CRC for
Water Sensitive Cities

Design of public realm to enhance thermal comfort

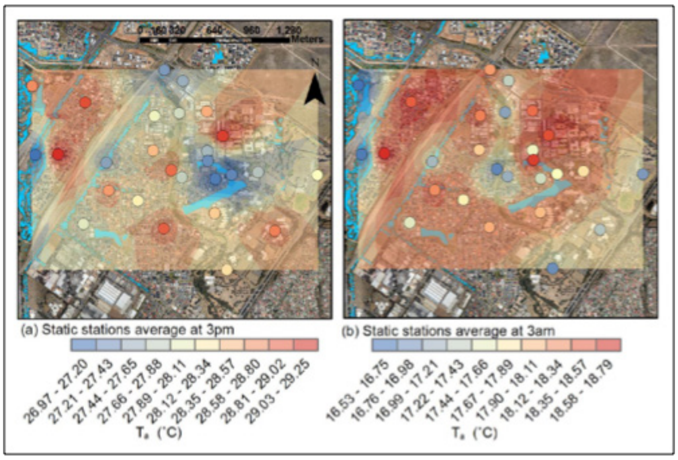
Improving thermal comfort in the public realm lifts the amenity of these areas and provides specific human health benefits. Research has been undertaken to show how to:

- **identify thermal comfort investment priorities; and**
- **design thermally comfortable outdoor spaces.**

Impact of urban development on thermal comfort

The urban climate is influenced by urban design in two ways:

- Spatially. The design of local landscapes has a strong effect on microclimate. Air temperature can vary quite dramatically over very short distances across a city: research shows that under warm summertime conditions the air temperature varied by up to 2.5 degrees within a mixed use development at Mawson Lakes in Adelaide.
- Temporally. Urban design affects both day and night-time temperatures - which are both important for thermal comfort. High night time temperatures are particularly critical to human health by limiting overnight recovery from day time heat stress.



Average air temperature in Mawson Lakes Adelaide at (a) 3 pm and (b) 3 am (source: Broadbent, 2015)

Identifying thermal comfort priorities

CRC for Water Sensitive Cities researchers have developed a framework to prioritise investment in improving thermal comfort. The framework identifies priority areas based on:

Heat exposure: how hot is it?

One approach to identify heat exposure hotspots is to use satellite thermal remote sensing of land temperature (e.g. using Landsat 8 or MODIS). Land surface temperature generally follows the same pattern as air temperature.

A potentially quicker and cheaper approach uses the Water Sensitive Cities Toolkit which uses GIS data on current urban form to assess land use scenarios, WSUD features and to model the resulting surface temperatures.

Population vulnerability: who is most at risk from extreme heat?

Population vulnerability can be assessed based on risk factors such as:

- age extremes (e.g. ←4 years or → 65 years)
- low socio-economic status
- poor access to emergency services

This data is often available from the ABS or using knowledge held by Councils.

Behavioral exposure: where are these people?

Areas where people congregate have higher levels of behavioral exposure. These areas include:

- public transport hubs
- shopping districts
- parks and recreational areas

Identifying areas of co-incidence between these factors highlights the 'hotspots' for intervention.

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Designing thermally comfortable outdoor spaces

The design of cities directly influences the urban climate at a range of scales. Principles include:

Combine green infrastructure and water

Green infrastructure (e.g. trees and vegetated stormwater treatment systems) can reduce urban temperatures and therefore improve thermal comfort by providing shade and promoting evapotranspiration. The greatest impact can be achieved using trees and irrigation together.

Urban forest

Trees provide cooling via transpiration and shade. The shading benefit of a tree is influenced by:

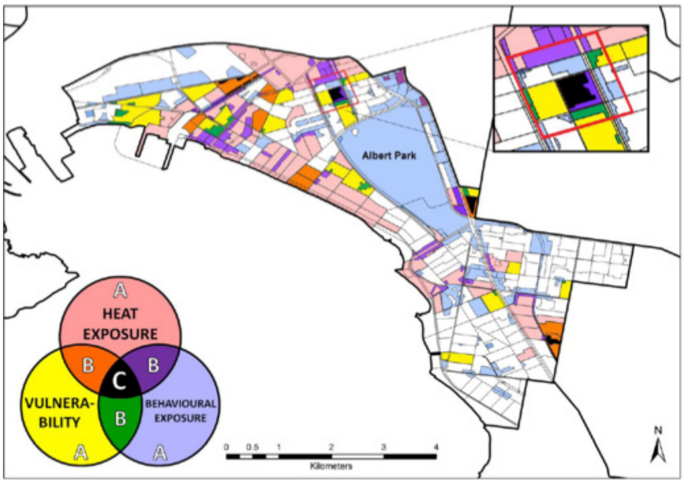
- leaf shape, size and density
- canopy shape (canopies that are short and wide provide more shade than trees that are tall and thin
- nature of the surrounding landscape (e.g. whether there is already shade from buildings)

Researchers recommend using a mix of tree species in urban areas to build resilience against future urban climatic changes and other pressures on trees. Generally, broadleaf tree species provide the most evapotranspiration (provided they have access to a water source).

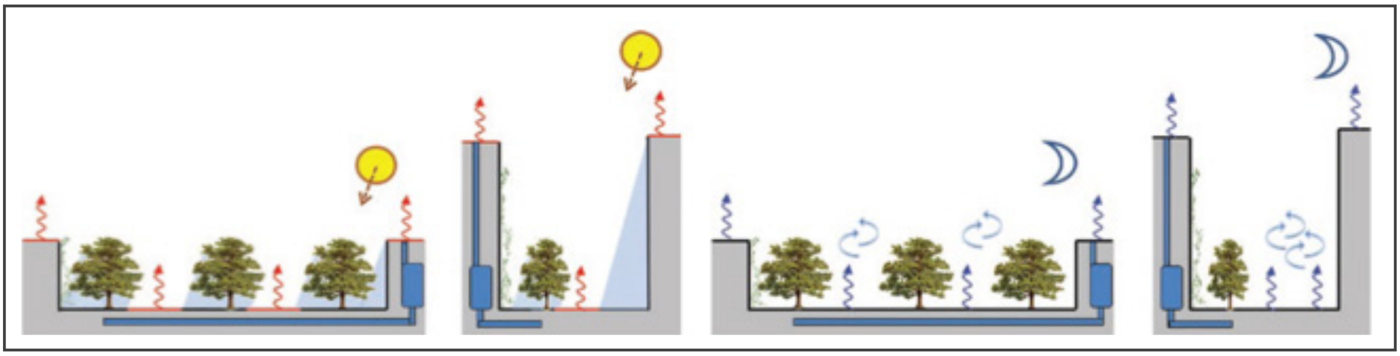
Street typology

Modelling shows that to provide shading during the day and allow heat to escape at night time:

- large broad trees should be used in wide streets,
- slimmer trees should be placed on the sunlit side of the street in narrower streets.



Priority neighbourhoods for mitigation of high urban temperature using green infrastructure in the City of Port Phillip. Darker colours (purple, orange and green) represent higher priority locations, and black represents the highest priority locations for heat mitigation and UGI implementation. The inset is an identified priority neighbourhood surrounded by the red box (Source: Norton et al., 2015).



Indicative impact of tree placement on daytime shade and night-time heat release (Source: Coutts, 2013)

Further reading

Coutts, A. Tapper, N. Loughnan, M. Demuzere, M. Broadbent, A. Motazedian, A. White, E. Phan, T. Thom, J. Gebert, L. Pankhina. D. (2015) Determine the microclimatic influence of harvesting solutions and WSUD at the micro-scale: Presented as FREQUENTLY ASKED QUESTIONS. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities

Coutts, A (2013) Design and placement of WSUD for improved micro-climate. Presentation at WSUD 2013, Gold Coast, , November 2013

Nice, K, Coutts, A. Tapper, N. Krayenhoff, E. (2015) VTUF-3D: An urban micro-climate model to assess temperature moderation from increased vegetation and water in urban canyons In: 9th International Conference on Urban Climate, 20-24 July, Toulouse, France

Norton, B. Coutts, A. Livesley, S. Harris, R. Hunter, A. Williams, N. (2015) Planning for cooler cities: A framework to prioritise. November 2013 green infrastructure to mitigate high temperatures in urban landscapes. Landscape and Urban Planning, 134, 127-138.

Further information

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