Regional Natural Resource Management (NRM)

Institutional, Strategic and Environmental Scans Report

A report prepared to assist NRM North and NRM South in the development of the NRM Regional Strategies (2015 – 2020)

April 2015

Report produced for NRM North and NRM South by:

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Report overview

This report presents the findings of the Regional Natural Resource Management (NRM) Institutional, Strategic and Environmental Scans Project 2015. The Project was undertaken to gather data, material and stakeholder insight to inform the 2015 to 2020 NRM Regional strategies currently under development for the Northern and Southern NRM Regions of Tasmania.

The report has been prepared for NRM North and NRM South by PDF Management Services, Natural Resource Planning, Climate Planning and Resonance Consulting (the Project Team). This project was commissioned to undertake the three scans (Institutional, Strategic and Environmental) and include a specific consideration of climate change.

The Project Team also completed a State-wide Stakeholders Engagement Project to elicit the views of NRM stakeholders about the next NRM regional strategies. The *State-wide Stakeholders Engagement Report* also contains relevant institutional, strategic, environmental and climate change information and should be read as a companion document to this report.

The content of this report is drawn from a desktop review of key literature and stakeholder engagement with individuals and organisations representing a wide cross section of landscapes and asset classes and a diverse range of interests in natural resource management. Stakeholders were engaged through an electronic survey, regional stakeholder workshops, organisational meetings and individual interviews.

It is important to recognise that the information presented comes from a scan of key literature, past NRM regional strategies and stakeholder engagement activities associated with the project. This report should not be viewed as a detailed analysis or evaluation of NRM activities.

Institutional Scan Results

The institutional scan recognised the vast array of stakeholders. Over 500 organisations and individuals where invited to share their views for this project and more than 120 participated. Natural resource management and climate change touch many sectors and, while there may be broad agreement on the overall direction and priorities, there are multiple drivers, sectorial needs and competing interests affecting each stakeholder.

The next NRM regional strategies will need to take into account the following stakeholder sectors: primary production; industry and manufacturing; local, Tasmanian and Australian governments; educational and research institutions; community based organisations and interest groups; Aboriginal people and communities in particular; and the general public.

Local government is a key stakeholder with a significant capability to influence natural resource management and climate change outcomes. The next NRM Regional strategies should consider structures and initiatives to increase involvement and commitment by local government.

A number of stakeholders were engaged both through this project and the State-wide Stakeholders Engagement Project. The quality and quantity of information received indicates a level of interest and arguably potential for participation that is currently untapped or underutilised. Some stakeholders expressed an interest in greater involvement in both strategy development and implementation on the basis that they have a shared responsibility and a capacity to influence positive change to natural resource assets.

The scan highlighted the diversity in stakeholder responsibilities, needs and participation in natural resource management. It is important that the next NRM Regional strategies recognise that stakeholders are not a homogenous group. Further work is required to build on existing knowledge to differentiate stakeholder capabilities and participation needs and to customise communication and engagement methods.

It is proposed that Themed Reference Groups be established to support institutional, strategic and environmental initiatives, including in areas such as professional development, organisational change, governance or stakeholder engagement. This could also include sector or topic-specific groups, for example, local government or climate change. The current Southern Councils Regional Councils Climate Change Adaptation Project is an example of the type of groups that are envisaged.

Some of the Themed Reference Groups could be strategic, with senior level personnel operating at a State level; and others could function at regional and/or local levels and be more operational in focus.

Characteristics of effective Themed Reference Groups would include:

- being driven by end users - outcome focused, not process focused
- involving representation by relevant technical experts
- involving representation by relevant stakeholders
- having the capacity to access additional expertise and resources
- gaining the credibility and capability to influence decisions and initiatives
- having the ability to communicate effectively with stakeholders
- using clear performance goals and measurement.

Strategic Scan Results

NRM Regional strategies are important guiding documents for the management of natural resources in Tasmania. They are reviewed every five years by NRM bodies on behalf of their stakeholders and the NRMs are currently in the process of developing the third iteration of their respective strategies.

The first of NRM regional strategies (2005-2010) provided extensive detail and included a large number of specific targets in the areas of 'resource conditions' and 'management actions'. The second round of strategies (2010-2015) were less detailed and focussed on priority setting and implementation. Feedback from this project suggests that stakeholders are looking for a mid-point between these approaches in the next NRM Regional strategies.

Stakeholders engaged for this project expressed a preference for greater consistency in the presentation of strategies from each region and for multi-regional and State information, issues and priorities to be presented the same way for all regional strategies. This was particularly important to those organisations that operated across multiple regions. Stakeholders also expressed a desire for the regional strategies to provide collective leadership that would improve engagement and better reflect issues confronting key sectors, such as Aboriginal communities.

The NRM Regional strategy reviews and implementation are resourced and undertaken by NRM North and NRM South with a concerted effort to engage as many stakeholders as possible. Although an emphasis of 'shared ownership' is strongly reflected in the strategies and promoted by the NRMs, there appears to be a disconnect between this intention and the actual buy-in of some stakeholders (especially those stakeholders that operate at the whole of state level).

This project suggests that the level of stakeholder buy-in, including the degree to which the NRM Regional strategies influence stakeholder planning and operations is low. Approximately 30% of stakeholders in both NRM North and NRM South reported not considering the NRM regional strategies in their natural resource management actions and/or planning.

While the two previous NRM regional strategies involved extensive stakeholder engagement, this report proposes that the next NRM regional strategies move towards a more collaborative and empowering form of engagement. This means stronger relationships and increased partnership involving shared responsibility, accountability, power and control.

This might be achieved by establishing formal structures and processes (for example, a stakeholder-driven Regional Strategy Taskforce or Working Group) that enables stakeholders to co-design the strategy content and collectively share accountability for implementation, monitoring and evaluation. It is important to note that successful strategy can be as much about how the strategy is developed as it is about what is in the strategy.

Forming such a structure may not be realistic before the next NRM regional strategies are drafted, however, this report recommends a group of this kind be established as soon as possible to guide the implementation of the next NRM regional strategies and be in place to support the next regional strategies in five years' time.

The need for the regional strategies to be more aligned has already been recognised by the three NRM regions in Tasmania and they have agreed on a common framework for the content of the 2015-2020 regional strategies. This report strongly supports that action.

Key considerations identified for the development of the next regional strategies include to:

- improve consideration of the longer term (e.g. to 2035) - especially for NRM South and to undertake a concerted effort to reflect where the next 5 year strategy fits within that longer timeframe;
- have a clearer representation of differing stakeholder needs and to identify how conflict between these needs and necessary trade-offs can be better managed;
- recognise that although the regional strategies are 'owned' by all in the region, NRMs hold a key role in implementation. As such, regional strategies should reflect capacity building processes necessary to implement the strategies, especially those associated with strategic organisational influence, climate change and information systems);
- ensure that effective data and information management is identified in the strategies as a core element for implementation and collaboration. Improved data management and information sharing can act as a conduit to further opportunities for the NRM regions to work collaboratively.

In part, NRM the regional strategies will be judged on the outcomes achieved in the improved condition of natural resource assets. Making judgements on performance and outcomes is dependent on effective indicators and measurement. There appears to be scope for improvement in this area which warrant consideration in the next regional strategies. This would need to include broad stakeholder participation in indicator development and performance monitoring.

Environmental Scan Results

The need for an information systems approach to information and knowledge management is a key finding of the environmental scan. In an NRM world suffering from information overload, this approach is critical to supporting the achievement of environmental outcomes in a changing climate.

It is proposed that the three Tasmanian NRM regions resource the establishment of an ongoing, structured and participatory approach to data and knowledge management on a collective basis.

It is also proposed that Themed Reference Groups as suggested above, be established with regard to specific environmental areas. These Themed Reference Groups would be formed to coordinate activity regrading elements of the proposed asset classification including: the monitoring of new information; design of information storage systems; and communication of the outcomes of the Themed Reference Group work among stakeholders.

A key consideration in formulating the above recommendation was the discussions with stakeholders who consistently identified the importance of measurement, monitoring and evaluation as part of any meaningful strategic effort. Baseline information to enable monitoring and assessing environmental change is required. Some information and data already exists, however, more work is required to consolidate this into baseline material in some areas. Design of this component of the next regional strategies should reflect that NRMs have real constraints in terms of resourcing evaluation activities and therefore additional indicator development and monitoring and evaluation may need to be considered as a more collective and collaborative effort.

A range of documentation relating to previous NRM regional strategies and key external drivers (e.g. Tasmanian Government NRM framework and priorities) were reviewed under the project. Most of the content of previous strategies and associated issues remains relevant for the next NRM North and NRM South regional strategies. The use of a shared format for strategies across the three Tasmanian NRM regions is supported, and the current draft proposed structure is considered to be suitable for this purpose.

An important finding is that the proposed asset 'Community' within the structure is about strategy and capacity, and that the proposed use of 'Landscapes' in the structure provides the means by which the asset is addressed among different socio-economic and geographic groups.

The review of documents identified variations in focus and emphasis on NRM assets and issues between the two strategy periods (2005-2010 and 2010-2015), and within the latter period differences between the NRM North and NRM South regions were greater. A draft asset classification, to be maintained over time by the Themed Reference Groups, is provided as a recommended common foundation for future strategies.

The proposed asset classification system consists of four asset classes as follows:

- land (comprising two assets for land and soil resources and terrestrial biodiversity);
- freshwater and inland aquatic systems;
- coastal and marine systems; and
- air.

It was identified in developing this classification system that further consideration may need to be given to treating biodiversity as a separate asset class. This is due to the extensive overlap between terrestrial, freshwater, coastal and marine and urban environments.

A range of recent documents relating to the incorporation of climate change into NRM regional strategies was also reviewed. Climate change in Tasmania is predicted to be of lower magnitude than across much of mainland Australia but is still likely to have significant impacts on NRM assets. In particular, impacts in the shorter term are likely to be focused in sensitive environments (coast and marine, freshwater and alpine systems). However, irrespective of time frames of change, the recent information sources reviewed point to a need to focus planning on two principles:

- prioritising and managing important values to secure them (but also including trade-offs around some); and
- managing other assets so that NRM activities goes with the flow of climate change rather than trying to resist it.

These principles are incorporated into the development of the recommended focus areas for the NRM North and NRM South strategies.

The recent documentation around climate change points to a need for dynamic planning of NRM activity to respond to changing circumstances. The unpredictability of climate extremes and the occurrence of tipping points in natural systems arising from climate change, mean such an approach is required. This needs to be reflected in the next NRM regional strategies in two ways:

- providing for review triggers within the strategies themselves, i.e. review can occur within the strategy period; and
- ensuring that the design of programs, strategies and activities is robust to a range of climate change scenarios[1], rather than that existing at a point in time.

The environmental scan contains a number of recommended focus areas for the next NRM North and NRM South regional strategies. These are based on multiple sources including: the reviews of previous strategy and climate change documents; the assets and issues classification and analysis; and stakeholder responses to a number of focused questions around the asset classification, issues affecting stakeholders, priority issues for the next strategies, ability to manage under climate change, and key landscapes in which NRM activity on the assets and issues might be focused.

The table below identifies the recommended focus areas and key elements of the approach for the two regions.

[1] See recommended approach in Dunlop *et al.* (2013), p71. Although primarily designed for biodiversity this approach is considered appropriate across a range of NRM assets.

Recommended focus area	NRM North	NRM South
Land – land and soils		
Soil management	Regional focus	Regional focus
Vegetative cover	Regional focus	Regional focus
Water-related land and soil issues	Common focus between regions	Common focus between regions
Land - biodiversity		
Ecologically functioning landscapes	Regional focus	Regional focus
'Special' values	Common focus but variation in regional delivery	Common focus but variation in regional delivery
Change and emerging issues	Common focus implemented collaboratively	Common focus implemented collaboratively
Freshwater and inland aquatic systems		
Water ecosystem health	Regional focus	Regional focus
Important freshwater areas	Common focus but variation in regional delivery	Common focus but variation in regional delivery
Water supply and utilisation	Regional focus	Regional focus
Change and emerging issues	Common focus implemented collaboratively	Common focus implemented collaboratively
Coastal and marine systems		
Threated coastal features	Common focus but variation in regional delivery	Common focus but variation in regional delivery
'Special' values	Common focus but variation in regional delivery	Common focus but variation in regional delivery
Marine debris	Common focus implemented collaboratively	Common focus implemented collaboratively
Change and emerging issues	Common focus implemented collaboratively	Common focus implemented collaboratively
Air		
Greenhouse gas emissions	Regional focus	Regional focus
Wood smoke and particulates	Regional focus	n/a

Tasmanian Aboriginal people and communities

The Tasmanian Natural Resource Managament Framework refers to the important connection between of the Tasmanian Aboriginal people and the land, water and cultural heritage of the State. This important connection is mentioned in each of the NRM strategies, however there is no tangible evidence to show how the consideration of Aboriginal issues influences regional scale NRM activities or strategic direction.

Although there has been an array of individual activities and interactions with Aboriginal communities, there is room for improvement. There is an opportunity for NRM North and NRM South to work with Cradle Coast NRM and with Aboriginal people and communities to reset this relationship and explore new ways to work together in the development and implementation of the next NRM regional strategies – ways that are directed by Aboriginal people and shared by all stakeholders.

This report recommends that all 3 NRM regions collectively initiate dialogue with Aboriginal people as a matter of priority.

Climate Change

Climate change is a game changer for natural resource management. It is a risk multiplier for existing stressors and introduces a variety of new challenges that will threaten the systems that underpin our economies and communities. This scan has identified that organisational understanding, resourcing and action across the State with regard to climate change appears to be relatively low. This is not surprising in some ways, given the nature and complexity of the issue. This report suggests that the greatest chance of achieving results in regard to climate change will be through organisations working collectively and collaboratively. NRM North and NRM South are well placed to lead and facilitate the structures and initiatives to enable stakeholders to take on this challenge together.

In order for results to be achieved in relation to climate change, commitment is needed at an organisational leadership and management level. Eight governance indicators have been developed to assist organisations assess their current position and identify priorities and areas for further activity.

Stakeholders generally reported low levels of planning and resourcing in regard to their organisational response to climate change. This report also identified the opportunity for professional development of stakeholder organisations and the provision of timely and relevant information as potential activity areas for NRM regional strategies.

Review of the Act

This report and the *State-wide Stakeholders Engagement Report* have been timely in regard to the proposed review of the Natural Resource Management Act (2002).

The reports for both projects provide a resource and commentary from stakeholders that should assist NRM North and NRM South with input into the review.

Key NRM North Findings

- The NRM North stakeholders expressed a positive level of satisfaction about engagement between themselves and NRM North (63% extremely satisfied or satisfied).
- The top three landscapes that were the regional stakeholders' core business (in order) are Productive, Natural and Coastal and Marine.
- Each of the previous strategies reflected the complex nature of natural resource management. The 2005-2010 and 2010-2015 strategies did not differ considerably as the latter was built on top of the 2005-2010 strategy. Both contained an asset-based framework. However, actions and targets where more simplified than the first strategy (2005-2010). Neither strategy referred to the other regional NRM bodies (although in practice strong ties exist between all three).
- It is not clear in the past strategies how the stakeholders (who have a collective ownership of the strategies) are performing. There does not seem to be an appropriate system (with supporting database architecture) that allows all stakeholders to access data, upload data and monitor performance of the actions over time (for a dynamic and transparent approach for a stakeholder review of the performance of the strategies).

- The institutional scan highlighted the fact that the region has a considerable number of stakeholders representing a broad range of interests. This presents a considerable challenge for the development of the next strategy in regards to managing trade-offs, goal conflicts and identifying priority actions.
- The online survey showed that there was a strong difference in the strategy impact between those who work across the state (e.g. State agencies) and those who work specifically in the NRM North region. For example 31% of the stakeholders in the NRM North Region stated that the strategy influences their natural resource management actions 'considerably' – compared to just 3% of state-wide stakeholders.
- The stakeholder engagement showed that the strengths of the previous strategies were on providing information and actively building capacity.

Key NRM South Findings

- The NRM South stakeholders expressed a positive level of satisfaction about engagement between themselves and NRM South (59% extremely satisfied or satisfied).
- The top three landscapes that were the regional stakeholders' core business (in order) are Natural, Productive and Coastal and Marine.
- Each of the previous strategies reflected the complex nature of natural resource management. The 2005-2010 and 2010-2015 strategies differed considerably. The 2005 strategy was more of a targeted strategy with more definitive targets, whereas the 2010 strategy took a 'big picture' approach. Neither strategy referred to the other regional NRM bodies (although in practice strong ties exist between all three).
- It is not clear in the past strategies how the stakeholders (who have a collective ownership of the strategies) are performing. There does not seem to be an appropriate system (with supporting database architecture) that allows all stakeholders to access data, upload data and monitor performance of the actions over time (for a dynamic and transparent approach for a stakeholder review of the performance of the strategies).
- The stakeholder engagement showed that the strengths of the previous strategies were on providing information and actively building capacity.

- The institutional scan highlighted the fact that the region has a considerable number of stakeholders representing a broad range of interests. This presents a considerable challenge for the development of the next strategy in regards to managing trade-offs, goal conflicts and identifying priority actions.
- The online survey showed that there was a strong difference in the strategy impact between those who work across the state (e.g. State agencies) and those who work specifically in the NRM South region. For example 29% of the stakeholders in the NRM South Region stated that the strategy influences their natural resource management actions 'considerably' – compared to just 3% of state-wide stakeholders.
- In regards to climate change the stakeholders in the region are only in the embryonic stages of planning for climate change, with little resources or formal processes being undertaken to manage this important issue.

Conclusion

In addition to identifying the important issues and topics that need to be included in the next NRM regional strategies, this project has identified a need for a slightly different model to underpin their development, implementation and measurement.

This model features the following components:

- involvement and participation of stakeholders at a level beyond simple consultation
- structures and processes that enable stakeholders to collectively co-design and implement the strategy and to share and measure the results
- strategic thinking and initiatives underpinned by an effective data and information management system
- Themed Reference Groups to muster relevant stakeholders and expertise to collectively prioritise and act on key projects
- differentiation and targeting of specific stakeholder groups such as local government
- increased understanding and capacity to act in relation to climate change
- efficient resource use by all regions working collectively and across regional boundaries on joint projects and initiatives
- stronger connection to, and direction from, Tasmanian Aboriginal people and Aboriginal communities.

The project consistently highlighted the need for stakeholders to work collectively and collaboratively to best achieve results and initiate change in natural resource management. Although this has always been the focus of NRM North and NRM South, there is still room for improvement – especially related to working across borders to capitalise on economies of scale.

NRM North and NRM South are seen by stakeholders as trusted, credible and neutral – not aligned with any political or radical agenda. In addition, NRM North and NRM South board members and senior staff have other roles within the sector, government and the community that provide opportunities to elevate natural resource management considerations to many other forums.

NRM North and NRM South are well placed to facilitate and guide the kind of collective and collaborative stakeholder efforts that will lead to improved outcomes for the natural resource assets in Tasmania.

List of key recommendations

Institutional recommendations

Recommendation 1

Prior to development of the regional NRM strategies, a short paper (less than 10 pages) on local government and NRM be prepared to identify and discuss the issues and drivers for local government that impact on natural resource management and engagement with the regional NRM process. The paper should be prepared with input from the sector, both individually and collectively through the regional and State representative bodies.

Please note: this model of preparing sector specific discussion and engagement papers is recommended for use with other sectors in line with specific topics under consideration from time-to-time.

Recommendation 2

The 6 global mega-trends identified in CSIRO's Our Future World Report 2012 need to be considered in draft of the next strategies.

Recommendation 3

The next regional strategies for both NRM North and NRM South should include additional stakeholder analysis that identifies and/or builds on key issues for each stakeholder.

Recommendation 4

To measure the effectiveness of the next regional strategies in influencing stakeholders' consideration of climate change in natural resource management, a metric could be included to assess the extent to which the climate change policies of stakeholder organisations consider natural resource management.

Recommendation 5

It is recommended that processes and structures used to develop and implement the NRM North and NRM South regional strategies should address stakeholder's perceptions that the regional strategies are the responsibility of the NRM regions. Alternative structures need to be developed in each region which involve stakeholders in overseeing the development, finalisation and implementation of the regional NRM strategies.

Recommendation 6

It is recommended that Aboriginal people and communities be engaged to determine the cultural context and priorities for inclusion in all three regional NRM strategies.

Recommendation 7

NRM effectiveness is dependent on the level of ownership of strategies among regional stakeholders. Therefore additional methods of increasing stakeholder engagement and ownership of the regional NRM strategies need to be developed. Suggestions include: more inclusive ways of engaging smaller stakeholder groups; formal and informal engagement processes; transparency and openness in communication and information; face-to-face engagement opportunities; to get stakeholders participating by attending, hosting and promoting events and activities; and to ensure two-way communication and engagement processes.

Recommendation 8

NRM regions should promote reference to the regional NRM strategies in each individual Local Government Strategic Plan to give natural resource management and climate change sufficient status and resource allocation and accountability for outcomes, reporting and evaluation.

Recommendation 9

NRM North and NRM South should adopt the 8 governance indicators (Page 92) used in this report to measure climate change responsiveness.

1. *Extent that stakeholders have a formal policy or process for climate change;*
2. *Resource allocation for the management of climate change issues;*
3. *The level of stakeholder expertise /capacity in climate change management;*
4. *Access to climate change information*
5. *Extent of climate change risk assessments or adaptation planning*
6. *Monitoring the identified barriers to adaptation*
7. *Inclusion of climate change in local government strategic plans*
8. *The existence of a database management system.*

Recommendation 10

The next regional NRM strategies should prioritise 'supporting stakeholders to incorporate climate change and resourcing for climate change initiatives into their next strategic plans and natural resource management plans'. This might involve supporting in-house capacity building such as training and professional development, the production of governance and policy templates and other guidance materials, for example risk assessment frameworks.

Additional Institutional Findings ***

*** *Please note: these findings are outside the scope of this project. The observations has however, been included as operational issues for further consideration by NRM North and NRM South when implementing the next Regional Strategies.*

Observation 1

It is recommended that the NRM regions adopt and lead a best practice approach to climate change governance. Both the SCARP Report and the AdaptNRM portal provide directions for the NRM agencies to undertake these actions.

Observation 2

It is recommended that NRM North and NRM South analyse the preferences of individual stakeholders to determine their NRM interests and their desired level and type of involvement in responsive engagement mechanisms – such as formation of working parties and reference groups.

Observation 3

It is recommended that NRM North and NRM South should develop a data base that classifies stakeholders by their areas of interests; willingness to be involved; preferred involvement methods; and preferred communication methods and frequency.

Strategy recommendations

Recommendation 1

1a. Explicitly state Aboriginal values relating to relevant landscapes in key asset areas in the NRM Regional Strategies.

1b. Engage with bodies such as the Interim Aboriginal Heritage Council to generate and embed key priorities in future NRM Regional Strategies.

1c. Implement an ongoing Aboriginal engagement strategy which builds relationships and mutual understanding; supports participation on the NRM Council and NRM regional committees; and facilitates priority actions.

Recommendation 2

Other considerations for inclusion in next strategies include; building stakeholder knowledge of the legislative principles and structures which underpin the delivery of effective natural management outcomes; aligning regional priorities with government funded projects; selecting actions that realistically reflect available resources and create the structure to lever of other funding and access stakeholders may have to other resources; and building on the success of earlier work.

Recommendation 3

The roles and functions of NRM Facilitators located in local Councils need to be reviewed in light of the priorities identified in the next regional NRM strategies – to determine the best ways to allocate NRM regional staff to achieve the objectives of the regional NRM strategies.

Recommendation 4

NRM Regional strategies should include a set of measures and indicators that align with or are easily adaptable by NRM stakeholders (see indicators under Institutional Scan).

Recommendation 5

NRM Regional Strategies should be based on and deliver data and evidence to substantiate the economic benefit (and analysis of costs and benefits) to encourage stakeholder investment in natural resource management and climate change initiatives.

Recommendation 6

NRM Regional Strategies should consider the inclusion of longer term directions or goals (20 years+) to create a context for the next 5 year strategy.

Recommendation 7

The next NRM Regional Strategies should prioritise 'supporting stakeholders to incorporate climate change and resourcing for climate change initiatives into their next strategic plans and natural resource management plans'.

Environmental recommendations

Recommendation 1

Themed Reference Groups be established to support institutional, strategic and environmental initiatives including areas such as professional and organisational development, governance or stakeholder engagement and participation.

Recommendation 2

The proposed classification of Land, (land and soil resources and terrestrial biodiversity); Freshwater and Inland Aquatic Systems; Coastal and Marine Systems and Air be adopted as the framework for analysing, prioritising, engaging, monitoring and reporting of NRM assets and issues.

Please note:

Additional environment landscape and asset recommendations are detailed in the body of this report where the relevant context and considerations are provided.

Additional Environmental Finding ***

*** *Please note: this finding is outside the scope of this project. The observation has however, been included as operational issues for further consideration by NRM North and NRM South when implementing the next Regional Strategies.*

Observation 1

It is recommended that the three Tasmanian NRM regions should collectively resource the establishment of an ongoing, structured and participatory approach to data and knowledge management.

1 Introduction

1.1 Background

Natural Resource Management North (NRM North) is the regional natural resource management body for northern Tasmania and NRM South is the regional natural resource management body for southern Tasmania. Both are established under the *Tasmanian Natural Resource Management Act 2002* ('the Act') as two of the three natural resource management bodies in the State. The Act prescribes the functions of the two organisations which can be summarised as:

- identifying the region's natural resource management priorities;
- developing a regional plan (Strategy) to address these priorities; and
- facilitating the implementation of actions designed to enhance natural resource management in the region.

These functions are undertaken through providing knowledge and information, engaging and developing community capacity, partnering and leveraging funds, and delivering strategic on-ground works.

NRM North covers the eight municipal areas comprising Northern Tasmanian Development (NTD) and includes the coastal zone and adjacent State waters. NRM South covers the twelve municipal areas comprising the Southern Tasmanian Councils Authority (STCA) and includes the coastal zone and adjacent State waters.

The Institutional, Strategic and Environmental Scans Project ('The NRM Scans Project) has been initiated by NRM North and NRM South to provide a comprehensive foundation from which to develop the next iteration of the respective organisation's regional NRM Strategies.

At the core of this project are three detailed scans comprising the following elements:

Environmental Scan – assessment of the biophysical features and assets of each region, including an assessment and review of the impacts of climate change and other processes, and the associated risks and opportunities.

Strategic Scan – review of the two previous regional Strategies to understand the achievements, limitations and constraints of these strategies, as well as to recognise the volume of NRM implementation achieved through these strategies

Institutional Scan – review of regional capacity and the model, to identify opportunities and mechanisms to improve integration with other planning and decision making processes that influence natural resource management at a State or regional scale. The scan also identifies potential indicators of success.

In undertaking these scans the project has also included significant amounts of stakeholder engagement in order to provide perspective and inputs across the three elements.

1.2 Report logic

The project has involved a diverse range of activities, with many overlapping in terms of the various scans. Rather than report on the outputs of individual activities the report has been structured to present the outcomes of the various activities within the context of each specific scan.

Within each section of the report there is a concluding section that summarises key points arising from the section and recommendations. Key points from each of the sections are then used to inform the Report Overview. Where there are clear differences between NRM North and NRM South on particular issues they have been identified and discussed.

Recommendations have been broken up as per the categories described in Table 1. Also, recommendations can apply to NRM North or NRM South separately, or both and are annotated accordingly. Recommendations have been consolidated into a list following the Report Overview.

Recommendation type	*Scope of recommendation*
Institutional recommendation	Relates to the organisations involved in regional NRM, their internal resourcing and process, and how they relate to other organisations
Strategy recommendation	Relates to the strategic approach to NRM, how issues are identified and managed.
Environmental Recommendation	Primarily environmental issues

Table 1 NRM Scans Project – recommendation categories

1.3 Report structure

The report has been structured into the following chapters:

1.3.1 Methodology

A short description of how the project was delivered and the main packages of work that have informed the project findings and recommendations.

1.3.2 Project context

There are a number of other related issues and projects that impact on the regional NRM processes and provide context for this project, in particular:

- State-wide Stakeholders Engagement Project
- Climate change
- Previous regional strategies.

1.3.3 Institutional Scan

This scan frames the milieu within which the regional NRM bodies and their stakeholders work. In this chapter commentary is made on the regulatory framework, the importance of local government and the identification of the stakeholders, the relevant sectors, assets and landscapes with which they align. Relevant policies and regulations associated with climate change that will influence natural resource management are also presented. Finally, this chapter covers the issue of climate change governance and presents a review of the NRMs stakeholders against a set of climate change adaptation governance models.

1.3.4 Strategic Scan

This chapter explores the previous NRM strategies for NRM North and NRM South, provides insight from stakeholder engagement about the current influence of the strategies on stakeholder natural resource management as well as commentary on issues associated with processes for the implementation of the next strategies. The Strategic Scan also sets the scene for the Environmental Scan in Chapter 3.

1.3.5 *Environmental Scan*

The purpose of the Environmental Scan is to contribute information and perspectives on natural resources for consideration in developing the next round of NRM regional strategies.

The scan consists of three parts: an analysis of documents relevant to the next round of NRM strategies; a draft asset classification for consideration and consultation in strategy development; and a discussion of important co-requisites for asset information and knowledge to be effectively incorporated into strategies and their implementation.

2 Project methodology

2.1 Project delivery

The NRM Scans Project has been managed by Andrew Baldwin, NRM North and Luke Diddams, NRM South. To provide staff within NRM South and NRM North the opportunity to contribute to, rather than *drive*, the project an external project team was engaged by NRM South to undertake the key project activities. The Project Team comprised the following personnel:

- Michael Gordon and Ged Dibley (PDF Management Services)
- Donovan Burton (Climate Planning)
- Rod Knight (Natural Resource Planning)
- Timothy Phillips (Resonance Consulting).

2.2 Methodology

Element	**Key activities**
Staff workshops	Members of the project team met with staff from both NRM North and South in a group setting to identify and discuss key issues.
Regional Stakeholder Workshops – North and South	Two regional workshops were held Launceston and Hobart
NRM Stakeholder Survey (incorporates the State-wide stakeholder engagement project)	Design, deployment and analysis of an online survey
Institutional Scan	Scan and summarise the regulatory and institutional milieu in which NRM organisations operate; Identify and engage with the key stakeholders to gain their insight and input about barriers and enablers for natural resource management associated with the institutional arrangements; and Review climate change governance (i.e. the extent that climate change is considered by the NRM agencies and the stakeholders).

Element	Key activities
Strategic Scan	Record and reflect on previous regional NRM strategic planning Assess alignment with the agreed principles (e.g. Assets, Landscapes, MERI, implementation) Critique and provide realistic and robust advice Be critically linked to the institutional analysis (adaptation governance)
Environmental Scan	Review the identified strategic documents identified in the brief Identify and review additional strategic documents of relevance to the review of the regional strategies Systematically classify the relevant issues identified by the strategic documents Present each issue as an accessible summary for use in developing new regional strategies, including profiles of available knowledge and data, knowledge and data gaps, climate change implications, potential significance for NRM bodies, and associated social-economic and cultural perspectives.

Table 2 NRM Scans Project – methodology overview

The methodology is expanded upon within each scan component.

Section summary

Key point 1 NRM North and NRM South initiated a project to undertake institutional, strategic and environmental scans to inform the development the next iteration of the regional NRM strategies. The project was undertaken by an external project team with high levels of input from NRM staff and external stakeholders.

Key point 2 The NRM Scans Project has included the following tasks and activities: workshops and meetings with NRM staff, workshops with regional stakeholders in the North and South, a comprehensive NRM stakeholder survey, an Environmental Scan, a Strategic Scan and an Institutional Scan.

3 Project context

3.1 State-wide Stakeholders Engagement Project

In parallel with the NRM Scans Project, the Project Team has undertaken a State-wide Stakeholders Engagement Project on behalf of the NRM Cradle Coast, South and North. While separate projects there have been areas of overlap, particularly around stakeholder views and issues and to the greatest extent possible the Project Team has incorporated these issues into both reports.

The State-wide Stakeholders Engagement Project has been delivered through three key activities, undertaken sequentially to allow the learnings and observations from preceding activities to inform the next activity.

3.1.1 NRM Stakeholder survey

A comprehensive online survey was developed to address both the NRM Scans Project (this report) and the State-wide Stakeholders Engagement Project. The survey was distributed to over 480 stakeholders with a direct or indirect interest in natural resource management. The list of survey recipients was prepared by the Project Team with input from the three NRM regions, and those on the distribution list were invited to forward the survey on to colleagues and others in their networks. In addition, the survey was distributed via Facebook, twitter and organisational and industry newsletters.

3.1.2 State-wide Stakeholders Forum

A focussed two hour forum was held on 19 November 2014 at the Royal Yacht Club of Tasmania. It involved a number 26 of State-wide stakeholders and representatives from each of the three NRM regions. The forum was structured to include discussion about the regional planning process and to provide an opportunity for attendees to provide direct feedback to the Project Team and the NRM regions on issues and priorities.

3.1.3 Targeted Stakeholder Interviews

Following the State-wide Stakeholders Forum the Project Team reviewed the responses to the NRM Survey and the attendee list to identify key State-wide stakeholders not represented in either activity. A list of State-wide stakeholders for direct engagement was discussed with the three NRM regions. A decision made to bring forward a number of the stakeholder interviews from the NRM Scans Project to ensure appropriate coverage of State-wide stakeholders. A total of five targeted stakeholder interviews were undertaken.

Interviews were held with the following organisations and their representatives:

- *Department of State Growth* – Penny Wells and Robert Miley
- *Department of Primary Industries, Parks, Water and Environment* – John Whittington and Alistair Clark
- *Tasmanian Chamber of Commerce and Industry* – Michael Bailey
- *Tasmanian Farmers and Graziers Association (TFGA)* – Peter Skillern
- *Tasmanian Planning Commission (TPC)* – Greg Alomes

Section summary

Key point 3 In parallel with the NRM Scans Project, the three NRM regions have also conducted the State-wide Stakeholders Engagement Project. The project was undertaken via a survey, a State-wide stakeholder forum and targeted stakeholder interviews. The outputs of this project have directly informed the NRM Scans Project.

3.2 Climate change planning and adaptation

The reality of climate change is indisputable. The impacts are already manifesting in many parts of the world through increases in extreme events, population displacement, damage to infrastructure, species shifts, regulatory changes and challenges to insurance availability and affordability.

The latest scientific projections see the world heading towards a global average 4°C increase by 2100, compared to preindustrial times[2]. Although there is an imperative to reduce the global carbon footprint to avoid the unmanageable, there is also a critical need to adapt to the changing climate that is unavoidable.

The natural environment faces a multiplicity of stressors (such as urbanisation, deforestation, agriculture and so on) and many of these are likely to be affected by climate change and associated management actions. Compared to mainland Australia, Tasmania is less likely to be impacted by the direct impacts of climate change. However this does not mean that it faces no threats. For example, it is estimated that over $200 billion of assets are exposed to 1.1m of sea level rise, crops will face increased threats from disease and considerable stress will be placed on the aquaculture and marine fisheries[3].

Although individual and short term events are difficult to reliably attribute to climate change, land managers and planners are becoming increasingly aware of its potential effects on their activities. Their responses to the issue are likely to have deep and profound effects on how natural resources are managed, both positively and negatively.

Areas in which manager behaviour modification has been observed include:

- preparedness, prevention and response to high fire risk, with potential implications for nature conservation values and priorities assigned to different management functions;
- increasing fodder reserves and water availability for stock - with its associated economic costs for rural businesses;
- distortion of prices for limited resources (e.g. water) as producers move to diversify into more secure activities; and
- putting things in the 'too hard basket' (often already hard without the uncertainties of climate change).

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[2] (Rosenfeld, D., S. Sherwood, R. Wood and L. Donner, Climate Effects of Aerosol-Cloud Interactions *Science*, Jan. 2104, Vol. 343, 379-380.) and (*'World Bank Group. 2014. Turn Down the Heat: Confronting the New Climate Normal. Washington, DC: World Bank. © World Bank.)*

[3] Will Steffen, John Hunter and Lesley Hughes (2014) Counting the Costs: Climate Change and Coastal Flooding by (Climate Council of Australia).

Climate change risks can manifest in a wide array of ways - shifting extremes, slow, subtle changes in averages or nonlinear step changes. Although a wealth of information exists about the possible impacts of climate change, much is still unknown.

NRM agencies play a critical role in maintaining currency of the issues and acting as a catalyst for collaborative change. Understanding and managing climate change issues for natural resources is a complex issue that can only be managed through a collaborative process. It requires a deep understanding of the current state of the environment, the critical sensitivities and the anticipated changes and a flexible system to ensure collaborative outputs are maximised. This needs to occur in a context where there is a wealth of competing interests that might result in adaptation-specific goal conflict. For example, one solution to urban sea level rise risk may be through construction of sea walls, however this may come at the expense of coastal impacts with cascading impacts through the aquaculture industry.

Ultimately, managing the natural environment through the emergence of direct and indirect climate change is about informed decision making. At the same time, NRM organisations need to ensure their systems are suited to understanding the shifting collaborative landscape as it responds to emerging issues and opportunities. The issue of managing regional climate change effects and adaptation is a collective issue. Although each stakeholder within this project maintains individual roles and responsibilities, all parties also recognise that planning for climate change will need to incorporate shared roles and responses.

Section summary

Key point 4 Climate change presents a range of risks and opportunities that within the context of natural resource management, need to be understood, assessed and managed. Understanding and managing climate change issues for natural resources is a complex issue that can only be managed through a collaborative process. NRM agencies play a critical role in maintaining currency of the issues and acting as a catalyst for collaborative change.

3.3 Previous regional strategies

3.3.1 Short history of the regional NRM model in Tasmania

Natural resource management has become central to the delivery of many environmental programs throughout Australia. This has been facilitated through the establishment of relationships and obligations between the Australian Government and recognised Natural Resource Management organisations and Catchment Management Authorities.

The origin of this model of NRM delivery lies in the mid-term review of the National Heritage Trust (Howard Partners, 2000[4]) established under the proceeds of the first tranche of the privatisation of Telstra. It identified a number of problems with delivery, including in the areas of complexity, efficiency, strategic focus, and monitoring.

Formal arrangements for the delivery of natural resource management activities were established in Tasmania by the *Tasmanian Natural Resource Management Act 2002*. The Act establishes a Council with responsibility to advise the Minister on priorities and funding for natural resource management activities. NRM priorities are contained within the Tasmanian Natural Resource Management Framework (DPIWE, 2002[5]). The framework outlines two groups of priorities:

- *Process priorities* – capacity building; education / communication; and research; and
- *Natural resource management priorities* – water management; vegetation management (forest and non-forest); soil management; management of weeds, pests and diseases; and management of the coastal / marine environment. (p7)

Priorities in the framework were part of a more general review of the NRM in Tasmania in 2008, which recommended:

> 'That the Minister seek the advice of the NRM Council on priority-setting arrangements that are more agile, and will provide guidance for both planning and assessing NRM activities at a regional level. This advice is to be

[4] Howard Partners (2000).
[5] Department of Primary Industries, Water & Environment (2002).

provided within six months of the acceptance of the Review by the Minister.' (DPIPWE, 2008[6], p16).

The Act also provides for the Minister to declare incorporated associations to be 'regional committees'. These committees are the three current regional organisations – NRM Cradle Coast, NRM North and NRM South.

Regional committees under the Act are responsible for drafting regional strategies, which are submitted to the Council to formulate advice to the Minister on their accreditation. Regional strategies are required to be reviewed every five years. The Tasmanian NRM regional organisations differ from some mainland bodies (e.g. some Catchment Management Authorities) in having no regulatory power in relation to priority setting or implementation of strategies.

3.3.2 Previous approaches to the regional NRM Strategies

The Tasmanian NRM regions have produced two rounds of regional strategies. The first round of strategies (2005) were relatively detailed and complex documents, with a structured classification and large numbers of 'resource condition targets' and 'management action targets'. The second round of strategies (2010) were more simply structured, with a much more general approach to setting of priorities and their implementation.

In moving towards a third round of NRM strategies, Tasmania's NRM organisations have indicated an intention to seek a practical balance between principles and detailed priorities. This is to be achieved through a common strategy format that identifies both NRM assets and landscapes. Assets are the natural resources that are the target for management (e.g. land and soils, coastal). Landscapes are social patterns in which organising participation is likely to have similar characteristics (e.g. urban landscapes, production landscapes).

[6] Department of Primary Industries & Water (2008a).

3.3.3 Challenges with the regional NRM model in Tasmania

The regional NRM organisations in Tasmania operate in an environment with a significant number of influencers outside their control:

- Levels of core funding are not guaranteed and to date have been reliant on both State and Commonwealth Government.
- Project-specific funding from Governments is often tied to priorities that may not reflect those of the NRM regional organisations.
- Funding cycles are more tied to political cycles than those necessarily needed to achieve NRM outcomes over the longer term.
- Sections of Government and business may be pursuing policies and directions that are not entirely consistent with NRM priorities.
- Other aspects of Government may overlap the NRM ambit and affect outcomes both positively and negatively, e.g. land use planning and approvals.
- Government priorities may not always align with the priorities of regional NRM stakeholders.
- Priorities set in a regional NRM strategy may not be those of NRM regional stakeholders or may create trade-offs due to competing interests.
- Interest and capacity of regional NRM stakeholders may not be sufficient to achieve priorities in NRM strategies.
- NRM effectiveness relies on a sense of ownership of strategies among regional stakeholders.
- The scope and scale of relevant NRM priorities may be beyond realistic or available levels of resourcing.
- Regional NRM stakeholders may hold divergent views on NRM priorities and methods to address them.
- A range of different levels of interest and roles influence direction (e.g. State government, local government, community groups, local groups, and individuals).
- Existing networks of relationships may have evolved separately from NRM to meet particular purposes, but do not necessarily have a comfortable fit with NRM processes.

This level of complexity presents major challenges for natural resource management both generally and for the regional NRM organisations. Perhaps not surprisingly, NRM issues have been described as a 'wicked problem' (*sensu lat.* Rittel and Webber, 1973[7]) in that they '...defy efforts to delineate their boundaries and to identify their causes, and thus expose their problematic nature' (p167).

The current delivery model for NRM across Australia is in part, an approach to addressing the wicked problem, particularly in the area of governance. A major challenge is achieving rigour and consistency in addressing NRM planning and implementation at all levels of engagement. Developing and effectively implementing NRM strategies is a major part of that challenge.

Section summary

Key point 5 The origin of this model of NRM delivery lies in the mid-term review of the National Heritage Trust established under the proceeds of the first tranche of the privatisation of Telstra. It identified a number of problems with delivery, including in the areas of complexity, efficiency, strategic focus, and monitoring.

Key point 6 Since its inception in 2001, the approach to regional NRM has changed, starting initially as a highly prescriptive process with detailed priorities and actions through to a high level approach with broad strategic themes and priorities. With the next iteration of the strategies the NRM regions have expressed the desire to achieve a middle ground between the two, and deliver a strategic planning process that provides a focus and direction, while allowing an adaptive approach that enables resources to be moved in response to new information and emerging priorities.

[7] Rittel, H.W.J. & Webber, M.M. (1973).

3.4 Tasmanian Aboriginal People and NRM

There has been a Tasmanian Aboriginal population for approximately 40,000 years. However, early European settlement resulted in considerable injustice for the Aboriginal population which is likely to have affected natural resource management today. The institutional system that guides Tasmanian natural resource management is Euro-centric in origin (formed along colonial political boundaries) and this may influence the ability for effective consideration in any NRM strategy. For example, the *Tasmanian Natural Resource Management Act* (2002) does not specifically refer to any Aborginal matters. In fact, none of the words Aboriginal, Indigenous or Traditional Owner can be found in the Act. Nonetheless, the Tasmanian Natural Resource Management Framework (TNRMF) (which guides the strategies) does specifically consider Aboriganal culture and people:

> 'The Tasmanian Aboriginal community has a strong link to the State's land and waters. This link is reinforced by Tasmania's many significant Aboriginal cultural heritage sites. All the priorities identified below are therefore relevant to the Aboriginal community'[8].

The TNRMF also states that the NRM Council Composition should include members of the Aborignal communities and that Aboriginal communities need to represented in Regional Committees.

There is currently an Aboriginal person on the NRM South Committee. In the past there have been Aboriginal people on the NRM North Committee and the NRM Council however, there is not at this time. Both NRM South and NRM North continue to build relatiohsips with the Aboriginal Community and Aboriginal people – including work on joint projects and partnerships.

Continuing to build these relationships is an important aspect of the next NRM Regional strategies and should assist in increasing representation of Aboriginal people on the NRM Council and NRM Regional Committees.

[8] Department of Primary Industries, Water & Environment (2002).

Aboriginal communities, Aboriginal organisations and Aboriginal people in Tasmania are diverse and the complexity of sourcing and including the voices of Aboriginal people is challenging. This includes addressing issues such as representation and inclusion; engagement processes; identification of needs, aspirations and priorities; partneships and structures; and roles in NRM Regional strategy implementation.

The impact of early Tasmanian settlement on Tasmanian Aboriginies is difficult to ignore and presents complex challenges for those involved in natural resource management. These challenges are further compounded by the fact that Tasmanian Aborginal heritage and activities are at risk from existing and emerging climate change impacts (especially sea level rise related issues in the inter-tidal and sub-tidal regions).[9] However, the extent of the risk is relatively unknown:

> 'There has not been any specific assessment of the vulnerability of Indigenous communities in Tasmania, based on socio-economic, geographical, or cultural differences, to the impacts of climate change. Nor has there been any research into indirect effects from changes to Tasmania's natural environments (for example, changes to fishing, hunting and cultural practices)'.[10]

As well as the above, a report by the Commonwealth of Australia stated that challenges for regional Aboriginal knowledge may be affected by:

- *Poor understanding of Indigenous knowledge*
- *Devaluation of Indigenous knowledge by Western science*
- *Low cultural awareness*
- *Not consulting the right people*
- *Lack of mechanisms to protect Indigenous knowledge*
- *Aboriginal organisations not working together*
- *Lack of resources and frameworks for Indigenous knowledge*
- *Community needs not being met*
- *Accountability processes are unclear*
- *Current planning processes are inappropriate*
- *Poor information access and flow* [11]

[9] McDonald *et al.* (2013).
[10] *Ibid*, p.110
[11] Commonwealth of Australia (2004).

The above statements highlighting the dearth of understanding of these issues is also supported by comments from the online survey that were made by those representing some Aboriginal matters. They stated that they wanted the following better reflected in the next NRM strategies:

- Aboriginal heritage knowledge
- Aboriginal heritage protection
- A commitment to elevate the capacity of Aboriginal communities
- Aboriginal heritage and cultural assets must be mentioned.

One respondent to the survey also stated that in order to achieve the above, the NRM bodies themselves must improve their knowledge of Aboriginal heritage. All past NRM strategies from NRM North and NRM South mention Aboriginal issues and have included a statement that was prepared for and endorsed by the Tasmanian Aboriginal Land Council, Tasmanian Aboriginal Centre and the Aboriginal Land Council of Tasmania.

Some involvement of Aboriginal people in the natural resource management sector is acknowledged, for example, one of the members of the NRM South Board is an Aboriginal person and both regions work on specific projects with Aborginal people such as the development of an Aborginal social enterprise providing employment in land manaement.

It is important that the next NRM Regional strategies strive for increased involvement of Aboriginal communities, organisations and people in the structures and management processes for both the strategy development and implementation. This involvement needs to be underpinned by a genuine commitment to developing an understanding of the cultural and economic dimensions of natural resources from the perspective of Tasmanian Aboriginal people.

Although historical and institutional matters may somewhat act as barriers for more effective consideration of Aboriginal matters, some opportunities do exist for NRM bodies:

> 'The non-statutory nature of current arrangements means the regional NRM bodies are not perceived by Aboriginal communities as part of the state or Australian governments. This allows them to develop unique relationships with landholders, peak bodies, Indigenous groups and others.'[12]

According to the recent Australian Census, almost 20,000 people in Tasmania identify with being from the Aboriginal or Torres Straight Islander communities.[13] Although no land in Tasmania has passed the Native Title Act's registration test, 'Aboriginal communities in Tasmania were granted a number of small parcels of land under the Aboriginal Lands Act 1995 (Tas) (s27)'.[14]

In the creation and implementation of the next NRM strategies it may be valuable for the Tasmanian NRM bodies to explore the approaches undertaken in other jurisdictions:

- **The Queensland Indigenous Facilitators Network (QIFN):** Also known as the 'Murri Network', the Network is comprised of: Indigenous facilitators from each regional NRM body, nominated and/or endorsed by the relevant body; Indigenous Land Management Facilitators based in Queensland; a representative from DERM and; the Regional Groups Collective providing administrative support. QIFN aims to strategically and equitably support and advise on the effective engagement and participation of Indigenous Australians in NRM.[15]
- **The Wet Tropics Aboriginal Cultural and Natural Resource Management Plan (Aboriginal Plan):** Prepared by the Wet Tropics Aboriginal Plan Project Team in conjunction with the Traditional Owners of the Wet Tropics Natural Resource Management region. The vision to develop the Aboriginal Plan came from Traditional Owners and the way in which the Aboriginal Plan has been developed has been driven by Traditional Owners. The establishment of

[12] Queensland Government (2011).
[13] Australian Bureau of Statistics (2012).
[14] Hobart Community Legal Service (2013)
[15] Queensland Government (2011), p12.

> Traditional Owner advisory structures to guide the process has ensured accountability to Traditional Owners throughout the process of developing the Aboriginal Plan.[16]

Furthermore, there may be an opportunity for all three NRM regions to enage collectively with Tasmanian Aboriginal people through a State-wide forum, such as the Interim Aboriginal Heritage Council. The TNRMF and the formulation of the upcoming regional strategies provide a reason to initiate this engagement and discussions on how to improvement the level of interaction between the regional NRM process and the Tasmanian Aboriginal communities.

Section Summary

Key point 7 The boundaries and operating areas of the three regional NRM bodies in Tasmania are euro-centric and potentially a barrier to the involvement of Tasmanian Aboriginal people in the regional NRM processes.

Strategy recommendation (general) 8

1a. Explicitly state Aboriginal values relating to relevant landscapes in key asset areas in the NRM Regional Strategies.

1b. Engage with bodies such as the Interim Aboriginal Heritage Council to generate and embed key priorities in future NRM Regional Strategies.

1c. Implement an ongoing Aboriginal engagement strategy which builds relationships and mutual understanding; supports participation on the NRM Council and NRM Regional Committees; and facilitates priority actions.

[16] Wet Tropics Aboriginal Plan Project Team (2005).

4 Institutional Scan

The aim of the institutional scan is to review past and present arrangements between organisations and partners with a role in NRM at the regional scale. Institutional arrangements are often one of the major factors that constrain or improve effective implementation of natural resource management priorities, in particular in multi-scale and multi-level governance contexts. Therefore, there also needs to be a wider context-specific understanding of the constraints and different impacts accruing from governance arrangements specific to regional and local climate adaptation planning. This includes understanding state, regional and local governance arrangements and responsibilities and also identifying where possible constraints might arise because of these arrangements.

The method used for the institutional scan centred around three key activities:

1. Scan and summarise the regulatory and institutional milieu in which NRM organisations operate;
2. Identify and engage with the key stakeholders to gain their insight and input about barriers and enablers for natural resource management associated with the institutional arrangements; and
3. Review climate change governance (i.e. the extent that climate change is considered by the NRM agencies and the stakeholders).

The findings from these activities are presented below and where possible are grouped by the stakeholder's geographic focus (e.g. All of Tasmania, NRM North and NRM South). Furthermore where appropriate and/or possible, the findings are also presented by stakeholder typology (e.g. local government, business etc.).

4.1 Sectoral issues and drivers

The regional NRM model sits within a complex community, industry and government context. This includes multiple stakeholder groups, or sectors, who in addition to managing their own natural resource management issues, respond to a range of other external and internal factors such as political and policy direction/change, market impacts on pricing, competition, regulation and compliance.

A brief analysis of relevant sectors is provided in Table 3.

Sector	Key issues and drivers impacting on management of natural resources
Primary production	Climate, pricing and market forces, input costs, landowner perspectives and priorities, productive capacity, tenure and management, debt levels, regulation
Industry and manufacturing	Pricing and market forces, input costs, regulation
Local Government	Local community and political priorities, resource constraints, regulation, community activity and engagement with natural resource management issues, relationships, local economic strengths and weaknesses
State Government	Government policies and priorities, regulatory responsibilities, resource constraints
Federal Government	Government policies and priorities, regulatory responsibilities, resourcing constraints
Community based 'care' groups	Local on ground issues, funding and grants, group membership and dynamics
Educational and research institutions	Government policies and priorities, funding and grants

Table 3 Sector analysis: Issues and drivers impacting on management of natural resources

While all of these sectors are important and, to varying extents were represented in the stakeholder surveys, local government stands out as a significant stakeholder group that warrants more detailed discussion, for the following reasons:

- Specifically mentioned by the regional NRM bodies as a critical stakeholder;
- Actively involved in the regional NRM process through hosting and funding local NRM facilitators;
- Local representation of community issues and priorities; and
- Regulatory responsibility for strategic and statutory land use planning.

4.1.1 Local government

As well as the NRM Act (2002), the management of natural resources in Tasmania is also heavily influenced by local government regulations and actions (especially through land use and strategic planning processes). The importance of local government is evident in the literature on the NRM websites and the relationships they maintain with them:

> 'Local government represents the community. As the closest level of government to the people, it is in a unique position to identify community needs and make sure that those needs are met in the most appropriate way. In Southern Tasmania, local government plays a key role in managing the region's natural resources through delivering on-ground actions that improve or protect natural assets such as beaches, roadsides, local reserves as well as investing in partnership projects that deliver sound NRM outcomes. (NRM South 2015)[17]
>
> In the northern Tasmanian region, local government has a particularly important role in NRM and NRM North has partnered with them to deliver joint positions and outcomes. This partnership is vital to ensure the best possible outcomes for the region.' (NRM North 2105)[18]

Both NRM South and NRM North provide support for NRM Facilitators in selected Councils in their region. This support often comes through co-funding arrangements for staff or for specific projects or goals. For NRM South Facilitators are located in the municipalities of Sorell, Tasman, Glamorgan Spring Bay, Derwent Valley, Central Highlands, Huon Valley, Hobart and Kingborough.

For NRM North, the Facilitators are located in the municipalities of Northern Midlands, Dorset and Meander Valley with a Tamar Facilitator servicing the George Town, West Tamar, Launceston municipalities. The general role of the Facilitators is to provide support for Councils and the community in the implementation of specific projects associated with natural resource management.

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[17] NRM South website, last accessed 6 February 2015. http://www.nrmsouth.org.au/local-government/
[18] NRM North website, last accessed 7 February 2015. http://www.nrmnorth.org.au/our-staff

Future engagement with the sector needs to be based on a deeper understanding of the local and sector issues and drivers that impact on each Council's willingness and capacity to be involved with the regional NRM process.

4.1.1.1 Local level issues and drivers

At the local level the relationship between the regional NRM organisations and individual Councils is highly varied. Some Councils are 'signed up' to the regional NRM model, hosting and funding local facilitators and proactively seeking to align their activities with the regional priorities. At the other end of the sector, there are small Councils where internal financial constraints make it extremely difficult to be involved in anything other than core business; alternatively, the local political focus is on driving maximum use of natural resources for local economic development - with minimal government intervention.

A generic approach to engagement with local government and the development of productive relationships is unlikely to be effective. A strong relationship with the Council's General Manager and other senior managers is critical to understanding local issues and identification of the most effective touch points between the Council and the regional NRM process.

4.1.1.2 Other sector issues and drivers

There are a range of external issues and drivers that impact on Councils at the sector level. Significant examples in recent times include

- Water and sewerage reforms
- Amalgamations
- Regulatory change, particularly new regulations on asset and financial management.

The Local Government Association of Tasmania (LGAT) undertakes a census of elected representatives every 3-5 years. The most recent census data is from 2011. (note: A new census was being prepared at the time of preparation of this report). While the primary aim of the census is to capture demographic data about the elected representatives it also contains questions on what is important to them and what they perceive are public concerns.

Of the 18 important issues to elected representatives reported in the 2011 survey, environmental sustainability (assuming this issue includes NRM) was ranked 11 and climate change 13. The top 5 issues were:

- Financial sustainability
- Planning and development
- Rate determination
- Roads
- Water and sewerage reform.

Climate change and NRM were identified as some of the least important issues to the public as perceived by the elected representative, with the top 5 issues being:

- Economic conditions
- Planning and development
- Rates
- Roads
- Transparent government.

Although climate change and NRM issues rated low on the elected representative issues, it more likely to be a reflection of the failure of elected members to understand the complexities and interconnectedness of NRM and climate change issues rather than it being a 'non-issue' for Councils.

4.1.1.3 Opportunities

Like all large regulated organisations, corporate strategy, planning and budget processes are where priority issues are identified and assessed, actions determined and resources allocated. The Council Strategic Plan holds considerable significance in the Local Government Act (1993) as it directs a municipality's long term financial management plan and long-term asset management plan.

Each year when Councils undertake their budget review process, they align actions in order of the priorities and directions identified in their Council Strategic Plan. As such, any alignment with NRM strategies into Council Strategic Plans is likely to be influential for natural resource management objectives throughout the lifetime of the Strategic Plan.

Section summary

Key point 8 There are a range of local and sector level issues that inform the scope and extent of local government engagement in regional NRM. The regional NRM bodies need to proactively understand these issues and drivers to ensure relationships and actions with individual Councils are optimised.

Key point 9 There are has been a tendency by the regional NRMs to adopt pre-existing local government activities *with* the regional NRM Strategy. More effort needs to go into developing an understanding of local issues and priorities and identification of ways that the regional NRM process can add value at the local level, and vice versa.

Key point 10 While local government is a significant player in the management of natural resources, natural resource management and climate change do not appear to be priority issues for the majority of Councils.

Institutional recommendation – (general) 2 Prior to development of the regional NRM strategies, a short paper (less than 10 pages) on local government and NRM be prepared to identify and discuss the issues and drivers for local government that impact on natural resource management and engagement with the regional NRM process. The paper should be prepared with input from the sector, both individually and collectively through the regional and State representative bodies.

Please note: this model of preparing sector specific discussion and engagement papers is recommended for use with other sectors in line with specific topics under consideration from time-to-time.

4.2 Climate Change: The game changer for natural resource management

Climate change is the great game changer for natural resource management[19]. In a broader context and at a global level, the World Economic Forum[20] has identified four natural resource and climate change related risks in the top ten risks facing the planet, namely:

- Water crises
- Failure of climate change mitigation and adaptation
- Great incidence of extreme weather events
- Food crises.

For those who manage the natural resources of Tasmania, climate change cannot be ignored, delayed or be given tokenistic recognition. There is considerable evidence that the Australian natural environment is already feeling (and responding to) the effects of a changing climate.

However, planning for climate change in Australia is in state of flux. At the national level, climate change has become a polarising and political issue that has resulted in an array of inconsistent legislation and direction[21]. At the State level climate change is directed through the Tasmanian Climate Change Office (TCCO), which maintains a strategic position in the Department of Premier and Cabinet. The TCCO has funded and managed a considerable number of mitigation and adaptation projects since its inception[22].

Although climate change is considered in a number of State, regional and local policies and actions, implementation is still in the nascent stages and has predominantly focussed on the protection of assets or managing risk to life (e.g. development controls for coastal inundation from sea level rise).

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[19] Wallis *et al.* (2015).
[20] World Economic Forum (2014).
[21] Talberg *et al.* (2013).
[22] See http://www.climatechange.tas.gov.au

Furthermore, it is also evident that roles and responsibilities for climate change management are not clearly defined or understood by decision-makers at the State and local level (e.g. confusion surrounds liability issues for decisions associated with coastal defences).

The NRM regional bodies in Tasmania are members of the Southern Slopes Climate Change Adaptation Research Partnership (SCARP) which is 'led by the Tasmanian Institute of Agriculture (TIA) at the University of Tasmania, in conjunction with the Victorian Centre for Climate Change Adaptation Research (VCCCAR) and the Victorian Department of Environment and Primary Industries, (DEPI)'.[23]

Tasmania's direction on climate change mitigation and adaptation is directly and indirectly shaped by an array of legislation, policies and agreements across a broad range of jurisdictions. It should be noted that the direction is also shaped by the dearth of some legislation, policies and actions. A report by the SCARP team provides very good summary of these and an amended summary table drawn from this work is presented below (**Table 4**).

More information about the extent of consideration of climate change in the previous and current NRM Strategies, the SCARP partnership and institutional issues associated with the extent of climate change management, is presented in the climate change governance review (refer Section 4.6). Further information about climate change for specific assets and landscapes can be found in the Environmental Scan.

Scope / Jurisdiction	Legislation / Policy / Agreement
International	The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol
	Ozone Protection and Synthetic Greenhouse Gas Management (1989)
	United Nations Convention on Biological Diversity (1993)
	World Heritage Convention (1975)
	The Ramsar Convention

[23] Southern Slopes Climate Change Adaptation Research Partnership (2014).

Scope / Jurisdiction	Legislation / Policy / Agreement
	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
	Australia/Japan Agreement for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA);
	Australia/China Agreement for the Protection of Migratory Birds and their Environment (CAMBA)
	Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA);
National	Carbon Credits (Carbon Farming Initiative) Act 2011
	Direct Action Plan and Emissions Reduction Fund
	Reducing carbon grants (miscellaneous)
	Environment Protection and Biodiversity Conservation Act (1999)
State	Climate Change (State Action) Act 2008
	Land Use Planning and Approvals Act 1993
	State Policies and Projects Act 1993
	Tasmanian Planning Commission Act 1997
	Local Government Act 1993*
	Tasmanian State Coastal Policy 1996
	Emergency Management Act 2006
	Water Management Act 1999
	Environmental Management and Pollution Control Act
	State Policy on Water Quality Management
Regional	Regional Land Use Planning Strategies
	Regional Councils Climate Change Adaptation Strategies* (for example Southern Tasmanian Councils Authority)
Local	Municipal Planning Schemes
	Municipal Strategic Plans*
	Municipal Asset Management Plans*

Scope / Jurisdiction	Legislation / Policy / Agreement
	Municipal Long-term Financial Management Plans*
	Municipal (Climate Change) Policies*

Note: * Identifies legislation / policies / agreements not presented in the SCARP report but determined by the Project Team to be important in regards to climate change and natural resource management.

Table 4 Relevant climate change-related legislation, policies and agreements[24].

Section summary

Key point 11 It is clear climate change is a significant risk facing our natural systems and the communities that rely upon them. A collaborative multi-stakeholder approach will be required. Both regional NRM organisations, as stakeholder based organisations working at the landscape scale, are well positioned to contribute to such a collaborative approach.

4.3 Emerging mega trends

As well as the issue of climate change, it is important to frame any NRM strategies in the context of emerging mega trends. The following six megatrends below are the Project Team's summary of the CSIRO's Our Future World Report (2012)[25] and highlight an array of increasing challenges that will need to be reflected and/or considered in long term planning.

4.3.1 More from less

The earth has a finite supply of natural resources which are being depleted at an alarming rate in order to maintain society's lifestyle. As the world's population increases, so does the demand for water, energy and food. Water scarcity will greatly affect regions with insufficient water to meet human needs, or with inadequate financial capacity to develop water resources.

[24] Wallis *et al* (2015), pp42-53.
[25] Hajkowicz *et al.* (2012).

The increasing extraction rate of coal, oil, natural gas and coal seam gas will accelerate to a point at which it is economically unviable to extract these non-renewable resources. While investments in energy supply infrastructure are being prioritised to meet peak energy demands, there is little attention focussed on reducing carbon emissions to combat global warming. Food supply and demand face the challenges of reduced agricultural land due to degradation and over-cultivation as well as increases in meat consumption in developing countries. The unsustainable harvesting and processing of natural resources will increase waste generation on both a local and global scale. The 'more from less' megatrend explores how people can set aside resource conflicts to develop new methods for allocating the worlds limited resources to ensure quality of life for current and future generations.

4.3.2 Going, going,... gone?

Many of the natural assets that humans value and depend upon are unqualifiable in terms of their monetary value, and therefore are at greater risk of being damaged or mismanaged. The 'going, going ...gone?' megatrend explores the current decline of biodiversity, asking what actions human beings will take to protect the world's environmental resources in the future. Human consumption of environmental resources is causing increased pressures on natural habitats and species, and contributing to the decline in biodiversity. Habitat fragmentation continues to be the principle cause of 'biodiversity loss and diminished ecosystem services'. With climate change impacts on flora and fauna species now being observed, there is a need to understand, quantify and forecast the extent of these impacts on future biodiversity. This well-documented decline in biodiversity has triggered a rise in the human response, with increases in the number of protected areas and growing conservation efforts for critical biodiversity sites.

4.3.3 The silk highway

World economic activity is forecast to slow in the short term and then the economic hotspot will shift eastwards from Saudi Arabia to the two powerhouses of the new world economy, India and China. Rapid economic growth in developing countries is increasing the demand for natural resources, as people transition out of poverty and into middle class societies.

Australia has strengthened its economic ties with China, with resource exports increasing and trade links continually growing over the last decade. The projected decline in commodity prices will however impact the Australian economy which depends heavily on natural resources to generate export income. Australia's environmental resources serve to expand the tourism opportunities by strengthening and diversifying the trade connections with Asia. Rapid industrialisation in India could see an extraction of natural resources from previously untouched mineral reserves, increasing commodity supplies from developing countries. This megatrend explores how Australia's economy is rapidly transforming into 'the silk highway' with new export markets and trade relations for natural resources.

4.3.4 Forever young

'Forever young' explores the pressure on society's financial resources required to sustain an aging population with an increased life expectancy. Challenges associated with an ageing population include the emergence of a new demographic profile in which the median age will rise from 36.8 years to between 41.9 and 45.2 years by 2056[26]. There will be an increase in people aged 65 years and over as well as a decrease in the relative population who are engaged in the workforce. Advances in medical science and healthcare have resulted in longer life expectancies which is the major cause of an aging population. This is widening the retirement savings gap and creating a larger shortfall in retirement savings for the current workforce. Lifestyle illnesses are a contributing factor of escalating healthcare expenditure, with increased financial resources required for hospitals, medical benefits, pharmaceuticals and private health insurance. The concept that an ageing population is an 'asset' is not fully utilised by society, however there is great potential for elderly citizen's skills, knowledge, wisdom and mentorship to be used as a resource.

[26] Australian Bureau of Statistics (2008).

4.3.5 Virtually here

Digital media is allowing people to form new connections, to deliver and access services, to obtain information and to perform transactions. As a result, online retail and teleworking is growing rapidly with impacts on labour markets, retail models, urban design and transport systems. The structure of the retail sector is powered by changing consumer preferences, shifting spending patterns and growing online sales. The digital world is changing societal behaviours, with a consumer trend toward collaborative consumption; whereby consumers share the same product to save money and improve resource efficiency. Modern information and communication technology are changing business models, shifting the work dynamic from a physical office location to virtually anywhere - from home, cafes, parks, libraries or public spaces. Companies are opting for design improvements such as open plan office spaces and activity based layouts to provide staff with workplace alternatives. The digitally connected world is 'virtually here', with this megatrend exploring how people, information, services and resources interact in a world of increased connectivity.

4.3.6 Great expectations

People of the future will have 'great expectations' for more personalised services and high-end experiences due to increased income and oversupply of consumable resources. In both the developed and developing world, incomes are predicted to grow considerably over the coming decades. As some people transition out of poverty and into middle income classes, they will look beyond the basic necessities in search for advanced services and experiences. Consumers will increase spending on education, art, culture and entertainment and tourism, while also demonstrating an increased awareness of morals and ethics when purchasing consumable products. More efficient production processes and preferences for experiential services have seen a decline in relative material consumption in developed countries. While wealthy people have great expectations and privileged lifestyles many of the world's poor people still live in survival mode, requiring resources such as food, water, clothing, shelter and security. Closing the gap between poverty and wealthy societies should be the world's 'great expectation'.

4.3.7 Applications for Big Data in Natural Resource Management

Big data is large, complex and fast moving information which requires advanced data management and processing tools[27]. By using a range of data sources to investigate the complex inter-relationships within natural systems, there is potential for big data applications in natural resource management. Powerful modelling tools can be used to anticipate resource costs and production volumes, allowing businesses to adjust their strategic management to optimise the allocation and utilisation of natural resources.

Policy makers, scientists and industrialists can apply big data techniques when implementing policies and strategies to sustainably manage and protect nature's ecosystems and species. Advancements in implantable monitors will allow for big data transfer from free-ranging animals to wearable transmitters[28]. Such systems will improve our understanding of animal's physiological and behavioural responses associated human interactions and climate change. There are also applications for big data management in pollution treatment and prevention. The manufacturing and construction industry can benefit from integrated management approaches that use big data to reduce the consumption of resources and energy while improving product quality, worker health and safety and environmental efficiency.

[27] Hems *et al.* (2013).
[28] Laske *et al.* (2014).

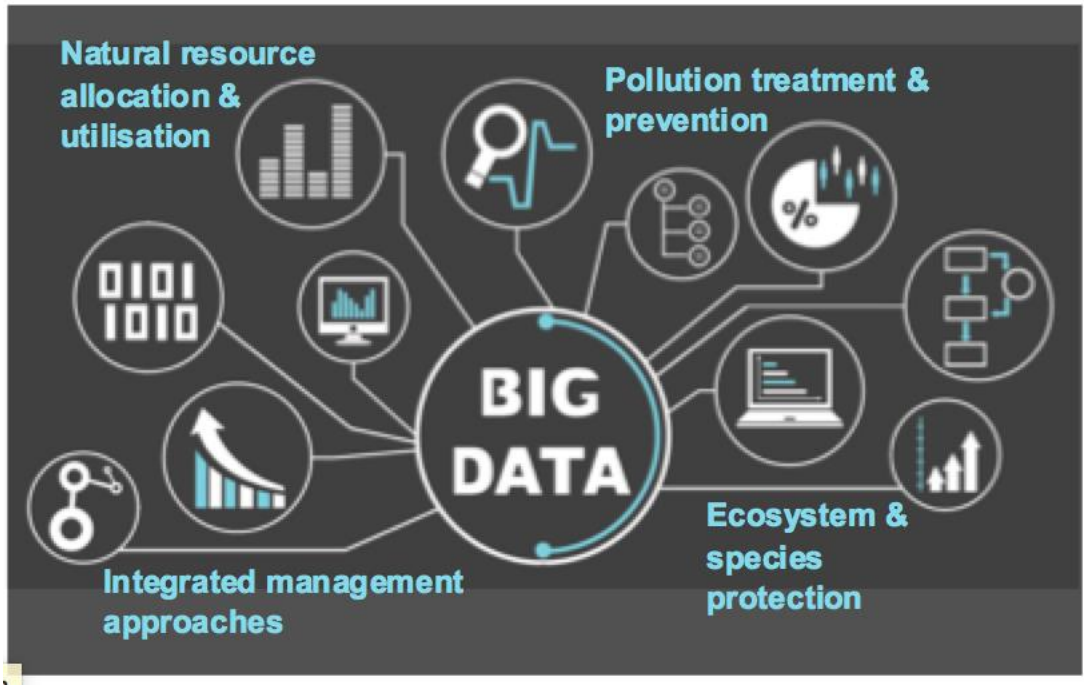


Figure 1 Applications for big data in natural resource management[29]

4.3.8 Potential responses to emerging mega trends

Mega trend	Potential response in regional NRM context
More from less	NRM bodies will need to keep abreast of global food security trends (and increased demand for protein and dairy), combined with the favourable climatic conditions in Tasmania may see a growing conflict between the natural environment and increased agricultural activity.
Going, going, gone	NRM bodies could use their influence with local Councils to explore the conflict between urban growth and habitat fragmentation. Promotion of urban gardens, urban eco-habitats, native planting and so on, may help reduce the impact of these issues.
The silk highway	Rapid growth in demand for dairy products in Asia (especially China) will see increased dairy production and

[29] Singh, T. (2014).

Mega trend	Potential response in regional NRM context
	may increase the stressors on the natural environment. NRMs should consider ways to promote sustainable solutions, especially with 'dairy in conversion' activities.
Virtually here	NRM bodies must keep pace with the information age. Identify processes and systems that allow for sharing of information, facilitate a creative commons approach to NRM information sharing, undertake NRM 'hackathons' and work closely with universities and SenseT.[30]
Great expectations	Tasmania may see an increase in tourism which if managed well, will provide economic growth and increased protection and/or awareness of the natural environment. There is an opportunity for NRM bodies to with key stakeholders to promote the market of sustainable tourism.
Big data	NRM bodies need to ensure that their staff and systems are utilising the availability of big data. If managed well big data may decrease the overall cost of monitoring and evaluation of KPIs, reporting and strategic scans.

Table 5 Emerging mega trends and regional NRM

Section summary

Key point 12 CSIRO's Our Future World Report from 2012 identifies a number of mega trends for consideration when developing longer term natural resource management strategies.

Institutional recommendation (general) 2 The 6 global mega-trends identified in CSIRO's Our Future World Report 2012 need to be considered in draft of the next NRM Regional strategies.

[30] A hackathon is where a large number of people meet to undertake a collaborative computer programming approach to solve specific problems or utilize the data to support a specific sector or cause.

4.4 Stakeholder identification and engagement

The very nature of natural resource management results in a considerable number of stakeholders from a broad array of organisations types. These are shaped by existing formal and informal institutional arrangements.

Recognising the above regulatory framework, the first stage of the institutional scan was to identify the key organisations that are (or should be) regarded as key stakeholders. Once identified the Project Team established a process to determine key contact points within the organisations in order to invite them to participate in the online survey and/or regional workshops. This was done in part through the review of stakeholder contact lists from NRM North and NRM South. Where gaps were identified in contact lists the Project Team used their own existing networks and stakeholder lists. The Project Team also used the 'snowballing' method where they asked key contacts to also forward on links to the online survey and/or recommend people to contact.

It is important to note that the scope of this study did not encompass engaging directly with the community, other than through the online survey. Each of the regional NRM organisations undertook their own community engagement in parallel with this project.

The stakeholders were classified by the Project Team into seven key categories with a number of sub categories (see **Table 6**) and these were used as the primary point for initial invitations for survey participation and invitations to the workshops. In total, over 480 individuals were identified and contacted. The primary point of contact was email (although some participants were contacted initially through telephone or direct contact). Invitations to participate in the survey were also distributed using the social media platforms of the NRMs (e.g. Facebook).

Category	**Type**	**#**
Heads of Department or Chief Executive Officers	Various community, private, peak bodies and government agencies	35
Local Government	Council staff	12

Category	Type	#
Local Government	General managers and/or Council general email addresses	53
Local Government	Regional and State-wide organisations	4
State Government	Staff	97
Non-government organisations	Local and 'care' groups	86
Non-government organisations	Environmental or social organisations	42
Non-government organisations	Professional associations	3
Non-government associations	Recreational groups and bodies	4
Industry	Manufacturing and service industries	12
Industry	Consultants	7
Industry	Government business enterprises and utilities	13
Industry	Representative bodies and associations	31
Non-government associations	Recreational groups and bodies	4
Industry	Primary producers	26
Natural Resource Management organisations	Local and sub-regional NRM bodies	15
Natural Resource Management organisations	Regional NRM bodies	10
Others	Individuals involved in NRM activities	14
Others	Research or academic institutions	20

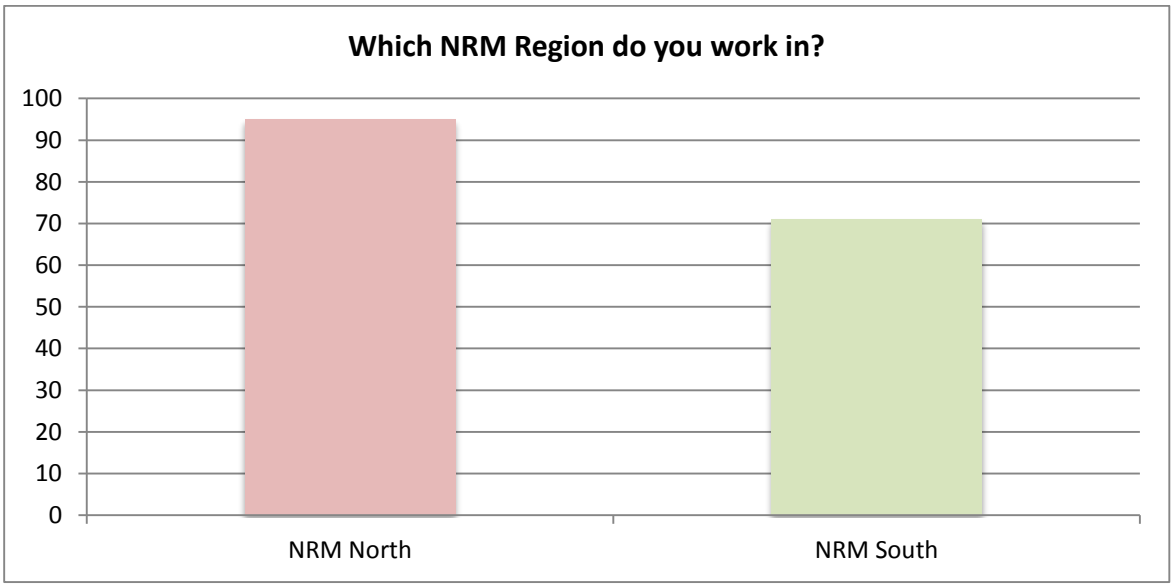
Table 6. Combined stakeholder categories and number of contacts for the NRM Scans Project.

A number of engagement activities were undertaken for this project, with almost 500 stakeholders contacted through the online survey and two region workshops.

The online survey was distributed to over 480 stakeholders. A total of 126 responses were received from a broad array of stakeholders spanning NRM North and NRM South. Respondents were asked a range of questions that identified the participant's NRM region/s that they worked in and their organisation type.

State government, local government and primary producers represented the highest proportion of respondents. Over 10 % of respondents stated that they aligned with 'other' and the entered their organisation type in manually. The majority of these were private landholders, with others being from an Aboriginal group, retired and a private agronomy business.

What is important to note is that there are a diverse array of stakeholders and each of these will have their own guiding legislation, governing styles, operating timeframes and priorities associated with natural resource management.



Note: each result includes those who work across both regions – e.g. State agencies

Figure 2 Respondent type and region

Respondents were also asked to identify themselves as an individual (e.g. community member), a staff member working for an organisation or on behalf of a whole organisation. These questions were asked in order to allow the Project Team to apply filters in the survey response during the analysis phase. The online survey was open for participation for approximately 8 weeks from 16th October 2014 to 10th November 2014.

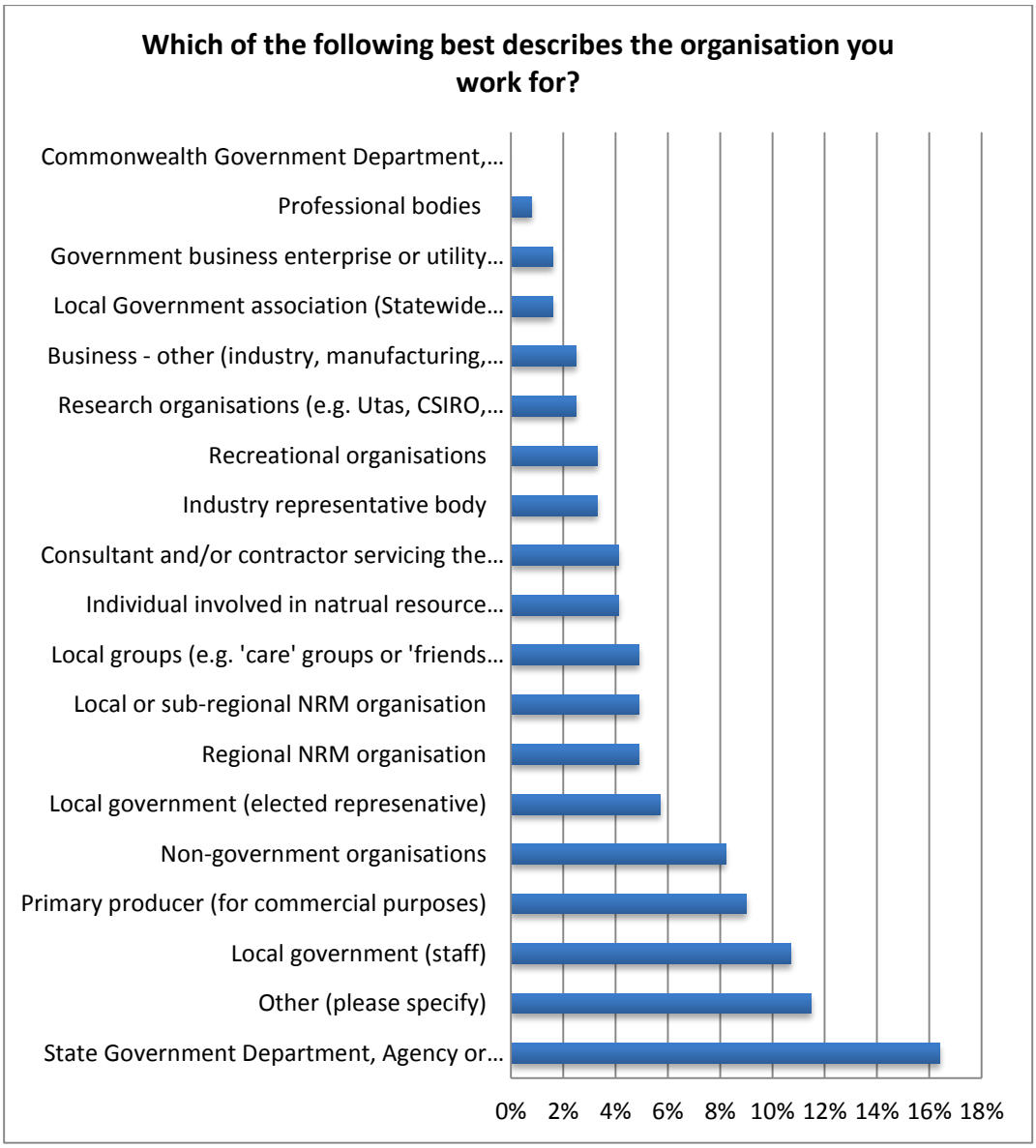


Figure 3 Respondent employment category (combined NRM North and NRM South)

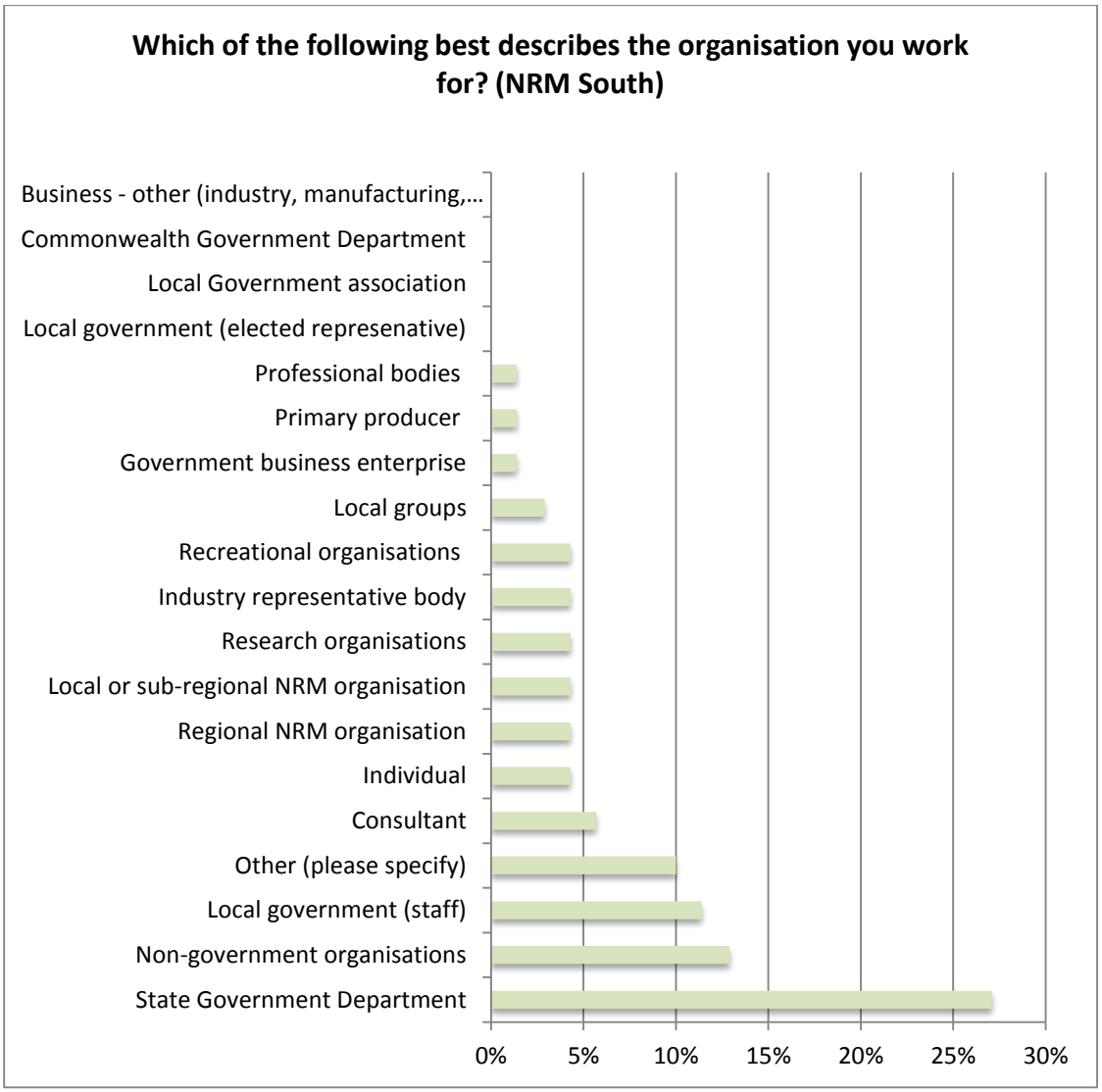


Figure 4 Respondent's employment category (NRM South Region)

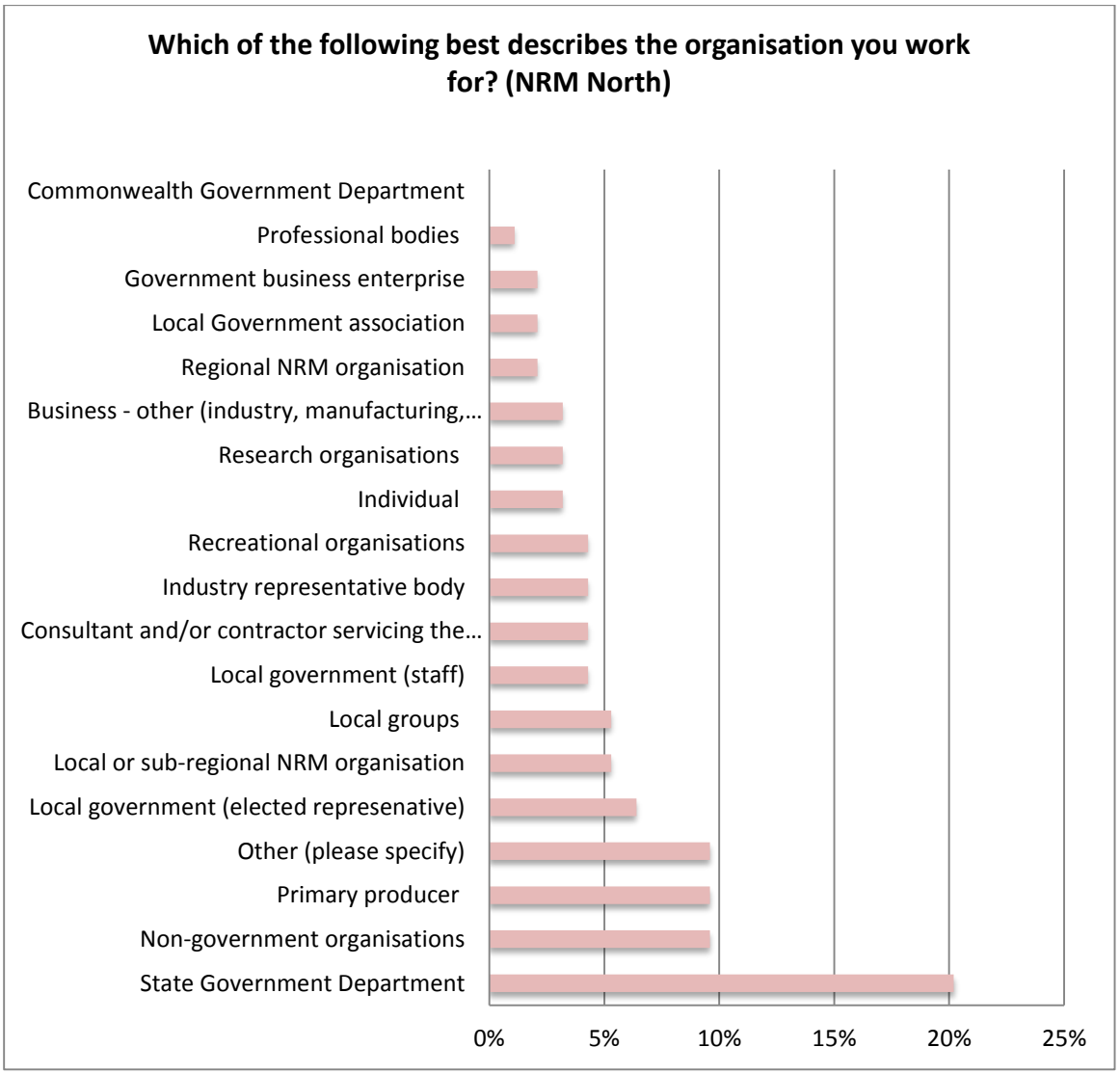


Figure 5 Respondent's employment category (NRM North Region)

The two half-day regional workshops occurred on the 5th (Hobart) and 6th of November 2014 (Launceston). The workshops were designed to:

- Review, validate and add value to the Stakeholder survey findings;
- Consider and propose responses to the identified natural resource management issues;
- Better understand the partnerships and relationships required to support regional natural resource management;
- Discuss climate change issues relating to natural resource management;
- Provide NRM North and NRM South with regionally specific input to support the development of the north and south strategies on behalf of their respective communities;

- Increase awareness of natural resource management and facilitate additional engagement between stakeholders with varying levels of interest and involvement in natural resource management; and
- Further embed the regional NRM strategies into stakeholder planning and organisational and industry strategy development.

4.4.1 Engagement findings associated with the institutional scan

4.4.1.1 Understanding the stakeholder's core business

The survey respondents were asked about their core business using the Landscape typology used by the NRM bodies. A considerable percentage of those who worked across the entire State indicated that their core business was Productive (74%) and Natural (70%). For those who worked specifically in the NRM North region the Productive landscape (67%) scored the highest followed by Natural (54%) and Lifestyle (27%). In comparison, the top three landscapes that were identified as being core business for the respondents working solely in the NRM South region were Natural (65%), Productive (62%) and Coastal and Marine (52%). The lowest score for core business from the respondents was that of the Urban Landscape category (less than 20% in both the North and the South regions).

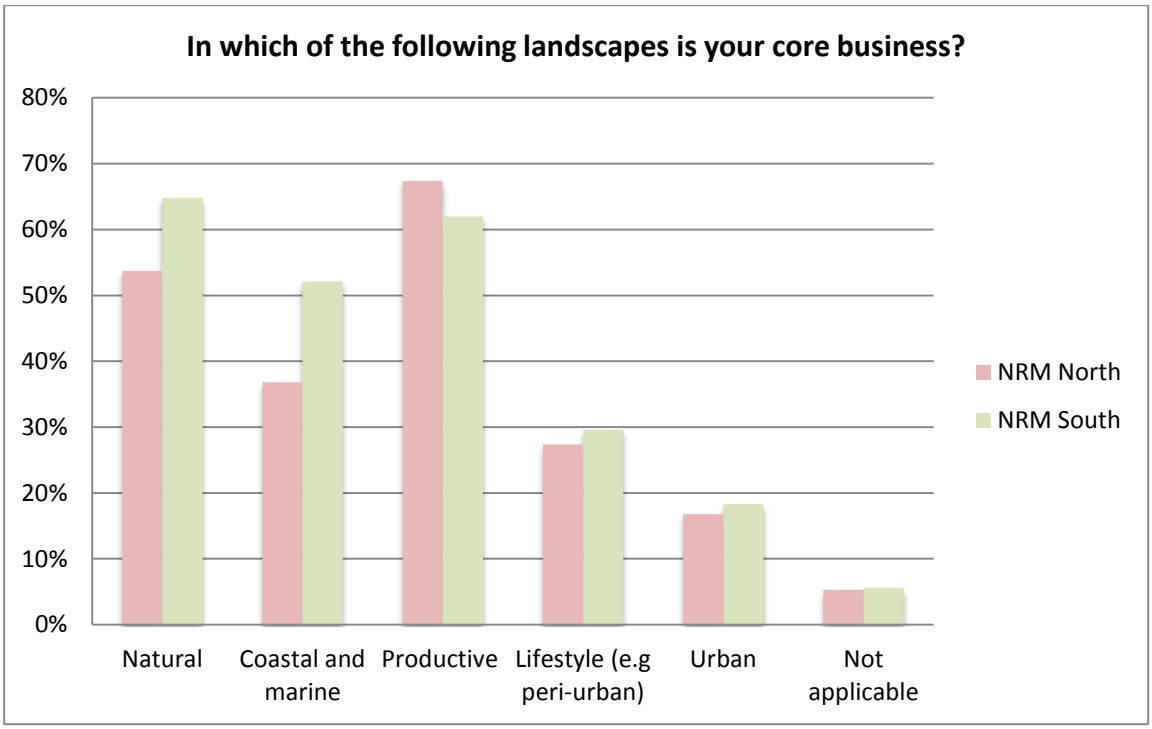


Figure 6 Core business of survey respondents by location

Although it is evident that both NRMs have a strong involvement in Council activities through the Facilitator program, there was a very low response rate from Councils in the online survey and in the workshops, with 11 respondents identifying as working for local government (three from the NRM North Region and eight in the NRM South Region).

At the workshops four Councils were represented at the NRM South event (Sorell, Kingborough, Glenorchy and Tasman Councils) and two represented at the NRM North event (North Midlands Council and Launceston City). The Southern Tasmanian Councils Authority attended the workshop in Hobart and the Northern Tasmanian Development body was represented at the workshop in Launceston.

Notable gaps were observed in the attendance by some organisations and sectors. There is a range of potential reasons for non-attendance of these organisations, for example, local government elections, but without further investigations none of these possibilities can be ruled in or out.

Given that NRM planning in Tasmania is guided by a range of NRM legislation, it seemed prudent to ascertain the extent of the stakeholder's awareness and understanding of relevant legislation. This is important as any barriers or opportunities to improving natural resource management identified by the stakeholders will need to be couched within the realms of that Act. Information gleaned from the workshops, face-to-face discussions, the State-wide Stakeholders Engagement Project and through the Project Team's survey analysis suggested that some of the stakeholders are confused about the roles and responsibilities of the regional NRM bodies and the powers that they have (or do not have) under the NRM Act (2002). This can lead to challenges associated with the management of stakeholder expectations.

This means that careful consideration is required when analysing the results from the surveys and workshops. Some issues identified by the participants may stem from the processes and the content associated from the NRM Strategies while others may in fact stem from higher order legislation and governance that the regional NRM bodies have no control or little influence.

The results from the online survey supports this need for a considered analysis with 34% of respondents in NRM North and 28% of those in the NRM South region stating that they either did not know that there was an NRM Act (NRM North 5%; NRM South 3%) or were not aware of the details inside the legislation (NRM North 29%; NRM South 16%).

For those that stated that they had a very good understanding of the Act, the results showed that 15% of those working solely in the NRM South region had a very good understanding compared to 16% of those in the NRM North area (**Figure 7**).

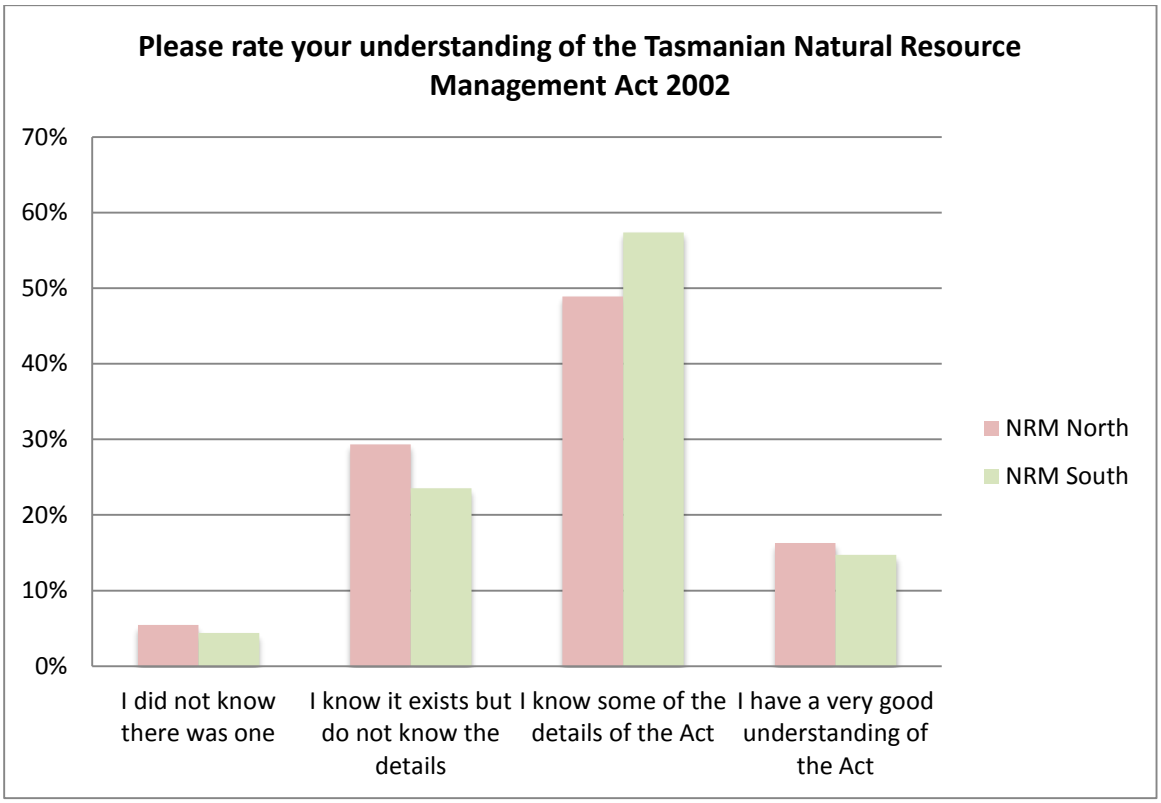

Please rate your understanding of the Tasmanian Natural Resource Management Act 2002
70%
60%
50%
40%
30%
20%
10%
0%
I did not know there was one
I know it exists but do not know the details
I know some of the details of the Act
I have a very good understanding of the Act
NRM North
NRM South

Figure 7

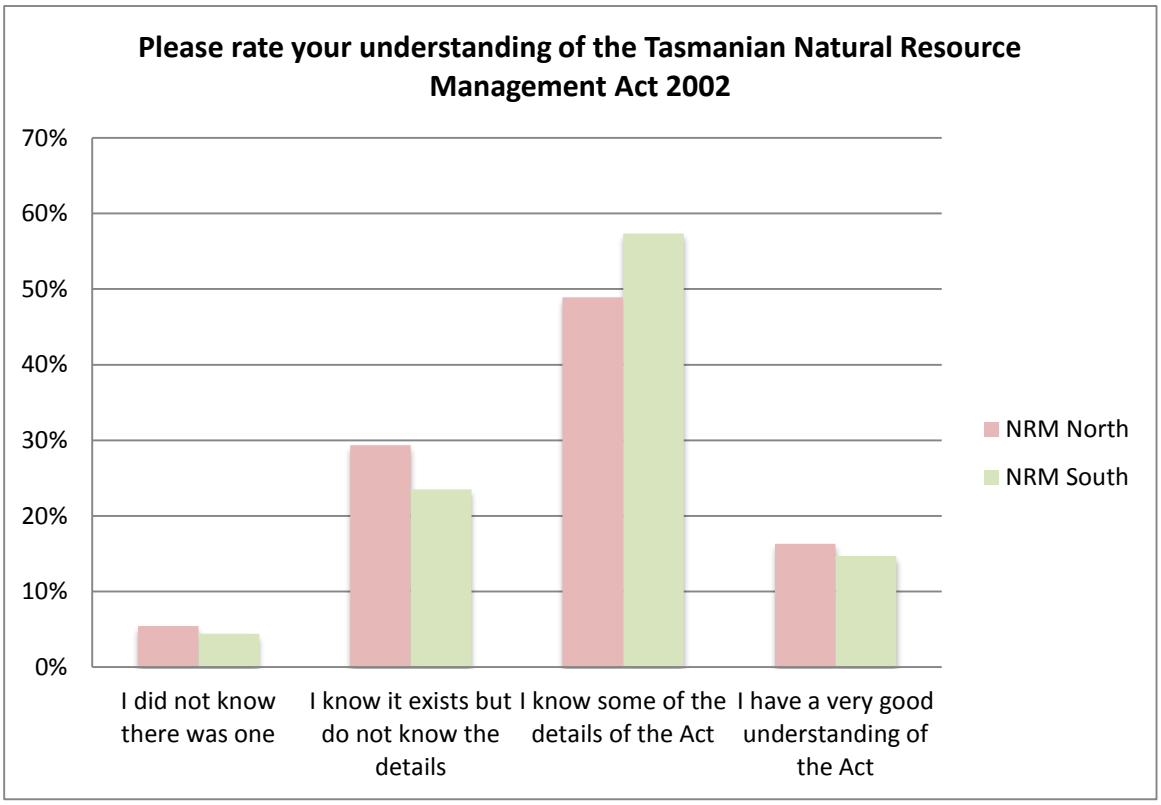


Figure 7 Understanding of Tasmanian NRM Act by location

At the regional workshops there was minimal discussion by the participants about the NRM Act (2002) - although one person called for a minimalist approach for any future revisions of the Act stating 'less is more'. The issue of the NRM Act (2002) was more widely discussed by participants at the State-wide Stakeholders Engagement Project[31].

As mentioned previously, the NRM bodies have a diverse array of stakeholders. This diversity is evident in the distribution of how the respondents to the online survey indicated their level of interaction with the NRM bodies. Although there was a large range of interaction types, there were three responses that received the highest scores:

1) Partner with NRM bodies on projects and initiatives;

2) Collaborate on natural resource management issues of mutual benefit; and

3) Participate in events and activities.

[31] PDF Management Services (2015).

The above results were very similar across the geographic scope of the respondents. What is interesting about these results is that the top three focus on collaborative processes. When looking for responses that had reasonable differences between NRM North and NRM South, very few had large differences although the one that centred on 'seeking funding' from the NRM bodies had approximately 12% difference in responses (NRM North 44% and NRM South 56% of respondents identified this as a usual activity) (**Figure 8**). Aside from the top three results, there are at least eight key interactions that stakeholders have identified. This presents a considerable challenge for regional NRM bodies who operate on tight (and diminishing) resources.

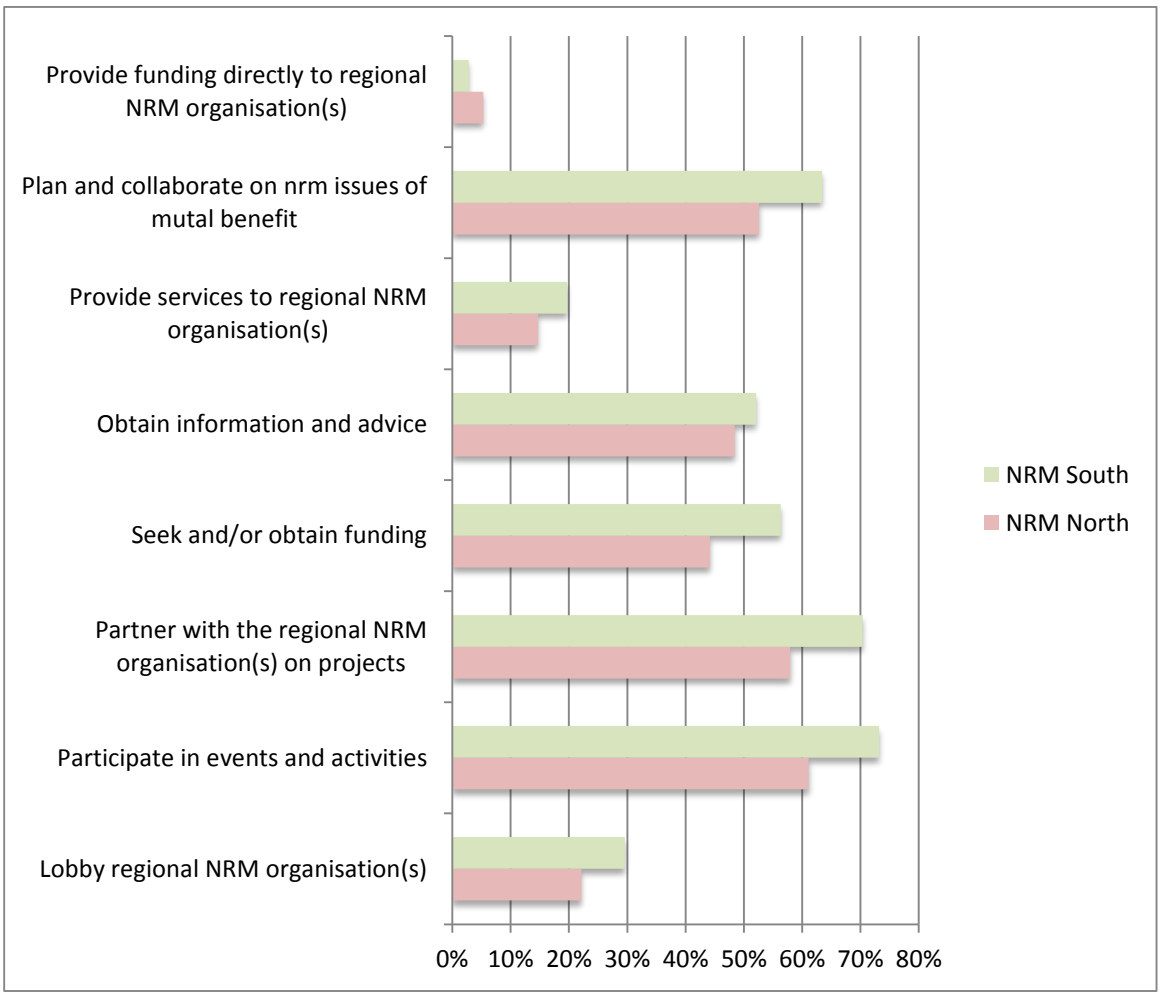


Figure 8 Respondent's relationship to the regional NRM organisations

The relatively high score of collaborative (based activities with the NRMs) is also evident in the survey results that showed a larger percentage of the respondents were members of a natural resource management working group. This result was stronger for those who identified that they worked NRM North area (56%) compared to those who worked in the NRM South area (47%).

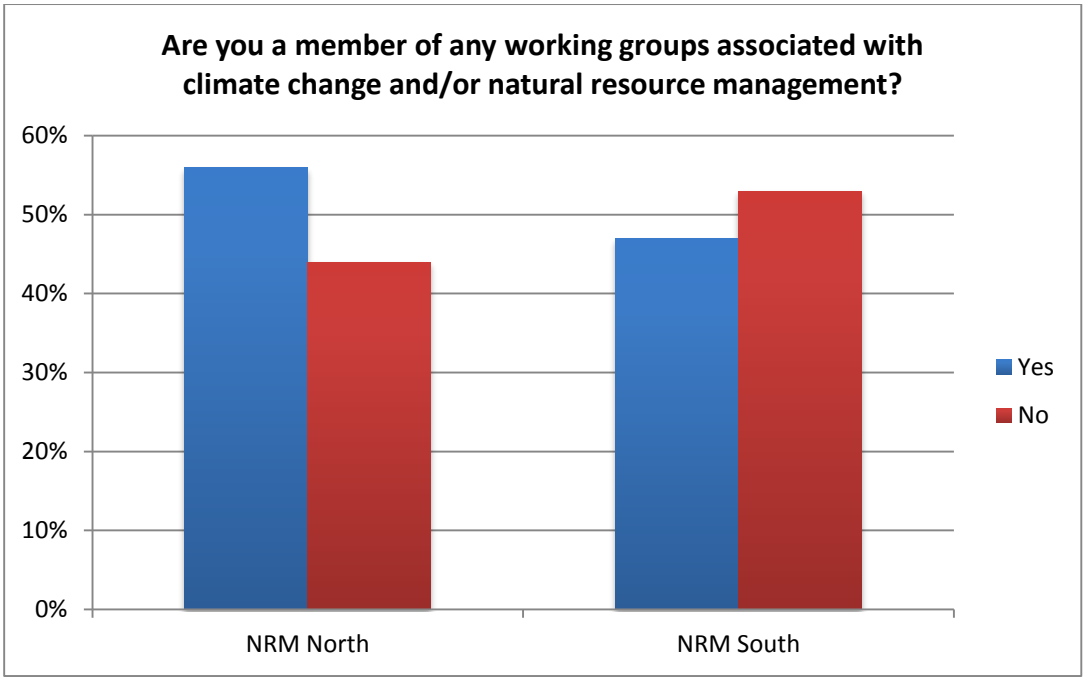


Figure 9 Percentage of respondents involved in an NRM working group

Collaboration was also a key theme that emerged in the regional workshops. Collaboration was identified by many in both workshops as being one of the existing strengths of the NRM bodies - although improvements were suggested. In the NRM South workshop one of the emerging themes expressed by many participants was the need for collaboration across sector lines. Others thought that themes (e.g. climate change or assets) rather than sectors might be more beneficial. Participants at both workshops and the online survey identified a need to better collaborate with Aboriginal stakeholders.

A reoccurring theme that emerged in both of the workshops and throughout the online survey, was a call for a more structured approach to managing the collaboration between stakeholders and for a better way to manage the multiple boundary issues.

In regards to NRM governing structures there was a call by many for either just one NRM group or for the three NRM bodies to be better directed under a common State-wide framework and implemented at the existing NRM regional level to cater for local needs. There was a range of options presented by the workshop participants and in the survey to improve collaboration - although no consensus was reached for the preferred model.

Some participants stated that they wanted to see more formal written agreements between stakeholders, while others said that formal agreements were too constraining. Some participants wanted to see just one NRM body with local implementation planning and others stated that they wanted to see three bodies with an over-arching state-wide approach to principles, common approach to measurement (what is measured and how), and key performance indicators.

Section summary

Key point 13 Attendees at the regional workshop for NRM South identified the need for increased collaboration across sectors to address NRM issues.

Key point 14 Participants in both regional workshops and respondents to the survey identified the need for increased collaboration with and involvement of Aboriginal stakeholders.

Key point 15 Participants in both regional workshops and respondents to the survey identified the need for a more structured approach to managing collaboration between stakeholders (including more improved collaboration with Aboriginal groups).

Institutional recommendation (general) 3 The next regional strategies for both NRM North and NRM South should include additional stakeholder analysis that identifies and/or builds on key issues for each stakeholder.

This recommendation highlights that stakeholders are not a homogenous group and better understanding of individual stakeholders and/or categories of stakeholders will aid targeting of engagement activities, information dissemination and communication. It is recognised that some stakeholder knowledge already exists and the focus of this recommendation is to build on this information.

4.4.2 Stakeholder recognition of key actors in natural resource management

With such a diversity of stakeholders it is difficult to identify the key players in the NRM environment. The online survey asked participants to weigh the importance of stakeholders for the management of natural resources. The top five organisations/ sectors that received the highest responses for being 'essential' were:

1. State government department/s (55%)
2. Primary producers (for commercial purposes) (50%)
3. Local groups (49%)
4. Local government (45%)
5. Commonwealth government department/s (43%).

Interestingly regional NRM bodies were ranked seventh on this list (41%), see **Figure 10**.

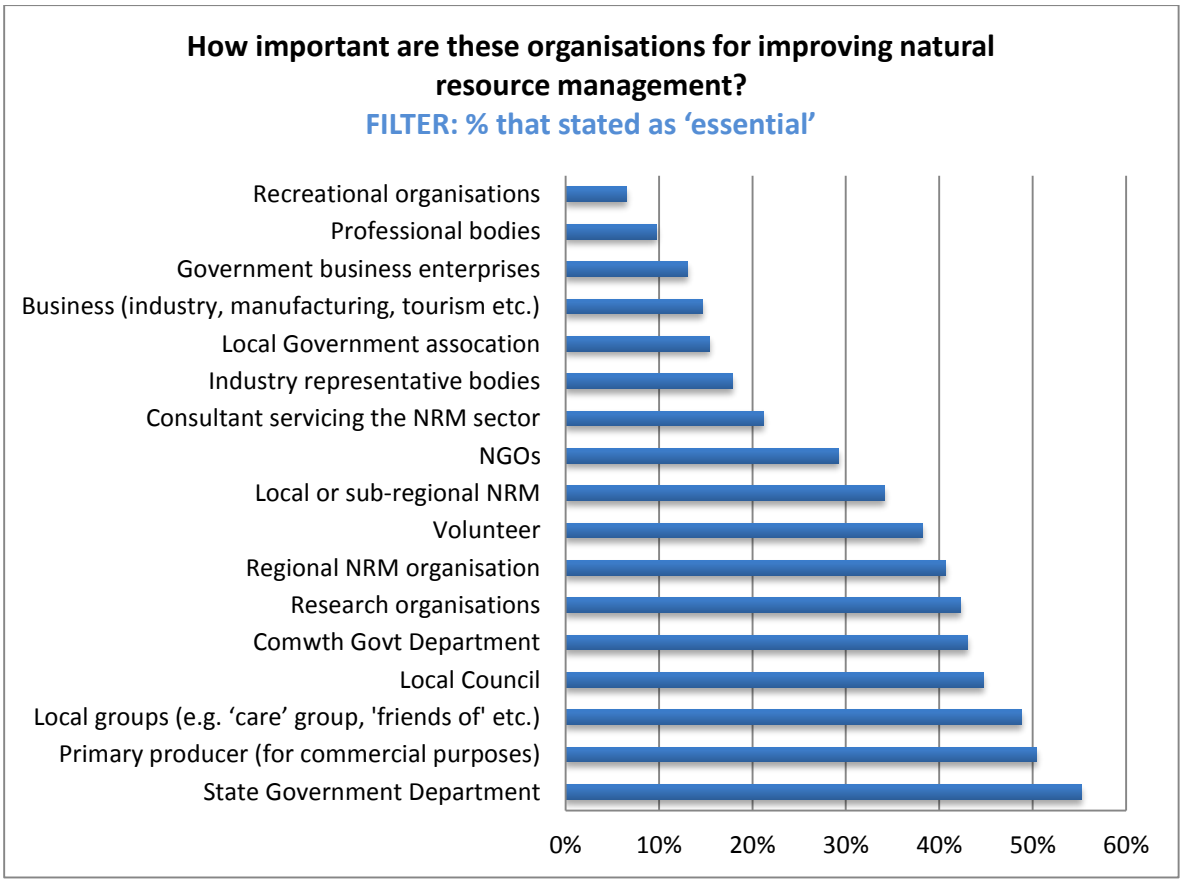


Figure 10 Importance of organisations in improvement natural resource management

However, when looking at the results of the respondents who classed regional NRM bodies as 'important' they received a higher score (44%) and ranking (4th), see **Figure 11**.

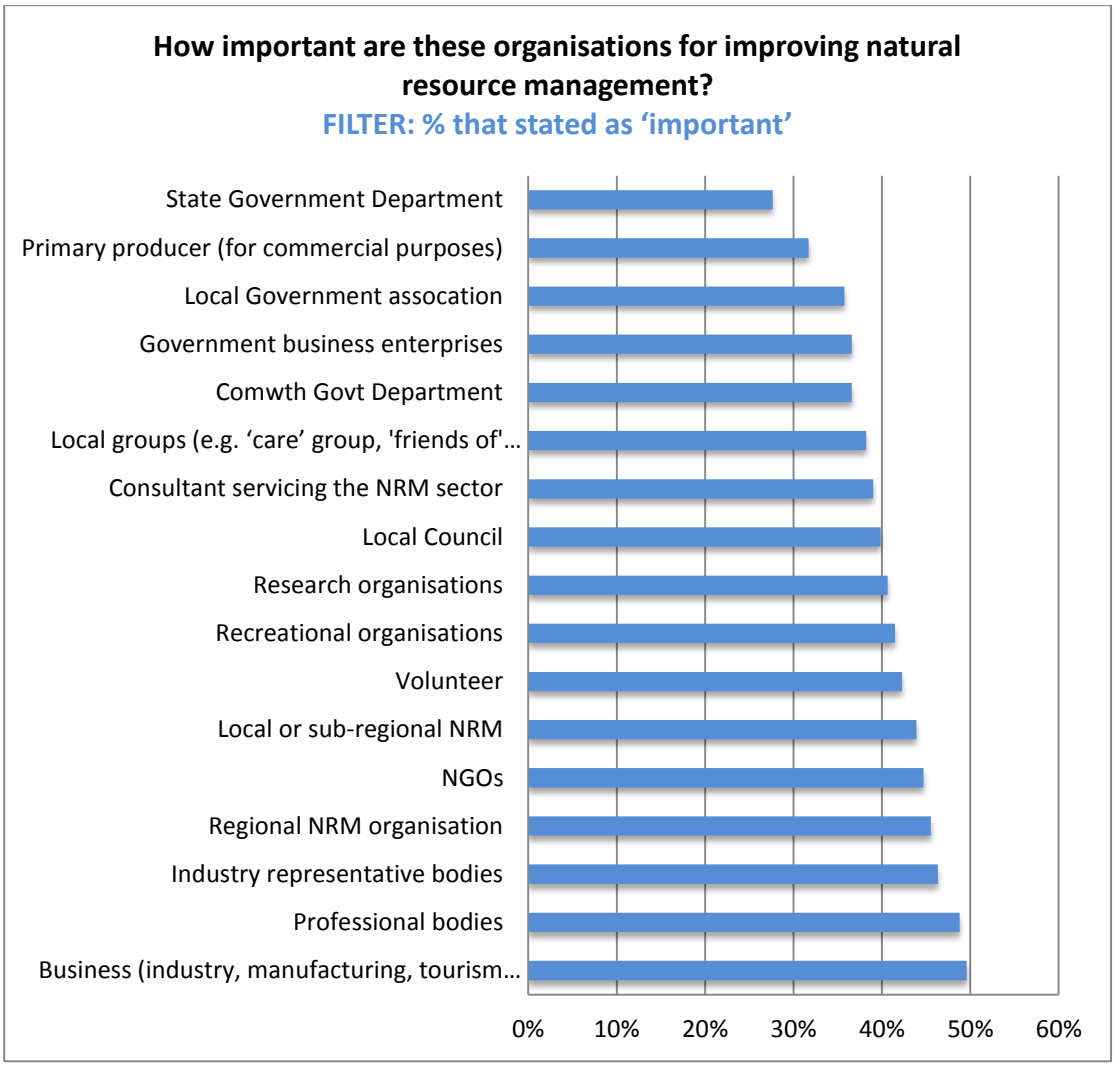


Figure 11 Respondents weighting of organisations for improving natural resource management

When applying a further filter to represent only survey participants who work in the NRM North or NRM South, the combined results (see **Figure 12**) showed a marked difference where in the 'essential' category they were ranked second equal with 52%. The top five with this filter applied were:

1. Primary producer (for commercial purposes) (54%)
2. Regional NRM bodies (52%)
3. Local council (52%)
4. Local groups (52%)
5. Local or sub-regional NRM groups (48%)

The important finding here is that all the stakeholders recognise that there is not one key organisation in natural resource management and that there are a number of essential and important actors in the space. Furthermore, the weighting of who is essential / important changes, depending on the geographic scale of the stakeholders (and probably changes over time as well).

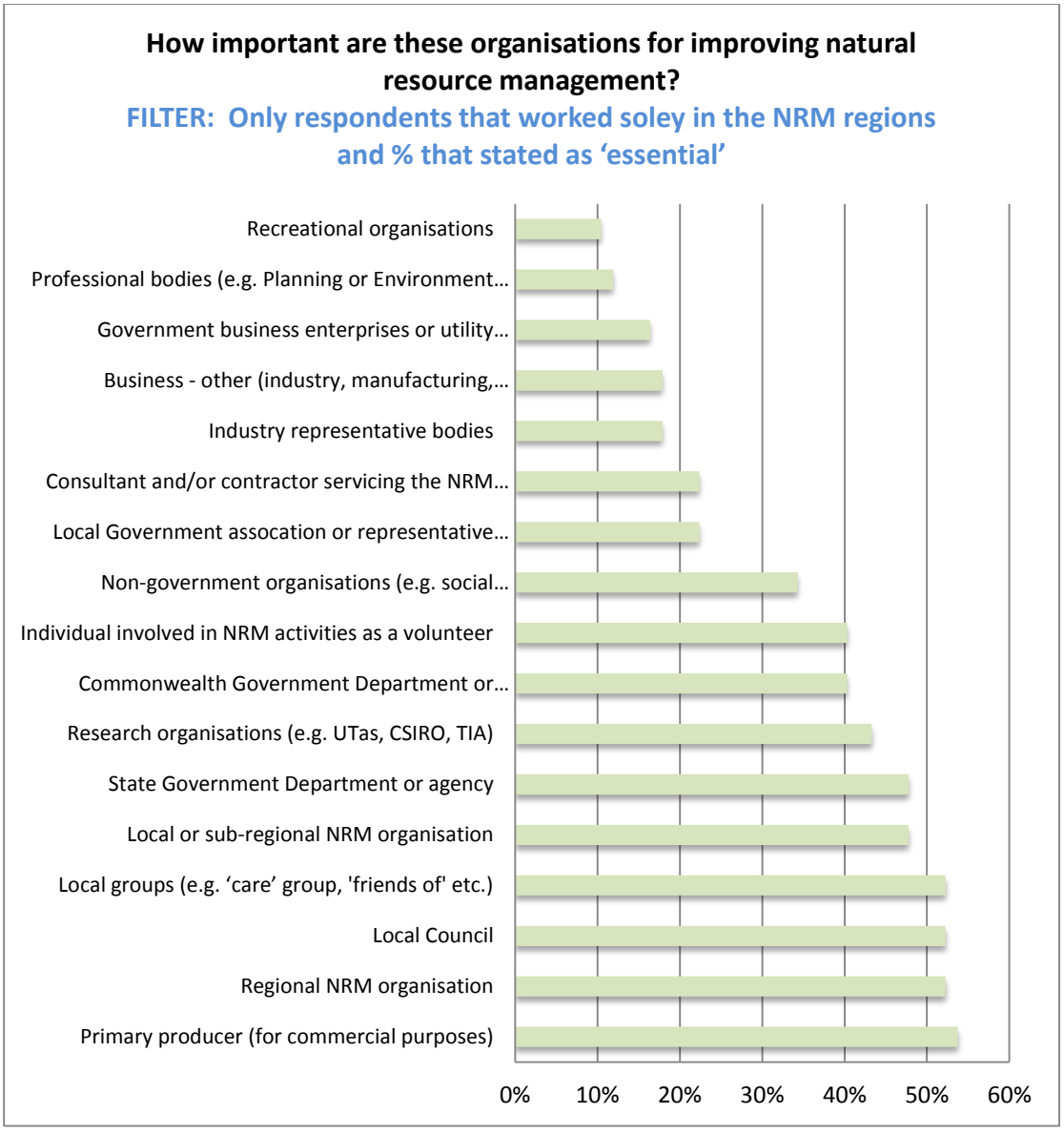


Figure 12 Importance of organisations to improving NRM – region based respondents who stated regional NRM bodies are essential (NRM South)

When looking at the NRM specific results, it was interesting to note that a very large percentage of respondents in the NRM South region indicated that local government was essential (75%) for improving natural resource management compared to NRM North (41%), where their highest score for 'essential' was regional NRM bodies (54%). See **Figure 13** and **Figure 14** for further information.

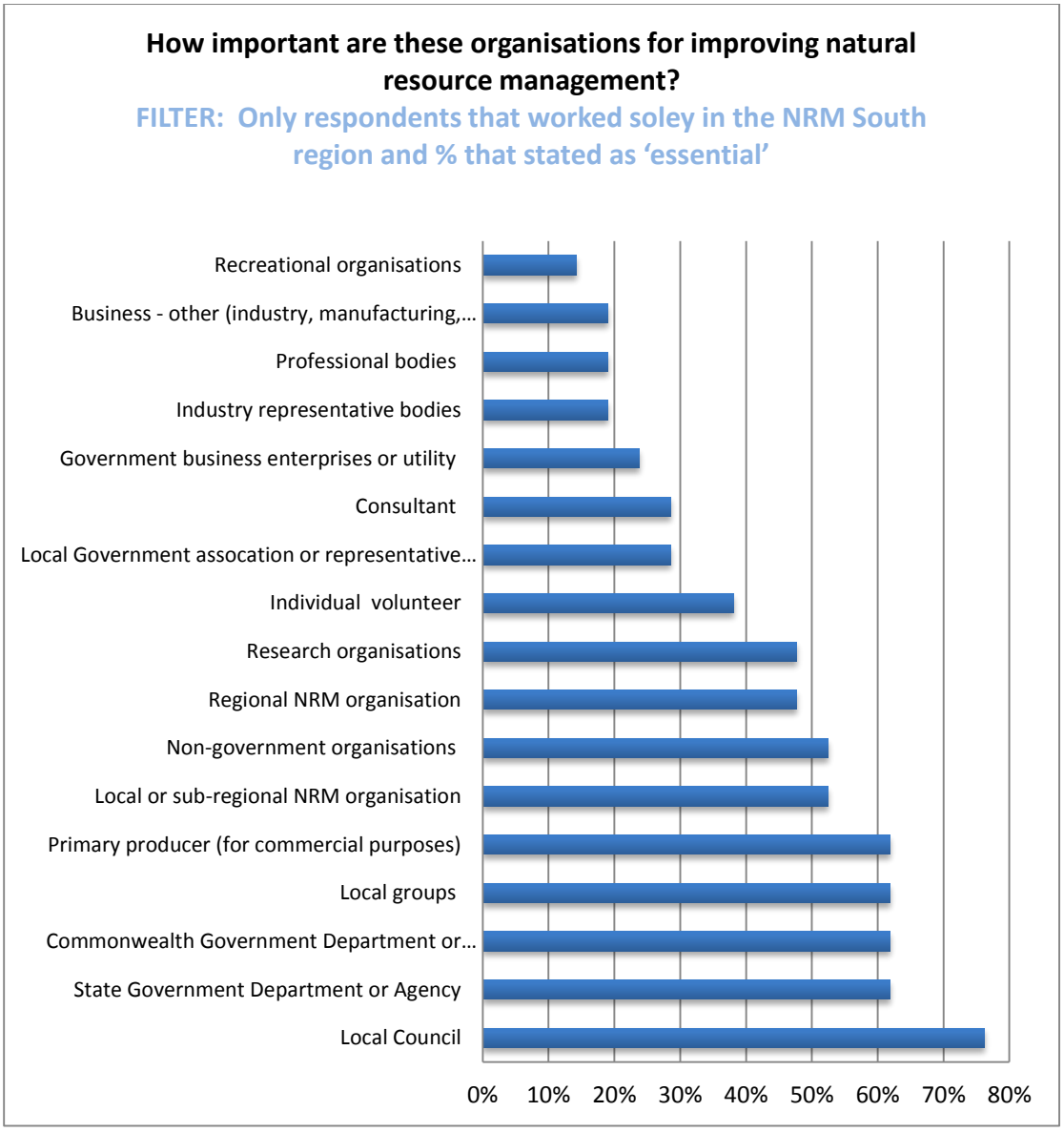


Figure 13 Percentage of respondents working solely in the Southern NRM Region that stated regional NRM bodies are essential to improving natural resource management

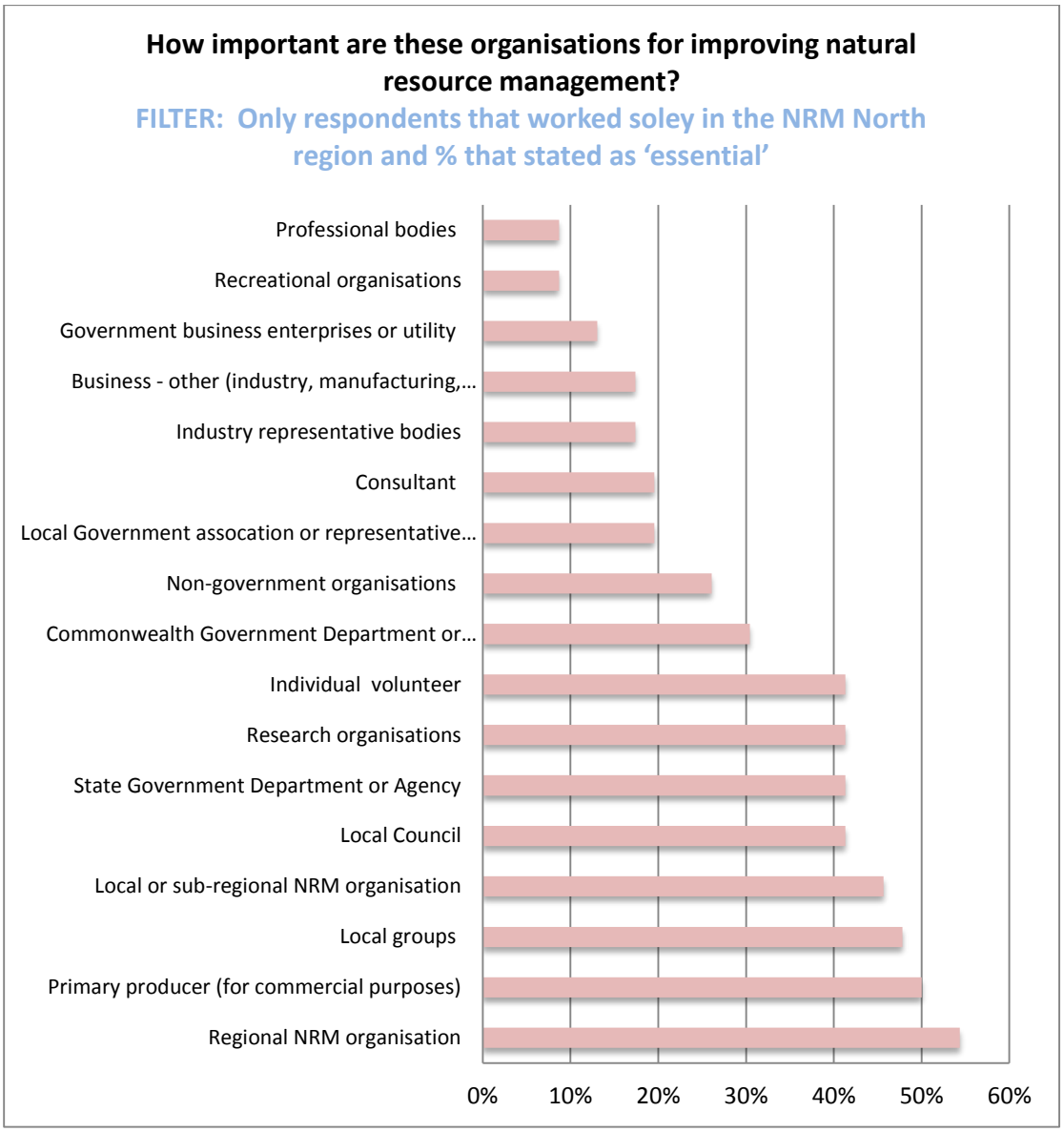


Figure 14 Percentage of respondents working solely in the Norhern NRM Region that stated regional NRM bodies are essential to improving natural resource management

Section summary

Key point 16 All stakeholders recognised that there is not one key organisation in natural resource management and that there are a number of essential and important actors in the space. Furthermore, the weighting of who is essential / important changes, depending on the geographic scale of the stakeholders (and probably changes over time as well).

4.5 Climate Change Governance

The projections for the natural environment of the future suggest 'most places in Australia having, by 2070, environments that are more ecologically different from current conditions than they are similar' (Dunlop et al 2013, p.7). The projected changes will affect biodiversity outcomes in a broad number of ways (see **Table 7**), which are likely to have cascading impacts on the resources that underpin our socio-economic system.

Interestingly, the extent of change for parts of the Tasmanian natural environment will be, on a whole, less dramatic compared to the mainland (although changes will still occur) (Dunlop et al 2013, p.7). However, it is this relatively less severe impact that may drive population, agribusiness and other industry shifts to Tasmania and therefore place an increase on the demand for natural resources and stressors on the environment.

Already Tasmania has been identified as a place for industries to hedge their climate change related risks. For example, viticulture industries from Europe and mainland Australia are already investing in the State due to the improved climatic conditions for wine grape growing.

Climate change and associated responses can affect the natural environment in a number of ways (see Table). However, it is also important to recognise that the management of natural resources can also help contribute to the mitigation of greenhouse gas emissions.

Dimension of biodiversity	Scenarios of ecological change
Species outcomes	• In situ adaptation: Species either unaffected, cope, adapt in situ, adapt locally (within their existing distributions), evolve; possibly with reduced abundance and range. • Regional shifts: Species disperse and establish at new sites matching their regional bioclimatic habitat; possibly declining in areas of pre–climate change distribution. • Coping with new species: Species colonise from elsewhere, some altering habitat and species interactions, altering the realised niche of resident species; possibly contributing to reductions in the abundance and range of resident species.
Ecosystem Outcomes	• Change in composition: Loss of species and establishment of new species; potentially reducing local species richness and diversity; structure and function may or may not change significantly. • Change in structure: Changes in the relative abundance or dominance of species lead to change in habitat structure; potentially resulting in a simplification of habitat; may or may not include changes in composition and function. • Change in function: Changes (loss) in net primary productivity, for example, as a consequence of change in function due to changes in environmental potential or abundance of producer species and food-web interactions; productivity possibly below its potential.
Landscape Outcomes	• Change in type of ecosystems and land/water uses: Changes in land, water, and sea uses and changes in types and functioning of ecosystem; but not necessarily the net balance; potentially including loss of particular ecosystems or services. • Intensification of land/sea use: Less hospitable matrix for species and ecosystems as land uses intensify and agro-ecosystems expand; may happen rapidly in response to technology and climate adaptation opportunities; likely to include loss and degradation of supporting habitat for species and ecosystems.

	• Expansion of land/sea use: Potentially more hospitable matrix and reduction in extent and intensity of land, water, and sea uses; in response to decreased productivity of fisheries, grazing, cropping systems, etc; reduced water availability; potentially leading to increased habitat availability for native biodiversity, but land abandonment may be preceded by degradation.

Table 7 Potential impacts of climate change on biodiversity[32]

It is important to recognise that change to the natural environment due to climate change is inevitable and is a core component of natural resource management. In fact Dunlop (2013) states that 'resisting change from the current to the future biodiversity state through ecological management is seen as ecologically infeasible. It may even be counterproductive' (p.17).

Although there is a wealth of literature that identifies climate change projections and ramifications for the natural environment, responding to climate change is new territory for many organisations. This makes information collection for the NRM bodies very challenging.

The Project Team has drawn on the work of Burton (one of the Project Team members) who has explored the core components of organisational climate change adaptation governance, especially in the local government context[33]. Burton (2013) highlights the important differences between the two key themes to climate change adaptation:

> **Specific adaptation actions:** These are actions that respond directly to specific or general risks. In general these actions usually are about risk transfer, risk avoidance, risk management or risk acceptance (these actions may or may not be mutually exclusive). For example, an adaptation response to rising sea levels affecting human settlement could be to manage the risk through planning and design standards, transferring the risk to insurers, avoiding the risk through planned retreat or accepting the risk and letting the market influence

[32] Dunlop *et al.* (2013).
[33] Burton (2013).

behaviour. Sometimes in the adaptation literature this is also referred to as 'outcomes-based' measures.

Adaptation governance: This is about the core system that supports climate change adaptation actions. It includes institutional arrangements, resource allocation, executive and interdepartmental support, inclusion in strategic planning, supporting head of power, financial planning and any other activity that will enable climate change adaptation to be mainstreamed into an organisation's activities. Sometimes in the adaptation literature this can also be referred to as 'process-based' measures.

It is important to note that while an assessment of the above two themes (specific and process-based adaptation actions) is essential for understanding resilience to climate change, it is also prudent to focus initial emphasis on adaptation governance. This is because unless it can be ensured that an organisation's internal adaptive capacity is robust, there is a risk that specific adaptation actions will be ad hoc and constrained by limited resourcing and political support. This is an issue recognised in the adaptation literature:

> *The whole point of the work on adaptation processes is to have risks (and opportunities) associated with climate change . . . actually addressed in decision-making at some practical level*[34].

The difficulties rest in the multiple complexities of attempting to understand so many unknown possibilities that may occur over time. For example, it is nearly impossible for an adaptation practitioner to project how a range of potential future climates in one location may affect a shifting range of coping thresholds for the social, natural and economic environment, while considering other stressors and influences (e.g. carbon pricing, technological advancement, oil price shocks).

Recognising that multiple futures are possible, lends support to the need for robust decision-making frameworks that can respond as issues and information emerge over time. In fact, this has been identified as the priority for Australian local governments:

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[34] Smit & Wandel (2006), p.285.

> [organisations] *will better respond to the challenges of climate change in an environment where adaptive responsibilities are clear, response and evaluation frameworks are consistent across jurisdictions, approaches to mainstreaming climate change adaptation are implemented, and decisions are made on the basis of the best data and information.* (NCCARF 2013, p.1)

Although the above quote was specifically directed towards local government, it has merit is all sectors, including natural resource management. In effect, when looking at the two themes presented here (process and outcomes-based actions) it becomes evident that one static report, at one specific time, cannot manage the dynamics required in understanding and responding to a changing climate. For the regional NRMs, collecting and analysing individual reports on assets and landscapes is valuable but also takes considerable time and resources. Meanwhile if the NRM stakeholders do not have systems in place to respond to the information in those reports, very little impact will be made to improve the region's resilience to the effects.

Assessing the success of specific adaptation actions is complex, especially in the realms of natural resource management. For a start, the time scales in which some of the environmental changes may occur just do not lend themselves to easy evaluation of these outcomes-based measures.

It should be recognised that it is not possible to assess the governance of the key stakeholders directly for each stakeholder (that is, undertaking a detailed analysis of each organisation) due to the large numbers and distribution of the NRM stakeholders. For NRM bodies to gain an understanding of the issues, they will need to understand and monitor their own adaptation governance as well as maintain a general understanding of the adaptation governance of all of their stakeholders. Although this is a very challenging and data-intensive task it is achievable over time and under the right conditions.

Given the constraints listed above, all of the governance indicators described below come from the results of the online survey together with some scoping desktop review of publically available literature.

The Project Team identified eight key governance indicators that were measurable and had relevance to NRM bodies maintaining an understanding of the degree of climate change consideration by its stakeholders. They are:

1. Extent that stakeholders have a formal policy or process for climate change
2. Resource allocation for the management of climate change issues
3. The level of stakeholder expertise /capacity in climate change management
4. Access to climate change information
5. Extent of climate change risk assessments or adaptation planning
6. Monitoring the identified barriers to adaptation
7. Inclusion of climate change in local government strategic plans
8. The existence of a database management system.

Each of these indicators can be expanded on over time as systems are implemented for easier information gathering. The indicators are not given a specific scoring but instead a qualitative commentary is provided - although all of the indicators are presented in a way that can be easily compared to over time. It will also be relatively simple for the NRMs to create a scoring system that suits their priorities should they wish to do this.

Institutional observation It is recommended that the NRM regions adopt and lead a best practice approach to climate change governance. Both the SCARP Report and the AdaptNRM portal provide directions for the NRM agencies to undertake these actions.

Please note: this finding is outside the scope of this project. The observation has however, been included as an operational issue for further consideration by NRM North and NRM South when implementing the next Regional Strategies.

4.6 Scoping assessment of climate change governance indicators

4.6.1 Extent that stakeholders have a formal policy or process for climate change

As a formal recognition of the need to understand and manage climate change related issues, this indicator is perhaps one of the most crucial of all for climate change governance. An internal climate change policy allows the organisation to place a climate change lens over its activities and use the existing system to drive adaptation. It also de-politicises the issue of climate change and takes out the 'belief' problem (that is often associated with climate change management and acts as an implementation barrier away from decision-makers).

For this project, the stakeholder results are measured through the results of the online survey as well as from a commentary on some of the key stakeholders (from desktop analysis and workshop notes). The survey results showed that of the 32 organisations surveyed 47% stated that they did not have a formal approach to managing climate change, 41% did have a formal approach and 12% were unsure (**Figure 15**).

This presents both a challenge and an opportunity for regional NRM bodies. The challenge is that they do not know the 'official' stance or approach that many of its stakeholders will take in regards to planning for climate change. As such, it will not know whether any climate change actions in the strategies will complement or be in conflict with stakeholders. The opportunity presented is that the NRM bodies may be able to work with those who do not have a formal climate change policy or approach to management and influence their consideration of natural resource issues. However, to do this the NRM bodies will first need to know themselves what issues and/or responses they will be advocating for.

These results provide a baseline for an important key performance indicator. It can be further expanded over time by assessing the extent of organisations with climate change policies considering natural resource management.

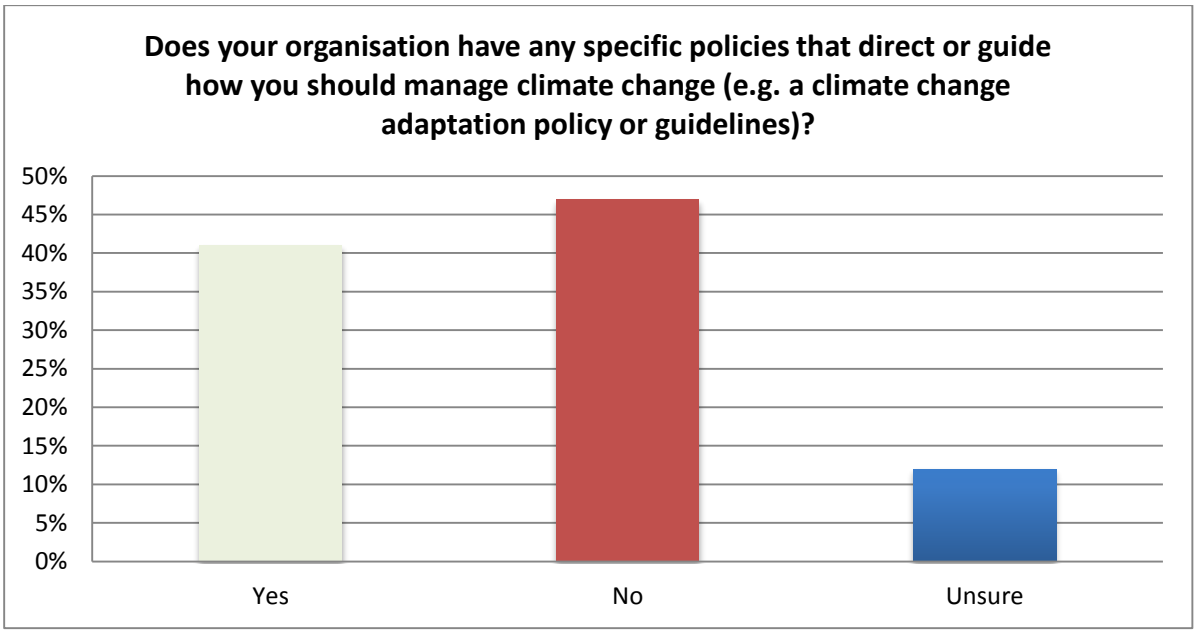

Figure 15 Percentage of organisationals that have specifc climate change policies (all respondents)

4.6.2 Resource allocation for the management of climate change issues

Monitoring an organisation's resource and staffing commitment to climate change is critical to supporting ongoing climate change adaptation. If an organisation only relies on external consultants for adaptation research and responses, then it is doing very little to increase the internal adaptive capacity of its organisation.

Furthermore, without a permanent, adequate annual budget the organisation will only be able to undertake adaptation actions in an ad hoc manner. The ultimate goal for adaptation should be to mainstream consideration of climate change across all organisational activities.

For this project, the stakeholder results are measured through the results of the online survey. The results shown for this question are quite concerning. Almost three quarters of the organisations surveyed (73%) indicated that they have no ongoing budget for managing climate change (mitigation or adaptation). Only 18% stated that they had a permanent budget for mitigation and even less (12%) allocated resources for adaptation (**Figure 16**).

The results are very similar when a geographic filter is also applied (**Figure 17**). An interesting point to note is that when compared to the previous question, approximately 25% of those who answered 'yes' to having a formal climate change process do not have any resources allocated to support it.

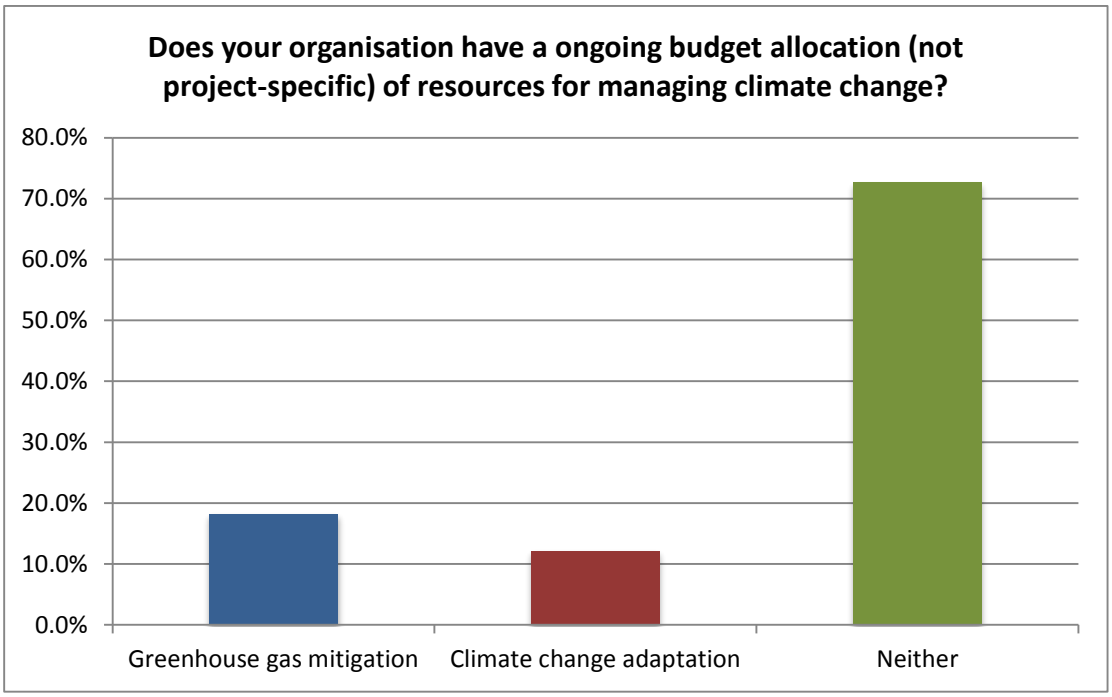

Figure 16 Perecentage of organisations that have an ongoing budget for managing climate change (all locations)

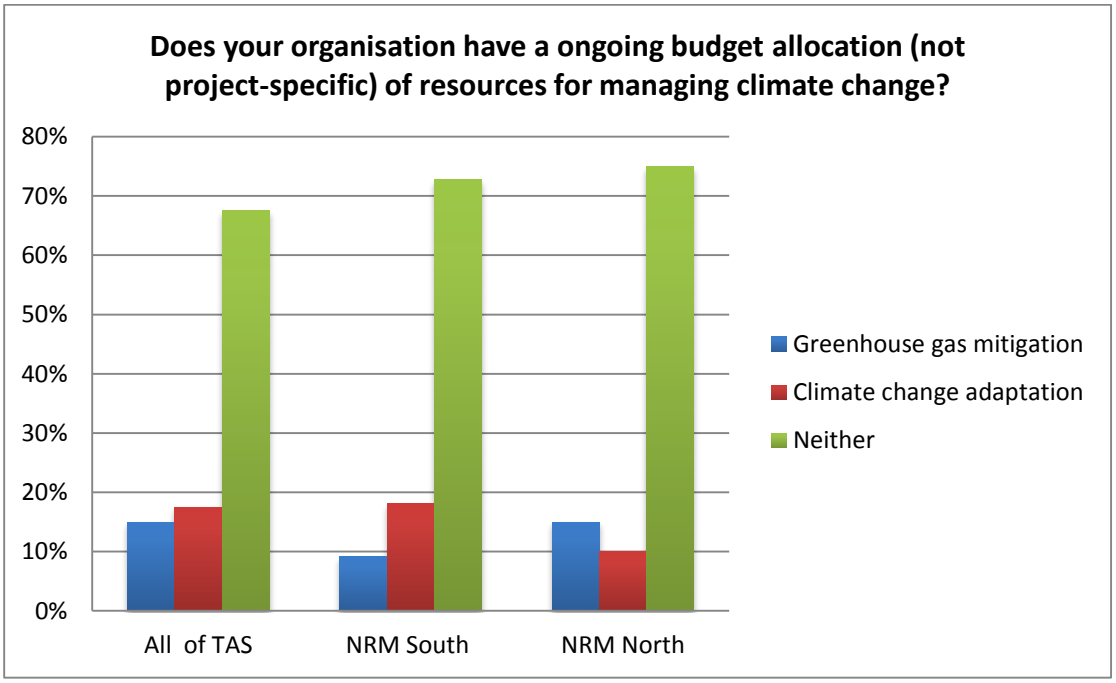

Figure 17 Percentage of organisations that have an ongoing budget for managing climate change (by location)

4.6.3 *The level of stakeholder expertise /capacity in climate change management.*

Understanding the complex issues surrounding adaptation requires a reasonable degree of expertise and/or experience. Climate change has often been framed as an environmental issue and one that gets added to the existing remit of staff who may or may not have the right expertise to understand the complex issues and influence implementation. Matching skill sets to the problems is critical especially if any issues result in litigation. Many organisations have their liability for negligence covered but it is usually a condition of the insurance that the staff making decisions are adequately skilled to do so.

The assessment of this indicator comes from the results of four questions in the online survey. The first asked participants to describe their understanding of climate change management. Approximately 56% of people (NRM South 60%; NRM North 56%) stated that they had a reasonable understanding 28% (NRM South 21%; NRM North 27%) stating they had limited and 13% (NRM South 19%; NRM North 14%) self-describing as having an extensive understanding of climate change management (Figure 18).

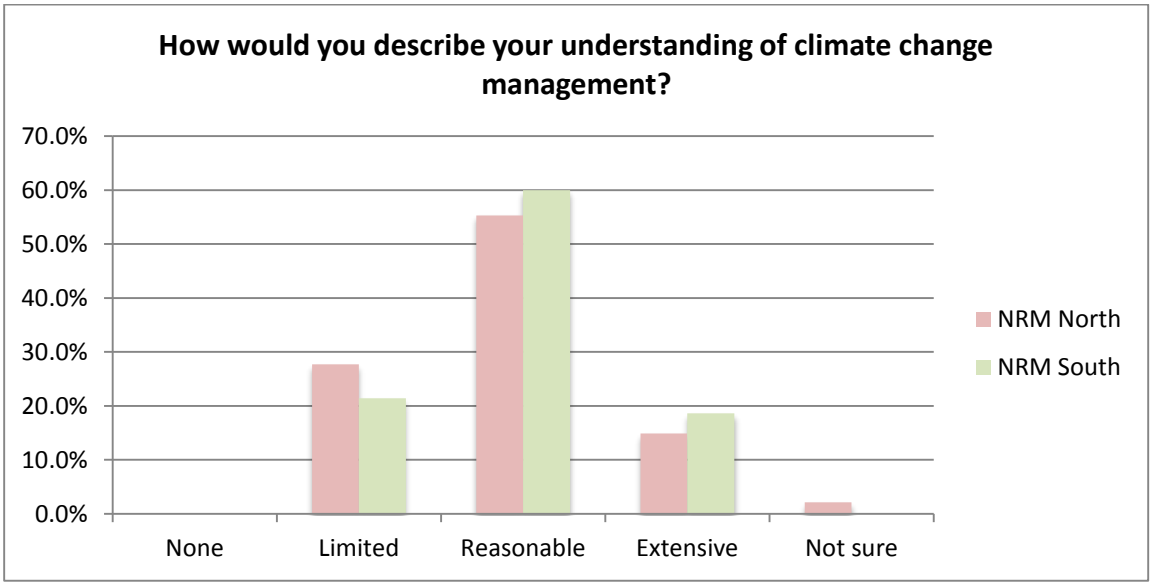

Figure 18 Respondents understanding of climate change management

The second question that explored the skills of the survey participants asked about the level of education and/or training associated with climate change. A large percentage of respondents stated that they were self-taught (that is, actively sought out relevant information) (56%). However, when this is combined with those who stated that they have had no training (20%) the resulting total of those with no formal training is 76%. Interestingly, 50% of those who stated that they had an 'extensive' understanding of climate change management have not had any formal qualification or training associated with climate change management.

These results show that there is a need for training and/or an accreditation process for those who are likely to make climate change related decisions in the natural resource management arena. Climate change adaptation is about informed decision-making and managing trade-offs. When undertaking considerations associated with climate change the NRM bodies should be cautious when dealing with any staff or organisations who do not have any expertise in this field.

The third question asked participants of the survey how well they knew the difference between climate change mitigation and adaptation. This question was asked as it is people frequently confuse the two. The results of the survey supported this suspicion. Only a little over half were certain about the difference (51%), with 38% stating they had a partial understanding and 11% stating that they did not know the difference at all (**Figure 21**).

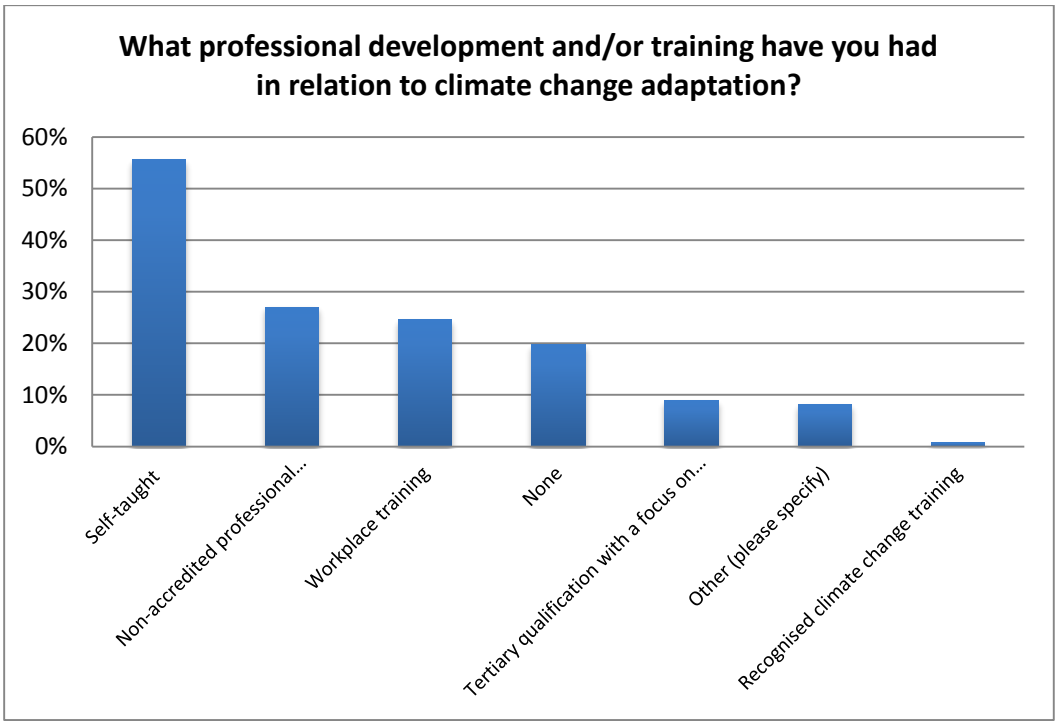

Figure 19 Respondents extent of professional development / training for climate change (all locations)

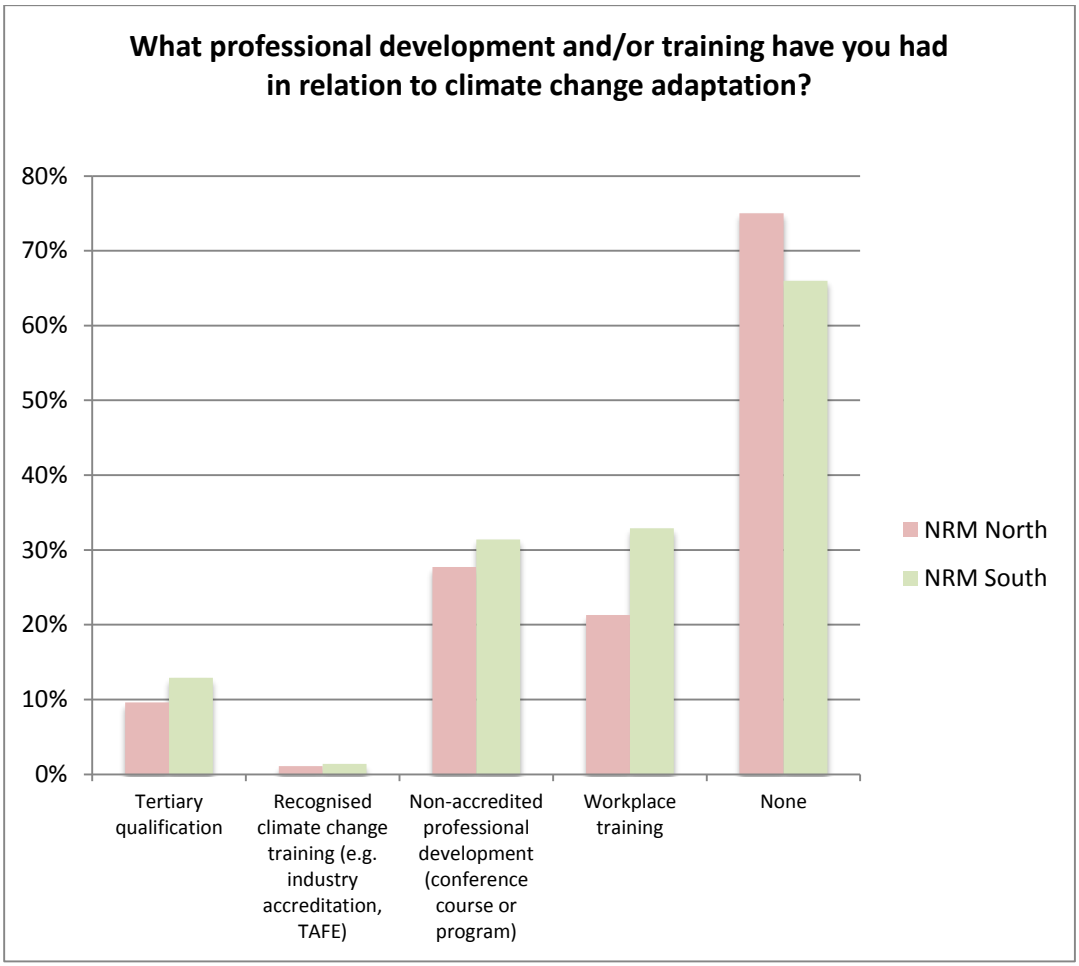

Figure 20 Respondents extent of professional development / training for climate change (by location)(NB. Responses 'self taught' and 'none' combined)

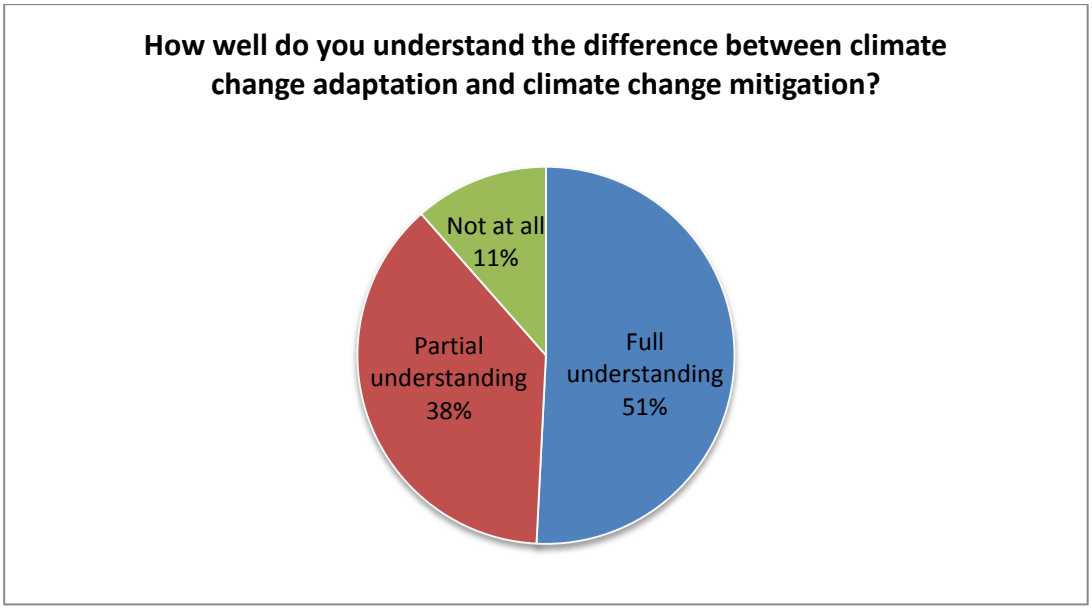

Figure 21 Respondent's ability to differentiate between mitigation and adaptation

The fourth question for this indicator asked participants about their perceived ability to plan for climate change when undertaking natural resource management. The results showed that approximately 40% of respondents stated that they would need support from outside of their organisation to do so (**Figure 22**). The results of this question have a similar spread when separated by location (**Figure 23**).

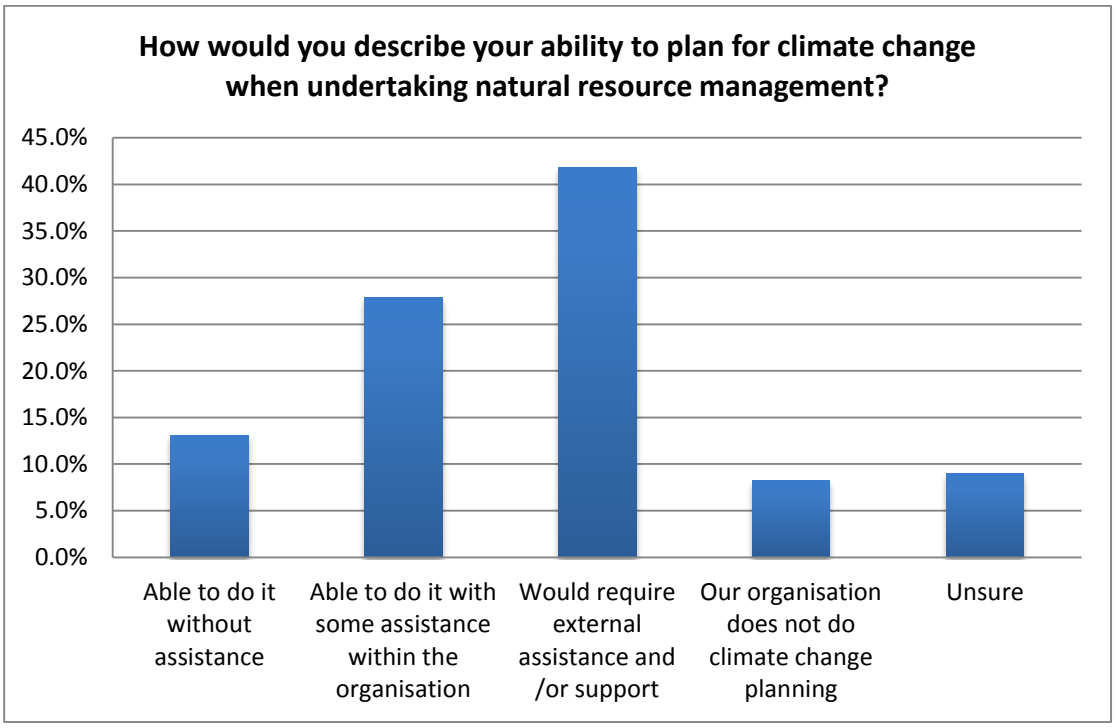

Figure 22 Respondent ability to plan for climate change when undertaking natural resource management (combined NRM North and NRM South)

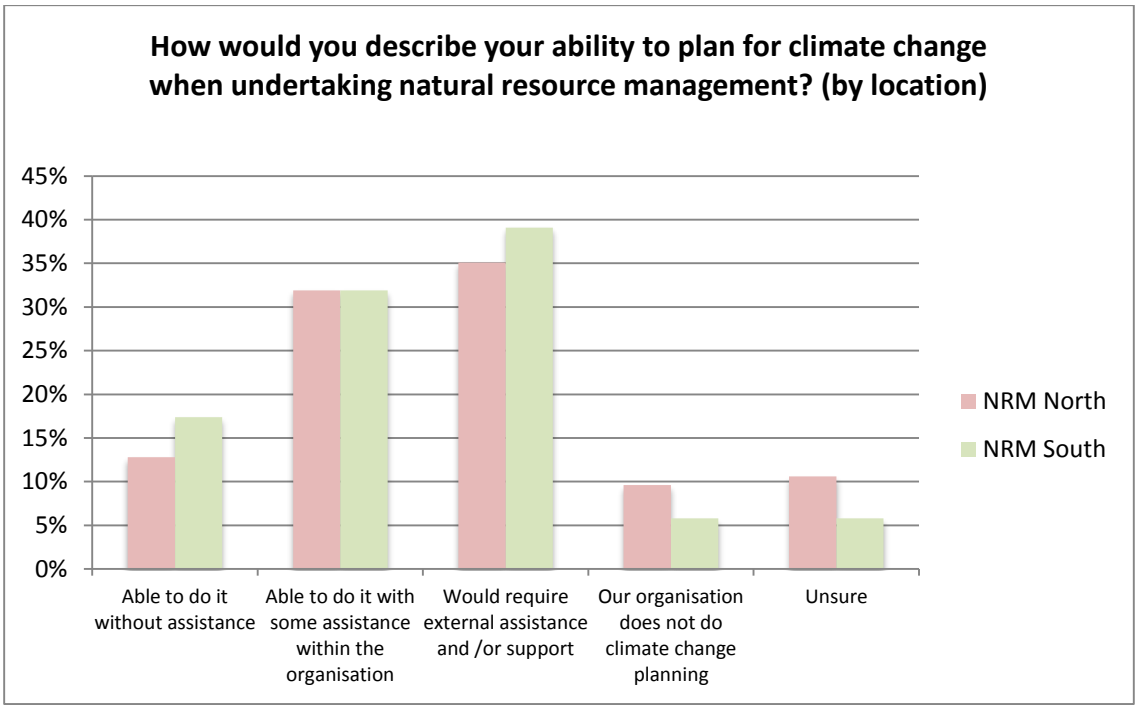

Figure 23 Respondent ability to plan for climate change when undertaking natural resource management (by location)

4.6.4 Access to climate change information

Understanding the impacts of climate change requires access to climate change information. This is a core indicator as often information access is identified as a barrier to implementation. Furthermore, information about climate change projections and its potential impacts is constantly changing as the scientific currency changes. The NRM bodies are currently in a fortunate position to be in a partnership with academic institutions that better position themselves to obtain access to scientifically robust information relevant to their area.

The group, called the Southern Slopes Climate Change Adaptation Research Partnership (SCARP), is a consortium led by the Tasmanian Institute of Agriculture (TIA) together with the Victorian Centre for Climate Change Adaptation Research (VCCCAR) and the Victorian Department of Environment and Primary Industries, (DEPI).

SCARP aims to enable four broad outcomes by linking climate impacts and adaptation research with the planning and regional plans/strategies of the nine NRM regions/CMAs within the Southern Slopes Cluster (SSC):

- *NRM organisations have updated their plans to include robust and context-relevant adaptation and impacts information;*
- *NRM organisations have increased their capacity to incorporate new climate change related information into strategic and tactical planning;*
- *SCARP team has developed into an interdisciplinary team that is able to reconcile supply and demand for climate impacts and adaptation information; and*
- *Appropriate, use-oriented climate impacts and adaptation information has been delivered to NRM organisations in fit-for purpose formats and platforms*.[35]

The NRM bodies are also in a fortunate position to be reviewing their strategies in time to have access to 'the most comprehensive information ever released for Australia, [which] has been prepared with an emphasis on informing impact assessment and planning in the natural resource management sector'.[36] The information is derived from the CSIRO and the Bureau of Meteorology's latest climate change projections. The projections for Australia are separated into 'super cluster' and 'sub-cluster' areas for regionalisation. The NRM bodies in Tasmania fall into the Southern Slopes sub-cluster and have a detailed technical report for regionally significant climate change projections out to the 2090 average. [37]

The NRM bodies also have early access to AdaptNRM which 'is a national initiative that aims to support NRM groups in updating their NRM plans to include adaptation planning for climate change'.[38]

[35] Leith *et al* (2013).
[36] http://www.climatechangeinaustralia.gov.au/en/about/
[37] Grose *et al.* (2015a).
[38] http://adaptnrm.csiro.au/about-adaptnrm/

In regards to information access at present there is a wealth of scientifically current and robust information available for NRM bodies and their stakeholders. However, it is important to note that accessing the information is one thing – being able to interpret it into decisions is another matter and requires resourcing, relevant skills and strategic direction.

As well as having access to information about climate change, NRM bodies need to understand the information needs of their stakeholders. The online survey asked participants how NRM bodies could help them with their adaptation planning. The largest response from the participants centred on 'risk identification' with respondents wanting information on risks (65%) facing specific species, ecosystems or natural assets or relevant adaptation options (62%). Other information needs that scored relatively highly included information on the economic impacts of climate change on natural resources (53%) and information on ecosystem-based adaptation (53%).

The results from this question identify that the stakeholders see the regional NRMs as a player in the provision and/or interpretation of information associated with climate change. The challenge for NRMs is to determine what their capacity is to deliver on this expectation and to work closely with its stakeholders to determine/clarify roles and responsibilities associated with climate change.

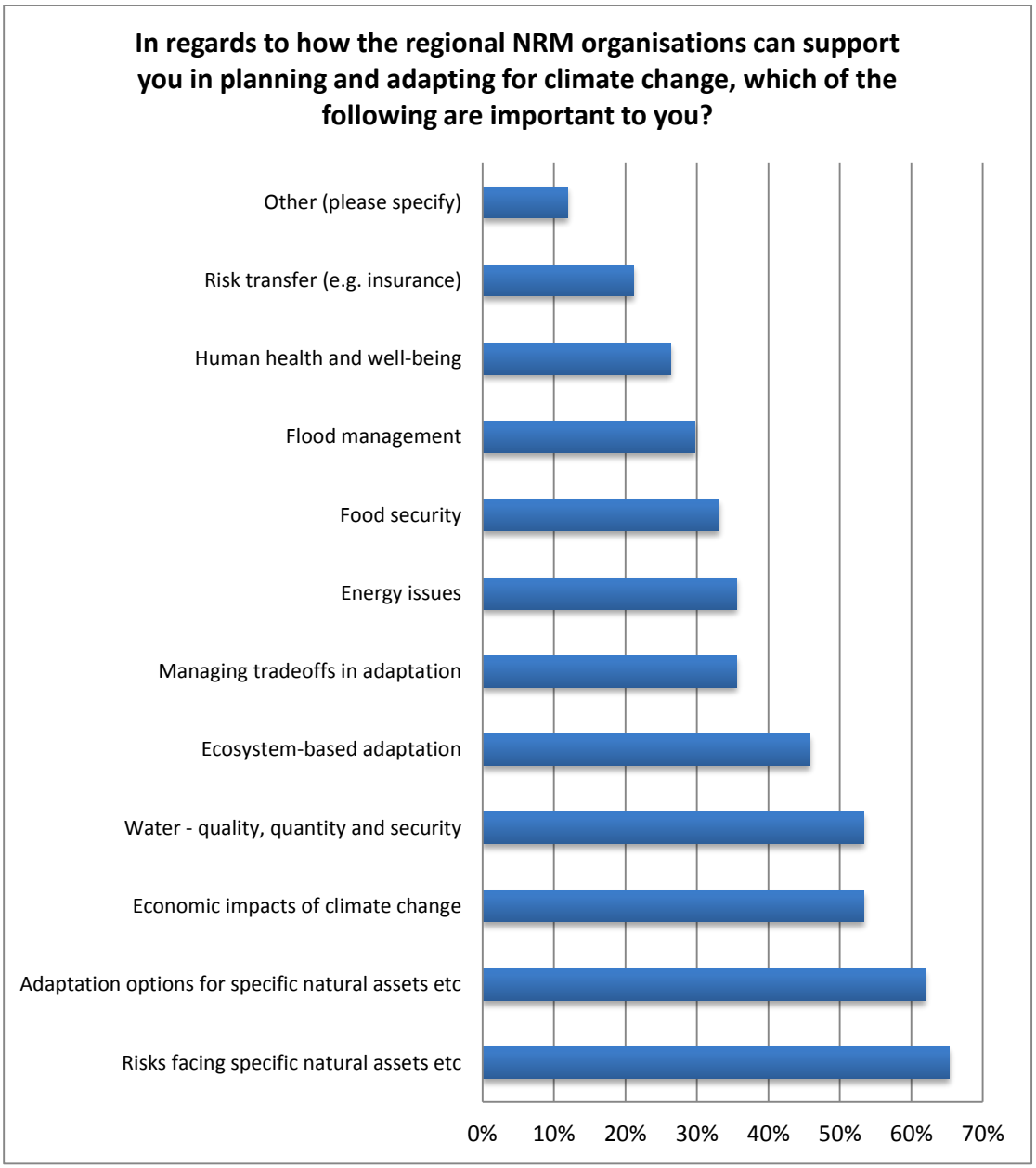

Figure 24 Information that respondents think is NRM bodies can provide to help them make decisions for climate change adaptation (all locations)

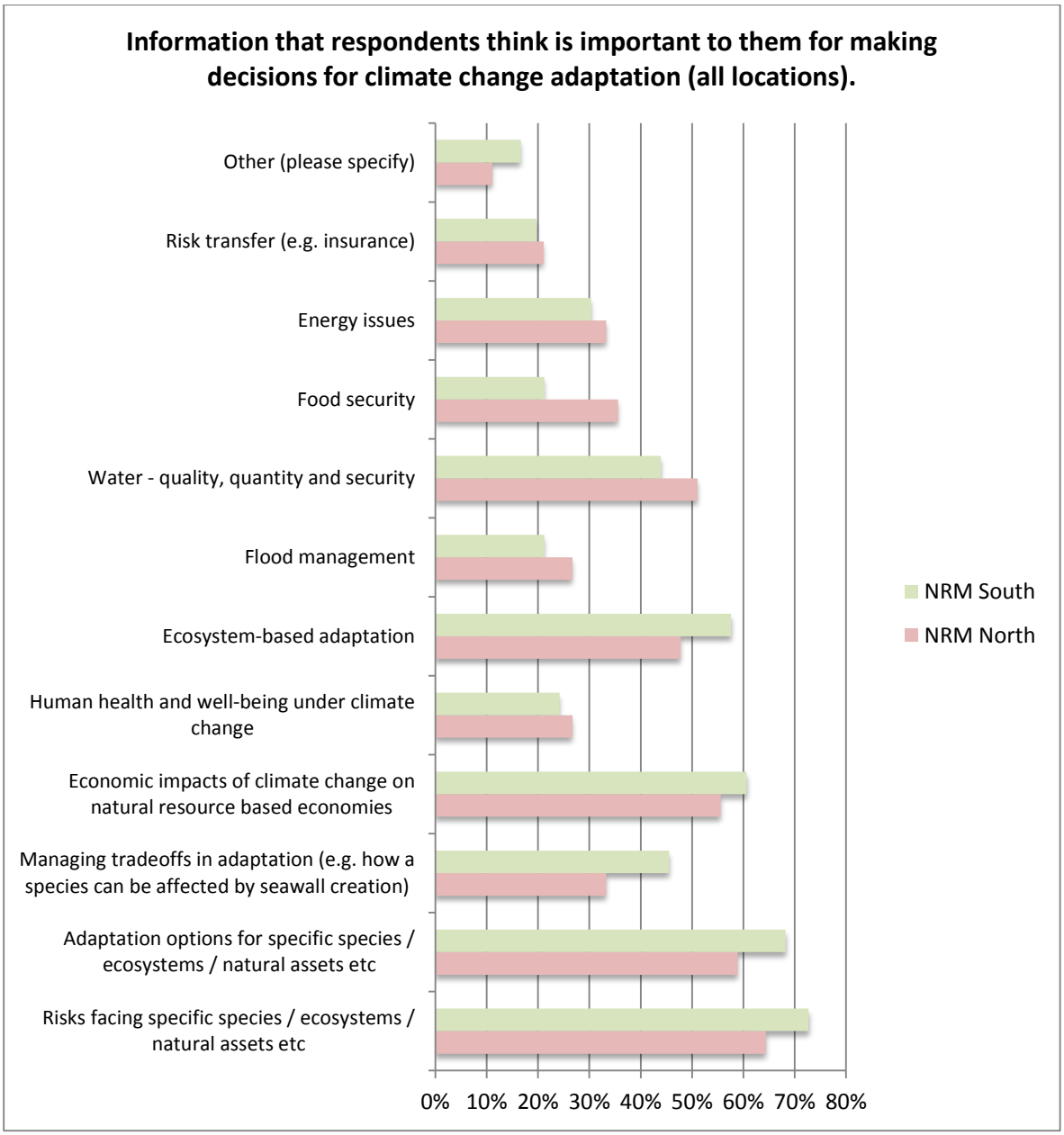

Figure 25 Information that respondents think is NRM bodies can provide to help them make decisions for climate change adaptation (by location)

4.6.5 Extent of climate change risk assessments or adaptation planning

Climate change risk assessments provide organisations with the critical information they need to understand the impacts that climate change may present. Risk assessments take many forms, although in Australia most of them tend to follow the ISO Risk Assessment framework AS 31000. Understanding specific risks is a complex task and undertaking detailed risk assessments can be expensive, time consuming and involve numerous experts and stakeholders. Because of these limitations many organisation have opted for scoping or high-level risk assessments to begin with.

The simplicity of the scoping assessment has many benefits, but according to Jones and Preston, (2010, p.7) 'simplicity can lead to risk being inappropriately framed'.[39] It seems prudent for organisations with limited resources and/or executive or political support to engage in scoping risk assessments in the initial stages, before building up to pursue a deeper understanding of specific issues over time.

NRM stakeholders were asked if they had undertaken (or were planning to undertake) any form of climate change activity (e.g. risk assessments, adaptation planning, community engagement and specific research). The responses to this question provides a good general overview into the climate change activities. Future questions could drill down further (e.g. differentiate between scoping and detailed risk assessments, quantified findings and so on).

The results showed that a little over 60% of organisations had undertaken some form of risk assessment (62%), and just under that had undertaken (or were intending to undertake) adaptation planning (59%). Only 35% indicated that they had (or were intending to undertake) research associated with climate change (**Figure 26**).

[39] Jones & Preston (2010).

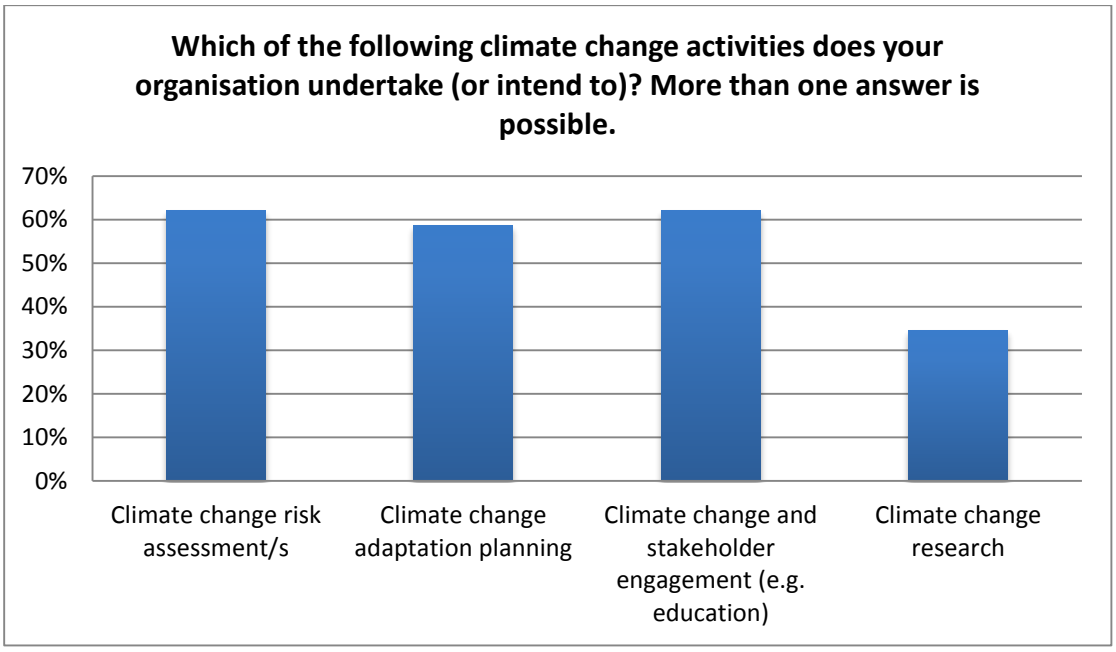

Figure 26 Extent of climat echange activities undertaken (or plan to be undertaken) by respondents

4.6.6 Inclusion of climate change in local government strategic plans

As mentioned earlier in this report, local government is recognised by the NRM bodies as a key player in the implementation of natural resource management. This was also reflected in the online survey that rated local government as one of the essential stakeholders.

Councils are uniquely placed to deliver actions related to climate change and natural resource management but operate in a relatively tight institutional framework. The most important document in a Council is the Strategic Plan. It is a their core guiding document combining the community's aspirational vision, together with Council's commitments to actions to achieve these goals. The Tasmanian Local Government Act 1993 (LGA 1993) requires all Councils to prepare a Strategic Plan for a minimum of five years. The new amendments to the LGA 1993 specifically direct Councils to ensure that Financial Management Plans and Strategies and Asset Management Plans and Strategies must 'be consistent with the strategic plan for the municipal area'.

A desktop review of the 12 Councils in the NRM South Region and the 8 Councils in the NRM North region was undertaken. Each of the strategic plans was reviewed for key words such as 'climate change', 'greenhouse gases', 'carbon', 'adaptation' with the results presented below.

Municipality	**Consideration of Climate Change in the Strategic Plan**
Brighton	Strategic plan 2011-2021: No consideration
Central Highlands	(Strategic Plan 2009-2014, Natural Resource Management and Environmental Monitoring: 7.6: Work with the Local Government Association of Tasmania and relevant government agencies to progress climate change issues for the Central Highlands
Clarence	Strategic Plan 2010-2015 _Community Safety and Wellbeing: Provide essential infrastructure to support, sustain and enhance community safety and social wellbeing - Develop and implement plans for dealing with :climate change, sea level rise, bushfire, emergencies
Derwent Valley	Strategic plan 2011-2015: p11 Environmental Objectives - EN1.2 To utilise best practice methods to control environmental damage to the banks of the Derwent River created by storm surge, climate change and sea level rise
Glamorgan Spring Bay	Community Strategic Plan July 2013- Page 14 Extreme weather events, emergencies and the possible impacts of climate change need to be planned for and managed to ensure the safety of our towns and communities.)
Glenorchy	Strategic plan: 2011-2016 : 3.2: Manage the effects of climate change for the benefit of Glenorchy. 3.2.1. Minimise greenhouse gas emissions and address the impacts of climate change.)
Hobart	Hobart City Strategic Plan 2014-2019: FD2 Management, through the protection of its natural environment, will continue to be a priority along with minimising environmental harm, pollution and managing the impacts of climate change; 5-Year Priority: Leading climate change mitigation and adaptation practices; Strategic Objectives:

Municipality	Consideration of Climate Change in the Strategic Plan
	Show leadership in addressing and responding to climate change impacts.
Huon Valley	2010-2015 Strategic Plan: 1.5 Natural Environment: Decreased Carbon Footprint, Climate change opportunities initiated and measured
Kingborough	Kingsborough Council Strategic Plan 2010-2020: 2.1. Greater awareness of the causes and effects of climate change and community action taken to reduce the carbon footprint of Kingsborough: 2.2 Implemented climate change risk management and adaptation strategy 2.3 Improved management of natural hazards; 3.3 A safe, prepared, resilient community.
Sorell Council	Strategic Plan 2014-2018: No consideration
Southern Midlands	Strategic Plan 2012 - 2017: 3.5.1 Implement strategies to address the issue of climate change In relation to its impact on Council's corporate functions and on the Community
Tasman	Strategic Plan 2011 to 2016_5.3.1.3: Review and update the Tasman Municipality Emergency Management Plan to include risks introduced or exacerbated by climate change, including bush fire and sea level rise.
Break O'Day	Strategic plan 2011-2015: Environment and Planning: Minimise the impacts of climate change: Develop climate change strategy (Link to MMP) that would include:1. Identification and plan for threats/impact from climate change. 2. Review of land use zones to ensure they take account of identified threats and impacts from climate change.
Dorset	Strategic Plan 2014-2018. Goal 3: Encourage a resilient response to the effects of climate change in coastal
Flinders	Strategic Plan 2011: No consideration
George Town	Strategic Plan 2012/2017 - stay well informed on contemporary thinking about climate change and take its potential impacts into account in decision making.

Municipality	Consideration of Climate Change in the Strategic Plan
Launceston	Strategic Plan 2014-2024: Key Direction 2: To manage the risks of climate related events, particularly in the area of stormwater management.
Meander Valley	Community Strategic Plan 2014-2024: No consideration
Northern Midlands	Strategic Plan 2007-2010: 2.1 Long Term Economic Development: Prepare an Economic Development Strategy which addresses the following: Impact of the GFC and climate change policy on investment and development in NMC
West Tamar	No consideration

Table 8 Consideration of climate change in northern Tasmanian Council's strategic plans

In order to assess the profile of climate changes among other stakeholders, the Project Team also undertook a scan of approximately 50 industry organisations and industry groups. The scan included a key word search on the organisation's website for the term 'climate change' and was undertaken to identify policies or position statements on climate change. The results of the scan yielded only six of the 50 organisations with formal position statements or guidance for climate change in a publically available document (not including projects) on their website:

- BHP
- Norske Skog
- Rio Tinto
- Hydro Tasmania
- GlaxoSmithKline plc
- Regional development Australia

Section summary

Key point 17 NRM North and NRM South are well placed to lead the collation and dissemination of climate change data and information and to establish and maintain communication and networking processes to enable stakeholders to plan for and respond to climate change both individually and collectively.

Key point 18 Stakeholders indicated a desire and willingness to be engaged by the NRM Regions for information and involvement is areas such as collaboration on natural resource management issues of mutual benefit; obtaining information and advice; seeking and obtaining funding; partnering in projects and initiatives; participation in events and advocating and influencing natural resource management decisions.

Key point 19 Analysis suggests that while specific stakeholders may be different in the North and South Regions, their perceptions of NRM and NRM strategies does not vary significantly (Variations for most indicators are between 8 to 10%).

Institutional recommendation (general) 4 To measure the effectiveness of the next regional strategies in influencing stakeholders' consideration of climate change in natural resource management, a metric could be included to assess the extent to which the climate change policies of stakeholder organisations consider natural resource management.

Institutional recommendation (general) 5 It is recommended that processes and structures used to develop and implement the NRM North and NRM South regional strategies should address stakeholder's perceptions that the regional strategies are the responsibility of the NRM regions. Alternative structures need to be developed in each region which involve stakeholders in overseeing the development, finalisation and implementation of the regional NRM strategies.

Institutional recommendation (general) 6 It is recommended that Aboriginal people and communities be engaged to determine the cultural context and priorities for inclusion in all three regional NRM strategies.

Institutional recommendation (general) 7 NRM effectiveness is dependent on the level of ownership of strategies among regional stakeholders. Therefore additional methods of increasing stakeholder engagement and ownership of the regional NRM strategies need to be developed. Suggestions include: more inclusive ways of engaging smaller stakeholder groups; formal and informal engagement processes; transparency and openness in communication and information; face-to-face engagement opportunities; to get stakeholders participating by attending, hosting and promoting events and activities; and to ensure two-way communication and engagement processes.

Institutional recommendation (general) 8 NRM regions should promote reference to the regional NRM strategies in each individual Local Government Strategic Plan to give natural resource management and climate change sufficient status and resource allocation and accountability for outcomes, reporting and evaluation.

Institutional recommendation (general) 9 NRM North and NRM South should adopt the 8 governance indicators used in this report to measure climate change responsiveness.

9. *Extent that stakeholders have a formal policy or process for climate change;*
10. *Resource allocation for the management of climate change issues;*
11. *The level of stakeholder expertise /capacity in climate change management;*
12. *Access to climate change information*
13. *Extent of climate change risk assessments or adaptation planning*
14. *Monitoring the identified barriers to adaptation*
15. *Inclusion of climate change in local government strategic plans*
16. *The existence of a database management system.*

Institutional recommendation (general) 10 The next regional NRM strategies should prioritise 'supporting stakeholders to incorporate climate change and resourcing for climate change initiatives into their next strategic plans and natural resource management plans'. This might involve supporting in-house capacity building such as training and professional development, the production of governance and policy templates and other guidance materials, for example risk assessment frameworks.

Institutional observation *** It is recommended that NRM North and NRM South analyse the preferences of individual stakeholders to determine their NRM interests and their desired level and type of involvement in responsive engagement mechanisms – such as formation of working parties and reference groups.

Institutional observation *** It is recommended that NRM North and NRM South should develop a data base that classifies stakeholders by their areas of interests; willingness to be involved; preferred involvement methods; and preferred communication methods and frequency.

******* *Please note: this finding is outside the scope of this project. The observation has however, been included as an operational issue for further consideration by NRM North and NRM South when implementing the next Regional Strategies.*

5 Strategic Scan

The aim of the Strategic Scan is to understand and learn from the achievements, limitations and constraints of the first two regional strategies of each region.

This scan recognises the significant breadth of NRM activity and is intended to provide a platform from which to consider development of the next round of regional strategies. This strategic scan examines the content and framing of the previous strategies and draws on examples of academic literature and a small selection of other NRM regions to identify potential framing or content deficiencies. The performance of the previous strategies has been assessed by using the results of the stakeholder surveys and specific responses from the regional workshops. It is important to note that the scope of this project did not include an appraisal of the performance and procedures of the NRM organisations. However, the Project Team believe that an appraisal is warranted, as the function, performance and capacities of the NRM bodies is likely to strongly affect the implementation of the strategies.

5.1 NRM North and NRM South 2005-2010 strategies

The first round of regional strategies produced by NRM North and NRM South were relatively detailed documents. They were also underpinned by a larger set of background documents describing the current state natural resources of Tasmania and identifying issues needing to be managed.

Both strategies broadly address similar groups of NRM assets but used different terminology and structure of their strategies to describe their approach. These are listed in the table below (section order has been changed to indicate equivalence where possible).

NRM North	NRM South -
Biodiversity	Managing native flora and fauna
Water	Managing water
Land	Managing land resources
Estuaries, coasts and marine	Managing marine, coastal and estuarine systems
Atmosphere	-
Cultural heritage	Managing cultural landscape
Building sustainable communities	Managing for a sustainable community and sustainable economy

Table 9 NRM North and NRM South – asset descriptions in 2005 strategies

The NRM North strategy was based on an explicitly asset-based framework and described as a set of 14 'action packages':

- Supporting and maintaining a viable native vegetation system in good condition in each of the bioregions to maintain landscape character and integrity and protect the Region's biodiversity
- Maintaining and/or improving water quality in freshwater and marine, coastal and estuarine systems
- Supporting the sustainable use of Northern Tasmania's water resources
- Minimising the spread of weeds, pests and diseases
- Protecting key terrestrial, freshwater and marine, coastal and estuarine ecosystems, species and their habitats
- Building sustainable communities
- Maintaining and/or improving soil condition
- Maintaining and/or improving air quality
- Maintaining and/or improving river health

- Protecting wetlands
- Minimising the spread of salinity
- Protecting key landforms (geodiversity) and cultural landscapes
- Addressing climate change and greenhouse effect

The NRM South strategy used an asset-based framework less explicitly than that of NRM North and described these through a set of regional foci:

- Ensuring a balance between environmental, economic and social outcomes
- Maintaining and/or improving water quality in freshwater and marine, coastal and estuarine systems
- Securely and sustainably allocating surface and groundwater resources for domestic, agricultural, industrial and environmental purposes
- Ensuring a minimum level of native vegetation in good condition is retained in each of the bioregions to maintain landscape character and integrity and protect the Region's biodiversity
- Protecting key terrestrial, freshwater and marine, coastal and estuarine ecosystems, species and their habitats
- Preventing further spread of weeds, pests and diseases
- Maintaining and/or improving soil condition
- Preventing further spread of salinity
- Protecting key landforms (geodiversity) and Cultural Landscapes

The two approaches were broadly similar, with a major difference being the inclusion of an action package for addressing climate change and the greenhouse effect in the NRM North Strategy. In contrast, the NRM South strategy incorporated discussion of climate change into a range of issues.

Both strategies contained targets that were to be met over different timeframes, as shown below, refer **Table 10**.

Target	NRM North	NRM South
Aspirational Targets	The long-term targets for the desired condition of the Region's natural resources over the next 50+ years. Aspirational Targets guide regional planning by setting a context for the measurable Resource Condition Targets.	The desired condition of the Region's natural resources in the long term (50 years).
Resource Condition Targets	The expected outcomes from the implementation of Management Actions over the next 10-20 years. Unless otherwise indicated, change in the resource condition will be measured against 2004 baseline levels.	The desired condition of the natural resources in the medium term (10-20 years). Must be SMART (Specific, Measurable, Achievable, Realistic and Time-bound) (e.g. % improvement in water quality in the Derwent River by 2015).
Management Action Targets	The short-term targets (1-5 years) that relate specifically to Management Actions. MATs contribute to the Resource Condition Targets.	The desired short-term outcomes and outputs of Management Actions over one to five years. They should contribute to achievement of one or more Resource Condition Targets
Management Action	The direct actions that address the causes and symptoms of the threats and issues facing an asset. The MAs are grouped into Action Packages (APs) that address the priority issues for each asset, and are linked to the RCTs and MATs towards which they contribute.	Activities to be undertaken to improve the condition of the Region's natural resources.

Table 10 Summary of targets from 2005-2010 strategies for NRM South and NRM North

Both strategies described large numbers of Resource Condition Targets and Management Action Targets to be pursued under the strategies.

5.1.1 2005-2010 Strategy Considerations of Climate Change

Both the NRM North and NRM South 2005-2010 strategies mentioned climate change, although there was little in regards to measurable actions. The focus of NRM North centred on general awareness and an alignment with national strategies as well as a stronger focus on greenhouse gas mitigation compared to adaptation. In the 2005-2010 NRM South strategy there were some strong direct actions (e.g. creation of a climate change strategy by 2006 and the creation of a greenhouse response strategy) associated with mitigation and adaptation. The following text is taken from the content in the NRM North and NRM South Strategies 2005-2010 to highlight the key considerations.

5.1.1.1 NRM North 2005

10.5 Condition of Estuarine, Coastal and Marine Asset, Threatening Processes and Priority Issues: Vegetation clearing, alteration of drainage and fire regimes, weed/pest invasions, nutrient and sediment pollution in run-off, and climate change impacts are some of the reasons for this loss and modification [of habitat loss]

Less Urgent Land Use Management Actions

- *MAM14: Assess, plan and implement practices to manage the impacts of climate change and sea level rise on estuaries, coasts and marine environments, in line with the National Biodiversity and Climate Change Action Plan.*

11.4.3 Managing the Asset The National Biodiversity and Climate

- *Change Action Plan 2004-2007 is designed to coordinate the activities of National and State Governments, and sets out specific objectives, strategies and actions that will be taken to reduce the impacts of climate change on biodiversity. NRM North will endeavour to implement the Plan where possible through the relevant MAs. The National Greenhouse Strategy provides the strategic framework for advancing Australia's domestic greenhouse response [54], [36]. The Tasmanian Greenhouse Statement provides information on Tasmania's greenhouse gas emissions status. It also presents goals designed to*

help further increase our current sink capacity and so complementing the National Greenhouse Strategy, together with actions that are currently being undertaken or planned to address greenhouse gas emissions [53].

11.5 Condition of the Atmosphere Resource, Threatening Processes and Priority Issues

- *There are two major components of the atmosphere relevant to Northern Tasmania: the quality of the ambient (outdoor) air, and the potential for climate change to occur as a result of a build-up of carbon dioxide and other greenhouse gases. Both processes result from increased emission of pollutants into the atmosphere.*

11.5.2 Climate Change and Greenhouse Effects

- *Greenhouse gas emissions include water vapour, carbon dioxide, methane, nitrous oxide, ozone in the lower atmosphere, and CFCs. The Region contributes its share of greenhouse gases to the stratosphere through use of fossil fuels, industrial processes, and inefficient energy-use practices. Considerable work is still required to meet greenhouse gas emission reduction objectives in Tasmania. A future opportunity for the Region to contribute to meeting greenhouse gas emission targets is through the maintenance of carbon sinks in ecologically mature tracts of vegetation. Greenhouse gas emissions have the potential to contribute significantly to global warming; they also contribute (though there are more significant ozone depleting substances) to a depletion of ozone in the upper atmosphere and thus to increased levels of ultraviolet radiation. The indirect effects of climate change are less clear.*

  Unlike most other NRM issues in Northern Tasmania, climate change cannot be controlled, or significantly influenced, by actions within the Region alone. The Region can, however, prepare itself for the impacts that will arise from climate change. This response will be in line with the National Biodiversity and Climate Change Action Plan 2004-2007. The Region can also ensure that it meets international commitments to cooperate in reducing the global effects of climate change, however small that response is in global terms. If climate changes more rapidly than human and natural systems can respond, many species and ecosystems and much human investment may be lost.

While the impacts are difficult to assess, they are likely to include:

- *Loss of coastal areas to erosion and inundation;*
- *increased damage from storms, including wind and flooding and crop losses;*
- *Increased insurance costs;*
- *Changes in frequency, distribution and intensity of diseases, affecting human health, crops and native plants and animals; and*
- *Degeneration of ecosystems through loss of species*

Atmosphere Package Two: Greenhouse Gas Emissions

- *This package involves establishing a framework to address climate change by reducing greenhouse emissions and creating carbon sinks, and by reducing, and making more efficient use of energy. It also involves making information available and offering alternative energy sources. Actions will be undertaken in line with the National Biodiversity and Climate Change Action Plan 2004-2007.*
    - *MAA23: Support and promote initiatives implementing the National Climate Change policy.*

5.1.1.2 NRM South Strategy

The 2005-2010 NRM South Strategy had the following considerations of climate change:

2.3 Threats to Southern natural resources and related management challenges

- *Climate change*

2.4 Recent trends in resource condition

- *However, increasing human use and climate change are potential threats, particularly to alpine and sub-Antarctic ecosystems.*

Potential climate change impacts on vegetation and fauna

- *Changes to rainfall, fire incidence, intensity and duration of sunlight, inundation from rising sea levels changing carbon dioxide levels may affect native vegetation and fauna. There is evidence that prolonged periods of drought in Tasmania since the 1970s have contributed to the cause of*

*dieback of white gum (*Eucalyptus dalrympleana, E. rubida, E. viminalis*) forests. Alpine vegetation is also at risk from global warming.*

Management Action F13:

- *Continue to compile, collect and make available data, and conduct research on an integrated basis, focusing on: Climate Change*

9.1.2 Managing climate change

Managing the potential impact of climate change and greenhouse gas emissions is an important aspect of natural resource management. It is not possible to be certain of the future magnitude and effects climate change, but it is scientifically recognised that the effects will be wide-ranging. Whilst it is recognised that these issues are global in their effects and management requirements, some management implications exist for the Southern Region. Significant biological resources and landscape values, such as alpine and sub-alpine ecosystems and coastlines, are at risk from climate change. Agriculture, forestry, fishing and aquaculture may all need to adjust to ensure enterprises are able to adapt to changing climatic patterns.

5.2 NRM North and NRM South 2010-2015 regional strategies

NRM North and NRM South produced a second round of regional strategies in 2010. The strategies differed significantly in structure from the 2005-2010 strategies, particularly in not having the same structure of aspirational, resource condition and management actions targets in particular prescriptive and highly detailed targets.

The two strategies also diverged in their structure and emphasis. The NRM North strategy remained more aligned to an asset-based classification but with an increased emphasis on priorities and a simplified set of targets. It comprised six program areas:

- Rivers and water for life;
- Flora and fauna at a landscape level;
- Climate ready and responsible;
- Healthy coasts and seas;

- Productive landscapes; and
- Community partnerships.

Each program area was described in terms of:

- The broad strategy to implement the program;
- Mechanisms to be applied;
- The role(s) of NRM North;
- Regional objectives; and
- Resource outcomes.

The strategy also included a set of prioritisation criteria for the mechanisms in each project area, as shown below (**Table 11**).

Criterion	High	Med	Low	Notes
1. Contribution To Asset Condition	A	B	C	Expected contribution to the condition of one or more priority assets.
	Significant	Moderate	Low or indirect	
2. Need for Action	***A***	***B***	***C***	Is there an urgent need to undertake this action; i.e. if it is delayed, will there be a significant reduction in resource condition or a major blow-out in the cost of managing the resource?
	Urgent need for action	Needs action in the medium term	Action not time bound	
3. Prerequisite Action	**Yes / No**			Do one or more actions depend on this action first occurring?
4. Commitment Of Stakeholders	1	2	3	Expectation of how many relevant stakeholders would be committed to supporting the action.
	Most	Around half	Few (< ¼)	
5. Feasibility Of Actions	1	2	3	Degree of confidence that intended outcomes will be achieved.
	Very high degree of confidence		Low degree of confidence	
6. Cost of Action	High		Low	Financial cost of action.

Table 11 Prioritisation criteria

The NRM South 2010-2015 strategy was focused on a set of five strategies:

1. Maximise return for natural resource management investment;
2. Increase community awareness of the Region's natural resource assets;
3. Manage current and emerging threats to the Region's natural assets;
4. Measure and report changes in natural resource condition;
5. Increase stakeholders' capacity to use the Region's natural resources wisely.

Each strategy was accompanied by a set of headline indicators. Of most relevance to this scan are the indicators for strategies 3 and 4, as shown below (Table 12).

Strategy 3. Manage current and emerging threats to the Region's natural assets	**Strategy 4. Measure and report changes in natural resource condition**
• Number of threats addressed • Number of stakeholders addressing threats • Number of environmental flows calculated (and implemented in a water management plan) • Number and extent of climate change adaptation plans in the Region that address the vulnerability and adaptive capacity of natural assets • Number of new pests or diseases reported/established • Number of pests eradicated • State Coastal Policy is approved and implemented • Marine reserves are established in accordance with the Tasmanian Marine Protected Area Strategy • Land use planning provides for sustainable use of natural resources and protects significant environmental assets and landscapes	• Number of resource condition reports available (e.g. State of the Derwent) • Completion of State of the Region report • Data availability for baselines of natural resource condition

Table 12 NRM South 2010-2015 Strategy: Indicators for strategies 3 and 4

Each of the NRM South strategies contained a set of recommended specific actions, ranging in number from 7-11. The recommended actions under strategy 3 were broadly consistent with the asset classification and targets system from the 2005-2010 strategy, albeit within a less prescriptive and structured framework than previously.

1. Improve the connectivity of vulnerable habitat areas.
2. Minimise the negative impacts associated with development on native habitat and species.
3. Undertake climate change risk and vulnerability assessments for public reserves (land and marine) and develop adaptation strategies as required.
4. Reduce the threats to natural values posed by invasive species, bushfire re, climate change including sea level rise, urban development and unsustainable human activities.
5. Promote efficient and socially just use of shared water resources while simultaneously maintaining the health of the Region's natural water assets.
6. Undertake research to support industry adaptation in vulnerable natural asset areas in the Region (e.g. aquaculture, fisheries, forestry and agriculture).
7. Develop and implement a strategic framework and guiding principles for the encouragement of sustainable (and resilient) economic development opportunities in the Region.
8. Ensure that land use planning and development (local and regional level) incorporates consideration of natural resource considerations and seeks to take reasonable steps to minimise the adverse impacts of development on the Region's natural resource assets.
9. Include consideration of climate change and greenhouse emission impacts in the environmental impact assessment of development, in accordance with the framework outlined in the Tasmanian Climate Change Strategy.
10. Develop regional-scale climate change scenarios for use in climate change risk and vulnerability assessments and develop targeted adaptation strategies.

11. Conduct a comprehensive cost-benefit analysis of the nature of opportunities to mitigate the adverse impacts of climate change on natural resource condition. (p20)

5.2.1 2010-2015 Strategy Considerations of Climate Change

Both strategies consider climate change, however the NRM South consideration is much more extensive. NRM South has included climate change in its Key Indicators but there are no timelines set or comparative data provided. NRM North included specific actions associated with climate change however, they were classed as 'less urgent'. The SCARP project team also reviewed the NRM North and NRM South 2010-2015 Strategies for consideration of climate change[40]. Their results are presented below

NRM North: Climate Ready and Responsible program

- *Emphasis on air pollutants*
- *CC 'emerging as a key over-arching natural resource management issue of the 21st century, this themes seeks to assist the urban and agricultural environments to deal with climate change and emission issues in simple ways; from reducing agricultural greenhouse gas emissions to helping urban communities achieve energy efficiency outcomes, we work with a range of partners to adapt and mitigate the effects in an uncertain climate.' (31)*
- *Mechanisms: to 'raise community awareness of climate change and its likely NRM impacts' (33)*
- *'Assist in the implementation of the Tasmanian Framework for Action on Climate Change' (34)*
- *Healthy Coasts and Seas program*
    - *Coastal management – 'working on-ground to conserve coastal environments for resilience to climate change and other impacts' (35)*
    - *Habitat loss as a result of climate change impacts*
    - *Mechanisms:*
        - *'Investigate, assess and prioritise high value sites (environmental, heritage, recreation values and public infrastructure), at risk from*

[40] Harwood *et al.* (2013), p59-63.

accelerated coastal erosion, sea level rise and other climate change impacts.' (40)

- *'Support the management of prioritised high value sites which are vulnerable to climate change impacts, in order to mitigate/minimize degradation of environmental, heritage and recreation values and public infrastructure.' (41)*

- *Productive Landscapes program*
  - *Resource Outcome - biodiversity*
    - *'Ecological connectivity and function to ensure resilience to climate change and other threatening processes, to be maintained or improved by 2020.' (49)*

NRM South 2010-2015 Strategy consideration of climate change

- *Headline Indicator for 'Manage current and emerging threats to the Region's natural assets':*
  - *'Number and extent of climate change adaptation plans in the Region that address the vulnerability and adaptive capacity of natural assets' (x)*
  - *Strategy review process – climate change as one reason for this process (3)*
- *Strategic Context*
  - *Emerging risks*

CLIMATE CHANGE: 'Climate change will provide multiple risks and opportunities across the Region, community and natural resource sectors. Identifying the risks and vulnerability to (and adaptive capacity of) natural resources, communities and productive activities that depend on natural resources will be essential in developing well-targeted adaptation responses. There will also be a focus on understanding the resilience of ecosystems to climate change and identifying opportunities to support ecosystem adaptation. Adaptation will be the main focus of natural resource management activity in the climate change area. However, identification and development of opportunities for sustainable greenhouse gas mitigation in a range of sectors, including the

agricultural and forestry sectors, will present new issues and opportunities for natural resource management and should form part of the development of a sustainable and resilient regional economy and community.' (6)

- *CUMULATIVE LAND USE AND DEVELOPMENT PRESSURE: 'increased exposure of communities to coastal zone risks associated with climate change' (6)*

Strategic issues in the region

- *NEW PRIORITIES FOR THE COMMUNITY*
  - *'understanding the implications of global warming on the future regional climate and understanding the implications of climate change on natural resources both marine and terrestrial to identify priority issues (scenario modelling and risk and vulnerability assessment);*
  - *developing strategies, and implementing these, for both mitigation of greenhouse gas emissions and adaptation to climate change' (12)*

SIGNIFICANT CHALLENGES FOR NATURAL RESOURCE MANAGEMENT

- *'These changing operating environments and community priorities point to two core significant issues for the Region. These are climate change (particularly its implication for adaptation, but also for opportunities in mitigation via natural resource activities) and ongoing pressures associated with land use change and development.' (12)*

EMERGING OPERATING ENVIRONMENTS

- *'an evolving climate change policy and regulatory environment that will present opportunities and risks for the regional economy and natural resource oriented industries' (12)*
- *'an emerging understanding about bio-physical changes associated with climate change (risks, threats and opportunities) through the roll-out of research activity in the climate change impacts and adaptation field across sectors and scales' (12)*

CLIMATE CHANGE

- *'The global imperatives for acting on climate change, including the need for mitigation and adaptation, are now clear. The Australian Government is now a party to the Kyoto Protocol and is implementing a program of mitigation actions. It also has a National Adaptation Program, which is rolling out and facilitating priority adaptation research, collaboration and engagement of stakeholders. Similarly the Tasmanian Government has committed to a greenhouse gas emission reduction target to reduce emissions to at least sixty per cent below 1990 levels by 2050 while it also recognises that there are many climate change risk and adaptation issues that need to be understood.*
- *The most significant climate change challenge for natural resource management in the Region will be the management of the impacts of climate change on natural resources, particularly key natural resource values. There are numerous issues for the Region to consider, including understanding:*
    - *which natural systems and natural resource commercial activities are most at risk;*
    - *which natural systems we should facilitate adaptation for;*
    - *the extent of the challenge spatially, sectorally and temporally.*
- *Management of water resources (particularly water availability, river flows and the impact this has on water quality and other natural resources) will continue to be a key issue for the Region due to both natural climate variability and potential impacts of climate change.*
- *Mitigation of global warming, via measures to reduce greenhouse gas emissions and enhance sinks, will engage natural resource management on a number of fronts.*
- *Mitigation considerations include carbon sequestration, the need to limit the removal of carbon sinks through the management of forests and land use change, and private landholder commercial carbon offsetting or soil sequestration opportunities. Mitigation*

responses will also need to pervade other sectors throughout the community, including urban growth and development, individual lifestyle choices, industry, government and commercial activities. Some of these may have implications for natural resource management, such as the way we design and develop our urban environments into the future.' (13)

ACTION THEME AREAS FOR THE MANGAMENT OF NATURAL RESOURCES – need to be undertaken in 'context of climate change risks and opportunities'

- *'the need for baseline data and continued monitoring and evaluation;*
- *development of systems and mechanisms for better policy, planning and decision making*
- *engagement of the community in, and about, natural resource management*
- *implementation of strategic and integrated natural resource management programs and activities' (13)*

3.2 KEY IMPROVEMENT OBJECTIVES

3.2.2 ENHANCE THE RESILIENCE OF LOCAL COMMUNITIES

- *'A series of macro-scale changes are creating new threats to the future health of the Region and the communities that rely on the natural resources. Chief among these is climate change with its consequent threats in terms of increased major storm events, catastrophic bushfires, species extinction and disease migration.*
- *These changes bring a new dimension to the traditional challenge associated with the effective management of the interface between human settlements and the natural assets of a given Region. The effective response to this challenge will require adoption of actions that improve the resilience of local communities in the face of climate change related events.' (16)*

3.3 STRATEGIES AND ACTIONS

- *3.3.2 Strategy 2: Increase community awareness of the Region's natural resources (20)*
- *[Specific actions recommended]:*
    - *raise stakeholder awareness about the need to consider climate change impacts on current and future natural resource management practices, including the development of appropriate adaptation strategies.' (20)*
- *3.3.3 Strategy 3: Manage current and emerging threats to the Region's natural assets – e.g. 'the impact of climate variability on water resources' (20)*
    - *[Specific actions recommended]:*
    - *3. 'Undertake climate change risk and vulnerability assessments for public reserves (land and marine) and develop adaptation strategies as required.' (20)*
    - *4. 'Reduce the threats to natural values posed by invasive species, bushfire, climate change including sea level rise, urban development and unsustainable human activities.' (20)*
    - *'Include consideration of climate change and greenhouse emission impacts in the environmental impact assessment of development, in accordance with the framework outlined in the Tasmanian Climate Change Strategy'*
    - *10. 'Develop regional-scale climate change scenarios for use in climate change risk and vulnerability assessments and develop targeted adaptation strategies.'*
    - *11. 'Conduct a comprehensive cost-benefit analysis of the nature of opportunities to mitigate the adverse impacts of climate change on natural resource condition.' (20)*

5.3 General Strategy Content Analysis (2005 & 2010- 2015)

This section looks at the content and function of the previous strategies for NRM North and NRM South. It is adapted from insights presented in a report that assesses Natural Resource Management (NRM) Monitoring, Evaluation & Reporting (MER) initiatives in Australia and overseas[41].

5.3.1 General Conceptual Framework

The general approach to displaying the conceptual framework of the strategies may serve as a useful guide for the readers/users of the strategy as it introduces legitimacy to the formation of the strategy and/or defines the boundaries of the framework. The NRM North 2005 Strategy follows 14 Action Packages, which are aligned with the key regional assets (however only 13 Action Packages are listed). Similarly, the NRM South 2005 Strategy contains some of these actions; however it also incorporates the seven guiding principles described in the Tasmanian Natural Resource Management Framework.[42]

The NRM North and NRM South 2010-2015 Strategy also follow the seven guiding principles in their frameworks, with these guiding principles explicitly stated in the NRM South 2010-2015 Strategy. Although the NRM North 2010-2015 Strategy does not specifically state that it has based its strategy on the Tasmanian Natural Resource Management Framework, in its strategy it states that one of its goals is to promote the natural resource management principles.

5.3.2 Visual Display

Graphics form an important part of any document and can either improve or detract from the readability of the content. In a study of business strategies 'subjects who were exposed to a graphic representation of the strategy paid significantly more attention to, agreed more with, and better recalled the strategy than did subjects who saw a (textually identical) bulleted list version.'[43] The NRM North and NRM South strategies created in 2005 and 2010 all differ visually from each other.

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[41] Thoms *et al.* (2011).

[42] Department of Primary Industries, Water & Environment (2002), p.15.
[43] Kernbach *et al.* (2014).

Although visual appeal is subjective, the Project Team believe the report style format of the NRM North 2005 Strategy, with use of a serif typeface, split columns, justified text and minimal visual aids, significantly reduces the strategy's readability. The more recent NRM North 2010-2015 Strategy shows improvements to the previous strategy with clearer presentation and formatting, however this document is text-heavy and contains complex diagrams.

The NRM South 2005 Strategy is clearly formatted, however the lack of colour and overuse of bullet points makes the content visually unappealing. While the NRM South 2010-2015 Strategy's inclusion of photographs and charts sees it having a more professional and appealing feel than that of the previous strategy, both strategies lack a vibrant visualization that may aid the communication of the key points. Improvements may include info-graphics and web-based (and interactive) versions of the strategies.

Content relevance for the next strategy

While there have been general improvements in the visual presentation, especially with NRM South 2010-2015 neither strategies as physical reports may be as relevant in what is now the 'information age'. While having printable elements of the report is still valuable there is also a very strong argument to shift the strategies to an online platform.

5.3.3 Stakeholder consideration

Given the fact that the strategies are framed as having collective ownership it is prudent to explore how the strategies have reflected the stakeholder input. The NRM South strategies created in 2005 and 2010-2015 clearly state the methods used to engage the stakeholders. The NRM South 2010-2015 Strategy used workshops, online surveys and written submissions to develop their goals. This was an improvement to the process provided in the previous NRM South 2005 Strategy which only included consultation with community groups and specialists. Both NRM North strategies specify the specific number of people who participated and a general breakdown of participants by sector. Although the strategies list stakeholder concerns in the appendix it would be useful to have an action set against each of these issues to show that it is being considered or why it is or is not in the strategy.

The 2005 and 2010 NRM North strategies used a similar consultation process including community workshops, feedback survey as well as targeted meetings with key stakeholders. The principal difference was the adoption of an online survey platform used for the NRM North 2010-2015 Strategy. Neither strategy specified the number of people who participated in the process or the breakdown by sector. The Project Team believes that NRM North should include the data about the numbers that participated to improve transparency of the process.

It may be worthwhile for both NRM North and NRM South to list all of the organisations that participated in the development of the strategies so any gaps are clearly identified by those reading the strategy. It should be noted that neither NRM body mentions the other NRM regions in their strategies.

Content relevance for the next strategy

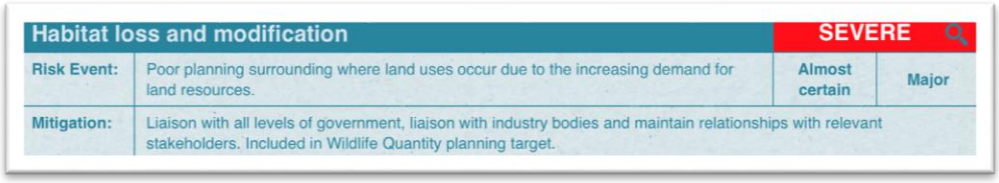
Stakeholder consideration in all the previous strategies is still highly topical for the next regional strategies. However improvements for both strategies could be made if key stakeholders could upload their actions or intentions into the NRM strategies. This may not be feasible for the launch of the next strategy but reference to the approach could be made in the strategy that invited stakeholders to upload / include their own comments on how they align with the targets and what their future goals and actions are.

5.3.4 Identification of risks

There are a range of risks that can challenge the implementation of a strategy and publically stating those risks shows a commitment to transparency and informs the reader of the potential limitations. The NRM South 2005 Strategy does not quantify regional risks nor does it identify risks in the implementation of the strategy. In the recent amendment, the NRM South 2010-2015 Strategy states that the key risks identified include: 1) Changing priorities of key natural resource management partner organisations; 2) Inability to demonstrate tangible outcomes; 3) Duplication of effort and/or failure to take account of project synergies; 4) Decline in funding availability for natural resource management.

The Strategy also states that NRM South will host a live implementation plan to deal with uncertainty, however a word search of the NRM South Website found no implementation plan, meaning that a live implementation plan does not exist or that stakeholders do not have easy access to this if it does exist. Furthermore, there is no quantification about the likelihood or consequence of the risks (e.g. in a risk matrix).

While the NRM North 2005 Strategy prioritises the management of Actions Packages through a risk ranking, the more recent NRM North 2010-2015 Strategy has no specific mention of risks associated with the delivery of the strategy or quantification of the regional risks. For transparency and better identification or justification of priorities it may be beneficial to include a risk matrix for risks that may affect the delivery of the strategies (including a visual quantification of the risks to the region) (see Figure 1).



Habitat loss and modification		SEVERE	
Risk Event:	Poor planning surrounding where land uses occur due to the increasing demand for land resources.	Almost certain	Major
Mitigation:	Liaison with all levels of government, liaison with industry bodies and maintain relationships with relevant stakeholders. Included in Wildlife Quantity planning target.		

Figure 27 Example of a risk displayed in a tradition risk register format (Condamine NRM Plan 2015)[44]

Content relevance for the next strategy

As is mentioned above the next strategies should include consideration of likelihood and consequences about the risk of not achieving the goals and actions. The idea of a 'live implementation plan' as mentioned in the NRM South 2010-2015 strategy is considerable valid for the next strategies but must be made publically available.

[44] http://www.nrmplan.com.au/risks

5.3.5 Fast and slow variables

The natural environment functions across a broad range of temporal scopes, whether it be the few hours of a Mayfly through to the thousands of years for a Huon Pine. Landscapes change over even longer periods. This broad range of temporal scope means that NRM bodies need to reflect multiple (and flexible) scales in their strategies. In the NRM North and NRM South 2005 strategies, each issue is provided targets for varying timeframes. Management Action Targets are given short timeframes of 1-5 years, Resource Condition Targets are within a 10 to 20-year timeframe and Aspirational Targets extend up to 50 years.

The more recent NRM South 2010-2015 Strategy has removed these targets, opting for a more generalised approach. The Strategy's vision states that:

> 'the Southern Region's natural resources will be protected, sustainably managed and improved for the shared environmental, social and economic benefit of our Region by a well-informed, well-resourced and actively committed community.' (p. ix)

Although the above vision can be construed as a long time frame, no specific dates are mentioned. There is also a dearth of short-term targets other than a five yearly review of the Strategy and stakeholder reflection and reporting on the strategy's implementation being held every two years.

Content relevance for the next strategy

While the target definitions have been omitted from the NRM North 2010-2015 Strategy, it does specify longer time frames for its specific goals with the longest goal being scoped out to 2025. It would be beneficial if both NRM bodies had State-wide and regional goals and activities that were reflective of the dynamic natural timeframes. Long term targets of 30 or 50 year would provide a common goal for all NRM stakeholders to work towards, allowing for incremental change. Short-term targets could be more flexible and allow for short term triggers/thresholds and environmental changes (e.g. biosecurity issues, bushfire an).

5.3.6 Data considerations

It is now the information age. Well-managed data can help identify emerging trends, identify information gaps and automatically feed displays of key performance indicators. Poorly managed data results in duplication, quality control issues and increased resource expenditure. Often data is a forgotten part of a strategy and not recognised as critical infrastructure. The NRM South 2010 - 2015 strategy highlights the importance of data and includes it as a headline indicator. It also recognises that there is a need for 'ongoing improvement in the collection and availability of baseline data about natural resource condition, and monitoring of natural resource health and environmental change to inform rational and well-guided decision making and effective natural resource management planning.' What is not clear are the roles and responsibilities associated with data management.

The NRM North 2010-2015 Strategy also recognises the importance of data and has a number of specific actions associated with data management, including:

> 'Support and facilitate access to and use of information, databases and training to increase knowledge and skill levels of managers/ supervisors in NRM.'

However, there does not seem to be an appropriate system (with supporting database architecture) that allows all stakeholders to access data, upload data and monitor performance of the actions over time.

Surprisingly, the goals for data management in the older 2005 NRM strategies are more closely aligned with the future vision of an information age. The NRM South 2005 Strategy aims to facilitate integrated information delivery systems through the development of an interactive web platform to provide access to GIS and other data. In addition, the NRM North 2005 Strategy seeks improve their data management by providing baseline data and establishing a publicly accessible centralised database.

Current data management is via the NRM Portal managed by DIPWE which requires log in access, immediately creating user filters and barriers. Both of the NRM strategies should give serious consideration to a shared allocation of resources (including with Cradle Coast) to create a shared database portal that is publically available.

This presents opportunities for creative open-source development of applications that can be generated by industry and citizens for NRM reporting and management. For example the Condamine Catchment NRM in Queensland has created a range of tools to support their strategy. This includes NRM Plus which allows for individuals to share NRM related information (see **Figure 28**).

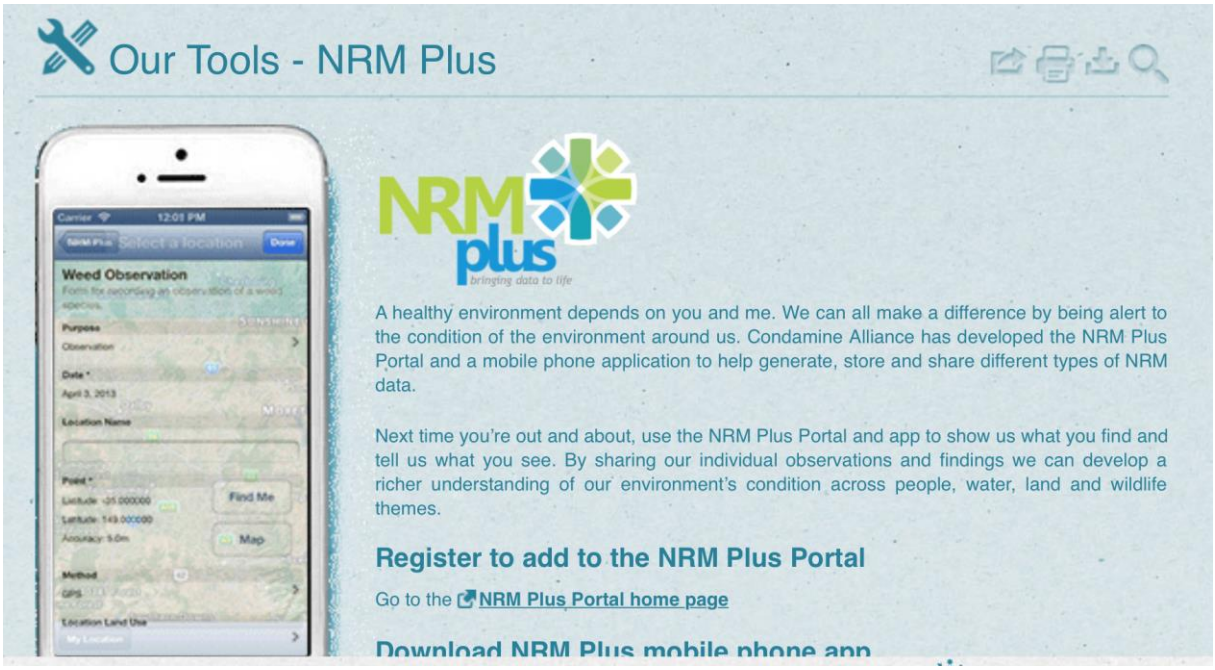


Figure 28. NRM Plus – An NRM app developed by the Condamine Alliance NRM[45]

Content relevance for the next strategy

The historical data management system that supports the previous strategies has little significance for the next regional strategies. As is stated in section 5.3.2 the information age should be recognised in the strategies (even if the next strategy states that a target is to better utilise the opportunities presented in the digital age).

45

5.3.7 General environmental considerations

The general content of each of the previous regional strategies is presented in the Environmental Scan in this report (see Section 6.3.12 and 6.3.13). A broad summary of those findings found in that section and the relevance of the content for the next strategies is presented below.

Both NRM North and NRM South utilised an asset-based classification in the two previous regional strategies (both 2005-2010 and 2010-2015). However the emphasis given to the classification has varied between the two strategies. In the 2005-2010 strategies NRM North and NRM South's approach were generally similar, with a major difference being the inclusion of an action package for addressing climate change and the greenhouse effect in the NRM North Strategy. In contrast the NRM South strategy incorporated discussion of climate change into a range of issues.

In the 2010-2015 strategies the strategies diverged further (both in structure and emphasis) where the NRM North strategy remained more aligned to an asset based classification but with an increased emphasis on priorities and a simplified set of targets. The NRM South 2010-2015 strategy removed much of the detail and focussed more strategically.

On reflection of the 2005-2010 and 2010-2015 strategies most of the content remains relevant. The long-term aspirational targets presented in the first NRM strategies is particularly relevant and should be included in any future strategies. The next strategies should ensure that there is enough detail to systematically work through the actions and identify roles and responsibilities. The past strategy with the most relevant approach for the next regional strategies would be the 2010-2015 regional strategy for the NRM North region.

5.4 Strategy influence on stakeholders

An important component of the Strategic Scan is to assess the nature and degree to which information from regional NRM bodies shapes and influences the natural resource management undertaken by the stakeholders. When looking at the survey results it was interesting to note that those who work across the whole state (and therefore span more than one NRM region) had very little consideration of the strategies. However, at the NRM-specific regional level the influence was quite strong. In fact 31% of respondents working in the NRM South region and 25% of those working in the NRM North region stated that the NRM strategies informed their natural resource management considerably (compared to 3% of those who worked across the whole State) (**Figure 29**).

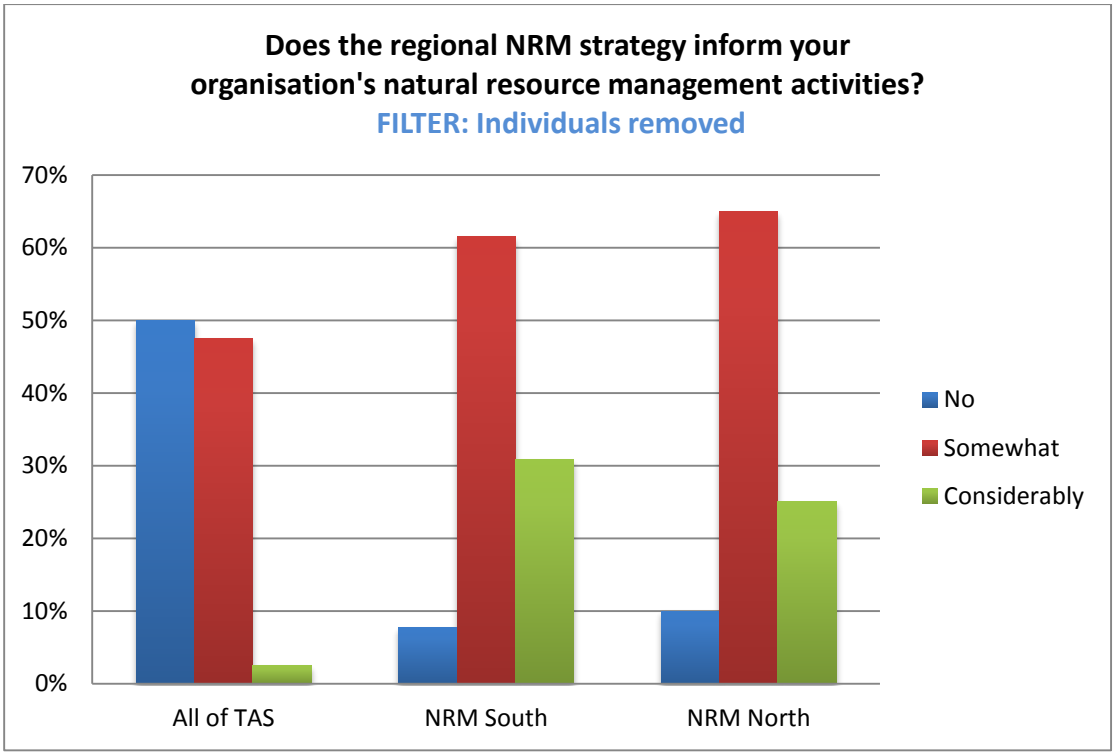


Figure 29 Extent to which the regional NRM strategies influences other organisations

This issue was identified by some people at the regional workshops. Some participants stated that the NRM Strategies need to be better reflected in local government management and policies, especially in relation to land use planning. This was expanded by some who stated that NRM bodies should be more actively involved in informing Council strategies (as opposed to having Facilitators focussing on individual issues). The comments from respondents to the above question where positive overall.

Survey participants were also asked to think back over the previous two strategies (from 2005 through to now), describe the outcomes achieved in the following areas?

- Provision of information
- Brokered decision-making
- Capacity building
- Provision of funding
- Supported the development and implementation of the regional strategies by all stakeholders
- Increased the consideration of NRM assets in stakeholder activities
- Improved the condition of NRM assets.

The results for these are presented below.

Provided information about natural resources, the management of resources and sustainability

The results show that the previous strategies had an impact here with approximately 60% of respondents stating that they had a reasonable level of impact or above.

Very few stated that there was little or no impact.

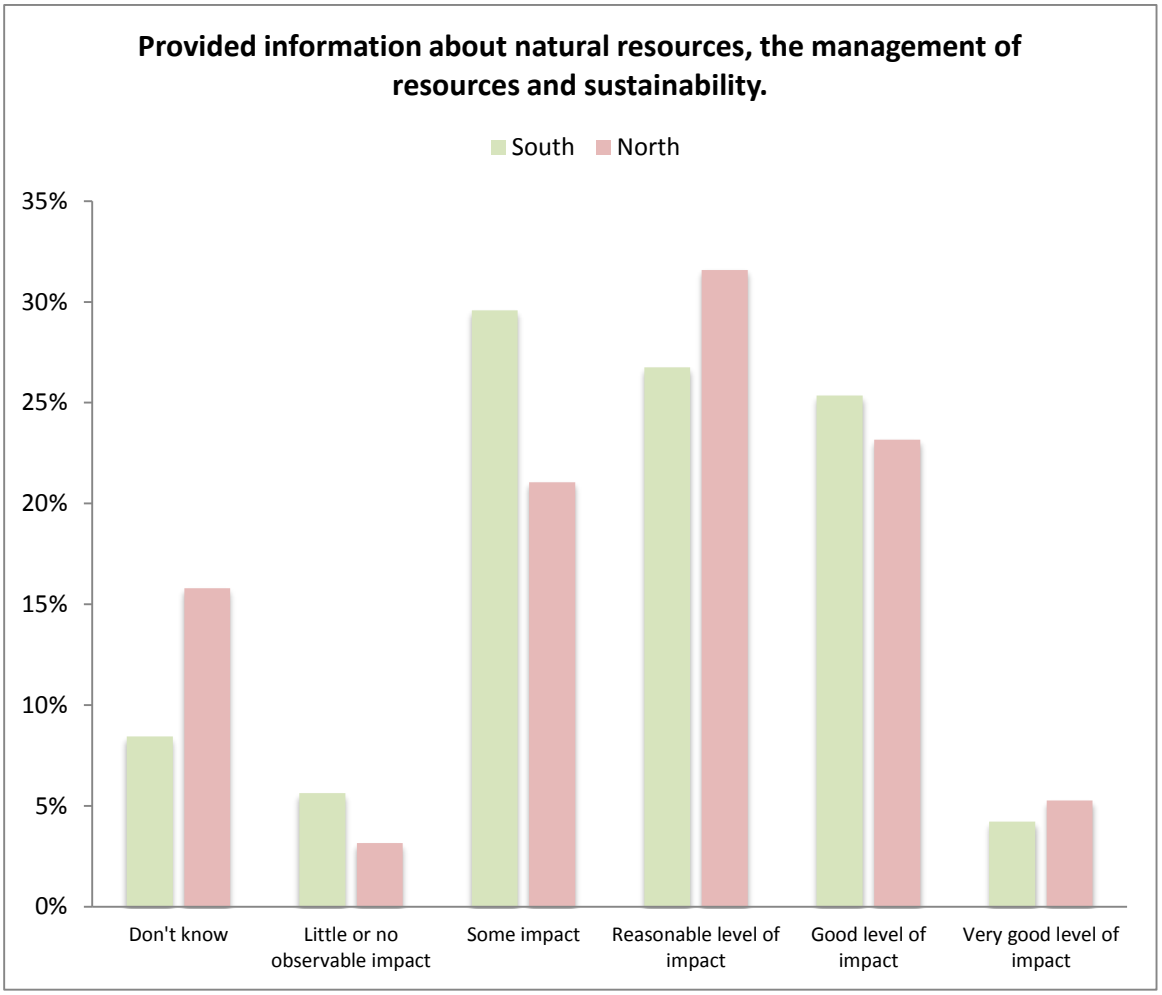


Figure 30 Survey response – level to which the regional NRM strategies provided information

Brokered and facilitated decision making in natural resource management, especially involving multiple jurisdictions and ownership entitlements

This question received an array of responses with a reasonably high percentage of respondents stating that they 'did not know'. Approximately 40% of respondents stated that they had a reasonable level of impact or above. The largest geographic discrepancy was for the answer 'some impact' (**Figure 31**)

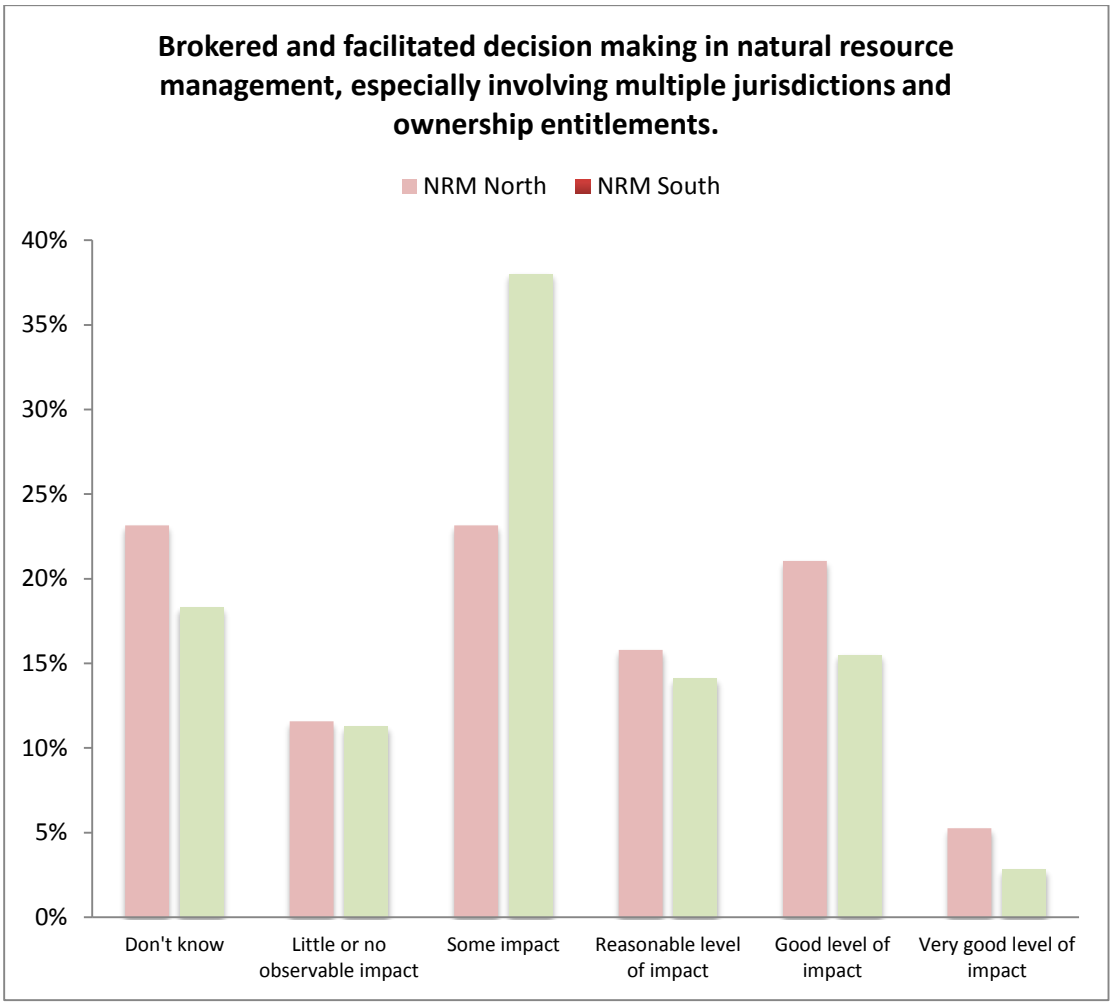


Figure 31 Brokered and facilitated decision making in natural resource management, especially involving multiple jurisdictions and ownership entitlements

Actively built capacity with natural resource management stakeholders to manage natural resource management issues

This question highlighted a strong positive influence of capacity building as a result of the previous strategies. Approximately 50% of respondents stating that they had a reasonable level of impact or above (**Figure 32**).

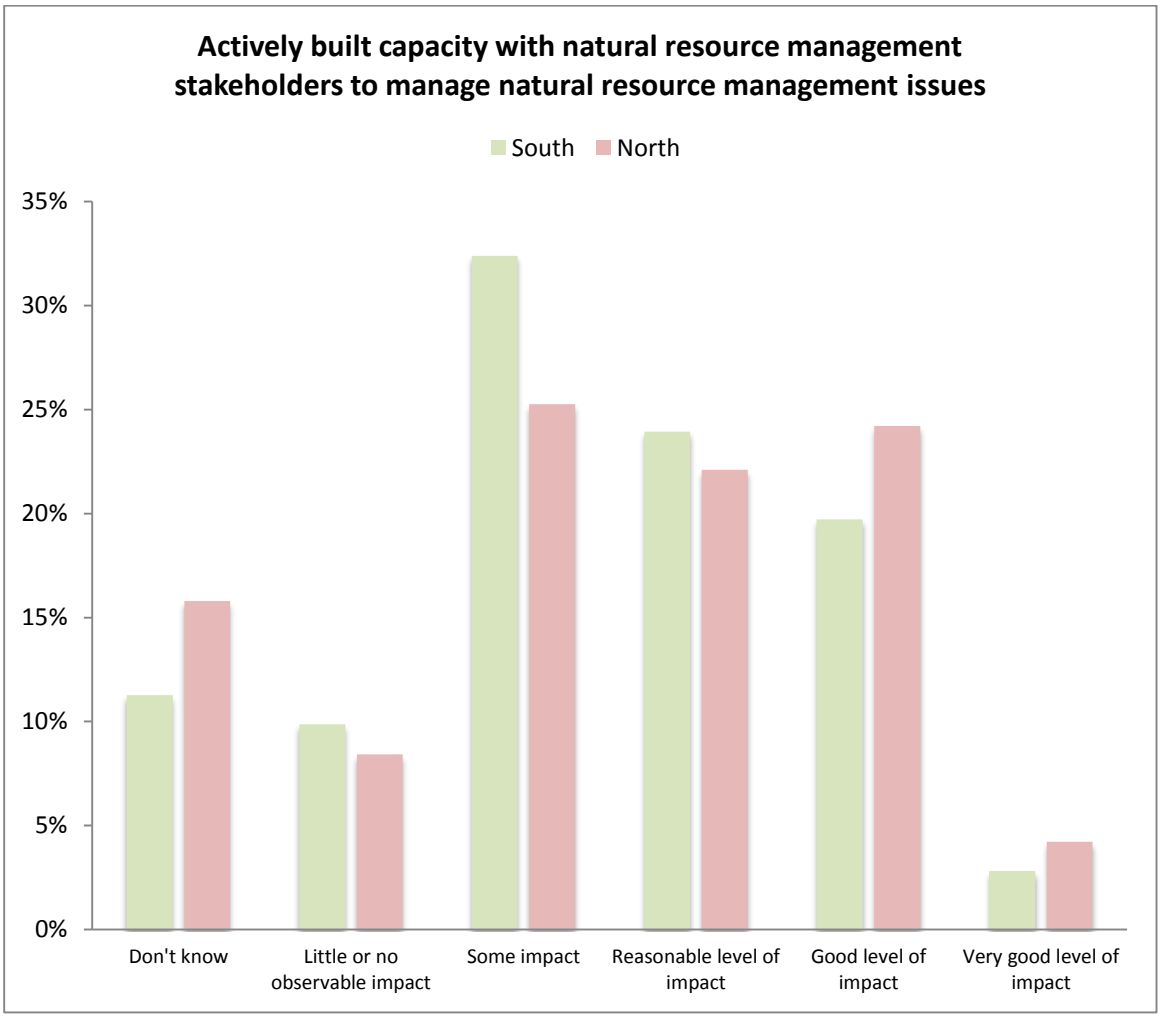


Figure 32 Actively built capacity with natural resource management stakeholders to manage natural resource management issues

Gained funding and delivered contracts for natural resource management projects.

This element had the highest positive rating from the respondents. Approximately 60% -70% of respondents stating that the strategies had a reasonable level of impact or above for this indicator.

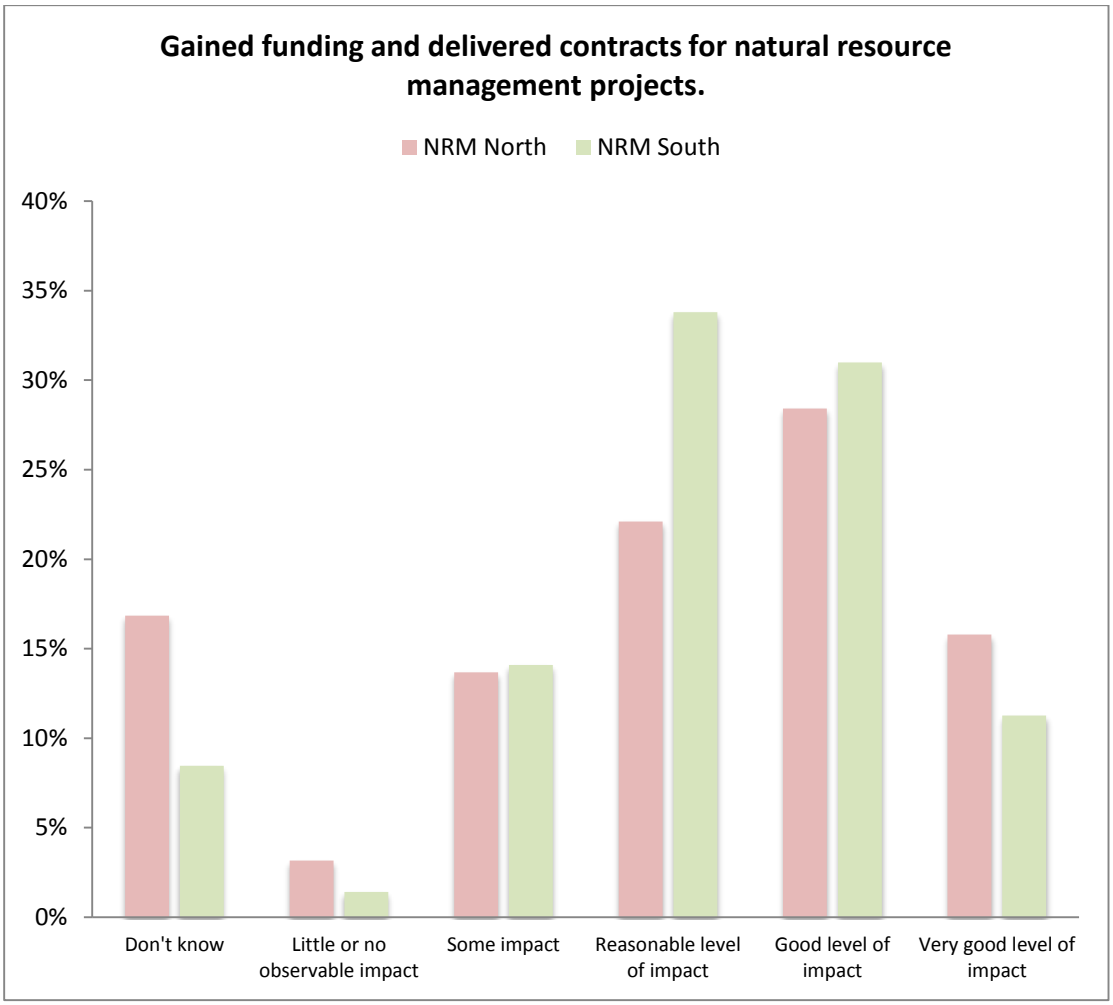


Figure 33 Survey results – impact of regional NRM bodies on gaining funding and delivering contracts

Supported and facilitated the development and implementation of the regional strategies by all stakeholders

Approximately 50% of respondents stated that the strategies had a reasonable level of impact or above for this indicator. This indicator also had a reasonably high score for those who answered 'don't know' (NRM North 21%; NRM South 14%)

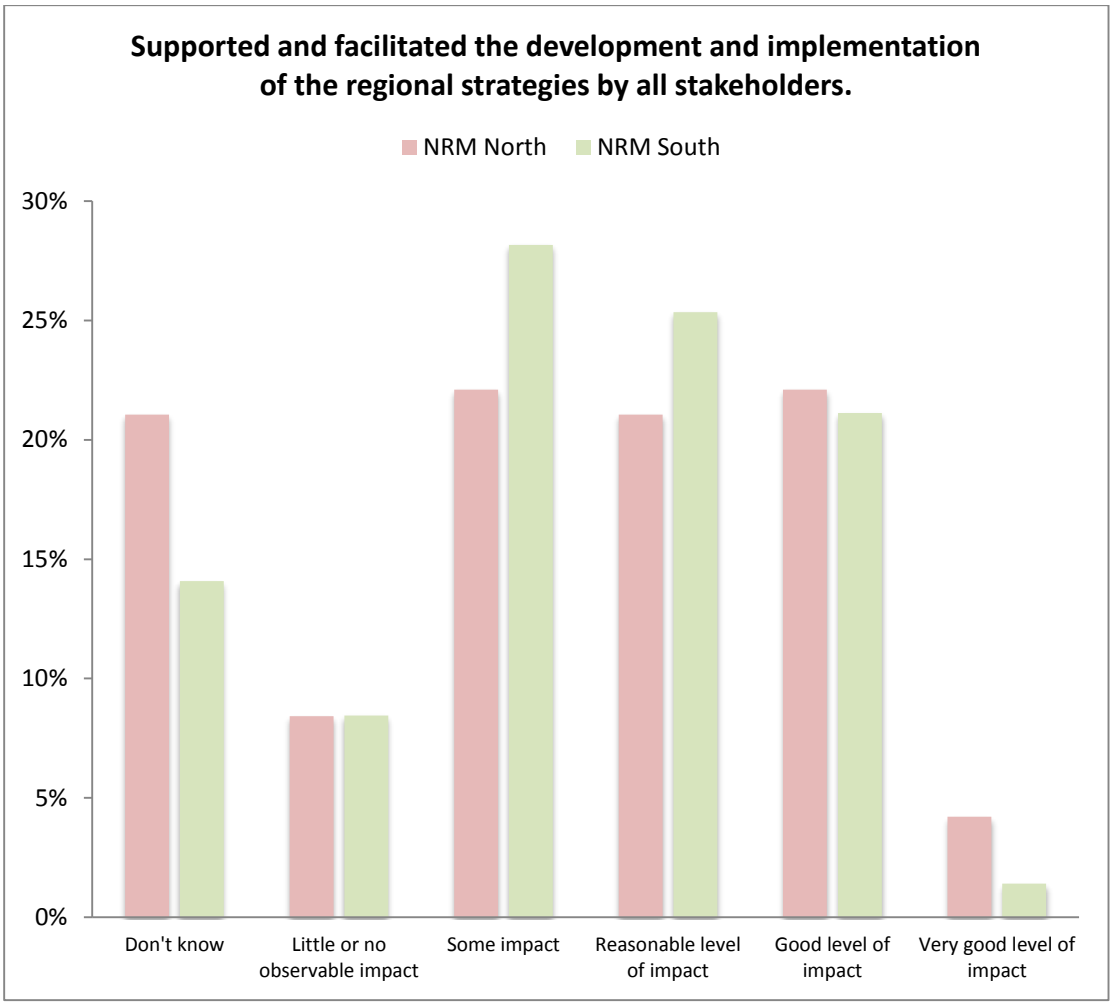


Figure 34 Survey results - facilitated the development and implementation of the regional strategies

Elevated the consideration NRM assets in action / strategies

Approximately 20-30% of respondents stated that the strategies had a reasonable level of impact or above for this indicator. This indicator also had a very high score for those who answered 'don't know' (NRM North 26%; NRM South 27%)

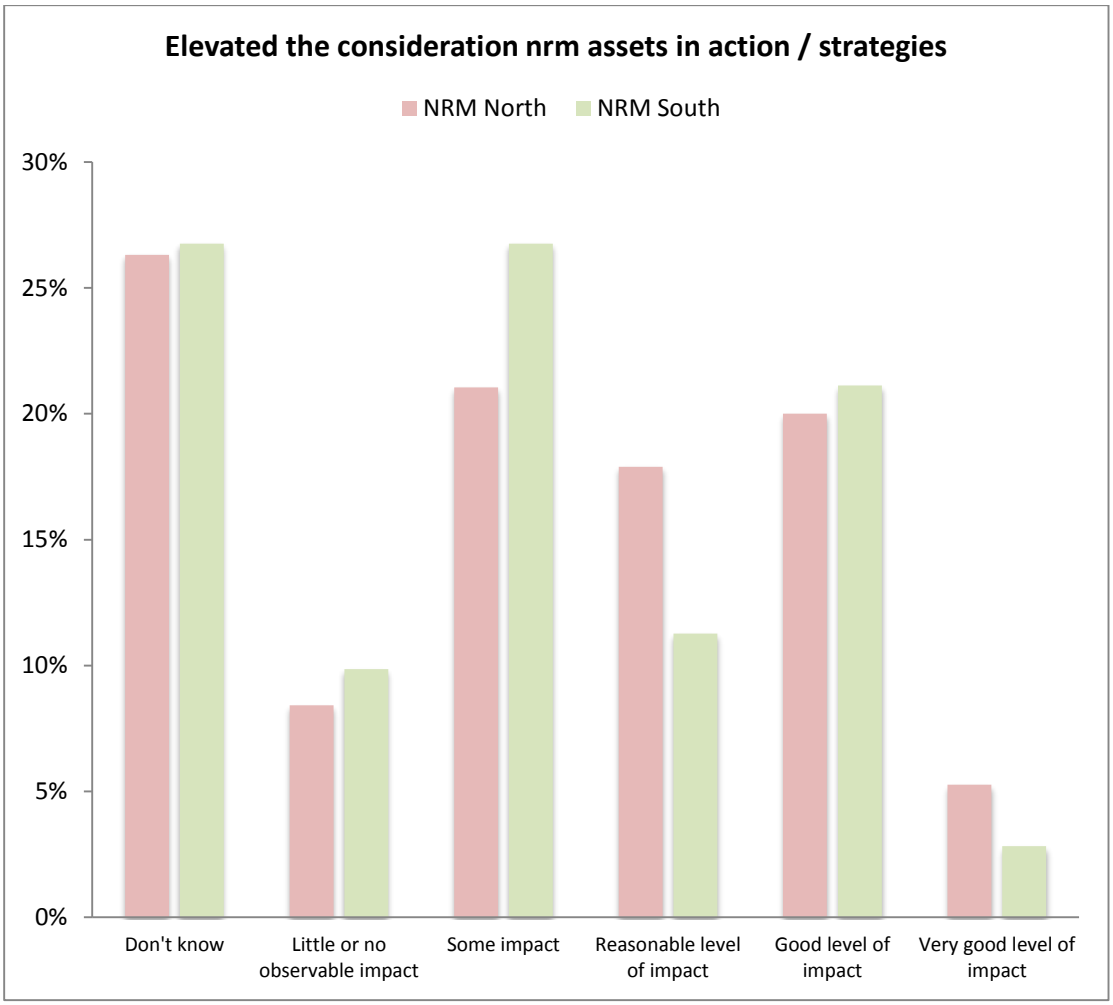


Figure 35 Survey results – impact of regional NRM bodies in elevating the consideration of NRM assets

Improved the condition of NRM asset/s

The response to this question had the most uncertainty. Approximately 20% of respondents stated that the strategies had a reasonable level of impact or above for this indicator. The highest score was 'don't know' (NRM North 36%; NRM South 32%)

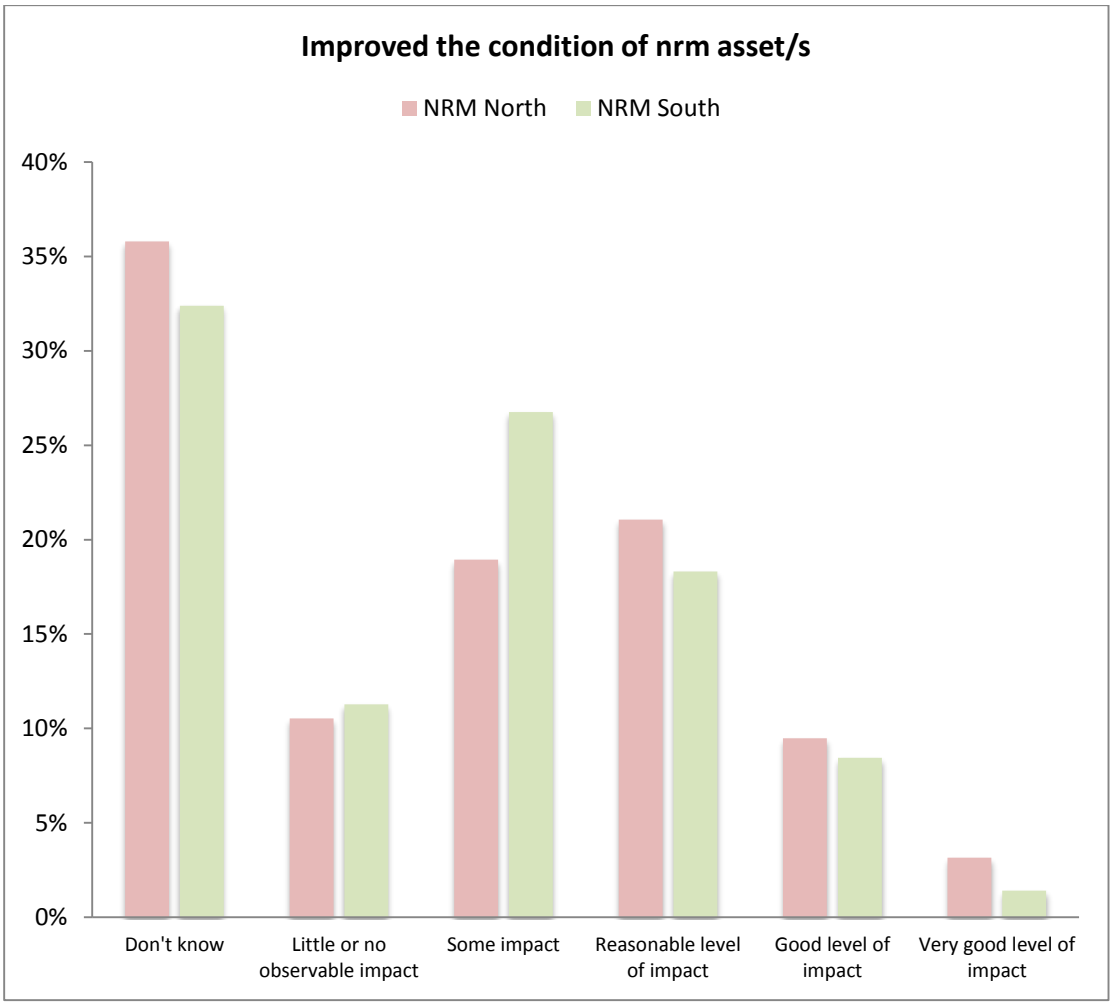


Figure 36 Survey results - improved the condition of NRM asset/s

5.5 Communication and engagement between stakeholders

As shown by Wallis et al (2015) communication is an important element for natural resource management. The Project Team recognises that the broad range of natural resource management stakeholders means that communication needs to be 'fit-for-purpose for the different stakeholders' (p.140). Considered engagement will support the awareness, ownership and uptake of any NRM strategy and help drive refinements over time.

A question about engagement satisfaction between NRM bodies and stakeholders was asked in the online survey. Overall the response for this question was reasonably positive with 63% of respondents stating that they were either extremely satisfied (16%) or satisfied (47%). However, there were 32% who expressed either somewhat dissatisfaction (24%) or extreme dissatisfaction (8%) with the engagement process (**Figure 37**). Of those who expressed a level of dissatisfaction 19% worked in State government departments, 14% in non-government organisations and 11% were from local government. The regional breakdown for this question had a similar distribution.

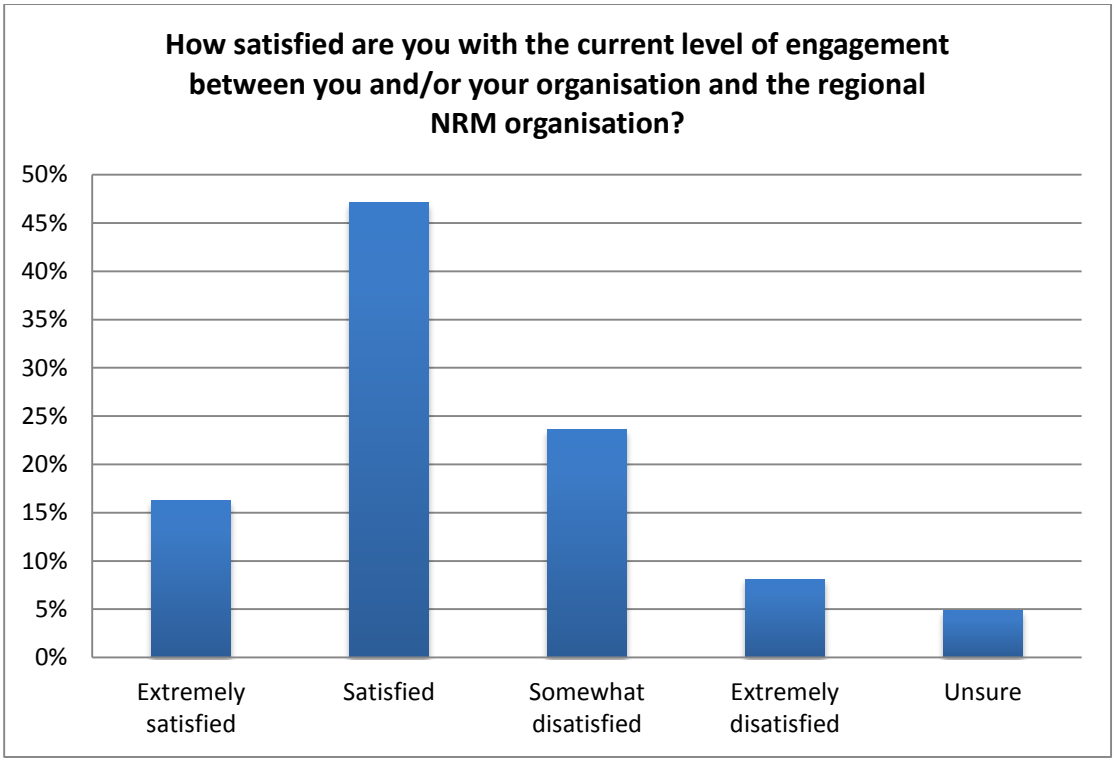


Figure 37 Survey results - level of satisfaction with NRM engagement (all locations)

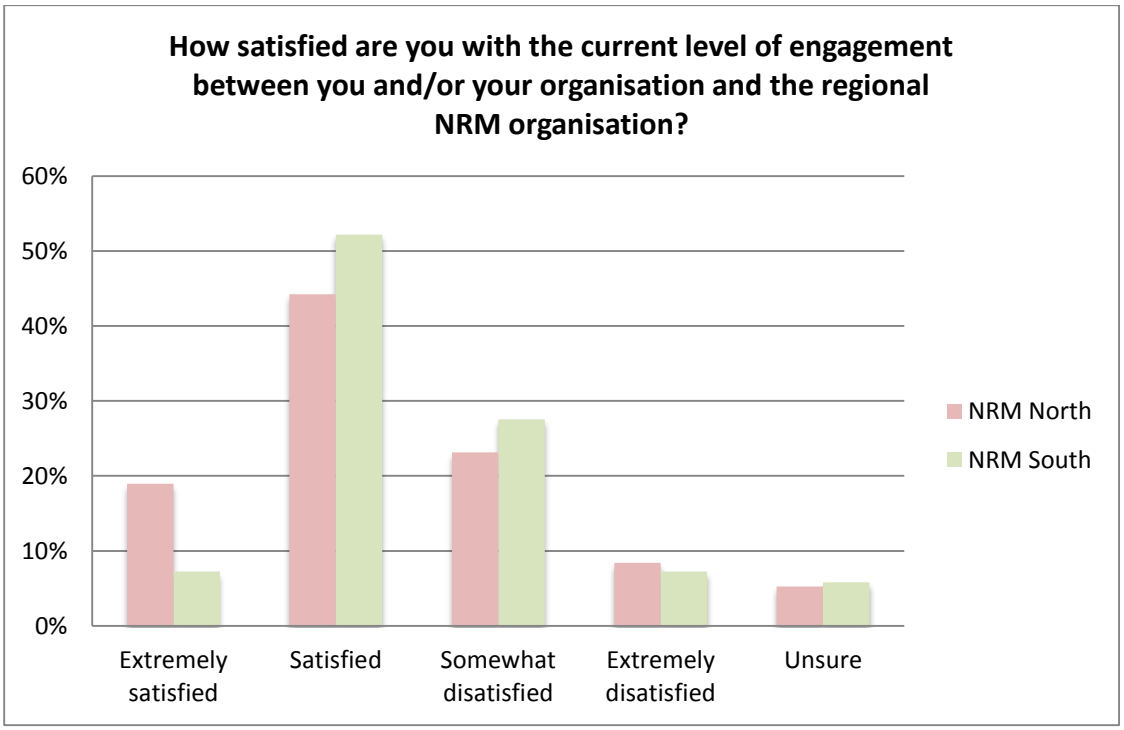


Figure 38 Survey results - level of satisfaction with NRM engagement (by location)

The online survey also explored the respondent's perception of the effectiveness of the NRM engagement process. This question differs from the above, which was about the satisfaction between NRM bodies and themselves whereas this question asks them about the effectiveness overall. Just under half of the respondents stated that they thought the effectiveness was either very good (15%) or good (32%). A similar proportion (41%) stated that there was room for improvement and 7% stated that they considered the engagement to date as being ineffectual (**Figure 39**).

The survey responses from the previous two results seem to suggest that more than half of the respondents were happy about the level of effectiveness of the engagement but were not as satisfied about the substance or outcomes of the engagement. The reason for this could be that the NRMs are not delivering on the outcomes stated in the engagement or that there is confusion by the stakeholders about the roles and responsibilities of the NRMs. The regional breakdown for this question had a similar distribution (**Figure 40**)

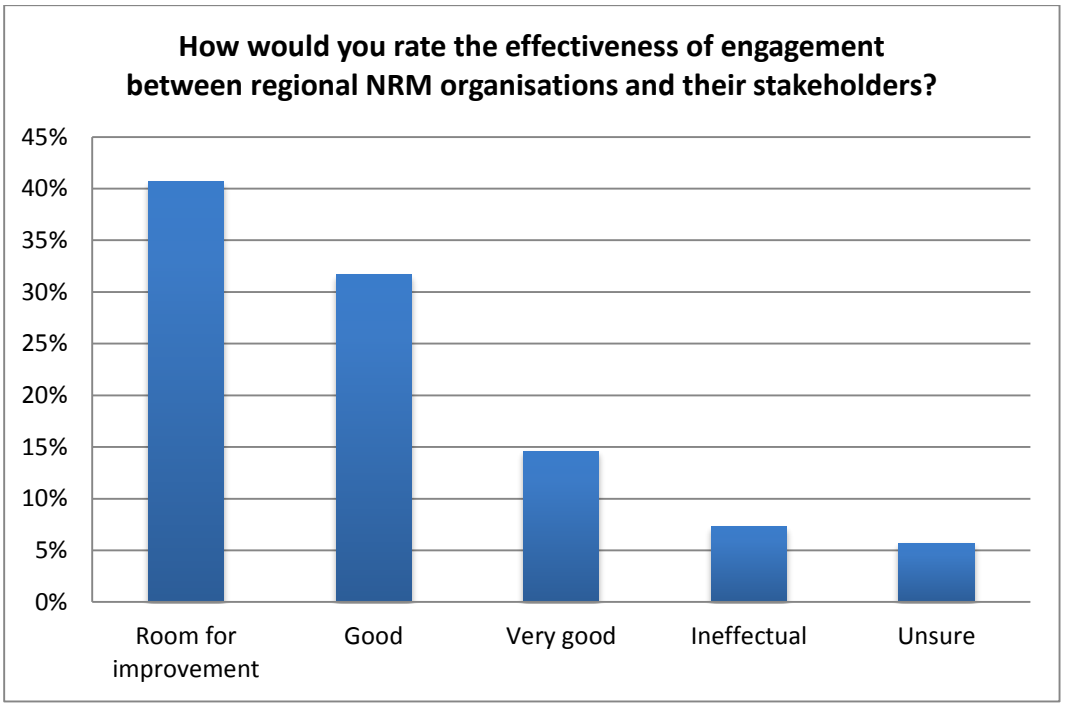


Figure 39 Survey results - views on the effectiveness of the enagement between NRM organisations and their stakeholders

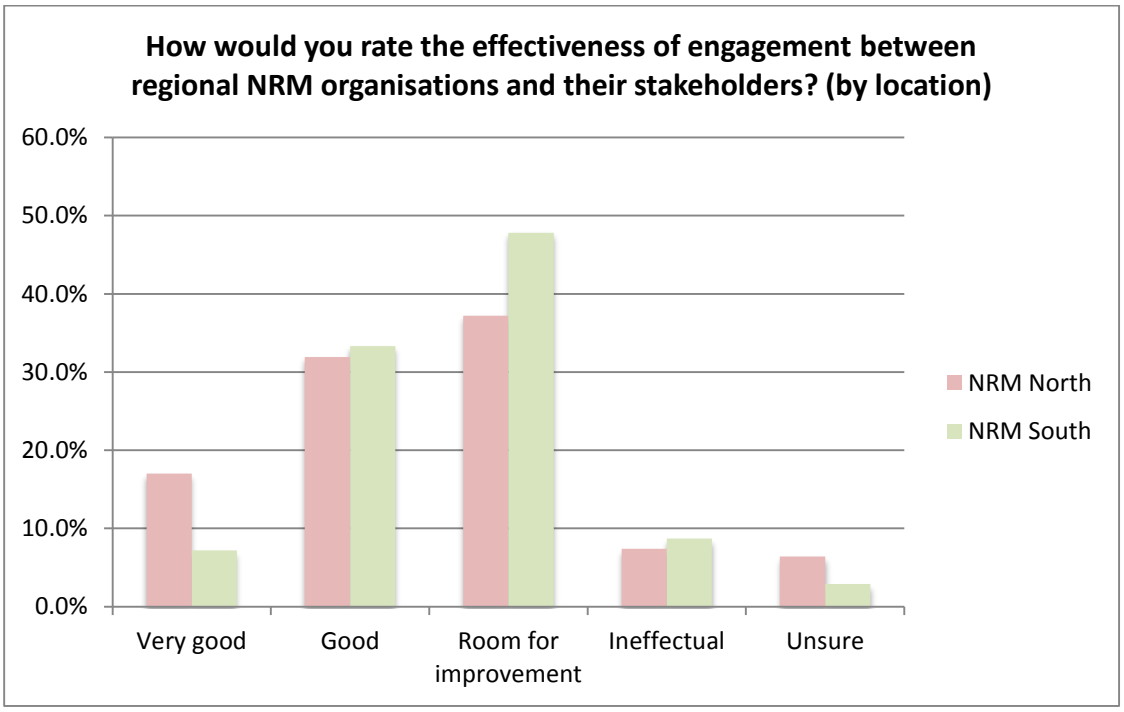


Figure 40 Survey results - views on the effectiveness of the enagement between NRM organisations and their stakeholders (by location)

In both of the workshops, participants stated that engagement between stakeholders needed to be differentiated. Some noted that some smaller stakeholder groups did not have the capacity to attend events and workshops.

Other key points raised in the workshops around engagement include:

- The need for both formal and informal processes to keep people and organisations connected;
- The need for transparency and openness of communication and information exchange;
- The importance of face-to-face engagement;
  The need to get institutions talking – continuously hosting committees, workshops, etc.; and
- To ensure that engagement and communication is recognised as a two-way process and that systems need to be in place to support this.

The above suggestions for improving engagement was also reflected in the online survey. Participants were asked about what they saw as the most effective method of communication for sharing information and news in the natural resource community. Two responses stood out from the rest – these were specific face-to-face meetings (70%) and email updates (67%). Two other notable methods also included were working groups (57%) and web page (49%) (**Figure 41**).

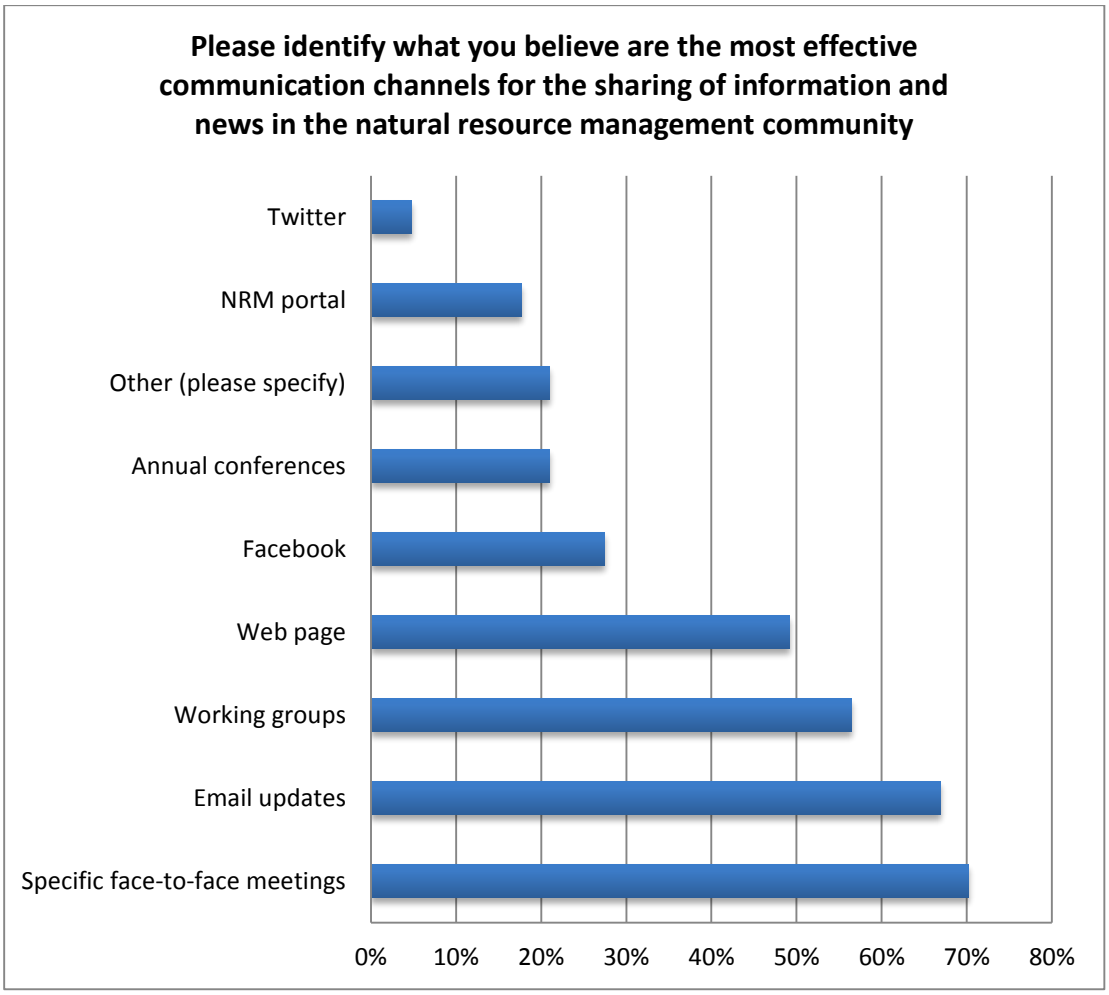


Figure 41 Survey results – views on most effective communication channels

When the responses to the above question were filtered by the geographic working area of the respondents, the rankings did vary somewhat. For example, for those who work solely in the NRM North region, 84% stated that they saw email as the most effective communication channel. The highest for those specifically in the NRM South region was face-to-face meetings (61%) (**Figure 42**). These differences highlight the value in local engagement and implementation.

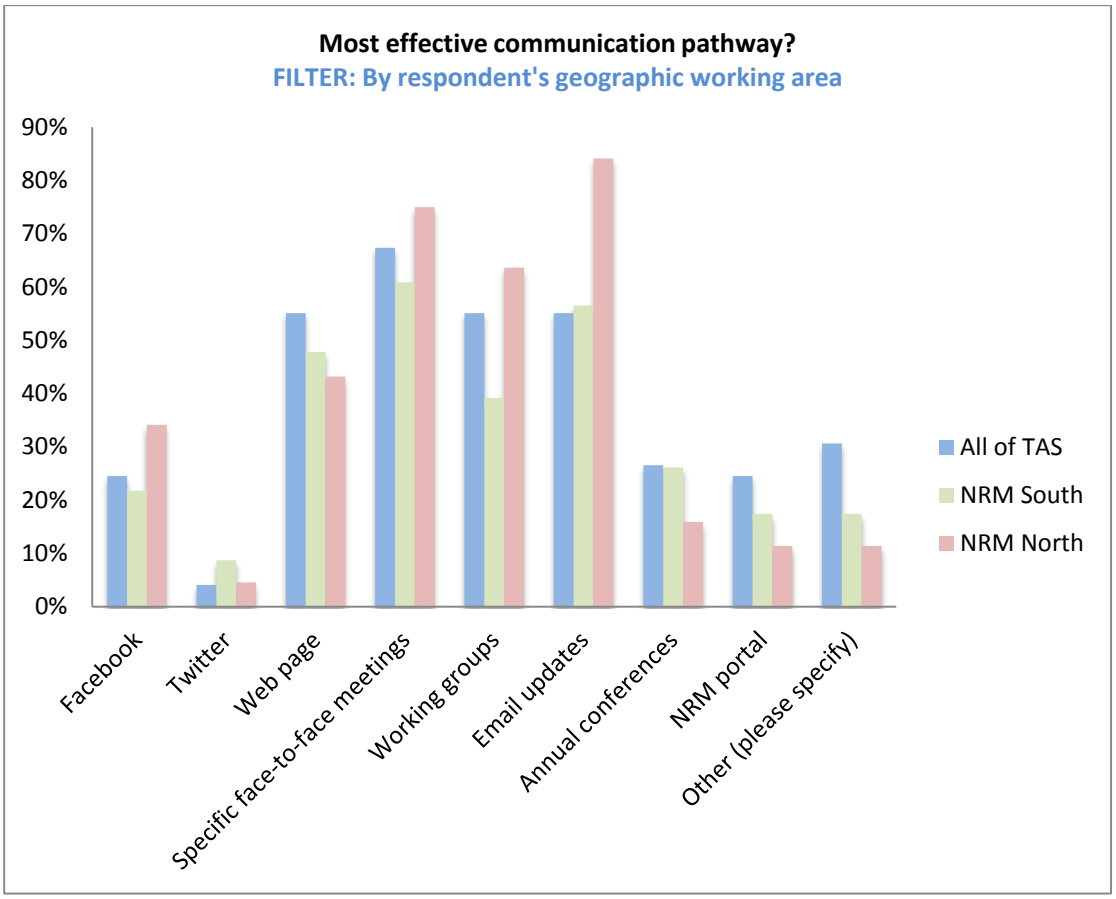


Figure 42 Survey results – views on most effective communiocations channels by location.

Section summary

Key point 20 Previous NRM North and NRM South strategies have been pitched at alternatively detailed and high levels. The impacts of these previous strategies on influencing stakeholders has been mixed.

Key point 21 Analysis supports the adoption of a balanced format that incorporates change planning principles, while remaining at a strategic position to guide investment and decision making into the future.

Key point 22 The status and credibility of the Regional NRM strategies needs to be elevated in order to increase the degree to which other stakeholders base their planning on the regional strategies. State-wide stakeholders seek consistency and commonality in the way multi-regional issues are reflected in the three Regional NRM strategies.

Key point 23 The process of the State NRM Council endorsing the final draft of the regional strategies and recommending their adoption to the Minister was seen as quite removed from the stakeholders.

Recommendations

Strategy recommendation (general) 9 Other considerations for inclusion in next strategies include; building stakeholder knowledge of the legislative principles and structures which underpin the delivery of effective natural management outcomes; aligning regional priorities with government funded projects; selecting actions that realistically reflect available resources and create the structure to lever of other funding and access stakeholders may have to other resources; and building on the success of earlier work.

Strategy recommendation (general) 10 The roles and functions of NRM Facilitators located in local Councils need to be reviewed in light of the priorities identified in the next regional NRM strategies – to determine the best ways to allocate NRM regional staff to achieve the objectives of the regional NRM strategies.

Strategy recommendation (general) 11 NRM Regional strategies should include a set of measures and indicators that align with or are easily adaptable by NRM stakeholders (see indicators under Institutional Scan).

Strategy recommendation (general) 12 Regional NRM strategies should be based on and deliver data and evidence to substantiate the economic benefit (and analysis of costs and benefits) to encourage stakeholder investment in natural resource management and climate change initiatives.

Strategy recommendation (general) 13 NRM Regional Strategies should consider the inclusion of longer term directions or goals (20 years+) to create a context for the next 5 year strategy.

Strategy recommendation (general) 14 The next NRM Regional Strategies should prioritise 'supporting stakeholders to incorporate climate change and resourcing for climate change initiatives into their next strategic plans and natural resource management plans'.

6 Environmental Scan

6.1 Background to the environmental scan

The purpose of the environmental scan is to contribute information and perspectives on natural resources for consideration in developing the next regional strategies for NRM North and NRM South. The scope of the work is:

> 'to conduct an assessment of the biophysical features and assets of each region; assess and review the impacts that climate change and other processes may have; and discuss the risks and opportunities which may present themselves'.

The most important finding of this scan relates to the need for a coordinated, ongoing, structured and participatory information systems approach to managing NRM data and knowledge across Tasmania. This need arises from the extent of 'information overload' to which the field of NRM is subject, and which is being exacerbated by the technologically-driven pace of information generation and the dynamic nature of the effects of both climate change and other drivers in natural resource management.

Discussion of this finding is presented *a priori* in this scan (section 6.2). It is important in setting the context for the further findings and recommendations as it defines a framework considered necessary to effective NRM planning and implementation in a complex and changing world.

The scan is, in effect, a review of a complex array of information, generated sometimes for disparate purposes, and an attempt to present the information and its implications within a coherent structure. To achieve this an assets based approach was adopted. The approach reflects a consistent theme in NRM North and NRM South strategies, plus other relevant material, in organising around NRM assets and issues. Section 6.5 provides more information on the basis for the choice of approach.

A large number of documents were reviewed for this scan. They can be broadly divided into three categories:

1. Documents relating to previous NRM strategies and the legislative and policy framework for NRM in Tasmania. The review of these documents is intended to identify the scope, structures and priorities of previous strategies and their relevance to the forthcoming 2015-2020 strategies of NRM North and NRM South. This review is presented in section 6.3.1.
2. Documents, resources and data that have been produced since 2010, in particular those relating to climate change such as the Adapt NRM, the Southern Slopes Climate Change Adaptation Research Partnership, CSIRO / Bureau of Meteorology climate change projections for NRM. These sources represent a combination of new research and also syntheses of existing knowledge. The main sources are described in section 6.3.2. Findings from this suite of information sources informs numerous components of the assets and issues scan and so are not uniquely referenced.
3. Other information sources identified during the course of the work that relate to particular aspects of NRM (e.g. one or a few related issues). Information and findings from these sources are included in the assets and issues scan and are uniquely referenced.

A further source of information for this environmental scan was the results of the survey developed for the project. The survey included a number of questions designed to elicit information from stakeholders on asset-focused NRM activity and priorities and on the impacts of climate change on stakeholder capacity to manage NRM assets and issues. A summary of findings from the survey is presented for each asset class and asset. The summaries are presented on a State-wide basis and also separately for respondents from the NRM North and NRM South regions to highlight any differences.

The documents, information sources and survey results described above were used to develop recommended areas for focus of NRM priority and activity for each of the two regions.

A number of the recommended areas for focus are common to both the NRM North and NRM South and, if adopted, will need to be tailored to the circumstances of each region. Some components of the recommended areas of focus are different between the two regions. These differences are highlighted where possible. The recommended areas of focus are included at the end of the analysis for each asset class or asset.

Due to the size and breadth of the environmental scan, the previous report structure whereby sections are summarised with key points and recommendations has not been followed. The key points and recommendations are embedded within each sections, typically within a table.

6.2 An information systems approach to data and knowledge management

Information overload and complexity is a reality for regional NRM organisations. The key finding of this environmental scan is that there are fundamental challenges in the management of NRM data and information and in its incorporation into NRM activity, and that this is only likely to become more severe due to increasing pace of information generation. This stress on NRM operations can be addressed through strategic and institutional implementation of systems which address the fundamental characteristics of NRM information in efficient and effective ways.

NRM activity is built on data, information, knowledge and understanding which is subject to ongoing change. This change can be profound when considered in the context of climate change or even of emergence of new scientific perspectives and understanding. Identifying relevant information at the time of writing and incorporating it into a new strategy using a classification is a second best outcome, as the currency of the priorities and appropriate approaches may be inadequate to deal with unpredicted or unanticipated change.

Maximising the value of the asset classification and effectively utilising the asset information and knowledge are essential to NRM activity. Achieving this objective can be achieved by adopting an information systems approach to information and knowledge management.

An information systems approach would involve clearly documented and implemented processes and trigger that review and apply information for maximum effect on NRM outcomes, particularly in ensuring strategic and institutional arrangements and initiatives effectively use appropriate information.

The key elements of an information systems approach to address these issues are outlined below. The elements identified are common to all three Tasmanian NRM regions and so would be best approached through coordinated allocation of resources. Some of the functions can potentially be provided by the NRM data library. However the library is more of a storage facility which is not underpinned by processes that ensure information is collected systematically, interpreted appropriately and communicated effectively.

The three Tasmanian NRM regions should collectively resource the establishment of an ongoing, structured and participatory approach to data and knowledge management. This responsibility would include the establishment and coordination of Themed Reference Groups around elements of the proposed asset classification, monitoring of new information, design of information storage systems and communication of the outcomes of the reference group work among stakeholders. It is envisaged that the reference groups would include both technical expertise and some stakeholder-based representation to promote ownership and to provide efficiency of communications with and among stakeholders.

The role of stakeholders in the Themed Reference Groups is seen as critical to their operation. To be effective it will be necessary for stakeholders to see the Groups as able to reflect, service and inform stakeholder priorities, and to provide or develop tools and information products which enhance their activities. For this to occur it will be important that stakeholders are actively engaged, and involved, in the formation of the Themed Reference Groups. In this sense the NRM regional organisations would only facilitate the Groups, rather than establish them and then invite stakeholders to become involved.

Themed Reference Groups would assist in the implementation of the Regional Strategies. The Groups would need to be driven by end users and stakeholders with a commitment to achieving the outcomes sought from the NRM Regional Strategies.

Key areas of work to be delivered through the collective resourcing and operation of the Themed Reference Groups are described below.

6.2.1 Maintenance of classification

The classification of NRM assets and issues is central to designing and implementing effective NRM activity. This review has identified that the classification of NRM assets and issues is relatively stable. However there does not appear to be systematic use of the classification as the basis for communication among stakeholder, priority setting and measuring effectiveness.

The classification should be subject to scheduled periodic review (e.g. as part of developing new strategies) and include explicit consultation with stakeholders. Procedures for triggering a review of part(s) of the classification also need to be in place, particularly to address unanticipated changes. The role of the classification as the focus for NRM activity also needs to become a core part of NRM communications. A database system and template for storing information about assets and issues needs to be designed and maintained (see below) and new information and its potential effects on priorities readily communicated to stakeholders on an ongoing basis.

6.2.2 Systematic data gathering and sharing

Detailed information and data about NRM assets and issues is subject to continuous change. Efficiency in addressing data and information can be achieved through a systematic approach designed to ensure the most relevant sources of information are monitored. Key elements of such as system might include:

- Systematic monitoring of key information sources (especially a sample of relevant scientific journals) and the allocation of relevant information to the classification using the classification template.
- Use the themed reference groups to discuss the implications of changing information and ensuring it the classification template is populated with links to relevant sources and also with current, agreed interpretations on the issues to which they relate.

- Regular communication of new information and profile updates to stakeholders using a range of communication methods. This is important to help ensure that perspectives on NRM issues are not overly-concentrated on the 'silos' of popular interest at the expense of importance and urgency.

6.2.3 Priority setting, change and communication

The rapid progression of climate change highlights the need for priorities to be both appropriate and responsive to changing information and circumstances, i.e. to be effected through a dynamic planning model. In this context it is likely that NRM priorities may change during the term of a strategy. Key elements of effective and responsive priority setting include:

- Transparent processes for setting priorities, particularly through first decoupling of objective scientific perspectives (e.g. important and urgency), capacity (e.g. no stakeholder interest or capacity) and circumstances (e.g. funding focused on other issues) so that the range of considerations applied to any priority is clear. This is particularly important in the context of climate change, as adaptation will inevitably involve trade-offs and compromises and these need to be made transparently.
- Processes and principles for triggering reconsideration and potential change to priorities.
- Involvement of stakeholders in setting priorities probably needs to occur on a more regular basis than at the time of review of strategies. Use of groups similar to that outlined above for information gathering and sharing may provide a basis for building ownership in the context of almost inevitable competing priorities.
- Regular communication to stakeholders of current or changed priorities needs to occur on an ongoing basis. Priorities embedded in a strategy whose basis cannot be readily seen in subsequent NRM activity are less likely to be owned and adopted.

The SCARP spreadsheet template for conducting current situation assessments should be reviewed by the Themed Reference Groups and, with any modifications needed, used as a common format for input of information to priority setting.

6.2.4 Baseline information

Baseline information is important for measuring change in the condition of natural resources (even if the change is negative). The documents reviewed for this environmental scan do not provide a coherent basis of approach to baseline monitoring. It is perhaps only the background reports to the 2005-2010 strategies which contain sufficient information on which baselines could be developed. There also appears to be a view among stakeholders (and perhaps in the NRM organisations themselves) that there is less baseline information than is actually the case.

An example is the availability of State-wide data on vegetation condition, which is widely regarded as not available. In fact a State-wide layer of vegetation condition (called 'biophysical naturalness') was produced for the Regional Forest Agreement process in 1996. It was maintained partly for programs such as the Private Forest Reserves Program[46]. Underlying disturbance data from forestry operations has been maintained continuously by Forestry Tasmania and a wide range of Government, NRM and private programs and activities have collected condition data using a range of methods which could be readily adapted into the baseline format.

A barrier to the wider use of baseline data concerns perceptions of its nature. It is a common preconception that baseline data needs to be stable and not subject to change. In reality baseline data on many issues is subject to ongoing change, particularly as new information comes to light and the quality and accuracy of information improves. For example improvements to vegetation mapping across Tasmania since 1996 mean that the baseline for many vegetation types has changed from that believed to be the case when first compiled. These changes represent improvement understanding of the 1996 baseline, not changes to it.

[46] Comprehensive, Adequate & Representative Scientific Advisory Group (2004).

In the context of using baselines in NRM it is important to distinguish changes to the baseline from changes ***from*** the baseline. The latter are measures of change whereas the former are not. Baselines for a range of NRM assets and issues which are not currently available are likely to be able to be developed relatively efficiently (see discussion integrated data products below).

6.2.5 Integrated data products

The development and use of integrated spatial data products is important for effective NRM planning and monitoring. The current tendency around spatial data for NRM in Tasmania is that GIS layers are developed for a single purpose and not integrated with other layers. Whilst this may meet the needs of a specific approach, the needs of NRM for comprehensive information can be more effectively met if related GIS data products are spatially integrated in a logical consistent structure. Integration also allows for multiple inputs on a single issue to be compared, and hence can be useful in determining changes to and changes from baselines.

An example of data integration is a range of data products maintained by one of the project partners (NRP) that include State-wide integrated products based on multiple inputs for vegetation (vegetation community, bioregions, old growth forest, vegetation structure and biophysical naturalness), land resources (land systems mapping, 1:250k and 1:25k geology, 1:100k soils mapping, Aeolian landforms, karst and field mapped data) and freshwater ecosystems (a single GIS layer combining all six themes from the Conservation of Freshwater Ecosystems Values project).

Investment in building and maintaining integrated data products increases over time, and can result in ongoing costs for maintaining powerful data products being relatively modest.

6.2.6 Monitoring, evaluation and reporting

NRM regional organisations are constrained in having limited resources and, at the time of writing, a Commonwealth-imposed maximum of 10% of provided funds being spent on monitoring and reporting. On the other hand, stakeholder workshops conducted as part of this project frequently identified the importance of monitoring but also highlighted constraints around design of monitoring systems and the resource implications for NRM organisations. This issue is further complicated by the facts of the NRM organisations having a limited number of 'levers' to effect change, principally through voluntary activity, but an expectation from Governments to improve and report on the condition of NRM assets and issues.

The issue has been further compounded in Tasmania with the cessation of State of the Environment reporting in 2014. However it is also likely that opportunities for a cooperative approach to reporting may be available, for example in supporting local government strategies under the *Local Government Act 1993.* The cessation of State of the Environment reporting represents a major institutional change to the policy environment in which Tasmania's regional NRM organisations operate, and removes an important centralised role in information collation, interpretation and dissemination.

The recommended approach to this situation is to task the Themed Reference Groups with responsibility for designing efficient monitoring and evaluation systems for NRM assets and issues and for identifying synergies and potential partners. Due to resource limitations of the NRM organisations, it may not be possible for all assets and issues to be subject to monitoring and reporting and indicators may be considered in the alternative. An ongoing but rolling program of reporting represents one option for achieving cost efficiencies in reporting. Under such an approach reporting in any one year would be restricted to a pre-determined set of assets and issues, with a scheduled return period in which the status, condition and change in all assets and issues would be reported (e.g. every 5 or 10 years).

It is important to note that the approach recommended above is not for the NRM regional organisations to take up the responsibilities of State of the Environment reporting. It is envisaged that there will be some issues (e.g. those within their strategy focus areas) in which they would take a lead role in monitoring and reporting, but not others. At the time of writing, the area of centralised information collation, interpretation and reporting for Tasmania's environment is uncertain. Cooperation among a range of stakeholders with different reporting foci is probably the most that can be expected in the near term.

A further area which should be explored for monitoring and reporting is the development of harmonisation processes. Many people working in NRM-related fields develop approaches to measurement that are tailored to their own needs or constraints, and is considered one reason for the only partial uptake of standardised methods for measurement of some NRM assets and issues. Harmonisation processes may be an efficient alternative to standardised methods, involving discussion and review of different methods to identify common sets of indicators that can be arrived at through different methods while still being sufficiently robust to satisfy reporting needs.

6.2.7 An asset based approach

Biophysical features and assets are the foundational area of interest of natural resource management organisations. However they are also often complex and effective NRM activity requires integrated approaches that can address multiple features and assets. This complexity and inter-relatedness gives rise to a need for consistency in language and approach to NRM.

The use of classification systems for NRM assets is an attempt to provide a logical structure and consistent language for use in their planning and management. The Tasmanian regional NRM organisations have utilised asset-based classification in the two previous regional strategies (2005-2010 and 2010-2015); however the emphasis given to the classification has varied between the two strategies.

The Australian Government also gave considerable emphasis to asset classification, producing a set of recommended national assets and indicators for NRM[47]. The national assets and indicators are incorporated into the national monitoring, evaluation, reporting and improvement (MERI) framework[48], which indicates they were to become a living document intended to change over time. The MERI framework in turn forms the basis of the current National Landcare Programme monitoring and reporting plan[49]. (Although at the time of writing the national assets and indicators were not available as a web-accessible document).

The approach adopted for this environmental scan is that an asset-based classification is warranted because both of its inherent utility and suitability in the NRM context, and also in enabling the next round of NRM strategies to build on previous work. However it may be more appropriate that it is considered as an assets and issues scan to avoid preconceptions that the term 'environment' may be simply a reference to the natural environment.

Section summary

Environmental recommendation (general) 1 Themed Reference Groups be established to support institutional, strategic and environmental initiatives including areas such as professional and organisational development, governance or stakeholder engagement and participation.

Environmental observation It is recommended that the three Tasmanian NRM regions should collectively resource the establishment of an ongoing, structured and participatory approach to data and knowledge management.

Please note: this finding is outside the scope of this project. The observation has however, been included as an operational issue for further consideration by NRM North and NRM South when implementing the next Regional Strategies.

[47] Department of Environment, Water, Heritage & the Arts (2008).
[48] Australian Government (2009).
[49] National Landcare Programme (2014).
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6.3 Document analysis

The NRM field is subject to a plethora of information sources and requirements. The purpose of this document analysis for the environmental scan is to identify key factors from a range of relevant documents that may need to be considered in developing the next regional strategies. A particular focus is on ensuring that assets and issues identified in the analysis are reflected in the classification (section 3) and to identify any identified aspects of climate change adaptation.

A range of documents relevant to NRM strategies were analysed. These include historical documents from the time of establishment of the NRM organisations through to new and emerging documents that may provide relevant information and perspectives. The purpose of the analysis is not to 'reinvent the wheel' but to identify things that may have changed or emerged, and that can be incorporated into profiles of the NRM assets that are built on the cumulative knowledge base.

6.3.1 Previous NRM strategy documents

6.3.1.1 Tasmanian Government 2002 NRM Act and Framework

Tasmania's Natural Resource Management organisations are established under the *Natural Resource Management Act 2002.* The Tasmanian Natural Resource Management Council established under the Act is responsible for accrediting and overseeing regional NRM committees (the NRM regional organisations) and for advising the Minister overseeing the Act on the principles and priorities for NRM in Tasmania. The Minister is responsible for determining the principles and priorities.

The current NRM principles and priorities for Tasmania were adopted in the 2002 Natural Resource Management Framework[50]. A number of the principles are directly relevant to the environmental scan:

- Ecosystem Approach – Natural resource management should be based on an understanding of the relationship between natural resources and the ecosystems they support, and upon careful monitoring of change over time.
- Priority Based – Natural resource management actions are to be undertaken according to priorities that are based on the best available science and information, and relevant experience, as well as on assessment of the relative cost-effectiveness of various options.
- Prevention is Better than Cure – It is often more efficient to prevent damage rather than repair it. Therefore, where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The Framework also identified five high level resource management priorities for the State, refer **Table 13**.

[50] Department of Primary Industries, Water & Environment (2002).

Priority	Values	Issues	Focus areas
Water management	Clean drinking water, biodiversity, aquatic ecosystem health (freshwater, wetlands, estuarine, marine), irrigation for agricultural production, industrial use, aquaculture and fisheries production, recreation and tourism.	Environmental flows, water allocation, diffuse and point source pollution.	Agricultural and forestry land use practices, riparian vegetation management, sewage and stormwater treatment, drinking water treatment and road management.
Vegetation management (forest and non-forest)	Biodiversity, ecosystem health, soil stabilisation, ground and surface water impacts (e.g. water table and salinity effects), tourism and recreation, stock shelter and aesthetics.	Clearing and management practices, high conservation priority forest and non-forest communities and rural tree decline.	Forestry and agricultural practices.
Soil management	Agricultural and forestry production, biodiversity and ecosystem health.	Erosion, soil structure, salinity, stream turbidity, sedimentation and its impacts on amenity and infrastructure.	Agricultural and forestry land use practices.

Priority	Values	Issues	Focus areas
Management of weeds, pests and diseases	Agricultural, forestry, aquaculture and fishery production, biodiversity, ecosystem health, safe food and market image.	Weeds of State and national significance, marine and terrestrial feral pests, *Phytophthora cinnamomi*, plant and animal diseases.	Quarantine policy and operation, weed management on public and private land, translocation and farm hygiene, and ballast water management.
Management of the coastal / marine environment	Aquaculture and fishery production, recreation and tourism, biodiversity and ecosystem health.	Estuarine nutrient loading, inshore habitat degradation, changes in community structure associated with harvesting of some species, pest incursions, fishery sustainability, coastal vegetation management and area reservation.	Fisheries and aquaculture practices, sewage treatment and land use practices.

Table 13 Tasmanian NRM Framework 2002- resource priorities

6.3.1.2 NRM North and NRM South 2005-2010 Strategies

The first round of regional NRM strategies produced by NRM North and NRM South and were relatively detailed documents. They were also underpinned by a larger set of background documents describing the current state natural resources of Tasmania and identifying issues needing to be managed.

Both strategies broadly address similar groups of NRM assets but used different terminology and structure of their strategies to describe their approach. These are listed in **Table 14** below (section order has been changed to indicate equivalence where possible).

NRM North	NRM South -
Biodiversity	Managing native flora and fauna
Water	Managing water
Land	Managing land resources
Estuaries, coasts and marine	Managing marine, coastal and estuarine systems
Atmosphere	-
Cultural heritage	Managing cultural landscape
Building sustainable communities	Managing for a sustainable community and sustainable economy

Table 14 NRM North and South regional assets and action headings

The NRM North strategy was based on an explicitly asset-based framework and described as a set of 14 'action packages':

- Supporting and maintaining a viable **native vegetation** system in good condition in each of the bioregions to maintain landscape character and integrity and protect the Region's biodiversity
- Maintaining and/or improving **water quality** in freshwater and marine, coastal and estuarine systems
- Supporting the **sustainable use** of Northern Tasmania's water resources
- Minimising the spread of **weeds, pests** and **diseases**
- Protecting key terrestrial, freshwater and marine, coastal and estuarine **ecosystems, species** and their **habitats**
- Building **sustainable communities**
- Maintaining and/or improving **soil condition**
- Maintaining and/or improving **air quality**
- Maintaining and/or improving **river health**
- Protecting **wetlands**
- Minimising the spread of **salinity**
- Protecting key landforms (**geodiversity**) and **cultural landscapes**
- Addressing **climate change** and **greenhouse effect**

The NRM South strategy used an asset-based framework less explicitly than that of NRM North and described these through a set of regional foci:

- Ensuring a balance between environmental, economic and social outcomes
- Maintaining and/or improving water quality in freshwater and marine, coastal and estuarine systems
- Securely and sustainably allocating surface and groundwater resources for domestic, agricultural, industrial and environmental purposes
- Ensuring a minimum level of **native vegetation** in good condition is retained in each of the bioregions to maintain landscape character and integrity and protect the Region's biodiversity
- Protecting key terrestrial, freshwater and marine, coastal and estuarine **ecosystems, species** and their **habitats**
- Preventing further spread of **weeds, pests** and **diseases**
- Maintaining and/or improving **soil condition**
- Preventing further spread of **salinity**
- Protecting key landforms (**geodiversity**) and **Cultural Landscapes**

The two approaches were broadly similar, with a major difference being the inclusion of an action package for addressing climate change and the greenhouse effect in the NRM North Strategy. In contrast the NRM South strategy incorporated discussion of climate change into a range of issues.

Both strategies contained targets that were to be met over different timeframes, as shown in **Table 16**.

Target	NRM North	NRM South
Aspirational Targets	The long-term targets for the desired condition of the Region's natural resources over the next 50+ years. Aspirational Targets guide regional planning by setting a context for the measurable Resource Condition Targets.	The desired condition of the Region's natural resources in the long term (50 years).
Resource Condition Targets	The expected outcomes from the implementation of Management Actions over the next 10-20 years. Unless otherwise indicated, change in the resource condition	The desired condition of the natural resources in the medium term (10-20 years). Must be SMART (Specific, Measurable, Achievable, Realistic and Time-bound) (e.g. % improvement in

Target	NRM North	NRM South
	will be measured against 2004 baseline levels.	water quality in the Derwent River by 2015).
Management Action Targets	The short-term targets (1-5 years) that relate specifically to Management Actions. MATs contribute to the Resource Condition Targets.	The desired short-term outcomes and outputs of Management Actions over one to five years. They should contribute to achievement of one or more Resource Condition Targets
Management Action	The direct actions that address the causes and symptoms of the threats and issues facing an asset. The MAs are grouped into Action Packages (APs) that address the priority issues for each asset, and are linked to the RCTs and MATs towards which they contribute.	Activities to be undertaken to improve the condition of the Region's natural resources.

Table 15 North and South targets summary

Both strategies described large numbers of Resource Condition Targets and Management Action Targets to be pursued under the strategies.

6.3.1.3 NRM North and NRM South 2010-2015 regional strategies

NRM North and NRM South produced a second round of regional strategies in 2010. The strategies differed significantly in structure from the 2005-2010 strategies, particularly in not having the same structure of aspirational, resource condition and management actions targets in particular prescriptive and highly detailed targets.

The two strategies also diverged in their structure and emphasis. The NRM North strategy remained more aligned to an asset based classification but with an increased emphasis on priorities and a simplified set of targets. It comprised six program areas:

- Rivers and water for life;
- Flora and fauna at a landscape level;
- Climate ready and responsible;
- Healthy coasts and seas;
- Productive landscapes; and
- Community partnerships.

Each program area was described in terms of:

- The broad strategy to implement the program;
- Mechanisms to be applied;
- The role(s) of NRM North;
- Regional objectives; and
- Resource outcomes.

The strategy also included a set of prioritisation criteria for the mechanisms in each project area, as shown below.

Criterion	High	Med	Low	Notes
1. **Contribution To Asset Condition**	**A**	**B**	**C**	Expected contribution to the condition of one or more priority assets.
	Significant	Moderate	Low or indirect	
2. Need for Action	***A***	***B***	**C**	Is there an urgent need to undertake this action; i.e. if it is delayed, will there be a significant reduction in resource condition or a major blow-out in the cost of managing the resource?
	Urgent need for action	Needs action in the medium term	Action not time bound	
3. Prerequisite Action	**Yes / No**			Do one or more actions depend on this action first occurring?
4. Commitment Of Stakeholders	**1**	**2**	**3**	Expectation of how many relevant stakeholders would be committed to supporting the action.
	Most	Around half	Few (< ¼)	
5. Feasibility Of Actions	**1**	**2**	**3**	Degree of confidence that intended outcomes will be achieved.
	Very high degree of confidence		Low degree of confidence	
6. Cost of Action	High		Low	Financial cost of action.

Table 16 NRM North prioritisation criteria.

The NRM South 2010-2015 strategy was focused on a set of five strategies:

- Maximise return for natural resource management investment;
- Increase community awareness of the Region's natural resource assets;
- Manage current and emerging threats to the Region's natural assets;
- Measure and report changes in natural resource condition;
- Increase stakeholders' capacity to use the Region's natural resources wisely.

Each strategy was accompanied by a set of headline indicators. Of most relevance to this environmental scan are the indicators for strategies 3 and four, as shown **Table 17**.

Strategy 3. Manage current and emerging threats to the Region's natural assets	**Strategy 4. Measure and report changes in natural resource condition**
• Number of threats addressed • Number of stakeholders addressing threats • Number of environmental flows calculated (and implemented in a water management plan) • Number and extent of climate change adaptation plans in the Region that address the vulnerability and adaptive capacity of natural assets • Number of new pests or diseases reported/established • Number of pests eradicated • State Coastal Policy is approved and implemented • Marine reserves are established in accordance with the Tasmanian Marine Protected Area Strategy • Land use planning provides for sustainable use of natural resources and protects significant environmental assets and landscapes	• Number of resource condition reports available (e.g. State of the Derwent) • Completion of State of the Region report • Data availability for baselines of natural resource condition

Table 17 NRM North 2010 strategy, relevant Strategy 3 & 4 indicators

Each of the NRM South strategies contained a set of recommended specific actions, ranging in number from 7-11.

The recommended actions under strategy 3 were broadly consistent with the asset classification and targets system from the 2005-2010 strategy, albeit within a less prescriptive and structured framework than previously.

1. Improve the connectivity of vulnerable habitat areas.
2. Minimise the negative impacts associated with development on native habitat and species.
3. Undertake climate change risk and vulnerability assessments for public reserves (land and marine) and develop adaptation strategies as required.
4. Reduce the threats to natural values posed by invasive species, bushfire, climate change including sea level rise, urban development and unsustainable human activities.
5. Promote efficient and socially just use of shared water resources while simultaneously maintaining the health of the Region's natural water assets.
6. Undertake research to support industry adaptation in vulnerable natural asset areas in the Region (e.g. aquaculture, fisheries, forestry and agriculture).
7. Develop and implement a strategic framework and guiding principles for the encouragement of sustainable (and resilient) economic development opportunities in the Region.
8. Ensure that land use planning and development (local and regional level) incorporates consideration of natural resource considerations and seeks to take reasonable steps to minimise the adverse impacts of development on the Region's natural resource assets.
9. Include consideration of climate change and greenhouse emission impacts in the environmental impact assessment of development, in accordance with the framework outlined in the Tasmanian Climate Change Strategy.
10. Develop regional-scale climate change scenarios for use in climate change risk and vulnerability assessments and develop targeted adaptation strategies.
11. Conduct a comprehensive cost-benefit analysis of the nature of opportunities to mitigate the adverse impacts of climate change on natural resource condition. (p20)

6.3.2 Tasmanian Government 2008 review of NRM framework

The Tasmanian NRM framework was reviewed by the Department of Primary Industries, Water and Environment in 2008. The review was broad in nature to reflect the widespread nature of changes to natural resource management that were introduced as a consequence of the *Natural Resource Management Act 2002*.

The review made 18 recommendations; however they are predominantly relevant to the strategic and institutional scan components of the project. Some of the recommendations are relevant to the strategic scan and are listed below:

> *Recommendation 5: That, while noting the broad support for the current set of NRM principles, the Minister request the NRM Council to advise on amendments as suggested in the course of the Review, including the drafting of a new principle on the importance of adaptability, flexibility and resilience in NRM.*
>
> *Recommendation 6: That the Minister seek the advice of the NRM Council on priority-setting arrangements that are more agile, and will provide guidance for both planning and assessing NRM activities at a regional level. This advice is to be provided within six months of the acceptance of the Review by the Minister.*
>
> *Recommendation 7: That the current legislated process for establishing and applying accreditation criteria that incorporate both State and relevant national concerns be retained, and that the State continue to work with other jurisdictions on the development of national standards and a robust framework for setting targets.*
>
> *Recommendation 11: That State Government Agencies, local government, regional planners preparing regional land use strategies and other regulators are to take into consideration the information on natural resources and regional priorities (including targets) contained in the regional NRM strategies and regional investment proposals, so that this information can inform their work; they are also to develop and / or maintain strong working relationships with the regional NRM committees, as appropriate.*
>
> *Recommendation 18: That section 20 of the Act be amended to provide more flexibility in the timing of future reviews, by specifying that all reviews after this*

initial review should occur between four and seven years after completion of the previous review.

The review also commented on a number of issues that are relevant to this report's Environmental Scan but were not included as recommendations. It noted that there was consistent feedback that the Framework did not take account of climate change (p13) and reported that a recurring theme expressed in consultation on the Framework was the need for it to '...reflect, either through its principles or priorities, the implications of climate change for the protection and management of Tasmania's natural resources.' (p12).

The review provided contradictory conclusions as to where and how in the NRM Framework climate change should be addressed:

'This Review's conclusion, however, in light of subsequent discussions with governments and non-government stakeholders, is that climate change is most appropriately addressed under the NRM priorities rather than principles. It was evident however, that it would be of value to include a principle that recognises the potential for accelerated change, a rapidly expanding knowledge base and the need to have a capacity for responsiveness.' (p13)

No changes to the Tasmanian NRM Framework were made in response to the Review.

6.3.3 Rare Consulting 2009 review of NRM South 2005-2010 strategy

NRM South commissioned Rare Consulting to conduct a scan (to avoid confusion and for the purposes of this report a 'review') of strategic environmental issues and emerging concerns in 2009. The review consisted of review of NRM documents, stakeholder websites, consultation with NRM staff and interviews with stakeholders. Analysis of the review is relevant for both NRM North and NRM South due to the similar structure of their 2005-2010 strategies and also the high degree of commonality across the two regions (and of the State as a whole).

Whilst the review noted a range of achievements, it also made a number of key findings:

'a lack of quantitative information on the state of natural resources made it difficult to provide a meaningful assessment of quantitative changes in the resource condition. The study team noted that the Tasmanian State of the Environment Report is due to be published in the near future and should provide more insight in respect of this issue.' (p vi)

The lack of baseline and quantitative information is noted and is addressed in the recommended information systems approach to data and knowledge management. The potential overlap with the State of the Environment Reporting process was significant but this is no longer the case with withdrawal of SoE reporting by the current Tasmanian government.

The review also identified that there were '...significant data gaps in baseline and monitoring data for natural resource condition assessment' (p vii). Gaps in the scope of NRM issues being addressed were observed in the area of management of cultural landscapes and the need to address rural tree decline. The latter issue in particular has continued to expand in recent years, with associated but largely undocumented impacts on biodiversity and on cultural landscapes. Extent and impact of tree decline is also likely to accelerate under climate change. The review considered that baseline data was important to quantify the extent of issues, prioritise appropriately and monitor effectively (p xii); these are addressed in section 4 of this environmental scan.

The review observed that the NRM South 2005-2010 strategy '... spreads itself too thinly in terms of focused activities and desired outcomes as expressed through the targets for each natural resource theme area' (p vii). Although this finding is primarily relevant to the strategic and institutional scans, it also points to a number of issues relevant to this environmental scan:

- Whether the organisation of environmental asset and issue and information can be improved so that activity is more easily focused?
- Whether appropriate priority setting is taking place to ensure that NRM activity is focused in areas of the greatest need?

Importantly, the review noted the pervasive effects of a lack of fit between regional NRM aspirations and factors that influence potential activity such as funding priorities of the Commonwealth and State governments. Whilst the scan identified a need to consider funding sources other than the Commonwealth government, there is equally a need for NRM regional organisations to proactively influence government funding decisions through clear and effective communication of the priorities for their regions and of the implications of this for their ability to effect positive NRM outcomes (especially of important gaps it might create).

The review identified a range of ongoing and emerging issues for the NRM South region, which are considered to still be applicable in 2015 and also relevant to NRM North. Ongoing issues and pressures were:

- the continuation of invasive weed management (an ongoing challenge for a variety of stakeholders);
- the management of impacts associated with urban and infrastructure development, and land use change;
- the management of rivers and catchments and estuaries to improve water quality, flows and ecosystem condition;
- the protection of ecosystems and species for biodiversity;
- the management of salinity.

Of particular note in this list is that the urban and infrastructure development and land use change are not identified as priorities in the NRM Framework.

The list of new priorities identified in the review is also considered still current and relevant to both the NRM North and South regions:

- understanding the implications of global warming on the future regional climate and understanding the implications of climate change on natural resource assets to identify priority issues (scenario modelling and risk and vulnerability assessment);
- developing strategies, and implementing these, for both mitigation of greenhouse gas emission and adaptation to climate change;
- pursuing more sustainable behaviours and practices across a range of community sectors (including households, industry and commerce and government);

- the recognition that natural resource management issues associated with new major infrastructure projects and cumulative development pressures need to be better managed (including integrated planning for the continued urban expansion of greater Hobart and coastal settlements, land use reclassification, and major infrastructure projects such as the Tasmanian Irrigation Development Scheme).

Although both the ongoing and emerging issues are considered in this environmental scan to be still current, a major gap which was not identified specifically was rapid change in the coastal and marine environment.

The review recommended four steps be incorporated into development of the 2005-2010 strategy. These have a number of implications for development of NRM strategies and their effective implementation, as highlighted in below in **Table 18**.

Rare Consulting 2009 recommendations for strategy development	**Comments and observations arising from this environmental scan**
STEP 1 Identification of the Southern Region's aspirational goals for the next five years through stakeholder consultation.	The process identifies aspirational targets over too short a time frame for effective management of many NRM issues. Long term aspirational targets, as for example in the 2005-2010 strategies, are very important.
STEP 2 Identification and prioritisation of achievable actions that will help to work towards the goals identified through stakeholder consultation.	Identification and prioritisation are addressed in sections 3 and section 4.
STEP 3 Construction of headline indicators by which to measure natural resource management outcomes based on the headline goals identified.	
STEP 4 Documentation of the 2010 Strategy in a succinct and easily referable way.	Existence of succinct documentation is desirable but should be the front end of an information management system around NRM assets and issues that is robust, comprehensive and fully integrated into NRM planning and activity.

Table 18 2009 Rare Consulting review and relationship to Environmental Scan.

6.3.4 Australian Government 2012 principles for NRM planning

The Australian Government plays a critical role in the NRM system nationally, primarily through its role as a major funder of NRM organisations across Australia. The effect of this role lies particularly in the setting of priorities for NRM. These help to deliver both on international obligations around NRM (e.g. biodiversity) and also on domestic environmental priorities.

The issue of alignment between Commonwealth priorities and those of NRM organisations is well known and documented. Put simply, Commonwealth priorities may not be those expressed by stakeholders in regional NRM, NRM regional bodies or State Governments and their agencies. This issue pervades all three of the scans undertaken for this project.

One key area of Commonwealth government positioning that fundamentally affects this environmental scan is through its establishment of principles and minimum requirements for NRM, which were published in 2012[51]. The principles identify a range of NRM issues that need to be reflected in the classification of assets and issues for NRM North and NRM South:

> 'The updated regional NRM plans are expected to consider a range of state and Australian Government frameworks, policies, strategies or legislation on topics relating to but not limited to:
>
> - native vegetation
> - water
> - wetlands
> - soils
> - groundwater
> - stock routes
> - biodiversity
> - salinity
> - flora, fauna, threatened species
> - river health
> - weeds and pest animals
> - biosecurity
> - bushfire
> - cultural heritage
> - site-based / asset-specific management plans
> - agriculture, forestry and fisheries
> - Ramsar wetlands and World Heritage Areas

[51] Department of Sustainability, Environment, Water, Population & Communities (2012).

- coasts and marine
- NRM governance and planning strategies
- strategic land use planning
- native title
- national parks, marine parks, crown land, local government
- climate change, including the Clean Energy Future plan, CFI and adaptation frameworks and policies.'

6.3.5 Tasmanian NRM's draft preferred structure for strategies

Tasmania's three regional NRM organisations have drafted a preferred structure for the next round of regional strategies. The purpose of the preferred structure is to provide a consistent format for strategies across all three regions.

The preferred structure includes asset-based classification to be accompanied by documentation of asset descriptions and status, threats and pressures. Five asset classes are identified in the structure:

- Land;
- Water;
- Coasts and marine;
- Air; and
- Community.

The preferred structure introduces the concept of 'landscapes' as the foundation of strategies for NRM activity. Landscapes are social patterns in which organising participation is likely to have similar characteristics (e.g. urban landscapes, production landscapes). The intention of landscape strategies is that they include key activities to be implemented term of the next regional strategy, based on review of past approaches and consultation with stakeholders. Five landscapes are identified in the preferred structure:

- Natural;
- Coastal and marine;
- Productive;
- Lifestyle; and
- Urban.

The structure of the asset classification has broad similarity to a range of the documents reviewed for this environmental scan. The exception is the inclusion of Community as a separate. Whilst the community are an extremely important asset for effective NRM (in many cases they will be a pre-requisite), the same systems for storing, analysing, prioritising and presenting information on the biophysical assets of NRM - the natural resources that are the target for management (e.g. land and soils, coastal) – is difficult to conceptualise for the Community asset.

In this context it is probably appropriate to consider the landscapes in the preferred structure as the way in which the strategies can conceptualise, organise, prioritise and develop Community needs to be effective in both valuing assets and being actively and effectively involved in their management. Much of the material presented in the strategic scan of this report relates to the Community as an asset.

The draft structure was incorporated into various aspects of the institutional, strategic and environmental scans of this project, as was tested through various methods such as the information review for this scan, the stakeholder survey, during consultative workshops and interviews, and through incidental meetings and conversations. On the whole it is observed that the division of assets and strategies appears to a workable basis for the next regional strategies of both regions. The main areas where further clarity may be required are:

- Whether biodiversity should be included in the Land asset or as a separate asset. This arises through it being an issue in most of the asset classes and so being confounded, duplicated not being clearly communicable.
- The Community asset is difficult to conceptualise within the same framework as the physical asset classes. A suggestion from this scan is that the proposed Landscapes represent an unpacking of the Community asset as socially organised stakeholders likely to have common approaches to NRM assets and issues.
- The coastal and marine landscape delivered consistently confusing results in stakeholder responses around the NRM assets and issues. It was frequently identified as an important landscape for delivery of approaches to assets and issues not associated with coastal and marine landscapes. As the landscape is also an asset, consideration should be given to providing further bounding

and definition of its scope and stakeholders, as many stakeholders in this landscape will also be within natural, productive and urban landscapes.

Section summary

Key point 24 Most of the values and issues identified in the Tasmanian NRM Framework 2002 remain relevant for the next Regional NRM strategies. The most notable addition is in the need to address climate change on a more urgent and systematic basis.

Key point 25 The scope of both the regional NRM strategies was very broad and, although prioritised and focused in different ways, was reliant on funding being matched to the priority areas and to be sufficient to achieve effective outcomes. The 'ambitious' nature of the strategies highlights the dichotomy for the two regions in having little power to effect change, being largely confined to voluntary 'levers', but being subject to expectation to both effect positive change and to be able to report across the full gamut of NRM assets and issues.

Key point 26 The significant reformatting of the strategies from those of 2005-2010 to 2010-2015 appears to be an attempt to address the absence of adequate funding for all regional priorities, and to provide for the regions to able be more effectively manage expectations. The divergence in format of strategies potentially makes comparisons between the regions more difficult. It is noted that both strategies sought to broadly continue to emphasise similar issues to those in the 2005-2010 strategies but using methods which probably reflected an increased understanding of regional stakeholder issues than at commencement in 2005. The use of a transparent priority setting framework in the NRM North strategy is noted as has been carried forward into this scan's recommendation for data and knowledge management (see section 6.2).

Key point 27 The Tasmanian Governments 2008 review of the NRM Framework did not provide clear guidance to the NRM regions on how to proceed with consideration of climate change for their strategies. It also missed an opportunity to highlight that the 2002 Framework was based around assessment of NRM assets and issues as relatively static and predictable, whereas the realities of climate change uncertainty dictate a more dynamic approach is needed.

Key point 28 The findings of the Rare Consulting review are largely still relevant. Some issues identified as gaps in the NRM South strategy (e.g. tree decline) have continued to deteriorate and need to be given a higher priority or improved design of strategies to address them. It is considered that the findings of the Rare Consulting review are, on the whole, relevant to both the NRM North and NRM South 2005-2010 strategies. The key exception is that State of the Environment reporting is no longer being undertaken in Tasmania. As Tasmania's NRM regional organisations have reporting obligations (and expectations) as part of their remit, this change is significant. The recommended information systems approach to data and knowledge management addresses reporting, but it should be noted that it may not be the role of NRM organisations to take over the State of the Environment reporting role, but to work with other organisations so that across the NRM stakeholder community effective reporting is available.

Key point 29 The Australian Governments 2012 principles for NRM planning present the NRM regions with an 'all things to all people' problem. They confound asset-related issues with issues around strategy and institutional arrangements. Although the principles cover most relevant aspects of NRM they are largely unstructured and have the risk of transferring conceptual design issues that should apply generally onto the regional themselves. This in turn has potential to lead to the regions individually using limited resources on 'first principles' issues, thus leading to inconsistency between the regions on common issues.

Key point 30 On the whole the draft NRM strategy structure developed by 3 regions for the division of assets and strategies appears to a workable basis for the next regional strategies.

6.4 Recent information sources for climate adaptation planning

6.4.1 Climate futures for Tasmania downscaled climate modelling

Tasmania is fortunate in having some of the finest scale climate modelling in the world. Most global circulation models (GCM) are relatively coarse in scale, resulting in Tasmania being represented by just a few grid cells. This coarse scale is not suited for regional planning around climate change.

The Climate Futures for Tasmania project used dynamic downscaling of a number of GCMs to generate fine scale climate models at approximately 10 km resolution. These models were further adjusted to provide consistency between actual climatic observations and modelled 'current' conditions to produce outputs that can be used confidently at a finer scale[52] in biophysical, agricultural and hydrological applications to assess and identify general climate change impacts within the State[53]. The climate futures project also produced a range of technical reports relevant to a range of NRM issues – agricultural impacts[54], water and catchments[55], extreme events[56], severe wind[57] and extreme tide and sea level events[58].

A summary of the major physical changes predicted for Tasmania by the downscaled modelling for Climate Futures Tasmania is shown in Table 19. The table shows changes to selected key averages and extremes both generally and, where able to be discerned, for each of the NRM North and NRM South regions.

Whilst the downscaled modelling highlights predicted variations on a relatively fine-scale basis, it is limited in being based on the now superseded IPCC 4 set of global climate models. These models have been superseded by the more recent IPCC 5 models but these have not been downscaled to the same resolution as the climate futures Tasmania data, and nor is there any indication of available resources to do so.

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[52] Antarctic Climate & Ecosystems Cooperative Research Centre (2010a), Corney *et al.* (2010).
[53] Antarctic Climate & Ecosystems Cooperative Research Centre (2010b), Grose *et al.* (2015b).
[54] Antarctic Climate & Ecosystems Cooperative Research Centre (2010c), Holz *et al.* (2010).
[55] Antarctic Climate and Ecosystems Cooperative Research Centre (2010d), Bennett *et al.* (2010).
[56] Antarctic Climate & Ecosystems Cooperative Research Centre (2010e), White *et al.* (2010).
[57] Cechet *et al.* (2012).
[58] McInnes *et al.* (2011).

A suitable technical process needs to be designed to determine principles by which the CSIRO-BoM IPCC5-based climate projections for Tasmania East and Tasmania West (and subsequent future projections) can be adapted for use in NRM planning at scales comparable with those produced for climate futures Tasmania. This would not be a core function for NRM regions but would need to occur on a State-wide basis through cooperation of a range of organisations. Direct translation of IPCC5-based projections to the downscaled model resolution will introduce greater uncertainty into predictions which are also uncertain, so a risk-based approach is recommended (i.e. what is the risk to the natural resource if an adaptation action is incorrect).

Issue	Tasmania - general	NRM North	NRM South
Temperature changes	Mean temperature change in Tasmania is projected to be relatively uniform, in the range of 2.6-3.3^0 for the high emissions scenario and 1.3-2.0^0 for the lower emissions scenario.	Projected change to average temperatures uniform over region.	Projected change to average temperatures uniform over region.
Temperature extremes	Substantial decrease in number of frost days (<0^0).	Greatest decrease in central regions, e.g. northern midlands.	Greatest decrease in central regions, e.g. southern midlands, Derwent Valley. Extreme reduction in frost frequency (8x) on central plateau.
	Increase in extreme temperature range (difference between minimum and maximum for year).	General but particularly the north coast (1^0 change).	General but particularly south east Tasmania (e.g. Hobart 3^0 change)
	Increase in diurnal temperature range (difference between daily minimum and maximum).	General across region.	General across region. Increase in diurnal range for every month on central plateau.
	Increase in number of nights with minimum temperature >20^0.	Increase in northern coastal areas and on Flinders Island.	Increase in eastern coastal areas.
	Increase in number of heat waves (>=3 consecutive days over 28^0).	Significant increases in heat waves in northern midlands and to north coast (including Tamar Valley).	Significant increases in heat waves in southern midlands and Derwent Valley.

Issue	Tasmania - general	NRM North	NRM South
	Increase in number of days over 25^0 across Tasmania (2-3 x current) and largest at lower elevations.	Large increase in northern midlands.	Large increase in southern midlands.
	Increase in number of warm days and warm spells (>=3 consecutive days over 20^0).	Up to 4x increase in central north (e.g. Meander NRM sub-region), northern midlands, Tamar and northern coastal plains.	Increase in southern midlands and Derwent Valley
	Decrease in cold spells	General	General
	Decrease in cold waves (>= 3 consecutive days under 5^0).		Up to 10 fold reduction in cold waves on central plateau.
Rainfall changes	Change to average rainfall.	High emissions scenario identifies increase in average annual rainfall over most of the region. Increases are greatest (>40mm) over the east coast and Flinders Island. Smaller increases (0-40mm) are projected for most of the northern coastal plain, Tamar Valley and northern midlands. A small reduction (0-20mm) is projected for parts of the north east highlands, with a larger reduction (40-100mm) through the Meander Valley into the central highlands.	High emissions scenario identifies increase in average annual rainfall over approximately half of the region. Increase is greatest (>40mm) over the east coast, south west coast, Tasman Peninsula and lower reaches of the Huon, Derwent and Coal River valleys. Smaller increases (<40mm) are projected for the southern midlands and middle reaches of the Derwent. Moderate decreases (0-20mm) are project over most of the southern ranges. Larger decreases (20-120mm are projected for the central plateau, becoming more pronounced towards the north west of the region.

Issue	Tasmania - general	NRM North	NRM South
	Change to seasonal rainfall patterns.	Wetter summers in north east.	Wetter summers on east coast.
Rainfall extremes	Increase in number of very wet days, more intense daily rainfall totals and 6 minute rainfall rates.	Increase in number of very wet days in north east and Flinders Island.	Significant increases in 6 minute rainfall rate in eastern Tasmania. Increased number of very wet days on east coast, particularly Tasman Peninsula. Projected decrease in extreme wet days in the central highlands in all seasons.
	Change to 5 day rainfall totals (variable across State).	Increase in north east and Flinders Island.	Decrease in central highlands. Increase on east coast.
	Change to risk of flooding.[59] Limited change to flooding predicted for large catchments with significant upstream storages.	Increased flooding in north east coastal areas. Increase flooding risk for small flood prone catchments lacking significant upstream storage.	Increased discharge of flood events in the Huon River. Increase flooding risk for small flood prone catchments lacking significant upstream storage.
	More intense heavy downpours combined with longer dry periods.		
	Decrease in the number of rain days.	General.	General.
	Duration of wet and dry spells. Average (often incorrectly called 'normal')	Little change to duration but cumulative rainfall deficits and surpluses likely to increase.	Little change to duration but cumulative rainfall deficits and surpluses likely to increase.

[59] Climate Futures Tasmania assessment of likely changes to flooding was restricted to the Mersey, Forth, Huon and Derwent Rivers.

Issue	Tasmania - general	NRM North	NRM South
	conditions are likely to occur less often in some regions.		
Tide and sea level changes	Global average increase of mean sea level of 5-14cm by 2030 and 83m by 2100.	General	General
Tide and sea level extremes	Increased store surges and storm tides. 1-in-100 year events likely to occur at 1-in-50 or 1-in-10 year frequencies by 2030, and at 2-6 (low end scenario) or annually (high end scenario) by 2100.	Increased frequency of large storm tides.	Increased frequency of large storm surges.
Evaporation	Average pan evaporation across Tasmania is projected to increase by 17-21% over from 2.6 mm/day in 2000 to 3.2 mm/day in 2100. Increases are generally greater in winter than in summer.	Increases in pan evaporation are highest (>0.54 mm/day) along the east coast and Flinders Island. The northern midlands, Tamar Valley and northern coastal plain have projected increase of 0.42-0.54 mm/day. The rest of the region has projected increases mainly in the range of 0.30-0.42 mm/day.	Increases in pan evaporation are highest (>0.54 mm/day) along the east coast and Tasman Peninsula and in a small area of the south west centred on Strathgordon. The southern midlands and Derwent Valley areas are projected to increase by 0.42-0.54 mm/day. Most of the rest of the region is projected to have increased pan evaporation of 0.30-0.42mm/day, with the exception of the south coast where projections are in the range 0.18-0.30 mm/day.
	Average evaporation across Tasmania is projected to	Increases in evaporation are highest (>0.16 mm/day) along the east coast and	Increases in evaporation are highest (>0.16 mm/day) along the east coast and

Issue	Tasmania - general	NRM North	NRM South
	increase from 1.8 mm/day in 2000 to 1.9 mm/day in 2010. Increases are generally greater in winter than in summer.	Flinders Islands. Lower altitude areas across the northern half of the region shows projected increases of 0.10-0.16 mm day. Smaller increases of 0.06-0.10 mm/day are projected for southern parts of the northern midlands, Fingal Valley, north east highlands and east coast hinterland.	Tasman Peninsula and for a large part of the south west around Strathgordon. Almost all of the rest of the region shows smaller projected increases of 0.06-0.10 mm/day. The area between Orford and Sorell shows only a slight projected increase (0.02-0.06 mm/day).

Source: Climate Futures for Tasmania summaries and reports (see description and list in text above).

Table 19 Climate Futures Tasmania physical changes summary

6.4.2 CSIRO Bureau of Meteorology climate change projections for NRM

The CSIRO and Bureau of Meteorology have produced update climate change projections for Australia's NRM regions. The projections are based on 40 global climate models and four emissions scenarios for the 21st century.

The climate change projections are organised around regional clusters. Tasmania was assessed in the Southern Slopes cluster and reported as two sub-clusters – one each covering roughly the eastern (Tasmania East) and western (Tasmania West) geographic halves of Tasmania. The Tasmania East sub-cluster includes nearly all of the NRM North region and most of the NRM South Region. The Tasmania West sub-cluster roughly includes the part of the NRM South region that is contained within the Western Tasmania Wilderness World Heritage Area.

A summary of the projections for each of the two sub-clusters is provide below.

Observation: The CSIRO-BoM projections represent an updated set of projections than was available for the climate futures Tasmania projections. However, the resolution of the outputs – 2 regions for Tasmania – mean that variation within the NRM North and NRM South regions is difficult to determine. Local-scale variation of some climatic factors in Tasmania is high relative to many other parts of Australia due to large topographic relief over small distances, extensive rain shadow effects, latitudinal positioning relative to pressure system patterns, and large topographic variation in solar radiation (and associated factors such as primary productivity and evapotranspiration) over local scales due to lower angle of sun incidence – two sides of the same hill or valley can be markedly different. In the absence of updated downscaling of the CSIRO-BoM projections, the technical process described in the previous section is recommended in order to gain the benefits of both products.

Climate attribute	Tasmania East (NRM North and eastern part of NRM South)	Tasmania West (western part of NRM South)
Rainfall	Generally little change or an increase in winter rainfall but a decrease in spring is projected with medium confidence. Changes to summer and autumn rainfall are possible but less clear. For the near future, natural variability is projected to dominate any projected changes. In the near future (2030) natural variability is projected to predominate over trends due to greenhouse gas emissions. Rainfall increases are projected (medium confidence) for SSTE in winter. By the middle of the century, and under high emissions, winter and spring changes are projected to be evident against natural variability. Changes to summer and autumn rainfall are possible but not clear, and regional changes specific to eastern Tasmania are possible. Available fine-scale modelling provides further detail on possible spatial variation in rainfall response.	Generally less rainfall in spring (high confidence) and more rainfall in winter is projected (medium confidence). Changes to autumn rainfall are possible but less clear and there is a projected tendency for decrease in summer. For the near future, natural variability is projected to dominate any projected changes. In the near future (2030) natural variability is projected to predominate over trends due to greenhouse gas emissions. Understanding of physical rainfall processes (southward shift of winter storm systems), supported by climate model results, indicate a rainfall decrease for spring (high confidence), and little change or increase for winter (medium confidence). The projected winter increase over Western Tasmania is up to 20 per cent and decrease in spring is up to -33 per cent by 2090 under high emissions. By the middle of the century, and under high emissions, spring and perhaps winter changes are projected to be evident against natural variability. Changes to autumn rainfall are possible but not clear, and there is a tendency for projected decrease in western Tasmania in summer. Available fine-scale modelling provides further detail on possible spatial variation in rainfall response.
Temperature	Average temperatures will continue to increase in all seasons (very high confidence). There is very high confidence in continued substantial increases in projected mean, maximum and minimum temperatures projected in line with our understanding of the effect of further increases in greenhouse gas concentrations.	Average temperatures will continue to increase in all seasons (very high confidence). There is very high confidence in continued substantial increases in projected mean, maximum and minimum temperatures projected in line with our understanding of the effect of further increases in greenhouse gas concentrations.

Climate attribute	Tasmania East (NRM North and eastern part of NRM South)	Tasmania West (western part of NRM South)
	For the near future (2030), the annually averaged warming across all emission scenarios is projected to be around 0.4 to 1.1 °C above the climate of 1986–2005. By late in the century (2090), for a high emission scenario (RCP8.5) the projected range of warming is 2.3 to 4.0°C. Under an intermediate scenario (RCP4.5) the projected warming is 0.9 to 1.9 °C.	For the near future (2030), the annually averaged warming across all emission scenarios is projected to be around 0.2 to 1.1 °C above the climate of 1986–2005. By late in the century (2090), for a high emission scenario (RCP8.5) the projected range of warming is 2.1 to 3.6°C. Under an intermediate scenario (RCP4.5) the projected warming is 0.9 to 1.8 °C.
Extreme temperature	More hot days and warm spells are projected with very high confidence. Fewer frosts are projected with high confidence. Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells (very high confidence). Frost-risk days (minimum temperatures under 2 °C) are expected to decrease across the cluster (high confidence)	More hot days and warm spells are projected with very high confidence. Fewer frosts are projected with high confidence. Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells (very high confidence). Frost-risk days (minimum temperatures under 2 °C) are expected to decrease across the cluster (high confidence)
Extreme rainfall and drought	Increased intensity of extreme rainfall events is projected, with high confidence. Even though annual mean rainfall is projected to experience little change or decrease in the region, understanding of the physical processes that cause extreme rainfall, coupled with modelled projections indicate with high confidence a future increase in the intensity of extreme rainfall events. However, the magnitude of the increases cannot be confidently projected. Time spent in drought is projected, with medium confidence, to increase over the course of the century.	Increased intensity of extreme rainfall events is projected, with high confidence. Even though annual mean rainfall is projected to experience little change or decrease in the region, understanding of the physical processes that cause extreme rainfall, coupled with modelled projections indicate with high confidence a future increase in the intensity of extreme rainfall events. However, the magnitude of the increases cannot be confidently projected. Time spent in drought is projected, with medium confidence, to increase over the course of the century.

Climate attribute	Tasmania East (NRM North and eastern part of NRM South)	Tasmania West (western part of NRM South)
Marine and coast	Mean sea level will continue to rise and height of extreme sea-level events will also increase (very high confidence). There is very high confidence in future sea-level rise. By 2030 the projected range of sea-level rise for the cluster coastline is 0.08 to 0.18 m above the 1986–2005 level, with only minor differences between emission scenarios. As the century progresses, projections are sensitive to concentration pathways. By 2090, the intermediate emissions case (RCP4.5) is associated with a rise of 0.31 to 0.66 m and the high case (RCP8.5) a rise of 0.45 to 0.89 m. Under certain circumstances, sea-level rises higher than these may occur. Late in the century warming of the Southern Slopes coastal waters poses a significant threat to the marine environment through biological changes in marine species, including local abundance, community structure, and enhanced coral bleaching risk. Sea surface temperature is projected to increase in the range of 2.1 to 5.1 °C by 2090 under high emissions (RCP8.5). The sea will also become more acidic, with acidification proportional to emissions growth.	Mean sea level will continue to rise and height of extreme sea-level events will also increase (very high confidence). There is very high confidence in future sea-level rise. By 2030 the projected range of sea-level rise for the cluster coastline is 0.08 to 0.18 m above the 1986–2005 level, with only minor differences between emission scenarios. As the century progresses, projections are sensitive to concentration pathways. By 2090, the intermediate emissions case (RCP4.5) is associated with a rise of 0.29 to 0.63 m and the high case (RCP8.5) a rise of 0.41 to 0.83 m. Under certain circumstances, sea-level rises higher than these may occur. Late in the century warming of the Southern Slopes coastal waters poses a significant threat to the marine environment through biological changes in marine species, including local abundance, community structure, and enhanced coral bleaching risk. Sea surface temperature is projected to increase in the range of 1.9 to 4.0 °C by 2090 under high emissions (RCP8.5). The sea will also become more acidic, with acidification proportional to emissions growth.
Other	FIRE WEATHER: There is high confidence that climate change will result in a harsher fire-weather climate in the future. However, there is low confidence in the magnitude of the change to fire weather. This depends on the rainfall projection and its seasonal variation. Relative changes are comparable across all three sub-clusters. EVAPORATION: Potential evapotranspiration is projected to increase in all seasons as warming progresses (high confidence).	FIRE WEATHER: There is high confidence that climate change will result in a harsher fire-weather climate in the future. However, there is low confidence in the magnitude of the change to fire weather. This depends on the rainfall projection and its seasonal variation. Relative changes are comparable across all three sub-clusters. EVAPORATION: Potential evapotranspiration is projected to increase in all seasons as warming progresses (high confidence).

Climate attribute	Tasmania East (NRM North and eastern part of NRM South)	Tasmania West (western part of NRM South)
	HUMIDITY AND SOLAR RADIATION: An increase in solar radiation and a decrease in relative humidity is projected in the cool season through the century (high confidence). This will be influenced by changes in rainfall (and associated changes to cloudiness) and temperature in the cluster. Changes in summer and autumn are less clear.	HUMIDITY AND SOLAR RADIATION: An increase in solar radiation and a decrease in relative humidity is projected in the cool season through the century (high confidence). This will be influenced by changes in rainfall (and associated changes to cloudiness) and temperature in the cluster. Changes in summer and autumn are less clear.

Table 20 Summary of CSIRO-Bureau of Meteorology climate change projections for Tasmanian sub-clusters

6.4.3 The SCARP project

The Southern Slopes Cluster Climate Adaptation Research Partnership (SCARP) is a collaborative research program designed to address the emerging and game changing nature of climate change for NRM through the development of processes, products and tools to assist NRM planning, in particular capacity to undertake strategic planning in a changing climate. The SCARP cluster is focused on the three Tasmanian NRM regions and 6 Catchment Management Authorities in New South Wales and Victoria.

The SCARP projects was designed around four sub-projects:

- An Adaptation Pathways approach to NRM planning for climate change;
- Spatial adaptation priorities for NRM implementation;
- Climate change impacts synthesis and assessment; and
- Learning and knowledge brokering for NRM adaptation.

Two of the four sub-projects are relevant to the environmental scan – spatial adaptation priorities and climate change impacts synthesis.

At the time or writing the spatial prioritisation sub-project of SCARP had not been completed. This has implications for the strategy development process for both NRM North and NRM South, as their timelines will preclude use of this output.

The key output of the SCARP project relevant to this environmental scan is the SCARP synthesis report[60]. The report is supported by a number of more detailed appendices and also spreadsheets summarising

- climate change impacts and drivers and their effects on estuarine, marine, coastal, flora and fauna, soil, water and community NRM asset; and
- a template for developing current situation assessments for NRM assets and issues through consideration of scale, stakeholders and stake, understanding and uncertainty, capacity and urgency.

[60] Wallis *et al.* (2015).

The aim of the synthesis report is to provide a key reference source for NRMs to inform the development of their regional strategies, operational plans, programs and projects. The report is supported by a number of more detailed appendices.

The synthesis report is relevant to all three scans being prepared for NRM North and NRM South. Its relevance to the environmental scan is in providing:

- a synthesis of the effects of climate change on NRM assets, based primarily on literature review including a number of recent publications developed specifically to assess climate change; and
- a summary of current information in relation to climate change across the three Tasmanian NRM regions.

The synthesis reports identifies the effects of climate change on NRM assets using an asset-based classification. Assets addressed are broadly similar to those described in the Tasmanian NRM region's draft preferred structure for strategies but diverge in treating biodiversity as a separate asset rather than one which is conflated into the land/terrestrial and water/coastal/marine assets and (see also discussion of this issue for the NRM draft preferred structure).

The synthesis report also presents a range of general findings on nature and impacts of climate change and descriptors of general climate impacts in Tasmania. Summaries of these are included in **Table 21** and **Table 22**

Observations: The next regional strategies for NRM North and NRM South will need to be developed in the context of changing spatial priorities over time. At the time of writing, SCARP spatial prioritisation outputs that affect sub-regional priorities were contained within a draft guidance document. It is recommended that sub-regional priorities within the next strategies be described subject to review within the period of each strategy, in response to further elaboration of the SCARP outputs and other relevant and emerging information sources. As a general principle it is also important that the strategies recognise that spatial priorities will change irrespective of climate change, although it will exacerbate the need. Hence provision needs to be made in the strategies for ongoing review of spatial priorities. This need can be addressed through the Themed Reference Groups recommended as part of the information systems approach to data and knowledge management.

The SCARP spreadsheets on climate change impacts and drivers and situation assessment could be used as a starting point for the Themed Reference Groups to provide a common format for prioritisation decision making (see key recommendation in section 6.2).

Tasmanian NRM's draft preferred regional strategy structure - assets	**SCARP syntheses on the effects of climate change on NRM assets**
Land	Land, soil and agricultural productivity
	Terrestrial biodiversity
Water	Freshwater systems
Coasts and marine	Coasts, coastal wetlands and estuaries
	Marine ecosystems
Air	not assessed
Community (Considered as part of strategic scan)	not assessed

Table 21 Comparison of asset structures between the Tasmanian NRM organisations and the SCARP project

Key climate variables / associated indicies	Terrestrial Biodiversity	Freshwater Systems	Coasts and Estuaries	Marine Ecosystems	Land, soils and agriculture	Community
Average annual temperature	■	■			■	
Minimum daily air temperature	■				■	
Maximum daily air temperature	■				■	■
Heatwave	■	■	■		■	■
Seasonal temperature regimes	■				■	■
Frost	■				■	■
Snow cover	■					■
Sea Surface Temperature (SST)			■	■		■
Marine heat waves (warm water pulse)			■	■		
Average annual rainfall		■	■		■	■
Seasonal rainfall	■	■			■	
Regional runoff	■	■			■	
Seasonal runoff	■	■			■	
River flow		■	■			■
Annual average wind speed and direction			■			
Extreme wind	■		■		■	■
Total cloud cover						■
Average annual radiation		■			■	
Annual average relative humidity	■				■	
Evaporation	■				■	
Incremental SLR	■		■			
Extreme sea-level, storm surges and tides	■		■			
Atmospheric CO2	■	■		■	■	
Ocean accidification				■		
Intense rainfall		■	■		■	■
Drought / extended dry spells	■	■	■		■	■
bushfire intensity	■	■			■	■
bushfire frequency	■				■	■

Source: Wallis *et al.* (2015), p65.

Table 21 Table C.1 Climate variables of most importance across generic asset classes in the Southern Slopes

Key climate variables / associated indicies	alpine	dry forest	wet forest	lowland grassland	heathland	coastal	moorland /peatland	wetland
Average annual temperature	■						■	■
Minimum daily air temperature	■							
Maximum daily air temperature		■	■	■				
Heatwave	■	■						■
Seasonal temperature regimes	■	■	■	■	■	■		■
Frost	■							
Snow cover	■							
Sea Surface Temperature (SST)								
Marine heat waves (warm water pulse)								
Average annual rainfall	■	■	■	■	■	■	■	■
Seasonal rainfall	■	■	■	■	■	■	■	■
Regional runoff							■	■
Seasonal runoff							■	■
River flow							■	■
Annual average wind speed and direction						■		
Extreme wind	■	■	■					
Total cloud cover								
Average annual radiation								
Annual average relative humidity								
Evaporation	■	■	■	■	■	■	■	■
Incremental SLR								■
Extreme sea-level, storm surges and tides						■		■
Atmospheric CO2	■	■	■	■	■	■	■	■
Ocean accidification								■
Intense rainfall							■	■
Drought / extended dry spells	■	■	■	■	■	■	■	■
bushfire intensity	■	■	■		■	■	■	■
bushfire frequency	■	■	■		■	■	■	■

Source: Wallis *et al.* (2015), p66.

Table 22 Table C.2 Climate drivers of most importance across generic sub-types of the terrestrial biodiversity asset in the Southern Slopes

6.4.4 AdaptNRM

AdaptNRM is a national initiative that aims to support NRM groups in updating their NRM plans to include climate adaptation planning. The project is being run by the CSIRO and the National Climate Change adaptation Research Fund with the aim of providing NRM groups with materials and data products to assist NRM strategic planning. At the time of writing some Adapt NRM product were not available.

AdaptNRM was developed as a series of modules. Those that are relevant to this environmental scan are the weeds and biodiversity modules.

6.4.4.1 Adapt NRM weeds

The AdaptNRM weeds technical guide[61] provides a synthesis of climate change impacts on weeds, their current and future distribution, and approaches to developing adaptation-based plans for weed management. The guide identifies a number of facets of changes to weeds and ecosystem that are relevant to Tasmanian NRM planning:

- modelling of weeds currently in southern Australia against potential future weed species distributions generally indicates a southern shift;
- initiatives to increase landscape connectivity to facilitate species movements under climate change may also facilitate increased weed invasion;
- processes for identifying refugia will need to include provision for minimising risk from weeds, as they are predicted to have a high and sustained risk from weeds;
- the major threat of weed invasion within Australia is from neighbouring regions; and
- novel ecosystems are and will continue to arise that contain assemblages of both native and weed species.

The AdaptNRM project has also produced a data access portal[62] that provides access to models of the current and predicted 2070 potential distribution of about 100 invasive plant species. An example of the models is shown in Figure 43 for *Acacia cyclops,* a native plant of South Australia that is invasive of coastal dunes and does

[61] Scott *et al.* (2014).
[62] Accessible at https://data.csiro.au/dap/home?execution=e3s1 using the keyword 'AdaptNRM'.

not currently occur in Tasmania but for which suitable conditions under climate change become more widespread.

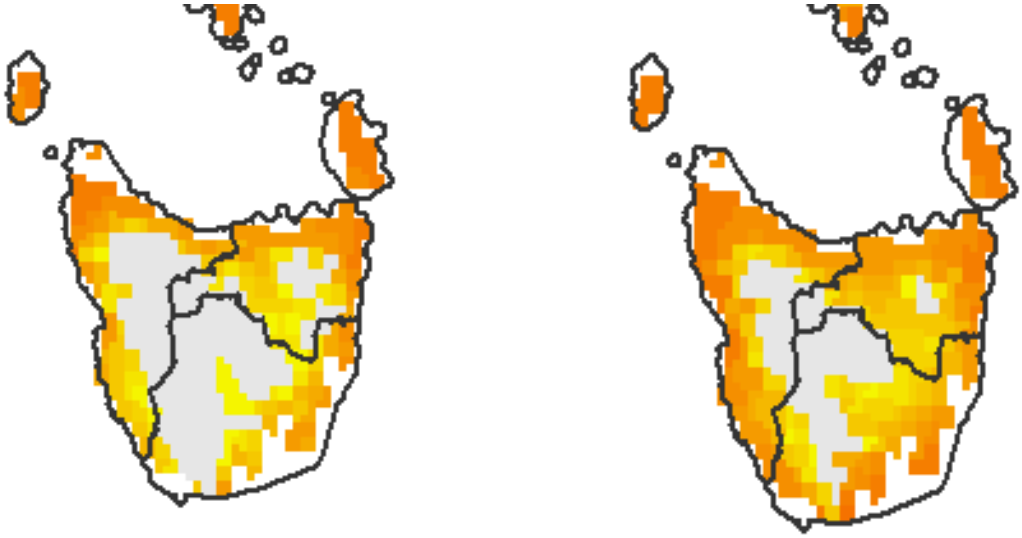


Figure 43 ***AdaptNRM CLIMEX model of*** **Acacia cyclops** ***for 1975 (left) and 2070 (right). Darker colours indicate more suitable climatic conditions***

Observations: The AdaptNRM weeds module provides a solid foundation for NRM planning around weeds, both in terms of process and content. A number of organisations have important roles in weed prevention and control. NRM organisations and stakeholders are unlikely to have a significant role in prevention and quarantine, which is a regulatory function of Biosecurity Tasmania. However there are potentially important roles in early detection, education, control and recording. An identified need arising from the AdaptNRM CLIMEX models is for them to be made more accessible for Tasmanian use including: identifying the weeds from which Tasmania is at risk; summarising current presence/absence and also current/future changes to climatic suitability (for example as paired maps as above). Addressing this need is an important precursor to prioritising weeds for the developing and implementing the next NRM regional strategies.

6.4.4.2 AdaptNRM biodiversity

Note: The AdaptNRM biodiversity adaptation guide was released after the draft of this environmental scan had been prepared. The information present below presents a simple overview of its outputs. However further work to interpret the module outputs will be needed in developing the NRM North and NRM South strategies.

The AdaptNRM biodiversity module uses modelling of biodiversity at the ecological community level to assess the similarities and differences between current communities and those predicted to occur under future climates. The approach has been developed out of recognition that that traditional ecological modelling has been done on a species by species basis and is useful for species of special concern. However it is not suited to changes that are likely to occur under climate change which may affect much larger numbers of species and alter entire biological communities.

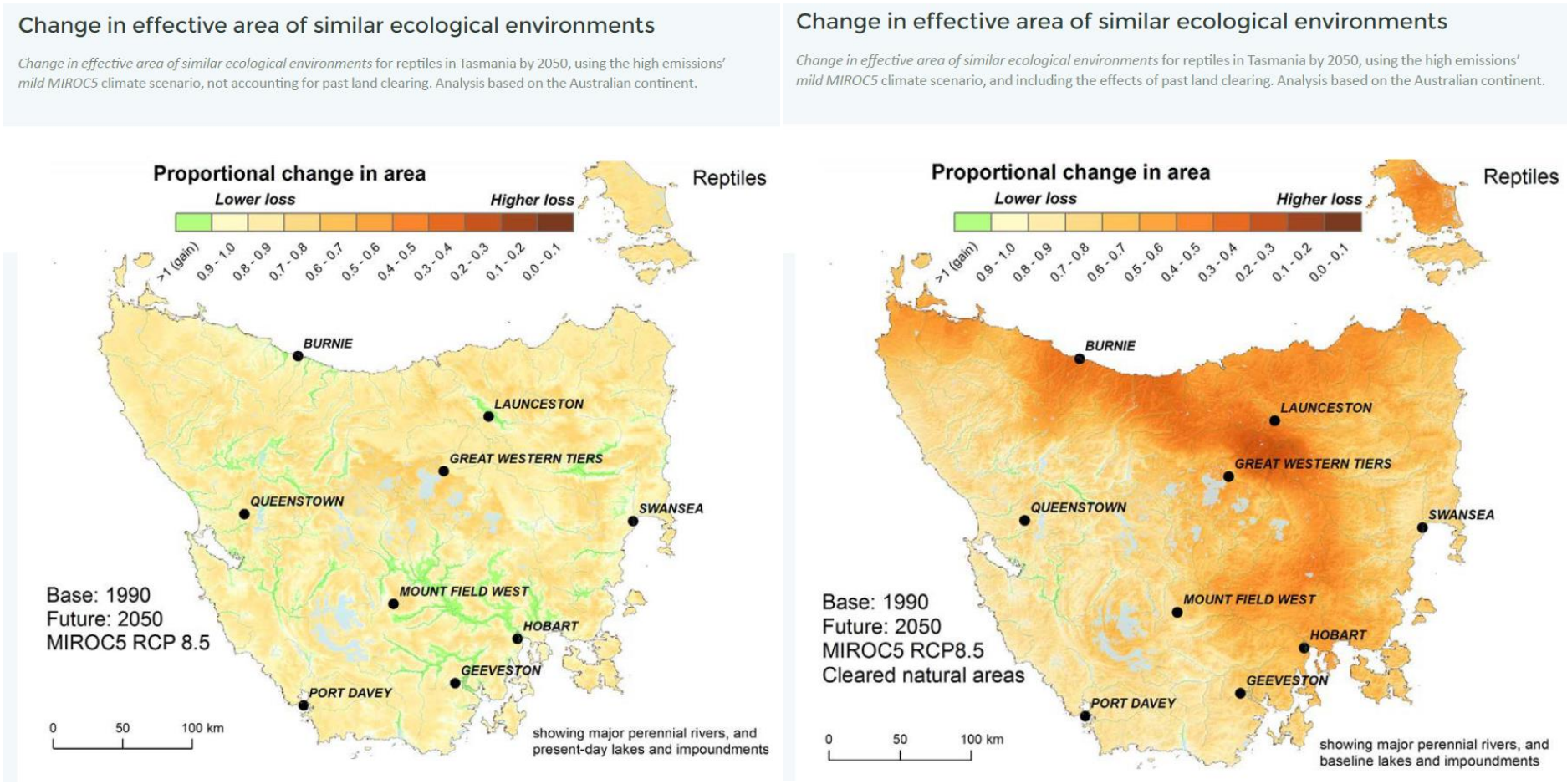
The key outputs of the module relevant to the environmental scan are the technical guide[63] and modelled datasets. The models measure the ecological similarity between a baseline of 1900 and projected characteristics for 2050 based on a low and a high emissions scenario for four groups of terrestrial biodiversity – vascular plants, mammals, reptiles and amphibians. Models are presented at a resolution of 250m across Australia.

The results of the modelling highlight a number of issues for Tasmanian NRM planning:

- Overall, Tasmania is among a small number of areas of Australia where potential for change is lowest.
- Projected change for mammals is more severe in intensively utilised agricultural zones of Tasmania when the effects of clearing are taken into account (i.e. cleared areas are not considered future habitats).
- A similar pattern is reported for reptiles which predict relatively high change in effective area of similar ecological environments when the effects of clearing are taken into account (see Figure45).

[63] Williams *et al.* (2014).

Observations: The AdaptNRM biodiversity data indicate Tasmania has among the lowest projected changes for terrestrial biodiversity groups in Australia. However, accounting for the effects of past clearing significantly exacerbates projected impacts for at least mammals and reptiles. The most pronounced effects on reptiles are in the heavily utilised agricultural parts of the NRM North region and to a lesser degree across much of the agricultural land elsewhere in the region and in the NRM South region also. Interpretation of the spatial outputs of the module for Tasmania needs to be undertaken through a process of technical and stakeholder consultation focused on recommending actions for implementation through the NRM North and NRM South strategies. At the time of writing a number of outputs of the AdaptNRM project had not been finalised (e.g. assessing benefits of revegetation, potential for refugia). This highlights the need for timely review of new information its implications for asset and issues management (see key recommendation of this scan).



Source: AdaptNRM biodiversity technical guide, pp47-48

Figure 44 Impact of effects of past clearing on future effective area of Tasmania reptiles

6.4.5 National Climate Change Adaptation Research Facility (NCCARF) climate-ready conservation objectives

The NCCARF climate-ready conservation objectives project[64] was designed to test new approaches to conservation of biodiversity under climate change. It was based on a recognition that climate change impacts on biodiversity present a challenge to societal aspirations to preserve biodiversity in its current state, i.e. its abundance and distribution, and that continuance of approaches based on this view would likely reduce prospects for many elements of biodiversity under climate change.

The project sought to test three principles for conservation planning under climate change:

1. Conservation strategies accommodate large amounts of ecological change and the likelihood of significant climate change–induced loss in biodiversity.
2. Strategies remain relevant and feasible under a range of possible future trajectories of ecological change.
3. Strategies seek to conserve the multiple different dimensions of biodiversity that are experienced and valued by society.

The project developed prototype tool for assisting natural resource managers to operationalise the climate-ready adaptation criteria developed in this project. The tool is based around a step-wise set of 12 questions to be addressed in developing climate-ready conservation plans. The process and questions are summarised in Figure 46.

The project tested the objectives for conservation planning under climate change against 26 conservation strategy documents from a range of scales, including 3 from Tasmania:

- Tasmanian Wilderness World Heritage Area Management Plan 1999;
- Natural Resource Management Strategy for Southern Tasmania 2010–2015; and
- Tasmanian Land Conservancy Strategy Plan 2011–2015.

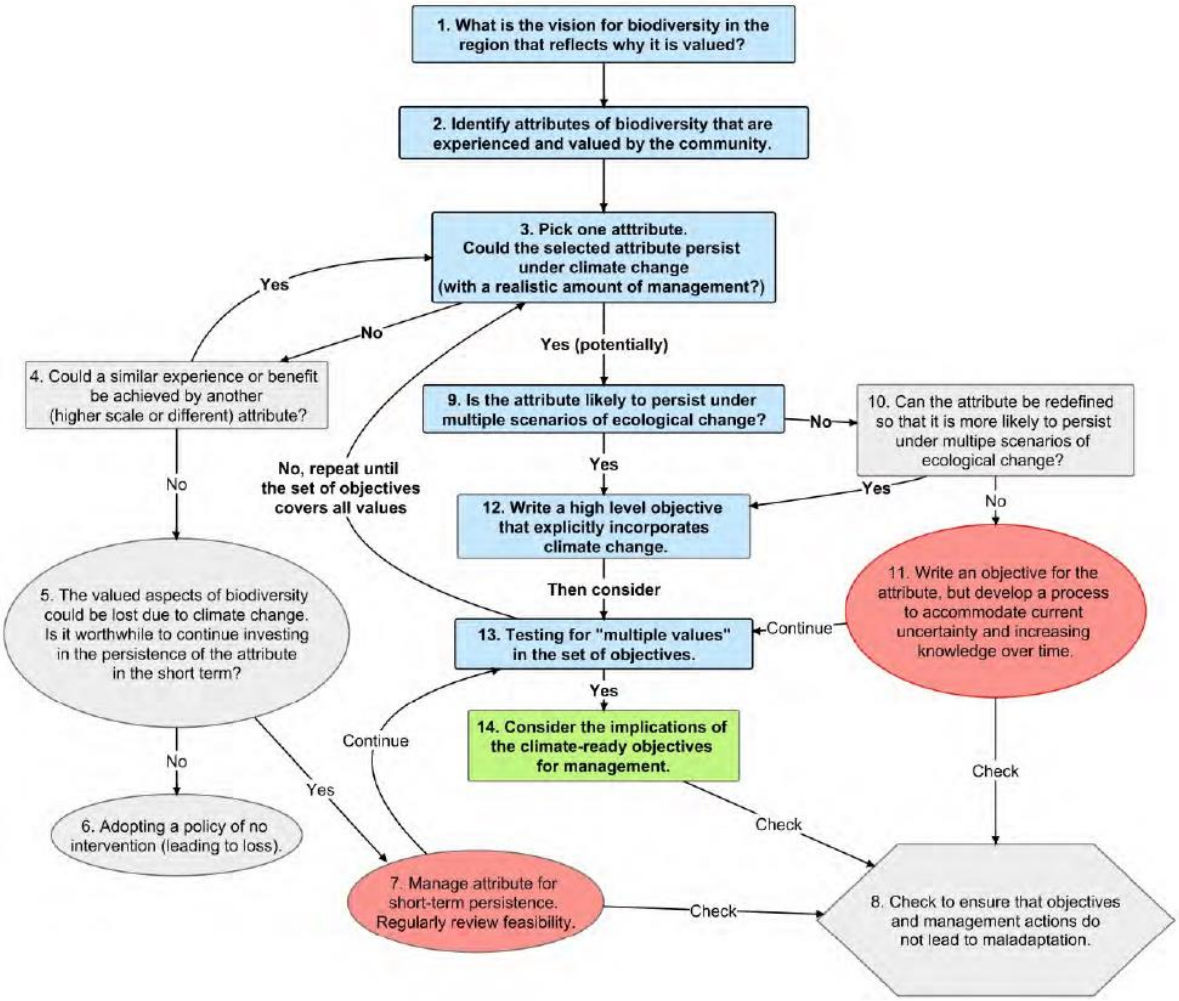
The project also included a case study the Tasmanian Central Highlands.

[64] Dunlop *et al.* (2013).

Observations: The climate-ready conservation objectives provide a useful framework for testing the robustness of proposals for addressing biodiversity in the next NRM North and NRM South regional strategies, although they have much more general utility for a range of NRM planning. The objectives were considered in developing the recommended focus areas for biodiversity arising from this scan (presented separately for NRM North and NRM South after each asset and issues assessment). However the scan is exactly that – a scan – and further consultation on development of these elements of the strategy should:

- utilise the process contained within the prototype tool; and
- highlight the principles stakeholders should consider in providing comment.

The principles and tool should also be used as part of the terms of reference for Themed Reference Groups addressing biodiversity, and also for the development of strategy implementation. The results of the Tasmanian Central Highlands workshop highlight the sorts of issues that need to be considered in applying the principles, so could provide the basis for validating whether the principles have been met and/or what additional work may be needed.



Source: Dunlop et al. 2013, p71

Figure 45 NCCARF climate-ready conservation planning tool questions and process

Factors that support the region becoming climate-ready	Challenges that require attention for the region to become climate-ready	Key issues raised
• Intact landscape – and wilderness area that is loved and valued by community. • Strong recognition of 'landscape' as a valued dimension of biodiversity as well as importance placed on healthy ecosystems and species. • High capacity in lead agency to anticipate, understand and plan for climate change adaptation.	• Lack of formal collaborative arrangements between science and land management agencies and a mismatch between the scientific work (which reflects the interests of scientists) and the needs of land management agencies. • Range of land tenures managed by different land management agencies and private land owners with different objectives and variations in their capacity to Anticipate and plan for the impacts of climate change. • No clear outcome-oriented biodiversity objectives currently in plans. • Unclear how to set objectives with such a large amount of uncertainty. • Getting the right people involved in the climate-ready preparation – what engagement models should be used? • Competing objectives (even within agencies), which is likely to increase under climate change and is driven by competing legislative frameworks; this was identified as a potential major challenge. • Climate change impact projects – need assistance in understanding and analysing the data – questions regarding what metrics to use/to develop to help understand and monitor change. • No weather stations in study area (few in Tasmanian Wilderness WHA) that are appropriate for monitoring the climate change impacts on the WHA.	• Compound impacts – lots of other impacts on biodiversity as well as climate change, therefore may need to think about 'human impacts' and not just climate change; this view is driven by funding-body language and priority setting. • Queries as to exactly how to make biodiversity planning dynamic – tool? Update plans regularly? • How to create the political space for changes in strategy in response to climate change? • How do we do pre-emptive climate change–impact planning early on in the transformation? • Don't know when 'enough change is enough' and requires intervention versus letting something go. • Raises questions about whether it is possible to separate measures of condition from ecosystem type? • Agreed that this was possible (e.g. by measuring change in net primary productivity), although there is no single measure of ecosystem health. Could

Factors that support the region becoming climate-ready	Challenges that require attention for the region to become climate-ready	Key issues raised
	• Day-to-day management is driven by 'lists' and 'actions' and 'approaches' under existing legislation and the legislative context of planning. • Lack of senior management/political understanding and support for incorporating climate change into biodiversity planning slippery words and multiple meanings of words – very confusing and makes issues difficult to discuss, especially among diverse agencies. • Ready access to good planning tools but lack of confidence in using them (e.g. database tool/analytical tool): o need resources to maintain and improve databases; o need courage to look at priorities and stop doing some things; o need confidence in tools (variable output depends on users).	look at historical data for suitable benchmarks.

Table 23 Factors that support the region becoming climate-ready

6.5 Proposed draft asset classification

The approach adopted for this environmental scan has been that an asset-based classification of NRM assets and issues is a useful basis on which strategies can be built and their associated activities progressed – analysing, prioritising, engaging, monitoring and reporting. The documents analysed in the previous section all contain elements of a classification system for NRM assets and issues. Whilst they do not provide a single emergent classification that has been universally applied, they do contain sufficient common elements and themes which can form the basis for organising NRM information.

The proposed draft classification presented below has been developed as a conceptual structure in which the overwhelming majority of assets and issues identified in section can be located. It has also been designed to reflect the draft preferred structure for the next NRM strategies (see Section 6.3.5) and in particular to be consistent with the structure used in the SCARP report to synthesise current knowledge on climate change. The latter is important as a feature of climate change (and of NRM generally) is the continual emergence of new information. A relatively stable frame of reference is needed in this context, so that comparisons can be made with past conditions, decisions and outcomes of activities and adaptation actions.

The proposed draft asset classification does not include Community as an asset, as provided for in the draft preferred structure for the next strategies. This is not because the Community is not an NRM asset – in fact it is an incredibly important asset – but rather because the focus of the proposed classification is on the biophysical features that are the subject of NRM interest. Actions by the Community, as an asset in NRM, need to be viewed differently and this is provided for by the Landscapes approach in the draft preferred structure.

Four asset classes are proposed to be included in the draft classification. One of the asset classes – land – is separated into two assets to reflect major partitioning in terrestrial natural resources around terrestrial biodiversity and land and soil resources.

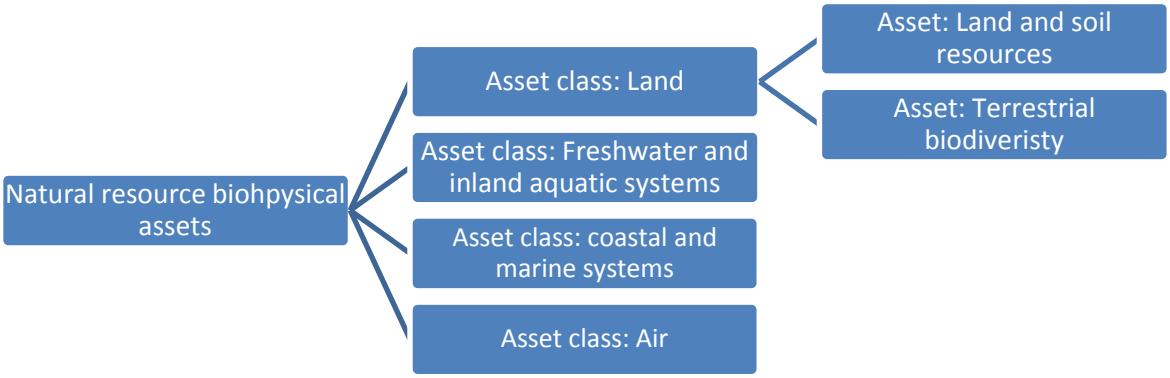


Figure 46 Proposed draft classification for NRM assets

The area of the classification which is most problematic and needs further consideration by the NRM regions is around biodiversity. Some biodiversity elements are specific to particular assets while others apply more generally across the three assets of land, freshwater and coast and marine. For example, habitat for hollow dwelling species fits exclusively within the specialised habitats issue of terrestrial biodiversity. In contrast threatened species occur across all three of these asset classes. The issue is further compounded in some elements of biodiversity requiring different habitats for different parts of their life cycle, e.g. birds that are land nesting but feed in water, frogs that breed in aquatic habitat but spend the bulk of their life in terrestrial habitat.

The key issues for consideration are:

- the need to organise information consistently and efficiently;
- the ability to contribute to reporting on frameworks that span issues, for example Commonwealth international reporting on the Convention on Biological Diversity; and
- the needs of the NRM regions and stakeholders in planning and carrying out management activities in different environments (i.e. assets) and social settings (e.g. landscapes).

The sections which follow provide an overview of each asset class against a standardise format. Each asset is assessed in terms of:

- the proposed list of issues to be included within each asset;
- a template designed to summarise current knowledge, potential climate change impacts, available data and knowledge gaps for issues within the asset class; and
- a summary of responses from the stakeholder survey on key aspects of the asset.

The asset class templates are of their nature incomplete. Whilst a large volume of information has been reviewed in their compilation, it is inevitably incomplete and subject to ongoing change. Hence it should be considered as a starting point for design and implementation of an information systems approach to data and information management, as discussed in section 4. Information in the template draws on the documents analysed for the scan (section 2), consultation around specific issues, a previous review of land and soils, biodiversity, and freshwater assets in the Tasmanian Midlands[65] and on other incidental sources identified during the scan.

The summary of responses on each asset class from the survey is based on a standard set of questions around each asset:

- the issues within the asset class that impact on the respondents NRM management activities;
- the issues seen to be priorities for the next round of regional strategies;
- the ability of the respondent to manage each issue under climate change;
- the relative importance of the different landscape in managing the asset class; and
- an indicator of capacity-impact deficit in relation to climate change.

The capacity-impact deficit is designed to give a very general indicator of the gap between the reported impact of each issue on respondent's management activities

[65] Knight & Cullen (2009).

and their reported capacity to manage the same issue under climate change. To standardise for different numbers of respondents the indicator is expressed as the percentage change between the reported impact on management activities and the reported ability to manage under climate change. The capacity impact deficit is calculated by the following formula:

$$\text{Capacity impact deficit} = -\left(1 - \left(\frac{\text{Climate ability response}}{\text{Issue impact responses}}\right) \times 100\right)$$

Climate ability response = number of respondents reporting issue is able to be managed as a result of climate change.

Issue impact response = number of respondents reporting issue as directly impacting on their management activities.

For example, if 50 of respondents reported an issue as among those most impacting on their management, and only 10 of respondents reported having ability to manage the issue under climate change, the capacity-impact deficit would be 80%. In contrast if 40 respondents reported ability to manage the same issue under climate change then the capacity-impact deficit would be 20%.

The capacity-impact deficit is not a quantitative measure. Instead it is intended to provide a simple way of examining which issues within an asset class may be more or less likely to be able to be managed by stakeholders under climate change.

The asset assessment and survey analysis for each asset is followed by a set of recommendations for the main 'focus areas' that are recommended for consideration in the next NRM regional strategies. These are presented separately for each region, though for some recommended focus areas coordinated approaches either across Tasmania as a whole or for just the NRM North and NRM South regions is recommended.

It should be noted that the recommended focus areas are not designs for NRM programs. They aim to simplify the asset classification by focusing on synergies that have been identified between the various issues within each asset and also on areas where issues such as monitoring, evaluation and reporting may have common elements.

The recommended focus areas could be used as one input in designing programs for the next regional strategies but these will need to consider other inputs as well.

6.5.1 Asset class: Land – Asset: land and soil resources

6.5.1.1 Land and soil resource - classification

Classification: Twelve major issues were identified from the document review as most important for land and soil resources and were included in the stakeholder survey.

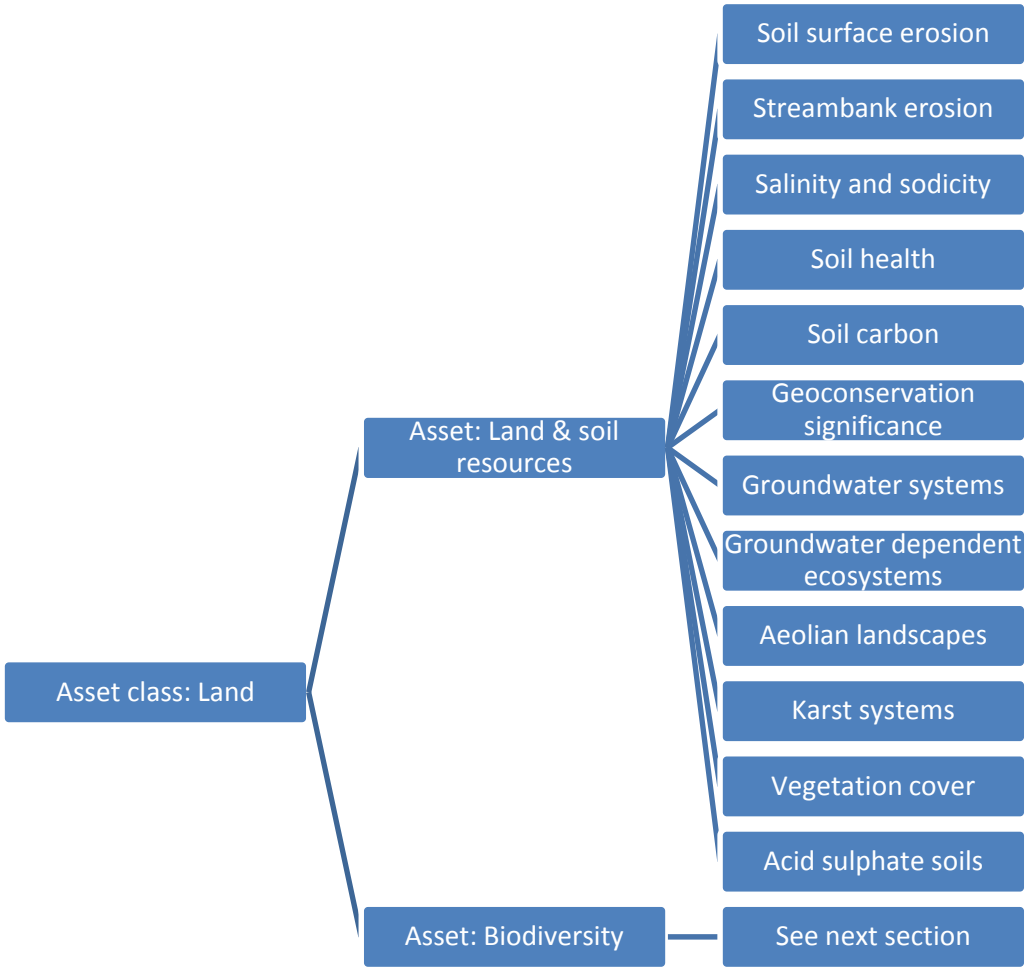


Figure 47 Land and Soil resources – key issues

6.5.1.2 Asset: Land and soil - asset knowledge and status assessment

6.5.1.2.1 Issue: soil surface erosion

Asset issue	Description
Contextual summary	Surface erosion risk is the accelerated loss of soil surface material through the agents of wind and water. Surface erosion can occur as sheet, rill, gully erosion, or tunnel erosion, slumping and landslip. Soil surface erosion is a natural process that can be exacerbated through poor land management.
Current knowledge	Current knowledge on soil erosion in Tasmanian is dated. Hazard assessments for various forms of erosion by land unit were included in the 1978-1989 land systems reports for Tasmania[66]. A State-wide report on erosion and land degradation, largely by land system, was published in 1995[67] and there have been a number of localised assessments addressing erosion[68]. Erosion risk is also summarised in the Forest Practices Code[69].
Change, pressures, climate change	Expansion of intensive irrigated agriculture is a major land use change with potential to affect soil erosion. Climate change can increase soil erosion directly through extreme events (e.g. rain storms, wind storms, extended drought) and through indirect effects on other land and soil issues that may increase erodibility. Failure to respond to changed or extreme climatic conditions with changed management may increase erosion.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Soil reconnaissance mapping for Tasmania can inform erosion risk (partial coverage of both NRM North and NRM South region). • Classification of soil erosion risk types for land system components within mapped land systems (see land systems reports referenced above). • Maps of soil erosion and land degradation based on land systems (see Grice 1995). • Mapping of land system components and associated erosions risks are available for app. 600,000 ha of the NRM North and NRM South regions[70]. ***NRM North***

[66] Davies (1988), Pemberton (1986, 1989), Pinkard (1980), Pinkard & Richley (1982), Richley (1978, 1984).
[67] Grice (1995).
[68] Cullen (1995), Grose (2003), Kidd (2003), Moreton (2003).
[69] Forest Practices Board (2000).
[70] Natural Resource Planning land components master spatial data layer, unpublished.

Asset issue	Description
	• Finer scale soils mapping is available for the Waterhouse area. ***NRM South*** • Finer scale soils mapping is available for the Tunbridge area and part of the Coal River valley. ***Known issues*** • Recent high resolution State-wide modelling of digital soil surfaces by DPIPWE represents a significant step forward in data and is freely available[71] but has not yet been interpreted for erosion hazards or other soil management issues. • Mapping and monitoring of seasonal ground cover is due to commence in Tasmania in the near future and will have utility in assessing soil surface erosion.
Regional considerations and recommendations	• Soil surface erosion is included in the recommended focus area for soil management.

6.5.1.2.2 Issue: streambank erosion

Asset issue	Description
Contextual summary	Streambank erosion is the removal of material from the banks, beds and associated wet areas of streams through the action of water. Streambanks are naturally relatively dynamic, particularly under high flows, but changes can be caused or accelerated by the coupling of underlying sensitivity (e.g. from poorly cohesive soils) and inappropriate land management.
Current knowledge	Information sources for streambank erosion as largely as above for soil erosion, however there has been relatively little assessment in agricultural areas.

[71] http://www.asris.csiro.au/viewer/TERN/

Change, pressures, climate change	Changes to stream hydrology from catchment diversion (+ve and –ve changes to water and sediment flows) associated with agricultural and urban development have been historic and may have increased in recent years. Abundance and management of riparian vegetation and of riparian zones has improved in some areas but declined in others, but on the whole is not well known. Climate change has potential to increase streambank erosion through extreme events but impacts will be closely related to management. The recent projections of a potential 30% increase in extreme rainfall for the Southern Slopes may exacerbate streambank erosion.
Key data, information and resources	***General note:*** See information sources above for surface soil erosion. ***State-wide or NRM North and NRM South*** • DPIPWE CFEV database contains a range of data (e.g. upstream riparian vegetation, hydrologic modification) by each Tasmanian river section catchment (n = ~360k) and accumulated upstream catchment, which can be used to help assess streambank erosion risk arising from catchment hydrology. • Some Rivercare plans contain localised assessments of streambank erosion. ***Known issues*** • Some data contained within CFEV is significantly out of date, particularly both river section catchment accumulated upstream native riparian vegetation. • Currently there is little systematic or landscape scale data on extent and nature of streambank erosion.
Regional considerations and recommendations	• Soil surface erosion is included in the recommended focus area for soil management.

6.5.1.2.3 Issue: salinity and sodicity

Asset issue	Description
Contextual summary	Salinity is the accumulation of salt in soils and water. Sodicity is the aspect of salinity associated with high levels of ionic sodium in soils. Excessive sodicity can lead to loss of soil structure. Salinity arises from two sources – primary salinity from inundation or seepage from existing sources (water or minerals) and secondary salinity from changes in surface vegetation or water application (e.g. from irrigation).
Current knowledge	The most comprehensive report on salinity in Tasmania was published in 2000[72], which used land systems and their constituent components as the units of assignation for salinity risk and presence. They estimated 53,500ha of Tasmanian agricultural land was affected by salinity in 2000, with an estimated increase of 1.5% per year. Salinity was reported as most frequently associated with Quaternary sands and sandstones, Tertiary mudstones and Tertiary complexes, and is most widespread in areas of low to medium rainfall. It has been estimated that at least 23% of Tasmanian soils are sodic[73]. In common with salinity-prone land, sodic soils mostly occur on Triassic and Permian mudstones and sandstones, and on the Tertiary and more recent sediments within them. More detailed assessments have been undertaken in some particular areas of concern[74]. Most older assessments of salinity and sodicity relate to certain groundwater flow systems, which have been mapped and identify relatively fine scale variability in attributes associated with salinity and sodicity, based on geological mapping, of 13 types of groundwater flow systems[75]. Indicators of salinity and change have been tested on a trial area in the NRM North region to determine those most suited for use in Tasmania[76].
Change, pressures, climate change	Much of Tasmania's salinity and sodicity is a function of underlying soil conditions. The issues are exacerbated in some areas by land management practices and catchment clearing. Expansion of intensive agriculture and loss of trees from catchments (in particular extensive tree decline) may exacerbate extent and severity. Climate change impacts may separately or in combination with land management exacerbate salinity and its effects. Impacts on biodiversity and freshwater systems are likely

[72] Bastick & Walker (2000).
[73] Doyle & Habraken (
[74] Kidd (2003).
[75] Latinovic *et al.* (2013).
[76] Bastick *et al.* (2007).

Asset issue	Description
	to accompany increased salinity under climate change, particularly as a result of increased drought and evaporation. Coastal areas subject to inundation, storm and tide surge and changes to coastal groundwater are likely to be affected by increased salinity.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Older data on salinity and sodicity are as above for soil erosion. • Older data based on interpretation of land systems components hazards information, including salinity, has been summarised. • Tasmanian groundwater flow systems mapping is the finest scale assessment currently available on a State-wide basis, but still requires assessment at local scales. • Finer scale mapping of the above salinity assessment is available for parts of the NRM North and NRM South region[77]. • The new DPIPWE soil surface modelling for Tasmania includes indicators of salinity (electrical conductivity) and sodicity (depth to sodic layer). • Municipal salinity assessments are available for all local government areas in the NRM North and NRM South regions. ***Known issues*** • A key knowledge gap is interpretation of the DPIPWE soil surface data to produce updated risk assessments. • Existing distribution of soil decline due to sodicity and salinity at local scales is not well documented. • Knowledge gaps are likely to always be present at finer scales due to land management practices, in the long term effects of agricultural intensification, in the cumulative effects of climate change and agricultural intensification.
Regional considerations and recommendations	• Salinity and sodicity are primarily included with the recommended focus area for soil management, as this is the scale at which local scale management of issues is likely to be feasible. • Salinity and sodicity will be affected at broader scales through the recommended land and soil focus area on vegetative cover and water-related soil issues, and the biodiversity recommended focus area for ecologically functioning landscapes, as both these focus areas aim to effect management at scale consistent with catchment-scale

[77] Natural Resource Planning land components master spatial data layer.

Asset issue	Description
	drivers of salinity. Timely cross-referencing of these focus areas would be needed to ensure potential synergies are being realised.

6.5.1.2.4 Issue: soil health

Asset issue	Description
Contextual summary	Soil health (or soil condition) refers to the overall range of physical and chemical characteristics of soils, usually relative to some reference, 'healthy' or 'normal' state. Characteristics include chemical (e.g. pH, nitrogen), physical components (e.g. sand, silt, clay), depth measures (e.g. of the soil horizons, to sodic layers). Soil health also includes functional components such as the cycling of nutrients and the actions of the soil biota.
Current knowledge	Knowledge on soil health in Tasmania is currently patchy. Tasmania soils have been reported to have been subject to decline in soil condition particularly in cropping soils and sandy soils[78]. Some types of crops can lead to difficulty in maintaining soil condition due to limitations on the types of materials, for example use of poppy stubble on soils used for producing edible greens (due to prohibited use of animal wastes) was found to increase both soil pH and salinity when applied as an alternative[79].
Change, pressures, climate change	Intensification of agricultural activity may have produced changes in soil health in Tasmania but the nature and extent of change is limited and patchy. Changes are most likely to be associated with the move to intensive irrigation, change to pastures (e.g. from annual to perennial and vice versa) and grazing regimes and potentially from fire. Many of the effects of climate change on soil health are already identified issues for land and soils (e.g. soil carbon, erosion due to dryness); however climate change has the ability to exacerbate these effects.

[78] Sparrow *et al.* (2006).
[79] Harding & Cotching (2009).

Key data, information and resources	***State-wide or NRM North and NRM South*** • Existing coarse and fine scale soil maps for parts of Tasmania (see list under soil surface erosion) describe a number of the attributes needed for some aspects of reference state for soils. • The recent DPIPWE soil surface mapping for the State includes a wide range of attributes relevant to soil health but have yet to be analysed. ***Known issues*** • Data and knowledge on soil health is increasing rapidly. • The DPIPWE Soil Condition Evaluation and Monitoring Program[80] will provide longitudinal information on soil health but is currently into only the second five year sampling program[81].
Regional considerations and recommendations	• Soil health is included in the recommended focus area for soil management. It is a broad term with a wide range of attributes related to other soil issues.

6.5.1.2.5 Issue: soil carbon

Asset issue	Description
Contextual summary	Soil carbon (or soil organic carbon) is the stored carbon component of soil organic matter.
Current knowledge	Knowledge on soil carbon is limited and based largely on modelled data. Tasmanian research has found concentrations ranging from 69-158 Mg C ha^{-1} but also identifies land use as a strong explanatory variable contributing to considerable uncertainty in the baseline[82]. Baseline data for 2010 shows total soil carbon in Tasmania to be 1.05 GT (range 0.85-1.27) [83].
Change, pressures, climate change	Intensification of agriculture has potential to deplete soil organic carbon. Tasmanian research has found cropping sites to have 29-35% less soil carbon than pastures (see Cotching et al. below). Warmer and drier climate has been predicted to lead to a reduction in soil carbon, thus contributing to total greenhouse gas levels.

[80] http://dpipwe.tas.gov.au/agriculture/land-management-soils/land-and-soil-resource-assessment/soil-condition/monitoring-soil-condition
[81] http://www.farmpoint.tas.gov.au/farmpoint.nsf/news/632B853ECE87249ACA257DDC0010D6ED
[82] Cotching *et al.* (2013).
[83] Rossel *et al.* (2014).

Asset issue	Description
Key data, information and resources	***State-wide or NRM North and NRM South*** • DPIPWE digital soil surface mapping contains a fine scale ***Known issues*** • The reported impact of land use mean that data accuracy at finer scales is likely to be limited. This can be partly addressed through interpretation of the DPIPWE soil surface mapping.
Regional considerations and recommendations	• Soil carbon is included in the recommended focus area for soil management. • Soil carbon will also be strongly influenced by actions taken in connection with the recommended focus area for vegetative cover.

6.5.1.2.6 Issue: geo-conservation significance

Asset issue	Description
Contextual summary	Geoconservation has the aim of preserving the natural diversity of significant geological, geomorphological and soil features, their underlying processes, and to maintain natural rates and magnitudes of change in those features and processes[84].
Current knowledge	Sites of geoconservation significance maintained in the Tasmanian Geoconservation Database[85]. It rates sites by their significance and sensitivity (some sites like the Central Plateau surface are significant but not sensitive). The geoconservation database is updated on a regular basis.

[84] Sharples (2002).
[85] http://dpipwe.tas.gov.au/conservation/geoconservation/tasmanian-geoconservation-database

Change, pressures, climate change	Sensitive geoconservation sites are vulnerable to *ad hoc* individual actions such as extraction and vandalism. Some such as karst are also sensitive to land management practices. Geoconservation areas that are sensitive to land management may become more sensitive under climate change. Coastal geoconservation sites may be negatively impacted by sea level rise, action of storms, and collapse of features such as cliffs and dunes. Although the geoconservation database is regularly maintained, it is a listing of known sites rather than those identified from systematic State-wide survey.
Key data, information and resources	***State-wide or NRM North and NRM South*** • The Tasmanian geoconservation database is a maintained spatial layer and can be viewed in the LIST or Natural Values Atlas. Some sensitive sites are not publically accessible. It ranks geoconservation sites by significance and sensitivity, which can be used to inform planning and management requirements. ***Known issues*** • Boundaries are often poorly defined for large geoconservation features. • Sites within the database have not been assessed for sensitivity under climate change although some impacts are likely particularly around the coast.
Regional considerations and recommendations	• Areas of geoconservation significance do not fit easily within any of the recommended focus areas. However, many geoconservation features occur in other land and soil issues. Further consideration and consultation may be needed as to how it should be accounted for in NRM planning and implementation, particularly identifying those geoconservation sites where attention to management may be required.

6.5.1.2.7 Issue: groundwater systems

Asset issue	Description
Contextual summary	Groundwater is water found underground in the spaces between soil, sand and rock. Groundwater systems are the larger scale features of groundwater related to its storage, movement and composition.
Current knowledge	Groundwater plays a critical and often underestimated role in a wide range of natural systems – land and soils, freshwater systems and in biodiversity. Groundwater flow systems in Tasmania have classified into thirteen types[86]. The connectedness of groundwater to surface water systems has been assessed[87], and their connectedness has also been classified into thirteen regions. Some work has been done on the important task of integrating ground and surface water management[88].
Change, pressures, climate change	A range of pressures on groundwater systems have been reported, including prevalent and increasing use in some areas (north and north west), the full allocation of surface water catchments and the risk associated with a lack of groundwater licensing[89]. Increasing extraction of water under expanded irrigation has potential to affect groundwater. Hydraulic fracturing of subsurface geology to extract gas and/or oil is an emerging issue that is currently under review. Climate change impacts on groundwater may include reduced recharge with reduced rainfall, increased depletion due to greater extraction both directly and from connected surface water systems, and intrusion of saline water into aquifers from sea level rise.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Classification and mapping of Tasmanian groundwater systems is available, but is relatively coarse in scale. ***Known issues*** • Data and knowledge gaps on groundwater are substantial and include lack of information on use, limited understanding of management needs and limited knowledge of the systems themselves (see Sheldon 2012 below),

[86] Harrington *et al.* (2009), Latinovic *et al.* (2003).
[87] http://dpipwe.tas.gov.au/water/groundwater/groundwater-surface-water-connectivity
[88] Household (2011).
[89] Sheldon (2012).

Asset issue	Description
Regional considerations and recommendations	• Groundwater systems are included in the recommended focus area of water-related land and soils issues.

6.5.1.2.8 Issue: groundwater dependent ecosystems

Asset issue	Description
Contextual summary	Groundwater dependent ecosystems (GDEs) are surface or subsurface areas where communities of plants, animals and other organisms have their extent and life processes dependent on groundwater.
Current knowledge	Current knowledge of the types and distribution of GDEs in Tasmania is limited. CFEV used expert assessment to identify a range of types – karst, deflation basins, freshwater crayfish burrows, porous and fractured rock aquifers, sub-surface streams in talus and alluvium and vegetation types associated with shallow water tables[90]. Other types of GDEs are coastal wetlands, peatlands, estuaries, springs, rivers, headwater lakes[91] and deflation basis wetlands.
Change, pressures, climate change	Pressures and potential climate impacts on GDEs are broadly as described above for groundwater systems. However any effects on GDEs may also be significant where they are associated with important biodiversity values such as threatened species and vegetation communities.
Key data, information and resources	***State-wide or NRM North and NRM South*** • CFEV data on GDEs. • Some additional data is available on the Australian Atlas of Groundwater Dependent Ecosystems[92]. ***Known issues*** • Information on the location and type of GDEs in CFEV limited to known point locations (n=115). More recent work on groundwater systems has improved knowledge but a systematic assessment of GDEs has not been undertaken.

[90] Department of Primary Industries & Water (2008b).
[91] Sheldon, R. (2012).
[92] http://www.bom.gov.au/water/groundwater/gde/map.shtml

Asset issue	Description
Regional considerations and recommendations	• Groundwater dependent ecosystems are included in the recommended focus area for water-related land and soil issues.

6.5.1.2.9 Issue: aeolian landscapes

Asset issue	Description
Contextual summary	Aeolian soils are those that have been deposited by the wind. Without vegetation cover they have high susceptibility to wind erosion. Aeolian soils include dunes, lunettes (lake-side dunes) sand sheets and deflation basins from which aeolian material has been eroded
Current knowledge	Aeolian soils in Tasmania are common around the coast and inland including the Midlands, the North East, the South East, and have limited occurrence on the eastern Central Plateau. In many places they are important agricultural assets. Where associated with greater topographic relief they can also be at risk of landslip[93].
Change, pressures, climate change	Change and pressures are largely as described above for soil surface erosion. Climate change may lead to accelerated erosion of aeolian soils as faster desiccation may lead to more frequent loss of vegetative cover.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Aeolian features have been mapped at a coarse scale by DPIPWE. • Most aeolian features in the agricultural areas of NRM North and NRM South are identified as significant in the Tasmanian geoconservation database. • Other data sources as described above for surface erosion include material relevant to aeolian landscapes. • The recent DPIPWE soil surface modelling includes percentage sand in the modelled soils at high resolution (80m) and is publically available. • Finer scale classification of basin characteristics has been undertaken[94].

[93] McIntosh & Kiernan (2003).
[94] Rayburg & Neave (2009).

Asset issue	Description
	Known issues • The DPIPWE mapping of aeolian features is incomplete, with many features in western and southern Tasmania not mapped[95].
Regional considerations and recommendations	• Aeolian landscapes have been included in the recommended focus area for soil management. This is in recognition of the sensitivity of the soil of these features to management actions. Aspects of aeolian landscapes are also relevant under the recommended focus areas for vegetative cover and water-related land and soils issues (e.g. deflation basin wetlands).

6.5.1.2.10 Issue: karst systems

Asset issue	Description
Contextual summary	Karst is terrain where the geology and landforms are influenced by solubility of certain rocks, including limestone, dolomite and magnesite.
Current knowledge	Knowledge of karst in Tasmania is relatively advanced, although unknown features continue to be discovered particularly in forestry operations. Karst areas in Tasmania are often of geoconservation significance for their formation and also frequently contain threatened or other species uniquely adapted to cave environments. Cave-dwelling fauna is a recognised priority species group under the RFA (see biodiversity asset). Karst is also a significant commercial resource for the production of lime (e.g. for agriculture, cement).

[95] Tasmanian Planning Commission (2009). http://soer.justice.tas.gov.au/2009/image/938/index.php

Change, pressures, climate change	Management of karst in Tasmania is variable. Karst may be sensitive to local and catchments scale impacts of management. Karst is routinely managed under the forest practices systems. Not all karst on private land has historically been well managed and land purchases have been used to secure management[96]. Karst is potentially subject to increased pressure under climate change. Reduced water entrance and flow in karst systems may alter significant cave features and threaten some biodiversity values. Increase sediment input to karst may occur as a result of extreme rainfall events and also from increased frequency and intensity of fires.
Key data, information and resources	***State-wide or NRM North and NRM South*** • The Tasmanian Karst Atlas has been used to store and classify the location of karst features. • Karst was a separate theme in the CFEV project and all karst features included in its assessment have been assigned representative and integrated conservation values and conservation management priorities. ***Known issues*** • The currency and maintenance of inventory of karst in Tasmania is unclear, as a number of assessments have been produced since the last publication of the Tasmanian Karst Atlas. • Data in the CFEV karst assessment is out of date.
Regional considerations and recommendations	• Karst management would be addressed primarily though the recommended focus area on water-related soil issues. • Major karst features have a limited distribution on private land in the regions; the notable exception being the Mole Creek karst in the NRM North region.

[96] Australian Government (2006).

6.5.1.2.11 Issue: vegetation cover

Asset issue	Description
Contextual summary	Vegetation cover is the physical structure and temporal characteristics of plants. It native, exotic and mixed vegetation types that may be permanent (e.g. forest) or impermanent (e.g. crops). Vegetation cover has an important role in limiting soil erosion and maintaining soil health.
Current knowledge	Some aspects of vegetation cover are relatively well known. For example, many types of native vegetation will form effectively permanent vegetation cover. There is likely to be greater variation in vegetative cover in agricultural land due to variation in land use and management; however on the whole is lower.
Change, pressures, climate change	Expansion of intensive irrigation is likely to have led to longer periods of reduced vegetative cover in some areas. Droughts often results in extended periods of exposed soils in dryland grazing systems, though vary with individual circumstances. Vegetation cover under climate change is likely be variable. Reduced cover (e.g. from drought, temperature extreme rainfall) may lead to increased risk of soil erosion and nutrient loss. However, increased CO_2 in the atmosphere also stimulates plant growth and may lead to increased cover. Interaction between these two factors may make regional predictions difficult.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Limited data currently available from systematic sources. ***Known issues*** • Systematic data on vegetation cover are not currently available. Some available data can be used to identify areas in which variation or reduction in cover may occur. Other data such as satellite or LiDAR may be required to measure change. • Mapping and monitoring of seasonal ground cover is due to commence in Tasmania in the near future and will have utility in assessing soil surface erosion.
Regional considerations and recommendations	• Vegetative cover has been included as a single issue recommended focus area for the next strategies of both NRM North and NRM South. This is in recognition of its importance to a wide range of land and soil issues and also strong relationships with biodiversity, freshwater and inland aquatic systems and some coastal issues (e.g. through effects of hydrology, sedimentation).

6.5.1.2.12 Issue: acid sulfate soils

Asset issue	Description
Contextual summary	Acid sulfate soils are soils that contain metal sulphides and have been formed in water logged conditions, usually in sedimentary or organic material. They are stable while waterlogged but when exposed to oxygen produce sulphuric acid. After rain and following dry periods the sulphuric acid is transported through the soil.
Current knowledge	Acid sulfate soils underlie some of Tasmania's coast and inland areas. A reconnaissance scale assessment of the distribution of acid sulfate soils in Tasmania has been undertaken[97] and updated mapping was completed in 2009[98].
Change, pressures, climate change	Increased regulation of aquatic systems and placement of regulatory structures may increase acid-sulphate soil formation by increasing the amount and duration of soil submerging[99]. Climate change is expected to exacerbate sulphide oxidation, re-instate reductive geochemical processes or change the export and mobilisation of contaminants while the interaction of land management (e.g. man-made drainage) will also have a significant role in how the effects of climate change on acid sulfate soils [100].
Key data, information and resources	***State-wide or NRM North and NRM South*** • Spatial data on acid sulfate soils in Tasmania is available on theLIST, including as separate layers for inland and coastal acid sulfate soils. ***Known issues*** • Available mapping of acid sulfate soils is from a range of sources whose accuracy and reliability are varied. This creates a need for field verification when approaching management. • Areas of possible future acid sulfate soil formation arising from land use or climate change are not known.

[97] Gurung (2011).
[98] https://www.thelist.tas.gov.au/app/content/data/geo-meta-data-record?detailRecordUID=ef959cf8-64ff-48c2-9568-c5745cd3f2f0
[99] http://dpipwe.tas.gov.au/agriculture/land-management-soils/soil-management/acid-sulfate-soils
[100] Bush *et al.* (2010).

Asset issue	Description
Regional considerations and recommendations	• Acid sulfate soils are included in the recommended focus area of soil management. It should be noted that some areas of coastal acid sulfate soils will be addressed under the coastal and marine asset.

6.5.1.3 NRM North – land and soil discussion and recommendations

6.5.1.3.1 NRM North land and soils survey responses

Land and soils as core business

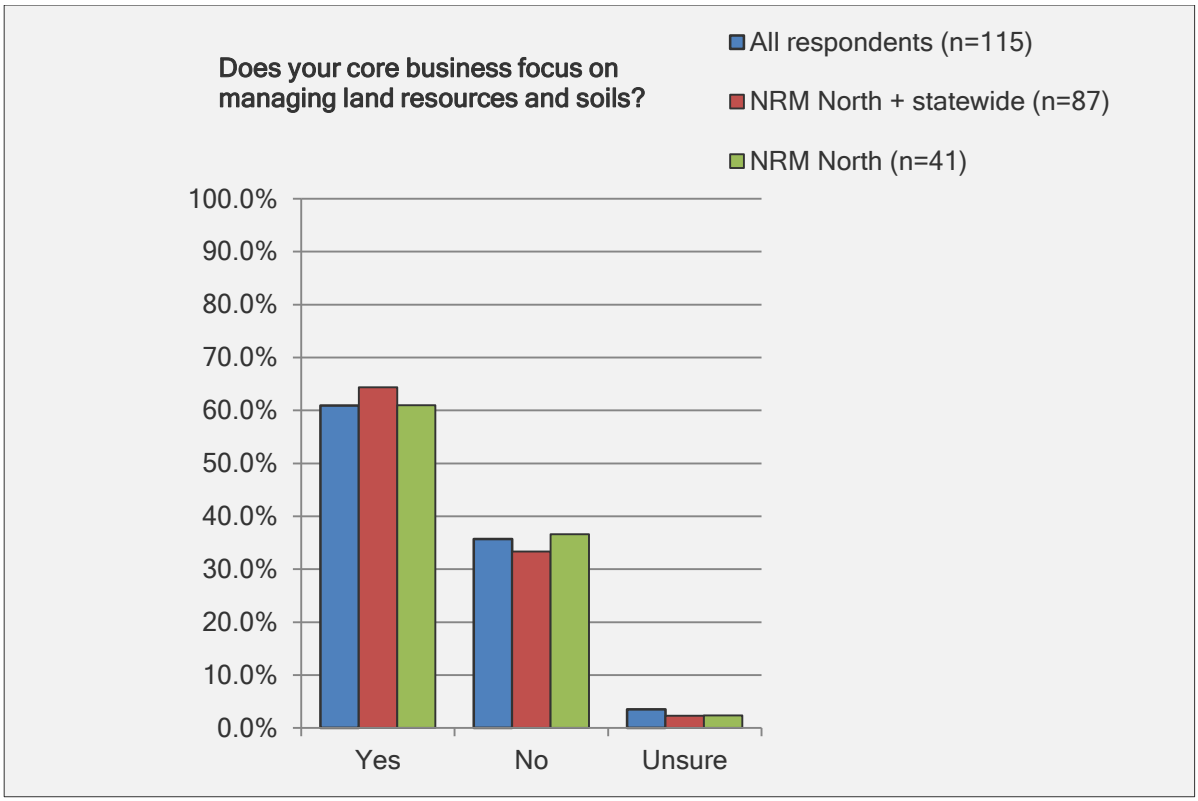


Figure 48 Survey response – core business, land resources and soil

A relatively large number of survey respondents provided information on land and soil resources. Among the 115 respondents 61% identified land and soils as part of their core business. A total of 87 (76%) of those respondents identified as having core business that includes the NRM North region – 41 being respondents working only in the region and a further 46 working State-wide. The response indicates a strong focus among stakeholders on land and soils in the NRM North region.

Issues impacting on management of land and soils

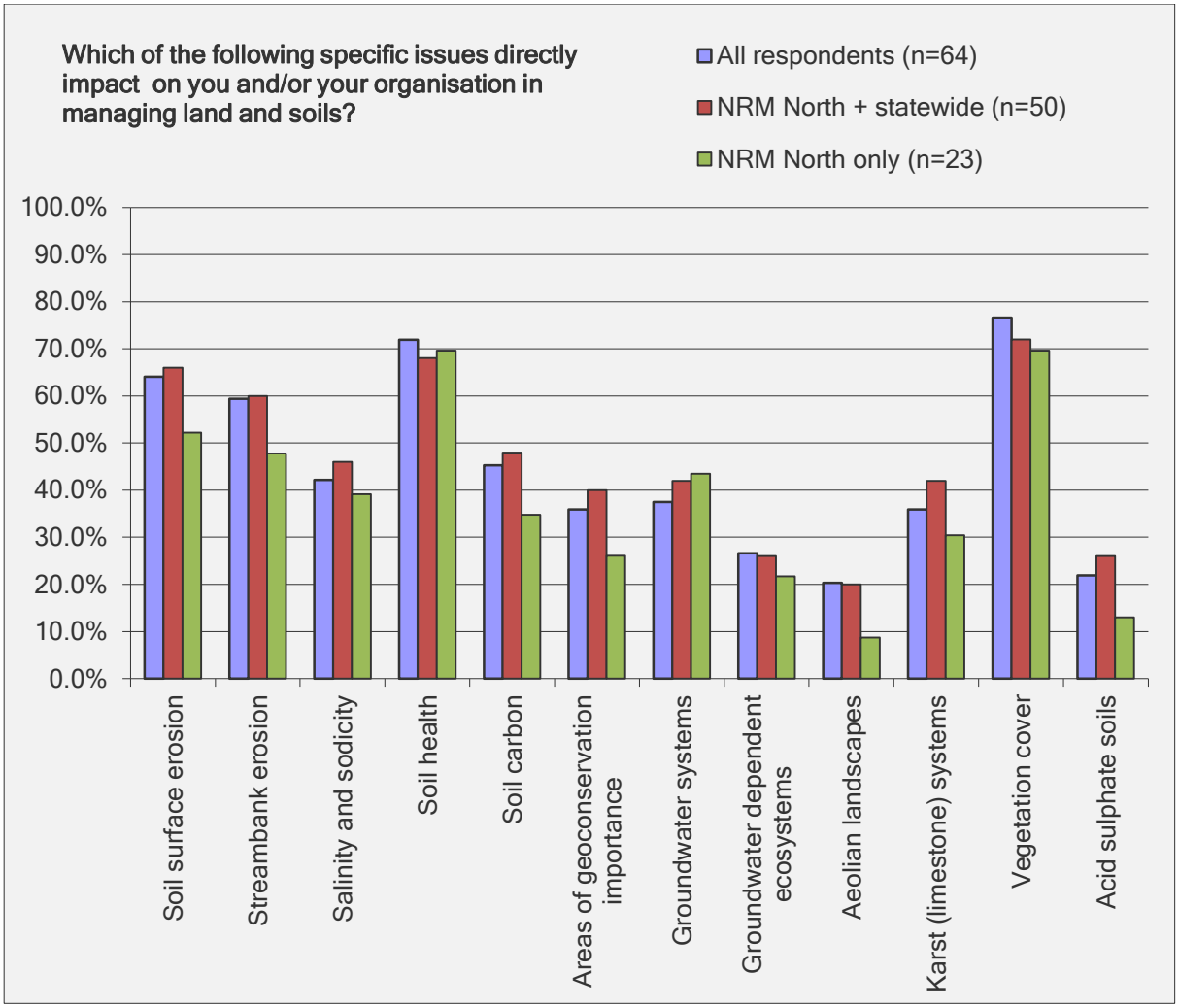


Figure 49 Survey responses – Issues impacting on management of land and soils

The effect of land and soil issues on stakeholder management activities in the NRM North region was varied. Four issues – surface erosion, streambank erosion, soil health and vegetation cover – were indicated by over 50% of respondents as impacting their management and among these around 70% identified vegetative cover and soil health is impacting their activities. These results point towards an emphasis on production-oriented land and soil management among stakeholders in the region. In contrast, land and soil issues associated with water-related land and soil issues (salinity, sodicity, groundwater and karst) and geoconservation values were not strongly identified by the respondents as impacting their activities in the region.

Priority land and soil issues

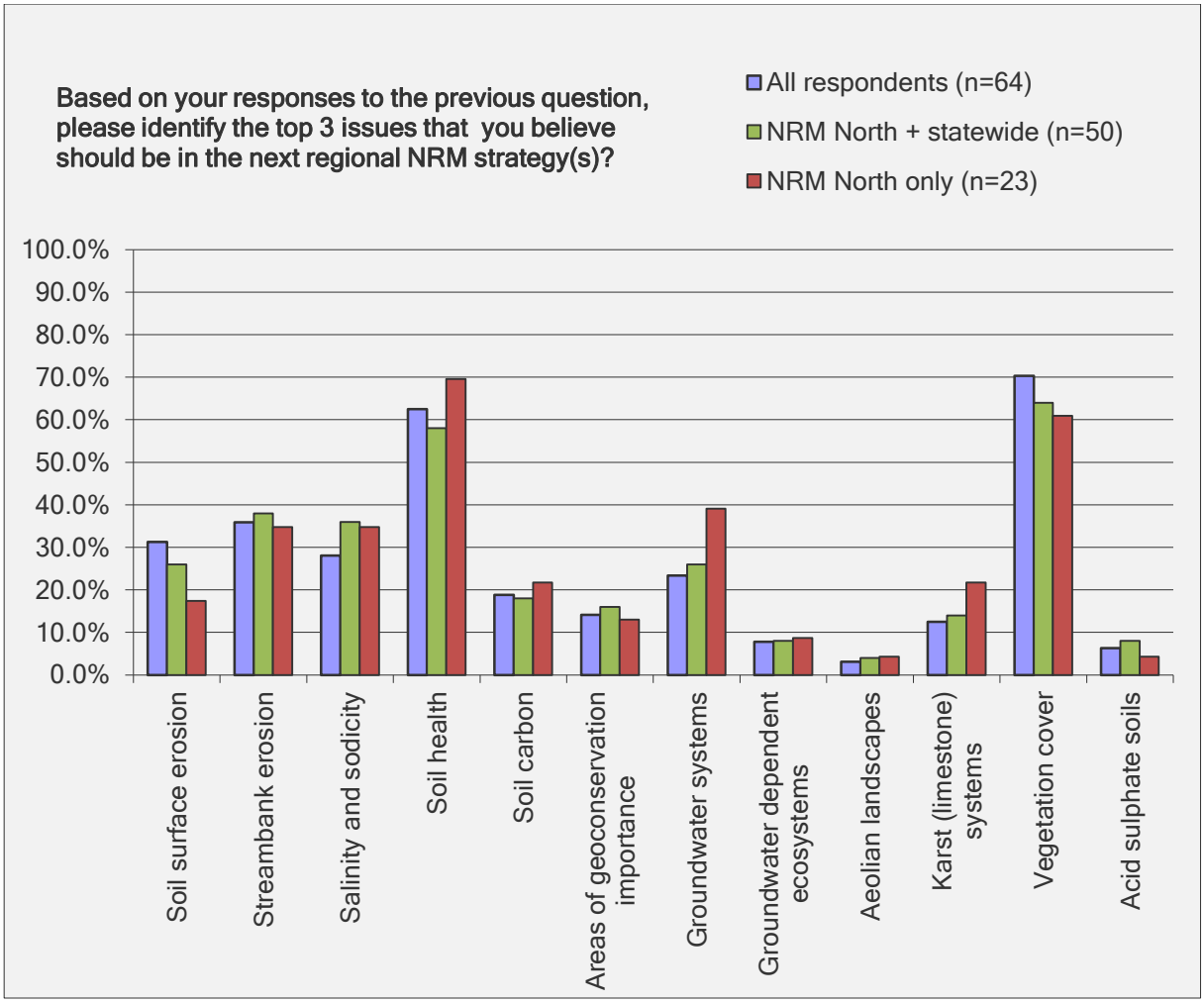


Figure 50 Survey responses – priority land and soil issues for next Strategy

The views among stakeholders on high priority land and soil issue for the next NRM North regional strategy were more strongly focused than those reported for current impact on management activities. Two issues – vegetative cover and soil health – were considered priorities by a very large margin over other issues. This may indicate recognition that these issues may deliver synergies across a range of issues, particularly those related to soil management. The lower priority ratings given to water-related land and soil issues is potentially of concern, as the asset analysis indicates these to be important, particularly in productive landscapes, and they are also likely to be significantly affected by climate change.

Climate change capacity

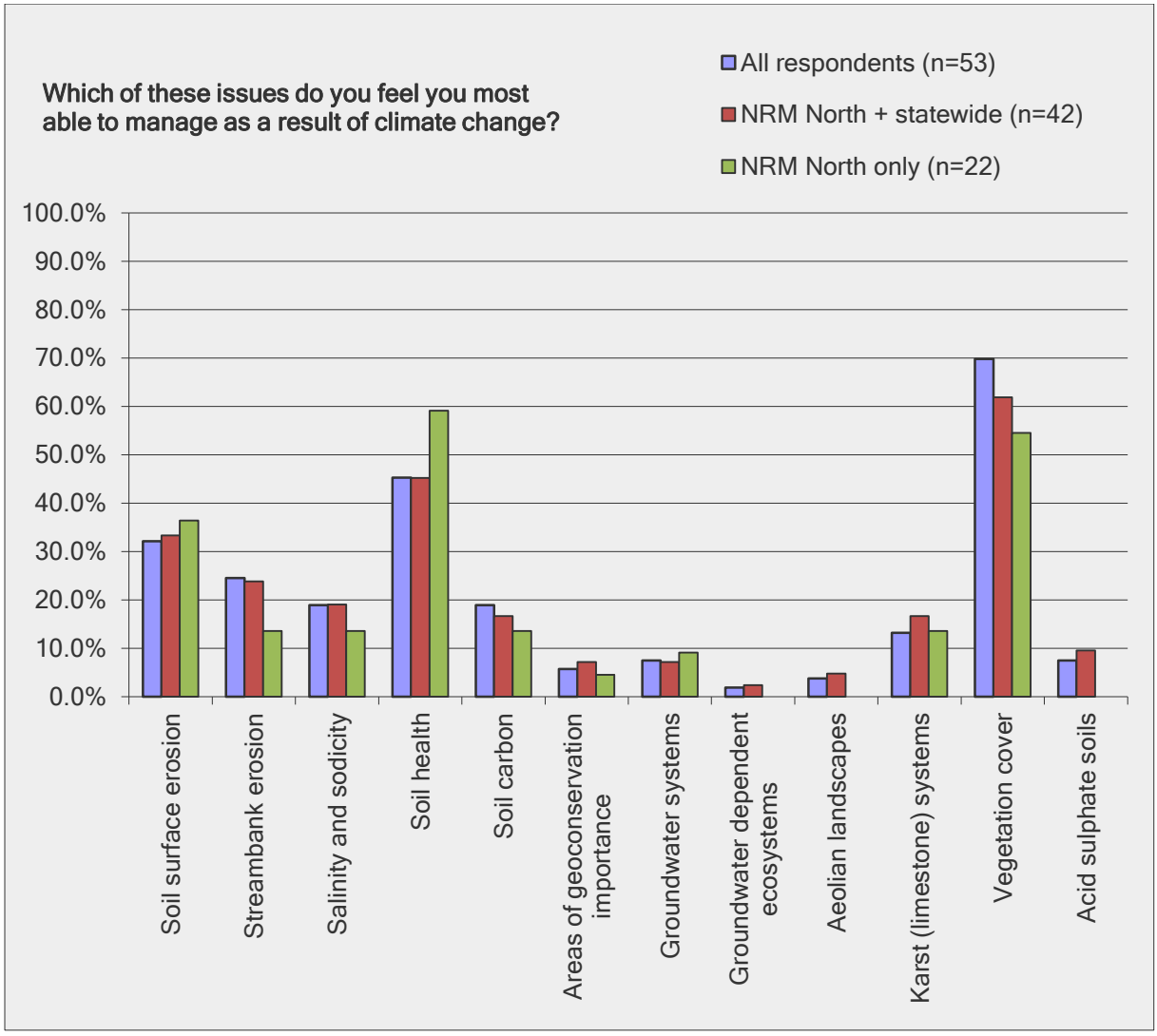


Figure 51 Survey response – management of land and soil issues from climate change

Respondents from the NRM North on the whole expressed relatively low levels of ability to manage land and soils issues as a result of climate change. As with impact and priority, surface erosion, streambank erosion, soil health and vegetation cover were most strongly identified as able to be managed. However vegetation cover was the only issue (70%) identified by more than 50% respondents as able to be managed. Soil health was also identified as able to be managed under climate change. Respondents with a focus only in the NRM North region had greater confidence to manage soil health under climate change that either the whole pool of respondents or the combined NRM North pool. However, reported ability to manage vegetative cover was lower for NRM North only respondents than for either the State-wide pool or the combined NRM North pool.

Low levels of reported ability to manage water-related land and soil issues may represent issues associated with skills, resourcing, coordination or a sense of the magnitude of the areas over which these issues need to be managed.

Capacity-impact deficit

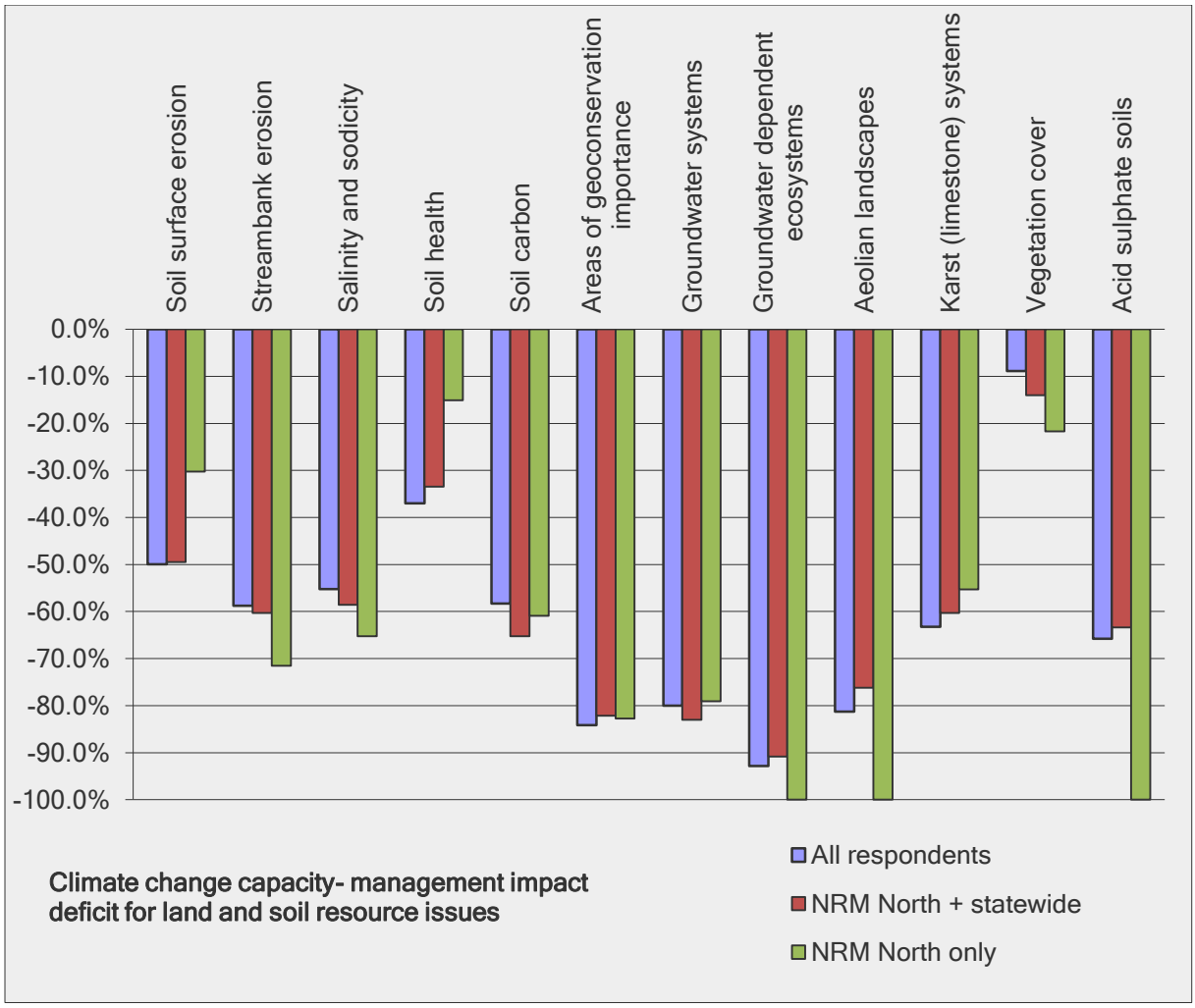


Figure 52 Survey responses – Climate change capacity-impact deficit for land and soil resources issues

The capacity-impact deficit for the NRM North region shows considerable variation. Vegetation cover and soil health remain distinct in having been reported as having a high impact on activities of respondents and relatively high reported ability to be managed under climate change. Three issues – groundwater systems, groundwater dependent ecosystems and acid sulfate soils show a similar pattern in having been reported as having low impact on regional respondents, relatively low priorities for the next NRM North strategy and low ability to manage under climate change.

The reported zero ability of NRM North only respondents to manage these issues is of concern.

Landscape perspectives

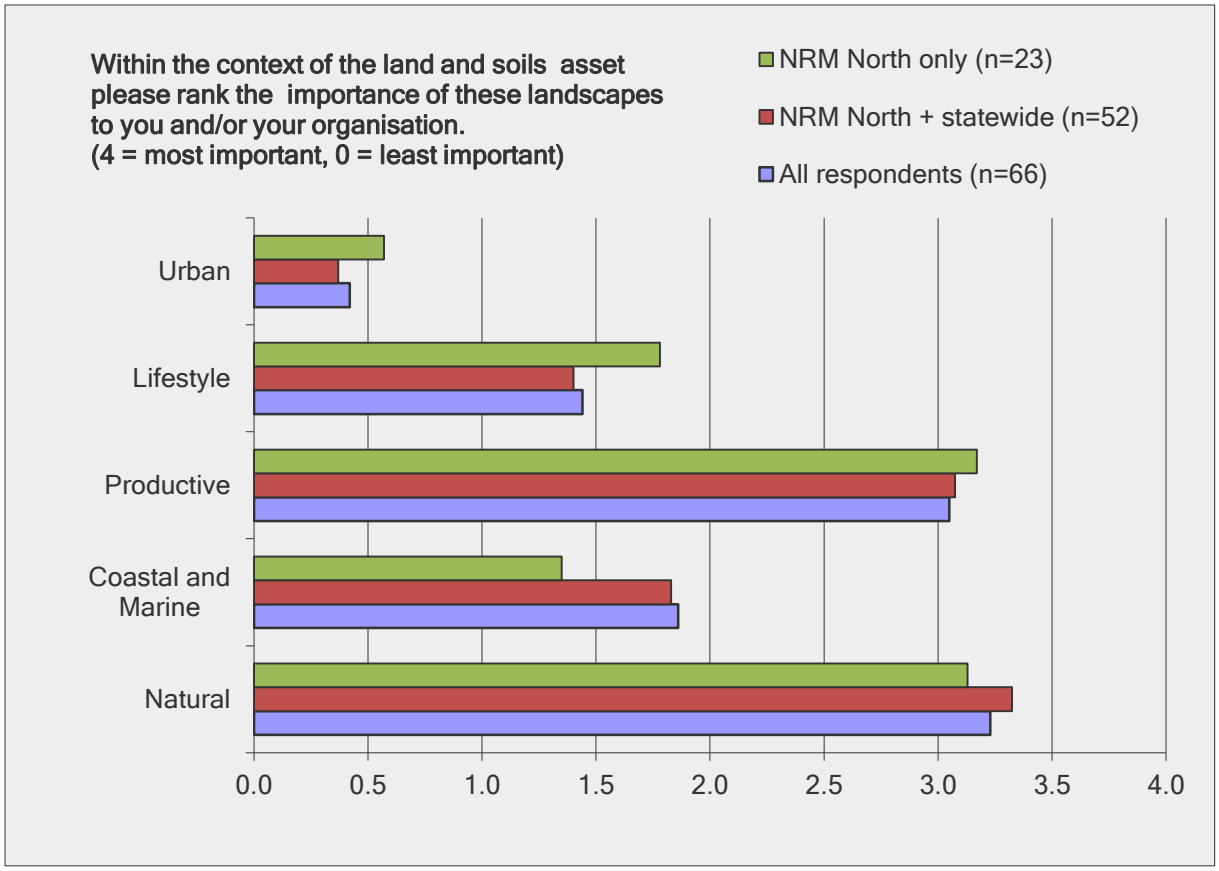


Figure 53 Survey responses, landscape importance for land and soils asset

Respondents were asked to identify the landscape they considered to be most important for management of land and soil issues. The results show a very strong recognition of natural landscapes and productive landscapes as important to respondents from the NRM North region. In contrast, urban landscapes were not seen as important to respondent organisations for land and soil management. The importance of the coastal and marine landscape to regional respondents is unusual and may indicate confounding around definitional issues.

6.5.1.3.2 NRM North – recommended land and soil focus areas

On the basis of the information in the previous sections and on notes and observations from stakeholder engagement sessions, three focus areas are recommended for the next NRM North regional strategy – soil management, vegetative cover, and water-related land and soils issues. These focus areas are considered to provide significant opportunities to achieve synergies and efficiencies in planning and implementation. They include in their scope all issues identified in the land and soil classification.

The proposed focus area on water-related land and soil issues is provided as a common recommendation for both the NRM North and NRM South regions due to the commonality of many issues within the scope and also underlying need for additional work to develop strategies to deliver NRM outcomes in this field.

A summary of key aspects of each of the three focus areas is presented in the tables below.

Land and soils focus area 1: soil management

Aspect	Description
Issues scope	Soil management for NRM North would include the issues of soil surface erosion, streambank erosion, salinity and sodicity (overlap with water-related land and soil issues), soil health, soil carbon, aeolian landscapes and acid sulfate soils (overlap with water-related land and soil issues).
Importance	Soil management fundamentally underpins much of agricultural production and is also important for aspects of biodiversity and carbon sequestration and storage. The high proportion of the NRM North region which is used for more production purposes, particularly and increasingly more intensive purposes, means the importance of this issue in the region is high. Risks to some aspects of soils are increased under climate change, particularly erosion and soil carbon reduction under extreme conditions.
Stakeholder perspectives	Five of the issues within this proposed focus area were ranked by respondents in the NRM North combined pool as in the top 5 issues for current impact on land and soil management. The group of issues as a whole was rated as moderate priorities for the next regional strategy and with also as only moderate ability to be managed under climate change.
Key delivery landscapes	Productive landscapes are considered to be the main priority for soil management in the next NRM North regional strategy.

Aspect	Description
Sub-regional aspects	Much of the data on soil management in Tasmania is dated. Identification of sub-regional priorities will be significantly enhanced by interpretation of the recent DPIPWE digital soil surface data for the state. However existing known areas of risk for soils (e.g. on light, sedimentary, dispersive and salt prone soils) are unlikely to change and will include areas of the northern coastal plain, northern midlands aeolian features.

Land and soils focus area 2: vegetative cover

Aspect	Description
Issues scope	Managing vegetative cover is recommended as a single issue focus area due to its important role in a wide range of soil and land issues. These relate particularly to its role in preventing soil erosion and land degradation, catchment scale impact on hydrology, maintaining soil health and productive capacity, and as a key tool in managing and restoring areas subject to past damage. Managing vegetative cover will also be important in helping manage extreme events such as drought or rainfall events, irrespective of whether they arise from 'natural' causes or as a result of climate change.
Importance	The issue is considered to be of high importance for the NRM North region.
Stakeholder perspectives	Managing vegetative cover was the most consistent and highly reported issue by NRM North respondents for the land and soils asset. It has a high current impact on management activities, is seen as a high priority for the next regional strategy, and is seen as being able to be managed under climate change. These results point to a significant opportunity for NRM North to promote activities that will have benefits across multiple assets and sectors of society.
Key delivery landscapes	Managing vegetative cover would be prioritised mainly in the productive and lifestyle landscapes.
Sub-regional aspects	Key issues in determining subregional priorities. In drier parts of the NRM North region (e.g. northern midlands, Fingal Valley) a focus on issues such as grazing management to prevent loss of cover (esp. in critical early-stages of drought periods) and on promoting resilience through diversifying pasture species and longevity (i.e. annual vs. perennial) might be considered. In parts of the region which have naturally higher rainfall or are predicted to have an increased frequency of extreme rainfall events a greater emphasis might be given to vegetative cover which has more substantive soil protection properties (e.g. tree and shrub retention and revegetation) in sensitive areas.

Land and soils focus area 3: water-related land and soil issues

Common recommendation for both the NRM North and NRM South regions.

Aspect	Description
Issues scope	The scope of the recommended focus area on water-related soil issues is intended to address the issues of groundwater systems, groundwater-dependent systems, karst and also potentially aspects of acid-sulfate soils management and salinity and sodicity (the latter also soil management issues). These issues are included as a common focus area due to limited understanding of the natural resource, its utilisation and potential implications of climate change. The scope of this issue is primarily a technical one to develop greater understanding of planning and management requirements and to feed that information into NRM planning and activity around other affected assets (e.g. soil management, biodiversity freshwater systems and coastal systems) and also to inform approaches to management of water-related land and soil features.
Importance	Water-related land and soil issues are part of the interface between freshwater aquatic systems and the more 'traditional' perception of land and soil management. Tasmania has many and varied groundwater flow systems but further work on a collaborative basis is needed to promote its effective management.
Stakeholder perspectives	Water-related land and soil issues were reported overall by both NRM North and NRM South as having a lower impact on current management, as the lowest priorities for both the NRM North and NRM South regional strategies, and as having low ability to be managed under climate change. It is considered that existing stakeholder networks for both regions underestimate the importance of these issues.
Key delivery landscapes	Productive and (to a lesser extent) lifestyle landscapes are likely to be the main areas where NRM activity would be best delivered. There will also be a role in coastal systems around issues such as altered groundwater flows and potential effects on acid-sulfate soils. Natural landscapes may be important for managing both water inputs to groundwater systems and also significant localised features (e.g. karst, groundwater dependent ecosystems).
Sub-regional aspects	Major sub-regional aspects of NRM activity around this focus area will need to be developed through a technical and stakeholder consultative process. Some major features of priority (e.g. the Mole Creek karst in the NRM North) can currently be identified but a systematic overview is lacking.

6.5.1.4 NRM South – land and soil discussion and recommendations

6.5.1.4.1 NRM South land and soils survey responses

Land and soils as core business

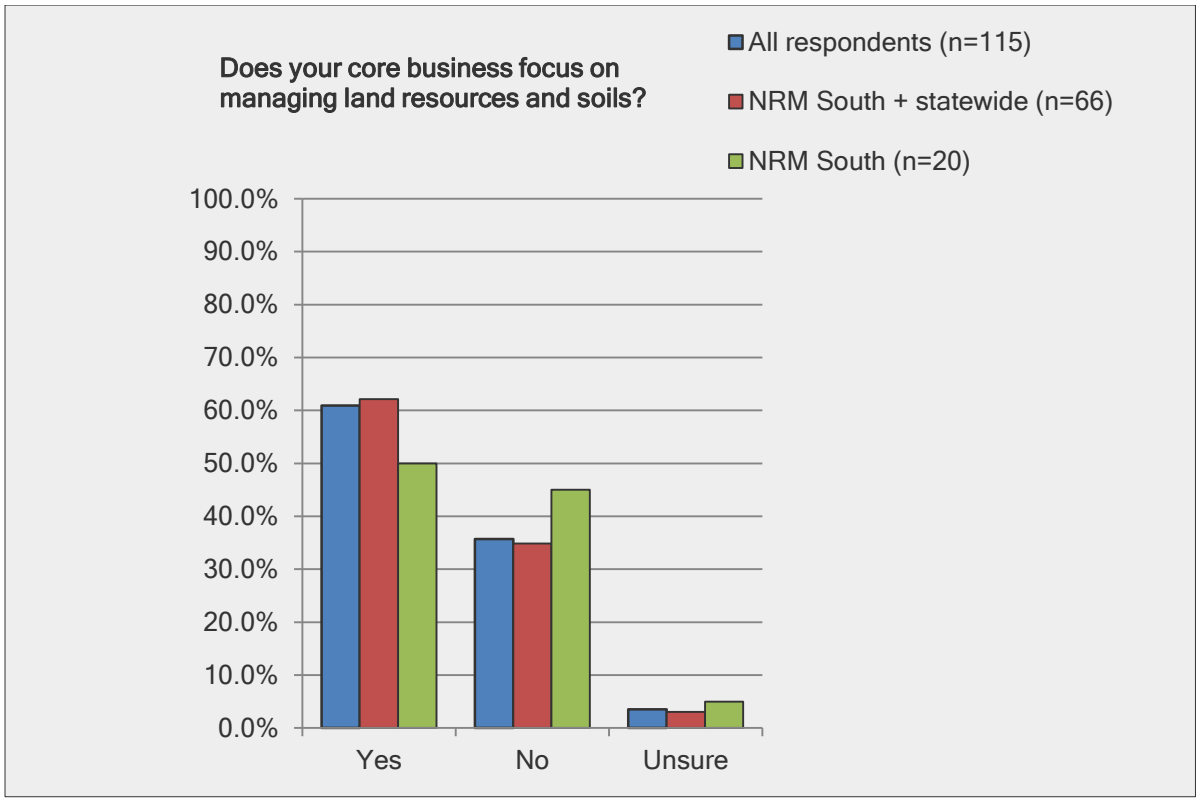


Figure 54 Survey results – land and soils as core business

A relatively large number of survey respondents provided information on land and soil resources for the NRM South region (n=66). Among the combined pools of respondents 62% identified land and soils as part of their core business.

Stakeholder impacts

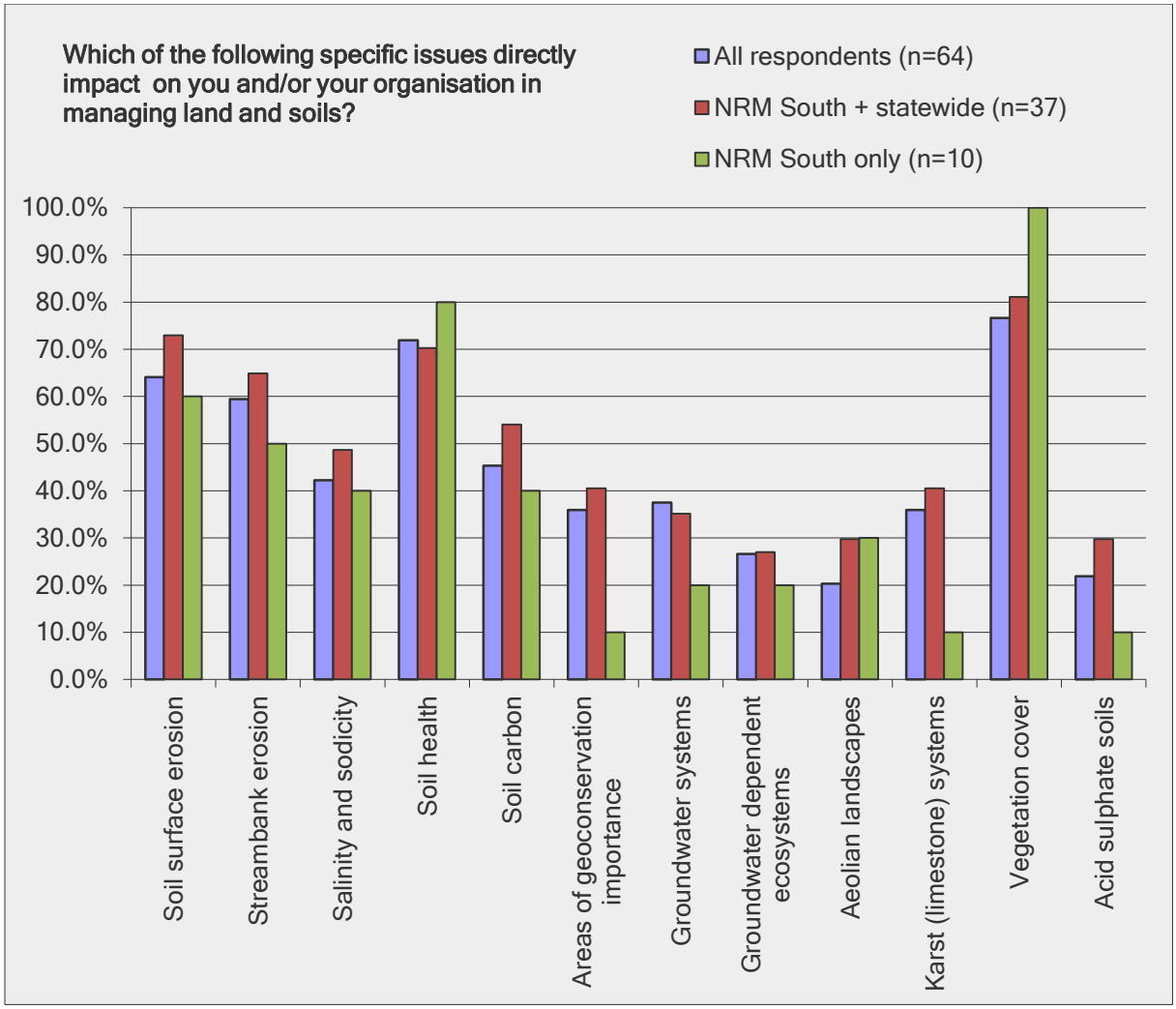


Figure 55 Survey results – stakeholder impacts

The effect of land and soil issues on stakeholder management activities in the NRM South region was relatively high (mean = 49.5%, minimum = 27%). Fiver issues – surface erosion, streambank erosion, soil health, soil carbon and vegetation cover – were indicated by over 50% of respondents as impacting their management. Five issues broadly related to soil management (surface erosion, streambank erosion, salinity and sodicity and soil carbon) form a higher set of responses than for the twelve issues as a whole (mean = 62%, minimum = 49%). Vegetation cover has the highest impact on respondents in the NRM South region (81%).

Priority land and soil issues

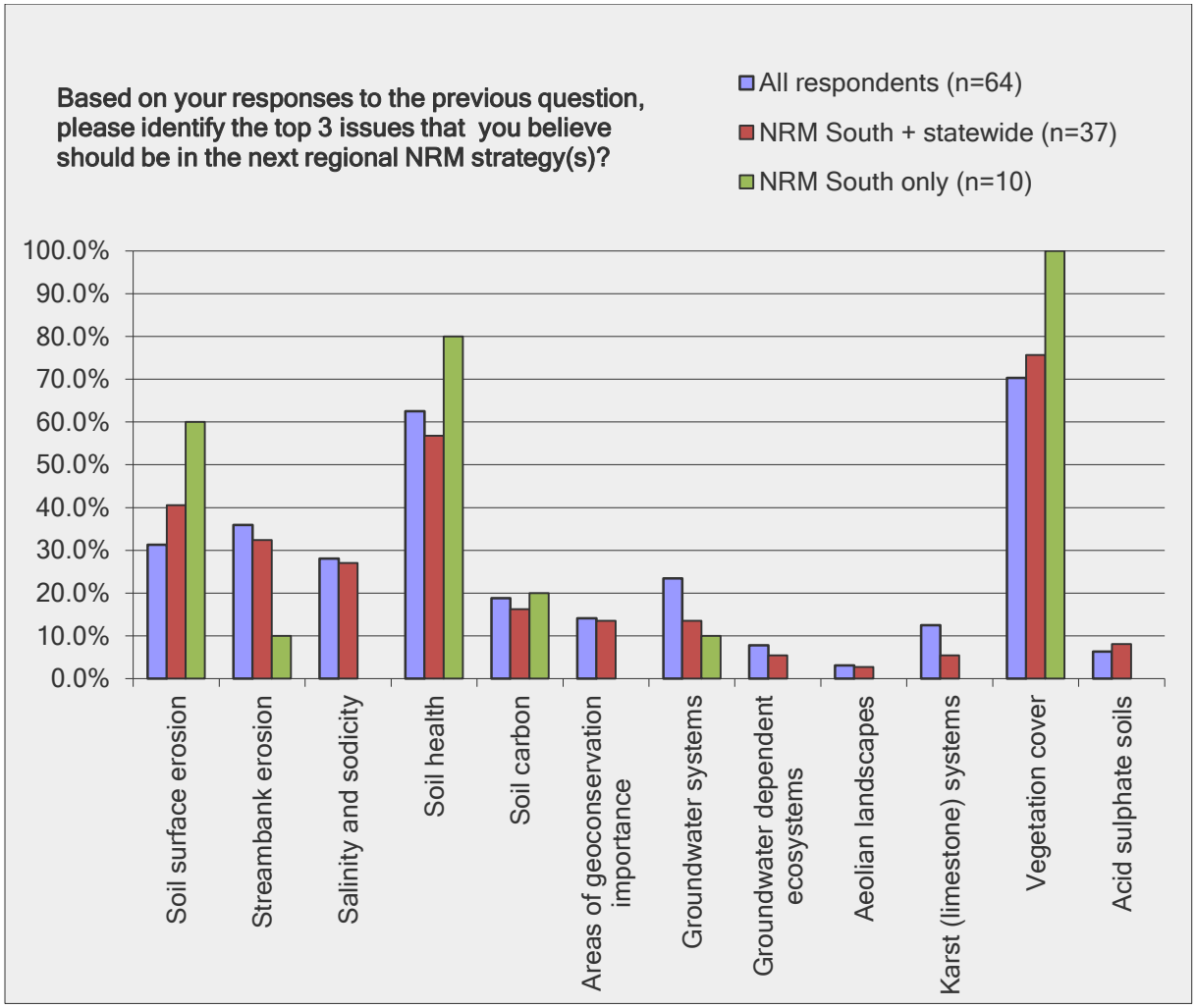


Figure 56 Survey results – stakeholder views

The views among stakeholders on high priority land and soil issue for the next NRM South regional strategy was more varied than the impact of the issues. The same five issues related to soil management– surface erosion, streambank erosion, salinity and sodicity, soil health and soil carbon – were reported as higher priorities than all other issues except vegetation cover, which was the most frequently reported priority (76%). All other issues – half of the total - were considered to be priorities by less than 20% of respondents. This indicates a skewed set of priorities among NRM South respondents.

Climate change capacity

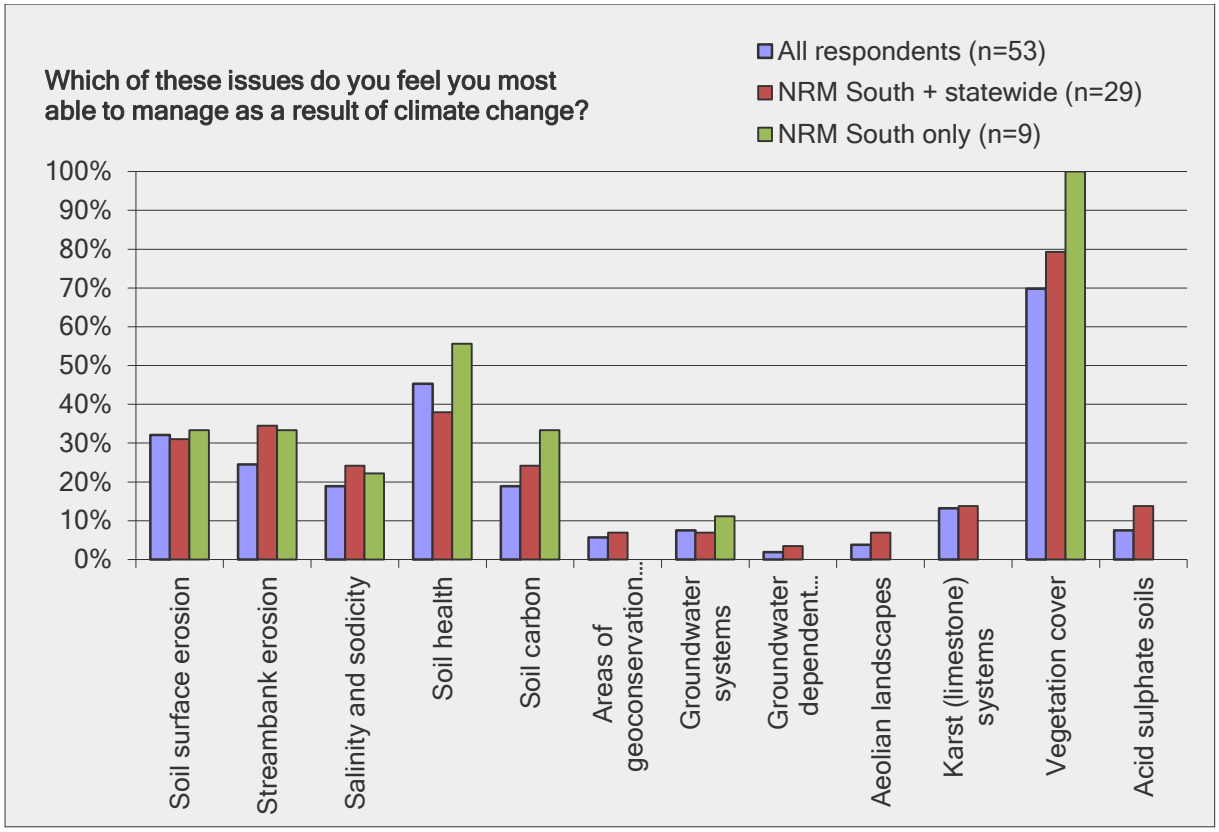


Figure 57 Survey results – stakeholder capacity

Reported ability of NRM South respondents to manage land and soil issues under climate change showed the same pattern as reported above for current impact and priorities for the next regional strategies, *viz:* a higher level of reported ability for five issues related to soil management (surface erosion, streambank erosion, salinity and sodicity, soil health and soil carbon) and the highest reported ability in the management of vegetative cover (79%).

Capacity-impact deficit

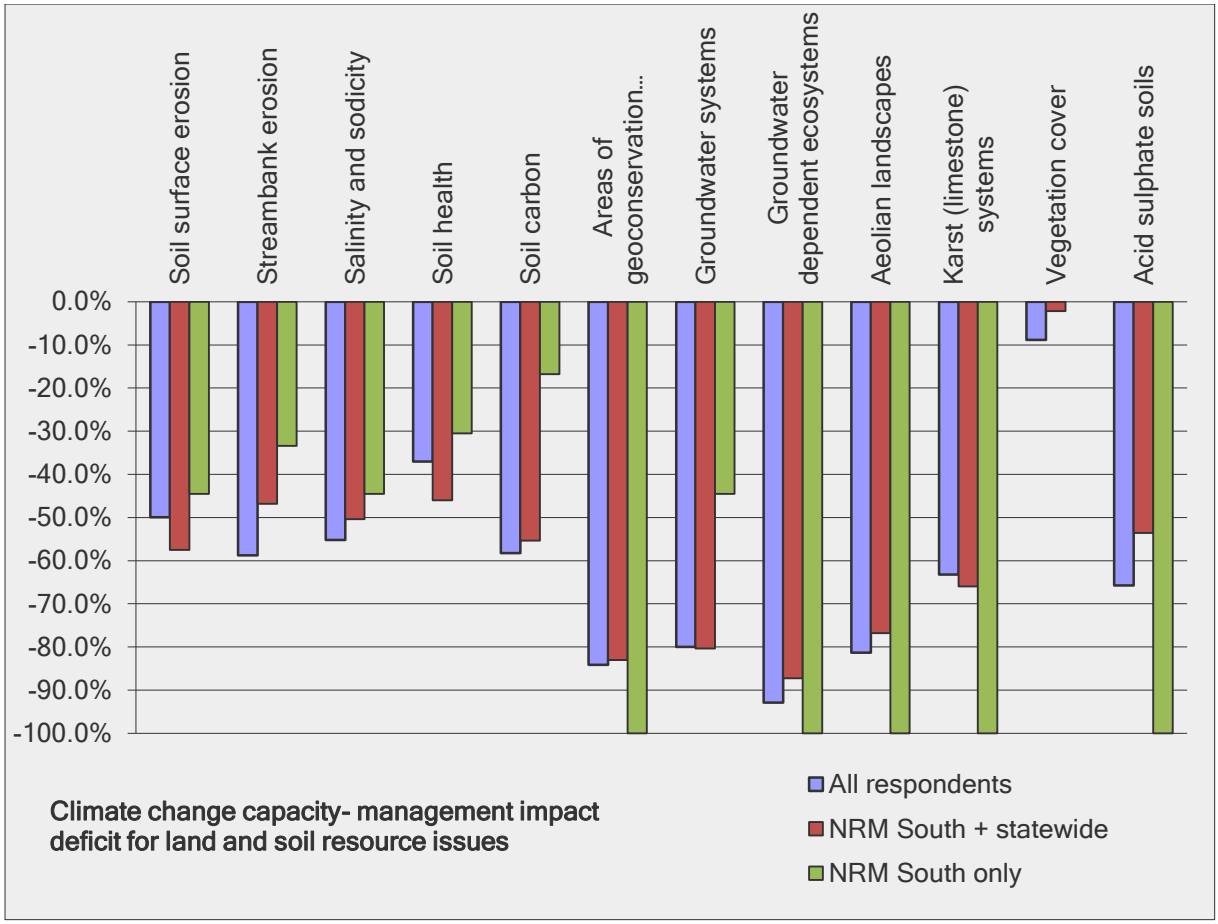


Figure 58 Survey results – stakeholder capacity-impact deficit

The capacity-impact deficit for land and soil issues in the NRM South regions shows almost the reverse of the pattern identified for current impact, regional strategy .priority. The issues with the lowest reported current impact, priority and manageability under climate change showed the greatest impact-capacity deficit. However, respondent numbers for these issues were low so need to be interpreted with caution. Managing vegetative cover was the issue with the lowest impact-capacity deficit among NRM South respondents, and the group of five issues associated with soil management showed moderate-high levels of change.

Landscape perspectives

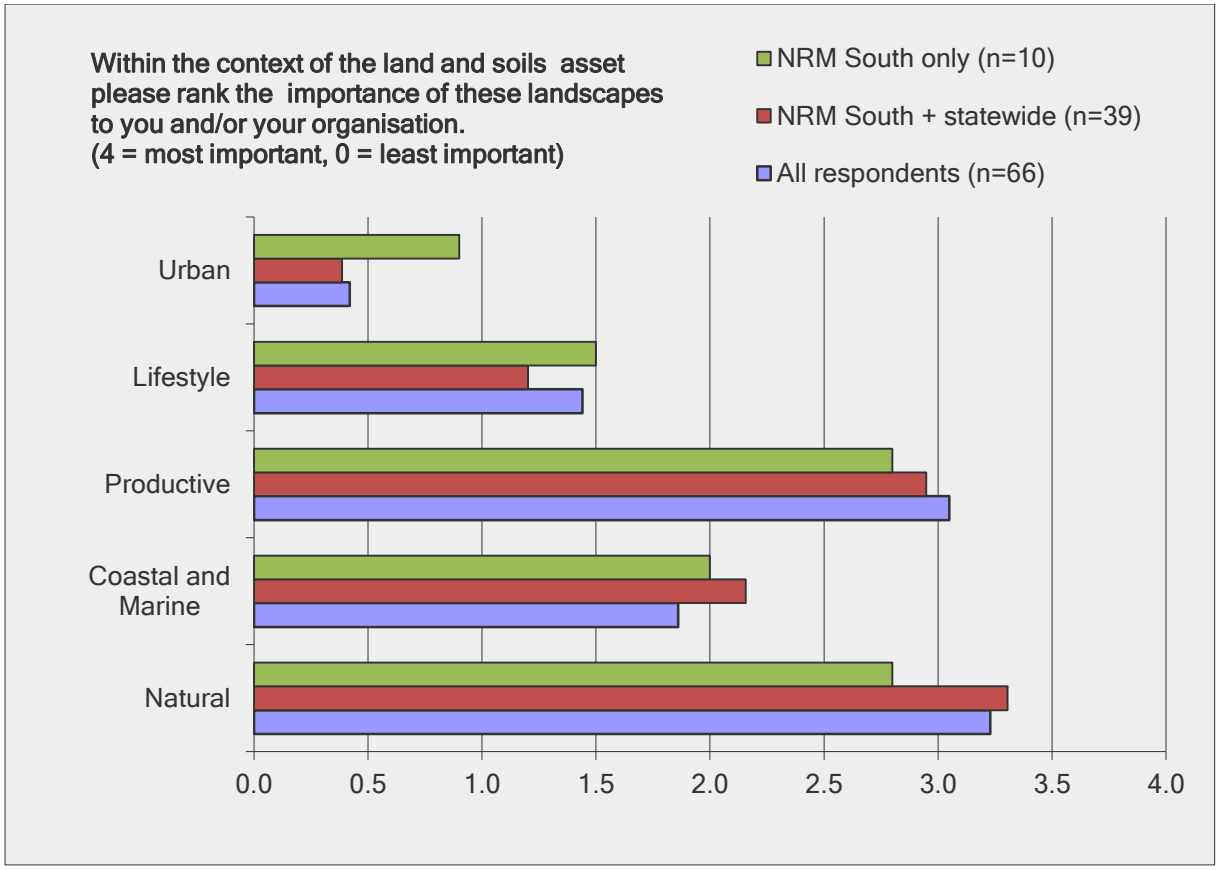


Figure 60 Survey results – landscape ranking

As with the results for NRM North, respondents from NRM South ranked natural landscapes as more important to their organisations than productive landscapes. Although the difference is relatively small, both landscapes occurring as near equal maxima is interesting. Also in common with NRM North, coastal and marine landscapes issues for NRM South were ranked as more important than lifestyle or urban landscapes, confirming observations from a number of the asset classes that perceptual issues around the boundaries of the coastal and marine landscape may need to be given attention in the NRM planning and implementation process.

6.5.1.4.2 NRM South – recommended land and soil focus areas

On the basis of the information in the previous sections and on notes and observations from stakeholder engagement sessions, three focus areas are recommended for the next NRM South regional strategy – soil management, vegetative cover, and water-related land and soils issues. These focus areas are considered to provide significant opportunities to achieve synergies and efficiencies

in planning and implementation. They include in their scope all issues identified in the land and soil classification.

The proposed focus area on water-related land and soil issues is provided as a common recommendation for both the NRM North and NRM South regions due to the commonality of many issues within the scope and also underlying need for additional work to develop strategies to deliver NRM outcomes in this field.

A summary of key aspects of each of the three focus areas is presented in the tables below.

Land and soils focus area 1: soil management

Aspect	Description
Issues scope	Soil management for NRM South would include the issues of soil surface erosion, streambank erosion, salinity and sodicity (overlap with water-related land and soil issues), soil health, soil carbon, aeolian landscapes and acid sulfate soils (overlap with water-related land and soil issues).
Importance	Soil management fundamentally underpins much of agricultural production and is also important for aspects of biodiversity and carbon sequestration and storage. Although a lower proportion of land in the NRM South region is used for agricultural production than in NRM North., it use is becoming increasingly more intensive, increasing the importance of these issues in the region. Risks to some aspects of soils are increased under climate change, particularly erosion and soil carbon reduction under extreme conditions.
Stakeholder perspectives	Five of the issues within this proposed focus area were ranked by respondents in the NRM South combined pool as in the top 5 issues for current impact on land and soil management. The group of issues as a whole was rated as relatively high priorities for the next regional strategy (exceeded only be vegetative cover) having similar ability to be managed under climate change.
Key delivery landscapes	Productive landscapes are considered to be the main priority for soil management in the next NRM South regional strategy. Some priority might be given to lifestyle landscapes, however these would be prudently restricted to areas where impact and risk are likely to be high. This landscape also needs to be considered in light of the important task of soil data interpretation presented below.
Sub-regional aspects	Much of the data on soil management in Tasmania is dated. Identification of sub-regional priorities will be significantly enhanced by interpretation of the recent DPIPWE digital soil surface data for the state. However existing known areas of risk for soils (e.g. on light, sedimentary, dispersive and salt prone soils) are unlikely to change and will include

Aspect	Description
	areas of the northern coastal plain, northern midlands aeolian features. Soil management within the NRM South region would be restricted predominantly to freehold land, as the extensive areas of public land in the region are subject to existing legislative and regulatory frameworks and procedures.

Land and soils focus area 2: vegetative cover

Aspect	Description
Issues scope	Managing vegetative cover is recommended as a single issue focus area in the NRM South region due to its important role in a wide range of soil and land issues. These relate particularly to its role in preventing soil erosion and land degradation, catchment scale impact on hydrology, maintaining soil health and productive capacity, and as a key tool in managing and restoring areas subject to past damage. Managing vegetative cover will also be important in helping manage extreme events such as drought or rainfall events, irrespective of whether they arise from 'natural' causes or as a result of climate change.
Importance	The issue is considered to be of high importance for the NRM South region, particularly parts of the region prone to significant drought (e.g. Derwent Valley).
Stakeholder perspectives	Managing vegetative cover is the most consistent and highly reported issue by NRM South respondents. It has a high current impact on management activities, is seen as a high priority for the next regional strategy, and is seen as being able to be managed under climate change. These results point to a significant opportunity for NRM South to promote activities that will have benefits across multiple assets and sectors of society.
Key delivery landscapes	Managing vegetative cover would be prioritised mainly in the productive and lifestyle landscapes.
Sub-regional aspects	Key issues in determining subregional priorities. In drier parts of the NRM South region (e.g. southern midlands, Derwent Valley) a focus on issues such as grazing management to prevent loss of cover (esp. in critical early-stages of drought periods) and on promoting resilience through diversifying pasture species and longevity (i.e. annual vs. perennial) might be considered. In parts of the region which have naturally higher rainfall or are predicted to have an increased frequency of extreme rainfall events (e.g. Tasman Peninsula) a greater emphasis might be given to vegetative cover which has more substantive soil protection properties (e.g. tree and shrub retention and revegetation) in sensitive areas.

Land and soils focus area 3: water-related land and soil issues

Common recommendation for both the NRM North and NRM South regions.

Aspect	Description
Issues scope	The scope of the recommended focus area on water-related soil issues is intended to address the issues of groundwater systems, groundwater-dependent systems, karst and also potentially aspects of acid-sulfate soils management and salinity and sodicity (the latter also soil management issues). These issues are included a common focus area due to limited understanding of the natural resource, its utilisation and potential implications of climate change. The scope of this issue is primarily a technical one to develop greater understanding of planning and management requirements and to feed that information into NRM planning and activity around other affected assets (e.g. soil management, biodiversity freshwater systems and coastal systems) and also to inform approaches to management of water-related land and soil features.
Importance	Water-related land and soil issues are part of the interface between freshwater aquatic systems and the more 'traditional' perception of land and soil management. Tasmania has many and varied groundwater flow systems but further work on a collaborative basis is needed to promote its effective management.
Stakeholder perspectives	Water-related land and soil issues were reported overall by both NRM North and NRM South as having a lower impact on current management, as the lowest priorities for both the NRM North and NRM South regional strategies, and as having low ability to be managed under climate change. It is considered that existing stakeholder networks for both regions underestimate the importance of these issues.
Key delivery landscapes	Productive and (to a lesser extent) lifestyle landscapes are likely to be the main areas where NRM activity would be best delivered. There will also be a role in coastal systems around issues such as altered groundwater flows and potential effects on acid-sulfate soils. Natural landscapes may be important for managing both water inputs to groundwater systems and also significant localised features (e.g. karst, groundwater dependent ecosystems).
Sub-regional aspects	Major sub-regional aspects of NRM activity around this focus area will need to be developed through a technical and stakeholder consultative process. Some major features of priority (e.g. the Mole Creek karst in the NRM North) can currently be identified but a systematic overview is lacking.

6.5.2 Asset class: Land – Asset: biodiversity

6.5.2.1 Biodiversity - classification

Classification: Twelve major issues were identified from the document review as most important for managing biodiversity and were included in the stakeholder survey.

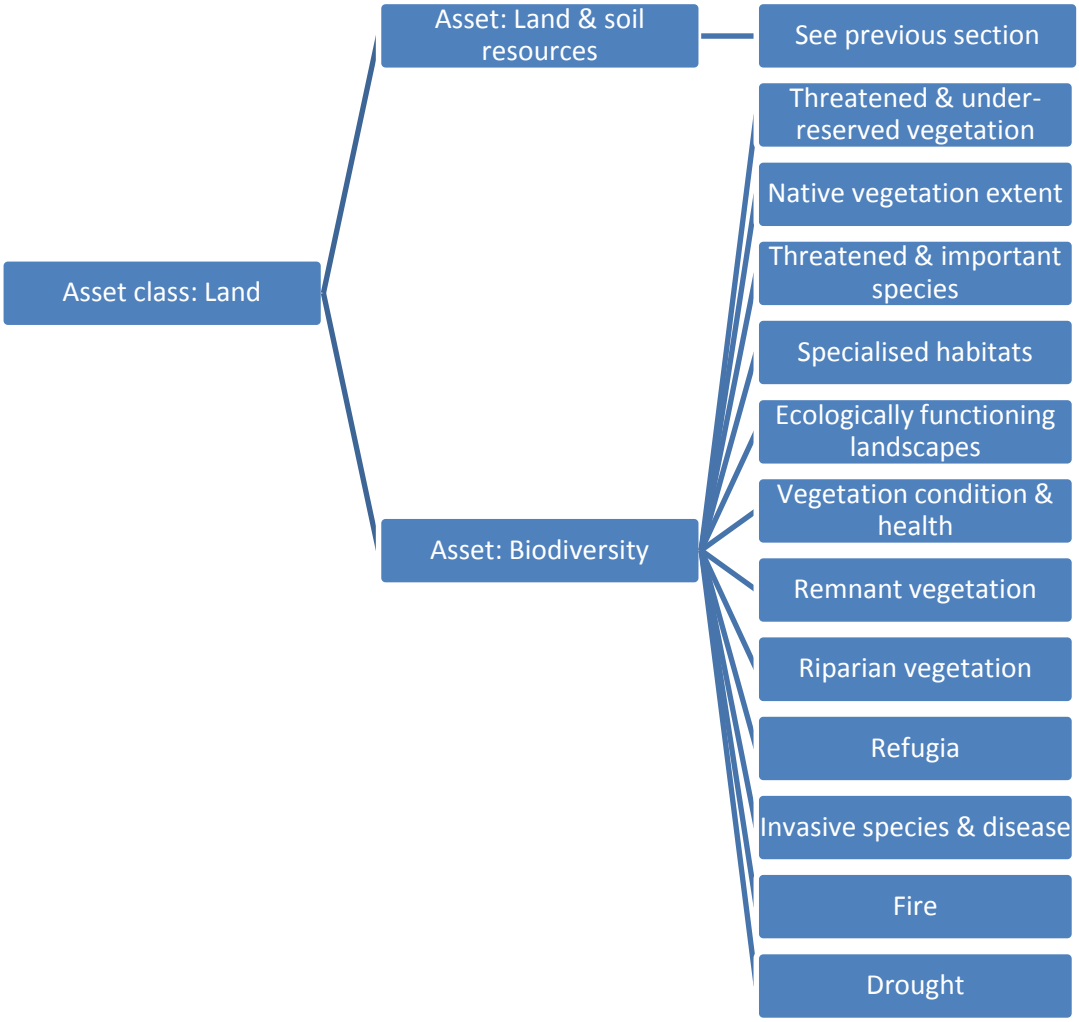


Figure 59 Biodiversity asset classification

6.5.2.2 Asset: Biodiversity - asset knowledge and status assessment

6.5.2.2.1 Issue: threatened and under-reserved vegetation

Asset issue	Description
Contextual summary	Threatened vegetation are vegetation communities listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or *Nature Conservation Act 2002*. Under-reserved vegetation are vegetation communities which do not have sufficient area in conservation reserves, and whose representation in reserves does not match its distribution across the landscape and does not include adequate examples of the natural variation within the communities (i.e. comprehensive, adequate and representative[101]).
Current knowledge	A range of native vegetation communities are listed as threatened under the schedules of the *NC Act*. A smaller number of vegetation communities are listed under the *EPBC Act*. There is limited commonality across the current listings (see knowledge gaps). Tasmania's system of conservation reserves is extensive but is not complete. Some vegetation communities have very low levels of reservation and occur predominantly on private land where options and availability of land for reserves may be limited.
Change, pressures, climate change	Pressures on threatened and under-reserved vegetation are discussed below for native vegetation extent. Some threatened native vegetation continues to be approved by Governments and Councils and some illegal clearing also occurs. There have been substantial advances in improving reservation on public and private land since but currently there is limited activity in this area other than from non-Government organisations. The effects of climate change on native vegetation generally (see below) are likely to be magnified for threatened and under-reserved vegetation. Some threatened communities (e.g. lowland grasslands) may contract further, while others (e.g. alpine ecosystems) are likely to become threatened and have a high probability of disappearing altogether. Some events consistent with climate change patterns have already been reported[102]. Climate change poses significant problems for traditional concepts of the reserve system, due to change in the distribution of communities and potential emergence of 'novel' communities[103]. However there is also some evidence from Europe that well managed reserves may make vegetation more resilient

[101] Commonwealth of Australia (1997).
[102] Visoui & Whinam (2015).
[103] Hobbs *et al.* (2009).

Asset issue	Description
	to climate change[104]. Potential impacts of climate change on some threatened vegetation communities has been assessed[105]. Engineering solutions to protect property and infrastructure may also lead to a conflict between competing interests (e.g. increased bushfire risk may see increased pressure for removal of threatened vegetation types).
Key data, information and resources	***State-wide or NRM North and NRM South*** • Data on the distribution of threatened vegetation in Tasmania is readily available through Tasveg; however it is limited around issues of reliability. • DPIPWE publishes an annual assessment of the area of each vegetation community in conservation reserves by State, bioregion, NRM region and municipality but it is not tied to a framework for adequacy of reservation. • The Tasmanian Land Conservancy has developed processes for assessing the adequacy of reservation across all vegetation types but the results have not yet been published. Assessment of forest reservation against target levels has also been completed and updated[106]. • An updated assessment of bioregional reservation levels of forest ecosystems and old growth forests against the JANIS targets framework has been prepared for Forestry Tasmania and reflects changes from passage of the *Tasmanian Forests (Rebuilding the Forestry Industry) Act 2014*[107]. ***Known issues*** • The transfer to from the Tasveg 2.0 classification to Tasveg 3.0 has resulted in there no longer being a clear relationship between listing under the *Nature Conservation Act 2002* and mapped communities in Tasveg 3.0. However, the number of communities is small and their distribution and extent relatively limited. • There is a significant backlog in the assessment of threatened communities under the *EPBC Act*, particularly forest vegetation types. • Threatened ecosystems lists do not yet include all communities that may be threatened by climate change. • Available vegetation mapping has varying levels of reliability and frequently requires field verification.

[104] Yirrkala *et al.* (2014).
[105] Department of Primary Industries, Water & Environment (2010).
[106] Knight (2014a), Attachments 10 & 11.
[107] Knight (2014b).

Asset issue	Description
	• Some *EPBC Act* listed vegetation communities to not nest within the available mapping systems (e.g. lowland native grasslands, *Callitris oblonga-Eucalyptus ovata* forest) and so are not identifiable within Tasveg.
Regional considerations and recommendations	• Threatened and under-reserved native vegetation are addressed under the recommended focus area for biodiversity special values.

6.5.2.2.2 Issue: native vegetation extent

Asset issue	Description
Contextual summary	Native vegetation extent is an attempt to measure the adequacy of the non-reserved areas to support biodiversity generally outside of reserves (i.e. the elements of biodiversity not subject to focused conservation attention).
Current knowledge	The issue of native vegetation extent is closely related to the concept of ecologically functioning landscapes. The State Government's permanent forest estate policy[108] provides for minimum levels of forest vegetation to be maintained on a State-wide and bioregional basis. There is no equivalent assessment of non-forest vegetation. It is important to note, however, that the effects of native vegetation can have influences at multiple scales[109], so simple measures such as State or bioregional extent may be misleading.
Change, pressures, climate change	Native vegetation extent has continued to be reduced in Tasmania, however the types of vegetation lost has varied over time. Major losses were in dry forests to agriculture in the 1980s[110], and in dry and wet forests for plantation establishment in the late 1990s – early 2000s. Clearing slowed substantially after this time but has continued in some activities (e.g. urban expansions, agricultural expansion and intensification). Climate change may have limited impact on the extent of native vegetation *per se* but is likely to affect the composition of the vegetation communities. Vegetation at the drier end of the spectrum is more likely to be lost.

[108] Tasmanian Government (2007).
[109] For example see Cunningham *et al.* (2014).
[110] Kirkpatrick (1991).

Asset issue	Description
Key data, information and resources	***State-wide or NRM North and NRM South*** • Current data on native vegetation extent is available from Tasveg 3.0. • RFA data provide (vegetation combined with biophysical naturalness) provide data on native vegetation extent in 1996. • The Tasmanian Land Conservancy has analysed change from 1996 to 2013 using the Tasveg 2.0 classification by community and bioregion. ***Known issues*** • Not significant except perhaps for ongoing improvement to identifying vegetation threatened by climate change and also early indicators of the effects of change, i.e. ability to access data on shorter intervals at higher frequency.
Regional considerations and recommendations	• Native vegetation extent is included in the recommended focus area of ecologically functioning landscapes. Use of indicators around this issue will require some development of the scales at which it should be applied.

6.5.2.2.3 Issue: threatened and important species

Asset issue	Description
Contextual summary	Threatened species are those listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* and/or *Threatened Species Protection Act 1995.* Important species are species not listed as threatened but which have been credibly identified as being of conservation concern or significance. This issue might also be called 'priority species'.
Current knowledge	Lists of Tasmanian threatened species are considered relatively complete. They are also updated on a regular basis with listing of new species, changes in status of listed species and delisting of species no longer considered threatened. Knowledge of the distribution of many priority species is good and improvements are regularly reported. Population size and trends are less well known and are patchy across species and species groups. Knowledge of the management needs of priorities is varied.

Change, pressures, climate change	Activities affecting threatened species are regulated under the *EPBC Act* and *TSP Act*. Other regulatory provisions also apply, for example through the Forest Practices System and local council planning schemes. Some loss of priority species sites and habitat occurs through approval of some development and land use activity, illegal activities (sometimes reported but extent unknown) and ignorance. Some loss of species sites and habitats occurs as part of overall management regimes designed to maintain populations. Major pressures apply to many threatened species in certain parts of the State. For example the many threatened species that occur in dry woodlands and grasslands are heavily dependent on land management practices that are not always aligned with species requirements. Climate change pressures on Tasmania's priority species are substantial and appear likely on the whole to increase due to many of the characteristics that already predispose them to risk[111].
Key data, information and resources	***State-wide*** • Data on threatened and priority species is extensive and widely available. Recorded locations of all but a few highly sensitive species are available through the Natural Values Atlas. Data and knowledge on species habitats is variable and spatial habitat models exist for some species. • Prioritisation of threatened species recovery has been completed for the three Tasmanian NRM regions[112]. • Species range and habitat boundary polygons are available for selected threatened and priority species in the Natural Values Atlas. • Spatial habitat models for about 100 priority fauna species, based on Forest Practices Authority habitat descriptions, have been developed[113]. ***Known issues*** • Data and knowledge gaps around threatened species are inevitable. • Knowledge and gaps are substantial for some species but far less so for others. • Available species models are often purpose-specific and based on limited data. • 'Critical habitat' for threatened species under the *TSP Act* has not been determined for any listed species.

[111] Department of Primary Industries, Water & Environment (2010).
[112] Threatened Species Section (2010).
[113] Knight (2014a), Attachment 7 and unpublished update.

Regional considerations and recommendations	• Threatened and important species are included in the recommended focus area for biodiversity special values. • Information and knowledge around priority species is extremely complex and often highly specialised and cannot be dealt with thoroughly here. The recommended information systems approach for NRM data and information management is particularly relevant for this issue.

6.5.2.2.4 Issue: specialised habitats

Asset issue	Description
Contextual summary	Specialised species habitats are those that support identified assemblages of species that have common habitat or management requirements. Species assemblages may include threatened and non-threatened species. This issue might also be called 'priority species groups'.
Current knowledge	Priority species groups are usually identified because of knowledge of the commonality of habitat or life cycle requirement or threats. A number of species groups associated with specialised habitat are recognised in Tasmania. Hollow dwelling species (n=29) and cave fauna are priority species groups under the Regional Forest Agreement due to reduction in availability of mature eucalypt abundance and restricted, specialised and sensitive habitat respectively. Woodland birds are a recognised species group due to widespread and declining populations due to a range of factors. Shorebirds are another species group with specialised habitat requirements (see coastal and marine systems below).
Change, pressures, climate change	Currently recognised specialised species habitats have arisen primarily out of recognition of threats of common threats or pressures on their species assemblages. Pressures on hollow dwelling species arise from a number of causes, including removal of mature eucalypts in forest operations, land clearing and loss of trees in urban (often for safety) and agricultural areas (tree decline). Expansion of irrigation has resulted in removal of many paddock trees, from areas where abundance was already low, due to the inflexible configuration of pivot irrigators. Arrangements for managing mature eucalypt habitat at the landscape scale are well advanced for public native forests but remain relevant for private land. Lag time for replacement of mature eucalypts is of the order of centuries irrespective of environment, with current trajectories of decline particularly in

Asset issue	Description
	paddock trees of great concern. Loss of mature eucalypts in agricultural areas is likely to accelerate under climate change induced drought and regenerative events may decrease in frequency and survival. Increase in fire frequency and intensity associated with climate change is also likely to accelerate loss of mature eucalypts. These effects are also likely to apply to woodland birds to be accentuated through loss of habitat structural diversity – a key driver of decline in this group.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Forest Practices Authority data is available on the predicted abundance of mature eucalypt habitat across the State[114], and is updated on a regular basis. Data on density of habitat at multiple scales is also available[115]. • Data on cave fauna is available from the Natural Values Atlas, from karst mapping and as some species models (see threatened and priority species above). ***Known issues*** • Data on habitat for woodland birds is incomplete. Tasveg maps dry eucalypt forests but does not distinguish forest and woodland forms. Data on tree density is however contained within Forestry Tasmania's air photo interpretation database but has variable accuracy over agricultural land. Data that might inform assessment of habitat quality for woodland birds is limited (see discussion on vegetation condition below).
Regional considerations and recommendations	• Specialised habitats for biodiversity are included in the recommended focus area for biodiversity special values.

[114] Koch (2011).
[115] At the time of writing this data had been identified as containing a\systematic error and in need of updating.

6.5.2.2.5 Issue: ecologically functioning landscapes

Asset issue	Description
Contextual summary	Ecologically functioning landscapes are those that can maintain the composition, functions and processes of their biodiversity. They also provide important ecosystems services.
Current knowledge	Ecologically functioning landscapes are an issue in biodiversity as ecological function has been reduced over large areas, particularly heavily cleared agricultural landscapes. A wide range of factors have been identified as contributing to landscape scale ecological function; however the effects of various factors are variable and often specific or important only to particular species or species groups. There is however reasonable consensus that heavily cleared landscapes have reduced landscape function and have and/or will continue to suffer decline in biodiversity, including through the existence of 'extinction debt' for species still extant but in irreversible decline[116]. Factors influencing landscape ecological function include the pattern and magnitude of past clearing, connectedness of extant vegetation, vegetation patch size and habitat quality within patches. Configuration and quality of habitat have been identified as important in moderately cleared landscapes but below a threshold values may be of reduced importance than the quantity of habitat alone[117].
Change, pressures, climate change	Ecological function of Tasmanian landscapes is on the whole high, with the exception of heavily cleared agricultural landscapes. These areas are likely have continued to decline even in the absence of high rates of land clearing in these areas, principally due to continuing degradation of remnants, removal and death of paddock trees (keystone ecological structures[118]), habitat modification (e.g. deer), inappropriate fire regimes, and existing extinction debts. The impact of climate change on these factors is likely to accelerate loss of ecological function. In addition, climate change induced changes to species assemblages may induce changes which cannot be predicted. The potential for unexpected, rapid and irreversible collapse of some ecosystems or of the ecosystems in some areas as a result of climate change is real. Maintaining connectivity or establishing corridors for species movements is frequently identified as

[116] James & Saunders (2001).
[117] Doerr *et al.* (2013).
[118] Manning *et al.* (2006).

Asset issue	Description
	important under climate change; however some research indicates that this will not be effective[119].
Key data, information and resources	***State-wide or NRM North and NRM South*** • Data relevant to a range of factors affecting landscape ecological function are discussed below (remnants, riparian vegetation and condition). • A fine-scale (0.1 ha) integrated spatial assessment of landscape ecological function is available in NRP's regional ecosystem model[120]. • Tools such as GapCLOSR can provide assessment of landscape function for individual species. ***Known issues*** • Data and knowledge gaps around landscape ecological function are substantial due to the complexity of natural systems and also of the range of influences. • Ongoing assessment to compare outputs from different methods is probably required in order to establish ranges of plausible outcomes, much as occurs for predictions of climate change. • Almost all planning for effective outcomes for ecologically functioning landscapes requires some field assessment.
Regional considerations and recommendations	• Ecologically function landscapes are a recommended focus area for both NRM North and NRM South.

[119] Donatiu (2009).
[120] Knight & Cullen (2010a).

6.5.2.2.6 Issue: vegetation condition and health

Asset issue	Description
Contextual summary	Vegetation condition and health are the structure, composition, health and trajectory of vegetation communities at a site.
Current knowledge	Current knowledge of vegetation condition in Tasmania is relatively advanced. Vegetation Condition Benchmarks have been established for Tasmanian native vegetation communities[121] that incorporate both site and landscape attributes[122]. A range of other methods have been developed for different purposes, including specific projects[123], site based activities[124], and for rapid assessment to facilitate mapping[125]. State-wide spatial data on biophysical naturalness (a measure of condition) was produced for the RFA process[126], and has recently been updated using a combination of limited field surveys and updated disturbance data from Forestry Tasmania's PI-type database[127]. Factors affecting vegetation condition in Tasmania are diverse. Activities such as forestry have known impacts and assessments on condition that form part of management. Vegetation condition across much of the agricultural areas of Tasmania is variable but a large proportion is disturbingly poor (and getting poorer).
Change, pressures, climate change	Changes to vegetation condition across Tasmania have not been directly measured and is likely to be variable but on the whole is probably declining. Key declines are in remnant vegetation on agricultural land, in cutting of mature forest stands, and in urban and peri-urban areas due to lack of management, fire, weeds and disease. Climate change is likely to increase pressure on vegetation condition from all these factors, particularly through the effects of drought, fire, changes to keystone species (e.g. pollinators, ecosystem engineers) and plant and animal diseases. Actual effects will occur concurrently with land management and be difficult to anticipate, thus requiring use of indicators and trigger points. Impacts may also occur from adaptation trade-offs (e.g. more aggressive fuel reduction burning).

[121] Michaels (2006).
[122] Confounding site condition with landscape context in this type of methods has been criticised. See McCarthy *et al.* (2004).
[123] Assessment Method Advisory Panel (2007), Eigenraam *et al.* (2007), Green & Sprod (2007).
[124] Barnes & McCoull (2002).
[125] Knight & Cullen (2010b).
[126] Tasmanian Public Land Use Commission (1996).
[127] Natural Resource Planning Atomic Planning Units spatial data layer. Unpublished.

Asset issue	Description
Key data, information and resources	***State-wide or NRM North and NRM South*** • Data on vegetation condition exists in various locations, although its integration with other important and related data is limited. • An updated State-wide layer of biophysical naturalness has been produced (2013 data)[128]. It has limitations but is the only complete coverage of vegetation condition currently available. • Relatively large holdings of relevant spatial are held by DPIPWE, Forestry Tasmania, Forest Practices Authority and Natural Resource Planning. ***Known issues*** • Some data may exist but have privacy constraints on its use. • Newer methods of data collection, such as satellite and LiDAR interpretation, provide scope for substantial improvement to vegetation condition mapping. • The existing State-wide spatial layer of biophysical naturalness has not captured all available data and accuracy and reliability are limited by input data attributes.
Regional considerations and recommendations	• Vegetation condition and health are included in the recommended focus area for ecologically functioning landscapes. • In many cases addressing biodiversity special values (a recommended focus area) will require management of vegetation condition and health.

[128] Natural Resource Planning spatial data prepared for forestry Tasmania. See pp19-21 in Knight (2014a).

6.5.2.2.7 Issue: remnant vegetation

Asset issue	Description
Contextual summary	Remnant vegetation is islands of native vegetation, below a specified size, that are surrounded by cleared land. Remnant vegetation has been identified as being of critical importance to landscape function and biodiversity.
Current knowledge	Biodiversity aspects of remnant vegetation have been extensively studied (not reviewed here). Research on remnants has examined characteristics such as size, shape, edge, isolation, condition and history. Although research has identified remnants as important, there is wide variation in their role for individual species and groups, in the influence of some factors but not others, and the effects of land use. Small remnants have not been universally found to be less important than larger remnants[129]. Prioritisation of remnants was included in the RFA process, which used a size threshold of <200 ha[130], and also in the national forest reserve criteria[131].
Change, pressures, climate change	There is some evidence that investment in extension services and education in the 1990s resulted in improvement in remnant management, but that the outcomes were biased towards lower productivity remnants rather than those of most nature conservation importance[132]. Ongoing pressures on unmanaged remnants from associated land use is likely leading to ongoing decline, though quality data are lacking. Some land use change, such as clearing for urban development or irrigation affects remnants. Introduced species such as fallow deer are causing damage to many remnant vegetation patches within their range. Climate change impacts on remnant vegetation are likely to increase stress and pressure over that which they are subject to by virtue of being remnants. Drought and fire have the potential to affect species competition, reproduction and persistence. Increased damage by agents such as insects or pathogens may also occur. In the absence of management, an increase in the transition of remnants from eucalypt woodlands and forests to degraded forms (e.g. scrubs, non-eucalypt woodlands, grassland) can be expected. Remnant vegetation is also recognised as a critical carbon store. Disruption to this store will contribute to increased greenhouse gas emissions. This may affect future

[129] Kirkpatrick & Gilfedder (1995).
[130] Tasmanian Public Land Use Commission (1997).
[131] Commonwealth of Australia (1997).
[132] Kirkpatrick *et al.* (2007), pp161-181.

Asset issue	Description
	carbon-constrained economic markets – (e.g. decrease the opportunity to gain carbon credits).
Key data, information and resources	***State-wide or NRM North and NRM South*** • Data on remnant vegetation extent can be readily derived from Tasveg mapping. • Some data attaching metrics to remnants has been produced[133] but is out of date. • Data on the size and condition of remnants and their distance to non-remnants is available[134], though condition data has limited reliability where not field verified. ***Known issues*** • Recent data on the condition and trajectory of remnants is largely lacking (though see Vegetation condition above). • Gaps also exist in the role remnants play for many species (these can be addressed under other issues). • Opportunity exists to extend longitudinal coverage of the previous large remnant studies (see Kirkpatrick and Gilfedder reference) and also other studies which have focussed on remnants[135].
Regional considerations and recommendations	• Remnant vegetation is included in the recommended focus area for ecologically functioning landscapes.

[133] Michaels *et al.* (2010).
[134] Natural Resource Planning Atomic Planning Units spatial layer, unpublished.
[135] MacDonald & Kirkpatrick (2003), Woolley & Kirkpatrick (1998).

6.5.2.2.8 Issue: riparian vegetation

Asset issue	Description
Contextual summary	Riparian vegetation is the terrestrial vegetation associated with streambanks and other wet areas and has characteristics influenced by the aquatic environment.
Current knowledge	Riparian vegetation is an important issue for terrestrial biodiversity as it has been shown to have Riparian vegetation has been found to have high biodiversity values relative to its extent and to have higher overall species diversity and density[136]. Some species occur almost exclusively in riparian vegetation while others use it for life cycle components. Maintenance and restoration of riparian zones is seen to have multiple benefits for biodiversity.
Change, pressures, climate change	The magnitude of change in Tasmania's riparian vegetation and its condition is largely unknown. Loss of riparian vegetation is expected to increase under climate change, particularly due to desiccation during drought and alteration to groundwater distribution and flows.
Key data, information and resources	***State-wide or NRM North and NRM South*** • CFEV river section catchments are attributed with the percentage riparian vegetation cover of the riparian zone. • Percentage riparian vegetation cover of riparian zones is recalculated using available data as part of the Regional Ecosystem Model[137]. • Tasveg mapping can be used to identify native or introduced riparian vegetation but is subject to issues of reliability. ***Known issues*** • Data on the condition of Tasmania's riparian vegetation is limited, although tools such as the Tasmanian River Condition Index are available that include riparian assessment. • CFEV data on percentage cover of riparian zones is out of date.
Regional considerations and recommendations	• Riparian vegetation is included in the recommended focus area for ecologically functioning landscapes. • Many biodiversity values occur either in whole or in part in riparian vegetation, so will be addressed in part in the recommended focus area of biodiversity special values.

[136] Martin *et al.* (2006).
[137] Knight (2014a), pp22-23).

6.5.2.2.9 Issue: refugia

Asset issue	Description
Contextual summary	Refugia are places of shelter, protection safety from threats. Refugia for biodiversity come in many different types and need to be classified both in terms of refugia ***for*** what and ***from*** what[138].
Current knowledge	The RFA process included identification of glacial refugia rainforest species and contemporary refugia for flora from fire and disease[139]. Climate change has resulted in an increasing recognition of the importance of refugia given the certainty of uncertain change. Climate change refugia in Tasmania have been identified for plant diversity[140], and the State has been identified as an important area nationally for climate change refugia[141].
Change, pressures, climate change	See discussion on current knowledge.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Refugia for glacial cycles, fire and disease were developed for the RFA. Data for fire and disease is significantly out of data • A range of work aimed at identifying refugia in Tasmania is currently underway, though much is yet to be completed[142]: o freshwater refugia for rivers completed for the midland (NERP Landscape and Policy Hub project); o draft layer of refugia fire completed but in need of review; o coastal refugia for shorebirds, vegetation and coastal plants in preparation; o refugia for 200 vertebrate fauna species based on modelled future suitable climate completed but spatial data not yet available (NERP landscape and policy hub project); o refugia from drought for woodlands based on 'greenspot' analysis has been completed[143].

[138] Adapted from Brown (2010).
[139] Tasmanian Public Land Use Commission (1997).
[140] Keppel *et al.* (2015).
[141] Reside *et al.* (2013).
[142] Status of refugia layers *pers. comm.* O. Carter (DPIPWE) to R. Knight 23 February 2015.
[143] Gould *et al.* (2015).

Asset issue	Description
Regional considerations and recommendations	• Refugia for biodiversity are included in the recommended focus area for special values. • Identifying suitable refugia, and monitoring their effectiveness over longer terms, would fall partly within the biodiversity change and emerging issues focus area.

6.5.2.2.10 Issue: invasive species and diseases

Asset issue	Description
Contextual summary	Invasive species and diseases are organisms that cause harm or disruption to native species and ecosystems. Species in this group are not simply exotic; they have an impact perceived as negative.
Current knowledge	Current knowledge of invasive species and diseases in Tasmania is variable. The effects of introduced herbivores such as rabbit are reasonably well known. However in contrast there is virtually no information on the impacts of the more recent introduction of fallow deer, despite widespread international findings on the negative effects of deer on other aspects of biodiversity[144]. Three pathogens are well known to have significant effects on biodiversity – *Phytophthora cinnamomi* fungus; Chytridomycosis (a fungal diseases of amphibians and Devil Facial Tumour Disease. Toxoplasmosis is emerging as a major wildlife disease, and is suspected to be associated with an increase in feral cat numbers as Tasmanian devils have declined[145]. Invasive plants (i.e. environmental weeds) are extensive in Tasmania including a number of Weeds of National Significance that negatively affect biodiversity over large areas.
Change, pressures, climate change	Invasive species and particularly disease are recognised as one of the most important likely impacts of climate change[146]. One of the important implications of climate change is that Tasmania is expected to increase in numbers of resident species and become a refugia for them[147]. The impact on current biodiversity values is unknown but potentially affect a wide range of biodiversity issues. Envelopes of climatic suitability for diseases such as PC and

[144] Natural Resource Planning bibliography of ecological studies of deer impact. Unpublished.
[145] Fancourt & Jackson (2014).
[146] Department of Primary Industries, Water & Environment (2010).
[147] Reside *et al.* (2013).

Asset issue	Description
	chytrid fungus are likely to shift under climate change. Trophic effects through ecosystems as a result of disease and changes in abundance of keystone species are potentially of very high impact.
Key data, information and resources	***State-wide*** • Adapt NRM weeds technical guide (planning processes). • Adapt NRM modelling of future weed climate suitability for approximately 100 invasive plant species. • Point location records of invasive species and some diseases are available in the Natural Values Atlas, but the use of such data needs to be carefully considered. • Considerable information is available on the distribution and impact of a small number of pathogens (e.g. PC, DFTD). • Recent modelling work has established the potential range and population size of fallow deer in Tasmania (N. Beeton, UTas). ***Known issues*** • Knowledge of the extent and impact of only a few agents (e.g. PC) is well advanced. For many invasive species and diseases knowledge is rudimentary and incomplete.
Regional considerations and recommendations	• Owing to their pervasive nature, invasive species and disease occur throughout the recommended biodiversity focus areas – ecologically functioning landscape, special values and change and emerging issues. This approach has been recommended so that approaches to invasive species and disease are centred on the values which they may impact, rather than on a weed, feral animal or disease of itself.

6.5.2.2.11 Issue: fire

Asset issue	Description
Contextual summary	Fire is the roles and impacts of natural, anthropogenic and climate change induced fire on biodiversity.
Current knowledge	Fire is included as an issue for biodiversity as it has an important influence on many facets of biodiversity, and this is recognised as increasing under climate change, particularly through increased fire frequency and intensity. Australian biodiversity has evolved under a range of influences from fire. Some are highly sensitive and can be permanently altered by fire, while others are highly dependent on fire but it is often strongly related to appropriate frequency, intensity and seasonality. Aboriginal burning regimes have played an important part in shaping the current ecology of many ecosystems, even to the point where large ecosystems, such as Tasmania's buttongrass plains, are recognised as cultural landscapes created by Aboriginal fire. Systems for managing knowledge and understanding fire are therefore needed to help manage biodiversity both now and under climate change.
Change, pressures, climate change	See current knowledge.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Tasveg 3.0 fire flammability and sensitivity attributes[148]. ***Known issues*** • Mapping and monitoring of seasonal ground cover is due to commence in Tasmania in the near future and will have potential utility in fire hazard assessment.
Regional considerations and recommendations	• Fire and its relationship to biodiversity is included in the recommended focus area for change and emerging issues. This is a common recommendation for both NRM North and NRM South. Although appropriate fire management is a current imperative for management of many facets of Tasmanian biodiversity, the potential changes to fire frequency and intensity mean that it needs a specific climate adaptation lens.

[148] Adapted to current Tasveg classification from Pyrke & Marsden-Smedley (2005).

6.5.2.2.12 Issue: drought

Asset issue	Description
Contextual summary	Drought is fluctuation in availability of water from rainfall for ecosystems.
Current knowledge	Drought is a naturally occurring phenomenon associated with low rainfall relative to the adapted needs of an ecosystem. It is included as an issue for biodiversity as increased frequency and severity is one of the impacts of climate change that is almost universally recognised, and one that affects almost all facets of biodiversity (and is also significant in freshwater and coastal and marine systems). A considerable body of research from mainland southern Australia[149] provides strong indicators of the potential impact of climate change induced droughts on Tasmania, for which there is already a range of evidence[150], and also of the relationships between drought and fire[151].
Change, pressures, climate change	See current knowledge.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Climate futures Tasmania downscaled climate modelling provides the best available information on regional and sub-regional changes to rainfall and seasonality.
Regional considerations and recommendations	• Drought is included as an issue in the biodiversity classification due to its predicted impact on biodiversity under climate change. It is included in the recommended focus area of change and emerging issues for biodiversity. • Addressing the impacts of drought on biodiversity has strong relationships to the ability to identify and manage refugia (included in biodiversity special values focus area) and also to increasing resilience through the ecologically functioning landscapes focus area.

[149] Bennett *et al.* (2013), Mac Nally *et al.* (2009).
[150] Duncan & Kiernan (1989), Kirkpatrick & Marks (1985), Visoui & Whinam (2015).
[151] Verkaik *et al.* (2014).

6.5.2.3 NRM North – Biodiversity discussion and recommendations

6.5.2.3.1 NRM North biodiversity survey responses

Biological diversity as core business

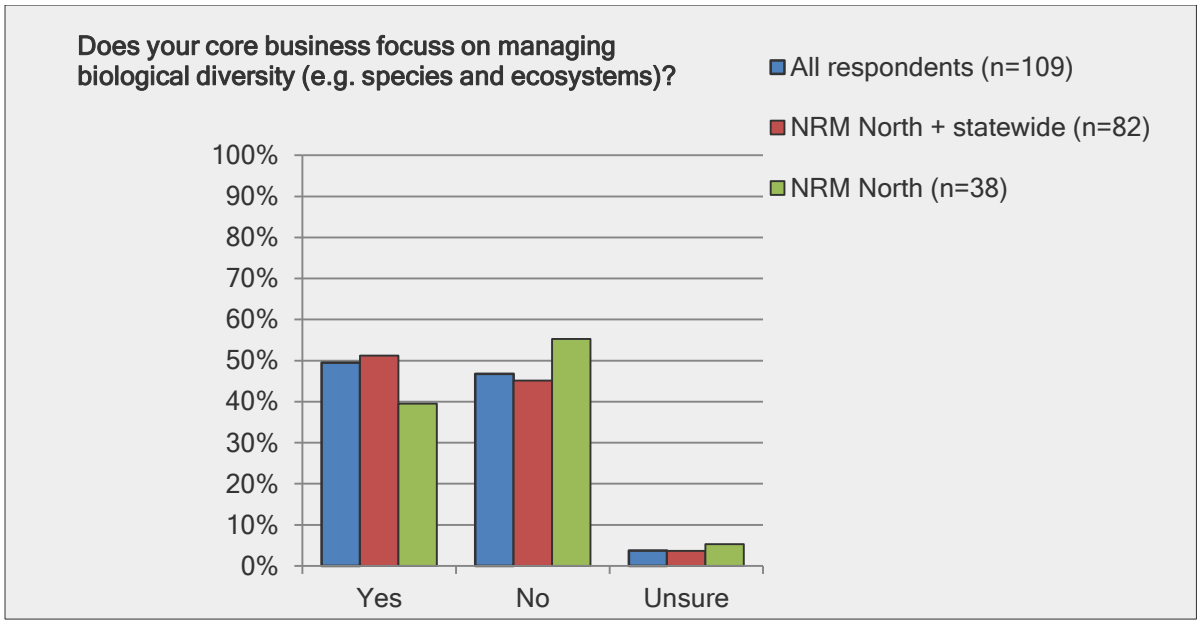


Figure 60 Survey results – biological diversity as core business

A relatively large number of people and organisations from the NRM North region identified whether biodiversity was part of their core business (n=82). Among those respondents, 51% indicated biodiversity was part of their core management activity.

Stakeholder impacts

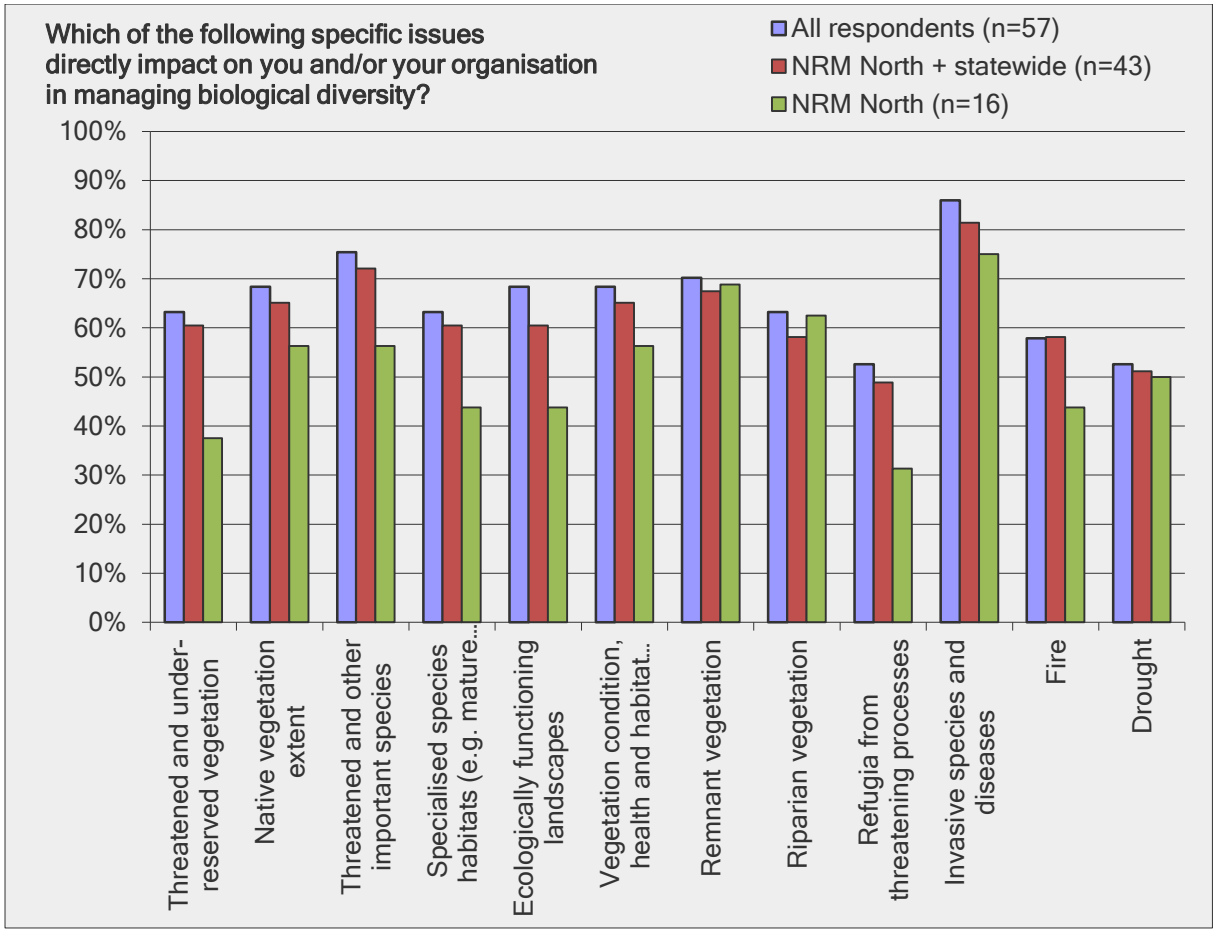


Figure 61 Survey results – issues impact on management of biological diversity

The range of biodiversity issues impacting on stakeholder activities in NRM North was uniformly high across all 12 biodiversity issues (mean = 62%, minimum = 49%). The highest of these was invasive species and disease (81%), reflecting the heavy emphasis given to weed management due to its impacts on both biodiversity and commercial activity. Among the key salinity and sodicity findings from these results is that respondents identifying themselves as working only in the NRM North region report a lower impact of biodiversity on their activities and for the NRM North combined pool (10 out of 12 issues).

Priority biological diversity issues

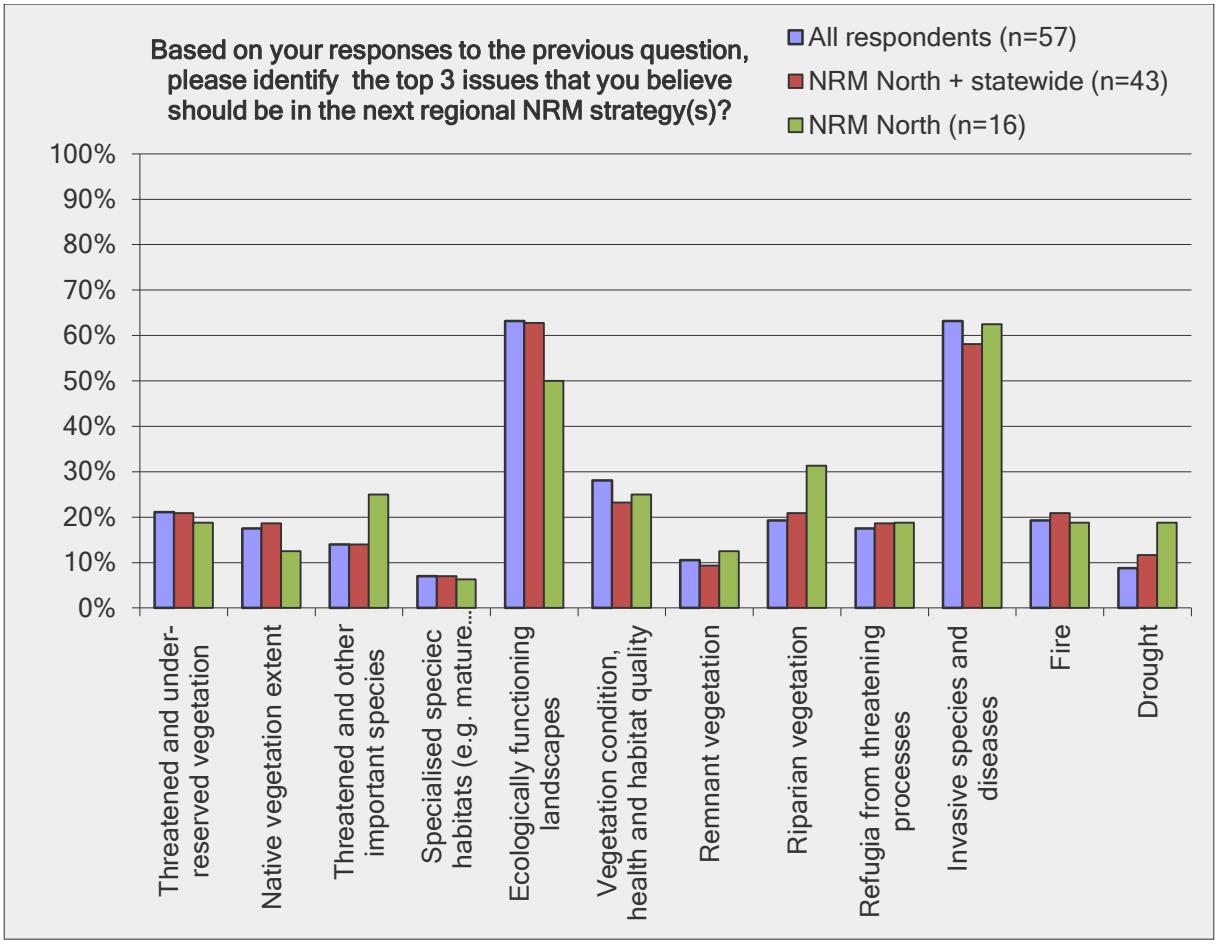


Figure 62 Survey results – priority biological diversity issues for next Strategy

Although NRM North respondents identified a wide range of biodiversity issues as impacting on their activities, reported priorities for the next NRM strategies were skewed strongly to two issues – ecologically functioning landscapes (63%) and invasive species and disease (58%). The next most reported priority was vegetation condition and health at less than half these figures (28%). Seven of the 12 biodiversity issues were identified as strategic priorities by less than 20% of respondents.

Climate change capacity

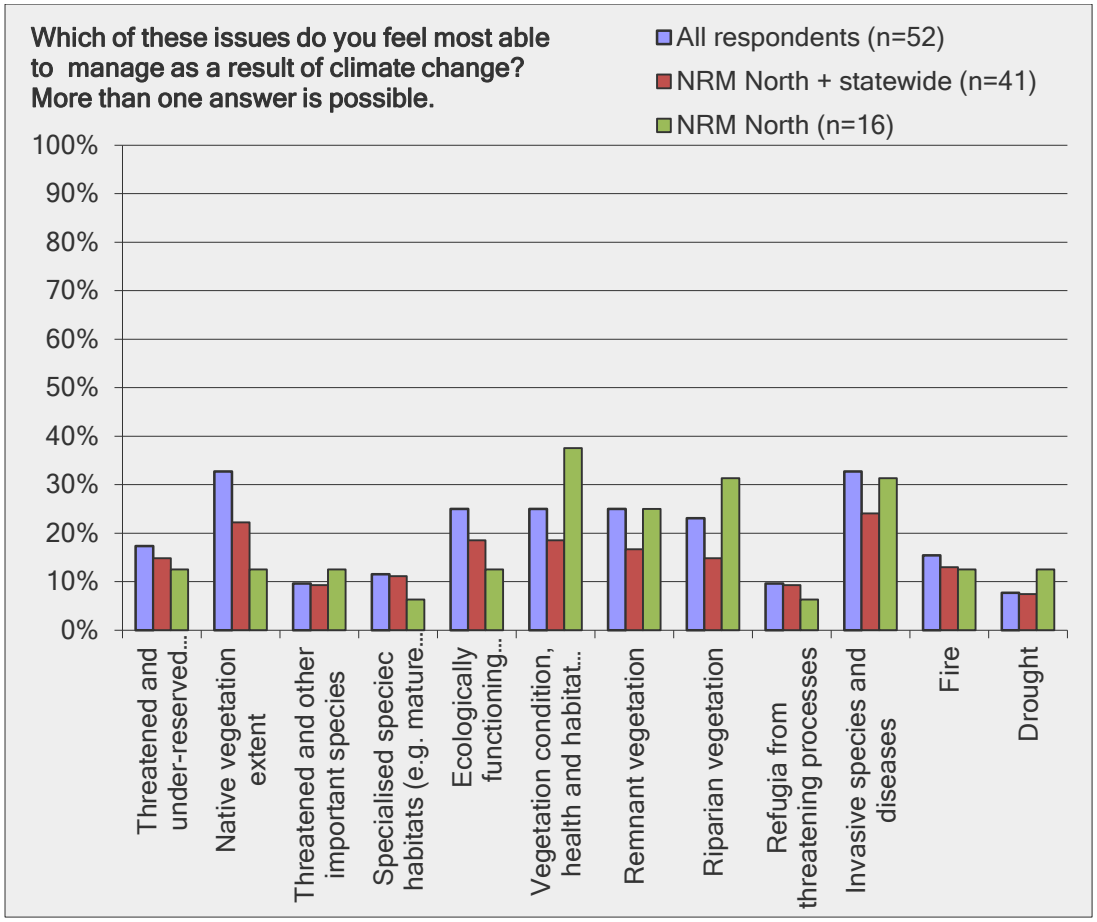


Figure 63 Survey results – climate change capacity

Respondents on the whole reported relatively poor ability to manage biodiversity under climate change (mean = 15%, maximum = 24%). Only two issues were reported by more than 20% of respondents as within their ability to manage – native vegetation extent (22%) and invasive species and disease (24%). The results suggest a degree of concern for management of biodiversity in the region under climate change.

Capacity-impact deficit

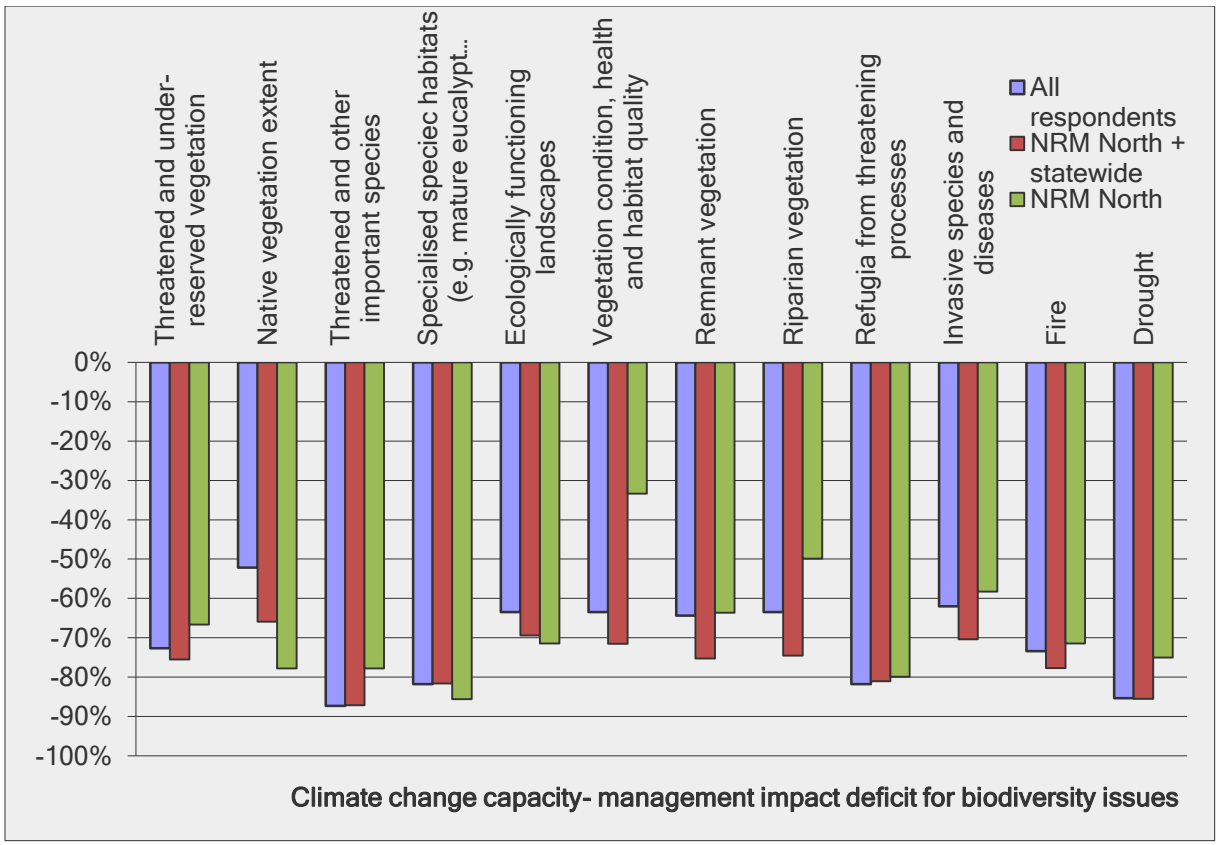


Figure 64 Survey results – Climate change capacity-impact deficit – biological diversity

The capacity-impact deficit among NRM North respondents for all biodiversity issues is universally large (mean = -76%, minimum = 66%).

Landscape perspectives

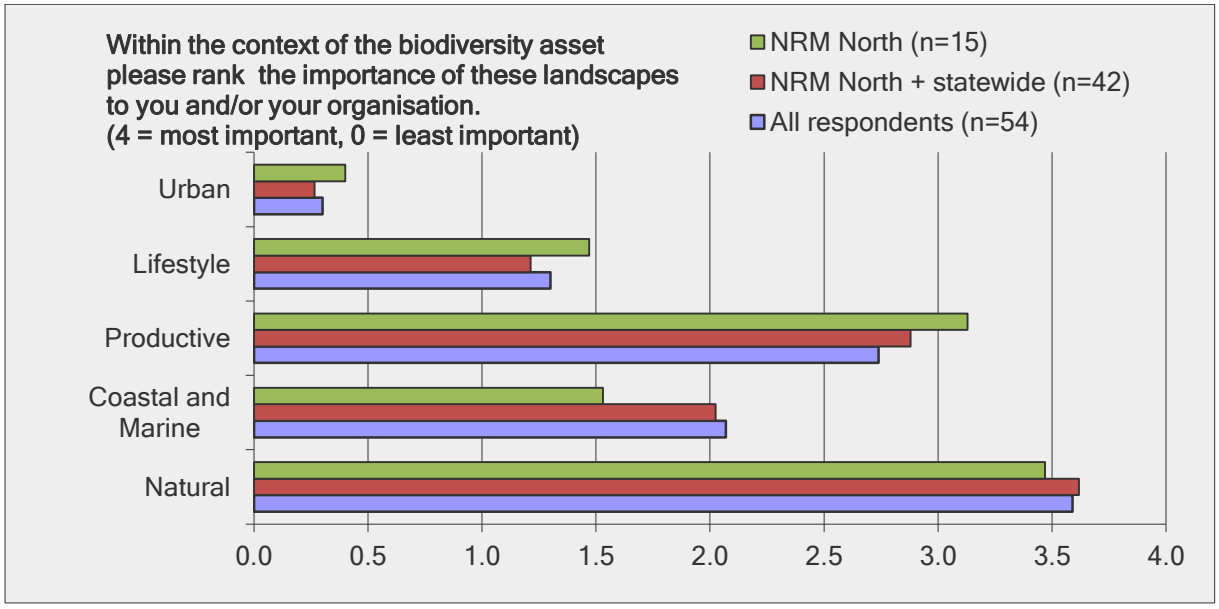


Figure 65 Survey results – stakeholder perspectives on biodiversity

Respondents from NRM North identified natural landscapes as the most important for biodiversity, followed by productive landscapes. Although the difference in average importance of the two is relatively small, it is likely that different approaches may be needed, for example natural landscapes may have a focus on preserving localised features of significance and providing refugia, while productive landscapes may be important for addressing ecological process- and function-related aspects of biodiversity. It is likely that threatened species will occur across both. Although ranked as of least importance lifestyle and urban landscapes are known to be very important for some biodiversity attributes so should not be omitted from biodiversity planning in the NRM North region.

6.5.2.3.2 NRM North – recommended biodiversity focus areas

Biodiversity focus areas for the next NRM North regional strategy have been developed from the analysis of the asset assessment to identify groups of closely related issues and responses from the survey. They have also been developed taking account of the three principles for climate-ready conservation objectives (see section 6.4.5).

Three focus areas are recommended for addressing biodiversity in the regional strategy – ecologically functioning landscapes, biodiversity special values and change and emerging issues. The recommended focus on change and emerging issues is presented as a common recommendation for both NRM North and NRM South, with a view to it being implemented on a cooperative basis between the three Tasmanian regions and in collaboration with a range of other relevant stakeholders.

Biodiversity focus area 1: ecologically functioning landscapes

Aspect	Description
Issues scope	The focus area of ecologically functioning landscapes is designed to address both the historical effects of clearing and degradation and the impacts of climate change on ecological processes and function at the landscape scale. Under climate change changes to species composition and assemblages is predicted to occur extensively. Maintaining and restoring ecologically functioning landscapes is designed to facilitate such change rather than aiming to maintain current or historic species patterns. The key elements of this focus area would be:

Aspect	Description
	• promoting retention of intact functioning landscapes; • restoring degraded native vegetation where it is important for landscape ecological function; and • providing revegetation initiatives to enhance and restore ecological function in a strategic manner (i.e. where the benefits are likely to be more immediate and substantial). The focus area encompasses a number of issues from the biodiversity classification: native vegetation extent; vegetation condition health and habitat quality; remnant vegetation; riparian vegetation; and some aspects of invasive species (where they affect landscape function). This focus area needs to be considered in the context the recommended 'special' values focus area. In some cases promoting management of special values may be counter the objectives of landscape ecological function but may be a higher priority where values are irreplaceable and at threat.
Importance	Biodiversity conservation is important as it is the subject of legislative obligations at the international, national, state and (to varying degrees) local government, a range of regulatory processes, government and non-government programs and substantial community interest. The focus on ecologically function landscapes recognises the importance of both adapting to climate change and of preventing further endangerment of biodiversity values.
Stakeholder perspectives	NRM North stakeholder reporting of impact of biodiversity on management activities was very high for the issues in this focus area. However reported priorities were highly skewed and gave the highest priority to ecologically functioning landscapes. Ability to manage the issues within the focus area were low, suggesting a strong need to emphasise capacity in program design.
Key delivery landscapes	Natural, productive and lifestyle landscapes would be the main targets for delivery of this focus area, however the types of activities would vary. Natural landscapes would be delivery targets to maintain and enhance landscape function. Productive landscapes would include all three elements (retention, restoration and revegetation) but would have a greater need for restoration and revegetation. Lifestyle landscapes would be a minor component of delivery and would need to be considered based on need.
Sub-regional aspects	Most public land in the NRM North region is subject to regulatory control which maintains landscape function to varying degrees, and so would not be a regional focus. Private land within the region contains a mixture of land where landscape function is intact, variegated and substantially degraded (see figure 66). Maintaining landscape function in intact

Aspect	Description
	landscapes in the region would be based on either potential threat or opportunity to concurrently protect special values. Variegated landscapes within the region represent the greatest opportunity for improving landscape function efficiently (e.g. midlands south of Campbell Town, Fingal Valley, along the northern coastal plain and some areas in the Tamar and Meander Valleys. Landscape function is substantially degraded across much of the floodplains of the northern midlands. Restoring landscape function in these areas would be a long term goal and needs to proceed with careful design to ensure activities make have a meaningful impact (isolated plantings is a sea of pasture or crops will have limited impact). Restoration in these areas need not necessarily focus on existing native species, but on those with the greatest prospects of survival and of providing effective habitat.

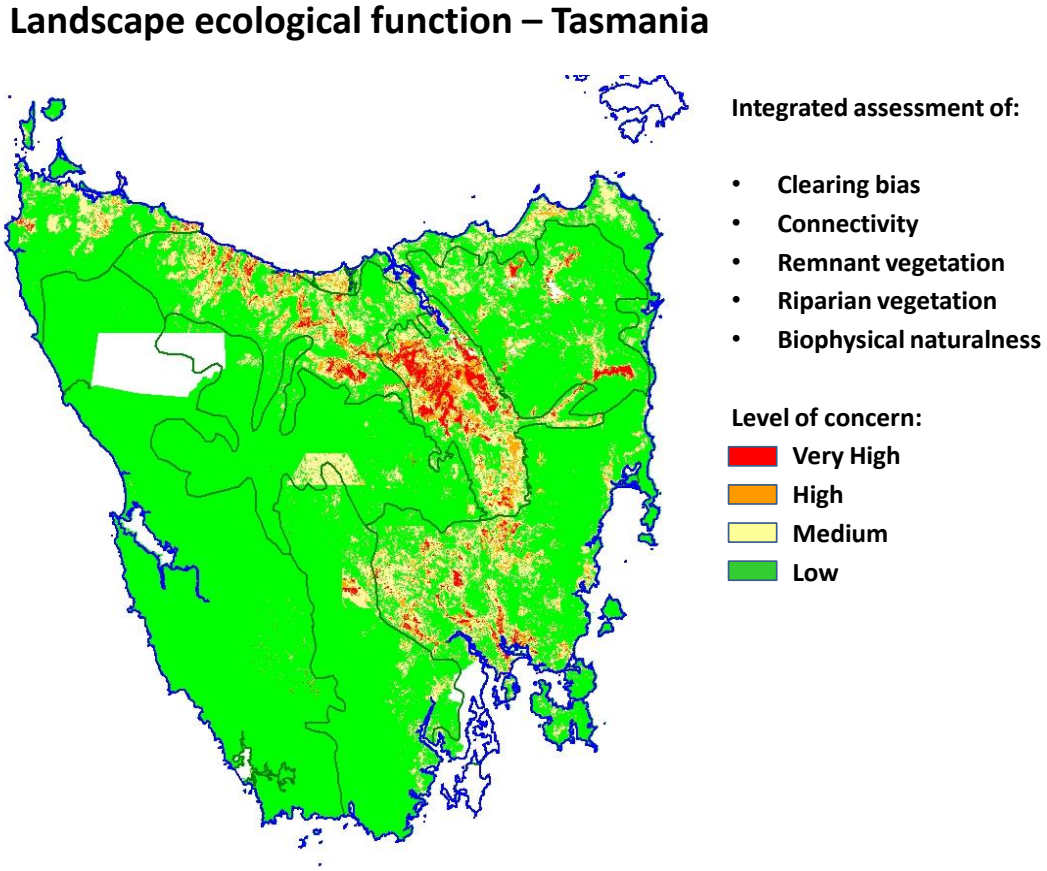


Figure 66 Landscape ecological function in Tasmania[152]

[152] Knight (2012).

Biodiversity focus area 2: special values

This focus area is presented as common recommendation for the NRM North and NRM South regions. It should be reviewed following release of the NRM spatial prioritisation work and resolution of geographic priorities, and also after initial review by a Themed Reference Group to identify priorities. NRM activity around special values will require coordination and cooperation among a wide range of stakeholders, including regulators. However, delivery of activity on special values particularly on private land will need to utilise more local and/or regional networks to secure engagement. Hence this focus area requires both a coordinated State-wide approach among all three Tasmanian NRM regions but regional delivery of priorities that are relevant within each region.

Aspect	Description
Issues scope	The biodiversity focus area of special values is intended to help facilitate NRM activity on biodiversity values which are consider important to keep, are appropriate priorities relative to other values, and for which there are reasonable prospects of success under current conditions and climate change. The issues from the biodiversity classification included in this focus area are threatened and under-reserved vegetation, specialised species habitat, threatened and other important species and refugia.
Importance	Biodiversity values are identified as 'special' because there is an agreed sense that loss should be avoided where possible, giving them an elevated importance for biodiversity conservation. The importance of addressing special values in NRM activity is heightened by the reality that existing resources are insufficient to address all values and climate change significantly reduces the survivability of many values *in situ*. Hence a key driver in assessing the importance of special values is the need to prioritise and make acceptable trade-offs.
Stakeholder perspectives	The special values within the biodiversity classification were all identified by both NRM North and NRM South respondents as having a high impact on their current management activities, as being low priorities for the next regional strategies, and as having lower ability to be managed under climate change. As the focus on special values is at least in part to do with maintaining irreplaceable values, the results suggest that investment in capacity and coordination of priority setting will be required.

Aspect	Description
Key delivery landscapes	Special values may need to be delivered across all NRM landscapes. Some special values will be more concentrated in one landscape than another (e.g. threatened species in the Midlands Biodiversity Hotspot are located primarily in production landscapes). However variation in planning and management needs for special values is substantial and will need to be considered first on a prioritised basis and then on a case by case basis.
Sub-regional aspects	Identification of priorities for special values is a precursor to the identification of priorities areas within the NRM North region. It needs to be undertaken on an ongoing basis by a Themed Reference Group and be informed by the results of current and future work on spatial prioritisation.

Biodiversity focus area 3: change and emerging issues

Common recommendation for NRM North and NRM South.

Aspect	Description
Issues scope	A focus area on change and emerging issues in biodiversity is designed to provide for a watching brief on emerging issues flagging for adaptive management responses to NRM priorities. The focus area is designed to support dynamic planning for biodiversity conservation and to provide coverage of three issues from the classification with potentially pervasive effects on biodiversity under climate change – emerging invasive species, fire and drought. It is recommended that the scope and design of this focus area for NRM activity include further technical and stakeholder consultation and be coordinated on an ongoing basis jointly by the three Tasmanian NRM regions in cooperation with other organisations (e.g. Biosecurity Tasmania, Tasmanian Climate Change Office, DPIPWE, TIA, Tasmanian Fire Service, research institutions).
Importance	This focus area is considered to be of very high importance due to the potentially widespread effects of climate change on biodiversity. Climate change has the potential to further imperil already stressed biodiversity values, and also to enhance prospects of some.

Aspect	Description
Stakeholder perspectives	Stakeholders reported only low ability to manage biodiversity under climate change in both the NRM North (range = 7-24%, mean 15%) and NRM South regions (range = 5-38%, mean = 18%).
Key delivery landscapes	It is anticipated that the outputs of work on change and emerging issues would be incorporated into NRM activity in other focus areas and landscapes will vary accordingly.
Sub-regional aspects	Sub-regional aspects of this focus area will vary and most cannot be identified in advance (see recommended approach in 'Issue scope' above). However some such as fire and drought can be prioritised within regions based on existing knowledge of risk.

6.5.2.4 NRM South – biodiversity discussion and recommendations

6.5.2.4.1 NRM South biodiversity survey responses

Stakeholder response

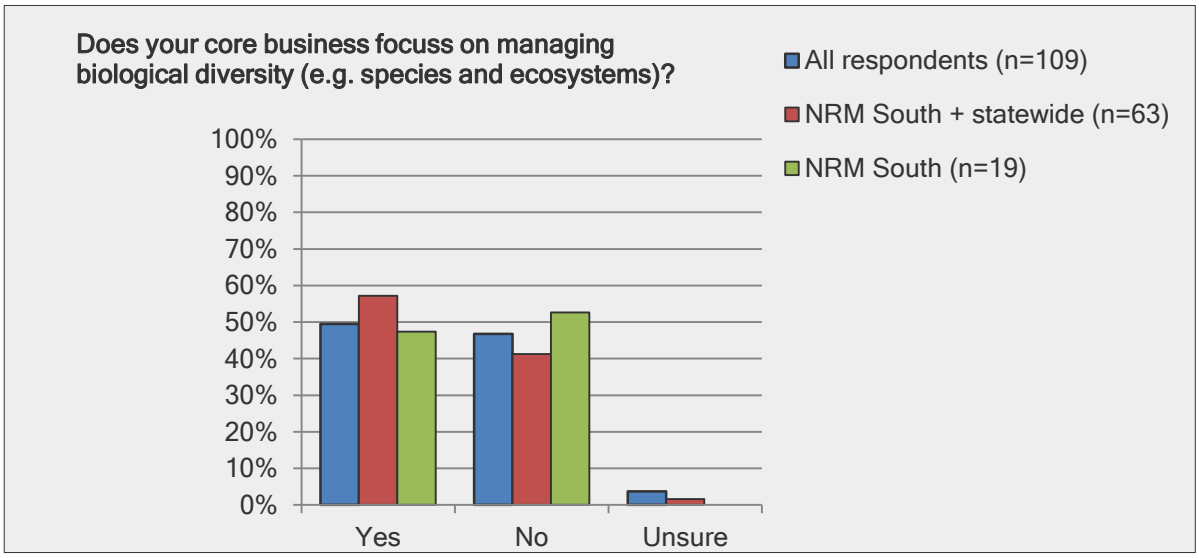


Figure 67 Survey results – stakeholder perspectives managing biodiversity

A relatively large number of people and organisations from the NRM South region identified whether biodiversity was part of their core business (n=63). Among those respondents, 57% indicated biodiversity was part of their core management activity.

Stakeholder impacts

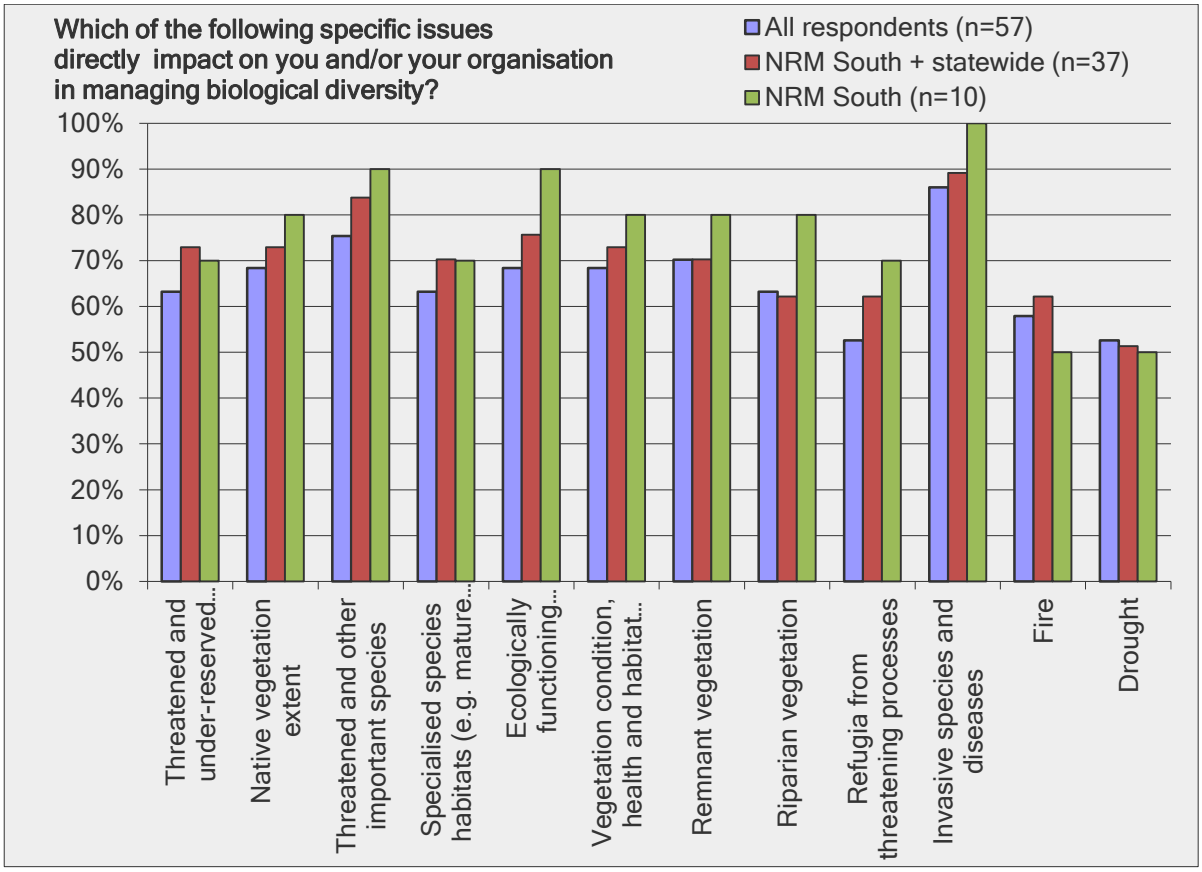


Figure 68 Survey results – stakeholder diversity impacts

The range of biodiversity issues impacting on stakeholder activities in NRM South was uniformly high across all 12 biodiversity issues (mean = 75%, minimum = 51%). The highest of these was invasive species and disease (89%), reflecting the heavy emphasis given to weed management due to its impacts on both biodiversity and commercial activity. Among the key observations of the results is that respondents identifying themselves as working only in NRM South only report a higher impact of biodiversity on their activities than for the NRM South combined pool (higher on 8 out of 12 issues).

Stakeholder priorities

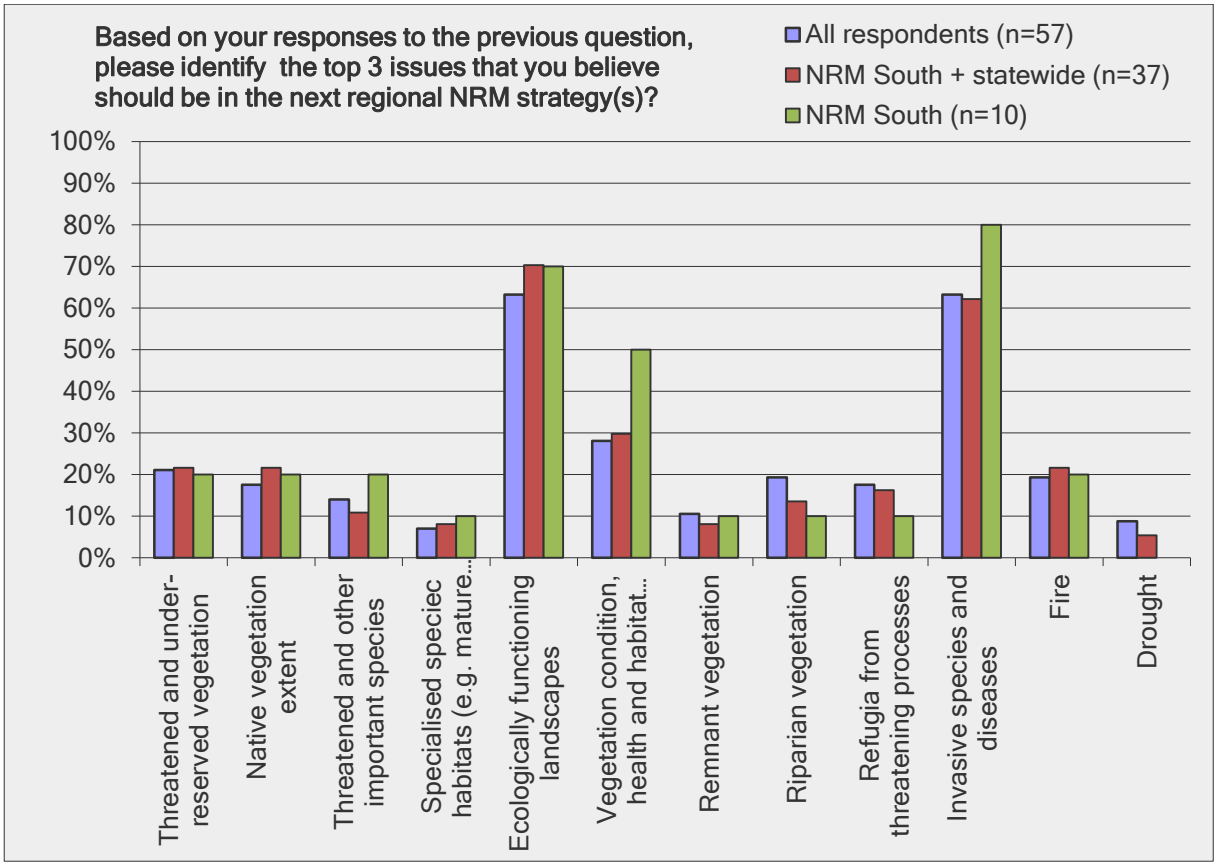


Figure 69 Survey results – top 3 issues in next Strategy

The pattern of response of reported priorities for the next NRM South strategy was the same as that for NRM North – although respondents identified a wide range of biodiversity issues as impacting on their activities, reported priorities for the next NRM strategies were skewed strongly to two issues – ecologically functioning landscapes (70%) and invasive species and disease (62%). The next most reported priority was vegetation condition and health at less than half these figures (30%). Three of the 12 biodiversity issues were identified as strategic priorities by less than 10% of respondents – specialised species habitats (8%), remnant vegetation (8%) and drought (5%).

Climate change capacity

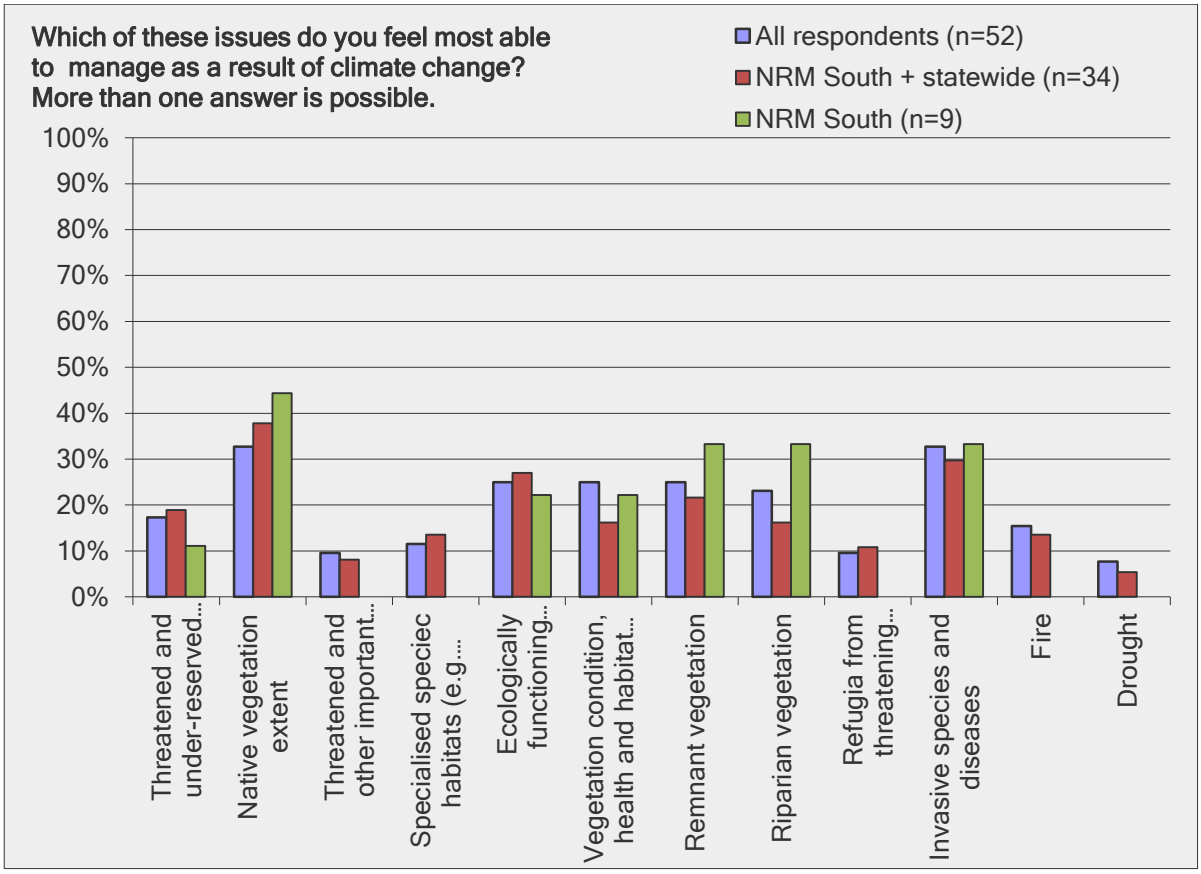


Figure 70 Survey results – top 3 issues most able to manage

Respondents on the whole reported relatively poor ability to manage biodiversity under climate change (mean = 18%, maximum = 38%). Only two issues were reported by more than 30% of respondents as within their ability to manage – native vegetation extent (38%) and invasive species and disease (30%). There is a minor grouping of results around four issues relevant to managing biodiversity at the landscape scale – ecologically functioning landscapes, vegetation condition and health, remnant vegetation and riparian vegetation (mean = 20%, range = 16-27%)- The results suggest a degree of concern for management of biodiversity in the NRM South region under climate change.

Capacity-impact deficit

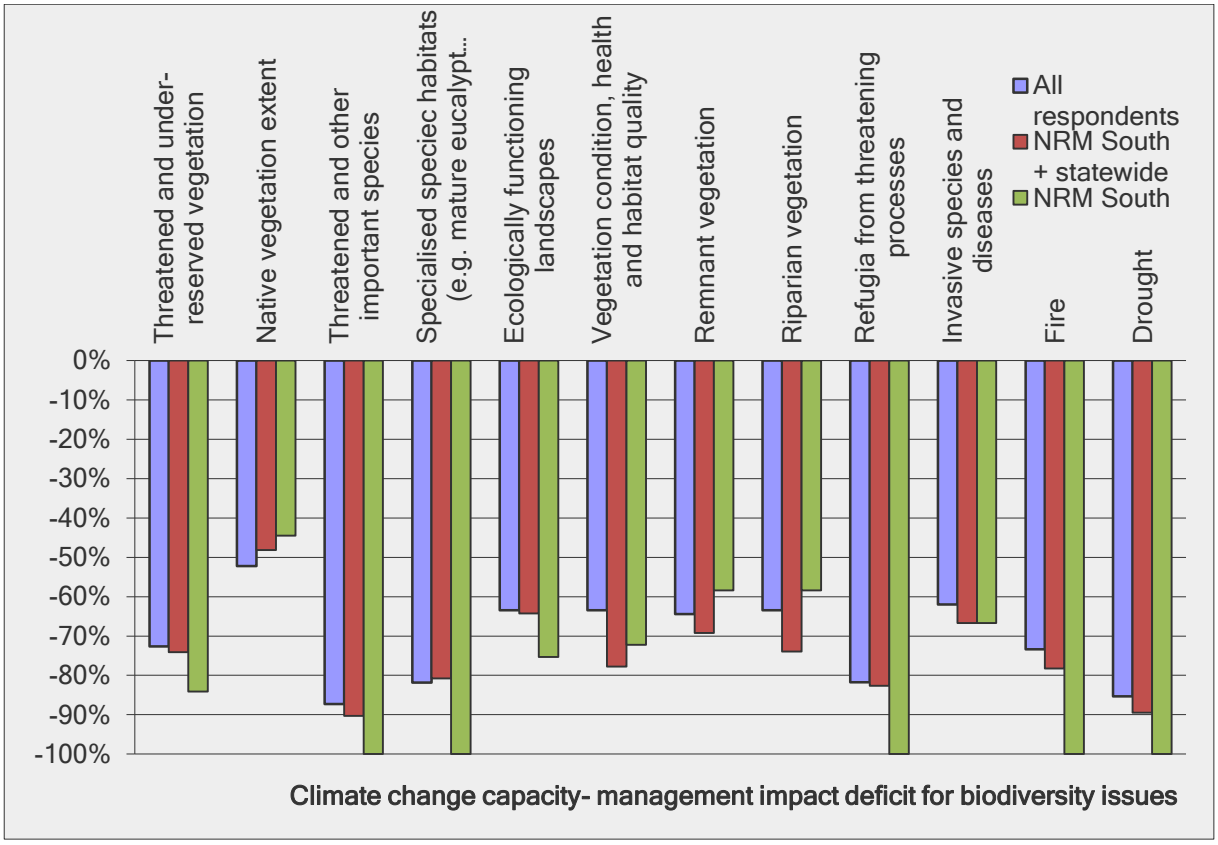


Figure 71 Survey results – top 3 issues most able to manage

The capacity-impact deficit among NRM South respondents for all biodiversity issues is large (mean = -75%) but shows a greater range (48-90%) than for the same results for NRM North (65-87%). The only issue with a capacity-impact deficit less than 50% was native vegetation extent (48%). The difference of this issue from others may reflect an important recognition among stakeholders that it may be easier to maintain native vegetation cover under climate change than it is to maintain current vegetation types, composition and condition.

Landscape perspectives

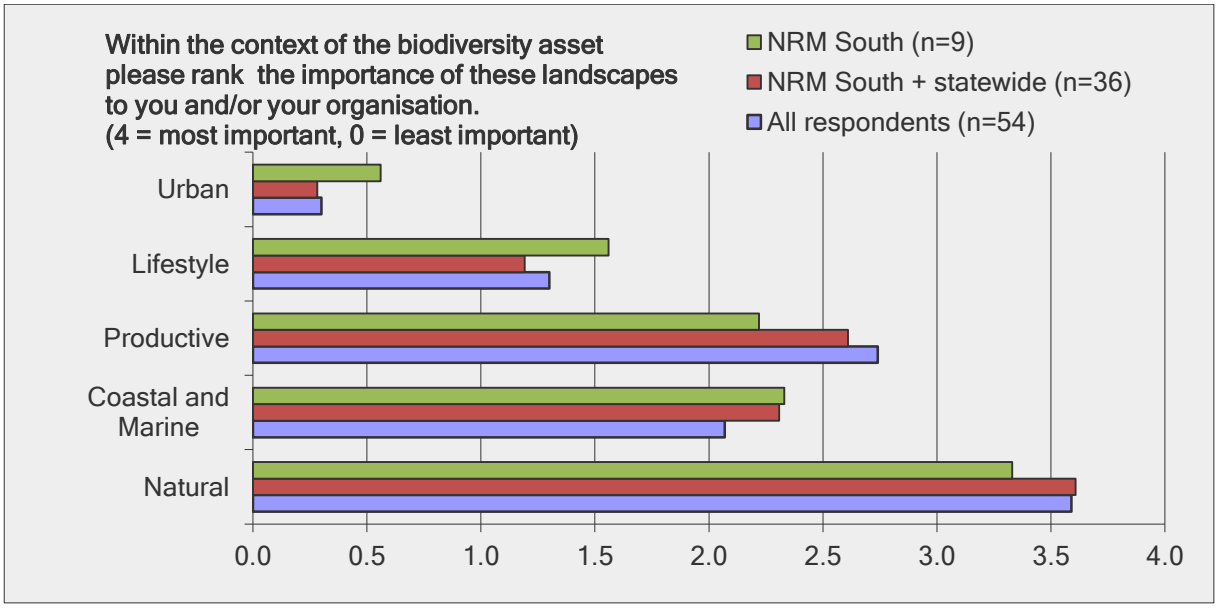


Figure 72 Survey results – biodiversity landscape rankings

Respondents from NRM South identified natural landscapes as the most important for biodiversity. Productive landscapes were ranked on average as second and were similar in reported importance to coastal and marine landscapes. The consistently high reporting of coastal and marine landscapes may indicate a need for further differentiation of the boundaries of this landscape. Although ranked as of least importance lifestyle and urban landscapes are known to be very important for some biodiversity attributes so should not be omitted from biodiversity planning in the NRM North region.

6.5.2.4.2 NRM South – recommended biodiversity focus areas

Biodiversity focus areas for the next NRM South regional strategy have been developed from the analysis of the asset assessment to identify groups of closely related issues and responses from the survey. They have also been developed taking account of the three principles for climate-ready conservation objectives (see section 6.4.5).

Three focus areas are recommended for addressing biodiversity in the regional strategy – ecologically functioning landscapes, biodiversity special values and change and emerging issues. The recommended focus on change and emerging issues is presented as a common recommendation for both NRM North and NRM South, with a view to it being implemented on a cooperative basis between the three Tasmanian regions and in collaboration with a range of other relevant stakeholders.

Biodiversity focus area 1: ecologically functioning landscapes

Aspect	Description
Issues scope	The focus area of ecologically functioning landscapes is designed to address both the historical effects of clearing and degradation and the impacts of climate change on ecological processes and function at the landscape scale. Under climate change changes to species composition and assemblages is predicted to occur extensively. Maintaining and restoring ecologically functioning landscapes is designed to facilitate such change rather than aiming to maintain current or historic species patterns. The key elements of this focus area would be: • promoting retention of intact functioning landscapes; • restoring degraded native vegetation where it is important for landscape ecological function; and • providing revegetation initiatives to enhance and restore ecological function in a strategic manner (i.e. where the benefits are likely to be more immediate and substantial). The focus area encompasses a number of issues from the biodiversity classification: native vegetation extent; vegetation condition health and habitat quality; remnant vegetation; riparian vegetation; and some aspects of invasive species (where they affect landscape function). This focus area needs to be considered in the context the recommended 'special' values focus area. In some cases promoting management of special values may be counter the objectives of landscape ecological function but may be a higher priority where values are irreplaceable and at threat.

Importance	Biodiversity conservation is important as it is the subject of legislative obligations at the international, national, state and (to varying degrees) local government, a range of regulatory processes, government and non-government programs and substantial community interest. The focus on ecologically function landscapes recognises the importance of both adapting to climate change and of preventing further endangerment of biodiversity values.
Stakeholder perspectives	NRM South stakeholder reporting of impact of biodiversity on management activities was very high for the issues in this focus area. However reported priorities were highly skewed and gave the highest priority to ecologically functioning landscapes (as an issue) and also to invasive species. Ability to manage the issues within the focus area were low-moderate (27-30%), suggesting a need to emphasise capacity in program design.
Key delivery landscapes	Natural, productive and lifestyle landscapes would be the main targets for delivery of this focus area, however the types of activities would vary. Natural landscapes would be delivery targets to maintain and enhance landscape function. Productive landscapes would include all three elements (retention, restoration and revegetation) but would have a greater need for restoration and revegetation. Lifestyle landscapes would be a minor component of delivery and would need to be considered based on need.
Sub-regional aspects	Most public land in the NRM South region is subject to regulatory control which maintains landscape function to varying degrees, and so would not be a regional focus. Private land within the region contains a mixture of land where landscape function is intact, variegated and substantially degraded (see figure 65 in NRM North recommendations). Landscape function for most of the private land in the NRM South region is relatively intact and tend to be located on lower values land around the periphery of public land. Maintaining landscape function in these parts the region would be based on either potential threat or opportunity to concurrently protect special values. Variegated landscapes within the region represent the greatest opportunity for improving landscape function. These occur in areas around Oatlands, in scattered areas on the east coast. Landscape function is substantially degraded in parts of these areas (e.g. Kempton, lower Coal valley and scattered areas in the Derwent Valley) but their size is substantially smaller than further north in the midlands. Restoring landscape function in these areas would be a long term goal but one that can be promoted in concert with activity around the areas of variegated landscape function.

Biodiversity focus area 2: special values

This focus area is presented as common recommendation for the NRM North and NRM South regions. It should be reviewed following release of the NRM spatial prioritisation work and resolution of geographic priorities, and also after initial review by a Themed Reference Group to identify priorities. NRM activity around special values will require coordination and cooperation among a wide range of stakeholders, including regulators. However, delivery of activity on special values particularly on private land will need to utilise more local and/or regional networks to secure engagement. Hence this focus area requires both a coordinated State-wide approach among all three Tasmanian NRM regions but regional delivery of priorities that are relevant within each region.

Aspect	Description
Issues scope	The biodiversity focus area of special values is intended to help facilitate NRM activity on biodiversity values which are consider important to keep, are appropriate priorities relative to other values, and for which there are reasonable prospects of success under current conditions and climate change. The issues from the biodiversity classification included in this focus area are threatened and under-reserved vegetation, specialised species habitat, threatened and other important species and refugia.
Importance	Biodiversity values are identified as 'special' because there is an agreed sense that loss should be avoided where possible, giving them an elevated importance for biodiversity conservation. The importance of addressing special values in NRM activity is heightened by the reality that existing resources are insufficient to address all values and climate change significantly reduces the survivability of many values *in situ*. Hence a key driver in assessing the importance of special values is the need to prioritise and make acceptable trade-offs.
Stakeholder perspectives	The special values within the biodiversity classification were all identified by both NRM North and NRM South respondents as having a high impact on their current management activities, as being low priorities for the next regional strategies, and as having lower ability to be managed under climate change. As the focus on special values is at least in part to do with maintaining irreplaceable values, the results suggest that investment in capacity and coordination of priority setting will be required.

Aspect	Description
Key delivery landscapes	Special values may need to be delivered across all NRM landscapes. Some special values will be more concentrated in one landscape than another (e.g. threatened species in the Midlands Biodiversity Hotspot are located primarily in production landscapes). However variation in planning and management needs for special values is substantial and will need to be considered first on a prioritised basis and then on a case by case basis.
Sub-regional aspects	Identification of priorities for special values is a precursor to the identification of priorities with the NRM South region, and needs to be undertaken on an ongoing basis by a Themed Reference Group and be informed by the results of current and future work on spatial prioritisation.

Biodiversity focus area 3: change and emerging issues

Common recommendation for NRM North and NRM South.

Aspect	Description
Issues scope	A focus area on change and emerging issues in biodiversity is designed to provide for a watching brief on emerging issues flagging for adaptive management responses to NRM priorities. The focus area is designed to support dynamic planning for biodiversity conservation and to provide coverage of three issues from the classification with potentially pervasive effects on biodiversity under climate change – emerging invasive species, fire and drought. It is recommended that the scope and design of this focus area for NRM activity include further technical and stakeholder consultation and be coordinated on an ongoing basis jointly by the three Tasmanian NRM regions in cooperation with other organisations (e.g. Biosecurity Tasmania, Tasmanian Climate Change Office, DPIPWE, TIA, Tasmanian Fire Service, research institutions).
Importance	This focus area is considered to be of very high importance due to the potentially widespread effects of climate change on biodiversity. Climate change has the potential to further imperil already stressed biodiversity values, and also to enhance prospects of some.

Aspect	Description
Stakeholder perspectives	Stakeholders reported only low ability to manage biodiversity under climate change in both the NRM North (range = 7-24%, mean 15%) and NRM South regions (range = 5-38%, mean = 18%).
Key delivery landscapes	It is anticipated that the outputs of work on change and emerging issues would be incorporated into NRM activity in other focus areas and landscapes will vary accordingly.
Sub-regional aspects	Sub-regional aspects of this focus area will vary and most cannot be identified in advance (see recommended approach in 'Issue scope' above). However some such as fire and drought can be prioritised within regions based on existing knowledge of risk.

6.5.3 Asset class: freshwater and inland aquatic systems

6.5.3.1 Freshwater inland and aquatic systems - classification

Classification: Ten major issues were identified from the document review as most important for managing freshwater systems and were included in the stakeholder survey.

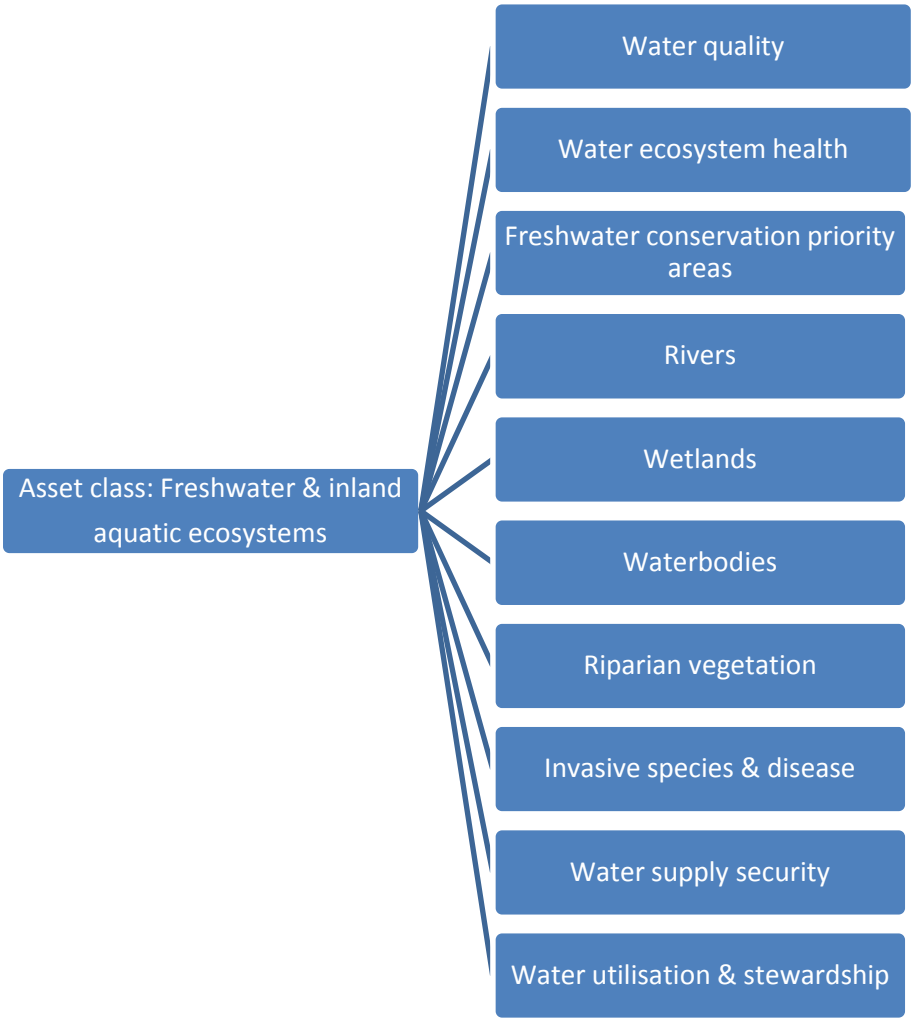


Figure 73 Freshwater inland and aquatic systems asset classification

6.5.3.2 *Asset: freshwater and inland aquatic systems - asset knowledge and status assessment*

6.5.3.2.1 Issue: water quality

Asset issue	Description
Contextual summary	Water quality describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect to its suitability for a particular purpose. Attributes considered as contributing to water quality will vary with purpose.
Current knowledge	Knowledge of various aspects of water quality in Tasmania is varied. Monitoring in undertaken on a systematic basis as part of a baseline monitoring network across the State. A 'State of the Rivers' provided a baseline to 2003[153] for the major catchments where land use is more intensive. Waterways monitoring reports covering streamflow, water quality and riverine health were prepared annually from 2004-2008 for all 48 Tasmanian catchments[154]. The movement and persistence patterns of pesticides in Tasmanian rivers were the subject of the Tasmanian river catchment water quality initiative[155]. A large number of separate studies and reports addressing aspects of water quality in Tasmania is some data (mostly on water flows, limited water quality) is available via the Water Information System of Tasmania (WIST)[156].
Change, pressures, climate change	Water quality in Tasmania is generally high relative to mainland and global norms. However natural variation; is substantial. Long term changes in water quality from urbanisation, cumulative effects of current practices. Some expanding land uses such as dairying under irrigation systems have potential to affect water quality through nutrient enrichment to streams (e.g. nitrates[157], phosphorous[158]). Increased river regulation to facilitate irrigation has potential effects on water quality. Climate change impacts on water quality are expected to be negative through factors such as increased salt content[159], reduced flushing and increased

[153] http://dpipwe.tas.gov.au/water/water-monitoring-and-assessment/water-monitoring/surface-water-quality/state-of-rivers-reports
Note: Not referenceable as a single document.
[154] http://dpipwe.tas.gov.au/water/water-monitoring-and-assessment/waterways-monitoring-reports
[155] Department of Environment, Heritage & the Arts (2009).
[156] http://wrt.tas.gov.au/wist/ui?command=content&pageSequenceNo=11&click=[0].HomeLink#fopt
[157] Burkitt (2014).
[158] Weatherley *et al.* (2011).
[159] James *et al.* (2009).

Asset issue	Description
	water temperatures. Heavy rain after drought, or moderate rain after fire, may produce pulses of sediment and nutrients that significantly affect water quality.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Continuous monitoring data from Tasmania's network of gauging stations is collected by DPIPWE and is accessible via the WIST, though it has limited content around water quality. ***NRM North*** • Extensive water quality data is available for some areas, for example monitoring results[160] and report cards[161] for the Tamar Estuary.
Regional considerations and recommendations	• Water quality forms part of the recommended focus area for water ecosystem health.

6.5.3.2.2 Issue: water ecosystem health

Asset issue	Description
Contextual summary	Water ecosystem health is the aspects of water quality, flow regimes and site and catchment characteristics that contribute to maintenance of in stream biota and biotic communities.
Current knowledge	Water ecosystem health has strong relationships with water quality (see above). However other aspects of the hydrological system that may affect in stream biota are highlighted through a focus on health rather than quality alone.
Change, pressures, climate change	Current pressures and climate change impacts on water ecosystem health are expected to be driven by the same factors identified above for water quality. Additional pressures may arise from the improved agricultural opportunities from climate change, leading to increased agricultural activity and associated impacts on water ecosystem health.

[160] http://www.nrmnorth.org.au/teer-ecosystem-health-assessment-program-monitoring-report-2012
[161] http://www.nrmnorth.org.au/technical-report-for-the-freshwater-monitoring-framework-and-report-card

Asset issue	Description
Key data, information and resources	***State-wide or NRM North and NRM South*** • See water quality data above. • CFEV data for all freshwater themes contains an assessment of overall 'naturalness'[162] for each freshwater feature, and also a wide range of relevant inputs that can be used to assess differential impacts. Formulation of the naturalness index is different for each theme. • The Tasmanian River Condition Index is a well-developed tool suitable for use by the NRM regions in monitoring water ecosystem health but is not funded for use or incorporated in (particularly) government activities[163]. ***NRM North*** • Revised CFEV models for the South Esk basin on the effects of climate change on riverine attributes. ***Known issues*** • CFEV input data for naturalness are significantly out of date.
Regional considerations and recommendations	• Water ecosystem health is a recommended focus area for the next strategies of both NRM North and NRM South. • The extensive monitoring and relatively mature reporting frameworks developed for the Tamar and Derwent estuaries provide a valuable basis from which to design NRM activities around water ecosystem health.

[162] Department of Primary Industries & Water (2008b).
[163] This is in contrast the centralisation of Vegetation Condition Benchmarks for some monitoring purposes, and highlights an unequal prioritisation of freshwater ecosystems compared to that for terrestrial biodiversity.

6.5.3.2.3 Issue: freshwater conservation priority areas

Asset issue	Description
Contextual summary	Freshwater conservation priority areas are sites or features that have been identified for management emphasis to address one or more conservation values.
Current knowledge	Freshwater conservation priority areas can be identified from a range of sources. Internationally significant wetlands are formally listed under the Ramsar convention and subject to the provisions of the *EPBC Act*. The Directory of Important Wetlands in Australia provides recognition against a range of measures including representativeness, ecological or hydrological importance, role as refugia or in supporting critical species life cycle components and populations, threatened communities, and social or cultural significance[164]. Within Tasmania freshwater conservation priority areas form part of the CFEV assessment system, which rates all features in rivers, wetlands, water bodies, saltmarsh, karst and estuaries according to their representative conservation value, integrated conservation value (based on presence of 'special values') and conservation management priority. A subset of these would be considered freshwater conservation priority areas.
Change, pressures, climate change	Climate change impacts on freshwater conservation priority area are as for impacts on freshwater ecosystems generally, but may be accentuated where the values giving areas their importance are sensitive (which many will be).
Key data, information and resources	***State-wide or NRM North and NRM South*** • The CFEV database contains a ranking of the relative conservation management priority of all freshwater features in the State. • Areas identified Directory of Important Wetlands in Australia would be considered important freshwater conservation priority areas. ***Known issues*** • Some Inputs to the CFEV analysis are significantly out of date, and use of modelled data may mean site characteristics are not those at a given site.

[164] http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important

Asset issue	Description
Regional considerations and recommendations	• Freshwater conservation priority areas are included in the recommended focus area of important freshwater areas. • The CFEV database is considered to be critical information infrastructure for Tasmania's NRM regions. • An important component of the recommended focus area is a collaborative process across the three NRM region and other organisations, in particular local councils, for the upgrade of CFEV. The work required to achieve this was scoped prior to the Tasmanian government decision to cease resourcing of the CFEV database.

6.5.3.2.4 Issue: rivers

Asset issue	Description
Contextual summary	Rivers are the surface features through which fresh water actively flows, either through channels that are incised or through broader shallow depressions.
Current knowledge	Many aspects of rivers are addressed separately in the freshwater classification (e.g. water quality, ecosystem health, priority conservation areas). Rivers are included as a separate issue within the freshwater asset class in recognition of the need to maintain information on riverine systems and to focus consideration onto NRM-related issues that may affect them. Knowledge of Tasmania rivers is relatively advanced. The most comprehensive classification and data collation on is contained within the CFEV database. Many of Tasmania's' river features have been altered various combinations of direct human impact and landscape change. For example some smaller streams are likely to have moved from being broad chains of ponds to incised channels; a modification reported to have occurred extensively in temperate Australia[165].

[165] Hazell *et al.* (2003).

Change, pressures, climate change	Tasmania's rivers have been subject to considerable change historically and more recently, particularly with the expansion of irrigation. Smaller areas have been affected by urbanisation. Key changes since European settlement include catchment clearing, abstraction, regulation, channelisation, introduced species and disease, sedimentation, erosion and pollution. Some modelling of the combined effects of climate change and irrigation in the South Esk basis has identified changes in the distribution and extent of some CFEV assemblages and also that some may potentially disappear.
Key data, information and resources	***State-wide or NRM North and NRM South*** • CFEV rivers classification and associated data attributes. ***NRM North*** • Landscape and Policy hub CFEV scenarios for climate change and irrigation combinations. ***Known issues*** • CFEV data is out of date. It also does not include all mapped streams. Location of some mapped streams is inferred rather than confirmed.
Regional considerations and recommendations	• NRM issues associated with rivers are addressed between the recommended focus areas of water ecosystem health and important freshwater areas.

6.5.3.2.5 Issue: wetlands

Asset issue	Description
Contextual summary	Wetlands are areas where the substrate is saturated by water, either seasonally or permanently, and supports distinct ecosystems associated with the saturation. Wetlands are distinguished from waterbodies by the absence of permanent open water and from rivers by the absence of water flow and include ecosystems such as moorlands and peatlands.
Current knowledge	Many aspects of wetlands are addressed separately in the freshwater classification (e.g. water quality, ecosystem health, priority conservation areas). Wetlands are included as a separate issue within the freshwater asset class in recognition of the need to maintain information on wetland systems and to focus consideration onto NRM-related issues that may affect them. Knowledge of Tasmanian wetlands is relatively advanced. The most comprehensive classification and data collation on is contained within the CFEV database.
Change, pressures, climate change	Tasmanian wetlands have historically been modified by many of the same factors that have affected rivers (see above). However effects of climate change on wetlands are likely to be different and include salinisation from increased temperature and reduced water input[166], and change to terrestrial rather than wetland ecosystems due to drying. Changes in species composition will also occur. Factors in climate change likely to have the greatest impact on wetlands include: increased temperature, extreme heat and seasonal change, changes to rainfall, runoff, river flows, extreme events and drought; fire; and the direct effects of CO_2 on plants and the associated ecosystem. Wetlands may also face pressure from other adaptation activities (e.g. creation of flood levies).
Key data, information and resources	***State-wide or NRM North and NRM South*** • CFEV wetlands spatial data and attributes. • Directory of Important Wetlands in Australia. ***Known issues*** • Spatial data in the CFEV wetlands classification is of limited accuracy and reliability. Elements of the classification have also been identified as needing review.

[166] James *et al.* (2009).

Asset issue	Description
Regional considerations and recommendations	• NRM issues associated with wetlands are addressed between the recommended focus areas of water ecosystem health and important freshwater areas.

6.5.3.2.6 Issue: waterbodies

Asset issue	Description
Contextual summary	Lakes and waterbodies are generally characterised by still, open water which may undergo cycles of physical stratification and mixing. They also provide important habitat for a large number of aquatic flora and fauna species, some of which are endemic to the state.[167]
Current knowledge	Some aspects of waterbodies are addressed separately in the freshwater classification (e.g. water quality, ecosystem health, priority conservation areas). Waterbodies are included as a separate issue within the freshwater asset class in recognition of the need to maintain information on lake and waterbody systems. Knowledge of Tasmanian wetlands is relatively advanced due to a long history of research associated with development and utilisation. Many of Tasmania's larger waterbodies are semi-natural in having raised water levels through dams on existing lakes. The most comprehensive classification and data collation on is contained within the CFEV database.
Change, pressures, climate change	Historical changes to Tasmanian waterbodies have been relatively extensive. Impoundment, regulation for irrigation and electricity production and introduction of exotic species (e.g. trout) have altered many lake ecosystems. Recent changes to the major waterbodies have been in the patterns of regulation to provide for peak rather than base-load electricity production and some water diversions for irrigation. Climate change impacts on waterbodies are likely to be significant and include reduced inflow from rainfall, greater fluctuation from extremes of drought and rain, emergence of new invasive species, and water quality issues associated with increased temperatures (e.g. algal

[167] CFEV definition

Asset issue	Description
	blooms). Some smaller waterbodies may move from being permanent to semi-permanent. Organisms that live in waterbodies that are intermittently connected by stream flows may become isolated.
Key data, information and resources	***State-wide or NRM North and NRM South*** • The CFEV classification is the most comprehensive available system on the ecosystems composition of waterbodies and the factors affecting them. ***Known issues*** • CFEV waterbodies were only a small subset (n=1,346) of the total number of waterbodies in Tasmania, based on being above a size threshold of 1 ha, although a few small but highly significant waterbodies were also included. Whilst spatial data is available for smaller natural waterbodies and recently constructed impoundments, knowledge of their characteristics is limited.
Regional considerations and recommendations	• NRM issues associated with waterbodies are addressed between the recommended focus areas of water ecosystem health and important freshwater areas. • The NRM North region contains relatively few large water bodies. • Most larger waterbodies in the NRM South region have robust management systems in place, so may not need a specific focus in NRM activity.

6.5.3.2.7 Issue: riparian vegetation

Note: This issue could equally be called 'riparian zones' to distinguish it from the biodiversity issue of the same name.

Asset issue	Description
Contextual summary	Riparian vegetation is the vegetation associated with streambanks and other wet areas and has characteristics influenced by the aquatic environment. The facet of riparian vegetation that is important to freshwater systems is the role that vegetation can plan in affecting the aquatic environment.
Current knowledge	Riparian vegetation is included in both the biodiversity and freshwater asset classes. However riparian vegetation has a distinct set of relationships with the aquatic environment. These include providing for part of the life cycle needs of aquatic species, regulating water temperature (and flow-on effects like oxygen content) by providing shade, providing coarse and fine inputs of litter and debris to the aquatic environment, stabilising stream banks and acting as filters to sediment and other inputs from overland flows. Managing and enhancing freshwater riparian zone is important and has multiple benefits, so should be a priority for NRM planning and activity.
Change, pressures, climate change	Riparian vegetation has been removed or modified (e.g. by weed invasion) over much of the urban and agricultural landscapes of Tasmania, as well as in areas of plantation established prior to regulation under the Forest Practices System. Rates of loss of riparian vegetation appear relatively low (though quantitative data are lacking) and there has been an increased emphasis in recent years on maintenance, rehabilitation and revegetation of riparian zones. Riparian zones have been identified as important for both terrestrial and aquatic systems under climate change. They are considered to be highly vulnerable to unmanaged impacts under climate change but to also provide opportunities to mitigate climatic effects if subject to adaptive management.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Spatial data on riparian vegetation is available in the CFEV database, which includes attributes for native riparian vegetation cover of the riparian zones of rivers (50m width), wetlands and waterbodies (100m buffer).

Asset issue	Description
	Known issues • CFEV data on riparian vegetation is out of data, and also does not include all freshwater features to which riparian vegetation may be relevant.
Regional considerations and recommendations	• Freshwater riparian zones are included in the recommended focus area for aquatic ecosystem health. • This issue has significant overlap with the biodiversity asset class, in particular the recommended focus areas for ecologically functioning landscapes and, in some areas, biodiversity special values. Cross-referencing to identify co-benefits in NRM activities should be undertaken due to the opportunity to realise efficiency.

6.5.3.2.8 Issue: invasive species and diseases

Asset issue	Description
Contextual summary	Invasive species and diseases in freshwater and aquatic systems are biological agents that can harm biotic composition, ecosystems and processes and/or alter their physical, hydraulic or hydrological characteristics.
Current knowledge	Many aspects of invasive species and disease in aquatic systems are addressed in previous elements of the classification as feature-type issues (waterbodies, wetlands, rivers, riparian zones) or in the attributes of the water itself (water quality, water ecosystem health). The purpose for including aquatic invasive species and disease is to focus on the need for a systematic overview for their range and effects. This also includes known pests and diseases that are not present in Tasmania but need to be considered in terms of their potential impact (e.g. didymo) and appropriate response.

Change, pressures, climate change	Aspects of invasive species and disease are described for relevant issues above. Potential change from new invasive species or diseases is ever present, as illustrated with the introduction of European carp to Lakes Crescent and Sorell. Climate change is recognised as likely to increase occurrence of new pests and diseases. Some of the effects of these on aquatic systems in their natural or naturalised occurrences elsewhere are known, but the predictability of effects in new ecosystems is limited. Diseases associated with freshwater are globally significant for human health and new diseases may emerge in Tasmania due to climate change.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Some weeds assessed using CLIMEX models in the AdaptNRM weeds module would be considered freshwater invasive species. • Important practices for preventing the spread of freshwater pathogens are contain in the 'Keeping it Clean' manual[168].
Regional considerations and recommendations	• Invasive species and diseases within freshwater aquatic systems are pervasive and likely to increase under climate change. This issue would be addressed through the recommended focus areas for aquatic ecosystem health and important freshwater areas where impact on freshwater values needs to be addressed, and under the focus area of change and emerging issues to address threats, new incursion and spread particularly as a result of climate change. • This issue will require ongoing review in consultation with researchers, and DPIPWE invasive species and biosecurity units.

[168] Allen & Gartenstein (2010).

6.5.3.2.9 Issue: water supply security

Asset issue	Description
Contextual summary	Water supply security is the ability to plan for and regulate water supplies sufficient for a range of purposes. These can include for extractive purposes and also for environmental flows.
Current knowledge	Water supply security for Tasmania is relatively high, due to high and reliable rainfall over much of the State. Significant infrastructure (e.g. dams, diversions, pipelines) and planning means that there is considerable flexibility in moving water between catchments to meet specified needs. Environmental flow needs in Tasmania have been investigated[169] and established environmental flows framework has been implemented. Reports containing recommended environmental flows have been completed for most catchments affects by water extraction. At the time of writing Water Management Plans under the *Water Management Act 1999* have been completed for ten catchments[170] and are in draft form for two others[171].
Change, pressures, climate change	Need for knowledge and understanding of water supply security has increased in recent years. Irrigation expansion projects in Tasmania have potential to impact on security of supply, but has been assessed as part of development of new schemes. The importance of water supply security under climate change is highly accentuated
Key data, information and resources	***State-wide or NRM North and NRM south*** • Environmental flow reports and Water Management Plans as noted for current knowledge. ***Known issues*** • A significant proportion of catchments have completed environmental flow reports but do not have water management plans to effect their implementation. • Testing of scenarios of impacts of climate change on water supply security appear to be limited. For example the Tasmanian sustainable yields assessment[172] is based on predictions only to 2030, beyond which projection is difficult due to increasing uncertainty on climate beyond that data.

[169] Department of Primary Industries, Parks, Water & Environment (2010).
[170] http://dpipwe.tas.gov.au/water/water-management-plans/adopted-water-management-plans
[171] http://dpipwe.tas.gov.au/water/water-management-plans/draft-water-management-plans
[172] See summary report one of seven of CSIRO (2009).

Asset issue	Description
Regional considerations and recommendations	• Water supply security is included in the recommended focus area of water supply and utilisation.

6.5.3.2.10 Issue: water utilisation and stewardship

Asset issue	Description
Contextual summary	Water utilisation and stewardship are the efficient and responsible allocation and use of water resources.
Current knowledge	Some of the relevant knowledge around water utilisation and stewardship are addressed above for water supply security. However water supply and stewardship is considered a separate issue as it relates to how water is used after it has left a water supplier and before it re-enters the regulated water system. It is considered a separate issue as stress on water supplies is likely to increase under climate change, which brings increased importance for efficient and responsible use.
Change, pressures, climate change	Water utilisation and stewardship will increase in importance under climate change. In addition to impacts on freshwater systems, aspects of use are likely to become heightened issues among the NRM community.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Extensive data on water utilisation is maintained by DPIPWE Water Management Branch and also other bodies such as Taswater, Hydro Tasmania and Tasmanian Irrigation. ***Known issues*** • Actual water abstractions are known to differ substantially from approved abstractions but is difficult to measure and can only be improved over time.
Regional considerations and recommendations	• Water utilisation and stewardship are part of the recommended focus area for water supply and utilisation.

6.5.3.3 NRM North – freshwater and inland aquatic systems discussion and recommendations

6.5.3.3.1 NRM North freshwater and inland aquatic systems survey responses

Stakeholder response

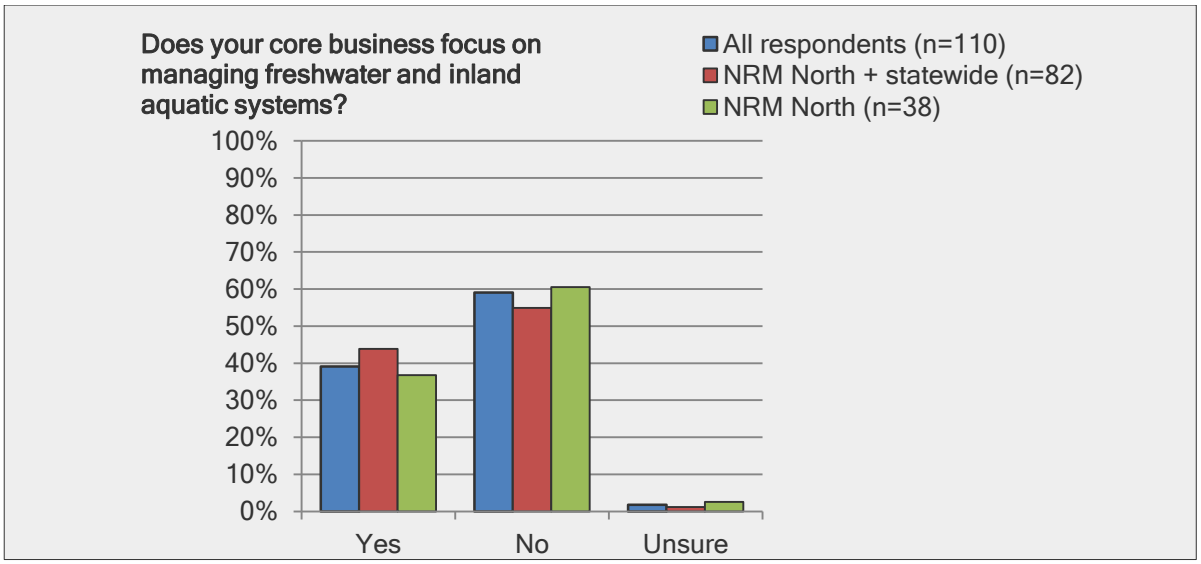


Figure 74 Survey results – freshwater and inland aquatic systems focus

A moderate proportion of survey respondents provided information on freshwater systems. Among the 110 respondents only 44% from the NRM North combined pool identified freshwater and inland aquatic systems as part of their core business comprising 22 identifying as working on a State-wide basis and 14 working in the NRM North region only.

Stakeholder impacts

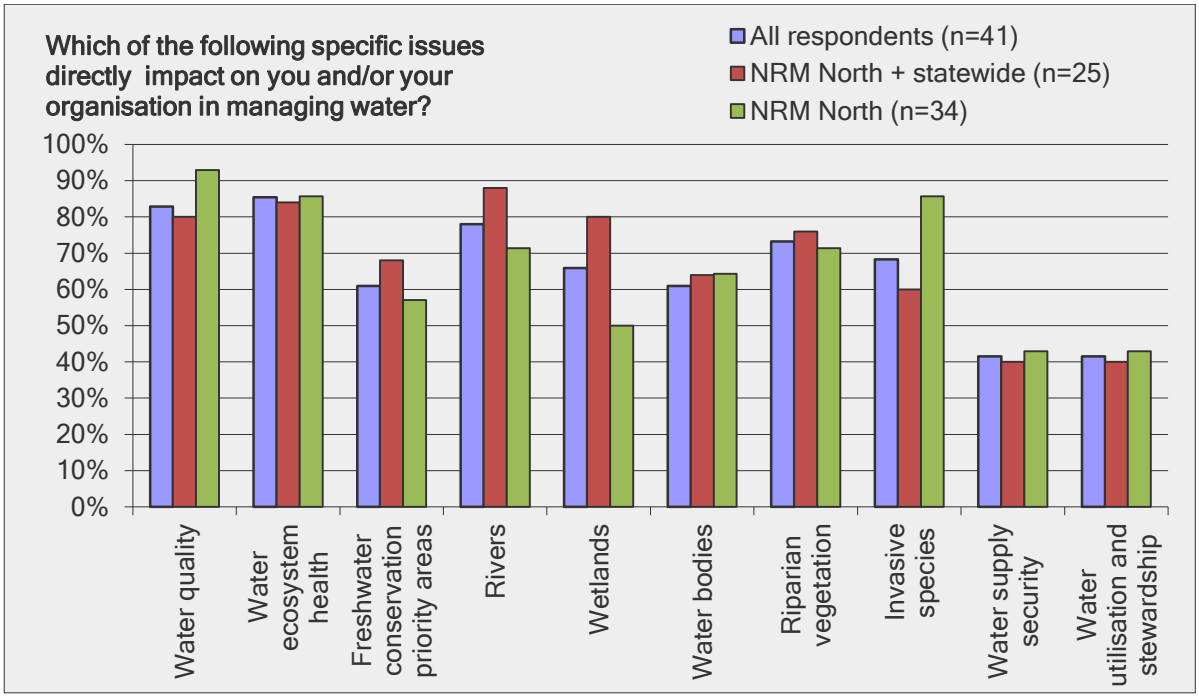


Figure 75 Survey results – stakeholder impacts

Survey responses indicated freshwater and inland aquatic systems have a diverse impact on NRM North respondents. The average reporting rate for impact of freshwater issues on management activities was high (66% NRM North only, 68% NRM North combined pool), indicating the importance of a wide range of factors in effective management of this asset. All ten issues for this asset were reported by over 40% of respondents as having an impact on management activities. Five issues were reported by more than 70% respondents from either the NRM North combined pool or NRM only group as impacting their water management activities – water quality (80% and 93%), water ecosystem health (84% and 86%), rivers (68% combined pool) , wetlands (80% combined pool), riparian vegetation (76% and 71%) and invasive species (86% NRM North only).

Stakeholder priorities

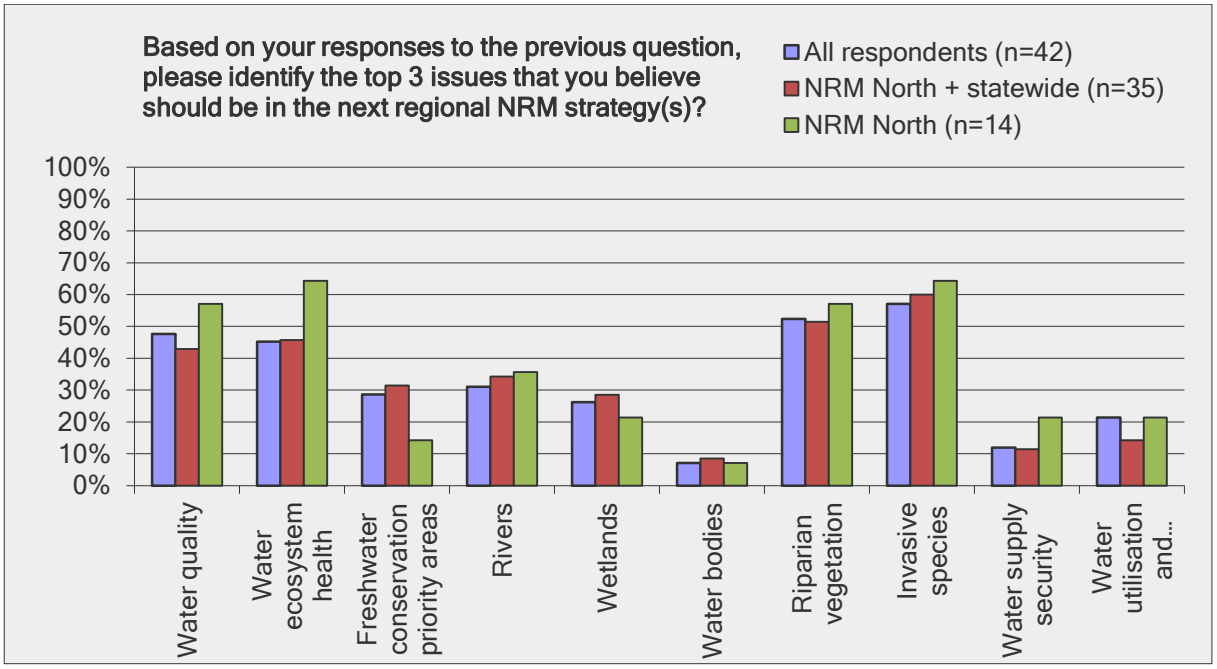


Figure 76 Survey results – stakeholder priorities

Reported priorities for the next NRM North regional strategies were markedly lower than current reported impact – the most highly rated priority was 64% for water ecosystem health compared to 84% for the same issue under current impact and a maximum of 93% (water quality, NRM North only) across all freshwater issues. Reported priorities for the NRM North region were skewed toward four issues – water quality (46% combined pool), water ecosystem health (46% combined pool), riparian vegetation (51% combined pool) and invasive species (54% combined poo). The feature-based freshwater issues (priority areas, rivers, wetlands and waterbodies) scored significantly lower as priorities (mean = 26%). The relatively low priority given to freshwater conservation priority areas suggests further consideration may need to be given to the issue in strategy development (e.g. Are areas already well managed?. Are there barriers to uptake?) The two freshwater utilisation issues (security of supply and utilisation and stewardship) were the second and third lowest reported priorities. These figures are of concern due to the potential impact of climate change on water resource availability and likely increasing pressure during extremes, particularly drought.

Climate change capacity

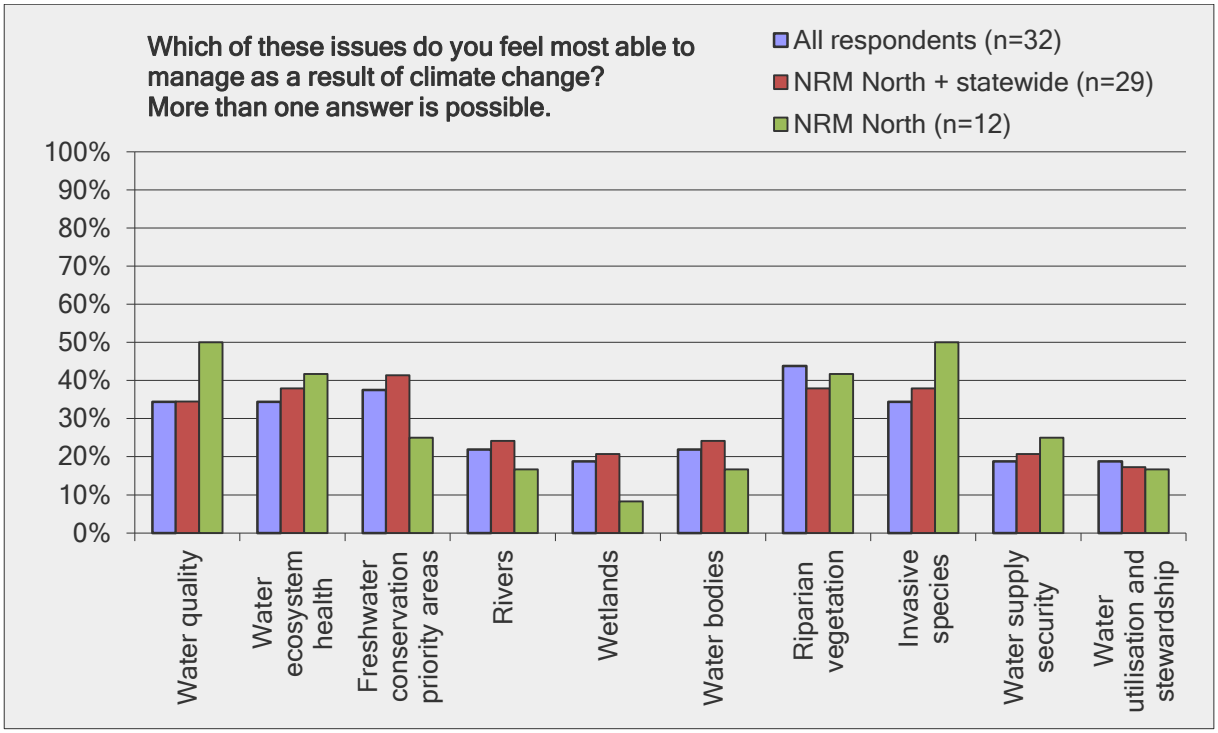


Figure 77 Survey results – stakeholder capacity

Respondents on the whole reported only relatively moderate ability to manage freshwater issues under climate change in the NRM North region. Responses formed two distinct groups in which variation was limited. Five of the ten issues were reported by more than 30% of respondents as within their ability to manage – water quality, water ecosystem health, freshwater conservation priority areas, riparian vegetation and invasive species. The relatively high confidence for managing invasive species is interesting given the likely increased incursion of invasive species introduction due to climate change, stochastic events and human fault. The remaining five issues formed a distinct group in terms of respondent ability, with an average of 20% and a range of just 3%. The inclusion of water supply and utilisation in this group is of concern, particularly in the area of utilisation where behavioural issues and economic drivers can have significant impacts.

Capacity-impact deficit

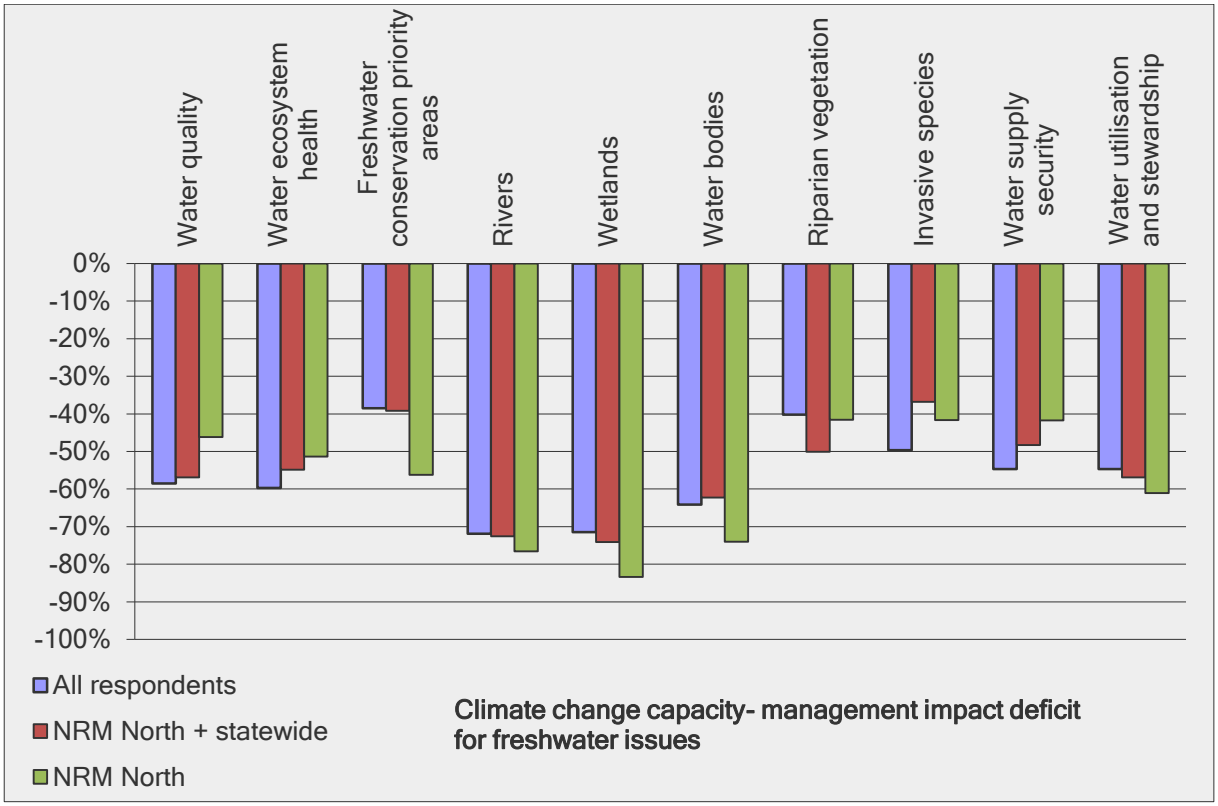


Figure 78 Survey results – stakeholder capacity-impact deficit

The capacity-impact deficit reported for freshwater and aquatic systems in the NRM North region is relatively high (though not as high as for some other assets). The capacity-impact deficit for all freshwater issues is greater ranges from 36-74% (mean = 55%). Three of the issues have a deficit greater than 60% (rivers, wetlands and waterbodies). The capacity-deficit is lowest for management of freshwater priority areas (39%) and invasive species (37%).

Landscape perspectives

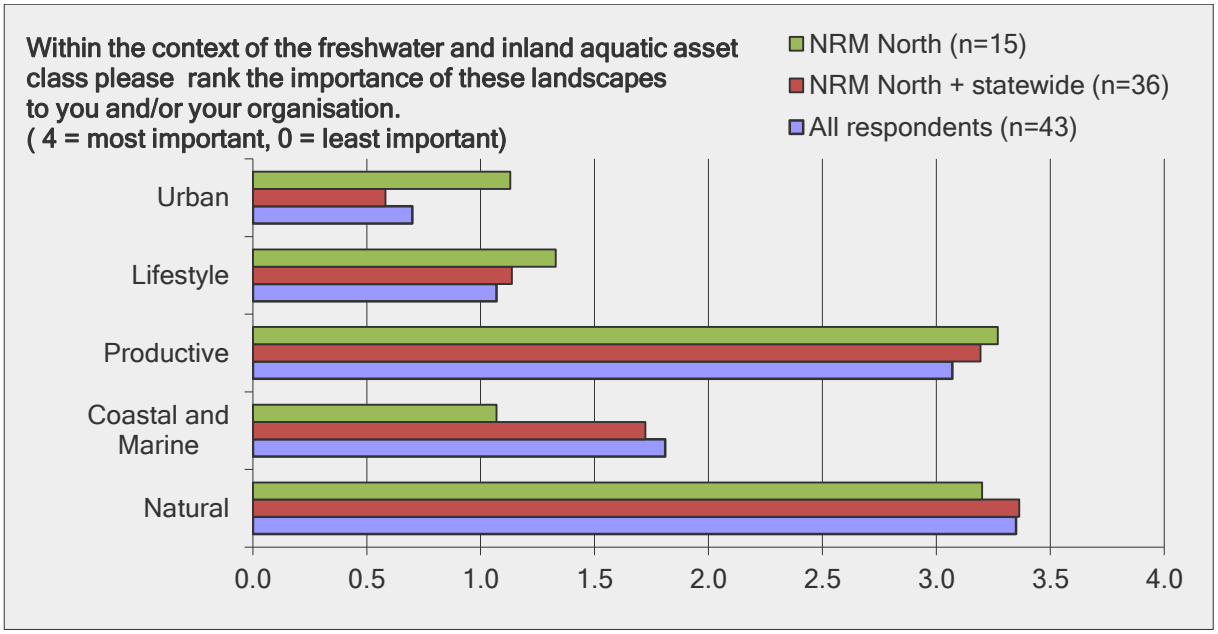


Figure 79 Survey results – stakeholder landscape perspectives

Respondents were asked to identify the landscape they considered to be most important for management of freshwater. The results show a very strong recognition of natural and productive landscapes in the NRM North as important for freshwater. However it is likely that the types of focus might be different between them (e.g. conservation of existing values, water quality management for utilisation). Urban and lifestyle landscapes were not seen as particularly important to respondent organisations for freshwater management. Urban areas within the may be important for addressing water utilisation issues.

6.5.3.3.2 NRM North – recommended freshwater and inland aquatic systems focus areas

Four areas of focus in freshwater and inland aquatic systems in the NRM North region are recommended for the next regional strategy - aquatic ecosystem health, freshwater conservation priority areas, supply and utilisation, change and emerging issues. These focus areas have been selected to encompass to range of issues in the classification but to focus management approaches for the feature-based issues (rivers, waterbodies and wetlands) within two focus areas – aquatic ecosystem health and important freshwater areas.

The same focus areas are recommended for the NRM North and NRM South regions. Differences in issue characteristics with and between the regions will necessitate different priorities for activity. However some issues such as the pressing need to update the CFEV database should be pursued jointly across all three Tasmanian NRM regions and other relevant organisations, particularly local government. This is addressed through a common recommended focus on freshwater conservation priority areas for both the NRM North and NRM South regions. The focus area on change and emerging issues is also presented as a recommended joint priority to be pursued jointly across all three Tasmanian NRM regions. Both these focus areas provide an opportunity for the regional organisations to provide a leadership role.

Freshwater and inland aquatic systems recommended focus area 1 – aquatic ecosystem health

Aspect	**Description**
Issues scope	The proposed focus on aquatic ecosystem health is designed to provide an integrated approach to management of a number of related issues – water quality, water ecosystem health, riparian vegetation and, where established, the impacts of invasive species (potential new invasions are addressed under the change and emerging issues focus area). The term 'aquatic ecosystem health' has been selected as an overarching term likely to be well recognised by NRM stakeholders. It is anticipated that the focus area would focus on: • promoting use of the Tasmanian River Condition Index methodology for rivers; • undertaking further development on increasing utility of methods for wetlands and waterbodies (possibly using ANZECC water quality guidelines in the interim); • protecting and re-establishing riparian vegetation, particularly in heavily cleared landscapes (due to the co-benefits for terrestrial and aquatic biodiversity, for carbon sequestration and storage potential and for helping managed streambank erosion, i.e. across three assets) on all types of freshwater features including intermittent streams where higher water availability is likely under climate change; • managing invasive aquatic species where their impact is significant (not all weeds necessarily have significant impact); • working collaboratively with the other NRM regional bodies and organisation such as councils to build updating of CFEV to establish ongoing reporting capacity.

Aspect	Description
Importance	Aquatic ecosystem health (as broadly defined above) is an extremely important area for NRM activity as it affects a wide spectrum of values – ecosystems and biodiversity, suitability for commercial and domestic purposes, and social amenity. Potential climate change impacts on water ecosystem health are significant.
Stakeholder perspectives	The four issues identified as falling within this focal area were identified by stakeholders in the NRM North region as having a relatively high impact on their management, as the highest priorities for the next regional strategy, and encompass four of the five issues identified as having the higher (albeit relatively moderate) ability to be managed under climate change. Past experience suggests that a primary focus on the water quality aspect of water ecosystem health may provide the issue recognition needed to trigger greater involvement of stakeholders.
Key delivery landscapes	This focus area would need to be delivered primarily in the production and lifestyle landscapes. Lifestyle landscapes are included as inappropriate and unmanaged activities have potential to cause localised harm to aquatic ecosystem health.
Sub-regional aspects	Sub-regional priorities for delivery of this focus area should be considered in terms of where aquatic ecosystem health has been most affected and areas within region where land use change is greatest. Heavily cleared parts of the region (e.g. northern midlands) would be considered priority areas for delivery. In these parts of the region particular attention could be paid to heavily cleared sub-catchments, particularly streams in the middle to higher reaches to effect hydrological change. Lower catchments and larger streams are likely to require a focus on riparian zones, particularly fencing, revegetation and management to reduce localised but potentially high impacts on water ecosystem health (e.g. through shading, reducing runoff). The parts of the NRM North region which are undergoing significant land use change with potential water health impacts (i.e. irrigation scheme areas) should be considered as priorities. Promotion of managing water ecosystem health would include prioritising identified important freshwater conservation areas.

Freshwater and inland aquatic systems recommended focus area 2 – important freshwater areas

Common recommendation for both the NRM North and NRM South regions.

Aspect	Description
Issues scope	This recommended focus area is intended to address management of freshwater conservation priority areas identified through CFEV and other assessments. It is anticipated that the focus area would comprise two elements: • a coordinated approach with the other Tasmanian NRM regions and organisations such as local councils to syndicate updating of the CFEV database (which has not been maintained or updates since 2004) including the identification of freshwater conservation priority areas; • developing communicable messages around the concept of important freshwater conservation areas; • communication and promotion; and • incorporation of priority areas into the delivery of the aquatic ecosystem health focus areas.
Importance	Important freshwater areas derive their significance from having freshwater attributes which stand them apart from others of the same type by virtue of their representative value or through having 'special' values (e.g. threatened species or vegetation, important wetlands) that need considered management.
Stakeholder perspectives	Important freshwater conservation areas received only moderate recognition among stakeholders of current impact and priority for the next regional strategy. They were also seen as having moderate ability to be managed under climate change, although this is considered likely to be variable.
Key delivery landscapes	Natural, production and lifestyle landscapes are likely to be key to promoting effective NRM activity around freshwater conservation priority areas.
Sub-regional aspects	Freshwater conservation priority areas in the current (2004) CFEV analysis are scattered widely across both the NRM North and NRM South regions. A combined technical and stakeholder consultation process is recommended to identify particularly high priorities to be targeted within each region. It is anticipated that many freshwater conservation priority areas will be identified as priorities for other reasons (e.g. threatened

Aspect	Description
	species and vegetation for biodiversity) so may not need to be approached separately.

Freshwater and aquatic systems recommended focus area 3 – water supply and utilisation

Aspect	Description
Issues scope	This issue is intended to focus on the issues of water supply and security and water utilisation and stewardship from the freshwater asset classification. Water supply security for agricultural, domestic and industrial use is largely subject to planning and regulatory processes. However security under climate change is more uncertain due to extremes so an emphasis on promoting efficient and responsible utilisation is recommended.
Importance	Water supply security is one of the key global issues emerging under climate change. Although Tasmania's water supplies are predicted to be less affected than elsewhere (and include some areas of increase in local ***average*** rainfall), the extremes under climate change mean that measures to promote better utilisation can help provide a buffer to impacts during extreme events. Existing assessment of water supply security for Tasmanian irrigation schemes is only to 2030 (CSIRO sustainable yields project); however variation from long term averages and to extremes are predicted to be more pronounced after 2030.
Stakeholder perspectives	These issues were not strongly recognised by stakeholders in the NRM North region.
Key delivery landscapes	Urban and production landscapes are those where use and hence issues around utilisation are greatest.
Sub-regional aspects	Areas of intense water use would be the priorities within the NRM North region for this focus area. These would include the regional population concentration and industrial areas in the Tamar Valley, dispersed industrial sites within the region (e.g. agricultural processing facilities, feedlots), existing concentrations of irrigation activity and the areas subject to irrigation schemes. Promotion of efficient use as an opportunity with cost-benefit would likely be the key delivery mechanism for this focus area.

Freshwater and aquatic systems recommended focus area 4 – change and emerging issues

Common recommendation for both NRM North and NRM South.

Aspect	Description
Issues scope	A focus area on change and emerging issues in freshwater and aquatic systems is designed to provide for a watching brief on emerging issues flagging for adaptive management responses to NRM priorities. The focus area is designed to support management of aquatic ecosystem health and invasive freshwater and aquatic species. It is recommended that the scope and design of this focus area for NRM activity include further technical and stakeholder consultation and be coordinated on an ongoing basis jointly by the three Tasmanian NRM regions in cooperation with other organisations (e.g. Biosecurity Tasmania, Tasmanian Climate Change Office, research institutions).
Importance	This focus area is considered to be of very high importance due to the pervasive importance of freshwater and aquatic systems on natural, commercial and social values and 'health'.
Stakeholder perspectives	Although this focus area has a relatively technical focus it is designed to help address gaps in reported ability to manage (principally by adaptation) under climate change. Excluding the feature-based elements of the classification (rivers, wetland and waterbodies), the capacity impact deficit across issues was uniformly at moderate-high levels ranging from 34-71% for the NRM South combined pool, 37-74% for the NRM North combined pool and 40-72% for all survey respondents (including NRM Cradle Coast and respondents who did not identify a region).
Key delivery landscapes	Urban, lifestyle and productive landscapes, and in some cases natural landscapes, would be the main priorities for delivering the outputs of this focus area.
Sub-regional aspects	Sub-regional aspects of this focus area will vary and cannot be identified in advance (see recommended approach in 'Issue scope' above).

6.5.3.4 NRM South – freshwater and inland aquatic systems discussion and recommendations

6.5.3.4.1 NRM South freshwater and inland aquatic systems survey responses

Stakeholder response

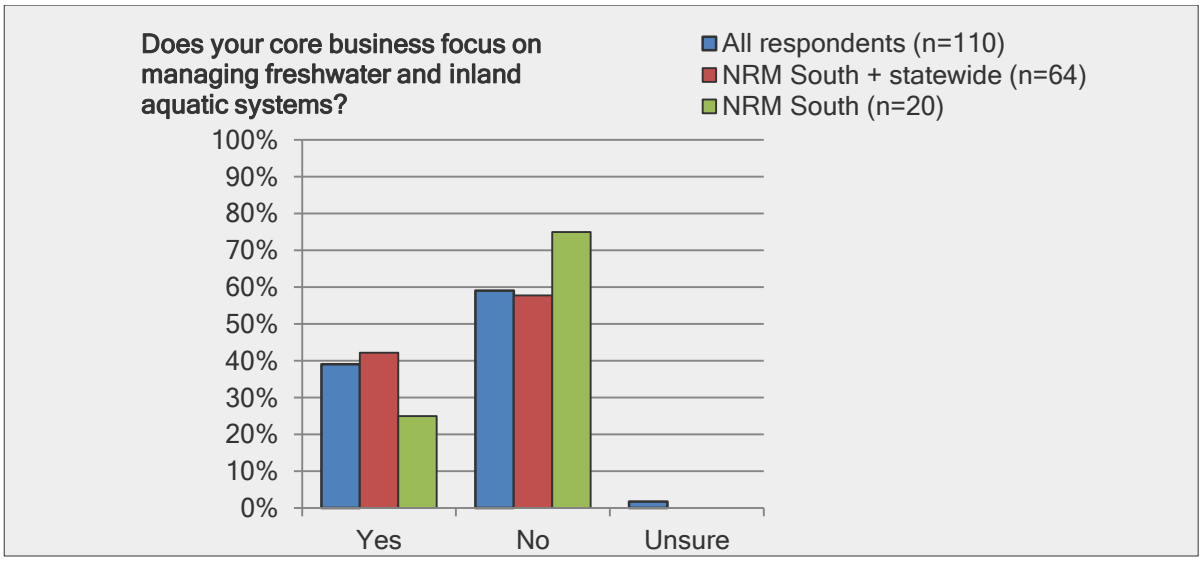


Figure 80 Survey results – freshwater and inland aquatic systems focus

A relatively moderate proportion of survey respondents provided information on freshwater and inland aquatic systems. Among the 110 respondents 42% from the NRM South combined pool identified freshwater as part of their core business comprising 22 identifying as working on a State-wide basis but only 5 working in the NRM South region only. As overall response levels are low the results should be interpreted with caution. Only the NRM South combined pools are considered informative for the analysis and are assessed in the following sections.

Stakeholder impacts

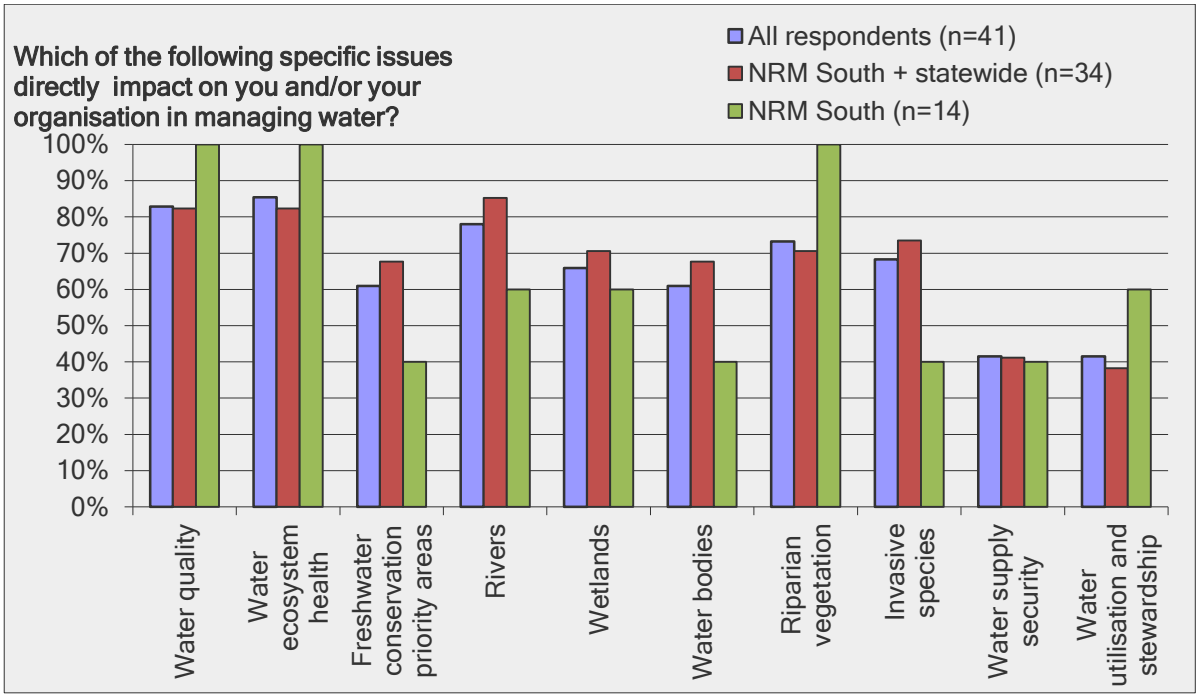


Figure 81 Survey results – stakeholder impacts

Survey responses indicated freshwater and inland aquatic systems have a broad range of impact on NRM South respondents. The average reporting rate for impact of freshwater issues on management activities was high (68% NRM South combined pool, and identical to NRM North responses), indicating the importance of a wide range of factors in effective management of this asset. All ten issues for this asset were reported by over 38% of respondents as having an impact on management activities. Eight issues were reported by more than 65% respondents from the NRM South combined pool as impacting their water management activities and three were reported by more than 80%– water quality (82%), water ecosystem health (82%) and rivers (85%). Water security, utilisation and stewardship were reported as having a moderate impact on NRM South respondents (38-41%) and is almost identical to the results from NRM North respondents (40%).

Stakeholder priorities

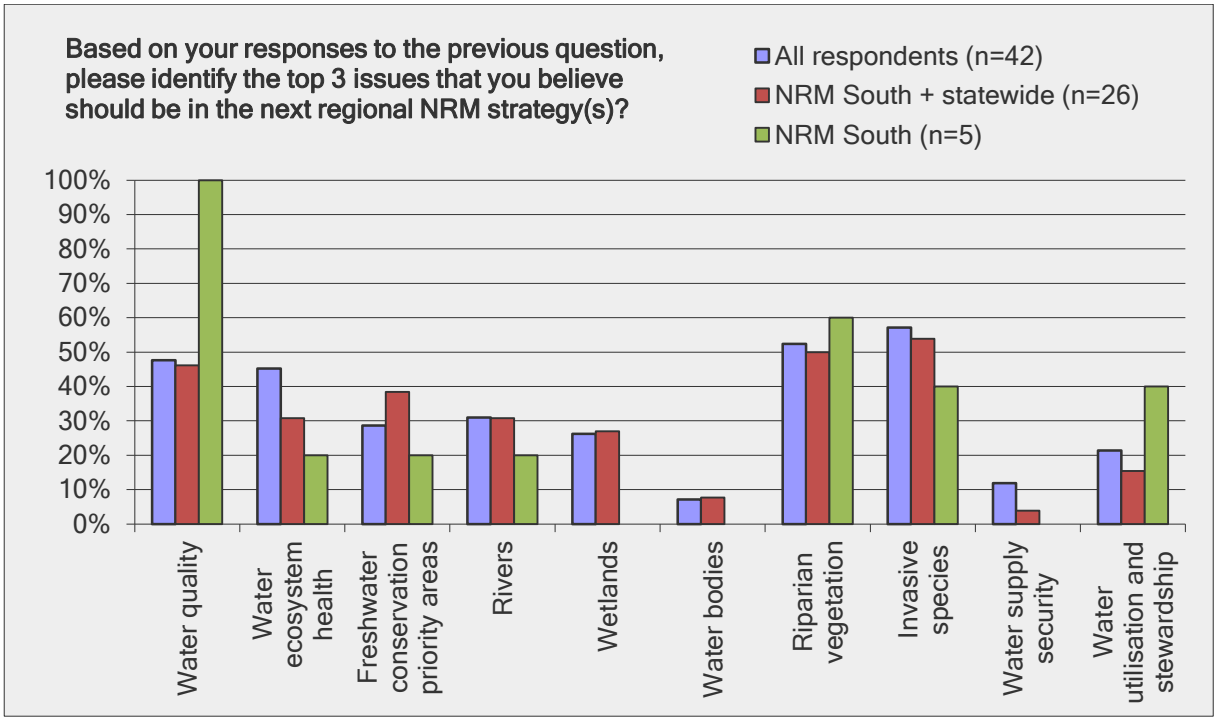


Figure 82 Survey results – top 3 issues for next Strategy

Reported priorities for the next NRM South regional strategy were lower than current reported impact for every issue in the freshwater classification – the most highly rated priority was 54% for invasive species compared to 74% for the same issue under current impact. Reported priorities for the NRM South region were broad but included three issues which were considered priorities by less than 20% of respondents – waterbodies (8%), water supply security (4%) and water utilisation and stewardship (15%). The relatively low priority given to freshwater issues among NRM South respondents suggests there may be a divergence with the NRM South region between stakeholder perceived priorities, technical importance of appropriate management and potential impacts of climate change. Water supply and utilisation are likely to become more significant issues under climate change and require adaptive planning in readiness particularly for extreme events.

Climate change capacity

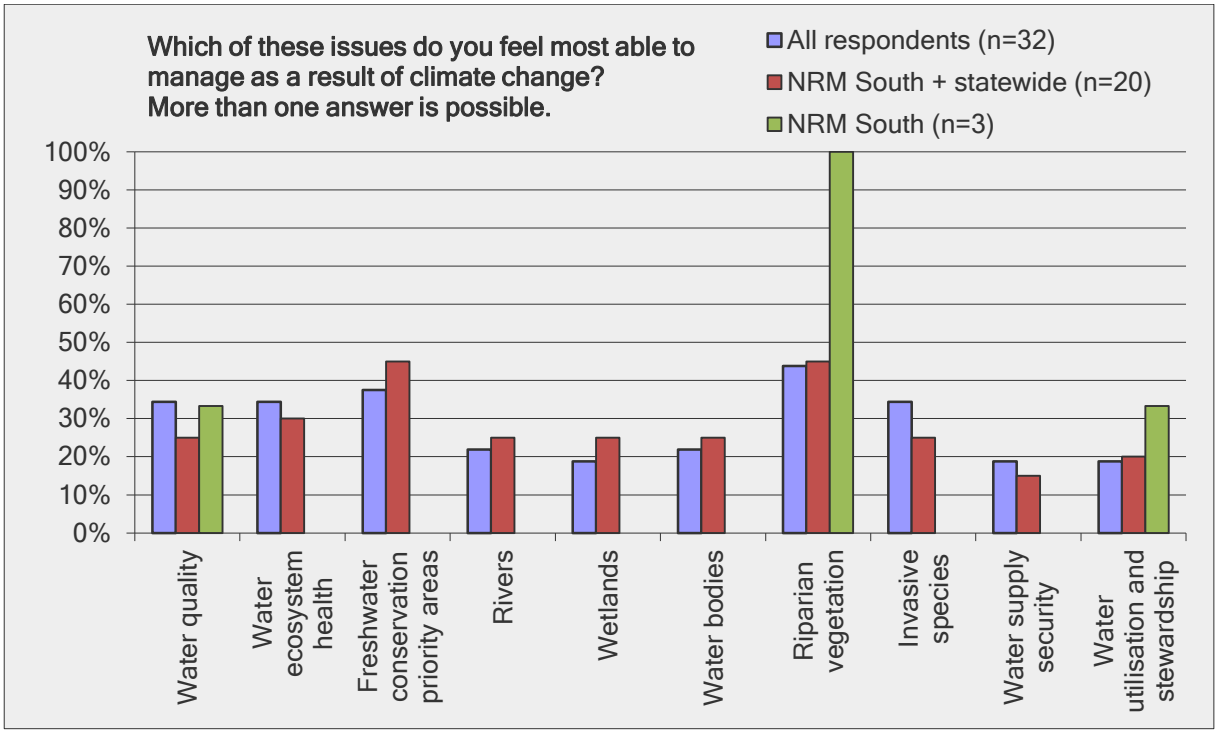


Figure 83 Survey results – stakeholder capacity

Respondents on the whole reported only relatively low-moderate ability to manage freshwater issues under climate change in the NRM South region. Responses were mainly in a relatively narrow range with 8 issues between 15% and 30%. Only two issues were as having greater than a 40% ability to be managed under climate change – freshwater conservation priority areas (45%) and riparian vegetation (45%). The relatively low confidence for managing invasive species (25%) suggests further work may be required in planning and skills development to be able to apply adaptive management responses.

Capacity-impact deficit

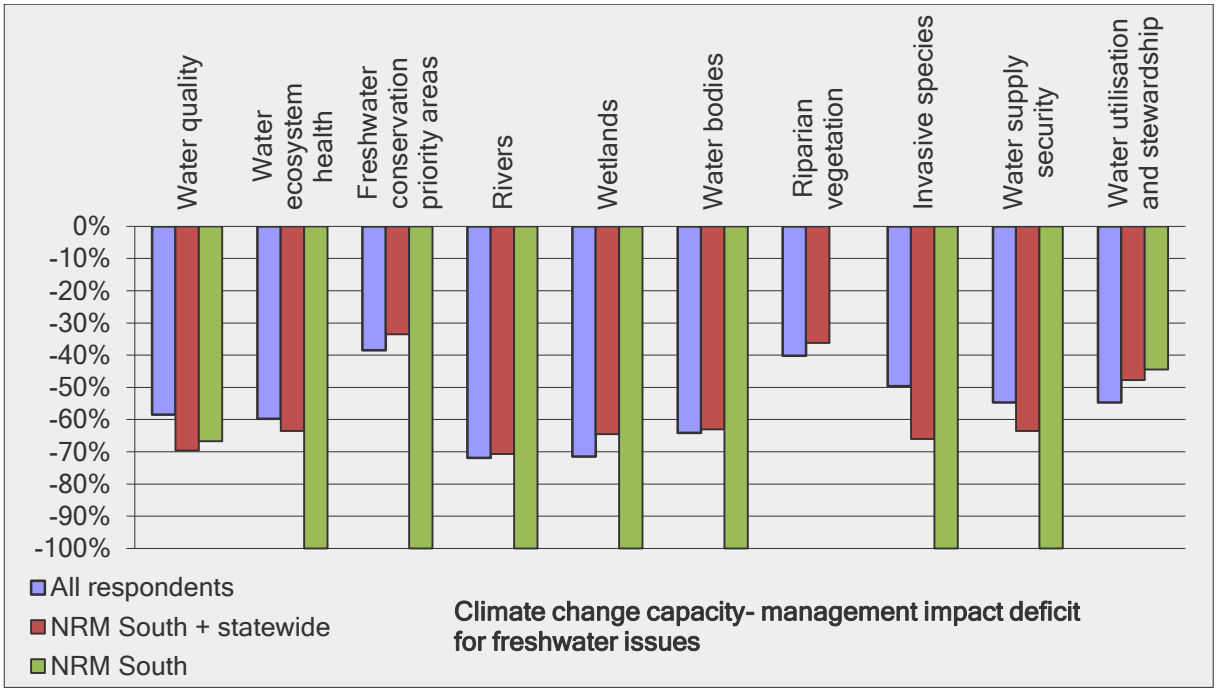


Figure 84 Survey results – stakeholder capacity-impact deficit

The capacity-impact deficit reported for freshwater and aquatic systems in the NRM North region is relatively high within the NRM South region. The deficit for all freshwater issues is in the range of 34-71% with a relatively high mean deficit of 58%. Six of the freshwater issues in the region have a deficit greater than 60% (water quality, water ecosystem health, river, wetlands, waterbodies, invasive species and water supply security). These results suggest capacity development for managing impact of climate change on freshwater values may be needed. The capacity-deficit is lowest for management of freshwater priority areas (34%) and riparian vegetation (36%).

Landscape perspectives

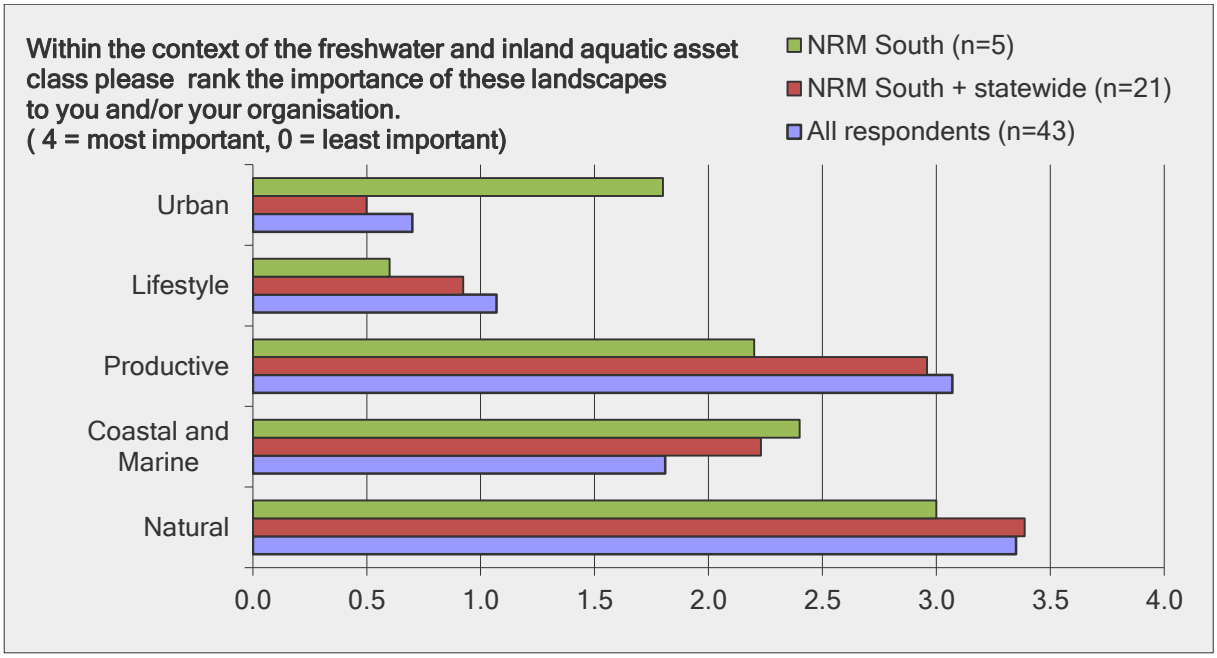


Figure 85 Survey results – stakeholder perspectives

Respondents were asked to identify the landscapes they considered to be most important for management of freshwater. The results show a very strong recognition of natural and productive landscapes in the NRM South region as important for freshwater – a similar response as for NRM North. However it is likely that the types of focus might be different between them (e.g. conservation of existing values in natural landscape, water quality management for utilisation in productive landscapes). Urban and lifestyle landscapes were not seen as particularly important to respondent organisations for freshwater management. Urban areas, particularly the greater Hobart population centre, may be important for addressing water utilisation issues but may involve engaging stakeholders different ways (e.g. mass media).

6.5.3.4.2 NRM South – recommended freshwater and inland aquatic systems focus areas

Four areas of focus in freshwater and inland aquatic systems in the NRM South region are recommended for the next regional strategy - aquatic ecosystem health, freshwater conservation priority areas, supply and utilisation, change and emerging issues. These focus areas have been selected to encompass to range of issues in the classification but to focus management approaches for the feature-based issues (rivers, waterbodies and wetlands) within two focus areas – aquatic ecosystem health and important freshwater areas.

The same focus areas are recommended for the NRM South and NRM North regions. However differences in issue characteristics with and between the regions will necessitate different priorities for activity in terms of issues and sub-regional areas.

Some issues such as the pressing need to update the CFEV database should be pursued jointly across all three Tasmanian NRM regions and other relevant organisations, particularly local government. This need is addressed through a common recommended focus on freshwater conservation priority areas for both the NRM North and NRM South regions. The focus area on change and emerging issues is also presented as a recommended joint priority to be pursued jointly across all three Tasmanian NRM regions. Both these focus area provide an opportunity for the regional organisations to provide a leadership role.

Freshwater and inland aquatic systems recommended focus area 1 – aquatic ecosystem health

Aspect	Description
Issues scope	The proposed focus on aquatic ecosystem health is designed to provide an integrated approach to management of a number of related issues – water quality, water ecosystem health, riparian vegetation and, where established, the impacts of invasive species (potential new invasions are addressed under the change and emerging issues focus area). The term 'aquatic ecosystem health' has been selected as an overarching term likely to be well recognised by NRM stakeholders. It is anticipated that the focus area would focus on:

Aspect	Description
	• promoting use of the Tasmanian River Condition Index methodology for rivers; • undertaking further development on increasing utility of methods for wetlands and waterbodies (possibly using ANZECC water quality guidelines in the interim); • protecting and re-establishing riparian vegetation, particularly in heavily cleared landscapes (due to the co-benefits for terrestrial and aquatic biodiversity, for carbon sequestration and storage potential and for helping managed streambank erosion, i.e. across three assets) on all types of freshwater features including intermittent streams where higher water availability is likely under climate change; • managing invasive aquatic species where their impact is significant (not all weeds necessarily have significant impact); • working collaboratively with the other NRM regional bodies and organisation such as councils to build updating of CFEV to establish ongoing reporting capacity.
Importance	Aquatic ecosystem health (as broadly defined above) is an extremely important area for NRM activity as it affects a wide spectrum of values – ecosystems and biodiversity, suitability for commercial and domestic purposes, and social amenity. Potential climate change impacts on water ecosystem health are significant.
Stakeholder perspectives	Stakeholder perspectives on the issues within this focus area within the NRM South region were varied. As noted in the questionnaire analysis, respondent numbers were low and need to be interpreted cautiously. Some of the results point to capacity issues among stakeholders that may need to be addressed. Past experience suggests that a primary focus on the water quality aspect of water ecosystem health may provide the issue recognition needed to trigger greater involvement of stakeholders.
Key delivery landscapes	This focus area would need to be delivered primarily in productive landscapes, and also lifestyle landscapes but to a lesser degree. Lifestyle landscapes are included as inappropriate and unmanaged activities have potential to cause localised harm to aquatic ecosystem health.
Sub-regional aspects	Sub-regional priorities for delivery of this focus area should be considered in terms of where aquatic ecosystem health has been most affected and areas within region where land use change is greatest. Heavily cleared parts of the region (e.g. Derwent Valley, southern midlands) would be considered priority areas for delivery. In these parts of the region particular attention could be paid to heavily cleared sub-catchments, particularly streams in the middle to higher reaches to effect hydrological

Aspect	Description
	change. Lower catchments and larger streams are likely to require a focus on riparian zones, particularly fencing, revegetation and management to reduce localised but potentially high impacts on water ecosystem health (e.g. through shading, reducing runoff). The parts of the NRM South region which are undergoing significant land use change with potential water health impacts (i.e. irrigation scheme areas) should be considered as priorities. Subregional priority areas might include the larger irrigation scheme areas (e.g. southern midlands component of Midlands water scheme, Southern Highlands scheme) Promotion of managing water ecosystem health would include prioritising identified important freshwater conservation areas; however these are scattered widely across the region.

Freshwater and inland aquatic systems recommended focus area 2 – important freshwater areas

Common recommendation for both the NRM North and NRM South regions.

Aspect	Description
Issues scope	This recommended focus area is intended to address management of freshwater conservation priority areas identified through CFEV and other assessments. It is anticipated that the focus area would comprise two elements: • a coordinated approach with the other Tasmanian NRM regions and organisations such as local councils to syndicate updating of the CFEV database (which has not been maintained or updates since 2004) including the identification of freshwater conservation priority areas; • developing communicable messages around the concept of important freshwater conservation areas; • communication and promotion; and • incorporation of priority areas into the delivery of the aquatic ecosystem health focus areas.
Importance	Important freshwater areas derive their significance from having freshwater attributes which stand them apart from others of the same type by virtue of their representative value or through having 'special' values (e.g. threatened species or vegetation, important wetlands) that need considered management.

Aspect	Description
Stakeholder perspectives	Important freshwater conservation areas received only moderate recognition among stakeholders of current impact and priority for the next regional strategy. They were also seen as having moderate ability to be managed under climate change, although this is considered likely to be variable.
Key delivery landscapes	Natural, production and lifestyle landscapes are likely to be key to promoting effective NRM activity around freshwater conservation priority areas.
Sub-regional aspects	Freshwater conservation priority areas in the current (2004) CFEV analysis are scattered widely across both the NRM North and NRM South regions. A combined technical and stakeholder consultation process is recommended to identify particularly high priorities to be targeted within each region. It is anticipated that many freshwater conservation priority areas will be identified as priorities for other reasons (e.g. threatened species and vegetation for biodiversity) so may not need to be approached separately.

Freshwater and aquatic systems recommended focus area 3 – water supply and utilisation

Aspect	Description
Issues scope	This issue is intended to focus on the issues of water supply and security and water utilisation and stewardship from the freshwater asset classification. Water supply security for agricultural, domestic and industrial use is largely subject to planning and regulatory processes. However security under climate change is more uncertain due to extremes so an emphasis on promoting efficient and responsible utilisation is recommended.
Importance	Water supply security is one of the key global issues emerging under climate change. Although Tasmania's water supplies are predicted to be less affected than elsewhere (and include some areas of increase in local ***average*** rainfall), the extremes under climate change mean that measures to promote better utilisation can help provide a buffer to impacts during extreme events. Existing assessment of water supply security for Tasmanian irrigation schemes is only to 2030 (CSIRO sustainable yields project); however variation from long term averages and to extremes are predicted to be more pronounced after 2030. The parts of the region which are likely to be at greatest risk of water supply reduction into the longer term future, based on Climate Futures Tasmania, are those reliant on rainfall from the central plateau where reductions in rainfall are predicted to be greatest.
Stakeholder perspectives	These issues were not strongly recognised by stakeholders in the NRM South region.
Key delivery landscapes	Urban and production landscapes are those where use and hence issues around utilisation are greatest.
Sub-regional aspects	Areas of intense water use would be the priorities within the NRM South region for this focus area. These would include the regional population of greater Hobart, existing concentrations of irrigation activity (e.g. Coal Valley)and the areas with new water schemes coming on stream (e.g. Bothwell-Clyde area, Swan Valley). Promotion of efficient use as an opportunity with cost-benefit would likely be the key delivery mechanism for this focus area, though is likely to require different approaches between domestic and agricultural users.

Freshwater and aquatic systems recommended focus area 4 – change and emerging issues

Common recommendation for both NRM North and NRM South.

Aspect	Description
Issues scope	A focus area on change and emerging issues in freshwater and aquatic systems is designed to provide for a watching brief on emerging issues flagging for adaptive management responses to NRM priorities. The focus area is designed to support management of aquatic ecosystem health and invasive freshwater and aquatic species. It is recommended that the scope and design of this focus area for NRM activity include further technical and stakeholder consultation and be coordinated on an ongoing basis jointly by the three Tasmanian NRM regions in cooperation with other organisations (e.g. Biosecurity Tasmania, Tasmanian Climate Change Office, research institutions).
Importance	This focus area is considered to be of very high importance due to the pervasive importance of freshwater and aquatic systems on natural, commercial and social values and 'health'.
Stakeholder perspectives	Although this focus area has a relatively technical focus it is designed to help address gaps in reported ability to manage (principally by adaptation) under climate change. Excluding the feature-based elements of the classification (rivers, wetland and waterbodies), the capacity impact deficit across issues was uniformly at moderate-high levels ranging from 34-71% for the NRM South combined pool, 37-74% for the NRM North combined pool and 40-72% for all survey respondents (including NRM Cradle Coast and respondents who did not identify a region).
Key delivery landscapes	Urban, lifestyle and productive landscapes, and in some cases natural landscapes, would be the main priorities for delivering the outputs of this focus area.
Sub-regional aspects	Sub-regional aspects of this focus area will vary and cannot be identified in advance (see recommended approach in 'Issue scope' above).

6.5.4 Asset class: Coastal and marine systems

6.5.4.1 Coastal and marine systems - classification

Classification: Ten major issues were identified from the document review as most important for managing coastal and marine systems and were included in the stakeholder survey. Further review identified that coastal saltmarshes had been omitted from the survey list. They are included in the classification below and discussed in the coastal and marine issues table.

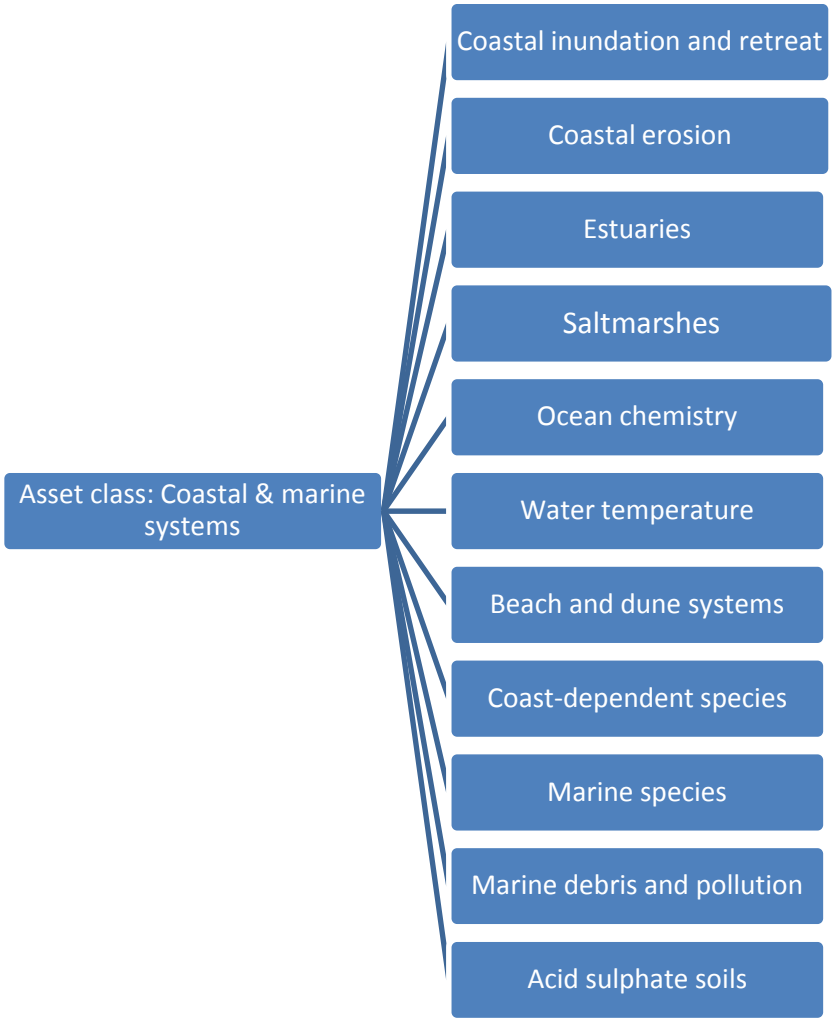


Figure 86 Coastal and marine systems asset classification

6.5.4.2 Asset: Coastal and marine systems - asset knowledge and status assessment

6.5.4.2.1 Issue: coastal inundation and retreat

Asset issue	Description
Contextual summary	Coastal inundation is the submerging of coastal land by sea water. Coastal retreat is the inland migration of coastal features to suitable areas created as a result of coastal inundation.
Current knowledge	Both coastal inundation and retreat (also called recession) occur naturally in response to changing sea levels under climate fluctuations, from tectonic movement and from natural processes of accretion and erosion around the coast. In the contemporary context they are directly associated with climate change and are a major issue for coastal management and adaptation. Projected sea level inundation areas around the coast have been mapped at a relatively fine scale. The nature of coastal retreat can only be partially inferred from the inundation projections, so have a less comprehensive current knowledge base. A number of Councils have implemented studies of climate change impacts in their coastal areas[173]. Areas of potential coastal inundation and retreat around the Tasmanian coastline have been identified and classified into a system of susceptibility zoning[174].
Change, pressures, climate change	Sea level rise under climate change is a specified as range of probabilities. Actual sea level rise over time will need to be monitored and additional scenarios generated over time as data availability increases. This uncertainty highlights the need for adaptive planning that is not dependent on predictability of future events. See also current knowledge.
Key data, information and resources	***State-wide or NRM North and NRM South*** • A range of fine scale data are available for sea level rise of a range of heights and at different times through to 2100[175]. A range of data are available (see Sharples et al. below).

[173] For example see SGS Economics & Planning & University of New South Wales Water Research Laboratory (2009).
[174] Sharples *et al.* (2013).
[175] Lacey *et al.* (2012).

Asset issue	Description
	• Climate Futures LiDAR fine scale digital elevation model data is available for viewing on theLIST and is freely available for download. • Vulnerability of different geomorphic types of coast (clayey, rocky, soft and unclassified shores) spatial data for Tasmania[176]. • Smartline mapping of Tasmanian coastline. • Soft sediment landforms in Tasmanian coastal zones[177]. ***Known issues*** • The current sea level rise data does not include regional shifts in land movement (e.g. from sediment deposition around the coast). • It not clear where responsibility lies maintaining this information at a localised level.
Regional considerations and recommendations	• Coastal inundation and retreat is included in the recommended focus area for threatened coastal features due to the widespread effects sea level rise from climate change are likely to have. The recommendation is made as common for both the NRM North and NRM South region.

[176] Available on LIST and described in Sharples (2006).
[177] Available as single layer on LISTmap, based on Sharples & Mowling (2006a, 2006b).

6.5.4.2.2 Issue: coastal erosion

Asset issue	Description
Contextual summary	Coastal erosion is the removal of coastal materials through the actions of wind, waves, tidal current, drainage or high winds.
Current knowledge	Coastal erosion and areas of coastal erosion risk are included in a separate issue from coastal inundation and retreat as they are the areas from which erosion may occur but are not necessarily areas that will be subject to inundation. Coastal erosion may be followed by shoreline recovery. Some aspects of coastal erosion are associated with retreat (e.g. inland movement of dune) but other such as accelerated erosion of cliffs, erosion of dune faces, undermining coastal structures and gouging and movement of sub-tidal deposits (e.g. silts at river mouths). These actions are particularly important under climate change as they will introduce further uncertainty into the coastal zone. Coastal erosion in Tasmania has been investigated with types of erosion classified and susceptibility zoning prepared for both erosion and recession (retreat)[178].
Change, pressures, climate change	See current knowledge
Key data, information and resources	***State-wide or NRM North and NRM South*** • Smartline mapping of Tasmanian coastline. • A range of other data as described in Sharples et al. below. • Soft sediment landforms in Tasmanian coastal zones[179]. ***Known issues*** • Geomorphic processes are subject to some uncertainty, which is likely to be increased with some extreme events or from natural processes (e.g. cliff weathering). • Coastal erosion susceptibility zoning may need to be reviewed over time to reflect actual changes.
Regional considerations and recommendations	• Coastal erosion has been included in the recommended focus area of threatened coastal features.

[178] Sharples *et al.* (2013).
[179] Sharples and Mowling (2006a, 2006b).

6.5.4.2.3 Issue: estuaries

Asset issue	Description
Contextual summary	Estuaries are semi-enclosed or periodically closed coastal bodies of water in which the aquatic environment is affected by the physical and chemical characteristics of both fluvial drainage and marine systems[180]. Estuaries are areas of invaginated coastline where land sourced freshwater flows mix with sea water and are also influenced by tidal flows. Fresh water in estuaries can originate from river flows or from groundwater.
Current knowledge	Some facets of estuaries are addressed separately in the coastal and marine classification (e.g. water temperature, coast dependent species). Estuaries are included as a separate issue within the coastal and marine asset class in recognition of the need to maintain information on estuarine systems. Knowledge of Tasmanian estuaries is variable. Some of Tasmania's larger estuaries have been relatively well studied (e.g. the Tamar[181] and Derwent[182] estuaries). Some estuaries are of recognised significance for biodiversity, particularly their component wetlands. The most comprehensive classification and data collation on estuaries is contained within the CFEV database. Estuaries are included in as a freshwater ecosystem in CFEV due to the significant effects that catchment attributes and management can have.
Change, pressures, climate change	Pressures on Tasmanian ecosystems include siltation, weed invasion, invasive fish (e.g. *Gambusia holbrooki*), altered flow regimes, historic and contemporary water pollution, recreational impacts, and illegal dumping. Estuaries are expect to come under considerable pressure and alteration under climate change, including from disruption to fluvial systems, catchment impacts from extreme rainfall and drought, inundation from sea level rise, increased average temperatures, associated issues such as algal and diatom blooms, greater incursion of saltwater 'wedges', changes to mixing of fresh and sea water, and

[180] Definition adopted by CFEV from Edgar *et al.* (1999).
[181] Bowkett & Kirkpatrick (2003), Hydro Tasmania (2003a, 2003b, 2003c), Pringle (1993).
[182] http://www.derwentestuary.org.au/scientific-and-technical-reports/

Asset issue	Description
	changes to species composition[183]. However these effects will be strongly influenced by estuarine type (e.g. soft sediment or flooded valley), catchment water management, and interaction with local land use and land management.
Key data, information and resources	***State-wide or NRM North and NRM South*** • The CFEV database contains a comprehensive classification of Tasmanian estuaries, spatial data on biological and physical attributes and conservation prioritisation. ***NRM North*** • Monitoring data, reports and report cards of the Tamar Estuary and Esk River Program. ***NRM South*** • Mapping of estuarine habitat in the NRM South region is available[184]. • Collated data of marine habitats from a range of sources is available for the Derwent Estuary (Derwent Estuary Program, available on LISTmap). • Monitoring data and reports of the Derwent Estuary Program. ***Known issues*** • CFEV data on estuaries is out of date, particularly with respect to changes in catchment factors (e.g. hydrology, flows, cover).
Regional considerations and recommendations	• Estuaries are included in the recommended focus area of threatened coastal features, due to the pervasive effects of sea level rise under climate change. The focus area is a common recommended for both NRM North and NRM South.

[183] Further information and references are available in Department of Primary Industries, Water & Environment (2010), p48.
[184] Mount *et al.* (2005).

6.5.4.2.4 Issue: coastal saltmarshes

Asset issue	Description
Contextual summary	Saltmarshes as freshwater-dependent ecosystems that are influenced by the marine environment. They are recognised by their communities of plants and animals that can tolerate high soil salinity and periodic inundation by sea or brackish water[185]. In the current context coastal saltmarshes also include tidal wetlands.
Current knowledge	Saltmarshes are treated as freshwater ecosystems under the CFEV classification. However they are included in this classification of coastal and marine issues due to them being confined to the coastal zones (inland saltmarshes are part of CFEV wetlands). Current knowledge of saltmarshes is considerably improved over that contained in CFEV, including mapping of saltmarsh in the NRM North[186] and NRM South[187] regions and sea level rise analysis for NRM South[188]. Subtropical and temperate coastal saltmarshes are also now listed as Vulnerable under the *EPBC Act*.
Change, pressures, climate change	Saltmarshes have been subject to considerable historical degradation. In addition to changes to catchment hydrology and associated processes, they have often been drained, grazed and even used as rubbish tips. Research comparing saltmarsh change over the period 1975-2009 found 18% lost to human modification, 4% lost to coastal retreat and vegetation change over 21% of their area[189]. Saltmarshes are particularly vulnerable to a range of impacts of climate change and change is already occurring (see Prahalad et al.). Changes to catchment and local hydrology are potentially significant, although the latter are likely be harder to anticipate. Rising sea levels will mean that a number of saltmarshes will be inundated. Some will be able to retreat to areas further inland as the area of suitable conditions moves; however this will be dependent on sympathetic management. Others are likely to disappear completely where there are no retreat areas. Coastal saltmarshes may also face pressure from other adaptation activities (e.g. creation of sea walls and flood levees).

[185] CFEV definition
[186] Prahalad (2014).
[187] Prahalad & Jones (2013).
[188] Prahalad & Pearson (2013).
[189] Prahalad *et al.* (2011).

Asset issue	Description
Key data, information and resources	***State-wide or both regions*** • Updated mapping of saltmarshes has been prepared for all three Tasmanian NRM regions. These data have been included in the current release of Tasveg (v3.0). Coastal saltmarsh migration pathways have been mapped for the Derwent Estuary. • Further work on Tasmanian coastal saltmarsh is currently being undertaken as part of a University of Tasmanian PhD project (V. Prahalad, supervisor J.B. Kirkpatrick). ***NRM North*** • NRM North coastal wetlands atlas[190]. ***NRM South*** • Coastal native vegetation condition spatial data for Derwent estuary in Clarence municipality (2009 Derwent Estuary Program). • Coastal native vegetation viability spatial data for Derwent estuary in Clarence municipality (2009 Derwent Estuary Program). • Coastal native vegetation significance spatial data for Derwent estuary in Clarence municipality (2009 Derwent Estuary Program). • Coastal native vegetation significance spatial data for the upper Derwent estuary (2009 Derwent Estuary Program). • Coastal weeds spatial data for the Derwent estuary in Clarence municipality (2009 Derwent Estuary Program). • Coastal weeds spatial data for the upper Derwent estuary (2009 Derwent Estuary Program). • Coastal saltmarsh migration pathways have been mapped for the Derwent Estuary[191]. ***Known issues*** • Some of the attributes of saltmarshes included in the CFEV analysis (e.g. naturalness, representativeness, conservation management priority) are not included in more recent data.
Regional considerations and recommendations	• Coastal saltmarshes and tidal wetlands are addressed in the recommended focus area on coast-dependent species and ecosystems. The focus area is recommended to be

[190] Prahalad (2014).
[191] Prahalad *et al.* (2009).

Asset issue	Description
	implemented through a collaborative program involving all three Tasmanian NRM regions and other stakeholders. • Consolidation of coastal saltmarsh data into a single systematic framework compatible with CFEV is suggested as part of the recommended focus area.

6.5.4.2.5 Issue: ocean chemistry

Asset issue	Description
Contextual summary	Ocean chemistry is a climate change associated issue due to alteration to the chemical composition of sea water as a result of increase absorption of carbon dioxide and temperature.
Current knowledge	Ocean chemistry under climate change is altered in a number of ways. Absorption of CO_2 by the oceans causes increased acidity, with potential flow on effects for calcium and carbonate based solids in ocean ecosystems (e.g. shellfish, crustaceans). It is not currently known what effect increased sea surface temperature (see issue below) will have on ocean acidification[192] – an important concern given the east coast of Tasmania's very high levels of change in ocean temperature – but a combined effect has been reported in some species[193].. Levels of oxygen in the ocean global are showing evidence of decline. The ocean floor is stores vast quantities of methane-hydride – some estimates are in the range 1,000-5,000 GT[194] -which if released will exacerbate the greenhouse effect and compound climate change impacts. Ocean acidification has been identified as a threat to biodiversity on Tasmania's sea mounts[195].
Change, pressures, climate change	See current knowledge.

[192] http://www.ozcoasts.gov.au/indicators/ocean_acid.jsp
[193] Parker *et al,* (2009).
[194] http://worldoceanreview.com/en/wor-1/ocean-chemistry/climate-change-and-methane-hydrates/
[195] Antarctic Climate & Ecosystems Cooperative Research Centre (2008).

Key data, information and resources	***State-wide or NRM North and NRM South*** • Change report cards provide useful and updated summaries of climate change impacts[196]. • Localised data on marine water chemistry may be available from baseline data for the aquaculture industry. ***Known issues*** • Although the effects of changing ocean chemistry are an identified risk (e.g. to shellfish) no data could be identified that are specific to Tasmania. • A key knowledge gap for the effects of altered ocean chemistry in Tasmania is its relationship to increased sea surface temperature
Regional considerations and recommendations	Ocean chemistry is included in the recommended focus area of change and emerging issues for coastal and marine systems.

6.5.4.2.6 Issue: water temperature

Asset issue	Description
Contextual summary	Ocean and coastal sea water temperature is a climate change associated issue due to the potentially pervasive effects of increased temperature.
Current knowledge	The Tasman sea off the east coast of Tasmania has been identified as a global hotspot of ocean water temperature change, which is estimated to be increasing at 3-4 times the global average[197]. The effects of ocean warming on marine biota is expected to be multi-dimensional, with some species adapting to warmer conditions, other dying out, and others undergoing range shifts to new areas with favourable conditions. Key areas of effects are in altered species physiological responses (e.g. growth rates), distribution, phenology (e.g. timing of breeding) and abundance[198]. The effects of warmer temperatures are already being seen in the southward movement of some fish species; kelp

[196] http://www.oceanclimatechange.org.au/content/index.php/2012/home/
See also Poloczanska (2009a, 2009b).
[197] Wu *et al.* (2012).
[198] Doubleday *et al.* (2009).

Asset issue	Description
	forests are expected to decline and have ecological and commercial consequences; algal blooms in coastal and marine system may increase.
Change, pressures, climate change	See current knowledge.
Key data, information and resources	***State-wide or NRM North and NRM South*** • CSIRO Marine Climate Change report cards provide useful and updated summaries of climate change impacts in the marine environment[199]. ***Known issues*** • Data relating to ocean water temperatures is large and complex. • Interpreted knowledge is likely to be more significant for NRM bodies. This will require collaboration in particular with researchers. • Data and knowledge gaps are ongoing and will need to be addressed within adaptation frameworks.
Regional considerations and recommendations	• Ocean water temperature is included in the recommended focus area of change and emerging issues for coastal and marine systems.

[199] http://www.oceanclimatechange.org.au/content/index.php/2012/home/
Also Poloczanska *et al.* (2009a, 2009b).

6.5.4.2.7 Issue: dune and beach systems

Asset issue	Description
Contextual summary	Beach and dune systems are sections of the coastline dominated by unconsolidated deposits. Beaches are typically composed of sand but sometimes are composed of small rocks (shingle beaches). Dunes are composed of sand which is typically deposited and transported by wind.
Current knowledge	Beach and dune systems are included as an issue in coastal and marine systems due to their importance in active geomorphic processes associated with the coastline, some areas of geomorphic significance and also because of their accentuated vulnerability to alteration (change, retreat, erosion) under climate change. Beach and dune systems are also home to important plant species, vegetation and fauna (e.g. shorebirds – see coast dependent species). Deposition of organic material (e.g. coarse woody debris from floods, seaweed and kelp) provide the basis for a distinct ecosystem. Beach systems in the NRM North region tend to be more tide-dominated and tide-modified than in NRM South, where wave-dominated beaches created by exposure to Southern Ocean swells are more prevalent.
Change, pressures, climate change	Tasmanian beaches are subject to a range of pressures. Human interference with coastal water patterns (e.g. breakwaters) have resulted in erosion of some areas. Recreational and agricultural activities have led to instability of some dune systems. Erosion of foredunes occurs naturally, has been exacerbated by settlement in some areas, and will increase under climate change. Weeds are a major problem in some beach and dune systems200.

[200] Rudman (2003).

Key data, information and resources	***State-wide or NRM North and NRM South*** • Comprehensive data on the physical characteristics of beach and dune systems is available in the Smartline database[201]. Smartline also incorporates the ABSAMP beach database[202]. • Some aspects of vegetation on dune systems is mapped in Tasveg. • Indicative geomorphic values mapping of the Tasmanian coastline (LISTmap). • Smartline mapping of Tasmanian coastline. • Historic and present dune mobility around the Tasmanian coast[203]. ***NRM North*** • ShoreBase data and reports provide extensive information of foreshore physical characteristics and stressors[204] (e.g. foreshore aquatic sediment risk, risk of removal or disturbance of foreshore biota). ***NRM South*** • Foreshore values, condition and pressures mapping[205]. ***Known issues*** Knowledge of Tasmanian beach and dune systems is relatively advanced, due to the early recognition of climate change effects. Additional gaps in knowledge of beach and dune systems are likely to emerge over time as the coastline changes.
Regional considerations and recommendations	• Beach and dune systems are included in the recommended focus area for threatened coastal features, due to the pervasive and significant impacts of climate change. The focus area is presented as a common recommendation for NRM North and NRM South.

[201] http://www.ozcoasts.gov.au/coastal/introduction.jsp
[202] http://www.ozcoasts.gov.au/coastal/beach_intro.jsp
[203] Spatial data available in LISTmap but accompanying report not able to be located.
[204] Migus (2011).
[205] Migus (2008).

6.5.4.2.8 Issue: coast dependent species and ecosystems

Asset issue	Description
Contextual summary	Coast-dependent species and ecosystems are those that occur exclusively in coastal systems or are dependent on them for important life functions (e.g. breeding). This issue includes beach and dune and species.
Current knowledge	Coast-dependent species and ecosystems form part of a range of other issues (e.g. threatened species and ecosystems for biodiversity). They are include as a separate issue in coastal and marine systems as their environment has distinct characteristics, management requirements and history of change, all of which are likely to be further influenced by climate change. Tasmanian coast-dependent species and ecosystems include dune vegetation, shorebirds, shoreline plant and animal assemblages. Species and ecosystems in this issue are differentiated from marine species and ecosystems by having primarily reliance on the terrestrial rather than marine characteristics of the coast.
Change, pressures, climate change	Coast-dependent species and ecosystems have been subject to considerable pressures. Species groups such as shore-nesting birds include many highly endangered species that are affected by use of beaches (e.g. destruction of eggs and chicks by vehicles, people, pets and feral animals)[206]. Some migratory species are threatened both on Tasmanian beaches, during their migrations, and by habitat alteration and destruction in the northern hemisphere. Some coastline ecosystems are also recognised as threatened vegetation types (e.g. Tasveg spray zone coastal complex and seabird rookery complex mapping units). Climate change is expected to significantly impact coast-dependent species and ecosystems, including through sea level rise and beach and dune erosion.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Natural Values Atlas species location records. • Tasveg State-wide vegetation mapping. • Coastal fauna significance spatial data (2006 NRM North and South coastal values project). • Coastal native vegetation condition spatial data (2006 NRM North and South coastal values project)

[206] Bryant (2002).

Asset issue	Description
	• Coastal native vegetation viability spatial data (2006 NRM North and South coastal values project). • Coastal vegetation significance spatial data (2006 NRM North and South coastal values project). • Coastal observed fauna habitat spatial data (2006 NRM North and South coastal values project). • Coastal potential fauna habitat spatial data (2006 NRM North and South coastal values project). • Coastal weed spatial data (2006 NRM North and South coastal values project). • Birds Tasmania shorebirds studies and data. ***NRM North*** • ShoreBase data and associated report[207] provides a range of data relevant to this issue (e.g. foreshore bacterial pathogen risk, risk of removal and disturbance of foreshore biota, introduced species risk). ***NRM South*** • Coastal native vegetation condition spatial data for Derwent estuary in Clarence municipality (2009 Derwent Estuary Program). • Coastal native vegetation viability spatial data for Derwent estuary in Clarence municipality (2009 Derwent Estuary Program). • Coastal native vegetation significance spatial data for Derwent estuary in Clarence municipality (2009 Derwent Estuary Program). • Ecological disturbance and foreshore condition spatial data[208] (includes integrated biological value assessment). ***Known issues*** Work is currently being undertaken to investigate the vulnerability of beach-nesting shorebirds and seabirds to sea level rise.
Regional considerations and recommendations	• Coast dependent species and ecosystems are included in the recommended focus area for coastal special values, due to their high vulnerability to sea level rise under climate change. The focus area is recommended as a common approach to be undertaken on a collaborative basis among all three Tasmanian NRM regions and other stakeholders.

[207] Migus (2011).
[208] Migus (2008)

6.5.4.2.9 Issue: marine species and ecosystems

Asset issue	Description
Contextual summary	Marine species and ecosystems are those that occur almost exclusively in marine or tidally inundated areas or are dependent on them for critical life functions.
Current knowledge	Tasmania's marine ecosystems are diverse and globally significant. This arises largely from a complex physical coastline, isolation, offshore islands and convergence of ocean currents providing both a wide variety of habitats and niches and high productivity in the marine environment. Many species in the marine environment are unique and some are threatened. Tasmania's kelp and seagrass meadows are recognised as highly significant. Some marine systems are contained within Marine Protected Areas but the percentage is extremely low. Both the 2003[209] and 2009[210] State of the Environment reports identified a significant lack of knowledge about coastal, estuarine and marine ecology, and the condition of that ecology creates uncertainty about how to manage human impacts. Although knowledge is improving, particularly driven by the need to understand climate change impacts variation in the knowledge base is considerable.
Change, pressures, climate change	Marine ecosystems face considerable pressure from existing human use and activity. Appropriate management of fishing activity (commercial and recreational) is a key to some aspects of marine systems. There are historical legacies of poor fisheries management in the past (e.g. earlier scallop industry) and there are ongoing issues with appropriate levels of take and size limits. Tasmanian marine systems are subject to the impacts of a number of invasive species (e.g. northern Pacific seastar, *Undaria* pinnatifida). Marine species and ecosystems are among the top worldwide issues for vulnerability to alteration as a result of climate change. Under climate change the distinction between native species and invasive species is likely to become more blurred. Marine ecosystems which are currently under considerable pressure and which are key ecosystem drivers (e.g. seagrass meadows, kelp forests) are expected to become more vulnerable to climate change due to

[209] 2003 State of the Environment report: http://soer.justice.tas.gov.au/2003/cem/7/issue/87/ataglance.php
[210] 2009 State of the Environment report: http://soer.justice.tas.gov.au/2009/nat/4/issue/33/ataglance.php

Asset issue	Description
	physical, chemical and ecosystem changes in the ocean[211]. Some of the major changes in Tasmania's marine environment are southward movement of species to the east coast. Translocation of species to control effects arising from other species migrations have been considered and tested against decision-making frameworks but have been found to be difficult due to lack of scientific evidence[212].
Key data, information and resources	***State-wide or both regions*** • Data on the distribution of marine species is monitored through the Redmap program[213]. • Data on marine species in the Natural Values Atlas is relatively limited. • Marine species and ecosystems are on the whole poorly known compared to terrestrial biodiversity. • The rapid rate of change in Tasmania marine systems means that data and knowledge gaps will be constantly emerging. • A governance framework for adapting to climate change on the east coast of Tasmania has been developed[214]. • Marine seagrass beds 1950, 1970 and 1990[215], available on LISTmap). ***NRM South*** • Southeast Tasmania 1:25,000 marine habitat mapping (Tasmanian Aquaculture and Fisheries Institute 2000). • Derwent estuary 1:25,000 marine habitat mapping (Tasmanian Aquaculture and Fisheries Institute 2000).

[211] For a more complete summary see Johnson *et al.* (2011).
[212] For an example see Bax *et al.* (2013).
[213] http://www.redmap.org.au/article/changes-in-tasmanias-marine-ecosystems/
[214] Lockwood *et al.* (2013).
[215] Rees (1993).

Regional considerations and recommendations	• Marine species and ecosystems would be addressed through the common recommendation for NRM North and NRM South to participate in State-wide initiatives around coastal and marine issues. The two focus areas in which marine species and ecosystems would feature most strongly are: o special values; and o change and emerging issues.

6.5.4.2.10 Issue: marine debris and pollution

Asset issue	Description
Contextual summary	Marine pollution is the entry of chemicals, particles, industrial, agricultural and residential waste or noise into the ocean. Marine debris is a form of marine pollution in the form of floating plastic materials that are lightweight and nearly indestructible[216].
Current knowledge	Marine debris includes many materials traditionally regarded as flotsam and jetsam in oceans and on beaches – human rubbish, plastic containers, fishing gear[217]. Its input to marine systems occurs as a result of accidents, damage, ignorance and negligence. It is a major problem for a large number of marine species and can cause death or injury either by toxicity or by the physical effects of ingestion or entanglement. Seventy-seven species of marine wildlife in Australian waters are known to be affected by marine plastic debris[218], including a number of Tasmanian marine mammals and seabirds. Large quantities of marine debris occur in Tasmania's coastal and marine systems. Marine pollution is that associated with more traditional sources – shipwrecks, land-sourced effluent. These marine pollution sources are largely regulated however a number of areas with historical legacies of significant impact persist (e.g. the Derwent estuary). Marine debris is listed as a key threatening process under the *EPBC Act*.

[216] Adapted from http://definitions.uslegal.com/m/marine-pollution/
[217] For example see Jones (1995).
[218] Ceccarelli (2009).

Change, pressures, climate change	Marine debris has potential to be positively and negatively effects by climate change. Extreme storm events may lead to greater input of debris to marine systems from ships at sea and from damage to fishing equipment and aquaculture infrastructure. Ironically any reduction in fishing due to climate change may lead to less marine debris from this source.
Key data, information and resources	***NRM North*** • Some data on marine debris is available from clean-up activities and for northern Tasmania[219]. ***Known issues*** • Available data contains many gaps. A longitudinal study of spatial and temporal variation in marine debris has been recommended (see Slavin below).
Regional considerations and recommendations	• Marine debris is an extremely important issue in the marine environment. It has been recommended as a common single issue focus area for both NRM North and NRM South. A cooperative program across the Tasmanian NRM regions and other stakeholders is considered the most appropriate way to address the issue.

6.5.4.2.11 Issue: acid sulfate soils

Asset issue	Description
Contextual summary	Acid sulfate soils are soils that contain metal sulphides and have been formed in water logged conditions, usually in sedimentary or organic material. They are stable while waterlogged but when exposed to oxygen produce sulphuric acid. After rain and following dry periods the sulphuric acid is transported through the soil.
Current knowledge	Acid sulfate soils are included as an issue in the land and soils asset class. They are included as a coastal and marine issue as much of their current extent is within coastal areas, so need to be considered in NRM planning and activity.

[219] Slavin (2011).

Asset issue	Description
Change, pressures, climate change	Most of the issues around acid sulfate soils are as described for land and soils. Under climate change exposure of acid sulfate soils in coastal areas is expected to increase and formation of new areas of acid sulfate soils can be expected where prolonged inundation of susceptible substrates occurs. Coastal acid sulfate soils have been found to be a stressor of 'extreme risk' to foreshore condition in northern Tasmania, due to change to pH arising from disturbance to coastal acid sulfate soils[220].
Key data, information and resources	***State-wide or NRM North and NRM South*** • A number of resources identified for this issue in the land and soils asset class apply. • Coastal acid sulfate soils mapping (available in LISTmap). • Marine subaqueous/intertidal acid sulfate soils mapping (available in LISTmap). ***NRM North*** • ShoreBase data and report (see Migus 2011 below). ***Known issues*** • An additional knowledge gap is the location of potential future acid sulfate soil formation under climate change. Assessment of the DPIPWE digital soil surface modelling data with relevant hydrological data may be appropriate.
Regional considerations and recommendations	• Coastal acid sulfate soils would be addressed mainly under the recommended focus area of threatened coastal features. However impacts on other values (e.g. shoreline ecosystems from altered pH) would also be addressed as part of the recommended focus area for coastal special values.

[220] Migus (2011).

6.5.4.3 NRM North – coastal and marine discussion and recommendations

6.5.4.3.1 NRM North coastal and marine systems survey responses

Stakeholder response

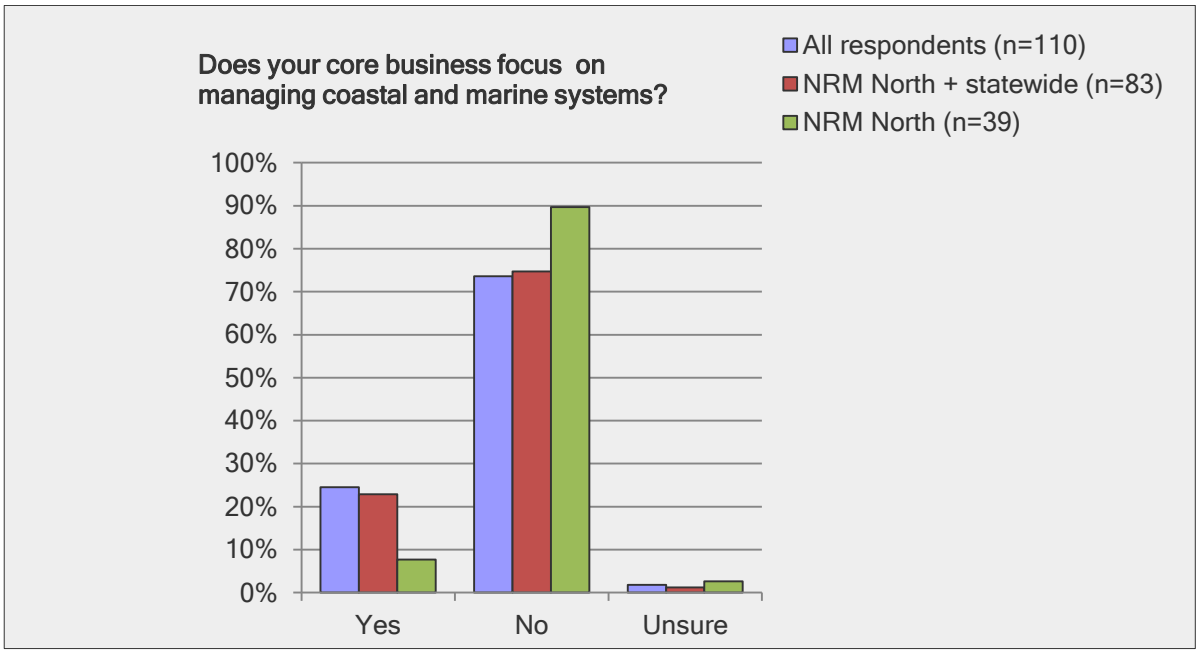


Figure 87 Survey results – stakeholder coastal and marine focus

A total of 110 responses were provided on whether coastal and marine ecosystems were core business for respondents. The response was extremely low for both the NRM North combined pool (22%) and particularly the NRM North only group (8%). The data indicate that only relatively small numbers of respondents in the NRM North region are actively involved in managing coastal and marine systems.

Stakeholder impacts

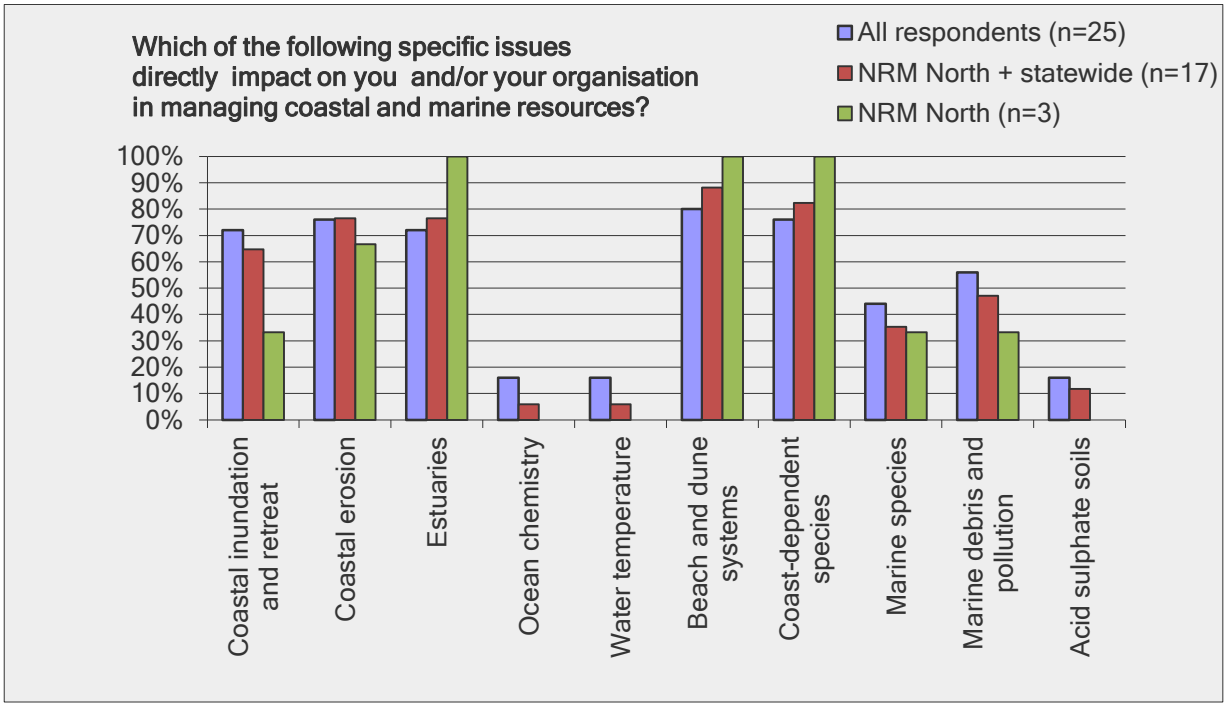


Figure 88 Survey results – stakeholder coastal and marine impacts

Only 3 respondents who identified in the NRM North only group indicated that coastal and marine systems were part of their core activity. Results from this group should not be considered informative; however they may also point to sectoral issues that result in interest in coastal and marine issues not having any significant association with the NRM regions, which are terrestrially defined. Among the NRM North combined pool (n=17), five issues were identified by greater than 50% of respondents as impacting their management activities – coastal inundation and retreat (65%), coastal erosion (77%), estuaries (77%), beach and dune systems (88%) and coast-dependent species (82%). Ocean chemistry and temperature and coastal acid sulfate soils had very limited impact on respondents' management activities in the NRM North region.

Stakeholder priorities

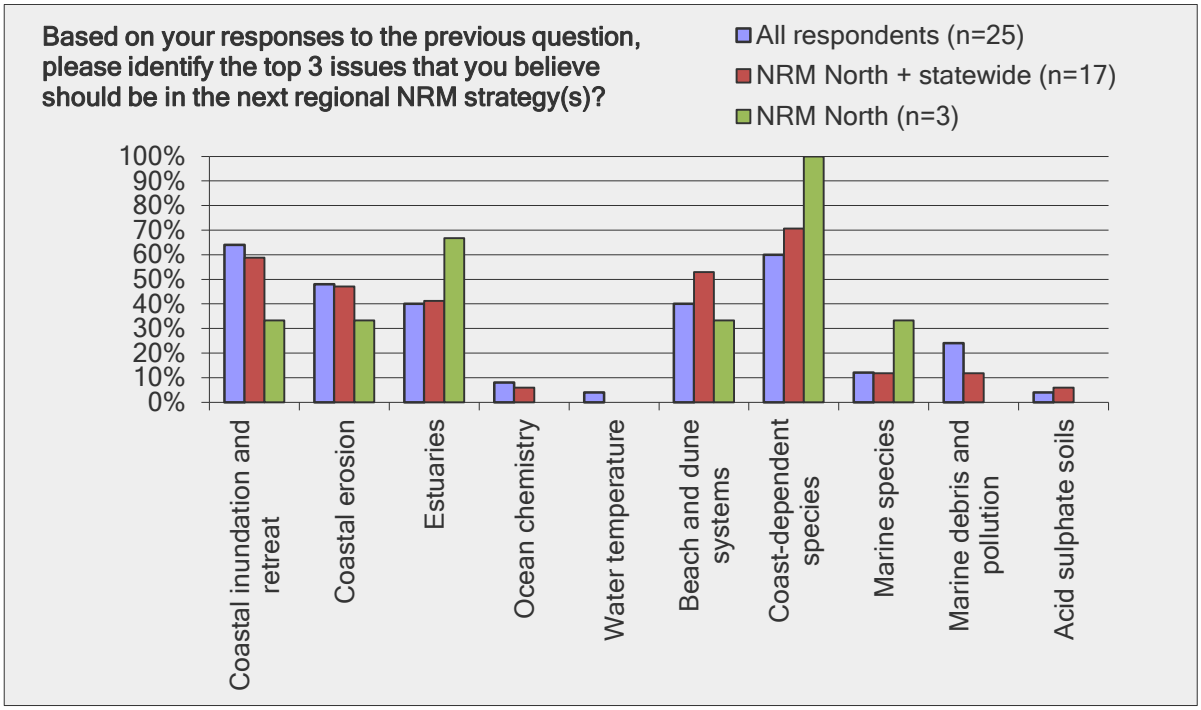


Figure 89 Survey results – stakeholder top 3 issues for next Strategy

Reported priorities for the next regional strategies were skewed strongly toward the same five issues identified as impacting management activities of NRM North combined pool respondents – coastal inundation (59%), coastal erosion (47%), estuaries (41%), beach and dune systems (53%) and coast-dependent species (71%). The remaining five issues were considered priorities by less than 12% of respondents, with four of these being issues related primarily to the marine environment.

Climate change capacity

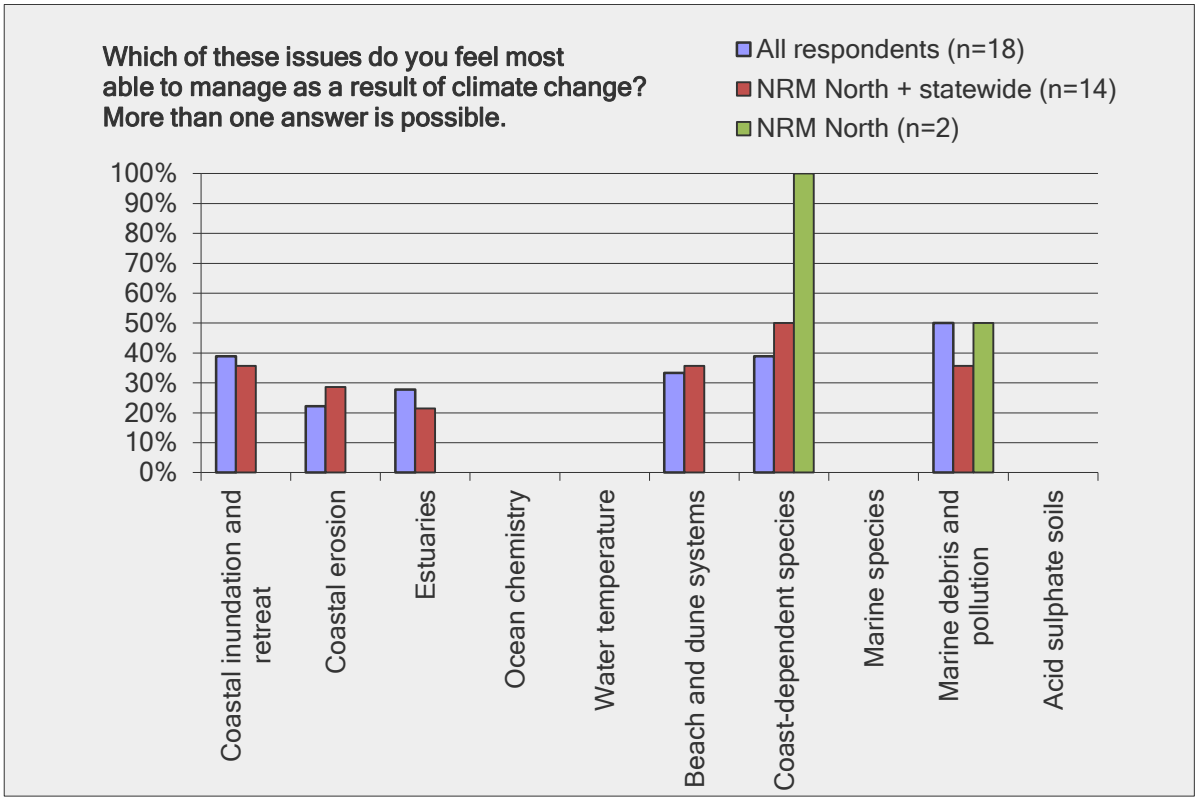


Figure 90 Survey results – stakeholder capacity

Respondents on the whole reported low ability to manage coastal and marine issues under climate change. Only six of the ten issues were identified by the NRM North combined pool as able to be managed at all, ranging from 21% to 50%. Of particular concern is that four issues were not identified by any respondents as within their ability to manage under climate change – ocean chemistry, water temperature, marine species and acid sulfate soils. The inclusion of acid sulfate soils in this list is surprising given the existence of available mapping[221] and guidelines for management in Tasmania[222].

[221] LIST data layer 'Coastal areas of Tasmania with potential to contain acid sulfate soils http://maps.thelist.tas.gov.au/listmap/app/list/map?layout-options=LAYER_LIST_OPEN&cpoint=147.43,-42.85,10000&srs=EPSG:4283&bmlayer=3&layers=250

[222] http://dpipwe.tas.gov.au/agriculture/land-management-soils/soil-management/acid-sulfate-soils

Capacity-impact deficit

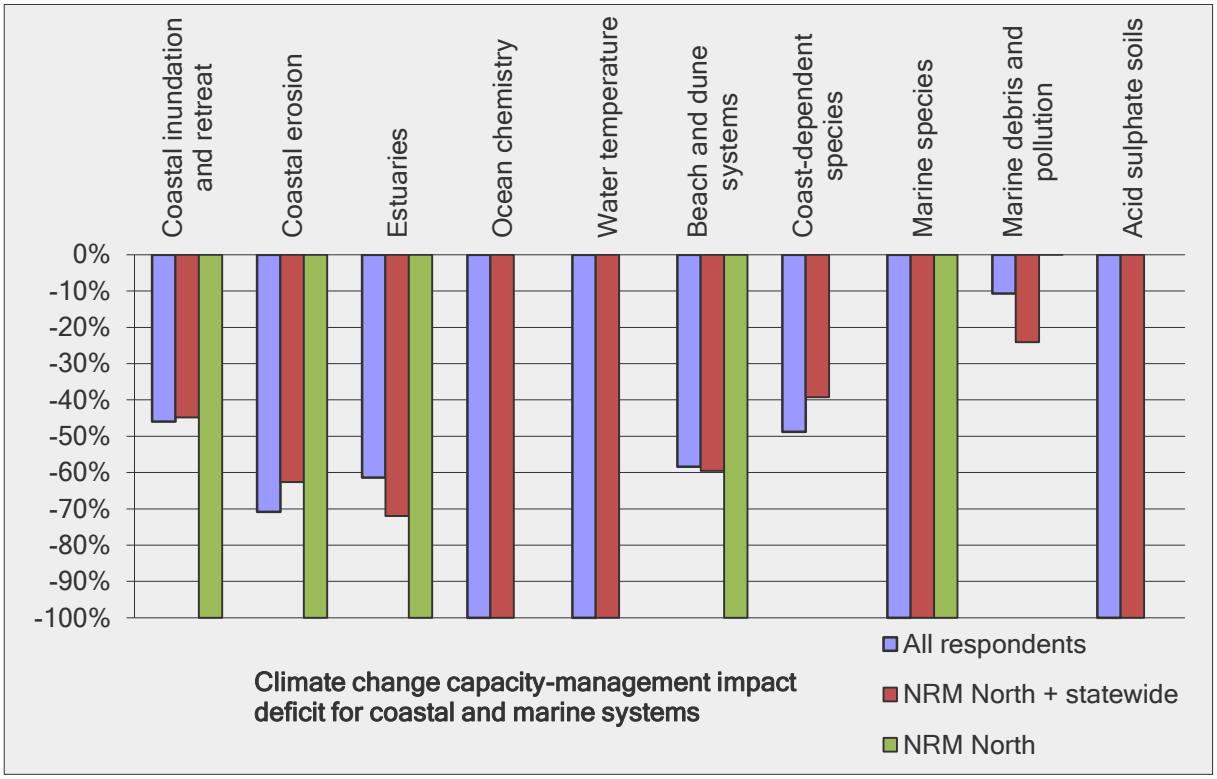


Figure 91 Survey results – stakeholder capacity impact-deficit

Not surprisingly, the capacity deficit for the four issues identified in the previous section as having no reported ability to manage is 100%. The deficit is also significant for five of the remaining issues which exceed 40% difference between impact and ability – coastal inundation (-45%), coastal erosion (-63%), estuaries (-72%), beach and dune systems (-60%) and coast-dependent species (-39%). Only marine debris and pollution has a small difference between current impact and management ability under climate change (-24%).

Landscape perspectives

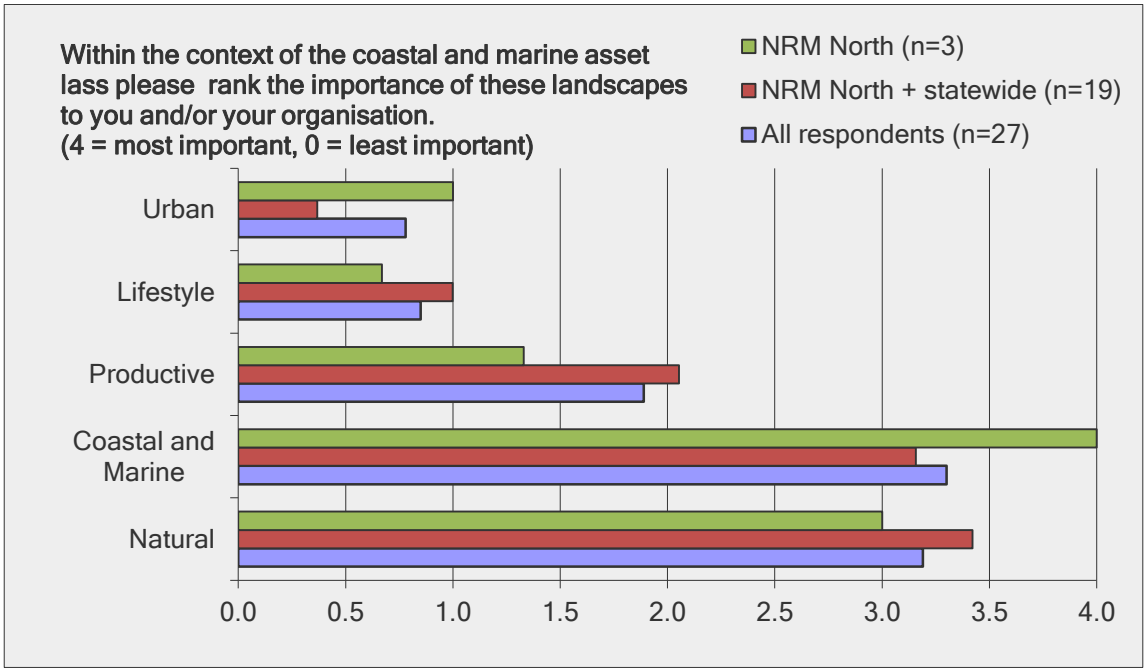


Figure 92 Survey results – stakeholder landscape perspectives

Somewhat surprisingly, respondents in the NRM North combined pool identified natural landscapes as more important for managing coastal and marine issues than the coastal and marine landscape. However the difference in average responses is small and it is possible that there were perceptual issues in distinguishing the two landscapes (no definitions were provided). Urban ecosystems were ranked as of least importance for coastal and marine issues. Impacts on coastal values and resources, economic and social disruption and dislocation to urban areas located in the coastal zones of Tasmania is a well-documented concern under climate change, so the low ranking of this landscape is surprising.

6.5.4.3.2 NRM North – recommended coastal and marine system focus areas

Four areas of focus in coastal and marine systems are recommended for the next strategy - threatened coastal features, 'special' values, marine debris, and change and emerging issues. The similarity of many aspects between the NRM North and NRM South regions is high.

There are also questions about promoting and organising NRM activity among stakeholders in the marine environment that may mean organisation around terrestrial NRM regions may have limitations, particularly in the marine environment. For these reasons recommended marine and focus areas for both regions are identical and are presented in section 6.5.4.5.

6.5.4.4 NRM South – coastal and marine discussion and recommendations

6.5.4.4.1 NRM south coastal and marine systems survey responses

Stakeholder response

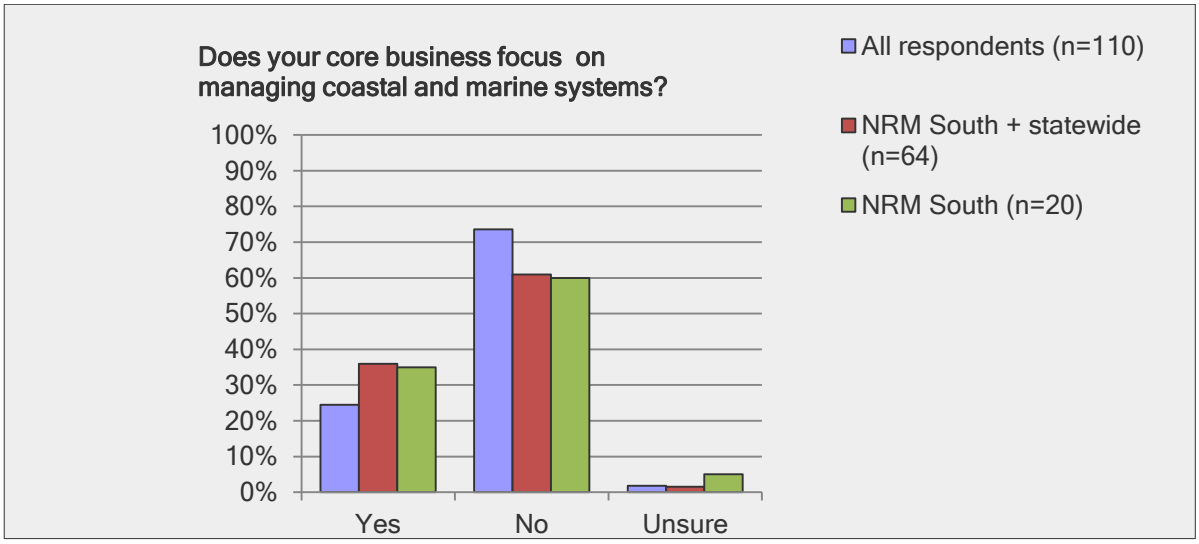


Figure 93 Survey results – coastal and marine systems focus

A relatively small number of survey respondents provided information on coastal and marine systems. Among the 110 respondents only 36% of the NRM South combine pool (n=23) identified marine and coastal systems as part of their core business.

Stakeholder impacts

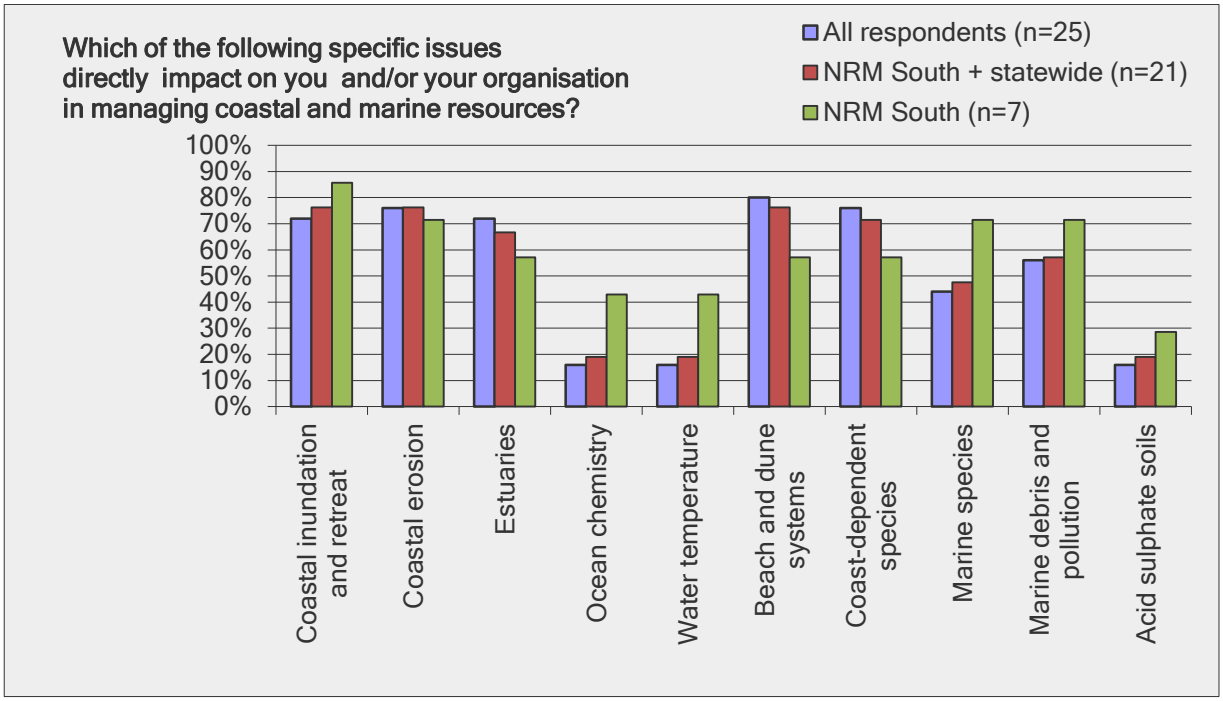


Figure 94 Survey results – stakeholder impacts

Although the number of respondents was relatively small, the range of coastal and marine issues impacting on stakeholder activities was relatively broad. Seven of the ten issues for this asset were reported by over 47% of NRM South combined pool respondents as having an impact and four were reported by over 70% - coastal inundation (76%), coastal erosion (76%), beach and dune systems (76%) and coast-dependent species (71%). Three issues were identify by less only 16% of respondents – ocean chemistry, water temperature and acid sulfate soils. The potential effects of ocean chemistry and water temperature under climate change are significant however the low number of respondents makes interpretation difficult.

Stakeholder priorities

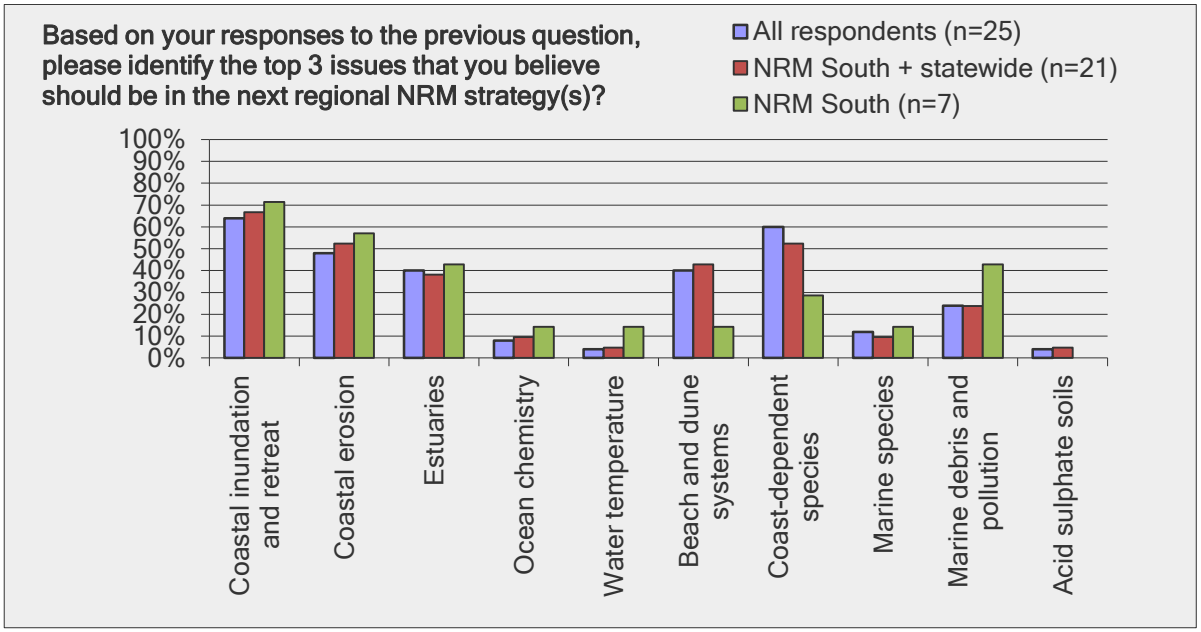


Figure 95 Survey results – stakeholder top 3 issues for next Strategy

Reported priorities for the next NRM South regional strategy were skewed strongly toward five issues – coastal inundation (64%), coastal erosion (48%), estuaries (40%), beach and dune systems (40%) and coast-dependent species (60%). The remaining five issues were considered priorities by less than 25% of respondents, with four of these being issues related primarily to the oceanic marine environment.

Climate change capacity

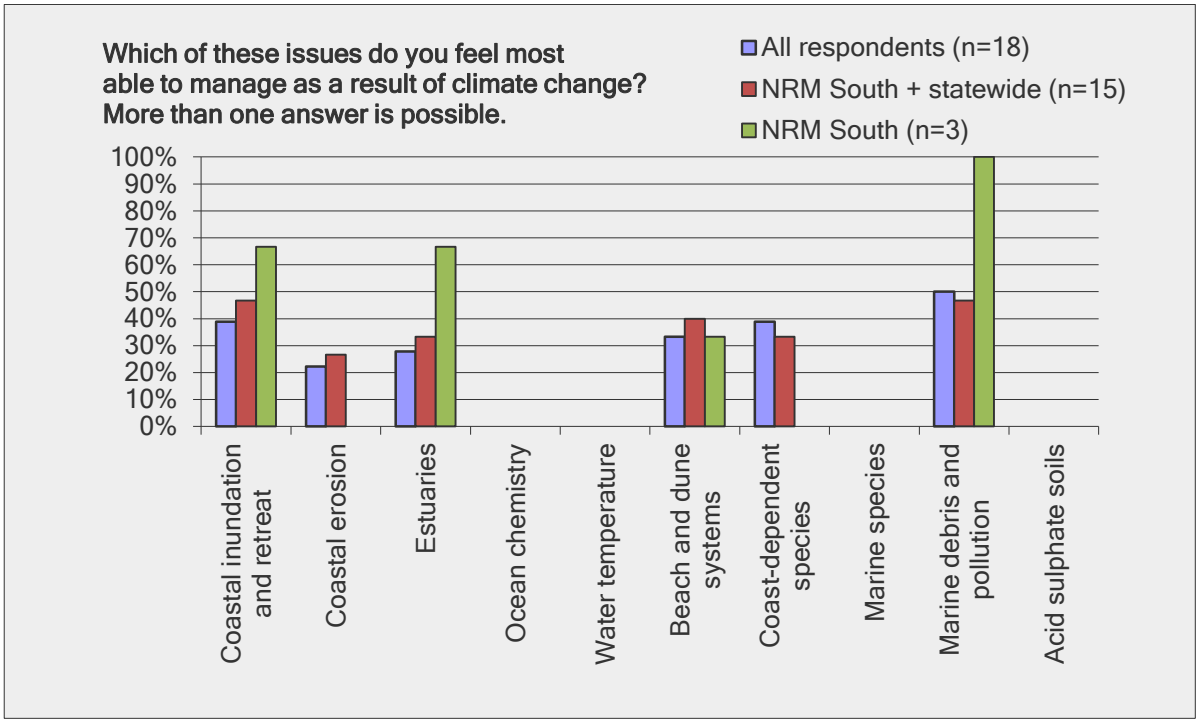


Figure 96 Survey results – stakeholder capacity

Respondents from the NRM South combined pool on the whole reported at best only a moderate ability to manage coastal and marine issues under climate change. Only six of the ten issues were identified by respondents as able to be managed, ranging from 33% to 47%. Of particular concern is that four issues were not identified by any respondents as within their ability to manage under climate change – ocean chemistry, water temperature, marine species and acid sulfate soils.

Capacity-impact deficit

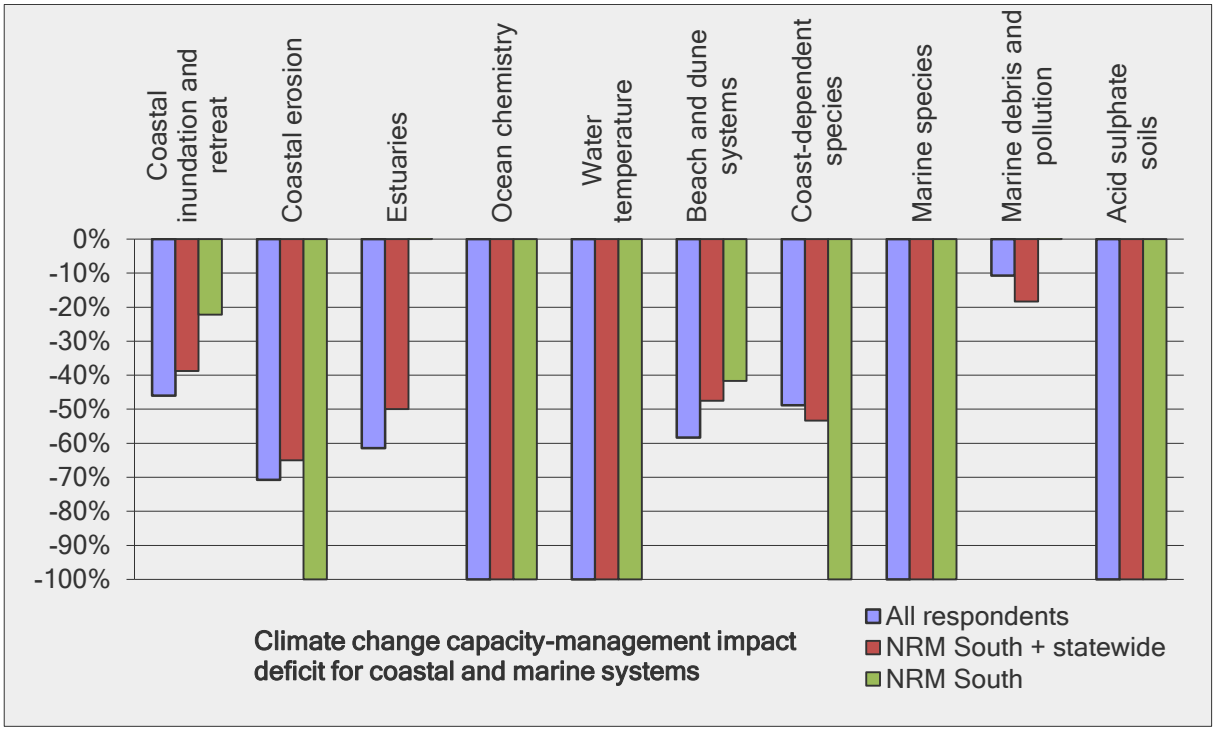


Figure 97 Survey results – stakeholder capacity-impact deficit

The capacity deficit for the four issues identified in the previous section as having no reported ability to manage is 100%, though is unreliable given the low number of respondents. The reported deficit among the NRM South combined pool respondents is also significant for five of the remaining issues, which range from 39-65% difference between impact and ability – coastal inundation, coastal erosion, estuaries, beach and dune systems and coast-dependent species. Only marine debris and pollution has a small difference between current impact and management ability under climate change.

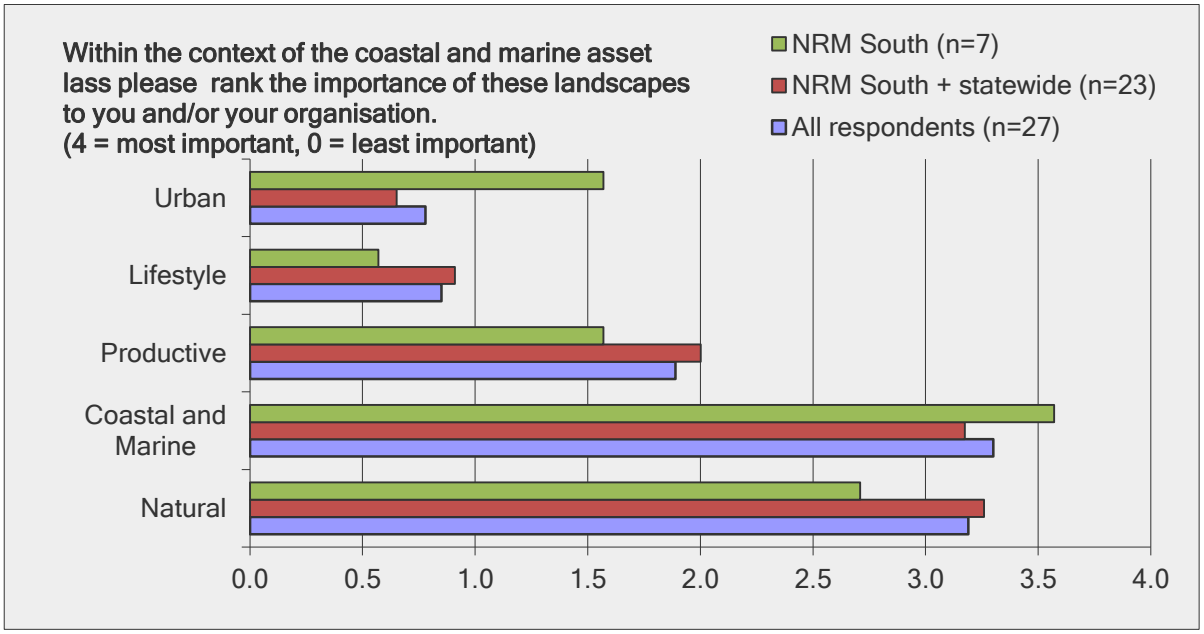


Figure 98 Survey results – stakeholder landscape rankings

As with results from NRM North, the NRM South combined pool respondents identified natural landscapes as a slightly higher overall priority landscape for coastal and marine issues than for the coastal and marine landscape itself. The difference, although relatively small, may be a function of perceptual differences about the nature of landscapes and their boundaries. Somewhat surprisingly, urban ecosystems are ranked as of least importance for coastal and marine issues. Economic and social disruption and dislocation to urban areas located in the coastal zones of Tasmania is a well-documented concern under climate change, and is particularly critical for some parts of the NRM South region (e.g. Kingston, Hobart eastern shore, Dolphin Sands near Swansea).

6.5.4.4.2 NRM South – recommended coastal and marine system focus areas

Four areas of focus in coastal and marine systems are recommended for the next strategy - threatened coastal features, 'special' values, marine debris, and change and emerging issues. The similarity of many aspects between the NRM South and NRM North regions is high. There are also questions about promoting and organising NRM activity among stakeholders in the marine environment that may mean organisation around terrestrial NRM regions may have limitations, particularly in the marine environment. For these reasons recommended marine and focus areas for both regions are identical and are presented in section 6.5.4.5.

6.5.4.5 Combined NRM North and NRM South recommended focus areas for coastal and marine systems

Four common areas of focus in coastal and marine systems are recommended for the next regional strategies of both NRM North and NRM South - threatened coastal features, 'special' values, marine debris, and change and emerging issues. These focus areas have been selected in order to provide coverage of all issues in the classification, with the latter focus particularly important due to high rates of change and potential uncertainty of impacts in the marine environment.

The common recommendations arise due to similarity of many aspects between the NRM North and NRM South regions. There are also questions about promoting and organising NRM activity among stakeholders in the marine environment that may mean organisation around terrestrial NRM regions may have limitations, particularly in the marine environment.

In making common recommendations for both regions it is anticipated that the process of strategy development and implementation will include a component aimed at identifying different priority sites and/or areas within each of the two regions.

Coastal and marine asset recommended focus area 1 – threatened coastal features

Aspect	Description
Issues scope	The proposed focus on threatened coastal features is designed to focus on the physical effects of climate change on the issues of coastal inundation and retreat, coastal erosion, beach and dune systems and estuaries. Coastal acid sulfate soils are also included as potential activation of these soils under climate change is identified as likely to increase.
Importance	Coastal areas are likely to undergo some of the largest changes as a result of climate change. Disruption to settlements and coastal economic activity (marine and land) are potentially significant. The issue is considered of high importance for next regional strategies of both NRM North and NRM South.
Stakeholder perspectives	The issues within this focus area were identified as among the top 5 coastal and marine priority issues for the next NRM North regional strategies of both NRM North and NRM South. They also have reported low reported levels of ability to be managed under climate change – a deficit which needs to be overcome due to the extent and impact of potential change.
Key delivery landscapes	This focus area would need to be delivered in the urban and coastal and marine landscapes.
Sub-regional aspects	Priority areas to address coastal inundation, retreat and erosion will need to be developed from Tasmania's coastal vulnerability mapping and in cooperation with other stakeholders, particularly local government. The existing NRM North focus on the Tamar estuary and NRM South focus on the Derwent estuary would continue as priorities but may need to be extended to other estuaries in the regions that are high priorities in CFEV. Coastal acid sulfate soils are prevalent across relatively large parts of the coastal zone of both regions.

Coastal and marine asset recommended focus area 2 – 'special' values

Aspect	Description
Issues scope	Coastal and marine special values are those that have particular conservation management needs as a result of current condition or emerging as a result of climate change. Issues in this focus are include coast-dependent species (e.g. shorebirds), threatened marine species and ecosystems (e.g. kelp forests, seagrass). The intent of this focus area is to promote activity that may reduce threats or mitigate impacts on the values. Some sites of geoconservation significance may also be considered 'special' coastal and marine values at threat from sea level rise.
Importance	The coastal and marine special values are considered to be of high importance as their need for management arises largely from threats.
Stakeholder perspectives	Coast-dependent species were identified relatively strongly by both the NRM region combined pool respondents, but marine species received little recognition.
Key delivery landscapes	Urban and coastal and marine landscapes are key delivery landscapes for these special values.
Sub-regional aspects	Prioritisation of sub-regional areas for promoting special values management needs to be considered through a technical and stakeholder process, as the number of values is large, their character diverse and their distribution extensive.

Coastal and marine asset recommended focus area 3 – marine debris

Aspect	Description
Issues scope	This focus area is designed to focus on behavioural issues around the very high rates of plastic debris in Tasmania's marine environment and particularly seabirds and marine mammals. Key potential actions are education to reduce inputs and clean-up activities to remove debris in coastal areas.
Importance	The high rates of occurrence of marine debris in Tasmanian marine species, the extreme longevity of plastic material in the marine environment, increasing population and a potential increase in debris from fishing due to more severe storms mean that the issue should be considered as of high importance.
Stakeholder perspectives	The issue was identified as having a high current impact on respondents and also one reasonably able to be managed under climate change. That it was given an extremely low priority for the next NRM regional strategy suggests additional work with stakeholders may be required to develop effective strategies.
Key delivery landscapes	Urban and coastal and marine landscapes.
Sub-regional aspects	Activities to reduce input of plastics to the marine environment should be focussed on education at key recreational boat launching facilities and ports of fishing vessels in the regions, and through both commercial and recreational fishing organisations. A technical assessment is needed to determine if clean-up activities focused on particular sites in the region can produce measurable benefits, or whether ingestion and entanglement are too widespread for targeted activities to be effective.

Coastal and marine asset recommended focus area 4 – change and emerging issues

Aspect	Description
Issues scope	Change and emerging issues in coastal and marine systems are intended to address issues that were not strongly identified by survey respondents, particularly the issues of marine temperate and chemistry. The focus is needed to provide a dynamic overview of change in coastal and marine systems particularly the emergence of unanticipated changes and effects. It is also recommended that the focus area would provide for consideration of new information (e.g. IPCC climate change predictions) that may not be readily translatable to scales that are useable at the scale of individual NRM regions.
Importance	This focus area is considered of high importance for a number of reasons: • while some changes can be predicted (e.g. to marine species distributions) flow-on effects through ecosystems may not be identifiable in advance; and • change and emerging issues are likely to involve both threats and opportunities.
Stakeholder perspectives	The focus area has a relatively technical focus. However communication to stakeholders of information on change and emerging issues, and of changes to NRM priorities that arise, would be important.
Key delivery landscapes	Urban and coastal and marine landscapes.
Sub-regional aspects	Sub-regional aspects of this focus area will vary and cannot be identified in advance.

6.5.5 Asset class: Air

6.5.5.1 Air - classification

Classification: Six major issues were identified from the document review as most important for managing air and were included in the stakeholder survey.

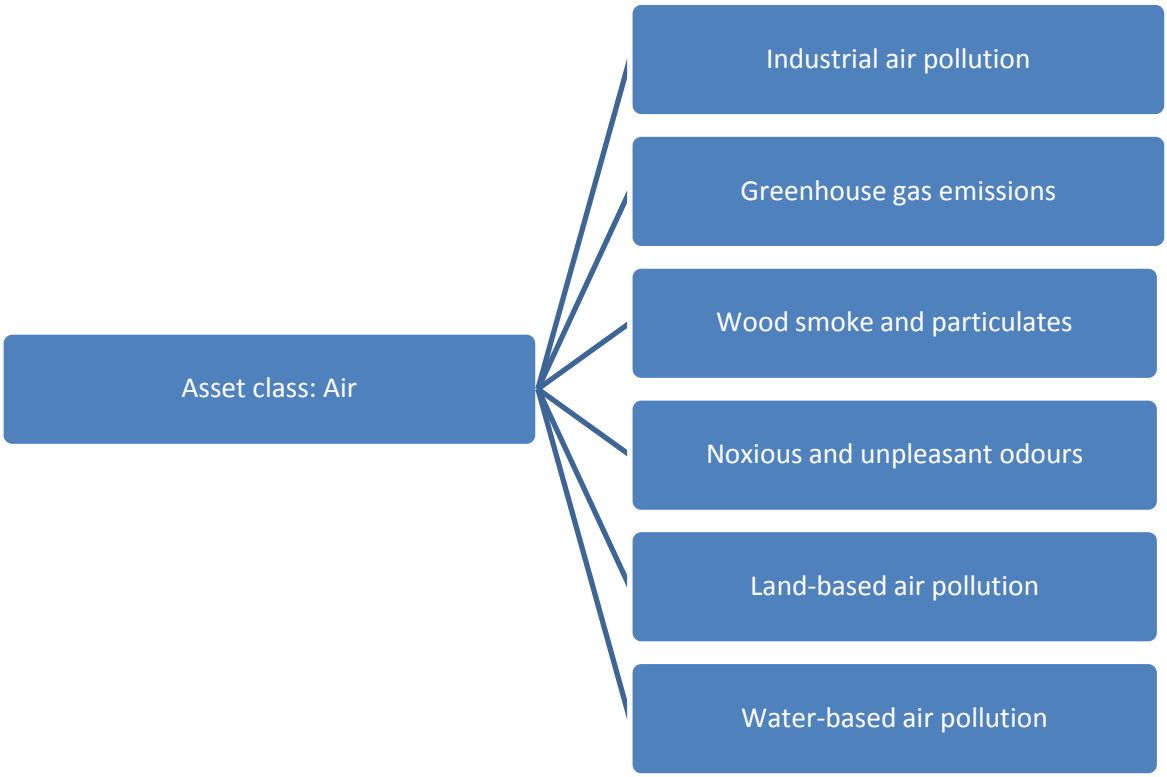


Figure 99 Air asset classification

6.5.5.2 Asset: Air - asset knowledge and status assessment

6.5.5.2.1 Issue: industrial air pollution

Asset issue	Description
Contextual summary	Industrial air pollution is point or diffuse sources of emissions of gas that harm the environment or can cause physical harm to people.
Current knowledge	The majority of industrial air pollution sources are subject to a range of regulatory processes (e.g. *Land Use Planning and Appeals Act, Environment Protection Act)*, which is largely outside the voluntary remit of NRM. The role for NRM in this issue is probably limited to ensuring data on industrial air pollution is publically available for reporting purposes.
Change, pressures, climate change	Industrial air pollution frequently contains gaseous compounds which are also greenhouse gases. A carbon constrained market may have the ancillary benefit of improved air quality. Long-term risk from geo-engineering to limit greenhouse gases is an issue than should be monitored.
Key data, information and resources	***State-wide or NRM North and NRM South*** • This issue is subject to regulatory processes including monitoring.
Regional considerations and recommendations	• As this issue is subject to regulation, it is not considered necessary for inclusion in a recommended focus area for either NRM North or NRM South.

6.5.5.2.2 Issue: greenhouse gas emissions

Asset issue	Description
Contextual summary	Greenhouse gases emissions are point or diffuse sources of gases that absorb solar radiation and may contribute to global warming. They include carbon dioxide, methane, fluorocarbons, nitrous oxide and a range of others.
Current knowledge	Current knowledge of Tasmanian greenhouse gas emissions is contained within the latest emissions report (see available data). Knowledge of effects are discussed separately for other assets and issues.
Change, pressures, climate change	The climate change impacts of greenhouse gas emissions are pervasive across almost all areas of NRM interest.

Key data, information and resources	***State or NRM North and NRM South***
	• Greenhouse gas emissions are reported at a range of scales – State, national and global. Tasmanian greenhouse gas emissions have been reported for 2011-2012[223] and include a breakdown of emissions by sectors:
	  • energy;
	  • industrial processes;
	  • agriculture;
	  • waste;
	  • land use, land use change and forestry; and
	  • other sectors.
	• Baseline data for 1989-1990 is also available.
	Known issues
	• Knowledge gaps around the effects of greenhouse gas emissions introduce considerable uncertainty to the NRM field. Dealing with this uncertainty forms part of the information systems approach to NRM data and knowledge recommendation, and also generally through actions identified in the institutional and strategic scans. Action by NRMs on aspects of the latter two scans is likely to provide more detail on emissions by less major individual emitters in the context of implementing governance to adapt to climate change. Uncertainty around non-point source greenhouse gas emissions from coal seam gas fracking should be monitored.

Regional considerations and recommendations	• Greenhouse gas emissions are a recommended focus area for both NRM North and NRM South.

[223] Tasmanian Climate Change Office (2014).

6.5.5.2.3 Issue: wood smoke and particulates

Asset issue	Description
Contextual summary	Wood smoke and particulate pollution arises from incomplete combustion of fuels, or release of harmful materials either from within fuels or as a result of combustion. It includes both a range of toxic gaseous compounds[224] and harmful particulates. Particulates are a mixture of inhalable and fine solid and liquid particles less than 10 micrometers in size. Wood smoke and particulate pollution occurs when concentrations of the gaseous, solid or liquid components are sufficient to cause discomfort or harm to humans or other organisms.
Current knowledge	The basis for definition of particulates is their documented medical effects on humans. Areas of particular focus for addressing this type of pollution have included the Tamar region in NRM North. Emissions from forestry regeneration burns and also from other fires are sometimes controversial.
Change, pressures, climate change	As well as the impacts on human health, wood smoke and particulate pollutants can both contribute to and reduce climate change impacts. Some contents are greenhouse gases while others. Others such as smoke may reduce warming effects but do little over the long term to mitigate impacts.
Key data, information and resources	***State-wide or NRM North and NRM South*** • Wood smoke and particulate pollution forms part of the inventory presented in the National Pollution Inventory. Emissions in the inventory are available for viewing for the State by emissions type and also as annual profiles by municipality[225]. Baseline data is available back to 1988/89. • Extensive work has been undertaken in the Tamar Valley to reduce particulate pollution by reducing emissions from wood heaters, including work by State and local government and NRM North.

[224] http://epa.tas.gov.au/epa/harmful-substances-in-wood-smoke
[225] http://www.npi.gov.au/npidata/action/load/browse-search/criteria/year/2013/browse-type/Location/state/TAS

Asset issue	Description
Regional considerations and recommendations	• Wood smoke and particulates is a recommended focus area for the next NRM North strategy. Work on this issue would be undertaken on a collaborative basis. In the absence of any significant funding, the key role for the region is around education.

6.5.5.2.4 Issue: noxious and unpleasant odours

Asset issue	Description
Contextual summary	Noxious and unpleasant odours are those that are harmful or distressing to people.
Current knowledge	Noxious and unpleasant odours tend to occur on either a regular or occasional basis rather than continuous. Some facilities such as abattoirs and food processing plants are more likely to be associated with odour than others. Larger sources of odour are regulated by the Environmental Protection Authority while smaller facilities are the responsibility of local councils.
Change, pressures, climate change	Climate change impacts on sources of odour are largely unknown. Higher average temperatures might increase odour in some circumstances (e.g. from intense livestock management facilities). Changes to hydrology might cause exposure of certain material to air and result in release of odour (e.g. wetland, acid sulfate soils).
Key data, information and resources	***Known issues*** • Available data on odours is limited and often localised. • Odours may be an issue which are difficult to assess other than on a case by case basis but major sources are subject to regulation by local government and the Environment Protection Authority.
Regional considerations and recommendations	• It is not considered there is a need to include this issue within a recommended focus area for either NRM North or NRM South.

6.5.5.2.5 Issue: land based air pollution

Asset issue	Description
Contextual summary	Land-based sources of air pollution include facilities such as waste disposal areas. Although included in the classification, their effects are largely associated with the issues identified above and could be considered for removal.
Current knowledge	Not assessed. Other than regulated sources of land-based air pollution (e.g. refuse sites) knowledge around this issue is poor.
Change, pressures, climate change	Land-based air pollution in Tasmania contributes directly to the global greenhouse gas levels
Key data, information and resources	***Known issues*** • Land-based air pollution in Tasmania is subject to substantial regulation.
Regional considerations and recommendations	• It is not considered there is a need to include this issue within a recommended focus area for either NRM North or NRM South.

6.5.5.2.6 Issue: water based air pollution

Asset	Description
Contextual summary	Water-based sources of air pollution include facilities such as sewage treatment plants. Although included in the classification, their effects are largely associated with the issues identified above and could be considered for removal.
Current knowledge	Not assessed. Knowledge of water-based air pollution in Tasmania is poor.
Change, pressures, climate change	Water-based air pollution (e.g. of methane from waterbodies) contributes to greenhouse gas levels.
Key data, information and resources	***Known issues*** • Knowledge of water-based sources of air pollution is relatively poor, although some aspects (e.g. odour) are subject to regulation.

Asset	Description
Regional considerations and recommendations	• It is not considered there is a need to include this issue within a recommended focus area for either NRM North or NRM South.

6.5.5.3 NRM North – air asset and issues discussion and recommendations

6.5.5.3.1 NRM North air issues survey responses

Stakeholder response

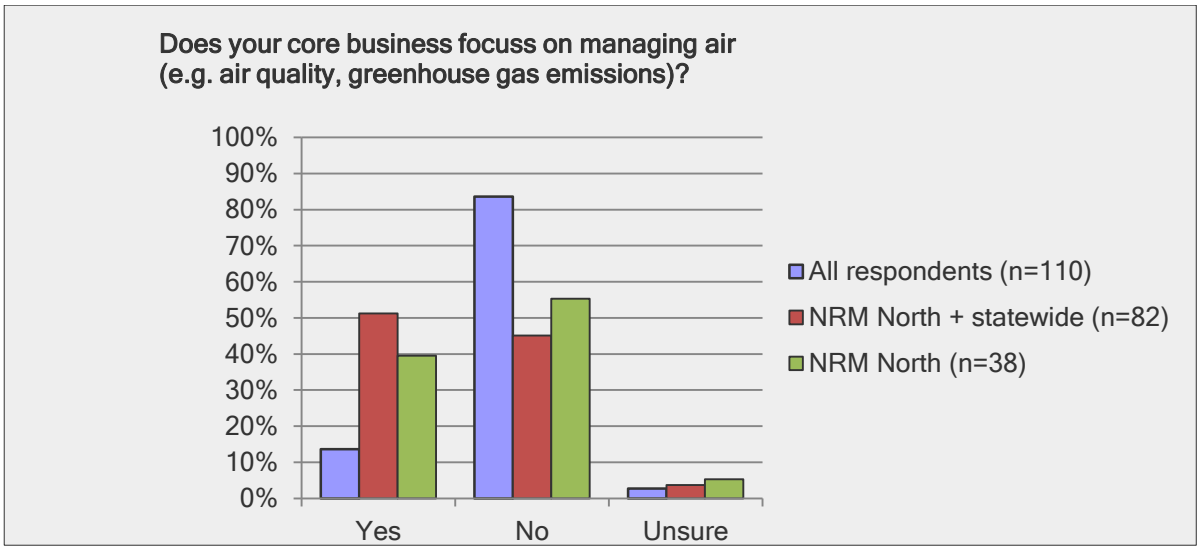


Figure 100 Survey results – stakeholder capacity

A relatively large number of respondents from NRM North (n=82) answered the questions on the air asset. Of these 50% of the combined NRM North plus State-wide respondent pool and 40% of the NRM North only respondents indicated air was part of their core business. These results indicate air issues are important to a relatively large number of NRM North stakeholders.

Stakeholder impacts

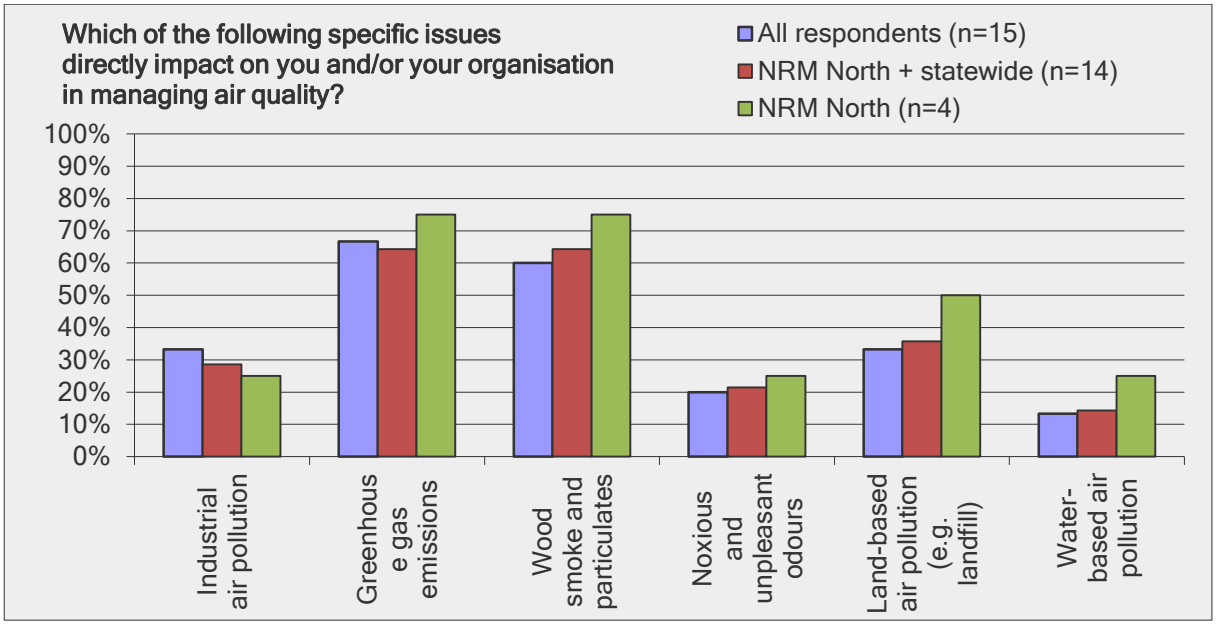


Figure 101 Survey results – issues impacting on air quality management

Although there a relatively large number of respondents identified air issues as part of their core business, very few from among all the reported groupings identified it as having a significant impact on their management, and the number of respondents identifying as operating in the NRM North only region is too small to be informative. The overall low response rate may reflect that many aspects of air are already subject to regulation. Within the NRM North respondents, the issues of greenhouse gas emissions and wood smoke and particulates were identified by more than 60% of respondents. This may reflect the more industrialised nature of parts of the NRM region, particularly the Tamar Valley, and the history of health issues around air quality and the involvement of NRM North in addressing these.

Priority air quality issues

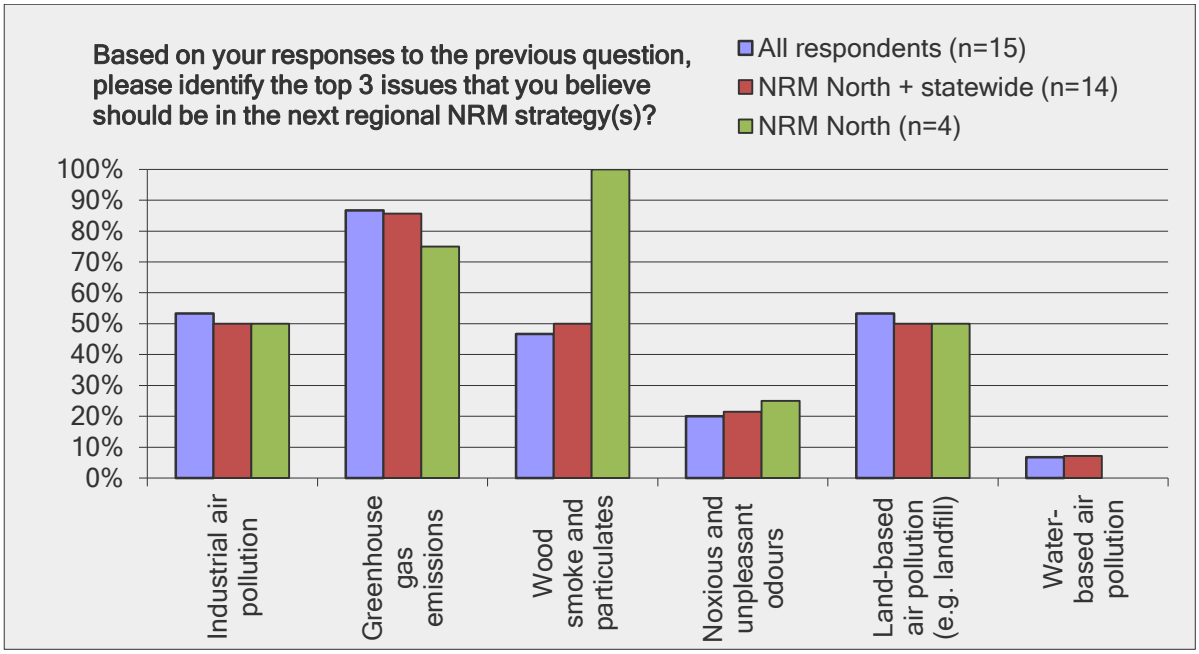


Figure 102 Survey results – priority air quality issues for the next Strategy(s)

Responses on priorities for air issues in the next NRM North regional strategy were low overall and too low from the NRM North only group to be informative. Unsurprisingly due to substantial overlap between State-wide and NRM North combined respondents (14 of 15, there is little difference between perceived priorities among the two groups. Greenhouse gas emissions were the most frequently reported priority for the next regional strategies (>80%). It exceeded by a significant amount reported regional priorities for industrial air pollution (50% combined group), wood smoke and particulates (50% combined group) and land-based air pollution (50% combined group).

Climate change capacity

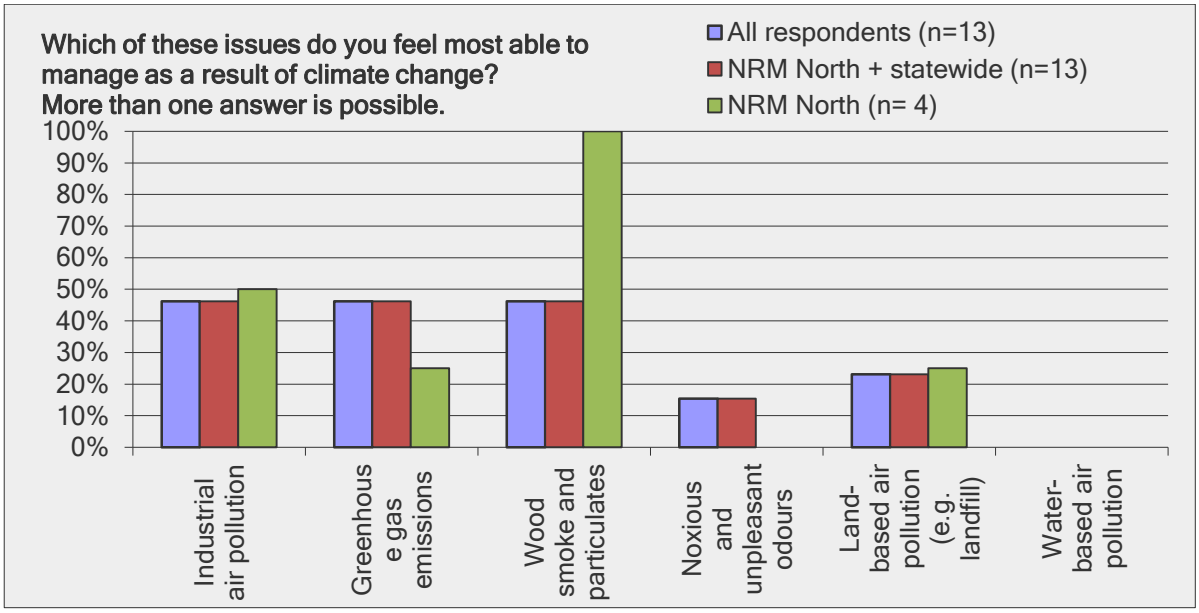


Figure 103 Survey results – ability to management air quality issues as a result of climate change

The reported ability of respondents to manage air issues under climate change was low. Ignoring the result from low NRM North only respondents, all other reported climate change management ability was less than 50%, even among issues subject to regulatory control. Three issues were reported identically as having the same manageability (46%) for respondents – industrial air pollution, greenhouse gas emissions and wood smoke and particulates. Although the number of NRM North only respondents is very low, the high reported ability to manage wood smoke and particulates under climate change may reflect a small group of people with skills and competence gained through previous activity on this issue in the region.

Capacity-impact deficit

Climate change capacity- impact deficit - air quality

The capacity-impact deficit for the NRM North region shows variable effects of climate change on ability to manage air issues. Respondents did not report any reduction in their ability to manage industrial air pollution under climate change. This finding is consistent with the major sources of industrial pollution being subject to regulation. Respondents from the NRM North combined pool reported only limited reduction (-28%) in ability to manage wood smoke and particulates under climate change, and respondents from NRM North only reported no reduction. A similar reduction was evident for managing greenhouse gas emissions among the NRM North combined pool (-28%), but there was a much larger reduction seen by NRM North only respondents (-66%). The capacity-impact deficit for other air issues (odour and land- and water-based air pollution) are difficult to interpret.

Landscape perspectives

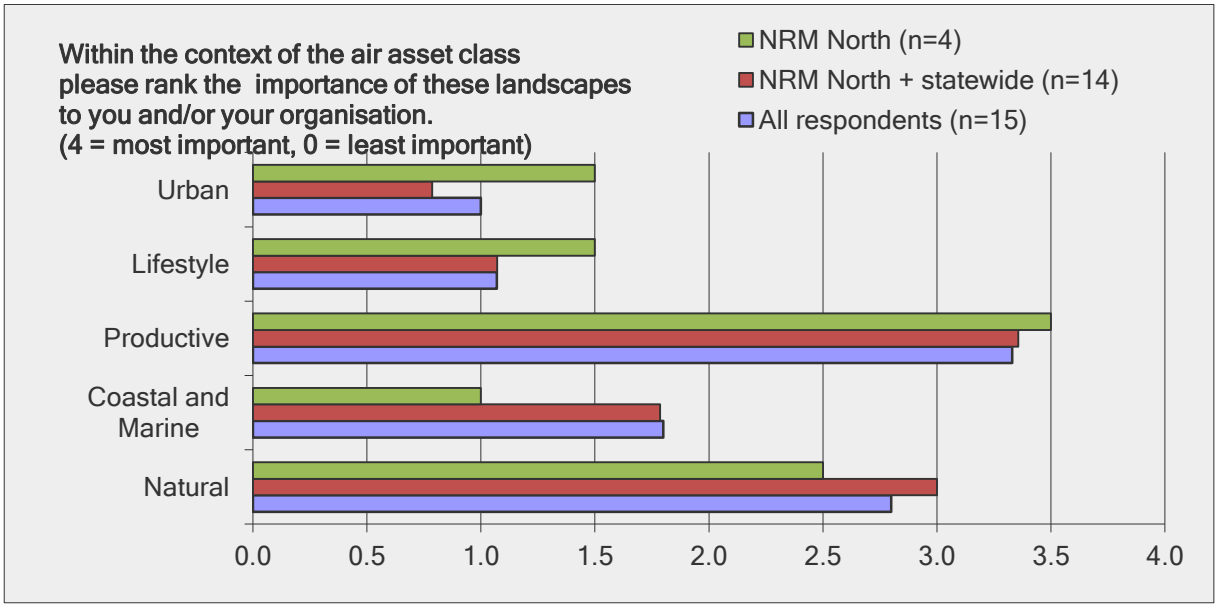


Figure 104 Survey results – importance of landscapes in context of air asset class

Productive and natural landscapes were identified by respondents as most important to them for managing air issues. Surprisingly urban ecosystems were identified as being least important, despite being associated with a significant number of air-related issues. The results of this question need to be considered with caution due to the low number of respondents.

6.5.5.4 NRM North – recommended air focus areas

Based on the asset analysis and survey responses to air issues in the NRM North region, two areas of focus are recommended for the next regional strategy – greenhouse gas emissions and wood smoke and particulates. These issues are recommended as they are more capable of being influenced by behavioural decisions – a lever to which NRM activity is suited. In contrast, the other issues around air quality (industrial, land-based, water-based and noxious odours) are subject to regulatory processes.

6.5.5.4.1 Air asset recommended focus area 1 – greenhouse gas emissions

Aspect	Description
Issues scope	The scope of this issue is encouraging behavioural or commercial decisions that result in avoidance of greenhouse gas emissions or reduction in emissions through increased efficiency of greenhouse gas energy uses.
Importance	Australia is a relatively small contributor to global greenhouse gas emissions due to its small population but a large contributor on a per-capita basis. The importance of including greenhouse gas emissions in an NRM strategy is based on a perceived need for developed countries like Australia to provide a leadership role in demonstrating reduction in emissions.
Stakeholder perspectives	Greenhouse gas emissions were identified in stakeholder responses as having a high impact on activities and as priorities for the next regional strategies, but having somewhat less ability to be managed under climate change.
Key delivery landscapes	The key landscapes most likely to be relevant for this focus area are: • urban, particularly through decisions around transport (e.g. personal, 'food miles', and energy efficient use and design; • productive, particularly through options to increase carbon storage and to promote alternative or efficient energy use; and • natural, particularly though avoiding emissions. Design of programs for the productive and (particularly) natural landscapes is more complex than for that in urban areas, and includes some overlap with issues where policy setting are currently challenging (e.g. in avoided deforestation). Further consultation and design of suitable programs is needed.
Sub-regional aspects	Activities promoting reduction in greenhouse gas emissions are likely to be more efficient in more heavily populated areas. Transport choices are probably only likely to have any impact within the regional population centre of the Tamar Valley. Energy use efficiency and design might be successfully targeted both in the main regional population centre and in the larger regional towns.

6.5.5.4.2 Air asset recommended focus area 2 – wood smoke and particulates

Aspect	Description
Issues scope	The scope of this issue is to continue to reduce particulate pollution in the Tamar Valley. Although considerable improvement has been made, the underlying conditions that result in smoke and particulate accumulation remain in place.
Importance	Wood smoke and associated particulates is a major public health issue for the Tamar Valley.
Stakeholder perspectives	Wood smoke and particulates were identified as having relatively high impact on NRM North respondents, as moderate priorities for the next regional strategy, and an issue with limited impact of climate change on manageability.
Key delivery landscapes	The key delivery landscape for this recommended focus area is urban, in particular the Tamar Valley.
Sub-regional aspects	The recommended focus area is limited to the Tamar Valley.

6.5.5.5 NRM South – air asset and issues discussion and recommendations

6.5.5.5.1 NRM South air issues survey responses

Air issues as core business

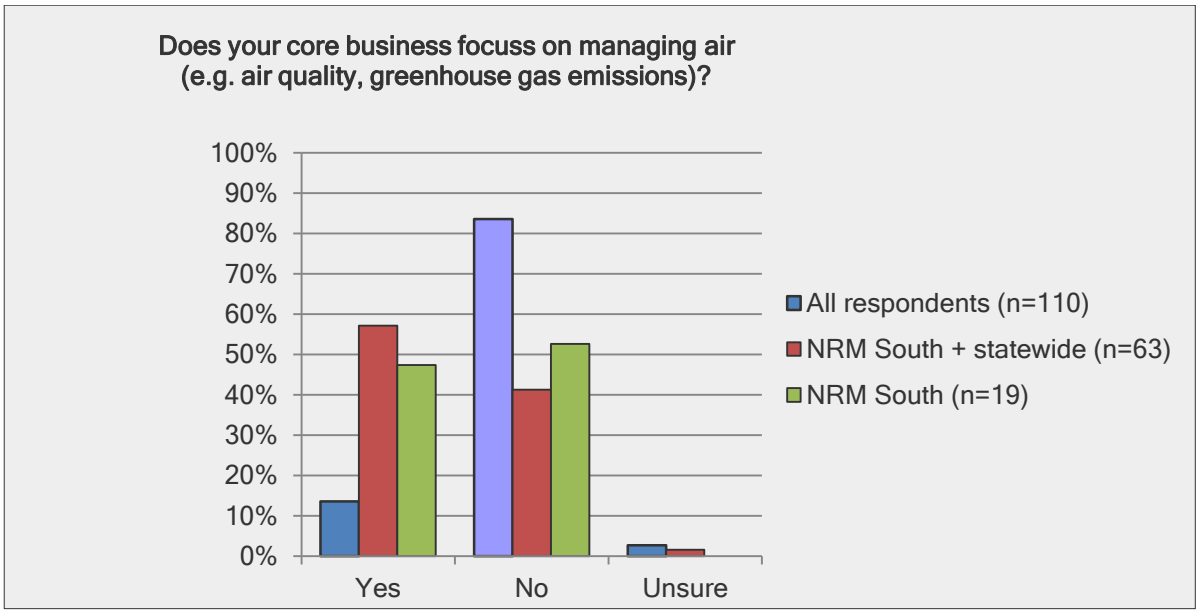


Figure 105 Survey results - managing air as core business

Slightly more than half (n=62) the respondents who identified air as part of their core business were associated with the NRM South region. Of these 57% of the combined NRM South pool and 48% of the NRM South only respondents indicated air was part of their core business. These results indicate air issues are important to a relatively large number of NRM South stakeholders.

Stakeholder impacts

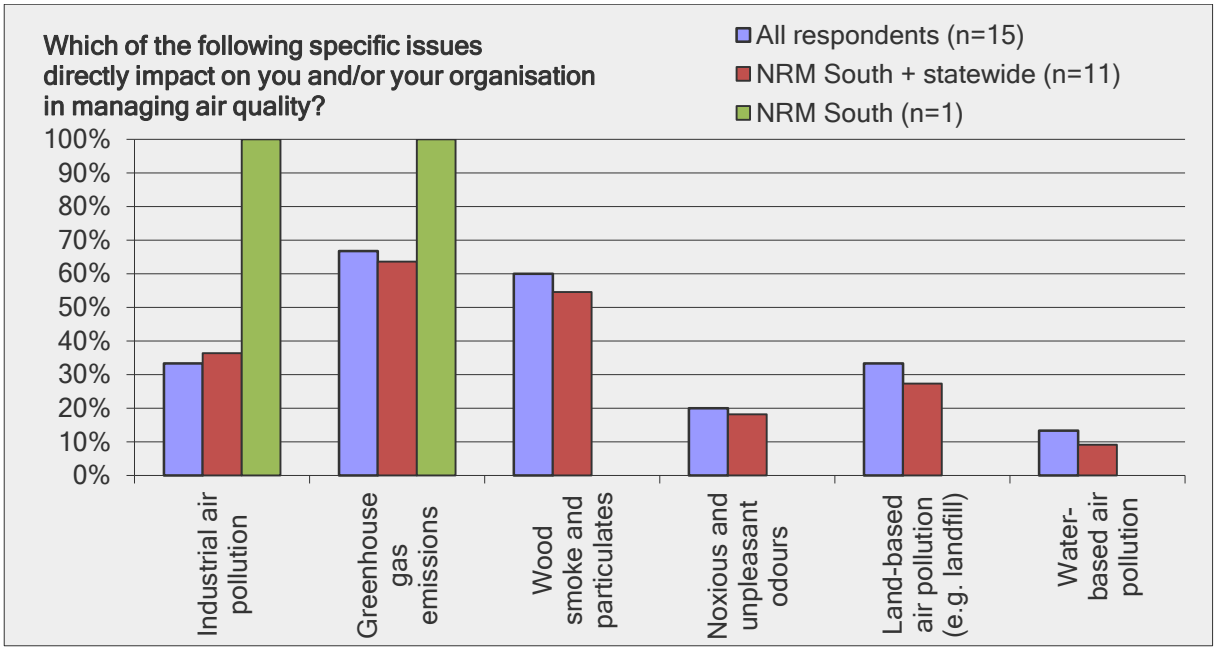


Figure 106 Survey results – issues impacting on air quality management

Although there a relatively large number of respondents identified air issues as part of their core business, very few from among all the reported groupings identified it as having a significant impact on their management. In particular the number of respondents identifying as operating in the NRM South region only (n=1) is too small to be informative. The overall low response rate may reflect that many aspects of air are already subject to regulation. Within the NRM South combined pool respondents, the issues of greenhouse gas emissions and wood smoke and particulates were identified by 62% and 53% or respondents respectively. The relatively strong identified impact of wood smoke and particulates in the region may be partly influenced by the greater proximity of forestry regeneration burns to urban centres.

Stakeholder priorities

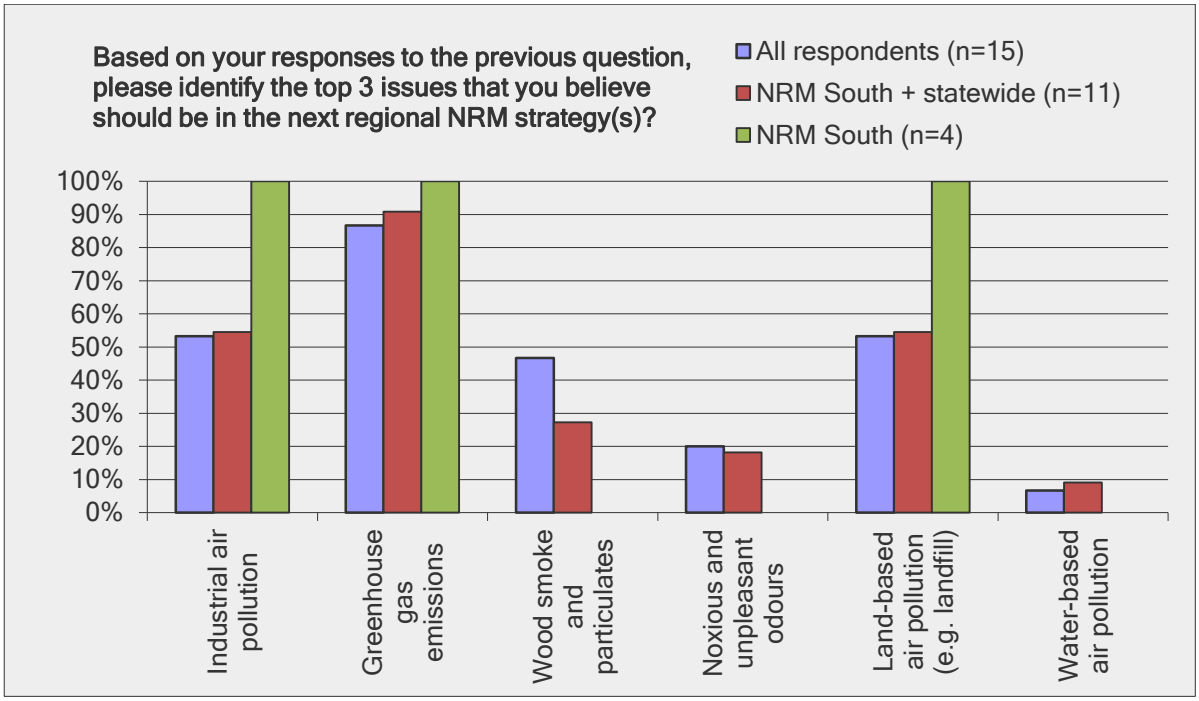


Figure 107 Survey results – stakeholder top 3 issues for next Strategy

Responses on priorities for air issues in the next NRM South regional strategy were low overall and too low from the NRM South only group to be informative. Unsurprisingly due to substantial overlap between State-wide and NRM South combined respondents (11 of 15), there is little difference between perceived priorities among the two groups. Greenhouse gas emissions were the most frequently reported priority for the next regional strategy by the NRM South combined pool (91%). Industrial air pollution and land-based air pollution were the next most frequently identified priorities (52-54%). As noted above this may be due to the greater proximity of forestry regeneration burns to urban areas, including potential confounding of responses.

Climate change capacity

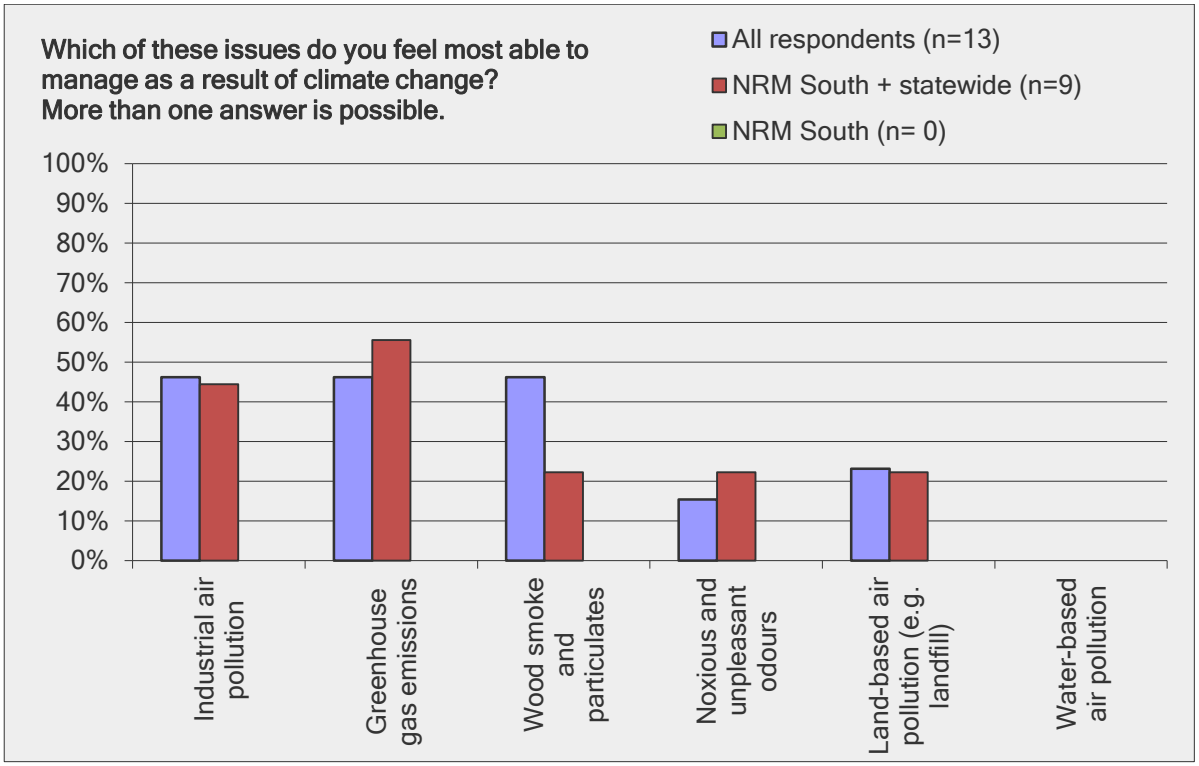


Figure 108 Survey results – stakeholder climate change capacity

The reported ability of respondents to manage air issues under climate change was low, with no reported ability from NRM South only respondents. With the exception of greenhouse gas emissions (55%, NRM South combined pool), all other reported climate change management ability was less than 50%, even among issues subject to regulatory control. Three issues were reported identically as having the same manageability (22%) for respondents from the NRM South combined pool – wood smoke and particulates, noxious odour and land-based air pollution. The small number of respondents for the region mean that the results should be treated with caution.

Capacity-impact deficit

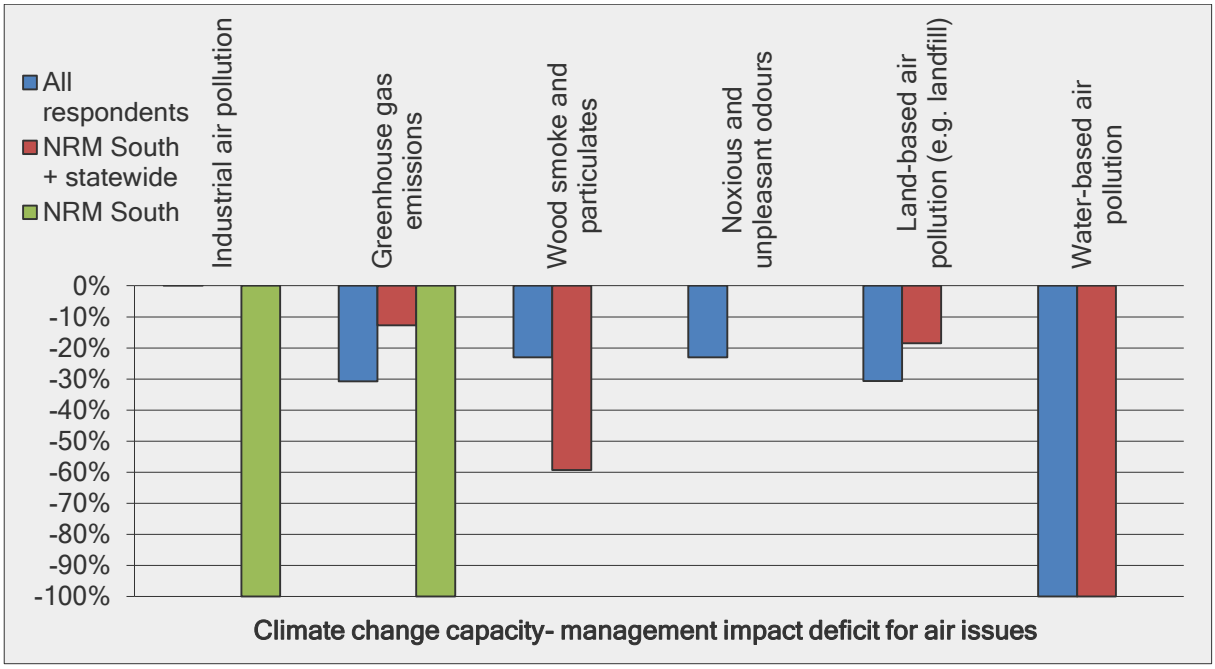


Figure 109 Survey results – stakeholder climate change capacity-impact deficit

The capacity-impact deficit for the NRM South region shows variable effects of climate change on ability to manage air issues. The only issues for which the results are considered informative are industrial air pollution, greenhouse gas emissions and land-based air pollution. Analysis of other air issues in the region is limited by the small number of respondents. Among the three issues, there was no capacity-impact deficit for industrial air pollution, and only moderate reductions for greenhouse gas emissions (12%) and land-based air pollution (19%).

Landscape perspectives

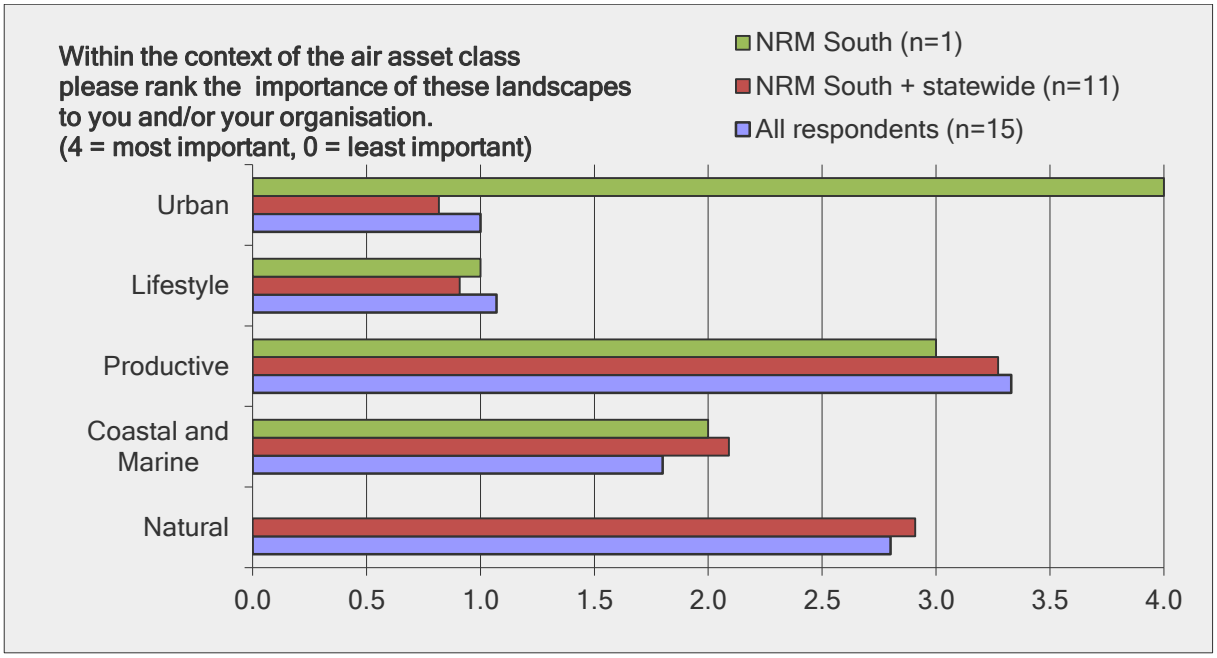


Figure 110 Survey results – stakeholder landscape perspectives -air

Productive and natural landscapes were identified by respondents in the NRM South combined pool as most important to them for managing air issues. Surprisingly urban ecosystems were identified as being least important, despite being associated with a significant number of air-related issues (e.g. greenhouse emissions). The results of this question need to be considered with caution due to the low number of respondents.

6.5.5.5.2 NRM South – recommended air focus areas

Based on the asset analysis and survey responses to air issues in the NRM South region, one area of focus is recommended for the next regional strategy – greenhouse gas emissions. This issue is recommended it is more capable of being influenced by behavioural decisions – a lever to which NRM activity is suited. In contrast, the other issues around air quality (industrial, land-based, water-based and noxious odours) are subject to regulatory processes. Although identified as a focus area for NRM North, wood smoke and particulates are not recommended as a focus area for NRM South as the issue in the region is likely to be more associated with the regulation of forestry regeneration burns rather than urban issues such as wood smoke.

Air asset recommended focus area 1 – greenhouse gas emissions

Aspect	Description
Issues scope	The scope of this issue is encouraging behavioural or commercial decisions that result in avoidance of greenhouse gas emissions or reduction in emissions through increased efficiency of greenhouse gas energy uses.
Importance	Australia is a relatively small contributor to global greenhouse gas emissions due to its small population but a large contributor on a per-capita basis. The importance of including greenhouse gas emissions in an NRM strategy is based on a perceived need for developed countries like Australia to provide a leadership role in demonstrating reduction in emissions.
Stakeholder perspectives	Greenhouse gas emissions were identified in stakeholder responses as having a high impact on activities and as priorities for the next regional strategies, and also in only minimum reduction in ability to manage under climate change.
Key delivery landscapes	The key landscapes most likely to be relevant for this focus area are: • urban, particularly through decisions around transport and energy efficient use and design; • productive, particularly through options to increase carbon storage and to promote alternative or efficient energy use; and • natural, particularly though avoiding emissions. Design of programs for the productive and (particularly) natural landscapes is more complex than for that in urban areas, and includes some overlap with issues where policy setting are currently challenging (e.g. in avoided deforestation). Further consultation and design of suitable programs is needed.
Sub-regional aspects	Activities promoting reduction in greenhouse gas emissions are likely to be more efficient in more heavily populated areas. Transport choices are probably only likely to have any impact within the main regional population centre around Greater Hobart. Energy use efficiency and design might be successfully targeted both in the main regional population centre and in the larger regional towns.

Environmental recommendation (general) 2 The proposed classification of Land, (land and soil resources and terrestrial biodiversity); Freshwater and Inland Aquatic Systems; Coastal and Marine Systems and Air be adopted as the framework for analysing, prioritising, engaging, monitoring and reporting of NRM assets and issues.

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