# RP2005: Urban Micro Climates

*Comparative study of major contributors to the Urban Heat Island effect in three Australian cities: Sydney, Melbourne and Adelaide.*














# Monitoring the Urban Climatic Trends and Impacts

## Gathering data to inform best practice for urban heat mitigation and adaptation

## Contents




LOW CARBON LIVING CRC

UCR URBAN CLIMATES RESEARCH

# The Project

**Investigating the impacts of heat on the composition and use of urban spaces.**

We are a multidisciplinary team collaborating across a broad academic and industrial community.

## Project Summary

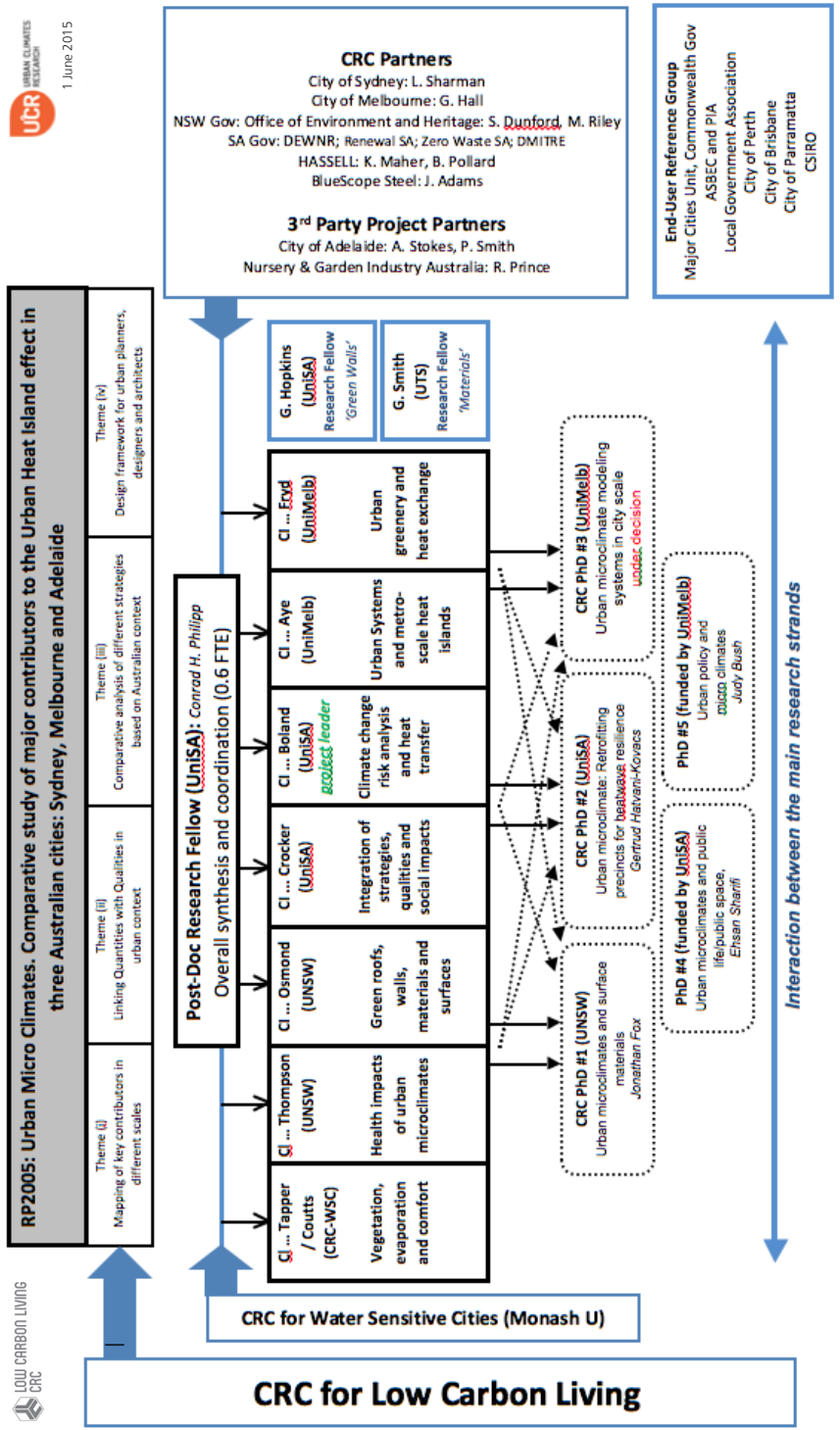
The $1.2 million research initiative aims to identify cost-effective strategies for mitigation of urban heat islands in Australian cities. 'Urban Micro Climates: Comparative Study of Major Contributors to the Urban Heat Island (UHI) in three Australian cities (Sydney, Melbourne and Adelaide)' is a three-based urban strategy for decision makers and policy formulation to reduce heat stress in three Australian cities.

This project will develop a cross-disciplinary, multi-scale understanding of Australian cities' microclimates, by focusing on the UHI effect and the interplay between urban form, density, surfaces and ambient temperature. It will be undertaken collaboratively by researchers from three universities, the CRC-WSC, two city councils, government bodies and industry partners.

There is a considerable body of international UHI research. This project aims to apply that knowledge to Australian cities and their particular issues, comparing the built environment in Sydney, Melbourne and Adelaide. It will consider co-relations between urban morphology, density, surfaces, materials, vegetation and the urban energy balance (solar and anthropogenic) as key factors of the UHI effect and its impact on people's use of public space.

The resulting analysis on the architectural, precinct and city scales will support decision making, policy formulation, urban planning and environmental management in line with the CRC-LCL aim to reduce Australia's carbon footprint.

This project is funded by the CRC for Low Carbon Living, a national research and innovation hub that supports Australian industry to be globally competitive in the low carbon built environment sector. It is supported by the Cooperative Research Centres program, an Australian Government initiative.





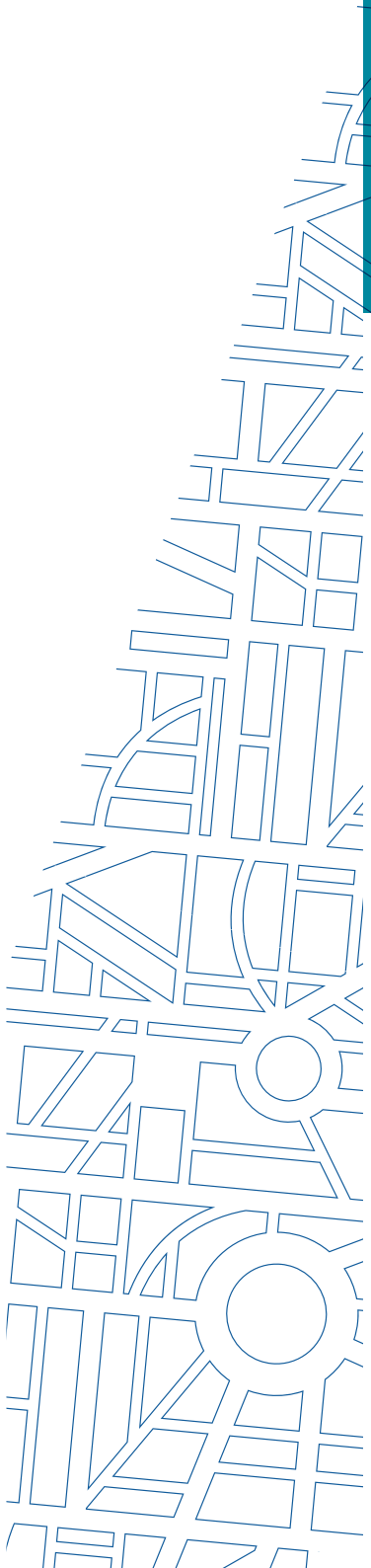

Timespan: July 2013 – June 2016

# The Project

## Research Objectives

Due to the lack of connection between the scientific research and the planning/design professions, the important research on UHI is still contained in a 'silo'. Thus it is neither perceived as a design criterion nor used as a clear and relevant design parameter. This study will bring together experts from different backgrounds with the aim of making UHI research more accessible to landscape and urban planners and designers, based on sound scientific knowledge, including publication of a 'Handbook of practical solutions for mitigating UHI in Australian cities'. The catalogue of easily realisable, feasible solutions in this publication will contribute to the necessary change in the planning and design professions and enable councils and other government agencies to develop and implement appropriate policy in their role as legislators and approval granting authorities.

The contributor cities (Sydney, Melbourne and Adelaide) are looking for a comparative study to better understand the most cost-effective options that meet the widest range of sustainability criteria as set out in their Sustainable Sydney/Melbourne/ Adelaide 2030 objectives and that are consistent with their proposed demonstration projects.



RO1. To advocate for the importance of urban microclimates as a quantifiable guiding principle for urban development policy and reform, promoting sustainable, healthy built environments in cities that support community use

RO2. To facilitate and disseminate research on urban microclimates and their essential characteristics, which can be used to build more comfortable cities

RO3. To develop a Australian City Urban Heat Index and to assess and award a 'Sustainable City' brand to those showing exceptional progress in mitigating UHI and achievement as 'Cool Cities'

RO4. To promote policy dialogue and peer learning among Australian cities, researchers and industry partners by organising conferences, seminars and exchange activities

RO5. To assemble successful practice and strategies for mitigating UHI in Australian cities and to provide capacity-development programs for stakeholders in cities that are striving to become 'Cool Cities'

RO6. To collaborate with related international associations and networks

RO7. To design a comprehensive framework to monitor and assess urban microclimates in Australian cities with key indicators and develop a cost-benefit analysis of measures to ameliorate urban microclimates

RO8. To develop a cost, benefit and risk analysis of the UHI mitigation options available.

# Comparative Study of Urban Heat Islands

*A five scale methodology across three Australian cities on macro and micro levels*

**Jonathan Fox:** PhD Researcher - UNSW.

## Thermal analysis, facades & walls.

Aims to establish predictive relations between façade design and their thermal characteristics (i.e. surface and air temperatures) by developing a vertical surface thermal classification tool.

- Individual buildings
- Relationship between vertical surfaces, material and outdoor
- Micrometeorology and thermodynamics

Development of a classification tool will enable architects, planners and decision-makers to make informed choices about the microclimatic effects of building design. Surface, air and mean radiant temperature information will be derived from material selection and façade composition options.

**Ehsan Sharifi:** PhD Researcher - UniSA.

## Socio-behavioural analysis.

Heat stress in higher densities affects the usability of public space and quality of public life. This research investigates correlations between urban microclimate variables of temperature, humidity and shade with the activity patterns of public life in five public spaces of Adelaide, Sydney and Melbourne, with the aim of:

- Highlighing the importance of microclimate modification.
- Underline the need for climate responsive public spaces.
- Identify links across quantities/quality in heat resilient space.
- Explore opportunities for public space adaptation to heat.

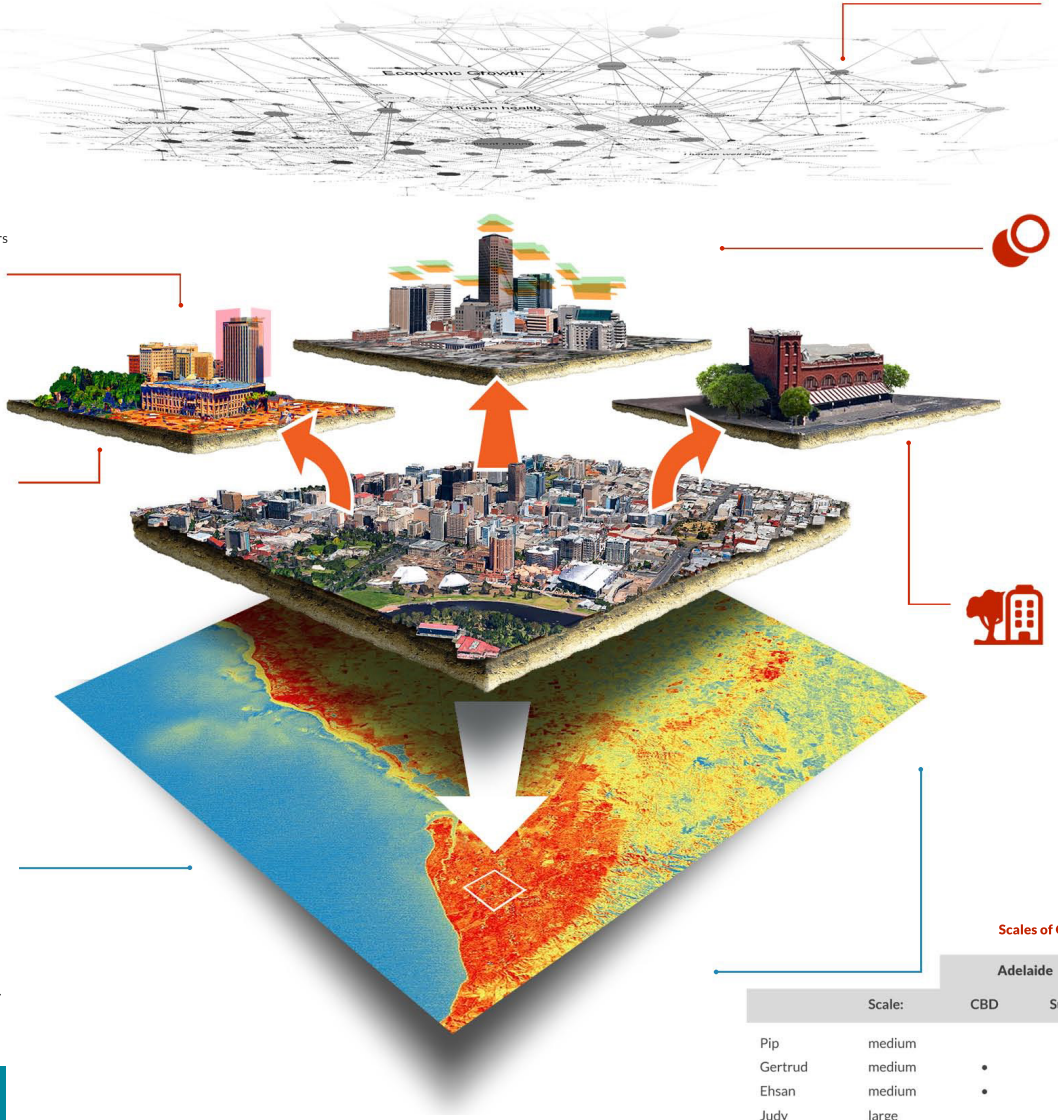
Outcomes will include the development of a heat resilient assessment tool and an index system to analyse and mitigate the heat stress in public spaces.

**Conrad Philipp:** UCR Coordinator & Research Fellow - UniSA.

## Satellite thermal imaging.

City-scale calculations are possible using remote thermal images. The Landsat 7 satellite allows the use of data across a timeframe since 1999. Around 90 thermal images will be investigated for each region of Melbourne, Sydney and Adelaide. In relation to the land use types the land surface temperature will be calculated to identify urban heat spots in the CBD and the suburbs for each of these cities.

- Heat studies (CBD and suburbs) in Adel' , Melb' & Syd'.
- Urban remote sensing calculation's (Landsat 7/8)
- Land surface calculations according to varying land use types.




## Project Visualisation

A practical representation of the way our research tiers align on varying scales and in varying fields for a comprehensive approach.

**Judy Bush:** Phd Researcher - UoM.

## Urban greenery & policy.

Examining policy, regulatory and communications approaches and strategies to support strengthened retention, expansion and efficacy of urban greenery in Australian cities, in relation to the urban heat island effect. This research will inform policy development and implementation, as well as improved practices and processes for knowledge translation between distinct communities and disciplines, contributing to trans-disciplinary and 'trans-cultural' endeavours to retain and expand urban greenery.

- City and nationwide research.
- Effective policy to maximise urban greenery.
- Implement science findings in policy.

**Philippa Hildebrand:** PhD Researcher - UoM.

## Thermal modelling of roof types.

Aims to identify Urban Hot Spots and capture diurnal variation in UHI intensity and spatial distribution of UHI on city-scale (including the urban heat effect in suburbs); To model impact of mitigation scenarios as a percentage increase in Green Roofs & Reflective Surfaces; And, discuss what temperature decreases (spatial and temporal) can be expected. Develop guidance for UHI planning (Building regs, location based mitigation) and comparison of mitigation costs / benefits.

- Heat island at urban scale (CBD and suburbs).
- City-scale modelling of diurnal variation and spatial distribution of UHI.
- Find best mitigation for expected drop in outdoor temp'.

**Gertrud Hatvani-Kovacs:** PhD Researcher - UniSA.

## Urban precinct resilience & potential retrofitting.

Using precinct-scale case studies of metropolitan regions of Adelaide and Sydney to define the resilience of each precinct to urban heat waves. Analysis of the most significant factors of precinct resilience will be carried out to determine the best retrofitting techniques for existing precincts. Strategies will be evaluated in terms of energy and carbon efficiency, financial affordability and perceived acceptability by population.

- Precinct scale research on HW resilience in CBD & suburbs.
- Identify best precinct mitigation & adaptation techniques.
- Include population vulnerability in evaluation of potential mitigation adaptation techniques.

**Scales of Observation Across All Three Metropolitain Areas:**

| | | Adelaide | | Melbourne | | Sydney | |
|---|---|---|---|---|---|---|---|
| | Scale: | CBD | Suburb | CBD | Suburb | CBD | Suburb |
| Pip | medium | | | • | • | | |
| Gertrud | medium | • | • | | | | • |
| Ehsan | medium | • | | • | | • | |
| Judy | large | | | • | • | | |
| Jonathan | fine | • | • | • | • | • | • |
| Conrad | large | • | • | • | • | • | • |

***Urban Micro Climates:** Comparative study of major contributors to the Urban Heat Island effect in three Australian cities (Sydney, Melbourne and Adelaide) (RP2005)

# The Project

## Research Output

- Extensive, comprehensive, detailed and up-to-date urban micro climate data
- UHI mitigation-oriented design framework for city councils, urban planners and architects
- Cost–benefit analysis of key strategies to mitigate the UHI effect in Australian cities
- A clear pathway for use of materials, vegetation and forms based on the microclimates in Australian cities; evidence-based policy development
- Handbook of practical solutions for mitigating UHI in Australian cities
- There is a considerable body of international UHI research. This project aims to apply that knowledge to Australian cities and their particular issues, comparing the built environment in Sydney, Melbourne and Adelaide. It will consider co-relations between urban morphology, density, surfaces, materials, vegetation and the urban energy balance (solar and anthropogenic) as key factors of the UHI effect and its impact on people's use of public space.

## Outcomes

**Activities in detail**

- Review of relevant literature in architectural science, engineering, climatology, public health and urban planning
- Gather data based on aerial and hand-held thermal photography, contextual measurements (dimensions and climate data) and spatial observational data
- Data analysis
- Synthesise results to a format suitable as decision-making tools for end-users.

**Deliverables**

- Project outcomes will include reports, publications (national and international) and presentations, including papers at major and important conferences.
- Data collection on urban micro climates to provide a comprehensive picture of three interconnected scales, which will provide an extensive archive of urban microclimate statistics and analysis for three Australian cities.
- 5 completed PhD theses.

# Research & Resources

## CRC for Low Carbon Living (CRCLCL)

**Innovations for a Sustainable Australian Built Environment: Enabling Low Carbon Buildings, Cities and Communities.**

The key challenge for the CRC for Low Carbon Living is to underpin a globally competitive Australian Built Environment Sector while addressing climate change by bringing together leading innovators from the public and private sectors to develop the scientific, technological, industrial, educational and social resources required for Australian communities to develop a low carbon built environment.

- Built Environment focus
- Multi-disciplinary approach
- Exploring building scale, precinct/urban scale and community scale research that delivers on low carbon outcomes
- Utilisation agents include governments, industry, professions and community.
- All in the context of national and international research and development.

We are committed to three integrated research programs for our research activity and projects. Our projects and activities translate across these eight impact pathways, a journey towards a low carbon economically viable built environment:

### Program 1: Integrated Building Systems

- Integrated solar technologies for buildings
- Low carbon materials
- Integrated design, showcase, ratings and standards

### Program 2: Low Carbon Precincts

- Digital information platform
- Integrated assessment of design
- Precinct-level demand forecasting for distributed infrastructure networks
- Health and productivity co-benefits

### Program 3: Engaged Communities

- Transition Scenarios and Affordability
- Drivers and Barriers to Community Engagement
- Living Laboratories
- Education and Capacity Building

**1** Harnessing the Australian sun

**2** Lowering the embodied carbon in buildings

**3** Mainstreaming low carbon buildings

**4** Designing integrated low carbon precincts

**5** Evidence base for low carbon living policy

**6** Enhancing community engagement

**7** Living laboratories low carbon lifestyle narratives

**8** Enhance education and capacity building

# Research & Resources

## Objective

**To contribute groundbreaking research to the CRC for Low Carbon Living.**

We are committed to understanding and helping to mitigate the impacts of heat on our urban precincts.

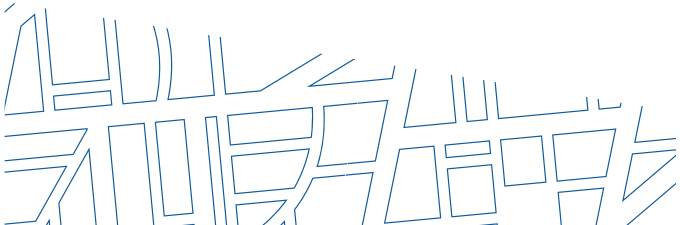
## Working with the CRC

Integrated within the CRCLCL research framework as part of 'Program 2: Low Carbon Precincts', this project 'RP2005: Urban Micro Climates' is a study applying knowledge about urban micro climates in Sydney, Melbourne and Adelaide towards shared information supporting climate adaptive planning. The project will outline the characteristics of urban micro climates, and produce an effective way to monitor and record information about micro climates for use by planning agencies, service providers and developers.

More information on the whole CRC research initiative that we contribute to can be found here: www.lowcarbonlivingcrc.com.au/research

Infrastructure changes in the built environment, resulting from the expected 60 per cent growth in Australia's population by 2050, will significantly influence and entrench the way we consume energy and our resulting carbon signature. The Low Carbon Precincts program therefore focuses on reducing the carbon footprint of our urban systems, with key consideration being given to integrating the interlinked aspects of energy, water, waste, transport and buildings – all of which have significant carbon signatures as well as human health impacts.

The challenge is to reduce the carbon footprint of precinct infrastructure through the development of better tools and planning techniques that will make low carbon infrastructure valuable and desirable to the buyer. As a result, low carbon precincts will be transformed into highly desirable lifestyle options. Improved planning of precincts will allow carbon footprint to be reduced to zero in the longer term, at the same time as quality of life continues to grow.



# Research & Resources

The program will develop new knowledge and tools that enable the design of, and stimulate the market for, low carbon infrastructure at the precinct scale. This will facilitate property developers and local government partners providing low carbon infrastructure development as well as redevelopment and retrofitting at the planning point of delivery. An emphasis on research education and training in building information modelling (BIM), and extension to a new precinct scale (PIM) platform, will dramatically improve SME design productivity. Integrated tools will be developed for demand forecasting at the precinct level, covering energy, transport, waste and water. Design and assessment tools for precincts, focusing on low carbon performance, will be developed, applied and tested. Health and productivity co-benefits analysis will demonstrate the increased value and stimulate demand for low carbon precincts.

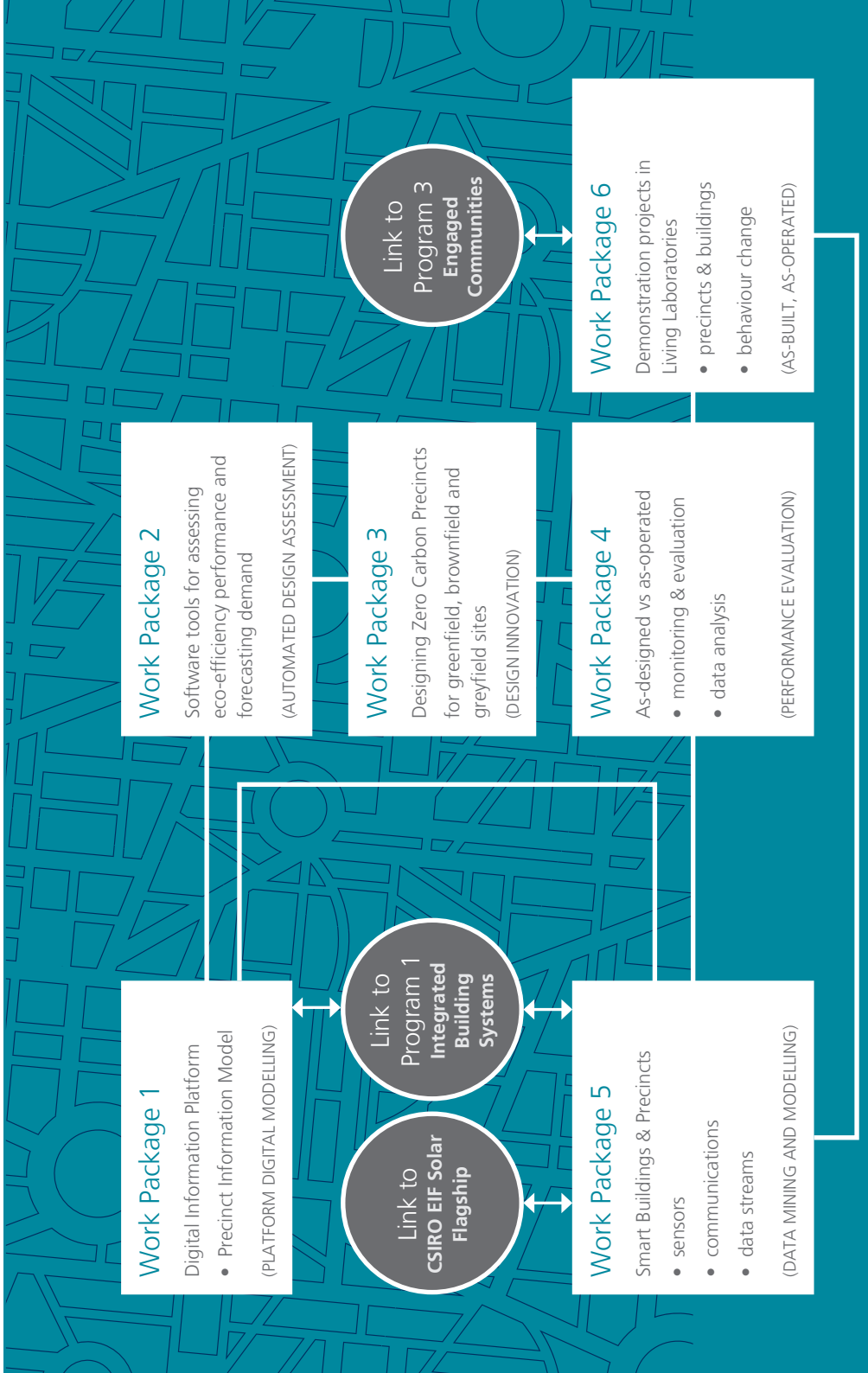
**Program Low Carbon Precincts includes the following Activities:**

- Activity 1: Digital Information Platform
- Activity 2: Precinct Planning and Design

See this along with the other contributing Programs and Activities on the CRC website:

lowcarbonlivingcrc.com.au/research/program-2-low-carbon-precincts

The proposed workflow structure for the Low Carbon Precincts program is indicated above. It includes six connected work packages, which also link to the other programs in the CRC and to the CSIRO EIF Solar Flagship.



# Research & Resources

## Activity: Precinct Planning & Design

(Aggregating 3 activities in an impact tool) Automated multi-criteria (energy, carbon, water, cost) performance assessment tools will utilise the PIM platform for precinct design, including embedded carbon and alternative energy and water options, not currently addressed by available tools. This will include integration of distributed energy supply opportunities, active modes of transport and integrated water infrastructure.

Co-benefits, such as health and productivity (eg physical inactivity and obesity alone cost Australia ~$35billion/yr) will also be quantified in tools that capture enhancements to precinct amenity, sustainability and liveability. This activity will provide common eco-efficiency performance metrics for decision support to the design professions, government and community. Work will build upon tools developed by CRC participants and capture the expertise of world leading built environment planning specialists

**Outputs of this activity include launch of:**

- An automated software tool for integrated precinct planning & design prototype from Year 3
- A precinct-scale demand forecasting tool for distributed utility networks from Year 2, and
- A health and productivity co-benefits calculator by Year 5.

**The CRCLCL Projects relating to this Activity are:**

RP2001:

Scoping study for Precinct Design and Assessment Tools

RP2005:

Urban Micro Climates: Comparative study of major contributors to the Urban Heat Island effect in three Australian cities (Sydney, Melbourne, Adelaide)

## Population and Urban Heat – a growing problem

As a result of dramatic worldwide urbanisation 50.5 per cent of the global population lived in cities in 2010; it is predicted that 70 per cent of people will be urban residents by 2050. 89 % of Australians lived in cities and 61 % of the Australians lived in a radiation of 75 km surround the five largest cities (Sydney, Melbourne, Brisbane, Perth and Adelaide). The socioeconomic advantages of urban living have attracted people to the cities. However, urbanisation has negative impacts that reduce significantly both the efficiency and liveability of cities. The urban heat island (UHI) is one of the adverse impacts caused by urbanisation and is the discernible temperature difference between urban and rural areas. This phenomenon is ascribed to the combination of inappropriate use of building and urban materials, urban morphology, the lack of vegetation, the extensive coverage of the stormwater sewage network, anthropogenic heat generation, altered wind patterns and increased air pollution in cities.


image: FLIR 7 thermal image (taken by Dr Conrad Philipp).

# Project Tracking

Twice a year industry and government partners attending the meeting included the city councils of Sydney, Melbourne and Adelaide, the NSW and SA governments, BlueScope Steel, Hassell and Nursery & Garden Industry Australia (NGIA). It is a good opportunity to review milestones and explore the end-user needs anticipated by the various stakeholders. The meetings help to focus the project for the partners by looking at data not only from the central city districts, but to extend and compare it against data of the surrounding suburb regions.

Five PhD students are now working under the guidance of the project co-ordinator, Dr Conrad H. Philipp, on different aspects of urban micro climates. Covering the 3 different states with two PhDs from UniSA, two from the University of Melbourne and one from UNSW.

Meetings are held at University of South Australia, University of New South Wales and University of Melbourne.

## CRC RP2005 Workshops:

**1st - 11 October 2013 - UniSA**

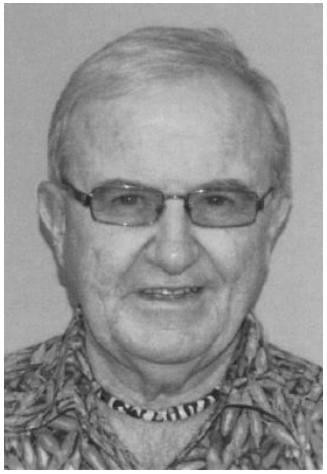
**2nd - 21 February 2014- UNSW**

**3rd - 26 September 2014 - UoM**

4th - November 2015 - UNSW

5th - June 2016 - UniSA

# Key Researchers



## Prof. John Boland
## UCR Project Leader

University of South Australia
School of Mathematics & Statistics

*Domain expert in materials, surfaces and thermodynamics*

### Profile

Prof John Boland has an extensive background in the application of mathematics to environmental and engineering problems (e.g. mathematical modelling of heat flows in domestic dwellings). He has been on the Management Committee of the ISES Solar World Conference, Adelaide 2001, and Co-Director of the 2010 Australia and New Zealand Industrial and Applied Mathematics Conference. Prof Boland is Associate Editor of the highly ranked journal associated with WREC, Renewable Energy, with paper handling duties. He is on the Technical Committee for their biannual conferences, setting the invited speakers and handling the reviewing process. He took up a similar role in the ISES International Conference in Kassel in August 2011 and has recently been named Chair of the Division of Resource Assessment and Climate for ISES, one of five divisions in the society. He has also been recently appointed to the Task 46 committee, Solar Assessment and Forecasting, of the International Energy Agency.

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### Selected publications

Jacovides, CP, Boland, J, Rizou, D, Kaltsounides, NA., Theoharatos, GA 2012, 'School Students Participation in Monitoring Solar Radiation Components: Preliminary Results for UVB and UVA Solar Radiant Fluxes', Renewable Energy, 39: 367–374.

Boland, J. &Agrawal, M 2011, 'Ecological Footprinting: What it Means and How to Put the Concept to Best Use', in Creating Sustainable Communities in a Changing World, ed PEJ Roetman & CB Daniels, Crawford House, Adelaide.

Boland, J 2010, 'Generation of Synthetic Sequences of Electricity Demand with Applications', in Uncertainty and Environmental Decision Making, ed JA Filar & A Haurie, Springer, New York, pp. 275–314.

Lauret, P, Boland, J &Ridley, B 2010, 'Derivation of a Solar Diffuse Fraction Model in a Bayesian Framework, Case Studies in Business', Industry and Government Statistics, 3(1): 108–122.

Boland, J, Filar, J &Howlett, P 2010, 'Environmental Problems, Uncertainty, and Mathematical Modeling', Notices of the American Mathematical Society, 57(10): 1286–1294.

Ridley, B, Boland, L &Lauret, P 2009, 'Modelling of Diffuse Solar Fraction with Multiple Predictors', Renewable Energy, 35(2): 478–483.

Magnano, L, Boland, J. &Hyndman, R 2008, 'Generation of Synthetic Sequences of Half-Hourly Temperature', Environmetrics, 19: 818–835.

Boland, J& Ridley, B 2008, 'Modelling Diffuse Radiation, Recent Advances' in Solar Radiation Modelling, ed Vr Badescu, Springer, Verlag, pp. 193–220.

Webby, RB, Boland, JW, Howlett, PG, Metcalfe, AV& Sritharan, T 2006, 'Conditional Value at Risk for Water Management in Lake Burley Griffin', ANZIAM Journal, 47: C116–C136.

### Academic qualifications

PhD, University of Adelaide, Australia
M Math, University of Waterloo, Canada
B Math (Hons), University of Waterloo, Canada

# Key Researchers

## Assoc. Prof. Susan Thompson

## UCR Key Researcher

*Domain expert in urban planning with expertise in healthy built environments*

### Profile

Susan Thompson is an urban planner with specific expertise in creating healthy built environments. She is the Director of the Healthy Built Environments Program within the City Futures Research Centre, Faculty of Built Environment at UNSW. She also holds the position of Associate Professor in planning and between 2005 and 2008 was the Head of the Planning and Urban Development Program. Susan Thompson brings to the project an internationally recognised research capability through work on different projects variously funded by the ARC, NSW Department of Health and the Australian Housing and Urban Research Institute. Her academic career grant total is over $3.23 million. Her research capacity is augmented by a thorough knowledge of qualitative methods in people-place research, an ability to work effectively across the theory / practice divide in policy relevant contexts, together with a strong background in local government planning practice in diverse communities. The applied nature of Susan's research is recognised by frequent invitations to present to meetings of professional practitioners. She is also invited to contribute to key reference groups and advisory panels focusing on health and the built environment.

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University of New South Wales
Faculty of the Built Environment

### Selected publications

Kent, J &Thompson, SM 2012, 'Health and the Built Environment: Exploring Foundations for a New Interdisciplinary Profession', Journal of Environmental and Public Health, doi:10.1155/2012/958175.

Kent, J, Thompson, SM &Capon, A 2012, 'Healthy Planning', in Planning Australia: An Overview of Urban and Regional Planning, ed SM Thompson & PJ Maginn, Cambridge University Press, Melbourne.

Thompson, SM, Kent, J &Wheeler, A 2011, 'Healthy Built Environments: Connecting and Strengthening Communities', paper presented to the Third World Planning Schools Congress, Perth, 4–8 July.

Thompson, SM& Kent, J 2011, 'Supporting Human Health: Focusing Effective Built Environment Interventions', paper presented to the State of Australian Cities Conference, Melbourne, 29 November – 2 December.

Phibbs, P &Thompson, SM 2011, The Health Impacts of Housing: Toward a Policy-Relevant Research Agenda, AHURI Final Report No.173, Australian Housing and Urban Research Institute, Melbourne.

Kent, J, Thompson, SM &Jalaludin, B 2011, Healthy Built Environments: A Review of the Literature, Healthy Built Environments Program, UNSW, Sydney.

Capon, AG &Thompson, SM 2011, 'Built Environments of the Future', in Making Healthy Places: Designing and Building for Health, Well-being and Sustainability, ed AL Dannenberg, H Frumkin & RJ Jackson,Island Press, USA, pp. 366–378.

Wheeler, AR &Thompson, SM 2010, 'The Future Health & Environmental Sustainability of South East Queensland: Evaluation of the Regional Plan', Australian Planner, 47(3): 152–161.

Crawford, J, Barton, H, Chapman, T, Higgins, M, Capon, AG &Thompson, SM 2010, 'Health at the Heart of Spatial Planning', Planning Theory & Practice11(1): 91–113.

Harris, P, Harris, E, Thompson, SM, Harris-Roxas, B &Kemp, L 2009, 'Human Health and Wellbeing in Environmental Impact Assessment in New South Wales, Australia', Environmental Impact Assessment Review, 29: 310–318.

### Academic qualifications

PhD, University of Sydney, Australia
Master of Town & Country Planning, University of Sydney, Australia
Bachelor of Arts (Hons), Macquarie University, Australia
Diploma of Education, Macquarie University, Australia

# Key Researchers

## Dr. Paul Osmond

### UCR Key Researcher

University of New South Wales
Faculty of Built Environment

*Domain expert in materials, surfaces and thermodynamics*

### Profile

Dr Paul Osmond is a senior lecturer and director of the postgraduate Sustainable Development program at the University of New South Wales Faculty of Built Environment (FBE). He has been engaged with sustainable development since the 1980s, both in practice and more recently, through teaching and research. Prior to taking up a lecturing position in FBE in 2010, Paul was manager of the UNSW Environment Unit. In that role he was accountable for development and implementation of the University's Environmental Management Plan, and in particular, integration of ESD principles into campus planning and development. Paul came to UNSW from local government, where he was responsible for a variety of pioneering environmental management, landscape and urban design programs and projects. His previous professional background includes experience in forestry, freelance technical journalism and the metal industry. He is a Certified Environmental Practitioner (CEnvP), registered Environmental Auditor, permaculture designer and Green Star Accredited Professional.

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### Selected publications

Wilkinson SJ, Osmond P, Heller A, Manion J, Sumich M, Sharman L (2014). "Community awareness of green roofs in Sydney", Zero Energy Mass Custom Homes 2014 International Conference, Londrina-Parana, Brazil, 04 - 06 June.

Osmond PW, Dave M, Prasad DK, Li F (2013). Greening Universities Toolkit, United Nations Environment Programme, Tongji University.

Haddad S, King SE, Osmond PW (2012). "Enhancing thermal comfort in school buildings", 10th International Healthy Buildings Conference, Brisbane, 08 - 12 July.

Osmond PW (2011). "Towards a sustainability indicator set for Australian cities", 4th International Urban Design Conference, Gold Coast, Queensland, 21 - 23 September.

Osmond PW (2011). "The convex space as the 'atom' of urban analysis", Journal of Space Syntax 2(1):97-114.

Osmond PW (2010). "Application of 'streamlined' material accounting to estimate environmental impact", Proceedings of World Academy of Science, Engineering and Technology 6(69):668-678.

Osmond PW (2010). "Hemispherical photography as a tool for urban sustainability evaluation and design" OIDA International Journal of Sustainable Development 1(9):63-74.

Osmond PW (2010). "The urban structural unit: towards a descriptive framework to support urban analysis and planning", Urban Morphology 14(1):5-20.

Osmond PW (2009). "Application of near-infrared hemispherical photography to estimate leaf area index of urban vegetation", 7th International Conference on Urban Climate, Yokohama, Japan, 29 June - 03 July.

Osmond PW (2007). "Quantifying the qualitative: An evaluation of urban ambience", 6th International Space Syntax Symposium, Istanbul, Turkey, 12 - 15 June.

### Academic qualifications

PhD, UNSW, Australia
MA (Design), RMIT, Australia
Grad. Dip. Env. Mgt, Charles Sturt, Australia
BSc, Monash, Australia

# Key Researchers

## Assoc. Prof. Lu Aye

### UCR Key Researcher

University of Melbourne
Department of Infrastructure Engineering

*Domain expert in system modelling, simulation and optimisation*

### Profile

Associate Professor Lu Aye has over 30 years of engineering experience in university teaching, research, development, demonstration and commercialisation of renewable energy technologies. He has direct involvement in the design and thermal performance monitoring of buildings in Australia and Thailand. He recently won two large ARC Linkage grants totalling $1.3M in funding from the ARC and industry partners. He has established an internationally recognised research group, Renewable Energy and Energy Efficiency (RE&EE) Group in 2008 at the university. He is currently the leader of the RE&EE Group. He is also the Deputy Theme Leader of Sustainable Systems and Energy at the Melbourne Engineering Research Institute (MERIT).

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### Selected publications

Aye, L (in press), 'Heat Pumps', Encyclopedia of Environmental Management, ed SE Jorgensen, CRC Press, NY, pp. 1–34.

Tyson, A, George, BA, Aye, L, Nawarathna, B & Malano, H 2012, 'Energy and Greenhouse Gas Emission Accounting Framework for Groundwater Use in Agriculture', Irrigation and Drainage, DOI: 10.1002/ird.1645.

Aye, L, Ngo, T, Crawford, RH, Gammampila, R & Mendis, P 2012, 'Life Cycle Greenhouse Gas Emissions and Energy Analysis of Prefabricated Reusable Building Modules', Energy and Buildings, 47: 159–168.

Hes, D, Livesley, S, Jensen, C, Aye, L& Williams, N 2012, 'Healthy Cities, Climate Change and the Role of High Albedo Surfaces and Green Infrastructure', paper presented at the 5th Healthy Cities: Working Together to Achieve Liveable Cities Conference, Geelong, 6–8 June.

Livesley, SJ, Aye, L, Hes, D, Dawkins, A, Lhendup, T, Caffin, M& Williams, NS 2011, 'Trees Provide Energy Saving Benefits to Adjacent Buildings for a Small Water Cost', Proceedings of State of Australian Cities National Conference 2011, Melbourne, 29 Nov – 2 Dec, pp. 1-8.

Hes, D, Dawkins, A, Jensen, C & Aye, L 2011, 'A Modelling Method to Assess the Effect of Tree Shading for Building Performance Simulation', paper presented at Building Simulation 2011, the 12th International Conference of the International Building Performance Simulation Association, Sydney,14–16 November.

Aye, L& Fuller, RJ 2005, 'The Proposed Heating and Cooling System in the CH2 Building and its Impact on Occupant Productivity', Australian Journal of Construction Economics & Building, 5(2): 32-39.

### Academic qualifications

GCertUni Teaching, University of Melbourne, Australia
PhD, University of Melbourne, Australia
MEngSc, University of Melbourne, Australia
GCertComputing, Rangoon Institute of Computer Science, Burma
BE (Mechanical), Rangoon Institute of Technology, Burma

# Key Researchers

## Prof. Nigel Tapper
## UCR Key Researcher

*Urban climate expertise, Research Leader CRC for Water Sensitive Cities*

### Profile

Nigel Tapper holds a Personal Chair in Environmental Science (a climate science specialist) at Monash University where over the last 12 years he has variously served as Head of the School of Geography and Environmental Science, Foundation Director of the Monash Sustainability Institute (a key university research institute responsible for facilitating and coordinating Monash-wide research across the key themes of climate, water, energy, biodiversity and transport), and Joint Coordinator of the Monash Atmospheric Science Program (the only ERA 5 rated atmospheric science program in Australia). Nigel was fundamentally involved in building this world-leading program over the last two decades and leads the Environmental Climatology Group (~25 staff and graduate students). Nigel is a Project Leader and key researcher in the new CRC for Water Sensitive Cities and a Director (Urban Climate) in Monash Water for Liveability. Nigel has published four books, 11 book chapters and over 130 refereed research publications and has supervised close to 30 PhD students in an academic career spanning 30 years.

### Selected publications


Coutts, A, Beringer, J, Loughnan, M& Tapper, N(in press),'Watering our Cities: The Capacity for Water Sensitive Urban Design to Support Urban Cooling and Improve Human Thermal Comfort', Progress in Physical Geography.

Tapper, N 2012, 'Adapting Urban Environments to Climate Change: A Case Study of Melbourne Australia', in Schooling for Sustainable Development: A Focus on Australia, New Zealand, and the Oceanic Region, ed M Robertson, Springer Science+Business Media BV, Berlin.

Wong, T, …Tapper, N (and 12 others) 2012,Blueprint 2012: Stormwater Management in a Water Sensitive City, Centre for Water Sensitive Cities, Clayton, Vic.

Loughnan, M, Nicholls, N, Tapper, N & Chandra, S 2011, 'Which Postcodes are Most Vulnerable to Hot Weather in Melbourne? A Spatial Analysis of Human Vulnerability to Heat Events',Epidemiology, 22(S1): S140.

Coutts, AM, Beringer, J& Tapper, N 2010,'Changing Urban Climate and CO2 Emissions: Implications for the Development of Policies for Sustainable Cities',Urban Policy and Research 28: 27–47.

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Coutts, A, Beringer, A & Tapper, N 2007, 'Impact of Increasing Urban Density on Local Climate: Spatial and Temporal Variations in the Surface Energy Balance in Melbourne, Australia', Journal of Applied Meteorology, 47(4): 477–493.

# Key Researchers

## Dr. Ole Fryd
## UCR Key Researcher

University of Melbourne
Faculty of Architecture, Building and Planning

*Domain expert in Water Resilient Green Cities*

### Profile

Ole Fryd is a Lecturer in Urban and Environmental Planning. He holds a PhD from the University of Copenhagen (2011) and a MSc in Urban Design from Aalborg University (2005).
His research focuses on the integration of strategic planning, physical urban design and appropriate environmental management praxes with a special emphasis on integrated urban water management. Ole Fryd has an interdisciplinary and context-based approach to urban environmental challenges and tries to support a better way forward through seminars, publications and projects on the ground. His research focuses on the development of Water Resilient Green Cities as a means to 1) improve urban water supply, drainage and sanitation, 2) reduce flood and drought risks, 3) mitigate the environmental impacts of urbanisation and 4) create more liveable cities. Emphasis is on utilising and mimicking ecological processes in the urban landscape. Ole collaborates with ecologists, engineers, hydrologists, landscape architects and social scientists and is currently engaged with research projects on this topic in Australia, China, Ethiopia, Malawi and Tanzania. Ole is co-author of the book "Sustainable Wastewater Management in Developing Countries" (ASCE Press, 2010). He has published ten papers in international peer-reviewed journals and has an h-index of 4. His professional experience includes positions as researcher, lecturer, planner and consultant in Australia, Denmark, Greenland and Thailand. Prior to joining the University of Melbourne, Ole was an Assistant Professor in Landscape Technology and Urban Planning at the University of Copenhagen.

email // ole.fryd@unimelb.edu.au

### Selected publications

Backhaus, A. and Fryd, O. (2013). The aesthetic performance of urban landscape-based stormwater management systems: a review of twenty projects in Northern Europe. Journal of Landscape Architecture 8 (2), 52-63.

Fryd, O., Backhaus, A., Birch, H., Fratini, C.F., Ingvertsen, S.T., Jeppesen, J., Panduro, T.E., Roldin, M. and Jensen, M.B. (2013). Water sensitive urban design retrofits in Copenhagen – 40% to the sewer, 60% to the city. Water Science and Technology 67 (9), 1945-1952.

Pauleit, S., Fryd, O., Backhaus, A. and Jensen, M.B. (2013). Green Infrastructure and Climate Change. In: Loftness, V. and Haase, D. (eds.). Sustainable Built Environments, New York: Springer, pp. 224-248.

Backhaus, A. and Fryd, O. (2012). Analyzing the first loop design process for large-scale sustainable urban drainage system retrofits in Copenhagen, Denmark. Environment and Planning B: Planning and Design 39 (5), 820-837.

Fryd, O., Dam, T. and Jensen, M.B. (2012). A planning framework for sustainable urban drainage systems. Water Policy 14 (5), 865-886.

Møller, K.A., Fryd, O., Neergaard, A.D. and Magid, J. (2012). Economical, environmental and sociocultural sustainability of three constructed wetlands in Thailand. Environment and Urbanization 24 (1), 305-323.

Roldin, M.K., Fryd, O., Jeppesen, J., Mark, O., Binning, P., Mikkelsen, P.S. and Jensen, M.B. (2012). Modelling the impact of soakaway retrofits on combined sewage overflows in a 3 km2 urban catchment in Copenhagen, Denmark. Journal of Hydrology 452-453, 64-75.

Brix, H., Koottatep, T., Fryd, O. and Laugesen, C.H. (2011). The Flower and the Butterfly constructed wetland system at Koh Phi Phi – System design and lessons learned during implementation and operation. Ecological Engineering 37 (7), 729-735.

Fryd, O., Pauleit, S. and Bühler, O. (2011). The role of urban green space and trees in relation to climate change. CAB Reviews 6 (53), 1-18.

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Laugesen, C.H., Fryd, O., Koottatep, T. and Brix, H. (2010). Sustainable Wastewater Management in Developing Countries: New Paradigms and Case Studies from the Field. Reston, VA: ASCE Press.

Lehmann, M. and Fryd, O. (2008). Urban quality development and management: Capacity development and continued education for the sustainable city. International Journal of Sustainability in Higher Education 9 (1), 21-38.

Details about the Africa project can be found at www.watergreenafrica.dk

### Academic qualifications

PhD, University of Copenhagen
MSc, Aalborg University

# Key Researchers

## Dr. Robert Crocker

### UCR Key Researcher

*School of Art, Architecture and Design*

*Social Behaviour*

### Profile

Robert Crocker, D.Phil (oxon), is currently Acting Director of the Zero Waste SA Research Centre for Sustainable Design and Behaviour (SD+B). A Senior Lecturer in Art, Architecture and Design, he teaches design history, research methods and sustainability theory in the Sustainable Design Masters program, and supervises PhD students in the social and cultural aspects of Sustainable Design.

Robert is UniSA Coordinator of the UniSA DESIS Lab, a concentration of designers and researchers based in the School of Art Architecture and Design teaching and researching in sustainable design and social innovation. DESIS is an international association for Social Innovation and Sustainability. See www.DESIS-network.org

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### Selected publications

(Co-edited book), Motivating Change: Sustainable Design and Behaviour in the Built Environment. Edited by Robert Crocker and Steffen Lehmann (Earthscan / Routledge, London, 2013)

(Chapter in above) "From Access to Excess: Consumerism, 'Compulsory Consumption' and Behaviour Change', in Motivating Change (above), Chapter 1.

(Conference paper / journal article): "Transforming Consumerism by Design: Reconsidering Sustainability and Behaviour Change", AGIDEAS Research: Design for Business, vol 1 (Melbourne, AGIDEAS Press, 2012), pp. 44-55.

(Co-edited book) Steffen Lehmann and Robert Crocker (eds), Designing for Zero Waste: Consumption, Technologies and the Built Environment (London, Earthscan/Routledge, 2012)

(Chapter in Book) "'Somebody Else's Problem': Consumer culture, waste and behaviour change: the case of walking", in Steffen Lehmann and Robert Crocker (eds), Designing for Zero Waste: Consumption, Technologies and the Built Environment (London, Earthscan/Routledge, 2012), chapter 1.

(Chapter in book) "Getting to Zero Waste in the new mobile communications paradigm: a social and cultural perspective", in Steffen Lehmann and Robert Crocker (eds), Designing for Zero Waste: Consumption, Technologies and the Built Environment (London, Earthscan/Routledge, 2012), chapter 6.

# Key Researchers

*'We aim to develop a cross-disciplinary, multi-scale understanding of Australian cities' microclimates, by focusing on the Urban Heat Island (UHI) effect and the interplay between urban form, density, surfaces and ambient temperature.'*

## Dr. Conrad Philipp
## UCR Co-ordinator

*Post-doctoral research fellow*
*University of South Australia*

### Profile

Conrad Philipp graduated with a diploma in geography and urban planning from the Friedrich Schiller University Jena, Germany in 2009 and has worked for the JENA-GEOS-Ingenieurbuero GmbH as a deputy team leader. In 2013, Conrad received his PhD at the Institute of Urban Planning and Urban Design of the University of Duisburg-Essen, Germany with a dissertation titled 'The impact of a green belt on the urban development of a megacity: Interdisciplinary research on the example of Seoul (Republic of Korea)'. During his PhD, he held a scholarship from the Federal Republic of Germany and from the University of Duisburg-Essen. As a postdoctoral researcher at the sd+b centre, Conrad will coordinate the CRC (Low Carbon Living) research project 'Urban Micro Climates: Comparative study of major contributors to the Urban Heat Island effect in three Australian cities (Sydney, Melbourne, Adelaide)' and lead the team researching 'Urban Micro Climates: Comparative study of Tianjin, Shenzen and Shenyang' at the China-Australia Centre for Sustainable Urban Development.

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### Selected publications

E. SHARIFI, PHILIPP, C. & S. LEHMANN (ed.) (2014): Multi-scale analysis of the surface-layer urban heat island effect in five higher-density precincts of central Sydney. Chapter 21, p.375-393. In: Low Carbon Cities. Routledge

PHILIPP, C. (ed.) & W. GIELER (ed.) (2009): Development policy of non-European states. (edited book)

PHILIPP, C. & E. SHARIFI & J. LEHMANN & J. A. SCHMIDT (in process, 2014): Land surface temperature evaluation from Landsat 7 – ETM+: case study of the CBD Sydney, Australia.

PHILIPP, C. & C. BERGER (in process, 2014): GIS-adapted procedure of LST-estimation from Landsat 7- ETM+ data of Seoul, Republic of Korea.

PHILIPP, C. (2011): Korea & Europe – Economic and Political Relations. In: LEISSE, O. & TIMMERMAN H. (2011): Toward co-opeartion between Asia and Europe.

PHILIPP, C. (2011): Religion in Korea. In: BELLER, J. LUDWIG PORSCHE, M. & W. GIELER (2011): Social policy in comparison. Lit-Verlag.

PHILIPP, C. & BERKH, K. (2011): Religion in Japan. In: BELLER, J. LUDWIG PORSCHE, M. & W. GIELER (2011): Social policy in comparison. Lit-Verlag.

PHILIPP, C. (2011): Social Policy of Korea. In: BELLER, J. LUDWIG PORSCHE, M. & W. GIELER (2011): Religions in comparison. Bautz-Verlag.

PHILIPP, C. (2011): Social Policy in Japan. In: BELLER, J. LUDWIG PORSCHE, M. & W. GIELER (2011): Religions in comparison. Bautz-Verlag.

PHILIPP, C. (2010): Nigeria. In: GIELER W. (ed.) (2010): Africa lexicon: geography, history, culture, politics and economy.

PHILIPP, C. (2008): Migration Policy Laos. In: GIELER, W. (2008): Handbook of foreigners and immigration policy. From Afghanistan to Cyprus. LitVerlag.

PHILIPP, C. (2008): Migration Policy South Korea. In: GIELER, W. (2008): Handbook of foreigners and immigration policy. From Afghanistan to Cyprus. Lit-Verlag.

PHILIPP, C. (2008): Migration Policy Cambodia. In: GIELER, W. (2008): Handbook of foreigners and immigration policy. From Afghanistan to Cyprus. Lit-Verlag.

### Academic qualifications

Post-doc reserach fellow, University of South Australia, Australia
PhD, University of Duisburg-Essen, Germany
Max Plank Institute, Jena, Germany
Diploma, Friedrich Schiller University Jena, Germany

### Conferences

PHILIPP, C. (2013): The Impact of a Greenbelt on the Urban Development of a megacity. Korea-Germany International Seminar on Contemporary Urban Issues. In: Research Institute of Urban Planning and Real Estate Chung-Ang University, Korea, conference tape, 1, 35-56.

PHILIPP, C. (2012): The Impact of a Greenbelt on the Urban Development of a megacity. Interdisciplinary Research on the Example of Seoul (Republic of Korea). International Conference on Environmentally Sustainable Urban Ecosystems, Centre for Excellence for Integrated Land-use Planning and Water Resource Management, Department of Civil Engineering, Indian Institute of Technology, Guwahati, India, conference tape, 183.

PHILIPP, C. (2011): 5th International Conference & Workshop on built environment in Developing countries. The Impact of a Green Belt on the Urban Development of a megacity: Interdisciplinary Research on the Example of Seoul (Republic of Korea), Pengang, Malaysia, conference tape, 54.

PHILIPP, C. (2010): review of Korea. In: Japanese-German Center Berlin (2010): 3 German-Japanese-Korean Fellows seminar, c. tape, 60, 196 -211

# URC External Researchers

## Prof. Geoff Smith
## UCR External Researcher

University of Technology, Sydney

*Solar and Building Materials – advisor*
*roofs, facades, instrumentation, simulation*

### Profile

Currently Emeritus and P/T Professor. Advanced concepts in control and use of solar and thermal radiation using nanoscience, materials and thin films, complex glazing, cool roofs, cool coloured paints, phase change materials, radiative cooling, simulation of building and urban thermal performance, electrodes in OPV, selective materials for TPV, land use and climate change , low cost instrumentation for use in urban and non- urban thermal studies. Project leader CSIRO Flagship project (2011-2014), ARC DP project (2014-16), Skylight Industry funded project . Ongoing consultancies using our unique lab facilities for solar, visible and thermal data on façade materials for major building projects.

### Selected publications


Green Nanotechnology: Solutions for sustainability and energy in the built environment. G.B. Smith and C. G Granqvist, CRC press (Taylor and Francis), Boca Raton, USA, September, 2010. 447 pages, ISBN 978-1-4200-8532-7

Polymeric mesh for durable infra-red transparent convection shields: applications in cool roofs and sky cooling, A.R Gentle, K. L. Dybdal and G.B. Smith, Solar Energy Materials & Solar cells, 115, 79-85 (2013).

Multi-parameter sensitivity analysis: A design methodology applied to energy efficiency in temperate climate houses, G. B. Smith, J.L.C. Aguilar and A.R. Gentle, Energy and Buildings, 55, 668–673 (2012).

Optimized cool roofs: integrating albedo and thermal emittance with R-Value, A.R. Gentle, J.L.C. Aguilar and G.B.Smith, Solar Energy Materials and Solar Cells 95 (2011) 3207–3215.

Solar reflectance and conversion efficiency dependence of technologies for mitigating global warming, Ian Edmonds Geoff Smith, Renewable Energy 36, 1343-1351 (2011).

Amplified radiative cooling via optimised combinations of aperture geometry and spectral emittance profiles of surfaces and the atmosphere, G.B. Smith, Solar Energy Mat and Solar Cells, 93, 1696-1701, 2009

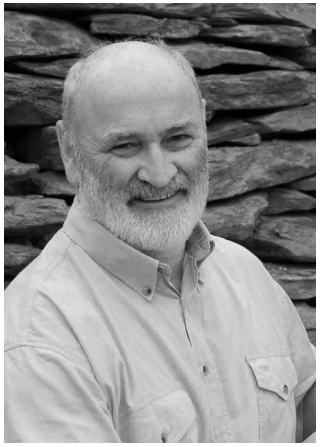
Radiative heat pumping from the earth using surface phonon resonant nanoparticles A.R. Gentle and G.B. Smith, NanoLetters, 10, 373-379, 2010.

Urban growth, albedo and global warming, G.B. Smith , A.R. Gentle and I. Edmonds, Proc. AUSES Solar2010 Conference http://www.auses.org.au/information-portal

Making cool roofs compatible with low heating and cooling loads, J.L. C Aguilar, G.B. Smith , A.R. Gentle and D. Chen, in "Fuelling the Future: Advances in Science and Technologies for Energy Generation, Transmission and Storage", (Editor A. Mendez-Vilas, BrownWalker, Boca Raton,USA) 2012, pps 530-534

Optimum integration of albedo, sub-roof R-value and phase change material for cool roofs,, JLC Aguilar, AR Gentle GB Smith and D..Chen, Proceedings 13th Conference of International Building Performance Simulation Association,, Chambéry, France, August 26-28, 2013.

# URC External Researchers



## Graeme Hopkins
## UCR External Researcher

Fifth Creek Studio

### Profile

Graeme Hopkins is a Registered Landscape Architect, Registered Architect and a Churchill Fellow. He is a principle of Fifth Creek Studio, and since the 1980s he has developed expertise in WSUD design and implementation, and the use of landscape strategies and natural systems within urban environments to provide climate change adaptation, with a particular focus on micro climate modification through the use of living architecture technologies such as green roofs and walls. He received a Churchill Fellowship in 2005 to study green roofs and walls overseas.

His book *Living Architecture: Green roofs and walls* (co-authored with Christine Goodwin) was published by CSIRO Publishing in mid-2011. Fifth Creek Studio was awarded the AILA South Australia Medal for Landscape Architecture 2012-13 for the book. He recently completed three research and monitoring projects funded jointly by the South Australian government and Aspen Development: a living wall feasibility study for Adelaide's climate, an innovative hybrid living wall system designed by Fifth Creek Studio and Woods Bagot for multi-storey buildings; and green roof trials to enable the development of an insulation performance tool for particular use in hot dry climates. This suite of projects won the 2013 AILA SA Excellence Award in the category of Research and Communications in Landscape Architecture.

Since 2013 Graeme has developed and presented a summer school course at the University of New South Wales' Faculty of Built Environment, entitled Living Architecture: Green roofs and green walls. This course encompasses students from the various disciplines with the faculty and is run over an intensive 2 weeks each January as semester unit.

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### Selected publications

Hopkins, G 2014, Living Architecture: Modifying the micro climate of urban canyons, World Green Infrastructure Congress 2014

Hopkins, G & A/Prof Corkey, L, Green roofs and walls – Training the next generation of living architecture professionals, World Green Infrastructure Congress 2014

Hopkins, G, Developing an R –Value for green roofs in the hot dry city environment of Adelaide, World Green Roof Congress Copenhagen, 2012

Hopkins, G, Better Landscape Better Life – Living Architecture Strategies : Creating Micro Climates for Human Comfort, International Federation of Landscape Architects (IFLA) Asia –Pacific Region Congress, Shanghai China, 2012

Hopkins, G & Goodwin, C. 2011, Living Architecture: Green Roofs and Walls, CSIRO Publishing, Aust.

Hopkins, G & Goodwin, C. 'Landscape Urbanism for Adelaide' (chp & boxes), Adelaide: Water of a City, Daniels, C (Ed.), 2010.

Goodwin, C and Hopkins, G. 'Bushtops - Eco-Friendly Gardens for High-Density Living' (chp & boxes), Adelaide: Nature of a City, Daniels, C and Tait, C. (Ed.), 2005.

# PhD Researchers

## Gertrud Hatvani-Kovacs

*Doctoral research candidate*
*University of South Australia*

*Principal Supervisor* *Professor John Boland*
*Co-supervisor* *Dr Martin Belusko, Dr John Pockett*

### Profile

Gertrud Hatvani-Kovacs graduated with an MSc degree in Architectural-Engineering in 2007 at the Budapest University of Technology. During her university studies she worked as a Student Demonstrator at the Department of Historical Architecture and Monuments where she assisted the research work of the Department and carried out own research project. After her graduation she worked as an Architect–Engineer and Certified Building Energy Auditor at engineering offices in Budapest. In the past two years, she was been involved in the project management of sustainable office developments at Skanska. As a LEED AP she contributed in the design and execution work of the first LEED Platinum building in Hungary. She is a chartered member of the Hungarian Chamber of Architects and as an Architect and Building Energy Certifier. She joined the Zero Waste SA Research Centre at UniSA in September 2013 as a PhD Candidate. Her research interests include: sustainable retrofitting, and citizens' evolution towards a more resilient living.

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### Thesis title

*Urban microclimate: retrofitting Australian precincts for heatwave resilience*

### Synopsis

As a result of intense worldwide urbanisation, 50.5 per cent of the global population lived in cities in 2010; it is predicted that 70 per cent of people will be urban residents by 2050 (WHO and UN-HABITAT 2010, 9). Although the socioeconomic advantages of urban living have attracted people to the cities (UN ESCAP 2013, 8) urbanisation also has negative impacts, such as social inequality, the loss of natural environments and air pollution (WHO and UN-HABITAT 2010, 7–10). Another adverse impacts of urbanisation is the discernible temperature difference between urban and rural areas, which is known as the urban heat island effect (UHIE) (Gartland 2008, 2).

The detrimental effects of the UHI reduce significantly both the efficiency and liveability of cities through the decreased use of public space, by endangering the ecosystem and causing adverse effects on the mental and physical well-being of the urban population. Recent studies have researched widely the physical and health impacts of heatwaves on cities and their inhabitants. (Koppe et al. 2004, 15–23; Gartland 2008, 140–151). Less research has been conducted on the interaction between city dwellers' capacity to adapt to heatwaves and the key indicators of heatwaves. Since urban inhabitants are not only contributors to – but also the victims of – UHIs, they are exposed to a feedback loop with negative impacts on their health and productivity. Furthermore, as more energy and water are consumed, even more waste heat and air pollution are generated (Ichinose, Matsumoto, and Kataoka 2008, 367). Consequently, the human role is a major part of the UHI cycle.

Despite the importance of the human population's impact in influencing the urban microclimate, the interplay between socioeconomic factors and urban heat islands is a relatively new and still emerging research topic (Koppe et al. 2004, 23–28). This study addresses that knowledge gap by exploring answers to three questions:

- What are the main characteristics of urban hot spots that pose the greatest risks to residents?
- How could an increased number of 'inbuilt adaptation opportunities' help residents of Australian cities to protect themselves against heatwaves?
- How could retrofitting on a precinct-scale mitigate urban heat island effects (UHIEs) and reduce greenhouse gas emissions without compromising indoor thermal comfort?

To address these questions case study research methodology will be applied to carefully selected case study sites in Sydney and Adelaide. The correlation between urban characteristics, population and precinct vulnerability will be analysed during heatwaves to identify the key indicators of UHIs and the vulnerability of the precincts, and to explore best mitigation techniques. The research is a part of the Cooperative Research Centre (CRC) for Low Carbon Living funded project titled, 'Urban microclimates – Comparative study of major contributors to the urban heat island effect in three Australian cities: Sydney, Melbourne and Adelaide' (RP2005). The project will be conducted with four other PhD students and leading researchers from three universities that include the University of South Australia, the University of Melbourne and the University of New South Wales.

## Selected bibliography


Baker, Nick, and Mark Standeven. 1996. Thermal comfort for free-running buildings. Energy and Buildings 23 (3):175-182.

Brager, Gail S, and Richard J de Dear. 1998. Thermal adaptation in the built environment: a literature review. Energy & Buildings 27 (1):83-96.

Ichinose, Toshiaki, Futoshi Matsumoto, and Kumi Kataoka. 2008. Counteracting Urban Heat Islands in Japan. In Urban Energy Transition–From Fossil Fuels to Renewable Power, edited by P. Droege. Amsterdam: Elsevier.

Kovats, R Sari, and Shakoor Hajat. 2008. Heat stress and public health: a critical review. Annu. Rev. Public Health 29:41-55.

Langlois, Neil, Jonathon Herbst, Kerryn Mason, John R Nairn, and Roger W Byard. 2013. Using the Excess Heat Factor (EHF) to predict the risk of heat related deaths. Journal of forensic and legal medicine 20:408–411.

Loughnan, Margaret, Nigel Tapper, Thu Phan, Kellie Lynch, and Judith McInnes. A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities. NCCARF 2013 Available from http://www.mappingvulnerabilityindex.com/home/project-overview (accessed 21 January 2014).

McGregor, Glenn R, Tanja Wolf, Simon Gosling, and M Pelling. Social impacts of heatwave Bristol Science Report – SC20061/SR6. Environment Agency, Bristol 2007 Available from http://www.adaptingmanchester.co.uk/sites/default/files/EcoCitiesHeatandPeople.pdf (accessed 19 November 2014).

Wong, Nyuk Hien, and Yu Chen. 2009. Tropical urban heat islands : climate, buildings and greenery. Edited by Y. Chen. New York: Taylor & Francis.




# PhD Researchers

## Ehsan Sharifi


*Doctoral research candidate*
*University of South Australia*

*Principal Supervisor Prof. John Boland*
*Co-supervisor Dr Alpana Sivam*
*Associative Supervisor Dr Conrad H. Philipp*


### Profile

Ehsan Sharifi graduated with a Master of Architecture (2002) and Master of Sustainable Design (2011), focusing on pedestrian friendly urban design. His research interests cover quality, liveability and the sustainability of public space. Previously he worked as a Lecturer at Shiraz University, focusing on the history and theory of urban design and rehabilitation of existing urban precincts. Ehsan was the recipient of UniSA's President Scholarship and School of Art, Architecture and Design Scholarship in 2012, and a National AAD Travel Grant in 2013 for his PhD at the sd+b Centre. Ehsan is currently an UHI researcher at Zero Waste Centre for Sustainable Design and Behaviour (sd+b) and workshop supervisor of Sustainable Urban Design at the School of Natural and Built Environment at UniSA, Adelaide.

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## Thesis title

*An Exploratory Case Study of Behavioural Impacts of Urban Heat Island Effect in Public Spaces of Three Australian Cities: Sydney, Melbourne and Adelaide*

## Synopsis

Continuing current carbon emissions could raise the overall surface temperature in Australian cities up to 3.4°C or more by 2070. Australia has experienced five severe heat waves: in 1939, 2004, 2007, 2009 and 2012. Heat waves are becoming more frequent and last for longer in recent years. Such heat stress increases the health risk of spending time outdoors and boosts the need for energy consumption, particularly for cooling during summer.

Cities, however, experience the effect of additional heat storage, which is trapped in thermal mass. This can result in the city centre being significantly hotter compared to the pre-urban surroundings (frequently up to 4.5°C or more). This phenomenon is known as the Urban Heat Island (UHI) effect. Urban structure, land cover, landscape and metabolism are underlined as key contributors in city scale, which foster the storage of sunlight radiation heat, exhausted waste heat and ambient heat in thermal mass of the built environment. Alongside cities' substantial energy consumption and concomitant heat production, public life in most metropolitan areas is suffering from the UHI effect during the summer, when natural-cooling systems are not effective at pedestrian level.

The current research is designed in three parts to investigate firstly, how heat stress in urban settings can alter humans' outdoor behavioural patterns; secondly, how such behavioural patterns can alter quality indicators of public space; and thirdly, how heat-sensitive public space and public life can facilitate lower carbon living in Australian context. This exploratory case study will utilise a mixed of qualitative and quantitative methods to develop a better understanding of how the overlap of heat waves and the UHI effect can alter public space quality and urban lifestyle carbon emissions.

The inquiry will use direct observation, thermal photography, filming, coding and mapping techniques for data collection.  Univariate, bivariate and multiple regression analysis will be used to investigate correlations between independent physical variables of the built environment and dependent variables of behavioural patterns in public space.

The proposed research can expand our understanding of how urban structure, land-cover and landscape transformation can facilitate quality and heat-sensitive public spaces in higher density urban settings.

## Selected bibliography


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Bosselmann, P (2008). Urban Transformation: Understanding City Design and Form, Island Press, Washington DC.

Erell E, Pearlmutter D & Williamson TJ (2011), Urban Microclimate: Designing the Spaces between Buildings, Earthscan, London.

Gartland L (2008), Heat Islands: Understanding and Mitigating Heat in Urban Areas, Earthscan, Sterling VA.

Gehl J (2010). Cities for People, Island Press, Washington DC.

Girardet H (2008), Cities, People, Planet: Urban Development and Climate Change, John Wiley, Hoboken NJ.

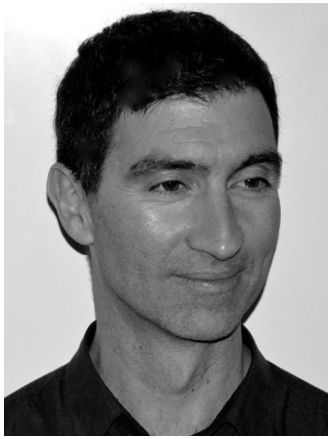
Lehmann S (2010), The Principles of Green Urbanism: Transforming the City for Sustainability, Earthscan, Washington DC.


## Recent publications


Sharifi E and Lehmann S (2012), 'Urban Heat Island Effect Mitigation in Rapidly Developing Cities', Proceedings 6th ICBEDC Conference, 4-6 December 2012, Adelaide, ISBN 978-0-646-58814-8, pp. 982-1000.

Sharifi E and Lehmann S (2014), 'Local measures to mitigate the urban heat island effect in hot and humid climate: Comparative case study of Sana'a, Bushehr and Dubai Marina', International Journal of Development and Sustainability, Volume 3 Number 1, ISSN: 2168-8662, pp. 38-54

# PhD Researchers



## Jonathan Fox

*Doctoral research candidate*
*University of New South Wales*

*Co-supervisor Professor Alan Peters*
*Co-supervisor Dr Paul Osmond*

### Profile

Jonathan obtained a Bachelor of Science (BSc) in Engineering from the University of Cape Town and a Bachelor of Architecture (BArch) from the University of the Witwatersrand in Johannesburg, South Africa. He worked in the disciplines of appropriate technology, product and productivity design, and architecture in Johannesburg, and briefly in Hong Kong, prior to establishing his own architectural practice in Sydney. He obtained his Master of Sustainability (MSust) at Sydney University and is now a Ph.D. candidate and sessional lecturer/tutor at the University of New South Wales (UNSW).

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### Thesis title

*The Effect of Architectural-Scale*
*Vertical Surfaces on Urban Microclimate*

### Synopsis

Buildings modify the radiative, thermal, moisture and aerodynamic processes that determine the microclimates of cities, contributing to the urban heat island (UHI) effect (Oke 1987). Horizontal and vertical urban surfaces control the conversion and partitioning of incident radiant energy within the urban atmosphere (Voogt 1995), hence each microclimate is "dominated by the characteristics of its immediate surroundings" (Oke 1987, 274). The receipt of direct solar radiation (and consequent surface heating), the decrease in solar radiation due to shading and the "local increase in solar receipt by reflection from sunlit walls" (Oke 1987, 264) are the most significant radiative effects of microclimate modification due to buildings (Oke 1987).

Importantly, the thermophysical properties of materials – both surface (e.g., emissivity and albedo) and molecular (e.g. specific heat, thermal conductivity, admittance, diffusivity, heat capacity and density) – and "the ability of a surface to hold or evaporate moisture" (Quattrochi & Ridd 1994, 2020) – control both the magnitude and temporal dynamics of radiant energy emissions from discrete urban surfaces (Quattrochi & Ridd 1994). The idealized urban canyon-air volume has three "active surfaces" – the two opposing building walls and the street (Oke 1987). The influence of vertical surfaces (i.e., walls) on the surface energy balance, and hence microclimate, increases with increased canyon aspect ratio (H/W), or taller, more densely spaced buildings (Voogt & Oke 1998). Increased vertical surface area and multiple reflections increase absorption of short-wave radiation (Oke 1987). The urban atmosphere within the urban canopy layer is therefore "conditioned by the temperatures of both horizontal and vertical surfaces" (Voogt & Oke 1998, 1999).

However, the spatial patterns and temporal dynamics of vertical surface temperatures are not directly observed by aerial or satellite nadir-pointing remote sensing technologies and when sampled by off-nadir (angled) remote sensors, result in directional bias (Voogt & Oke 1997, 1998). Therefore, "much of the uncertainty associated with surface (radiant) emissions" (Soux et al 2004, 403) is due to the underrepresentation of active vertical surfaces in UHI observations and the variability of vertical surface temperatures at the microscale (Soux et al 2004; Hartz et al 2006). Furthermore, whilst advances in hyperspectral imagery have enabled "automated" micro-scale (i.e., ~100 m) surface material and thermal mapping for precinct and canyon scale climatology (e.g., Heiden et al 2012), thermo-spatial mapping and the development of tools for investigating energy transfer relations at the architectural-scale (i.e., 1m -20m), where individual buildings are considered to be the "fundamental units to create the urban climate" (Cleugh & Grimmond 2012,52)' remains underdeveloped, particularly in relation to the energy partitioning processes of solar radiation receipt, long-wave radiation emissions and storage heat fluxes from complex vertical surfaces (Sham et al 2013; Grimmond et al 2010; Oke 2006; Voogt & Oke 2003).

The transferability of prior studies (e.g., Sham et al 2013; Samuels et al 2010; Hartz et al 2006; Hoyano et a11999; Voogt & Oke 1998, 1997) to measure, map, model and predict the dynamic thermal behavior of complex vertical urban surfaces (i.e., facades) is limited by uncertainty stemming from:

- Methodological challenges, sensor limitations and inconsistent metadata protocols.
- Paucity of field-based data collection and ground-validation.
- The omission or underestimation of the role of urban vertical vegetation.
- Inaccuracies regarding heat transfer coefficients and emissivity values.
- Unrepresentative sampling and inconsistent spatial/temporal classification, and;
- The difficulties of observing, classifying and modeling the "non-trivial complexity" of actual three-dimensional urban surfaces that exhibit greater temporal and spatialthermal variability than either controlled experiments or idealized models (Grimmond et al 2010; Soux et al 2004; Voogt & Oke 2003, 1997; Roth et al1989).

In order for architects to adopt microclimatic design principles, they need reliable diagnostic and predictive information about the microclimatic effects of buildings at spatial scales relevant to their decision-making. This research aims to investigate and establish quantitative, modifiable relations between the thermal properties of typical facade configurations (comprised of synthetic and natural vertical surfaces and materials) and observed outdoor surface, air and mean radiant temperatures, using ground-based infrared thermography, GIS and mobile micrometeorological instruments. The research addresses, and broadens, the fundamental question "whether there are systematic patterns of surface temperature related to street configuration" (Voogt & Oke 1998, 200) by developing an innovative methodology, the "Vertical Surfaces Thermal Typology" (VeSTT). Once developed, the VeSTT will enable automated vertical surface thermal classification corresponding to representative building facades, including the effects of orientation and materials, and thereby contributing to the predictive capacity of emergent microclimate design tools at scales suitable for architectural decision-making.

## Selected bibliography


Cleugh H.A. and Grimmond C.S.B., 2012, "Urban Climates and Global Climate Change", in Henderson-Sellers A. & Mc Guffie K. (eds.), The Future of the World's Climate, Elsevier, Chapter 3: 47-76. Oke T. R., 1987, Boundary Layer Climates, 2nd edition, Methuen, London.

Roth M, Oke T.R. and Emery W.J., 1989, "Satellite-derived urban heat islands from three coastal cities and the utilization of such data", Urban Climatology, International Journal Of Remote Sensing, 10(11): 1699-1720.

Sham J.F.C., Memon SA and Lo T.Y., 2013, "Application of continuous surface temperature monitoring technique for investigation of nocturnal sensible heat release characteristics by building fabrics in Hong Kong", Energy and Buildings 58:1-10.

Voogt J. A. and Oke T. R., 1997, "Complete Urban Surface Temperatures", Journal of Applied Meteorology, 36: 1117-1132.

Voogt J. A. and Oke T. R., 1998, "Radiometric Temperatures of Urban Canyon Walls Obtained from Vehicle Traverses", Theoretical and Applied Climatology, 60:199-217.

Voogt J. A. and Oke T. R., 2003,"Thermal remote sensing of urban climates", Remote Sensing of Environment 86(3): 370-384.


## Recent publications

Paper accepted in March 2014 for presentation at the upcoming 3rd International Conference on Countermeasures to Urban Heat islands, 13-15 October 2014, Venice, Italy.



# PhD Researchers

## Judy Bush

*Doctoral research candidate*
*University of Melbourne*

***Principal Supervisor*** ***Professor Lu Aye***
***Co-supervisor*** ***Dr Dominique Hes***

### Profile

*Executive Officer, Northern Alliance for Greenhouse Action, 2005-2014*

Northern Alliance for Greenhouse Action (NAGA), an alliance of Moreland Energy Foundation and 9 local government councils in northern metropolitan Melbourne, shares information, coordinates climate change actions and responses and cooperates on the research and development of innovative projects. My role included leading the alliance and facilitating the identification and dissemination of information, research and advocacy to NAGA's member councils and across the local government sector in Victoria. I participated as an industry partner in ARC funded linkage research projects, have sat on a number of expert reference groups and steering committees, and have undertaken policy research and analysis to inform NAGA's advocacy work with State and Federal Governments.

*Conservation Manager, Merri Creek Management Committee, 1997-2005*

My role was to lead MCMC's revegetation and maintenance of the Merri Creek habitat corridor, a largely urban waterway in northern metropolitan Melbourne. My role included development of conservation management plans, flora surveys and liaison and coordination with researchers and consultants. As part of the role I worked closely with the Australian Research Centre for Urban Ecology (ARCUE, a division of the Royal Botanic Gardens, based at the School of Botany, University of Melbourne), in supporting and informing its research and post-graduate student work.

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## Thesis title

*Modelling the Urban Heat Island Effect in Australian cities; Identifying key contributors and effective strategies to reduce urban heat in metropolitan areas.*

## Synopsis

This PhD will research effective policy, regulatory and communications approaches and strategies to support strengthened protection, expansion and efficacy of urban greenery in Australian cities (Adelaide, Melbourne and Sydney), in the context of climate change and urban heat island effect. This PhD project will utilise qualitative trans-disciplinary research methods to analyse and compare existing urban greenery policies and strategies, and to trial communications processes and methodologies, to achieve integrated work and knowledge of researchers, policy-makers and industry participants.

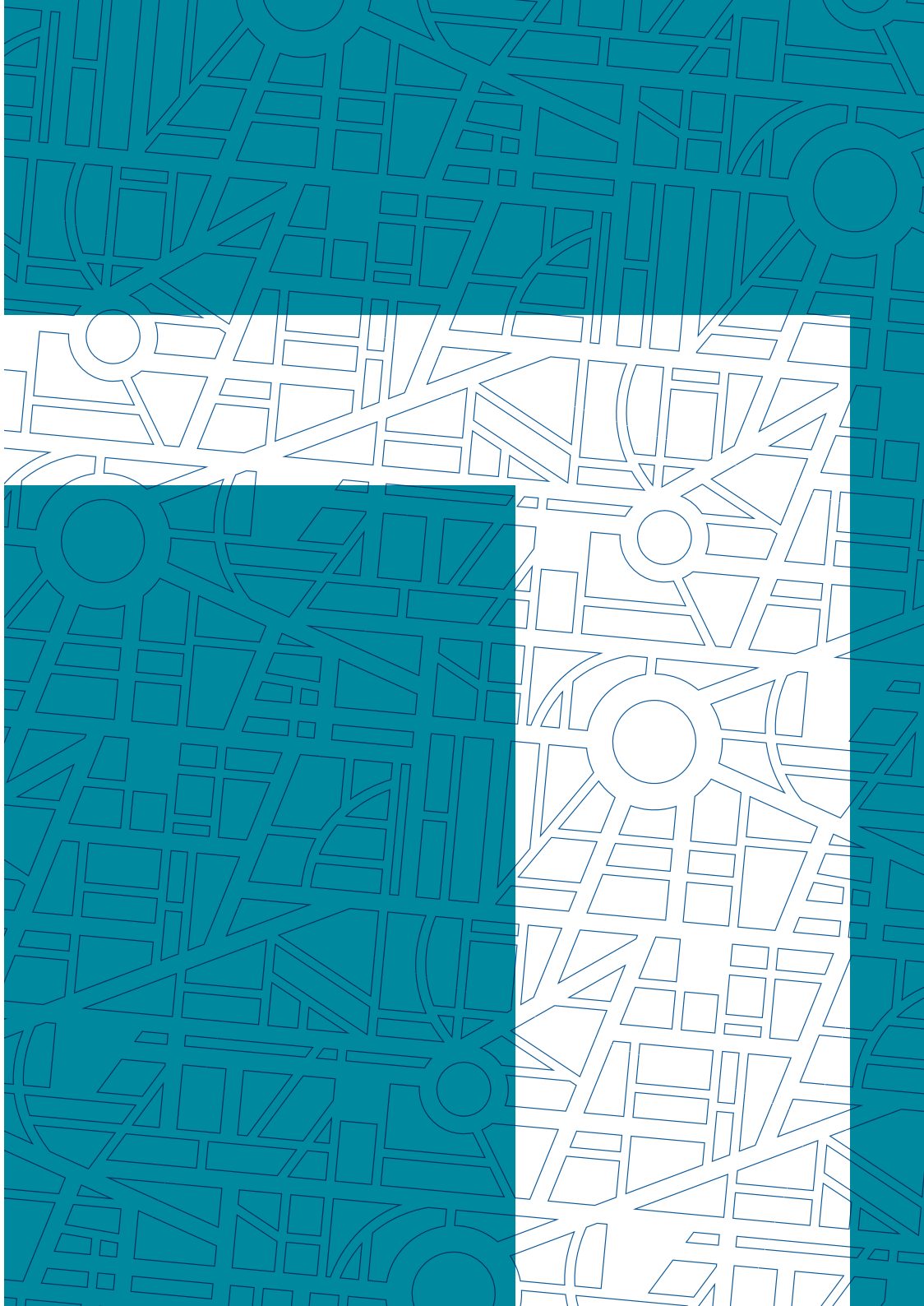
## Academic qualifications

Master Environmental Studies, University of Melbourne

Bachelor of Science (Hons), University of Melbourne

## Publications

Bush, J., Miles, B. and Bainbridge, B., 2003, Merri Creek: Managing an urban waterway for people and nature, Ecological Management and Restoration 4, 170-9. Article first published online: 31 OCT 2003, DOI: 10.1046/j.1442-8903.2003.00153.x



# CRC for Low Carbon Living

The CRC for Low Carbon Living (CRCLCL) is a national research and innovation hub that seeks to enable a globally competitive low carbon built environment sector.

With a focus on collaborative innovation, the CRCLCL brings together property, planning, engineering and policy organisations with leading Australian researchers. CRCLCL develops new social, technological and policy tools for facilitating the development of low carbon products and services to reduce greenhouse gas emissions in the built environment.

To achieve its goals, the CRCLCL will deliver:

- opportunities for lower-carbon manufacturing
- a more efficient and productive built environment sector as a whole
- engaged communities participating in low carbon living
- an evidence base for good planning and policy
- large-scale national capability development
- tools, technologies and techniques that will ensure the sector remains globally competitive

A key aim of the CRCLCL is to help cut Australia's residential and commercial carbon emissions by 10 mega tonnes by 2020, which is the environmental equivalent of taking 2.3 million cars off the road each year. This will be achieved through developing low carbon building construction materials and increasing the evidence base for government policy and planning, among other measures. Australia has set greenhouse gas emissions reduction targets of 25 per cent by 2020 and 80 per cent by 2050 compared with 2000 levels.

When the 2020 carbon reduction targets are met, the CRCLCL will have delivered a direct benefit of $250 million per year to the economy, while reducing risk to the $150 billion per year construction industry as it adjusts to a carbon-constrained economy.

Ultimately the CRCCLC will help unlock barriers to cost-effective carbon reduction opportunities, empower communities and facilitate the widespread adoption of integrated renewable energy. This will enable the sector to transition and contribute to Australia's greenhouse gas emissions targets while maintaining industry competitiveness and improving quality of life.

LOW CARBON LIVING CRC

Australian Government
Department of Industry and Science

Business Cooperative Research Centres Programme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## Partners

UCR is collaborating across government, industry and academia

## BlueScope Steel

Since 1915 the steel industry has been an essential part of Australia and its economy. BlueScope's heritage traces back to the very beginning. Our history has always been in steel making – but the future lies in selling Australian innovation, technology and expertise to the booming Asian and global growth markets. BlueScope's business has been built on the strength of our global partnerships, global networks and global brands.

Our track record of successful global partnerships enables us to prosper in widely diverse markets. In India, we have established a joint venture with the highly respected Tata conglomerate, a joint venture in Saudi Arabia is opening new opportunities in that expanding market, in North America, our 50:50 North Star BlueScope Steel joint venture with Cargill continues to perform strongly, and our joint venture with Nippon Steel – NS BlueScope Coated Products – will open exciting new markets and opportunities in Asia. Equally important are our successful partnerships with our customers. Many of our customers are Fortune 500 companies, and we can help them realise significant savings in the total cost of their buildings by reducing construction schedules.

Our global networks are another great BlueScope strength, with more than 100 facilities in 17 countries, employing over 16,000 people serving thousands of customers. Our strong partnerships and networks are built on BlueScope's great product brands, such as COLORBOND®, Clean COLORBOND® and ZINCALUME® steels, LYSAGHT® steel building products, and Butler® and Varco Pruden custom engineered buildings.


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## HASSELL

HASSELL is a leading international design practice with studios in Australia, China, South East Asia and the United Kingdom.

We judge the success of the buildings and places we design by the way people use and enjoy them – the clients who commission them, the people who inhabit them. Good design is about helping clients meet their needs and objectives. It is also about the way people feel when they experience it, a sense of meaning, connection and belonging.

Our design values are shared globally across all the HASSELL studios, by the talented people who work in them: architects, interior designers, landscape architects, urban designers, planners and specialist consultants.

We work together in integrated design teams because they produce the best outcomes for our clients. The increasingly complex projects that clients bring to us demand a culture built on collaboration, creativity, and innovation in design thinking and delivery.

Openness and empathy with our clients ensure their interests are at the heart of everything we design.

HASSELL

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## City of Sydney

The City of Sydney has adopted the first ever green roofs and walls policy for Australia, which sets out our commitment to increase the number of high quality green roofs and walls in the City. It is accompanied by a 3-year implementation plan to ensure the policy is understood, properly adopted and integrated into our activities. Both documents can be downloaded below. When the draft policy and 3-year plan were exhibited for public comment, the response was uniformly positive.

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### Advantages of a green roof or wall

Green roofs and walls provide many benefits to our city including:

- **Air quality**: Greenery on roofs and walls helps remove harmful air pollutants, making the air cleaner and healthier. They can also improve air quality inside the building.
- **Beauty**: Green roofs and walls are beautiful. They can turn a drab wall or bitumen roof into a striking feature of the building.
- **Biodiversity**: They provide space for insects, reptiles and bird life to find water, food and shelter. Biodiversity is vital for a healthy urban environment.
- **Health**: The human need to be around living plants is called 'biophillia'. Numerous studies show the physical and mental health benefits we experience from being in and around growing plants.
- **Insulation**: They insulate buildings, reducing our reliance on active heating and cooling, and energy consumption.
- **Noise**: They also help insulate the building from outside noise creating a quieter and more peaceful indoor environment.
- **Space**: Previously unused space can be turned into valuable space for recreation, growing food, gardening and so on.
- **Roof life**: They can extend the life of a roof by up to 40 years, limiting exposure to sun and weather. Green roofs keep temperatures more even and minimise expansion and contraction from temperature changes.
- **Solar panels**: They improve solar panel efficiency keeping the surrounding temperature at an optimum level.
- **Urban heat island effect**: Hard surfaces absorb heat from the sun and radiate it back into the environment, leading to higher city temperatures. Green roofs and walls lower this effect, making the city a more comfortable
- **Water**: They slow and clean the rainwater run-off from buildings, improving our waterways.

## City of Melbourne

As a local government authority, the City of Melbourne strives to achieve the community's vision of Melbourne as a bold, inspirational and sustainable city – a great place for people to live, work and visit. The City of Melbourne is committed to reducing our ecological footprint and we are working to ensure our people and organisations can adapt to climate change and build a sustainable future.

For more than fifteen years, the City of Melbourne has been working to become one of the world's most sustainable cities. As part of this commitment we have developed an Urban Forest Strategy and Growing Green Guide: a guide to green roofs, walls and facades to help cool the city and increase resilience to the impacts of climate change.

CITY OF MELBOURNE

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## New South Wales Government (OEH)

Working with the community Office of Environment and Heritage (OEH) cares for and protects NSW's environment and heritage, which includes the natural environment, Aboriginal country, culture and heritage, and built heritage. OEH supports the community, business and government in protecting, strengthening and making the most of a healthy environment and economy in NSW.

We also provide services and other support to: the Royal Botanic Gardens and Domain Trust; NSW Environmental Trust; Western Sydney Parkland Trust; Parramatta Park Trust; Centennial Park and Moore Park Trust; Historic Houses Trust; Taronga Conservation Society Australia; and the Environment Protection Authority (EPA).

Our 2014-17 Corporate Plan sets the strategic direction for OEH and is key to ensuring we achieve our strategic goals including government commitments and priorities.

A useful overview of previous work and achievements is provided within Annual reports.

Our organisation comprises eight functional areas. OEH is an agency within the NSW Department of Premier and Cabinet cluster.

NSW GOVERNMENT Office of Environment & Heritage

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## Government of South Australia (DEWNR)

The Department of Environment, Water and Natural Resources (DEWNR) was created on 1 July 2012 to bring together environment and natural resources management in South Australia. The new Department was created by amalgamating the Department for Water and the Department of Environment and Natural Resources.

DEWNR's role in managing the State's natural resources ranges from policy leadership to on-ground delivery with regional Natural Resources Management Boards. The issues we work on include water security, climate change, sustainable land management, public estate management and biodiversity conservation. We provide practical advice to government, industry and communities to achieve productive and balanced use of natural resources and to help improve the condition and resilience of our natural systems.

We work closely with communities and a diverse range of partners to help them make good decisions about how our natural resources are used and managed, and to help South Australians care for the land, water and sea that sustain us.

DEWNR is part of the Environment and Conservation Portfolio and reports to the Hon. Ian Hunter (Minister for Sustainability, Environment and Conservation, and Minister for Water and the River Murray). Our work helps government achieve its priorities and is informed by the government's commitments set out in South Australia's Strategic Plan and the State Natural Resources Management Plan and also by our Corporate Plan 2012-2014.

Government of South Australia
Department of Environment and Natural Resources

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## Adelaide City Council

Adelaide City Council envisions the City of Adelaide to be a vibrant, populous and sustainable Capital City built upon Adelaide's heritage and lifestyle with a reputation as a green City. A City in which recycled water supports our parks and gardens; efficient, clean energy powers the City; our walkways and public spaces are cool and shaded by trees; and our Park Lands cradle the City bringing the natural world right to the door of our residents and workers.

Council's strategies to deliver this vision of an environmentally sustainable City include:

- Preparing the City for the impacts of climate change
- Reducing carbon emissions and oil dependency
- Conserving water, energy and natural resources and minimising waste
- Landscaping streets, parks and public spaces so they are sustainable and productive
- Supporting environmentally sustainable design, construction and management of City buildings

Council's participation in the Urban Micro Climates project seeks to build the evidence base for action and develop practical solutions to support Council's vision for a sustainable and resilient City.

ADELAIDE CITY COUNCIL

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## Nursery Garden Industry Australia (NIGA)

Founded in 1945, Nursery & Garden Industry Australia (NGIA) is the peak industry body for the Australian nursery and garden industry and is responsible for overseeing the national development of this diverse and essential industry.

**A unified Australian nursery and garden industry that is productive, profitable and sustainable.**

The five objectives of the strategic plan 2010 – 15 are:

- Increase the sales value of nursery products and services through marketing and promote
- Enhance the capacity and efficiency of the industry's resources through upgrading industry skills, knowledge and practice;
- Build industry support through shaping government, public and related industry
- Understanding of the industry's benefits, and enhance these benefits through collaboration
- Invest in nursery product/service development to enable the industry to respond to growth opportunities and challenges;
- Support the industry through services and resources that enhance its capacity to respond to issues, capture opportunities and achieve the vision of this strategic plan.

As a supporter of the 'urban micro climates' research project the NGIA have established the following as goals that they hope will arise from our outcomes:

- Understand the 'living green infrastructure' policy framework between local, state and federal levels.
- Identify opportunities to increase green space adoption through sound policy initiatives across the 'living green infrastructure' policy framework
- Increase awareness of the benefits of 'living green infrastructure' including cooler, low carbon cities that mitigate the urban heat island effect
- Produce a triple bottom line business case for an increase in 'living green infrastructure' across Australian cities

Nursery & Garden Industry Australia

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## The Australian Institute of Landscape Architects (AILA)

The Australian Institute of Landscape Architects (AILA) champions quality design for public open spaces, stronger communities and greater environmental stewardship. AILA provide their members – in urban and rural Australia, and overseas – with training, recognition and a community of practice to share knowledge, ideas and action. With his members, AILA anticipate and develop a leading position on issues of concern in Landscape Architecture. Alongside government and allied professions, AILA work to improve the design, planning and management of the natural and built environment.

AILA represents 2000 (and growing) members throughout Australia and overseas. As a not-for-profit professional association, our role is to serve the mutual interests of our members and the wider profession. AILA governance is vested in the AILA National Council, which retains ultimate legal responsibility for the whole organisation and provides leadership by setting the strategic direction, budgets, policies and agendas. AILA staff, located in the National Office in Canberra and in state and territory chapters throughout the country, are responsible for advocacy, coordinating the delivery of membership services, and implementation of the AILA Strategic and Operational plan and council and local executive decisions.

Australian Institute of Landscape Architects ®

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## University of New South Wales Built Environment

The research strengths of UNSW's Faculty of the Built Environment (BE) reflect its multi-faceted professional foundations in a mix unique in Australia in its combination of disciplines such as architecture, landscape architecture, construction, property, planning, industrial and urban design. The Faculty's overall mission in design, delivery and management of the 21st century city informs a diverse research agenda providing leadership in tackling the challenges of change in urban environments at all scales. In the last Excellence for Research in Australia (ERA) national evaluation, UNSW was rated as the equal-top university across the spectrum of Built Environment and Design. Its ratings in Urban Planning and Construction were also the highest of all Australia's leading Group of Eight universities. These ratings recognise the strong and sustained performance of BE researchers in securing external grant funding and producing quality peer-reviewed research outputs.Research activity in BE embraces numerous aspects of applied, theoretical, social and design research including:

- Sustainable design
- Management strategies in the construction sector
- Housing policy and social inequality
- History and theory of the built environment
- Land use planning and urban development
- Urban design
- Digital design
- Creative practice
- Scholarship of learning and teaching

BE's research program is organised within a range of formal and collaborative structures supportive of innovative research with high social impact. Of the formal structures, the City Futures Research Centre is the faculty's specialised research centre dedicated to developing a better understanding of cities, their people, the policies that manage their growth, the issues they face, and the impacts they make on environment and economy. Under the City Futures umbrella are five main research programs addressing Housing Policy and Practice, Urban Planning and Policy, Sustainability and Climate Change Adaptation, Enabling Built Environments and Healthy Built Environments.

UNSW AUSTRALIA | Built Environment

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www.be.unsw.edu.au/research/welcome-associate-dean-research

## University of Melbourne - ABP

The Faculty of Architecture, Building and Planning (ABP) is a single-department Faculty, led by our Dean, Professor Tom Kvan. ABP is the custodian Faculty of the Bachelor of Environments which provides opportunities for students to specialise in their chosen subject within the multi-disciplinary framework that takes into consideration other complimentary Bachelor of Environments subjects. Melbourne School of Design is the graduate school of ABP, where students gain academic and practical experience in their chosen field at masters level. The Faculty has 82 academic staff and over 200 sessional tutors, many of whom are leading practitioners in the built environment and design fields. Almost half of our teaching and research staff are international coming from 20 countries including Asia, Africa, Europe and North America. Academic expertise within the Faculty is located essentially in six disciplines: Architecture, Landscape Architecture, Urban Design, Property, Construction and Urban Planning. Our academics conduct research and teach across undergraduate, graduate and research programs. They are actively engaged in collaborations and partnerships, both locally and globally, to produce research that responds to major social, economic and environmental challenges, as well as fundamental research related to the built and natural environments in Australia and Asia. Our researchers address key issues, such as mitigation of natural disasters, climate change, sustainability, the future of cities, population growth and urban density. We lead debate in many of these areas. We also contribute definitive knowledge and understanding of the history, conservation and heritage of the built and natural environment, built environment practice and management, urban morphology and design research.

The Faculty draws its research strength in part from its capacity to work in the multidisciplinary frame of its various built environment disciplines, as well as with colleagues in health, engineering, education, history and social sciences.

The Faculty is also committed to expanding its expertise in key curriculum and research areas and in 2012 alone we appointed several leading practitioners and academics including Brendan Gleeson, Professor of Urban Policy Studies, Donald Bates, Chair of Architectural Design and Alan Pert, Director of Melbourne School of Design.

THE UNIVERSITY OF MELBOURNE

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## University of Melbourne - Infrastructure Engineering

The Department of Infrastructure Engineering sits within the School of Engineering and houses the vital disciplines of Geomatics, Civil Engineering and Environmental Engineering.

Our focus is on engineering infrastructure that's sustainable. Infrastructure that considers the natural environment it supports, as well as the economy.

You'll see this in our research and in the design of our courses with the interaction of other disciplines such as Commerce and Science from first year right through to our flagship Masters of Engineering. Just as industry integrates its departments, The University of Melbourne integrates its disciplines.

In combining these disciplines, our vision for Infrastructure Engineering at The University of Melbourne reflects industry practice.

To this end, we're not just equipping you for a career in engineering. Our aim is to share knowledge, build capability and manage information to solve complex engineering challenges and develop future leaders in the community.

THE UNIVERSITY OF MELBOURNE

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## University of South Australia

The Division of Information Technology, Engineering and the Environment is UniSA's flourishing technology hub and a vibrant nexus for economic, social and environmental development.

From our campus, featuring state-of-the-art facilities and adjacent to the Technology Park industry research centre at Mawson Lakes, we engage in cutting-edge teaching, postgraduate research training and fundamental applied research.

Our three innovative schools offer you experiential learning through engagement with industry, government and the community. Our graduates are skilled professionals who can use the latest technologies intelligently to create sustainable solutions for our fast-changing world.

We are home to three major international research institutes and seven research centres.

Spanning future-focused disciplines including IT, environmental science, engineering, urban planning and more, our division has a lot to offer students, researchers and industry.

University of South Australia

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# Partners

End-user reference group

## CRC - Water Sensitive Cities

The CRC for Water Sensitive Cities brings together the inter-disciplinary research expertise and thought-leadership to undertake research that will revolutionise water management in Australia and overseas. In collaboration with over 70 research, industry and government partners, we will deliver the socio-technical urban water management solutions, education and training programs, and industry engagement required to make towns and cities water sensitive. With a research budget in excess of $100million, our research over the next nine years will guide capital investments of more than $100 Billion by the Australian water sector and more than $550 Billion of private sector investment in urban development over the next 15 years.

Through an extensive consultation process, our participants and stakeholders have identified a number of key challenges to urban water reform required to transform cities into liveable, resilient, sustainable and productive cities. To effectively address the complex inter-dependencies of the many socio-technical factors influencing water management in cities of the future, we will employ an inter-disciplinary delivery approach. This approach will place practitioners, policy makers and regulators in inter-disciplinary teams with researchers whose expertise may be in areas such as: water engineering; urban planning; commercial and property law; urban ecology; urban climatology and global climate science; social and institutional science; organisational behaviour; change management; the water economy; risk assessment; social marketing; and community health. These teams will be located at research hubs in Brisbane, Melbourne, Perth, and Singapore.

CRC for Water Sensitive Cities

Australian Government Department of Industry and Science | Business Cooperative Research Centres Programme

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# Partners

End-user reference group

## Parramatta City Council

The CRC for Water Sensitive Cities brings together the Parramatta City Council plays a major role in revitalising the local government area, providing more than 40 services to improve the quality of life for its residents and to make Parramatta a great place to live, work, play and invest.

Parra City Council Help DeskThere is a lot more to Council than the traditional view of 'roads, rates and rubbish'! Parramatta City Council has transformed its neighbourhoods and city centres, operates childcare centres, libraries, environmental initiatives, provides transport, a vast range of social services such as Meals on Wheels and Neighbourhood Aid, has a diverse events program, arts and cultural initiatives, maintains many facilities such as town halls and community centres, conducts economic development initiatives, processes development applications, strategically plans for the future development of the City as well as maintaining essential services such as waste collection and road maintenance.

**CRC-contact**

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## Planning Institute Australia

The Australian Sustainable Built Environment Council (ASBEC) www.asbec.asn.au is the peak body of key organisations committed to a sustainable built environment in Australia.

ASBEC's membership consists of industry and professional associations, non-government organisations and government observers who are involved in the planning, design, delivery and operation of our built environment, and are concerned with the social and environmental impacts of this sector.

ASBEC provides a forum for diverse groups involved in the built environment to gather, find common ground and intelligently discuss contentious issues as well as advocate their own sustainability products, policies and initiatives.

ASBEC is a non-profit volunteer organisation. Members commit their time, resources and energy to developing practical opportunities for a more sustainable built environment.

**CRC-contact**

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## Renewal SA

A discussion about the future shape of our state and its capital city has never been so timely. Indeed an exchange of ideas about how we live today, how we want to live tomorrow and how we will live in the future is at the core of my vision for the Urban Renewal Authority. It is about creating great places for people to live by forging strong community and private sector partnerships and accepting only the highest standards of design and planning. The Urban Renewal Authority has been established to present a fully integrated approach to urban development and deliver outstanding results for the people of South Australia. It represents a new way of planning for residential and industrial communities in South Australia. The URA will ensure these communities, both existing and those to be developed, have access to the necessary infrastructure and human services required to be fully inclusive and connected. Under the authority this will be done through an unwavering commitment to conversations and engagement with federal and state agencies, local communities, councils and most importantly individuals.

**CRC-contact**

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# Partners

End-user reference group

## Zero Waste SA

Zero Waste SA is a South Australian state government organisation which enables people to improve their recycling and waste avoidance practices, whether at home, at work or in industry.

Through collaboration, advocacy, financial incentives and education, we are working towards meeting the target to 'reduce waste by 35% by 2020 with a milestone of 25% by 2014 as set out in South Australia's Strategic Plan. Efforts made under South Australia's Waste Strategy 2005-2010 have reduced the amount of waste going to landfill in our State by 17.32% since 2003-04.

South Australia's waste management achievements have been recognised in the UN-HABITAT publication Solid Waste in the World's Cities, which assesses the waste and recycling systems of more than 20 cities worldwide.

"South Australia has demonstrated a high level of political commitment and willingness to 'stick its neck out' and implement some policies and legislation upon which other administrations take a more conservative position. The Zero Waste Act and Plastic Bag Ban are two excellent samples of South Australia's government showing leadership by putting in place arrangements to support a major drive towards the 3R's (reduce, reuse, recycle)."

Zero Waste SA's establishment was the result of the South Australian Government realising a new strategy was needed to increase waste avoidance and recycling. It was recognised that waste management in South Australia was still fundamentally reliant on landfill, despite efforts to change this.

On 1 July 2003, the Office of Zero Waste SA was proclaimed a statutory authority by the South Australian Government, and in February 2004, legislation to create Zero Waste SA was passed. Read the Zero Waste SA Act (2004) here.

ZERO WASTE SA

**CRC-contact**

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## Zero Waste Research Centre for sd+b

The CRC for Water Sensitive Cities brings together the The Zero Waste SA Research Centre for Sustainable Design and Behaviour (sd+b) came into being in 2009, after UniSA entered into a major collaborative initiative with the government agency Zero Waste SA. The idea: to facilitate research in sustainability and waste management practices that promote a resource recovery society that does more with less.

The Centre has since been working in a collaborative, multi-disciplinary capacity towards its vision of implementing the best of urban/environmental and social sciences research to help build sustainable and liveable cities in the Asia Pacific.

Our research focuses on influencing and informing public policy in environmental sustainability, design, urban planning and architecture. We also seek to assist communities, both locally and globally, to build better societies.

UniSA | Zero Waste SA Research Centre for Sustainable Design and Behaviour

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## Contact


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