Wollongong City Council

Urban Heat Strategy

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Executive Summary

Heat is increasingly recognised as a key risk to Australian communities across all parts of the continent. Heat has been described as a 'silent killer' because its consequences are relatively invisible, however heatwaves kill more Australians than any other natural disaster. They also cause many other negative impacts for people, the environment, and the economy, including acute shocks and chronic stresses.

When Wollongong experiences heatwaves, some cope by seeking out air-conditioned spaces, or cooling off at the beach or pool. However, these options aren't available or suitable for all of Wollongong's vulnerable residents. Some people are more vulnerable to the impacts of heat due to factors such as poor-quality housing, limited mobility, and social isolation. Older adults, young children and people with underlying health conditions are also more sensitive to the health impacts of heat.

Heat is also a growing risk as the climate changes. Average temperatures are increasing as well as temperature extremes, including more hot days, more heatwaves, and heatwaves that last longer. In urban areas, the impacts of heatwaves are compounded by the Urban Heat Island effect. Wollongong Council's 2022 Climate Change Adaptation Plan identified urban heat as a key issue needing further investigation, to better understand the risks and develop appropriate management strategies. This Urban Heat Strategy addresses these needs.

This strategy is focused on Council's role in addressing heat-related risks. Council has direct responsibilities to manage heat-related risks to work health and safety, and a clear opportunity to address heat in the planning, design and management of its own infrastructure including buildings, streets, parks and open spaces. Wollongong Council also recognises that it has a wide range of opportunities to support broader community resilience and environmental sustainability. The strategy identifies objectives and actions for Council to support the following four goals:

- Minimise the impacts of heat on the Wollongong community.
- Minimise the impacts of heat on the local environment.
- Plan and prepare Council's workforce for more frequent hot days and heatwave conditions.
- Plan, design and manage urban infrastructure to reduce the UHI effect, create cooler microclimates and support indoor thermal comfort.

Wollongong Council acknowledges that collaboration will be important to meet these goals, particularly where responsibilities are shared. As part of preparing this strategy, Council has begun engaging with other government agencies and community service providers on the topic of urban heat, to understand how Council can support others in their roles, multiplying their impact on community resilience.

Actions proposed in this strategy have been developed based on input from Council staff, including a series of cross-Council workshops which included representatives from Planning and Environment, Community Services, and Infrastructure and Works. This process identified opportunities for Council to embed heat-resilient principles into established organisational processes and build on existing programs and initiatives to address heat-related risks while also meeting other organisational objectives. The focus is on actions that are relevant and achievable in a short-term timeframe (3-5 years), so that Council can build knowledge and experience around urban heat before considering longer-term actions.

1 Introduction and purpose

Extreme heat presents risks to the Wollongong community and puts pressure on natural assets, Council facilities, operations and services.

1.1 Why Council has developed this urban heat strategy

Wollongong Council's 2022 Climate Change Adaptation Plan (Wollongong City Council, 2022a) identified urban heat as a key issue needing further investigation, to better understand the risks and develop appropriate management strategies.

In the past, heat has received less attention than other climate-related weather events such as floods and fires, because its consequences are relatively invisible, and its impacts typically only measured long after a heatwave has passed. For this reason, heat has been described as a 'silent killer'.

Heat is increasingly recognised as a key risk to Australian communities. Wollongong Council takes heat risks seriously because:

Heat has deadly consequences

Heat causes health problems including heat stress and related illness, respiratory problems, increased ambulance callouts, increased hospital admissions. Heatwaves kill more Australians than any other natural disaster (Coates, et al., 2014), living in warm neighbourhoods increases the heat-related mortality risks of residents by nearly 6% compared to those living in cooler suburbs, and older people are particularly vulnerable (Santamouris, et al., 2020; Schinasi, et al., 2018).

Heat also causes a range of other serious impacts on infrastructure, the economy, the environment and society

Peak electricity demand increases by almost 100% when temperatures rise from 20 to 40°C (Santamouris et al, 2017b). During heatwaves, extreme heat also puts physical stress on electricity infrastructure, therefore power outages become more likely. QUT (2010) also found significant impacts on transport infrastructure, including buckling of rail tracks and air conditioning failure in buses and trains.

Zander et al (2015) estimated Australia's annual lost productivity due to heat stress at work at $6.9 billion.

Heatwaves put flora and fauna under stress. Heatwaves can lead to mass deaths of sensitive species such as flying foxes and birds (Steffen et al 2014). Heatwaves also contribute to the degradation of water quality and the loss of biodiversity.

Urban heat causes a dramatic reduction in the amenity of the urban environment. Outdoor spaces become unusable, with impacts on health and wellbeing. These impacts are harder to quantify.

Climate change is increasing the frequency and duration of heatwaves in the local area

The climate of the Wollongong area is warming and projected to increase during this century. We can expect an increase in periods of extreme heat and that these are projected to occur more frequently and last longer than in the past. Refer to Section 3.3.

Urban areas are more exposed to heat

Urban areas are hotter than rural or natural areas, due to the Urban Heat Island (UHI) effect. Figure 1 shows how a large proportion of Wollongong's urban area can be 6-9 degrees warmer than baseline conditions, due to the UHI effect.

Urban areas are densely populated – including people vulnerable to heat

When hot temperatures and heatwaves affect urban areas, many people are exposed, including people who are vulnerable to the health impacts of heat - refer to Figure 2. Vulnerable groups include people are more sensitive to heat (e.g. older people, young children, those with underlying health issues) and people who are less able to adapt (e.g. people in poor quality housing, people with mobility challenges or people without the means to support air-conditioning or other controls).

Anyone can be affected by heatwaves

It is not only these vulnerable groups who are affected by heat – extreme heatwaves can be dangerous for anyone who does not take precautions to keep cool. This includes people who work or exercise outdoors in hot conditions.

Anywhere can be affected by heatwaves

Heatwaves can occur anywhere. The way heatwaves are defined by the Australian Bureau of Meteorology (BOM), is "Three or more days in a row when both daytime and night-time temperatures are unusually high — in relation to the local long-term climate and the recent past". Even though Wollongong is not usually the hottest place in the Greater Sydney region, it is not immune to the consequences of heatwaves.

Heat has direct impacts on Wollongong Council's operations

In recent years, Wollongong's beaches have become increasingly popular for daytrip visitors from greater Sydney. This increase in visitor numbers is leading to challenges for residents and Council. Problems include increased traffic on Lawrence Hargrave Drive, full parking areas near beaches and facilities, overuse of public toilets, garbage bins and shelters, as well as increased swimming outside of patrolled areas of beach. During a January 2018 heatwave (see Figure 3), Surf Life Saving NSW attended to dozens of rescues across the Illawarra, with some rescues requiring paramedics and hospital admissions (Illawarra Mercury, 2018).

Urban Heat Island

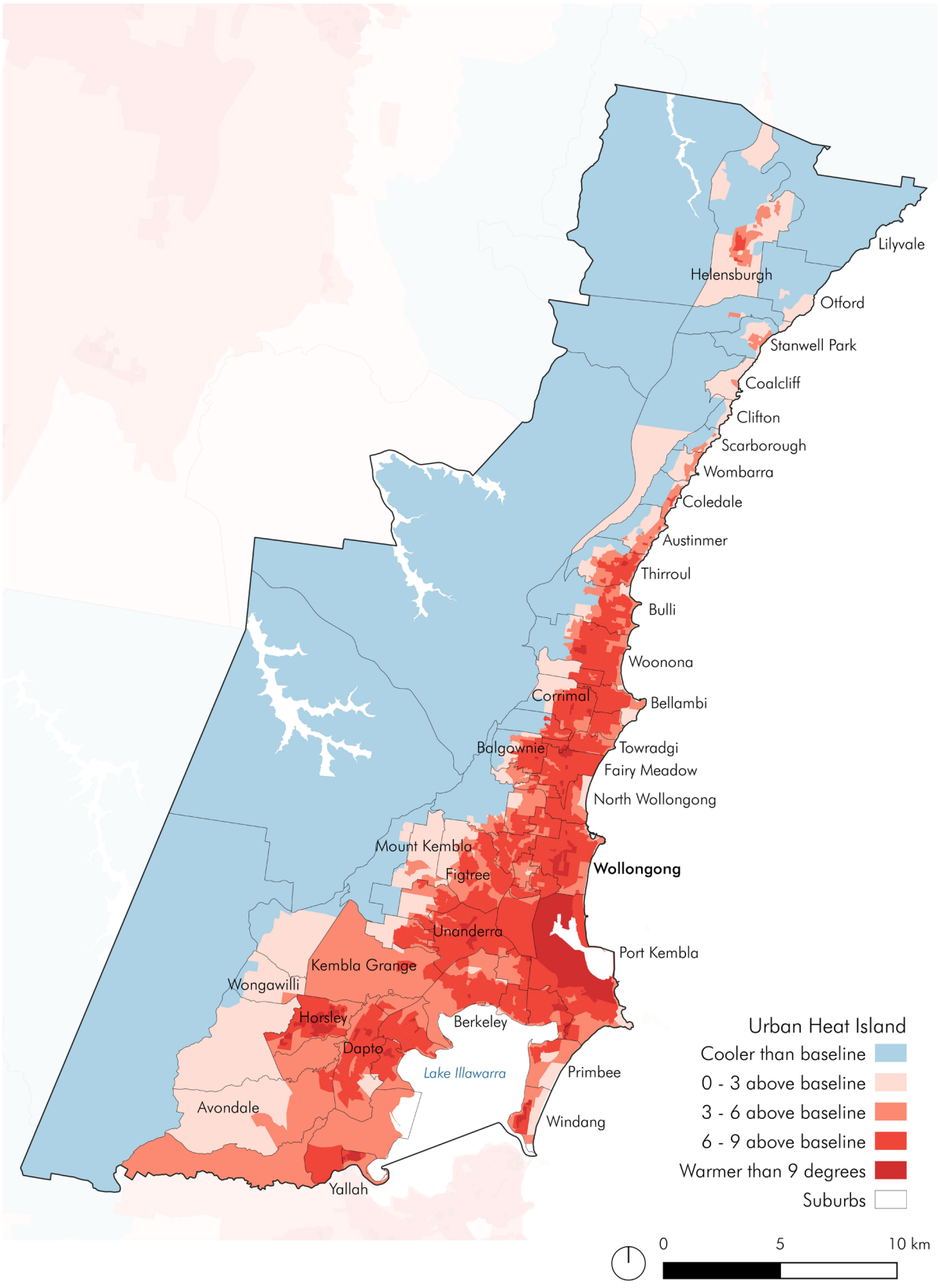
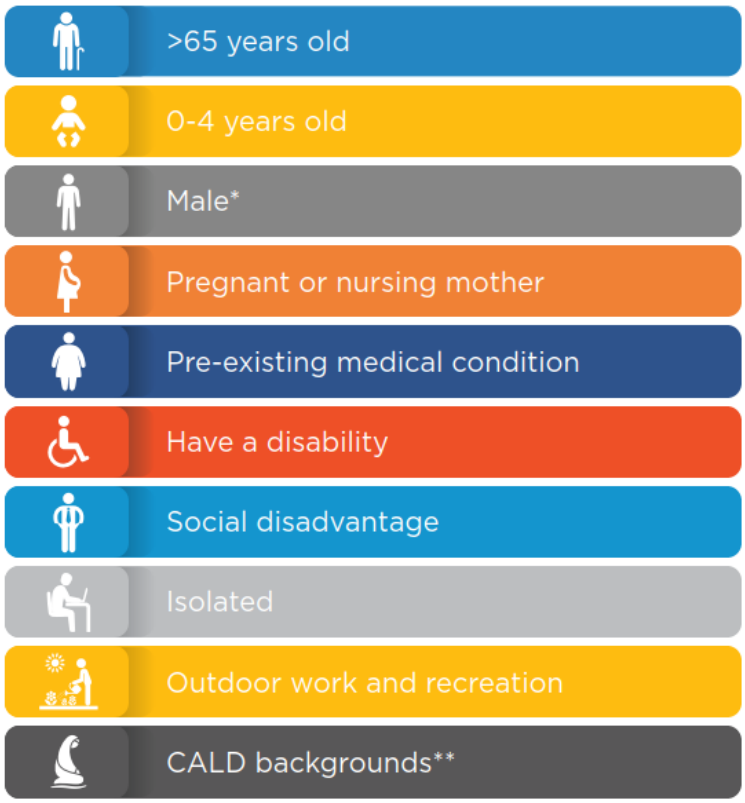


Figure 1: Urban Heat Island mapping for Wollongong LGA. Data published by NSW Government (NSW Government, 2019) based on CSIRO analysis of 2015/16 satellite imagery (Devereux & Caccetta, 2017).



*Men are more likely to work in outdoor, physical jobs, and may be less likely to seek medical advice.

**People from Culturally and Linguistically Diverse (CALD) backgrounds may be less likely to receive or understand mainstream warnings. May have limited social networks.

Figure 2: Groups most vulnerable to heatwaves (WSROC, 2021b)

Figure 3: Crowds at Port Kembla Beach and pool during a January 2018 heatwave (Image: Sylvia Liber/Illawarra Mercury)

Wollongong Council's Climate Change Adaptation Plan (Wollongong City Council, 2022a) identified the major risks of urban heat, outlined an initial adaptation pathway and established priority actions. It identified:

Risks of urban heat

- **Impacts on community health and safety**.
- **Additional demand on council services** such as pools, beaches, ocean pools, libraries, leisure centres, community centres and community transport, causing strain on these services and on council's staff who operate and maintain them.
- **Stress on physical assets** such as increased demand for water and energy.
- **Stress on natural assets** including direct stress to native animals and plants as well as broader pressure on biodiversity, ecosystem function, amenity.

Areas where Council can adapt

- **Planning** – strategic, statutory and land use planning.
- **Green infrastructure** – including maintenance of existing green infrastructure as well as planning of new planting.
- **Civil infrastructure** – including options to modify paved surfaces with cool surface treatments, as well as reducing paved surfaces where possible.
- **Buildings/facilities** – designing and operating Council buildings to maintain cool conditions during extreme heat.
- **Council services** – including planning and management of outdoor events that may be impacted by heat.
- **Partnerships** – working with others to tackle urban heat, including other parts of government, community organisations, businesses and the broader community.

Priority actions

- The first action in the list called for "further investigation of heat in the Wollongong area to understand this issue further and develop appropriate heat management strategies…"

This Urban Heat Strategy delivers on this first action, and also builds on the other heat-related actions adopted in the Climate Change Adaptation Plan.

1.2 Scope of this strategy

This strategy is focused on Wollongong City Council's role in managing urban heat and its impacts, however it has considered the context within which Council operates, including:

- **The climate** of the Wollongong LGA and the likely local impacts of climate change.
- **Local physical conditions** (e.g. paving, shade, tree canopy cover, water) which impact on the microclimate in the urban environment.
- **The community context** – behaviours and responses to heat, some of which are specific to the local area (e.g. many flock to local beaches), and impacts of heat on people in the local area, including vulnerable groups.
- **The local environment** including species and ecosystems vulnerable to the impacts of heat.
- **The organisational context**: beyond Council itself, other government agencies, non-government and community organisations who are involved in supporting the Wollongong community and environment to prepare, respond and adapt to heat.

In developing this strategy, Council has:

- Considered the policy context relevant to urban heat, from international to local level (Section 2).
- Investigated the current and future risks of urban heat to the local community and Council (Section 3).
- Undertaken staff and stakeholder consultation to understand risks from a local perspective, identify strengths and weaknesses of local capacity to respond to urban heat, and identify opportunities for this strategy (Section 4).
- Developed an action plan for Council, building on the actions in the Climate Change Adaptation Plan and including actions across a wide range of areas, from services and operations to planning and design of built and living infrastructure (Section 5).
- Identified implementation timeframes and targets, based on indicators that can be monitored by Council (Section 6).

1.3 Objectives

The objectives of this Urban Heat Strategy are:

1. **Leadership:** Demonstrate leadership in adaptation planning and action to increase resilience to urban heat.
2. **Knowledge-building:** Identify and understand the areas of Wollongong and sectors of the Wollongong community most vulnerable to heat impacts, stakeholders likely to be affected and the risks to council infrastructure, services and operations.
3. **Recognition:** Acknowledge the work that Council is already doing to address urban heat, and set out what Council can do in coming years to prepare for and adapt to increasing frequency and severity of hot days and heatwaves.
4. **Collaboration:** Support a collaborative and regional approach to to work towards reducing urban heat impacts in partnership with other relevant local stakeholders.

2 Context

In Australia, heat presents a growing challenge for urban areas as the climate changes. Recognising this, our approach to heat is evolving.

2.1 Australian context: increasing recognition of urban heat risks

Urban heat is gaining greater recognition as a key risk to Australians, which is increasing with climate change. Australia's most recent national State of the Environment Report (Australian Government, 2021) identified:

- Heatwaves kill more Australians than any other natural disaster, and heat contributes to the deaths of more than 1,000 people aged over 65 across Australia each year. This is expected to grow as the climate changes and our population ages.
- Heat causes other negative impacts on wellbeing including sleep, health, crime, income and labour productivity. Heat-related illness is likely to worsen with climate change, including respiratory problems where heat is a contributing factor, as it exacerbates air quality issues.
- Heat causes stress on infrastructure and resources such as energy and water, with the risk of blackouts and power shortages in heatwaves a particular concern.
- Heat causes stress on natural landscapes and living infrastructure in urban areas.

Several important pieces of research support the findings in the State of the Environment Report and have contributed to a greater understanding of heat risks, current and future impacts at national level, including:

- An examination of past extreme heat events in Australia between 1844–2010 found that during this period, extreme heat events have been responsible for more than the combined total of deaths from all other natural hazards (Coates, et al., 2014).
- Several studies have identified factors that contribute to the risk of heat-related deaths, including age, gender, socio-economic disadvantage, social isolation, geographical remoteness, the presence of disabilities (physical or mental), age of housing stock and the exposure of the neighbourhood (Coates, et al., 2022) (Santamouris, et al., 2020), (Schinasi, et al., 2018).
- A study of the impacts of heat on labour productivity estimated Australia's annual lost productivity due to heat stress at work at $6.9 billion (Zander, et al., 2017).
- An assessment of the climate vulnerability of trees from 29 Local Government Areas (LGA) across Australia found that 14% of all public trees (22% of species) in Australia's cities are at high risk from increased temperatures in an emissions limited climate change scenario (RCP4.5 by 2040), and 24% of all public trees (35% of species) in a business as usual emissions scenario (RCP8.5 by 2070) (Clean Air and Urban Landscapes Hub, 2017).

Australia's Bureau of Meteorology (BOM) has implemented heatwave forecasting and a heatwave warning service. The heatwave forecasts were first launched as a pilot in 2014, and the warning service implemented in 2022. The warning service includes BOM alerts as well as 5 sets of action statements

aligned to heatwave severity, agreed with by partner health and emergency service agencies across Australia (Bureau of Meteorology, 2022).

2.2 New South Wales context: emerging guidance and resources

Most of the activity on heatwave preparedness and heat adaptation planning is occurring at a local and regional level. NSW has a Climate Change Adaptation Strategy (NSW Government, 2022) which commits to actions in four areas:

1. Develop robust and trusted metrics and information on climate change risk.
2. Complete climate change risk and opportunity assessments.
3. Develop and deliver adaptation action plans.
4. Embed climate change adaptation in NSW Government decision making.

While the strategy is high level and not specific to heat, heatwaves are identified as a key climate change risk in the document and therefore it is expected that the outcomes will be relevant to heat, including improved metrics, updated climate projections, and risk assessments relevant to heat. NSW Government adaptation action plans would also help provide more certainty to local government.

Meanwhile, there is guidance available from NSW Government including:

- Climate change projections, including a regional snapshot for the Illawarra (NSW Office of Environment and Heritage, 2014).
- Climate change impact snapshots, including one focused on heatwaves (NSW Office of Environment and Heritage, 2015a).
- A guideline for local government on minimising the impacts of extreme heat (NSW Office of Environment and Heritage, 2016).
- A guide to climate change risk assessment for NSW local government (NSW Department of Planning, Industry and Environment, 2019).
- A more recent guideline on planning for natural hazards "Planning for a more resilient NSW" (NSW Department of Planning and Environment, 2021) and accompanying resource kit (NSW Department of Planning and Environment, 2022).
- Resources on NSW Government's 'Beat the Heat' website, which is focused on advice to the general community and health sector to assist with heat preparedness.

Also, NSW Government has started to undertake risk assessments at state level, for example a NSW Treasury assessment of economic risks (NSW Treasury, 2021) states that "By 2061, between 700,000 and 2.7 million additional days of work are projected to be lost every year [in NSW] due to the higher frequency and intensity of heatwaves" (NSW Treasury, 2021, p. 5). These lost workplace productivity cost estimations have to date only been modelled for four sectors for which higher proportions are known to work outdoors: agriculture, construction, manufacturing and mining, meaning that impacts would be larger across the broader economy.

This guidance and these resources have informed the assessment of risks and identification of adaptation actions in this Urban Heat Strategy for Wollongong.

2.3 Greater Sydney context: a key issue for Western Sydney

Heat is a key issue for Western Sydney, as temperatures reach greater extremes in Sydney's west than they do on the coast, and the region is developing rapidly. Therefore, Western Sydney councils have been looking for more detailed guidance and targeted action on urban heat. The Western Sydney Regional Organisation of Councils (WSROC) published their Turn Down the Heat Strategy in 2018 (WSROC, 2018) and since then have published several documents and tools relating to actions identified in their strategy:

- The Urban Heat Planning Toolkit (WSROC, 2021a), which translates the science of urban heat to practical guidance on planning and design to reduce its impacts, and specific options to improve local planning provisions.
- The Heat Smart Resilience Framework (WSROC, 2021b), which outlines how we should improve the management of heatwaves in NSW, with suggested actions for state and local government as well as other relevant stakeholders.
- The Cool Suburbs Tool (Siebentritt, et al., 2022), which is a rating and assessment tool for building heat resilience in urban planning and development.
- Heat Smart Toolkit: A guide for building heatwave preparedness in community organisations (WSROC, 2021c).
- Future Proofing Residential Development in Western Sydney (Upadhyay, et al., 2022), which reviewed the thermal performance of BASIX-compliant Western Sydney homes under future climate scenarios (climate zone 28), with the aim of understanding whether today's housing standards are future-ready. Key findings show that today's 'compliant' homes are not design for today's or future climates, are thermal unsafe during heatwaves, and continuing to design for historical climate, homes will neither be energy efficient nor heat resilient.

While WSROC clearly has a Western Sydney focus, much of their guidance is equally relevant to Wollongong. Note that the 'Future Proofing Residential Development' report follows a previous study (WSP, 2021) which applied the same methodology to examine development in Eastern Sydney and also found that homes built to current standards in Eastern Sydney would be thermally unsafe during future heatwaves.

2.4 Wollongong context: urban heat is relevant to many areas of Council

Urban heat is a multifaceted threat, posing a range of risks to human health, economy, infrastructure and the environment. It has the potential to cause impacts on a wide range of Wollongong Council's assets, services and operations. Council also has a wide range of opportunities to mitigate the impacts of heat and help the community adapt to greater extremes in the future. Therefore, there are a wide range of other plans and strategies which are relevant and connected to this Urban Heat Strategy.

Community Strategic Plan

Wollongong City Council's Community Strategic Plan (Wollongong City Council, 2022b) identifies the community's overarching goals and objectives for Council. The objectives include several which can be supported by this urban heat strategy.

Table 1: How this Urban Heat Strategy supports Community Strategic Plan objectives

Community Strategic Plan 2022 objectives		Supporting role of the Urban Heat Strategy
1.1	The natural environment is protected and enhanced.	Protecting the natural environment from the impacts of extreme heat and enhancing the adaptive capacity of vulnerable species and ecosystems. Enhancing the natural environment in priority locations to passively cool urban spaces and communities.
1.6	The sustainability of our urban environment is improved.	Ensuring new development is planned and designed to minimise future heat risks. Adapting existing homes, buildings, and infrastructure to prevent and reduce current and future urban heat risks.

Community Strategic Plan 2022 objectives		Supporting role of the Urban Heat Strategy
4.3	Residents have easy and equitable access to information resources and services.	Providing all residents with accessible information on urban heat and access to services that will help minimise their heat-related risks. Working with and supporting other community service providers to enhance their frontline services to incorporate heat awareness and preparation.
5.1	There is an increase in the physical fitness, mental health and emotional wellbeing of all our residents.	Ensuring that the Wollongong LGA remains liveable in a warmer climate with more frequent occurrences of extreme heat. Recognising that heat stress can affect anyone, not just physically but mentally, impacting lifestyle, health, and productivity.
5.3	The public domain is maintained to a high standard.	Ensuring the public domain includes adequate shade, water, living infrastructure and cool surfaces to minimise heat exposure in public places. Managing heat risks during outdoor events and warm season activities.
5.4	Community safety is improved.	Ensuring that those most vulnerable to the impacts of heat are considered in planning, design and service delivery.
5.5	Participation in recreational and lifestyle activities is increased.	Ensuring the LGA includes cool outdoor places where people can continue to enjoy recreational and lifestyle activities even when temperatures are high.
5.6	Residents have a high level of life satisfaction and personal happiness.	Providing a supportive environment to help residents adapt and thrive in a warmer climate.
6.1	Walking, cycling and public transport is an accessible and well resourced means of transport, and the use of private cars is reduced.	Ensuring that shade, water, living infrastructure and cool surfaces are considered in the planning and design of walking, cycling and public transport infrastructure.
6.3	Transport disadvantaged communities have increased access to services.	Ensuring that communities vulnerable to heat are considered in planning transport services.

Climate Change Mitigation and Adaptation Plans, and Sustainable Wollongong Strategy

These three related plans provide important context to the Urban Heat Strategy. Sustainable Wollongong 2030 (Wollongong City Council, 2020a) identifies six fundamental priorities which underpin this Urban Heat Strategy:

1. **A city whose council shows leadership**: Environmental and climate leadership underpins Council decision-making and service delivery which inspires the same in others.
2. **A city that works together**: Together, protect our environment, reduce emissions and increase our resilience to climate change.
3. **A low emissions city**: We will achieve net zero emissions by 2030 for Council operations, and together we will achieve net zero emissions by 2050 for the city.
4. **A city in harmony with our environment**: Our ecosystems and waterways are enhanced, our urban areas are cooler and greener, and our community is connected to our environment.

5. **A low waste city**: Our people only take what they need, reuse and recycle what they can, and are aware of the resources they consume.
6. **A climate and water resilient city**: Our infrastructure and community can adapt to a changing climate and water is valued as a vital natural resource.

The Climate Change Mitigation Plan (Wollongong City Council, 2020b) primarily addresses the 3rd priority above, while the Climate Change Adaptation Plan (Wollongong City Council, 2022a) primarily addresses the 6th. This Urban Heat Strategy is also focused on climate resilience, while also working to support the other priorities listed above.

Asset management and public facilities

Council's assets and public facilities face risks from urban heat and can also play a role in mitigating the impacts of heat on the community. Relevant strategies and plans include:

- Strategic Asset Management Plan 2018-2028
- "Places for the Future" Social Infrastructure Future Directions Plan: 2023-2036
- Wollongong City Libraries Strategy 2017-2022
- The Future of Our Pools Strategy 2014-2024
- Play Wollongong Strategy 2014-2024
- Sportsgrounds and Sporting Facilities Strategy 2017-21

Natural environment and living infrastructure

The local environment also faces risks from urban heat as well as playing a role in mitigating the impacts of heat on the community. Relevant strategies and plans include:

- Urban Greening Strategy 2017-37
- Illawarra Biodiversity Strategy 2011
- Lake Illawarra Coastal Management Program 2020-2030

Planning and design

Wollongong City Council also has the opportunity to address urban heat in development controls and relevant plans and design guidelines for public infrastructure, including:

- The Wollongong Local Environment Plan (LEP) and Development Control Plan (DCP)
- City of Wollongong Pedestrian Plan 2017-2021
- Wollongong Cycling Strategy 2030

2.5 International context: other cities are facing similar challenges

Cities around the world are facing similar challenges with heat, including other cities with a similar climate to Wollongong. In both Sydney and Athens, researchers have found positive feedback between the UHI and heatwave conditions. In Athens, there was intensification of the average UHI magnitude by up to 3.5 °C during heatwaves, compared to summer background conditions (Founda & Santamouris, 2017) and in Sydney, the difference between the peak average urban overheating magnitude during heatwave and non-heatwave conditions was around 8 °C (Khan, et al., 2020).

Two recent examples of unusually prolonged heatwaves have occurred in coastal cities with a similar climate to Wollongong:

- Between November 2022 and March 2023, Argentina experienced multiple heatwaves including a prolonged event in March 2023. The temperature in Buenos Aries exceeded the

maximum temperature threshold for a heat wave (32.3 °C) for 12 consecutive days (Buenos Aries Herald, 2023). Impacts were compounded by drought, fires, and power cuts, as well as poverty (Buenos Aries Times, 2023).

- Japan experienced a significant heatwave in June-July 2022. Temperatures in Tokyo reached at least 35 °C for nine consecutive days (Japan Times, 2022a). Electricity supplies were strained, and hospitalisations reached a record high (Japan Times, 2022b).

Seven cities, including Melbourne City, have appointed Chief Heat Officers, as part of a broader global heat program funded by Arsht-Rock in the USA. Chief Heat Officers seek to align efforts and unify response across sectors, organisations, and stakeholders, showing the value of co-ordination, prioritised and targeted delivery, information sharing, and thereby laying a tried and tested foundation for other cities to learn from.

2.6 Council's role in urban heat

With increasing recognition of urban heat and heatwaves as important risks to Australian communities, approaches to mitigate heat risks are emerging, including an emerging understanding of the roles that councils and others will play.

This is occurring in the context of a broader discussion: following recent fires and floods, about how to improve natural disaster preparedness, response and recovery; and following Covid-19, about how to build resilience to protracted events and chronic stresses.

Emergency preparedness, response and recovery from heatwaves

Responsibilities during heatwaves are set out in the NSW State Heatwave Subplan (NSW Government, 2023), however responsibilities set out in the plan are limited to state agencies/functional areas and specific emergency management roles (e.g. SEOCON, LEOCON). The Heatwave Subplan does not include any specific responsibilities for councils.

The Heatwave Subplan is only activated rarely, at the discretion of the State Emergency Operations Controller (SEOCON). For example, it was activated in December 2019, but is not activated every time there is a heatwave warning from the BOM. It is also mainly relevant during the heatwave itself and does not cover longer-term planning, preparedness and recovery activities, however its latest update (June 2023) does include a brief section on community resilience, stating that this will be supported by agencies via community information strategies and the provision of cool places, and also noting the roles of councils and non-government organisations, particularly in the provision of cool places.

Wollongong City Council recognises the central role it can play in building local community capacity to prepare, respond and recover from heatwaves.

Planning to reduce risks of heatwaves and adaptation to build resilience to urban heat

This strategy also covers:

- Longer-term planning for heatwaves: to minimise their risks and improve preparedness, both within Council itself and in the broader community.
- Measures to reduce the chronic stresses of urban heat on council and the community.

Within Council itself, the NSW Government guideline for local government on minimising the impacts of extreme heat (NSW Office of Environment and Heritage, 2016) identifies some specific areas of council responsibilities/services which could be affected by extreme heat, and where councils should therefore plan to minimise risks and improve preparedness within the organisation. These include:

- General responsibilities under the Local Government Act 1993 and the Work Health and Safety Act 2011.
- Other service areas which could be affected by extreme heat, including food safety, water supply provision, public health and environmental risk, road maintenance, bushfire risk and

emergency/disaster management (see *Public Health Act 2010* and the *Protection of the Environment Operations Act 1997*, *Roads Act 1993* and the *Food Act 2003*, the *Rural Fires Act 1997* and the *State Emergency and Rescue Management Act 1989 (amended)*).

In these areas, Wollongong City Council has specific responsibilities and this strategy considers how Council can continue to meet those responsibilities in the context of increasing urban heat and more frequent extreme heat events. Due to the nature of heat risks – their impacts and management responses, the mandate or responsibility to reduce heat risks does not squarely fit within one section or team of Council, but many parts of Council, and this is reflected in this strategy.

In the broader community, the local government guideline on extreme heat (NSW Office of Environment and Heritage, 2016) states up front that "coordinating actions to minimise the impacts of natural hazards on local communities requires a coordinated and collaborative approach" (NSW Office of Environment and Heritage, 2016, p. 6), which acknowledges that responsibilities are not always clear cut.

Wollongong City Council recognises the role it can play in reducing the risks of heat to the community, with actions that support both community resilience to heatwaves and reducing chronic stresses of urban heat.

Figure 4 illustrates how local government's roles in urban heat can be organised into direct responsibilities within their *control*, shared responsibilities where they work with other stakeholder to *influence* outcomes, and issues which concern them but are beyond their responsibilities.

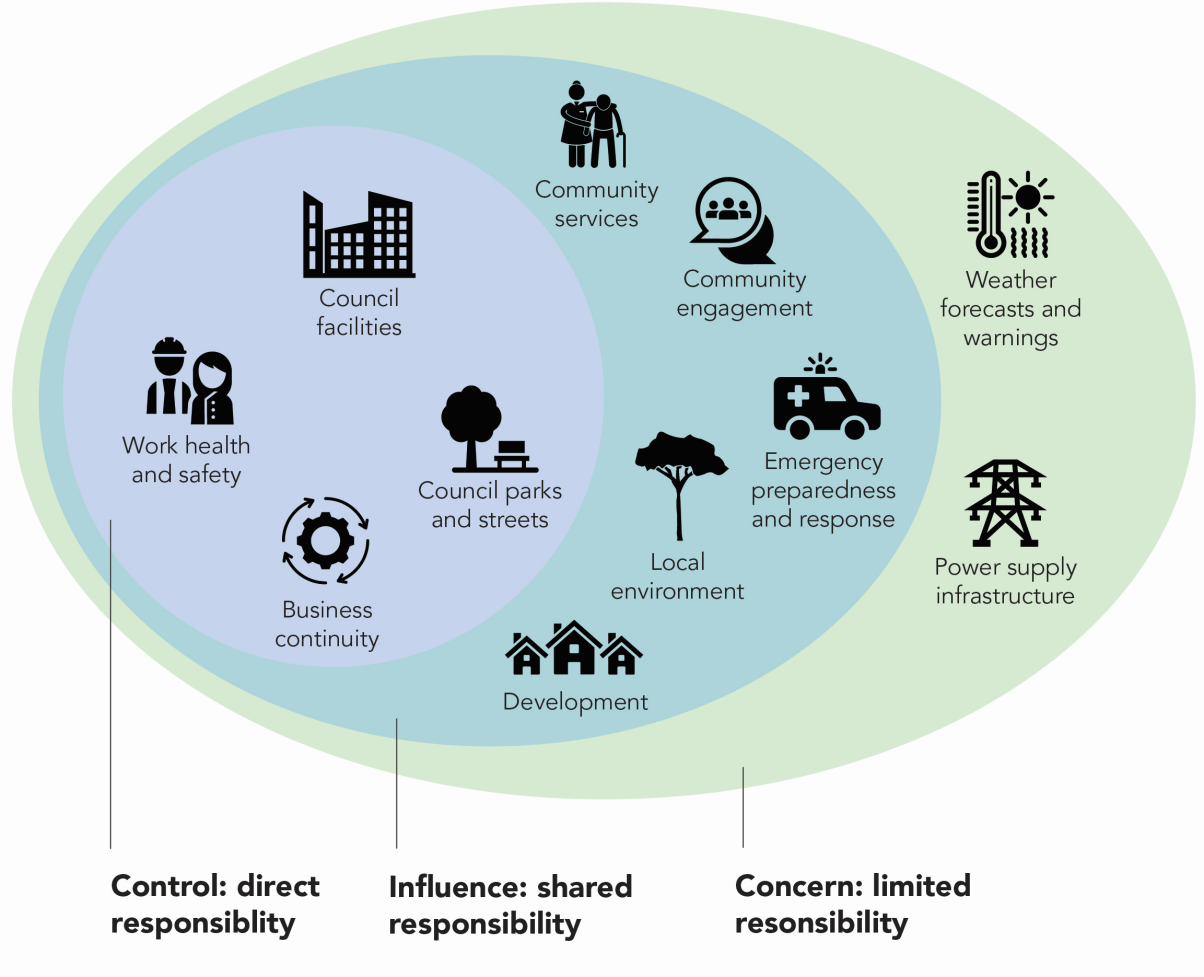


Figure 4: Local government roles in urban heat

3 Analysis of heat risks

Heat risks are multi-faceted, with acute and chronic aspects, and wide-ranging impacts. Everyone is at risk, but some are more vulnerable and need greater support.

Currently there are no standard methods to model or assess heat-related risks. This has been identified in the literature as an area for further research (Nazarian, et al., 2022) and by local policy advocates as a key need that should be addressed at state government level (WSROC, 2021b).

Therefore, the analysis of heat risks undertaken for this strategy presents a thorough picture of heat risks and includes quantitative indicators where possible, but its purpose is to build understanding rather than presenting in-depth quantitative analysis. It is based on current available data and guidance from the NSW Government.

3.1 Hot days and heatwaves

Hot days and heatwaves have specific definitions which are used throughout this document and are important to note when reading the sections below on current and future heat risks.

"Hot days" have been defined in the NSW Government's AdaptNSW climate change snapshots as days where the maximum temperature is greater than 35°C (NSW Office of Environment and Heritage, 2014). This is used as an indicator of the severity of heat in the climate change snapshot.

Heatwaves have been defined by the Australian Bureau of Meteorology (BOM) as "a period of three or more consecutive days of high maximum and minimum temperatures which are unusual for that location" (Bureau of Meteorology, 2023). The BOM uses a quantitative method to analyse heatwave risk based on forecast temperatures, and classify the risk as low-intensity, severe or extreme – see Table 2. The level of risk is based on the magnitude of the "excess heat factor" (EHF), which takes maximum and minimum temperatures over 3 consecutive days and compares them to long-term average temperatures for the location as well as average temperatures for the last 30 days. The same method can be used to analyse past temperatures and identify when heatwave conditions have occurred in the past.

Table 2: Heatwave categories defined by the Bureau of Meteorology

Heatwave categories	Description
Low-intensity heatwaves	The most common—most people are able to cope with this level of heat.
Severe heatwaves	Less frequent and are challenging for vulnerable people such as the elderly—particularly those with pre-existing medical conditions.
Extreme heatwaves	The rarest kind. They affect the reliability of infrastructure, like power and transport, and are dangerous for anyone who does not take precautions to keep cool—even those who are healthy. People who work or exercise outdoors are particularly at risk.

3.2 Past and current climate

Wollongong's past and current temperature records have been analysed using the following data (maximum and minimum temperatures):

- Data from Bellambi Automated Weather Station (AWS) (Stn. No.068228) for the last 20 years (2003-2022).
- Data from Wollongong University (Stn. No. 068188) for the period 1970-2000, which is used as the reference period for the long-term average, in the calculation of excess heat factor (EHF).

This has shown:

Wollongong currently experiences less than 10 hot days per year

Based on data from Bellambi AWS, during the last 20 years (2003-2022), Wollongong experienced hot days (maximum temperature >35°C) 39 times, i.e. an average of 2 days per year. These occurred in 16 out of the 20 years, with a maximum of 6 days in the summer of 2015-16. A plot of hot days is shown in Figure 5.

Low intensity heatwaves occur most years

Based on the BOM's definition of a heatwave, low-intensity heatwaves occur most years (17 out of the 20 years 2003-2022), and on average there are approximately 10 days per year that are classed as heatwave days. Note that NSW Office of Environment and Heritage (2015) states that across all parts of NSW there are typically around 10 to 15 days each year that are classed as heatwave days.

Significant heatwaves have occurred in November 2020, November 2015 and February 2011

Several significant heatwaves, with very high excess heat factor[1], are evident in Figure 6 including:

- **November 2020**: after a maximum temperature of 32.2°C on 28 Nov, the following 2 days had maximum temperatures of 39.3 and 39.7°C, while it only dropped to a minimum of 22.4°C overnight.
- **November 2015**: on 18 Nov the temperature reached 36.1°C, there was some relief on 19 Nov (25.1°C) then it reached 39.8°C on 20 Nov, after an overnight minimum of 20.1°C.
- **February 2011**: this event was prolonged, with overnight minimum temperatures above 21°C for six consecutive nights, 1-6 Feb, reaching a high of 24.5°C on 6 Feb. Daytime temperatures were also high, averaging 32°C over 1-6 Feb and peaking at 39.5°C on 5 Feb.

Not all heatwaves occur in the 'summer' months. The summer of 2015-16 included multiple heatwaves, the first in early October (which reached EHF>30; likely to be considered severe). In 2018, the latest heatwave of the season occurred in April.

January 2018 was likely also a significant heatwave event

In **January 2018**, there was a significant heatwave in the Greater Sydney region but data is missing from the Bellambi AWS. The event was described in a local news report, which highlights the crowds at Wollongong's beaches during the heatwave (Illawarra Mercury, 2018).

All the heatwave events listed above affected large areas of NSW. News reports and research papers on these events are either Sydney-focused or encompassing a larger area. For example, an analysis of

[1] Note that in the BOM's heatwave method described above, it is not clear exactly which events would be classified as severe or extreme, as in the BOM's method this is based on a complex statistical analysis, which is not easily replicated.

hospital emergency department (ED) and ambulance data from February 2011 showed that across a region extending from the Hunter to the Illawarra and inland to Lithgow and Goulburn, there were 104 and 236 ED visits for heat effects and dehydration respectively, and 116 ambulance calls for heat exposure, while all-cause ambulance calls increased by 14% and all-cause mortality increased by 13% (Schaffer, et al., 2012).

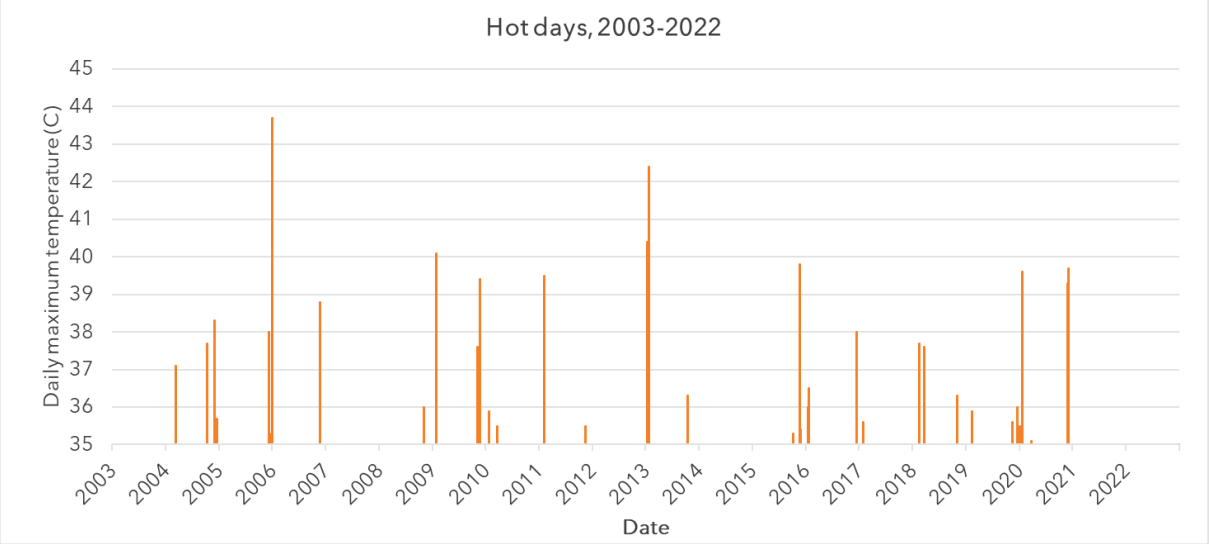


Figure 5: Hot days recorded at Bellambi AWS, 2003-2022

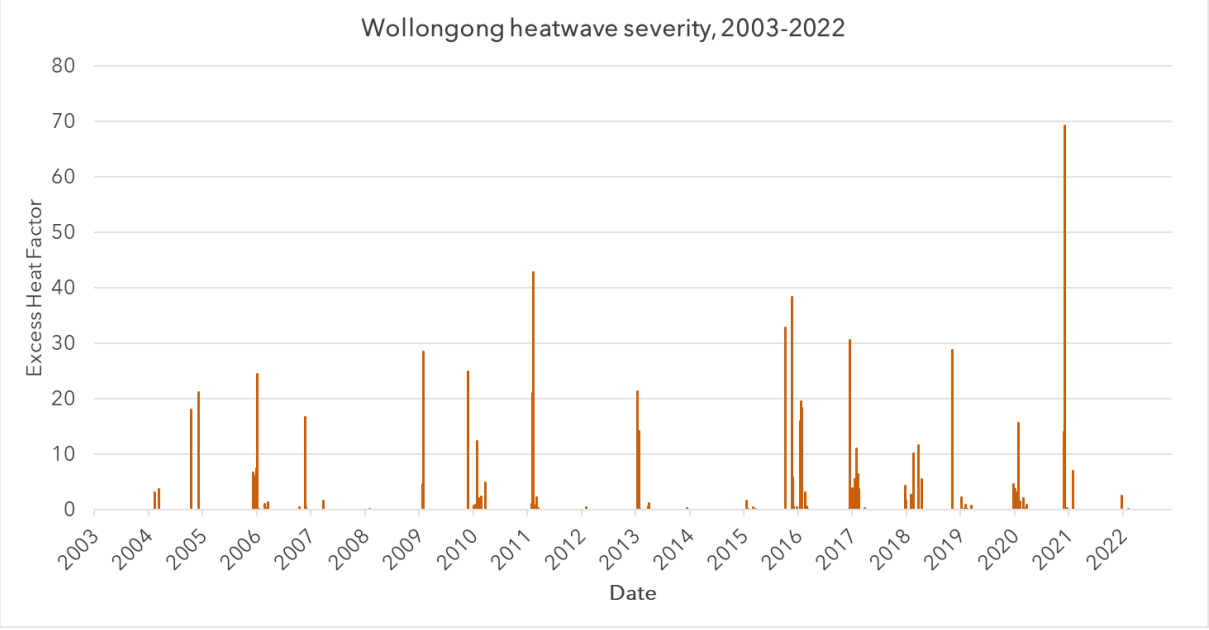


Figure 6: Excess heat factor indicating heatwave conditions, based on temperatures recorded at Bellambi AWS, 2003-2022

3.3 Climate change projections

A summary of the expected impacts of climate change is available in the AdaptNSW Illawarra climate change snapshot (NSW Office of Environment and Heritage, 2014) and heatwave impact snapshot (NSW Office of Environment and Heritage, 2015a).

These snapshots are based on climate change scenarios modelled in NARCliM version 1.0. This includes a suite of twelve regional climate projections for south-east Australia spanning the range of likely future changes in climate (NSW Office of Environment and Heritage, 2014). While NARCliM 1.0 and the snapshot reports are now almost ten years old, they remain the best information currently available at an appropriate scale.[2] NSW Government's Climate Change Adaptation Strategy (NSW Government, 2022) commits to updating local climate projections, scenario analysis and risk assessment in the coming years, therefore Wollongong City Council should also be able to update their assessment of climate-related risks as these resources become available from the NSW Government.

The Illawarra climate change snapshot (NSW Office of Environment and Heritage, 2014) shows that in the Illawarra, average maximum temperatures, average minimum temperatures and the number of hot days are all expected to increase in the future. Details are listed in Table 3.

The NSW heatwave snapshot (NSW Office of Environment and Heritage, 2015a) shows that heatwaves will occur more often and last longer. These changes are more pronounced in Western NSW than along the coast, but are still significant for Wollongong. In Western NSW heatwave amplitude (the hottest day of the hottest heatwave) is also expected to increase, but no significant increase in heatwave amplitude is expected in coastal areas. Heatwave details are also listed in Table 3.

Table 3: Expected future increases in key heat indicators in the Illawarra (NSW Office of Environment and Heritage, 2014) and (NSW Office of Environment and Heritage, 2015a)

Indicators	Expected increase in the near future (2020-2039)	Expected increase in the far future (2060-2079)
Average **maximum temperatures**	**+0.7°C**	**+1.9°C**
Average **minimum temperatures**	**+0.6°C**	**+2.0°C**
Annual **number of hot days**	**+2 days** (0–3 days per year across the 12 models)	**+5 days** (2–7 days per year across the 12 models)
Total number of **heatwave days** per year	**+0.9-1.5 days**	**+3-5 days**
Number of heatwaves per year	**+0.9-1.5 more**	**+2.5-3.5 more**
Heatwave duration (of the longest heatwave of the year)	**+1.5-2.5 days**	**+3-5 days**

[2] Note that NARCliM 1.0 scenarios were based on the IPCC 4th Assessment Report and the A2 emissions scenario (the most likely scenario at that time). IPCC's emissions scenarios have been updated for the more recent 5th and 6th IPCC Assessment Reports. NARCliM is currently being updated and NARCliM 2.0 will use a combination of IPCC's CMIP6 GCMs and regional climate models (RCMs) for 1951-2100 using multiple future climate scenarios. This dataset is due for release in 2023. There is also NARCliM 1.5 released in 2020, but NARCliM 1.5 is only recommended for use in combination with NARCLiM 1.0 data, or for stress testing against a hotter drier future. See NSW Climate Data Portal for more information.

With El Niño conditions predicted again by the end of 2023, and the indication that global temperature could surpass 1.5°C warming within the next 5 years, there is greater likelihood of hot days and heatwaves in the near future.

Heatwaves, hot days, and higher background temperatures (independently of heatwaves), are known to lead to increased morbidity and mortality, however local effects are difficult to predict. NSW Office of Environment and Heritage (2015) refers to international studies indicating an expected increase in heatwave mortality due to climate change, however this report makes no quantiative estimates of future heatwave mortality in NSW, stating that "although it is currently known that the intensity of a heatwave affects mortality and morbidity levels, it is unknown how this particular heatwave characteristic would combine with the projected increases in the other characteristics (i.e. frequency and duration) to affect human health" (NSW Office of Environment and Heritage, 2015a, p. 10).

3.4 Local heat vulnerability

Heat is a multi-faceted hazard which has a wide range of impacts on people, the environment, infrastructure and the economy. These impacts vary from place to place depending on the exposure, sensitivity and adaptive capacity of the local community, environment, infrastructure and systems. Figure 7 shows a basic framework combining these factors.

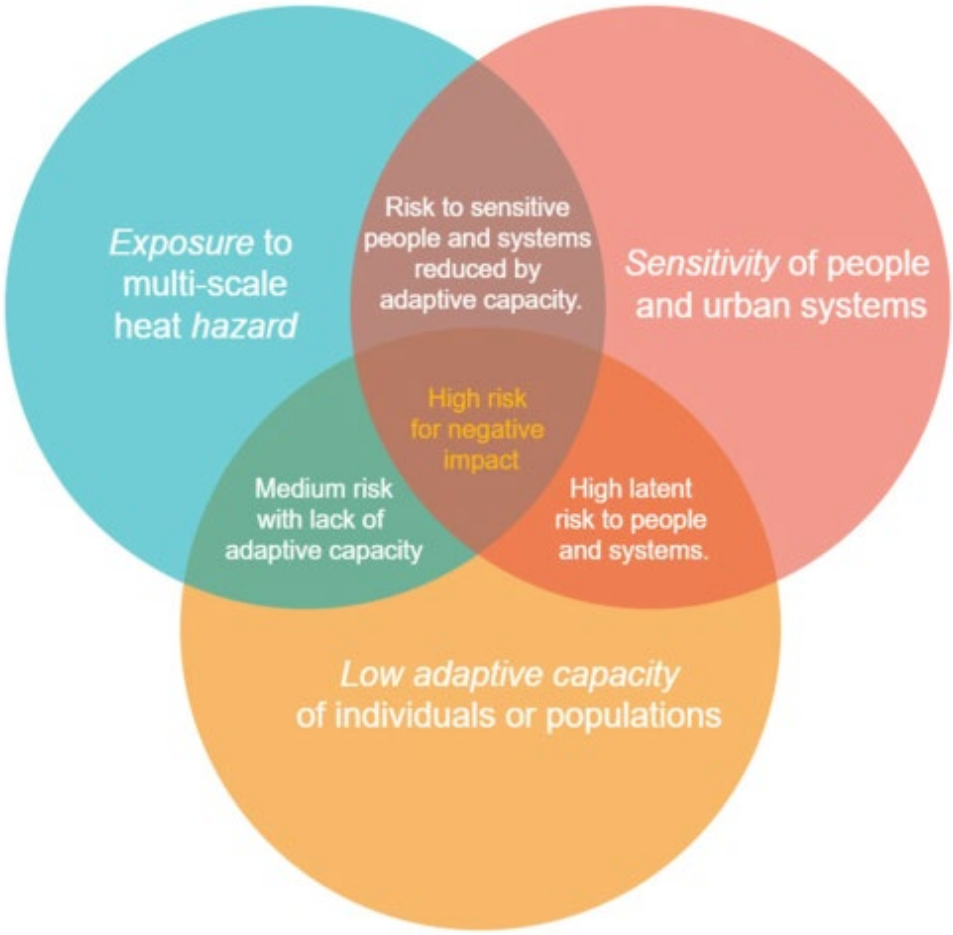


Figure 7: Heat vulnerability framework (Nazarian, et al., 2022)

Figure 7 notes that heat is a *multi-scale hazard*, and the meaning of this is illustrated in Figure 8. Heat risks can occur at multiple levels and cascade from one level to another. For example:

- When regional scale systems are under stress (e.g. transport and power supply infrastructure) this has flow-on effects at a local scale and limits individuals' capacity to adjust their behaviour to cope with heat.

- The urban heat island effect exacerbates the impacts of heatwaves for people living in urban areas. It can also exacerbate air pollution.
- At a smaller scale, the local microclimate is influenced by conditions in the immediate surroundings including building materials, vegetation and water in the landscape. Heat sources such as air conditioning systems can also have an impact on local microclimate, particularly where they exhaust heat near ground level.
- Buildings that perform poorly in terms of their indoor thermal environment are more hazardous for their occupants.

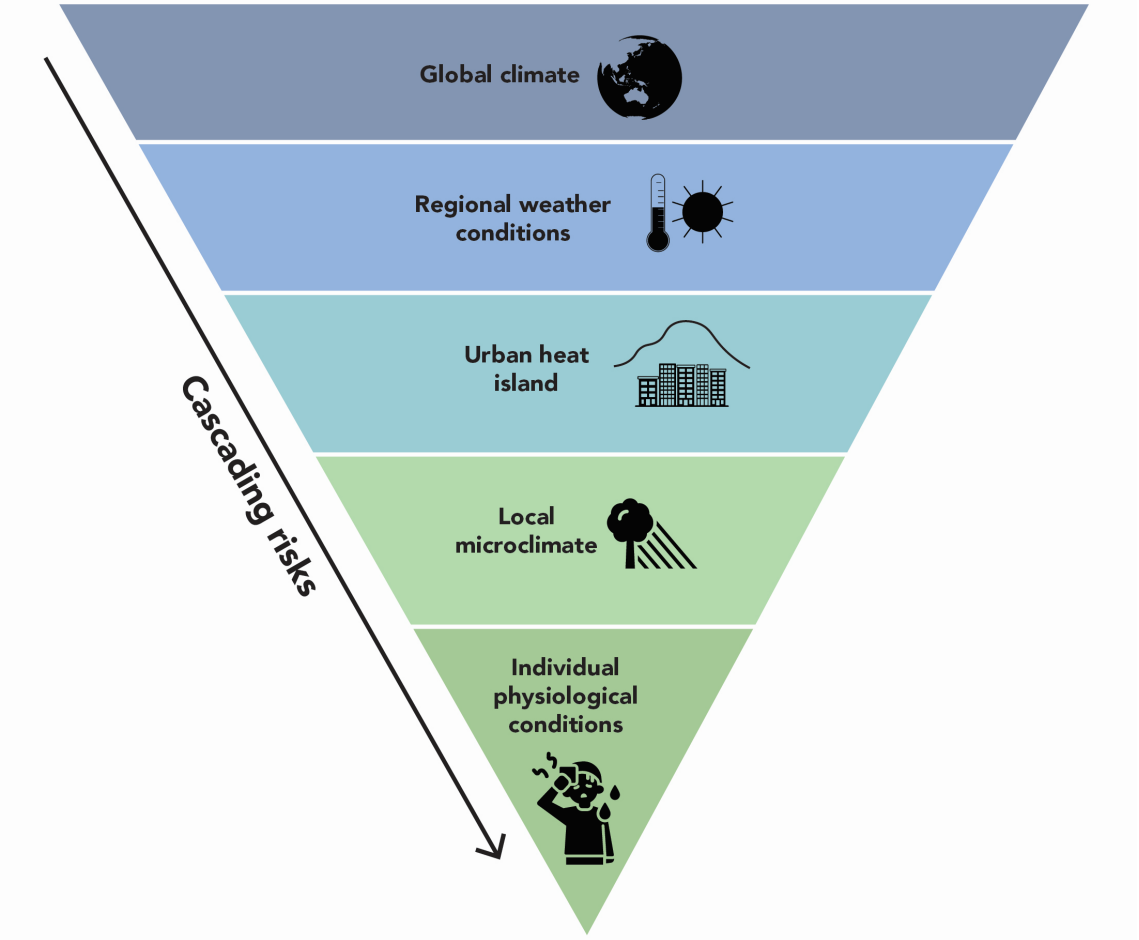


Figure 8: Multi scale hazards associated with heat

Factors which make some individuals more vulnerable to heat were listed in Figure 2. These included:

- Factors which make some individuals more sensitive to the impacts of heat, such as age (>65 or 0-4) and underlying medical conditions.
- Factors which reduce individuals' adaptive capacity, such as social disadvantage, isolation, disability, and having a CALD background.

The following sections examine the vulnerability of the local community, the environment, and Council as an organisation, through the lenses of exposure, sensitivity and adaptive capacity.

Local community vulnerability

NSW Government has published a heat vulnerability index dataset for the Sydney Greater Metropolitan Area (NSW Department of Planning and Environment, 2019). A heat vulnerability index (HVI) has been calculated as a score of 1-5 and mapped to Australian Bureau of Statistics (ABS) Statistical Area Level 1 (SA1) polygons. The HVI data for the Wollongong LGA is shown in Figure 9.

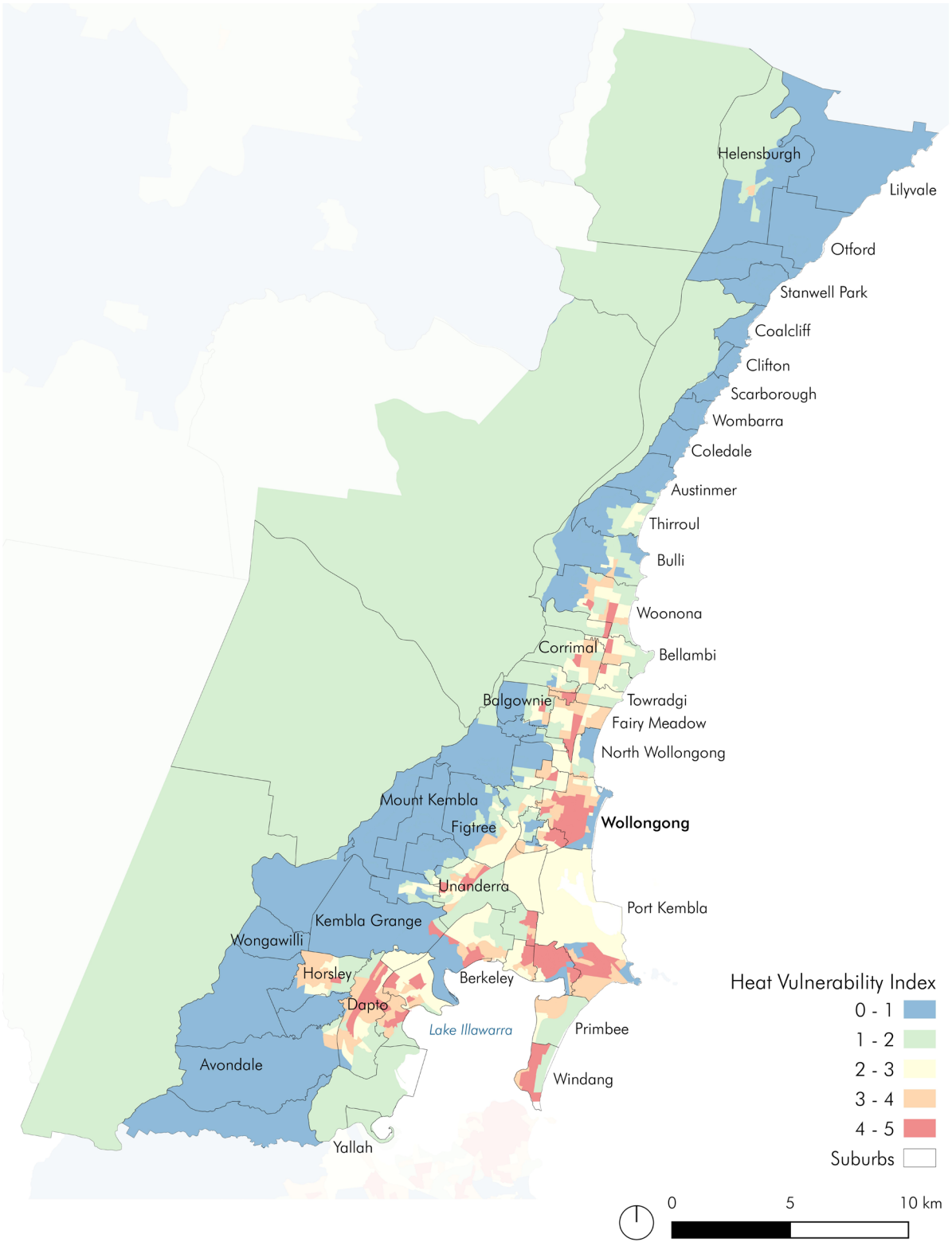


Figure 9: Heat Vulnerability Index for Wollongong LGA (NSW Department of Planning and Environment, 2019)

The HVI index is based on three separate sub-indices for exposure, sensitivity and adaptive capacity, which have also been assessed on a 1-5 scale. The user guide for NSW Government's urban heat data states that "HVI has been derived from the analysis of Land Surface Temperature data from Landsat 8 with vegetation cover data, integrated with socio-economic data from the 2016 ABS Census" (NSW

Government, 2019, p. 3). The metadata statement provides some further information about the datasets used as input to each index, and this is summarised in Table 4.

Table 4: Datasets used in the NSW Government 2016 HVI mapping

Sub-indices	Sources of data	
	As stated in metadata	**What this is understood to mean**
Exposure	"Temperature classes"	• Either land surface temperature (LST) or UHI temperature anomaly (as shown in Figure 1) based on CSIRO analysis of 2015/16 satellite imagery (Devereux & Caccetta, 2017).
Sensitivity	"Vegetation area, road area, population density, elderly, very young, persons needing care"	• Vegetation area (and possibly road area) based on 2016 vegetation cover dataset for Greater Sydney Region, derived from high resolution imagery and aerial photography (NSW Government, 2019). • Population density, age and need for care based on 2016 ABS census data.
Adaptive capacity	"SEIFA-IRSD and SEIFA-IEO"	• SEIFA (Socio-economic indexes for areas), derived from ABS 2016 census data. The IRSD is the Index of Relative Socio-Economic Disadvantage and IEO is the Index of Education and Occupation.

Based on the HVI mapping, seven key areas were identified in Wollongong LGA where heat vulnerability is higher:

1. Area around the Princes Highway from Bulli to North Wollongong
2. Wollongong CBD
3. Area around the Princes Highway from Figtree to Unanderra
4. Suburbs north of Lake Illawarra – Berkely to Port Kembla
5. Suburbs east of Lake Illawarra – Primbee and Windang
6. Suburbs west of Lake Illawarra including Brownsville, Dapto, Penrose, Kanahooka and Koonawarra
7. West Dapto Urban Release Area (where the developed area at Horsley provides an indication of the likely conditions that will occur across the whole urban release area after development).

These areas are shown in Figure 10 and their average exposure, sensitivity and adaptive capacity have been plotted in Figure 11. Figure 11 shows that:

- Areas 2, 4 and 5 stand out as having high sensitivity to heat.
- Areas 4, 5 and 6 stand out as having low adaptive capacity.
- The developed portion of Area 7, at Horsley, stands out as having high exposure. New development often has high heat exposure, before trees grow larger, but most of Horsley was developed around 20 years ago and exposure is still very high.

Note that the exposure index in the HVI, based on land surface temperature, gives a picture of the physical conditions on the ground but does not take into account all the local weather conditions which also affect people's exposure to heat (for example, humidity and wind). During hot weather and heatwaves, weather conditions can also be more severe in some areas than others. For example, local residents will be aware that sea breezes are more likely to have a cooling effect in the suburbs immediately adjacent to the coast (e.g. Areas 1-5) and less likely to reach Areas 6 and 7 west of Lake

Illawarra. However, weather conditions can vary from one event to another. The HVI is useful to understand the underlying conditions before other factors are imposed by the weather.

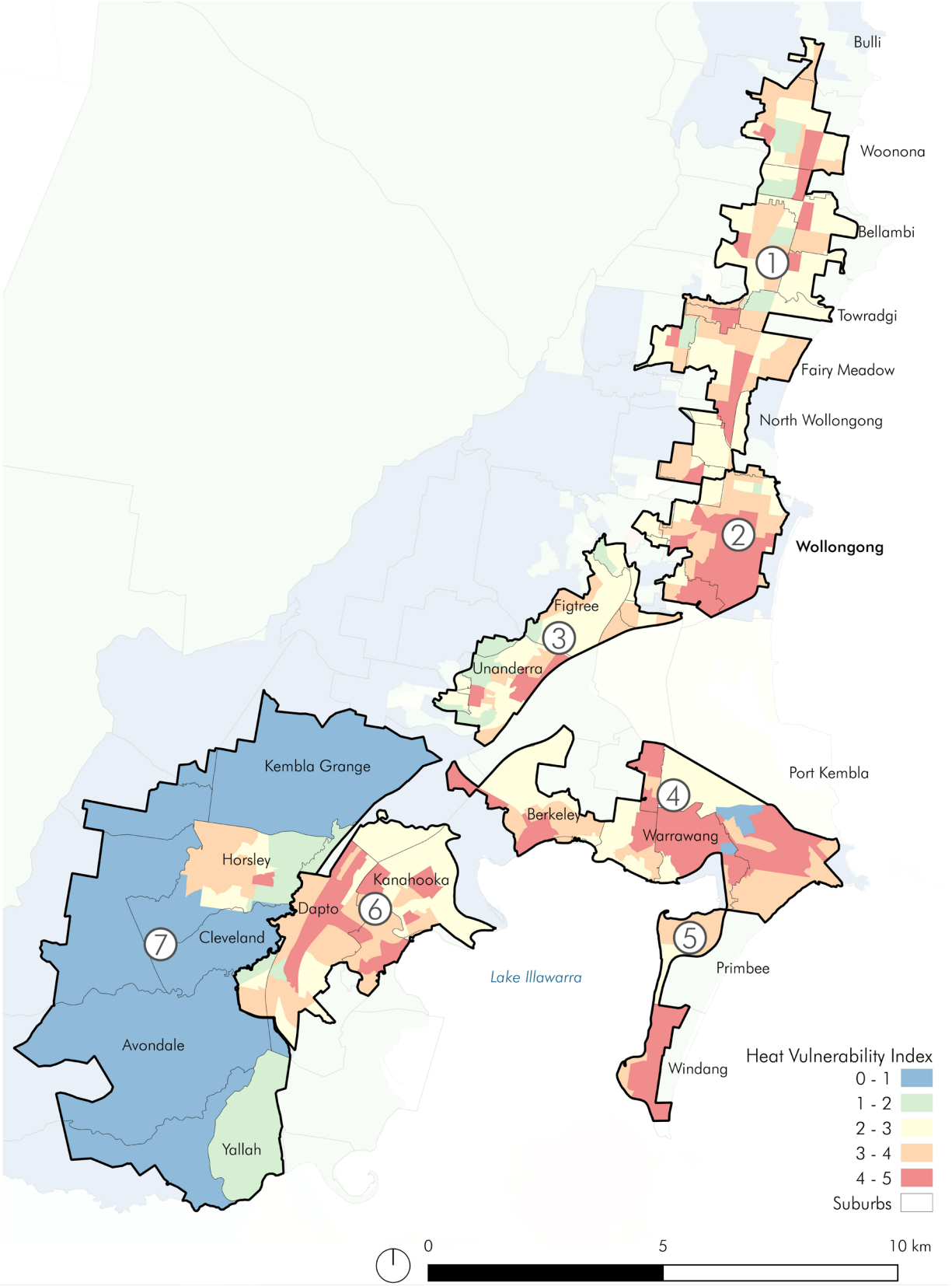


Figure 10: Focus areas in the Wollongong LGA where heat vulnerability is higher

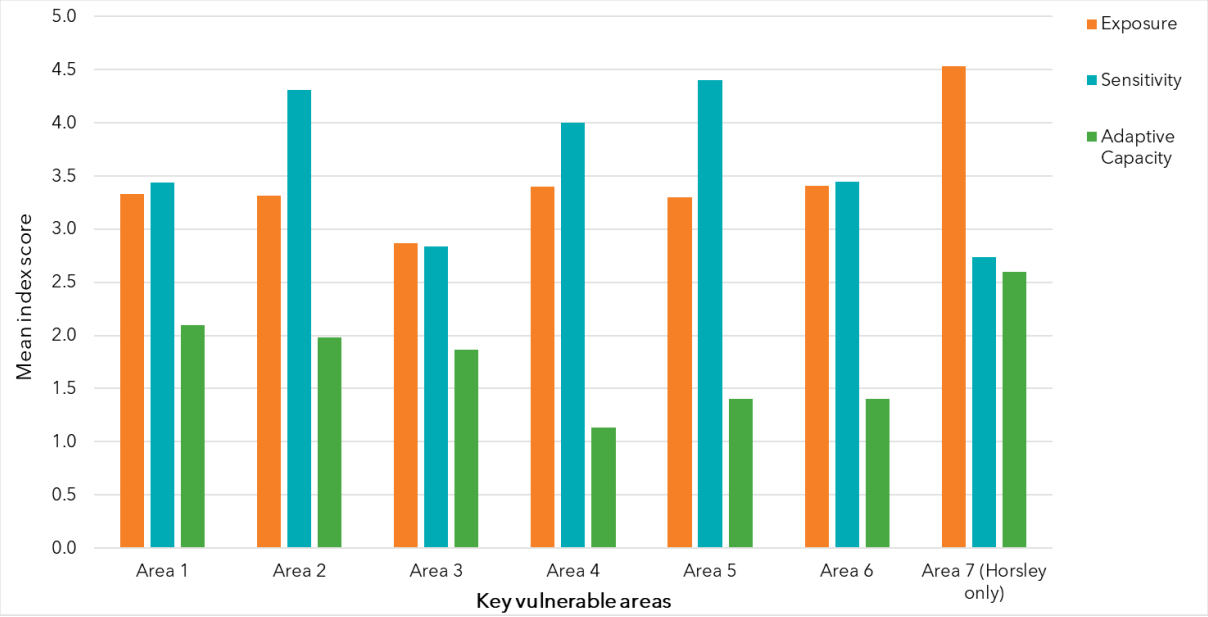


Figure 11: Characteristics of the areas in Wollongong LGA more vulnerable to heat

Local environmental vulnerability

Many local ecosystems and species are vulnerable to the impacts of heat. The Illawarra Biodiversity Strategy (Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, 2011) identifies local Endangered Ecological Communities (EECs), endangered populations, threatened species and critical habitat in the area. It identifies climate change as a key threat to biodiversity in general, with a range of direct and indirect impacts. Specific communities and types of species identified at risk, where heat is a relevant factor, are summarised in Table 5.

Table 5: Ecological communities and species vulnerable to heat-related impacts of climate change in the Illawarra (Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, 2011, Vol 2. p.19)

Type	Heat-related threats
Freshwater wetlands	Increasing threat from decreasing water flows and changes in water temperature and chemistry.
Rainforest	Increased evapotranspiration leading to decreased moisture levels / humidity.
Species at the northern limits of their range	Species likely to shift range to cooler latitudes or higher elevations.
Species and communities already stressed due to fragmentation	This applies to all vegetation of the Illawarra coastal plain.
Species with geographically restricted distributions and specialist habitat requirements	Many of the threatened and rare species in the Illawarra. Potential to migrate is more likely to be constrained by habitat fragmentation or other barriers.
Areas vulnerable to high fire intensity and frequency	Vast areas of the sandstone plateau, and escarpment.

Climate change and heat impacts are also relevant to urban green infrastructure. Urban trees are particularly vulnerable because of their long lifespan and inability to move to a cooler location. Urban vegetation is exposed to regional weather (e.g. heatwaves), the UHI effect and local effects from surrounding buildings and other infrastructure. Urban vegetation is also often exposed to other stresses which compound the effects of heat, including water stress, limited soil volume and competition for space.

Environmental health risks are also exacerbated by heat:

- **Recreational water quality**: Algal blooms may contaminate natural water bodies used for recreation, such as Lake Illawarra, which is vulnerable to eutrophication. Algal blooms are more likely during hot conditions.
- **Air quality**: "Elevated ozone levels in the Illawarra region can occur as a result of photochemical smog produced from local emissions, smog or precursors transported down the coast from the Sydney region, or emissions from regional bushfires. Exceedances of the 1-hour and 4-hour ozone national standards generally occur during the warmer months of the year, with peaks coinciding with periods of high temperature and with regional bushfire events." (NSW Office of Environment and Heritage, 2015b, p. 42)
- **Food safety**: "Higher air temperatures can increase cases of salmonella and other bacteria-related food poisoning because bacteria grow more rapidly in warm environments… Food safety can also become an issue if blackouts cause refrigeration to be interrupted." (NSW Department of Planning, Industry and Environment, 2019, p. 9).

Organisational vulnerability including Council infrastructure, workforce and services

Local government infrastructure, facilities, systems, staff and contractors are exposed to heat and have varying levels of vulnerability to its impacts. Council staff identified potential heat-related vulnerabilities relevant to Wollongong City Council, these are summarised in Table 6. This includes both direct issues (e.g. heat stress for outdoor staff) and indirect issues (e.g. impacts of increased demand for Council facilities).

Table 6: Organisational vulnerabilities

Areas of Council's operations	Likely pressures	Potential vulnerabilities
Council buildings open to the public, including Council's 7 libraries, and 30 community centres and halls.	Increased demand on hot days, as people seek relief from hot conditions.	Potential for buildings (with and without air conditioning) to become uncomfortably hot during heatwave conditions and possible heat-related power cuts.
Swimming pools operated by Council, including 6 freshwater chlorinated pools, 3 saltwater pools, and 9 rock pools.	Increased demand on hot days, as people seek relief from hot conditions.	Increased use for bathing may result in the need for increased cleaning and disinfection for swimming pools. Swimming pool operations could be compromised by heat-related power cuts.
Beaches patrolled by Council.	Increased demand on hot days, as people seek relief from hot conditions.	Potential increase in incidents (e.g. first aid issues, surf rescues). Increased demand for facilities near beaches such as bins and amenities. Risk of overflows, blockages, etc.

Areas of Council's operations	Likely pressures	Potential vulnerabilities
Other Council recreational facilities such as playgrounds, picnic areas, sports fields, shared paths.	Heat exposure for people using these facilities.	While there may be less demand for these facilities during hot conditions, those still seeking to use them may be exposed to additional risks if surfaces become dangerously hot or if shade and drinking water are lacking.
Local roads and parking facilities managed by Council.	Increased traffic and demand for parking where people are trying to access cooler places.	Increased risk of traffic and parking incidents. If there is significant congestion, people may be exposed to additional heat stress while trying to access cool places.
Events run by Council.	Heat exposure for event participants.	Event organisers need to be aware and plan contingencies for hot weather and heatwave conditions.
Communication and engagement	Increased need for locally relevant information on what to do during heatwave conditions.	During extreme events, local communities look to Council for locally relevant information (e.g. in their language, available locally, with information about local services and facilities). NSW Health has useful resources on the Beat the Heat web page, and public messaging is part of the NSW Heatwave Subplan (NSW Government, 2023), but Council should still be prepared to meet specific local needs (as occurred during the Covid-19 pandemic).
Community transport services including Free Gong Shuttle.	Increased need for services, particularly for vulnerable people seeking cooler places.	Potential for vehicles to become uncomfortably hot during heatwave conditions. Potential for community transport volunteers to be adversely affected by heat.
Workforce including staff, contractors and volunteers	Increased demand for some services. Heat exposure for workers.	Continuity of essential services. Capacity to respond to additional community needs during heatwaves. Work health and safety procedures need to be in place for staff, contractors and volunteers.
Trees and other urban green infrastructure maintained by Council.	Heat stress for vegetation. Increased bushfire risk in transitional landscapes.	Risk of vegetation die-off and dieback, particularly for species more vulnerable to heat and those experiencing multiple stresses. Risk of failure for new plantings if not yet fully established. Need for additional watering where this is feasible.
Civil infrastructure.	Additional stress on infrastructure due to hotter conditions and greater extremes.	Increased maintenance and more frequent renewal may become necessary. For example, asphalt roads wear faster in hotter conditions and can buckle in extreme heat. Concrete pavement performance is sensitive to changes in daily temperature range.

Areas of Council's operations	Likely pressures	Potential vulnerabilities
Public domain planning and design services (e.g. park and streetscape upgrades, public buildings).	Growing expectation for Council's works and projects to minimise UHI, create cool microclimates and support cool indoor environments.	Council's staff and consultants need to know how to plan and design cooler places, while also balancing other objectives. Council may need to trial new approaches (e.g. using different materials) on a small scale before rolling out more broadly.
Development planning and approvals.	Growing expectation for new private development to be designed to minimise UHI, create cool microclimates and support cool indoor environments.	Where possible, Council's LEP and DCP should enable appropriate design outcomes that minimise heat impacts of development. However, many developments follow other approval pathways and outcomes are beyond Council's control.
Emergency management.	Greater likelihood of extreme heatwaves requiring emergency response.	The NSW Heatwave Subplan (NSW Government, 2023) does not consider councils' role, and the local EMPLAN (Illawarra Local Emergency Management Committee, 2020) classifies heatwaves as a medium priority, which means has been no requirement to prepare a local Heatwave Consequence Management Guide.

3.5 Heat impacts

Heat-related hazards, vulnerabilities and impacts relevant to Wollongong City Council, as discussed in the sections above, are summarised in Figure 12. This shows how:

- Heat-related hazards include a range of different events, ranging from more frequent, less severe events (e.g. hot days) to less frequent, more severe events (e.g. severe and extreme heatwaves). Climate change increases the likelihood of all these events occurring.
- The community, environment, infrastructure and systems are vulnerable in different ways to different types of heat events.
- There a wide range of potential impacts relevant to Wollongong City Council, relevant to many different parts of the organisation.

What is not illustrated in Figure 12 is how there is also interaction between different vulnerabilities and impacts – for example, stress on electricity infrastructure can lead to power supply issues, affecting people's ability to cool their homes. Human behaviour during heatwaves (e.g. flocking to the beach) puts stress on public infrastructure. Essential workers may find themselves both under heat-related stress and higher demand in their roles.

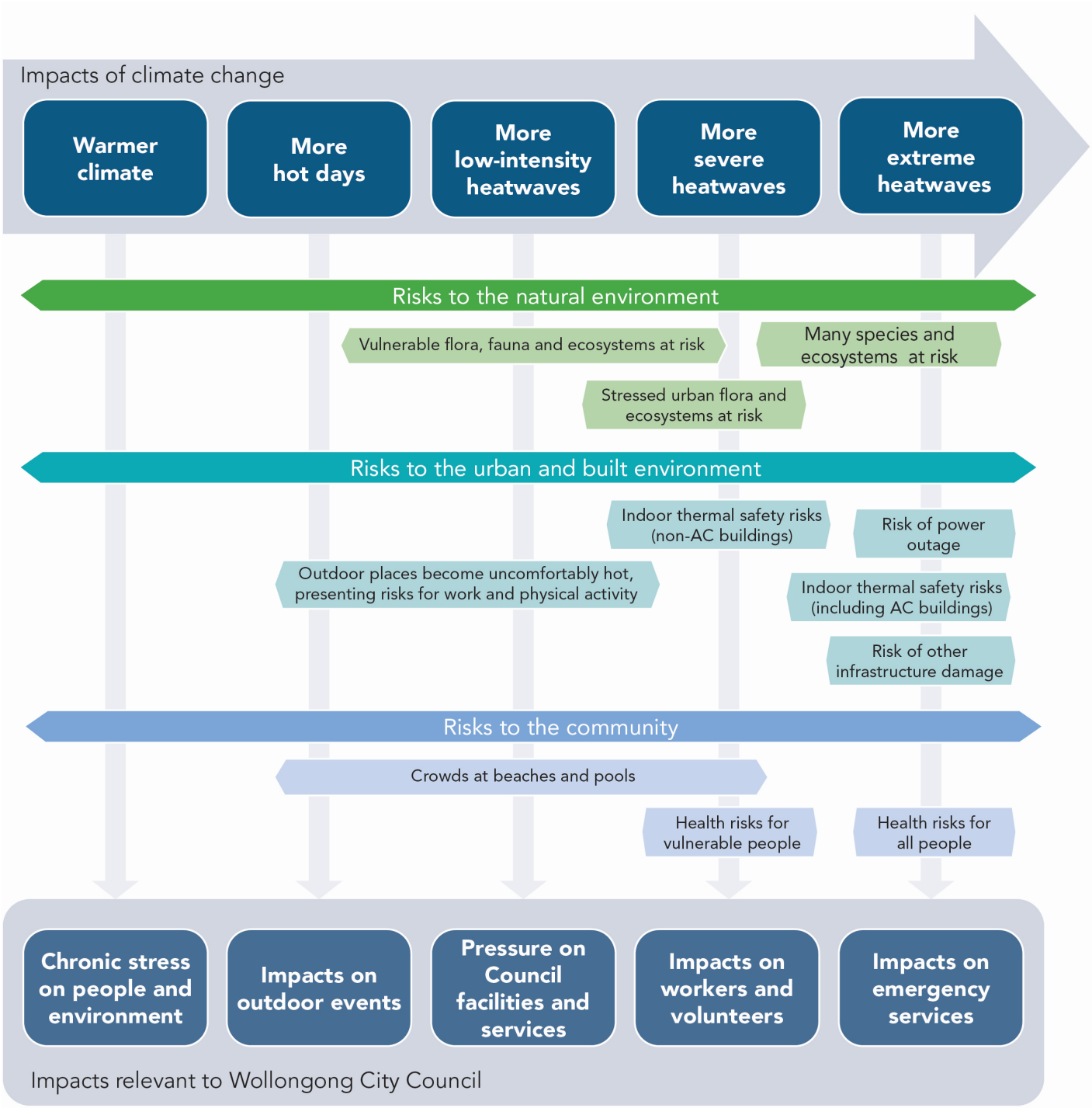


Figure 12: Heat impacts relevant to Wollongong City Council

4 Strategic directions

Wollongong City Council has important opportunities to improve their organisational capacity and reduce heat-related risks to the local community and environment.

Four overarching goals are described in the following sections:

1. **Community:** Minimise the impacts of heat on the Wollongong community.
2. **Natural environment:** Minimise the impacts of heat on the local environment.
3. **Workforce:** Plan and prepare Council's workforce for more frequent hot days and heatwave conditions.
4. **Built environment:** Plan, design and manage urban infrastructure to reduce the UHI effect, create cooler microclimates and support indoor thermal comfort.

Collaboration is also discussed in Section 4.5 as an important principle underpinning Council's approach.

4.1 Goal 1: Minimise the impacts of heat on the Wollongong community

Wollongong City Council has important opportunities to influence heat-related outcomes for the community through its roles in operating public facilities and providing public services, in communication and engagement, working with community service providers, and in local emergency planning.

The Climate Change Adaptation Plan included the following short-term and priority actions relevant to minimising the impacts of heat on the Wollongong community:

- Continue to consider the impact of heat on council services and the community as part of ongoing strategic planning.
- Summertime outdoor event planning will need to include extreme heat contingencies such as shading, water stations, alternative date provisions and communication strategies.
- Council will contribute to communicating how heat can be dangerous to health and how to best deal with it.
- Assess the suitability of Council facilities to be utilised for respite centres on hot days. This may include provisions for adequate water and food, power supply and potentially use of recycled water and appropriate landscaping to provide shade.
- Work with government and community stakeholders to promote the care and safety of community members and animals during heat events.

On this last point, Council identified a need for further exploration of how they could work more effectively with other government and community stakeholders to plan and prepare for heat events. See Section 4.5 for more information on how this has been progressed during the preparation of this strategy.

Staff consultation also identified opportunities for Council to consider:

- Planning for hot days and heatwave conditions in the operation of services such as community transport – particularly to consider the needs of vulnerable community members.
- Council's role during more severe and extreme heatwaves, which require a coordinated emergency response.
- Reflecting on experiences and applying lessons learnt from Covid-19 and the importance of working jointly and in coordination with all levels of government, local businesses, and local community service providers to reduce and manage health and economic impacts across the community.

4.2 Goal 2: Minimise the impacts of heat on the local environment

Wollongong City Council cares for the local environment in partnership with other government agencies and land managers. Council manages:

- Natural areas including Greenhouse Park, sections of the Illawarra Escarpment, Korrongulla Wetland, Mount Keira Summit Park, Puckeys Estate and Wollongong Botanic Garden.
- Waterways on Council land, including about 40 per cent of our area's creeks. Council shares responsibilities for some other waterways, for example Lake Illawarra is managed in partnership with Shellharbour City Council and the NSW Government.
- Urban green infrastructure in Council streets, parks, and open space.

The Climate Change Adaptation Plan included the following short-term and priority actions relevant to minimising the impacts of heat on the local environment:

- In partnership with Land Management Agencies and other Botanic Gardens, develop translocation programs for threatened Illawarra flora susceptible to mean temperature increase.
- Establish trial plantings of native tree species suited to predicted future climate for suitability and use in streets and parks.
- Review maintenance requirements for urban greening plantings - increased watering may be required to support recently planted vegetation.

Staff consultation also identified an opportunity for Council to look more closely at heat risks as an important consideration in planning for biodiversity corridors, waterways, foreshores, coastal dunes and other natural areas.

4.3 Goal 3: Plan and prepare Council's workforce for more frequent hot days and heatwave conditions

Staff consultation identified work health and safety as a key area for action. Council's workforce includes employees, contractors and volunteers. Under section 19 of the Work Health and Safety Act 2011, an employer has a legal duty to ensure the health, safety and welfare at work of all employees. Council should consider strategies to ensure the safety and protection of staff on hot days and during heatwave conditions. Note that this duty of care extends to people using council facilities including customers and volunteers.

Council should also consider business continuity in the context of increasing heat risks. Council provides a range of essential services which could be impacted by disruptions such as heat-related power outages and staff absences. Council also faces increased demand for some services during hot days and heatwave conditions. Business continuity planning should consider how essential services can be maintained, which may require contingency plans to be enacted during heat events.

The Climate Change Adaptation Plan included one action relevant to organisational preparedness: "Plan for the potential cost impacts of overlapping or more frequent heat events".

This strategy expands on this to cover work health and safety and business continuity in more detail, given the importance of these issues for Council.

4.4 Goal 4: Plan, design and manage urban infrastructure to reduce the UHI effect, create cooler microclimates and support indoor thermal comfort

Urban infrastructure includes buildings, parks, streets and other open spaces, civil infrastructure and green infrastructure. Council has important roles in:

- Planning, design and management of public land and assets – including Council-owned buildings, recreational facilities, streets, parks and open spaces.
- Land use planning and approvals for private development.

There is good evidence for the benefits of heat mitigation technologies, in terms of reducing both UHI intensity and building cooling demand. Research findings suggest that solutions involving the increase of the global albedo of the city (e.g. cool roofs, cool roads, green cover and tree canopy cover) demonstrate the highest benefits, achieving a reduction of peak ambient temperature of up to 3°C and of peak cooling demand of residential buildings of up to 20% (Santamouris, et al., 2018).

There are also growing community expectations for both public and private development to account for heat-related risks and to be designed to cope with increased heat, reduce the UHI effect, create cooler microclimates and support indoor thermal comfort.

The Climate Change Adaptation Plan included the following short-term and priority actions relevant to planning, design and management of urban infrastructure:

- Strategic land use planning must ensure adequate new greenspace is provided as part of land releases and protect riparian corridors from urban development.
- Further investigation of heat in the Wollongong area to understand this issue further and develop appropriate heat management strategies including city design, shade, construction materials and cooling infrastructure.
- Develop and implement a transitional landscape program aimed at increasing shade cover in passive open space precincts across all Parks and Reserves in the LGA
- Undertake a review of existing hardstand surfaces in urban areas and identify opportunities to de-pave unnecessary hardstands (car parks / paved surfaces) and / or prioritise the use of permeable treatments.
- Consider future heat scenarios in the design of new building assets to be able to support employees and community, e.g. passive design approaches (orientation, materials, fenestration, build-in shading etc.), air conditioning, environmental controls and suitable power supply.
- Investigate road surface treatment options to increase performance in hot weather.

4.5 Collaboration

Council's 2022 Climate Change Adaptation Plan clearly identified that climate change impacts such as heatwaves cannot be addressed in silos or by any one organisation. A collaborative coordinated and multi-layered response will be required to adapt to changes in climate. A network of organisations, each working to their strengths but acting in coordination, will have a more significant impact on addressing heatwaves and hotter temperatures.

Local community service providers are a key network of organisations that play a critical and direct service delivery role with communities. This has been highlighted during a recent NSW inquiry into improving crisis communications to CALD communities (NSW Legislative Assembly, 2023), following the COVID-19 pandemic. The inquiry found that "CALD community organisations gave vital support to their communities during COVID-19" and that "Collaboration between different levels of government, and CALD community organisations and networks is vital to effective communication with CALD communities during crises". CALD and other community service providers are uniquely placed to contribute to heatwave preparedness, response and resilience. Local knowledge, community connections and trust allow local service providers to have meaningful conversations about heat safety and, where possible, offer practical advice and support.

These service providers are:

- Key links for identifying and understanding vulnerable group needs and knowledge around risks.
- Channels to communities for sharing information and supporting action.
- Paths for direct action pre, during and after heatwaves.

During the development of this strategy, there was some initial engagement with community organisations, to begin developing a greater understanding of heatwave experiences, response capacity, and insights into the needs of community service providers and their community groups.

Engagement methods

A review of local community organisations sought to identify and prioritise community service providers that connect with community groups who have a higher-than-average risk of heat-related impacts (see Figure 2). Relevant service providers are:

- Health services, including mental health
- Services for older adults
- Multicultural and cultural associations
- Women's services
- Aboriginal and Torres Strait Islander services
- Community transport services
- Community centres
- Churches and religious groups
- Sporting groups
- Homelessness & low-income support groups
- Disability services
- Community-based advocacy groups
- Food services who interact with vulnerable groups
- Social housing providers

Engagement focused on the following three areas:

- **Understanding local community service organisations** – their key service group/s, their service locations, and if they have any existing working relationship with Council.
- **Understanding the communities that are being serviced by local organisations** – community types, how they are impacted, the barriers they face during heatwaves, their perception of danger to health, and resources that may be helpful.

- **Understanding community organisations' roles, experience, and response during heatwaves** – do they undertake any existing initiatives during heatwaves, awareness of other support initiatives, their experience in witnessing impacts and their ability or capacity to assist, activities that could help them or their organisation to assist, suggestions on activities that Council and government can undertake, and their interest in receiving further information or holding a heat workshop in future.

Engagement methods included phone discussions, meetings and a survey. The following community interagency meetings were attended in May 2023:

- Illawarra Refugee Issues Forum
- Community Centre Network
- Multicultural Communities Workshop

The survey was promoted at each meeting as well as via the Community Industry Group's (CIG) (formerly the Illawarra Forum) e-newsletter on 28 April 2023.

Results of engagement

Local community organisations indicated that heat is a concern for the communities they work with, including older residents, low income groups, culturally and linguistically diverse groups, people living with chronic illness and disability and people experiencing homelessness. Likely impacts of heat include stress regarding energy bills, difficulty getting from one place to another and negative health impacts.

Barriers preventing vulnerable community members from seeking relief during heatwaves include the cost of cooling, social isolation, language barriers, housing conditions, lack of transport and lack of access to air conditioned places. Some comments pointed out that while it is easy for many people in the Wollongong area to get to the beach to cool off, this option is not accessible or appropriate for everyone.

Community organisations indicated that practical assistance to vulnerable community members would be welcome, for example free access to local pools, free items such as door snakes, cool packs or hand held fans. They also pointed out the need for cool drinking water to be more readily available in the public domain, and more trees to be planted to reduce urban heat.

They also indicated that more information would be useful, for example:

- Information on accessing and understanding heatwave warnings
- Guidance on what to do when a heatwave is forecast, and during a heatwave
- Information on staying safe and keeping cool during hot weather
- Information on how to assist a person experiencing signs of heat stress
- A contact list of services who can help during a heatwave

Local community organisations were interested in further engagement, but also face many competing demands for their time – this should be considered in the design of future engagement.

5 Adaptation actions

The following sections outline opportunities for Council to work towards ten objectives, aligned with the four goals.

Table 7: List of objectives

Goals	Objectives
1. Minimise the impacts of heat on the Wollongong community.	1.1. Use Council's communication channels to help get relevant information out to the whole community before heatwaves occur and during heatwave conditions. 1.2. Facilitate community access to cool places (including indoor and outdoor venues appropriate to a range of different needs) on hot days and during heatwave conditions. 1.3. Engage with local community service providers to collaborate on meeting community needs on hot days and during heatwaves. 1.4. Work in partnership with others on the Local Emergency Management Committee to improve the planning for severe and extreme heatwaves requiring a coordinated multi-agency response.
2. Minimise the impacts of heat on the local environment.	2.1. Consider heat-related risks in planning and management of threatened species and ecosystems, biodiversity corridors, waterways, foreshores, coastal dunes, other natural areas and urban green infrastructure in the Wollongong LGA.
3. Plan and prepare Council's workforce for more frequent hot days and heatwave conditions.	3.1. Put appropriate measures in place to manage the health and safety of staff, contractors, volunteers and visitors using Council facilities and services and attending Council events on hot days and during heatwave conditions. 3.2. Put plans in place to continue operating essential services when heat-related disruptions occur.
4. Plan and design urban infrastructure to cope with increased heat, reduce the UHI effect, create cooler microclimates and support indoor thermal comfort.	4.1. Include consideration of urban heat in updates to Council's LSPS, LEP and DCP to strengthen provisions which reduce paved surfaces, enhance shade and canopy cover, retain more water in the landscape and provide cooling amenities. 4.2. Review and improve the UHI and microclimate outcomes in Council's parks, open spaces and streetscapes and seek opportunities to reduce paved surfaces, enhance shade and canopy cover, retain more water in the landscape and provide cooling amenities. 4.3. Review and improve the thermal performance of Council's buildings to raise standards in existing buildings, new buildings and upgrades.

5.1 Communication and engagement

Objective:

Use Council's communication channels to help get relevant information out to the whole community before heatwaves occur and during heatwave conditions.

What Council already does:

- Council uses its website, social media channels, email, post, customer service staff and community noticeboards to share information on a range of issues relevant to the community, including some related to weather – see example in Figure 13.
- Council has a Disaster Dashboard with sections on Covid-19, fires, floods, road and bridge conditions, and service outages. The Disaster Dashboard also includes information on environmental conditions (e.g. weather forecast and warnings).
- Council has experience engaging with local CALD communities and making sure information is accessible to those who need it. During Covid-19, Council played an important role getting information out to the local community.

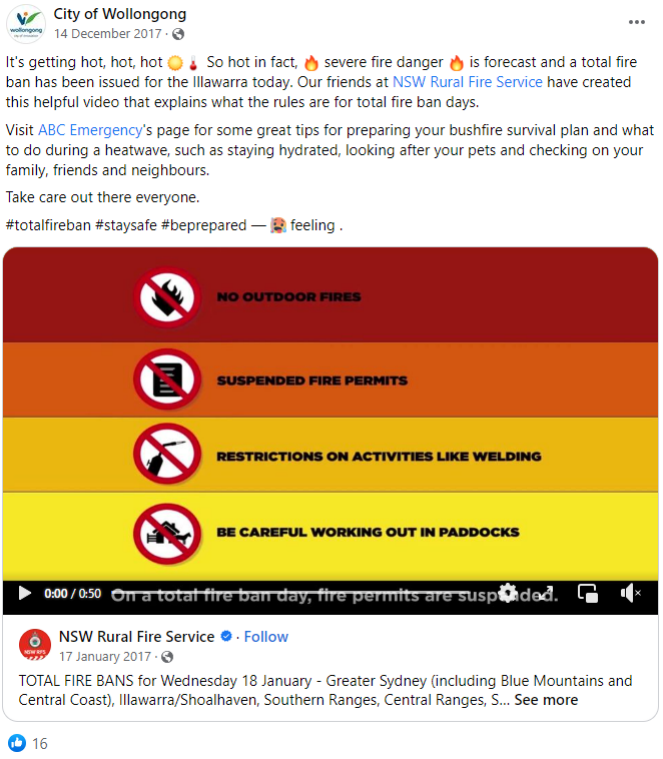


Figure 13: City of Wollongong Facebook post, 14 December 2017

Actions to build on this:

- Develop a communications plan including messages to go out before and during heatwave conditions. Many Victorian local councils have heatwave plans including detailed communication plans (Warrnambool City Council's Heatwave Plan is a good example) and some have produced their own collateral – see example in Figure 14.
- Increase the impact of communications by coordinating planning in collaboration with other local social infrastructure providers including Surf Lifesaving Illawarra.
- Refer to existing information available from other reliable sources including BOM weather forecasts, BOM heatwave warning service (see example in Figure 15) and NSW Government 'Beat the Heat' resources.
- Provide links to other useful resources/services that may help people (especially vulnerable community members) cope during heatwaves – e.g. Telecross (by Red Cross) assists eligible vulnerable and isolated people by calling them daily.

- Develop tailored local information on topics of importance to the local community. Examples of tailored local information could include:
    - Information about what kind of measures work best to stay cool in Wollongong's local climate and weather conditions – to help people prepare.
    - Messages about cool places people can access in the local area – including an invitation to come in when heatwave conditions are current.
    - Information sessions for local community groups.

Note WSROC's recommendation that "The NSW Heatwave Sub Plan identifies NSW Health as responsible for educating the public regarding actions to prevent, reduce or respond to extreme heat. The Beat the Heat campaign provides key messages, however these must be expanded in scope. Further tailored messaging and channels to suit local audiences is required." (WSROC, 2021b, p. 36).

Figure 14: One of many heat health communications materials from City of Yarra

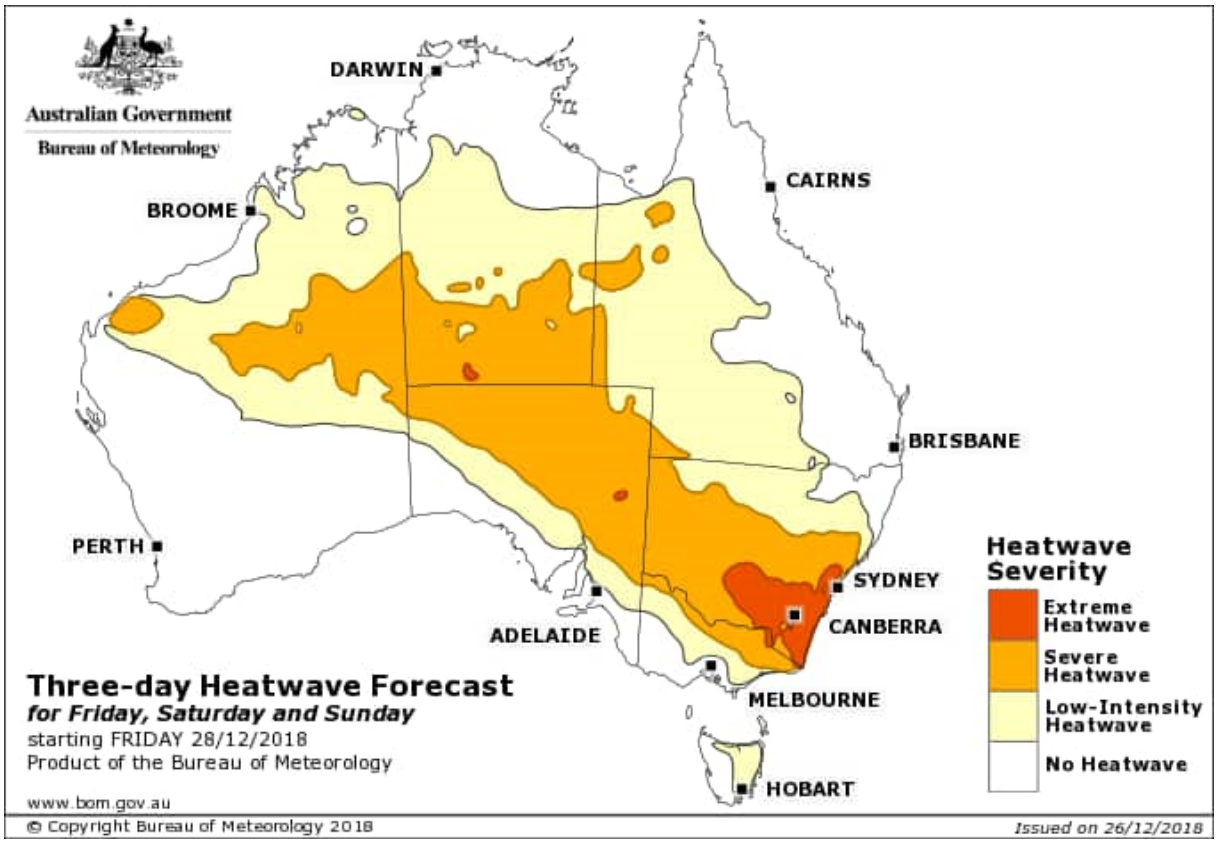


Figure 15: Example heatwave warning from BOM

5.2 Access to cool places

Objective:

Facilitate community access to cool places (including indoor and outdoor venues appropriate to a range of different needs) on hot days and during heatwave conditions.

What Council already does:

- People are already using a range of Council facilities and places managed by Council as cool places during hot conditions – including beaches, pools and libraries.
- Council provides community transport, which may help some people (particularly vulnerable community members) to access cool places.
- Council plans for future social infrastructure needs with a social infrastructure planning framework (Wollongong City Council, 2023) and Council is planning upgrades including new Community Centre and Library buildings at Warrawong and Helensburgh.
- Council prepared a 'Future of our Pools' strategy in 2014 (Wollongong City Council, 2014), which recognised that aquatic recreational activities are changing, and pools need to meet evolving needs. Heatwaves were not a prominent concern in 2014 but the changing climate is another reason why recreational needs are evolving.

Figure 16: Corrimal Library (image: Wollongong City Council)

- In hot weather, particularly when this occurs on the weekend, Council extends the patrolled hours for beaches patrolled by Council.

Actions to build on this:

- Consider how access to beaches and pools could be improved on hot days for those less able to get there. While beaches and pools may not be appropriate places for the most vulnerable community members to cool off during a heatwave, they can be a good option for many, including young people and families.
- Assess the suitability of Council facilities such as libraries and community centres to be utilised as cool centres on hot days. These places can provide a more appropriate offering for older adults and people with health conditions. A cool centre should include air conditioning, seating, cold drinking water, relevant information, and staff. It should be easy to get to and may include extended hours.
- Develop a cool centre plan and then get the message out to the community about the facilities and services on offer. Cool centres may only be 'activated' during hot weather – e.g. Blacktown Council activates theirs when a severe or extreme heatwave warning is issued.
- Assess whether vulnerable communities have the access they need to cool places, and identify priorities to improve existing or provide new facilities (for example, air conditioning upgrades at existing community centres). A recent community survey (Sweltering Cities, 2023) heard from 262 people about where they go when it gets hot, and what kind of facilities they would like to have in a cool place away from home.

5.3 Community service sector engagement

Objective:

Engage with local community service providers to collaborate on meeting community needs on hot days and during heatwaves.

What Council already does:

- Council works with other community service providers on a range of issues of importance to the local community.
- As part of preparing this strategy, there has been initial consultation with community service providers on the topic of urban heat.
- Undertakes social infrastructure planning to address current and future community needs.
- Coordinates several local groups and committees to provide a forum for specific issues, e.g. Aboriginal Reference Group, Neighbourhood Forums, Sports and Facilities Reference Group, Walking, Cycling and Mobility Reference Group.

Actions to build on this:

- Engage with interested community organisations to apply the recently developed Western Sydney Region of Councils 'Guide for Building Heatwaves Preparedness in Community Organisations', (WSROC, 2021c) especially focusing on supporting heatwave planning and community welfare initiatives.
- Develop a summer heatwave preparedness briefing for local community service providers that can be shared at the start of the summer season to inform providers of key initiatives and services that Council is undertaking to address increasing temperatures and heatwaves. This may include cool centres and places, changes to hours of operation, programs to cool streets and parks etc.
- Work with and support local community service providers to identify opportunities for direct community consultation and engagement on heatwave preparedness and response.
- Engage with the Illawarra Shoalhaven Local Health District, Health Promotion Unit, to identify opportunities to partner for local heatwave resilience, starting with the development of local messaging that could be distributed through Council services and networks.
- Engage with COORDINARE, the Primary Health Network for South Eastern NSW, to learn from recent climate disasters in the region (Black Summer bushfires 2019/20, in which 1353 homes were lost, floods, drought, and the COVID-19 pandemic), and how lessons from these events and experiences can be used to reduce community heatwave impacts in future.
- Engage with Surf Lifesaving Illawarra to identify improvements to beach infrastructure and possible training initiatives to respond to heat events, particularly during times when volunteers are the primary lifeguard response of Council.

5.4 Emergency management

Objective:

Work in partnership with others on the Local Emergency Management Committee to improve the planning for severe and extreme heatwaves requiring a coordinated multi-agency response.

What Council already does:

The Illawarra Emergency Management Plan (EMPLAN) (Illawarra Local Emergency Management Committee, 2020) includes a risk assessment framework, which is used to assess a wide range of risks. Heatwaves are included in the EMPLAN as a relevant local hazard, based on a previous Local Emergency Risk Management Study. In the current (2020) plan, heatwaves are rated as a Medium risk, based on:

- Unlikely occurrence ("Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or no recent incidents in associated organisations, facilities or communities; and/or little opportunity, reason or means to occur." Indicative frequency = once every 100 years).
- Moderate consequences ("Medical treatment required but no fatalities. Some hospitalisation. Localised displacement of people who return within 24 hours. Personal support satisfied through local arrangements. Localised damage that is rectified by routine arrangements. Normal community functioning with some inconvenience. Some impact on the environment with no long-term effect. Significant financial loss."

Actions to build on this:

In partnership with other organisations who share emergency management responsibilities:

- In the next revision of the local EMPLAN, review the risk rating for heatwaves and the arrangements in place under this plan. Across the range of heatwave events defined by the BOM (low-intensity, severe and extreme), a high risk rating is likely to be more appropriate in some cases it may even be considered extreme. This urban heat strategy provides additional information on heatwave risks, which should be considered when the EMPLAN is next updated.
- Also consider the risks of heatwaves occurring at the same time as bushfires, power failures and transport emergencies.
- If the heatwave risk rating is revised, consider the need for more specific planning for heatwaves, e.g. preparation of a consequence management guide. This should consider needs such as:
    - Emergency evacuation centres that can function during extreme heat, even when there are power outages. E.g. consider the need for backup generators (or at least a point where they can be plugged in).
    - Planning for events where heatwaves and bushfires, power and telecommunication outages occur together.
- Advocate for NSW Government to improve state-level heatwave planning and build local government capacity for heatwave management, noting WSROC's observation that "The 2020 Royal Commission into National Natural Disaster Arrangements found that local governments require further resourcing to fulfill their emergency management obligations (across all hazards). In the case of heatwave, lower level of maturity in emergency arrangements at all levels, means available resourcing is less likely to be allocated to heatwave." (WSROC, 2021b, p. 37).

5.5 Environmental management

Objective:

Consider heat-related risks in planning and management of threatened species and ecosystems, biodiversity corridors, waterways, foreshores, coastal dunes, other natural areas and urban green infrastructure in the Wollongong LGA.

What Council already does:

- Council manages urban green infrastructure and has prepared and implemented an Urban Greening Strategy since 2017 (Wollongong City Council, 2017), which includes a goal to increase average tree canopy cover from the current 17%, up to 35%. The strategy includes actions in four areas: increasing canopy cover, protecting and maintaining existing vegetation, diversifying planting to improve urban ecology and engaging with the community to raise awareness and increase participation in caring for urban landscapes.
- Council works in collaboration with others to preserve and enhance biodiversity – see Illawarra Biodiversity Strategy (Wollongong City Council, Shellharbour City Council and Kiama Municipal Council, 2011). This includes working to protect threatened ecosystems, control weeds and plant relevant species to keep the threatened ecosystem as healthy and diverse as possible so it can better cope with heat stress.
- Council has prepared plans for important natural areas in collaboration with others, including the Puckeys Estate Biobanking Site, Illawarra Escarpment Strategic Management Plan, and the Lake Illawarra Coastal Management Program.
- Council manages natural areas, waterways, foreshores, and coastal dunes.
- Council supports residents and community groups to care for and enhance green infrastructure, with resources including information, education, native plant sales and donations.

Figure 17: Tarrawanna Tiny Forest (image: Wollongong City Council)

Actions to build on this:

- Consider heat-related risks in future planning for biodiversity, natural areas, waterways and urban green infrastructure. This is likely to reinforce existing strategies rather than requiring any major change in direction.
- In partnership with other land managers, develop interventions for threatened species and ecosystems vulnerable to the impacts of heat. This could include translocation programs for threatened Illawarra flora.
- Identify vegetation suitable for urban green infrastructure in Wollongong's changing climate – Which Plant Where is a useful resource for this purpose.

5.6 Work health and safety

Objective:

Put appropriate measures in place to manage the health and safety of staff, contractors, volunteers and visitors using Council facilities and services and attending Council events on hot days and during heatwave conditions.

What Council already does:

- Council manages work health and safety including planning, management measures and monitoring effectiveness.
- Council has access to guidance available from SafeWork NSW e.g. SeasonalSAFE guide and template plan, which cover heat-related risks and management measures.

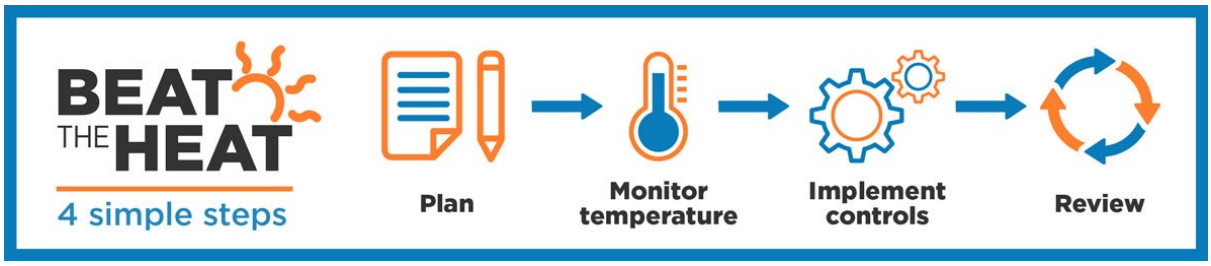


Figure 18: SafeWork NSW framework

Actions to build on this:

- Include consideration of heat stress impacts in the development of Council's Fatigue Procedure.
- Ensure the safety and protection of outdoor staff on hot days and during heatwave conditions, with measures such as appropriate clothing and PPE, shaded work areas, more frequent rest breaks, access to air conditioned spaces where possible, cold water, and flexible work arrangements such as early starts or late finishes (NSW Office of Environment and Heritage, 2016).
- Review contractors' WH&S plans to check if they have measures in place to manage heat-related risks.
- Consider heat as part of outdoor event planning in the heatwave season. Apply this to Council events as well as events run by others using Council venues. Consider contingencies such as shading, water stations, alternative date provisions and communication strategies. Consider thresholds at which

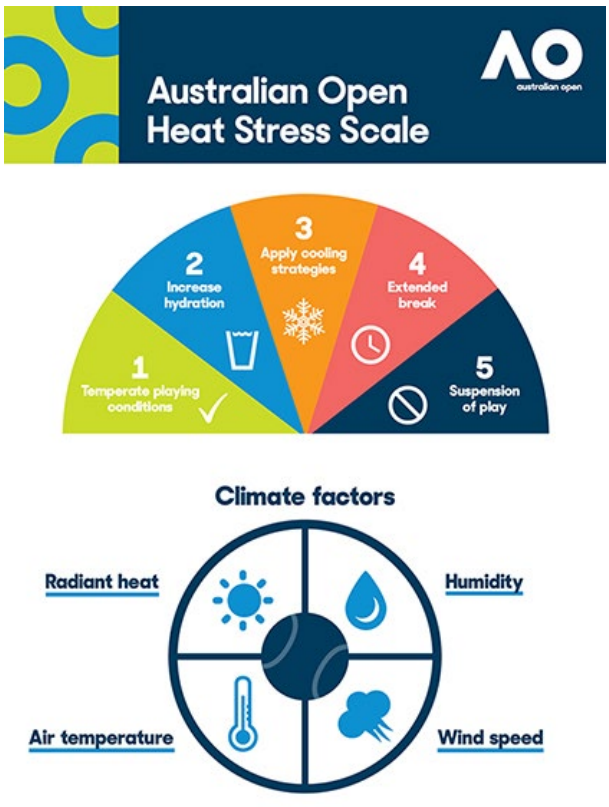


Figure 19: Australian Open Heat Stress Scale

different measures should apply. A heat stress scale developed by Sydney University, was used at the Australian Open (see Figure 19) and is currently being adapted for public use and trialled in Western Sydney.

- Assist volunteers (e.g. Bushcare, community transport volunteers) to plan for heat-related risks and put management measures in place.
- Provide information and training sessions to Council staff (potentially also to contractors and volunteers) to raise awareness of heat-related risks in the workplace, learn to recognise signs of heat stress and know what to do to minimise the risks and take appropriate action if heat stress occurs.
- In heatwave season, put heat-related risks on the agenda for WH&S toolbox talks.
- Addressing heat risks in public spaces and Council's buildings (refer to Sections 5.9 and 5.10 below) will also help reduce the risks for Council's contractors, volunteers and visitors.

5.7 Operational preparedness

Objective:

Put plans in place to continue operating essential services when heat-related disruptions occur.

What Council already does:

- Council provides essential services and sometimes has to manage these through disruptions beyond their control (e.g. recently, through Covid-19).
- Council has a range of approaches to maintaining services through challenging times. These include preventative measures such as increased staffing during times of high demand, through to reactive measures in response to disruptions such as loss of power or water access.
- Council has existing Business Continuity Plans for several of its major buildings. These plans provide a framework for responding to disruptions to normal business at these sites. This allows for consideration of workplace safety under a range of scenarios including heat impacts.
- The NSW Audit Office says that "In New South Wales, business continuity plans are widely used by local councils to help ensure continuity of service delivery, safety and availability of staff, availability of information technology systems and other systems, financial management and governance." (Audit Office of NSW, 2022)

Actions to build on this:

- Plan for more frequent heat events, which may cause both increased demand for certain services (e.g. at beaches and swimming pools, due to higher visitor numbers) and disruptions to Council's workforce (to protect workers from adverse effects of heat). Consider:
    - Actions which could be undertaken ahead of a heatwave to minimise issues during the event.
    - Tasks which need to be completed during heatwave conditions (potentially with an adjusted schedule or other measures in place to reduce risks to workers).
    - Tasks which could be delayed until heatwave conditions subside.
- Develop a business case to plan for the potential cost impacts of overlapping or more frequent heat events.

Recently, the NSW Audit Office reviewed planning for business and service continuity in two councils – Bega Valley and Snowy Valleys – and made specific recommendations for improvement (Audit Office of NSW, 2022). Wollongong City Council could cast the same lens over their planning to identify areas for improvement.

5.8 Addressing heat risks in development

Objective:

Include consideration of urban heat in updates to Council's LSPS, LEP and DCP to strengthen provisions which reduce paved surfaces, enhance shade and canopy cover, retain more water in the landscape and provide cooling amenities.

What Council already does:

- Climate action and resilience is already a key theme in the Wollongong 2020 Local Strategic Planning Statement (LSPS).
- This is supported by the Sustainable Wollongong 2030: A Climate Healthy City Strategy (Wollongong City Council, 2020a).
- Council's Local Environment Plan (LEP) and Development Control Plan (DCP) already include planning provisions which are relevant to reducing heat-related risks (e.g., provisions to protect waterways, trees and other vegetation, provisions requiring open space, street trees and other vegetation to be included in new development).
- Thermal performance of buildings is mostly covered by instruments beyond the DCP, including BASIX and the National Construction Code. However, Council does provide some guidance to home builders on sustainable design – currently Council has applied for an education grant for home builders, in collaboration with Shellharbour Council.
- Council is currently developing a Climate Friendly Planning Framework that includes consideration of LEP and DCP provisions related to reducing urban heat including building materials, green roofs and green facades.

Actions to build on this:

- Integrate consideration of heat-related risks into development planning. There are co-benefits between WSUD, biodiversity, recreation and reducing heat-related risks.
- Continue to update Council's LEP and DCP to address urban heat more clearly and comprehensively. The WSROC Urban Heat Planning Toolkit (WSROC, 2021a) provides a good starting point. Urban heat LEP and DCP provisions have been adopted by Penrith Council and Cumberland Council, and are also starting to appear in some recent site-specific DCPs (e.g. for the Aerotropolis, Growth Centres and other development precincts).
- Advocate for State Government to improve thermal performance standards in BASIX and amend Codes SEPP to improve heat-related outcomes in new development.
- When new development includes new streets, ensure that planning provisions facilitate increased street tree canopy. This is already a focus of Council's Urban Greening Strategy.
- Make locally relevant advice available to home builders and renovators on measures they can include to improve the thermal performance of their homes, including cool materials, insulation, shading, cross-ventilation.
- Consider incentives for home owners to plant trees in the private domain.

5.9 Addressing heat risks in public spaces

Objective:

Review and improve the UHI and microclimate outcomes in Council's parks, open spaces and streetscapes and seek opportunities to reduce paved surfaces, enhance shade and canopy cover, retain more water in the landscape and provide cooling amenities.

What Council already does:

- Wollongong Council manages trees in the public domain and the Urban Greening Strategy establishes a range of actions to "grow and nurture a healthy, diverse and well-managed urban forest to deliver a renewed and resilient place for people, enterprise, and the ecosystems that support us." (Wollongong City Council, 2017, p. 5).
- When Council upgrades streetscapes, these projects sometimes include new trees and other green infrastructure.
- Council has previously benchmarked shade in playgrounds (as of 2018) and planted trees at 55 playgrounds that were identified as having no, or limited shade. When Council upgrades play equipment and furniture in parks, these projects sometimes include new shade structures and/or are designed to take advantage of existing tree shade on site.
- Some of Council's parks include water play features, for example the Botanic Gardens, Cringilla Park, Kanhooka Park, Nicholson Park.
- Council has recently installed 15 new water bubblers in popular beach or foreshore coastal locations and community sporting facilities (see Figure 20).

Figure 20: Water bubbler at Thirroul (image: Wollongong City Council)

Actions to build on this:

- Identify parks and playgrounds to target with additional shade using Council's adopted hierarchy, preferably combining tree shade and structural shade for the best results in the long-term and in a wide range of weather conditions. Consider needs for shade over play equipment, seating areas and picnic tables.
- Identify high priority streets for cooling, targeting streets with high pedestrian movement and places like bus stops where people are more exposed to heat. Consider reducing paving, increasing tree canopy and providing structural shade. Locations to target with tree canopy should inform Council's priority tree planting program.
- Identify and prioritise locations along the Grand Pacific Walk, popular foreshore locations, key parks and sportsfields to provide more water bubblers/refill stations.
- As part of public domain projects, incorporate passive irrigation of trees and other vegetation. This is particularly worthwhile in high density environments where trees and other vegetation has limited access to water. Passive irrigation can improve vegetation health, tree growth and canopy cover, as well as reducing heat via evapotranspiration.

- Consider water features (e.g. ponds, fountains, water play) for targeted locations – water features are high cost but have a significant cooling effect in their immediate vicinity.
- Consider the use of cool materials in the public domain and parks. Options include lighter coloured and permeable paving materials. Some surfaces can be coated with a lighter coloured layer. However, there are some downsides to light-coloured pavements – they are more prone to staining, and can be glary. Materials and coatings which reflect heat (but not all wavelengths of light) are starting to become commercially available.
- Include an objective to reduce heat in public domain planning and design briefs. These could refer to existing available guidance such as WSROC's Urban Heat Planning Toolkit (WSROC, 2021a).

Figure 21: Crown Street Mall includes shaded seating

5.10 Addressing heat risks in Council's buildings

Objective:

Review and improve the thermal performance of Council's buildings to raise standards in existing buildings, new buildings and upgrades.

What Council already does:

- Council has demonstrated leadership in sustainable buildings, with the Administration Building becoming the first building in Australia to achieve a 6 Star Green Star – Performance rating, signifying 'Australian Excellence'. This was achieved after a project in 2014 to improve the building's operational performance from a sustainability perspective (Architecture and Design, 2015).
- Council has developed a draft Towards Net Zero Building Strategy that has guided internal decision making on major projects for many years, and is due for endorsement in 2023.

Figure 22: Council's 6 Star Green Star Administration Building (image: Wikimedia Commons)

Actions to build on this:

- Finalise and endorse the draft Towards Net Zero Building Strategy including guidance on thermal performance.
- Ensure that high thermal performance standards are defined in design briefs for new buildings and major upgrades. For buildings with outdoor spaces, alternative water supplies are also useful for cooling, as they enable sustainable water use for irrigation and cooling purposes.
- Identify priority buildings to improve thermal performance. Council has 30 community centres and halls, which provide spaces for a range of community activities, many catering to vulnerable community members. However, most of these are not air conditioned and would not be able to function as cool centres. The function of community centres and halls needs to be considered in the broader context of Council services and resources.
- Explore opportunities to collaborate with the University of Wollongong's Sustainable Buildings Research Centre to explore new technologies and approaches to managing heat in the built environment.

6 Implementation and accountability

High priority actions and indicators have been identified in the following sections.

6.1 High priority actions

The following actions are recommended as high priorities due to their importance and impact.

Table 8: High priority actions

Proposed high priority actions	Why this is a priority
1. **Communications:** Develop a communications plan including messages to go out before and during heatwave conditions.	A logical first step; start simple and build additional elements into the plan over time.
2. **Cool places:** Assess the suitability of Council facilities such as libraries and community centres to be utilised as cool centres on hot days.	A crucial first step to enable other actions to follow.
3. **Community service sector engagement:** Engage with interested community organisations to apply the recently developed Western Sydney Region of Councils 'Guide for Building Heatwaves Preparedness in Community Organisations', (WSROC, 2021c) especially focusing on supporting heatwave planning and community welfare initiatives.	This will help build understanding of community service provider needs.
4. **Emergency management:** In the next revision of the local Emergency Management Plan, review the risk rating for heatwaves and the arrangements in place under this plan.	Planning for major emergencies needs to follow this process.
5. **Environmental management:** In partnership with other land managers, develop interventions for threatened species and ecosystems vulnerable to the impacts of heat.	This action is targeted at ecosystems vulnerable to heat impacts and will build on existing conservation efforts.
6. **Work health and safety:** Include consideration of heat stress impacts in the development of Council's Fatigue Procedure.	Heat is an important contributor to fatigue.
7. **Operational preparedness:** Plan for more frequent heat events, which may cause both increased demand for certain services (e.g. at beaches and swimming pools, due to higher visitor numbers) and disruptions to Council's workforce.	Important to ensure Council is prepared to maintain essential services during disruptions caused by heat events.

Proposed high priority actions	Why this is a priority
8. **Development:** Consider urban heat more clearly and comprehensively in updates to DCP and other urban planning documents.	Council can demonstrate leadership and improve outcomes in local development.
9. **Public spaces:** Identify priority parks to target with additional shade, preferably combining tree shade and structural shade for the best results in the long-term and in a wide range of weather conditions. Consider needs for shade over play equipment, seating areas and picnic tables.	An action with important implications for liveability in a warmer climate.
10. **Council buildings:** Finalise and endorse the draft Towards Net Zero Building Strategy including guidance on thermal performance.	An opportunity for Council to demonstrate leadership in design and ensure high performance of future buildings in heat conditions.

6.2 Indicators

The following measurable indicators are suggested:

- Proportion of communications plan implemented annually.
- Number of Council's libraries and community centres functioning as 'cool places'.
- Number of community organisations undertaking heatwave preparedness planning.
- Number of heat-related WH&S incidents.
- Community satisfaction with essential services.
- Number of Council playgrounds with adequate shade or better.
- Number of water bubblers/refill stations operational across the LGA.
- Number of new buildings/major upgrades meeting high thermal performance standards.

7 Glossary

Adaptation	In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects (IPCC, 2022).
Adaptive capacity	The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (IPCC, 2022).
Adaptive comfort	Perceived thermal comfort that adjusts with varying outside conditions (WSROC, 2021a).
Albedo	A measure of the diffuse reflection of solar radiation from a surface, measured on a scale from 0 to 1, where a value of 0 would mean that all incident radiation is absorbed, and a value of 1 would mean that all incident radiation is reflected. In simple terms, high albedo surfaces reflect more solar radiation than they absorb.
Ambient temperature	Average air temperature in the environment. This term is used to refer to the average air temperature at the city-scale or precinct-scale (as distinct from a microclimate scale).
Climate change scenario	A coherent, plausible but often simplified description of a possible future state of the climate as influenced by climate change. It is not a prediction about the future, but rather it provides a means of understanding the potential impacts of climate change (Wollongong City Council, 2022a).
Emissions scenario	Emission Scenarios are a tool with which to analyse how driving forces may influence future greenhouse gas emission outcomes and to assess the associated uncertainties. They are used in climate change analysis, including climate modelling and the assessment of impacts, adaptation and mitigations (Wollongong City Council, 2022a).
Evapotranspiration	The process by which water is transferred from the land to the atmosphere, both via evaporation from the soil and other surfaces, and via transpiration by plants.
Exposure	The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC, 2022).

Extreme heat	Defined by the Climate Council as temperatures 40°C and over (Climate Council, 2014).
Feels like (temperature)	An expression of the equivalent temperature defined by human experience. "Feels like" temperature generally takes into account wind speeds and humidity, and may include other factors, to assess how the human body actually feels temperature (WSROC, 2021a).
Green infrastructure	Any vegetation in the urban environment.
Heatwaves	Defined by the Australian Bureau of Meteorology as a period of three or more consecutive days of high maximum and minimum temperatures which are unusual for that location (Bureau of Meteorology, 2023).
Heat Vulnerability Index (HVI)	A combined measure of exposure, sensitivity and adaptive capacity to urban heat on a scale of 1 to 5 based on quintiles, with 1 representing low exposure, low sensitivity or high adaptive capacity and 5 representing high exposure, high sensitivity or low adaptive capacity (NSW Government, 2019).
Hot days	The former NSW Office of Environment and Heritage (2014) and the Greater Sydney Commission (2018) have both defined "hot days" as those where the temperature reaches above 35°C, and the Greater Sydney Commission (2018) has recommended the number of hot days as a performance measure for addressing urban heat.
LGA	Local Government Area
LHD	Local Health District
Local Emergency Management Committee (LEMC)	Local Emergency Management Committees or LEMCs are responsible for emergency planning and management at the LGA level. LEMCs are chaired by the CEO of the Council in which the LEMC functions, and is supported by secretariat services (Local Emergency Management Officer). The remainder of the LEMC is comprised of representatives from local combat agencies, state agencies and service providers (e.g. local police, RFS, local health districts). It should be noted that the LEMC is not a committee of council, but a separate body under the SERM Act (WSROC, 2021b).
Local Emergency Management Officer (LEMO)	A staff member at council who represents council at, and manages secretariat services for the LEMC (WSROC, 2021b).
Microclimate	The climatic conditions of a very small or restricted area, especially when this differs from the climate of the surrounding area. In the case of urban heat, microclimate typically refers to conditions experienced at a human scale in different places within the urban environment – for example the microclimate in a well-irrigated landscape under a shady tree will be different to the microclimate in a paved area with no shade and surrounding heat-reflective surfaces (WSROC, 2021a).

Mitigation (of climate change)	A human intervention to reduce emissions or enhance the sinks of greenhouse gases (IPCC, 2022).
NARCliM	The NSW and ACT Regional Climate Modelling (NARCliM) initiative provides an ensemble of robust regional climate projections for south-eastern Australia that can be used by the NSW and ACT community to plan for the range of likely future changes in climate. It can be accessed via the AdaptNSW website.
NCOSS	NSW Council of Social Services. The peak body for social service providers in NSW.
Passive survivability	A building's ability to maintain critical life-support conditions in the event of extended loss of power, heating fuel, or water (WSROC, 2021a).
Passive thermal performance	A building's ability to maintain a comfortable and relatively stable internal temperature, without powered heating or cooling, in fluctuating external conditions (WSROC, 2021a).
Physical risk	The impact of climate hazards, both shocks such as flooding, extreme heat and bushfires, and stresses such as drought and habitat loss (Wollongong City Council, 2022a).
Radiant temperature	A measure of thermal radiation emitted from adjacent surfaces.
Resilience	Resilience is defined by Resilient Sydney as the capacity of individuals, communities, businesses and systems within a city to survive, adapt and thrive no matter what kinds of chronic stresses and acute shocks they experience (Resilient Sydney, 2018).
Risk management process	The systemic application of policies, procedures and practices to the tasks of communication, consultation, establishing the context and assessing, treating, monitoring, reviewing, recording and reporting risk.
Sensitivity	The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise) (IPCC, 2022).
Shocks	Acute events with direct impacts, such as extreme heat, bushfires and floods (Wollongong City Council, 2022a).
Solar Reflectance Index (SRI)	A measure of a constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100.
Stresses	Chronic phenomenon with longer-term and drawn out impact, such as drought and changes in habitat (Wollongong City Council, 2022a).

Surface temperature	Temperature measured at a surface.
Thermal autonomy	A measure of the percentage of time a building can maintain a specific set of comfort conditions passively (without air conditioning or heating), despite outdoor temperature fluctuations (WSROC, 2021a).
Thermal comfort	The condition of mind that expresses satisfaction with the thermal environment; i.e. the conditions in which a person feels neither too cold nor too warm (WSROC, 2021a).
Thermal emittance	The rate at which heat is radiated from a surface
Thermal safety	The condition of body that maintains balanced heat gains and losses with the environment to avoid inducing a dangerously low or high body temperature. A thermally safe environment remains within a range of temperatures that protect people from injury or death resulting from over-heating or over-cooling (WSROC, 2021a).
Universal Thermal Climate Index (UTCI)	A standard measure of "feels like" temperature.
Urban heat	A general term that refers to high temperatures in urban areas that pose a risk to our communities and infrastructure (WSROC, 2021a).
Urban heat island (UHI) effect	The tendency of cities to be much warmer than their rural counterparts. Urban surfaces such as roads and roofs absorb, hold, and re-radiate heat; raising the temperature in our urban areas. Human activities such as traffic, industry, and electricity usage also generate heat that adds to the urban heat island effect (WSROC, 2021a).
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2022).
Vulnerable communities	Any person or group of people at greater risk of heat-related impacts due to greater exposure (hotter temperatures), physical characteristics that make them prone to heat-related illness (chronic disease, mental health, old-age), or socio-economic circumstances that limit their capacity to respond (low-income, lack of transport, tenancy, social networks) (WSROC, 2021b).

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We value and protect our environment

We have an innovative and sustainable economy
Wollongong is a creative, vibrant city
We are a connected and engaged community
We have a healthy community in a liveable city
We have affordable and accessible transport

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