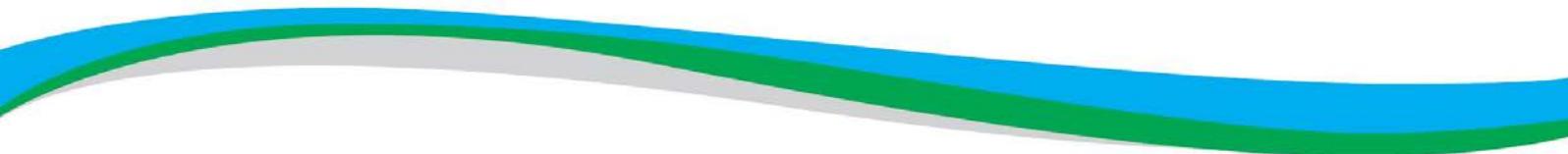


# Climate Change Science and Knowledge Plan

## Research Sector Workshop Summary Report

Mark Siebentritt and Graham Green



Goyder Institute for Water Research  
Occasional Paper No. 19/03



[www.goyderinstitute.org](http://www.goyderinstitute.org)



**Goyder Institute for Water Research Occasional Papers ISSN: 2204-0528**

The Goyder Institute for Water Research is a partnership between the South Australian Government through the Department for Environment and Water, CSIRO, Flinders University, the University of Adelaide, the University of South Australia and the International Centre of Excellence in Water Resource Management. The Institute enhances the South Australian Government's capacity to develop and deliver science-based policy solutions in water management. It brings together the best scientists and researchers across Australia to provide expert and independent scientific advice to inform good government water policy and identify future threats and opportunities to water security.



This project was co-funded by the Department for Environment and Water.

Enquires should be addressed to: Goyder Institute for Water Research  
Level 4, 33 King William Street  
Adelaide, SA 5000  
tel: 08 8236 5200  
e-mail: [enquiries@goyderinstitute.org](mailto:enquiries@goyderinstitute.org)

**Citation**

Siebenritt, M. and Green, G. (2019), *Climate Change Science and Knowledge Plan – Research Sector Workshop Summary Report*. Goyder Institute for Water Research Technical Report Series No. 19/03.

© Crown in right of the State of South Australia, Department for Environment and Water.

**Disclaimer**

The Goyder Institute advises that the information contained in this publication comprises general statements based on scientific research and does not warrant or represent the completeness of any information or material in this publication. The Institute does not warrant or make any representation regarding the use, or results of the use, of the information contained herein about its correctness, accuracy, reliability, currency or otherwise and expressly disclaim all liability or responsibility to any person using the information or advice. Information contained in this document is, to the knowledge of the Goyder Institute, correct at the time of writing.

# Contents

|   |  |    |
|---|--|----|
| 1 | Introduction .....                         | 1  |
|   | 1.1 Background .....                       | 1  |
| 2 | Sector specific issues.....                | 3  |
|   | 2.1 Emergency management .....             | 3  |
|   | 2.2 Health.....                            | 4  |
|   | 2.3 Natural resources and landscapes ..... | 5  |
|   | 2.4 Primary production .....               | 6  |
|   | 2.5 Infrastructure.....                    | 7  |
| 3 | Emerging cross sectoral issues.....        | 9  |
| 4 | Capability and capacity .....              | 13 |
| 5 | Key findings .....                         | 14 |

# Acknowledgments

We would like to thank the research sector stakeholders who attended the workshop.

# 1 Introduction

## 1.1 Background

The Department for Environment and Water is developing a Climate Change Science and Knowledge Plan, which will help guide future investment in the science and information needed by the public and private sector in South Australia to build a more climate resilient community, economy and environment.

This work follows from previous investment in building climate resilience in South Australia, such as through the development of regional climate change adaptation plans and the development of the SA Climate Ready climate projections, which are among the most comprehensive of any projections for an Australian State.

Seed Consulting Services was engaged to design and deliver a workshop focused engagement process to inform development of the Plan. Workshops were held in late 2018 with representatives of the following sectors:

- Emergency management;
- Health;
- Infrastructure;
- Primary production; and
- Sustainable landscapes.

It was recognised that each sector already had investigated how climate change will have an impact on how it functions, albeit to varying degrees. In this context, the focus of the workshops was to identify the types of science and information needed to inform priority decisions in the future.

To ensure that the results of the sector specific workshops were consistent with current science and research in South Australia, a research sector workshop was held on 5 April 2019. The workshop involved researchers from key research and development institutions with experience in relation to each of the five key sectors.

The aims of the workshop were to:

- Communicate what the Department for Environment and Water is doing to coordinate science and information for climate change response planning in South Australia;
- Present the science and information needs identified through the 2018 workshops;
- Identify where research interests intersect with climate change science and information needs; and
- Identify where ongoing or new research could address the knowledge gaps identified during the 2018 consultation workshops.

The workshop was structured around three lines of enquiry:

### Sector based discussions

- Do the information gaps identified really exist, or is the information available, but too complex, not easily accessible or incomplete?

- Are there additional information gaps that are also relevant to priority decision making for this sector that have not been identified?
- Is there specific research we should be aware of relevant to the information gaps?

#### Emerging cross sectoral information gaps

- Based on the sector discussions, are there particular information gaps that you believe are relevant to multiple sectors?
- Are there additional information gaps in SA relevant to decision making that have not been identified from the sector based discussions?

#### Research capacity and capability

- Do South Australian research and development institutions have the capacity and capability to address the proposed priority information gaps.

This report provides a broad summary of the feedback received at the workshop and therefore not all issues raised at the workshops are discussed. It should be noted that this report does not provide a literature review of what is already understood about climate change impacts for each sector. Where this is of interest, the Cross-sectoral Consultation Workshops Summary Report<sup>1</sup> should be consulted along with the broader literature relevant to that sector.

---

<sup>1</sup> Siebentritt, M. and Green, G. (2018), *Climate Change Science and Knowledge Plan - Cross-sectoral Consultation Workshops Summary Report*. Goyder Institute for Water Research Technical Report Series No. 19/02.

## 2 Sector specific issues

### 2.1 Emergency management

Drawing on the sector specific workshop held in 2018, the following priority information and knowledge gaps for emergency management were presented to participants for discussion:

- Improved understanding of the likelihood of compounding events (when two or more extreme weather related event coincide), to inform risk reduction strategies.
- Information to better understand and communicate the risks and vulnerabilities of communities and identify effective risk reduction strategies.
- Better understanding of the impact of increased temperature, reduced relative humidity and vegetation changes on future fire behaviour.
- Improved understanding of the response requirements for extreme weather events such as storms, heat waves and floods.
- Projected changes in soil dryness, vegetation and fire weather behaviour before, during and after prescribed burns.
- Information to assist climate-sensitive development in areas that are at high risk from natural hazards such as floods and fires.

With respect to information gaps and additional potential research in relation to the impact of climate change on emergency management, the workshop participants suggested that the future priorities should include:

- Localisation of the results of CRC for Natural Hazards research and considering its impacts for regional and remote South Australia. Many of the information gaps identified are already being addressed by research being undertaken by the CRC for Natural Hazards, however, the focus is mostly on Greater Adelaide.
- Planning for multi-hazards including developing a better understanding of the nature of compounding events.
- Improved understanding of the impact of cascading effects on extreme events (e.g. blackout impacts on hospitals) and how this can be addressed by using systems thinking and improved understanding of systems resilience.
- Analysis of the human health dimensions of fire risk and extreme heat, especially in regional areas.
- Greater emphasis on understanding what causes perturbations of a system such as movement beyond trigger points.
- Opportunities to better connect with the work that the Red Cross is undertaking on people at risk.
- Much of the focus of emergency management information gaps is human centric and needs to be balanced with consideration of other factors such as landscape management and biodiversity conservation.

- Further understanding of political vulnerability through supporting risk analysis as a way of understanding what influences decision making at a community level.

## 2.2 Health

Drawing on the sector specific workshop held in 2018, the following priority information and knowledge gaps for the health services sector were presented to participants for discussion:

- Surge event impact assessment – Specific extreme weather events, such as heat waves, to assess the preparedness of hospital infrastructure and other health services.
- Changes in disease patterns and community health – Specific issues of concern include legionella, mosquito-borne diseases, food-borne diseases, and weather-borne asthma events.
- How to identify climate vulnerable communities and how they can adapt and build resilience.
- Health infrastructure risk assessment – Data to enable the sector to better understand priority areas of vulnerability, the timing of potential impacts, and to explore mitigation options.
- How the demands on health sector staff will change through time and how this can be addressed through strategic and operational health sector workforce planning.
- Preventative health benefits of urban green space at a local scale in South Australia to inform planning and build the business case for green infrastructure.

With respect to information gaps and additional potential research in relation to the impact of climate change on human health and the health services sector, the workshop participants suggested that the future priorities should include:

- Greater benchmarking of how the health services sector is responding to extreme events, especially in culturally and linguistically diverse communities and for socially isolated people.
- Improved awareness raising of the benefits of preventative health measures such as active transport that can lead to policies that deliver a range of co-benefits including a more healthy and resilient community.
- Further investigation into emerging air quality issues that are influenced by climate change, such as dust and pollen, that can lead to respiratory diseases and conditions.
- Improved understanding of climate related risk factors for culturally and linguistically diverse communities.
- Greater attention to identification of risks to human health such as heat stroke and related conditions that in turn contribute to “surge” event planning for hospitals.
- Improved awareness of the breadth of services and infrastructure provided by the sector, including that the health sector is not just about hospitals and extends into the general practitioner network.
- Increased awareness of the impact of climate driven factors like drought are having on mental health in regional communities.

## 2.3 Natural resources and landscapes

Drawing on the sector specific workshop held in 2018, the following priority information and knowledge gaps for the natural resources and landscapes sector were presented to participants for discussion:

- Biodiversity conservation – Which species to prioritise for detailed analysis with respect to climate resilience, e.g. species most threatened with extinction, or whose ecological requirements are not met by landscape-level management
- Predicting future ecological communities – Future distribution of native plants and animals as a result of climate change and resulting landscape impacts
- Pest plant and animal communities – Future distribution and abundance of pest plants and animals, including when and where significant changes may occur
- Change in water demand profile – How the demand for water for potable, industrial, agricultural and environmental uses changes as conditions become warmer and drier
- Water resource modelling – Integration of climate projections into water resource modelling for water allocation and security planning
- Conservation areas – Strategies required to preserve the conservation function of land based and marine protected areas, accounting for changes in the distribution of plants and animals due to climate change.

With respect to information gaps and additional potential research in relation to the impact of climate change on natural resources and landscapes, the workshop participants suggested that the future priorities should include:

- Further investigation into the thermal tolerances for species and ecosystems and how this relates to changes in distribution and system tipping points.
- Research to explore how functional ecosystem priorities will change through time.
- Practical ways to ensure that natural resource management plans are helping to create more resilient natural landscapes should be developed.
- Improved understanding of the role of people in creating resilient landscapes and how this interacts with climate change drivers.
- Greater emphasis in natural landscapes research and planning on biosecurity as it is an important connection with other sectors such as primary production (with respect to weeds and invasive introduced animals) and emergency management (with respect to creating landscapes at greater fire risk).
- Continued investment into better understanding traditional knowledge as a way of providing insights into natural landscape management.
- Improved understanding of how climate change is impacting natural landscapes and ecosystems at a finer, micro scale.

- Improved understanding of the interaction between different climate factors, such as temperature, canopy dieback, rainfall and fire to better understand observed and projected system change.
- Further modelling of the relationship between water quality, especially for algae and cyanobacteria, and changes in water runoff.
- How conservation across Metropolitan Adelaide integrates with conservation in nearby reserves.
- Further analysis of the social perceptions of the value of different landscapes and how this influences preferences for future natural resources and landscape management.

## 2.4 Primary production

Drawing on the sector specific workshop held in 2018, the following priority information and knowledge gaps for the primary production sector were presented to participants for discussion:

- Water availability and quality – Improved understanding of how water quality, quantity and soil moisture will change in the future, for industries and production regions.
- Water demand – How farm/industry water requirements and demands may change with increased temperatures, reduced rainfall, and more frequent and intense heatwaves.
- Water supply – Changes in the water available in prescribed water resources planning areas and how this will impact allocations to producers.
- Chilling hours – Requirement for greater sharing of chilling hours information across sectors as the minimum daily temperatures increase.
- Management of foliar diseases in the viticulture industry and managing risks of smoke taint as a result of bushfire.
- Adapting bushfire preparedness of rural communities in response to a move to larger farms and smaller communities.

With respect to information gaps and additional potential research in relation to the impact of climate change on primary production, the workshop participants suggested that the future priorities should include:

- Greater emphasis on the impact of climate change on farming communities in addition to the impacts on stock and crops. This includes insights into how farm scale adaptation (e.g. trend toward larger farms) creates community scale challenges e.g. reduced numbers of volunteers, participation in community and sporting organisations.
- Further research on those aspects of climate change that impact sectors that generate the greatest revenue, such as the impact of hotter and drier conditions on cereal production which is an estimated \$4 billion industry in South Australian.
- Further assessment of the impact of higher temperatures on stock and cropping production, especially in relation to extreme heat thresholds for production.

- Investigation is needed into how to protect and adapt premium production sectors, such as wine producing regions in the Adelaide Hills that may be small in size but significant for regional economies and jobs.
- Awareness raising in Adelaide of the risks to primary production and adaptation response options, and how this might impact the availability and quality of food.
- Further exploration of options for management of overabundant native animals such as kangaroos and corellas.
- A greater understanding of how marine harvests are changing and what this will mean for the future viability of the seafood sector.
- Investigations into how the structure of native vegetation is changing and what the implications are for primary production, both for stock production and the connection between ecosystem services provided by insects and yields in the viticulture and horticulture sectors.

## 2.5 Infrastructure

Drawing on the sector specific workshop held in 2018, the following priority information and knowledge gaps for the infrastructure sector were presented to participants for discussion:

- Agreed data standards for designing climate resilient critical infrastructure.
- Consolidated data on coastal elevation, erosion and inundation risks and the impact of sea level rise in the coastal zone.
- Metropolitan scale stormwater run-off analysis with climate change and greater urban infill.
- Changes to performance of water sensitive urban design features under projected future average rainfall and high-intensity rainfall.
- Water security options analysis, including supply and demand side impacts.
- Risks to critical infrastructure such as wastewater management schemes in low-lying areas in the coastal zone.
- Adapting the design of new or existing infrastructure to improve its resilience to climate change impacts.
- City-scale urban water management analysis – quantifying benefits of urban irrigation, green infrastructure for city cooling.
- Location of protection infrastructure – optimal locations for protection infrastructure, such as flood levees.

With respect to information gaps and additional potential research in relation to the impact of climate change on infrastructure, the workshop participants suggested that the future priorities should include:

- Exploration of how transport links will be used in the future as escape or exit routes during extreme weather or bushfire events.
- Improved understanding of the nature of compounding events and their impact on power, water and telecommunications infrastructure.

- Identification of the knock on impact of infrastructure vulnerability to the community i.e. understand the intersection of individual and infrastructure vulnerability.
- Improved understanding of the tolerances of infrastructure and how it will be impacted by future extreme events with a view to sharing this information with key stakeholders to better manage expectations about asset life, service delivery.
- Development of an agreed position on the worst case scenarios that should be used for risk assessment and planning, allowing for cascading and compounding events.
- Assessment of the effectiveness of protection infrastructure and the extent to which it provides a false sense of security for community and businesses.
- Greater consideration of rural and remote infrastructure in addition to city based infrastructure.
- Increased focus on city scale water management strategies including the use of a Smart City water management approach.
- Inclusion of better information on population scenarios and demand side projections in regional water security plans.
- Greater use of economic analysis to understand drivers of behavioural responses and explore co-benefits and externalities.
- Assessment of the thresholds of existing green infrastructure and a consideration of what tree species to use to replace existing trees.
- Analysis of the location of cool refuges and how to prioritise where to further invest in their development.
- Risk assessment of the location and functionality of bushfire refuges.

### 3 Emerging cross sectoral issues

The discussion amongst participants of the outstanding research needs and information gaps across sectors identified a range of common themes. These were synthesised during a workshop process where participants were asked to identify their highest priority emerging cross sectoral information gaps. A transcribed list of the responses to this question is provided in Table 1.

A further assessment of the responses outlined in Table 1 was undertaken post the workshop to identify a core set of emerging cross sectoral issues. In summary the emerging cross sectoral issues identified were as follows:

- **Compounding events** – A compound event occurs when two types of extreme events coincide at a given location and time. There is a strong interest across multiple sectors in better understanding the impacts and response options to compounding extreme events and the potential cascading impacts across industries. This follows from a recognition that much of the historical climate risk assessment work undertaken is based on average changes in climate variables (e.g. temperature and rainfall), or estimates of extreme climate variables in isolation. However, it is now understood that some of the most significant impacts of climate change may occur as a consequence of compounding events, such as the storm driven power outages in South Australia in 2016.
- **People and communities** – There was a call for a much greater focus on people and communities in future research, exploring the interactions between people and ecosystems, and understanding the role of people as drivers of change. This also connects with comments about research in areas such as primary production, where it was suggested that understanding the resilience of the community is just as important as climate change impacts on production, yield, stock and farm assets.
- **Water use** – The importance of continuing to understand how water is managed in the South Australian landscape was highlighted. This includes further exploring alternative water use models and impact of changed water availability on the viability of all sectors considered in this project.
- **Public perception and education** – There was recognition that while awareness of the impacts of climate change has increased, there is still significant work required to educate the public and change perceptions. This will be especially important where people’s understanding of their own vulnerability and resilience will impact the decisions they make about how to respond to extreme events such as fire and flood.
- **Integration** – The relationship between sectors and how these will be collectively impacted on climate change was highlighted as a key area for further research. This has many dimensions including recognising that multidisciplinary approaches are crucial, defining cross sectoral thresholds to trigger coordinated adaptation, and developing ways to integrate sources of information/models spatially and across sectors.
- **Economics** – Feedback on emerging themes indicated that much of the historical work on understanding climate change impacts was in relation to physical risks, and that more work is required to translate this into economic costs and benefits, noting that this is essential to underpin future investment and business case in adaptation and mitigation activities.
- **Thermal tolerance** – Projections of average changes in temperature are well understood for South Australia, however, workshop participants identified that in many sectors understanding thermal tolerances is rapidly becoming a priority. This was especially highlighted given the record breaking

temperatures recorded in much of South Australia during the 2018/19 summer. This is important for people and industries in the north of the state where extreme temperatures are commonplace, pushing physiological tolerances of people and ecosystems to the limit. These concerns are also relevant further south where industries and ecosystems have evolved or been developed to function in more moderate temperature ranges.

- **Vegetation and fire** – A warmer and drier climate will lead to increasing fire risk, which is anticipated to drive large scale change in vegetation communities, which has relevance to primary production and conservation. Improved modelling will help private and public stakeholders better prepare for current and forecast changes.
- **Health** – There is confidence that there is a strong understanding of the impact of climate factors such as extreme heat on the morbidity and mortality of people living in cities. However, the health impacts of climate change in regional, rural and remote communities and how this impacts the viability of primary production and mining requires improved understanding. There was also a strong emphasis on understanding mental health impacts as well as physical health.

**Table 1. Transcribed list of emerging cross sectoral research needs and information gaps identified at the workshop. A synthesised list of the core themes to emerge from this workshop process is provided in the text under Section 3.**

| <b>Category</b>                              | <b>Priority</b>   |
|--|---|
| <b>Compounding events</b>                    | <ul style="list-style-type: none"> <li>• Compound events planning information.</li> <li>• Characterising future compounding extreme events and potential cascading impacts across industries.</li> <li>• Better understanding of cascading consequences, which links back to interconnectedness.</li> <li>• Stress testing for impact of cascading extreme events.</li> </ul>   |
| <b>People and communities</b>                | <ul style="list-style-type: none"> <li>• Better understanding of human-system interactions.</li> <li>• Improving knowledge of how to build community resilience.</li> <li>• Anticipating the need for transformational change.</li> <li>• Understanding the role of people as drivers of change.</li> </ul>   |
| <b>Water use</b>                             | <ul style="list-style-type: none"> <li>• Considering direct potable reuse.</li> <li>• Adapting water use.</li> <li>• Role of recycled water in primary production resilience.</li> <li>• Identifying time of year to apply water for salt leaching.</li> <li>• Determining the flexibility of industries to respond to climate projections.</li> </ul>  |
| <b>Public perception and education</b>       | <ul style="list-style-type: none"> <li>• Understanding how people perceive landscapes/environmental systems as they change.</li> <li>• Determining how to generate hopeful futures in a context laden with risk.</li> <li>• Determining how to facilitate better learning about the future climate risks across sectors.</li> </ul>   |
| <b>Integration across sectors and themes</b> | <ul style="list-style-type: none"> <li>• Bushfire risk communication.</li> <li>• Incorporating local and traditional knowledge and expertise.</li> <li>• Defining cross sectoral thresholds to trigger coordinated adaptation.</li> <li>• Developing whole of government planning scenarios for water, energy, transport and communications.</li> <li>• Recognising that multidisciplinary approaches are crucial.</li> <li>• Understanding landscape health and ecological changes due to climate change.</li> <li>• Exploring the temporal impact and risk of changes in an integrated way.</li> <li>• Developing ways to integrate sources of information/models spatially and across sectors.</li> <li>• Determining if there is a platform to integrate the data that has been collected in SA.</li> </ul> |

| Category                   | Priority  |
|----------------------------|---|
|                            | <ul style="list-style-type: none"> <li>• Effectively integrating multi factor (and multi-disciplinary) data for predictive modelling.</li> <li>• Tailoring climate information to specific sectors/impacts.</li> <li>• Identifying information needed to decide on trade-offs between competing options.</li> </ul>   |
| <b>Economics</b>           | <ul style="list-style-type: none"> <li>• Full evaluation of all benefits and costs.</li> <li>• Understanding the economics of mitigation and adaptation including co-benefits, externalities and behavioural responses.</li> <li>• Assessing impacts on economics of state and ability to adapt e.g. tourism and mining.</li> <li>• Obtaining greater information about how population and technological change interacts with climate change to influence demand for essential services e.g. water and energy.</li> </ul>  |
| <b>Thermal tolerance</b>   | <ul style="list-style-type: none"> <li>• Greater understanding of the role of microclimate on climate change impacts and adaptation.</li> <li>• Better understanding the implications of temperature trends and the impacts on communities, landscape and the environment.</li> <li>• Exploring the impact of temperature on production, health and risk.</li> <li>• Identifying temperature impacts on vulnerable groups.</li> </ul>   |
| <b>Vegetation and fire</b> | <ul style="list-style-type: none"> <li>• Understanding how climate and carbon dioxide influence vegetation and therefore fire risk and response.</li> <li>• Modelling how vegetation structure change under different future climates.</li> </ul>   |
| <b>Health</b>              | <ul style="list-style-type: none"> <li>• Exploring the relationship between rural community viability versus health infrastructure costs.</li> <li>• Determining how to retain GPs in rural communities.</li> <li>• Understanding mental health resilience of rural and regional communities.</li> <li>• Exploring the relationship between long term stress and emergencies such as drought.</li> <li>• Assessing the role of infrastructure planning and the co-benefits for health, especially for active transport.</li> <li>• Identifying if there are any health benefits of climate change.</li> <li>• Determining the distribution and equity of greenspace availability for biodiversity and health e.g. cooling effects.</li> </ul> |

## 4 Capability and capacity

Climate change science, risk management practices and adaptation policy and practice are evolving rapidly as new information becomes available from researchers and practitioners. Therefore, understanding the extent to which capability and capacity exists within South Australian research institutions is important to determine whether skills and expertise need to be built further within South Australia or brought in from elsewhere in Australia or overseas. A discussion in this regard was led by Dr Kane Aldridge, Director of the Goyder Institute for Water Research at the workshop.

The key feedback received during this session was as follows:

- There is a need for researchers to continue to strive to work across disciplines, looking at innovative ways of bringing data and information together to address integration challenges.
- Further assessment is needed of whether the information and knowledge gaps that exist are research related or whether they require greater emphasis on knowledge brokering.
- Research institutions in the State need to identify better ways of working together to solve cross sectoral issues, which will require cross institutional working arrangements
- Identifying better ways to link data sets to real world issues is a priority. This requires improved understanding of big data management and application of systems thinking.
- Researchers and practitioners need to continue to strive to identify onground needs in a way that informs research. The process by which this is done needs to be clear in the Climate Change Science and information Strategic Plan.
- Determining better ways to access information already available in existing sectors is required in order to build cross disciplinary capacity.

## 5 Key findings

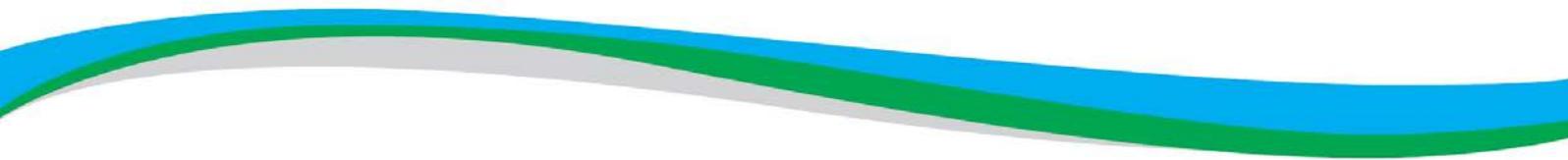
The research sector workshop provided an opportunity for researchers from across South Australian research and development institutions to review and identify potential additional priorities for inclusion in the Climate Change Science and Knowledge Plan. This workshop followed on from a series of sector specific workshops conducted in late 2018.

The workshop confirmed that the broad range of information gaps and knowledge needs for each of the priority sectors identified in the draft Climate Change Science and Knowledge Plan were appropriate. However, researchers also provided insights into additional knowledge needs and emerging research considerations. These were identified for each sector and across sectors.

In addition to the issues already identified in Sections 2 and 3 of this report, the following common themes should also be noted and considered in the final Plan:

- **Planning horizons** – Decision making needs to consider planning horizons and decision lifetimes. This describes the length of time taken to make a decision plus the duration of time over which the decision takes effect. This is especially relevant for planning of new infrastructure where the planning horizon may be over 50 years and new suburbs where the horizon is over 100 years. With planning horizons of this duration, the long term effects of climate change need to be considered as part of current day decision making. This requires explicit statements about the type of climate change scenario being used for planning e.g. 1°C by 2040 or 4°C by 2100.
- **Thresholds and trigger points** – Understanding when assets, services or systems reach thresholds and trigger points for changed management responses will become increasingly important. While the theory of thresholds and trigger points is well understood, identifying and applying them in practice is not well established.
- **Maladaptation** – When identifying adaptation actions across sectors an important issue will remain the risk of maladaptation, where an action taken to alleviate climate risk in one sector has a negative consequence in another.
- **Systems thinking** – Developing models for systems thinking was highlighted regularly throughout the workshop. This will become increasingly important as the effects of compound extreme events and cascading impacts come under greater scrutiny.
- **Role of community impacts on changing natural and production systems** – Much of the research into climate change has often focussed on physical climate risks to assets, crop yields, and natural systems. Yet, people play an active role in managing these systems. Understanding the impacts of climate change, such as extreme heat, on physical and mental health and how this influences the ability of communities to manage natural and production systems will become increasingly important. It is important that this research is undertaken by social scientists instead of bio-physical scientists.

In order to respond to the information gaps and knowledge needs identified in the Climate Change Science and Knowledge Plan requires sufficient capacity and capability in the research sector in South Australia. The workshop indicated that in addition to capacity, there is much greater need to continue to maintain and form new partnerships across institutions and sectors. This re-enforces the role of organisations such as the Goyder Institute that provide an institutional mechanism for research collaboration.



The Goyder Institute for Water Research is a partnership between the South Australian Government through the Department for Environment and Water, CSIRO, Flinders University, the University of Adelaide, the University of South Australia, and the International Centre of Excellence in Water Resource Management.