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C14 Urban Heat Management

A. Background

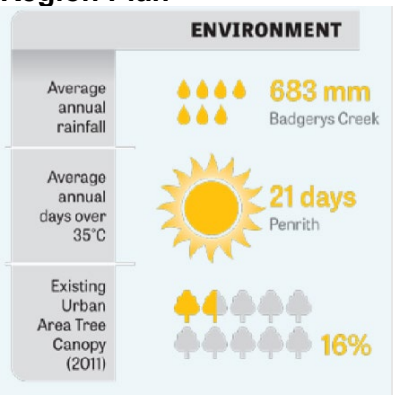
The Western Parkland City has been experiencing a trend of reduced rainfall, increasing temperatures and an increasing duration of extended periods of heat.

In addition to the above impacts, the Western Parkland City has experienced increased heat in developed areas, when compared with the temperatures in nearby areas with less development. This is called an Urban Heat Island Effect. This effect results from the impacts of increased urbanisation including the increase in hard, dark surfaces which retain heat and prevent the absorption of water. It is further exacerbated by loss of vegetation.

Land in the Western Parkland City is susceptible to urban heat impacts due to the region's existing climate, topography, and geographic position, as well as a large and growing residential population and rapid urban development.

As our city grows and becomes more urbanised, reducing and removing heat from the urban environment is critical to achieving an environment that has high amenity, provides opportunities for active, healthy, and safe activities and is comfortable throughout summer.

FIGURE 1: Western Parkland City environment context Source: Greater Sydney Region Plan



Poorly designed development contributes to the impact of the Urban Heat Island Effect by reducing vegetation, preventing rainwater infiltration, using materials which absorb heat and producing buildings which are not designed to mitigate the impacts of hot weather, thus increasing the risk to the Penrith community.

B. Other Relevant Sections of this DCP

This section should be considered in conjunction with other relevant chapters of the Penrith DCP 2014, to achieve sustainable outcomes and reduce the impacts of the urban heat island effect. Council will consider each development application on its merit, and in conjunction with consideration of other relevant instruments outlined in Part E, Application.

C. Aims of this Section

This section is intended to support Penrith Local Environmental Plan 2010 Part 7 Additional Local Provisions, clause X (*to be determined*), the Penrith Local Strategic Planning Statement, and the Penrith Cooling the City Strategy and Penrith Resilience Action Plan in managing and mitigating the Urban Heat Island Effect.

D. Definitions

Cool refuges: provide temperatures of no more than 27°C on extreme heat days and should also aim to achieve between 40% to 60% relative humidity. Principally through passive design for thermal comfort.

Efficient/Efficiency: The operational effectiveness of the subject is maximized by its design and location and any impacts on the effectiveness of the subject are managed or mitigated**.**

Extreme Heat: days where maximum air temperatures exceed 40°C.

Green roof: A green roof is vegetation covering at least 30% of available rooftop space -that is, space which is not occupied by structures housing plant, equipment, or stairway accesses. A green roof should provide measurable environmental benefits. The green roof includes a vegetated layer, growing medium, and a waterproof membrane. Plants grown in sectioned lots are acceptable, however, potted plants/planter boxes which cover less than 30% of available rooftop space are not considered as a green roof. Additional to the minimum 30% vegetation cover, a green roof can include facilities for renewable energy, water collection infrastructure, walkways, furnishings, and the like.

Green wall: Green walls are either free standing or part of a building that is partially or completely covered with vegetation. The wall may incorporate soil and/or inorganic material as the growing medium. There are two main types of green wall: green façades and living walls. Green façades are made up of climbing plants either growing directly on a wall or on specially designed supporting structures. The plant's shoot system grows up the side of the building while being rooted in the ground. With a living wall, modular panels are affixed to the wall and geo-textiles, irrigation and a growing medium combine to support a dense network of plants.

High Albedo: high solar reflectance

High thermal emittance: materials that release heat quickly.

Hot days: where maximum air temperatures exceed 35°C.

Solar Reflectance Index: (SRI) measures a surface's ability to reflect solar heat, as shown by a small temperature rise caused by the materials reflectance and emittance properties. It is defined so that a black surface is 0 and a white surface is 100.

Thermal comfort/thermally comfortable: temperatures of between 22°C to 27°C, with a relative humidity of 40% to 60%.

Urban Heat Island Effect: increased heat in developed areas, when compared with the temperatures in nearby areas with less development.

E. Application

This chapter of the DCP applies to all development within the Penrith LGA except for development within the following land use zones:

Zone Type	Does not apply to:
Waterway Zones	All zones

Conservation	C1 National Parks and Nature Reserves, C2 Environmental Conservation, C3 Environmental Management
Rural	RU1 Primary Production, RU2 Rural Landscape, RU4 Primary Production Small Lots

Development involving heritage items

For development involving heritage items or conservations areas identified under Penrith Local Environmental Plan 2010, a merit assessment will be undertaken to ensure the outcomes sought under this chapter are balanced with heritage conservation outcomes.

Development in bush fire prone areas

Development on land identified as bush fire prone must address the bush fire protection measures set out in *Planning for Bush Fire Protection 2019 (PBP).* Section 2.3 Bushfire Management in Chapter C2 Vegetation Management provides further details. While applicants should seek to achieve the outcomes sought in this chapter, where there is an inconsistency between the PBP provisions and the controls in this chapter, the PBP provisions prevail.

Excluded Development

Certain development may be subject to State Environmental Planning Policies (SEPP) that contain provisions that prevail over some of the controls within this chapter. Applicants are to ensure that the outcomes sought within this chapter are achieved to the extent that they are consistent with applicable SEPPs.

F. Development Controls

14.1. Cooling with Landscaping

1.1 Landscape Design

A. Objectives

a) To ensure outdoor areas incorporate cooling design elements to provide cool refuge during hot weather events.

b) To reduce the contribution of development on the Urban Heat Island Effect in Penrith through:

   i) integration of grey, green, and blue infrastructure in development,
   ii) adequate and appropriate provision of landscaping, and
   iii) Incorporating permeable materials into landscape design.

c) Retain and enhance existing vegetation and canopy coverage to reduce the impact of urban heat on the community.

d) Deliver appropriate quality and quantity of vegetation as green infrastructure with an integrated design approach to reduce development's contribution to the urban heat island effect.

e) To ensure development provides long term solutions to address the Urban Heat Island Effect in Penrith by:

i) Delivering green infrastructure which positively contributes to the amenity of the locality, while recognising the context and existing development patterns.
ii) Ensuring adequate and appropriate vegetation and conditions for healthy growth are provided, including vegetation that contributes to increasing the amount and health of the local tree canopy.
iii) Supporting passive design principles with landscaping to deliver landscaping that contributes to the conservation of energy and supports thermal comfort.

B. Controls

1) All required Landscape design plans are to be prepared in accordance with appendix F3. Plans are to demonstrate that:

   a) Trees are supported by understorey planting.
   b) Internal and external passive solar access is managed through tree and vegetation selection and location.
   c) Shading is provided to exposed Western façades.
   d) Adequate solar access has been provided to the dwelling and any proposed or future solar panels.
   e) Where feasible, there is shading to parking spaces and paved surfaces.
   f) Vegetation is co-located with existing trees, and/or clustered to improve its cooling effect, where this is not in conflict with other controls such as planning for bushfire prevention.
   g) Plantings include drought tolerant and heat resilient varieties and contribute to canopy coverage.
   h) Where feasible, permeable materials such as dry laid paving, permeable pavers, unbound aggregate, or bound paving are utilised and are appropriate for site conditions.

2) Developments are to be designed to ensure that existing mature trees including street trees can be retained.

3) Tree species selection and location must demonstrate consideration of the Landscape Design and Vegetation Management sections of this DCP, the List of Appropriate Trees (*currently under development)*, as well as the following:

   a) Shading effect, including location and maximisation of possible canopy size and density,
   b) Heat and extreme heat resilience,
   c) The character and constraints of the locality,
   d) Planting density,
   e) Nearby services, public authority requirements, easements, and hardstand areas,
   f) The availability of tree stock and species that are locally endemic and appropriate to the site,
   g) Tree pot sizes and mature growth sizes are appropriate for the site and ensure longevity,
   h) The site conditions, including soil type and salinity,
   i) NATSPEC “Specifying Trees – a Guide to Assessment of Tree Quality’ (Clark, R. 2003),
   j) Australian Standard AS2303,
   k) Council's Street and Park Tree Management Plan,
   l) any disruption of solar access for solar panels on existing or adjoining present and future development should be minimised, and

m) Any services or utilities infrastructure within the road reserve, such as power poles, overhead wires, drainage inlet pits, existing street trees and any existing driveways.

1.2 Green roofs and walls

A. Objectives

a) Deliver appropriate quality and quantity of vegetation that will contribute to green infrastructure with an integrated design approach to reduce development's contribution to the urban heat island effect.

b) To ensure development provides long term solutions to address the Urban Heat Island Effect in Penrith by:

i) Delivering green infrastructure which positively contributes to the amenity of the locality, while recognising the context and existing development patterns.

ii) Ensuring adequate and appropriate vegetation and conditions for healthy growth are provided, including vegetation that contributes to increasing the amount and health of the local tree canopy.

B. Controls

1) Where the use of green walls and roofs is proposed, developments should demonstrate consistency with technical guidelines provided in Appendix F4 of this DCP, and ensure:

a) Roofs and walls include appropriate load bearing and waterproofing to support installation of green features.

b) Plants selected provide coverage and are resilient to extreme heat and drought if provided outside buildings.

c) Automatic watering systems are installed to irrigate green roofs and walls, and are connected to sustainable, non-potable water supplies.

d) The cooling benefit of green walls should be maximised by co-locating functions within the site that benefit from the cooling effect of the green infrastructure to reduce reliance on mechanical cooling systems.

e) Green walls and roofs must be delivered by a landscape architect or designer with experience in successfully delivering this type of infrastructure. Examples of the landscape architect or designer's previous work should be supplied with the landscape design.

f) The landscape architect or designer should demonstrate in their plans how wind exposure, local temperature variations and rainfall have been considered in the designs.

g) A maintenance plan must be supplied with applications which include green roofs or walls that demonstrates long-term viability and access for maintenance.

1.3 Soil Volumes

A. Objectives

a) To ensure development provides long term solutions to address the Urban Heat Island Effect by ensuring the longevity of tree plantings through provision of adequate and appropriate conditions for healthy growth, including sufficient deep soil area and structure.

B. Controls

1) Minimum soil volume and planting area to be provided is to be based on minimum tree sizes, in accordance with Table 1:

TABLE 1: Tree size and planting site area

Maximum tree size at maturity	Planting site area required	Planting site depth required	Soil Volume per tree
Small (less than 8m tall or under 4m wide)	Less than 9.5m^2	1.0 to 1.3m	30m^3
Medium (9-12m tall or under 4-8m wide)	9.5m^2 to 18.5m^2	1.3m to 2.5m	35m^3
Large (Taller than 13m or wider than 8m)	More than 18.5m^2	>2.5m	80m^3

Guidance on tree sizes is provided in the List of Appropriate Trees (*currently under development).*

1.4 Tree Planting Specifications

A. Objectives

a) To ensure development provides long term solutions to address the Urban Heat Island Effect in Penrith by:

i) Delivering green infrastructure which positively contributes to the amenity of the locality, while recognising the context and existing development patterns.

ii) Ensuring adequate and appropriate vegetation and conditions for healthy growth are provided, including vegetation that contributes to increasing the amount and health of the local tree canopy.

iii) Delivering appropriate quality and quantity of vegetation as green infrastructure, with an integrated design approach to reduce development's contribution to the urban heat island effect.

B. Controls

1) Tree Planting location and numbers are to be provided in accordance with development type as detailed in Table 2:

TABLE 2: Minimum tree canopy cover by development type

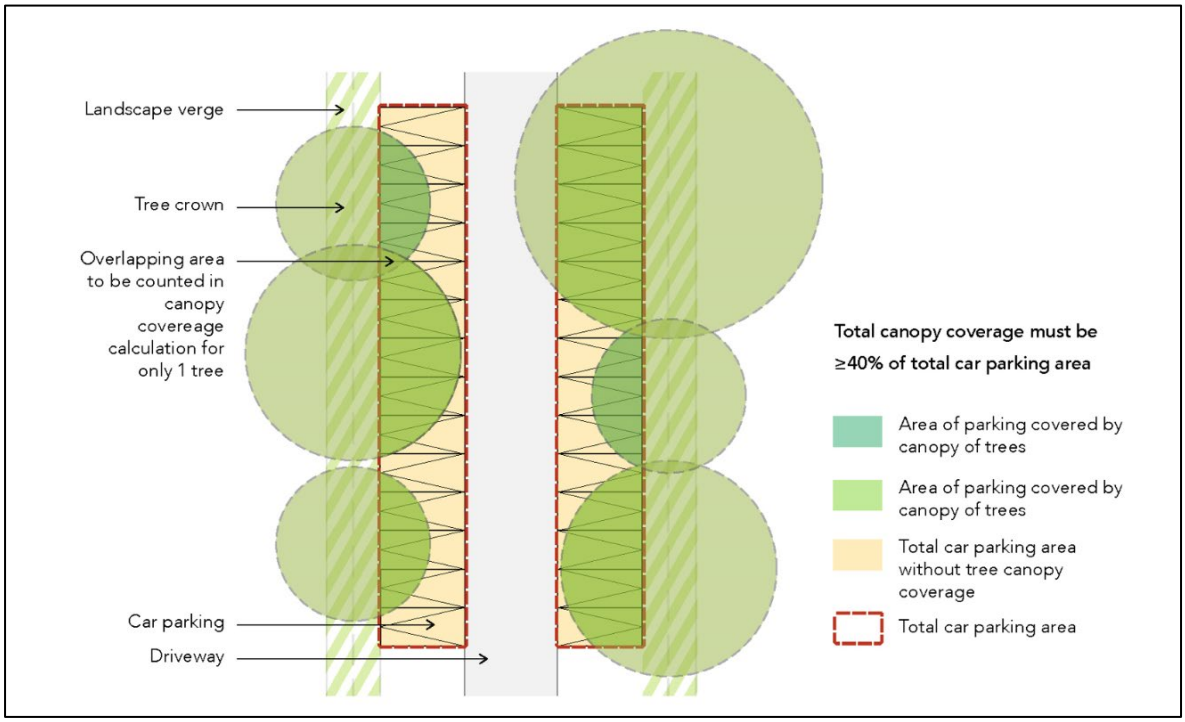
Development type	Tree canopy and planting
Single and Secondary Dwellings	*Front Setback* At least 1 small tree positioned to provide summer shade to the dwelling or hard surfaces. *Side Setback* Planting alongside boundaries is to provide small-to medium trees for sun-shading. *Rear Setback:* At least 3 trees situated to provide an interlocking canopy of small and medium trees and shrubs: predominantly species indigenous to the soils of Penrith City.
Dual Occupancies	*Front Setback* At least 1 small tree positioned to provide summer shade to the dwelling or hard surfaces. *Side Setback* Planting alongside boundaries is to provide small-to medium trees for sun-shading. *Rear Setback:* At least 3 trees situated to provide a corridor of habitat with an interlocking canopy of low to medium-height trees and shrubs.
Multi Dwelling Housing, Boarding Houses, Manor Houses and Group Homes	*Front Setback* At least 1 small tree positioned to provide summer shade to the dwelling or hard surfaces. *Rear Setback:* At least 3 trees are to contribute to an interlocking canopy of low to medium-height trees and shrubs. *Alongside boundaries*: At least 1 small-to medium height canopy tree per dwelling for sun-shading. *Parking Spaces:* Open parking spaces that are to be lined by an "avenue" of shady, overhanging trees
Residential Flat Buildings or equivalent	*Front Setback*

	At least 3 small to medium trees positioned to provide summer shade to dwellings or hard surfaces. *Along driveway verges and surrounding parking basements* Screen plantings of small to medium trees *Side Setback* Planting alongside boundaries is to provide small-to medium trees for sun-shading. *Rear Setback:* At least 3 trees to contribute to an interlocking canopy of low to medium-height trees and shrubs:
Industrial, Business, Tourism and Commercial development	*Open car parks on private land* a) A minimum of 40% tree canopy cover must be provided over the total combined area of all car parking spaces, where car parking is to be provided on the development site. b) Canopy cover is to be calculated by finding: The percentage of the specified area covered by the anticipated canopy at 2/3 of the selected species total maximum width, when fully grown. Figure 2 provides an example of how canopy cover should be calculated. c) Trees should be provided across the car park area and can be located within landscaped setbacks and deep soil zones. d) Where tree roots are expected to grow beneath car parking spaces, engineered tree pits or vaults and aeration infrastructure must be provided and designed in accordance with design guidance provided in engineering design guidelines, the Penrith Street and Park Tree Management Plan and this DCP. e) Wherever possible, canopy trees are to be orientated to the north, east or west of parking spaces to maximize shade during the day. f) Trees and woody plants above 200mm high should be planted a minimum of 600mm back from the wheel stop, measured from their trunks. Low planting should be provided in this space.
Additional controls for Industrial, Business, Commercial and Tourism development where landscaped setbacks are required.	a) Landscape setbacks must provide adequate soil area for tree planting and be filled with as many large trees as possible. Canopy from large trees should be supported with medium and small trees and vegetation to provide a collective cooling effect, where they will not obstruct views, signage, or impact safety.

2) All trees, including street trees, should be located to consider:

a) integration with development design to produce improved cooling effects through measures such as maximisation of shade provided to exposed building walls, hard surfaces, and pedestrian walkways,
b) any disruption of solar access for solar panels on existing or adjoining present and future development should be minimised,
c) whether there is appropriate soil area for root volume,
d) any services or utilities infrastructure within the road reserve, such as power poles, overhead wires, drainage inlet pits, existing street trees and any existing driveways, and
e) requirements in the Penrith Street and Park Tree Management Plan.

FIGURE 2: Canopy cover to be achieved over car parking spaces



1.5 Irrigation

A. Objectives

a) To reduce demand on potable water resources through an appropriate and sustainable supply of non-potable water for irrigation for cooling.

b) To ensure vegetation is irrigated, enabling it to better withstand urban heat impacts and enable the cooling effects of evaporation and evapotranspiration.

B. Controls

1) All development not covered by the State Environmental Planning Policy – BASIX is to provide drip irrigation or passive irrigation to private vegetated landscaped areas, that are:

a) serviced by sustainable supply of non-potable water that is of a scale that sufficient to supply a minimum of 80% of non-potable demand for the development, including indoor and outdoor use, toilets and laundry,
b) designed to be gravity fed, and
c) passive irrigation must be provided to turfed areas, street trees and landscaping where a drip irrigation system is not feasible.

1.6 Cooling with water

A. Objectives

a) To reduce the contribution of new development on the urban heat island effect by minimising impermeable surfaces to increase rainwater infiltration and allow improved cooling effects of evaporation.

b) To retain and provide design elements that retain water in landscapes to support cooling and allow for increased rainwater infiltration and evaporation.

B. Controls

1) All development must consider and incorporate features to store water in the landscape. These features must be incorporated into Landscape Plans to create cool zones and support vegetation. This can include:

   a) swimming pools, subject to controls in this DCP and state legislation,
   b) fountains and bird baths,
   c) water play features, subject to Council agreement and asset maintenance requirements when on public land,
   d) rain gardens, wetlands, ponds, or
   e) shallow trenches or swales within or near garden beds, where erosion is not an issue.

   The selected feature/s should be of an appropriate scale to maximise retention of rainwater on the site without affecting operation.

1.7 Street Trees

A. Objectives

a) To ensure development provides long term solutions to address the Urban Heat Island Effect in Penrith by:

   i) Delivering green infrastructure which positively contributes to the amenity of the locality, while recognising the context and existing development patterns.
   ii) Ensuring that there is adequate and appropriate provision of trees and that conditions for healthy growth and canopy are provided.
   iii) Delivering appropriate quality and quantity of vegetation as green infrastructure.

B. Controls

1) Street trees are to be provided at a rate of one tree for every 10m of site frontage, rounded down to the nearest 10m. At least one tree must be provided. Where possible,

trees should be of a scale sufficient to produce interlocking canopies, unless specific requirements are provided elsewhere in this DCP.

2) Street trees planted on the streets running in an East to West direction are to be native trees and trees planted on streets running from North to South are to be deciduous.

14.2. Cool Colours and Materials

A. Objectives

a) To ensure new development provides long term solutions to the Urban Heat Island effect.

b) Design and construct roofs and exterior walls and hardscaping with consideration of the impacts of material selection on urban heat.

c) Limit negative impacts of heat absorption by demonstrating that materials used are appropriate for the climate and their intended use, such as using green roofs/walls or cool roofs/walls and materials of low Solar Reflectivity Index to ensure high reflectivity and/or high thermal emittance, and that design responses are the most effective for the site.

B. Controls

1) A materials and finishes schedule is to be provided, and must include:
   a) product specifications where certain materials are relied upon to address the criteria of BASIX, Section J of the NCC or this DCP.
   b) Product specifications should include energy efficiency properties, such as:
      i) thermal mass,
      ii) effect on air flow,
      iii) appropriate colour and reflectivity, and
      iv) material permeability in landscape design.

2) Dark coloured roofs which retain heat will not be supported. All buildings and ancillary development are to minimise their contribution to the urban heat island effect by meeting the following requirements for cool roofs:
   a) Achieve the nominated Solar Reflectance Index (SRI) minimums:
      i) for roof pitches less than 15, a SRI minimum of 64, with a minimum 3 year manufacturer guarantee.
      ii) for roof pitches greater than 15, a SRI minimum of 34, with a minimum 3-year manufacturer guarantee.
      iii) for rooftop terraces a SRI minimum of 28, with a minimum 3-year manufacturer guarantee.
   b) At least 75% of the roof area is to meet nominated SRI values and/or be designed as a green roof. Areas where solar panels (PV) are mounted flat on a roof are excluded, all other roof areas with PV count toward the Cool Roof area calculation.
   c) Buildings in Mixed Use, Business, Tourism, and Industrial zones are to provide roof product cut sheets to confirm the materials used are within the required SRI. Other buildings may demonstrate consistency by illustrating materials and colours to be used within plans and design drawings and providing this information in their

Schedule of Materials and Finishes. Assessing officers may request further product information, if required.

d) Roofs that are 'downslope' from the publicly accessible places, such as in hilly areas, scenic areas or which are in view from taller adjacent buildings should avoid reflective white or very light-coloured finishes that could cause glare.

e) Thermally massive surfaces such as concrete should be avoided as a roofing material where shade or other coverage is not provided, or where roofs are not light in colour.

f) Roof tiles may be used, providing that the roofing is insulated in addition to ceiling insulation and provides a sufficient gap between insulation layers to allow for access and air movement. This is to be certified on any plan showing materials and finishes.

3) Walls, car parking spaces, driveways and landscaping materials should have a high albedo (be as light as possible) so that heat can be reflected into the landscape and absorbed, or where shade is provided.

4) Medium colours and materials with high thermal emittance (which release heat quickly) and/or permeable materials should be used in pedestrian areas where no shade is provided to minimise heat reflection and to mitigate heat retention.

14.3. Cooling through Building Design

A. Objectives

a) To ensure development in zones which are vulnerable to urban heat island impacts incorporates additional design responses to effectively manage increased heat loads on hot and extreme heat days.

b) To reduce carbon emissions from the development, considering both construction and operational emissions.

c) Design buildings for high passive thermal performance, to reduce reliance on energy for cooling and heating.

d) To ensure buildings are thermally comfortable by designing:

i) Floor plans that respond to the site and building use and orientation,
ii) Climate appropriate windows and glazing and the appropriate location of windows,
iii) Thermal mass orientated and situated to retain cool temperatures,
iv) Improved air movement and ventilation, particularly to encourage the flow of cool breezes and night air and to extract hot air,
v) Passive cooling features,
vi) Improved insulation and management of air exchanges,
vii) Appropriate shading, and
viii) Efficient operation of mechanical cooling systems.

e) To deliver internal spaces within every new development where temperatures remain thermally comfortable all year round.

B. Controls

Air circulation

1) Building design must demonstrate how it responds to the following considerations affecting air movement and ventilation:
    a) Capture and direction of north-easterly prevailing breezes and internal circulation should be prioritised for window and door design, number, size, and location, and considered in building orientation.
    b) Shading devices and/or window glazing should be provided to support:
        i) Minimisation of solar heat gain during summer, and
        ii) optimisation of solar heat gain during winter.
    c) Minimising air gaps by ensuring all openings can be closed and sealed when necessary, and that the building is well insulated. Window and door seals should be provided.
    d) The ability to isolate spaces through zoning sections of the floor area and building services to provide individual control of heating and cooling, particularly where mechanical systems regulate temperature.
    e) Security screens or fly screens should be provided over openings, where feasible and consistent with safety and fire controls.
    f) Promoting air circulation.
    g) Support for any other passive design elements.

External Building Design

2) Buildings should be designed on passive solar design principles which:
    a) Respond to orientation to maximise the northerly aspect and solar access in the cooler periods. Where the site permits, designs should deliver long, thin buildings with increased northern and southern exposure and limited exposure on eastern and western-facing facades and moderate depths.
    b) Reduce overheating in summer and promote solar gain in winter.

3) Development below 3 storeys must provide eaves with a minimum of 450mm overhang (measured to the facia board) and a minimum 600mm overhang on western-facing elevations, except where any walls are permitted to be built to the boundary. Alternative solutions to eaves may be considered, where it can be demonstrated that these provide appropriate sun shading and are integrated with the design of the development and have architectural merit.

4) Design for moderate size and number of openings with the majority to the north.

5) Where east and west facing residential walls are proposed to be brick or concrete and are exposed to summer sun, these walls should either be double brick or wall insulation should be provided and walls should be shaded.

6) Where concrete is used for walls in industrial, business, and commercial development and western walls are exposed, at least 50% of western elevations must be shaded from summer afternoon sun using either design features or vegetation. Where there is a zero-lot setback, this control does not apply.

7) Ensure roof design maximises opportunities for future installation of solar power and hot water adaptation through the consideration of:
    a) North-facing surface,
    b) Overshadowing, and

c) Structural support.

Internal Building Design

8) Cool Refuges for certain buildings are to be provided in accordance with Table 3, and must be identified on floor plans:

TABLE 3: Cool Refuge Requirements

Development Type	Cool Refuge Requirements
Residential development	• At least one habitable room on the ground floor of each dwelling or in the lobby and common rooms of residential flat buildings/ Apartments, should be provided as a cool refuge in summer, and at least one habitable room as a warm refuge in winter. • These spaces may be the same or separate.
Publicly accessible buildings (amenity buildings excluded)	• A cool refuge which may accommodate a minimum of 20 people.
Business, industrial, and commercial development (excluding shopping centres)	• Provide indoor and outdoor staff break areas that act as cool refuges. • Where feasible, workspaces should be designed to maintain thermal comfort. This is of particular importance to high density workplaces and commercial spaces.

9) In addition to the ability to be mechanically cooled (i.e., air conditioned), a cool refuge must demonstrate the following design criteria have been addressed to support thermal comfort:

a) Use of passive shading principles that considers the location of the refuge within the dwelling and use of moveable shade structures, window boxes or wider eaves,
b) Use of insulation and type in the walls, floor, and ceiling with the highest r-value appropriate for the site, or that the materials provide sufficient insulative properties so that insulations are not required,
c) Use of cross-ventilation is focused to channel north easterly breezes through the space and provide optimal cooling effects,
d) Minimising air exchanges so that spaces can also be enclosed when required.

10) At least three of the following design measures are to be provided in a cool refuge:

i) be located on the southern side of the building.
ii) have increased shade on walls or windows that are exposed to the north or west.
iii) have thermal mass levels appropriate to the amount of passive cooling available (cool breezes, consistent diurnal variations) and use thermal mass to delay peak cooling needs until after the peak demand period.
iv) have appropriate glazing of windows.
v) provide efficient mechanical cooling or ceiling fans.
vi) have space that is zoned to reduce air exchange.

vii) use of photovoltaic, solar, biomass or wind-powered cooling mechanisms to regulate air temperatures and movement, such as solar chimneys, evaporative cooling or earth coupling.

11) If a cool refuge is provided as an ancillary structure, roofing must be insulated.

14.4. Optimising Mechanical Heating and Cooling

A. Objectives

a) To minimise excess power usage and heat gain from mechanical heating and cooling systems.

b) To reduce the impact of heat rejection from heating, ventilation, and cooling systems from contributing to the urban heat island effect and prevent impacts to thermal comfort.

c) To reduce peak demand on the electricity grid and support a robust electricity network, by improving energy efficiency.

B. Controls

1) To mitigate the impact of heat rejection from mechanical cooling, units should not vent into areas where they may result in the heating of the public or private domain. This includes venting onto outdoor recreation spaces, windows of adjoining properties and hard surfaces that may retain heat including, paths, balconies, and courtyards.
2) Where it cannot be demonstrated that heat rejection cannot be achieved without venting into these spaces, this area must be excluded from any calculation of private and communal open space.
3) Mechanical cooling systems must be sited so that:
   a) airflow isn't impeded from and around units,
   b) there is ease of maintenance access, and
   c) any structure complies with controls for cool roofs and finishes.