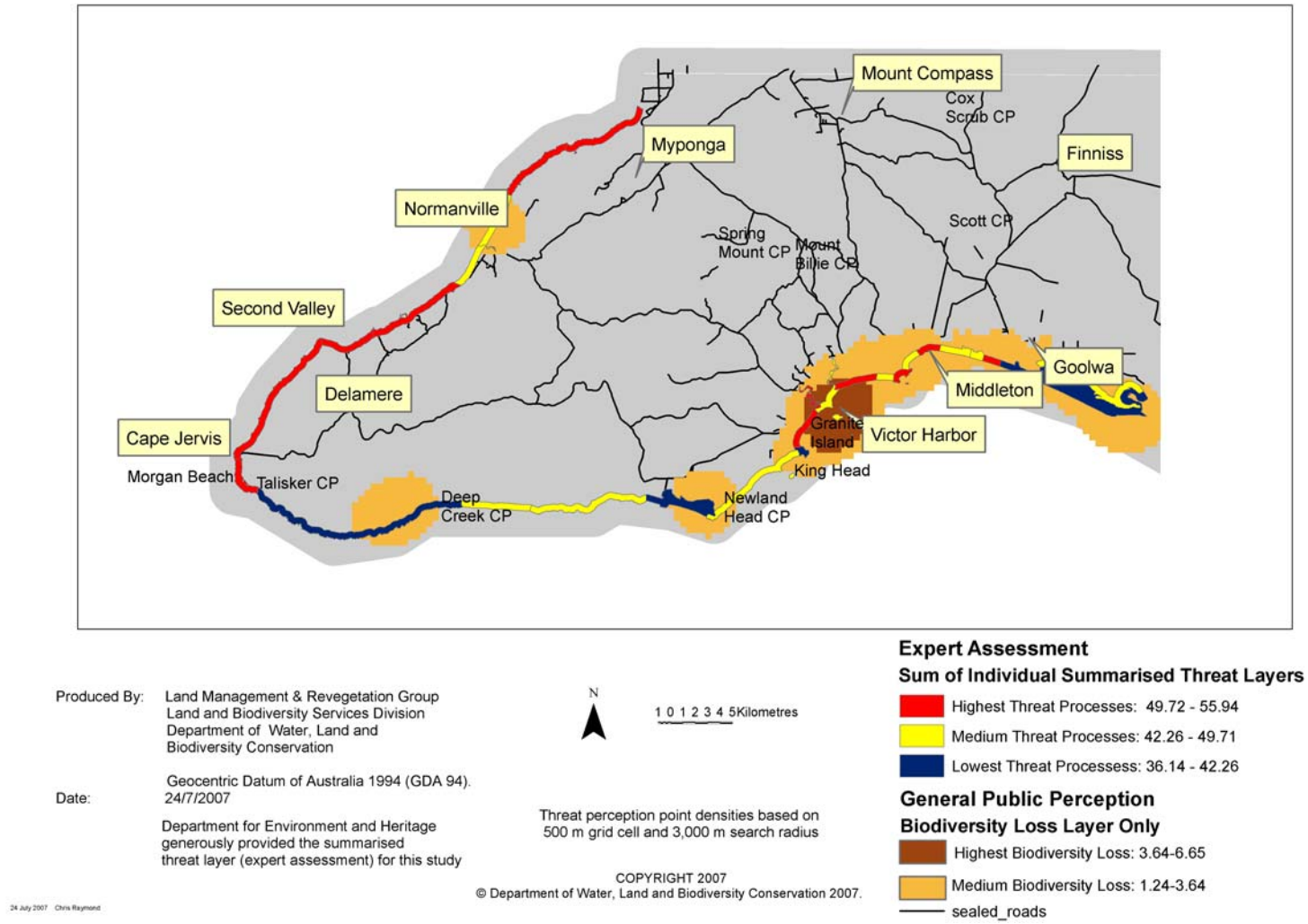


Figure 11. Comparison of expert assessment of conservation threat (Caton et al. 2007) and public perception of biodiversity loss within 3 km of the coastline

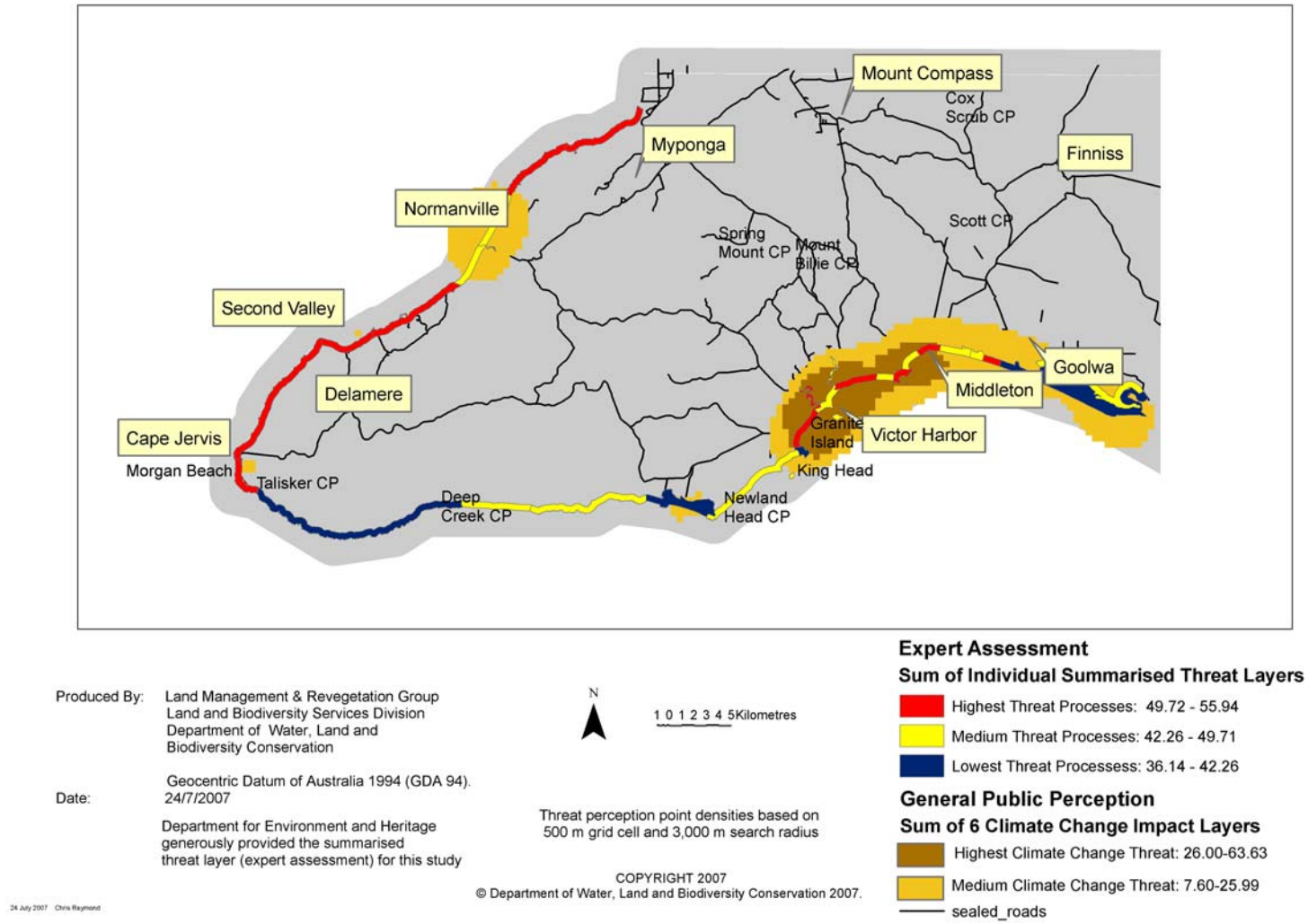


Figure 12. Comparison of expert assessment of conservation threat (Caton et al. 2007) and public perception of climate change threat within 3 km of the coastline

4. DISCUSSION

The main aim of the study was to provide information on community attitudes and values to inform NRM program development and implementation, with a focus on climate change adaptation responses. Responses were divided into school student and adult sub-groups considering the paucity of data on young people's attitudes toward climate change. Overall, both adults and students were concerned about climate change. They considered it to be a threat to their Southern Fleurieu quality of life and believed the changes would have significant impacts on the Southern Fleurieu and South Australian communities. These results support the 2003 Australian study showing general agreement that the world's climate is changing, and while not top-of-mind, climate change is an important issue facing Australians (AGO 2003).

If both school students and adults are concerned about climate change, what are their preferred adaptation responses and how can they be implemented? At the individual tier, respondents acknowledged the need for personal behaviour change that may include increased water efficiency around the home, such as taking shorter showers, planting drought tolerant trees and installing rainwater tanks, in addition to switching to green energy sources and adjusting farming practices to cope with climate variability and change. Respondents acknowledged incentives and enforcement initiatives are essential to promoting such behaviour change.

Those mentioned include:

- Imposing tighter restrictions on water allocation and use.
- Purchasing water licences.
- Enforcing a green purchasing policy.
- Developing an emissions trading scheme.
- Increasing incentives for the installation of rainwater tanks.
- Legislating for more energy efficient design of residential buildings.
- Providing new incentives for switching to green energy sources.

Adult respondents provided a number of other suggestions on how to respond to climate change, many of which displayed a sound understanding of the interactions between human and biophysical systems. The detailed responses may be a reflection of the socio-demographic of adult respondents. Adult respondents were more formally qualified than the regional population average and many were involved in agriculture or conservation industries.

Results suggest that any incentive or compliance measure needs to be supported by a strong education and awareness program. Like the Australia-wide study (AGO 2003), both school students and adults emphasised the need for improved climate change education programs within schools and across the broader community. The lack of knowledge about climate change issues was evident during the student workshops. Although school students described a warming, drying trend, the majority of youth participants had difficulty explaining fundamental concepts and terms such as the greenhouse effect, climate, weather and global warming. They also had difficulty recognising the interdependencies between atmospheric, water, land and biodiversity systems and human impact upon them. This is concerning given

most students were studying Geography or Environmental Studies and are potential advocates for climate change adaptation in the wider community. Clearly, an outreach/extension capacity is needed parallel to the science so that students and adults are not only aware of projected changes, but also the implications of this change on themselves, their families and the wider community. Interviews with key stakeholders during the conservation assessment revealed a similar response: the need to raise community awareness about natural systems (Caton et al. 2007). Stephen Schneider, 2006 South Australian Thinker in Residence and world leading expert in climate change, also suggests that sustainability must be incorporated into the curriculum at all levels, principally through a 'learning by doing approach' (Schneider 2006).

Identifying public perceived and expert assessed values and risks is an important precursor to the development of a climate change education and awareness program. Perceived landscape values aligned with expert assessment of conservation significance, with some obvious differences. Survey participants and experts assigned high biodiversity value to Deep Creek Conservation Park. Experts assigned lower conservation threat to Deep Creek Conservation Park than survey participants, but higher conservation threat to the area from Cape Jervis to Normanville. Survey participants did not assign high biodiversity value to two areas proposed by experts for corridor establishment: the area from Deep Creek Conservation Park to Morgan Beach and the area including King Head to Newland Head Conservation Park. What do these value gaps mean for conservation in general and climate change adaptation? Firstly, to engage the public in adaptation planning, the nature of the work must be locally relevant. For example, proposing revegetation programs between King Head and Newland Head without further community engagement may be unwise considering the public's biodiversity values for these places. Such a value gap provides grounds for discussion between technical staff and public about suitable adaptation responses. It may be that a local conservation group will agree to regional investment being targeted to this area, but the group may also require small, short term investment to achieve their own climate change adaptation aspirations in their place of interest. Only by mapping these values can land managers anticipate likely community responses, address points of difference and where appropriate target investment of resources to local values and concerns.

It is acknowledged that the LVM does not identify all priority assets for conservation. The conservation assessment identified additional areas of conservation significance which were assigned low biodiversity value by respondents in this study including the area from Deep Creek Conservation Park to Morgan Beach. The location of biophysical features and their poor accessibility are possible explanations for this difference. Some researchers assert that places become attractors for values as a result of direct experience with the setting. Respondents may have assigned fewer value dots to the Morgan Beach and King Head corridors because of their remoteness.

Assessment of climate change risks is a new dimension of the LVM. Climate change risks clustered close to coastal townships and/or conservation parks, and in many cases aligned with public perceived landscape values. According to the descriptive maps presented in this report, Deep Creek Conservation Park, Lower Murray and Coorong, Newland Head Conservation Park, Cox Scrub Conservation Park and Victor Harbor are priority areas for improving ecosystem resilience whereas the sub-region between Victor Harbor and the Coorong is a priority for managing sea-level rise, wave action and riparian flooding. The sea-level rise, wave action and riparian flooding findings is consistent with a recent DEH study which flags a number of sea-level rise implications for the Coorong, including the horizontal erosion of the sandy coastline and the salt water incursion into freshwater soaks around

Younghusband and Sir Richard Peninsulas (Matthews 2005). However, a more recent conservation assessment found threatening processes between Cape Jervis and Normanville which were not identified by survey respondents, highlighting the need for both expert assessment and public perception studies.

4.1 IMPLICATIONS FOR CLIMATE CHANGE ADAPTATION AND NRM PLANNING

This study has presented a new approach to linking human perception of place with expert measurement of biophysical condition. Local people, including rural landholders, secondary school students and Adelaide residents can identify place-specific areas of high and low conservation value on the landscape which can augment scientific or expert-driven knowledge systems. List and Brown (1999) refer to this broader picture of NRM systems as an 'expanded land management ethic'. It is a philosophical shift which emphasises multiple values on the landscape: the deeper spiritual and psychological meanings of the land in addition to its economic or biophysical meanings. It also acknowledges the values of multiple constituents, not just those of planning authorities or scientists.

It is recognised that engagement techniques that support this expanded land management ethic are relatively new in South Australia, as reflected in recent capacity assessments. In a national baseline of the social and institutional foundations of NRM programs (Fenton and Rickert 2008), SA was consistently lower than other states on matters of community engagement, including having an adequate community engagement strategy, the effectiveness of the engagement processes in contributing to regional decision making, the support of activities for community engagement, the level of participation in NRM activities by stakeholders, landholders and the community and the level of trust and transparency between the regional body and stakeholder groups in the engagement process. Further, community engagement was consistently addressed as a gap in the NRM planning cycle during a community capacity assessment pilot in the SA Arid Lands (Raymond, Cleary & Cosgrove 2006).

The LVM presented in this report is one of a number of sociological tools which support a systematic understanding of community attitudes and values, and improved representation of NRM stakeholders in decision-making. This report has shown that program managers can do much more than just consult with community groups, they can determine their values and use innovative tools such as the LVM to collaborate or empower. This means moving from 'listening and providing feedback' to looking for direct advice and innovation in formulating solutions to NRM problems. From a climate change perspective, empowerment may include taking note of the climate change projections and possible local impacts from expert advisers, comparing and contrasting them to public risk perspectives and using both knowledge systems to generate innovative solutions. Where there is value conflict, workshops may be required to 1) educate and raise awareness, or 2) learn from the collective wisdom in the local community and reframe adaptation strategies. However, it must be emphasised that public perceived values is only layer in assessment of climate change adaptation and NRM programs. SA has a strong history in biophysical investigation, which should not be lost, but rather augmented with other systems of knowledge for more integrated assessment of NRM priorities. In summary, NRM planning and program delivery should be seen as a co-ordinated process of measurement, social learning, and shared understanding across government, scientific and local community groups. A number of specific recommendations are made in section 5.

4.2 LIMITATIONS AND FUTURE DIRECTIONS

This study is not without its limitations, some of which are explored in this section. Firstly, there are scale issues when mapping perceived landscape values and risks in terms of both resolution and dot (grain) size. Survey participants were provided a large-scale map (around 1:125 000) limiting the ability to assign value to small-scale features on the landscape. Secondly, the sticker dots are uniform size. It is unclear whether survey participants assigned values to fine grained features such as buildings or larger grained objects such as townships. Important questions still need answering about how people assign value to small-scale features like scattered trees on their property compared to large-scale features such as national parks or habitat corridors which span multiple properties or bioregions. Similarly, there are questions surrounding the different scale of assessment and valuation – ecologists assigned values to the coastal strip only whereas survey participants could assign value to the entire Southern Fleurieu region.

The LVM does not systematically articulate the place meanings (e.g. activities, social interactions and biophysical features) which in this report are closely linked to values assigned by school students and adults. The next logical step is to enhance the spatial tool enabling it to link value intensities with place meanings for an improved understanding of the nature of value and agreement/conflict between public and NRM agencies.

The relationships between the non-assignment of place values and strategy approval ratings require further consideration. It was assumed in this report that public did not approve of conservation activities in areas they didn't value for biodiversity reasons; however, other factors may lead to approval or disapproval of conservation strategies. To address this gap, the relationships between policy preferences and landscape values could be examined across multiple settings. In the interim, the limitation can be addressed during follow up workshops with NRM stakeholders to determine the actual level of strategy approval.

When using the LVM, there is some bias towards those who are more knowledgeable of an area and have visited more places. Those people who can read maps and have frequented a greater diversity of places may assign more value dots to a landscape. But even then, remote areas that cannot be accessed by road may be less valued than those areas with open access. Future research could further investigate the role of place knowledge and access on sense of place and how these differences influence NRM behaviours.

Finally, collection of attitudinal and landscape value data is time and resource intensive. Each postal survey costs about $5.00 to produce and mail out, taking into consideration printing, postage and project officer time for packaging; and each completed survey costs at least $10.00 to digitise depending upon the approach used. The web-based LVM developed by the Canadian Government may be an efficient and effective alternative or supplement to the postal survey (Beverly et al. 2008). Access to fast internet speeds, level of computer knowledge and participant willingness to complete web-based surveys needs to be thoroughly considered if employing this technique. A combined workshop and postal/web-based approach could be applied in future LVM studies, particularly if the goal is to engage quiet voices in society, such as school students. In any process the 'personal touch counts'. For example, while not systematically investigated, the handwritten postcards appeared to substantially increase survey response, with over 60 survey returns within three days of mailing the postcard.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

This study has shown that authorities responsible for NRM and climate change planning should consider and act upon public perceptions of landscape value and climate change risk. Public perceived values and risks, as presented in this report, provide an important additional layer in climate change adaptation assessments. Soliciting these values early in the planning process may increase trust in decision-making and increase community support for and involvement in climate change adaptation responses. The values of quiet voices in society can also be recognised as part of this engagement process.

Both school students and adults were concerned about the projected impacts of climate change and acknowledged that tighter enforcement and incentive methods were needed to respond to climate change. Most of the participant concerns related to water use, water quality and water security in the Southern Fleurieu region, in recognition that a warming climate leads to reduced water availability. It is concluded that any enforcement or incentive method needs to be coupled with a strong education and awareness campaign at secondary and vocational levels. A number of school students, for example, had difficulties recognising the interdependencies between water, land and biodiversity systems and human impact upon them.

Public perceived values and climate change risks can also be overlaid with expert biophysical inventories for more integrated assessment of climate change adaptation priorities. Both survey participants and experts highly valued the conservation reserve systems in the Southern Fleurieu. This reflects positively on the efforts of authorities who manage reserve systems in the region. Some other areas, including the area between King Head and Newland Head Conservation Parks gave rise to differences between public and expert values and identified risks. The reasons for such value gaps should be discussed at follow up workshops, for example, whether access to proposed corridors influenced the intensity of valuation. Nonetheless, the value similarities and differences provide opportunities for improved understanding of public concerns and allow the appropriate targeting of adaptation responses.

This study used a consistent procedure for identifying value convergence or conflict, which could be replicated in other parts of the AMLR NRM region, SA or Australia:

- Identify the intensity of local and expert values or risks
- Identify the location of these values or risks on the landscape
- Determine the extent of spatial overlap with expert knowledge
- Relate the areas of value gap or coincidence to existing or proposed NRM strategies
- Use the resulting value and threat layers to facilitate workshops with NRM stakeholders, with the goal of obtaining further information about why those values and risks were important to survey participants.

The methods and results presented in this report have a number of implications for NRM planning across SA when considered in connection to a recent national NRM community capacity assessment (Fenton and Rickert 2008). The capacity assessment revealed that community engagement in NRM was consistently lower in SA than other states. One possible reason is that South Australian planning authorities continue to give preference to systematic collection of expert biophysical knowledge over public perceived knowledge in decision-making. This study has shown that, when collected using systematic sampling and survey techniques, both local and expert knowledge systems can have an important role in NRM planning. This recognition requires a commitment to designing and implementing suite of tools for systematically integrating the values and aspirations of local people (NRM volunteers, rural landholders, industry groups, school students, urban residents) into the planning cycle and support for reporting processes that promote two-way knowledge and information exchange between local landholders and regional, state and federal agencies. It also provides a means for agencies to move from just 'listening and providing feedback' to looking for direct input and innovation from local groups in formulating solutions to NRM problems.

5.2 RECOMMENDATIONS

The study recommendations are as follows:

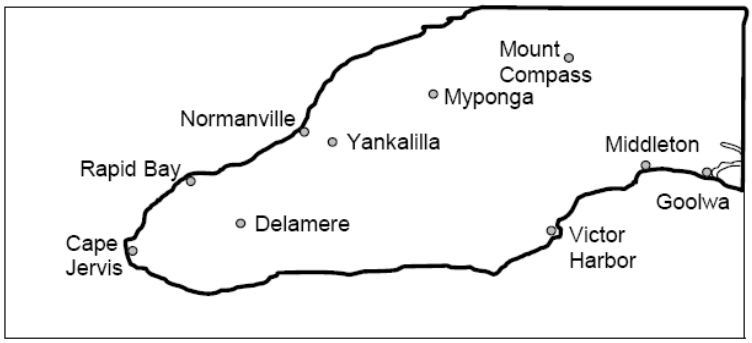
- DWLBC forward the report to NRM Council enabling it to consider the conclusions as part of a wider strategy to improve community engagement in NRM.
- NRM planning authorities responsible for climate change adaptation strategies use systematic social survey techniques, such as the LVM, to take into account public perceptions of climate change when designing NRM programs.
- Authorities engaged in establishing protective buffering by zoning (as recommended by Caton et al (2007) of the area including King Head to Newland Head Conservation Park note the need to promote the biodiversity value of the area in order to gain public support.
- Coastal planning authorities develop strategies to better understand why survey participants did not assign high conservation threat to the area between Cape Jervis and Normanville.
- Policy makers recognise public concern about freshwater security in the Southern Fleurieu and support the development of local adaptation strategies.
- Authorities responsible for communicating climate change issues continue to develop education and awareness-raising programs to increase public knowledge of the projected impacts of climate change across SA.
- NRM policy makers note the high conservation and climate change threat assigned by ecologists and survey respondents to the area between Victor Harbor and the Coorong.
- State NRM agencies consider the application of the LVM presented in this report to different land-use contexts and across different NRM issues, including the possibility of using a web-based approach to increase cost effectiveness.
- Local Government consider applying the LVM as part of their development planning and assessment processes.
- Researchers to develop new tools for understanding the connections between people and place at different geographic scales, and the relationships between place values and place meanings.

APPENDICES

1. WORKSHOP FLYER

Public Workshop

Mapping the Future of the Southern Fleurieu in Light of Climate Change



The (Group Name) presents
Mr Chris Raymond (SA Dept. of Water, Land & Biodiversity Conservation)

Mr Raymond will present a summary of global, national and state perspectives on climate change.

He will then ask:

- *What you value about the Southern Fleurieu region*
- *Your attitudes toward possible climate change impacts, and*
- *Your preferred strategies for responding to climate change*

Come along to gain insights and share your values on this important topic.

(Time & Venue)

RSVP: Chris Raymond by (Date)
Ph: 8303 9700
raymond.chris@saugov.sa.gov.au

Light refreshments will be available following the workshop

2. ORGANISATIONS AND GROUPS WHO PARTICIPATED IN THE STUDY

Alexandrina Council

Bashams Beach/Horseshoe Bay Advisory Committee

Carrickalinga Dunecare Group

City of Victor Harbor

Coastal Protection Board

Compass Creek Care

Coorong and Lakes District Consultative Committee

DEH Regional Staff

Finniss River Landcare Group

Fleurieu Beef Group

Fleurieu Birdwatchers

Fleurieu Horse and Pony Club

Fleurieu NRM Group

Friends of Bashams Park

Friends of Central Fleurieu Parks

Friends of Granite Island Recreation Park

Friends of Newland Head Conservation Park

Friends of the Hindmarsh River Inc

Goolwa Coastcare

Horse SA

Hindmarsh Island Landcare Group

Hindmarsh Residents Association

Inman River Catchment Group

Inman Valley/Torrensvale Landcare Group

Investigator College, Goolwa

Mount Compass Area School

Newland Head Conservation Group

Normanville Catchment Resource Centre

Parawa Agriculture Bureau

Port Elliot Town and Foreshore Improvement Association

Second Valley Progress Association

Victor Harbor High School

Victor Harbor Horse Riding Club

Yankalilla & District Dunes Advisory Group

Yankalilla Area School

Yankalilla Bay Catchment Action Group

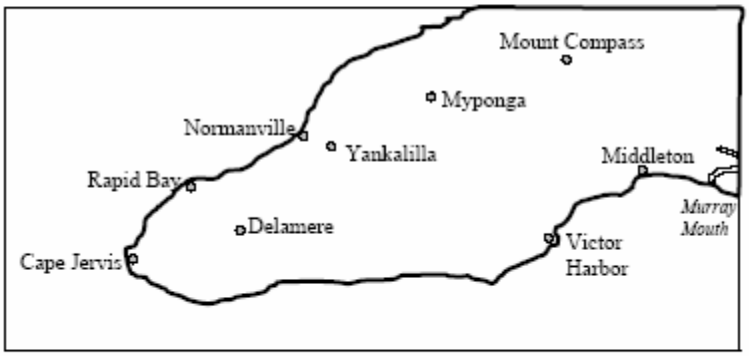
Yankalilla Council

3. WORKSHOP SURVEY

SURVEY ID .....

WORKSHOP DATE .....

Mapping the Future of the Southern Fleurieu in the Light of Climate Change



A Survey of Southern Fleurieu Residents:

Your views are important!

Australian Government

Department of the Environment and Water Resources

Australian Greenhouse Office

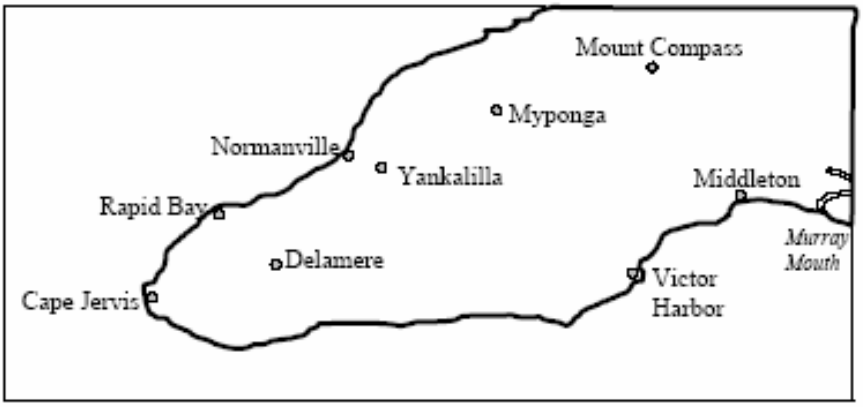
Government of South Australia

Please return your completed survey to the workshop facilitator prior to leaving

1

As a Southern Fleurieu resident, you may well have a personal interest in its future. This survey asks what you value about the Southern Fleurieu and your perception of climate change in the region. The primary focus of the study is the coastal strip or the area within 10 km of the beach.

During the workshop, the facilitator will be referring to the Southern Fleurieu region. See map below. It is recognised that this map includes areas outside of what is strictly known as the Southern Fleurieu, such as the Lower Murray and Murray Mouth; however, these areas have been included considering their critical importance to NRM.



Information collected from this survey will be made available to planning organisations such as the Adelaide and Mount Lofty Ranges NRM Board, Fleurieu NRM Group, Department of Water, Land and Biodiversity Conservation, Department of Environment and Heritage (SA) and the Australian Greenhouse Office, part of the Commonwealth Department of the Environment and Heritage. This survey is an important opportunity for you to express your vision for the Southern Fleurieu in light of projected climate change.

Please complete as much of the survey as possible. If a question is not clear, simply go to the next question. Please return the completed survey to the workshop facilitator at the end of the workshop.

We promise to keep unit record data confidential. All survey results will be presented in aggregated form. **Because we value your responses, we will send you an electronic copy of the survey results if you tick the box on page 10.**

We appreciate your participation in this survey.

Mr Chris Raymond Dr. Douglas Bardsley
Land and Biodiversity Services Division
Department of Water, Land and Biodiversity Conservation
raymond.chris@saugov.sa.gov.au
GPO Box 2834 Adelaide SA 5001
Ph. 8303 9700

Please note: While your opinions expressed in this survey will be presented to government agencies, the results may not change any previous government decision or influence future agency direction for the Southern Fleurieu region.

2

Part 1. Your familiarity with the Southern Fleurieu and threats to your quality of life

Q-1. About how long have you lived continuously in the Southern Fleurieu region? _____ **YEARS**

Q-2. How would you rate your knowledge of places in the Southern Fleurieu region? (Please circle one response).

1 Excellent
2 Good
3 Fair
4 Poor

Q-3. How would you rate your knowledge of places in the Southern Fleurieu region *compared to other* Southern Fleurieu residents? (Please circle one response).

1 More knowledgeable
2 About the same knowledge
3 Less knowledgeable
4 No opinion

Q-4 The following items may or may not be a threat to your quality of life as a resident of the Southern Fleurieu region. For each item, please indicate your level of *agreement* or *disagreement* about whether the item is a threat to your quality of life (please circle one response for each item).

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
a) More frequent, intense and widespread bushfires	1	2	3	4	5
b) Climate change	1	2	3	4	5
c) Reduced number of native animal and plant species (biodiversity loss)	1	2	3	4	5
d) Increased land erosion	1	2	3	4	5
e) More frequent river/creek flooding	1	2	3	4	5
f) Sea-level rise	1	2	3	4	5
g) New housing subdivisions	1	2	3	4	5
h) More frequent coastal storm surges	1	2	3	4	5
i) Other _____	1	2	3	4	5

Q-5 Prior to this workshop, how much attention have you paid to climate change issues facing SA? (Please circle one response).

1 No Attention
2 Little Attention – I have heard about climate change in the media but have not explored it further
3 Moderate Attention – I have heard about climate change in the media and regularly discuss the issue with friends and family, including how it may affect the Southern Fleurieu Region
4 Close and Constant Attention– I undertake my own research on climate change, and frequently read books, attend seminars and watch documentaries on the issue.

3

Part 2. Your climate change knowledge and level of concern

Q-6a Do you think the climate of the Southern Fleurieu Region has changed in the last 25 years? (Please circle one response for each item).

1 Major change
2 Little change
3 No change
4 Don't know

	Much Warmer	Warmer	No Change	Cooler	Much Cooler
b) In the last 25 years, are day temperatures:	1	2	3	4	5
c) In the last 25 years, are night temperatures:	1	2	3	4	5

	Much Greater	Greater	No Change	Less	Much Less
d) In the last 25 years, are rainfall totals throughout the year:	1	2	3	4	5
e) In the last 25 years, is rainfall variability:	1	2	3	4	5

f) Are there any other changes to climate that you have noticed in your region in the last 25 years? .....
.....
.....

Q-7a Do you think the climate of the Southern Fleurieu Region will change by 2030?

1 Major change
2 Little change
3 No change
4 Don't know

b) If so, how will it change? .....
.....
.....
.....

Q-8 Overall, how do you think climate change in the Southern Fleurieu region by 2030 will affect the ***quality of life*** of the following groups (please circle one response for each group).

	No Impact	Low Impact	Moderate Impact	High Impact
a) Yourself	1	2	3	4
b) Your Family	1	2	3	4
c) The Southern Fleurieu Community	1	2	3	4
d) The South Australian Community	1	2	3	4

4

Part 3 Preferred adaptation responses

Q-9 Can you suggest changes that could be implemented by yourself and natural resource management groups and agencies to reduce the impacts of climate change on the Southern Fleurieu region?

a) Yourself.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

b) Natural Resource Management Groups and Agencies .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

5

Part 4. Information About Yourself

Q-10. Which interest group best describes you? (Please circle one response).

1 Coastal Development
2 Conservation
3 Primary Production
4 Recreation and Tourism
5 Education

Q-11. What place or community do you live in the Southern Fleurieu region? _____

Q-12. Is this your permanent residence? **YES** **NO**

Q-13. Please circle your age group:

10-20 years	**40-50 years**
20-30 years	**50-60 years**
30-40 years	**60 years +**

Q-14. What is your gender? (Please circle one response).

1 Male
2 Female

Q-15. What is the highest level of formal education you have completed? (Please circle one response).

1 None
2 Primary/Some Secondary School
3 Secondary School
4 Vocational/Technical training
5 Tertiary
6 Postgraduate
7 Prefer not to answer

Q-16. What is your occupation? **OCCUPATION** _____

Q-17. Which employment category best describes you? (Please circle one response).

1 Agriculture
2 Tourism
3 Government
4 Education
5 Professional services
6 Commercial/retail
7 Tradesperson
8 Homemaker
9 Retired
10 Other (please specify)_____

Q-18. Which category best describes your home life? (Please circle one response).

1 Live alone
2 Couple with children
3 Couple (no children)
4 Other_____

*****5 MINUTE BREAK*****

6

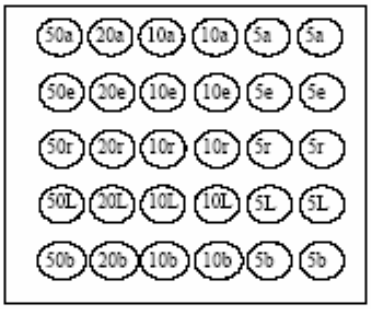
Part 5 Mapping Places on the Southern Fleurieu

Q-19 And now for something different! Different people value different places along the Southern Fleurieu for different reasons. In this section, please show us the specific places in the Southern Fleurieu you value. **Please follow the directions below.**

Step 1 Mapping Fleurieu Values

Find the ***attached*** Southern Fleurieu map and set of sticker dots. There are 8 sets of dots that identify different place values in the Southern Fleurieu such as scenic value or recreation value. Stick the dots on the Southern Fleurieu map where you think these values are. These dots also have "importance" ratings from 5 to 50 points. Put the largest scenic dots (for example 50a) on the most scenic places, the largest recreation dots (50r) on places with the highest recreation value, and so on with the other value dots. ***Use as many or few dots as you like.***

MAP DOTS



PUT ON

Aesthetic value

Economic value

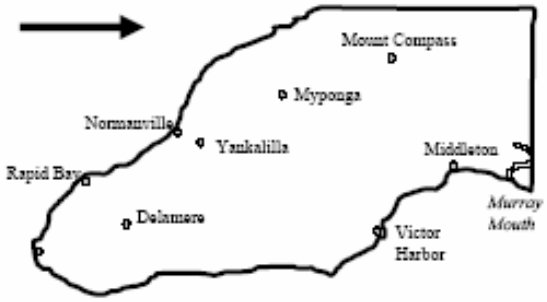
Recreation value

Learning value

Biodiversity value

Etc.

S FLEURIEU MAP



For each of your '50' value dots, we would like to know more about why the specific place is important to you. ***Please write your reason in the space provided below***

'50a' (aesthetic value).....

.....

'50e' (economic value) .....

.....

'50r' (recreation value) .....

.....

50L' (learning value).....

.....

'50b' (biodiversity value).....

.....

7

'50i' (intrinsic value) .....
.....

'50h' (heritage value) .....
.....

'50f' (future value) .....
.....

Step 2 Mapping Your Special Places

Find the 6 "Special Place" dots marked **P1 through P6.** These dots represent your favourite or "special places" in the Southern Fleurieu region. These places can be special for *any* reason. Place up to 6 dots on the map. ***In the space below, write the reasons why these places are special to you.***

Special Place #1 .....
.....

Special Place #2 .....
.....

Special Place #3 .....
.....

Special Place #4 .....
.....

Special Place #5 .....
.....

Special Place #6 .....
.....

STEP 3 Mapping Places for Development (or No Development)

Are there places in the Southern Fleurieu region where future development should or should not occur? ***Use as many or few dots as you like.***

Use **nd1** through **nd6** dots to show places where all future development should be prohibited (**nd** = no development).

Use **d1** through **d6** dots to show places where a ***development type of your choice*** could conditionally occur with a good plan (**d** = development of your choice).

PLEASE STATE YOUR DEVELOPMENT TYPE HERE: _____

8

STEP 4 Mapping Places which may be Vulnerable to Climate Change

Are there any specific places in the Southern Fleurieu region where you perceive environmental problems, such as biodiversity loss, may be intensified by climate change by 2030? Put the largest dots (for example 50BL) on the most vulnerable places, and so on with the other climate change impact dots. ***Use as many or as few dots as you like for each of the potential impacts listed***

Use **50bl** through **5bl** dots to show places vulnerable to biodiversity loss (**bl**=biodiversity loss).

Use **50Le** through **5Le** dots to show places vulnerable to land or coastal erosion (**Le**=Land/coastal erosion)

Use **50bf** through **5bf** dots to show places vulnerable to bushfire (**bf**=bushfire).

Use **50rf** through **5rf** dots to show places vulnerable to riparian flooding (**rf**=riparian flooding)

Use **50sr** through **5sr** dots to show places vulnerable to sea-level rise (sr=sea-level rise)

Use **50ws** through **5ws** dots to show places vulnerable to destructional wave action or coastal storm surges (ws=Wave action/coastal storm surges)

In the space below, write the reasons why you believe the places marked with 50-point dots may be vulnerable to climate change by 2030.

50bl (Biodiversity Loss) .....

.....

50Le (Land erosion).....

.....

50bf (Bushfire).....

.....

50rf (Riparian flooding) .....

.....

50sr (Sea-level rise) .....

.....

50ws (Wave action or coastal storm surges) .....

.....

9

Is there anything else you would like to tell us about the Southern Fleurieu and the potential threats and opportunities facing natural resource management in the region in the next 25 years? We would appreciate any comments.

Would you like to be sent a copy of the survey results?

☐ **YES. PLEASE SEND ME THE SURVEY RESULTS**

My email address is……

School address (if prefer a posted response):

……

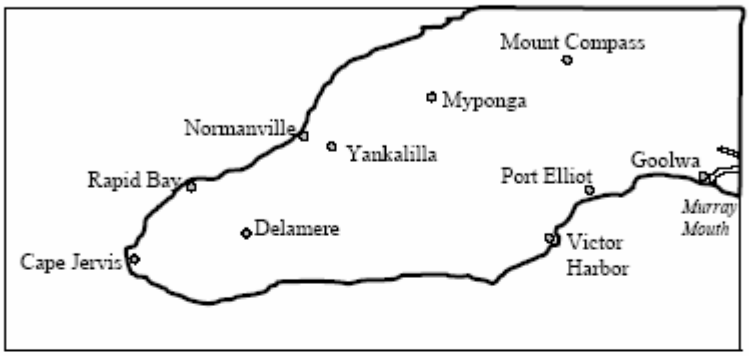
THANK YOU FOR YOUR HELP!

10

4. POSTAL SURVEY

SURVEY ID.....

Mapping the Future of the Southern Fleurieu in the Light of Climate Change



A Survey of Southern Fleurieu Property Owners:

Your views are <u>important!</u>

Australian Government
Department of the Environment and Water Resources
Australian Greenhouse Office

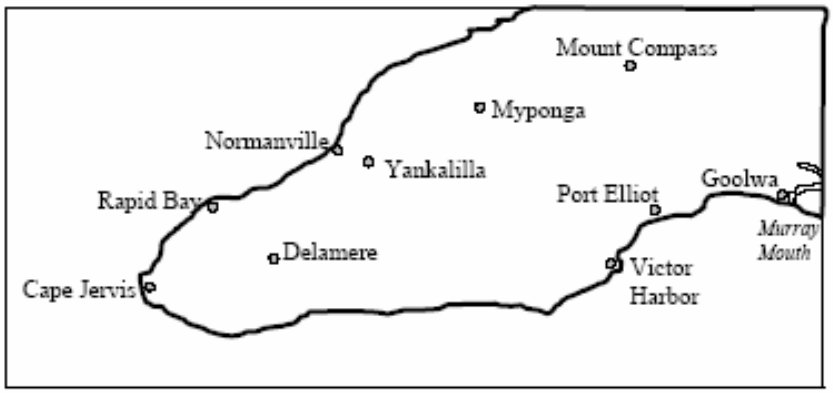
Government of South Australia

Please return your completed survey in the reply paid envelope provided

1

As a Southern Fleurieu property owner, you may well have a personal interest in its future. This survey asks what you value about the Southern Fleurieu and your perceptions of climate change in the region. The primary focus of the study is the coastal strip or the area within 10 km of the beach.

In this survey, we refer to the Southern Fleurieu region. See map below. It is recognised that this map includes areas outside of what is strictly known as the Southern Fleurieu, such as the Lower Murray and Murray Mouth; however, these areas have been included considering their critical importance to natural resource management (NRM).



Information collected from this survey will be made available to planning organisations such as the Adelaide and Mount Lofty Ranges NRM Board, Fleurieu NRM Group, Department of Water, Land and Biodiversity Conservation, Department of Environment and Heritage (SA) and the Australian Greenhouse Office, part of the Commonwealth Department of the Environment and Heritage. This survey is an important opportunity for you to express your vision for the Southern Fleurieu in the light of climate change.

Please complete as much of the survey as possible. If a question is not clear, simply go to the next question.

We promise to keep unit record data confidential. All survey results will be presented in aggregated form. Because we value your responses, we will send you an electronic copy of the survey results if you tick the box on page 10. Please remember to write your email or postal address on this page so that we can contact you.

Please return your completed survey in the reply paid envelope provided

We appreciate your participation in this survey.

Chris Raymond Douglas Bardsley
Land and Biodiversity Services Division
Department of Water, Land and Biodiversity Conservation
raymond.chris@saugov.sa.gov.au
GPO Box 2834 Adelaide SA 5001
Ph. 8463 6800

Please note: While your opinions expressed in this survey will be presented to government agencies, the results may not change any previous government decision or influence future agency direction for the Southern Fleurieu region.

2

Part 1. Your familiarity with the Southern Fleurieu and threats to your quality of life

Q-1a Is your permanent residence located in the Southern Fleurieu region?

1 Yes → If yes, how many years have you lived in the region? _____**Years**
2 No

Q-2. How would you rate your knowledge of places in the Southern Fleurieu region? (Please circle one response).

1 Excellent
2 Good
3 Fair
4 Poor

Q-3. How would you rate your knowledge of places in the Southern Fleurieu region *compared to other* Southern Fleurieu property owners? (Please circle one response).

1 More knowledgeable
2 About the same knowledge
3 Less knowledgeable
4 No opinion

Q-4 The following items may or may not be a threat to your quality of life as a property owner within the Southern Fleurieu region. For each item, please indicate your level of *agreement* or *disagreement* about whether the item is a threat to your quality of life (please circle one response for each item).

	Strongly Disagree	**Disagree**	**Neither Agree or Disagree**	**Agree**	**Strongly Agree**
a) More frequent, intense and widespread bushfires	1	2	3	4	5
b) Climate change	1	2	3	4	5
c) Reduced number of native animal and plant species (biodiversity loss)	1	2	3	4	5
d) Increased land erosion	1	2	3	4	5
e) More frequent river/creek flooding	1	2	3	4	5
f) Sea-level rise	1	2	3	4	5
g) New housing subdivisions	1	2	3	4	5
h) More frequent coastal storm surges	1	2	3	4	5
i) Other _____	1	2	3	4	5

Q-5 How much attention have you paid to climate change issues facing SA? (Please circle one response).

1 No Attention
2 Little Attention – I have heard about climate change in the media but have not explored it further
3 Moderate Attention – I have heard about climate change in the media and regularly discuss the issue with friends and family, including how it may affect the Southern Fleurieu region
4 Close and Constant Attention– I undertake my own research on climate change, and frequently read books, attend seminars and watch documentaries on the issue.

3

Part 2. Your climate change knowledge and level of concern

Q-6a Do you think the climate of the Southern Fleurieu region has changed in the last 25 years? (Please circle one response for each item).

1 Major change
2 Little change
3 No change
4 Don't know

	Much Warmer	Warmer	No Change	Cooler	Much Cooler
b) In the last 25 years, are day temperatures:	1	2	3	4	5
c) In the last 25 years, are night temperatures:	1	2	3	4	5

	Much Greater	Greater	No Change	Less	Much Less
d) In the last 25 years, are rainfall totals throughout the year:	1	2	3	4	5
e) In the last 25 years, is rainfall variability:	1	2	3	4	5

f) Are there any other changes to climate that you have noticed in your region in the last 25 years? .....
.....
.....

Q-7a Do you think the climate of the Southern Fleurieu region will change by 2030?

1 Major change
2 Little change
3 No change
4 Don't know

b) If so, how will it change? .....
.....
.....
.....

Q-8 Overall, how do you think climate change in the Southern Fleurieu region by 2030 will affect the ***quality of life*** of the following groups (please circle one response for each group).

	No Impact	Low Impact	Moderate Impact	High Impact
a) Yourself	1	2	3	4
b) Your Family	1	2	3	4
c) The Southern Fleurieu Community	1	2	3	4
d) The South Australian Community	1	2	3	4

4

Part 3 Preferred adaptation responses

Q-9 Can you suggest changes that could be implemented by yourself and natural resource management groups and agencies to reduce the impacts of climate change on the Southern Fleurieu region?

a) Yourself.....

.....

.....

.....

.....

.....

.....

.....

.....

b) Natural Resource Management Groups and Agencies .....

.....

.....

.....

.....

.....

.....

.....

5

Part 5. Information About Yourself and Your Property

Q-10. What type(s) of property do you own on the Southern Fleurieu? (Please circle one or more responses).

1 Residential (Your Permanent Residence)
2 Residential (Rental Property)
3 Holiday Home
4 Commercial
5 Vacant Land
6 Other _____

Q-11. How many properties do you own on the Southern Fleurieu? _____ **Properties**

Q-12. If you are a resident of the Southern Fleurieu, which town do you live in? _____

Q-13. Please circle your age group:

10-20 years	**41-50 years**
21-30 years	**51-60 years**
31-40 years	**61 years +**

Q-14. What is your gender? (Please circle one response).

1 Male
2 Female

Q-15. What is the highest level of formal education you have completed? (Please circle one response).

1 None
2 Primary/Some Secondary School
3 Secondary School
4 Vocational/Technical Training
5 Tertiary
6 Postgraduate
7 Prefer Not To Answer

Q-16. What is your occupation? **Occupation** _____

Q-17. Which employment category best describes you? (Please circle one response).

1 Agriculture
2 Tourism
3 Government
4 Education
5 Professional Services
6 Commercial/Retail
7 Tradesperson
8 Homemaker
9 Retired
10 Other (please specify)_____

Q-18. Which category best describes your home life? (Please circle one response).

1 Live alone
2 Couple with children
3 Couple (no children)
4 Other_____

6

Part 5 Mapping Places on the Southern Fleurieu

Q-19 And now for something different! Different people value different places along the Southern Fleurieu for different reasons. In this section, please show us the specific places in the Southern Fleurieu you value. **Please follow the directions below.**

Step 1 Mapping Fleurieu Values

Find the ***attached*** Southern Fleurieu map and set of sticker dots. There are 8 sets of dots that identify different place values in the Southern Fleurieu such as scenic value or recreation value. Stick the dots on the Southern Fleurieu map where you think these values are. These dots also have "importance" ratings from 5 to 50 points. Put the largest scenic dots (for example 50a) on the most scenic places, the largest recreation dots (50r) on places with the highest recreation value, and so on with the other value dots. ***Use as many or few dots as you like.***

MAP DOTS

50a	20a	10a	10a	5a	5a
50e	20e	10e	10e	5e	5e
50r	20r	10r	10r	5r	5r
50L	20L	10L	10L	5L	5L
50b	20b	10b	10b	5b	5b

PUT ON

Aesthetic Value

Economic Value

Recreation Value

Learning Value

Biodiversity Value

Etc.

ENCLOSED S FLEURIEU MAP

For each of your '50' value dots, we would like to know more about why the specific place is important to you. ***Please write your reason in the space provided below.***

'50a' (Aesthetic Value) .....

.....

'50e' (Economic Value) .....

.....

'50r' (Recreation Value).....

.....

50L' (Learning Value) .....

.....

'50b' (Biodiversity Value) .....

.....

7

'50i' (Intrinsic Value).....
.....

'50h' (Heritage Value).....
.....

'50f' (Future Value).....
.....

Step 2 Mapping Your Special Places

Find the 6 "Special Place" dots marked **P1 through P6.** These dots represent your favourite or "special places" in the Southern Fleurieu region. These places can be special for *any* reason. Place up to 6 dots on the map. ***In the space below, write the reasons why these places are special to you.***

Special Place #1 .....
.....

Special Place #2 .....
.....

Special Place #3 .....
.....

Special Place #4 .....
.....

Special Place #5 .....
.....

Special Place #6 .....
.....

STEP 3 Mapping Places for Development (or No Development)

Are there places in the Southern Fleurieu region where future development should or should not occur? ***Use as many or few dots as you like.***

Use **nd1** through **nd6** dots to show places where all future development should be prohibited (**nd** = no development).

Use **d1** through **d6** dots to show places where a ***development type of your choice*** could conditionally occur with a good plan (**d** = development of your choice).

PLEASE STATE YOUR DEVELOPMENT TYPE HERE: _____

8

STEP 4 Mapping Places which may be Vulnerable to Climate Change

Are there any specific places in the Southern Fleurieu region where you perceive environmental problems, such as biodiversity loss, may intensify as a result of climate change by 2030? Put the largest dots (for example 50bl) on the most vulnerable places, and so on with the other climate change impact dots. ***Use as many or as few dots as you like for each of the potential impacts listed***

Use **50bl** through **5bl** dots to show places vulnerable to biodiversity (native plant and animal) loss (**bl**=biodiversity loss).

Use **50Le** through **5Le** dots to show places vulnerable to land erosion (soil lost through the action of wind or water) (**Le**=Land erosion)

Use **50bf** through **5bf** dots to show places vulnerable to bushfire (**bf**=bushfire).

Use **50rf** through **5rf** dots to show places vulnerable to riparian (river or creek) flooding (**rf**=riparian flooding)

Use **50sr** through **5sr** dots to show places vulnerable to sea-level rise (sr=sea-level rise)

Use **50ws** through **5ws** dots to show places vulnerable to wave action or coastal storm surges (ws=wave action/coastal storm surges)

In the space below, write the reasons why you believe the places marked with 50-point dots may be vulnerable to climate change by 2030.

50bl (Biodiversity Loss) .....
.....

50Le (Land Erosion) .....
.....

50bf (Bushfire).....
.....

50rf (Riparian Flooding).....
.....

50sr (Sea-level Rise) .....
.....

50ws (Wave Action or Storm Surges) .....
.....

9

Is there anything else you would like to tell us about the Southern Fleurieu and the potential threats and opportunities facing natural resource management in the region in the next 25 years? We would appreciate any comments.

Would you like to be sent a copy of the survey results?

☐ **YES. PLEASE SEND ME THE SURVEY RESULTS**

My email address is……

Name and Postal address (if prefer a posted response):

……

THANK YOU FOR YOUR HELP!

10

5. LISTING OF OTHER PERCEIVED THREATS TO QUALITY OF LIFE

Item and comments	Overall	Students	Adults
Water			
Quality of water – salinity or human waste disposal	**6**		6
Drought/reduced rainfall	**8**	3	5
Reduced surface water availability	**5**		5
Reduced MR flows	**3**		3
More variable rainfall	**2**		2
Loss of Lake Alexandrina	**2**		2
Land			
Sustainability of primary production enterprises. (e.g. Tasmanian blue gums)	**4**		4
Increased wind speeds	**3**		3
Changing wind direction (e.g. north winds)	**2**	1	1
Cost of food production	**2**	1	1
Biodiversity			
Weed and pest invasion	**3**		3
Biodiversity loss	**3**		3
Development			
Unchecked coastal development (e.g. seven-storey hotels, marinas, Encounter Bay Shopping Centre)	**6**		6
People			
Population increase	**5**	2	3
Terrorism and war	**3**	3	

6. LISTING OF SUGGESTED INDIVIDUAL RESPONSES TO CLIMATE CHANGE

Item and Comments	Overall	Students	Adults
Water			
Take shorter showers	12	12	
Increase the use of greywater around the home	6	2	4
Install low flow shower heads	2	2	
Invest in water desalination plants	2		2
Install rainwater tanks and other water capturing devices	17	1	16
Install drip irrigation systems	1	1	
Construct new storages for retaining more water and for longer periods (e.g. stormwater wetlands)	1	1	6
Land			
Plant more drought tolerant trees and shrubs (to enhance biodiversity, reduce water usage around the home, stabilise banks etc.)	16	2	14
Adjust farming practices to cope with climate variability (e.g. reduce stock numbers to maintain feed, buy more hay in good seasons to have adequate stores to survive lean seasons)	10		10
Grow own produce (e.g. permaculture) and invest in local trading	3		3
Reduce, reuse and recycle	2	2	1
Plant windbreaks and preserve shade areas	2		2
Reduce lawn size	2		2
Convert from livestock to horticultural industries	1		1
Farm native animals which are adapted to local conditions	1		1
People			
Learn to live with less	8	8	
Educate self and others about climate change adaptation possibilities	5	1	4
Reduce population growth	4	3	1
Transport			
Minimise car usage (e.g. catch public transport, ride bike, be a one-car family)	21	11	10
Invest in hybrid cars and other vehicles with cleaner emissions	4	3	1
Drive in a more conservative manner	1		1
Increase the price of fuel	1		1
Energy			
Switch to green energy – solar, wind, hot rock	18	3	15
Turn electrical equipment off at the switch when not in use	12	11	1
Install fluorescent/low emitting light bulbs	11	6	5
Minimise the use of airconditioners (switch off when not needed, improved home insulation to reduce need)	3	1	2
Improve building thermodynamics	3	2	1
Install energy efficient electrical appliances	2	2	

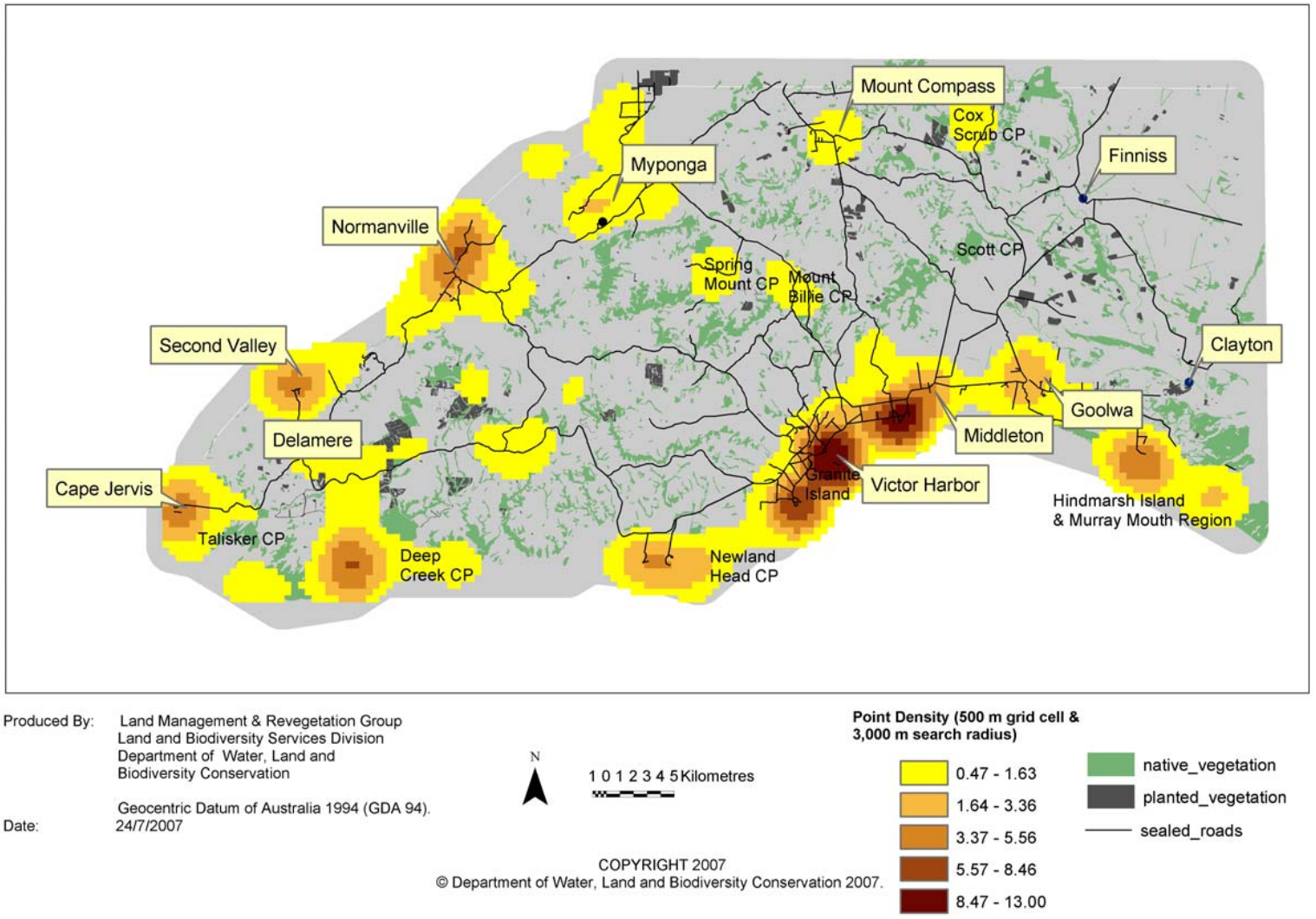
Item and Comments	Overall	Students	Adults
Don't burn off	2	2	
Ensure house designs maximise energy efficiency	3	1	2
Government Policy			
Lobby governments to increase uptake of efficient turbo diesel engines	2		2
Impose tighter restrictions on water allocation and usage (e.g. pay more for excessive water use)	2		2
Encourage state and federal government to legislate to reduce carbon outputs	1		1
Increase incentives for the installation of rainwater tanks	1	1	1
Lobby council to encourage recycling of water	1		1
Encourage governments to have genuine green purchasing policy to reflect on and recognise the precautionary principle	1		1
Applauding government agencies when 'right thing' is done – encouraging them to at times take the hard road rather than the simpler solution	1		1

7. LISTING OF SUGGESTED NRM AGENCY RESPONSES TO CLIMATE CHANGE

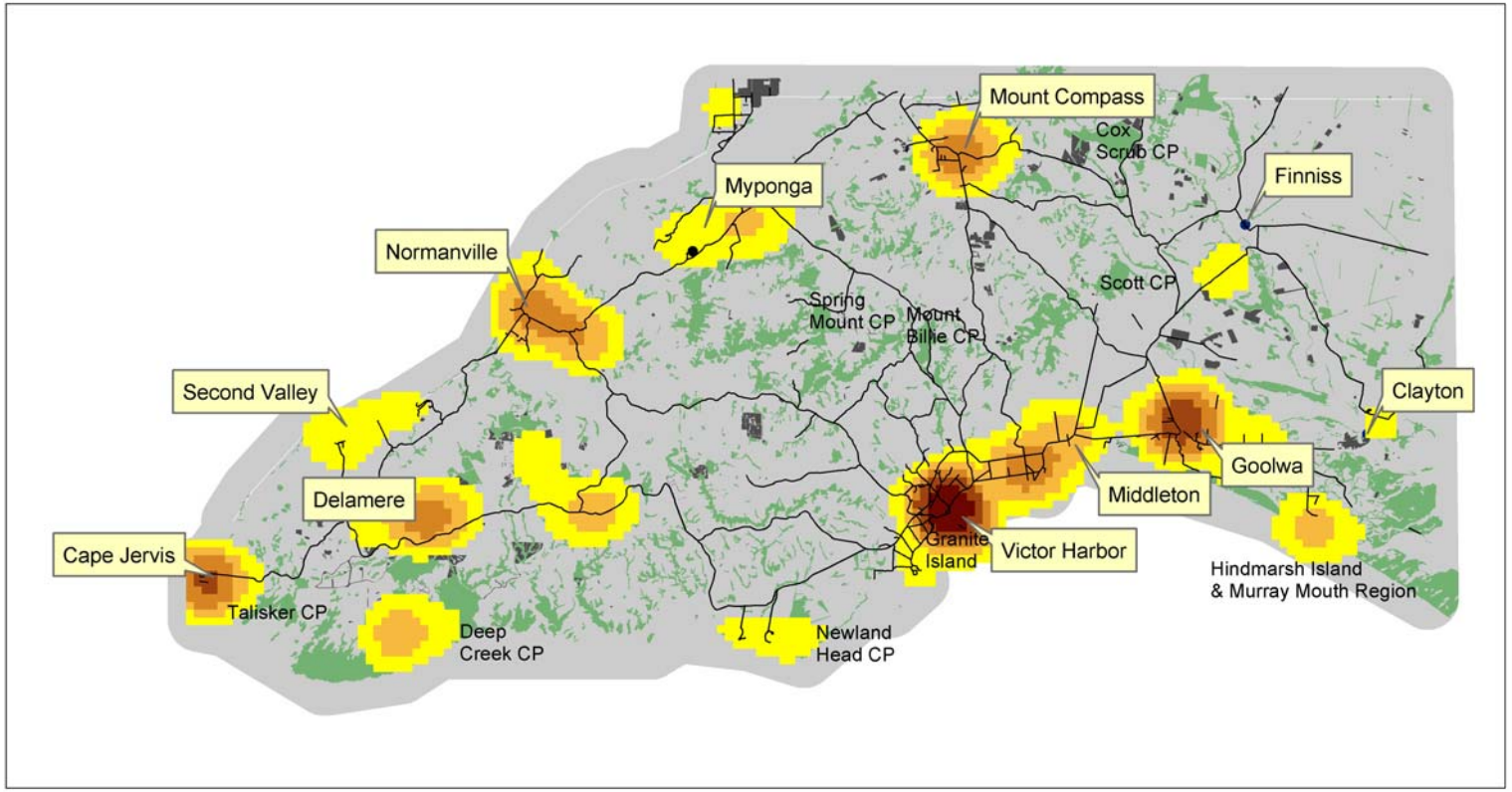
Item and Comments	Overall	Students	Adults
Water			
Impose tighter restrictions on water allocation and usage (includes buying back water licences).	6		6
Prevent the growth of water-loving crops, in particular rice, cotton and/or vines	5	1	4
Construct desalination plants along the SA coastline	4		4
Encourage construction of rainwater tanks (>10 000 L)	3		3
Prevent construction of new dams	2		2
Educate the general public about water efficient gardens	2		2
Feed more wetland areas from stormwater runoff grates – all effluent water to be recycled	2		2
Collect stormwater for treatment across catchment area			1
Enforce water restrictions – more work in media	1	1	
Increase value of water by charging much higher water rates	1		1
Release more freshwater into the lower lakes	1		1
Restrict unnecessary drawing of groundwater	1		1
Assist communities to access water grants and to implement renewable energy projects	1		1
Reuse treated water from sewerage works in agriculture	1		1
Incorporate climate risk considerations into WAPs			1
Remove barrages at Goolwa – return area to estuary controlled by tides	1		1
Land			
Plant more drought tolerant trees	6	1	5
Prevent the construction of nuclear power plants	2	2	
Stop tree felling and plant bigger tree plantations	1	1	
Develop revegetation plans for SA coastal areas	1		1
Establish community groups to protect, monitor and regenerate remnant vegetation areas	1		1
Link smaller valuable habitats to reduce vulnerability	1		1
Identify and protect endangered plant and wildlife species	1		1
Energy			
Establish natural power sources – wind farms, solar, tidal	3	2	1
Introduce public transport to regional areas in order to reduce reliance on cars	1	1	
Encourage car manufacturers to improve emission standards	1	1	
Encourage the establishment of large scale worm farms for recycling green waste	1		1
Tax 4WD users heavily – reduce their appeal	1		1
Investigate opportunities for carbon trading	1		1

People			
Education the general public about climate change, including how to adapt to a warmer climate	5		5
Fund a campaign about the environment and how/what affects we have on this earth	1	1	
Develop community committee to address climate change issues	1	1	
Establish incentive funds to plant trees, conserve water, recycle/reuse	1		1
Work with landholders to develop strategies for drought proofing properties and implement activities with less reliance as past rainfall patterns	1		1
Publicise 'how to' ideas and actions – visible to general community	1		1
Market Instruments			
Encourage federal government to provide Cities for Climate Protection funds for regional councils	1		1
Provide up-front interest free loans to implement climate change adaptation strategies	1		1
Provide tax incentives for companies wishing to establish alternative energy generation plants	1		1
Development			
Encourage seamless planning processes between local councils and other coastal action groups for the long-term wellbeing of the coastline	3		3
Turn around the mentality of development at all costs	3		3
Build display homes with energy saving systems, rainwater tanks, solar energy, fluor lighting etc	1		1
Stop growth of high-rise buildings on beach front	1		1
Keep development of the immediate foreshore and protect coastal lands	1		1
Review encumbrances to landowners (e.g. suitable plants, water tanks, water in lagoons, shrubberies etc)	1		1
Reduce coastal development through planning legislation	1		1

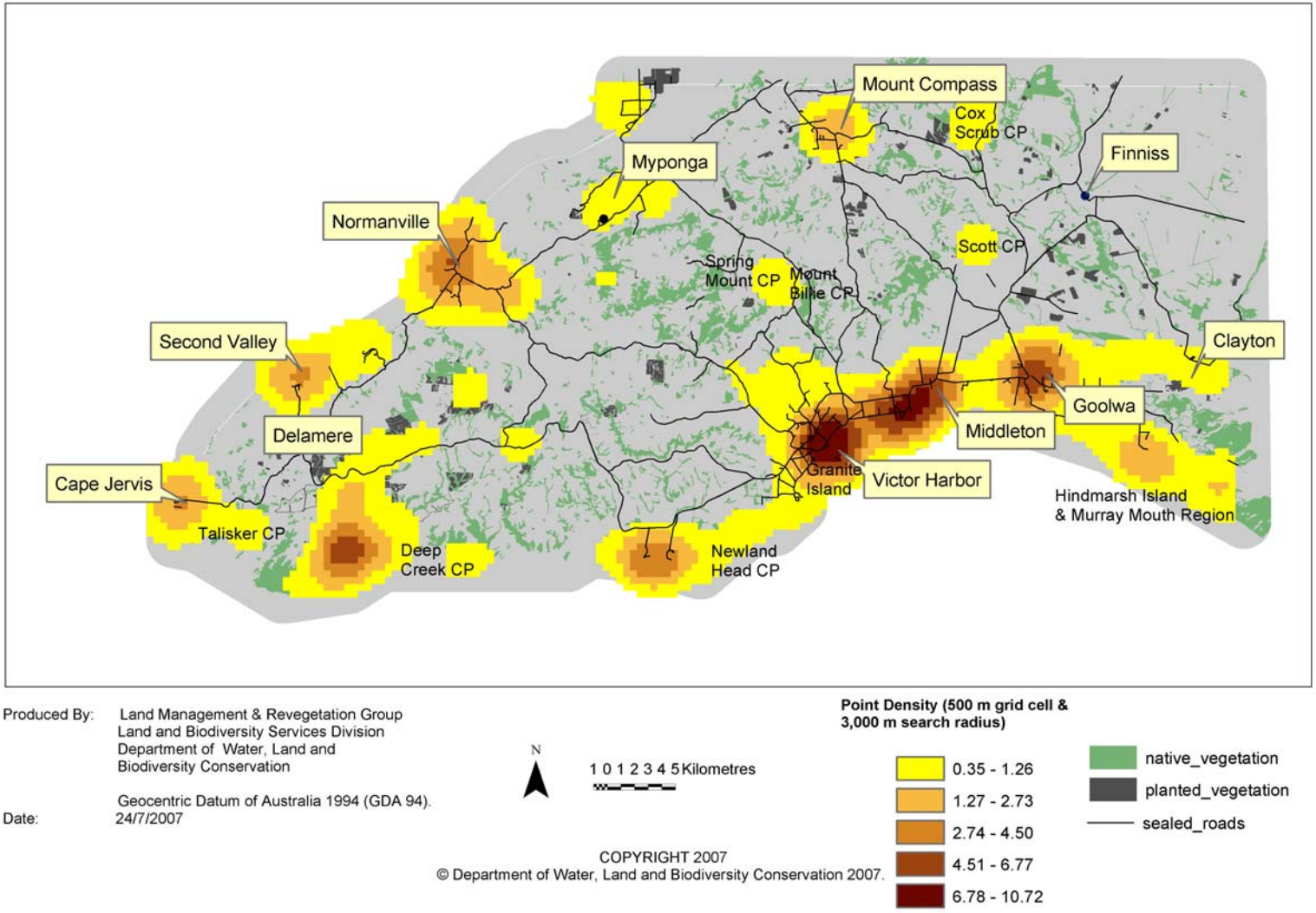
8. DENSITY ANALYSIS OF SCHOOL STUDENT AND ADULT AESTHETIC VALUES FOR THE SOUTHERN FLEURIEU REGION, SA



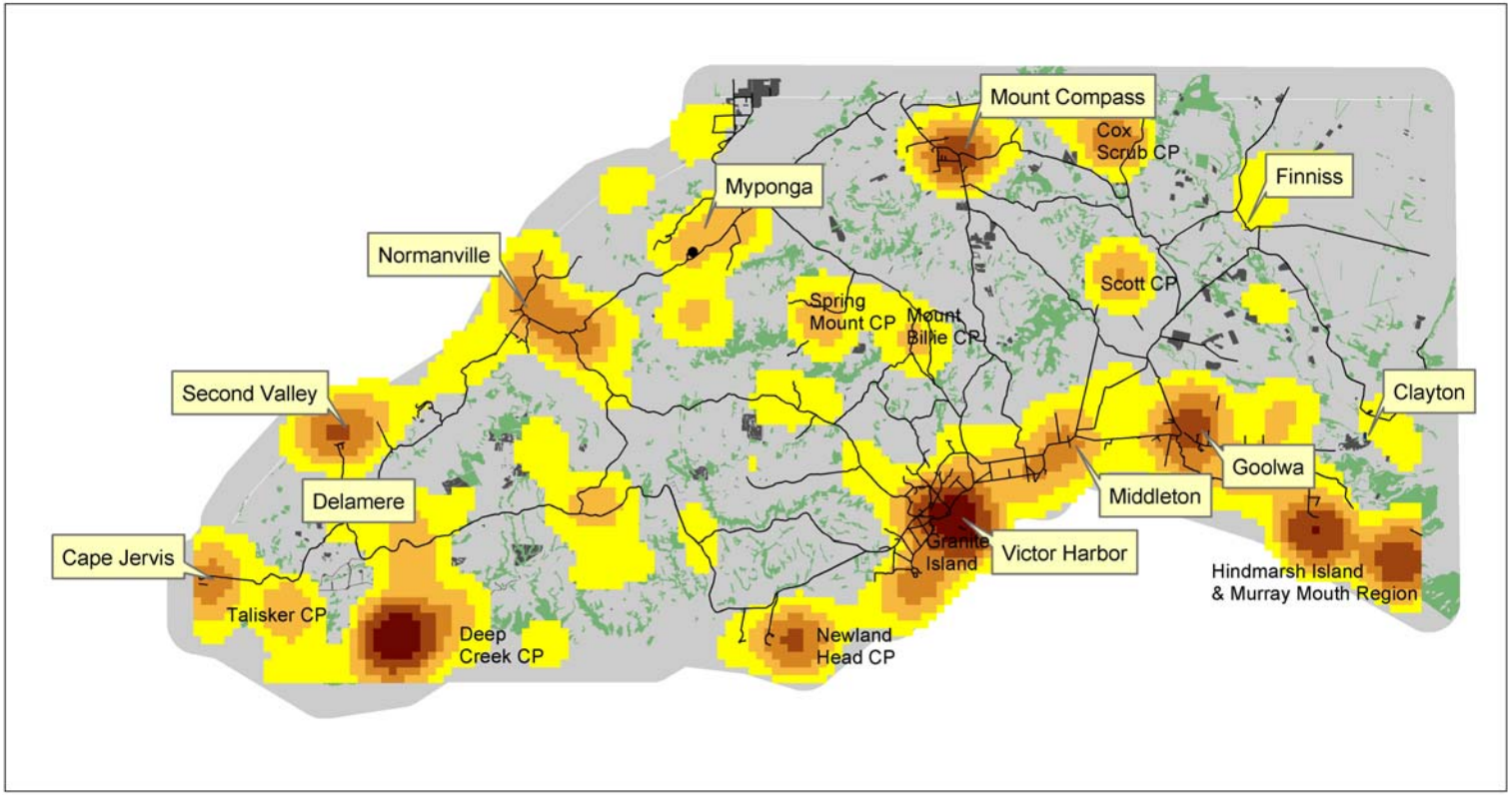
9. DENSITY ANALYSIS OF SCHOOL STUDENT AND ADULT ECONOMIC VALUES FOR THE SOUTHERN FLEURIEU REGION, SA



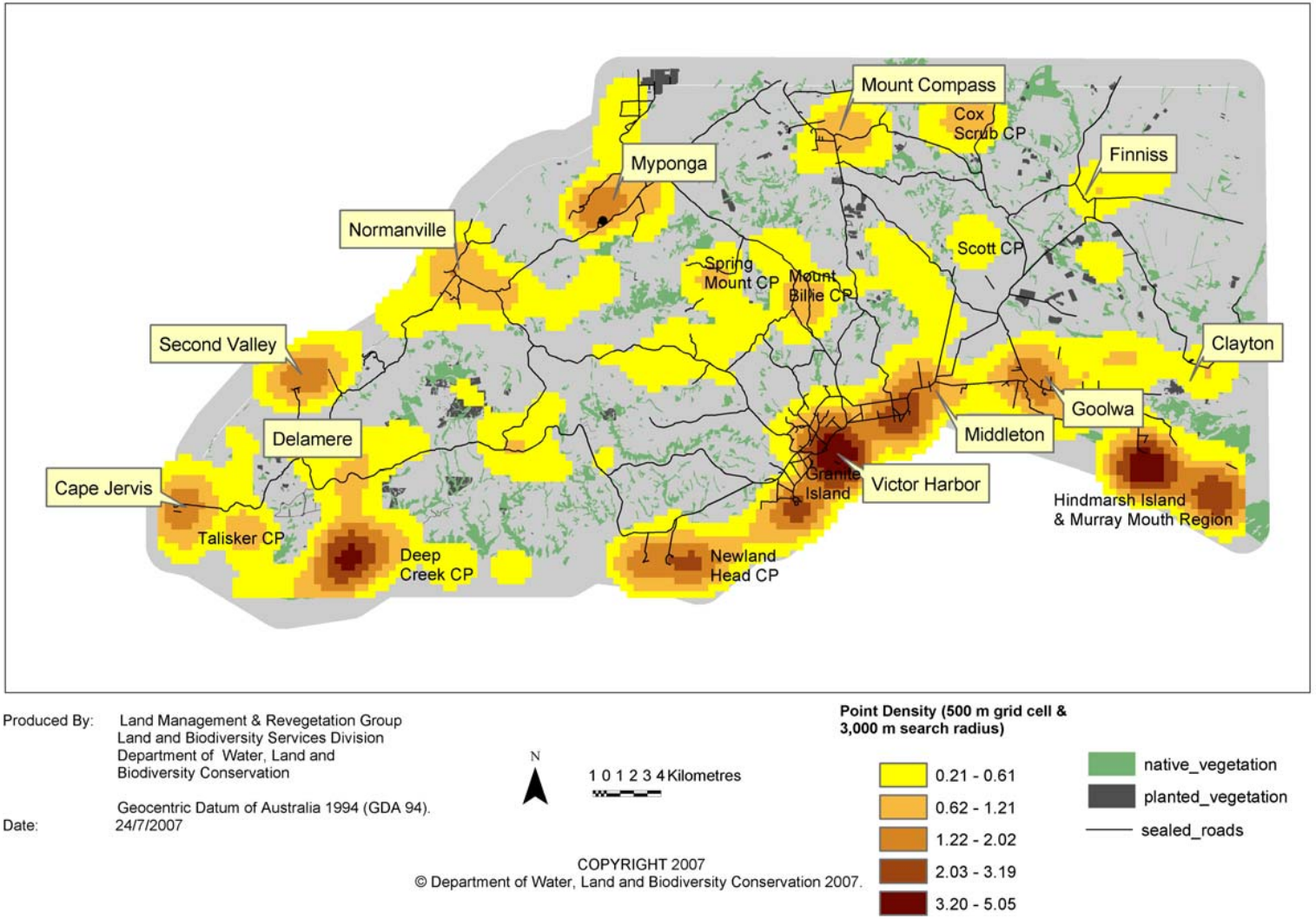
10. DENSITY ANALYSIS OF SCHOOL STUDENT AND ADULT RECREATION VALUES FOR THE SOUTHERN FLEURIEU REGION, SA



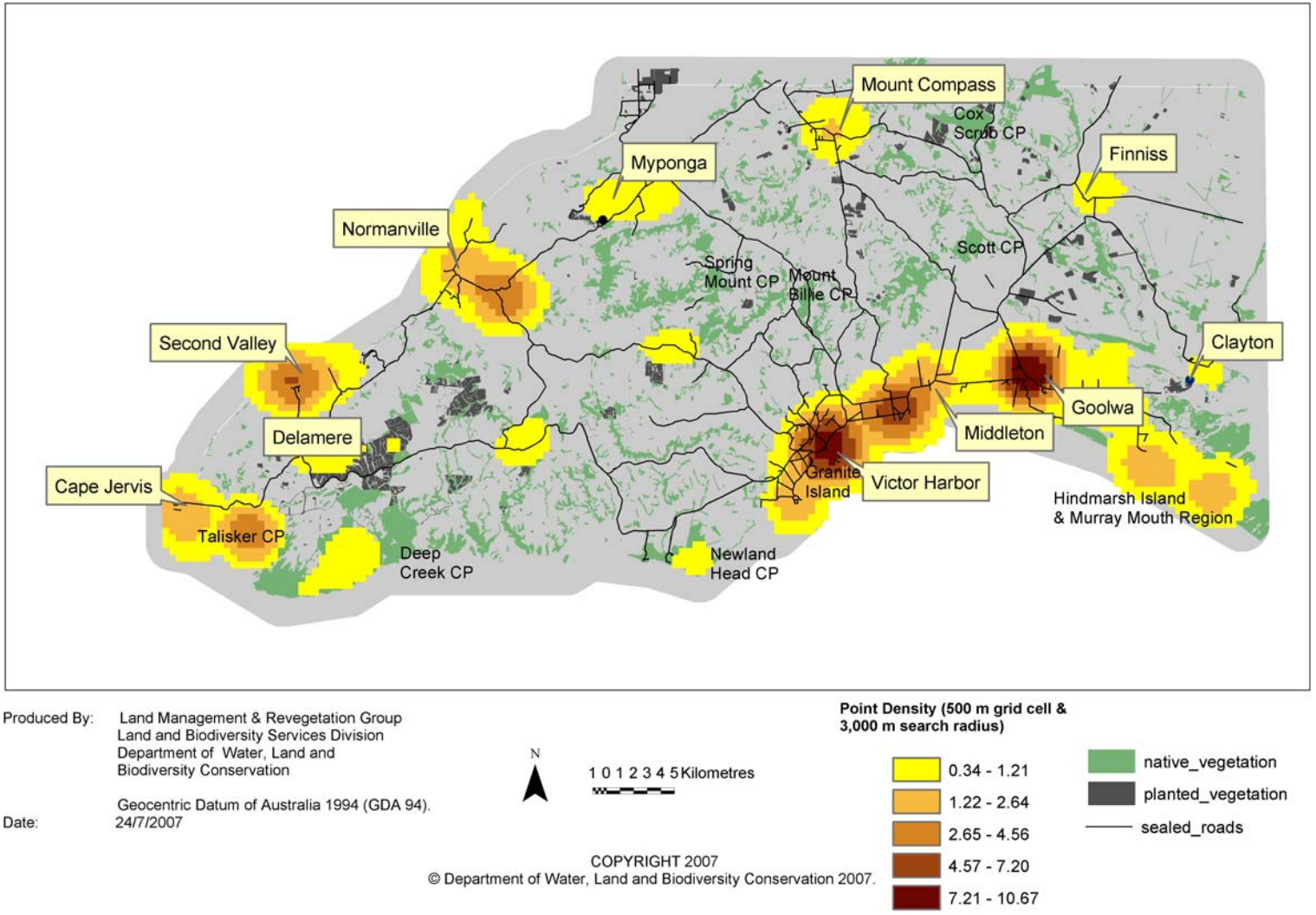
11. DENSITY ANALYSIS OF SCHOOL STUDENT AND ADULT LEARNING VALUES FOR THE SOUTHERN FLEURIEU REGION, SA



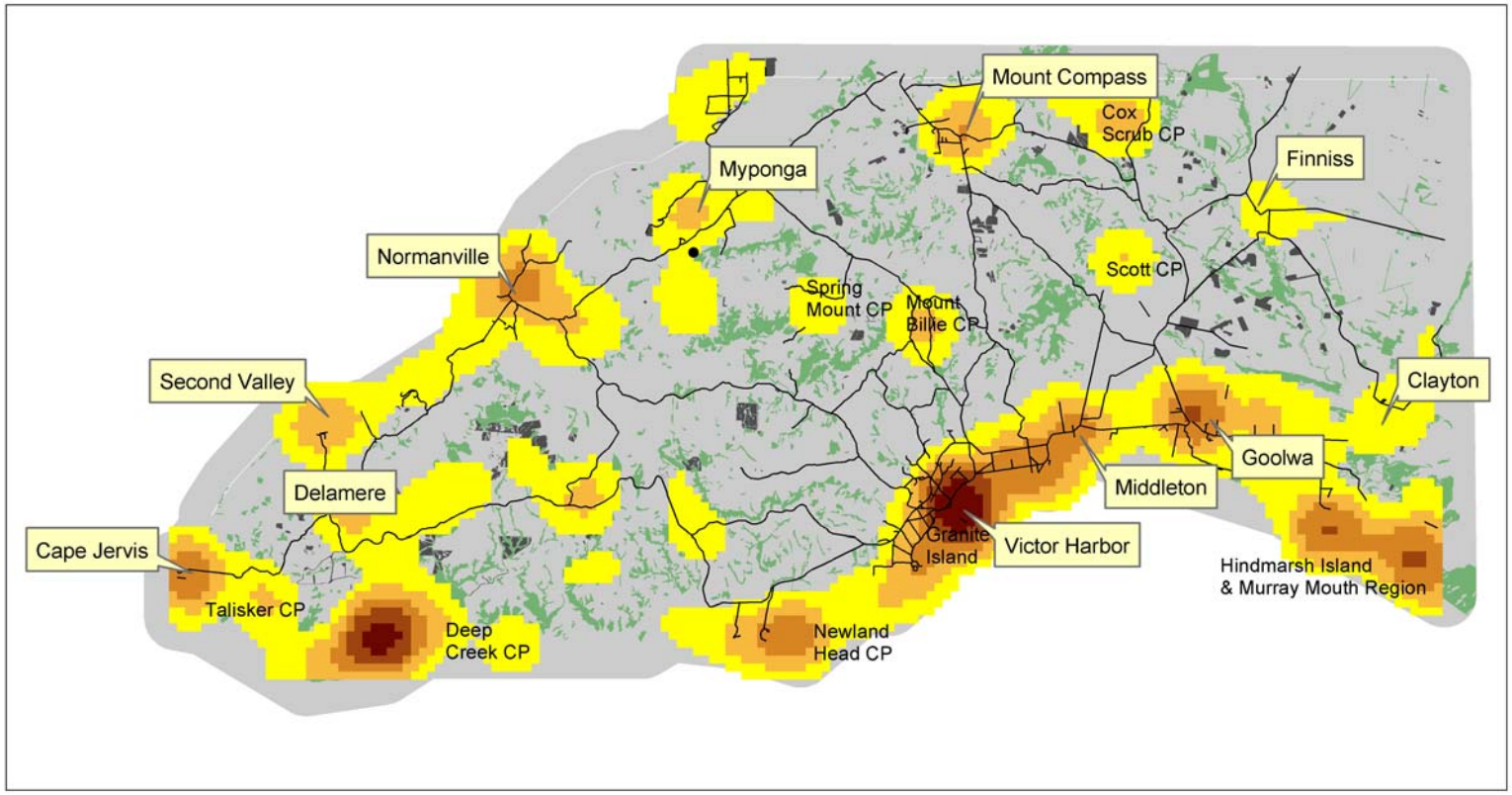
12. DENSITY ANALYSIS OF SCHOOL STUDENT AND ADULT INTRINSIC VALUES FOR THE SOUTHERN FLEURIEU REGION, SA



13. DENSITY ANALYSIS OF SCHOOL STUDENT AND ADULT HERITAGE VALUES FOR THE SOUTHERN FLEURIEU REGION, SA



14. DENSITY ANALYSIS OF SCHOOL STUDENT AND ADULT FUTURE VALUES FOR THE SOUTHERN FLEURIEU REGION, SA



GLOSSARY

AGO — Australian Greenhouse Office, part of the Commonwealth Department of the Environment and Water Resources

AMLR — Adelaide and Mount Lofty Ranges

AMLR NRM Board — Adelaide and Mount Lofty Ranges Natural Resources Management Board

Chi-square test — A statistical test based on comparison of a test statistic to a chi-square distribution. It is used to detect whether two or more population distributions differ from one another.

CSIRO — Commonwealth Scientific and Industrial Research Organisation

DEH — Department for Environment and Heritage (Government of South Australia)

Descriptive mapping — A GIS technique for determining the distribution and abundance of points within a defined area.

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

EPBC Act — Environment Protection and Biodiversity Conservation Act

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

Hotspots — Areas of high point density

IPCC — Intergovernmental Panel on Climate Change

Public – People who are not part of a professional discipline, such as ecology

LVM — Landscape Values Methodology

Landscape values — The values people hold or assign to places for different reasons, ranging from instrumental value (places that provide tangible benefits) to symbolic value (places that represent ideas). This study refers to eight landscape values: aesthetic, economic, recreation, learning, biodiversity, intrinsic, heritage and future.

Natural Breaks (Jenks) classification — a classification method which attempts to find clusters or concentrations of data and place class breaks between the clusters.

NRM — Natural Resources Management; all activities that involve the use or development of natural resources and/or that impact on the state and condition of natural resources, whether positively or negatively

Perceived climate change risks — The climate change risks people hold or assign to places. This study refers to six perceived climate change risks: biodiversity loss, land erosion, bushfire, riparian flooding, sea-level rise and wave action or storm surges.

Proportionate analysis — An analysis technique for determining the relative differences between two or more analysis groups.

Raster modelling — Representing a set of landscape components (e.g. areas of high conservation value) using grid cells.

Riparian — Of, pertaining to, or situated or dwelling on the bank of a river or other water body.

Sense of place — The entire suite of thoughts (cognitions) and emotional (affective) sentiments held regarding a particular geographic locale and the meanings one attributes to such areas.

T-tests — A statistical test that is used to find out if there is a real difference between the means (averages) of two different groups.

Snowball sampling — A non-probability sampling scheme in which you begin by sampling one person, then ask that person for the names of other people you might interview, then interview them and obtain a list of people from them, and so on.

REFERENCES

ABS 2006, National Regional Profile: Fleurieu Statistical Subdivision, viewed 16 August 2007, http://www.abs.gov.au/ausstats/abs@.nsf/

AGO 2003, 'Community Perceptions of Climate Change: A Report on Benchmark Research', prepared for the AGO by Colmar Brunston Social Research and Redsuit Advertising, Canberra

Alessa N, Kliskey A & Brown G 2008, 'Socio-ecological hotspots mapping: A spatial approach for identifying coupled social-ecological space', accepted for publication in *Landscape and Urban Planning* 85(1):27-39.

Altman IA & Low SM (eds.) 1992, *Place attachment*, Plenum, New York

Bardsley, D 2006, *There's a change on the way — An initial integrated assessment of projected climate change risks and adaptation options for Natural Resource Management in the Adelaide and Mt Lofty Ranges Region*, DWLBC Report 2006/06, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide

Bardsley D & Edwards-Jones G 2007, 'Invasive species policy and climate change: Social perceptions of environmental change in the Mediterranean', in *Environmental Science and Policy* 10(3):230–242

Beverly J, Uto K, Wilkes J & Bothwell P, 2008, 'Assessing spatial attributes of forest landscape values: An internet-based participatory mapping approach', *Canadian Journal of Forestry,* 38:289-303

Black AE & Liljeblad A 2005, *Integrating social values in vegetation models via GIS: The missing link for the Bitterroot National Forest*, Unpublished Report, viewed 12 October 2007, http://leopold.wilderness.net/research/updates/U005.pdf

Botterill L & Mazur N 2004, *Risk and risk perception: A literature review*, Rural Industries and Research Development Corporation, Canberra

Brown G 2005, 'Mapping spatial attributes in survey research for natural resource management: Methods and applications', *Society and Natural Resources*, 18(1), pp. 1–23

Brown G 2006, 'Mapping landscape values and development preferences: A method for tourism and residential development planning', in *International Journal of Tourism Research*, 8, pp. 101–113

Brown G & Reed P 2000, 'Validation of a forest values typology for use in national forest planning', In *Forest Science*, 46(2), pp. 240–247

Brown G, Reed P & Harris C 2002, 'Testing a place-based theory for environmental evaluation: An Alaska case study', in *Applied Geography*, 22 (1), pp. 49–76

Brown G, Smith C, Alessa L & Kliskey A 2004, 'A comparison of perceptions of biological value with scientific assessment of biological importance', in *Applied Geography* 24(2), pp. 161–180

Caton B, Fotheringham D, Lock C, Royal M, Sandercock R & Taylor R 2007, 'Southern Fleurieu Coastal Action Plan and Conservation Priority Study', prepared for Adelaide and Mount Lofty NRM Board, Alexandrina Council, City of Victor Harbor, District Council of Yankalilla, Goolwa to Wellington Local Action Plan and Department for Environment and Heritage (SA)

Cheng AS, Kruger LE & Daniels SE 2003, ' "Place" as an integrating concept in natural resource politics: Propositions for a social science research agenda', in *Society and Natural Resources*, 16, pp. 87–104

REFERENCES

City of Victor Harbor 2007, City of Victor Harbor: Council Profile, viewed 21 August 2007, http://www.victor.sa.gov.au/site/page.cfm?u=150

David E & Elise H 2007, 'Climate change: Community perceptions and discourses of risk', in *Journal of Risk Research*, 10(5), pp. 623–641

DEH 2007, DCDB Parcel, Land Services Group, DPTI, Adelaide

Dillman D 1978, *Mail and telephone surveys*, John Wiley and Sons, New York

DWLBC 2006, 'Land Use Mapping of South Australia – Mount Lofty Ranges'. DWLBC Knowledge and Information Division, Adelaide

Fenton, M & Rickert, A (2008) A national baseline of the social and institutional foundations of natural resource management programs, NLWRA, Canberra.

Fishwick L & Vining J 1992, 'Toward a phenomenology of recreation place', in *Journal of Environmental Psychology*, 12, pp. 57–63

Herzon I & Mikk M 2007, 'Farmers' perceptions of biodiversity and their willingness to enhance it through agri-environment schemes: A comparative study from Estonia and Finland', in *Journal of Nature Conservation*, 15(1), pp. 10–25

Hill B & Duffield R 2002, *Swamp Management Guidelines for the Fleurieu Peninsula*, Conservation Council of South Australia, Adelaide

IPCC 2007, *Climate Change 2007: The Physical Science Basis. Summary for Policy Makers*, IPCC Working Group 1 Fourth Assessment Report, IPCC Secretariat, Geneva, Switzerland

Jorgensen BS & Stedman R 2001, 'Sense of place as an attitude: Lakeshore owners' atitudes toward their properties', in *Journal of Environmental Psychology*, 21, pp. 233–248

Kaltenborn BP 1998, 'Effects of sense of place on responses to environmental impact: A case study among residents in an Arctic community', in *Applied Geography*, 18(2), pp. 169–189

Kraus N, Malmros T & Slovic P 1992, 'Intuitive toxicology: Expert and lay judgments of chemical risks, in *Risk Analysis*, 12, pp. 215–232

Kyle G & Chick G 2007, 'The social construction of a sense of place', in *Leisure Sciences*, 29, pp. 209–225

Lazo JK, Kinnel J, Bussan T, Fisher A & Collier N 1999, 'Expert and lay mental models of ecosystems: Inferences for risk communication', in *Risk Health, Safety, and the Environment*, 10, pp. 45–64

Lazo JF, Kinnell JC & Fisher A 2000, 'Expert and layperson perceptions of ecosystem risk', in *Risk Analysis* 20(2), pp. 179–193

Leiserowitz A 2006,' American risk perceptions: Is climate change dangerous?', in *Risk Analysis* 25(6), pp. 1433–1442

List P & Brown P 1999, 'Moving toward an expanded land management ethic', in *Nature and the Human Spirit: Toward an Expanded Land Management Ethic*, Eds. BL Driver, D Dustin, T Baltic, G Elsner, G Peterson, Venture Publishing, State College, PA

Lorenzoni I, Leiserowitz A, Franca Doria M, Poortinga W & Pidgeon N 2006, 'Cross-national comparisons of image associations with 'Global Warming' and 'Climate Change' among public in the United States of America and Great Britain', in *Journal of Risk Research*, 9(3), pp. 265–281

Lorenzoni I, Pidgeon N & O'Connor R 2005, 'Dangerous climate change: The role for risk research', in *Risk Analysis*, 25(6), pp. 1387–1398

Lothian A 2005, 'Coastal Viewscapes of South Australia', Scenic Solutions, Adelaide (unpublished report)

Lowe T 2007, 'Vicarious Experience vs. Scientific Information in Climate Change Risk Perception and Behaviour: A Case Study of Undergraduate Students in Norwich, UK', Technical Report 43, Tyndall Centre for Climate Change Research, UK

Matthews C 2005, 'Sea Level Rise and Climate Change: Implications for the Coorong and Lake Alexandrina and Albert Ramsar Site. A preliminary Investigation', Conservation Programs South East, Regional Conservation, Department for Environment and Heritage (SA)

McDaniels T, Axelrod LJ & Slovic P 1995, 'Characterizing perception of ecological risk', in *Risk Analysis*, 15(5), pp. 575–588

McInnes KL, Suppiah R, Whetton H, Hennessy KJ & Jones RN 2003, *Climate change in South Australia*, CSIRO Atmospheric Research, Melbourne

Minichiello, V., Aroni, R., Timewell, E. & Alexander, L. 1995, *In-depth interviewing: Principles, techniques, analysis*. Longman Australia, Melbourne.

National Land and Water Resources Audit 2001, 'Australian native vegetation assessment 2001',National Land and Water Resources Audit, Canberra

Nielsen-Pincus M In Review, *Mapping landscape values: An analysis of methods and geographical associations among values at the landscape scale*, available from Max Nielsen-Pincus, Director of the Crooked River Watershed Council

Pfueller, S, Zhu, X, Whitelaw, P & Winter, C In Press, Community Values for Murray River Forest Reserves in Victoria. Sustainable Tourism CRC, QLD.

Poortinga W & Pidgeon NF 2003, *Public Perceptions of Risk, Science and Governance. Main Findings of a British Survey on Five Risk Cases*, Technical Report, Centre for Environmental Risk, University of East Anglia, Norwich

Raymond C & Brown G 2006, 'A method for assessing protected area allocations using a typology of landscape values'. in *Journal of Environmental Planning and Management*, 49(6), pp. 797–812

Raymond, C, Cleary, J & Cosgrove, K 2006, *A Community Capacity Assessment Tool and Process for Natural Resource Management,* DWLBC Report 2006/35, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide.

Relph E 1976, *Place and Placelessness*, Pion, London

Rolston H & Coufal J 1991, A forest ethic and multivalue forest management', in *Journal of Forestry*, 80(4), pp. 35–40

Royal M 2007, 'Coastal Landscape Values Project – Southern Fleurieu Region Map', Department for Environment and Heritage (SA)

Schneider S 2006, *Climate Change: Risks and Opportunities*, Government of South Australia, Adelaide

Slovic P 1999, 'Comment: Are trivial risks the greatest risks of all?', in *Journal of Risk Research*, 2, pp. 281–288

Slovic P, Malmfors T, Krewski D, Metz CK, Neil N & Bartlett S 1995, 'Intuitive toxicology II: Expert and lay judgements of chemical risks in Canada', in *Risk Analysis*, 15(6), pp. 661–675

Smaldon D 2002, *An exploration of place attachment in Jackson Hole, WY*, University of Idaho, Moscow, ID

South Australian Government 2007, 'Tackling Climate Change: South Australia's Greenhouse Strategy', Government of South Australia, Adelaide

Stedman R 2003a, 'Is it really just a social construction? The contribution of the physical environment to sense of place', in *Society and Natural Resources*, 16, pp. 671–685

Stedman R 2003b, 'Sense of place and forest science: Toward a program of quantitative research', in *Forest Science*, 49(6), pp. 822–829

Stedman R 2004, 'Risk and climate change: Perceptions of key policy actors in Canada', in *Risk Analysis*, 24(5), pp. 1395–1406

Stedman R, Beckley T & Ambard M 2004, 'A picture and 1000 words: Using resident-employed photography to understand attachment to high amenity places', in *Journal of Leisure Research*, 36(4), pp. 580–606

Stokowski PA 2002, 'Languages of place and discourses of power: Constructing new senses of place', in *Journal of Leisure Research*, 34(4), pp. 368–382

Suppiah R, Preston B, Whetton PH, McInnes KL, Jones RN, Macadam I, Bathols J & Kirono D 2006, *Climate change under enhanced greenhouse conditions in SA,* Climate Impacts and Risk Group, CSIRO Marine and Atmospheric Research, Melbourne

Tuan YF 1977, *Space and place: The perspective of experience*, University of Minnesota Press, Minneapolis, MN

Tyrväinen L, Mäkinen K & Schipperijn J 2007, 'Tools for mapping social values of urban woodlands and other green areas', in *Landscape and Urban Planning*, 79(1), pp. 5–19

Urban and Regional Planning Solutions 2007, *Fleurieu Peninsula Region Integrated Strategic Tourism Plan 2007-2012*, Urban and Regional Planning Solutions, Adelaide

Williams, DR In Press, 'Pluralities of place: A user's guide to place concepts, theories, and philosophies in natural resource management', in L Kruger & T Hall (eds.), *Sense of Place in Recreation and Tourism Management* (PNW-GTR-xxx), USDA Forest Service, Pacific Northwest Research Station, Portland, OR

Williams DR, Patterson ME, Roggenbuck JW & Watson AE 1992, 'Beyond the commodity metaphor: Examining emotional and symbolic attachment to place', in *Leisure Sciences*, 14(1), pp. 29–46

Williams DR & Stewart SI 1998, 'Sense of place: An elusive concept that is finding home in ecosystem management', in *Journal of Forestry*, 95(5), pp. 18–23.

Williams DR, & Vaske JJ 2003, 'The measurement of place attachment: Validity and generalisability of a psychometric approach', in *Forest Science*, 49(6), pp. 830–840

Yohe, G.W., Lasco, R.D., Ahmad, Q.K., Arnell, N.W., Cohen, S.J., Hope, C., Janetos, A.C., & Perez, R.T. 2007 Perspectives on climate change and sustainability. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 811-841.

Zahran S, Brody S, Grover H, Vedlittz A 2006, *Climate change vulnerability and policy support*, Society and Natural Resources, 19(9), pp. 771–789