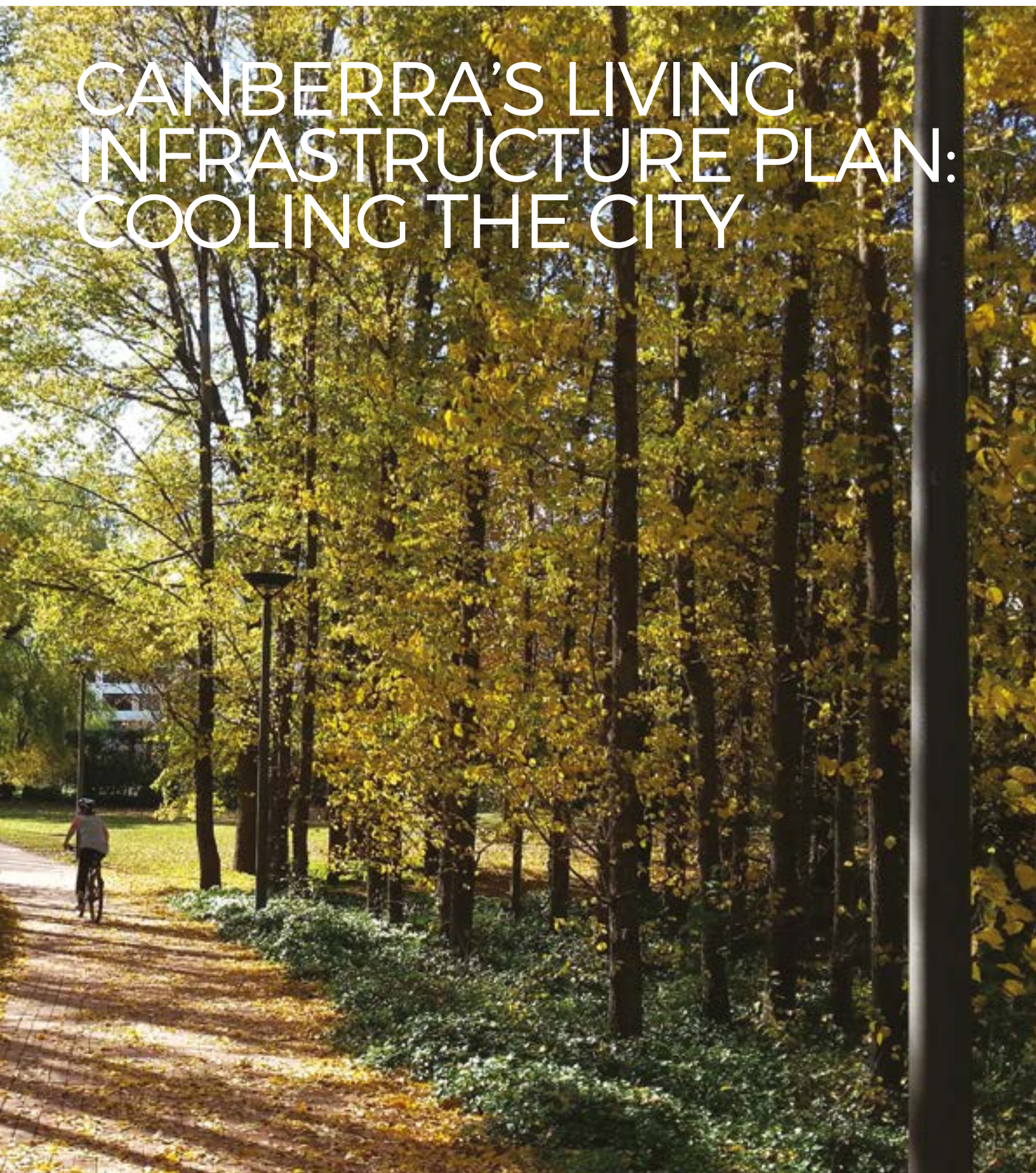


CANBERRA'S LIVING INFRASTRUCTURE PLAN: COOLING THE CITY



ISBN 978-1-921117-84-8

© Australian Capital Territory, Canberra 2019

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, Planning and Sustainable Development Directorate, ACT Government, GPO Box 158, Canberra ACT 2601.

Telephone: 02 6207 1923

Website: www.environment.act.gov.au

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, Planning and Sustainable Development Directorate at epsddcomms@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>



Photo by: Nilofar Rostazada



CONTENTS

MINISTER'S MESSAGE	1	ACTIONS	17
EXECUTIVE SUMMARY	3	Accounting for living infrastructure	17
Goals	4	How to value living infrastructure	18
Actions	4	Adopting targets	19
VISION	6	Living infrastructure on buildings	24
WHAT IS LIVING INFRASTRUCTURE?	7	Microclimate assessments	25
SCOPE AND PURPOSE	8	Improving planning processes and community resources	26
POLICY CONTEXT AND CONSULTATION	9	Planning our future urban forest	27
THE CHALLENGES WE FACE	11	Learning and doing	28
Heatwaves and urban heat	12	Realising the vision	31
Drought	14	GLOSSARY	32
Storms, floods and stormwater management	14	KEY REFERENCES	34
Our ageing urban forest	14	Climate and Adaptation Issues	34
Bushfire	15	Living Infrastructure in Other Cities	34
Retaining nature in the city	15	Urban Planning	34
GOALS	16	ACT Government Strategies	34
Climate-wise city	16		
Nature in the city	16		
Healthy city	16		
Prosperous city	16		





MINISTER'S MESSAGE

Canberra is the beautiful “Bush Capital”. Our city’s living infrastructure – that is, its trees, plants, soils and water systems – help make Canberra a special place to live. This natural environment is highly appreciated by Canberrans, and by visitors to our city.

Living infrastructure improves our wellbeing and health. It helps us connect to nature even while living in an urban environment. It provides space for outdoor recreation. It also provides shade, retains water in the landscape, and supports wildlife and biodiversity.

Canberra is moving into a new era. It is growing quickly, and its climate is changing due to global warming. It is essential that the ACT Government has a plan to respond to these challenges. This plan - the Canberra’s Living Infrastructure Plan: Cooling the City - sets out the ACT Government’s firm commitment to maintain and improve living infrastructure in Canberra. It recognises the critical role that living infrastructure plays in our city, and the increasingly important role it will play, particularly in cooling the city as the climate warms.

Climate change is already affecting Canberra. Its impacts include higher temperatures, and longer and more frequent heatwaves. Canberrans are increasingly suffering from the “urban heat island effect”. This occurs when pavements, roads and buildings absorb the sun’s heat and radiate it back, increasing temperatures day and night. A CSIRO study showed that the urban heat island effect causes large temperature differences between parts of Canberra – up to 10°C or more on a hot day. Locations with lower tree canopy cover experience a greater urban heat island effect, and this has consequent effects on comfort, health, energy use and costs.

This Plan seeks to address these issues. One of the key commitments in the Plan is to a new ‘tree canopy target’. By 2045, we aim to have 30% of Canberra’s urban environment covered by a tree canopy or a tree canopy equivalent (such as green roofs, shrub beds, wetlands and rain gardens etc). This is a significant commitment; currently Canberra’s urban tree canopy is about 21%.

The Plan is also alert to the new pressures that climate change places on our living infrastructure. It will ensure we take the latest science into account and that our living infrastructure is suited to our changing climate – one that is becoming drier and hotter.

Living infrastructure is a critical asset in our city. This plan seeks to protect it, to enhance it, and to take advantage of its benefits to improve wellbeing, amenity, and to help us adapt to the warming climate.

Our combined efforts will help us reach our shared vision for a sustainable, competitive and equitable city which is responsive and resilient to change.

Shane Rattenbury MLA,
Minister for Climate Change and Sustainability.

An aerial photograph of a landscape. In the foreground, there's a green field with a winding road and a small white building. The middle ground shows a town with many houses and buildings. In the background, there are blue mountains under a clear sky. The overall scene is bright and sunny.

ACKNOWLEDGEMENT OF COUNTRY

The ACT Government acknowledges the Australian Aboriginal and Torres Strait Islander peoples of this nation. We acknowledge and pay our respects to Elders, past, present and future of the Ngunnawal people as the Traditional Custodians of the lands on which we live and where we conduct our business. We recognise the significant contribution of the Ngunnawal people and neighbouring Nations—the Ngambri, Ngarigo, Wolgalu, Gundungurra, Yuin and Wiradjuri to the Canberra region. For thousands of years these Nations have maintained a tangible and intangible cultural, social, environmental, spiritual and economic connection to these lands and waters.

EXECUTIVE SUMMARY

Canberra is growing at one of the fastest rates of any capital city in Australia. Population projections indicate that our city will need to cater for more than 600,000 people by 2050. Canberra's Living Infrastructure Plan: Cooling the City (the Plan) provides strategic direction to help our expanding and densifying metropolitan areas become better prepared for and more resilient to climate change. It identifies options and opportunities provided by living infrastructure measures to enable us to continue to enjoy the benefits of:

- climate resilience
- economic prosperity and
- the amenities of nature
- health and wellbeing.

Through the ACT Planning Strategy 2018 the ACT Government has set a development target of 70% within the existing urban footprint. We recognise that urban density needs to be balanced with a natural environment, green spaces and trees.

The actions in the Plan will ensure we plan, design, construct and manage our city in a way that values, incorporates and protects natural assets. Using a continually expanding suite of living infrastructure options we can strategically and innovatively reduce our climate vulnerability and safeguard the liveability of Canberra.

The Plan also recognises that we need to be proactive in sustaining our city's existing natural assets or we risk losing them. Through an Urban Forest Strategy we will develop a forward plan for stabilising and enhancing our existing urban forest in a changing climate, and as our city form changes through urban intensification and expansion.

The goals that underpin the actions within this Plan are to achieve a:

- » Climate-wise city
- » Prosperous city
- » Nature in the city and
- » Healthy city.

A key goal of this Plan is to adopt and progress towards targets by 2045 that provide Canberra's urban footprint with:

- » the equivalent benefits of a 30% tree canopy cover and
- » 30% permeable surfaces.

We recognise these targets will require carefully tailored solutions to meet the diverse challenges and opportunities of our variable urban environment. We also are aware that these are not goals that the Government can achieve on its own. They require action on public and private land and will therefore be heavily reliant on a strong collaborative and collective effort.

Implementing this Plan to 2025 and beyond will help our growing city adapt to the challenges presented by climate change, and retain its attractiveness as a liveable, prosperous and sustainable 'city in the landscape'. It will help ensure our community has on-going equity of access to the benefits of living infrastructure through a planned, co-operative and locally responsive approach. It will also help safeguard the functioning of our landscape and the water, soil, biodiversity and wildlife systems that it supports and on which we as a community depend.



GOALS

Climate-wise city

To reduce the risks from the key climate change impacts of heatwaves, droughts, storms and bushfires, through resilient living infrastructure.

Nature in the city

To conserve and enhance Canberra's biodiversity and landscape function, quality of life and sustainability, which are reliant on our urban forest, open spaces, wildlife and water systems.

Prosperous city

To recognise that our landscapes, with living infrastructure asset components, are an essential part of our economic prosperity that create revenue and jobs.

Healthy city

To promote community-wide health and wellbeing through access to nature which provides recreational, fitness and relaxation opportunities, and improves mental health.

ACTIONS

METHODS	ACTIONS	DIRECTORATE TIMING
Accounting for living infrastructure	ACTION 1: Expand existing asset management system Complete inventory and mapping of living infrastructure and expand the public urban infrastructure asset management system to include urban living infrastructure to inform investment decision making, whilst investigating steps to implement an accounting framework, such as the United Nations System of Environmental Economic Accounting (SEEA), to value urban living infrastructure.	EPSDD, TCCS Interim progress report by 2021 Inventory and mapping by 2023
Adopting targets	ACTION 2: Living Infrastructure Targets Achieve 30% tree canopy cover (or equivalent) and 30% permeable surfaces in Canberra's urban footprint by 2045.	EPSDD Achieve by 2045

METHODS	ACTIONS	DIRECTORATE TIMING
Microclimate assessments	ACTION 3: Microclimate Assessment Guide Prepare a Microclimate Assessment Guide and mandate its use to inform policy and forward planning studies for centres, urban renewal projects and urban intensification precincts, with initial assessment of priority locations to inform a city cooling works program.	EPSDD By 2020
	ACTION 4: Microclimate Assessment Program Introduce requirement(s) for microclimate assessments of significant developments located in centres, urban renewal projects and urban intensification precincts, to assist with development assessment.	EPSDD Commence 2020
Improving processes and community resources	ACTION 5: Climate-wise Landscape Guide Prepare a guide for use by the community and built environment professionals to support effective landscape plans, and increase the opportunity for healthy, climate resilient and biodiverse gardens and public lands.	EPSDD Commence 2020
	ACTION 6: Landscape Plans Require multi-dwelling, mixed use and commercial development applications (DA) to have landscape plans that demonstrate how surface treatments and tree canopy cover targets will be met, and change the processes for certification of DA compliance accordingly.	EPSDD Commence 2020
	ACTION 7: Actsmart Programs Expand Actsmart web-based information and programs to incorporate the Climate-wise Landscape Guide to encourage and support community efforts to improve sustainability outcomes.	EPSDD Commence 2020
Planning our future urban forest	ACTION 8: Tree Protection Act Review Review and update the ACT Tree Protection Act 2005 to ensure consistency with the objectives of the Plan and suitability to Canberra's changing climate.	TCCS Commence 2020
	ACTION 9: Develop Urban Forest Strategy Develop a strategic plan for the public urban forest that outlines how the urban forest can be maintained and enhanced to improve amenity in a changing climate and deliver biodiversity outcomes.	TCCS Commence 2020
Learning and doing	Action 10: City Cooling Program Trial city cooling initiatives in high priority locations.	SLA, CRA Commence 2020
	Action 11: 'Oasis' Program Trial local park upgrades in high priority locations including watered grass, trees, seats, lights and drinking fountains.	EPSDD, TCCS Commence 2021
	Action 12: Shadeways Program Support the amenity and safety of active travel on trunk cycle and pedestrian routes with tree canopy shade and water points at key destinations.	TCCS Commence 2021
	Action 13: Demonstration Projects Showcase best practice climate-wise design through display houses and exhibition sites in Government projects.	EPSDD, SLA, Housing Commence 2021
	Action 14: Water Sensitive Urban Design Support trials and demonstration projects to retrofit infrastructure to allow hydration of open spaces using stormwater.	EPSDD Commence 2021
	ACTION 15: Public and private investment Investigate ways to encourage and incentivise living infrastructure on existing and future buildings in Canberra.	EPSDD By 2020

VISION

The ACT Government and ACT community want Canberra to be a sustainable, productive and equitable city which is resilient to the challenges of climate change and is a 'city in the landscape', drawing on its 'bush capital' and 'garden city' legacy.





WHAT IS LIVING INFRASTRUCTURE?

Our city's natural assets are 'living infrastructure': the vegetation, soils and water systems that help make our city a beautiful, enjoyable and environmentally sustainable place to live.

The urban landscape's living infrastructure components include street trees, ovals, wetlands, creeks, nature reserves, parks, private yards, green roofs and balconies, and living walls. Just like other infrastructure such as hospitals and energy networks, our living infrastructure provides a range of vital services to benefit us all. For example Canberra's natural spaces are the 'lungs of the city' with the vegetation providing the oxygen we breathe, removing air and water pollutants, and capturing and storing carbon. Integrating our natural assets into our urban form supports our city's ecologically sustainable development.

Living Infrastructure helps to make our city 'climate-wise' by enhancing its capacity to cope with the impacts of climate change and extreme weather events. It also supports our native wildlife, giving our unique biodiversity the best chance of survival - provided we continue to manage threats such as climate change and challenges such as increasing urbanisation.

Canberra's attractive, natural appearance has a direct impact on our economic sustainability. Our 'bush capital' character is a key factor in attracting tourists and making Canberra a desirable place to work, live in and do business. Suburbs with higher quantities of parks and gardens have higher property values, and businesses located on leafy streets have higher levels of walk-in trade.

Canberra's living infrastructure provides valuable social and health benefits. It makes Canberra a pleasant place to live, and offers enjoyable places for people to interact with each other and with nature. Contact with nature is particularly important in cities, and provides mental health benefits and a greater sense of happiness and wellbeing.

“There now exists a strong scientific underpinning and plenty of reliable evidence that humans seeing, or in the presence of, trees are healthier and less stressed.” (Comment to ACT Government 2018.)

Associate Professor Cris Brack Fenner School of Environment and Society, Australian National University



SCOPE AND PURPOSE

This Plan identifies challenges from climate change, urban growth and renewal, and the aging of the urban forest. As the impacts of climate change intensify, and as our city rapidly grows, we need to manage our natural environment carefully to preserve its health and amenity, protect biodiversity and to help keep the city cool and liveable. The Plan provides a response to address these challenges and to enhance Canberra's urban environment by:

- » reducing urban heat island effects and increasing access to shade
- » retaining water in the landscape and using rainfall better
- » improving water penetration to sustain vegetation and allow ground water recharge
- » improving access to and amenity of nature in the city
- » maintaining ecosystem services and biodiversity in the city's landscape.

POLICY CONTEXT AND CONSULTATION

The Plan is part of the ACT Government's wider climate change response and is a companion to the ACT Climate Change Strategy 2019–25 (Climate Change Strategy). The Climate Change Strategy highlights that despite the ACT's leading climate change response, there will be continuing and significant changes to our climate. These changes require adaptive responses to the way we manage our city and its natural resources.

The Plan is aligned with the ACT Planning Strategy 2018 direction to 'integrate living infrastructure and sustainable design to make Canberra a resilient city within the landscape'.

The ACT Planning Strategy 2018 commits to maintaining and enhancing Canberra's urban forest of trees and vegetation on properties, lining transport corridors, on public lands and where possible on roofs, facades and walls. Residential development provisions will be updated to mitigate against the loss of tree canopy cover and permeable surfaces as a result of urban intensification. These living infrastructure measures will need to be complemented by the use of climate-wise design and heat reflective materials in built infrastructure to reduce heat absorption capacity.

The Plan also complements other strategic policies including the Nature Conservation Strategy 2013–23, the ACT Water Strategy 2014–44: Striking the Balance with the Water Sensitive Urban Design, the Territory Plan code, and the Healthy Waterways program. The Plan will be implemented in accordance with the ACT's environmental policies and legislation, and our national environmental obligations.

This Plan has been informed by feedback that consistently shows residents and tourists highly value Canberra's landscape characteristics. Canberra's 'clean, green environment' is one of the main attractions for both locals and visitors.

The ACT Government undertook extensive community consultation on climate change and living infrastructure issues from December 2017 to April 2018. The community submitted many ideas and expressed their support for prioritising living infrastructure, with particularly strong support for enhancing our urban forest.

The Housing Choices Discussion Paper: Community Engagement Report in May 2018 identified the importance of protecting our city's bush capital and garden city principles, values and character.

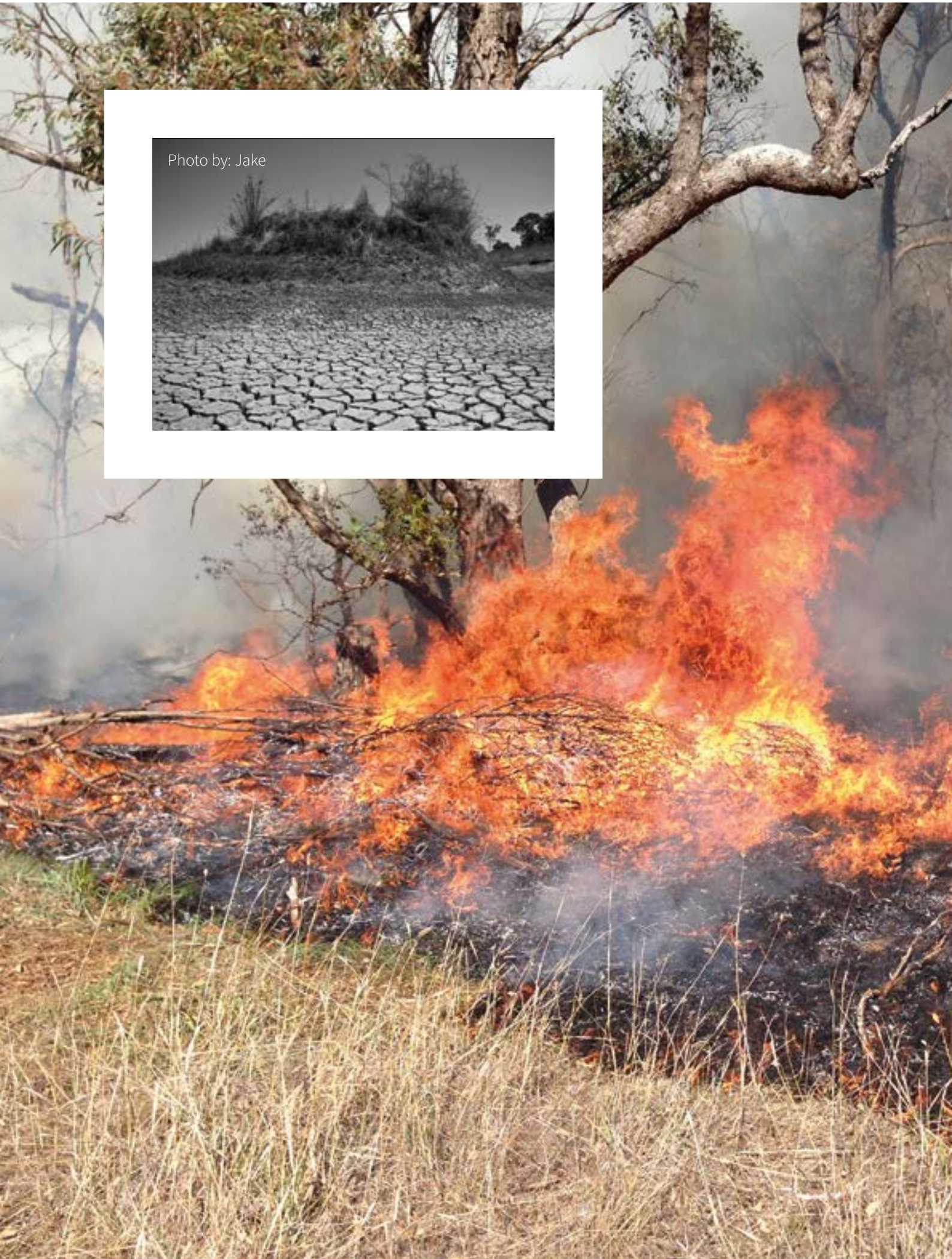
The Better Suburbs Statement 2030 in August 2018 (derived through citizen deliberation facilitated by the Government) makes clear that people regard living infrastructure as an essential feature of Canberra today and in the future.

"The liveability of our suburbs is intertwined with our natural environment. The value of our urban forest, green spaces and waterways underpins the amenity and beauty of each of our suburbs as well as Canberra as a whole." Better Suburbs Statement 2030 (Citizens Forum 2018)

70% of the ACT's land area is non-urban. Our many reserves and farmlands play a critical role in ensuring our city has a high quality and secure water supply, unique biodiversity, an attractive and natural setting for our daily lives, and extensive recreation and tourism opportunities. This Plan is focussed on Canberra's urban area and ensures that our urban footprint does not compromise the integrity of our surrounding natural assets and the dynamic ecosystems they support which sustain the viability of Canberra as a city.



Photo by: Jake





THE CHALLENGES WE FACE

While Canberra's green, leafy environment is the envy of many cities, it is facing several risks. Our city is growing and changing and the climate is becoming more variable and extreme. As climate change continues, heatwaves, storms with flash flooding, drought and bushfires are all likely to increase. These threats require changes to our approach in managing living infrastructure within the built environment footprint. This Plan recognises these threats and challenges and seeks to address them.

Canberra's climate is already changing, and in future the ACT can expect more
EXTREME WEATHER EVENTS.



Heatwaves
will become hotter, more frequent and last longer.



Droughts
will increase in severity and frequency.

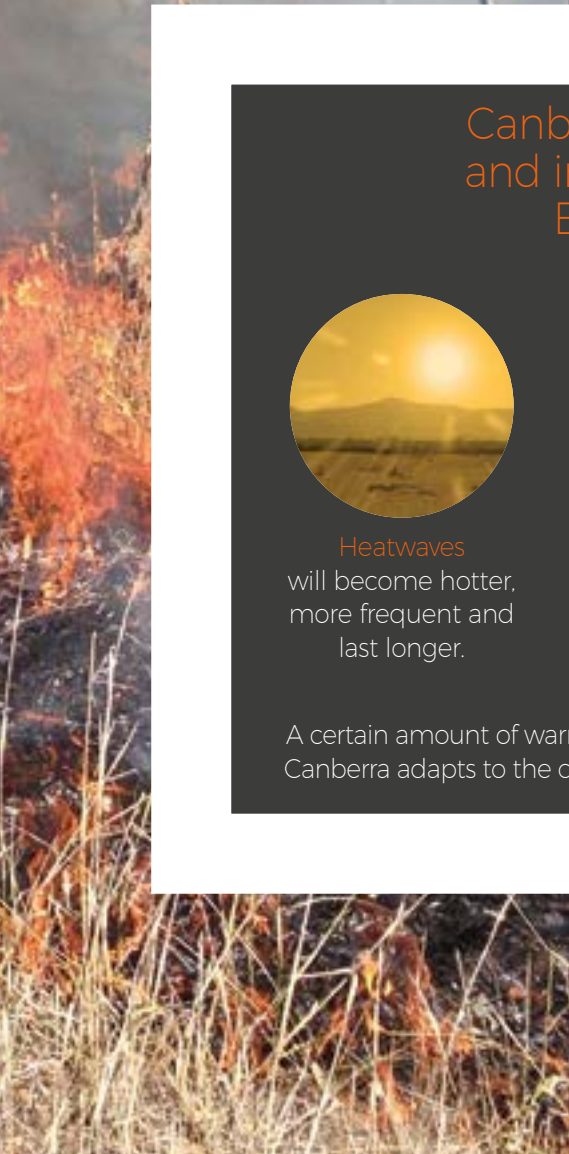


Storms
will become more intense, causing flash flooding.



Bushfire
weather will become more dangerous.

A certain amount of warming is already locked in. The ACT Government is committed to ensuring Canberra adapts to the changing climate, so that it can remain a vibrant, resilient and liveable city.





HEATWAVES AND URBAN HEAT

Climate change is amplifying heatwave frequency, intensity and duration. Based on long-term observations, the Bureau of Meteorology reported mean temperatures in the ACT have already increased by about 1°C since the 1950s. This included a run of four consecutive days of 40°C or above in Canberra from 15–18 January 2019. Canberra had only reached 40°C nine times in total in the first 94 years of observations from 1913 to 2006 (and did not reach 40°C at all between 1973 and 1998). In the 12 years from 2007 to February 2019, there have been 16, and the January 2019 heatwave was the first recorded period of more than 4 consecutive days over 40°C.

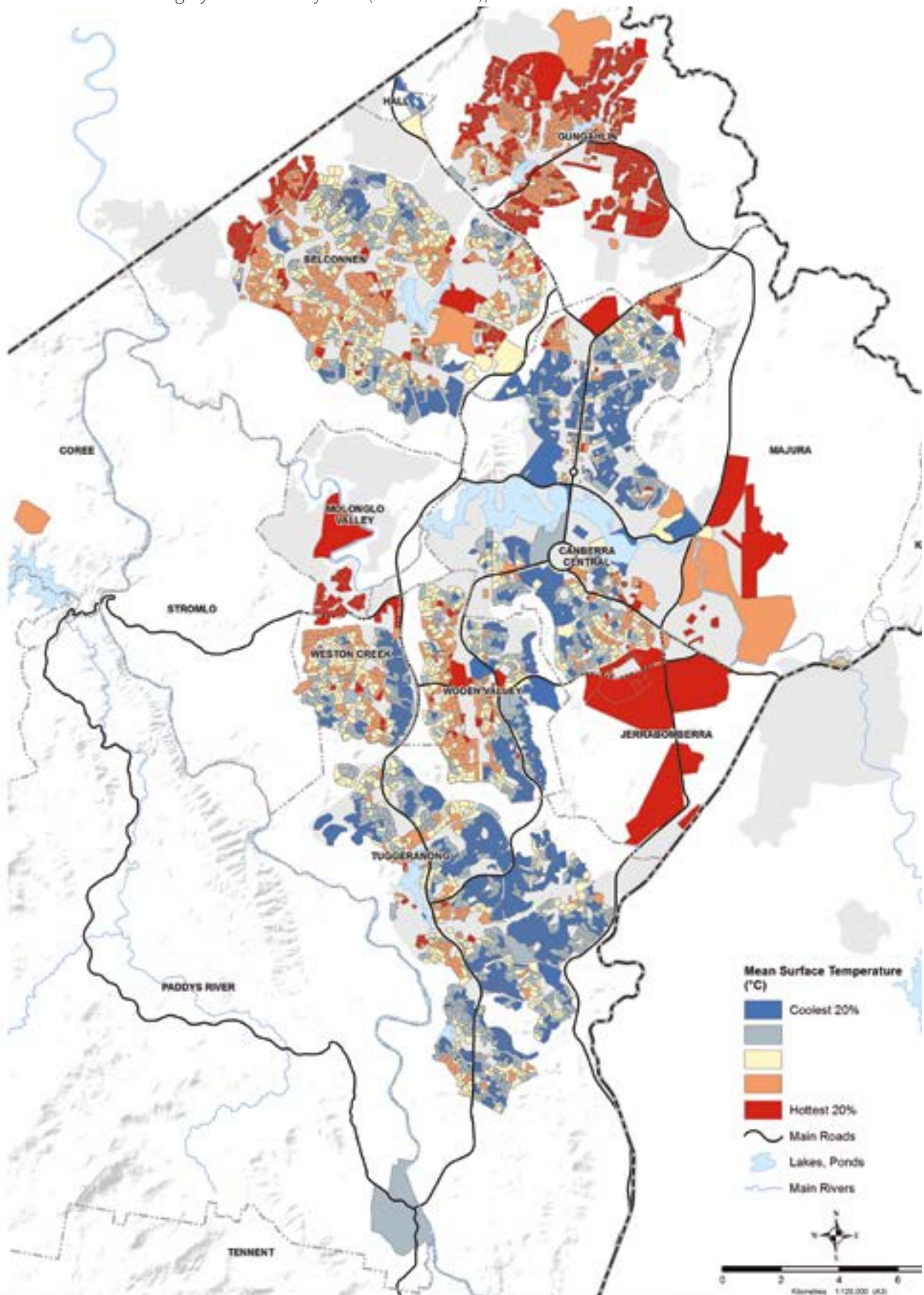
Heatwaves disproportionately affect the most vulnerable Canberrans, including children and the elderly, and those living in apartments and at the urban fringe. Warmer city temperatures increase the need to cool down buildings, leading to higher energy use and higher household costs. Hot weather reduces the opportunities for people to be active outdoors, including recreation and work. It is important to reduce urban heat to protect workers and ensure a healthy community.

The urban heat island effect is created by the built environment (such as buildings and paving) absorbing, trapping and then releasing heat. This leads to increased temperatures and prevents night time cooling.

The 2017 CSIRO study, Mapping Surface Urban Heat in Canberra, showed that the locations that experience the highest urban heat in Canberra are its town and group centres, industrial suburbs and newly developed areas (greenfield estates). The study found that in built-up areas, the surface urban heat island at night was around 8°C warmer in summer than in surrounding rural areas. Some of these new housing areas also have populations that are more vulnerable to heat, such as elderly people. Suburbs with lower tree canopy cover experience a greater urban heat island effect, with consequent impacts on dwelling comfort, and energy use and costs.



Figure from CSIRO study 2017, Mapping surface urban heat in Canberra showing hot spots. (Hot spots are defined as departures from 35°C, which is the mean land surface temperature for the area shown. Temperature is derived from Landsat 8 thermal imagery on 9 February 2017 (10.50 AM DST)).



SOURCE: Meyers J, Devereux D, Van Niel T and Barnett G (2017) Mapping surface urban heat in Canberra. CSIRO, Australia.



DROUGHT

Droughts are not just occurring in summer. Climate change is increasing the variability of rainfall and the localisation of storm cells. In 2018 insufficient summer rain followed by a dry autumn, winter and spring induced drought conditions in the Territory.

Healthy soils have a greater capacity to store water, filter pollutants and recycle nutrients. Having sufficient quantity of soil in open spaces and waterways provides cool oases during heatwaves and significant nature-based recreational opportunities.

Drought-proofing the city means providing more permeable surfaces to capture and use rain; investing in waterway naturalisation, and retrofitting existing infrastructure to divert, harvest, store and use stormwater at all scales. The ACT is currently progressing these initiatives through its Healthy Waterways program. These measures enable harvested stormwater to be used to water the city's open spaces and playing fields, limiting the need to use high value potable water.

STORMS, FLOODS AND STORMWATER MANAGEMENT

Changing rainfall patterns are predicted to bring more intense rainfall events with increased risk of flooding. The flash flood in Canberra's Sullivan's Creek catchment on 25 February 2018 demonstrated the intense storm precipitation that climate change is making more common.

Canberra's lakes and waterways are affected by pollutants (nutrients, organic matter and solids) washed into drains, waterways and water bodies. Outbreaks of blue green algae pose a serious threat to human health and result in periodic closures of Canberra's lakes. In 2018 Canberra lakes and swimming areas were closed on 43 days.

Ensuring high levels of permeability in the city's surfaces allows for water penetration. This reduces flash flooding, rehydrates the ground improving vegetation health, and mitigates the pressure on engineered stormwater infrastructure. Vegetation holds rain water in its foliage and its roots retain water in the soil. Slowing water flow through open spaces and wetlands will reduce risks from flash flooding from intense storms as well as improve water quality.

OUR AGEING URBAN FOREST

Canberra's urban forest has around 770,000 trees on public land (streets and parks). Over the last decade, Canberra's established suburbs have seen a net loss of trees on public land due to necessary removal from age and disease. Many exotic species planted in the early years of Canberra's urban settlement are reaching the end of their lives. Native species planted from the 1960s are simultaneously reaching the end of their lives. In addition, the increasing frequency of extreme heat and drought events is causing higher and faster rates of decline. The changing climate also has implications for what are the most suitable tree species for future plantings.



BUSHFIRE

Being the ‘bush capital’ brings the risks from bushfires close to home. Increased risk of bushfire means we need to carefully manage our grasslands, woodlands and forests to avoid catastrophes. Managing the extensive urban interface to lessen fire danger is complex.

The ACT Government manages bushfire risk by implementing the ACT Strategic Bushfire Management Plan and a 5 year Regional Fire Management Plan which inform the annual Bushfire Operational Plans. As our climatic conditions and risk levels change, we remain vigilant to ensure information is up to date, and continue to develop innovative methods in fire management to ensure our response actions are appropriate. An important part of an effective response is implementing site specific solutions along the urban edges to reduce bushfire risks, with more involvement of potentially affected residents.

RETAINING NATURE IN THE CITY

Canberra is growing at one of the fastest rates of any capital city in Australia, with the population expected to reach more than 600,000 by mid-century. The ACT Planning Strategy 2018 sets a target for 70% of new dwellings to be built in existing urban areas. This will help preserve our natural areas and landscapes while bringing greater vibrancy to our city.

Development on existing urban areas can lead to significant tree loss in two ways: as an unintended consequence of renewal and change, and through intentional removal to make way for buildings and pavements. The public land of our streets is intended as ‘nature strips’ for the common good, but this role is not always respected. The incremental impacts of compaction and damage from parking and construction activity significantly damages street trees.

The ACT community supports a more compact city, provided there are high quality outcomes. Creating quality living environments in dense urban areas will require an increase in vegetation and water features through innovative design solutions. These solutions will need improved planning processes and infrastructure construction standards and compliance to enable a wider range of appropriate living infrastructure options to be considered for local application. Investment in green walls, green roofs and ground level gardens could contribute to increases in amenity, and attract premium floor space rental rates and property values.

The part of Canberra’s urban forest that is on private land is estimated at around 770,000 trees - roughly equal to the number of trees on public land. If tree canopy protection is not given appropriate priority, one quarter to one half of this tree canopy cover could be lost over the next 20 years due to natural aging and removal for urban intensification. These issues will be investigated as part of a review of the ACT’s tree protection legislation.

Our city is home to many creatures other than humans. The birds, bees, butterflies, bats and other native wildlife populating Canberra are an integral part of our natural ecosystems. They also contribute to the joy of living here. Maintaining sufficient quantities of the right types of living infrastructure in and throughout the city is essential to maintain these natural ecosystems and the biodiversity they support.

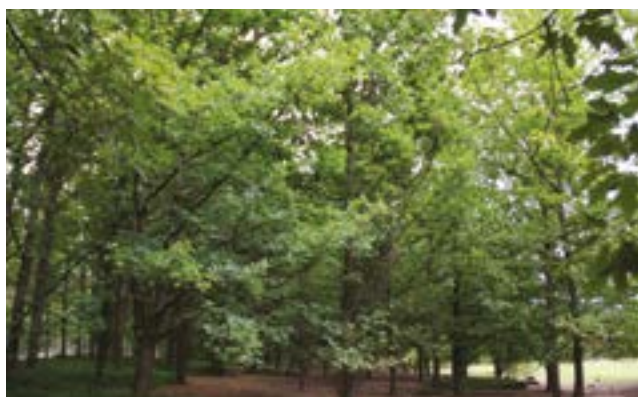
Although a higher proportion of residential development will occur in existing urban areas, Canberra’s growth will require new greenfield developments. Newer urban areas have higher dwelling densities, often with larger houses and smaller front and back yards. While the trees in newer suburbs will mature over time, the quantity of large growing trees on public and private land is not at levels sufficient to reduce climate change impacts or provide the amenity experienced in many older suburbs. Through this Plan, and the implementation of the ACT Planning Strategy 2018, the ACT Government will address these issues into the future.

“Increasing urban intensity should not necessarily lead to a reduction in greenery (look for example at Singapore), it’s just how we provide the greenery that may change.” (Comment to ACT Government 2018.) Professor Barbara Norman, Director Canberra Urban and Regional Futures

GOALS



Setting goals for a policy for living infrastructure ensures that as our population grows, and our city intensifies and expands, we retain the natural attributes our community values, and which give us the amenity and liveability we desire into the future. The actions in this Plan respond to four policy goals.



CLIMATE-WISE CITY

To reduce the risks from the key climate change impacts of heatwaves, droughts, storms and bushfires, and build resilience to a changing climate.

NATURE IN THE CITY

To conserve and enhance Canberra's landscape and urban ecosystems, for quality of life and sustainability, which rely on the health and functionality of our trees and other vegetation, open spaces, soils, wildlife (biodiversity) and water systems.

HEALTHY CITY

To promote community-wide health and wellbeing through access to nature which provides recreational, fitness and relaxation opportunities, and improves mental health.

PROSPEROUS CITY

To recognise that our landscapes, with living infrastructure asset components, are an essential part of our economic prosperity, and provide wide-ranging and vital benefits and revenue.

ACTIONS

The Plan consists of fifteen actions, planned to commence in 2019–20.

ACCOUNTING FOR LIVING INFRASTRUCTURE

Recognising trees, waterways, parks and soils as living infrastructure is itself an important step in managing our urban environment. These assets have significant value but we don't yet have an inventory and valuation system to track changes in their value over time. Nor do we know how expenditure to maintain the urban forest and irrigated open spaces affects their value.

The registration of and lifecycle accounting for these living infrastructure assets is essential for effective and sustainable management.

Valuation using the internationally recognised System of Economic Environmental Accounting (SEEA) method supports informed decision-making. For example, the ACT's public urban forest has been valued at around \$3.4 billion by the CSIRO's SEEA study. Maintaining or expanding the forest currently is considered an expense on the ACT budget. However, failure to maintain the forest leads to losses in value which can outweigh these expenses. Currently, there is a variable approach to asset management, with most living infrastructure assets not treated as a capital investment.

Making good decisions about living infrastructure requires recognition that living infrastructure expenditure is actually an investment. Accounting for and valuing this investment, will help inform Government decisions about living infrastructure. It will also provide increased certainty for growth, innovation and development of economic sectors that rely on natural outdoor spaces, such as tourism, recreation, research and education.

The ACT Government will therefore examine how it can transition to a system of accounting for living infrastructure that appropriately recognises the value of services delivered. This will be consistent with national agreement on a system of accounting based on the SEEA. Given the large value of living infrastructure and the early status of the SEEA system in Australia, any transition will happen over a number of years to preserve the integrity of the budget system.

The first step will be to compile a complete and accurate register of living infrastructure.

ACTION 1: Expand existing asset management system

Complete inventory and mapping of living infrastructure and expand the public urban infrastructure asset management system to include urban living infrastructure to inform investment decision making, whilst investigating steps to implement an accounting framework, such as the United Nations System of Environmental Economic Accounting (SEEA), to value urban living infrastructure.



HOW TO VALUE LIVING INFRASTRUCTURE

The Council of Australian Government's (COAG's) Meeting of Environment Ministers in 2016 agreed to collaborate on a common national approach to environmental economic accounting based on the United SEEA. This is to provide the basis for improved decision making about living infrastructure in the same way that the National Accounts provide a basis for decision making on financial management.

In 2018, CSIRO was commissioned to value (costs and benefits) two key elements of living infrastructure using the SEEA method: the public urban forest, and public irrigated grass areas. Benefits that were measured included energy savings from buildings, pollution removal, avoided run-off, property price increases and avoided morbidity from heat. Some key services, such as habitat, cultural value, amenity, population health and city cooling were not able to be valued.

Despite the exclusion of such key values, the study found that in 2018 the public urban forest had an estimated capital value of \$3.4 billion and delivered benefits of more than \$27 million per year to the community. The study also found that the benefits of irrigated open spaces included recreational benefits of \$24,000 per hectare for non-sport grounds, and \$76,000 per hectare for irrigated sports grounds plus additional revenue from sports ground hire.

The Australian Bureau of Statistics has used the SEEA method to investigate the value of assets and industry sectors as part of calculating Gross Domestic Product, and to inform policy and decision making on living infrastructure assets as big as the Great Barrier Reef and the Murray–Darling Basin. The Victorian Government has undertaken two SEEA assessments, Valuing Victoria's Parks and Marine and Coastal Ecosystem Accounting: Port Phillip Bay. These assessments have been used to inform policy and investment decisions.



ADOPTING TARGETS

Canberra will have increasing problems with urban heat and flash flooding unless action is taken to increase tree canopy cover and surface permeability. Through this Plan, the ACT Government is adopting targets to set a clear direction to encourage change and provide the basis for measuring progress.

ACTION 2: Living Infrastructure Targets

Achieve 30% tree canopy cover (or equivalent) and 30% permeable surfaces in Canberra's urban footprint* by 2045.

*Refer to the Glossary for the definition of the term 'urban footprint'. The ACT Government has decided to adopt targets for Canberra's urban footprint to achieve the equivalent benefits of a 30% tree canopy cover and 30% permeable surfaces by 2045. These targets will encompass both public and private land. The 30% tree canopy cover target requires a significant increase to Canberra's existing public urban tree canopy, which was estimated to be around 21% in 2015. This will require ongoing commitment and funding over many years. The 2045 timeline recognises the magnitude of this task and the realistic timeframe required for its implementation, and also aligns with the ACT's target date of 2045 for becoming a zero emissions city.

The many benefits of a canopy target

Shade reduces the sun's radiant heat on people and surfaces and is a key city cooling measure. Paved surfaces, like roads, are a major contributor to urban heat so it is particularly important to shade roads and pedestrian pavements.

Methods to cool the city include trees, irrigated grass, roof gardens, vine covered pergolas and fences, water bodies, fountains and mist jets. Providing appropriate shade to buildings reduces operational energy costs and improves thermal comfort inside.

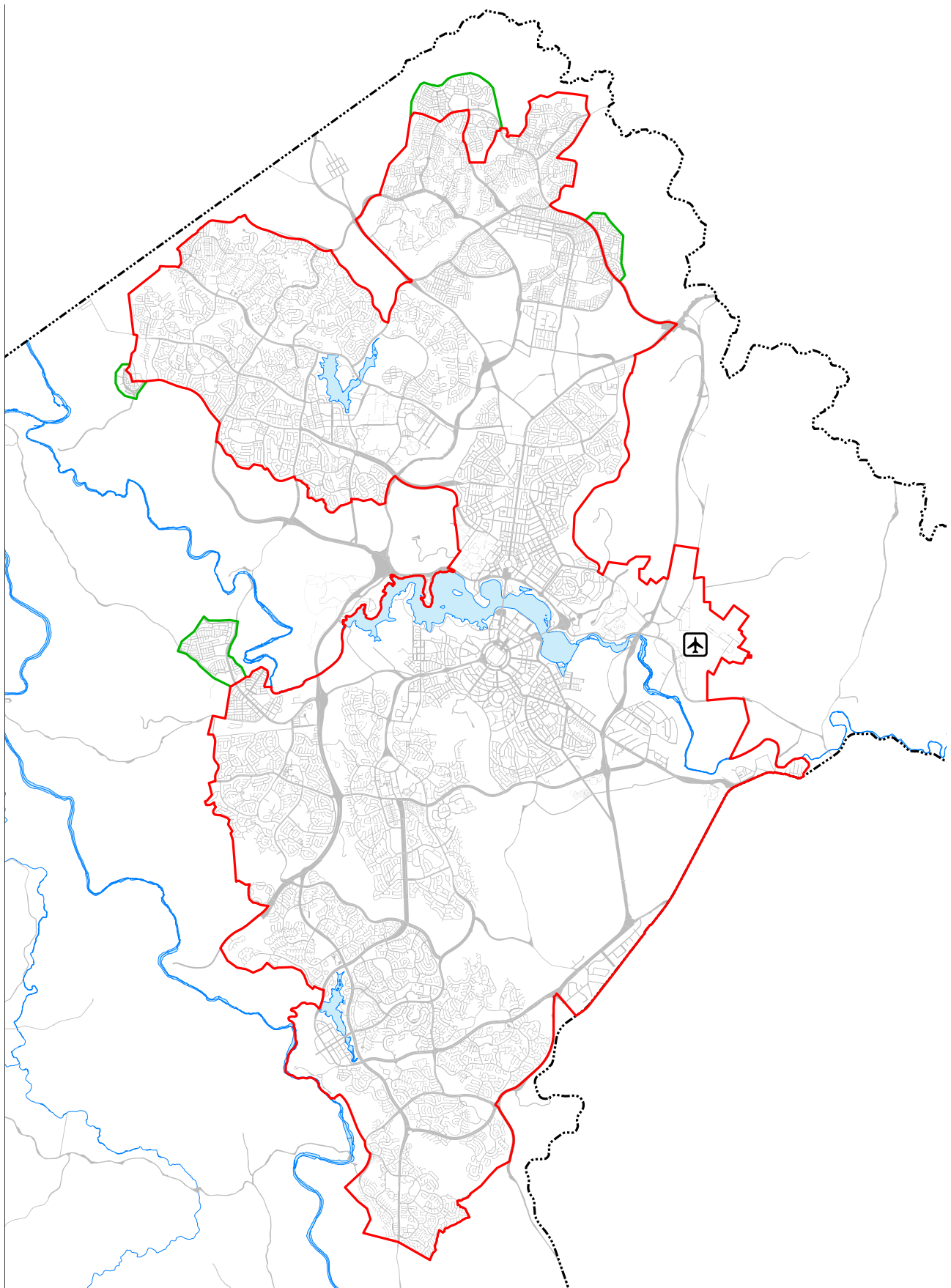
The Cooperative Research Centre's program for Low Carbon Living identified extensive tree canopy cover from shade trees as the most cost effective option over time, providing relief from excessive heat, making public spaces more usable and enjoyable, and improving connectivity between natural landscapes.

Recognising the important role of shade from trees, some cities around Australia have adopted canopy cover targets, generally in the range of 30–40%. The targets in different cities are not directly comparable as they vary by geographical scope (extent of city or local government area), the actions to meet the targets (i.e all vegetation or only trees), and different land use and ownership (inclusion of open spaces and/or private land).

Monitoring progress against the targets provides us with an indicator for sustainable urban development.

Table 1: Current targets across other municipalities in Australia

JURISDICTION	CURRENT LEVEL %	TARGET LEVEL %	DESCRIPTION	TARGET DATE	REFERENCE
City of Melbourne	22	40	Public realm canopy cover	2040	Urban Forest Strategy
Brimbank City Council (outer Melb)	6.2	30	Tree canopy coverage (public and private land)	2046	Urban Forest Strategy
Greater Adelaide	27.28	32.7	Urban Green Cover (streets, parks and private properties)	2045	Living Adelaide
City of Sydney	15.5	23 27	Green Cover (streets, parks and private properties)	2030 2050	Greening Sydney Plan
Brisbane City Council	35.4	40	Natural Habitat cover	2031	Brisbane. Clean, Green & Sustainable
City of Greater Geelong	10.9	25	Private and public land	2045	Urban Forest Strategy



 Established Urban Footprint 2016 (ABS)
 Extension of Urban Footprint Subsequent to 2016

Canberra Urban Footprint 2016 (ABS ASGS 2016)

<http://www.planning.act.gov.au> DPMH - 16 Challee Street Dickson ACT 2601

Scale: 1:75,000 (A2) Date: 6/11/2018



Ref: 181106
Rohan Connors



Why the 30% tree canopy cover target for Canberra?

Table 2: Current levels and targets for Canberra

CURRENT LEVEL %	TARGET LEVEL %	DESCRIPTION	TARGET DATE	REFERENCE
21	30	Tree canopy cover or equivalent, public and private land	2045	Living Infrastructure Plan and Urban Forest Strategy

Important considerations in setting a canopy cover target for Canberra include: our unique and diverse natural ecosystems; the landscape setting for the city with its topographic features; the limitations and opportunities of existing and new suburbs; the attributes of tree species suited to projected climate conditions in our region; and our environmental and conservation management policies and obligations.

In 2015, Canberra's urban area, the private and public lands including the reserves in our inner hills, ridges, buffer spaces (woodlands, waterways and grasslands), was estimated as having an average 21% tree canopy cover.

Some established parts of Canberra have higher shade cover from large growing tree species in streets, parks and private gardens. Other parts of the city such as Hume, Fyshwick, and Phillip have few street trees and low tree canopy cover. In addition, predicted drier conditions for Canberra mean that we do not have the same tree species options as other Australian capitals such as Brisbane, Sydney or Melbourne.

A feature of many trees which survive and thrive in harsher drier conditions is they provide less shade and have a smaller canopy.

Despite these inherent challenges, there are a range of living infrastructure options which we can draw from to realise the equivalent benefits of a 30% tree canopy cover. It is intended that the target will be measured at the city-wide scale and be delineated by Canberra's urban footprint boundary. Both public and private land will be included in the measurement.

Trees are recognised as being a cost effective living infrastructure option and provide multiple benefits for the environment, economy and human amenity. However, it may not always be feasible to include them in all established urban areas to the same degree. Alternative options may be used to achieve equivalent benefits as necessary. Over time through urban renewal and an adaptive management approach to landscape planning, treescaping options can be reassessed and the mix of living infrastructure measures applied can change in response to need, opportunity and feasibility.



How will the canopy and permeable surface targets work?

In implementing the targets, the Government will prioritise canopy cover from trees, and permeable surfaces from grass and ground cover beds, as the best ‘value for money’. However, there are multiple methods and measures to achieve equivalent benefits, and not every area will be suited to the same methods. Where 30% canopy cover cannot be easily achieved through tree and vegetation plantings, alternative locality-specific solutions will be used based on assessment of microclimate and built environment conditions. In assessing the most effective and appropriate living infrastructure options, the focus will be on achieving the suite of benefits, city cooling plus environmental services, equivalent to the 30% target.

Alternative treatments to meet the equivalence of the tree canopy cover and permeable surfaces targets may include green roofs and walls, wetlands and rain gardens, water features and fountains, watered grass, shrub beds, and climbers on structures. In higher density areas, roof and podium gardens are effective in retaining and/or slowing the flow of water, and also provide opportunities for city cooling, wildlife habitat, community gardens and high value open spaces.

As the Plan’s targets are to be achieved on both public and private land, the Government, community and business will need to work collaboratively to realise the desired outcome. The ACT Planning Strategy 2018 commits to reviewing planning and development codes, guidelines and standards to incorporate living infrastructure objectives. Implementation of the canopy cover target will be supported through the review of planning policy and mechanisms to maintain and enhance the urban forest in precinct, estate and district level planning processes, and review of relevant development and design guidelines.





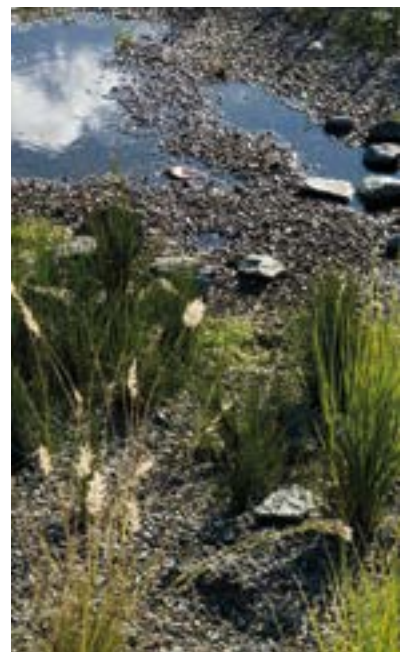
Measures to be included in these processes and guidelines will:

- » provide for a connected open space network and sufficient tree canopy cover for public spaces in precinct planning and greenfield estate design for residential areas.
- » provide for sufficient planting area and tree canopy cover in the planning of neighbourhoods, on residential blocks and for public spaces in urban intensification areas
- » mitigate against the loss of tree canopy cover, permeable surfaces and planting area as a result of residential urban intensification.
- » encourage community education about living infrastructure at the neighbourhood level.
- » support best-practice water sensitive urban design principles.

More permeable surfaces

The increasing intensification of Canberra, with higher densities in newer suburbs, infill and renewal projects, is increasing the amount of impermeable surfaces in the city. A recent study shows some new areas have 13% less nature strip permeability and soil than older suburbs.

The ACT's new 30% permeable surfaces target will support the revised Territory Plan and Water Sensitive Urban Design Code. It also sends a clear message to all in our community that we need to reduce urban run-off, and that stormwater is a valuable resource, to be used wherever possible to hydrate the ground, sustain vegetation and reduce pollution in our waterways.



LIVING INFRASTRUCTURE ON BUILDINGS

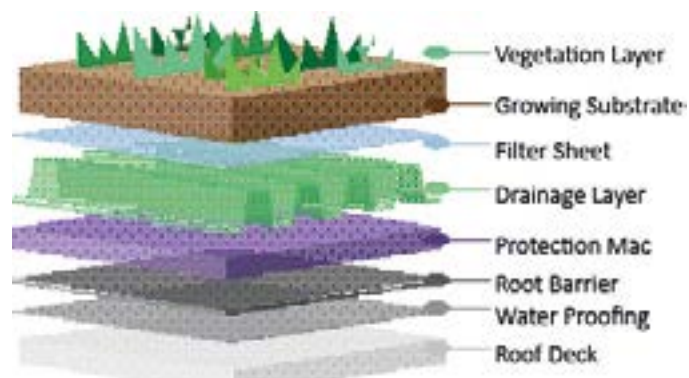
Including plants as part of buildings is well tested in other cities. Roof and podium gardens (or green roofs) have great potential to improve urban environments and can be incorporated into higher density residential, mixed use and commercial buildings, retrofitted to existing buildings or built into new ones. They can bring significant gains in aesthetics, recreation, and 'airway' biodiversity for birds and insects, without taking up additional land because they are part of the building footprint. At the same time, they can store water and provide cooling to reduce energy costs.

Green roofs and walls



Green roofs can be defined as 'intensive' or 'extensive' depending on the depth of growing medium (substrate), consequent overall weight and construction techniques. Intensive green roofs are similar to ground level gardens and cost more to construct due to deeper and heavier substrates. Extensive green roofs are comparatively inexpensive and have a restricted plant palette that can tolerate the harsh environmental conditions. With less structural upgrades needed, extensive green roofs are more easily retrofitted to existing buildings.

Figure from Green Roof layers
(Growing Green Guide, 2014)





MICROCLIMATE ASSESSMENTS

Canberra's districts all vary in their built environment constraints as well as topography, hydrogeological properties and microclimatic conditions. Determining measures for priority living infrastructure investment is likely to require assessment of local factors including quantity of impermeable surfaces, surfaces contributing to urban heat, and wind flow or blockage and turbulence.

Through understanding of natural systems and design options at different scales, we can tailor living infrastructure responses to best serve community needs. For example, increased permeability in streets and open spaces can increase tree canopy cover by improving the growing environment for vegetation through increased soil volume and hydration, which in turn allows the selection of larger growing trees.

Introducing microclimate assessments is therefore necessary to better inform decisions on how and where best to intervene.

ACTION 3: Microclimate Assessment Guide

Prepare a Microclimate Assessment Guide and mandate its use to inform policy and forward planning studies for centres, urban renewal projects and urban intensification precincts, with initial assessment of priority locations to inform a city cooling works program.

ACTION 4: Microclimate Assessment Program

Introduce requirement(s) for microclimate assessments of significant developments located in centres, urban renewal projects and urban intensification precincts, to assist with development assessment.

IMPROVING PLANNING PROCESSES AND COMMUNITY RESOURCES

A key mechanism to achieve the ACT Government's living infrastructure targets is to strengthen planning policy and statutory mechanisms to incorporate climate change adaptation considerations and resilience criteria into urban planning and design processes. This includes through support for the maintenance and enhancement of the urban forest at precinct, estate and district levels, and for the integration of a wide range of appropriate living infrastructure components in new estates and redevelopment planning and design processes. These measures are outlined in the ACT Planning Strategy 2018.

The Territory Plan review in 2019–20 will allow adjustment to planning regulations to support the living infrastructure targets. Additionally, the Municipal Infrastructure Standards that control and prescribe public realm development will be amended for consistency with revised policies and targets.

An integrated approach is required to achieve desired living infrastructure outcomes. The collaborative approach needs effective but flexible planning and design processes, codes and standards. Development proposals need to identify sustainable options suitable for the precinct, with all parties ensuring the outcomes meet the agreed intent. The development of a Landscape Guide, informed by microclimate information, will help development proponents prepare effective landscape plans.

The Government recognises the need for engagement through education for the community and business. Providing ongoing opportunities for participation, such as volunteering for nature, and resources for lifelong learning about living infrastructure, are important components of future collaborations between community, business and the Government. Specific actions on this are part of the ACT Climate Change Strategy 2020–25.



ACTION 5: Climate-wise Landscape Guide

Prepare a guide for use by the community and built environment professionals to support effective landscape plans, and increase the opportunity for healthy, climate resilient and biodiverse gardens and public lands.



ACTION 6: Landscape Plans

Require multi-dwelling, mixed use and commercial development applications (DA) to have landscape plans that demonstrate how surface treatments and tree canopy cover targets will be met, and change the processes for certification of DA compliance accordingly.

ACTION 7: Actsmart Programs

Expand Actsmart web-based information and programs to incorporate the Climate-wise Landscape Guide to encourage and support community efforts to improve sustainability outcomes.



PLANNING OUR FUTURE URBAN FOREST

In 2017, the Legislative Assembly agreed to protect and expand our urban forest and complete a review of the existing [ACT Tree Protection Act 2005](#). This Plan provides a strengthened framework for this review, including a target for the equivalent benefits of tree canopy cover of 30% by 2045.

ACTION 8: Tree Protection Act Review

Review and update the ACT Tree Protection Act 2005 to ensure consistency with the objectives of the Plan and suitability to Canberra's changing climate.

ACTION 9: Develop Urban Forest Strategy

Develop a strategic plan for the public urban forest that outlines how the urban forest can be maintained and enhanced to improve amenity in a changing climate and deliver biodiversity outcomes.

The 30% tree canopy cover target will contribute to a significant increase in the size of the urban forest over the next 25 years. However, to care for and safeguard our tree legacy and retain the benefits and services we currently enjoy for future generations, the ACT Government will develop an Urban Forest Strategy to 2045.

The Urban Forest Strategy and its implementation will be underpinned by an adaptive management approach to manage the changing climate and local microclimatic factors, as well as recognising the increasingly diverse city form and character. Species selection will be informed by the best available science including climate change science and the strategy will strengthen urban green corridors. The Urban Forest Strategy will outline the mix of species to be planted, taking into account biodiversity outcomes and suitability for the projected future climate. The Territory Plan codes and Municipal Infrastructure Standards will be amended to align with this approach.



LEARNING AND DOING

As our climate and city change, our approaches to managing our living infrastructure will need to adapt in response. By trialling approaches with on-ground works, we will be able to identify cost-effective ways to achieve a more liveable, environmentally sustainable and climate resilient city. The projects outlined below commence in 2021 to allow sufficient time to design, document and consult on proposed changes to priority trial sites.

Action 10: City Cooling Program

Trial city cooling initiatives in high priority locations.

Priority areas include those identified as having high exposure to the urban heat island effect and important locations for people to gather. Trials could include alternative vegetation options, water features, misting sprays or other measures to manage heat and improve amenity.

These trials will deliver cost-effective cooling measures in priority town centres, considering both public and private land. Such measures will focus on those that provide the highest cooling and amenity benefits.

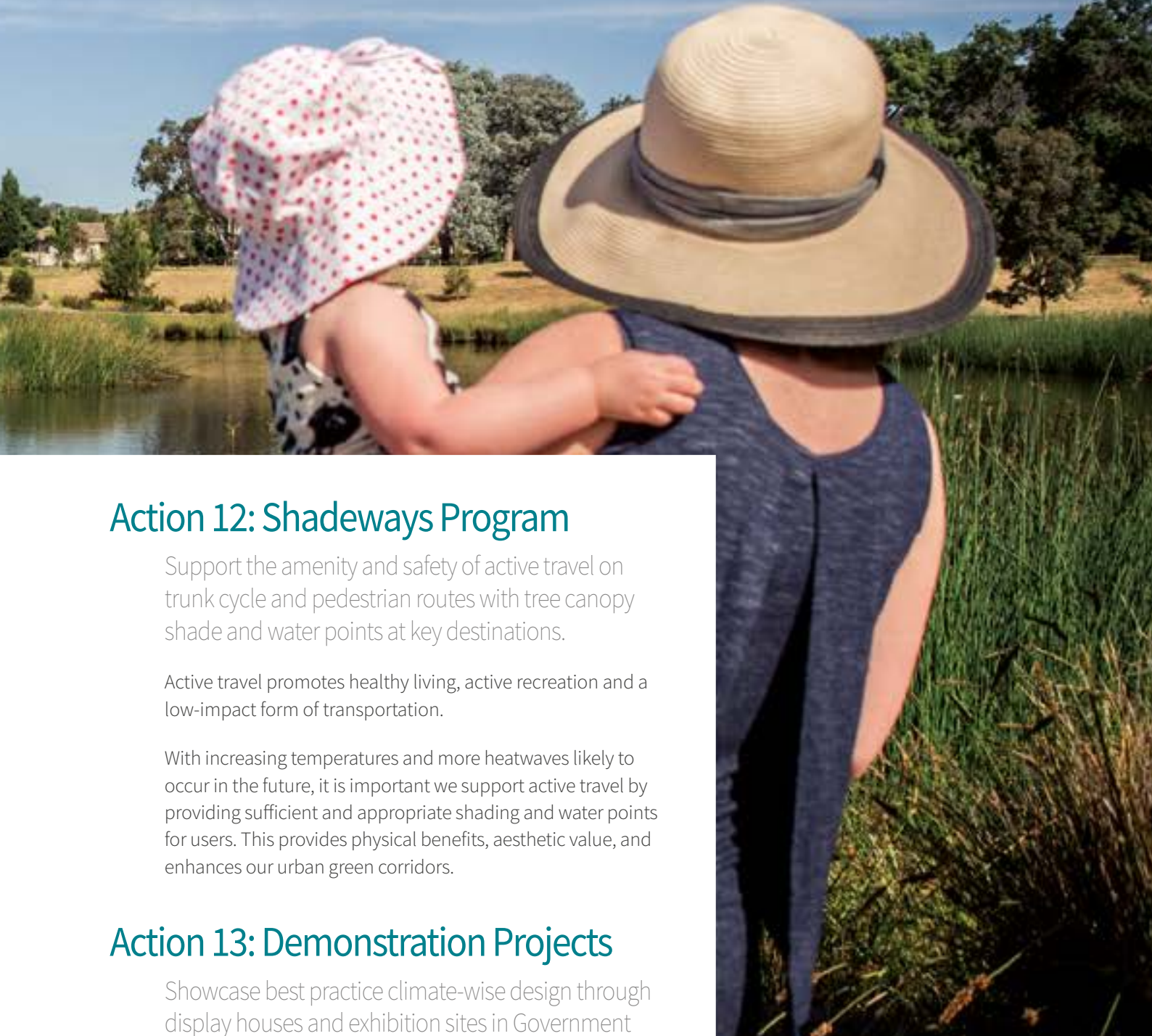
Action 11: 'Oasis' Program

Trial local park upgrades in high priority locations including watered grass, trees, seats, lights and drinking fountains.

Our parks are an important component of our urban forest and provide recreational and learning opportunities for the community. As we continue to face the challenges of climate change, in particular increased temperatures and more frequent heatwaves, it will become increasingly important that our parks are able to adapt to the impacts of a changing climate. This includes ensuring appropriate planting, shading, provision of water features and suitable paving and surface materials.

By upgrading our parks, we will support our community and ensure these valued public spaces will continue to remain attractive, useable and functional spaces for our community, and provide oasis in times of heat stress.





Action 12: Shadeways Program

Support the amenity and safety of active travel on trunk cycle and pedestrian routes with tree canopy shade and water points at key destinations.

Active travel promotes healthy living, active recreation and a low-impact form of transportation.

With increasing temperatures and more heatwaves likely to occur in the future, it is important we support active travel by providing sufficient and appropriate shading and water points for users. This provides physical benefits, aesthetic value, and enhances our urban green corridors.

Action 13: Demonstration Projects

Showcase best practice climate-wise design through display houses and exhibition sites in Government projects.

Demonstration projects provide opportunities for community education and participation in learning about best practice and innovative approaches to climate-wise design.

Education is an important tool in helping to assist in behaviour change and create greater awareness. By showcasing various best practice examples that exist in the ACT, the community, business and government can learn more about climate-wise design and lead to better application of climate-wise design in current and future projects.



Action 14: Water Sensitive Urban Design

Support trials and demonstration projects to retrofit infrastructure to allow hydration of open spaces using stormwater.

Water sensitive urban design is the integration of engineering and living infrastructure in a system to beneficially use stormwater and reduce flooding.

As our city expands and becomes more densely developed, and we face more intense rainfall and flash flooding, the existing land and water corridors need to be supplemented. Incorporating water sensitive urban design into the public and private realm is an effective integrated urban planning approach.

By enhancing and introducing water sensitive urban design we can improve water flows in the urban landscape, protect soils, and reduce water pollution.

Action 15: Public and private investment

Investigate ways to encourage and incentivise living infrastructure on existing and future buildings in Canberra.

In working towards achieving the 30% tree canopy cover and 30% permeable surfaces target, it is necessary that government, business and community work together and support and facilitate living infrastructure in both the public and private realm.

The ACT Government commits to exploring possible initiatives, including incentive options, that will facilitate the implementation of living infrastructure in existing and future buildings in Canberra.



REALISING THE VISION

Being the bush capital is part of Canberra's history and iconic character and retaining this legacy is important to residents and visitors alike. The changing climate poses risks to these natural attributes of our landscape, so our policies need to evolve in response to the new challenges we face.

This Plan sets out steps to ensure Canberra continues to be a sustainable, dynamic, productive and attractive city. It can only be realised through the collective efforts of Government, community, households and business working collaboratively for a more resilient urban environment to hand on to our children.

Implementing this Plan is action 4.22 in the ACT Climate Change Strategy 2019–25 and reporting on implementation progress will be part of the monitoring, evaluation, reporting and improvement undertaken for the Strategy



GLOSSARY

Biodiversity

The variability among living organisms from all sources (including terrestrial, aquatic, marine and other ecosystems and the ecological complexes of which they are part), at all levels of organisation, including genetic diversity, species diversity and ecosystem diversity.

Canopy cover

The equivalent cover and ecosystem benefits associated with a tree canopy cover.

Climate change adaptation

Actions taken to help communities and ecosystems adjust to changing climate conditions and their effects.

Conservation

The protection, preservation, management or restoration of biodiversity.

Ecosystem

A dynamic combination of plant, animal and micro-organism communities and their non-living environment (e.g. soil, water and the climatic regime) interacting as a functional unit. Examples of types of ecosystems include forests, wetlands, grasslands and tundra.

Ecosystem services

The services provided by the functioning of natural ecosystems which are essential to human survival and wellbeing. Natural ecosystems maintain the atmosphere; provide clean water; control soil erosion, pollution and pests; pollinate plants; and provide many other essential processes. The language of ecosystem services has emerged in recent decades as a way of representing the significance of the benefits humans derive from natural systems.

Greenfield

Greenfield areas are made up of undeveloped land outside of the existing urban footprint. Often located on the edge of existing urban areas. Greenfield development requires full assessment of environmental, infrastructure and planning issues, to determine future use and suitability for expansion of the city.

Group centre

Centres that service several nearby suburbs and provide easy access to major services, retailing and other commercial and community uses that meet the weekly needs of its catchment population.

Impermeable surfaces

Hard surfaces introduced by urban infrastructure which restrict or limit the permeability of surface layers of the landscape.

Infill

Development of unused or underutilised land in existing urban areas. It involves increasing the capacity of our existing urban area to support growth.

Liveability

This is a measure of city resident's quality of life and is used to benchmark cities around the world. It includes socioeconomic, environmental, transport and recreational measures.

Living infrastructure

Living infrastructure refers to all of the interconnected ecosystems within an urban catchment, including the 'green infrastructure' of trees, gardens, green walls and roofs, parks, reserves and open spaces, and the 'blue infrastructure' of our waterbodies including lakes, wetlands and waterways.

Natural resources

These resources include soil, water and marine resources; geological features and landscapes; native vegetation; native animals and other native organisms; and ecosystems.

Open space

Under the Territory Plan, the formal open space network of Canberra includes pedestrian ways, sportsgrounds, urban parks and other landscaped spaces. The urban edge has a complementary open space network, which is associated with Canberra's hills, ridges and major river corridors.

Permeable surfaces

Natural surfaces which allow water to penetrate and move through the underlying landscape.

Resilience

The capacity of a system to absorb disturbances and reorganise while undergoing change so as to retain essentially the same function, structure, identity and feedbacks.

Sustainable development

Forms of development that meet the needs of the present without compromising the ability of future generations to meet their needs.

Town centre

A town centre offers a wide range of facilities and services to serve the community and visitors from the surrounding district. Typically a town centre offers employment opportunities and provides higher order retail facilities, offices and consulting rooms; cultural, community and public administration; entertainment, educational, religious and residential facilities. Generally most urban districts in the ACT has a town centre providing access to goods and services bought less frequently.

Urban design

Urban design is the collaborative and multi-disciplinary process of shaping the physical setting for life in cities and towns. It involves the design of buildings, groups of buildings, spaces and landscapes, and the establishment of frameworks and processes that facilitate successful development.

Urban footprint

Is the geographic extent of the existing urban area. For the purposes of this Plan, the urban footprint boundary is as shown on the map on page 20 of this Plan, or as amended as the city continues to grow and expand.

Urban forest

The urban forest comprises all trees and other living infrastructure (including soil and water) contained within the urban footprint (see definition). It applies to both the public and private realms (e.g. streets, parks, residential blocks, road/pathway corridors, universities, schools, open spaces etc).

The urban forest provides important benefits to our urban ecosystem including shade, habitat and habitat connectivity, carbon storage, oxygen, removal of air and water pollution, reduced stormwater run-off as well as aesthetic value and enjoyment.

Urban heat island

An urban heat island is an area that heats up more than – and stays hotter than – its surrounding areas and has resulted from the introduction by humans of hard surfaces and urban development.

Urban intensification (areas)

Areas where further development and redevelopment is directed and is aligned with supporting infrastructure and provides the opportunity for renewal and investment in targeted locations.

Urban green corridors:

Connected fragments of green spaces, such as trails, parks and waterways, within the urban footprint that provide ecological corridors for plant and animal biodiversity and habitat.

Urban renewal

This is the process of improving the economic, social and environmental sustainability of a particular urban area through redevelopment of underutilised urban areas. It typically involves urban redesign, infrastructure renewal and investment, and identifying precincts and land for mixed use.

Water sensitive urban design

Is the planning, design or construction of the built environment to minimise water runoff and ensure any runoff causes the least amount of damage. It is also about wise use of that water to improve our urban environment.

KEY REFERENCES

CLIMATE AND ADAPTATION ISSUES

Can trees really cool our cities down?, Roland Ennos, Professor of Biomechanics, University of Hull, The Conversation, December 22, 2015

Trees for a Cool City: Guidelines for optimised tree placement Andrew Coutts and Nigel Tapper CRC for Water Sensitive Cities, 2017

Mapping surface urban heat in Canberra, CSIRO, December 2017

Risks to Australia's Urban Forest, Clean Air and Landscapes (CAUL) Hub, November 2017

Planning and Implementing Living Infrastructure in the ACT, CURF, May 2017

Australian Capital Territory climate change snapshot, NSW Government, November 2014

A carbon sequestration audit of vegetation biomass in the ACT, ANU Fenner School 2008

Microclimate modelling for urban heat island mitigation, Matthias Irger, 2016

Living Cities Workshop report, Australian Institute of Landscape Architects, 2016

Green Infrastructure, adapting to climate change, Australian Institute of Landscape Architects, 2016

Benchmarking Australia's Tree Canopy, Institute for Sustainable Futures, UTS, 2014

LIVING INFRASTRUCTURE IN OTHER CITIES

Greener Places, NSW Government, November 2017

NSW Urban Tree Cover Technical Guidelines, NSW Government, 2015

Adelaide Design Manual, Green Infrastructure Guidelines, Adelaide City Council, 2014

Melbourne Forest Strategy 2012–32, City of Melbourne, 2012

Green Infrastructure Economic Framework, Victoria University, 2015

URBAN PLANNING

Toward improved public health outcomes from urban nature, American Journal of Public Health, March 2015

Creating Liveable Cities in Australia, RMIT, October 2017

A report card on liveability in our cities, RMIT, October 2017

Urban green space interventional and health, World Health Organisation, 2016

ACT GOVERNMENT STRATEGIES

ACT Planning Strategy 2018

ACT Nature Conservation Strategy 2012–23

