



ACT
Government

ACT CLIMATE CHANGE ADAPTATION STRATEGY

LIVING WITH A WARMING CLIMATE

JULY 2016



ISBN: 978-1-921117-61-9

© Australian Capital Territory, Canberra 2016

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without written permission from:

Director-General,
Environment and Planning Directorate,
ACT Government,
GPO Box 158, Canberra ACT 2601.

Telephone: 02 6207 1923

Website: www.environment.act.gov.au

Printed on recycled paper

Accessibility

The ACT Government is committed to making its information, services, events and venues as accessible as possible.

If you have difficulty reading a standard printed document and would like to receive this publication in an alternative format, such as large print, please phone Access Canberra on 13 22 81 or email the Environment and Planning Directorate at epd_communications@act.gov.au

If English is not your first language and you require a translating and interpreting service, please phone 13 14 50.

If you are deaf, or have a speech or hearing impairment, and need the teletypewriter service, please phone 13 36 77 and ask for Access Canberra on 13 22 81.

For speak and listen users, please phone 1300 555 727 and ask for Access Canberra on 13 22 81.

For more information on these services visit <http://www.relayservice.com.au>

CONTENTS

MINISTER'S FOREWORD	3
EXECUTIVE SUMMARY	4
How will climate change impact the Canberra region	8
Why is adaptation important?	8
Approach to climate change adaptation	8
1. INTRODUCTION	16
1.1 Purpose	18
1.2 Government's objectives	18
1.3 The changing climate	19
1.4 Limits and barriers to adaptation	21
1.5 Actions to facilitate adaptation	21
2. THE NEED FOR ACTION	22
2.1 A growing and ageing city	24
2.2 Regional climate effects	24
2.3 Climate impacts	26
2.4 What the ACT Government is already doing	30
2.5 Adaptation approach	31
3. SECTORS AND ACTIONS	34
3.1 Sectoral assessments and actions	36
3.2 Sector 1: Disaster and emergency management	37
3.3 Sector 2: Community health and wellbeing	42
3.4 Sector 3: Settlements and infrastructure	46
3.5 Sector 4: Water	54
3.6 Sector 5: Natural resources and ecosystems	59
4. INTEGRATION AND INNOVATION	62
4.1 Integration	64
4.2 Innovation	66
5. REPORTING PROGRESS	68
5.1 Monitoring and reporting	70
5.2 Review	71
APPENDIX 1	72
REFERENCES AND END NOTES	76



MINISTER'S FOREWORD

Climate change affects our community as a whole and our response must therefore be across—and with—the community.

We are already witnessing the impacts of a warming climate, but government cannot respond to this change alone. Together we must prepare for the more extreme changes that lie ahead and increase our resilience in the face of them.

The ACT Government leads Australia in acting to mitigate and reduce the ultimate extent of climate change through its legislation, policy and on-ground works to reduce greenhouse gas emissions, particularly through renewable energy.

This same ambition and leadership is now being applied to adapt both our environment and our lifestyle to local climate changes caused by the greenhouse gases already accumulated in the atmosphere. Given these gases will continue to impact on our climate for decades and even centuries, we must act now to minimise their consequences for us and future generations.

To guide our collective efforts in adapting to climate change in a coordinated and economical manner, the government has developed the ACT Climate Change Adaptation Strategy.

This Adaptation Strategy identifies the key adaptation policy challenges for the ACT and asks the community to support our collective vision that by 2050 Canberra will be a sustainable and carbon neutral city that is adapting to a changing climate. This will be achieved through ambitiously reducing our greenhouse gas emissions, shifting to renewable energy sources, and enhancing the resilience of our people, our city, our natural environment and our economy through effective adaptation measures. The government is committed to Canberra's place as a world-leading sustainable city.

A handwritten signature in black ink, appearing to read 'S. Corbell'.

Simon Corbell MLA
Minister for the Environment

EXECUTIVE SUMMARY

Spring into life: Entry by Rupsa Neogy Kumar to the Challenge Accepted climate change competition



Figure 1: Climate change impacts and affected ACT sectors

ACT CLIMATE IMPACTS



Increased concentrations of greenhouse gases in the Earth's atmosphere since the industrial revolution mean global temperature rises over the remainder of the 21st century are inevitable, irrespective of efforts to reduce greenhouse gas emissions.

Our climate is already changing and we must adapt to these unavoidable changes if we are to thrive as a sustainable community. The ACT Government has therefore prepared this ACT Climate Change Adaptation Strategy – Living with a Warming Climate (the Adaptation Strategy). This strategy has been informed by a review of the potential impacts of climate change on, and the risks to, the ACT as the basis to develop actions that will help us adapt and reduce our vulnerability.

The purpose of the Adaptation Strategy is to help our community, our city and the natural environment adapt to climate change and become more resilient to the projected impacts by:

- » communicating the risks and impacts of climate change to our region (how climate change will affect us)
- » incorporating climate change risk considerations and adaptation actions in ACT Government policies, programs and practices
- » encouraging actions by us all to make changes in our daily lives that will increase resilience and foster emerging opportunities.

The ACT Government has been taking climate change seriously for over 20 years through decisive actions. The current Climate Change Strategy and Action Plan for the ACT, AP2 (2012) envisages that: “By 2060 we will be a more sustainable and carbon neutral city that is adapting to climate change.”¹

More recently, the ACT Government moved to amend this goal by bringing forward the date for carbon neutrality to 2050. This was in accordance with the Paris Agreement, agreed to by countries at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2015, to achieve a balance between greenhouse gas emissions and carbon sinks in the second half of this century, and to hold increases in global average temperatures to well below 2 °C above pre-industrial levels.

The primary focus of AP2 is on climate change mitigation through legislated targets for the reduction of greenhouse gas emissions by improving energy efficiency and increasing renewable energy generation. However, reducing greenhouse gas emissions, and thereby limiting the total amount of climate change, is only half the task; robust adaptation efforts need to be implemented as irreversible effects of climate change are already in train.

This Adaptation Strategy requires consideration of climate change impacts to be ‘mainstreamed’ into policies and practices across government, households, businesses and the community. It identifies that some people in our community and some ecosystems in our region have a higher vulnerability to the risks from climate change and therefore warrant particular focus.

‘global temperature rises over the remainder of the 21st century are inevitable’

HOW WILL CLIMATE CHANGE IMPACT THE CANBERRA REGION

Our climate is warming at an unprecedented rate, largely as a result of human activity, and is already 1 °C higher than it was 100 years ago. 2015 was the hottest year since records began.² The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea levels have risen. These changes are having, and will have, widespread impacts on human and natural systems.

The ACT and surrounding region is projected to experience longer, hotter summers and increased frequency and severity of storm events. This increases the level of threat from bushfires, heatwaves and violent storms to lives, property, economic activities and the natural environment.

In 2016 the ACT experienced its wettest January in 20 years, with almost double our average rainfall. However, temperatures were still above average, with six days reaching at least 35 °C. We also had our coolest January day since 1995, reaching just over 17 °C on January 5. These above average temperatures extended into February, March and April.

Information on climate change projections and climate impacts specific to our region have been generated from two primary sources: the NSW and ACT Regional Climate Model (NARClIM); and the Commonwealth and Scientific Industry Research Organisation (CSIRO) /Bureau of Meteorology (BOM) Climate Change in Australia – Projections for Australia’s Natural Resource Management Regions.

‘our climate is warming at an unprecedented rate, largely as a result of human activity’

WHY IS ADAPTATION IMPORTANT?

Adaptation and mitigation are complementary strategies for reducing and managing the risks of climate change.

The Intergovernmental Panel on Climate Change (IPCC) defines mitigation as the human intervention to reduce the sources or enhance the sinks of greenhouse gases¹ and adaptation as the process of adjustment to actual or expected climate and its effects.¹

ACT-specific climate projections indicate there is significant risk that extreme weather events will become more frequent and intense, adversely affecting life and property. Therefore, for future generations to enjoy the quality of life we enjoy now, actions are needed to increase our resilience to the effects of a changing climate.

This strategy, based on predicted climate hazards and risks, takes a measured and systematic approach to addressing the impacts of climate change by prescribing a set of actions to reduce inherent risks and increase our resilience.

APPROACH TO CLIMATE CHANGE ADAPTATION

The ACT Government has a three-pronged approach to climate change adaptation. The first approach is to ‘mainstream’ climate change adaptation, through consideration of climate impacts, throughout the planning and delivery of places, systems and essential services such as buildings, power, water and health services, as well as in the management of natural resources and ecosystems.

The second approach is to build resilience of our community proactively in a steady and incremental way, rather than reactively following a severe climate event.

Thirdly, adapting to climate change is everyone’s business. As such, everyone in our community has a role to play and can take actions to reduce their vulnerability. These actions need to be based on robust information and understanding. To achieve this, the ACT Government recognises the need to effectively engage and collaborate with diverse stakeholders across the region.

SECTORAL ASSESSMENTS AND ACTIONS

Consistent with accepted leading practice, the Adaptation Strategy adopts a sectoral assessment approach to identify climate change risks and consider adaptation actions. This assessment process includes:

- identifying the likely future climate impacts relevant to each sector
- considering adaptation activities already underway
- identifying any emerging issues and/or residual climate-related risks
- proposing new actions to address vulnerabilities
- articulating the desired outcomes of proposed adaptation measures.

Five sectors have been selected based on their relative priority in the Territory:

- » Disaster and emergency management
- » Community health and wellbeing
- » Settlements and infrastructure
- » Water
- » Natural resources and ecosystems

Reflecting the need to ramp up our existing adaptation work, high priority, short-term (between 2017 and 2020) actions are proposed for the five sectors, with a number of additional integrating actions to ensure cross-agency coordination.

The suite of 27 actions will enable the ACT Government to continue its work and ramp up engagement with business and households to build greater resilience in our community, our city and our environment.



*Disaster and
Emergency
Management*




*Community
Health and
Wellbeing*



*Settlements
and
Infrastructure*



Water



*Natural
Resources and
Ecosystems*



Actions for the Disaster And Emergency Management Sector

Actions by end 2017

1. Bushfire prone areas

The Government will consider whether the current regulatory settings of bushfire prone areas continues to adequately reflect bushfire risk.

2. Reducing impacts from the warming climate

Increase awareness of climate risks and what we all can do in our daily lives by:

- a. expanding Emergency Services Agency outreach to households in the Bushfire Prone Area
- b. expanding Actsmart programs to households in the bushfire prone area to incorporate bushfire education elements
- c. developing a web based tool for self-assessment of household climate adaptation and resilience.

3. Climate risk assessments

Undertake or update assessments of climate risk and resilience with upgrade proposals for:

- a. ACT Government owned and leased buildings
- b. ACT owned utility and services infrastructure and essential services delivery.

4. Framework for Flood Management

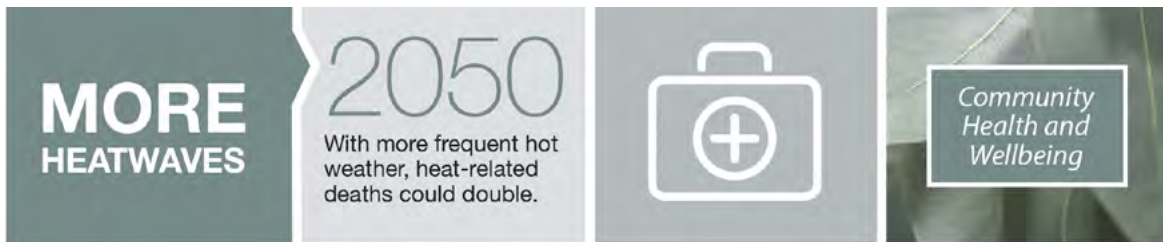
Complete a revision of the framework and ensure implementation.

5. Strategic Bushfire Capability Framework

Complete the capability framework under the Strategic Bushfire Management Plan.

Hazard reduction burning in autumn 2015





Actions for the Community Health and Wellbeing Sector

Actions by end 2017

6. Increasing healthy living

Support healthy living through:

- a. progressive implementation of the Active Travel Strategy through expansion of pathways with appropriate support infrastructure such as shade planting, drinking fountains, parking, seating and shower facilities
- b. assess opportunities for investment in community gardens in new estates and urban renewal areas.

7. Identify heat refuges

Review opportunities for ACT Government and other publicly accessible buildings to be used as heat refuges, and publish information on potential heat refuges around the ACT to enable at-risk individuals to seek out areas where they can go to for relief during extended periods of hot weather.

8. Workplace safety

Review ACT Government workplace health and safety policies and guidelines to ensure that potential climate impacts on workers are identified and addressed.

Actions by end 2020

9. Regional collaboration

Work with the region to improve awareness of climate change impacts to build resilience and adaptive capacity.

American Elms in Grant Crescent Griffith are a spectacular part of Canberra's urban forest. This living infrastructure makes this a desirable place to be day and night and in every season





Actions for the Settlements and Infrastructure Sector

Actions by end 2017

10. Climate impacts and planning

Introduce mandatory requirements to planning for new estates in Territory Plan and Sub-division guidelines and design standards that reflect leading practice with regard to future climate change scenarios.

11. City resilience

Increase built environment resilience and amenity by:

- a. reviewing design standards for public infrastructure to ensure climate change adaptation is considered
- b. introducing requirements to reduce heat absorption of building surfaces and pedestrian pavements.

12. Climate-wise buildings

Develop ACT region specific climate wise guides for buildings and estate planning.

Actions by end 2018

13. Sustainable procurement

Introduce mandatory minimum sustainability requirements for ACT Government capital works and asset upgrade projects to ensure assets and services are climate wise.

14. Tree lined pathways

Add to the Strategic Cycle Network Plan a program of shade tree planting for walking and cycling routes.

15. Living infrastructure

Develop and implement a strategy to enhance living infrastructure in the Territory, including targets for urban tree canopy cover.

Actions by end 2020

16. Building codes

The Government will consider whether current requirements in building codes adequately reflect projected climate change impacts on residential and commercial buildings.

Googong Township Pond and Wetland





Actions for the Water Sector

Actions by end 2017

17. Water for life

Evaluate stormwater infrastructure and initiatives for potential further expansion of:

- a. stormwater irrigation of priority public open spaces
- b. mitigation of nuisance flooding through increasing on-site retention and infiltration
- c. protection of aquatic habitats and prevention of waterway scouring.

18. Integrated catchment management strategy

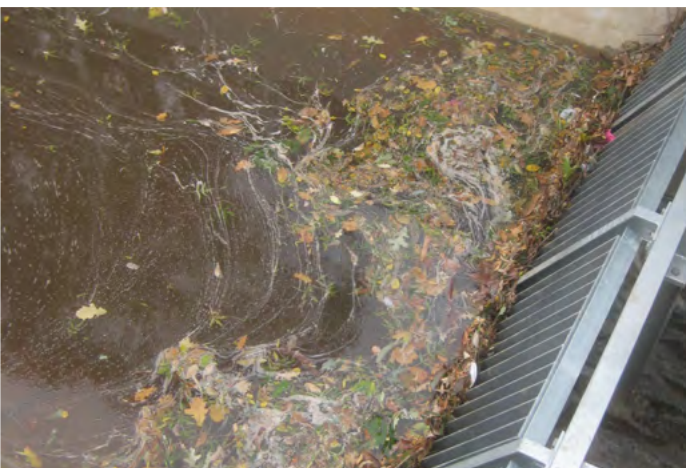
Ensure the plan for the catchments in our region is completed and being implemented.

Actions by end 2019

19. Basin Priority Project

Complete the construction of approved water quality improvement projects, incorporating new approaches to catchment 'treatment trains', in six priority sub-catchments.

Isabella GPT on Tuggeranong Creek





Actions for the Natural Resources and Ecosystems Sector

Actions by end 2017

20. Biodiversity conservation

At a landscape scale, promote better collaboration to:

- a. enhance the resilience and adaptive capacity of our ecosystems including through improved habitat condition and connectivity
- b. identify, protect and manage potential climate refugia across the region.

21. Safeguarding species

Undertake and facilitate targeted interventions to safeguard species under climate change.

22. Caring for land and water

Improve:

- a. knowledge and understanding of land managers about climate impacts and adaptation actions
- b. coordination of pest animal and plant control to contribute towards increased landscape resilience under climate change
- c. monitoring of climate impacts on ecosystems in our bioregion.

Grassland Earless Dragon





WSUD landscaped swale located in Plumsoll Ave, Casey

Actions for Innovation and Integration

Actions by end 2017

23. Awareness raising

Achieve more effective sharing of information across all stakeholder promotion and engagement efforts, including providing periodic updates on local climate impact research outcomes.

24. Sustainability alliance

Build on existing engagements with peak bodies and local knowledge brokers to create a cross-sector alliance that provides an efficient and effective vehicle to:

- share climate change and sustainability information across diverse groups to build understanding, support informed decision making and inspire action
- seek input on relevant ACT policy and program issues
- facilitate collaboration between sectors on challenges and opportunities of mutual interest.

25. Climate adaptation innovation

In projects across the city for new or existing public infrastructure, initiate the creation and or provision of trials to innovate in:

- materials, surfaces, structures, products or methods
- maximising capture and re-use of stormwater
- making public realm landscape treatments more climate resilient.

26. Climate adaptation training and education

Collaborate with vocational and academic institutions and peak bodies on new or innovative delivery of:

- programs for education, training and up-skilling of builders and trades people
- continuing professional development for Canberra and region built environment professionals.

Actions for Monitoring and Evaluation

Actions by end 2017

27. Monitoring and evaluation framework

Measure resilience as an outcome of successful adaptation, including:

- establishing a longitudinal community survey (commencing in 2016 and repeated in 2020)
- measurable and repeatable indicators to evaluate resilience across community sectors.



EPD staff promoting the draft consultation at Garema Place

1. INTRODUCTION



Oaks Estate Community Garden



1.1 PURPOSE

The ACT Climate Change Adaptation Strategy – Living with a Warming Climate (the Adaptation Strategy) supports the community, our city and the natural environment to become more resilient to the impacts from climate change to 2020 by:

- communicating the key impacts of climate change on the ACT and how this will affect us
- mainstreaming climate change risk considerations and adaptation actions in ACT Government policies, programs and practices
- encouraging actions by households and businesses to increase resilience and foster emerging opportunities

This strategy brings together information on the latest advice on the climate change impacts we are facing into the future and some of the measures we can take to reduce our vulnerability to them; in other words, to increase our resilience.

Commonwealth Park's Nerang Pool is an ornamental pond beside Lake Burley Griffin designed for human appreciation of nature (aesthetics and recreation) as well providing water quality functions.



1.2 GOVERNMENT'S OBJECTIVES

In preparing this Adaptation Strategy, the ACT Government's objectives are:

Mainstreaming:

- climate change adaptation becomes considered throughout the planning and delivery of places, systems and services, such as buildings, power, water and health services that support our daily lives.

Resilience:

- the climate resilience of our community should be enhanced in a steady and incremental way, rather than being prompted by a severe climate event. The ACT Government recognises the need to deliver effective engagement and collaboration with the community and to work together across our region to improve our resilience.

Leadership:

- by including climate change considerations in all policies and projects, the ACT Government seeks to provide leadership for community and business, particularly in investment planning and risk management. Taking action to adapt to a changing climate will incur some costs now, but will save us all in the longer term from loss of health, wellbeing and prosperity.

Effectiveness:

- by concentrating attention where most improvement can be gained over the short term (to 2020) the ACT can set itself on the path to transformative adaptation.

1.3 THE CHANGING CLIMATE

Life exists on our planet because of the ‘greenhouse effect’—a layer of gases around the planet that act like the glass in a greenhouse to stop too much heat from leaving Earth’s atmosphere and to keep the Earth at a relatively stable temperature. Global warming is the result of burning fossil fuels (coal, gas and oil) and other processes which release carbon dioxide and other gases, such as methane, into the atmosphere where, since the industrial revolution, they have accumulated. These greenhouse gases (known as GHG emissions) are bolstering the greenhouse gas effect, increasing the warming of the planet and contributing to changes in climate (and then weather) patterns across the planet.

Even with significant global action now to reduce or stop GHG emissions altogether, enough greenhouse gases have already accumulated that global warming will continue for decades and impacts will become increasingly more severe.

The Intergovernmental Panel on Climate Change (IPCC) estimates that on current trends, the global average surface temperature increase could be five degrees Celsius (5°C) by the end of the 21st century.

Climate modelling at our regional scale has been done for the ACT through the NSW and ACT Regional Climate Modelling (NARClIM) project, released in late 2014. Its findings are in line with the IPCC projections.

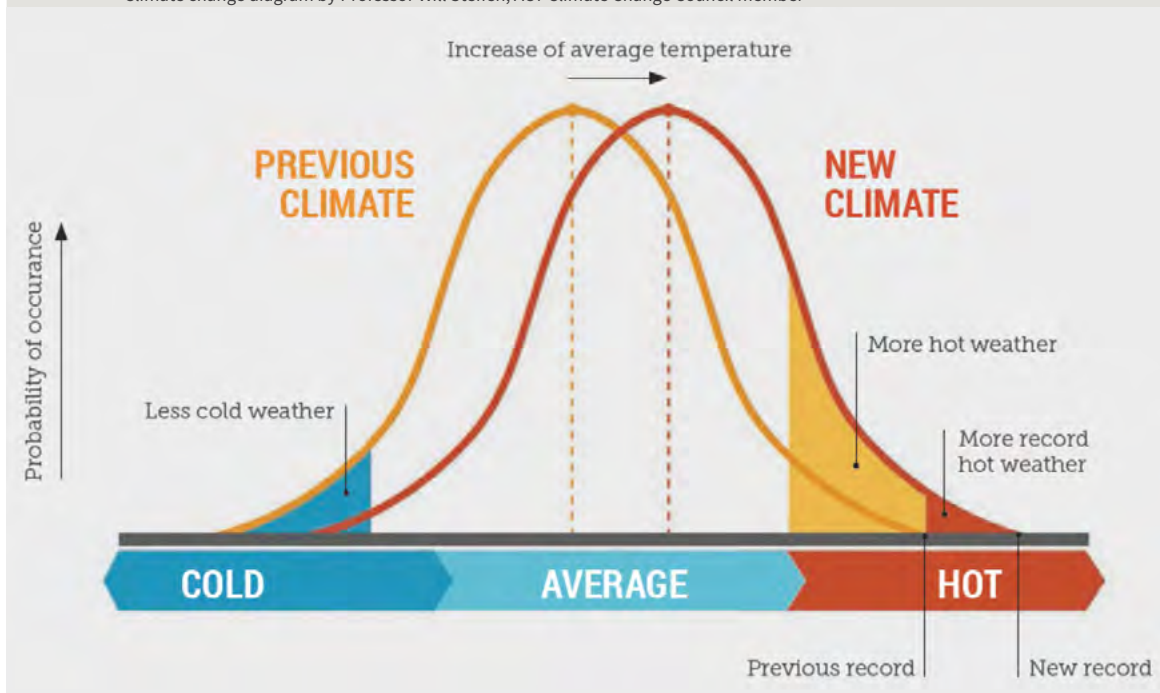
To prepare adequately for living in a warming climate, we must consider the multiple impacts on our way of life, including through ‘worst case scenario’ planning such as drought combined with a heatwave plus more bushfires. A real example of this scenario was the multiple impacts that occurred in the summer of 2014 in Victoria when Melbourne’s rail system stopped when temperatures over 40°C caused the buckling of train lines; impacts included people being stranded, the cancellation of sporting events, a large number of emergency call outs due to heat stroke, and rolling ‘brownouts’ of electricity supply due to demand for additional power for air conditioning.

The decisions governments and individuals make today about infrastructure, health, water management, agriculture, biodiversity, transport and housing will have lasting consequences for our children and future generations.

By considering the future climate when making these decisions, we will be in a better position to deal with the unavoidable impacts of climate change.

Figure 2: Diagram showing the warming of the future climate

Climate change diagram by Professor Will Steffen, ACT Climate Change Council member



In developing the Adaptation Strategy the following concepts have been considered:

- **Adaptation** to climate change involves the planning and activity by individuals, communities, businesses and governments to cope with the changing climate.
- **Sustainability** can be defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs.³
- **Vulnerability** to climate change is defined by the IPCC⁴ as the degree to which socio-economic and biological systems are susceptible to, and unable to cope with, adverse impacts of climate change.
- **Adaptive capacity** refers to the ability of a socio-economic or environmental system to change to better suit climatic effects or impacts. There are limits to the speed or degree to which some parts of these systems can change. Limitations can be economic, technical or behavioural. For example, the rate of climate change is faster than some species can adjust to. In this case they will migrate or be replaced by species more suited to the new climate.
- **Resilience** is the ability of a system to deal with different types of stresses or hazards in a timely, efficient, and equitable manner. Adaptation actions are intended to increase resilience to, and/or reduce the severity of, climate change impacts on both human and natural systems.
- **Transformation** in adaptation refers to changes that help us adapt to climate change beyond what can be achieved by small or incremental changes to a business-as-usual approach. It implies a completely different approach to the way services or goods are delivered. For example, a transformed transport system may not be arrived at by making fossil fuel powered vehicles incrementally more efficient but through their complete replacement by electric vehicles powered by renewable energy.
- **Maladaptation** is action that leads down a wrong or dead-end pathway due to a 'set and forget' approach rather than continuing to respond to change over time; or due to short-term decision making that does not apply intergenerational equity and lifetime considerations.
- **Mitigation** concerns activities to reduce, eliminate or prevent GHG emissions. This can be achieved by using more energy-efficient equipment and technology and/or replacing electricity generated by fossil fuels with electricity generated by renewable resources such as wind and solar energy.

Residential roof top solar hot water and solar panels in Canberra



1.4 LIMITS AND BARRIERS TO ADAPTATION

Considering adaptation actions for sectors means identifying what is at risk from climate change impacts and what must change to reduce vulnerability and increase resilience. This applies in both human and non-human systems, with actions by government and non-government sectors.

Actions need to recognise there are limits to adaptation. Not all climate change impacts can be adapted to by all people or all ecosystems. Understanding the limits to adaptation is important in conserving resources. If key species in an ecosystem cannot adapt to the incremental changes or are diminished by events such as frequent intense fires, the whole ecosystem is less resilient and may decline before adaptation to the new conditions can take place. Understanding the physiological limits to human and non-human systems in the ACT and region is necessary to be able to plan for transformative actions that will be suitable for the changing climate.

The pathways approach to climate change adaptation is the accepted best practice. An adaptation pathway can be gradual transformation with many small steps over time, or radical transformation with rapid change. Radical transformation is usually triggered by advances in knowledge and technology that are adopted.

1.5 ACTIONS TO FACILITATE ADAPTATION

The suite of high priority short-term (between 2017 and 2020) actions reflect the immediate need to accelerate transformative adaptation and are drawn from the sectoral assessments and integrating actions. The majority of actions are shown for completion by 2017. However, some actions are not due for completion until the end of 2020, reflecting the longer timeframes needed for these to be achieved.

2. THE NEED FOR ACTION

Ginninderra peppercress community engagement planting



2.1 A GROWING AND AGEING CITY

Planned from its inception, the ACT is home to Australia's capital city, Canberra. The ACT comprises over 2,350 square kilometres situated within the upper Murrumbidgee River catchment in the Murray–Darling Basin.

The Territory's population of 400,000 is growing, and is projected to reach 500,000 by 2033. Much of the population growth is projected to occur in the new development areas of Gungahlin and Molonglo. Canberra's future age profile is projected to show growth at all ages with one of the largest projected changes being population ageing; those aged 65 and over will increase from 11% of the population in 2012 to 22.5% in 2062.⁵

Guiding how population growth is distributed is critical to Canberra becoming a more compact, efficient city. Focusing urban intensification in town centres, around the mid-sized business and retail centres (group centres like Dickson and Mawson) and along the major public transport routes balances greenfield expansion, as is occurring in the Molonglo Valley.

Population growth and demographic changes affecting the ACT are reflected in similar changes in our region, with residential growth continuing to occur in all surrounding local government areas.

2.2 REGIONAL CLIMATE EFFECTS

The Territory's climate is termed 'cool temperate' and 'alpine'. Our diverse topography, from the surrounding mountain ranges to the plain where the city of Canberra sits, results in a wide range of microclimatic conditions. The other physical determinants of our climate are our latitude (between 35 degrees and 36 degrees south of the Equator); our elevation (from 450 to 1911 metres above sea level) and our distance from the sea (130 kilometres).

CSIRO climate projections

The climate projections for Australia, produced by the CSIRO together with the Australian Bureau of Meteorology (BOM), are provided in the State of the Climate 2014 report, and updated in the 2015 Climate Change in Australia⁶ report. The CSIRO and BOM projections state there was 'very high confidence' that temperatures would rise across Australia throughout the century, with the average annual temperature set to be up to 1.3°C warmer in 2030 compared with the average experienced between 1986 and 2005. Canberra is located in the Murray Basin cluster of the eight Australian climate regions for Australia modelled in the CSIRO reports.

Figure 3: Demographic projections for Canberra's population 2012 to 2060 (Source: Australian Bureau of Statistics).

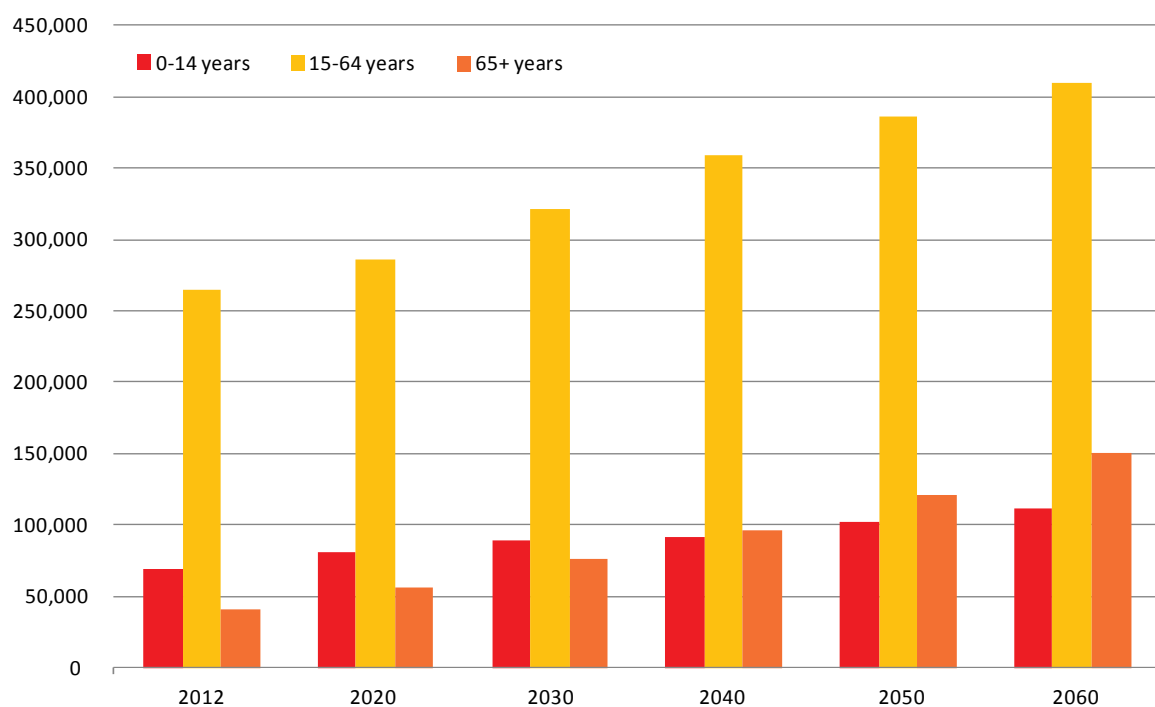


Figure 4: CSIRO Murray Basin Cluster map



Murrumbidgee River downstream of Tharwa

Temperature: By 2030 warming of 0.6–1.3°C above 1986–2005. By 2090, for a high emission scenario warming is 2.7–4.5°C; intermediate scenario warming is 1.3–2.4 °C above 1986–2005. Frost days, temperatures under 2°C, could halve by mid century.

Rainfall: In the near future (2030) natural variability is projected to predominate over trends due to GHG emissions. Late in the century (2090) cool season (April to October) rainfall is projected to decline. Time spent in drought is projected to increase over the course of the century.

NARClIM ACT regional projections

The NSW and ACT Regional Climate Model (NARClIM) project reported on future climate impacts for the ACT region on a 10x10 kilometre scale grid, which provided more refined climate projections than those previously available.

Key impacts identified include:

- The climate will be hotter, with warm days starting earlier in spring and with heatwaves more frequent and of longer duration.
- The annual quantity of rainfall may remain the same but will decrease in winter and spring and increase in autumn.
- The storm season will extend from spring into autumn.
- Longer periods of hotter weather will result in the environment being drier overall. This will contribute to an increase in severe fire weather days over a longer fire season.
- The identified trends of projected changes to the climate out to 2030 will continue and increase and intensify by 2070.



Canberra's dryer landscape a result of increased hotter days

2.3 CLIMATE IMPACTS

Changes to the climate are already occurring and will continue for the foreseeable future. The projections mean that adaptation actions need to be enhanced and supported with greater publicity so our community understands the importance of everyone taking action. The key climate impacts identified are explored in further detail below.






Erosion downstream of the Cotter Road on Yarralumla Creek during heavy rain



Figure 5: Key climate impacts for the ACT identified by NARClIM⁷

Projected changes for ACT



Projected temperature change	
 Maximum temperatures are projected to increase in the near future by 0.6 – 0.9°C	Maximum temperatures are projected to increase in the far future by 1.4 – 2.3°C
 Minimum temperatures are projected to increase in the near future by 0.4 – 0.7°C	Minimum temperatures are projected to increase in the far future by 1.4 – 2.3°C
 The number of hot days will increase	The number of cold nights will decrease
Projected rainfall change	
 Rainfall is projected to decrease in spring	Rainfall is projected to increase in summer and autumn
Projected Forest Fire Danger Index (FFDI) changes	
 Average fire weather is projected to increase in spring, summer and winter	The number of severe fire weather days is projected to increase in summer and spring



Temperature increase and heat wave

“Historically, in Australia more people die from heatwaves than they do from any other type of natural disaster.” Professor Will Steffen, ACT Climate Change Council member, IPCC scientist (2014)

Based on long-term (1910–2011) observations, temperatures in the ACT have been increasing since the 1950s. The ACT is projected to continue to warm into the near future compared to recent years (1990–2009). The projected warming trend is large compared to previous natural variability in temperature and is similar to the rate of warming projected for adjacent regions of NSW.

Currently Canberra experiences an average of fewer than ten very hot days (over 35°C) per year, with none in the alpine areas. In the near future of 2030 there will be up to an additional five hot days and in the far future of 2070, up to 20. The hotter weather will be mainly in spring and summer but will extend into autumn.

Temperature extremes, both hot and cold, can have considerable impacts on health, infrastructure and ecosystems. These projected extremes, rather than average temperature changes, bring greater risks.

Hot weather is normal in our summer season; however a heatwave is an extreme event. The definition of heatwave is relative to where you live and therefore to what you are already acclimatised. For the Canberra region, a heatwave is a series of more than three days with maximum daytime temperatures over 35°C without sufficient night-time cooling temperatures below 23°C.

Research into housing types in Canberra highlighted the cost-effectiveness of investing in building retrofits by considering a range of adaptation scenarios.⁸ Results showed that by 2070 climate change could mean the energy required to heat a typical Canberra home may be one-third lower, but energy for cooling could more than double.



Rainfall and drought

The first decade of the 21st century was characterised by the Millennium Drought and the return of El Niño conditions is anticipated in the near future. Bureau of Meteorology (2014)

The ACT currently experiences rainfall variability from season to season and from year to year, with no rain falling in some months. This is due to the complex interactions between regional weather patterns, the influence of larger-scale climate patterns such as El Niño/La Niña, and the topography of the Great Dividing Range.

Rainfall varies from over 1200 millimetres (mm) precipitation in the mountains, to 400–800 mm in the north of the city. Rain falls each season in a range from 100 mm to 300 mm. Canberra’s rainfall averages 52.4 mm per month and 629 mm annually. The average is 108 rain days per year, however local variability can mean no rain in some months and the whole season’s rain in just a few days.

Climate projections for the water cycle indicate even more reduced reliability of evenly spread rain throughout the year. In the mid to longer term, winter and early spring rain will decrease, but there will be more intense rain events in the warmer months of late spring and summer. Consequently, the annual average rainfall is not projected to vary significantly in the near future. However there is a higher degree of uncertainty about the annual average in the longer term. This is in part due to the ACT being between the drying projected for Victoria and the wetting projected for northern NSW (with the influence of cyclones moving south).

With increasing temperatures and decreasing reliability of rainfall each month, plant life will become stressed and respond as if in drought conditions. This combination will have flow-on effects for all natural ecosystems and urban landscapes.



Storms and flooding

“La Niña events are associated with flooding, such as Queensland floods in 2011 that left at least 38 people dead, affected about 70 towns, saw the evacuation of thousands of residents and hit the economy by about \$30 billion.”

Study published in Nature Climate Change (2014), lead author Dr Wenju Cai, CSIRO

Storms can happen at any time of the year but the current predominant period of storm activity (storm season) in the ACT is from September to the end of February. The longer-term projections for water cycle changes include tropical cyclones reaching further south, thereby increasing the frequency of storms over a lengthened storm season and potentially increasing the rainfall at this time of year.

More frequent and more intense storms with hail and intense rain can impact urban infrastructure systems and buildings and, in rural areas, the houses, crops, roads and bridges. Intense rain does not have time to soak into the ground and becomes stormwater run-off, potentially causing flash flooding. Stormwater can be a hazard to people getting around, cause damage to infrastructure and adversely impact the water quality in the city's lakes and ponds. Hail and intense rain can cause inundation and damage to buildings, damage trees and bring down phone and power lines. Canberra has been designed to cope with flash flooding from intense rain events. However with increasing intensity of storms, the design of the city and the ability of its existing infrastructure to cope will be tested. Additionally, an increase in storm frequency and/or intensity will increase demands on our emergency services.

At present in Australia, the damage associated with storms causes the greatest social, environmental and economic costs related to natural disasters. When events are severe, massive efforts by the community and the government are required for restoration and remediation. Research by CSIRO⁹ indicates that extreme La Niña events will almost double in frequency as the climate warms and will occur every 13 years compared with a past frequency of every 23 years.



Bushfires

‘The fire experienced by the ACT in 2003 was not a normal category of bushfire, although it started that way. Due to the fuel, weather and topographic conditions it became a firestorm. Since 2003 there have been over 30 such extreme fire events in Australia. This phenomenon is not yet well understood or able to be predicted; however increasing incidence is thought to be linked to the hotter and drier climate.’ ACT Emergency Services Agency (2014)

The risk of bushfire depends on three factors: enough dry vegetation (fuel), with weather favourable for fire spread and an ignition source. The Forest Fire Danger Index (FFDI), used in NSW and the ACT to quantify bushfire hazard levels, combines the weather factors of temperature, humidity and wind speed with an estimate of the fuel's state of dryness. FFDI projections come from daily measurements at 17 stations in NSW and the ACT.¹⁰ There are six categories of FFDI: a value of 12 or less indicates low to moderate; 12–25 is high; 25–49 is very high; 50–74 is severe; 75–99 is extreme; and above 100 is catastrophic.

In Canberra long-term FFDI estimates show the average daily FFDI is 7. The BOM issues Fire Weather Warnings when the FFDI is forecast to be over 50. The ACT is projected to experience an increase in both average and severe FFDI in the near and far future. The projected increase in fire hazard is three more days every decade, to occur mainly in summer and spring, with a decrease in autumn. The current ACT average of 1.1 severe fire weather days each year is projected to increase to 7 days per year by 2030 and 19 days per year by 2070.

This increasing bushfire risk and changing seasonality has consequences for how we manage the natural and built environments across all scales, from our national parks to our urban areas.

2.4 WHAT THE ACT GOVERNMENT IS ALREADY DOING

Canberra is generally well placed to adapt to some climatic changes because we have a planned city with relatively new infrastructure; we are not susceptible to sea level rise, storm surge or cyclones; and we have built above flood levels. Combined, these mean our city has inherent resilience and the ability to cope with these stressors and shocks.

Notwithstanding this, climate change will exacerbate a number of impacts that will need to be addressed. The ACT Government Territory Wide Risk Assessment Report¹¹ identified the three most extreme hazards for Canberra as:

- **Bushfires** have potential for: loss of life, casualties, property damage, loss of infrastructure and utilities and water supply; environmental, cultural, business and economic impacts; disruption to transport; evacuation; and impacts on Commonwealth assets.
- **Extreme heat** has potential for: fatalities; impacts on health; significant impact on vulnerable communities; impact on energy consumption and resulting disruption in supply; impact on the provision of essential services and infrastructure; increased risk to the environment, animals; and increased risk of bushfire.
- **Severe storms** have potential for: loss of life, injuries, property damage, loss of infrastructure and utilities; evacuation; impacts on vulnerable communities, local community, local businesses and local economy; disruption to transport and closure of roads; impact on the environment; and impacts on domestic animals and livestock.

Work is already underway by ACT Government agencies to address the extreme hazards identified in the Territory Wide Risk Assessment. However, residual risks and vulnerabilities will remain and our exposure to bushfires, heat, storms, rainfall variability and drought is expected to increase.

Climate change legislation

The ACT's *Climate Change and Greenhouse Gas Reduction Act 2010* (the Act) has a focus on climate change mitigation and establishes GHG emissions reduction targets, with monitoring and reporting provisions. Monitoring of the ACT's emissions shows GHG emissions per person is estimated to have peaked in 2006 and the ACT is on track to achieve our target of a 40% reduction in GHG emissions, based on 1990 levels, by 2020. See <http://www.environment.act.gov.au/cc/acts-greenhouse-gas-emissions>.

The Act enables other actions on climate change, such as the development of ACT Government policies and programs, and gives recognition to the private sector for actions they take.

ACT climate change policies and action plans

In 2007 the ACT introduced its policy on climate change, *Weathering the Change*, and its Action Plan 1. A key achievement of this policy was identifying the cross-cutting issues and establishing consideration of climate change impacts across government policies and decision making.

Following a review, a new climate change strategy and action plan (AP2) was adopted in late 2012. Implementation is continuing and focuses on mitigating the cause of climate change by reducing GHG emissions. AP2 recognises that adapting to ongoing changes to the climate needs to be ongoing and continuous.

The simplicity of the AP2 vision—"By 2060 we will be a more sustainable and carbon neutral city that is adapting to climate change"—belies how challenging this will be to achieve. However, it recognises that adapting to ongoing changes to the climate needs to be ongoing and continuous.

In May 2016 the ACT Government committed to a new target of carbon neutrality by 2050, having regard to the outcomes of the 21st Conference of the Parties to the UNFCCC.

Three adaptation actions under AP2 have been foundation steps for this Adaptation Strategy and are still relevant under the new target:

Action 15 – Territory Wide Risk Assessment

In 2012 the ACT Government completed an assessment of the potential risks of climate change to Territory life and property, including in acute weather and fire events. A revised version was completed in July 2014 and this work has been integrated into natural disaster and emergency risk management and planning.

Action 16 – Ministerial Statement on the built environment and urban open spaces

On 21 May 2014, Mr Simon Corbell MLA, Minister for the Environment, delivered his Ministerial Statement on Climate Change Adaptation. The statement included commitment to develop the ACT's Climate Change Adaptation Strategy. The brochure *Adapting to a Changing Climate: Directions for the ACT* explains this planned policy work.

Action 17 – Assessment of ecological systems

The risks to our natural ecosystems and biodiversity from a warming climate are very real and are dynamic. The ongoing assessment of the impacts of climate induced changes is needed and is included in the policy and action plan, ACT Nature Conservation Strategy 2013–23. This strategy (along with other key government strategies) has directly influenced this draft Adaptation Strategy.

Advice and assistance to our community

The ACT Government's Actsmart program is helping the ACT community adapt to climate change through a suite of programs that assist households, businesses and schools. The programs provide advice and assistance for a more sustainable future, for example by saving energy through increasing efficiency, reducing water use and reducing the levels of waste to landfill. Refer to the website

<http://www.actsmart.act.gov.au/home>.

Other key government work

The ACT Government continues to act on climate change impacts and consequent risks to public assets in all aspects of its work. By taking account of existing adaptation work, the government can identify gaps in our ability to respond to the impacts of climate change and help to build our community's resilience.

Climate change adaptation action around Australia

Action on climate change adaptation is occurring across Australia. The chart in Appendix 1 provides a snapshot from each jurisdiction, current in the first half of 2015 but omitting coastal and sea level rise works. While numerous actions are being taken at the city level (local government), this information has not been captured.

2.5 ADAPTATION APPROACH

Why adaptation is important

Adaptation is the process by which vulnerability to climate hazards is minimised. However, adaptation responses can vary greatly depending on the type and severity of the hazard and the capacity of the community to adapt.

Adaptation responses can range from resilience (changes or coping strategies to maintain business as usual) to transition (incremental system changes) and transformation (fundamental system change). In practice there is considerable overlap, and sub-components of systems may transform in order to maintain wider system resilience. An incremental approach to adaptation, achieved through an understanding of community behaviour and careful long-term planning by government in consultation with the community, carries reduced risk of disruption to society from abrupt transformation.

Figure 6: ACT Government initiatives responding to climate change

	Community Health and Wellbeing	Disaster and Emergency Management	Settlements and Infrastructure	Water	Natural Resources and Ecosystems
Urban renewal and transport projects <i>Capital Metro and the City and Northbourne Urban Design Framework</i>					
Design Standards for Urban Infrastructure					
Territory Plan development codes					
Climate Change Strategy and Action plan (AP2)					
Nature Conservation Strategy					
Pest Animal Management Strategy					
Planning Strategy					
Strategic Bushfire Management Plan					
Transport for Canberra					
Waste Management Strategy					
Water Strategy – Striking the Balance					
Weeds Strategy					
Actsmart programs					
Environment programs					
Air and water monitoring					
Flood modelling and mapping					
Community Recovery Plan					
Emergency Plan					
Healthy Weight Action Plan (Towards Zero Growth)					
Human Services Blueprint					
Public Housing Asset Management Strategy					
Territory Wide Risk Assessment Report					
Vulnerability (to Climate Change) Assessment Framework for Infrastructure					

Guiding principles

Climate change is complex and its exact patterns and impacts are not fully known or predictable. There is a degree of uncertainty in knowing what to change from what we are doing now (business-as-usual). Therefore, guidance is needed for sensible and wise decision making by government and non-government sectors. Leading practice sees the following four principles applied in climate change decision making.

Intergenerational equity principle

Intergenerational equity means considering the impacts of decisions made today on future generations. The *Climate Change and Greenhouse Gas Reduction Act 2010* requires “application of the intergenerational equity principle, along with requirements to consider the impacts on the community, particularly the disadvantaged”.

No regrets principle

The no-regrets¹² principle means taking decisions or actions to reduce or avoid potential negative consequences and, even if these do not eventuate, the actions and outcomes will not be regretted as benefits are achieved whether hazards take place or not.¹³ Decisions or actions that lack suitable climate foresight may result in greater future risks and costs. No-regrets measures can be done now as they enhance current living conditions with additional future benefits. For example, making buildings more comfortable and less energy dependent will help reduce both costs and GHG emissions into the future.

Decision lifetime concept

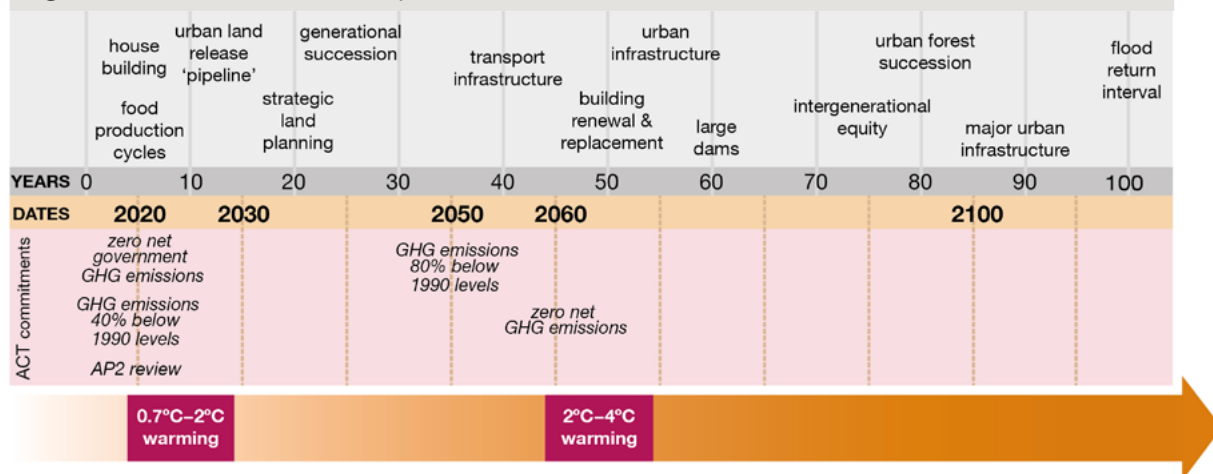
The decision lifetime concept means recognising the length of time into the future that will be affected by a decision. In adapting to climate change, the decisions we take now need to be effective in preparing us for the future climate. For example, a house is generally built to last over 50 years,¹⁴ so the design and construction decisions of today need to make it fit-for-purpose for that length of time.

Shared responsibility

The ACT Government’s approach to climate change adaptation is pragmatic: working together to manage the unavoidable and potentially harmful impacts of climate change to allow us all to continue to enjoy a good quality of life.

A shared responsibility approach was adopted by the ACT Government after the 2003 firestorm (accepting the McLeod report¹⁵ recommendation). This way of thinking is still relevant today and means we all take responsibility for managing our lives and do not expect the government is able to remove all risk for everyone. The ACT Government’s role is to act where there is a risk to public assets or services, or to assist where the free market will not meet the community’s basic needs.

Figure 7: Decision lifetimes concept illustrated for the ACT



Adapted from work by Stafford Smith, D.M., Horrocks, L., Harvey, A., Hamilton, C., 2011. Rethinking adaptation in a 4°C world. *Philosophical Transactions of the Royal Society A369*, 196–216.

3. SECTORS AND ACTIONS

City Walk in Canberra CBD



3.1 SECTORAL ASSESSMENTS AND ACTIONS




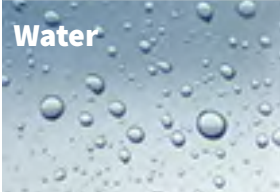

Sectoral pathway approach

The Adaptation Strategy considers adaptation issues and action across five key areas known as sectors. This approach is consistent with the National Adaptation Framework¹⁶ (2007) established by the Council of Australian Governments (COAG) and the Australian Government’s Climate Adaptation Outlook: A Proposed National Adaptation Assessment Framework (2013). The intent of this approach is to build understanding and adaptive capacity and reduce sectoral and regional vulnerability to climate change impacts.

As well as the sectors considered by the ACT, the National Adaptation Framework includes the agriculture and coast sectors. The coast sector was not included in the ACT assessment while the agriculture sector was considered to have a modest footprint in the Canberra context with some of the issues arising addressed across the emergency services, health and community and settlement and infrastructure sectors.

Table 1: The five key sectors for the ACT and the key ACT Government agencies responsible for action and monitoring adaptation details the scope of each sector with the lead ACT Government agencies responsible for taking action.

Table 1: The five key sectors for the ACT and the key ACT Government agencies responsible for action and monitoring adaptation

Sector	Scope	Key Government Agencies
 Disaster and emergency planning	The emergency planning and response to extreme weather events and natural disasters in the ACT and cross border with NSW.	<ul style="list-style-type: none"> Justice and Community Safety Directorate (with Emergency Services Agency, Police, State Emergency Service, Ambulance and Fire and Rescue Service and the Rural Fire Service) Community Services Directorate
 Community health and wellbeing	The essential services supporting the ACT community’s health and wellbeing.	<ul style="list-style-type: none"> Health Directorate Community Services Directorate Transport Canberra and City Services Environment and Planning Directorate
 Settlements and infrastructure	The physical infrastructure and social and economic components of the ACT.	<ul style="list-style-type: none"> Environment and Planning Directorate Transport Canberra and City Services Land Development Agency Community Services Directorate Justice and Community Safety Directorate
 Water	The quantity and quality of water resources in the ACT and adjacent regional catchments.	<ul style="list-style-type: none"> Environment and Planning Directorate Transport Canberra and City Services Office of the Commissioner for Sustainability and the Environment
 Natural resources and ecosystems	The species, ecosystems and natural resources in the ACT and region.	<ul style="list-style-type: none"> Environment and Planning Directorate Transport Canberra and City Services Office of the Commissioner for Sustainability and the Environment

In addition to the above, the Chief Minister, Treasury and Economic Development Directorate is responsible for cross-border issues and has an overarching policy coordination role.



3.2 SECTOR 1: DISASTER AND EMERGENCY MANAGEMENT

“Close to a quarter of all dwellings in the ACT are located in the area identified as bushfire prone in the draft maps. As the city grows, new suburbs are being developed on the western edge of Canberra, which includes new areas in Molonglo. Due to the concentration of people and houses, this western edge presents the greatest bushfire risk to life and property.” Minister for Emergency Services, Simon Corbell MLA

Climate change impacts

Climate projections indicate that emergency and disaster service levels will need to be enhanced as the risks of adverse climate impacts become incrementally higher. In the ACT, the greatest risk to life comes from extreme heat, severe storm and bushfires.

Reducing vulnerability to extreme heat

Heat related deaths do not attract the media attention that bushfires do, but they kill more Australians than any other extreme weather event. The ACT Emergency Plan 2014¹⁷ has a subsidiary Extreme Heat Plan 2014 and the ACT Ambulance Service is the front-line responder to this impact. Reducing the risk of increasing urban heat is discussed further in the settlements and infrastructure sector.

Reducing vulnerability to bushfire

The ACT's Emergency Services Agency (ESA) 2014 revision of the Strategic Bushfire Management Plan (SBMP) includes a new map of places at risk, i.e. the bushfire prone areas within the urban area of Canberra.

It is an ACT Government priority to reduce bushfire vulnerability by improving the ability of houses, gardens and open spaces on the urban edges to withstand ember, radiant heat and direct flame attack from bushfires. Consequently, it is proposed that the ACT's building requirements be changed to reflect the National Construction Code and the 'bushfire attack level' assessment.

The SBMP also foreshadows modifications to the design and management of the landscape on both public and private land at the urban edge.

Part of this will include expanding landscape management 'tools' to more widely use a mosaic of fuel reduction burning, both in and out of urban areas. Possible changes to existing 'rules' for our city are discussed further in the settlements and infrastructure sector.

Reducing impact of severe storms

NARCLiM projections indicate the ACT will be exposed to more intense rain events in the warmer months of late spring and summer with localised heavy rain occurring in short periods of time. These events are likely to overwhelm stormwater infrastructure, which is designed to cope with up to the 1% Annual Exceedance Probability (AEP) storm event through a combination of piped and overland flows to course localised flooding and prevent property damage.

Urban developments can also affect natural seepage and run-off and redirect concentrated water flows through stormwater systems. This can lead to localised flooding where existing stormwater infrastructure is not capable of accommodating increased water flows.

Canberra planning has always taken into account the need to avoid development in flood prone areas. Since the 1970s, planning for new urban development in the ACT has kept development above the 1% AEP flood level.

Ongoing actions to address the management of stormwater and flooding are presented in the ACT Water Strategy, released by the ACT Government in 2014. Through the Water Strategy, the ACT Government is updating flood studies for creeks and some major stormwater channels within and adjacent to urban areas.

These studies, along with climate change projections, will inform revisions to flood level mapping around the Territory.

Further work on flood and risk management will consider the implications of climate variability and climate change when assessing future flood risks and infrastructure opportunities and pressures.

Managing risks

Preparation for and responding to emergencies and disasters is a core role of government. The impacts and costs of recovery from severe weather events and natural disasters in the ACT are lower than many places in Australia due to our legacy of good design and planning. However, the cost of the 2003 fires was significant and, as climate changes are not static, emergency and disaster management must be ongoing.

As such, risk assessment of ACT Government services, assets and operations is routinely undertaken. Technological advances such as predictive modelling, fire detection and automated response systems also help in managing the risks from extreme weather and natural disasters. With the new climate projections, these assessments need to be routinely updated and remedial action taken.

Sharing responsibility

Responding to more fires, heatwaves and storms has obvious capacity, resource and management implications for governments across the region. These can be partly met by increasing the capability and capacity of the emergency services. Harnessing the community's local knowledge and experience through volunteerism is a realistic way to increase the 'surge capacity' of the services to prepare and respond to events.

Street flooding in Belconnen in 2014



Hazard reduction burning in autumn 2015

Combined with the harmonisation of systems and training across jurisdictional borders, volunteerism is one of a number of ways the government can increase its frontline capacity to respond to emergencies.

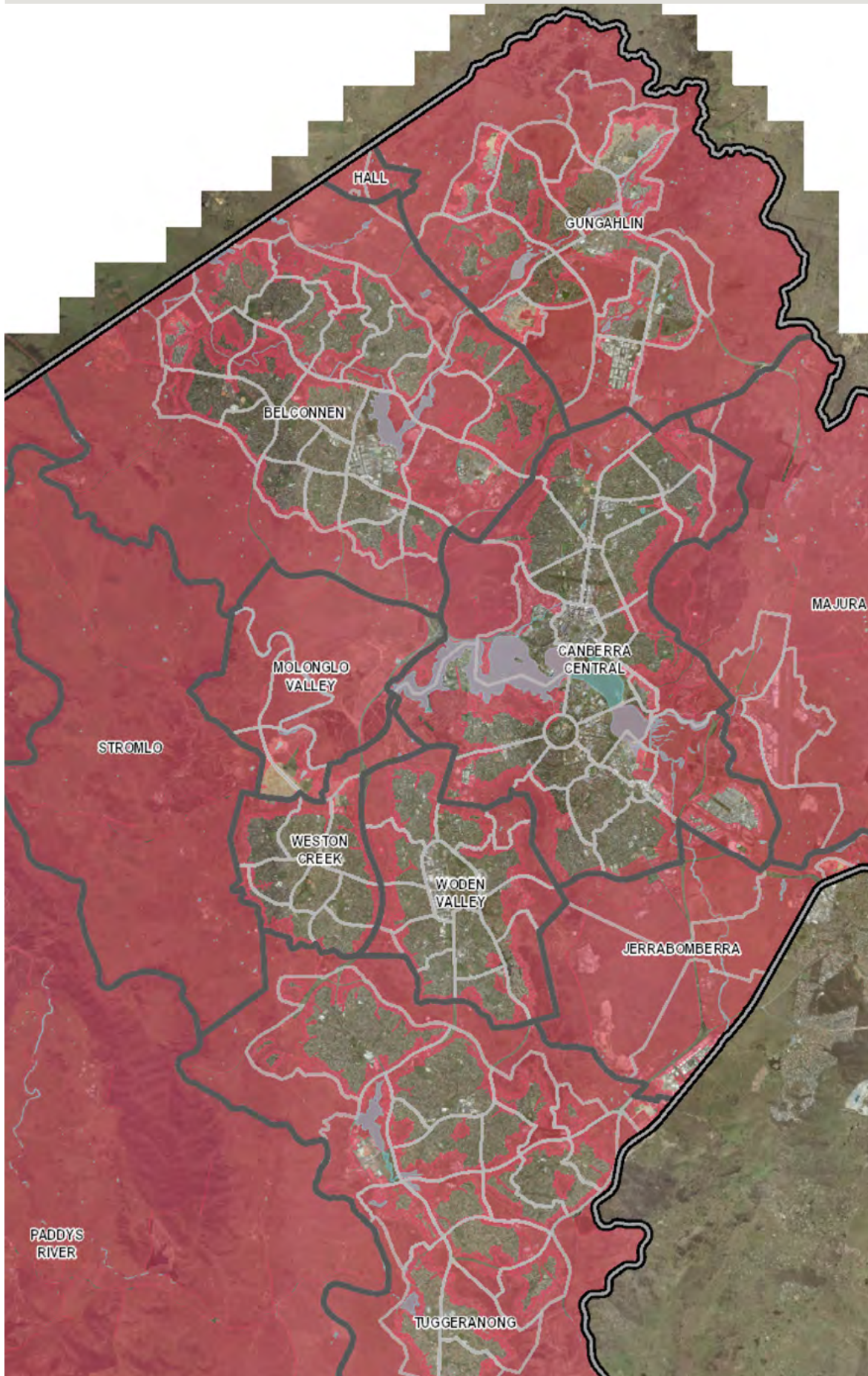
Private owners and occupants of all types of property are responsible for taking the necessary risk reduction measures on their property. While grazed farmland on the western edges of Canberra can help as a fire buffer for urban residents, all urban-edge properties need to respond each year, as seasonal conditions change, to minimise the risks from bushfire. Hazard reduction burning is undertaken as weather and seasonal conditions permit in the parks, reserves and farmlands around Canberra, with collaboration between the land owners and managers, the government fire crews and Rural Fire Service volunteers.

The commercial property sector and insurance industry are already re-assessing the risks; nationwide there are higher costs for flood and inundation insurance resulting from the recurring Queensland flooding.

The NARcliM projections indicate high fire fuel danger index (FFDI) in months traditionally used for control burns. Consequently this aspect of land management, along with all others, will need to be flexible to respond to seasonal conditions.

The State Emergency Service (SES) states that homeowners have the responsibility to take all necessary steps to protect their property from storms and flash flooding. Although the ACT SES does emergency repairs, permanent repairs are the homeowners' responsibility (www.esa.act.gov.au).

Figure 8: Canberra's bushfire prone areas shown in red.





Disaster and
Emergency
Management

Assessment Sector 1: Disaster and emergency management

Potential risks and impacts

- More death and injury in Canberra with more frequent heatwaves and more bushfires. In extreme events resources are stretched and response options are limited, so not all extreme events are able to be managed or mitigated (e.g. large-scale bushfire).
- More people become adversely affected as a result of extreme events when services are not able to meet demand.
- Existing buildings, gardens and open spaces within the ACT's bushfire prone areas are not renovated or maintained to meet revised standards and present a safety risk to the whole neighbourhood.
- Property insurance costs (to households and business) are increased as more buildings are affected by more extreme climate events, particularly storms.

Actions completed or underway

- Under the ACT's Emergency Management Plan, a suite of hazard specific sub plans are regularly updated to address climate projections including the Strategic Bushfire Management Plan, Extreme Heat Sub Plan, Flood Emergency Plan and Storm Emergency Sub Plan.
- Public announcements and awareness campaigns about risks from natural disasters are undertaken regularly and routinely each year, with additional education and services provided to higher risk sectors in the community.
- Collaboration within government utilises existing community facilities to provide sufficient and adequate refuges at times of extreme events and disasters.
- The revision of the Strategic Bushfire Management Plan 2014 sets out 12 objectives with 71 specific actions to reduce bushfire risk. The implementation and reporting on these actions is underway.
- The review and updating of the ACT's Design Standards for Urban Infrastructure and Building Code is being considered with National Construction Code amendments.

Emerging issues and residual risk

- ACT Government buildings and facilities need to be kept fit-for-purpose in the changed climate. To ensure government assets are compliant with risk assessment recommendations, programs of renewal and refurbishment need to be ongoing.
- To reduce the risk to the whole community, all householders and property owners need reminders to allow for risk assessment and remedial actions. Residents of all ages need to be trained and reminded about what to do in an emergency and maintain proficiency in risk responses.
- Cross-border emergency responses would be improved by ensuring there are enough volunteers to provide surge capacity in emergency situations and that all volunteers have standardised training and equipment.
- The impacts of climate change on the existing building stock will remain a safety issue for many years, with triggers for upgrading only likely when significant changes to a building are proposed.

Desired outcomes

- The Canberra and region community is resilient because residents are well informed about and prepared for all kinds of emergencies and individuals take responsibility for undertaking sufficient upgrading and management of their property to make it safe (climate wise).
- Across the region, emergency services have compatible systems and staffing. Well-trained volunteers provide regional surge capacity including first aid (triage for non-acute health services).
- Canberra's public assets, infrastructure and buildings are low risk to climate change impacts. Consequently, essential services such as water and power are provided with minimal cuts or 'brownouts'.
- Property insurance premiums in the ACT reflect effective management of climate risks.



Eco burn at Jerrabomberra West Nature Reserve

The existing emergency and disaster policies and plans, including the ACT Emergency Plan 2014 with its suite of sub-plans and the Strategic Bushfire Management Plan 2014, address the current and future risks. However routine updating of these documents needs to continue. To better address and take account of the emerging issues and move towards the desired outcomes, the work of all other ACT Government agencies will be ramped up to revise agency specific plans for services and assets with overt consideration of how these will remain fit-for-purpose over time.

As Canberra, Queanbeyan and neighbouring NSW villages, towns and lifestyle estates continue to grow and change, there needs to be an enhanced focus on the management of the rural lands that surround them. To enable effective and sufficient disaster and emergency responses, it is critical to identify the land characteristics and how to manage them, and to have the necessary capacity, capability and inter-operability. As fire ignores boundaries, increasing cross-border collaboration is required.

ACT and NSW volunteers provide invaluable services to keep us safe in times of need. The continuing climate changes will bring an increasing need for such help in the event of disasters and emergencies. Increasing the number and training of our volunteers is an important adaptation action that individuals and businesses can participate in to make our wider community more resilient.

The priority short-term actions for ACT Government are:

Actions by end 2017

1. **Bushfire prone areas**
The Government will consider whether the current regulatory settings of bushfire prone areas continues to adequately reflect bushfire risk.
2. **Reducing impacts from the warming climate**
Increase awareness of climate risks and what we all can do in our daily lives by:
 - a. expanding Emergency Services Agency outreach to households in the bushfire prone area
 - b. expanding Actsmart programs to households in the bushfire prone area incorporating bushfire education elements
 - c. developing a web-based tool for self assessment of household climate adaptation and resilience.
3. **Climate risk assessments**
Undertake or update assessments of climate risk and resilience with upgrade proposals for:
 - a. ACT Government owned and leased buildings
 - b. ACT owned utility and services infrastructure and essential services delivery.
4. **Framework for Flood Management**
Complete a revision of the framework and ensure its implementation.
5. **Strategic Bushfire Capability Framework**
Complete the capability framework under the Strategic Bushfire Management Plan.



Community Health and Wellbeing

3.3 SECTOR 2: COMMUNITY HEALTH AND WELLBEING

‘At present the social determinants of health (housing, food and disadvantage) present greater everyday risks to general population health and wellbeing than climate change. However the future climate extremes may well change this.’

Dr Andrew Pengilley,
ACT Deputy Chief Health Officer

Climate change impacts

Of the four key climate impacts identified for the ACT, extreme heat and bushfire present the most serious direct threat to lives in Canberra. Beyond direct risk to life, prolonged heat waves and drought can have physical and mental impacts.¹⁸

A 2015 report *No Time for Games: Children’s Health and Climate Change* from Doctors for the Environment states, “Extreme weather events and increasing temperatures are already causing childhood illness in households throughout Australia. Furthermore gastro-intestinal diseases, respiratory and heat related illnesses, and the physical and mental health impacts of floods, bushfires and droughts are all expected to rise”.¹⁹

Generally, climate extremes and related natural disasters most impact those who are least resilient to stressors and shocks of any kind. People’s ability to be resilient to climate change is directly related to their vulnerability, which is influenced by age, health and demographic characteristics. For example, if you are a healthy young working person you are more likely to be resilient to the stress or shock from an extreme event than a homeless older person.

Extreme weather events and increasing temperatures are already causing childhood illness



ACT Government staff partaking in lunch time activities

Green space and health outcomes

Several studies have shown linkages between green spaces and positive health outcomes. That is, exposure to green spaces can be psychologically and physiologically restorative. Observed health outcomes include improved mental health, increased physical activity and reduced deaths from blood pressure and stress.

Given this, actively managing green space can be an approach to build resilience to climate change. Notwithstanding this, in a hot and dry environment the green and shady areas that provide shelter, relief and areas for amenity and social cohesion are also stressed and must be proactively managed through appropriate tree and plant species selection and supportive infrastructure that allows for water capture and recycling.



Kitchen garden at Gundaroo restaurant 'Grazing' (photo from ACT Tourism)

Medical services and community health

Provision of health services to support the resident population is a core responsibility of government. Our health care provides for all demographics with a focus on the most vulnerable.

The ACT Population Health Strategic Framework and its subsidiary operational plans include how the ACT will respond under climate change impacts. The framework is regularly updated as the city grows and climate risks are better understood. Additionally, a range of government policies and programs contribute to general population health and wellbeing, for example the Healthy Weight Action Plan with its health promotion information and incentives for an active lifestyle.

Increasing community-wide resilience is, however, more social than medical. A caring community is where people actively help each other. Such social cohesion is a marker of community wellbeing and an effective measure of resilience. The provision of facilities and services, education and even the design of urban Canberra can contribute to fostering social interaction. Achieving the government's priority for a caring community that helps the vulnerable with fairness and equity is the best way to ensure the Canberra community maintains resilience to extreme events.

Local fresh food

The health of any community is closely tied to access to affordable fresh food. The people of the Canberra region will continue to be reliant on food produced elsewhere and transported here; however, it makes good sense to encourage more to be produced and sold locally to support diversification of the sector and support local business.

Around Australia the popularity of community gardens and school kitchen gardens is increasing, as is community interest in growing fresh food in and close to urban areas.²⁰ Globally, many cities are allocating land for 'urban farming' to supply locally-produced fresh food. Close proximity allows farmers to sell in local markets, which enhances their business viability, brings a closer relationship between city and country and helps develop pride in regional foods. With a warming climate the existing challenges to production will continue, and information and knowledge will become more important to support farmers as they adapt. Taking a collaborative regional approach will assist the successful adaptation of this sector.

Potential risks and impacts

- Death from heat through exacerbation of existing underlying health conditions and illness from excess exposure to heat and dehydration. This can affect those who are sick but also those who are well but are outdoor workers, sports people and children being active outdoors.
- Loss of productivity, with outdoor workers and school children sent home during heatwaves and extreme events.
- Safety, productivity and cost issues arising from buildings that are not designed and constructed to be resilient to climate impacts (bushfires, severe storms or heatwaves).
- Canberra's liveability depleted when urban open spaces and residential gardens that are not suited to climate extremes decline in health and amenity, thus affecting human health and wellbeing.

Actions completed or underway

- Community service announcements and notifications are made in advance of hot days, heatwaves, and other predicted extreme weather events as part of implementing the ACT's Emergency Plan.
- Current policies and programs such as the Healthy Weight Action Plan help the whole community keep healthy through awareness and incentives to eat well and stay active.
- To help housing be functional, comfortable and affordable year round, the ACT Government promotes the benefits of good design and the Actsmart programs assist the most disadvantaged with energy and water efficiency.
- With an increasing percentage of the community having higher medical needs (under 14 and over 65 years), health system services are routinely recalibrated to respond to demand, such as community health services suiting the needs in each district and different delivery models for non-acute services such as nurse practitioner clinics. Additionally a new hospital is being built in Belconnen to serve patients from the ACT and region.

Emerging issues and residual risk

- Community awareness of climate impacts needs to be high to inform and promote individual and collective actions by everyone to increase population resilience.
- The community, health and refuge facilities need to be routinely evaluated for distribution, capability and capacity given changing demographics and climate impacts.
- Urban centres, metropolitan parks, places and pathways need to be fit-for-purpose in a warmer climate with sufficient shade and drinking water.

Desired outcomes

- The Canberra and region community has fair and equitable access to health and community services and facilities sufficient for their needs; during extreme events surge capacity is assisted by community-based facilities and volunteers.
- Canberra remains a liveable city for all seasons, with its streets, centres and urban open spaces providing year round amenity, shade and shelter, and/or solar access as appropriate.
- All Canberra buildings are designed and built to be climate wise, operating efficiently to keep people safe and comfortable year round in an energy and water efficient manner.
- The design of urban areas, access to parks and recreation, and provision of public transport, walking and cycling facilities, encourages people to maintain a level of fitness which assists with climate change resilience.
- Canberrans are informed, aware and resilient to climate impacts and, as a caring and cohesive community, support family, friends and neighbours in the lead up to, during and after extreme events.



Canberrans walking up Mt Ainslie

The priority short-term climate adaptation actions for the ACT Government are:

Actions by end 2017

6. Increasing healthy living

Support healthy living through:

- a. progressive implementation of the Active Travel Strategy through expansion of pathways with appropriate support infrastructure such as shade planting, drinking fountains, parking, seating and shower facilities
- b. assess opportunities for investment in community gardens in new estates and in urban renewal areas.

7. Identify heat refuges

Review opportunities for ACT Government and other publicly accessible buildings to be used as heat refuges, and publish information on potential heat refuges around the ACT to enable at-risk individuals to seek out areas where they can go to for relief during extended periods of hot weather.

8. Workplace safety

Review ACT Government workplace health and safety policies and guidelines to ensure potential climate impacts on workers are identified and addressed.



Actions by end 2020

9. Regional collaboration

Work with the region to improve awareness of climate change impacts to build resilience and adaptive capacity.



3.4 SECTOR 3: SETTLEMENTS AND INFRASTRUCTURE

“...urban planning decisions have long legacies...decisions made in 2014 will shape future urban living, with the future retrofitting of the built environment a more expensive endeavour than forward planning.”
Canberra Urban and Regional Futures (CURF)
Working paper 4

Climate change impacts

The projected increases in extreme events of heat, bushfire and storms will have increasingly significant impacts on settlements and infrastructure. For example, the warming climate and the increasing number and duration of heatwaves will compound the existing urban heat island phenomenon in cities.

The expanded assessment of bushfire prone areas of Canberra, with the climate-induced increase in high fire danger days, means the city's public and private buildings and landscapes need to be 'fire wise'. This means modifications to building design and construction to reduce the risk from the assessed Bushfire Attack Level. The majority of Canberra's homes at the urban edge are well established. To varying degrees they will require transitioning through renovation and maintenance to increase safety and resilience in the event of bushfires. These activities are critical, alongside continued activities to educate householders.

The increasing number of storms with intense rain and high winds will also affect the city's infrastructure and buildings. The risk of adverse outcomes is well recognised by the insurance industry. To keep life and property safe (and premiums low) site-specific risks need to be addressed.

The ACT Government's 'rules' that determine how the city and its buildings are designed, built and managed is a suite of guidelines, codes, standards, regulations and practices. These rules need to be enhanced in light of the climate projections.

Climate-wise buildings

'Climate-wise' buildings are those that provide safe and comfortable living and working conditions, now and into the future. Relatively simple changes to the design, construction and maintenance of the city's buildings can significantly reduce adverse impacts from the changing climate. For example, increasing the size of gutters and downpipes reduces the risk of intense rain inundating a building. Similarly, a well-insulated building will keep people cooler during periods of prolonged heat.

A climate-wise building has three essential components:

- passive cooling through cross ventilation and night purging of hot air (some mechanical ventilation and cooling systems may be necessary for extreme events and for basements)
- passive heating through solar access with high thermal mass components to capture, store and release the sun's energy (heating systems may be necessary for colder periods)
- quality construction, detailing and materials (including sealing and insulation) to maximise heating and cooling and be resilient to bushfire and the intense rain and high winds of storms.

Converting existing buildings to be climate wise will cost money in the near term, but will save money to occupiers from lower operating costs (e.g. less energy and water use) for the life of the building. The co-benefits of climate-wise buildings are a safer community with reduced demands on emergency services.



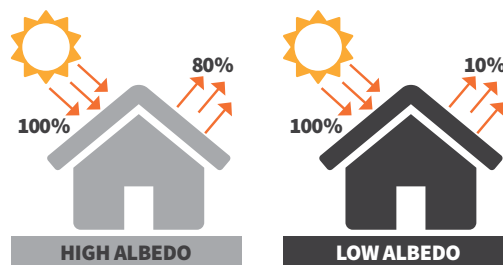
Nishi building in New Action demonstrates use of plants to cool buildings

Reducing urban heat with the albedo effect

To support the ACT Climate Change Strategy (AP2) vision for a more sustainable city, the government has committed to a number of transformative projects in urban renewal and transport, such as Capital Metro light rail, City and Gateway Urban Renewal and City to the Lake. As our city's density increases, more people will be dependent on the design and management of the city's public spaces. To maintain Canberra's status as one of the world's most liveable cities, and to make sure Canberra's centres are safe, pleasant and inviting for people all year round, the design and management of public and private open spaces will have to adapt to the warmer climate.

Highly developed areas such as city centres can experience higher average temperatures than surrounding suburban or rural areas, a phenomenon known as the 'urban heat island effect'. This is caused by the large quantity of materials (bricks, concrete, asphalt) that capture daytime heat and re-radiate it at night, warming the temperature in the day and night. Urban heat is frequently exacerbated by urban intensification and, under a warming climate, will become a problem for Canberra's major centres unless preventative action is taken.

One of the ways to reduce heat absorption is by using light colours and heat reflective surfaces in buildings and pavements, referred to as the albedo effect.²¹ The diagram below illustrates the way the albedo effect works.



Ice with snow (found at the polar caps and high altitude areas) has a high albedo of approximately 0.9 that is, most sunlight hitting the surface bounces back towards space. As the polar caps shrink there is less reflectivity. Water is much more absorbent and reflects about 10% of the incoming radiation, resulting in a low albedo of 0.1. Because 30% of the sun's energy is reflected by Earth, the Earth has an average albedo of 0.30 (reference www.esr.org/outreach/glossary/albedo)

Highly reflective materials or colours also increase glare, which can make places less pleasant. Conversely, the reflectivity is a benefit at night, as less lighting is needed for safety and amenity. Reflective surfaces can also increase the efficiency of rooftop solar panels by reducing the ambient temperature around the panel.

Although the albedo effect could be most beneficial in places where development intensity is greatest, data is needed about the existing urban fabric to provide the most suitable and site specific response.



Reducing urban heat with plants and water

Vegetation such as large trees and watered grass contribute significantly to reducing the urban heat island effect by providing shade and circulating moisture in the atmosphere by evapotranspiration, which has a cooling effect (trees and plants release moisture through natural processes).

Providing shade is the most effective way to avoid pavements and buildings heating up, for example canopy trees to shade pedestrian and vehicle pavements, or plants on sun exposed roofs and walls. It is important that the city's urban open spaces, parks and plazas keep the city cool and assist in bushfire protection. This means ensuring maintenance of the urban forest provides sufficient plant health requirements (water and soil).

Canberra's extensive open spaces and predominant low density makes room for large trees, however across the city their distribution is not uniform and more trees are needed to avoid localised 'hot spots'.

The ACT's temperature records indicate that Canberra city can be up to 4°C warmer than its surrounding rural areas in winter. In summer localised temperature differences can be over 12°C between pavements in sun or shade. Thermal imaging photos below taken by ACT Government on a 35°C day in February 2015 show the benefits of trees and lighter colour surfaces in reducing the temperature.

Figures 11 and 12, prepared by CSIRO from 2014 satellite imagery of Canberra's metropolitan areas, show where the city's trees are, and how trees and large bodies of water are providing a cooling effect.

Land Surface Temperature mapping for the Canberra metropolitan area shows cool areas (blue) and hot areas (red). These differences in the levels of heat correlate to tree cover (Figure 12). The major civic centres deliver most urban heat effect, with their expanses of roads, pavements and roofs.

Figure 9: Anketell Street, Tuggeranong. Pavement temperatures in HS 2=41°C (yellow) HS 1=30°C (blue) HS 3=47°C (red).

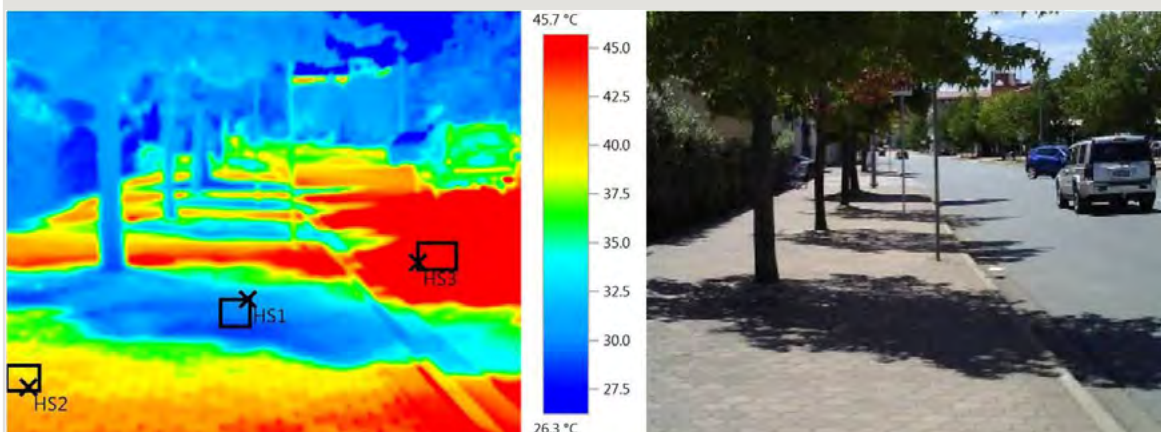


Figure 10: Ainslie Avenue, Civic Square. The ambient air temperature in CS1= 30°C and HS1 = 43°C pavement in the sun.

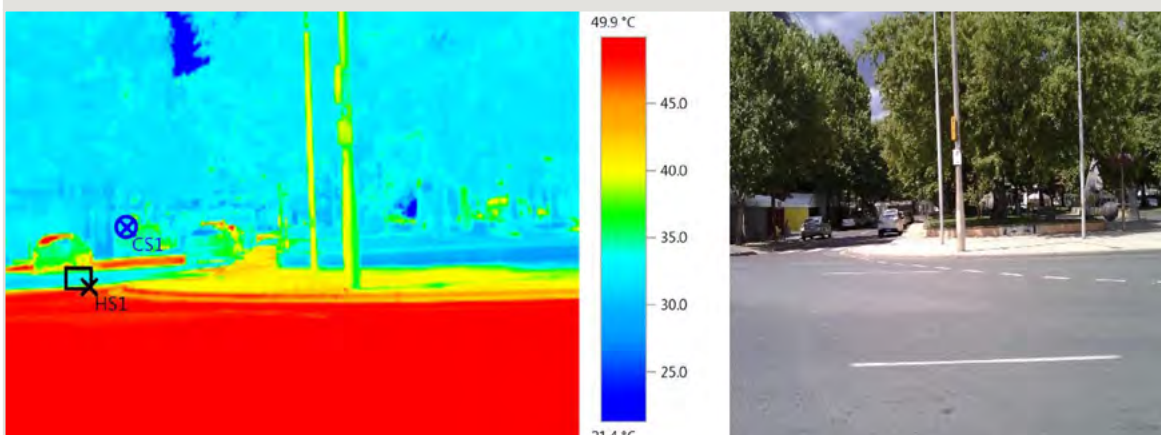


Figure 11: Canberra's metropolitan area high tree cover 2014

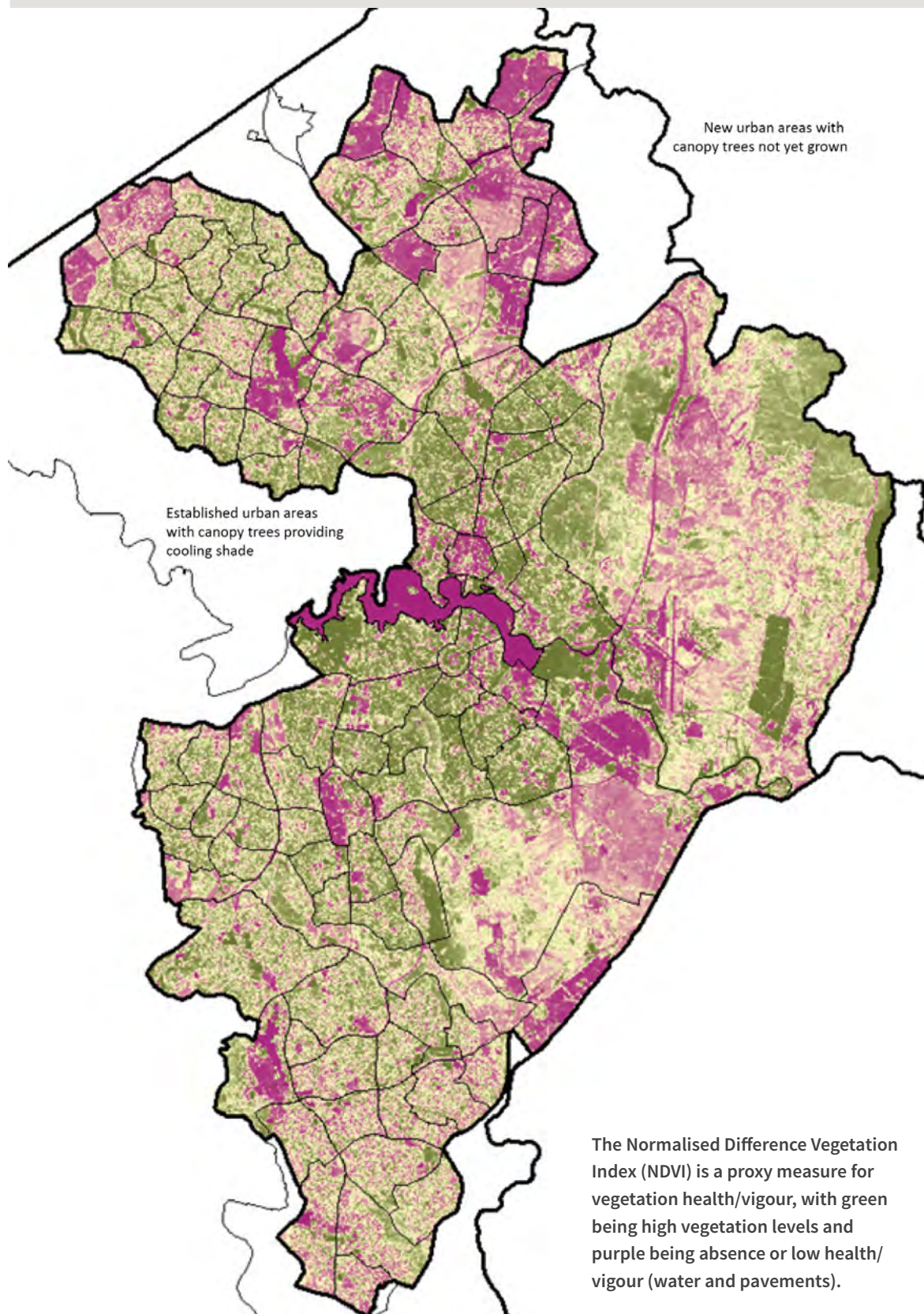
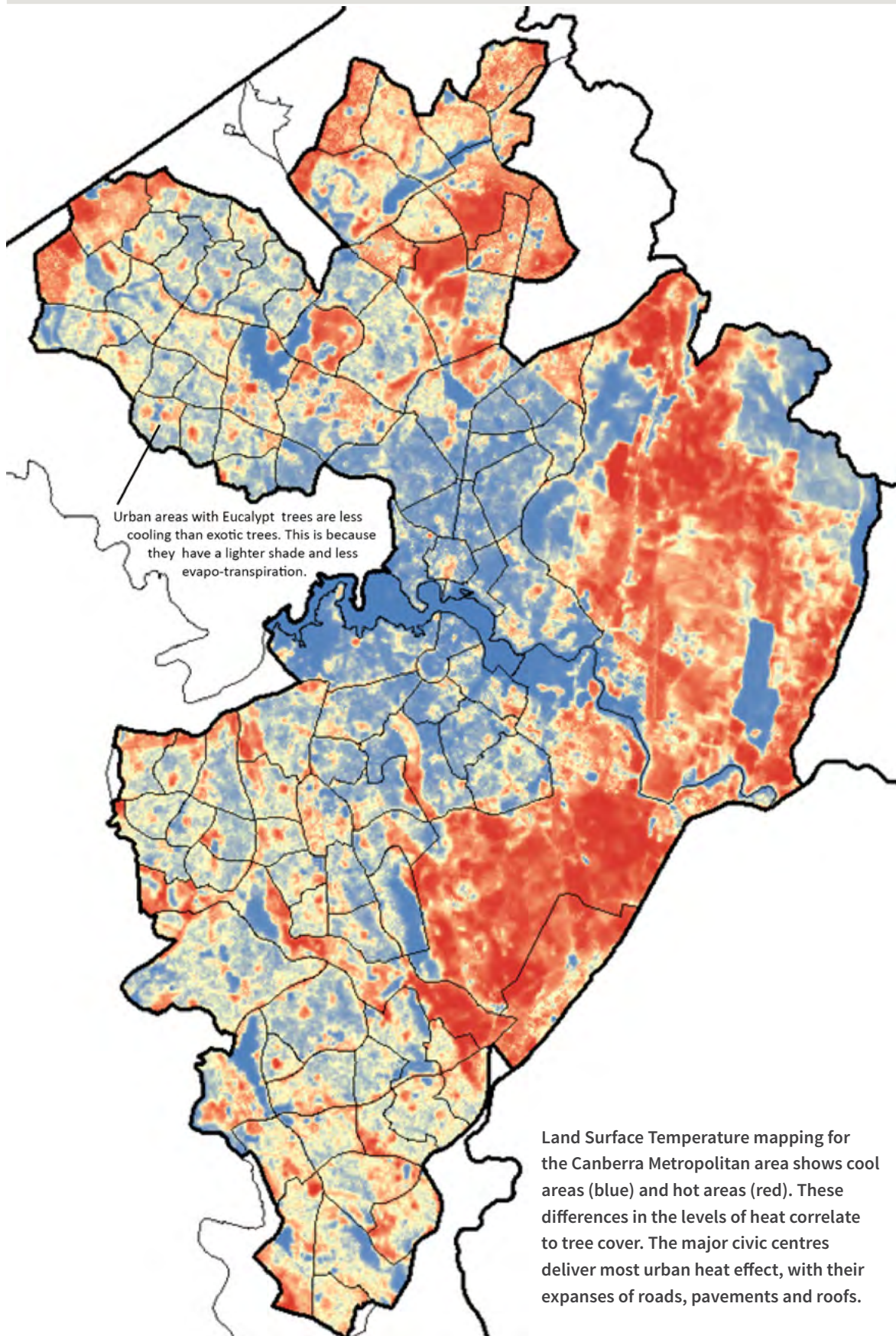


Figure 12: Canberra's metropolitan area land surface temperatures 2014



The coolest little city – reinvesting in living infrastructure

Canberra's open space system of verges, parklands and waterways provide amenity and places for travel, recreation and play. These places also provide environmental services such as clean air, clear water, healthy soils, shade and cooling. The integration of 'green' vegetation and public spaces, 'blue' stormwater and waterways and 'grey' soils, surfaces and structures is commonly called 'living infrastructure' or 'green infrastructure'.

Living infrastructure not only increases thermal performance and saves energy costs, but can also detain stormwater and add to the city's biomass. Bringing more vegetation into cities has multiple micro-climatic, social and economic benefits, including increases in personal wellbeing through increased connections to the natural environment (the biophilic city²²). The beneficial outcomes from living infrastructure include:

- a cooler city and reduced risk of urban heat
- enhanced amenity of public open spaces with improved air quality and outdoor comfort
- increased use of stormwater to irrigate the landscape and recharge groundwater
- reduced bushfire risk
- improved water quality in lakes and waterways with healthier aquatic ecosystems
- increased wildlife habitat in urban areas.

The natural and planted trees in our gardens, parks and bushland reserves are living assets that we value highly for their amenity and habitat values. However, heatwaves and drought will adversely affect their ability to provide their environmental services and maintain their amenity. During a drought, trees and other vegetation can become fire fuel 'wicks' that take bushfire further into the city; therefore the design and maintenance of open spaces needs to be both water wise and fire wise.

The ACT Water Strategy: Striking the Balance (2014) recognises the need to ensure there is sufficient water in the urban landscape to sustain vegetation, provide amenity and ameliorate climate risks.

The city's trees are an integral part of Canberra's living infrastructure and an evaluation is needed of the urban forest for its vulnerability and/or resilience to the projected climate.



American Elms in Grant Crescent Griffith are a spectacular part of Canberra's urban forest. This living infrastructure makes this a desirable place to be day and night and in every season

The 2020 Vision report in 2014 identified that Canberra has the greatest tree canopy cover of all capital cities in Australia, but the trees are not evenly distributed across all districts. This information builds on the recent urban forest audit, which can inform a revised Urban Forest Plan to direct future strategies to sustain healthy growth, including the provision of water and the enhancement of soil.

Access to parks with shade-giving trees is important for human health and wellbeing. Therefore, as the city's population density increases, the provision of quality open spaces becomes more important. In addition to high-use urban parks, Canberra's national capital open space system is a metropolitan scale framework that provides the landscape setting for the city. People experience this interconnected system in their daily lives, whether as the backdrop to views and vistas in travelling around, or in recreational visits to reserves.

While native trees will continue to provide canopy and wildlife habitat in Canberra, the use of deciduous trees is increasingly important. Their dense, shady summer canopy and higher evapotranspiration rates, which enhance humidity and cooling of the air below them, make them particularly useful for pedestrian areas and parklands. An assessment of climate impact resilience of the parks and their vegetation on public land (part of the urban forest) is needed to guide the planning, design and renewal of Canberra's landscape.

This is not only important for ameliorating the climate, it is a key strategy for economic resilience. Having Canberra widely known as the bush capital and a garden city is a drawcard to attract tourists and those in academia or researchers who choose to live in Canberra.



ASSESSMENT SECTOR 3: SETTLEMENTS AND INFRASTRUCTURE

Potential risks and impacts

- The amenity, character and liveability of Canberra are at risk from the impacts of climate change. The man-made landscape setting for the city, with its open space system and urban forest, needs significant investment to remain healthy and resilient. Over time the depletion of soil moisture would cause decline in health and amenity of public and private open spaces.
- There are no current mechanisms to make Canberra's existing buildings climate wise, but the government is considering raising construction standards at the urban edges.
- The property insurance industry recognises increasing climate risks and may increase premiums.
- The increasing urban density in some parts of the city can be accompanied by increasing urban heat, exacerbated by the warming climate.
- There is increased potential for physical and mental health issues associated with climate induced pressures on agricultural business.

Actions completed or underway

- To achieve a liveable 'city for all seasons' and enhance resilience of the public spaces, the revision of the Territory's regulations, plus preparation of a living infrastructure strategy, is proposed.

- The urban forest, already facing health and longevity issues, will be under further pressure from a warming climate. The review of the ACT's Design Standards for Urban Infrastructure (including Tree Species List for Canberra) is to include climate resilience considerations.
- Climate risk assessments of ACT Government assets, operations and services are commencing.
- Some Canberra households and commercial developers are building to higher sustainability standards. To maximise voluntary change towards climate-wise building design and construction, peak industry bodies are collaborating with government and academia to determine the desirable changes for new and existing buildings.
- Peak industry bodies continue awareness raising, training and up-skilling of practitioners.
- The ACT Government has introduced a 25% remission on Lease Variation Charges for commercial buildings that are built to the Green Building Council of Australia's 'Greenstar' standards and for residential buildings constructed at higher NABERS standards.
- Tourism agencies and non-government organisations in the region are fostering peri-urban food production and local markets.
- The ACT Government continues financial assistance to create community gardens.

Emerging issues and residual risk

- Implementing revised standards for building design and construction in the bushfire prone areas, based on Bushfire Attack Level assessments and new national construction codes, with a phased approach for the application of new standards, codes and regulations.
- Awareness-raising to encourage climate-wise development and alteration of existing and new buildings by owners and developers. Achieving sufficient knowledge and up-skilling of building and construction practitioners, plus built environment design professionals.

ACT Government has introduced a 25% remission on Lease Variation Charges for commercial buildings

- To encourage active travel, the off-road walking and cycling networks are being improved for connectivity. Under a warming climate, provision of shade and water needs to be part of the upgrade to improve safety and function.
- Canberra's existing living infrastructure needs to be well managed and sustained into the future. New areas need to be supported by adequate living infrastructure targeted to respond to climate impacts, making the city safer and more resilient.
- As a principle, a Living Infrastructure Strategy could address achieving a significant increase in the level of canopy cover in public open spaces where appropriate.

Desired outcomes

- Canberra is still the 'bush capital' with wildlife reserves and the national capital open space system through the city. The threat from bushfire is managed by: appropriate infrastructure and management and maintenance regimes along the urban edge; appropriate landscape treatment; and ensuring adequate water in the urban landscape.
- Canberra's urban open spaces are designed and maintained to be climate wise and to provide year round amenity, a city for all seasons. The urban forest will be watered with harvested stormwater wherever feasible.
- Canberra is Australia's leading city for active travel with its routes for off-road walking and cycling providing travel to destinations through a safe, shady and pleasant environment.
- Canberra's major centres and higher density urban areas do not make city heat worse because public and private sectors take active preventative measures.
- Living infrastructure is used to keep the urban environment resilient and minimise climate impacts.
- Canberra buildings are climate wise, using contemporary building materials and techniques and reducing heat by introducing lighter coloured materials and surface treatments.
- Urban and peri-urban food production is increasingly adopted by home-owners and supported by housing estate developers and unit corporations.

The recently released Minister for Planning's Statement of Planning Intent (2015) identifies the multiple synergies possible in developing Canberra in accord with the existing strategic policies. The priority short-term climate adaptation actions for ACT Government are:

Actions by end 2017

10. Climate impacts and planning

Introduce mandatory requirements to planning for new estates in Territory Plan and Sub-division guidelines and design standards that reflect leading practice with regard to future climate change scenarios.

11. City resilience

Increase built environment resilience and amenity by:

- a. reviewing design standards for public infrastructure to ensure climate change adaptation is considered
- b. introducing requirements to reduce heat absorption of building surfaces and pedestrian pavements.

12. Climate wise buildings

Develop ACT region specific climate wise guides for buildings and estate planning.

Actions by end 2018

13. Sustainable procurement

Introduce mandatory minimum sustainability requirements for ACT Government capital works and asset upgrade projects to ensure assets and services will be climate wise.

14. Tree-lined pathways

Add to the Strategic Cycle Network Plan a program of shade tree planting for walking and cycling routes.

15. Living infrastructure

Develop and implement a strategy to enhance living infrastructure in the Territory, including targets for urban tree canopy cover.

Actions by end 2020

16. Building codes

The Government will consider whether current requirements in building codes adequately reflect projected climate change impacts on residential and commercial buildings.



3.5 SECTOR 4: WATER

‘A sustainable water supply used efficiently provides for the optimal mix of supply options, encourages efficient use of water and is resilient to climate variability. It supports the social, economic and environmental needs of the ACT community.’ ACT Water Strategy 2014-44 Striking the balance, ACT Government

Climate change impacts

Recent climate modelling indicates total average rainfall in the ACT may not significantly change in the near future, but changes to the seasonality (when it falls) is likely to result in drier conditions in the winter and spring months. There will be continuing high variability of rain in any given month, however warmer temperatures are expected to increase evaporation, contributing to more frequent and more severe droughts.

The warming temperatures and increases in evaporation, accompanied by an increase in the rates of water use by plants and animals, means the ground will become drier. The consequences will be reduced regular in-flow of water into streams, ponds and lakes and, with drier soil, the health and growth of plants and soil organisms will be affected.

The water resources for both drinking (potable) and non-potable uses will be under pressure in a warming climate due to increased consumption in hotter weather. This will be compounded by an expanding population.

The projected increasing frequency and severity of extreme storms is likely to impact on both quantity and quality of water in dams, rivers, lakes, ponds and wetlands. This is because intense rain events have higher rates of stormwater run-off compared to gentle rain, which soaks into the ground (infiltration). Fast stormwater run-off can have higher pollutant loads, which combined with warmer temperatures, increase the likelihood of algal blooms and the need to do more to improve water quality. Intense rainfall also means the potential for more flash flooding and erosion in waterways.

ACT Water Strategy

The ACT’s waterways flow into the Murrumbidgee River, which is part of the Murray–Darling Basin. The ACT has obligations under the Murray–Darling Basin Plan to maintain its environmental assets and ecosystems. The ACT manages its water resources through a framework of set environmental flow guidelines. The ACT has the target to safeguard downstream use and environmental water needs so the water entering the Murrumbidgee River is of no lesser quality than when it entered into the ACT.

The ACT Water Strategy 2014–44: Striking the Balance²³ (2014) sets out how the ACT Government will manage the Territory’s water resources over the next 30 years to meet urban and environmental needs, and regional responsibilities. The strategy covers catchment management, stormwater and flood management, water supply and services, water for the environment, recreational water use and public health. The strategy aims to deliver security of water supply, improved water quality and catchment health, and a ‘water smart’ community.

The strategy’s implementation plan for the first five years is underway with three key outcomes: healthy catchments and water bodies; a sustainable water supply used efficiently; and a community that values and enjoys clean, healthy catchments.



Dickson Wetland



Rain gardens in Crace

Ecosystem health

The ACT's aquatic, riparian and wetlands ecosystems will experience significant pressures from climate change. These ecosystems will have to adapt to both fluctuating water availability and to a changing and more variable flow regime. Potential consequences include insufficient water for fish spawning at critical times and increased likelihood of weed invasion.

Drier conditions may lead to loss of riparian systems, with disconnected pools of water limiting the ability of plants and animals to disperse and reproduce. Combined with warmer water temperatures, this could potentially cause the destruction of entire fish populations because certain fish can only spawn within narrow temperature ranges or habitats. Small bodies of water may experience fish 'kills' from poor water quality, particularly where there are low levels of dissolved oxygen.

Aquatic, riparian and wetland ecosystems in urban and non-urban areas provide many human amenity and recreation opportunities. Other benefits include local temperature buffering, flood and erosion protection and water quality improvement by filtering pollutants. Greater understanding of the processes of aquatic ecosystems and the climate-related threats is required to ensure they remain functional while providing this range of services.

Water Sensitive Urban Design (WSUD)

In 2009, the ACT Government introduced the WSUD General Code into the Territory Plan to encourage reduced use of mains water, improve water quality and manage stormwater flows in urban areas. WSUD also plays a key role in reducing the impacts and risks from storms and flash flooding. The WSUD Code includes targets to reduce per capita potable water use by 25% from the entire network. This will be achieved through a 40% water use reduction target in all new urban development (when compared to 2003 developments), including new urban renewal projects.

A review of the WSUD code, released in August 2014, highlighted the importance of WSUD in managing urban stormwater. An updated WSUD Code and associated guidelines are currently being developed. This work, when completed, will directly contribute to the living infrastructure strategy.

WSUD Code includes targets to reduce per capita potable water use by 25%

Murray-Darling Basin and the Basin Priority Project

The water resource allocated to the ACT is a finite amount under the Murray–Darling Basin Plan, 2012. Within this ‘limit’, the ACT’s water use is dependent upon capacity to capture and store water; rate of use (extraction) and the opportunity to acquire water rights from outside the ACT. For example, the government recently launched the Inner North Reticulation Network to capture stormwater for later re-use and to also enhance water quality and reduce dependence on potable water.

Under the ACT Basin Priority Project, the Australian and ACT governments are funding up to \$93.5 million for improvements in water quality in the ACT’s waterways, which will impact downstream in the Murrumbidgee River. This project is focussed on six priority catchments and is to be completed by 2019.

The initial phase of the project includes monitoring and assessment of water quality and the effectiveness of existing water quality infrastructure, leading to a feasibility investigation for works that most effectively improve water quality outcomes. The second phase will see the construction of the infrastructure (see www.environment.act.gov.au/water/act-basin-priority-project). The Territory is also considering options to improve water quality through the use of gutters and drains, including community behaviour change.

Australian and ACT governments are funding up to \$93.5 million for improvements in water quality in the ACT’s waterways



WaterWatch volunteers taking water samples

Catchment approach

Taking a regional approach is necessary for the water sector to address the water quality obligations under the Murray–Darling Basin Plan.

An ACT priority is to reduce the amount of nutrients and other pollutants entering rivers, lakes and aquifers, particularly from urban areas. The ACT Government is taking a whole-of-catchment management approach to water quantity and quality issues, with involvement of the community through catchment bodies, the Australian and NSW governments, Icon Water and surrounding local governments.

This work is being supported by improved governance arrangements with the establishment of the ACT and Region Catchment Management Coordination Group under the *Water Resources Act 2007* to provide a forum for stakeholders to promote better coordination and alignment of effort in the ACT and region. A priority for the Coordination Group is to prepare an ACT and Region Integrated Catchment Management Strategy to guide its work.



ASSESSMENT SECTOR 4: WATER

Potential risks and impacts

- Insufficient reliability of seasonal rainfall brings drought like conditions resulting in unirrigated city landscapes declining in health and amenity. In declared droughts, water restrictions for irrigation of public and private land result in further loss of amenity plus increased fire risk.
- Stormwater harvesting and reuse opportunities not realised, leading to increasing use of potable water for irrigation and possible cost increases.
- Protracted drought means insufficient water for environment needs and aquatic systems decline, with Canberra's lakes increasingly unfit for human contact and use.
- Warmer temperatures provide more suitable conditions for a greater range of insect and water borne illnesses and diseases.

Actions completed or underway

- ACT's suite of policies and action plans for potable and non-potable water has taken climate impacts into consideration. Flood risk management planning is also underway (including stormwater capacity and infrastructure vulnerability) for public and private land that incorporates climate impacts.
- ACT Government has committed to reduce per capita water use by 25% in Canberra by 2023 from 2004 levels, and 40% in new developments and renewal (including extension and refurbishment). Noting that, whilst these are being met, the challenge will be to continue to meet targets as climate pressure increases.
- An ACT and Australian government funded Basin Priority Project has commenced to address water quality issues in the Territory under current and future climate scenarios.

- An ACT Water Resource Plan is currently under development to manage the ACT's water resources under the sustainable diversion limit set for both surface water and groundwater resources under the Murray–Darling Basin Plan.
- To achieve more strategic and efficient investment and coordination of effort, an ACT and Region Catchment Management Coordination Group has been established.

Emerging issues and residual risk

- Water sensitive urban design needs to be integrated as part of living infrastructure into the design and development of new (greenfield) and urban renewal (brownfield) areas to detain, retain and re-use stormwater and to protect aquatic ecosystems. This is increasingly important under climate change.
- New stormwater management and infrastructure requires new standards for design with investment for construction and commitment to maintenance and operations.
- Upgrading of watering for public open spaces using sub-surface stormwater systems and drip irrigation requires new standards for design investment in construction and commitment to ongoing management.
- To reduce the flood risk and reduce property insurance premiums, buildings and infrastructure may need to be designed and constructed to cope with intense rainfall and localised flooding.
- Alternative management and funding models are needed to recognise, publicise and fund water sensitive urban design and smart stormwater systems, including stormwater harvesting.
- Water needs that are not specifically allocated under the Murray–Darling Basin cap are met through the inter-state water trading market.

Desired outcomes

- The ACT has water security through investment in infrastructure, water trading and use of stormwater.
- Water and aquatic habitat monitoring continues with greater involvement of volunteers and landholders in regional water catchment management.
- Governance mechanisms in catchment and water management ensure water quality improvements.
- Priority public spaces and sporting facilities are effectively and efficiently watered to ensure amenity.
- The water cycle is visible in the landscape, with wetlands and lakes throughout the city being key attractions for recreation as well as wildlife habitat, while dependent ecosystems are resilient.
- Through education and awareness the community's behaviour ensures water is conserved and used efficiently.

Using WSUD means mimicking nature with areas of slow flow and cascades to change level. This investment in living infrastructure allows water to be expressed in the landscape and water to be cleaned naturally.



Addressing the emerging issues and working towards the desired outcomes at the catchment scale are largely enabled through the current strategies and plans. However, the best way to ameliorate city heat and retain urban liveability is to keep urban landscapes green and healthy. To keep water in the landscape under a warming climate with extreme events of drought and intense rain means increasing the detention, capture and use of stormwater. This needs to be across all districts of the city, in greenfield developments and urban renewal and intensification projects.


The priority short-term climate adaptation actions for ACT Government are:

Actions by end 2017

1. **Water for life**
Evaluate stormwater infrastructure and initiatives for potential further expansion of:
 - a. stormwater irrigation of priority public open spaces
 - b. mitigation of nuisance flooding through increasing on-site detention and infiltration
 - c. protection of aquatic habitats and prevention of waterway scouring.
2. **Integrated Catchment Management Strategy**
Ensure the plan for the catchments in our region is completed and being implemented.

Actions by end 2019

3. **Basin Priority Project**
Complete the construction of approved water quality improvement projects incorporating new approaches to catchment 'treatment trains' in six priority sub-catchments.



Natural Resources and Ecosystems

3.6 SECTOR 5: NATURAL RESOURCES AND ECOSYSTEMS

“Evidence over the last decade has shown that ecological change in response to climate change is unavoidable; it will be widespread and it will be substantial...the potential is for between 30% and 50% change in species composition over most parts of the ACT by 2030 and up to 70% change²⁴ by 2070”. CSIRO 2011 Implications of climate change for biodiversity²⁵

Climate change impacts

The magnitude and extent of a changing climate across Australian landscapes is a major issue for conserving biodiversity and continuing provision of ecosystem services.

In our region, the increased number of hot days and heatwaves, decreased number of frost days and changes to rainfall patterns will impact on species and ecosystems in different ways. CSIRO research indicates that, in certain scenarios, up to half the species in our region could change by 2050. Knowing how best to respond to these changes is limited by our ability to predict specific ecological changes.

Other threats and limits to adaptation

Climate change will likely exacerbate many existing threats to local biodiversity. For example, stressed plant and animal communities are more susceptible to decline from invasion by weeds and pests, attack by disease and/or damage from catastrophic bushfires. The form, function and/or composition of natural ecosystems will evolve under climate change, and some species may not survive. The primary aim of human intervention in the adaptation of natural systems is to avoid transformation to undesirable states where critical ecological functions degrade and ecosystems are lost.

Planning for resilience

We need to plan and act now to help biodiversity transition to a warmer and drier climate.

Current implementation of resilience-based approaches that minimise threatening processes, such as weeds, pest animals, disease and inappropriate fire regimes, is designed to improve nature’s capacity to adapt to future change. The ACT Nature Conservation Strategy 2013–2023 advocates ‘whole of landscape’ approaches that are tenure blind, cross-border programs to enhance resilience through improvements in habitat condition and connectivity. The ACT Biosecurity Strategy 2015–25 addresses threats to both biodiversity and productive landscapes.

Participatory workshops on biodiversity adaptation pathways identified the importance of:

- i. clarifying ‘tipping points’ or critical thresholds for decision making under climate change
- ii. adopting adaptive management (learn-as-you-go) approaches to help evaluate and modify management actions and investment priorities over time. Furthermore, incorporation of traditional land management practices, that is cultural burns, can help current land managers draw upon lessons learned through historical changes in climate.

CSIRO research indicates that, in certain scenarios, up to half the species in our region could change by 2050

Potential risks and impacts

- The rate of projected climate change threatens the ability of species and ecosystems to adapt. The magnitude and extent of change across ACT landscapes is unknown, which limits our ability to predict potential ecological changes.
- Some species will decline and become rare or extinct as they cannot accommodate the frequency or severity of extreme events such as heatwaves and bushfires.
- Climate change adds to the existing pressure on habitats from human land management.
- Competition from non-native species may intensify, causing decline of native species and/or ecosystems.
- The ecosystems that adapt are likely to have a different composition of flora and fauna and may have different functions and structure.

Actions completed or underway

- To improve conservation effectiveness under a changing climate, the knowledge and capacity of people and organisations involved in biodiversity management across public and private lands is being strengthened by government programs, including the Conservation Effectiveness Monitoring Program.
- To enhance the resilience of natural landscapes across the ACT and surrounding NSW, extensive habitat rehabilitation and enhancement of ecological connectivity is being undertaken by governments, catchment groups, Greening Australia, ParkCare, rural landholders and community volunteers.
- To improve the monitoring and risk management of invasive species, new tools and strengthened partnerships with NSW and communities are being applied.
- The ACT Nature Conservation Strategy 2013–23 sets priorities for conservation action, and the ACT Biosecurity Strategy 2015–25 prioritises threats to both biodiversity and productive landscapes.

Emerging issues and residual risk

- The adaptive capacity of ecosystems is dependent upon improving their resilience by minimising negative interactions from other stressors such as weeds, pest animals, disease and inappropriate fire regimes.
- Improvements in monitoring and forecasting of climate change impacts for species and ecological communities are needed to inform risk assessments and investment priorities for conservation.
- Appropriate management of nature reserves and rural leases is fundamental to landscape-scale conservation of biodiversity. Limiting management focus to only nature reserves is insufficient under climate change. For example, potential climate refugia may occur on public or private lands and, moving forward, these refugia need to be identified, protected and managed.
- Ex situ conservation actions such as translocations, captive breeding and seed banking could be considered for the most vulnerable threatened species where the feasibility and costs justify that approach, and it may assist ecosystem function.

ACT staff monitor the endangered Grassland Earless Dragon population at Jerrabomberra East Nature Reserve





The Murrumbidgee River log jam near Tharwa village is an example of working with nature to re-create living infrastructure to improve habitat (in this case for fish).

Desired outcomes

- All land managers work collaboratively to develop appropriate strategies to identify, protect and manage potential climate refugia across public and private lands in the ACT and region.
- Long-term planning and risk-based decision making increases the capacity of governments and community stakeholders to adaptively manage landscapes.
- People and organisations have the capacity and skills to help biodiversity adapt to change.
- The resilience of native species and ecosystems across the region is supported by a cross-tenure and cross-border approach to landscape conservation.
- There is targeted investment in both landscape restoration and species recovery under climate change.
- Appropriate land management practices ensure continuation of critical ecosystem services for people (clean air, clean water, healthy soils).

The ACT is well placed to take leadership at the landscape scale in our region to ensure sufficient knowledge by all land managers to sufficiently and consistently assist nature conservation and lead by example within the Territory.

The ACT Government priority short-term climate adaptation actions:

Actions by end 2017

20. Biodiversity conservation

At a landscape-scale promote better collaboration to:

- enhance the resilience and adaptive capacity of our ecosystems including through improved habitat condition and connectivity
- identify, protect and manage potential climate refugia across the region.

21. Safeguarding species

Undertake and facilitate targeted interventions to safeguard species under climate change.

22. Caring for land and water

Improve:

- knowledge and understanding of land managers about climate impacts and adaptation actions
- coordination of pest animal and plant control to contribute towards increased landscape resilience under climate change
- monitoring of climate impacts on ecosystems in our bioregion.

“Feral animals are the bane of every park management service in the country”
ACT Parks and Conservation Director,
Daniel Iglesias

4. INTEGRATION AND INNOVATION



Ragnarok. Entry by Paul Cowled into the Challenge Accepted climate change competition



4.1 INTEGRATION

To ensure coordination across government, and to influence and inspire change to climate change adaptation, actions must be specifically designed to integrate and reach out to business and the community. A suite of 'integration actions' is described below.

Awareness and information

Adapting to our warming climate will require actions across the entire local community. The government knows that the best chance we have of maintaining a productive and liveable city into the future, at lowest cost, is to work with the community, stakeholders and key partners to deliver the required changes.

It is anticipated the community will increasingly seek information on practical measures to increase their resilience and to refer to government as one of the key sources for this advice. Equally, the government will continue its efforts to engage effectively with the community.

The existing work of government needs to continue, through existing plans and policies such as the Healthy Weight Action Plan, but also by mainstreaming adaptation in the daily work of all parts of the ACT Government.

Therefore, an immediate action for all ACT Government agencies is to ramp-up communications and publicise what is being done and how the community can contribute.

Our community, individuals, businesses and organisations require more knowledge and awareness to enable them to know what to do to be more prepared for a changing climate. Therefore, work under the Community Engagement Strategy on Climate Change can refocus on this need and address the desired outcomes.

In delivering the Government's Community Engagement Strategy on Climate Change²⁶ sources of information and opportunities for community engagement include:

- the Actsmart sustainability portal (www.actsmart.gov.au), a central hub for the community providing information on climate change, energy and sustainability, including local environment-related events
- the Environment and Planning Directorate web page (www.environment.act.gov.au), where detailed information on climate change policy is available to the public and stakeholders
- increasing use of interactive media, including YouTube, Facebook and Twitter and enhanced coordination of digital media across government
- knowledge groups including the ACT Climate Change Council, the body advising the government on local climate change matters, and the city's universities, Canberra Institute of Technology and research institutions in close proximity, including CSIRO.

ACT Government staff partaking in a 'Healthy You' lunch time walk



Action by end 2017

23. Awareness raising

Achieve more effective sharing of information across all stakeholders through sustained promotion and engagement efforts, including providing periodic updates on local climate impact assessments and emerging research outcomes.



Actsmart workshop

Working in partnership

To affect meaningful and sustainable adaptation action, collaboration is required as “successful adaptation activities require the cooperation of a wide range of organisations and individuals”.²⁷ Furthermore, in the Australian context, evidence suggests that “for adaptation to be successful collaboration will have to become the new standard model for governance in Australia”.²⁸ Governance in this respect is not seen as the institutions/instruments of government per se, but more the arrangements and processes for steering and managing a new trajectory that is systemically viable in a climate-changing situation.²⁹

Seeking collaboration between the public, private, civil society and research sectors and the wider community for adaptation action is also consistent with the national Climate Change Adaptation Framework (2007), which states, “There is an important role for business and the community in addressing climate change risks, and governments will pursue a partnership approach to adaptation to manage risks and identify opportunities”.³⁰

The impetus for collaboration is a vested interest among the participants in understanding and resolving the challenges and opportunities presented by a changing climate. Specifically, participants are drawn together by a ‘shared responsibility to act’.³¹ This approach sees the collaborators as active participants in a value chain of activities ranging from exploration and discovery of issues/opportunities and the resultant conceptual design of responses, through development and delivery to evaluation and future planning. The participants bring to these processes diverse yet relevant knowledge, skills, resources and values specific to their sector, organisation and/or location.

In practice, this form of collaboration requires a ‘true’ partnership approach. True partnerships are about shared agendas as well as combined resources, risks and rewards. They are voluntary collaborations that build on the respective strengths and core competencies of each partner, optimise the allocation of resources and achieve mutually beneficial results over a sustained period. They imply linkages that increase resources, scale and impact.³²

The ACT Government’s approach is to work in partnership to ensure we all have the information and support we need to play our part and to share in the benefits of a city that is responding to, and adapting to, a warming climate. Through working in partnership we will also engage across the border with other governments in the Canberra region³³ as well as the Australian Government.

Action by 2017

24. Sustainability alliance

Build on existing engagements with peak bodies and local knowledge brokers to create a cross-sector alliance providing an efficient and effective vehicle to:

- a. share climate change and sustainability information across diverse groups to build understanding, support informed decision making and inspire action
- b. seek input on relevant ACT policy and program issues
- c. facilitate collaboration between sectors on challenges and opportunities of mutual interest.

4.2 INNOVATION

As we take adaptation actions we may be able to create related economic opportunities if we are proactive in identifying them and support their development. These opportunities may be in the fields of training and education; new design or materials in the built environment; enhanced environment and natural resource management practices; or new technologies, products, and businesses.

Adaption to a changing climate is not just a priority for government; adaptation strategies must also include the private sector. Adaptation strategies present opportunities for private businesses to gain competitive advantage through increasing demand for products or services. However, governments need to act first by providing relevant information as a basis for private sector action.

The ACT Government has demonstrated that a transition to a low carbon society can not only be good for the environment but also result in tangible benefits to our local economy.

In the procurement of renewable energy for the city, interested companies had to address the Local Investment Framework.³⁴ This has meant that in addition to the benefits of increased engineering, consulting and construction jobs, a series of local investments have been secured, including:

- wind farms managed from the ACT in new corporate and operations hubs
- new Pacific-region headquarters for private companies established in the ACT
- a new Renewable Energy Skills Centre of Excellence at Canberra Institute of Technology
- a new Masters course in wind energy at the Australian National University
- a Renewable Energy Innovation Fund, contributed to by industry.

Looking at the possibilities that adapting to the changing climate will bring can generate innovative ideas that can become the basis for new jobs and doing things differently.

Artist's impression of the proposed Royalla Solar Farm



Action by end 2017

25. Climate adaptation innovation

In projects across the city for new or existing infrastructure, initiate the creation and/or provision of trials to innovate in:

- a. materials, surfaces, structures, products or methods
- b. maximising capture and reuse of stormwater
- c. making public realm landscape treatments more climate resilient.

26. Climate adaptation training and education

Collaborate with vocational and academic institutions and peak bodies on new or innovative delivery of:

- a. programs for education, training and up-skilling of builders and trades people
- b. continuing professional development for Canberra and region built environment professionals.

The ACT's **second** wind auction will power up to **106,000** Canberra homes using **clean, sustainable** energy

ACT Government #CBR

5. REPORTING PROGRESS

Shaded walk ways in the city centre



5.1 MONITORING AND REPORTING

The ACT Government receives regular reports from agencies responsible for existing policies and strategies, for example on the Climate Change Action Plan 2 (AP2). An indication of progress is gained from monitoring and reporting on the implementation of the actions. It is proposed this existing mechanism be applied to include reporting progress on climate change adaptation.

When adopted, the Adaptation Strategy will have a set of actions that, along with other existing climate-related government work, will be routinely reported upon. This process is applied for the actions in AP2, with six-monthly updates provided to the government and made accessible online.

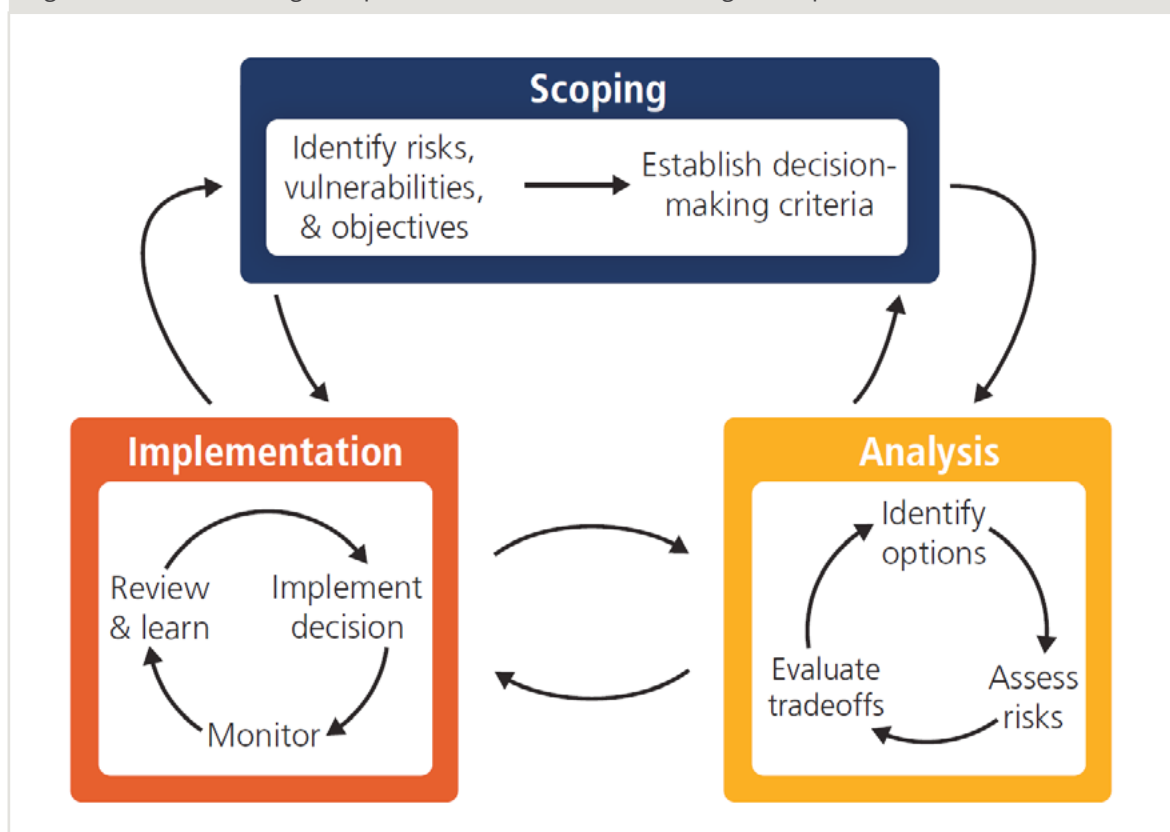
Additionally, each year the ACT Minister for the Environment tables a report in the Legislative Assembly on actions taken in responding to the challenges of climate change. This annual report, required under section 15 of the *Climate Change and Greenhouse Reduction Act 2010*, is where whole-of-government progress on the Adaptation Strategy will be reported.

Indicators for measuring resilience

To measure outcomes, the OECD 2015 publication *National Climate Change Adaptation: Emerging Practices in Monitoring and Evaluation*³⁵ states:

- The broad nature of adaptation demands a portfolio of monitoring and evaluation tools that, when combined, provide an overview of the larger resilience picture. The composition of the tools used will be most effective if they reflect domestic (place specific) circumstances and capacities.
- Climate change risk and vulnerability assessments can provide a baseline of domestic vulnerabilities to climate change against which progress on adaptation can be reviewed. If repeated, such assessments can also demonstrate how risks and vulnerabilities are changing over time.
- Indicators facilitate an assessment of progress made in addressing adaptation priorities. On their own, indicators cannot explain how the change came about. Reporting on, and using, indicators is resource intensive. They must therefore be carefully defined and, when possible, draw on existing data sources.

Figure 13: Climate change adaptation as an iterative risk management process



- Project and program evaluations can help identify what approaches to adaptation are effective in achieving agreed adaptation objectives and to understand what some of their enabling factors for success may be.

In addition to these factors, there are inter-relationships between scoping vulnerabilities, analysing response options and implementing actions (Figure 13). Furthermore, as changes in climate are not static, the approach to monitoring and evaluation needs to be adaptive over time. Given this, effective implementation of the Adaptation Strategy, and its ongoing monitoring and evaluation, will be an iterative process requiring periodic updates through to 2020. It should be noted that a review of the ACT’s climate change strategy and action plan is also scheduled for 2020

Actions by end 2017

27. Monitoring and evaluation framework

Measure resilience as an outcome of successful adaptation, including:

- a. establishing a longitudinal community survey (commencing in 2016 and repeated in 2020)
- b. measurable and repeatable indicators to evaluate resilience across community sectors.

Sub-national governments play a fundamental role to enhance coordination and cooperation across all levels of governments to boost policy coherence and to ensure concrete results of adaptation actions. In May 2015 the ACT joined the Compact of States and Regions (CoSR), whose purpose is to amplify the political commitments being taken by state and regional governments to avoid dangerous climate change. However, international support and collaboration for regional action on adaptation has been largely under explored.

In December 2015 the ACT Government joined the Regions Adapt initiative, a new global commitment to support and report efforts on adaptation at the state and regional level. This new initiative aims to establish a cooperative framework for regions to exchange experiences and best practices on their actions and

challenges when adapting to climate change. This will lead to improved conditions to achieve resilient territories and prevent irreparable situations and damage to respective economies, environments and citizens.

By participating in the Regions Adapt initiative, the ACT Government will collaborate, exchange knowledge and share best practice policy models with international partners that foster adaptation and resilience to climate change. This commitment includes to adopt or review plans on adaptation within two years, to implement an adaptation action in one of a series of thematic areas, and to report on the progress of the adaptation initiatives through the Compact of States and Regions platform.

This engagement will allow the ACT Government to ensure that adaptive practices adopted by the Territory represent international best practice and have the advantage of having been rigorously tested through other jurisdictions.

5.2 REVIEW

The actions presented in this strategy are designed to operationalise adaptation actions in the short term to 2020. However, adapting to climate change will be an ongoing and evolving process. While these actions are being implemented, ongoing consideration will be given to ways that adaptation measures can be further incorporated into ACT Government operations and the Territory as a whole.

This strategy will undergo a review in 2020, at which time climate change projections and international best practice will be further incorporated.

APPENDIX 1



New Acton community garden



Summary of climate change adaptation responses around the nation (not including coastal work).

TYPE OF ACTION	INITIATIVES
AUSTRALIAN GOVERNMENT	
Research and information exchange	National Climate Change Adaptation Research Facility (NCCARF) Phase two of NCCARF (\$8.8 million over 3 years (to 30 June 2017) was announced in October 2014. Three major focus areas: Australian Coastal Climate Change Adaptation Framework, Synthesis and Communication and Managing Adaptation Networks.
CSIRO and Bureau of Meteorology projections	National climate projections released in January 2015.
Natural Resource Management Adaptation Planning	'Cluster' adaptation planning for natural resource management with Catchment Management Authorities or peak Landcare bodies.
NEW SOUTH WALES	
Policy and planning	NSW 2021: A plan to make NSW number one sets goals and targets that support climate change action. Integrated regional vulnerability assessments (IRVA's)
Engagement and information	Adapt NSW web portal.
Research	New South Wales and ACT Regional Climate projections (NARCLIM) project covering NSW, ACT and most of Victoria. NSW Adaptation Research Hub with a \$2.75 m budget over three years.
QUEENSLAND	
Policy and planning	Climate adaptation strategy with a whole-of-government, whole-of-economy approach is due by the end of 2015.
Finance	Climate Change Adaptation Fund. Funding program with a budget of \$15 million over 3 years to support local governments develop coastal hazard adaptation strategies and pilot projects.
VICTORIA	
Legislation	<i>Climate Change Act 2010</i> . Includes: <ul style="list-style-type: none"> • development of a Climate Change Adaptation Plan every four years • requirement for government decision makers to take climate change into account when making specified decisions under other Acts. A review of the Act is due at the end of 2015.
Policy and planning	Victorian Climate Change Adaptation Plan (2013). Focussed on state level management of climate-related risks. A mid-term review is currently underway. A second plan is due by the end of 2016. Climate science for Victoria Update of information about observed changes in climate and a summary of projections currently underway.
Engagement	Climate Change Local Government Mentors Provides support and guidance to local government.

TYPE OF ACTION	INITIATIVES
SOUTH AUSTRALIA	
Policy and planning	<p>South Australia's Strategic Plan (2004, updated in 2011) – state level strategic plan, includes climate change considerations.</p> <p>Climate Change Vision — Pathways to 2050 (2014), a review by the Premier's Climate Change Council of policies and programs.</p> <p>Prospering in a changing climate: A climate change adaptation framework for South Australia (2012), has a related government action plan and is the mechanism to develop Regional Adaptation Plans (12 regions), work ongoing.</p> <p>New Strategy for climate change action due by the end of 2015.</p> <p>Climate Adaptation Planning Guidelines for Councils.</p>
Legislation	<p><i>Climate Change and Greenhouse Emissions Reduction Act 2007.</i></p> <p>Establishes Premier's Climate Change Council as an independent advisory body. Act to be reviewed by end 2015.</p>
TASMANIA	
Policy and planning	<p>Climate Change Action Plan, due by the end of 2015.</p> <p>Regional adaptation project.</p> <p>Regional and municipal risk assessments with adaptation plans are underway.</p> <p>Mitigating Natural Hazards through Land Use Planning Project, guidance in risk management and hazard adaptation.</p>
Engagement	<p>A 'one-stop-shop'.</p> <p>Sharing hazard information with the community.</p> <p>Disaster planning and preparedness for businesses provision of information to building capacity and resilience of small and medium-sized enterprises.</p>
WESTERN AUSTRALIA	
Policy and planning	<p>Adapting to our changing climate (2012).</p> <p>Climate change strategy focused on adaptation responses and recommended actions for key sectors.</p>

REFERENCES AND END NOTES

Lyneham wetlands



KEY REFERENCE DOCUMENTS

- ACT Government, 2014, ACT Water Strategy 2014-44: Striking the Balance.
- ACT Government, 2014, Adapting to a changing climate: Directions for the ACT.
- ACT Government, 2014, Community Engagement Strategy on Climate Change.
- ACT Government, 2014, Fact Sheet: Avoiding Heat-Related Stress.
- ACT Government, 2013, ACT Nature Conservation Strategy 2013-23.
- ACT Government, 2013, Triple Bottom Line Assessment Framework.
- ACT Government, 2012, ACT Planning Strategy: Planning for a sustainable city.
- ACT Government, 2012, AP2: A new climate change strategy and action plan for the ACT.
- ACT Government, 2012, Transport for Canberra: Transport for a sustainable city 2012-2031.
- Australian Government, 2007, National Climate Change Adaptation Framework.
- CSIRO and Bureau of Meteorology, 2015, Climate Change in Australia: Projections for Australia's NRM regions.
- CSIRO and Bureau of Meteorology, 2014, State of the Climate 2014.
- IPCC, 2014, Climate Change 2014: Impacts, Adaptation, and Vulnerability, Summary for policy makers.
- NASA, 2015, 2014 warmest year in modern record, <http://climate.nasa.gov/news/2221/>.
- NSW Government, NSW and ACT Climate Modelling Project (NARcliM)

USEFUL LINKS

- ACT Government climate change web site: <http://www.environment.act.gov.au/cc>
- IPCC website: www.ipcc.ch
- UNFCCC website: <http://newsroom.unfccc.int>
- Australian Government Department of Climate Change: www.climatechange.gov.au
- Tyndall Centre for Climate Change Research: www.tyndall.ac.uk
- UK Climate Impacts Programme: www.ukcip.org.uk
- Stockholm Environment Institute: www.sei.se
- UNFCCC on adaptation <http://unfccc.int/adaptation/items/4159.php>
- CSIRO Climate Adaptation Flagship: www.csiro.au/org/ClimateAdaptationFlagship.html
- Resilience Alliance: www.resalliance.org
- WeADAPT: <https://weadapt.org/>
- Eldis page on adaptation: www.eldis.org/go/topics/dossiers/climate-change-adaptation
- Community based adaptation exchange – Eldis: <http://community.eldis.org/.59b70e3d/>
- AusAid webpage on adaptation: www.ausaid.gov.au/keyaid/adaptation.cfm
- World Bank webpage on adaptation: <http://www.worldbank.org/en/topic/climatechange>
- OECD work on adaptation: www.oecd.org/env/cc/adaptation
- NCCARF website: <http://www.nccarf.edu.au/>

END NOTES

1. ACT Government. 2012. *AP2- A new climate change strategy and action plan for the Australian Capital Territory*.
2. The Climate Commission. 2016. *The Hottest Year on Record (Again)*. www.climatecouncil.org.au/hottestyear2015.
3. ACT Government. 2009. *People, Place, Prosperity – The ACT’s sustainability policy*.
4. Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability*. Ch 19 Conceptual framework for the identification and assessment of key vulnerabilities.
5. ACT Government population projections. <http://apps.treasury.act.gov.au/demography>.
6. CSIRO and Australian Government Bureau of Meteorology. *Climate Change in Australia*. <http://www.climatechangeinaustralia.gov.au/en/>.
7. NSW Government Office of Environment and Heritage. 2015. *Australian Capital Territory- Climate change snapshot*. www.environment.act.gov.au/cc/what-does-climate-change-mean-for-the-act.
8. Barnett G, et al. 2013. *Pathways to climate adapted and healthy low income housing*. National Climate Change Adaptation Research Facility, Gold Coast.
9. Cooper, D. 2015. *Extreme La Nina Events Set To Increase*. ABC Science 2015. Accessed online: <http://www.abc.net.au/science/articles/2015/01/27/4168376.htm>, Feb. 2015.
10. Blanchi, R, Lucas, C, Leonard, F and Finkele, K. 2010. *Meteorological conditions and wildfire-related house loss in Australia*. International Journal of Wildland Fire, vol. 19, pp. 914–926.
11. ACT Government. 2012. *Territory Wide Risk Assessment Report (Version 2 – July 2014)*.
12. Metropolis Initiative on Integrated Urban Governance. 2014. *No Regrets Charter: Principles for climate change adaptation in cities*.
13. Siegel P and Jorgensen S. 2011. *No-Regrets Approach to Increased Resilience and Climate Change Justice: Toward a Risk- Adjusted Social Protection Floor*. International Conference: Social Protection for Social Justice. Institute of Development Studies, UK 13–15 April 2011.
14. Scottish Building Standards Agency. 2007. *Design life of buildings: a scoping study*.
15. McLeod, Ron AM. 2013. *Report of the Inquiry into the Operational Response to the January 2003 Bushfires in the ACT*.
16. Council of Australian Governments. 2007. *National Climate Change Adaptation Framework*.
17. ACT Government. 2014. *ACT Emergency Plan*.
18. Jonathan A. Patz, MD, MPH; Howard Frumkin, MD, DrPH; Tracey Holloway, PhD; Daniel J. Vimont, PhD; Andrew Haines, MBBS, MD. 2014. *Climate Change: Challenges and Opportunities for Global Health*. JAMA Network, 312(15):1565-1580. Published online: <http://acmg.seas.harvard.edu/publications/aqast/articles/patz2014.pdf>.
19. Doctors for the Environment Australia. 2015. *No Time For Games: Children’s Health and Climate Change*.
20. Food Alliance and National Heart Foundation of Australia (Victorian Division). 2012. *Planning for food: Towards a prosperous, resilient and healthy food system through Victoria’s Metropolitan Planning Strategy*.
21. Misni A, Allan P. 2010. *Sustainable residential building issues in urban heat islands: the potential of albedo and vegetation*. University of Technology Mara, Malaysia, and Victoria University of Wellington, New Zealand.
22. Biophilia is a term popularised by Harvard University myrmecologist and conservationist E.O. Wilson to describe the extent to which humans are hard-wired to need connection with nature and other forms of life. <http://biophilicities.org/biophilicities.html>
23. ACT Government. 2014. *ACT Water Strategy 2014-44: Striking the Balance*.
24. CSIRO Climate Adaptation Flagship. 2011. *From Climate Change Challenges to Adaptation Solutions*. National Research Flagships Climate Adaptation.
25. CSIRO Land and Water Flagship. 2014. *Implications of climate change for biodiversity: a community-level modelling approach*.
26. ACT Government. 2014. *Community Engagement Strategy on Climate Change*.
27. Stockholm Environment Institute. 2005. *Objective Setting for Climate Change Adaptation Policy*.

28. Smith T, et al. 2008. *Systems Approach to Regional Climate Change Adaptation Strategies in Metropolises: Case Studies of Adaptive Capacity: systems approach to regional climate change adaptation strategies.*
29. Godden L, et al. 2011. *Water Governance in a Climate Change World: appraising system and adaptive effectiveness.* Water Resources Management.
30. Council of Australian Governments. 2007. *National Climate Change Adaptation Framework.*
31. The Partnerships Resource Centre. 2012. *Cross-Sector partnerships Formation – what to consider before you start.*
32. United Nations Foundation and World Economic Forum. 2003. *Public-Private partnerships: Meeting in the Middle.*
33. Adger W.N. 2001. *Scales of Governance and Environmental justice for Adaptation and mitigation of Climate Change.* Journal of International Development (#13).
34. ACT Government. 2012. *Renewable Energy Local Investment Framework.*
35. Organisation for Economic Co-operation and Development (OECD). 2015. *National Climate Change Adaptation: Emerging Practices in Monitoring and Evaluation.*

