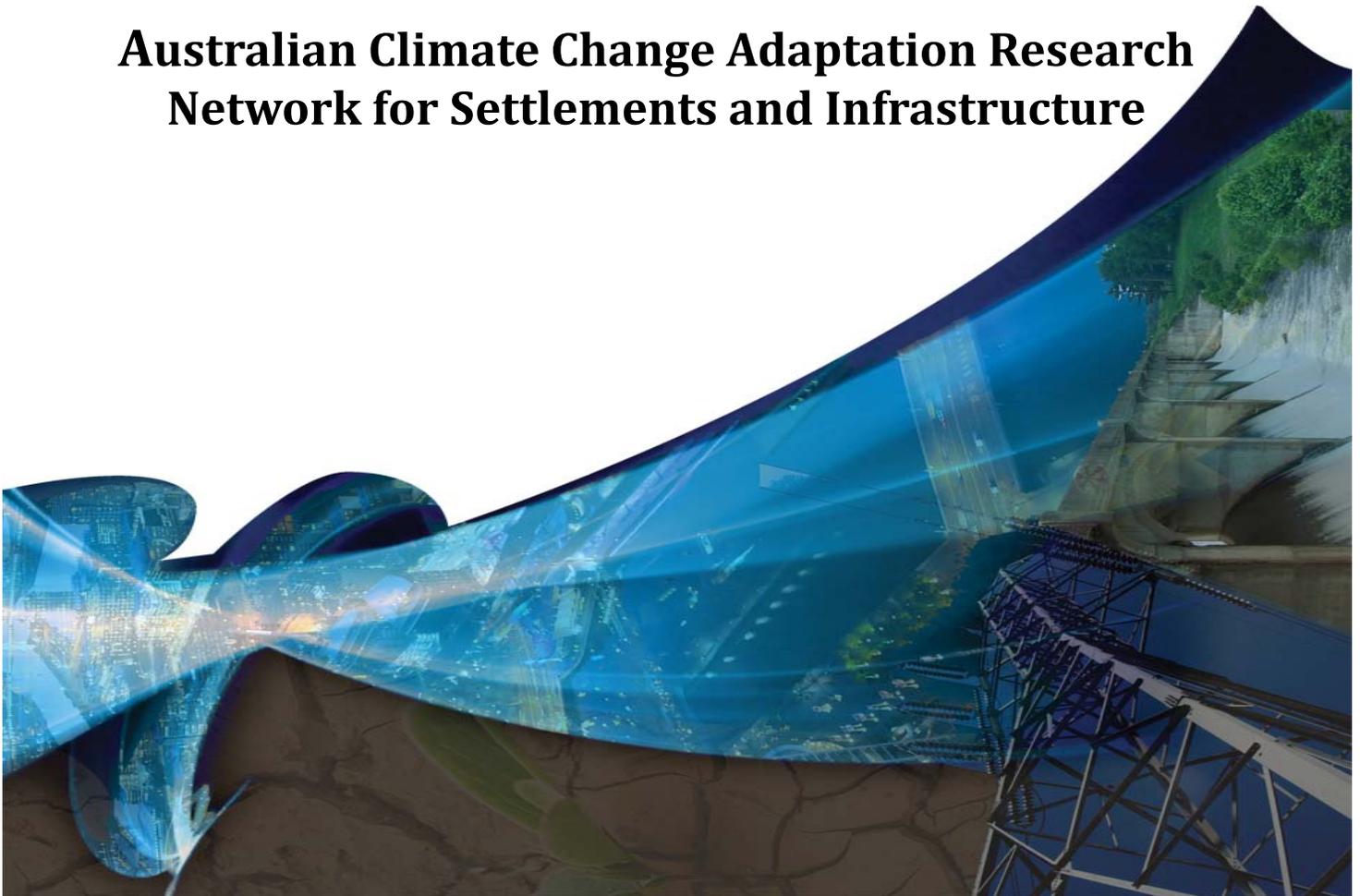


# PROCEEDINGS

**6th Early Career Researchers' National Forum & Workshop**  
**University of the Sunshine Coast**  
**21-23 November 2011**

**Australian Climate Change Adaptation Research  
Network for Settlements and Infrastructure**



ACCARNSI 6TH NATIONAL ECR FORUM AND WORKSHOP PROGRAM

**Day 1: Monday 21 November 2011**

9.45	<i>TEA AND COFFEE ON ARRIVAL</i>
10.00	Forum Welcome: ACCARNSI Network Convenor Associate Professor Ron Cox
10.15	GUEST SPEAKER - Professor Tim Smith, Director, Sustainability Research Centre, University of the Sunshine Coast, Qld
10.45	<i>MORNING TEA</i>
11.15	Population Ageing, Adaptation to Climate Change and the Built Environment <i>Tracie Harvison, University of New South Wales, NSW</i>
11.30	Australian Suburbia: Understanding Everyday Practices of Sharing for Climate Adaptation <i>Millie Rooney, University of Tasmania, TAS</i>
11.45	Past, Present and Future Landscapes: Understanding Alternative Futures for Climate Change Adaptation of Coastal Settlements and Communities <i>Jamie Trammell, University of New England, NSW</i>
12.00	Discussion lead by Professor Tim Smith
12.30	<i>LUNCH</i>
1.15	Climate Change Adaptation: Developing Metrics to Evaluate Effective Adaptation <i>Alianne Rance, EcoLogical Water Solutions, VIC</i>
1.30	Institutional, Legislative and Policy Frameworks for Environmental Planning in NSW: Help or Hindrance to Effective Adaptation? <i>Nadine White, Southern Cross University, NSW</i>
1.45	The Role and Capacity of Developers and the Financial Sector in Climate Change Adaptation <i>Zsuzsa Banhalmi-Zakar, Griffith University, QLD</i>
2.00	Discussion lead by Associate Professor Bruce Judd, UNSW
2.15	Dwelling on the Details of Adaptation <i>Pip Watson, University of Tasmania, TAS</i>
2.30	Investigating hospital facilities resilience to climate related extreme weather events: An application of resilience theory <i>Anumitra Chand, University of New South Wales, NSW</i>
2.45	A Systems Approach to Assessing the Adaptive Capacity of Hospitals to Cope with Climate Change Related Extreme Weather Events <i>Abbie White, University of New South Wales, NSW</i>
3.00	Discussion lead by Associate Professor Bruce Judd, UNSW
3.15	<i>AFTERNOON TEA</i>
3.30	WORKSHOP - 'Overcoming Barriers to Effective Climate Change Adaptation'
5.00	CLOSE
6.30	GROUP DINNER - Meet at Karma Waters Restaurant, Shop 5/7 Venning St (cnr Esplanade), Mooloolaba

**Day 2: Tuesday 22 November 2011**

9.15	<i>TEA AND COFFEE ON ARRIVAL</i>
9.30	Secular variation in rainfall and temperature in Eastern Australia <i>Yi-Ru (Lily) Chen, Griffith University, QLD</i>
9.45	Impacts of climate change on water resources in South Australia <i>Matt Gibbs, South Australian Department of Water, SA</i>
10.00	Investigating techniques to reduce evaporation from reservoirs in Australia under climate change threat <i>Fernanda Helfer, Griffith University, QLD</i>
10.15	Fill the dams? Feasibility of evaporation mitigation methods in dams <i>Simon Meares, University of New South Wales, NSW</i>
10.30	Discussion lead by Associate Professor Bill Peirson
10.45	<i>MORNING TEA</i>
11.15	Greenhouse Gas Emissions Reduction Strategies for Water Distribution Systems <i>Chris Stokes, University of Adelaide, SA</i>
11.30	Improving the Resilience of Urban Systems: Lessons from Community Scale Infrastructure Projects <i>Che Biggs, University of Melbourne, VIC</i>
11.45	<b>GUEST SPEAKER - Associate Professor Bill Peirson, ACCARNSI Node 4 Co-Convenor Climate Change Adaptation of Water Supply Systems</b>
12.15	Discussion lead by Associate Professor Bill Peirson
12.30	A climate change adaptation framework for the maintenance of road infrastructure: using a systems approach for sustainable outcomes <i>Ben Leonello, University of Adelaide, SA</i>
12.45	Integration model for sustainable design and climate change resilience in settlements and related transport infrastructure <i>Phillip Barend Roös, Deakin University, VIC</i>
1.00	Planning for low carbon cities: exploring the relationships between mobility and spatial patterns <i>Dong Lin, University of South Australia, SA</i>
1.15	Discussion lead by Associate Professor Ron Cox
1.30	<i>LUNCH</i>
2.15	<b>FIELD TRIP - Coastal Management Issues on the Sunshine Coast: the impacts of Climate Change Adaptation - Currimundi to Alexandra Headlands</b>
5.30/6.00	<b>RETURN TO MANTRA, MOOLOOLABA BEACH</b>

**Day 3: Wednesday 23 November 2011**

9.00	<i>TEA AND COFFEE ON ARRIVAL</i>
9.15	GUEST SPEAKER - TBC Key Engineering issues for Sunshine Coast Council
9.45	GUEST SPEAKER - Associate Professor Ron Cox, ACCARNSI Network Convenor Coastal Engineering Guidelines Update
10.15	SESSION TO BE ADVISED
10.45	<i>MORNING TEA</i>
11.15	Changing policies to fit the future: climate adaptation as policy change in South East Queensland, Australia <i>Johanna Mustelin, Griffith University, QLD</i>
11.30	Claiming the coastlines <i>Louise Gates, University of New South Wales, NSW</i>
11.45	How much is our coast worth? A review of environmental valuation approaches to natural coastal environments <i>Sally Kirkpatrick, Griffith University, QLD</i>
12.00	Uncertainty analysis in planning adaptation for climate change <i>Razieh Mosadeghi, Griffith University, QLD</i>
12.15	GUEST SPEAKER - Professor Rodger Tomlinson, ACCARNSI Node 1 Convenor Coastal Adaptation Issues
12.45	<i>LUNCH</i>
1.30	WORKSHOP - Participatory Planning using the Sunshine Coast as a case study <i>Sarah Adams, University of the Sunshine Coast, QLD</i>
3.15	<i>AFTERNOON TEA</i>
3.45	Forum Close: ACCARNSI Network Convenor Associate Professor Ron Cox
4.00	AIRPORT SHUTTLE to Brisbane Domestic Airport for return flights home (leaves from USC Sippy Downs campus)

BUILT ENVIRONMENT

**Tracie HARVISON**

*University of New South Wales, NSW*

[tracie.harvison@bigpond.com](mailto:tracie.harvison@bigpond.com)

**POPULATION AGEING, ADAPTATION TO CLIMATE CHANGE AND THE BUILT ENVIRONMENT**

*Tracie Harvison, Rachelle Newman and Dr Bruce Judd*

**Abstract:**

Two of the most critical issues facing human societies are climate change and population ageing. On their own, each has the potential to disrupt economic, social and environmental systems requiring major policy responses worldwide to ameliorate their detrimental impact, yet rarely has their combined effect been considered. This is despite the fact that it is now widely acknowledged that older persons are amongst the most sensitive groups within the population to the impacts of climate change due to their greater propensity for chronic disease and disability. If therefore population ageing and climate change are occurring concurrently, there is a compounding vulnerability for communities to the impact of climate change resulting from population ageing. This also needs to be considered in the context of the global trend of increased urbanisation with 70% of the world's population likely to be residing in cities by 2050. This suggests that the built environment of our cities will play critical role in helping communities mitigate and adapt to climate change, as well as support the increasing percentage of older persons within the population.

This paper, based on a recent international literature review of ageing and climate change adaptation funded by the Australian Climate Change Adaptation Network for Settlements and Infrastructure (ACCARNSI) of the National Climate Change Adaptation Research Facility (NCCARF), explores this important relationship between climate change and population ageing; and the role that cities can play in either amplifying or ameliorating the consequences of both. What is evident is that the design of cities and residential communities will need to consider much more seriously how they can contribute to improving resilience and adaptive capacity of older persons if the community's vulnerability to climate change is to be reduced.

BUILT ENVIRONMENT

**Millie ROONEY**

*University of Tasmania, TAS*

[millie.rooney@utas.edu.au](mailto:millie.rooney@utas.edu.au)

**AUSTRALIAN SUBURBIA:**

**UNDERSTANDING EVERYDAY PRACTICES OF SHARING FOR CLIMATE ADAPTATION**

*Millie Rooney*

**Abstract:**

Tackling such a large and complex problems as climate change requires an understanding of not just the immediate, but the fundamental factors shaping human-environment relationships. In this paper I argue the need for further explorations into what Elizabeth Shove terms ‘the barely visible gridlines of everyday life’; an understanding of what it is that drives us to live in our cities, our built environments, in the way that we do.

Brendan Gleeson (2010) has written that it is our cities which will be the lifeboats to see us through the climate crisis. Indeed, the huge infrastructure and social culture invested in cities makes them a considerable resource. In seeking to turn cities into lifeboats of the future, the environmentalist movement often draws on the concept of ‘sharing’ as a panacea to the supposed rampant consumerism and obsession with growth. Indeed ideas of sharing, or ‘collaborative consumption’ are increasingly being promoted in a range of areas as either warm fuzzy ideals, or as efficiency measures for weathering an economic storm. But what is sharing really? What does it mean conceptually and in practice? And how is such an understanding relevant to the creation of lifeboat cities and institutional reform? Thus using the concept and experience of sharing as a case study, I explore the lived and subjective experience of Australian suburbia.

COASTAL SETTLEMENTS

**Jamie TRAMMELL**

*University of New England, NSW*

[jamie.trammell@une.edu.au](mailto:jamie.trammell@une.edu.au)

**PAST, PRESENT AND FUTURE LANDSCAPES: UNDERSTANDING ALTERNATIVE FUTURES FOR CLIMATE CHANGE ADAPTATION IN COASTAL SETTLEMENTS AND COMMUNITIES**

*Jamie Trammell, Phil Morley and David Brunckhorst*

**Abstract:**

Current climate change vulnerability and adaptation studies tend to focus their impacts on present day landscapes, which compounds uncertainty associated with future landscape change. History has shown that, although landscapes are shaped by past elements, future landscape patterns will likely be very different than past landscapes: particularly due to rapidly changing human settlement areas and communities. How those landscapes will be different from today is examined in the Past, Present and Future Landscapes: Understanding Alternative Futures for Climate Change Adaptation of Coastal Settlements and Communities project funded by a Climate Change Adaptation Research Grants Program.

Although still underway, the project has built upon methods of mapping past and current land use trends in order to predict future settlement patterns. Scenarios describing alternative landscape patterns are being developed, as is the spatial patterns of potential future settlements and other landscape elements. The impacts associated with increased flood events, sea level rise and storm surges will all be assessed in the context of different future landscapes. By examining and comparing the alternative futures we will provide a quantifiable understanding of adaptation options in order to create more resilient landscapes under future climates.

PLANNING & POLICY

**Alianne RANCE**

**EcoLogical Water Solutions, VIC**

[alianner@elws.com.au](mailto:alianner@elws.com.au)

**CLIMATE CHANGE ADAPTATION: DEVELOPING METRICS TO EVALUATE EFFECTIVE ADAPTATION**  
**Alianne Rance**

**Abstract:**

With climate change and its impacts accepted by the scientific community and majority of society alike (Clark 2011; Mummery 2011; Philp *et al.* 2011; Nelson *et al.* 2007), focus is now shifting towards response mechanisms (Hedger *et al.* 2008). One approach to attenuating the impacts of climatic change is through ‘adaptation’ and the development of policies that facilitate this. With awareness of our vulnerability to climate change impacts increasing, Australian coastal communities are attempting to take action through various adaptation strategies and management plans. Yet means to evaluate effectiveness of adaptation action is not yet present on any scale; a significant gap in knowledge has been identified (Preston *et al.* 2010; Preston & Kay 2010). A tool for establishing a baseline of adaptation compliance and as an ongoing auditing tool will allow the quantification of adaptation within Australian coastal communities and avoid maladaptation.

This paper/presentation discusses findings from an honours thesis (Rance 2011) entitled, ‘*Climate Change Adaptation: Measuring Individual Community Response in Coastal Australia*’, a first pass attempt at quantifying adaptation compliance at a coastal community scale. The next step in research is what we can learn and how to move forward in effectively evaluating adaptation to climate change impacts. Research under a PhD is proposed to develop further an evaluation matrix to act as a baseline, and further as an auditing tool to effectively monitor adaptation progress throughout coastal Australia.

PLANNING & POLICY

**Nadine WHITE**

**Southern Cross University, NSW**

[nadine.white@scu.edu.au](mailto:nadine.white@scu.edu.au)

**INSTITUTIONAL, LEGISLATIVE AND POLICY FRAMEWORKS FOR ENVIRONMENTAL PLANNING IN NSW: HELP OR HINDRANCE TO EFFECTIVE ADAPTATION?**

*Nadine White*

**Abstract:**

Parts of New South Wales (NSW) have experienced warming of 1.5 to 2.0 degrees Celsius in the period 1960 to 2009, indicating that the impacts of climate change are already being felt. There is an urgent need for environmental planning and policy that can aid in reducing the negative physical impacts of climate change. Environmental planning by local government in NSW is regulated by state institutions and legislative and policy frameworks. This paper presents a review of these frameworks in the context of tourism (one of the most vulnerable industries to climate change) and climate change adaptation planning.

The study investigates NSW policy documents and legislation in order to identify local government responsibilities for planning for tourism (including strategic and development assessment planning) and for climate change adaptation. Additionally, relevant judicial decisions made in the NSW Land and Environment Court are also analysed. This research is timely in light of the current review of the NSW planning system, and the pace and scale of climatic impacts in areas with high tourism value.

The results indicate that, whilst the NSW planning system appears to be making some progress due to recent legislative changes, the progress is not substantive. Significant improvements, particularly to the *Environmental Planning and Assessment Act 1979*, need to be made. These changes need to occur as a matter of urgency in order for local governments to plan effectively for the impacts of climate change, thereby reducing the negative impacts of climate change on tourism infrastructure and industries.

PLANNING & POLICY

**Zsuzsa BANHALMI-ZAKAR**

**Griffith University, QLD**

[z.banhalmi-zakar@griffith.edu.au](mailto:z.banhalmi-zakar@griffith.edu.au)

**THE ROLE AND CAPACITY OF DEVELOPERS AND THE FINANCIAL SECTOR IN CLIMATE CHANGE ADAPTATION**

**Zsuzsa Banhalmi-Zakar**

**Abstract:**

The private development sector is one of Australia's largest economic sectors and the recipient of large investment flows. In 2010, new construction finance by the bank sector totalled nearly \$3.3 billion, adding to an outstanding credit of \$28 billion (RBA 2011). Loans for owner-occupied and investment housing from all types of lenders, including banks, totalled \$2.7 billion (RBA 2011). Not only is the urban development sector substantial in terms of size, but how the type of developments that materialise, will strongly shape our towns and cities and how they are able to respond and adapt to climate change impacts is a key question.

This working paper is an extension to a research on the role of environment and bank lending practices, and also part of a NCCARF funded larger project that seeks to investigate the institutional capacity of the private urban development sector to respond to the tasks and challenges of climate change adaptation in Australian cities and investigate the role of private financial mechanisms used to finance climate adaptive urban development. This project is appropriate because land-use planning and the development, finance and banking sectors were all identified in the SEID NARP Plan (p. 17-18) as stakeholders that need to be engaged in climate adaptation matters.

This presentation will report on the rationale and context for our research project and describes the key issues that we seek to investigate, opening up discussion on how institutional capacities of the urban development and private financial sector can be studied, measured and evaluated.

Reserve Bank of Australia (RBA) (2011), Lending Commitments - All Lenders, Bank Lending to Business , Money and Credit Statistics,  
<http://www.rba.gov.au/statistics/tables/index.html>

BUILT ENVIRONMENT

**Phillipa WATSON**

*University of Tasmania, TAS*

[pip.watson@internode.on.net](mailto:pip.watson@internode.on.net)

**DWELLING ON THE DETAILS OF ADAPTATION**

*Phillipa Watson*

**Abstract:**

In Australia a significant proportion of existing housing is in poor condition and requires adaptation if it is to support resilient climate responses and limit environmental impacts. The state of Tasmania faces a challenging path to housing adaptation due to socio-economic problems that are exacerbated by energy inefficient housing. This presentation reports on findings from a PhD project that examined dwelling adaptation in Tasmania in order to find better ways to support adaptation for energy efficiency and comfort. The thesis argues that more effective support of housing adaptation is needed and will require more detailed understanding of how and why households make adaptations. Responding to this argument and using qualitative methods, the thesis explores various aspects housing adaptations through householders' lived experiences. Characteristics that influence housing adaptations are explored including: the problem solving processes householders progress through; key influences; and, key capacities needed for adaptations. This presentation describes some of the findings from this detailed exploration and discusses the implications of the emerging detail in relation to reforming housing adaptation policy and improving stakeholder support for housing adaptations.

BUILT ENVIRONMENT

**Anumitra CHAND**

*University of New South Wales, NSW*

[a.chand@unsw.edu.au](mailto:a.chand@unsw.edu.au)

**INVESTIGATING HOSPITAL FACILITIES RESILIENCE TO CLIMATE RELATED EXTREME WEATHER EVENTS: AN APPLICATION OF RESILIENCE THEORY**

*Anumitra Chand*

**Abstract:**

The growing incidence of extreme weather events (EWEs) anticipated by climate change such as severe tropical cyclones, major flooding, storms and heatwaves has been widely recognised ((IPCC), 2007). This places a unique challenge for built infrastructure especially hospitals. These provide critical facilities and fundamental service that have to be operational even during disasters. However, research has demonstrated that hospitals services continuity has been compromised by extreme weather during the past recent events (Carthey et al., 2010, Loosemore et al., 2010). While the focus on infrastructure resilience and human health impacted by climate change has gained momentum, adapting hospital facilities to EWEs have not been fully explored. Healthcare facility guidelines have been developed at both local and international levels. However, how the specific lessons learnt from past events and how new knowledge regarding facility management during EWEs is internalised into hospitals disaster planning process is not known. Moreover, the existing disaster risk reduction methods are limited in dealing with the unknown risks associated to EWEs. Hence the purpose of this research is to investigate how hospitals facilities prepare to deal with EWEs. Resilience perspective focuses on people strengths as people learn and adapt accordingly. This study focuses on the learning processes that represent how people acquire new knowledge and collectively prepare the facility for EWEs. From a resilience perspective the link between hospital facility vulnerabilities to disasters and disaster preparedness, learning and adaptation is lacking. Therefore this research will focus on addressing this deficiency.

BUILT ENVIRONMENT

**Abbie WHITE**

**University of New South Wales, NSW**

**abbie.white@unsw.edu.au**

**A SYSTEMS APPROACH TO ASSESSING THE ADAPTIVE CAPACITY OF HOSPITALS TO COPE WITH CLIMATE CHANGE RELATED EXTREME WEATHER EVENTS**

**Abbie White**

**Abstract:**

This research is a part of the ARC Linkage Grant “Assessing the adaptive capacity of hospital facilities to cope with climate change related extreme weather events: a risk management approach.” The use of a systems approach evolved from an earlier phase of this research project, which highlighted the complex, far-reaching and interconnected nature of hospital systems. Earlier phases of this research also drew attention to the vulnerabilities that hospitals experience when faced with extreme weather events, in particular, the electricity supply system. With climate change likely to increase the frequency and severity of extreme weather events, it is more important than ever for hospitals to be able to adapt, be resilient and continue service delivery during extreme weather events. Hospitals not only face the physical stresses of extreme weather events, but also become a place of refuge for influxes of patients. A system dynamics approach was used to describe one important and vulnerable element of hospitals – the electricity supply system. In consultation with our research partners, we developed a causal loop diagram of a hospital electricity supply system at a generic level. This then became the basis of an exploratory system dynamics simulation model. This prototype model demonstrated the feasibility of creating a predictive model that could be used to test the resilience of hospital electricity supply systems. The importance of this model is that it will provide insights into how hospitals can become more resilient and adaptive to extreme weather events.

INFRASTRUCTURE

**Chris STOKES**

*University of Adelaide, SA*

[cstokes@civeng.adelaide.edu.au](mailto:cstokes@civeng.adelaide.edu.au)

**GREENHOUSE GAS EMISSIONS REDUCTION STRATEGIES FOR WATER DISTRIBUTION SYSTEMS**  
*Chris Stokes*

**Abstract:**

For Australian water utilities, climate change represents a major challenge in the coming decades, both financially and in terms of reliability. Water utilities will need to ensure that their infrastructure can perform within stricter environmental regulations, helping ensure financial security and an ability to maintain viability in an ever increasingly environmentally focussed industry. Water distribution is an energy intensive industry, with the majority of a water utility's electricity consumption being used for pumping. As a large emitter of greenhouse gases (GHG), water utilities have a responsibility to reduce their emissions. In addition to this, reducing GHG emissions will help water utilities to maintain a viable commodity with increasingly stricter climate change policies and financial charges.

To help achieve GHG reductions within the water distribution industry, an accurate model representing the GHG emissions associated with a WDS is required. In order to develop this, a water distribution and electricity consumption (WDEC) framework is presented. The WDEC framework represents the processes required to achieve an optimal WDS design for the objectives of both GHG emission and cost reduction. These processes include the design, operational management, simulation and evaluation of a WDS. The WDEC framework includes a dynamic model representing GHG emissions associated with the production of electricity consumed by a WDS. This representation will allow for increased accuracy of GHG emissions evaluation, allowing for further development within operational emission reduction strategies. The WDEC framework will lead to the development of guidelines, aimed at incorporating new technologies and strategies for the reduction of GHG emissions associated with a WDS.

INFRASTRUCTURE

**Che BIGGS**

*University of Melbourne, VIC*

[cbiggs@unimelb.edu.au](mailto:cbiggs@unimelb.edu.au)

**IMPROVING THE RESILIENCE OF URBAN SYSTEMS: LESSONS FROM COMMUNITY SCALE**

**INFRASTRUCTURE PROJECTS**

*Che Biggs and Paula Arcari*

**Abstract:**

Community-scale infrastructure systems are playing an increasing role in the provision of critical energy and water resources and services to Australian households. These systems show promise as a more environmentally benign and possibly more resilient alternative to conventional infrastructure. They are also often built in response to environmental concerns - including concerns about climate change. However, little is known about stakeholder motivations behind their development, about the role such systems might play in improving and undermining community resilience, or about the impact that such systems have on household adaptive capacity. To address this knowledge gap, a recent VCCCAR funded pilot project has investigated two contrasting community scale energy and water systems located in Melbourne. Key findings highlight the complexity of factors responsible for infrastructure system resilience and the importance of institutional and social enablers alongside technical design in fostering adaptive capacity. Findings also highlight how community-scale infrastructure projects can act as positive drivers of innovation in the utility sector. However, the research also identifies the potential for such projects to exacerbate vulnerability when cited in greenfield developments without support for building social and institutional cohesion. Overarching conclusions point to the need for a more holistic approach to planning and urban design that a) acknowledges the vulnerability of new developments to climate change through its impact on critical infrastructure, and b) integrates social and institutional resilience enablers within the built-form and infrastructure design.

INFRASTRUCTURE

**Yi-Ru (Lily) CHEN**

Griffith University, QLD

[lily.chen@griffith.edu.au](mailto:lily.chen@griffith.edu.au)

**SECULAR VARIATION IN RAINFALL AND TEMPERATURE IN EASTERN AUSTRALIA**

Yi-Ru (Lily) Chen

**Abstract:**

Rainfall intensity-frequency-duration relationships are widely used in engineering design to estimate the storm runoff volume and peak runoff rate. Future rainfall is expected to increase in its intensity and/or frequency of occurrence, and storm duration may be shortened in a CO<sub>2</sub>-warmed world. Literature suggests that the storm duration could be shorter and the rainfall intensity be higher in the future. Therefore, the current infrastructure such as stormwater drainage systems, bridges and dams may be inadequate during extreme events under the future climate conditions. This study analyzed rainfall characteristics and temperature from eight sites in Eastern Australia. Long term trends in rainfall and temperature are tested by Mann-Kendall analysis Long term. Two sets of two 30-year non-overlapping periods with the greatest contrast in mean annual rainfall and temperature were selected at each of the eight sites to test for significant changes in the mean annual temperature and rainfall intensity. Temperature has increased significantly at seven out of the eight sites, which has an agreement with global warming. Only Brisbane has a significant upward trend in annual rainfall. Changes in rainfall intensity for shorter durations (< 1hr) positively correlate with changes in the mean annual temperature. Changes in rainfall intensity for longer durations (≥ 1hr) positively correlate with changes in the mean annual rainfall. With six minutes duration, there is evidence to suggest that the rainfall intensity would increase in spite of a decrease in the mean annual rainfall. The correlation of rainfall intensity and annual rainfall and temperature could be further analyzed by collecting more rainfall data within one climate zone.

INFRASTRUCTURE

**Matt GIBBS**

**South Australian Department of Water, SA**

[matt.gibbs@sa.gov.au](mailto:matt.gibbs@sa.gov.au)

**IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES IN SOUTH AUSTRALIA**

**Matt Gibbs, Graham Green and Darren Alcoe**

**Abstract:**

The large range of regional rainfall changes indicated by current climate change projections leads to difficulties when planning climate change adaptation strategies for water resources. Policy makers and resource managers generally require greater constraint of the possible range of outcomes for the impacts of projected climate change on water resource capacity.

Focusing on individual, catchment scale resources (such as a reservoir catchment or aquifer recharge zone), models have been developed that incorporate rainfall and PET at daily time step, and calibrated to reproduce the historic sensitivity to their primary influencing variable, which is generally annual winter rainfall. A select range of Global Climate Model (GCM) projections that are considered suitable for South Australia has been downscaled, jointly considering both rainfall and potential evapotranspiration (PET) changes at a regional scale.

The range of results from these models has been condensed to simple relationships between rainfall and both runoff and recharge at an annual time scale. Projected changes in recharge or runoff are plotted against changes in a key climate change indicator variable, generally mean annual or winter rainfall. This provides a trend line which is representative of the sensitivity of the water resource to changes in rainfall, accompanied by changes in potential evapotranspiration. The relationship provided allows the water resource planner/manager to read off the amount of change projected for the resource in response to the amount of rainfall change predicted by their selected climate change projection.

This method of presenting water resource impact projections places an emphasis on encouraging users of the information to select the degree of climate change for which they want to plan, while also providing them with the projected impact outcomes that result from the median of the most widely used projections.

INFRASTRUCTURE

**Simon MEARES**

*University of New South Wales, NSW*

[sdmeares@gmail.com](mailto:sdmeares@gmail.com)

**FILL THE DAMS? FEASIBILITY OF EVAPORATION MITIGATION METHODS IN DAMS**

*Simon Meares*

**Abstract:**

Evaporation rates can exceed the annual average rainfall by over one order of magnitude (Peirson et al, 2011). This is the primary cause of water loss in dams in the arid regions of Australia, and whilst there are many evaporation mitigation methods currently available on the market, there has yet to be acceptance en-masse by agricultural communities. Storing water in the pore space of sand or gravel fill has been shown to significantly reduce evaporative losses (Wipplinger 1958), and field trials and practical implementation have shown success of methods in Africa, India and the Middle East.

This study evaluates the practical and economic feasibility of filling dam storages with aggregate in arid regions of New South Wales, furthering the preliminary modelling conducted by Bennet (2007). Broken Hill and its surrounds are used as a case study, as it has long faced issues of reliable water supply (Hardy 1968).

Potential problems and the practicalities of construction have been researched and solutions to specific problems have been developed. Lifetime issues assessed include siltation, microbial clogging of the pore space, dam wall stability, environmental impact and seepage. Construction issues assessed include the availability of fill, labour and machinery, modification of the current dam structure, pumping, and all associated costs. Through cost analysis, this study concludes that given suitable conditions and availability of local resources, the conversion to aggregate filled dams may provide a feasible evaporation mitigation solution. Field trials are required to validate findings and to test the solution methods developed herein.

INFRASTRUCTURE

**Fernanda HELFER**  
Griffith University, QLD

[f.helfer@griffith.edu.au](mailto:f.helfer@griffith.edu.au)

**INVESTIGATING TECHNIQUES TO REDUCE EVAPORATION FROM RESERVOIR IN AUSTRALIA UNDER CLIMATE CHANGE THREAT**

*Fernanda Helfer*

**Abstract:**

Climate change is projected to have significant impacts on conditions affecting water supply, such as evaporation. In Australia, research suggests that increased evaporation rates will occur throughout all seasons, with a 0-10% increase by 2030 and a 0-32% by 2070. The threat of reduced water availability and increased water demand due to growing population and industry is leading the country to research new strategies to reduce evaporation from existent water supply dams. This study investigated the use of destratification by air-bubble plumes and suspended covers to reduce evaporation from reservoirs in Australia using modelling. Air-bubble plume systems may reduce evaporation by lifting the dam's cold bottom water to the surface and lowering surface temperatures. Suspended covers may reduce evaporation by blocking the incoming solar radiation onto the water surface and also by decreasing the wind speed over the water. When applied to a large farm dam in Queensland, the modelling results showed a great potential for suspended covers to reduce evaporation. For the 300-day period of simulation, the reduction in evaporation with suspended covers was 60%. Destratification, on the other hand, showed not to be an effective technique. The method would reduce evaporation only in spring, when the surface temperatures of the lake would be lowered and kept low. In summer, however, the cold water lifted to the surface would be heated at such a rapid rate, that the surface temperatures would not be kept cold, increasing both the heat stored in the water body and evaporation rates.

INFRASTRUCTURE

**Ben LEONELLO**

*University of Adelaide, SA*

[ben@sustsd.com.au](mailto:ben@sustsd.com.au)

**A CLIMATE CHANGE ADAPTATION FRAMEWORK FOR THE MAINTENANCE OF ROAD INFRASTRUCTURE: USING A SYSTEMS APPROACH FOR SUSTAINABLE OUTCOMES**

*Ben Leonello and Jackie Venning*

**Abstract:**

Climate adaptation is now a pressing issue Australia-wide for the future development and maintenance of road infrastructure. Road asset managers can expect to operate under different climatic regimes in coming decades with the likelihood of higher maintenance costs and lower road asset life expectancy. A business-as-usual approach may lead to inappropriate decision-making resulting in inefficient resource use, increased community disruption, adverse economic impacts and/or associated legal liabilities. A risk based climate change adaptation framework has been developed for the maintenance of road infrastructure that allows road asset managers to explore the implications of various climate change scenarios when deciding how, when and where maintenance should take place. Decision-making frameworks have traditionally supported economic growth with environmental remediation. This paper describes a climate change adaptation framework that can effectively integrate economic, social and environmental aspects in asset management decision-making processes. The framework, developed in consultation with road asset managers, uses tailored risk, vulnerability criteria and embraces sustainability principles within a system-based construct.

BUILT ENVIRONMENT

**Phillip Barend ROÖS**

**Deakin University, VIC**

[proos@deakin.edu.au](mailto:proos@deakin.edu.au)

**INTEGRATION MODEL FOR SUSTAINABLE DESIGN AND CLIMATE CHANGE RESILIENCE IN SETTLEMENTS AND RELATED TRANSPORT INFRASTRUCTURE**

**Phillip Barend Roös**

**Abstract:**

The development of sustainable communities and the delivery of sustainable transport infrastructure, which are resilient against climate change impacts, has been identified by the Australian Government as a key issue to the sustainable future of all Australians living in our growing cities and coastal settlements. This research inquiry seeks to understand the nature of sustainable communities and specifically the delivery of sustainable settlements and transport infrastructure which are resilient against climate change impacts. The developing of the integration model will base its decision structure on the methodology of classification systems modelling which inherently provides information on the cluster of similarities or differences. To find answers for various scenarios in the urban cluster, the research will explore the principles of design patterns and pattern language and will attempt to explain why a particular scenario causes problems, and what the possible solutions are for the problem. Key to the framing of the research outcomes will be the consideration of design based principles sourced from multidisciplinary design streams, such as architecture, urban design, transport infrastructure engineering, and civil engineering and planning. Additional to design, themes of integration to be considered will be environment and biodiversity, urban ecology, climate change adaptation and resilience, environmentally sustainable design, economic parameters, and social-cultural impacts.

PLANNING&POLICY

**Dong LIN**

**University of South Australia, SA**

[lindy010@mymail.unisa.edu.au](mailto:lindy010@mymail.unisa.edu.au)

**PLANNING FOR LOW CARBON CITIES: EXPLORING THE RELATIONSHIP BETWEEN MOBILITY AND SPATIAL PATTERNS**

**Dong Lin**

**Abstract:**

The reduction of greenhouse gas emissions to achieve low carbon cities is attracting increasing attention due to global climate change. Sustainable mobility, characterized by less dependence on motor vehicles and fewer vehicle miles travelled (VMT), is believed to be one of the most important contributors to build low carbon city.

With the decentralization and evolution from the monocentric to the polycentric spatial structure that large cities have experienced in recent decades, urban geographers and urban planners have from various perspectives highlighted their interest in polycentric urban development. In particular, the study of how employment decentralization in metropolitan areas (based on polycentric spatial structure development) affects trip length and travel mode choices has created many intense debates.

There are two major reasons for the debates. The first reason is whether the evolution of a polycentric spatial structure in mega cities could provide more opportunities to enhance a spatial match between the job and the housing location selection of workers who live in suburban areas. Accordingly, employment decentralization would improve travel patterns and urban environments such as shortening individual commuting distance, less reliance on private cars as well as reducing greenhouse gas emissions by car. The second reason is whether and how jobs-housing balance policies minimise people's commuting trips, thereby reducing energy consumption and carbon dioxide emissions in metropolitan areas. In this study, empirical studies from the U.S. and China will be discussed.

COASTAL SETTLEMENTS

**Johanna MUSTELIN**  
Griffith University, QLD

[j.mustelin@griffith.edu.au](mailto:j.mustelin@griffith.edu.au)

**CHANGING POLICIES TO FIT THE FUTURE: CLIMATE ADAPTATION AS POLICY CHANGE IN SOUTH EAST QUEENSLAND, AUSTRALIA**

*Johanna Mustelin*

**Abstract:**

Climate change adaptation has become one of the key policy fields in recent years. The call for urgent adaptation has seen multiple new policies, and the development of risk and vulnerability assessments at Federal, state and local levels in trying to tackle the projected impacts in time. This has increased the responsibilities particularly for local governments and introduced new requirements for policy change. Many local governments in Australia are now in the process of changing their planning schemes to accommodate climate change impacts. This process of policy change however is not as straightforward as we often assume. This presentation outlines some of these intricacies faced by policy- and decision-makers in South East Queensland in their efforts to adapt to climate change, while also balancing the “normal” requirements for effective public institutions. The presentation will discuss issues such as the role of uncertainty, the differing perceptions around evidence and its validity in evidence-based policymaking, and the arguments around what in fact counts as effective adaptation.

COASTAL SETTLEMENTS

**Louise GATES**

University of New South Wales, UNSW

[louise\\_gates@hotmail.com](mailto:louise_gates@hotmail.com)

**CLAIMING THE COASTLINES**

Louise Gates

**Abstract:**

With the combined effects of development pressures and sea-level rise, the coastlines and foreshore areas that we currently take for granted look set to become scarce resources. Australians have a strong affinity with the coast, as evidenced by the escalating value of waterfront properties. Coastal land is subject to a variety of uses, including swimming, surfing and other recreational pursuits, that provide intrinsic and economic benefits to coastal communities. These uses have long formed part of the Australian culture and identity, kindling expectations that they will continue to exist in perpetuity.

Yet, current laws and strategic policies in NSW do not afford adequate recognition or protection to many of the most valuable attributes and uses of coastal areas. In the absence of statutory protection, those common law principles continue to operate which grant private landowners rights to ensure their interests are maintained, potentially at the expense of coastal ecosystem migration and beach amenity. This presentation aims to expose the disparities between the expectations, and the current legal rights, of private landowners, public beach users, and other interested stakeholders under future sea-level rise scenarios.

It is argued that common law principles that have traditionally favoured the protection of private property rights are unsuited to future climates. Legislative changes are required to re-prioritise and ensure that those characteristics of coastal places that are afforded protection from the rising seas are those that are most highly valued by the greater community.

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COASTAL SETTLEMENTS

**Sally KIRKPATRICK**  
Griffith University, QLD

[s.kirkpatrick@griffith.edu.au](mailto:s.kirkpatrick@griffith.edu.au)

**HOW MUCH IS OUR COAST WORTH? A REVIEW OF ENVIRONMENTAL VALUATION  
APPROACHES TO NATURAL COASTAL ENVIRONMENTS**

*Sally Kirkpatrick*

**Abstract:**

Our coastal environment is worth billions of dollars annually in the goods and services that it provides. Realising the many different values provided and placing a comparable figure on them may assist in future planning, management, tradeoffs and use of these assets. The total value of Australia's natural assets is, however, not well known although there have been a number of studies that consider both the market and non-market values of specific areas of our coastal environment.

This presentation will provide a summary of reports and papers that provide an estimate of the value for the following coastal assets: coastal/marine ecosystems, beaches (including surfing), coral reefs, coastal lakes and wetlands and the intertidal zone (estuaries, seagrasses and mangroves). It will also discuss a number of different environmental valuation approaches, which are used to quantify the value of the environment through estimating a dollar figure based on the goods and services provided by that particular environment. This concept is based on people's willingness to pay for or willingness to forego these goods and services.

The presentation also discusses some of the difficulties in estimating intrinsic values, such as non-market values (values of existence and bequest). Examples are provided of several valuation techniques that have been developed to assist in capturing these non-market values. These include the travel cost method (how much people pay to visit the environment in question), contingent valuation method (a survey based on preferences of how much people are willing to pay) and contingent choice method (asking respondents to make tradeoffs amongst a set of environmental characteristics).

PLANNING&POLICY

**Razieh MOSADEGHI**

**Griffith University, QLD**

[r.mosadeghi@griffith.edu.au](mailto:r.mosadeghi@griffith.edu.au)

**UNCERTAINTY ANALYSIS IN PLANNING ADAPTATION FOR CLIMATE CHANGE**

**Razieh Mosadeghi**

**Abstract:**

This paper focuses on uncertainty typologies and their different dimensions while planning and making decisions for adaptation to climate change. International acknowledgement of climate change and the need for ecologically sustainable development has raised the interest in complex planning decision-making to new heights. Decision makers are currently facing the challenge of uncertainties ranging from ambiguity in defining problems and goals to uncertainty in data and models. This issue is more acute when making decisions related to strategic planning for small areas (approximately < 1000 km<sup>2</sup>). These uncertainties, however, need to be incorporated and assessed during the decision making and planning process to determine the risks and exposure of humans and the environment to potential impacts.

The problem of increasing complexity and uncertainties in decision-making has been addressed in two different ways during the past 15 years. On the one hand, considerable resources have been allocated towards improving the accuracy of projection models that are capable of simulating hydrological, atmospheric and ecological processes and consequently reducing model uncertainty. In tandem, applying multidisciplinary approaches such as multi-criteria decision making (MCDM) techniques provides for knowledge integration across environmental, physical and social sciences, and includes their relevant political dimensions. The research presented here not only sets out the advantages of applying MCDM techniques, but also identifies three categories of uncertainty and new directions for considering these when making decisions for adaptation to climate change.

COASTAL SETTLEMENTS

**Sarah ADAMS**

**University of the Sunshine Coast, QLD**

[sarahadams2611@gmail.com](mailto:sarahadams2611@gmail.com)

**UNDERSTANDING ADAPTATION TO CLIMATE CHANGE ON QUEENSLAND'S SUNSHINE COAST**  
**Sarah Adams**

Climate change is a complex, multi-dimensional problem that is embedded in the way global industrialized societies operate on a daily basis. Climate change is one of several 'wicked problems', characterized by interdependencies, circularities, and conflicts between stakeholders.[1] Defining goals, understanding the scope, and identifying solutions are obstinately difficult tasks for these tricky and aggressive problems.[2]

Research to date on climate change adaptation has focused on objective determinants of adaptive capacity, such as resource constraints.[3,4] However, subjective aspects of adaptive capacity – values, ethics, and risk perceptions – play an equally important role in adaptation decision-making.[3,5] The goals of adaptation are rarely discussed or stated explicitly, but differences in goals and priorities among individuals, groups, and institutions can limit adaptation decision-making and subsequent action.[4]

Spatial planning at the local scale can act as a "switchboard"[6] for integrating climate change with issues such as population growth, transportation, food and water supply, and energy use. Visual spatial planning tools such as maps, models and digital visualizations can help in defining problems, integrating concerns, and identifying alternatives and impacts.[7] Empirical and experimental research on group decisionmaking in social dilemmas indicates that face-to-face communication substantially increases cooperation, leading to better outcomes for the group over the long-term.[8]

This study employs participatory spatial planning methods and a physical 3D model of a coastal landscape to create an arena for investigating people's capacity to develop adaptation goals, decisions, and conflict resolution.[9] Typically, physical 3D models are used to bridge the gap between digital mapping technologies and communities with limited access to computer technology or literacy. Such low-technology models have been used successfully in Latin America, Africa, South East Asia and Australia.[10]

Participatory planning with a physical 3D model:

- Enables people to more clearly visualize landscapes (compared to a 2D map)
- Enables people to directly change features on the model (compared to computer or technician-mediated changes)
- Facilitates face-to-face communication and emphasizes communal decisionmaking[10]

The Sunshine Coast in South East Queensland is a collection of communities most widely known as a recreation and vacation destination and is under considerable pressure from development associated with tourism and the 'Sea Change' migration.

The low-lying geography is naturally vulnerable to storm surges and flooding, which will likely be exacerbated by climate change, and its dispersed and automobile dependent communities are vulnerable to oil depletion.[11]

Participatory planning commonly involves community stakeholders and local residents in real decision-making situations.[10] For this study, university students will be recruited for two reasons: 1) there are several research projects and community initiatives currently underway in South East Queensland that draw on the same pool of planners, officials, stakeholders and residents, and 2) it would be premature to involve residents or planners/councillors until the approach is tested. Therefore, senior undergraduate and graduate students will be recruited across a range of disciplines (engineering, planning, geography, sustainability, humanities, etc.). Groups of 4 to 6 participants will be presented with a table-top 3D model of the Sunshine Coast region, and given information about current conditions and most likely future conditions. Each group will be asked to envision a realistic desired future for 2100, discuss goals and priorities, negotiate trade-offs, make decisions, and plan for transitions.

The discussions will be observed and video-recorded. The data – spoken words, interactions, outcomes, and participant explanation of their decisions – will be analysed to explore the unfolding of integrated, future-focused, adaptation planning. The research aims to shed light on the following questions:

- How are adaptation problems understood by participants?
- What goals are articulated for the future?
- How are these goals operationalized through decisions and negotiation?
- What factors or decision logics are important in adaptation?
- How are adaptation transitions conceptualized and articulated?

Adger et al (2009) argue that ethics, knowledge, risk and culture are the “core problems of adaptation decision-making at all institutional and political scales and across all cultures”. [5] This study will contribute to a better understanding of the social decision-making processes that underlie long-term planning for complex problems. It will also contribute to development of participatory spatial planning methods and practice. The study is part of the South East Queensland Climate Adaptation Research Initiative, funded by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

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