



Sydney2030/Green/Global/Connected

CITY OF SYDNEY  

# Adapting for Climate Change

A long term strategy for the City of Sydney

*Adapting for climate change – a long term strategy for the City of Sydney is a supporting document to the Environmental Action 2016 – 2021 Strategy and Action Plan that was endorsed by the City of Sydney in March 2017. The City's most up to date set of environmental targets and actions are contained in Environmental Action 2016 – 2021 Strategy and Action Plan.*

*city of villages*

# Costs of Inaction

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# Lord Mayor's message

## The City is already taking action.

### Lord Mayor Clover Moore

Climate change is the biggest challenge our cities face.

As part of our Sustainable Sydney 2030 plan, we set a target of a 70% reduction in greenhouse gas emissions across our local government area and in our own operations by 2030.

To achieve our targets, we have developed a series of innovative master plans for energy efficiency, renewable energy, and tri-generation.

We have already made considerable progress. Greenhouse gas emissions in our organisation have been reduced by 21% and across our local government area by 12%. This has been achieved even as our economy continues to grow because carbon intensity has fallen nearly 30%.

We continue to be frustrated by the lack of political leadership at a global and national level needed to reduce greenhouse emissions, so we must also plan to make the City of Sydney resilient to a changing climate.

The City is already taking action.

We have planted more than 10,250 trees to absorb pollution and reduce summer temperatures towards a target to increase the City's urban canopy cover 50% by 2030.

We are implementing an Urban Ecology Strategic Action Plan to conserve and maintain our biodiversity, the first green roofs and walls policy in Australia, and a Decentralised Water Master Plan to reduce water demand, increase recycling and improve stormwater quality.

Adapting for Climate Change completes our suite of sustainability master plans. The strategy is based on the latest climate science that shows how our climate has already changed, the changes that are projected into the future, and how they will impact on the City of Sydney.

The consensus projection for Sydney is an increase in average temperature up to of 3.1 degrees by 2070.

Heat is the most acute climate risk we face in Sydney. Bushfires and floods capture the media coverage but extreme heat kills more people than any other natural disaster in Australia. In the Black Saturday Melbourne bushfires of 2009, 173 people died from the fires but there were 374 deaths from extreme heat – many of them elderly, vulnerable residents.

By 2070, extreme heatwaves – such as the one we experienced in 2011 – are projected to increase from a 1 in 100 event to a 1 in 2 event. Rising average temperatures will push summer-like conditions into much of the year.

Air pollution is also expected to worsen which will affect people with respiratory issues – especially our old and our very young – causing productivity and health issues. Other risks include heavy rain events and flooding, and in the longer-term rising sea levels and storm surges.

The Climate Adaptation Strategy includes a series of actions to address these risks such as a Heatwave Response Plan, flood management plans, and a Sea Level Rise Adaptation Action Plan. It is a collaborative strategy which establishes a framework to work with leading scientists, other levels of government, businesses, utilities, the not-for-profit sector and our residents.

The City of Sydney was recently selected by the Rockefeller Foundation to join the 100 Resilient Cities Initiative – a global initiative to build the resilience of cities to future shocks and stresses including climate change. Participating in the 100 Resilient Cities Initiative will allow us to learn from how others are adapting to climate change.

As part of the 100 Resilient Cities Initiative, the City will be developing a resilience strategy for Metropolitan Sydney in partnership with other councils. Forty of Sydney's 41 councils recently attended the agenda-setting workshop to initiate the project.

The impacts of climate change will occur over a long timeframe. There are many uncertainties. Depending on the action taken around the world to reduce emissions, the forecast temperature increases may be higher or lower.

Consequently, we must also ensure we have the systems in place to refine and change the Climate Adaptation Strategy in response to new information. The City will incorporate climate adaptation considerations into all future decision-making at Council and establish a climate risk and adaptation reference panel that will review the Climate Adaptation Strategy over time.

The Climate Adaptation Strategy has been prepared by working with our community, businesses and other levels of government. The City extends our thanks to the individuals and organisations who have contributed. Together we will build our capacity to adapt and respond to a changing climate and maintain the wellbeing and prosperity of our global city.



A handwritten signature in black ink that reads "Clover Moore".

**Clover Moore**  
**Lord Mayor**

# Executive summary

**In simple terms, climate change adaptation means:**

- **Taking action to reduce the impacts of a changing climate.**
- **Taking action to harness any beneficial opportunities.**

**We can do this by:**

- **Changing our plans and behaviour.**
- **Building stronger, smarter buildings, facilities and infrastructure.**
- **Talking, listening to and working with our community, including residents and businesses.**
- **Coordinating with the NSW and Australian Governments.**

## Our climate is changing...

Inaction is not an option. Governments, businesses and communities must act now to ensure our community is ready to face the likely impacts of climate change. Far more than that, the City of Sydney is working to ensure that our city continues to thrive and is more liveable than ever.

## so we must adapt...

This strategy sets out the impacts the changing climate will have on our city, the risks these pose and the actions the City of Sydney, businesses and communities must take now and in the decades to come. This is our first adaptation strategy and has been written to raise the issues and opportunities that adapting to climate change will present. As our understanding of the risks and responses develops over time, so the adaptation strategy will evolve in the years to come. This will ensure that the City of Sydney continues to be a resilient and globally competitive place to work and live.

The ongoing prosperity of the City of Sydney Local Government Area (LGA) is vital to the nation. The LGA represents 7% of the national economy and 22% of the NSW gross domestic product. Sydney is the tourism gateway to Australia. It is home to nearly 20,000 businesses and 200,000 residents. The city continues to grow. Each day, there are an estimated 1.15 million residents, workers and visitors in our local government area. The area generates \$108 billion worth of economic activity annual, which is around 33% of Metropolitan Sydney's economic activity and 22% of the NSW State gross domestic product (GDP).

## with a long-term strategy...

This strategy covers 2015 to 2070. It is founded on five principles to ensure that it is:

1. Resilient and long-term: politically sustainable, economically efficient and socially inclusive
2. Flexible and dynamic: able to evolve and respond to unexpected trends and consequences
3. Based on the most up-to-date data
4. Able to harness natural environmental systems
5. Delivered via a comprehensive and effective communication strategy.

These guiding principles have been drawn from the recommendations made by the Citizens' Panel.

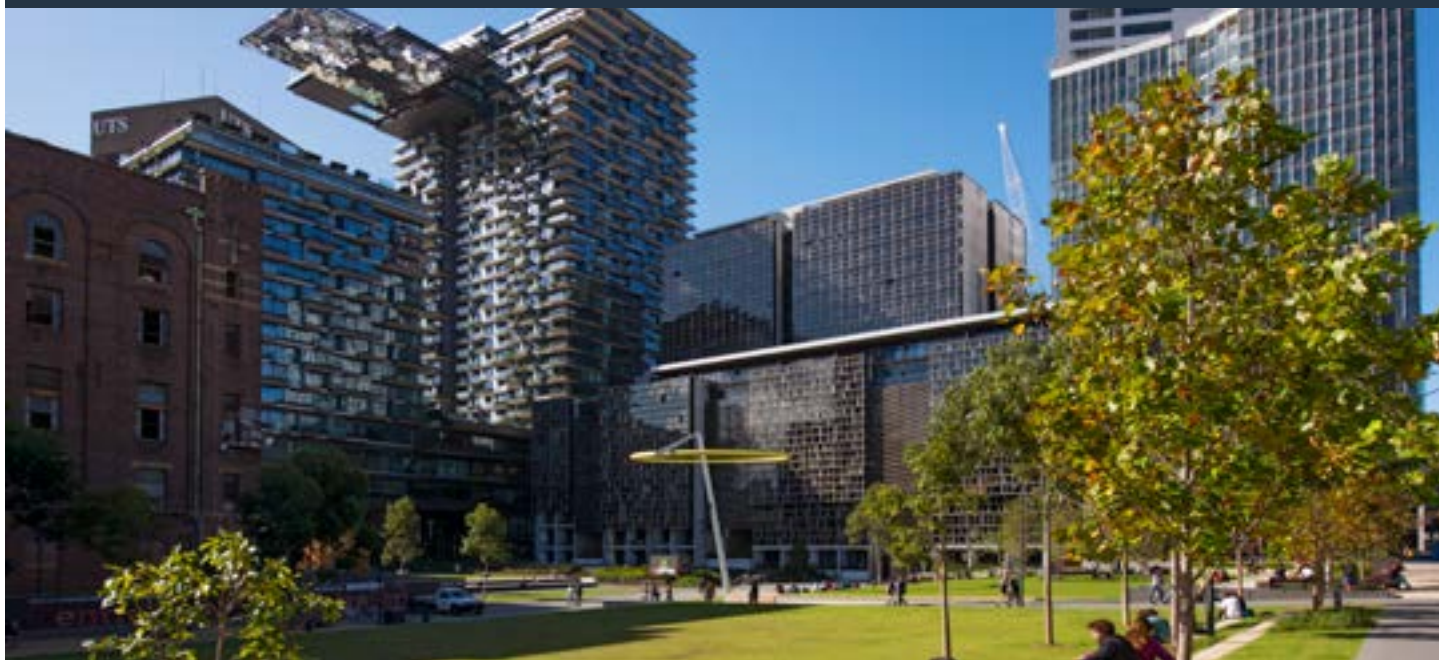
## developed with broad consultation...

The City undertook a rigorous risk assessment process to identify and rank the climate risks that face us. We consulted with stakeholders from state and local governments, utilities, emergency services, business and community groups and internal stakeholders.

We engaged a citizens' panel that gave us the opportunity for in-depth conversation with residents to hear their concerns about climate change risks and their priorities for action.

We also looked to our own experts. Their involvement has been vital in the development of this Strategy.





### to explain climate change adaptation...

We first need to understand climate science, and the changes to our climate that have already been experienced and those projected in the near-, mid and long-term future. We then need to understand what this means for the city and what are the likely impacts from these changes. This knowledge can help us to reduce the risks we face over time we can continue to provide quality services and facilities to our residents, visitors and business communities.

### by understanding the climate risks for Sydney...

This strategy draws from the latest global, national, state and local climate data and modelling. The modelling reflects the direction, magnitude and range of change for all the climate variables seen in the NSW Government's NARClIM<sup>1</sup> model. This means that future collaboration with the NSW Government will be easier, as policies and decisions will be made from a common basis.

A Science Reference Group (SRG) was established to oversee the scientific inputs and project methodology that form the basis of this strategy. This gives us confidence that our work is based on a very sound foundation.

For Sydney in 2070, the changing climate will likely mean:

- An increase in average temperatures
- An increase in extreme heat days
- An increase in air particulates and pollution
- An increase in rainfall intensity and storm events
- Continued variability in annual rainfall
- An increase in bushfire conditions
- An increase in drought conditions
- An increase in sea levels and the extent of coastal inundation.

### and setting out a pathway over time to address...

Time lines for managing climate change are longer than most government strategic planning. This is a major challenge: to prioritise actions to both mitigate and adapt to climate changes over such a long time.

Some actions must start now and continue over a long period, while others will not require action for many years.

### increasing heat...

Sydney's climate is gradually warming. Projections are an increase of just over 3.1°C by 2070 and 4.5°C by the year 2100. As the average temperature creeps up, the hottest days will become hotter, more frequent and last longer. Such an increase in extreme heat could lead to many impacts on Sydney that include strain on vital infrastructure systems like energy and transport, community health problems, and an increase in air pollution which in turn will further compound health issues.

Our top priority actions include:

- Develop a Heatwave Response Plan aligned with the NSW State Heatwave Sub Plan.
- Raise awareness and understanding of heatwaves, air pollution, bushfires and other climate-related events.
- Investigate a heatwave and extreme event warning system.
- Work with energy companies to assess the trigger points and extent of potential vulnerability of the city's power supply.



### changing rainfall patterns and drought conditions...

Sydney's rainfall pattern will continue to feature the natural variability that sees the dry and wet periods we know well. At the same time, deluges and heavy rainfall are expected to remain a feature of Sydney's weather patterns and are likely to increase.

We already have experience in dealing with drought conditions. Their expected increase will create more challenges for the City to maintain public open spaces and greenery.

Actions to address these changes are to:

- Continue flood management work to assess the extent of the vulnerability of properties and key assets.
- Work with emergency services agencies to prioritise and coordinate responses.
- Continue investigation of the City's own asset risk profile to increases in extreme weather.
- Factor changing rainfall, flooding and drought patterns into land use planning, infrastructure design, and strategies for parks, gardens, open spaces and urban forests.

### bushfire conditions and air quality...

Climate change will lead to an increase in the conditions that contribute to bushfires. The City of Sydney local government area is not at direct risk from bushfires. But nearby bushfires can cause smoke and poor air quality; this is already known to Sydneysiders. High daytime temperatures in combination with fossil fuel emissions (such as vehicle exhausts in the city) and bushfire smoke, can lead to respiratory difficulties and hospitalisation. The likely disruptions that bushfires could cause to services and productivity also need to be considered in adapting to a changing climate.

Key actions to address this issue are to:

- Contribute to the emergency response to pollution from bushfires, including an early warning system.
- Contribute to community awareness and education on health risks from smoke and ozone pollution.
- Identify and reduce the sources of emissions that contribute to exceeding pollution limits (such as active transport options).





### rising sea level...

The risk posed by the rising sea level is a longer-term issue for the City. A detailed understanding of the likely impacts, expected timing and suitable responses is necessary. Current analysis places the risk of inundation as minor with a very gradual increase over several decades, primarily due to our LGA's relatively small foreshore area and its topography. We need to be prepared and understand what responses will be if any effects accelerate.

To address rising sea level, we will:

- Develop a sea level rise adaptation action plan.
- Assess sea level rise and storm surge impacts on City planning and implement an appropriate flooding standard.
- Advocate for a consistent NSW State planning framework to address sea level rise and storm surge.

### understanding combined risks...

Climate change risks must become part of our day-to-day work in providing services and infrastructure to our residents, community, business and visitors. In addition to addressing the specific climate risks described above, action must be taken for broad preparation. The City will:

- Incorporate climate adaptation into all future key decision-making at Council.
- Establish a climate risk and adaptation reference panel with key stakeholders to review science, risks and coordinated responses.
- Advocate for the revision of engineering and building standards and codes to address climate change.
- Monitor developments in climate change science and global emissions.

### with a clear role...

The City must adapt to the changing climate to prepare our community and to protect our assets and services. We are working with other councils in Australia. We are also coordinating with C40, the global cities network to maximise our learning from local government colleagues from around the world.

### Climate change adaptation and mitigation: What's the difference?

This strategy is all about preparing the city to *adapt* to the changing climate. This is distinct from attempts to *mitigate* climate change, which refers to actions to reduce our contribution to human-made climate change, for example the City of Sydney reduces its carbon emissions via energy efficiency, and by promoting of walking and cycling as modes of transport.

Both are important.

Mitigation is vital to worldwide efforts to reduce the human influence on the global climate system. Adaptation is necessary to respond to the changes already underway and likely to continue.

Mitigation strategies can also be effective adaptation strategies or opportunities. For instance, the City of Sydney's Energy Efficiency Master Plan sets out a series of measures that will significantly reduce energy consumption in the buildings within our local government area. By using energy more efficiently, these buildings will help mitigate their impact on the climate by generating fewer emissions. At the same time, they are adapting to climate change by using less energy to operate, which puts less strain on the energy grid and makes it more resilient during extreme climate events.



### **commitment to collaboration...**

The City of Sydney enjoys a high degree of cooperation and collaboration with organisations from government, industry, business and the community. We are committed to continue working with all partners to effectively respond to the complex challenges of climate change.

### **and ongoing strong governance to ensure successful long-term adaptation.**

We will create a standing body, an Adaptation Reference Panel to coordinate, review and communicate our ongoing response to the changing climate.

A Science Reference Group (SRG) was established to oversee the scientific inputs and project methodology that form the basis of this strategy. This gives us confidence that our work is based on a very sound foundation. Our technical consultants note in their final project report (see Appendix A, p. 62):

“The similarity in direction, magnitude and range of results across the SimCLIM, NARCLIM and OEH impact profile datasets mean that the City can have confidence in the climate projections used throughout the risk assessment process of the project. The SRG has reviewed both the climate projections used in the risk assessment process as well as the difference between data sets outlined above. They agree that the small differences between the datasets are highly unlikely to have made any material difference to the outcomes of the risk assessment process.”



# 01

## What does climate change mean for us?

The global climate is changing. We are already experiencing changes in Sydney. These are expected to continue, so we must respond by anticipating and planning to manage the likely risks that threaten our city.

The ongoing prosperity of the local government area is vital to the national interest. The LGA represents 7% of the national economy and 22% of NSW gross domestic product. The LGA is home to nearly 20,000 businesses and 200,000 residents, and welcomes half a million visitors a day. Sydney is the tourism gateway to Australia and continues to grow. Between 2007–12, the local area saw growth in:

- Employment +13.6%
- Number of businesses + 10.5%
- Population +10.1%
- Number of dwellings + 5.9%
- Floor space in buildings +3.3%

The City of Sydney is proud to collaborate with our government, business and community partners to foster such vitality and growth. We must now extend these successful relationships to work together to ensure that our city, its people and commerce are resilient in the face of risks presented by climate change.

Effective adaption will reduce our vulnerability to changing climate. It will also increase the city's resilience to the possible shocks that climate change could cause, such as heatwaves and floods. Our ability to recover from and prosper after such events will come from the capability of our people and our preparation and planning.

The natural environment can reduce impacts of climate change while delivering other benefits for cities around the world. It is a major component of Sustainable Sydney 2030. For example, through the Greening Sydney plan, we are increasing the benefits from natural ecosystems such as shade, water treatment, urban cooling and pleasant and enjoyable spaces. These benefits also contribute to our climate change adaptation.

## 01 What does climate change mean for us?



The social impacts of and responses to climate change are important components of our adaptation planning. Our research has identified that the impacts of extreme heat and air pollution will have a particularly acute impact on the most vulnerable people in our community. An important task will be identifying who the most vulnerable are, where they are located, and how best to resource them and establish support networks.

A significant economic imperative to this planning work is the economic impact of climate change through the immediate impacts such as the interruption of vital services and infrastructure like energy, transport and communications. In the longer-term, potential disruptions to workforce productivity must be considered in terms of structural impacts if certain sectors are impacted such as tourism or transportation. An increasing number of extreme weather events could lead to reduced economic certainty which could lead to less stable economic growth. At an individual level, empirical studies are showing that workers' physiological response to the changing climate can also lead to productivity losses, for instance heat stress can lead to illness and increased absenteeism.

The City of Sydney has already undertaken many actions of adaptation – economic, social and economic – which are highlighted throughout this strategy. The Climate Adaptation Strategy is the City's next step in preparing a framework to coordinate the necessary broad range of actions to be taken over time with the collaboration of multiple partners: other organisations, communities, individuals and levels of government.

### Box 1: **C40 case studies:** **Learning from other leading global cities**

The *C40 Cities Climate Leadership Group*, now in its tenth year, connects more than 75 of the world's greatest cities, representing over 500 million people and one-quarter of the global economy. Created and led by cities, C40 is focused on tackling climate change and driving urban action that reduces greenhouse gas emissions and climate risks, while increasing the health, wellbeing and economic opportunities of urban citizens. The City of Sydney is an active member in the C40 Climate Change Risk Assessment Network. The Network brings together forward-thinking cities to exchange best practices in understanding and prioritising risk and planning investment, with the aim of building more resilient cities.

#### **North America**

C40's partner, the *Global Cool Cities Network*, studied the role of cool surfaces and vegetation in reducing heat mortality. The study evaluated the deaths from actual heat events in Washington DC, New York City, Baltimore and Los Angeles and found that an increase of 10 percentage points in urban surface reflectivity could reduce the number of deaths during heat events by an average of 6%. Adding a 10% increase of vegetative cover to the increases in reflectivity yielded an average 7% reduction in mortality during heat events.

#### **Singapore**

Singapore has implemented two significant finance and incentive programs to encourage greening the city. Under the *Skyrise Greenery Incentive Scheme*, the National Parks Board will fund up to 50% of installation costs of green roofs and vertical greenery. The URA's scheme, *Bonus Gross Floor Area for Rooftop Outdoor Refreshment Areas On Landscaped Roofs*, allows existing buildings within the key activity corridors in the Orchard and Downtown Core planning areas to have additional floor area if owners provide a substantial amount of rooftop landscaping for their developments.

#### **New York City**

The NYC *°CoolRoofs Programme*, launched in 2009, has coated over 5.7 million square feet (529,547 square metres) of the rooftops of 626 buildings with a white, reflective coating. The program provides savings directly to building owners by reducing cooling costs 10–30%. It has proven to be an effective way to help tackle the urban heat island effect and reduce greenhouse gas emissions: every 2,500 square feet (232 square metres) of roof that is coated can reduce the city's carbon footprint by one tonne of CO<sub>2</sub> per year.



[www.c40.org/](http://www.c40.org/)



### The changing climate

Our climate is changing. We know this from the latest peer-reviewed and published science from around the world. Every major scientific body in the world supports the theory that humans are influencing the global climate. We have taken this information from the global level to assess the likely changes and impacts for Sydney and our surrounding areas. This process has been conducted with the oversight of the City's Science Reference Group, made up of the representatives of some of Australia's leading climate science organisations including the Commonwealth Science Industry Research Organisation (CSIRO), the Bureau of Meteorology (BoM), The Australian National University Climate Change Institute, University Corporation for Atmospheric Research, the NSW Office of Environment and Heritage (OEH) and the policy think tank, the Climate Institute (see Box 8 for details).

#### Box 2: **Climate future summary: In 2070 in Sydney, the changing climate will likely mean:**

- An increase in average temperatures
- An increase in extreme heat days
- An increase in air particulates and pollution
- An increase in rainfall intensity and storm events
- Continued variability in annual rainfall
- An increase in bushfire conditions
- An increase in drought conditions
- An increase in sea levels and the extent of coastal inundation.

### Observed changes

Australia's climate has become warmer since national records began in 1910, especially since 1950. The average surface air temperature has become warmer by 0.9°C since 1910. While this average increase of just less than 1°C may not sound significant, it is: the impact has been more very hot days and fewer very cold days.

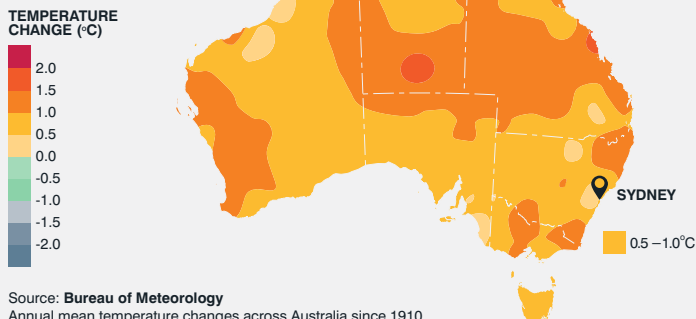
Extreme fire weather has increased and the bushfire season has become longer. This has been exacerbated by a decrease in rainfall across Southeastern Australia.

The sea level has risen at a rate of 3.2mm per year for the last 20 years. This is due to the expansion of the oceans through warming (thermal warming) and the loss of mass from glaciers and ice sheets. The City of Sydney is relatively sheltered due to our location, the structure of the harbour and the topography of the local government area. Surrounding areas with coastal and estuarine features will, however, be more exposed to ongoing sea level rise.

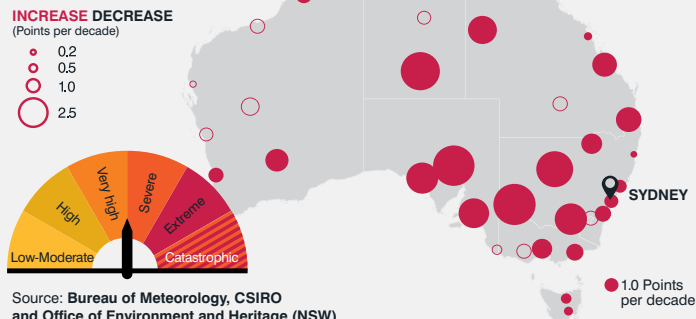


# 01 What does climate change mean for us?

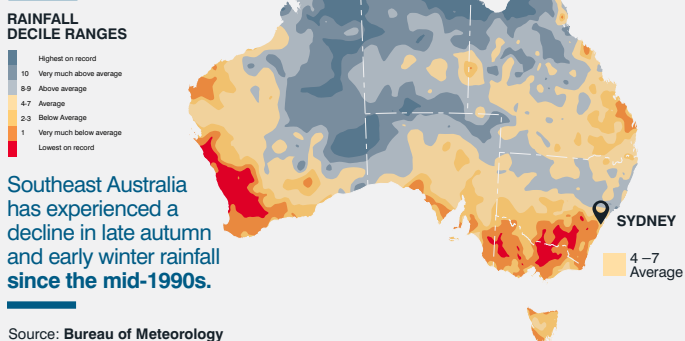
Australia's mean temperature has **warmed by 0.9°C** since 1910.



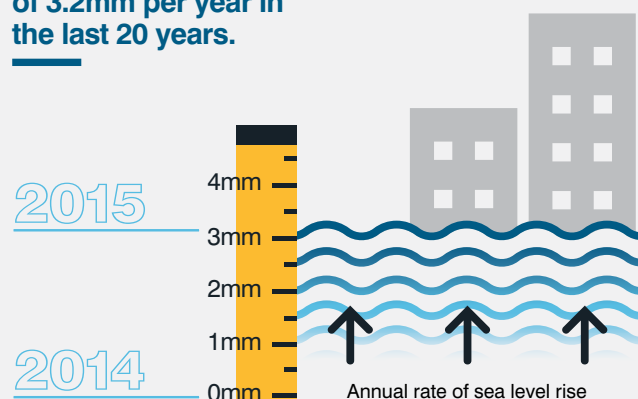
The largest increases in fire weather have been **in the southeast and away from the coast.**



Rainfall in the Southwest of Western Australia has been very much below average to **lowest on record.**



Sea level rose at a rate of **3.2mm per year** in the last 20 years.



## Projected changes

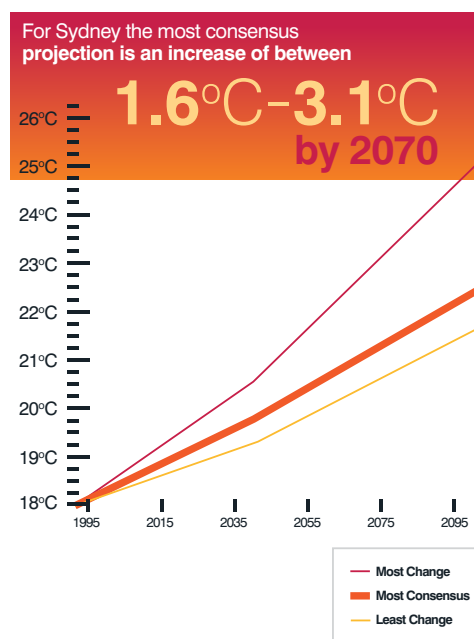
The climate modelling, which form the foundation of this strategy are based on the scenario that represents the world's current emissions trajectory (that is, if we continue current emission intensity as well as economic and population growth) described in Section 6. This has been chosen by the City as it represents the highest risk case and is consistent with a risk averse approach and was supported by the project's Science Reference Group (SRG). We will review the global average temperature and the rate of change as future data becomes available, notably the IPCC's Assessment reports which are released every seven years (see Section 6 – Future Reviews for more detail). The AR5 was released in 2014.



**Average temperature:** Average annual temperatures are expected to increase. In 1995, the average temperature in Sydney was 18.0°C. This is projected to increase to between 19.6° and 21.1° in 2070.

**Figure 1: The most consensus line shows an increase for Sydney of between 1.6°C and 3.1°C by 2070**

Average temperature



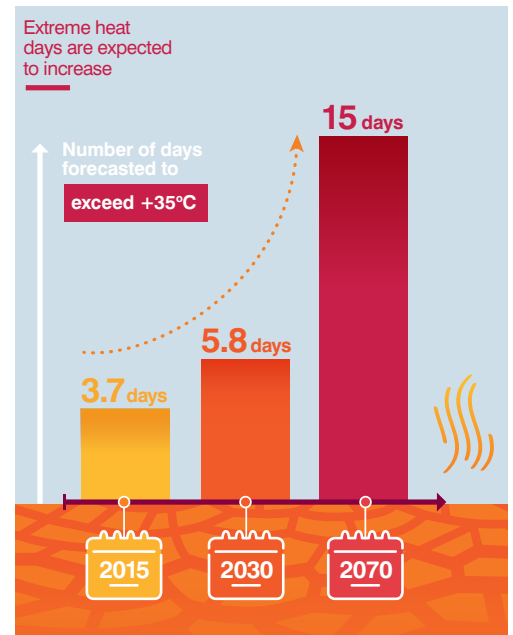


**Heatwaves:** Extreme heat days are expected to increase. This means that heatwaves will become hotter, last longer and be more frequent.

The heatwave of 37.7°C that Sydney experienced in 2011 would have been considered a 1 in 100 year event in 1995. This is projected to become a 1 in 2 year event by 2070, meaning that heatwaves of such a magnitude could be expected every two years on average.

Sydney currently experiences days of extreme heat, that is, over 35°C, 3.7 times a year on average. Our research concluded that by 2030 this is projected to increase to 5.8 times a year and is likely to occur 15 days a year by 2070. Such an increase in the occurrence of extreme heat will have a significant impact on our community.

**Figure 2: Projected number of days of extreme heat**

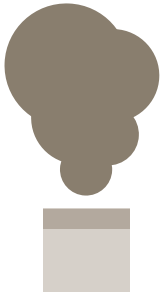


**Rainfall:** Natural variability in annual rainfall will continue so we will see dry spells and drought as well as wet periods. We will continue to experience heavy rainfall events, and these are likely to increase in frequency. Current 1 in 50 year events will likely become 1 in 20 year events, so we are likely to experience *both* dry spells and an increase in rainfall intensity.

**Figure 3: Expected changes in rainfall**



## 01 What does climate change mean for us?



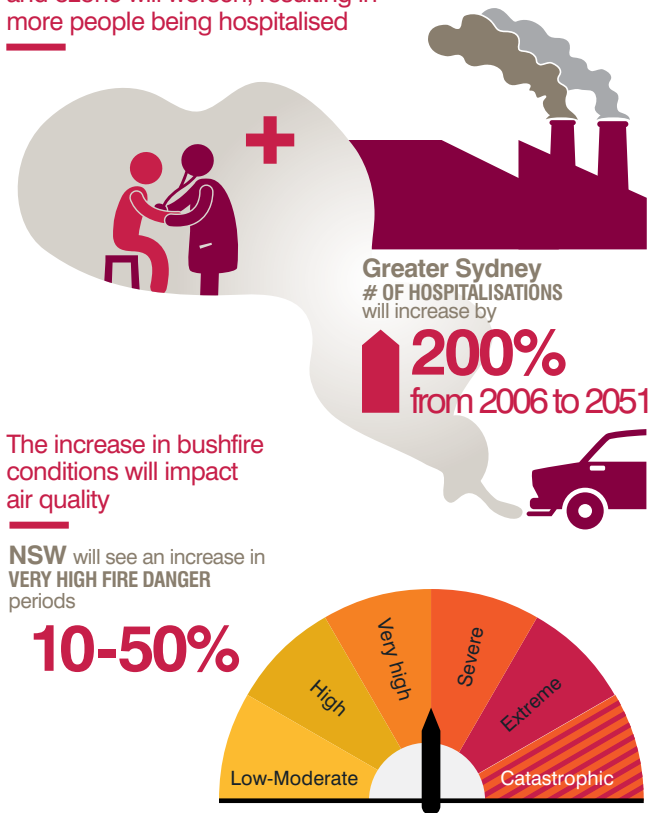
**Air pollution:** Air particulates and ozone are expected to increase. Hospital admissions in Greater Sydney, not just the City of Sydney LGA, due to air pollution are projected to rise by over 200% by 2051 compared to the 1996–2005 baseline.<sup>7</sup>



**Bushfire conditions:** Bushfire conditions are expected to increase as the climate becomes hotter and drier with the duration of very high fire danger periods expected to increase 10–50%. An increase in bushfires in the areas surrounding Sydney is likely to place strain on essential services and will impact air quality in the city.

**Figure 4: Impacts of air pollution and increase in bushfire conditions**

Due to warming and pollution, air quality and ozone will worsen, resulting in more people being hospitalised

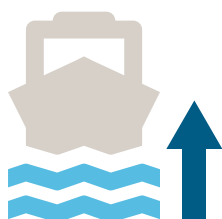






**Drought conditions:** Drought conditions in the region surrounding Sydney are expected to increase which will be uncomfortable for humans, but also interfere with plant growth and survival and with the welfare of animals, including pets, in terms of their food and reproduction. Drought can also have an obvious broader impact on food production.

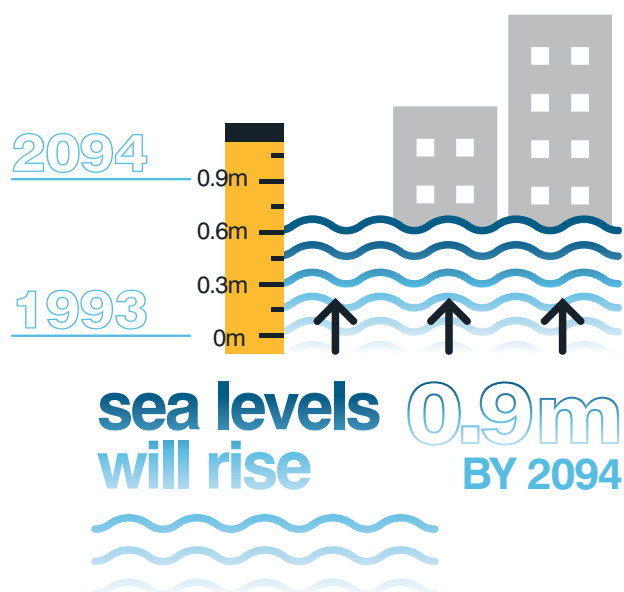
**Figure 5: Impacts of likely drought conditions**



**Sea level rise:** Increase in sea levels and in the extent of coastal inundation is expected. The sea level is projected to rise by 0.9m by 2094 from a 1993 base. This increase is likely to be non-linear, meaning that it will not take place in a smooth gradual annual increase, but rather it is likely to have periods of rapid increase and at other times slow increases. Due to the protected location of the City of Sydney's LGA within Sydney Harbour and its topography, the short-term risk of inundation is limited but it is important to monitor the ever improving science on sea level rise.

**Figure 6: Projected sea level rise**

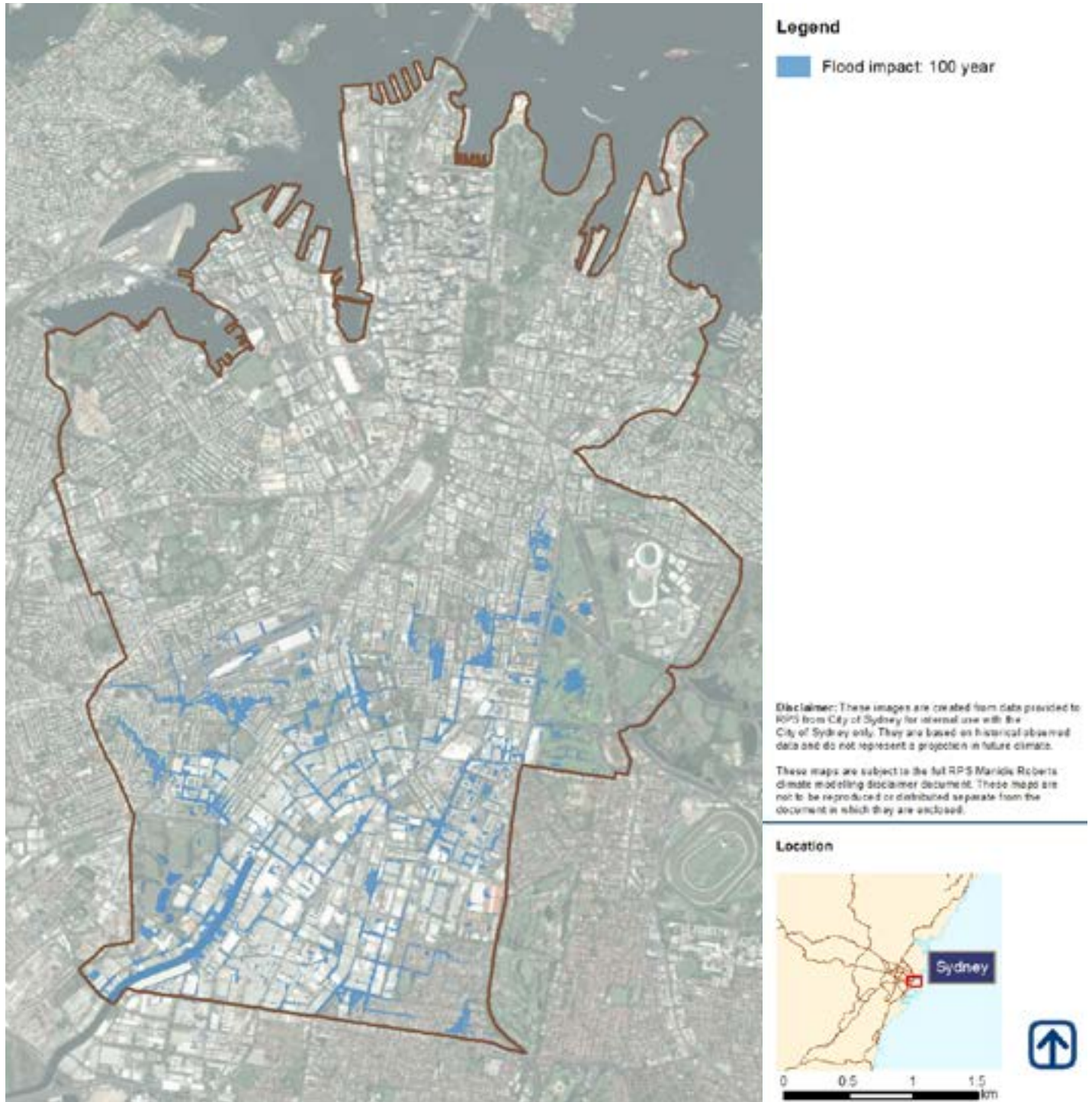
Coastal inundation is expected, although Sydney's LGA will have limited risk for many decades



## 01 What does climate change mean for us?

The image in Figure 7 shows the observed exposure for the peak water levels for a 1 in 100 year fluvial flood for the whole LGA. This is the current flood plain map without the impact of climate change and is the focus of the City's current interim flood management planning.

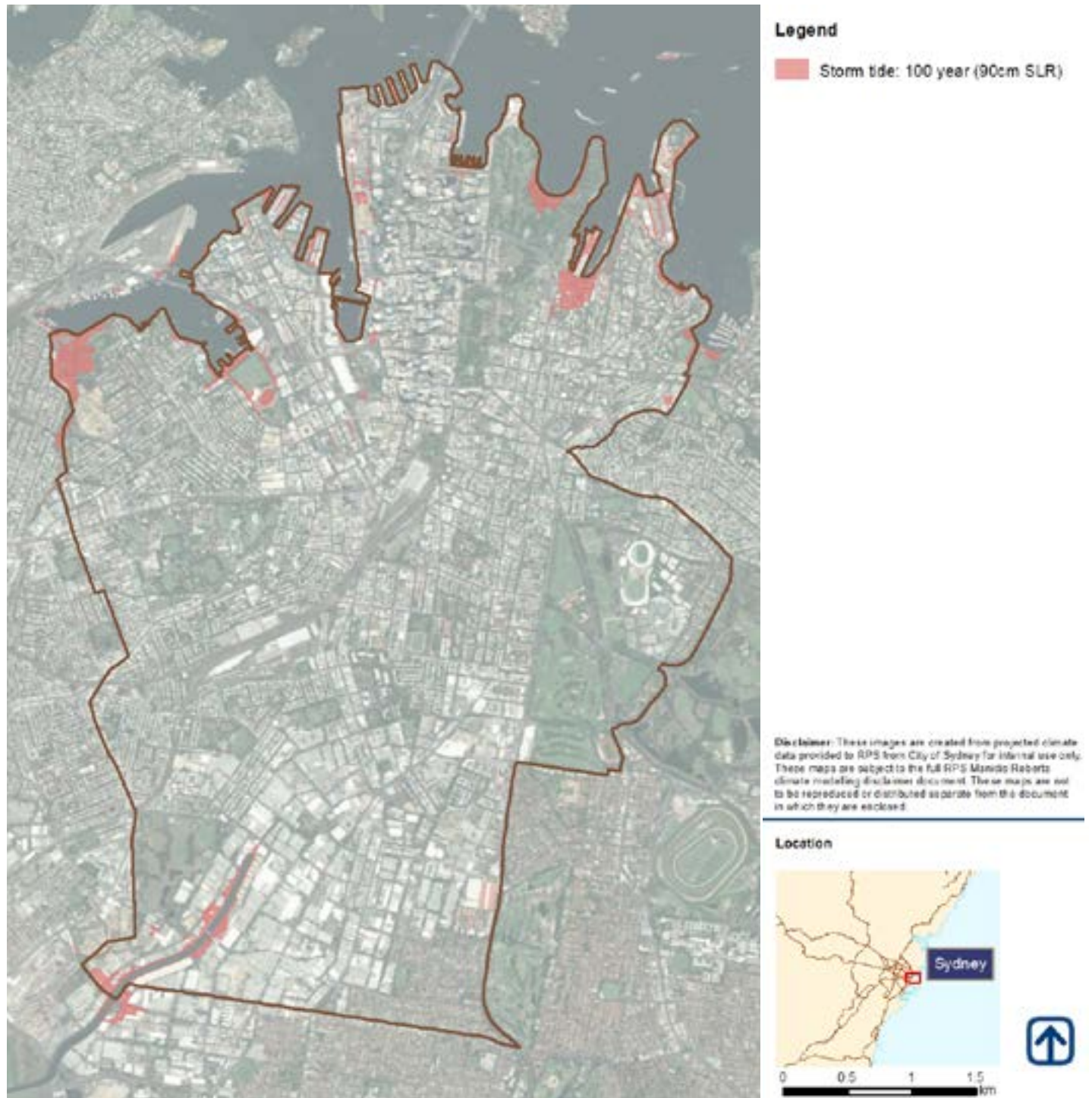
**Figure 7: The current 1/100 peak water levels for a 1 in 100 year fluvial flood**



Original source: Sydney Coastal Councils Group.

The image in Figure 8 shows the inundation extent of a modelled sea level rise event for the whole LGA: the likely inundation that would occur by the end of this century, assuming that the sea level had risen by 90 cm and a one in 100 year storm surge occurred. The areas around Garden Island, Woollahroomooloo, Farm Cove, Bicentennial Park (Glebe) and the Alexandria Canal will be most impacted, highlighting the need for whole-of-government long-term planning.

**Figure 8: Extent of inundation of a modelled 1/100 storm surge with a 0.9m sea level rise event for the City of Sydney local government area at the end of the century, assuming that the current emissions scenario continues**



Original source: Sydney Coastal Councils Group.



# 02

## Our role

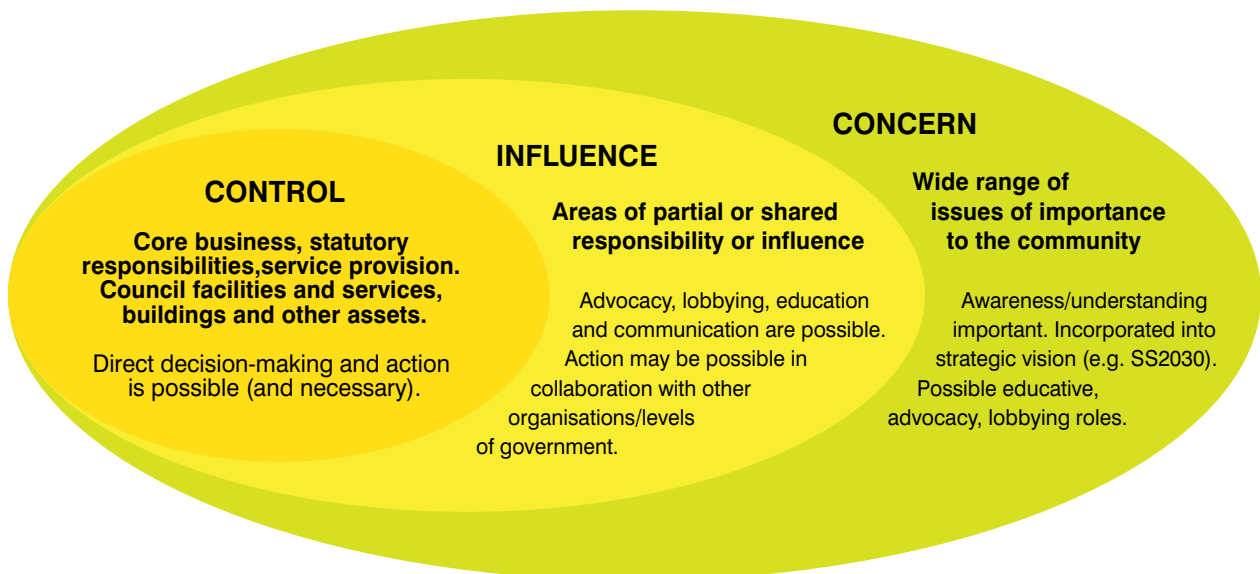
Working with partners from industry, state, federal and local governments, businesses and the community will be essential for Sydney to adapt to the realities of a changing climate, and to implement this strategy over the long term. Together, we can ensure Sydney continues to be a thriving city.

As shown in Figure 9, the City's actions will at times come directly under our **control**; for some we will seek to **influence** them through collaboration with others and finally, some issues and actions are important and of **concern**, but the City cannot address them directly.

Sydney must adapt to the changing climate to protect our communities, assets and services. This is a well-accepted practice with over 90 councils around Australia in the process of or having already prepared a climate change adaptation strategy or plan.

Global cities around the world are also preparing. We are coordinating with C40, the global cities network<sup>8</sup>, to maximise our learning from local government colleagues from around the world (see Box 1).

**Figure 9: This diagram has been taken from the Sustainable Sydney 2030 Vision and explains the City's spheres of influence**



### Australian, state and council adaptation frameworks

Just as climate models cover the national, state and local levels of government, each level has developed their own approach to climate change adaptation within their own jurisdiction. These are shown in Figure 10. The City has been consciously engaged with the other levels of government in the development of this strategy, noting their approaches.

Our strategy aligns with the NSW Government's Plan 2021<sup>9</sup> that sets the target to “minimise impacts of climate change in local communities”.

**Figure 10: The Australian<sup>10</sup>, New South Wales and City of Sydney adaptation frameworks**



### City of Sydney plans and policies

The key strategic policies and plans, and their impact on this strategy, sit under the City of Sydney's Sustainable Sydney 2030

- Community Strategic Plan
- Delivery Program
- Operational Plan
- Resourcing Strategy
- City Plan.

These plans are publicly available from the City of Sydney website.<sup>11</sup>

There are many other existing plans and policies that include adaptation actions. This strategy consolidates them and identifies new actions where gaps exist. Existing actions will be referred to in this strategy as required.



### **Climate adaptation within Sustainable Sydney 2030**

Sustainable Sydney 2030 is the City's guiding strategic plan for the sustainable development of the city to 2030 and beyond. Sustainable development is about linking the physical environment with the economy, society and cultures with bold ideas and good governance that will result in better outcomes for current and future communities. Sustainable Sydney 2030 expresses the community's vision and the City's commitment to a green, global and connected city.

Sustainable Sydney 2030 demonstrates that the City constantly and continually focuses on sustainable practices that provide services and benefits to the community, while protecting the interest of the natural environment and remaining fiscally responsible. The City will not only adapt to climate change, but will also be an environmental leader through its actions to support the development of green industries and reduce greenhouse emissions.

### **Delivery program**

The delivery program identifies the City of Sydney's goals and the steps required to reach our long-term vision and objectives. The strategic directions framework of Sustainable Sydney 2030 (from the Community Strategic Plan) drives the major projects, programs and service area measures.

### **Operational plan**

The operational plan is the yearly implementation of the four-year Delivery Program.

The yearly plan includes:

- Performance indicators
- Projects, programs and services to be delivered
- Detailed budget and revenue policy, including rates, fees and charges.

### **Monitoring**

The delivery program and annual operational plan are monitored through half-yearly, annual and four-yearly performance reports, and quarterly and yearly financial reports to Council. These reports provide details of our operational performance, and progress towards the Sustainable Sydney 2030 goals.

### **Resourcing strategy**

To support the community's objectives, as expressed in Sustainable Sydney 2030, a long-term resourcing strategy is required as part of the Integrated Planning and Reporting framework. This serves to both inform and test the aspirations expressed in the strategic plan and how Council's share of the required actions might be achieved.

The Resourcing Strategy (2015), which accompanies the SS2030 Community Strategic Plan includes four components:

- Long Term Financial Plan
- Workforce Strategy
- Asset Management Strategy
- Information and Communication Technology Strategic Plan





Costs for the principal activities undertaken by the City of Sydney under Sustainable Sydney 2030, including the continued provision of current services at the appropriate levels necessary to meet the objectives of the community strategic plan, are brought together in the Long-term Financial Plan. This provides a 10-year view of costs and what can be funded by the City of Sydney.

The City of Sydney's workforce capacity to meet the objectives of the strategy and the broad challenges and responses to planning our future workforce are outlined in the Workforce Strategy (2015).

Asset management is a critical area of local government responsibilities, governed by legislated standards. The status, needs and resourcing plan for each key asset area in the City's care are shown through the Asset Management Strategy (2015).

The ICT Strategic Plan establishes a roadmap to ensure that ICT facilities, initiatives and resourcing are aligned with the City's strategic goals. The plan will guide the City's business units as they develop, upgrade and transform the nature and substance of services to clients and communities in order to deliver on Sustainable Sydney 2030 outcomes and targets.

### City plan

The City plan is a single set of planning controls that will guide future development throughout the City of Sydney Local Government Area. The City plan consists of a single Local Environmental Plan (LEP) and Development Control Plan (DCP) and supporting information.

The LEP is the principal legal document for controlling development and guiding planning decisions made by Council. The LEP provides development controls for new buildings and other development. The controls include environmental protection measures, tree protection and conservation protection requirements.

The DCP supports the LEP with more detailed planning and design guidelines which help promote climate adaptation. For example, the City's DCP includes protection of existing trees on private property and promotes canopy coverage.

The City's planning controls are a primary mechanism for ensuring the built form of Sydney remains resilient in the context of a changing climate.

# Climate risks and adaptation actions



This section outlines the major climate risks the City of Sydney faces and the actions we will take to manage those risks and adapt to the changing climate.

It is based on the technical report prepared by our expert advisers (attached in Appendix A) which provides a comprehensive assessment of the climate change risks that the City of Sydney is likely to face. The report includes 32 risk statements that were developed through workshops with staff and our external stakeholders from government and its agencies, the business community and not-for-profit organisations.

In response to these risk statements, 232 suggested actions were developed through further workshops with both internal and external stakeholders. The comprehensive action tables are an invaluable record of the known and anticipated risks of climate change and how to address them between now and 2070.

Our next step is to convert this list into a workable strategy, identifying the highest priority actions with the greatest reach. This sets a pathway for the City to follow over time, in collaboration with government, business and the community. Climate change impacts will be felt over a long period and our planning must reflect this timescale.

## 3.1 Increasing heat

The Sydney climate is gradually getting warmer, projected to increase by just over 3.1°C by 2070 and by 4.5°C by the end of this century. As the average temperature creeps up, the hottest days will become hotter, more frequent and last longer. Such an increase in extreme heat could lead to many impacts on Sydney including strain on vital infrastructure systems like energy and transport, community health problems, and an increase in air pollution, which in turn will further compound health problems.

Heat-related risks and the actions to respond to these risks are listed here. For detailed analysis see Appendix A.

### Risks

Our analysis identified that an increase in extreme heat could lead to the following risks:

**Heat stress** – Higher incidents of heat stress and other related illnesses among the community will result in a decrease in comfort levels and an increase in hospital admissions, pressure on social services and morbidity.

**Community health** – Along with associated bushfire smoke, increased heat will exacerbate the conditions for ozone and air particulates. This will cause an increase in incidents of respiratory distress, resulting in an increase in hospital admissions and morbidity.

**Flora and fauna health** – The projected level of increased heat will impact the health of existing flora and fauna in the LGA.

**Changed biodiversity** – Increased pressure on local biodiversity will result in the degradation of natural assets and morbidity to both native flora and fauna.



**Urban heat island** – Areas that already experience urban heat island effects within the local area will be exacerbated, leading to precincts that are too hot. This will lead to social and economic impacts. See Figure 11.

**Energy system strain** – Extreme heat will place strain on the energy system decreasing system efficiency and the performance of the energy network. Electricity consumption will also increase due to a surge in peak demand for air conditioning.

**Power disruptions** – Extreme heat will lead to power supply disruptions from programmed load shedding and heat damage to network infrastructure.

**Reduce workforce productivity** – As conditions become too hot for people to work outside during parts of the day, and the indoor thermal comfort is affected by pressures on cooling, workforce productivity will be impacted.

**Behaviour change** – Negative changes in behaviour may result, in particular increases in violence and anti-social behaviour, in turn leading to increased demand for emergency and social services.

**Reduced outdoor activity** – The increased risk of heat stress and dehydration associated with outdoor exercise, along with reduced air quality, may result in reduced appeal for outdoor physical activities such as walking and cycling.

**Transport disruption** – Extreme heat will lead to increases in heat impacts to transport infrastructure, resulting in congestion, major delays and mass transit disruption with the potential stranding of commuters.

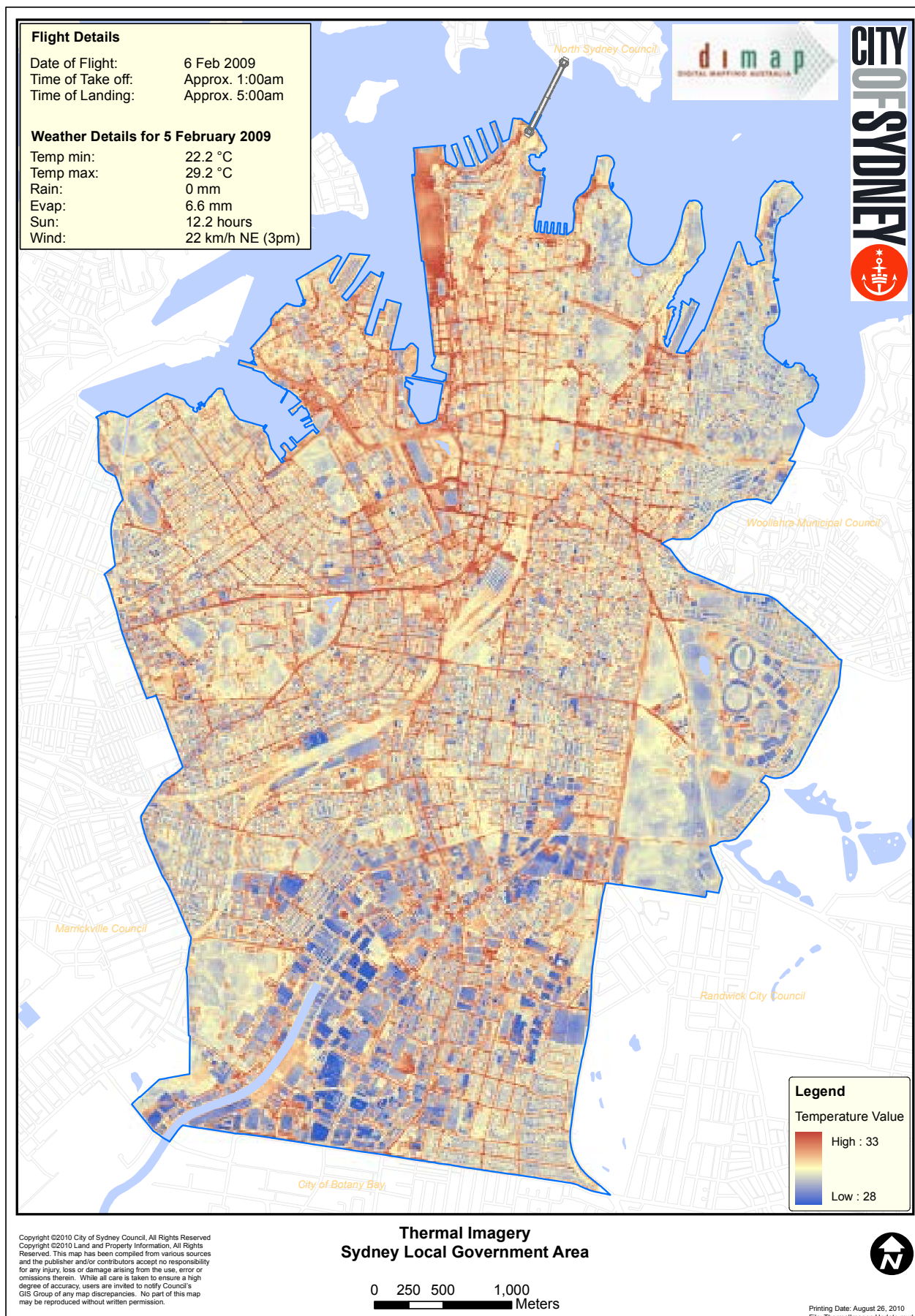
**Congestion** – Commuters may opt to use private vehicles rather than public transport to access the city centre to avoid potential delays and discomfort, resulting in increased congestion.

**Strain on council resources** – Demand for refuge areas for respite will increase, putting strain on available resources.

**Infrastructure degradation** – Extreme heat will accelerate the degradation of concrete structures and softening of pavements leading to the need for more frequent repairs, increasing costs and pressure on resources.



**Figure 11: Photograph of the local area taken using a thermal imagery camera which shows the ambient heat from surfaces within the City of Sydney LGA late at night.**





### Objective: increasing heat

Sydney's residents, workers, visitors and ecological services will be healthy and productive, and vital infrastructure will be resilient during periods of extreme heat.

### Action Pathways

#### 2015–2030

- H1** – Maintain existing adaptation policies and programs
- H2** – Develop Heat Wave Response Plan aligned with the NSW State Heatwave Sub Plan.
- H3** – Communicate and raise awareness on heatwaves, air pollution, bushfire and other climate events. Investigate a heatwave and extreme event warning system.
- H4** – Work with energy companies to assess the trigger points and potential extent of vulnerability of the city's power supply.
- H5** – Increase the urban forest and biodiversity to reduce the urban heat island effects, as well as address changing rainfall patterns and increased air pollution.
- H6** – Amend the business continuity plan to consider extreme heat on essential services.

#### 2030–2050

- H7** – Consider further revision to event protocols to enable safe, successful events in hot and extreme conditions.
- H8** – Design City buildings, facilities, streets and public open space to cope during periods of extreme heat.

#### 2050–2070

- H9** – Review the City's infrastructure, buildings and facilities and services to assess their performance in the face of the changed climate.

## Detailed Actions

Risk	Action	Responsibility
Stopping the City's existing policies and programs would reduce our growing adaptive capacity.	<b>H1</b> – Maintain existing policies and programs including: <ul style="list-style-type: none"> <li>a. Emergency management coordination</li> <li>b. Work Environment Operational Procedure</li> <li>c. Urban Forest Strategy ♦</li> <li>d. Greening Sydney Plan</li> <li>e. Urban Ecology Strategic Action Plan</li> <li>f. Cool Pavements trial</li> <li>g. Social Sustainability Discussion Paper (in progress).</li> </ul>	City of Sydney – control
Extreme heat will impact on: <ul style="list-style-type: none"> <li>–Human health causing heat stress ♦</li> <li>–Infrastructure causing disruption</li> <li>–Workforce productivity</li> </ul>	<b>H2</b> – Develop Heat Wave Response Plan aligned with the NSW State Heatwave Sub Plan 2011, including analysis of vulnerable communities, transport and likely behaviours including: <ul style="list-style-type: none"> <li>a. Community vulnerability analysis to identify who is most at risk, where they live and opportunities to assist them (including refuge points) ♦ This will be followed by a vulnerable communities communications plan.</li> <li>b. Detailed pollution-related actions</li> <li>c. Communication strategy to raise community awareness and provide warnings during risk periods, including investigation of a heatwave alert system ♦</li> <li>d. Internal communication plan to manage and respond to extreme heat events</li> <li>e. Engagement with Transport NSW to coordinate approach to public transport pinch points</li> <li>f. Examine event protocols to determine if any amendments are needed, including scheduling</li> <li>g. Examine work health and safety (WHS) impacts and response, and feed into WHS policy</li> <li>h. Continue research and trials in reducing the urban heat island effect</li> <li>i. Identify staff training needs: safety, design, ecology.</li> </ul>	City of Sydney – control and coordinate with: <ul style="list-style-type: none"> <li>–Local Emergency Management Committee</li> <li>–Transport NSW</li> <li>–Council of Social Service of New South Wales (NCOSS)</li> <li>–Department of Family and Community Services</li> <li>–City of Sydney Inclusion (Disability) Advisory Panel</li> </ul>



Risk	Action	Responsibility
Lack of awareness of the risks posed by extreme heat and heatwaves and how to manage them will place people at serious health risk.	<b>H3</b> – Communicate to and raise awareness of the public and staff on the heatwave response plan and what to do in heatwaves, bushfires and other climate events including increased air pollution, for people and animals (including pets ♦), and investigate a heatwave and extreme event warning system. ♦	City of Sydney working with: –Local Emergency Management Committee
Extreme heat will impact infrastructure, causing disruption.	<b>H4</b> – Work with agencies and stakeholders, especially energy companies, to assess the trigger points and potential extent of vulnerability of the city's power supply to help build resilience across the network. Include investigation of pack-up power supply options.	City of Sydney working with others: –Ausgrid –TransGrid
Rapid loss of soil moisture due to extreme heat events will result in pressure on environmental assets. Extreme heat will also increase pressure on ecosystems, leading to impacts on local biodiversity and canopy cover such as morbidity.	<b>H5</b> – Plan now and implement actions to future-proof areas that are at risk of rapid loss of soil moisture, such as parks, open space through better coverage, irrigation needs (note link to R4). Use the natural ecosystem to address climate pressures and help mitigate and adapt to climate change. Continue research, trials and best practice to harness biodiversity and urban forestry to reduce urban heat island effects, as well as address changing rainfall and increased air pollution.	City of Sydney working with others: –Botanical Garden and Domain Trust –Centennial Park and Moore Park Trust
Failure of critical infrastructure could impede the City's ability to carry out its core business.	<b>H6</b> – Amend business continuity plan to consider the impact extreme heat on essential services.	City of Sydney, control
Extreme heat could place attendees at City events at risk of heat stress.	<b>H7</b> – Consider further revision to event protocols to enable safe, successful events in hot and extreme conditions including research on feasibility of a public steward program and event safety plans.	City of Sydney working with others
Conventional designs and construction may not cope in times of extreme heat.	<b>H8/H9</b> – Design (and review over time) City buildings, facilities, infrastructure, streets and public open space to cope during periods of extreme heat and assess their performance in the face of the changed climate.	City of Sydney, control

♦ Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.

Note: External bodies needed for collaboration in delivering actions have been suggested for short-term actions only, as medium and long-term actions are too far away to appoint responsibilities.

## 03 Climate risks and adaptation actions

### Box 3: What we're already doing to address heat risks in the city

The City's Greening Sydney Plan has overseen 10,250 new street trees planted since 2005 and 49,664 square metres of landscaping installed throughout the City's streets and parks since 2008. By increasing shade and reducing hard surfaces that absorb the sun's warmth, we actively reduce the heat held in the city, known as the 'urban heat island effect'.

#### Urban Forest Strategy ♦

The City of Sydney's Urban Forest Strategy was adopted in February 2013. Urban forestry can be described as the science and art of managing trees, forests and natural ecosystems in and around urban communities to maximise the physiological, sociological, economic and aesthetic benefits that trees provide society (Schwab 2008). This strategy provides healthy and diverse landscaping in our streets and parks, and creates beautiful streets and public spaces that contribute to the health and wellbeing of everyone. Urban forestry is one of the most effective ways to reduce the urban heat island effect, generate fresh air, absorb stormwater, and provide cool spaces and respite during extreme heat – all of which help us adapt to the changing climate.



♦ *Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.*

#### Urban Ecology Strategic Action Plan

The City of Sydney's Urban Ecology Strategic Action Plan was adopted in March 2014. A diverse and thriving urban ecology makes our city a healthier and more attractive and enjoyable place to live. The focus of the plan is the city's biodiversity and to restore and conserve resilient urban ecosystems that support a diverse range of locally native flora and fauna species. In doing so, it creates a liveable city for all of its inhabitants. This climate adaptation strategy adds to the climate adaptation benefits delivered through the Urban Forest Strategy.

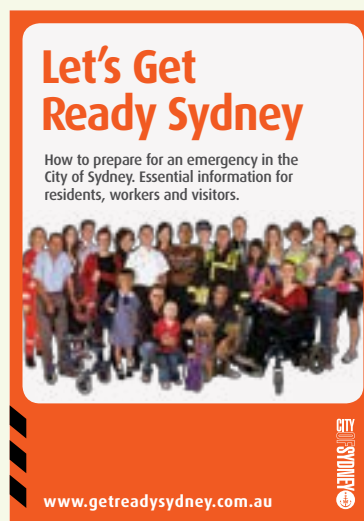
#### Cool pavements trial

The City of Sydney is trialling a lighter-coloured pavement in Myrtle Street, between Abercrombie and Smithers streets in Chippendale, as part of an investigation into ways of reducing temperatures in urban areas. Lighter-coloured surfaces generally do not absorb as much light or retain as much heat as dark surfaces, and therefore have the potential to reduce temperatures, resulting in lower energy bills for surrounding buildings, and improved road strength. The project examines how and if lighter-coloured pavements and other hard surfaces can reduce the urban heat island effect, and potential benefits of doing so. It is being undertaken in collaboration with the University of New South Wales.



### Emergency management coordination

The City of Sydney takes a strong, proactive role in emergency management preparation and planning to address multiple risks, including climate risks such as heatwaves, flooding and storms. The City chairs the Local Emergency Management Committee (LEMC), which includes members from the New South Wales Police Force, Fire and Rescue NSW, Ambulance Service of NSW, NSW State Emergency Service and Health NSW, among others. The LEMC is convened within the framework of the Ministry for Police and Emergency Services and oversees the Local Area Disaster Plan that is put into effect in the case of a large-scale emergency. In addition to preparations behind the scenes, the LEMC has also prepared the “Let’s Get Ready Sydney” booklet to help residents and businesses be ready in the event of an emergency. “Let’s Get Ready Sydney” provides a good example of the City’s existing approach to collaborating with other agencies to prepare our community for the unexpected. See [getreadysydney.com.au](http://getreadysydney.com.au)



### Social Sustainability, policy and programs – currently under development

The City of Sydney is currently developing a Social Sustainability Strategy that outlines our approach to maintaining and improving the community’s social wellbeing. This strategy is one of the four pillars of Sustainable Sydney 2030. The City has already developed other key strategies and policies that address the environmental, economic and cultural facets of sustainability. Social sustainability is about the continued wellbeing of people and communities. It means people can cope with the normal stresses of life to realise their full potential. Socially sustainable communities are happy, healthy and productive.

The Social Sustainability Strategy will tie in with our adaptation work: it will address vulnerability to climate change risks, identify community members who are currently vulnerable, and develop actions to strengthen their resilience.

### Outdoor Working Conditions

The City’s Safety Management System was updated in 2014 and places a strong emphasis on ensuring safe working conditions that recognise the risks of heat and heat-related stresses, particularly in the section “Hot Environments – Risk Factors and Controls”. Our safety management system will be crucial to ensure staff are safe in the face of the changing climate.







### 3.2 Changing rainfall patterns and drought conditions

Sydney's rainfall pattern will continue to feature significant natural variability with dry periods and wet spells. We will also experience a likely increase in deluges of heavy rainfall.

We already have experience in dealing with drought conditions. These will continue to place pressure on the City to maintain our public open space and greenery. Further afield, increased drought conditions could impact Australia's capacity to grow food, a concern raised during our community engagement sessions.

#### Risks

##### **Intense rainfall – property/infrastructure damage:**

An increase in intense rainfall, wind and hail events, in combination or isolation, may result in extensive damage to property – infrastructure including street lights and embankments, buildings and trees. This will increase clean-up efforts, disposal and maintenance costs. Past events have also shown that this risk can result in opportunities for skilled labour to repair and rebuild.

**Intense rainfall – displacement:** An increase in intense rainfall and hail events may result in damage to properties, causing displacement and disruption to community, business and other activities while clean-up and recovery occurs. In the short term, this may increase the need for and cost of emergency housing or shelter, rebuilding skills, disaster relief, and social services. In the longer term, this may impact productivity and reputation.

**Intense rainfall – flash flooding:** Heavy rainfall can cause stormwater drainage systems to back up and cause localised flash flooding of roads, public spaces and property. This may result in an increase in property damage, localised traffic congestion, and vehicular and pedestrian accidents, as well as the loss of parking spaces in low-lying areas and basements.

##### **Intense rainfall – localised power infrastructure damage:**

An increase in intense rainfall and high winds, in combination or isolation, may result in damage or inundation of electricity and gas power infrastructure and vital equipment, resulting in energy interruptions. Powerful storm activity can bring down powerlines and flood power substations and vital equipment located in basements, potentially causing extensive blackouts and service interruptions across the city, including to transport. This risk extends beyond the LGA where the power is sourced and transmitted.

**Intense rainfall – overflow of contaminants:** An increase in intense rainfall has the potential to cause an overflow of the sewerage system and stormwater systems, releasing contaminants and creating hazardous water quality conditions downstream causing a risk to public health.

**Increased storms causing disruption:** An increase in the frequency and intensity of extreme storms including high winds could damage assets and disrupt services in the city.

**Airport delays:** An increase in the frequency and intensity of extreme weather events (such as heatwaves coupled with bushfire smoke, hail storms and storm surges) can cause major disruptions to flights arriving and departing from Sydney Airport due to reduced safe operating conditions and the potential inundation of the runway. Although outside the City's LGA, this has a potential impact on Sydney's and the nation's economy.



**Communication disruption:** An increase in the frequency and intensity of extreme weather events may lead to IT and communications equipment disruptions, resulting in the loss of vital equipment and telecommunications.

**Decreased rainfall – reduced amenity:** Dry periods leading to drought conditions could result in reduced water availability for gardens and open space areas, resulting in reduced scenic and social amenity and limiting recreation and respite areas. Due to drought conditions, water restrictions may be imposed, limiting the amount of irrigation available for open space areas and private gardens. This may result in:

- The hardening of playing surfaces, increasing risk of injury and liability.
- Reduced availability of playing fields and informal recreational areas.
- Loss of the cooling properties of open space zones and respite areas, adding to the urban heat island.
- Degradation of areas of natural beauty, which has detrimental effects on the physical and mental health of the population.

**Decreased rainfall – changed and weakened biodiversity:**

Periods of low precipitation, coupled with extreme conditions such as extreme heat days and drought, may result in the environmental degradation of open space including the dieback of vegetation such as trees and grass, the loss of local biodiversity and reduced water flows. The quality of canopy cover and urban trees may be impacted by both the ongoing decrease in rainfall, and an increase in rainfall events that may place pressure on weakened trees.

**Decreased rainfall – food security:** An increase in the frequency and intensity of extreme weather and/or drought may reduce the production of local fresh produce which is grown in the Sydney Basin, community gardens and the wider national and international food supply chain. This may impact the availability of local produce supplies for the city's food retailers, cafés and restaurants, and the availability and affordability of food for the local community.





### Objective: changing rainfall and drought conditions

The City of Sydney will be prepared for a future with less overall rainfall, while also being ready to deal with heavy rainfall, flooding and storms when they occur.

#### Action Pathways

##### 2015–2030



- R1** – Continue flood management work to assess the extent of the vulnerability of properties and key assets.
- R2** – Work with emergency services agencies to prioritise and coordinate responses.
- R3** – Continue investigation of the City's own asset risk profile to increases in extreme weather.
- R4** – Factor changing rainfall, flooding and drought patterns into land use planning, infrastructure design (including water sensitive urban design), and strategies for parks, gardens, open spaces and urban forestry.

##### 2030–2050



- R5** – Adopt new design measures for improved protection of council property and infrastructure from more severe rain, hail and wind.
- R6** – Identify high-risk areas for modification of infrastructure, facilities and buildings.
- R7** – Assess the business continuity risks (airport, tourism, communications, energy, water) and responses for the City and surrounding areas.

##### 2050–2070



- R8** – Re-assess the extreme weather risks and responses for the city and surrounding areas.





### Detailed Actions

Risk	Action	Responsibility
Intense rainfall – displacement, disruption, property/ infrastructure damage	<b>R1</b> – Continue flood management work to assess extent of vulnerability of properties and key assets to more severe and frequent rainfall, flooding, hail and wind. Consider design responses. Communicate with owners of property and infrastructure owners at risk. ♦	City of Sydney – control and influence working with: –The Australian Building Codes Board –Department of Planning and Environment
Intense rainfall – communication disruption	<b>R2</b> – Work with emergency services agencies to prioritise and coordinate response including: a. Public awareness and warning b. Work with ICT providers and emergency services agencies to ensure continuity of communications that are vulnerable and vital to emergency response c. Resourcing – Local Emergency Management Officer (LEMO) and State Government and agencies d. Clean-up planning and costs management.	City of Sydney – control and influence, working with: –Local Emergency Management Committee
Intense rainfall –property/ infrastructure damage	<b>R3</b> – Continue investigation of the City's own buildings' risk profile to increases in extreme weather.	City of Sydney – control
Intense rainfall – displacement, disruption, overflow contaminants. Decreased rainfall – reduced amenity, degradation of living/ natural assets, changed biodiversity	<b>R4</b> – Factor changing rainfall, flooding, storm and drought patterns into: a. Land use planning – input into LEP and DCP b. Infrastructure design (including water sensitive urban design, stormwater management, roads, pavement) – working with Sydney Water c. Parks, gardens and open space d. Urban Ecology Strategic Action Plan – managing (protecting and enhancing) local biodiversity e. Urban Forest Strategy – managing less rainfall, more storms and changing species diversity.	City of Sydney – control and influence, working with: –Sydney Water, where relevant

## 03 Climate risks and adaptation actions



Risk	Action	Responsibility
Intense rainfall –property/ infrastructure damage	<b>R5</b> – Adopt new design measures for improved protection of Council property and infrastructure from more severe rain, hail and wind.	City of Sydney – control
	<b>R6</b> – Identify high-risk areas for modification of infrastructure, facilities and buildings.	City of Sydney – control and influence, working with: –Sydney Water
Increased extreme weather – impact on economic productivity, such as airport delays	<b>R7</b> – Work with other agencies and organisations to re-assess the business continuity risks (airport, tourism, communications, energy, water) and responses for the city and surrounding areas.	City of Sydney – influence and concern: –Tourism Australia –Destination NSW –Sydney Airport Corporation –Sydney Water –Networks NSW –Telstra/Optus
Increased extreme weather – displacement, disruption, property/infrastructure damage	<b>R8</b> – Work with other agencies and organisations to re-assess extreme weather risks and responses for the city and surrounding areas.	City of Sydney – influence and concern, working with: –Sydney Water –Office of Environment and Heritage

◆ Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.

Note: External bodies needed for collaboration in delivering actions have been suggested for short-term actions only, as medium and long-term actions are too far away to appoint responsibilities.

## Box 4: What we're already doing to address changing rainfall patterns in the city

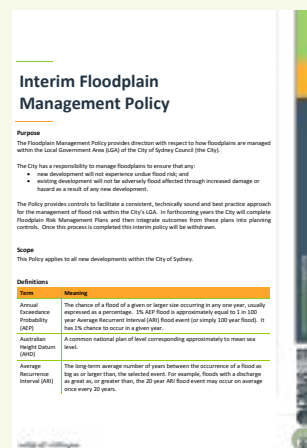
### Flood Plain Management Planning

Wet weather in early 2012 hit Sydney hard. The resulting floods caused considerable damage to public and private property. Some people had to be rescued from their cars. Plans are needed to safeguard flood-prone areas from this kind of weather. Councils are required to address flooding issues under the NSW Government's Flood Prone Land Policy.

Floodplain management plans are being developed for areas at risk of flooding that will examine the causes and extent of possible flooding and what can be done to improve safety and reduce property damage. Reducing the risk of future flooding means managing flood-prone areas properly with responsible development and drainage infrastructure.

The City of Sydney Council endorsed its draft **Interim Floodplain Management Policy** in May 2014. The policy represents a responsible and forward-thinking approach to manage flooding issues, which will ensure

that development in the City is not at undue risk of flooding and that proposals do not increase flood risk for existing properties. For Council's full resources on flood management, including the policy, visit: [cityofsydney.nsw.gov.au/vision/better-infrastructure/floodplain-management](http://cityofsydney.nsw.gov.au/vision/better-infrastructure/floodplain-management)



Studies have been conducted and plans prepared for the following catchment areas. For details and to download these plans, please visit the City of Sydney website: [www.cityofsydney.nsw.gov.au/vision/better-infrastructure/floodplain-management](http://www.cityofsydney.nsw.gov.au/vision/better-infrastructure/floodplain-management)

#### Alexandra Canal

The Alexandra Canal Catchment area covers the suburbs of Alexandria, Rosebery, Erskineville, Beaconsfield, Zetland, Waterloo, Redfern, Newtown, Eveleigh, Surry Hills and Moore Park. This also includes major development precincts such as Green Square, Victoria Park, Lachlan, Ashmore and Epsom Park

#### Blackwattle Bay

The Blackwattle Bay catchment area includes Glebe, Chippendale, Darlington and parts of Camperdown, Ultimo and Redfern. The areas include a mix of residential, commercial, industrial and parklands that are spread over 315 hectares.

#### Centennial Park

The Centennial Park catchment includes parts of Paddington, Moore Park and Centennial Park. The overall catchment is about 153 hectares. Land uses within the catchment include residential, commercial and industrial properties as well as parklands.

#### Darling Harbour

The Darling Harbour catchment includes the inner-city suburbs of Haymarket, Surry Hills and parts of Pyrmont, Ultimo and Sydney. This area covers around 307 hectares. The Darling Harbour catchment drains into Darling Harbour via Sydney Water's trunk drainage system.

#### Green Square-West Kensington

The area is about 240 hectares in size, with the City directly responsible for 64 hectares. Paddington, Darlinghurst, Edgecliff and Rushcutters Bay are included in the plan. A mix of residential, commercial and industrial properties exist within this area.

#### Johnstons Creek

The Johnstons Creek Catchment area includes the suburbs of Annandale, Camperdown, Forest Lodge and parts of Glebe and Newtown. The overall area is approximately 224 hectares and the land uses are a mix of residential, commercial, industrial and parklands.

#### Rushcutters Bay

Parts of Paddington, Darlinghurst and Rushcutters Bay are suburbs included within this catchment, which covers an area of about 64 hectares within the City of Sydney.

#### Sydney City

The City area catchment includes the suburb of Millers Point, Barangaroo, Dawes Point, the Rocks and parts of Sydney. The area covers about 199 hectares within the City's local area. The City area catchment drains into Sydney Harbour at a number of locations.

#### Woolloomooloo

Woolloomooloo, Darlinghurst, Kings Cross, Potts Point and parts of Rushcutters Bay are suburbs included in this catchment, which covers an area of about 265 hectares. The City and Sydney Water have jointly prepared a flood study for this catchment.



### Case study: Green Square – adapting the site to manage flooding

The \$8 billion Green Square project is transforming the southern precinct of our local area into a vibrant and sustainable urban environment. From its industrial past, Green Square is emerging as a place of innovative housing design, bespoke business and retail, and creative and engaged communities proud of their area's past and future.

Green Square is set to become a true exemplar of green living with developments linked to recycled water, people linked to shops, parks, gardens and entertainment with bike and walking routes, and public transport.

Long before its industrial history, the Green Square redevelopment site was the former Waterloo wetland and is therefore prone to flooding. To adapt the site to address this risk, a flood mitigation solution has been required to prepare the precinct for its transformation into a new town centre, a major new residential, retail and cultural hub.

The Green Square Trunk Stormwater Project, co-funded by the City of Sydney and Sydney Water, is underway (as at June 2015) to minimise or reduce the hydraulic hazard in key flood risk areas. In particular, the project is aimed at significantly reducing flood risk in the Green Square urban renewal area, and minimise any downstream flooding impacts. It is also facilitating private and public development at Green Square Town Centre and Epsom Park.

The project involves the design and construction of a 2.5 kilometre stormwater pipe, from Link Road, Epsom Park to the Alexandra Canal, Alexandria. The implementation of the new trunk drain, along with updates to the local stormwater drainage will improve the flood hazard, and flood depth in the area, particularly at the Joynton Avenue, Botany Road, Green Square Railway Plaza, O'Riordan Street and Lachlan Street.

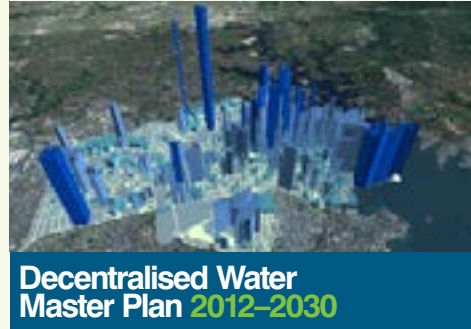
*This photo shows some of the new stormwater pipes being installed as part of the trunk stormwater project.*



**The Decentralised Water Master Plan**, adopted in July 2012, will help the city adapt to a dryer future through its blueprint to: ♦

1. Reduce mains water consumption across the LGA by 10% of 2006 levels by 2030 through water efficiency programs.
2. Reduce mains water consumption in Council's own buildings and operations to 10% below 2006 levels by 2030 through water efficiency and connection of Council facilities to park-based or precinct-scale recycled or alternative non-potable water supplies.
3. Replace 30% of mains water demand across the City of Sydney local government area with recycled or alternative non-potable water generated from local water resources by 2030.

4. Reduce sediments and suspended solids by 50% and nutrients by 15% discharged into the waterways from stormwater run-off generated across the LGA by 2030. Although not climate-related, reducing pollution in our waterways is a significant outcome that will improve our environment.



♦ *Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.*

### **Drought proofing our plans and parks**

The City has developed the Parks Water Savings Action Plan, the Irrigation Management Plan, the draft Storm Water Harvesting Asset Management Plan), and specifications for irrigation management, and storm water and recycled water infrastructure maintenance. The City has delivered \$1.2M of irrigation system improvements to achieve system efficiency over the past five years. We are currently updating the Parks Water Savings Action Plan, and have recently embarked on a program to evaluate the top 10 water-using sites to define our approaches to future water harvesting initiatives. This is a good example of the practical application of our ever-improving knowledge around water management and will help us adapt to a future with reduced rainfall.



### Case study: City property and the extreme weather of April 2015

Sydney's severe weather event in April 2015 provided a glimpse of weather patterns that may form in Sydney over the coming decades. It demonstrated the City's existing preparedness and continual improvement within Council to manage the impacts of extreme weather.

The City of Sydney property division, City Property, and its managing agents and sub-contractors worked effectively to manage the impacts from the combination of intense weather conditions – heavy rainfall of 100mm over a 24-hour period – and damaging winds exceeding 100kph.

The City Property Business Continuity Action Plan (BCAP) was activated at the start of this low pressure system nearing Sydney, which ensured that sufficient resources were immediately available to repair damage or install temporary controls safely. City Property will continue short, medium and long-term rectification of repairs and upgrades to ensure the integrity of the property portfolio for future severe weather events.

The impacts of the severe weather took three of the 245 buildings in the City Property's portfolio out of operation due to concerns for site safety for its occupants. A detailed list of storm impacts such as sewer back flow, tree failure and leaks from roof failure was created, and a "lessons learnt register". All this knowledge will be applied to the Preventative Maintenance Program that will include:

- Increasing the frequency of roof maintenance to ensure the free flow of stormwater and roof drainage
- Assessing the structural risks from severe weather to ensure integrity of structures
- Capital works improvement for the Property Portfolio

The lessons learned will also serve as an important guide for the next severe weather event. City Property will consider nominating design parameters for more frequent than 1 in 100 year events for new buildings and upgrades.

*Photos of the fallen tree at the Broughton Street childcare facility*



### Case study: Community storm response

The extreme weather in April 2015 put our community to the test. A collaboration of teams from the City of Sydney, NSW Department of Family and Community Services (FACS), NEAMI, Mission Beat and the NSW Police banded together to assist homeless persons across the city during three days of torrential rain, wild winds and intermittent storms.

In response to the severe weather warning initially issued by the Bureau of Meteorology, City staff set up a temporary accommodation shelter at Abraham Mott Hall in Millers Point to provide rough sleepers with somewhere to sleep, clothing, bedding, food, health assistance and referrals to specialist homelessness services that assist with longer-term accommodation outcomes.

Despite the dangerous conditions, it was all hands on deck as City staff helped those in need as the rain, wind and storms battered every corner of the city. 61 rough sleepers took refuge at the Abraham Mott Hall shelter with 46 people accepting temporary accommodation and two securing long-term sustainable housing.

*Generous donation of blankets by NSW Department of Family and Community Services*







### 3.3 Bushfire conditions and air quality

Climate change will lead to an increase in the conditions that contribute to bushfires. Our local area is not at direct risk from bush fires but will experience the impacts of smoke and poor air quality.

An additional risk is the increased generation of ozone which results from high daytime temperatures in combination with fossil fuel emissions such as vehicle exhaust in the city. This is a serious health risk separate to, but compounded by bushfire smoke and can lead to respiratory difficulties and hospitalisation.

The likely disruptions caused by bushfires also need consideration for adapting to a changing climate.

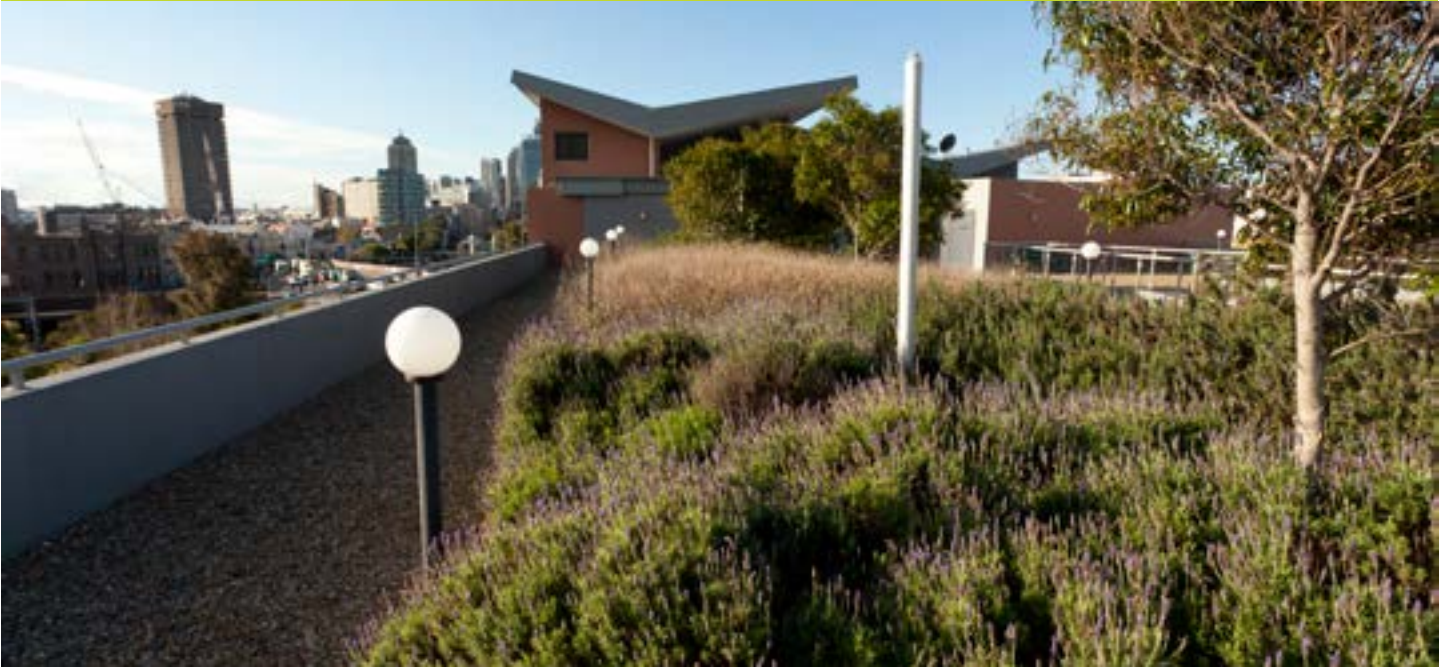
#### Risks

**Community health impacts:** An increase in extreme heat and the associated bushfires in the Greater Sydney Basin is likely to exacerbate the conditions for ozone and air particulates. This could lead to breathing difficulties and serious respiratory distress.

**Disruption and reduced productivity:** Bushfires in the city's surrounding areas could disrupt business due to disruption to commuters, resources and services, resulting in a loss of economic productivity.

**Regional impacts:** Our analysis identified that bushfires will continue to cause extensive property and infrastructure damage across the Greater Sydney Region with cascading impacts on the local area, including:

- Damage to the transport network delaying or stranding CBD workers.
- Limited availability of emergency response and social services within the CBD due to transfer of capacity to regional disaster zones.
- Reduced productivity and economic loss due to CBD workers and LGA workforce taking leave to volunteer or defend property.
- Quality and quantity of water supply in catchments could be affected.



### Objective: bushfire conditions and air quality

The Sydney community will be prepared for and aware of how to respond in periods of bushfire and poor air quality.

#### Action Pathways

##### 2015–2030



- B1** – Contribute to the emergency response to pollution events from bushfires.
- B2** – Contribute to community awareness and education on smoke and ozone pollution health risks, including considering an early warning system – link to Action H3.
- B3** – Identify and reduce the sources of emissions that contribute to exceeding pollution limits.
- B4** – Limit working hours for outdoor staff during high bushfire weather and ozone pollution events – link to H2.
- B5** – Include response to bushfire and ozone pollution dangers in the Heatwave Response Plan – link to H2.

##### 2030–2050



- B6** – Re-identify vulnerable community members and where they seek refuge during periods of extreme weather – link to H2.

##### 2050–2070



- B7** – Re-evaluate and update actions to respond to bushfire and pollution conditions in the LGA and metropolitan area.

## Detailed Actions

Risk	Action	Responsibility
Air quality – community health impacts	<b>B1</b> – Work with emergency services, government agencies and community groups on the emergency response to pollution events from bushfires – link to Action <b>H2</b> . ♦	City of Sydney – control and influence, working with: –Local Emergency Management Committee
Air quality – community health impacts	<b>B2</b> – Support relevant stakeholders/agencies in providing information and a community awareness and education campaign on the nature of ozone risks – targeted to susceptible groups, such as the elderly and very young – link to Action <b>H3</b> . a. Community awareness program ♦ b. Note for event management, such as events on high-pollution days scenario planning, link to Action <b>H2</b> .	City of Sydney – control and influence with: –NSW Family and Community Services –Council of Social Service of New South Wales (NCOSS)
Air quality – community health impacts	<b>B3</b> – Identify the sources of emissions that contribute to exceeding pollution limits and investigate long-term strategies to reduce their volume.	City of Sydney – control and influence, working with: –NSW Environment Protection Authority –Roads and Maritime Service –Transport NSW
Workforce health and safety.	<b>B4</b> – Limit working hours for outdoor staff during high bushfire weather and ozone pollution events – link to Action <b>H2</b> .	City of Sydney – control
Air quality – community health impacts	<b>B5</b> – Work with relevant agencies to include response to bushfire and ozone pollution dangers in the Heatwave Response Plan – link to Action <b>H2</b> .	City of Sydney – control and influence, working with: –Local Emergency Management Committee
Air quality – community health impacts	<b>B6</b> – Identify vulnerable community groups and members and the assets and facilities they use to seek refuge during periods of extreme weather – Link to Action <b>H3</b> , but update for this later timeframe. ♦	City of Sydney – control and influence
Air quality – community health impacts	<b>B7</b> – Evaluate actions to date and assess bushfire and pollution conditions in the LGA and metropolitan area. Base updated risk assessment and actions on these observations.	City of Sydney – control and influence

♦ Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.

Note: External bodies needed for collaboration in delivering actions have been suggested for short-term actions only, as medium and long-term actions are too far away to appoint responsibilities.



### Box 5: What we're already doing to address changing bushfire conditions and air quality in the city

#### Active Transport Plans and Cycle Network ♦

The City has a number of initiatives underway to reduce the need for private car use in the city by providing safe alternatives, and therefore reducing particulate pollution that contributes to ozone generation. Chief among our approach is the “Connecting Our City – Transport Strategy” with its key objectives to reduce transport energy use and greenhouse emissions.

At present, about 95,000 trips are made into the city centre every day by private cars and commercial vehicles. This adds to Sydney's congestion. It is already costing businesses and residents across the region over \$3.5 billion a year, projected to rise to \$7.8 billion by 2020. It is becoming almost impossible to fit more cars on our roads. To keep the heart of our city moving, we need to develop a system that supports all forms of transport – walking, cycling, driving, and public transport, as well as the use of commercial and delivery vehicles. By replacing some private car trips with better public transport and more options to get around, we can reduce congestion and air pollution while improving Sydney's liveability and global competitiveness.

It's all about getting the right mix of public transport, cars, pedestrians and cyclists to ensure the city's heart is healthy, vibrant and attractive for business and recreation.



#### Urban Forest Strategy ♦ and Urban Ecology Strategic Action Plan

The Urban Forest Strategy was adopted by Council in 2013. Through its implementation and the increase in the area of tree canopy, the City will actively improve the air quality in our local government area as well as cool local neighbourhoods.

Targets for the Urban Ecology Strategic Action Plan include increasing bush restoration sites by 100% from a baseline of 4.6 hectares, by 2023. This will deliver cleaner air benefits from increased vegetation.

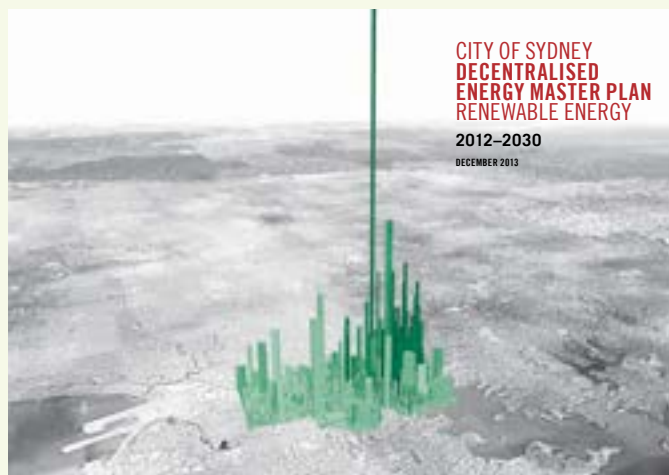
♦ *Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.*

### City of Sydney Green Infrastructure Master Plans

We have been working on a series of Master Plans to set out how green infrastructure can dramatically improve efficiency and environmental performance in the City of Sydney local government area.

The City of Sydney has developed an **Energy Efficiency Master Plan** which shows that total energy used by buildings across the local government area can be reduced by 31% below 2006 levels by using energy more efficiently. This means less demand for fossil fuel generation that contributes to climate change and air pollution.

In 2014 the City also adopted its **Renewable Energy Master Plan** which shows that by 2030, renewable electricity generation can provide 30% of electricity used in the local government area. Renewable energy is clean in terms of the carbon emissions that contribute to climate change, and there are no particulate or other pollutants that contribute to air pollution.



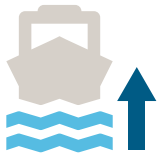
The **Advanced Waste Treatment Master Plan** outlines a solution where waste is treated as a valuable resource. Non-recyclable waste contains valuable resources that are lost if buried in landfill. The Master Plan examines a range of technologies that are in use elsewhere, and finds the best solution is to convert solid waste into a gas. Together with recycling, this can avoid up to 95% of waste going to landfill and reduce greenhouse gas emissions.

The **Decentralised Energy — Trigeneration Master Plan** shows that local energy generation is more than twice as efficient as coal-fired power stations that produce around 80% of Sydney's electricity. Heat by-products created at coal-fired power stations are wasted. With local trigeneration, heat that is otherwise wasted can be captured for air-conditioning, heating and hot water services.



The **Decentralised Water Master Plan** is summarised on page 35 of this strategy.

For further details see [www.cityofsydney.nsw.gov.au/](http://www.cityofsydney.nsw.gov.au/)



### 3.4 Sea level rise

The risk posed by the rising sea level is a longer-term issue for the City of Sydney to confront. A detailed understanding of the likely impacts, timing and suitable responses is necessary. However, current analysis places the risk of inundation as minor with a very gradual increase over several decades, primarily due to our LGA's relatively small foreshore area and topography. While the issue should not be ignored, there are more immediate climate change risks faced by the LGA, and the City of Sydney acknowledges that other councils face sea level inundation risks sooner and to a greater degree.

The highest inundation event occurs when a king tide, storm surge, and wind and wave effects combine to create what is known as extreme sea. Like other hazards, extreme sea events can vary in size, in this case depending on the tide and the severity of the storm surge and weather conditions. Generally, some level of extreme sea event occurs each year but currently does not pose a major inundation risk to the city.

Inundation risk is projected to change significantly as sea levels rise – especially in the case of more rare and severe extreme sea events such as a 1 in 100 year event. Although not of immediate concern, such events should be factored into coastal management. The City is an active member of the Sydney Coastal Councils Group to contribute and benefit from shared resources and experience to address this and other coastal management issues.

The City also recognises that the risk of sea level rise is at times controversial; various coastal LGAs offer differing council statutory responses. Accordingly, we call on the NSW Government to establish a consistent position

based on the latest studies and modelling by the Office of Environment and Heritage. A clear and well-communicated planning framework for sea level rise will alleviate much of the stress generated by planning for rising sea level for residents, developers and councils.

#### Risks

**Increased financial burden:** Our analysis identified that rising sea levels, coastal inundation and saltwater intrusion could increase the financial burden for maintenance and protection, and threaten the financial value and viability of properties and infrastructure along the Sydney Harbour foreshore, and to a lesser extent low-lying areas in the south of the LGA. This may include homes, businesses, coastal assets and open space areas such as parks and gardens. The risk also highlights the issue for property developers and owners of disclosing that properties are within hazard zones, and what conditions of consent for development are needed in these areas.

**Reduced accessibility and aesthetics:** Rising sea levels and coastal inundation could have the potential to reduce accessibility to and the aesthetic qualities of the City's iconic cultural and tourism precinct, including both the private and public amenities of Circular Quay and the Royal Botanical Gardens). Potential erosion of places of indigenous cultural or community significance along the Sydney Harbour foreshore is a risk. There is potential that impacts to the foreshore may also impact events hosted in this area such as Vivid and the New Year's Eve and Chinese New Year celebrations.

**Impeded transport:** Rising sea levels and coastal inundation could limit transport access and egress both directly along the foreshore areas and across the wider transport network. This may include transport networks located outside of the LGA which are dependent on the network, and ferries, footpaths, roads, rail and Sydney Airport.





### Objective: sea level rise

The City of Sydney will be aware of the risks posed by rising sea level and will coordinate its response with the NSW Government, land and infrastructure owners and residents in coming decades.

### Action Pathways

#### 2015–2030



- S1** – Develop a sea level rise adaptation action plan including identification of protection methods for at-risk foreshore areas and assets.
- S2** – Assess sea level rise and storm surge impacts on City planning and implement appropriate flooding standards.
- S3** – Advocate for a consistent NSW State planning framework to address sea level rise and storm surge.

#### 2030–2050



- S4** – Re-evaluate protection methods for at-risk foreshore areas and assets.

#### 2050–2070



- S5** – Research in preparation for when direct actions need to be enacted by the City.

### Box 6: What we're doing to understand sea level rise

The City of Sydney is coordinating with other councils to address sea level rise through the **Sydney Coastal Councils Group** ♦. The City is an active member and contributor to the Sydney Coastal Councils Group, which provides a forum to pool councils' resources in research and advocacy for improved coastal management including detailed studies into sea level rise.

The SCCG was established in 1989 to promote coordination between member councils on environmental issues relating to the sustainable management of the urban coastal environment. The group has undertaken project work to further understand climate adaptation, for example, projects such as:

- Audit of Sea Level Rise, Coastal Erosion and Inundation Legislation and Policy (2011) involved a comparative assessment of Australian State and Territory planning and coastal legislation and policies that address sea level rise, coastal erosion, coastal inundation and storm surge, prepared by the EDO NSW.
- Mapping and Responding to Coastal Inundation (2012) mapped areas of risk to determine risk and develop consistent model planning and management responses in consultation with relevant state government agencies and the broader community. (NCCARF Adaptation Good Practice project).
- Demonstrating Climate Change Adaptation of Interconnected Water Infrastructure (2012) developed information, guidance and capacity building activities to ensure that organisations responsible for managing water infrastructure are able to implement appropriate asset management systems in a changing climate.
- Prioritising Coastal Adaptation Development Options for Local Government (2013) used multi-criteria analysis to prioritise adaption options in response to coastal inundation and erosion.



♦ Such coordinated research activities were a recommendation from the Citizens' Panel for inclusion in the City's adaptation strategy.

## Detailed Actions

Risk	Action	Responsibility
Sea level rise poses a long-term risk to parts of the LGA, public and private assets. ♦	<p><b>S1</b> – Develop a sea level rise adaptation action plan with stakeholders and agencies with a long-term vision for the city's foreshore that addresses the protection of foreshore reserves, and environmental, heritage and recreational areas threatened by the predicted sea level rise. ♦</p> <p>The plan must include:</p> <ul style="list-style-type: none"> <li>–Investigating long-term (over 50 years) zoning and development law changes for affected areas.</li> <li>–Developing timing, or at least trigger points, for possible adaptation actions related to sea walls, forced retreat, risk management, building design and acquisitions.</li> <li>–Implement a communication program to raise awareness among residents, businesses, council facility users and council staff on the likely impacts of sea level rise and storm surges. ♦</li> <li>–Identify and prioritise adaptation actions for each of the City's key infrastructure assets that are at risk and likely to be impacted. ♦</li> <li>–Investigate any impacts to the water table and footings/ concrete walls of buildings with basements. ♦</li> </ul>	<p>City of Sydney – control and influence, working with:</p> <ul style="list-style-type: none"> <li>–Office of Environment and Heritage</li> <li>–Department of Planning and Environment</li> <li>–Land owners</li> <li>–Community members</li> </ul>
The City's planning, designs and specification must factor in sea level rise. National standards and codes must also factor in changing parameters to address the risk of sea level rise and storm surge.	<p><b>S2</b> – Ensure that sea level rise and storm surge are factored into City infrastructure plans and master plans. Such a review must recognise that current standards may no longer be a sufficient benchmark, as flooding is predicted to occur more frequently, thus altering the risk profile. Examples of plans to be reviewed include:</p> <ul style="list-style-type: none"> <li>–The current Flood Plain Management Review</li> <li>–The Decentralised Water Master Plan</li> <li>–The Asset Management Strategy</li> </ul>	City of Sydney – control



Risk	Action	Responsibility
Inconsistent government response to sea level rise causes confusion and anger among residents and the business community.	<b>S3</b> – Advocate for a consistent NSW State planning framework to address sea level rise and storm surge. This recognises the difficulties facing local councils, and the pressure from their constituency and insurers for an equitable and affordable response. Such a framework will shape LGA-based land use planning.	City of Sydney – control and influence, working with: –Department of Planning and Environment –Sydney Coastal Councils Group
Sea level rise poses a long-term risk to parts of the LGA.	<b>S4</b> – Re-evaluate and implement protection methods as needed for at-risk foreshore areas and assets, noting best practices developed by other areas that have faced sea level rise risks in the past, and including public awareness.	City of Sydney – control and influence
	<b>S5</b> – Further research for when the City may need to take direct actions, including: –Emergency response actions to localised inundation (pumps, sand bags) –Improve drainage around at-risk buildings and infrastructure –Carry out stabilisation works and flood defences (such as engineering, vegetation).	City of Sydney – control and influence

◆ Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.

Note: External bodies needed for collaboration in delivering actions have been suggested for short-term actions only, as medium and long-term actions are too far away to appoint responsibilities.



### 3.5 Combined risks and actions

The City of Sydney recognises that climate change presents a wide range of risks and must therefore become part of our day-to-day thinking as we go about the task of providing services and infrastructure for our LGA's residents, community, business and visitors. In addition to addressing the specific climate risks above, action must be taken for broad preparation.

#### Risks

Our analysis identified the following overarching areas of risk to our community and the city from the changing climate. These are broad areas of risk that do not fit into a single dimension of climate change.

**Embedding adaptation** – Unless climate change adaptation is embedded into Council's thinking, planning, procedures and building standards, it will not be effective.

**Adaptation coordination and communication** – Poor coordination and communication across government, infrastructure owners, business and community could lead to poor adaptation.

**Liveability** – Liveability refers to the living conditions and quality of life in our city, and could be put at risk if climate change makes the city a less desirable place to be.

**Business activity and economic productivity** – The projected climate impacts are likely to interrupt business activities and impact the city's long-term desirability for the city workforce, reducing innovation as well as the workforce's skill base, education level and participation, all of which will impact economic productivity.

**Social wellbeing** – Wellbeing refers to a state of health, comfort or contentment, and the social wellbeing of Sydneysiders could be negatively impacted if climate risks are not suitably addressed and communicated.

**Out-of-date standards and codes** – The City of Sydney maintains its assets and services to the highest standards. However, design standards and building codes are based on historical climate data and information, and as such may not be resilient to future climatic conditions. Some change is underway, as seen in The Australian Building Codes Board's 2014 paper, "Resilience of Buildings to Extreme Weather Events". This is important work that must translate into action as adaptive building standards.

**Up-to-date science and data** – Climate adaptation relies on an understanding of evolving climate science, actual global emissions and climate data. Failure to stay up to date could lead to poor decision-making.

**Financial viability** – Future climatic conditions could impact on the financial viability of Council and the capacity, capability and overall resilience of the LGA to withstand climate events.

**Insurance affordability and availability** – An increase in extreme weather events such as storms, flooding and heatwaves, combined with a lack of confidence in the way climate change adaptation is being managed, could lead to a decrease in the affordability of insurance premiums or the withdrawal of insurance for the City's assets and property, and for business and households in the LGA.

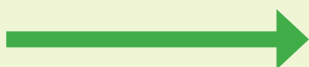


### Objective: combined risks

The City of Sydney will be prepared for the likely impacts of the changing climate and will provide a coordinated response with our community, businesses and other levels of government.

### Action Pathway

#### 2015–2030



- C1** – Incorporate climate adaptation into all future key Council decision-making.
- C2** – Establish a climate risk and adaptation reference panel with key stakeholders to review climate science, risks and a coordinated response.
- C3** – Advocate for the revision of engineering and building standards and codes to address climate change.
- C4** – Work with local business community to develop material that will assist businesses to adapt.
- C5** – Investigate partnering with Sydney Water and the Office of Environment and Heritage to trial the Adapt Infrastructure tool to coordinate inter-agency responses.
- C6** – Monitor developments in the climate change science and actual global emissions.

#### 2030–2050



- C7** – Continue to monitor developments in the climate change science and actual global emissions.
- C8** – Review land use planning, factoring adaptation into future zoning and approvals.

#### 2050–2070



- C9** – Continue to monitor developments in the climate change science and actual global emissions.
- C10** – Review land use planning, factoring adaptation into future zoning and approvals.
- C11** – Keep this strategy in action with a supporting implementation plan, maintaining an ongoing mandate for Council.



### Detailed Actions

Risk	Action	Responsibility
Unless climate change adaptation is embedded into Council's thinking, planning and procedures, it will not be effective.	<p><b>C1</b> – Develop procedures to ensure that climate resilience is incorporated into all future key Council decision-making (projects, plans, strategies, procurement, contracts, risk framework and insurance etc.).</p> <ul style="list-style-type: none"> <li>–Business continuity plan (especially impact on operations and services).</li> <li>–Requests for tender, tender evaluation, contract terms and conditions, consultant briefs, design specifications, master planning, land use planning.</li> <li>–Note for revisions of City strategies, master plans and policy documents including social and economic.</li> <li>–Local Environment Plan (LEP) and Development Control Plan (DCP) revisions must take climate change risks into account.</li> <li>–Property management including building design and operations optimised for higher average and extreme heat.</li> <li>–Asset and facilities management, noting insurance implications. ♦</li> </ul>	City of Sydney – control and influence

Risk	Action	Responsibility
Poor coordination and communication across government, business and community could lead to poor adaptation. ♦	<p><b>C2</b> – Establish a climate adaptation reference panel with key government agencies, business and the community to periodically review the latest climate science, the risks and the coordinated response. This may sit within broader stakeholder collaboration as part of the 100 Resilient Cities program.</p> <p>–Develop a communication strategy to ensure a broad audience is reached for overall and risk-specific response to match the staged framework of the overall adaptation strategy. ♦</p>	<p>City of Sydney – influence working with:</p> <ul style="list-style-type: none"> <li>–NSW Office of Environment and Heritage</li> <li>–Health NSW</li> <li>–Family and Community Services</li> <li>–Sydney Water</li> <li>–Ausgrid</li> <li>–The Sydney Business Chamber</li> <li>–Council of Social Service of New South Wales (NCOSS)</li> <li>–Better Buildings Partnership</li> <li>–Metropolitan Local Aboriginal Land Council</li> </ul>

Risk	Action	Responsibility
The City of Sydney maintains its assets and services to the highest standards. However, design standards and building codes are based upon historical climate data and information and as such may not be resilient to future climatic conditions.	<b>C3</b> – Advocate to relevant agencies on the need to revise engineering and building standards and codes for exposed buildings and infrastructure. This action will require prolonged advocacy and work with various standards bodies including: <ul style="list-style-type: none"> <li>–Standards Australia</li> <li>–The Australian Building Code Board<sup>12</sup></li> <li>–Institution of Engineers Australia</li> <li>–The Institute of Public Works Engineering Australasia (IPWEA)</li> <li>–Building Regulation Advisory Council</li> <li>–Department of Planning and Environment</li> </ul> As well as coordination with other councils and council groups, such as Southern Sydney Regional Organisation of Councils (SSROC), Shore Regional Organisation of Councils (SHOROC), The Sydney Coastal Councils Group Inc. (SCCG).	City of Sydney – influence and concern, working with standards bodies, other councils and council groups
Business activity will likely face disruptions that could lead to financial loss.	<b>C4</b> – The City will work with business stakeholders to consider the best way to inform the local business community on the likely business impacts and develop responses that assist individual entities in their continuity planning.	City of Sydney – control and influence with business stakeholders eg Sydney Business Chamber
Failure to coordinate adaptation responses with other infrastructure owners and managers may lead to additional risks.	<b>C5</b> – Investigate collaborating with Sydney Water and the Office of Environment and Heritage to trial the Adapt Infrastructure tool to coordinate inter-agency responses and quantitative analysis, measurement and manage of risks and adaptation actions.	City of Sydney – control and influence, working with: <ul style="list-style-type: none"> <li>–Sydney Water</li> <li>–Office of Environment and Heritage</li> <li>–Other participating agencies</li> </ul>



Risk	Action	Responsibility
Climate adaptation relies on an understanding of evolving climate science, actual global emissions, and climate data. Failure to stay up to date could lead to poor decision-making.	<b>C6/7/9</b> – Monitor developments in the climate change science and actual global emissions trajectory to inform revisions of City's climate adaption strategy.	City of Sydney – control and influence, collaborating with: –NSW Office of Environment and Heritage –CSIRO –BoM
Future climate events may place Council development approvals under scrutiny.	<b>C8/10</b> – Review the City's land use and planning framework to so that adaptation to relevant and identified risks is factored into development. –Local Environment Plan (LEP) and Development Control Plan (DCP) revisions must take identified climate change risks into account having regard to existing regulation.	City of Sydney – control and influence
Future climatic conditions could impact on the financial viability of Council and LGA.	<b>C11</b> – Keep this strategy and supporting implementation plan in action and maintain an ongoing mandate for Council to stay up to date and coordinated with other relevant bodies in addressing the changing climate.	City of Sydney – control and concern

◆ *Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.*

*Note: External bodies needed for collaboration in delivering actions have been suggested for short-term actions only, as medium and long-term actions are too far away to appoint responsibilities.*

### Box 7: What we're doing to address climate change risk related to insurance

#### Engaging with insurers ◆

The City has identified at-risk assets and is actively engaged with our property insurers to communicate how we are managing the associated risks of climate change and what steps we are undertaking to reduce them. We are also working with our liability insurers on third party liability risks, and discussing with them the specific actions the City is taking to minimise those risks, including the implementation of this strategy.



◆ *Recommendations from the Citizens' Panel for inclusion in the City's adaptation strategy.*

# 04

## Working together to implement this strategy

### From strategy to action

Effective climate change adaptation requires action, not just policy and planning. This strategy will become embedded into the City of Sydney's operations through a detailed implementation plan.

High-level actions will be allocated to specific business units and will become part of the City's operational plan. This will capture short and medium-term actions. Specific short-term actions will then be allocated to specific Council officers and be integrated into the performance planning system.

Many of the actions set out in this strategy require ongoing interaction and cooperation with organisations outside the City of Sydney. While we can only control actions that are our direct responsibility, we will use our reporting and communications to help hold others to the same level of account as those within our own organisation.

### Monitoring

For specific internal accountabilities, the performance planning system will establish and track individual progress against set actions.

Tracking and reporting on the implementation of the Climate Adaptation Strategy will become part of the City's Green Report<sup>13</sup> which is published bi-annually to communicate our progress against all environmental and sustainability targets and in relevant policy areas.

Internally, actions will become part of applicable Business Unit Plans and come under the Council's performance planning system. This links the overall strategy to specific actions allocated to named Council officers. This is an effective management tool as it is used in all other areas of Council activities.

### External collaboration

Working at the level of local government in policy development requires significant collaboration with other levels of government and its agencies, and with other organisations. As seen in the body of this strategy, we draw upon climate science for multiple layers of modelling, from global to national and state; this adaptation strategy sits within the framework of both Australian and state-level documents. Likewise, many of the adaptation measures will sit within broader responses, such as the NSW Heatwave Response Sub Plan, which sits under the NSW Government's own framework for emergency management.

In addition to government, other external stakeholders – the business community, the not-for-profit sector, our residents and the broader community – must play a part for Sydney to adapt and become truly resilient in the face of a changing climate. The City of Sydney is proud of our record in engaging and consulting with our stakeholders and we will continue to do this to successfully deliver this strategy in the decades to come.



### Adaptation Reference Panel

A key legacy of this strategy will be a standing body to coordinate, review and communicate the ongoing response to climate change. The City will establish an Adaptation Reference Panel to ensure a coordinated approach to adaptation. So many of the City's activities and responsibilities are dependent on collaboration and coordination with government, business and community organisations. These relationships will be central to the success of our ability to adapt to change, and working with these organisations is therefore an important component of the City's adaptation strategy.

Likely organisations to participate in the group include:

- The NSW Office of Environment and Heritage (custodians of the NARClIM model)
- Health NSW
- Family and Community Services
- Sydney Water Corporation
- Ausgrid
- The Sydney Business Chamber
- Council of Social Service of New South Wales (NCOSS)
- Better Buildings Partnership
- Metropolitan Local Aboriginal Land Council

### Harnessing existing networks

In addition to establishing a new body, the City will join an existing body that already performs a collaborative role, to harness the strength of an existing network. The Business Adaptation Network (BAN)<sup>14</sup> was established by Green Cross Australia.<sup>15</sup>

BAN membership crosses different sectors:

- Utilities: Sydney Water, Melbourne Water, Optus, Australia Post, Ergon Energy
- Research organisations: CSIRO, ANU, Griffith University, Environment Institute of ANZ
- Government: City of Melbourne, Queensland Government
- Professional services: KPMG, RPS, Ernst and Young, AECOM, ARUP, Minter Ellison
- Developers: Lend Lease, Stockland
- Manufacturing: BlueScope Steel

The network includes members beyond the City of Sydney LGA's remit; however, collaborating with a multidisciplinary body such as this will strengthen our understanding of the most suitable adaptation actions and practices available.

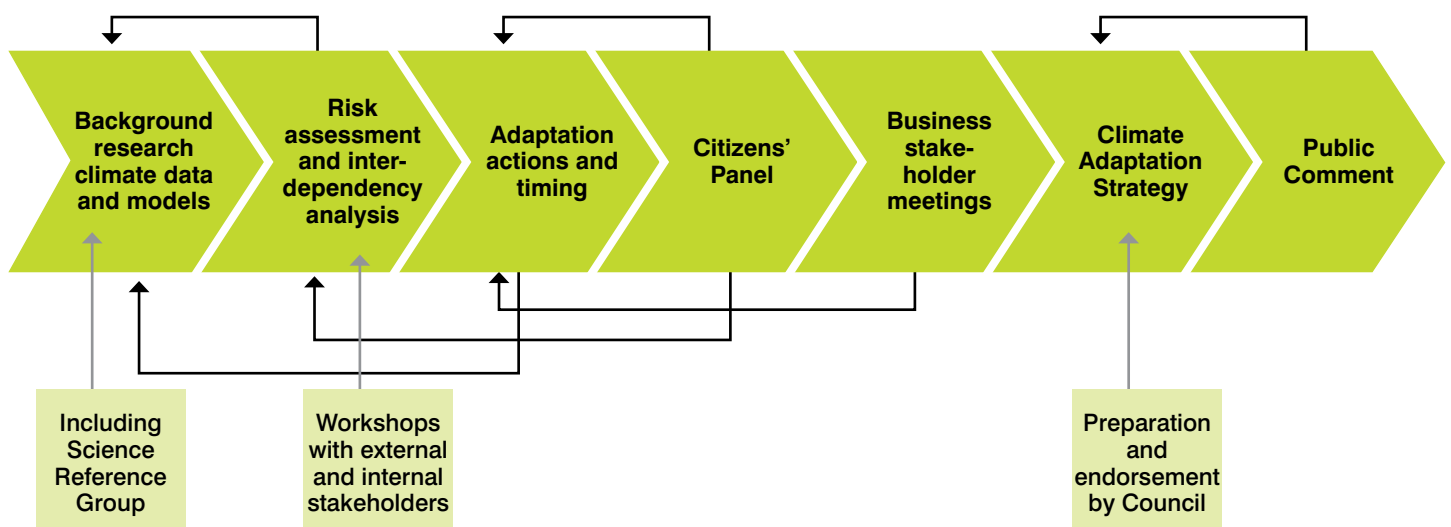
# 05

## How we developed this strategy

The City of Sydney has undertaken a thorough and inclusive approach to develop this strategy. The following steps were taken to establish an evidence base to understand climate change, and then identify the risks and the best way to address them. We worked with many external, internal and community stakeholders.

This diagram represents the major steps in our approach:

1. Establish the scientific baseline with oversight from the City's Science Reference Group.
2. Conduct a risk assessment and analysis with specialist consultants RPS and KPMG, City staff and external stakeholders.
3. Identify actions to respond to risks with City staff and external stakeholders.
4. Engage community to capture residents' perspectives and feed them back into the actions.
5. Meet and communicate with key business stakeholders to capture their perspectives and feed them back into the actions.
6. Prepare the Climate Adaptation Strategy for endorsement by Council.
7. Put strategy on exhibition for public comment.



Arrows looping back to previous stages note the iterative nature of the process.



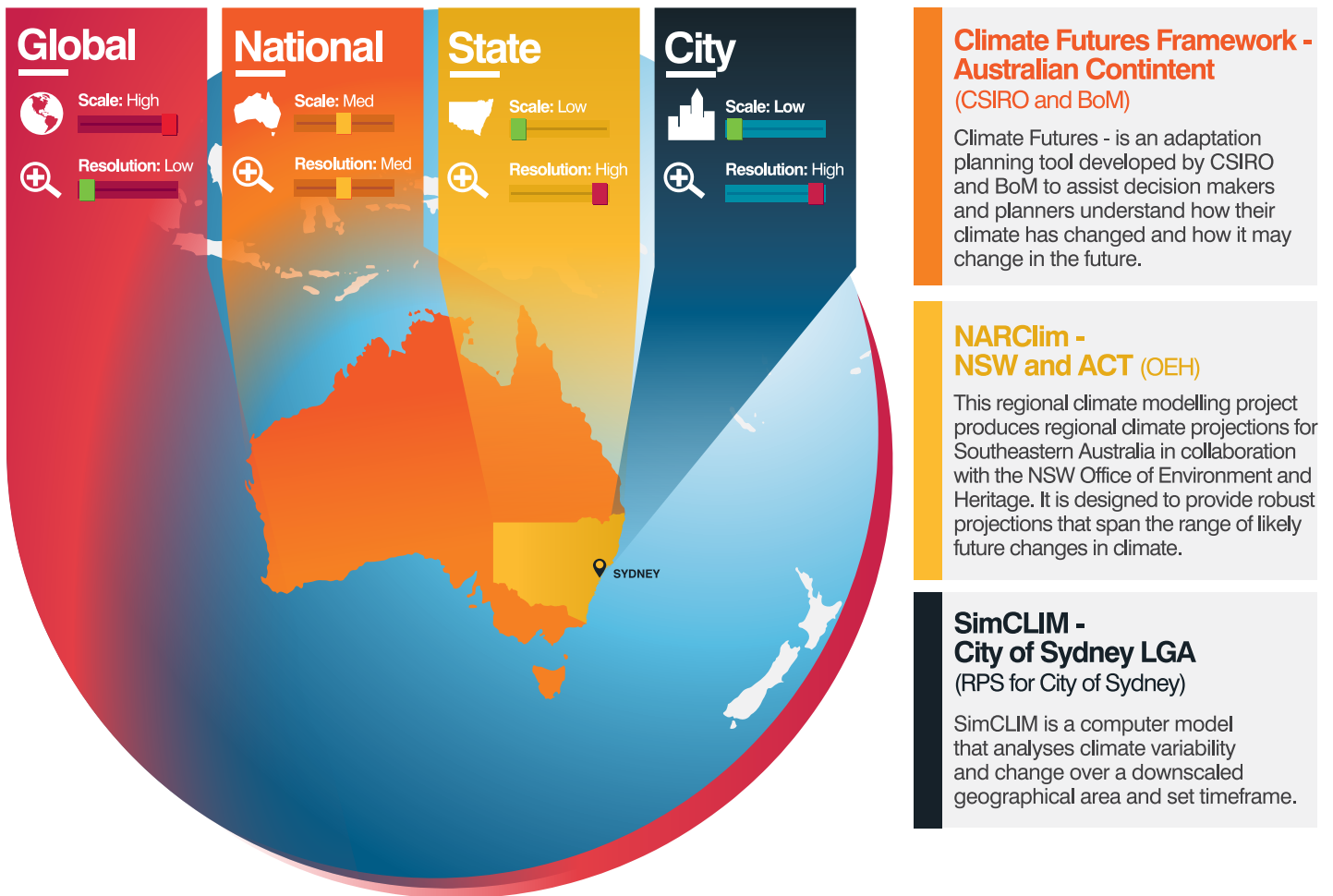


### Fitting the climate models together

This strategy draws from the latest global, national, state and local climate data and modelling. Figure 12 on page 57 demonstrates how these different scales of model and framework – global, national, statewide and City of Sydney-specific – relate to one another. Referred to as downscaling by statisticians and scientists, the models reference each other as the scale becomes smaller, for example, the City of Sydney model must make reference to and be consistent with the models from larger geographical areas.

The City commissioned city-specific modelling using SimCLIM whilst ensuring that it sufficiently relates to state, national and global models. In particular, we sought to ensure that the modelling reflected the direction, magnitude and range of change for all the climate variables seen in the NSW Government's NARCLIM<sup>2</sup> model. Consistency with this model means that future collaboration with the NSW Government will be easier, as policies and decisions will be made from a common basis.

**Figure 12: The scale and detail of the global, national, state and Sydney climate models and how they relate to each other.**



### Global Climate Models - (UN IPCC)

Global Climate Models are mathematical formulations of the processes that comprise the entire global climate system. Climate models can be used to make projections about future climate. These are coordinated at an international level by the United Nations Intergovernmental Panel on Climate Change (UN IPCC).



A Science Reference Group (SRG) was established to oversee the scientific inputs and project methodology that form the basis of this strategy. This gives us confidence that our work is based on a very sound foundation. Our technical consultants note in their final project report (see Appendix A, p. 62):

“The similarity in direction, magnitude and range of results across the SimCLIM, NARCLIM and OEH impact profile datasets mean that the City can have confidence in the climate projections used throughout the risk assessment process of the project. The SRG has reviewed both the climate projections used in the risk assessment process as well as the difference between data sets outlined above. They agree that the small differences between the datasets are highly unlikely to have made any material difference to the outcomes of the risk assessment process.”

### Allowing for uncertainty

As with all modelling exercises, uncertainty remains a part of the climate science. But this is not an excuse for inaction. We know that measured changes have already occurred in the climate system at a global and Australian scale. We also know that change is certain to continue. The likely projections of the future climate have sufficient certainty to factor these changes into our planning, operations and thinking.

The City's response to areas of scientific uncertainty is to engage with the scientific community, as we have done through the Science Reference Group, to monitor the science, and to remain informed as the body of knowledge increases.

Climate science uses complex models to project future possibilities. But like projections in other disciplines, estimations are based on the best available information. They are not a guarantee of what will happen in the future. However, like economic and financial projections, climate projections are crucial for future planning, and provide the best basis from which to anticipate and prepare for likely change.

The projections for precipitation remain the area of greatest uncertainty in the current modelling, wind is also difficult to project. For this reason, the City will pay particular attention to scientific developments investigating changing rainfall and wind patterns in future iterations of climate modelling at all levels.





### Emission scenarios

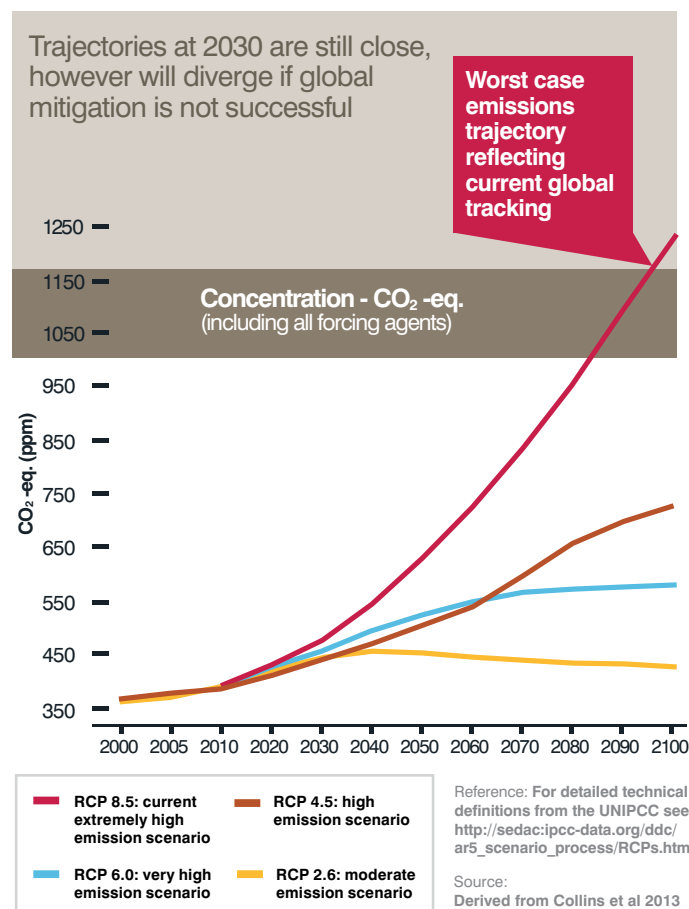
The future level of greenhouse gas emission generated by human activity is another area of uncertainty. These emissions are driving the changes to our climate, so it is important to select the scenario that reflects the current emission scenario to anticipate the extent of future climate changes. Four major scenarios are used by the United Nations Intergovernmental Panel on Climate Change (IPCC) in their Fifth Assessment Report<sup>3</sup> to project the likely trajectory of emissions, as can be seen in Figure 2 opposite.<sup>4</sup> For this strategy's modelling, the City has selected the worst-case trajectory, in red, which depicts emissions continuing to grow in volume throughout the century from current levels.

The most prudent approach to not understate or underestimate the risk at the outset. This was supported by the Science Reference Group. This strategy allows flexibility so that the city is prepared for the worst situation but also addresses the two major sources of uncertainty in the projections, the different emissions scenarios and the possibility of different results using the same emissions scenario. The adaptation strategy can be held or slowed down if a less impacting scenario with lower emissions emerges – or indeed, if new scientific work reveals that some changes or impacts will not occur as soon or with the same impact first suggested by the models.

The trajectory lines in Figure 13 opposite show the divergence of the different emission scenarios to the year 2100: no significant difference at the year 2030 but significant divergence from 2050 onwards. This highlights the need for the effective mitigation and adaptation actions set out in this strategy. The City's future climate change planning will need to take into account any changes to emissions scenarios in future IPCC assessment reports.

**Figure 13: Greenhouse gas emission scenarios**

The rise of greenhouse gas emissions require effective mitigation actions







### Box 8: Science Reference Group

The City convened the Science Reference Group to oversee all scientific inputs to the strategy, the modelling and the overall project methodology. This was an important component of the project due to the complexity of climate science and to ensure the City's planning is based on the best available evidence and projections.

The City extends our thanks to the participating organisations who contributed their time and expertise pro bono to the Science Reference Group:

- The Commonwealth Scientific and Industry Research Organisation.
- The Bureau of Meteorology.
- The Australian National University, Climate Change Institute.
- University Corporation for Atmospheric Research.
- The New South Wales Office of Environment and Heritage.
- The Climate Institute.

### Our approach to risks, responses and timeframes

#### Risk interdependence

The City of Sydney has undertaken a rigorous risk assessment process to identify and rank the climate risks we face. We undertook this with external and internal stakeholders: from state and local government, utilities, emergency services, business and community groups, and across the City's various divisions and business units.

In addition to a conventional risk assessment that identifies risks and then the likelihood and consequences of the risk event, KPMG used its actuarial skill set to conduct an interdependency analysis. This analysis identified the links between various risks, the direction of the relationship between the risks, and their perceived severity. This allows the anticipation of knock-on effects from a given risk and to target our response appropriately. For example, by knowing that a bushfire in the surrounds of Sydney can lead to a high level of air pollution in our local area, we know that this is likely to lead to community health risks, a need to change outdoor working patterns and to reduce physical activity. In response, even though the risk event occurs outside our LGA, the City will work with other agencies to increased community awareness of related health risks and explore an early warning notification system.

A second example is the important interdependence between electricity and water infrastructure. If extreme weather disrupted energy supply to an area of the city, it could also impact the pumps and other equipment used to manage drinking water and wastewater in that area, unless an assessment had identified these related risks and a response had been planned in advance. The City's planned participation in the Adapt Infrastructure program with Sydney Water (see action C5 page 51) will address this type of infrastructure risk interdependence.

Basing our practice on risk interdependency analysis enables the city to prepare for risks more thoroughly by understanding how various risks relate to one another.



### Box 9: Stresses, shocks and risks

- A useful way to think about the risks facing Sydney due to climate change is to consider the shocks and stresses we are likely to experience. The terms ‘shocks’ and ‘stresses’ have been popularised in this context by the 100 Resilient Cities<sup>5</sup> program, pioneered by the Rockefeller Foundation. This terminology is useful in understanding what risks will ‘stress’ the city through gradual and perhaps ever-present risk, such as increased average temperatures, and which risks will ‘shock’ the city, such as heatwaves and severe storms.
- Sydney is participating in the 100RC program and in 2015, the City will appoint a Chief Resilience Officer to lead resilience planning for metropolitan Sydney, to be part funded by the 100RC.

### Timeframes, pathways and iteration

When thinking about climate change, the timeframe is longer than that of most government strategic planning. This is a major challenge: to prioritise actions to both mitigate and adapt to climate changes that occur over such a long timeframe.

The timeframe in Figure 14 opposite has been created for the City’s climate adaptation planning. This long-term view is crucial, recognising that some actions need to start immediately, continuing over a long period, while others are must be planned for now but will not require action for many years.

The strategy takes a ‘pathway’ approach. The term ‘pathway’ is used in the field of climate change adaptation to refer to a set of actions over time, describing an overall direction and major milestones while offering the flexibility to adapt to changing circumstances.

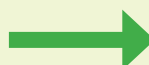
Climate change adaptation is an emerging and iterative long-term process that will need review, revision and fine-tuning as we go along. A pathway approach will help us set out the intended direction and major actions required, without locking us into specific timeframes. This is important considering the time scales used when looking at changing climate, and the fact that better information about impacts will become known over time.

In this case, a detailed project plan that sets out specific objectives and achievements would not be appropriate. However, the City, with our technical advisers, has prioritised climate change risks and responding actions as the foundation for this strategy.

**Figure 14: Timeframe for adaptation planning**

#### Short-term

**2015–2030**



Actions in this timeframe are regarded as business as usual, applying current best practice and policy

#### Mid-term

**2030–2050**



Actions in this time frame are regarded as altering the way we carry out day-to-day work and by taking physical protection measures

#### Long-term

**2050–2070**



Actions in this timeframe are regarded as significantly different to current practice





### Engagement and stakeholder involvement

Just as the City cannot deliver this strategy on our own, we could not have prepared it on our own either. We have worked with many stakeholders to ensure that the knowledge, views and experiences of a broad range of people and organisations have helped shape our climate adaptation strategy. Our engagement has involved:

#### Citizens' panel

A key contribution to the development of this strategy has been from residents and the community. The citizens' panel provided valuable guidance. The panel was convened in November 2014 in collaboration with the University of Sydney. The panel met over two-and-a-half days. The process gave the City the opportunity for in-depth conversation with residents to hear their concerns about climate change risks and their priorities for action. The panel provided a set of overarching principles (included in the introduction to this strategy) and identified and prioritised risks and adaptation actions (adopted throughout the risk and actions in this strategy).

The citizens' panel final presentation is attached in Appendix B. Where recommendations have been included in the strategy, they have been denoted with the ♦ symbol.

#### External workshops

The City of Sydney enjoys a high degree of cooperation and collaboration with other organisations from government, business and the community in the delivery of our broad range of services. Climate change involves complex challenges. To effectively respond to them, the involvement of our external stakeholders has been essential to identify likely risks and how to address them with suitable actions.

Our series of risk workshops involved over thirty relevant organisations: emergency services, transport, social services, housing providers, energy, gas and water utilities, State and Commonwealth environmental departments, building portfolio owners and managers, the insurance industry, neighbouring councils and the City of Melbourne.

Further meetings have also been held with peak industry groups such as the Sydney Business Chamber, Tourism Australia and representatives from the IT and telecommunications sector.



### Internal workshops

The City of Sydney itself is a large and varied organisation. It manages many assets and facilities and delivers a broad range of services, involving staff from a wide range of disciplines and responsibilities. Involving staff from across various divisions and business units has been vital in the development of this Adaptation Strategy.

A series of workshops, meetings and review sessions have ensured that their perspective of risks has been accurately understood and that the suggested actions are viable. Successful adaptation will require embedding an understanding of climate change in the thinking and planning of the City and its staff. Involvement in this phase of strategy development has been the first step in this inclusive and iterative process.

### Existing adaptive capacity

In preparing this strategy, we assessed our existing capacity to adapt to the changing climate. This was a useful exercise. It provided us with an organisational baseline. Working from this baseline ensures that this strategy is embedded in the City's operations.

Our advisers found "some good work underway and that some strong progress has been made but, there is much room for improvement and future development."<sup>6</sup> This aligns with the City's own view of our preparedness: we have many existing initiatives such as the Urban Forest Strategy, the Floodplain Management review and the Decentralised Water Master Plan, but an overarching framework is needed to tie these and other required actions together over time.

This Climate Adaptation Strategy will build upon the City's existing adaptive capacity to reach appropriate levels as needed.



# 06

## Future reviews

The City of Sydney’s approach to climate change adaptation is based on the best available science. As shown earlier in this document, the climate science used to reach our planning decisions references the global and national level and becomes more detailed as we focus on Sydney-specific modelling.

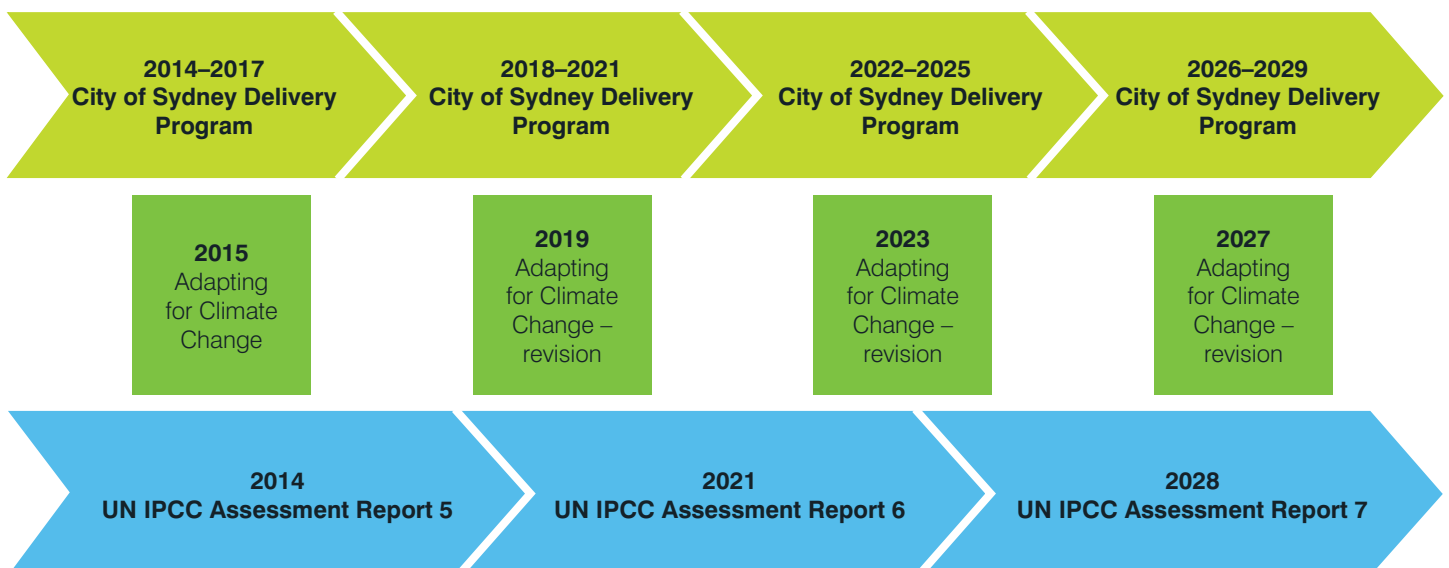
The foundations of this approach are the global climate models that are summarised every seven years in an “Assessment Report” by the United Nations Intergovernmental Panel on Climate Change (IPCC). Assessment Report Five (AR5) from 2014 was used as the starting point for the science used in this adaptation

strategy – and it is therefore sensible to revisit climate science and the scientific inputs to our models every seven years, after the publication of the latest UN IPCC Assessment Report.

The challenge for the City will be to balance the updated cycle of scientific input that is generally tied to a seven-year cycle with the legislated integrated planning and reporting cycle which is tied to a four-year cycle. So, the City will need to incorporate updated climate data as it becomes available every seven years, but also ensure that the reviews of planning tied to the four-year cycle, incorporates the latest climate information.

**Figure 15: Proposed adaptation strategy revision cycle**

It should be noted that although a review is recommended every four years, unexpected climate events may prompt an earlier review of the climate risks and Council’s actions. Similarly, if at the time of review, there are no major changes from those projected in the baseline assumptions, the strategy may need only minor rather than full revision.



# 07

## References and further reading

The literature on climate change is always evolving. The most relevant references for further information are therefore websites that have reputable information from many trusted sources.

The following resources are recommended and have been used by the City of Sydney to inform the development of this strategy:

### Local Government

- The Sydney Coastal Councils Group  
[www.sydneycoastalcouncils.com.au/](http://www.sydneycoastalcouncils.com.au/)
- Association of Local Government NSW  
[www.lgnsw.org.au/policy/climate-change/planning-for-climate-change](http://www.lgnsw.org.au/policy/climate-change/planning-for-climate-change)

### State

- Office of Environment and Heritage, Adapt NSW portal  
[www.climatechange.environment.nsw.gov.au/](http://www.climatechange.environment.nsw.gov.au/)

### National

- Australian Government Department of Environment  
[www.environment.gov.au/climate-change](http://www.environment.gov.au/climate-change)
- The National Climate Change Adaptation Research Facility (NCCARF)  
[www.nccarf.edu.au/](http://www.nccarf.edu.au/)
- Commonwealth Science Industry Research  
[www.csiro.au/en/Research/OnA/Areas/Assessing-our-climate/Climate-adaptation-research](http://www.csiro.au/en/Research/OnA/Areas/Assessing-our-climate/Climate-adaptation-research)
- Bureau of Meteorology  
[www.bom.gov.au/climate/change/](http://www.bom.gov.au/climate/change/)
- The Climate Institute  
[www.climateinstitute.org.au/](http://www.climateinstitute.org.au/)
- The Australian Building Codes Board, natural disaster mitigation  
[www.abcb.gov.au/en/work-program/Natural%20Disaster%20Mitigation.aspx](http://www.abcb.gov.au/en/work-program/Natural%20Disaster%20Mitigation.aspx)

### International

- The Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report (AR5)  
[ipcc.ch/report/ar5/](http://ipcc.ch/report/ar5/)
- The C40 Cities Climate Leadership Group (C40)  
[www.c40.org/](http://www.c40.org/)
- The Cities and Biodiversity Outlook  
[cbobook.org/index.php](http://cbobook.org/index.php)



### City of Sydney

The City of Sydney makes all major planning and policy documents publicly available through our website:  
[www.cityofsydney.nsw.gov.au/](http://www.cityofsydney.nsw.gov.au/)

Here are links to the major documents referred to in this strategy:

- Sustainable Sydney 2030  
[www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0005/209876/Community-strategic-plan-2014.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0005/209876/Community-strategic-plan-2014.pdf)
- Flood Plain Management  
[www.cityofsydney.nsw.gov.au/vision/better-infrastructure/floodplain-management](http://www.cityofsydney.nsw.gov.au/vision/better-infrastructure/floodplain-management)
- Renewable Energy Master Plan  
[www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0003/153282/Renewable-Energy-Master-Plan.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0003/153282/Renewable-Energy-Master-Plan.pdf)
- Decentralised Water Master Plan  
[www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0005/122873/Final-Decentralised-Water-Master-Plan.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0005/122873/Final-Decentralised-Water-Master-Plan.pdf)
- Energy Efficiency Master Plan  
[www.cityofsydney.nsw.gov.au/vision/towards-2030/sustainability/carbon-reduction/energy-efficiency](http://www.cityofsydney.nsw.gov.au/vision/towards-2030/sustainability/carbon-reduction/energy-efficiency)
- Green Reports  
[www.cityofsydney.nsw.gov.au/council/forms-and-publications/environmental-plans-reports](http://www.cityofsydney.nsw.gov.au/council/forms-and-publications/environmental-plans-reports)
- Urban Forest Strategy  
[www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0003/132249/Urban-Forest-Strategy-Adopted-Feb-2013.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0003/132249/Urban-Forest-Strategy-Adopted-Feb-2013.pdf)
- Greening Sydney Plan  
[www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0009/135882/GreeningSydneyPlan.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0009/135882/GreeningSydneyPlan.pdf)

- Urban Ecology Strategic Action Plan  
[www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0011/198821/2014-109885-Plan-Urban-Ecology-Strategic-Action-Plan\\_FINAL-\\_adopted.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0011/198821/2014-109885-Plan-Urban-Ecology-Strategic-Action-Plan_FINAL-_adopted.pdf)
- Green Roofs and Walls  
[www.cityofsydney.nsw.gov.au/vision/towards-2030/sustainability/greening-the-city/green-roofs-and-walls](http://www.cityofsydney.nsw.gov.au/vision/towards-2030/sustainability/greening-the-city/green-roofs-and-walls)
- Transport Strategies and Actions  
[www.cityofsydney.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0006/124926/SummaryReport2012.pdf](http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0006/124926/SummaryReport2012.pdf)

### Thanks

The City of Sydney would like to extend our thanks to the many people and organisations who contributed to the development of this strategy. Meaningful engagement with our stakeholders is central to the success of climate change adaptation – so we're very grateful for the time and expertise given to our planning process. Our heartfelt thanks to:

- The Citizens' Panel
- The Science Reference Group
- All of our external stakeholders
- Our internal stakeholders

### Endnotes

1. [climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARcliM/](http://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARcliM/)
2. [climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARcliM/](http://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARcliM/)
3. [ipcc.ch/](http://ipcc.ch/)
4. The scenarios are known as Relative Concentration Pathways (RCPs). See RPS project report for further details, pp. 35–36.
5. [www.100resilientcities.org/#/-\\_Yz44MDYzOCdpPTEocz5j/](http://www.100resilientcities.org/#/-_Yz44MDYzOCdpPTEocz5j/)
6. RPS “City of Sydney Climate Risk and Adaptation: Project Report” 2015, p. 24.
7. Source: adapted by RPS from Cope et al, 2008, see Appendix A, p46
8. [www.c40.org](http://www.c40.org)
9. [www.nsw.gov.au/sites/default/files/nsw\\_2021\\_plan.pdf](http://www.nsw.gov.au/sites/default/files/nsw_2021_plan.pdf)
10. [www.environment.gov.au/climate-change/adaptation/publications/climate-adaptation-outlook](http://www.environment.gov.au/climate-change/adaptation/publications/climate-adaptation-outlook), this is framework has been proposed but not adopted.
11. [www.cityofsydney.nsw.gov.au/council/forms-and-publications/integrated-planning-reporting/community-strategic-plan](http://www.cityofsydney.nsw.gov.au/council/forms-and-publications/integrated-planning-reporting/community-strategic-plan)
12. The Australian Building Codes Board released a highly relevant paper in 2014; “Resilience of Buildings to Extreme Weather Events” [www.abcb.gov.au/en/work-program/Natural%20Disaster%20Mitigation.aspx](http://www.abcb.gov.au/en/work-program/Natural%20Disaster%20Mitigation.aspx)
13. [www.cityofsydney.nsw.gov.au/council/forms-and-publications/environmental-plans-reports](http://www.cityofsydney.nsw.gov.au/council/forms-and-publications/environmental-plans-reports)
14. [www.greencrossaustralia.org/our-work/climate-adaptation/business-adaptation-network.aspx](http://www.greencrossaustralia.org/our-work/climate-adaptation/business-adaptation-network.aspx)
15. [www.greencrossaustralia.org/](http://www.greencrossaustralia.org/)



## Abbreviations, Acronyms and Definitions

**Adapt:** Taking action to reduce the impacts and harness opportunities arising from climate change (in this context).

**Adaptive capacity:** The ability of a system to design or implement effective adaptation strategies to adjust to information about potential climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (Ballard, 2009).

**Biodiversity:** All aspects of biological diversity, especially including species richness, ecosystem complexity, and genetic variation.

**BoM:** Bureau of Meteorology

**Climate event:** The occurrence of a climate impact such as a heatwave, drought or flood.

**Climate impact:** An effect of climate change, which can be environmental (such as drought conditions on parks and open spaces), social (such as air pollution and extreme heat leading to health impacts on vulnerable people) or economic (such as flooding leading to workforce disruption and increased insurance premiums).

**CSIRO:** Commonwealth Science Industry Research Organisation

**Ecosystem:** The animals, plants, and microorganisms that live in one place, as well as the environmental conditions that support them.

**Ecosystem services:** The material, psychological, mental and physical well-being benefits that humans derive from the functioning of an ecosystem, such as clean air, healthy soil, storm water management, regulation of climate through shade and cooling, plant pollination, and recreational and cultural opportunities. These are the foundation of human wellbeing and most economic activity because almost every resource that humans use on a day-to-day basis relies directly or indirectly on nature.

**Emissions scenario:** The likely future quantity of greenhouse gases emitted into the atmosphere. For modelling purposes the UN IPCC uses four different scenarios, each the result of a different combination of socio-economic, technology, demographic, policy, institutional and biophysical assumptions.

**Estuarine:** An estuary is a body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the seawater. Estuaries and the estuarine lands surrounding them are places of transition from land to sea, and from freshwater to saltwater (such as parts of Sydney Harbour).

**Fluvial:** Used in geography and geology to refer to the processes associated with rivers and streams and the deposits and landforms created by them.

**Greenhouse gas:** Gases that trap heat in the atmosphere. Greenhouse gases (GHG) from human activities are the most significant driver of observed climate change since the mid-20th century.

**IPCC:** Intergovernmental Panel on Climate Change. The IPCC is a United Nations body.

**IPCC AR5:** The Fifth Assessment Report (AR5) in a series of such reports by the IPCC. Assessment Reports provide an update of knowledge on the scientific, technical and socio-economic aspects of climate change. They are released every seven years. AR5 was released in 2014.

**King tide:** Occur twice a year and extend above the highest water level reached at a high tide on an average day. They occur when the orbit and alignment of the Earth, moon and sun combine to produce the greatest tidal effects of the year.

**LGA:** Local Government Area, the area over which a council has jurisdiction.

**Mitigate:** Taking action to reduce our contribution to human-made climate change by minimising emission and sequestering of greenhouse gases

**Most consensus:** The climate projection results that are supported by the highest number of climate models.

**NARClIM:** The NSW and ACT Regional Climate Modelling (NARClIM) Project is a research partnership between the NSW and ACT governments and the Climate Change Research Centre at the University of NSW.

**NCCARF:** National Climate Change Adaptation Research Facility

**OEHS:** NSW Office of Environment and Heritage

**Pathway:** Used in the field of climate change adaptation to refer to a set of actions over time, describing an overall direction and major milestones while offering the flexibility to adapt to changing circumstances.

**Resilience:** The capacity of individuals, communities, institutions, businesses, and systems to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.

See Appendix A, Glossary, p. 164 for further useful terminology and definitions.

**Risk management:** A coordinated set of activities and methods that is used to direct an organisation and to control the many risks that can affect its ability to achieve objectives.

**RPS:** Specialist consultancy that lead the climate adaptation advisory work for the City.

**Sea level rise (SLR):** Long-term increases in the mean sea level due to the greenhouse effect and associated global warming. The sea level at any point in time is determined by the mean sea level, the state of the tide, wave set-up, responses to air pressure and near-shore waves. It may sometimes be affected by additional flows of water from land.

**Shocks:** Sudden, sharp events that threaten a city, including floods and droughts, heatwaves and coastal inundation.

**SimCLIM:** SimCLIM is a software tool designed to facilitate the assessment of risks from climate change – used as the basis of this strategy.

**Storm surge:** The increase in coastal water level caused by the effects of storms, consisting of two components: the increase in water level caused by the reduction in barometric pressure and the increase in water level caused by the action of wind blowing over the sea surface.

**Stresses:** Events that weaken the fabric of a city on a day-to-day or cyclical basis, such as a reduction in rainfall, an increase in night time temperatures and rising sea level.

**Urban forestry:** Urban forestry can be described as the science and art of managing trees, forests and natural ecosystems in and around urban communities to maximise the physiological, sociological, economic and aesthetic benefits that trees provide society (Schwab 2008).

**Vulnerability:** The extent to which a system is susceptible to, or unable to cope with, adverse effects of climate change including climate variability and extremes. It depends not only on a system's sensitivity but also on its adaptive capacity.

# Appendix A

RPS project report.

# Appendix B

Citizens' Panel, final presentation.



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