Australian Institute of Landscape Architects

AILA POSITION STATEMENT

LIVEABLE CITIES

COOLING CITIES – Urban Heat Island Effect

Introduction

"The liveability of Australia's cities will be affected by how their sustainability is managed."
Department of Infrastructure & Regional Development, *State of Australian Cities* 2013 [i]

As average temperatures continue to rise, and the number of extreme heat days increase annually, methods to cool our cities are becoming increasingly important. With over three-quarters of Australians now living in urban areas[ii], combating the "urban heat island effect" within our cities is becoming a major public health issue.

The State of Australian Cities 2013 reports "People living in cities, particularly those in Australia's inland cities, can be more susceptible than non-urban dwellers to the effects of heatwaves as a result of the urban heat island (UHI) effect. This is caused by the prevalence in cities of heat-absorbing materials such as dark coloured pavements and roofs, concrete, urban canyons trapping hot air, and a lack of shade and green space in dense urban environments."[iii]

Increases in urban temperatures can increase air pollution, greenhouse gas emissions and reduce human comfort, making it harder for people to cool down. Research undertaken by Melbourne City Council has found that average temperatures within Melbourne's CBD are up to 4°C higher than the surrounding suburbs. During the evenings, the temperature difference can be up to 12°C. As a result, on hotter days and nights health risks increase for the most vulnerable within cities, particularly the young and elderly.

Melbourne averaged approximately 200 heat-related deaths in 2013, in comparison to the state road toll of 242 deaths. By 2030, the number of deaths as a result of heat is expected to double.[iv]

The City of Melbourne has commissioned a report into the current and future costs associated with heat, heat waves and the intensification of the urban heat island effect. It considered the impacts on health, transport infrastructure, energy demand and infrastructure, trees and animals, and crime. The report concluded: "The total economic cost to community due to hot weather is estimated to be $1.8 billion in present value terms. Approximately one-third of these impacts are due to heatwaves. Of the total heat impact, the urban heat island effect contributes approximately $300 million in present value."[v]

Over half of the surfaces within our cities are heat absorbing materials, such as darker coloured roofs, car parks, roadways and footpaths. The urban heat island effect occurs because of the capacity (thermal mass) of these darker surfaces to absorb the sun's energy, converting up to 80 per cent of sunlight into heat that is stored and then released, raising local temperatures. As development occurs, these darker, absorbent surfaces and materials are increasing, while the overall extent of vegetation, shade and open spaces is decreasing within our cities.

Cooler cities provide the following benefits:

- Better air quality – an annual economic benefit of nearly $1 billion annually in the USvi
- More resistant to heat- and pollution-related illness and death
- Reduced peak energy demand and CO2 emissions (For every 1°F / 0.6°C increase in temperature, peak utility loads in medium and large US cities increase by 1.5 – 2.0 per cent)vii
- Healthier, more comfortable and enjoyable urban spaces

Landscape architects have a major role to play in the design of cooler cities and the mitigation of rising temperatures at a city-wide, neighbourhood and local site scale. The planning, design and construction of our urban environs, through the application of green roofs and walls, street trees and tree planting, greener open-space design, rain gardens and reflective roofs and pavements can all contribute to improving the comfort, quality and health of the city and its residents. Every 1°C temperature reduction that can be achieved through the better design of cities can equate to five per cent energy saving through reduced cooling loads.viii Reduced cooling loads will have significant social, economic and environmental impact to the long term sustainability of Australian cities.

Alternatively, without changing the way we manage the growth of our cities, a Flinders University-led study has found that a 1°C temperature increase boosts cooling loads by 1.5million kWh per year, generating 1000 tonnes in carbon dioxide emissions. ix

Key issues

The development and densification of urban areas has progressively contributed to the warming of cities through the urban heat island effect. The planning and design standards applied to development within urban areas provide limited recognition for mitigation against the urban heat island effect, resulting in:

- Poor site planning (orientation), leading to design of buildings that consume increased energy for mechanical heating and cooling
- Maximising the development area of the sites, including loss of existing green space and undervalued importance of existing trees
- Building design and construction using darker, heat absorbent materials and surfaces
- Reduction in communal and private open spaces in redeveloped sites, including reduction in amount of planting compared to paving
- Limited requirement to address urban heat island effect through design standards, materials selection or green initiatives (green walls or roofs)

Across neighbourhoods, the changing character of local streets and public spaces has seen the decline in many of the elements that would help mitigate against warming, including:

- Increase in extent of hard paved areas, predominately with darker, heat absorbent materials
- Loss of trees and tree canopy cover, through age, maintenance or as a result of local redevelopments
- Loss of green open spaces, grassed areas and planted areas, including redevelopment of vacant lots
- Decline of maintenance standards required to support greener streets and public spaces

The perceived higher maintenance costs associated with the upkeep and renewal of streetscapes and public spaces has seen a progressive decline in the quality and quantity of measures to cool urban areas.

AILA position

AILA advocates for the recognition of the urban heat island effect and for greater efforts to limit the impact of warming on the long term sustainability of urban areas across Australia.

AILA encourages greater awareness of the impacts of densification and urbanisation, and the opportunities that exist to integrate effective cooling measures into the planning, design, redevelopment and management of urban areas.

AILA recognises climate responsive design and adaptation initiatives should be a shared responsibility between all tiers of government, allied design professionals, developers and the wider community.

AILA advocates for:

- Greater protection of existing trees within urban areas through increased value assessment of their worth to deter removal and drive responsive design outcomes
- Commitment from all tiers of government to annually increase net tree canopy cover across urban areas, including streetscapes, parks and public spaces. Studies have indicated that shade trees can reduce surface temperature by up to 19°C and lower atmosphere temperature by 5-7°C.x
- Greater incentivisation or regulation for the inclusion of green roofs and green walls in new urban developments and maximise opportunities to retrofit into existing sites (refer Green Walls and Roofs Position Statement)
- Greater incentivisation or regulation for specification of reflective roofs and footpaths / pavements surfaces, as well as specification of materials with lower embodied energy. Lighter coloured surfaces have an increased ability to emit absorbed heat – studies indicate that the use of cool roofs and pavements can reduce local temperatures by 2-3°C, as well as lower the running cost of buildings.xi
- Greater awareness of the value in maximising the greening of new and existing urban spaces. Studies have indicated that grass surfaces can reduce surface temperature by 24°Cxii, and planting vegetation for shade can reduce a building's cooling energy consumption by up to 25 per cent annually.xiii

- Greater consideration to master plan urban sites to address sun paths, prevailing winds, over shadowing and utilisation of other natural systems to reduce the long term requirements for mechanical heating and cooling systems.
- The establishment of a national Cooling Cities criteria to assess/rate the impact of new development or redevelopment will have on local conditions, with expectation that sites design aspire to zero net addition to local temperatures

Strategies for the adaption or mitigation of urban heat within existing cities, suburbs or local sites should be recognised and targeted. AILA recognises the importance of design and mitigation, as well as the role governments and individual efforts can make to collectively tackle rising temperatures and maximise the benefits of cooling across urban areas.

Case Studies

Cool Houston: A Plan for Cooling the Region (2004)
The Plan was developed for the eight-county Houston region to reduce the urban heat island effect across its urban areas, targeting decision points and decision makers to "set forth actions that will literally change the surface of the region". It sets 10-year goals relating to increasing the use of:

- Cool paving
- Cool roofing
- Cool trees
- Air quality
- Quality of life
- Water quality

Olympic Parklands, London
The development of new parklands within established urban areas of the outer boroughs of London spurred strategic green infrastructure planning, design, implementation and management to improve the boroughs' environmental performance for the 2012 Olympics and beyond. A report concluded: "Green Infrastructure has also been central to providing a high quality environment for the neighbouring mixed use communities, establishing a setting for future economic development".[xiv]

The role of green infrastructure in establishing the parklands also supported the Olympic Development Authority's Sustainable Development Strategy, including 45 hectares of biodiversity/habitat and 102 hectares of Metropolitan Open Lands in transformation[xv].

Flisvos Project, Athens, Greece
The introduction of 2500 trees and bushes and 4500m² of reflective paving within an established park in Athens was found to "decrease the peak ambient temperature during a typical summer day, up to to 1.9°C... the surface temperature in the park was reduced up to 12°C while comfort conditions have been improved considerably".[xvi]

Pale Pavement Trial, City of Sydney, Australia
The City of Sydney is trialing a lighter-coloured road pavement in Myrtle Street, between Abercrombie and Smithers streets in Chippendale, to investigate ways of reducing the impact of urban heat island effect in urban areas.

Lighter-coloured road or paving surfaces do not generally absorb as much light, or retain as much heat as dark surfaces and therefore have the potential to reduce temperatures, result in lower energy bills for surrounding buildings, and improve road strength.[xvii]

Urban Forrest Strategy, City of Melbourne, Australia

The City of Melbourne has established a strategy to manage the regeneration of its existing tree population, against the challennges of age and health, climate change and urban growth. The strategy recognises that trees contribute enormously to Melbourne's status as the world's most liveable city.

The strategy aims to mitigate the urban heat island effect and bring down inner-city temperatures by doubling the canopy cover from 22 per cent to 40 per cent by 2040[xviii]

Supporting research/links

202020 Vision
www.202020vision.com.au
Global Cool Cities Alliance
www.globalcoolcitites.org
Cool Roof Toolkit
www.CoolRoofToolkit.org
State of Australian Cities 2013
http://www.infrastructure.gov.au/infrastructure/pab/soac/
The Victorian Centre for Climate Change Adaption (VCCCAR)
www.vcccar.org.au
Landscape Institute Position Statement - Landscape architecture and the challenge of climate change
http://www.landscapeinstitute.org/PDF/Contribute/LIClimateChangePositionStatement.pdf

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.

Other position statements

Green Walls and Roofs

Further information

[i] **Infrastructure.gov.au, (2015) *State of Australian Cities 2013* [online] Available from:** http://www.infrastructure.gov.au/infrastructure/pab/soac/files/2013_08_INFRA1782_MCU_SOAC_CHAPTER_4_WEB_FA.pdf [Accessed 19 March 2015]

[ii] Block,A. Livesley, S., Williams, N. 'Responding to the Urban Heat Island: A Review of the Potential of Green Infrastructure' Available from: http://www.vcccar.org.au/sites/default/files/publications/VCCCAR%20Urban%20Heat%20Island%20-WEB.pdf [Accessed 19 March 2015]

[iii] Infrastructure.gov.au, (2015) *State of Australian Cities 2013* [online] Available from: http://www.infrastructure.gov.au/infrastructure/pab/soac/files/2013_00_INFRA1782_MCU_SOAC_CHAPTER_4_WEB_FA.pdf [Accessed 19 March 2015]

[iv] toll, M., island', M. and identified, C. (2014). *Melbourne city centre a death trap as heat-island effect takes its toll*. [online] The Age. Available at: http://www.theage.com.au/victoria/melbourne-city-centre-a-death-trap-as-heatisland-effect-takes-its-toll-20140116-30xt8.html [Accessed 30 May 2015].

[v] AECOM, (2015). *Economic Assessment of the Urban Heat Island Effect*. [online] Melbourne: City of Melbourne. Available at: https://www.melbourne.vic.gov.au/Sustainability/AdaptingClimateChange/Documents/UHI_Report_AECOM.pdf [Accessed 10 Jun. 2015].

[vi] Globalcities.org ,(2015). *A Practical Guide to Cool Roofs and Cool Pavements*. [online] Available at: http://www.coolrooftoolkit.org/wp-content/pdfs/CoolRoofToolkit_ExecSummary.pdf [Accessed 19 March 2015]

[vii] ibid

[viii] Lehmann, S. (2014). *Green Spaces Can Combat Urban Heat Stress - The Adelaide Review*. [online] The Adelaide Review. Available at: http://adelaidereview.com.au/form/green-spaces-can-combat-urban-heat-stress/ [Accessed 9 Jul. 2015]

[ix] Blogs.flinders.edu.au, (2015). *Flinders News > Adelaide Urban Heat Island project*. [online] Available at: http://blogs.flinders.edu.au/flinders-news/tag/adelaide-urban-heat-island-project/ [Accessed 9 Jul. 2015]

[x] VALUE Value-landscapes.eu, (2015). *Study finds tree shade to be most effective at cooling our cities - VALUE - Valuing Attractive Landscapes in the Urban Economy*. [online] Available at: http://www.value-landscapes.eu/news/12/Study+finds+tree+shade+to+be+most+effective+at+cooling+our+cities.html [Accessed 19 Mar. 2015].

[xi] Globalcities.org ,(2015). *Cooler Cities: Global Cool Cities Alliance*. [online] Available at: www.globalcoolcities.org/cool-science/cooler-cities/ [Accessed 19 March 2015]

[xii] Value-landscapes.eu, (2015). *Study finds tree shade to be most effective at cooling our cities - VALUE - Valuing Attractive Landscapes in the Urban Economy*. [online] Available at: http://www.value-landscapes.eu/news/12/Study+finds+tree+shade+to+be+most+effective+at+cooling+our+cities.html [Accessed 19 Mar. 2015]

[xiii] Epa.gov, (2003) *Cooling Summertime Temperatures: Strategies to Reduce Urban Heat Islands*. [online] Available at: http://www.epa.gov/heatislands/resources/pdf/HIRIbrochure.pdf [Accessed 19 Mar. 2015]

[xiv] Learninglegacy.independent.gov.uk (2015) *Olympic Parklands Green Infrastructure*. [Online} Available from: http://learninglegacy.independent.gov.uk/documents/pdfs/design-and-engineering-innovation/164-green-structure-dei.pdf [Accessed 19 Mar. 2015]

[xvxv] ibid

[xvi] M. Santamouris M, Gaitani N, Spanou A, Saliari M, Gianopoulou K, Vasilakopoulou K, and Kardomateas T. *Using cool paving materials to improve microclimate of urban areas – Design realisation and results of the Flisvos Project. (*Original Paper is published in : Building and Environment, Volume 53, July 2012, Pages 128-136) [online] Available from: http://www.coolrooftoolkit.org/wp-content/uploads/2015/02/Flisvos-Cool-Pavement.pdf [Accessed 19 Mar. 2015]

[xvii] Cityofsydney.nsw.gov.au, (2015). *Urban heat island effect - City of Sydney*. [online] Available at: http://www.cityofsydney.nsw.gov.au/vision/towards-2030/sustainability/carbon-reduction/urban-heat-island [Accessed 30 May 2015].

[xviii] Melbourne.vic.gov.au, (2015). *Melbourne's Urban Forest Strategy – making a great city greener - City of Melbourne*. [online] Available at: https://www.melbourne.vic.gov.au/Sustainability/UrbanForest/Pages/About.aspx [Accessed 9 Jul. 2015].