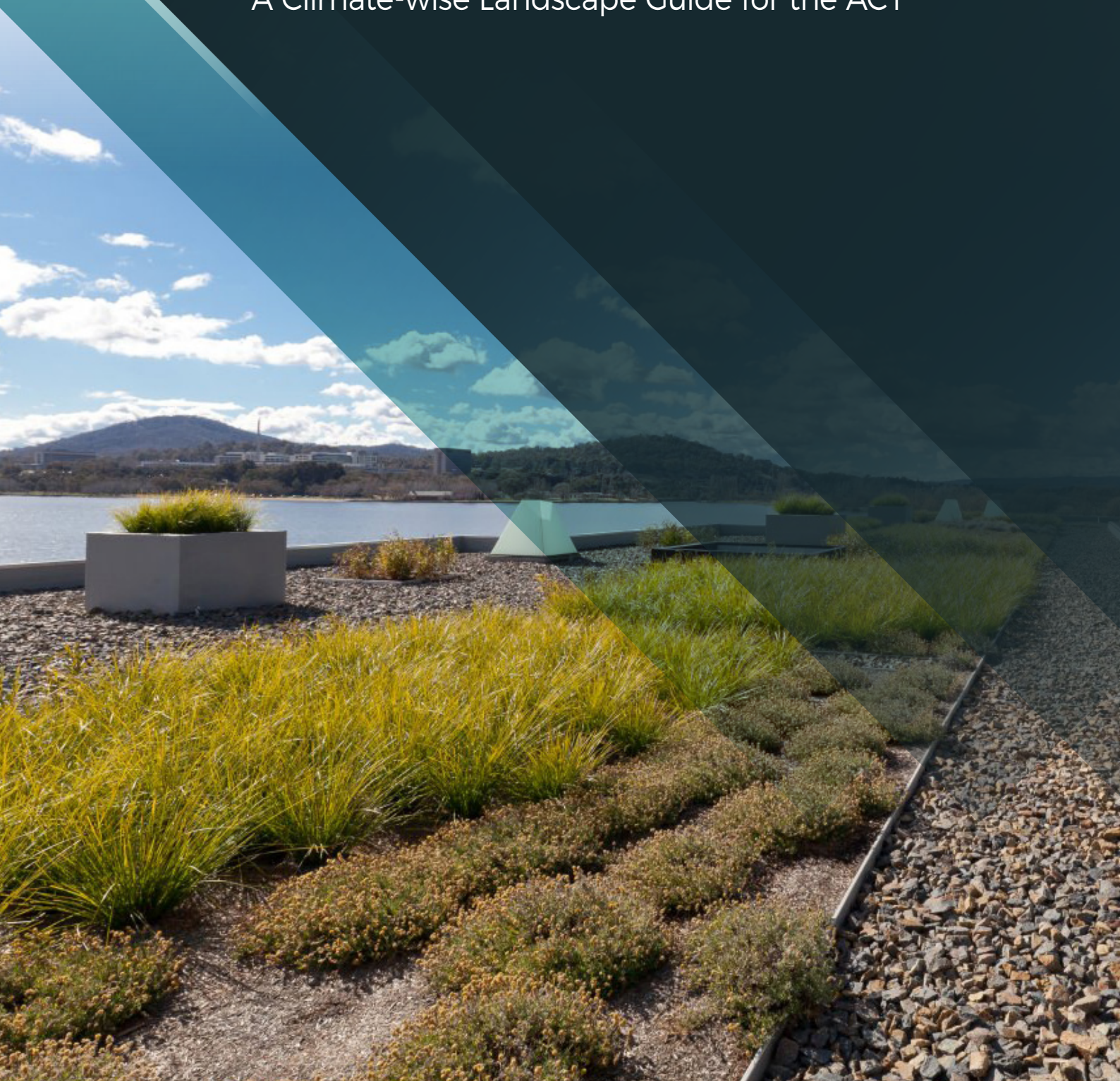
ACT Government

Gawari Ngilanmanyin
Remembering the Bush

A Climate-wise Landscape Guide for the ACT



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Acknowledgement
This guide was prepared by AECOM Australia. The ACT Government thanks everyone who contributed to the development of the guide.

Contents

Acknowledgement of Country

Ngunnawal Acknowledgement
Dhawura nguna ngurumbangu gunanggu Ngunnawal
Nginggada dindi dhawura Ngunnawalbun yindjumaralidjinyin
Mura bidji mulanggaridjindjula
Naraganawaliyiri yarabindjula.

This country is Ngunnawal peoples ancestral, spiritual homeland
We all always respect elders, male and female, as well as Ngunnawal country itself
They always keep the pathways of their ancestors alive
They walk together as one.

EPSDD Acknowledgement
The Environment, Planning and Sustainable Development Directorate acknowledges the Ngunnawal people as Canberra's first inhabitants and Traditional Custodians of Ngunnawal Country. We recognise the special relationship and connection that Ngunnawal people have with this Country.

The Ngunnawal people are a thriving people whose life and culture is connected unequivocally to this land in a way that only they understand and know, and is core to their physical and spiritual wellbeing.

The segregation of the Ngunnawal people from Culture and Country has had long-lasting, profound and ongoing health and wellbeing effects on their life, cultural practices, families and continuation of their law/lore. We acknowledge the historic dispossession of the Ngunnawal people of Canberra and their surrounding regions. We recognise the significant contribution the Ngunnawal people have played in caring for Country. For time immemorial they have maintained a tangible and intangible cultural, social, environmental, spiritual and economic connection to these lands and waters.

01 Introduction

1.1 How to use the guide

This guide provides advice on how to achieve a climate-wise landscape at different stages of development and for different types of landscapes. The guide provides general actions on key elements that are critical to achieving a climate-wise landscape. The Guide is divided into three key sections:

01 Introduction

Sets the vision and objectives, provides an outline of Canberra's climate and landscape context, and introduces mitigation measures and benefits to be explored further.

02 Key actions

Checklists

Advice on approvals and checklists that can be used at any stage of your process to ensure best practice climate-wise expectations will be met.

Key Elements

Breaks the development of a climate-wise landscape down into the elements:

Site & Design | **Soils** | **Water** | **Vegetation** | **Materials**

Then provides step-by-step recommendations and information for the three stages of developing your climate-wise landscape:

A. Planning
B. Design
C. Construction + Maintenance

03 Case studies

Provides best practice design examples at three key scales of landscapes:

- Residential
- Multi-use/Commercial/Industrial
- Campus/Precinct

Glossary

1.2 How will the guide help you?

Applying this Guide will help you to reduce costs, improve productivity and amenity, keep healthy and safe and protect biodiversity.

The Guide has been developed for a range of users including: individual homeowners, developers, building sector professionals, landscape architects, planning sector professionals and government departments involved in the planning, design and delivery of diverse private open space and landscape types.

All users of this guide will have differing levels of technical knowledge, budget and motivations.

I lead the school maintenance department

We want to reduce our carbon footprint by reviewing the materials, products and energy used in our external spaces.

I am building a house

I want to make sure my new garden is planned properly so that plants and trees thrive and we create habitat for native animals in our backyard.

I am designing an urban infill project

We want to ensure the open spaces and private landscapes meet our buyer's expectations around sustainability, liveability and cost efficiency.

I am assessing development approvals

I need a tool to review development applications against criteria for climate-wise landscapes at multiple scales to make sure they are maximising opportunities and incorporating industry best practice actions.

I am redesigning my garden

I need to know how to make it as climate-wise as possible when I am constrained by existing structures and trees. I have a limited budget and want to get the biggest environmental value out of by budget.

I am developing a new industrial estate

I need to know how I can make the open spaces climate-wise to attract the best tenants and meet ACT Government expectations in the preparation, design, construction and maintenance phases.

1.3 Canberra's landscape

Canberra's strong landscape character comes from the unique history of its design and development as the nation's capital.

To ensure long term success of climate-wise landscapes in Canberra, an understanding of Country and how sustainable Indigenous management practices can be adopted is critical.

Understanding what the surrounding landscape character is for your site, and how this influences your landscape is the first step to creating a sustainable outcome. It involves thinking beyond site boundaries so a landscape complements and enhances the character of its surroundings.

The Griffin Plan, Garden City movement and Bush Capital identity , which were the foundation for the design of the city of Canberra, were all based on creating an urban landscape that recognised and celebrated the local landscape context. These design principles guided the realisation of the capital nestling amongst the bushland hills of the Murrumbidgee River catchment and can be used to inform future urban landscapes within the ACT.

Caring for Country

Canberra is Ngunnawal country. The Ngunnawal are the Traditional Custodians of this region.

The Ngunnawal people's culture and story are not only embedded in archaeological finds, they are also preserved within the landscape through oral tradition, dance, memory, ceremony, artistic depictions and stories. Cultural landscapes refer to the mountains, waterholes, rivers, caves, rock formations, flora, fauna, wind and air, that is the interconnected web of these elements including customary Ngunnawal traditions and knowledge.

When Ngunnawal people care for the land, they also care for their culture. Working on land not only gives Ngunnawal people a sense of personal pride, it also affirms their identity through a cultural belonging and connection to the land. This has direct benefits to the health and wellbeing of their community.

Caring for Country stems from cultural connection and responsibility that First Nations people have for the care and protection of their Country. For Ngunnawal people maintaining Ngunnawal Country, it's ecological and spiritual balance is of high importance and honours their lore, stories and responsibilities for the care of Country. Under careful guidance, terrestrial and aquatic resources are managed periodically for the purpose of long term sustainability.

Together, knowledge of the natural world and Ngunnawal philosophies are the basis of caring for ceremonial sites, landforms, resources, instilling values, sharing stories and language and asserting ancestral obligations to Ngunnawal Country.

Working and being on Ngunnawal Country is essential to the wellbeing of Ngunnawal people and affirms their identity and relationship to their homeland.

Ngunnawal Plant Use

The Ngunnawal Plant Use field guide provides information on the native plants of the ACT region and their many Ngunnawal uses.

The ACT's Traditional Owners, the Ngunnawal people, used and continue to use the plant resources of this region for food, medicine, tools and weapons, fire, ceremonial purposes, water, fibre, dye and paint.

This robust, full-colour, 96-page field guide includes:

- an introduction to Ngunnawal history and natural resource use
- descriptions and photos of 69 plant species, including their Ngunnawal use, distribution, and method of propagation further reading and references.

Ngunnawal Plant Use captures and records traditional Ngunnawal plant knowledge and use in a contemporary context.

The book was published and funded by the ACT Government. It was produced in partnership with the United Ngunnawal Elders Council and the Ngunnawal community, Murrumbung Yurung Murra staff (a network of ACT Government Aboriginal staff working in Natural Resource Management, Heritage and Parks), the Yurung Dhaura Aboriginal Land Management Team and Greening Australia.

Ngunnawal Plant Use cover

Reflecting on Ngunnawal Plant Use. Artwork by Carolyn Young, 2015. Source: ABC News

1.4 What is a climate-wise landscape?

Vision

A climate-wise landscape has the ability to adapt to a changing climate and continue to provide social, environmental and health benefits to the community and environment. A climate-wise landscape embeds sustainability, climate resilience and best practice design principles.

This climate-wise landscape guide is an outcome of Canberra's Living Infrastructure Plan. It is intended for use by the community and built environment professionals to assist in the planning and design of healthy, climate resilient and bio-diverse gardens and public lands.

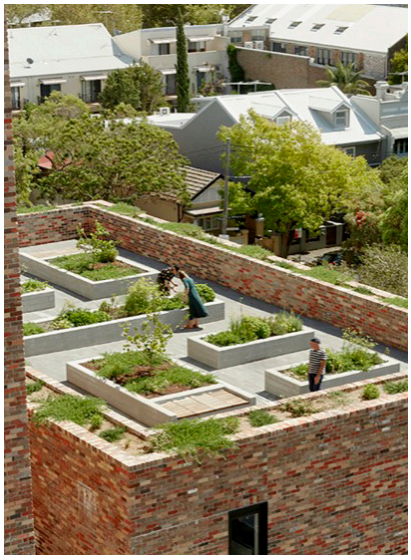
Despite efforts to reduce emissions, the ACT community will experience an increasingly extreme and unpredictable climate. Planning for a more extreme climate and designing to reduce our carbon footprint can help the ACT manage the impacts of climate change and create a more climate-wise environment.

The key goal of this guide is to support people with climate-wise landscape design and implementation and in turn support progress towards the Living Infrastructure Plan targets of **30% urban canopy cover and 30% permeable surfaces** within the ACT urban area. The ACT Government cannot achieve the targets on their own. A collaborative effort is required to ensure all opportunities on both public and private land are maximised.

A climate-wise landscape...

groups the right plants together

merges landscapes with structures



grows food in unexpected places

considers micro-climate at macro and micro scales

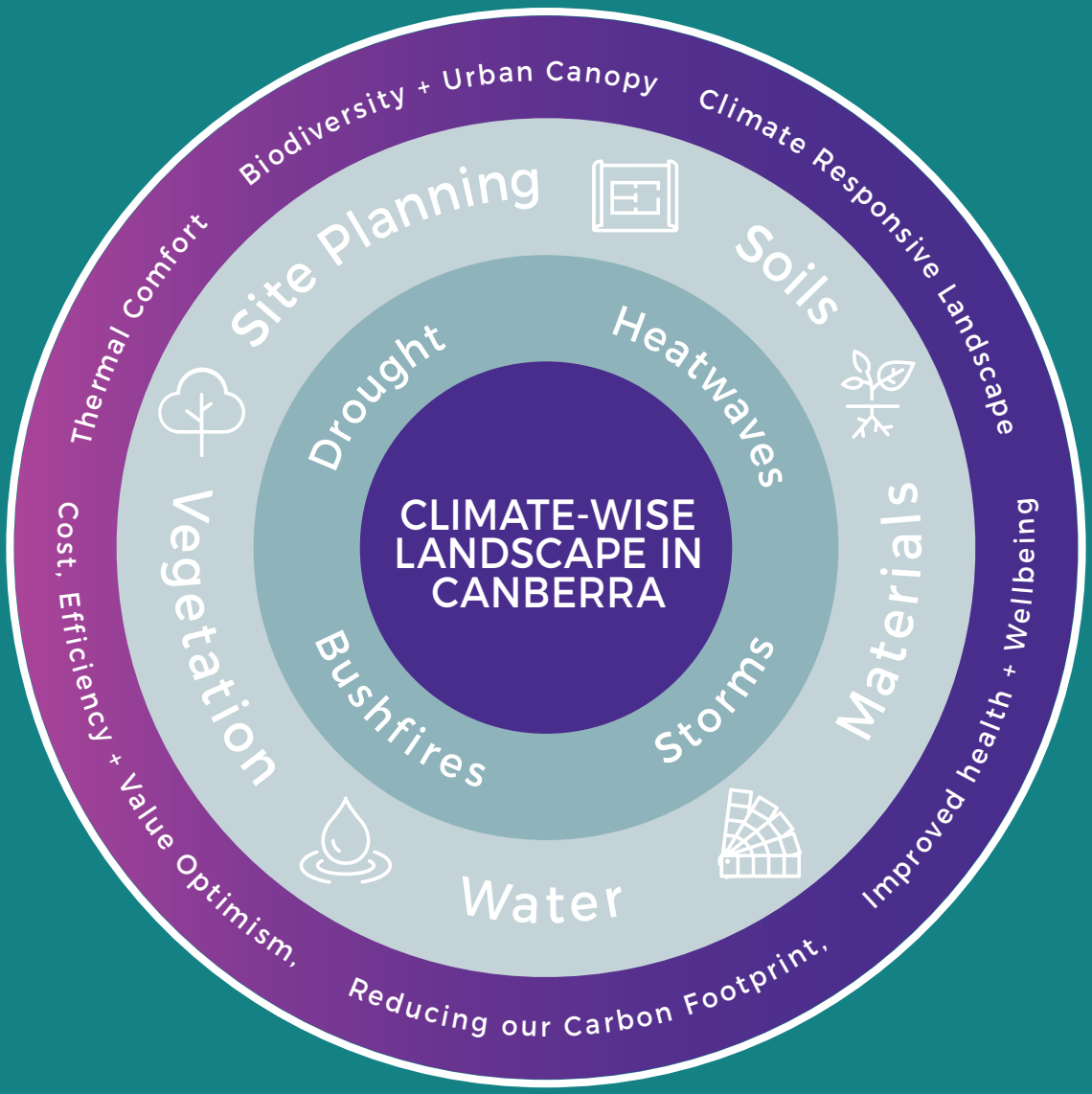
thinks differently about surfaces

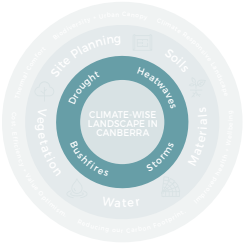
sets a robust foundation for all things to thrive

captures and uses water in sustainable ways

1.5 Climate-wise Landscape Strategy

This strategy diagram represents the relationships between the challenges, key actions and goals as they relate to achieving climate-wise landscapes in the ACT.





Challenges + issues

The below describes what the expected climate challenges are for Canberra, and the issues and impacts these challenges create for landscapes in the ACT.

Challenges

Heatwaves
will become hotter, more frequent and last longer.

Droughts
will increase in severity and frequency.

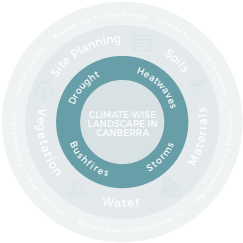
Storms
will become more intense, causing flash flooding.

Bushfire
weather will become more dangerous.

Issues

- Currently, Canberra experiences fewer than 10 hot days each year (temperatures above 35°C). Number of hot days could increase to 11 days per year by 2030 and 25 days per year by 2070
- Average temperatures are projected to increase by 0.9°C by 2030 and 2.3°C by 2070
- Hot days and heatwaves will be exacerbated in some parts of the city by the heat island effect
- Future spring and winter rainfall will likely decrease
- Evaporation and evapotranspiration is projected to increase
- Droughts are expected to occur more often
- Rainfall is projected to increase in summer and autumn
- Weather conducive to thunderstorms will occur more often, which frequently start summer bushfires through dry lighting
- The bushfire season is sometimes starting earlier than normal
- The number of severe fire weather days is projected to increase, particularly in spring and summer
- Increased temperatures, particularly in autumn, are changing the safe time frames for planned hazard reduction burning.

Source: New South Wales and Australian Capital Territory Regional Climate Model (NARCliM 1.0 and 1.5).
Refer to Climate Change in the ACT Region.



Impacts

The impact of drought, storms, heatwaves and bushfires on the landscapes of the ACT are wide-ranging. Below are some of the impacts already being experienced by the ACT community.

Less water available for plant growth and irrigation due to less rainfall and increased evaporation.

Drier fuel loads for bushfires increases risk and severity.

Species decline of both plants and animals, leading to lack of biodiversity and disruption to the ecosystem structure.

Urban Heat Island effect means hotter, less comfortable and liveable urban environments.

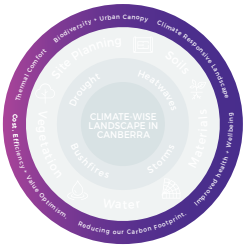
Saturated ground in extreme rainfall events de-stabilises trees creates more surface run-off.

More topsoil degradation and erosion due to heavy storm rainfall.

Long periods of no rain followed by storm rain means the soil is too compacted and “hydrophobic” to absorb the water and recharge groundwater systems.

Increased frequency and severity of storms and associated damage is leading to increased insurance costs.

Increased temperatures put the lives of people and animals at risk. More people die during heatwaves than from all other natural disasters combined.



Climate-wise landscape goals

A climate-wise landscape should demonstrate the below outcomes in order to measure success. Each landscape will achieve these outcomes through differing integration of the key actions, with differing priorities for landscapes of varying scales, locations and contexts.

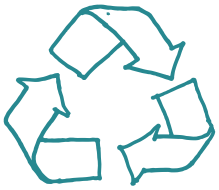
Thermal comfort and urban heat island mitigation

Protected and enhanced biodiversity and urban canopy

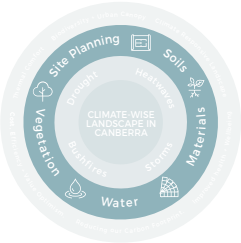
Landscapes that are resilient to the challenges of climate change

Cost, efficiency and value optimisation

Improved health and well-being of people, plants and animals



Reduced carbon footprint



Key elements

The critical relationship between the five key elements listed below must be considered when preparing, designing, constructing and maintaining a landscape responsive to local climate pressures.

The following pages introduce these elements and explain:

- Why is it important
- Key issues
- Key benefits

Site Planning: Get to know your site, what the issues are, and what opportunities exist to set the foundation for success.

Soils: Create healthy soils which are the foundation for healthy plant growth.

Water: Implement Water Sensitive Urban Design as a way to minimise runoff, maximise capture and secure water for our landscapes.

Vegetation: Maximise trees and plants which create shade, provide habitat and increase landscape resilience.

Materials: Choosing correctly can assist in urban cooling, develop circular economy and preserve natural processes.

Site planning

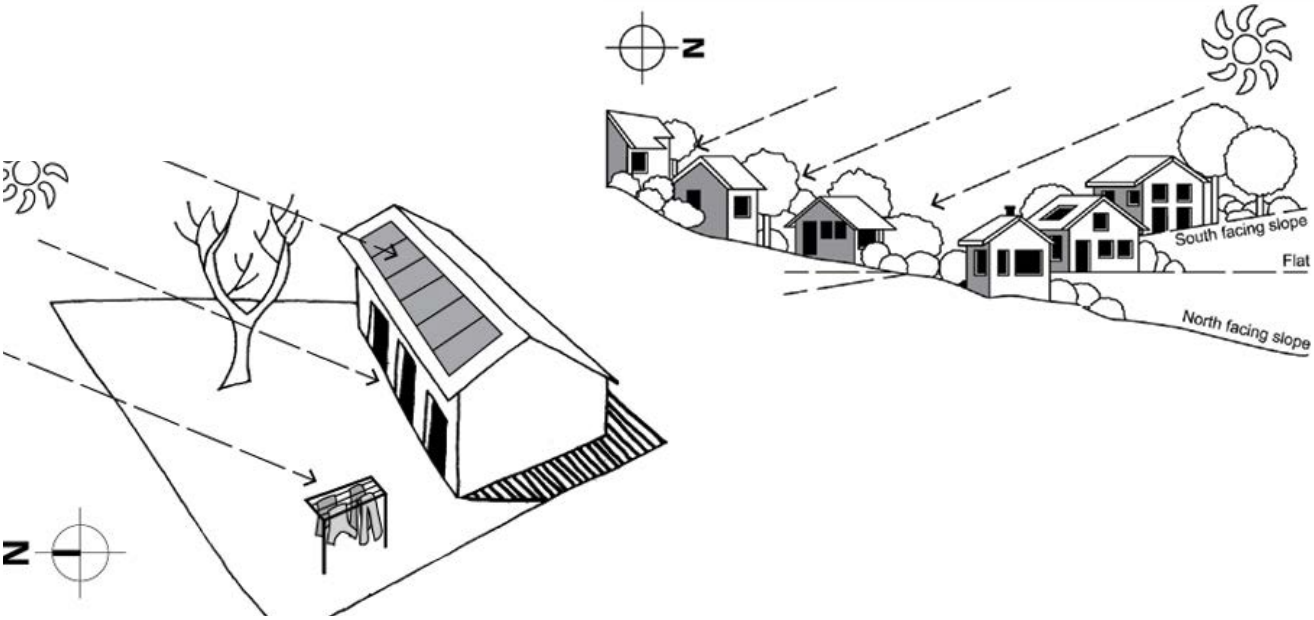
Why is it important?

Understanding your site is the first step in creating a climate-wise landscape. By taking some time at the beginning of the design process to take a step back and look at the site in a holistic way you are much more likely to end up with a result that is better for the end user and the environment.

From a climate-wise perspective this means thinking at the start about how you will achieve a good canopy cover, how water permeates the site and what other environmental benefits you might be able to achieve, as well as your vision and aspirations for the human aspects of the design such as amenity, health and culture.

Key issues

1. Inefficient orientation of the built form and landscape
2. Difficult slope and water movement
3. Not enough space for trees and planting



House orientation diagram. Source: www.yourhome.gov.au/passive-design/orientation

Key benefits

- By understanding the micro-climates you can design to maximise natural comfort.
- Instant shade and habitat if you can retain existing trees or vegetation.
- Increased biodiversity if you support and enhance the surrounding ecosystems.
- Maximising the amount of water going to your plants and minimise runoff into stormwater pipes.
- Fewer long term maintenance issues.
- Reduced chance of future design work and associated costs.
- Lower risk during construction due to early identification of risks.
- Good quality landscape can increase property values.
- Natural shade can reduce heating/cooling costs for adjacent buildings.

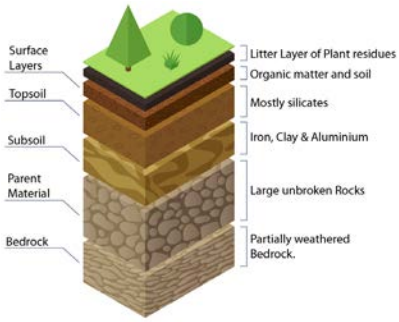
Soils

Why is it important?

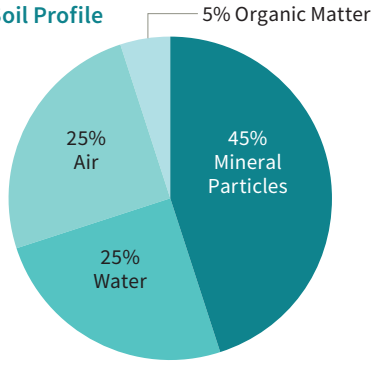
Healthy soils are the foundation for healthy plant growth. A healthy soil contains organic matter that is broken down by bacteria, fungi, worms and other insects to provide nutrients to plants. Soil structure is vital as plant roots need access to oxygen. Un-compacted soil allows the filtration of rainwater and helps to prevent flooding.

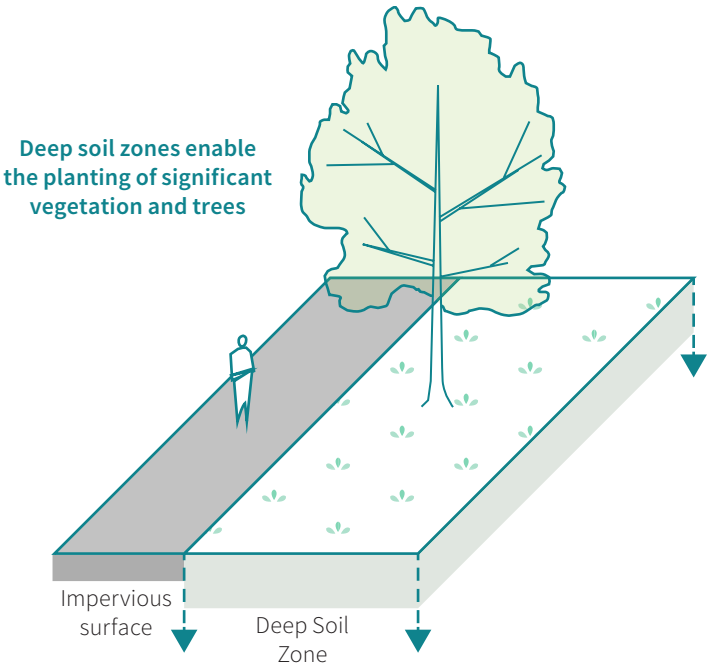
Soil type and quality determines what you can grow. Canberra's soil conditions can vary dramatically, and can have different qualities affecting nutrients, moisture levels and drainage. Understanding the soil properties is essential to knowing what to do to keep your soils and plants healthy. Maximizing your deep soil area enables the planting of significant vegetation and trees. The deeper the soil, the greater ability it has to support the healthy vegetation to its full potential.

Soil Composition



Soil Profile





Key benefits:

- Better plant growth, from improved nutrition
- Improved moisture retention in the soil, better drought tolerance
- Improved soil structure
- Reusing kitchen waste
- Reducing CO_2 emissions through carbon sequestration in soil.

Key issues

1. Erosion/compaction
2. Poor quality soils
3. Insufficient deep soil

Water

Why is it important?

Future climate predictions for Canberra indicate lower annual rainfall, greater rates of evapotranspiration and increased periods of drought. Water sensitive urban design (WSUD) is a way of planning our cities 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. The key principles are:

- To reduce the demand for potable (fit for drinking) water by using alternative sources of water such as captured rainwater and treated wastewater and encouraging water efficient appliances
- To minimise the generation of wastewater and to treat wastewater to a suitable standard for re-use and/or release to receiving waters
- To treat urban stormwater to a quality where it can be reused and/or discharged to surface waters
- To use stormwater in the urban landscape to improve the visual and recreational amenity of developments.

Key benefits

- Water capture and reuse reduces our dependence on using potable water for irrigation.
- Retaining water on site increases planting success and growth rate.
- Improved landscape amenity comes with a healthy landscape.
- Increased soil and plant moisture leads to reduced flammability of bush fire fuels.
- Cooling effects—having water on site improves thermal comfort within urban areas.
- Improved water management and design can reduce flooding risk, increase water quality.
- Habitat creation can help protect and conserve vulnerable species and communities.

Canberra's Water Strategy 2014-2044: Striking the Balance

The ACT is wholly situated within the Murrumbidgee River Catchment, which feeds into the Murray-Darling River system.

The way you manage water on your site directly impacts one of Australia's largest and driest river systems.

The ACT Water Strategy is focused on achieving three outcomes:

1. Healthy catchments and water bodies
2. A sustainable water supply used efficiently
3. A community that values and enjoys clean, healthy catchments

Refer to the Strategy for detail on what you can do to help achieve the above outcomes by managing water wisely on your site. ACT Water Strategy 2014-44

NOTE: If you change the WSUD initiatives built into your site this impacts on the broader catchment. A certificate of compliance may be required to ensure your changes are not adversely impacting the broader system.

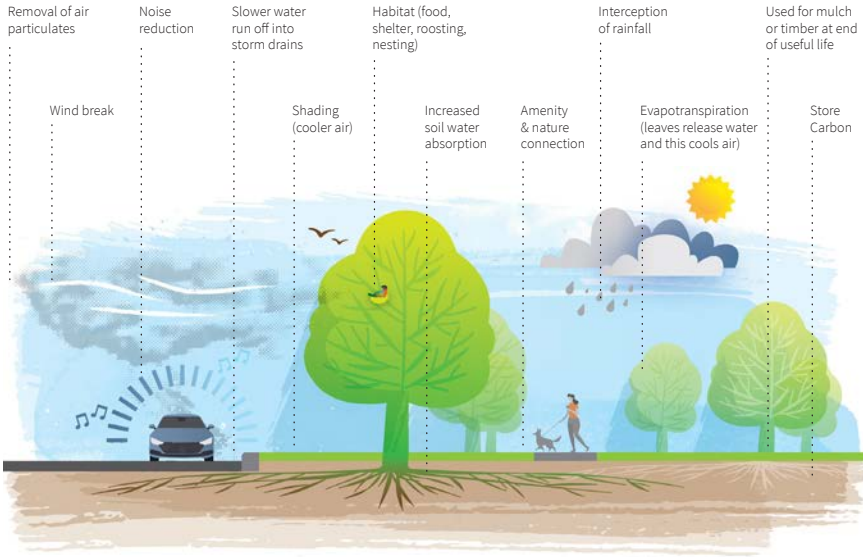
Key issues

1. Inconsistent rainfall
2. Not capturing what is falling
3. Inefficient water use

Vegetation

Why is it important?

Vegetation within cities provides not only aesthetic benefits but is of great ecological importance. Maximising canopy cover and providing a diversity of vegetated areas will increase the resilience of landscapes to change and provide many social, environmental and economic advantages. Prioritising the establishment and maintenance of healthy vegetated areas in our private open spaces will help to achieve the target of 30% tree canopy cover and 30% permeable surfacing.



Functions of healthy urban trees - source: TCCS Values of Street Trees in the Urban Environment

Key issues

1. Poor plant health
2. Not enough shade
3. Incorrect plant selection

Incorrect plant selection for local climate

Not enough shade to provide protection

Key benefits

- Natural shade and cooling for buildings and open spaces—this may provide energy savings.
- Enhanced biodiversity—creating new habitat, e.g. encouraging bees, birds and other insects.
- Increased slope stability, reduced erosion.
- Shelter against winds, screening of undesirable views.
- Improved site amenity—visual appeal and a sense of place and local identity.
- Improved health and wellbeing—improve air quality, improved mental wellbeing through connection to nature.
- Manage stormwater—improves infiltration and the reduced need for watering.
- Carbon storage—woody plants.
- Helps to combat climate change by mitigating the urban heat island effect and through carbon sequestration.
- Increased property value—10% increase in street tree canopy can increase value of properties by an average of $50,000 (AECOM, Green Infrastructure Report).

Materials

Why is it important?

Material selection can assist in the cooling of cities, the reduction of the urban heat island effect, developing a circular economy and the preservation of natural processes. The colour, composition and permeability of materials and surfaces can significantly influence site characteristics, such as the energy use, thermal comfort and impact on natural habitats and water flows of a site. Prioritising the use of porous materials will help to achieve the goal of 30% permeable surfacing on your site.

Most materials will come at some cost to the environment, whether it be the amount of CO_2 produced during the manufacturing stage or any negative impacts due to the transport of the material. However, there some climate-wise steps and choices that can be considered to select more sustainable materials, improve the life cycle of your materials and reduce the environmental and social impacts of poor material choices.

Key benefits

- Cooler environment
- Increased stormwater permeability
- Encourage a circular economy through recycling
- Reduced CO_2 emissions: Help to combat climate change
- Improved aesthetics and visual interest.

Key issues

1. Considering permeability in isolation to urban heat
2. Cost limitations of some materials
3. Surface treatment vs functionality of space

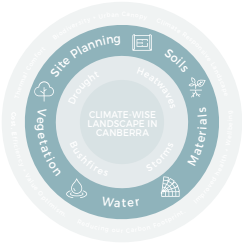
Maximisation of porous surfaces creates a varied, interesting landscape of complementary textures

Impermeable driveway

Permeable driveway

02 Technical guidelines

2.1 Key actions



The key actions for each element provide guidance to achieve a climate-wise landscape, no matter the scale, location or context of the landscape.

Site Planning | Soils | Water | Vegetation | Materials

Each key action element outlines:

Action checklists

- **A** Preparation
- **B** Design
- **C** Construction + maintenance

Reference tools

Action Icons are provided as pull-outs associated with the technical content:

Did you know?

Watch out for!

Budget boosters

Top three actions

Highlights main priorities

2.2 Government approvals

It is important that climate wise landscaping be considered at the earliest opportunity, such as when preparing applications for approval. This will ensure that climate-wise landscape outcomes can be maximised. Equally, it is important that before you commence any landscape works you obtain the relevant approvals.

Approvals

Most new development or renovation work will need to go through an approval process. This could be a Development Approval (DA), Building Approval (BA) or other approvals, depending on what you are planning to do. Refer to ACT Build Buy or Renovate for details.

Some projects may not need development approval if they meet general criteria as well as specific exemption criteria. Refer to DA exemption self-check to determine if your project is exempt from needing DA approval.

Territory Plan Codes

There are many requirements within the ACT Development Codes that are relevant to climate-wise design such as:

- % Open space areas
- % Planted areas
- Deep soil provision
- Material selection
- Shade
- Water sensitive urban design
- Tree protection
- Bushfire protection.

Refer to the ACT Development Codes for the rules relating to new development and approval requirements.

Protected Trees

Protected Trees cannot be removed without approval from the Conservator. It is an offence under Part 3 of the Tree Protection Act 2005 to undertake a tree damaging activity or groundwork activity on a Protected Tree without approval. Refer to Information about Tree Protection on Leased Land for details.

2.3 Action checklists

The action checklists below summarise the key actions for the 5 elements and can be used during the preparation, design and construction+maintenance phases to optimise the climate-wise initiatives included in the landscape.

A Preparation

	Y/N
Site and design	
Habitat: Map endemic vegetation communities in your area. Are there any threatened species on your site?	
Views: Identify any views or elements that you want to screen, or any that you want to enhance and frame.	
Micro-climate: Analyse the wind, sun and shade, at different times of the day and year.	
Topography: Map slopes and levels.	
Water: Understand how water flows through the site and identify if there any drainage issues.	
Soil: Identify what type of soil is on the site, and how deep it is.	
Vegetation: Look at existing trees, find out their species, age and health. Look at shrubs, grasses and ground covers, identify species and determine if they are to be retained, transplanted or replaced.	
Materials: Identify features or materials that can be retained, reused or recycled.	
Risks: Understand if the site located in a flood prone or bushfire prone area and what that means for you.	
Soils	
Soil testing: Undertake appropriate soil testing and identify soil type/s on your site. Do your soils have an appropriate water holding capacity that supports plant growth?	
Issues: Identify any existing soil issues where underlying problems may need to be addressed, e.g. waterlogging, compaction, etc.	
Protect: Identify the areas of the site to be planted and protect those soils from construction works.	
Site topsoil: If topsoil can be re-used on your site identify an appropriate storage location and reuse plan.	
Imported topsoil: If you really do you need to import soil to your site, determine the best mix/ composition of the imported soil. Do any site initiatives require a specialised soil mix?	
Deep soil: Ensure your deep soil zones are maximised and comply with the site's permeable surfacing requirements and relevant development codes.	
Structural soil: Identify if the installation of structural soil cells would aid in the long term health and viability of any of your proposed trees.	

	Y/N
Water	
WSUD targets: Identify the targets relevant to your development, if applicable.	
WSUD design: Do you need a specialist to design/coordinate a stormwater management system?	
Water treatment: If you require water treatment elements work out areas and locations.	
Hydrological context: Map water courses on and adjacent to your site and understand connection to the broader network.	
Rainwater capture: Is this a possibility on your site?	
Grey-water: Can you reuse greywater within your site?	
Irrigation: Consider irrigation system options and map preferred areas of irrigation.	
Water elements: Identify areas where water can be used for amenity, habitat and passive cooling.	
Vegetation	
Local ecosystems: Do you have any remnant threatened plant communities on your site? Do you have a plan to maintain, protect or enhance that community?	
Protected or regulated trees: Do you have any protected (regulated or registered) trees on your site (ACT Tree Protection Act 2005)? If so, have you sought the required approvals?	
Arboricultural assessment: Have you consulted an arborist to assess the species, age and health of the trees?	
Existing trees: Have you retained existing trees wherever possible with minimal impact on the root system? Have you allowed adequate soil area / space to allow existing trees to thrive?	
Vegetated areas: Have you maximised the planted areas of the site in line with the relevant Development Code / 30% permeable surface target?	
Watering requirements: Have you considered how you are going to water the planting and if irrigation is required?	
Food production: Have you considered a vegetable garden or bush tucker garden? Can you apply permaculture and companion planting principles to this?	
Bushfire: Is your property within a bushfire zone?	
Green buildings: Have you identified if green buildings or structures could be implemented on your site and maintained sufficiently?	
Materials + surfaces	
Permeable areas: Have you maximised the permeable paving on the site in line with the 30% permeable surface target?	
Reflective materials: Does your material selection help to reduce urban heat, e.g. reflective roofing?	
Access: Have you considered accessibility for all potential site users?	

B Design

	Y/N
Site and design	
Vision: Determine what you want to achieve on your site and who the key users will be.	
Opportunities and constraints: Summarise all the site analysis and planning information.	
Concept Plan: Plan the 30% permeable areas (deep soil zones, permeable paving). Identify trees to be protected and retained as well as key locations to implement new tree planting to attain the 30% canopy coverage required. Map out activity areas, access points, surface finishes, walls, steps and ramps.	
Detailed plan: Refine the concept into more detail that can be used for a DA (if required) or construction.	
Access and safety: Review the safety of users and ensure accessibility meets the required standards.	
Specialist Inputs: Identify if you need to engage any specialists to assist with parts of the design such as bushfire, flood or water sensitive urban design.	
Soils	
Site soil amelioration: Identify the additives needed to improve you site soil and how this will be achieved. These can be incorporated during digging for smaller areas or using mechanical cultivation (e.g. tilling) in larger spaces. Ensure any compacted soil areas are aerated, taking care around existing trees.	
Imported topsoil: Work out depths and areas required. Ensure it is locally sourced.	
Soil depth: Ensure that an adequate depth of soil has been allowed to support healthy plant growth.	
Recycle food and garden waste: Install a compost system or worm farm on site to recycle food and garden waste.	
Mulch: Ensure garden areas are mulched using sustainable materials.	
Root barriers: Locate root barriers to prevent potential damage to structures.	
Water	
Rainwater capture: Identify required water tank/storage sizes and appropriate locations.	
Greywater reuse: If used ensure integration with the rainwater tank and meets all relevant safety requirements.	
Passive irrigation: Maximise passive irrigation/infiltration, directing water flow from hard surfaces to planted areas/permeable surfaces.	
Water treatment elements: If required to meet water quality targets ensure that they are fully integrated into the landscape to maximise amenity, habitat and cooling value.	
Natural water elements: ensure that they are fully integrated into the landscape to maximise amenity, habitat and cooling value.	

	Y/N
Vegetation	
Canopy coverage: Does your site achieve at least 30% canopy coverage?	
Proposed trees: Have you ensured proposed trees have enough deep soil area and are located far enough from any buildings/structures so the roots do not impact the structure?	
Tree species selection: When selecting your new trees, have you considered their mature height, shape, and how long they take to reach maturity? Have you determined the purpose of the trees? Can this be used to address multiple needs?	
Plant selection: Have plant species been considered to reduce water usage/capitalise on WSUD systems? Have you considered the local conditions (micro-climate) of the site?	
Biodiversity: Does your planting support biodiversity, e.g. variety of plant species that support wildlife?	
Lawn alternatives: Does the site support an alternative to a traditional lawn, e.g. groundcovers or wildflowers?	
Green buildings: Does the design of your green building or structure consider required soil types/ volumes/loads, prioritise indigenous plant species, sustainable watering methods, efficient maintenance practices?	
Materials + surfaces	
Recycled materials: Is there opportunity to use locally sourced recycled materials or reuse existing materials on site?	
Sustainable material choice: Have you considered the environmental impacts of your material selection, e.g. CO_2 produced during manufacturing? Are you aware of the sustainability credentials of the materials you've selected?	
Lighting: Have you considered the impacts of lighting within the landscape? Can you utilise solar lights?	
Life Cycle Assessment: Have you completed a Life Cycle Assessment if required?	

C Construction + maintenance

	Y/N
Site and design	
Requirements: Consider how the open space will be safely maintained and irrigated.	
Risks: Consider any special requirements that might be required for bushfire of flood prone areas.	
Smart technology: Review if this could be implemented to support certain maintenance requirements.	
Soils	
Aeration: Periodically inspect soils in areas prone to compaction, e.g. high foot traffic. Ensure soil remains loose and aerated.	
Organic matter: Maintaining a healthy organic content in the top soil.	
Mulch: Implement a regular mulching regime.	
Water	
Rainwater tanks: Identify the maintenance requirements of your rainwater tank.	
Water treatment elements: Identify the specific requirements for the construction and management of these. Is a WSUD construction and maintenance plan required?	
General water elements: Weeding and tidyng will be required.	
Irrigation: Periodically inspect the sites irrigation system to ensure performance.	
Vegetation	
Tree management: Have you developed a Tree Management Plan if required?	
Vegetation management: Have you considered the long term maintenance requirements of the planting style and species you have chosen?	
Vegetation protection: Is a Vegetation/Tree Protection Plan required and is it being adhered to during construction?	
Plant feeding: Have you considered organic feeding processes such as composting or worm farms?	
Green Building: Has a sufficient maintenance regime been developed for the green systems installed? Do you need specialist equipment or professional assistance?	
Materials + surfaces	
Ongoing maintenance: Are you aware of the on-going maintenance requirements for your choice of material? Have you implemented appropriate measures at the design/planning phase to maximise the benefits/function of your material or surface?	
Recycled materials: For reused/recycled products, have they been treated accordingly?	
Hard surfaces: Have your surfaces been treated with an appropriate stain, sealer or additive?	

2.4 Site planning

A Preparation

Take some time before you begin designing to thoroughly assess your site. Doing this properly can save time and money in the long run.

Surrounding character and ecosystems: Look at the surrounding land and neighbourhood and think about how your site will fit into this. Identify the endemic species to your area, if there are any threatened species, are you part of a wider ecological corridor. Refer to ACTmapi Significant species, Vegetation Communities and Registered Trees.

Adjacent landscape elements: Review potential impacts on adjacent waterways, properties and vegetation and look at ways to mitigate adverse impacts and ideally enhance them. Consider the solar access of your neighbouring properties as well as any potential risks such as root damage to hardstand or building structures that may impact your planting design.

Views, topography and drainage: Highlight views or elements that you want to screen, or that you want to enhance and frame. Identify steep slopes that may need terracing and any drainage issues.

Site micro-climate: Micro-climate is created by the aspect, amount of sun and shade in your garden, the prevailing winds and the slope. It is affected by: buildings; walls; fences; structures; the placement of hard surfaces that may radiate extra heat; trees; shrubs; and windbreaks. Refer to ACTSmart: Micro-climate fact sheet.

Existing vegetation and soil: Look at existing trees, find out their species, age and health and whether they are regulated or registered. Are there any invasive plant species that need to be dealt with? Find out what type of soil is on the site, and how deep it is.

Refer to section **2.7 Vegetation** and section **2.5 Soils**.

Other site assets: Identify any features or materials that can be protected and retained, or reused and recycled.

Potential Risks: Research if the site is located in a flood prone or bushfire prone area. Refer to ACTMapi Bushfire and Flood maps.

Top three actions

1. Approvals required and relevant codes?
2. Plan for 30% canopy and 30% permeable area
3. Site analysis

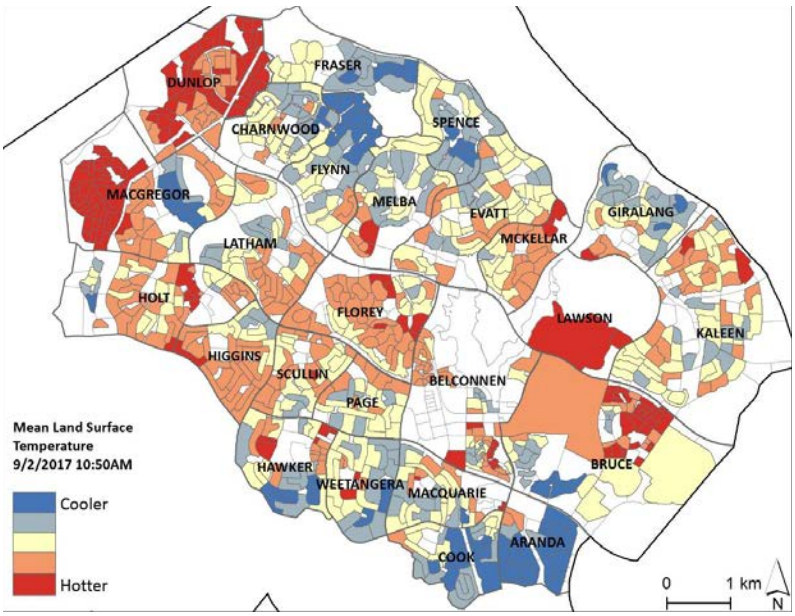
Nature Mapping

Understanding how your site forms a piece of a broader network of movement and habitat for flora and fauna will ensure you are influencing the health of the broader landscape.

Canberra Nature Map allows people to contribute latest sightings of rare plants in the ACT

iNaturalist allows you to record observations, share with fellow naturalists and discuss your findings.

Understanding your particular climate challenges and issues: Research and understand the specific climate issues facing your local area and what are possible mitigation measures. *The CSIRO Mapping surface urban heat in Canberra* can help explain current and future pressures on your district.



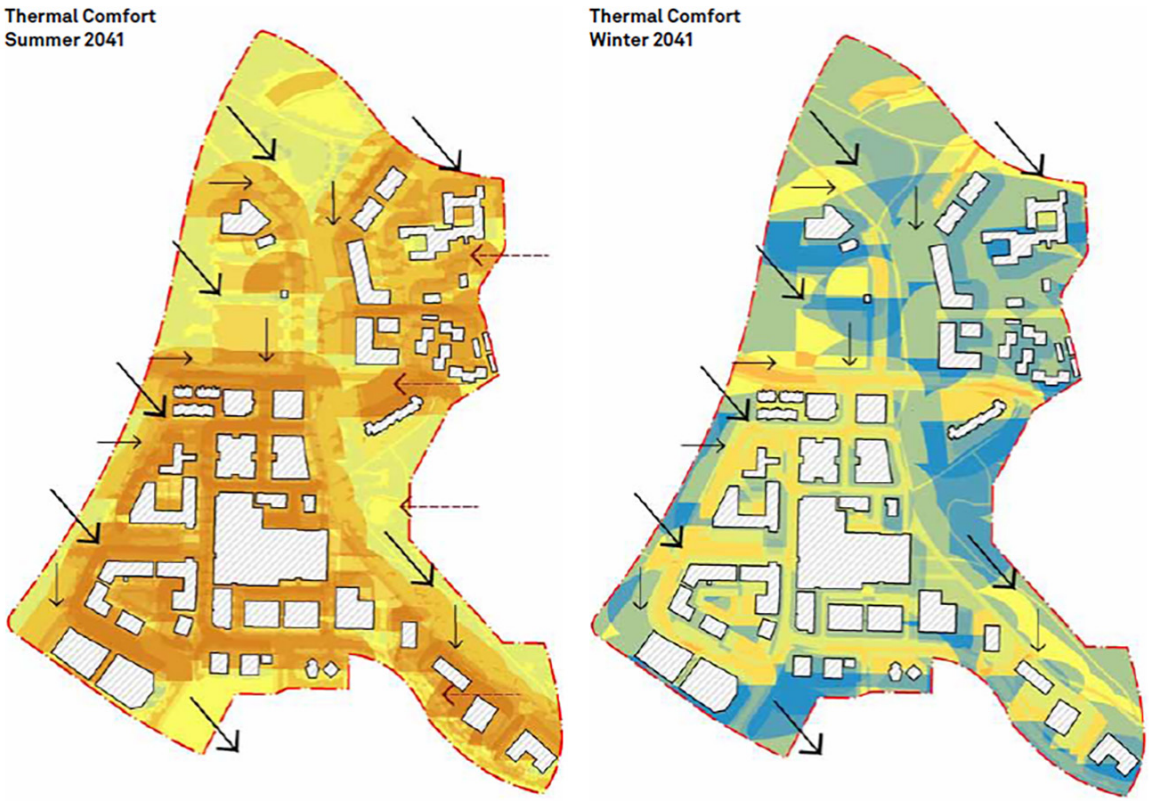
Summer Neighbourhood Heat Exposure and Vulnerability. Source: CSIRO Mapping surface urban heat in Canberra 2017

Development Approvals

Most new development will need to go through an approval process. Depending on the scale of your development and block size, there are % area requirements for open spaces and planting.

Contingency

Remember to allow for a contingency in your budget to cover any unexpected costs and request itemised quotes from contractors/suppliers so that works can be suitably staged if required.



Weston Thermal Comfort mapping: Source - EPSDD/AECOM

B Design

Opportunities and constraints plan: This can be a way to summarise the parameters that will shape your design, for example trees retained, views to highlight, fence to screen.

Vision: Decide what the key design objectives are and who will be using the space. For example, is it to create a native bush garden to maximise bird-life, or is it a lush urban oasis for the family to enjoy? ACTsmart: Starting from Scratch could be helpful**.**

Access and circulation: Identify the entry points and the desired movements for pedestrians and vehicles. Consider this in conjunction with levels to work out which paths could be accessible and where steps or ramps might be needed. Thinking about this will help to set up the structure of the space.

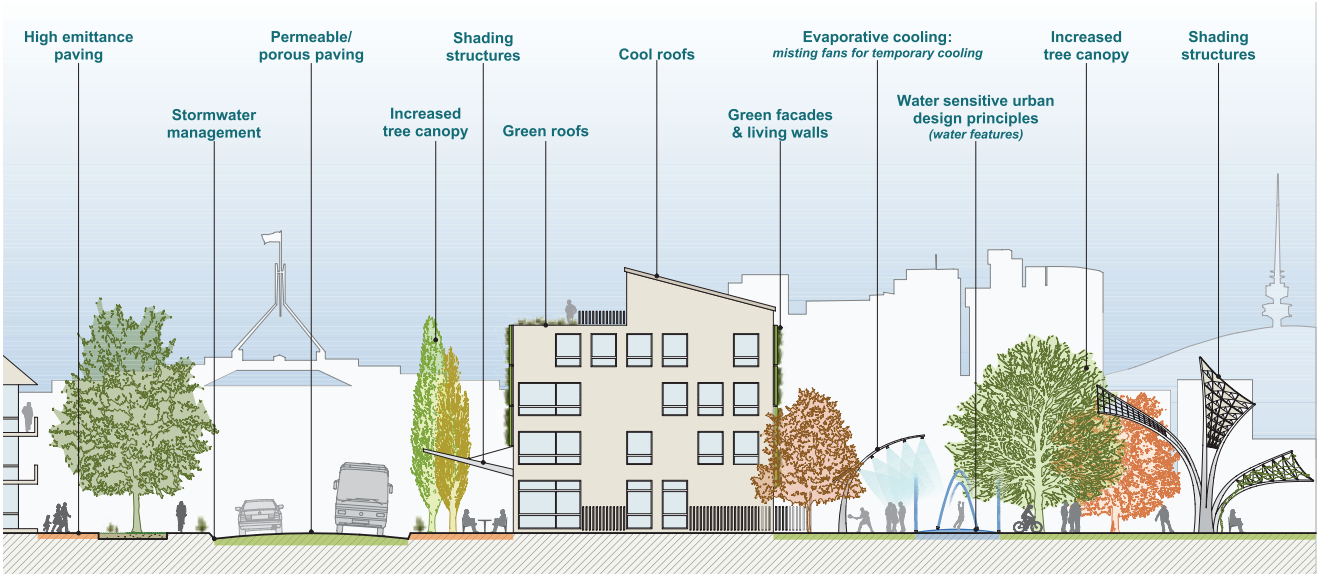
Tree canopy cover: The target is to achieve at least **30% tree canopy cover,** so locate new trees with space to grow to maturity without causing future damage to buildings, structures or services. Consider how big you want the trees to grow and whether they would be best as evergreen or deciduous. Refer to section **2.7 Vegetation** for more details on planting.

Materials and surfacing: The target is to achieve at least **30% permeable surfacing** so maximise planting areas and identify where you really need paving. Refer to section **2.8 Materials** for more details on materials.

Levels: Resolve the levels and any associated walls, steps, ramps that might be needed. Cross sections can be useful.

Water: Look at the location and sizing of water detention elements such as tanks or basins, as well as irrigation, water treatment options and site drainage. Refer to section **2.6 Water** for more details on water.

Safety: This might include lighting, passive surveillance or other considerations. A Safety in Design review should be done for communal open spaces.



Canberra Summer cooling strategies. Source: Low Carbon Living CRC: Guide to Urban Cooling Strategies 2017. This study investigated and made recommendations for urban cooling strategies at a scale applicable to campus, precinct, and suburb scales to reduce the heat island effect and achieve thermal comfort for larger multi-lot developments.

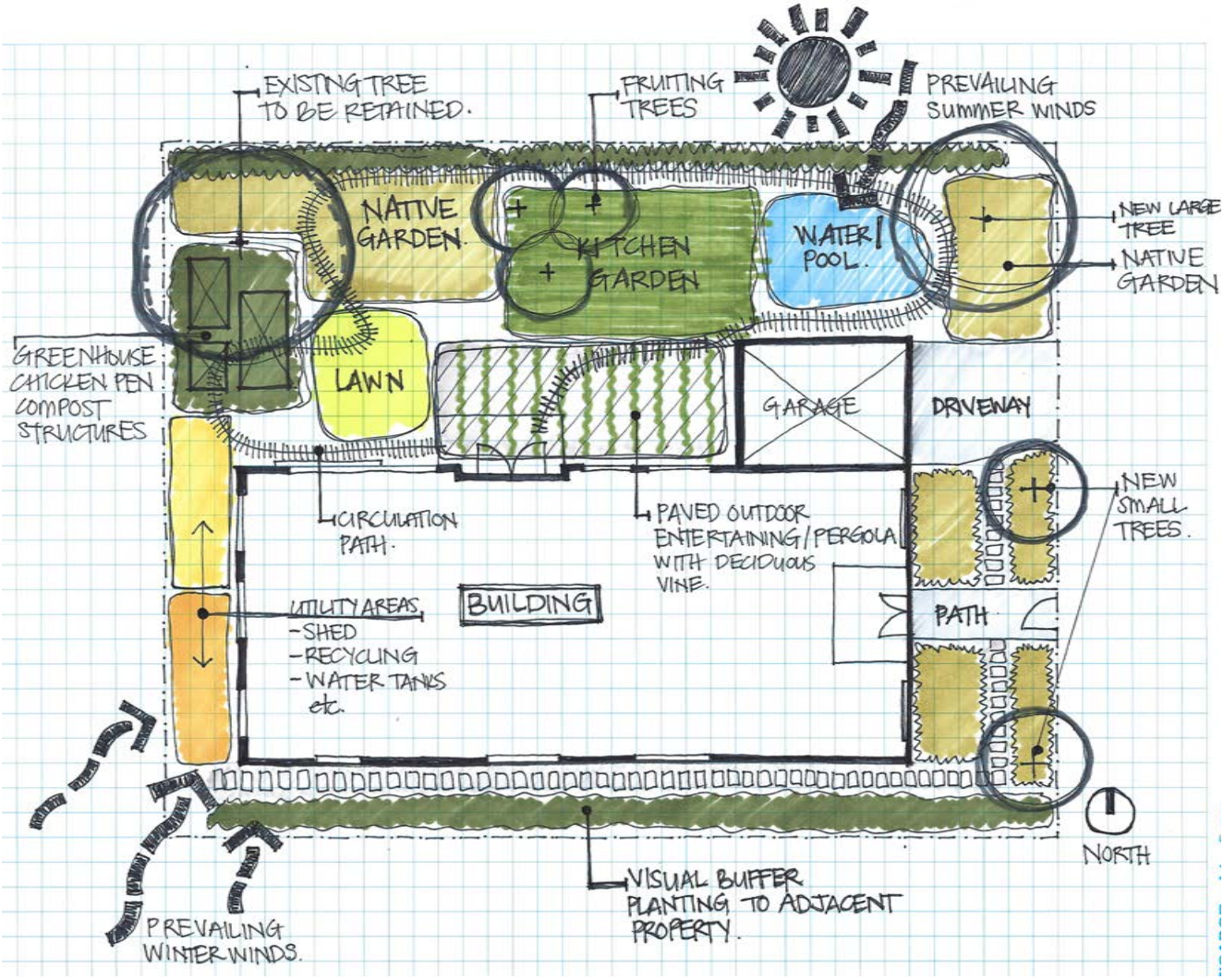
Concept Design

A high level concept 'bubble diagram' can help to organise the site into different areas, for example native garden, seating area, playground. Can spaces be multi-purposed? This plan would typically show:

- activity areas
- access points and paths
- trees to be retained, proposed trees and planted areas
- paved areas / surface finishes
- walls, steps, furniture and other hard elements
- indicative levels and slopes.

Detailed Design

Once the concept has been agreed the next step is to refine this in more detail to enable Government approvals and then construction.



High level concept bubble diagram maps out existing features to be retained, functional zones and areas of focus for specific climate-wise initiatives.

C Construction + maintenance

In the long term a space will perform better if the maintenance has been considered at the planning stage. Some homeowners might want a hands-on garden whilst other non-residential spaces may have minimal long term attention.

Mowing: Think about how the space will be maintained. For example, are lawn areas practical to mow or would they be better as a planted area?

Trees: Think about the mature long term size and form of the trees, and potential issues such as limb drop.

Weeds: If permeable paving is being installed a weed suppressing underlay can reduce maintenance. The Weeds Australia website allows residents to report, manage and identify weeds as well as providing links to agencies and community participation programs. https://weeds.org.au/

Safety: Always consider what maintenance may be required to ensure the safety of users in the open space, such as in water ways, adjacent to roads and against building edges.

Monitoring: Consider how you will track regular maintenance requirements. There are Smart technology options you can install that alert you when certain maintenance activities need to occur, providing greater efficiency of time and resources.

Smart technology monitoring

Smart garden monitors can be used to read soil moisture and temperature. These can then wirelessly connect to tap timers, which can be monitored on your smartphone!

This can reduce the amount of water you use by only irrigating when it is required.

Reference tools and technical guides

Below are additional resources for help during the planning stage:

- Canberra's Living Infrastructure Plan
- CSIRO Mapping surface urban heat in Canberra provides a detailed explanation of the urban heat challenges Canberra is facing, data and mapping to communicate the issues, and mitigation measures.
- AILA - Adapting to Climate Change: Green Infrastructure provides information on green infrastructure planning, increasing connectivity, multi-functionality, and landscape performance in the built environment.
- CRC Low Carbon Living publications including Guide to Low Carbon Landscapes and Guide to Low Carbon Precincts.
- My Smart Garden provides advice and resources on growing food, sheltering homes from sun and wind, creating homes for wildlife , using water wisely and recycling waste.
- City of Melbourne, Sustainable Gardening Booklet gives you practical advice on gardening in private spaces, such as roof tops, balconies and smaller front and back yards.
- Sustainable Gardening Australia is a not-for-profit organisation that provides information, connects people and communities through a shared passion for sustainable landscape planning, design and maintenance.
- Climate-wise Landscaping: Practical Actions for a Sustainable Future, Reed and Stibolt, 2018. This book provides simple and practical steps homeowners and landscape professionals can take to maximise the ability of their landscape to adapt to a changing climate.

The following web-tools assist in identifying and tracking sun movement and micro-climates on your site:

- Sollumis.com provides solar information for different locations in Australia at different times of the year.
- Sunsurveyor is an application that gives detailed site specific data on sun and shade throughout the year.

2.5 Soils

A Preparation

Understand your soil to know which plants are the most suited to your site conditions. In Canberra's urban areas, most soils have shown to have a high clay content which can be subject to compaction and drying out. Test and understand your soil type before you commence any works.

Local context: The ACT Soil Landscapes dataset provides information of soils, landscapes and physical and chemical constraints to land use in the ACT. There are 55 different soil landscapes identified within the ACT. Refer to the ACTmapi: Soil and Hydro-geological Landscapes Map for more information on soil types on your site.

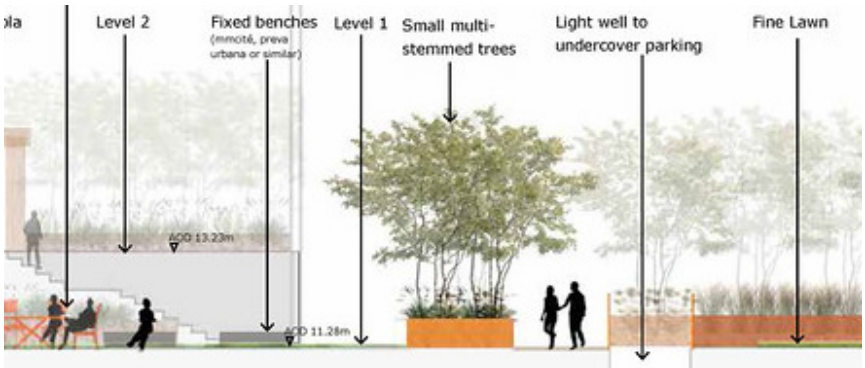
Soil testing: There are several soil tests that you can do yourself to test the soil type and drainage. Alternatively, a commercially available soil test can determine the fertility and health of your soil by measuring the pH and pinpointing nutrient deficiencies (such as SESL Australia).

Protection: Identify the areas of the site to be planted and protected from compaction during construction.

Deep soil zones: It is important to maximise your deep soil zones where possible to enable the successful planting of significant vegetation and trees. Minimal soil disturbance should occur within the drip-line of existing trees.

Planting on podium / raised planting beds: Sometimes planting needs to occur over a solid structure. It is important to identify early on how deep these planting beds need to be to allow for adequate soil depth as well as a drainage layer.

Structural soil: If your site is constrained by urban features such as paved roads, footpaths and service trenches, any tree plantings in the soils around these elements might be susceptible to failure due to inadequate soil volume. Consider the use of structural soil cells, which allow for both the structural foundations of urban elements whilst providing adequate soil volume for tree roots.



Podium planting on concrete slab

Top three actions

1. Use ameliorated site soil
2. Ensure sufficient deep soil areas are provided
3. Recycle food waste as compost

Top soil reuse

Topsoil is a finite resource that has taken millions of years to form. Poorly managed topsoil stripping and stockpiling during development can lead to poor soil quality with cost implications for soil and landscape remediation. A topsoil management and reuse plan can assist in maximising the recovery and reuse of soil on site which in turn could reduce the costs associated with imported soil and/or soil disposal.

Identify an appropriate storage location and keep your topsoil on site while the construction works are completed.

Citygreen Stratacell installed at Thomas Street Sydney (Chinatown)

B Design

Providing healthy soil is an essential part of creating a healthy environment for plants, trees, worms and other microorganisms to thrive.

Cultivation: Topsoils need to be loose to provide adequate aeration for the soil and plant roots. If the soil is compacted, it may need to be dug or ripped to improve its structure. Care needs to be taken around existing tree roots.

Site soil amelioration: The upper layer of topsoil should be visibly darker in colour, and contain high concentrations of organic matter and microorganisms. In some circumstances, additions such as organic matter, gypsum or fertilizer may need to be added to improve structure and fertility. A soil wetting agent might be required if your soil is water repellent. Refer to the ACTSmart The importance of soil fact sheet for tips improving your soil.

Imported topsoil: If topsoil does need to be imported ensure it meets Australian Standards. A premium mix will provide many benefits over a cheaper alternative that may save you money in the long term.

Compost: This sustainable soil additive will boosts organic content in your topsoil. Composting is an excellent initiative not only to keep your soil healthy but to reduce household and kitchen waste. Compost can either be bought or for more information on creating your own compost refer to the ACTSmart Composting fact sheet for more information.

Mulch: This should be installed over damp soil to a depth of 75-100 mm. Unlike compost, it is not worked into the soil. The layer acts to protect soil and roots from temperature change and assist in retaining soil moisture. Organic mulches are best as they also break down to feed the soil. For more information, refer to the ACTSmart Mulching Fact sheet.

Lightweight soils: These may be required for podium landscapes, which require higher irrigation regimes. Consider the use of soil crystals in these areas.

Root barriers: The use of root barriers can provide protection to the surrounding infrastructure against disruption from tree roots, with minimal impact on the tree. Root barriers should be installed vertically in a continuous length in a narrow trench dug on the tree side of the pavement or kerbs with the top edge flush with the finished ground.

Root Barriers can prevent damage to adjacent structures and services

Worm farms and composting

Use worms to recycle food scraps and other organic material into a valuable soil compost. Not only are worm farms a great educational tool, they are an ideal solution to reduce your household waste and reduce greenhouse gas emissions. Worm farms produce both compost from castings as well as liquid fertilizer.

Compost bins provide greater flexibility than some worm farms as they are able to handle a greater variety of biomaterials such as lawn cuttings and leaf litter. Compost bins are more resilient to sudden changes in conditions such as heatwaves.

Consider what may be the best waste recycling system for your landscape.

Composting is a great way to sustainably improve your soil

C Construction + maintenance

There are various methods that can be employed during the construction of a landscape to both retain healthy site soil, or improve site soil to ensure the establishment of a thriving landscape.

The Municipal Infrastructure Design Standards provide technical specification guidance for various aspects of landscape construction including topsoil management, re-use, amelioration etc.

Maintaining healthy soils relates back to soil requirements of oxygen, water and organic content:

Aeration: Ensuring your soils remain loose and avoiding compaction.

Water: Ensuring your soils have a healthy water balance and retain moisture for plants.

Organic matter: Periodically incorporate compost/organic matter to enhance your soils nutrients and maintain healthy soil habitat for beneficial organisms such as worms. Avoid or minimise the application of chemicals such as pesticides that could impact the soils composition.

Reference tools and technical guides

Below are additional resources for help on how to plan, design for and maintain soils:

- Gardening Australia 2016 Series 27 Episode 09 - Know Your Soil shows how to do a Ribbon test, a pH test and a Drainage test.
- Vegesafe is a program by Macquarie University (NSW) which provides resources and testing for soils from residents across Australia.
- Leake, S. & Haege, E., SESL Australia, 2014, Soils for Landscape Development: Selection, Specification and Validation.

Relevant Australian Standards:

- **AS4419:2018** Soils for landscaping and garden use.
- **AS4454:2012** Composts, soil conditioners and mulches.

Watch out!

Compaction
Soil compaction can happen over time as result of foot traffic, heavy water and/or machinery, especially over turfed areas. Ensure soils are loose and aerated to allow for oxygen and water to filter through.

Waterlogging
Waterlogging may be a result of multiple factors such as compaction issues, site design or water management.

Exposed subsoil
Exposed subsoil on the surface is a common result of construction. Be sure to check you have adequate topsoil, which is usually darker in colour. Often plant failure is attributed to plants being planted directly into subsoil which does not have the organic content to support plant growth.

Waterlogged lawn and garden

Unhealthy vs. healthy soil

2.6 Water

A Preparation

Thinking about water use and planning the water elements in your open space is essential to ensure an integrated and successful landscape outcome.

WSUD: Identify the WSUD targets applicable to the development type and scale. Then identify the suitable WSUD strategy for the site to meet the criteria. This may include a fully integrated solution, on-block measures or neighbourhood solutions. Refer to the ACT Practice Guidelines for Water Sensitive Urban Design - Module 1: Introduction to WSUD in the ACT.

Site context: Map water courses on or adjacent to your site and understand their connection to the broader network.

Rainwater capture: Review roof areas and potential water volumes to inform tank sizing, then where these tanks might fit. They can be above ground, or if space is restricted there are below ground options.

Grey-water capture: This is more cost effective if integrated into new build developments however can be retrofitted.

Irrigation: Identify where irrigation might be needed. Review the ACTsmart: Irrigation fact-sheet to ensure the most efficient method of irrigation.

Treatment: Do you have space on your site for water treatment elements such as swales, bio-retention basins, ponds or wetlands. These need to be located to consider the site topography and drainage.

Visual amenity and cooling: Are there spaces that would benefit from water as a cooling element, and if so how can they be located to maximise usability.

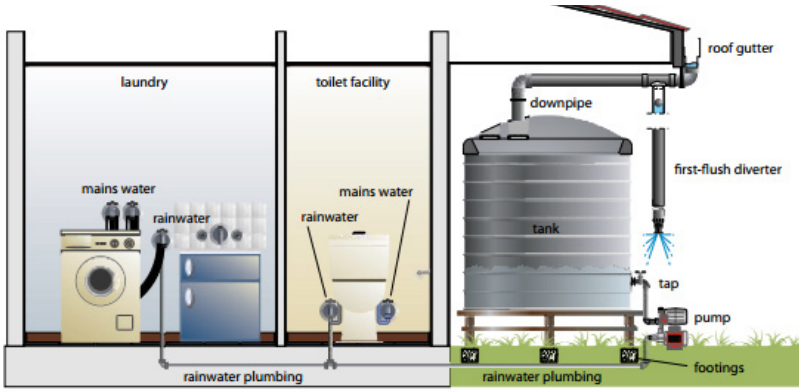
Top three actions

1. Rainwater capture - install a rainwater tank
2. Maximise water infiltration
3. Water elements integrated into the landscape

WSUD targets

In the ACT, property owners who are building, redeveloping or significantly extending their properties will need to demonstrate how they meet water efficiency targets. This applies to all residential, commercial and industrial developments.

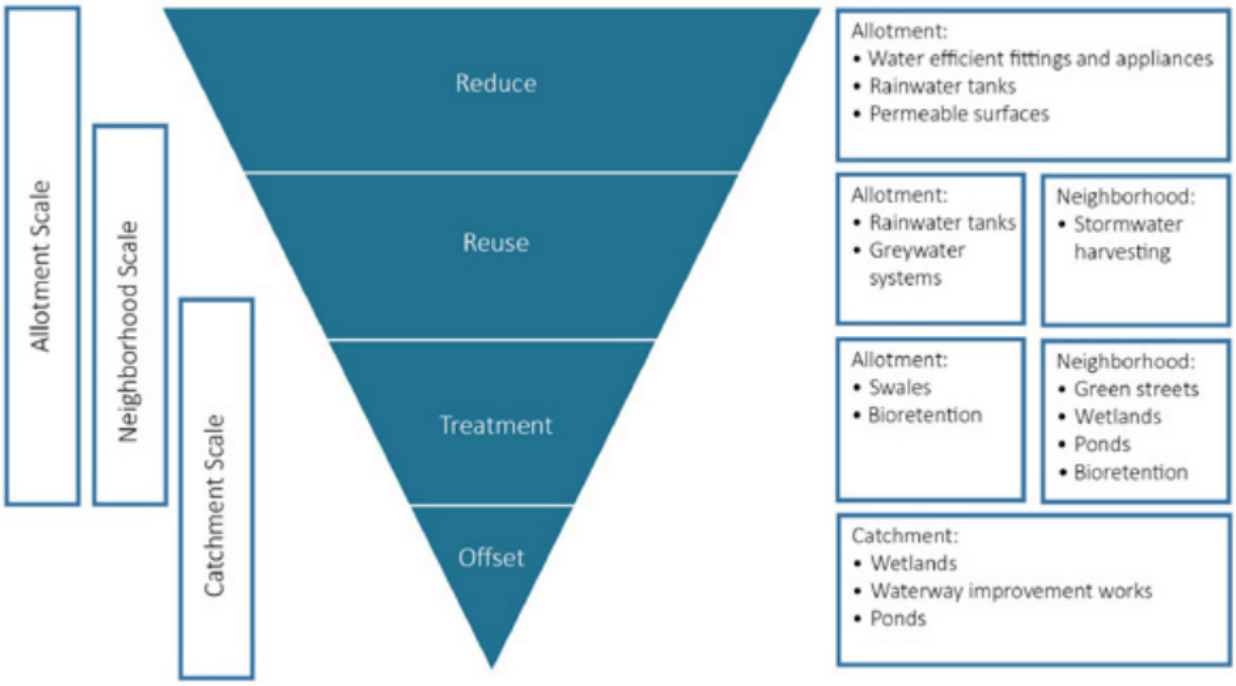
Refer to the ACT Government Territory Plan 11.10 Waterways: Water Sensitive Urban Design General Code.



Rainwater Tank Configuration. Source: Guidelines for residential properties in Canberra (ACT Government, 2010)

Rainwater tanks

In 2010 the ACT Government set a target to reduce Canberra's mains water consumption by 25% by 2023. Currently 6.7% of ACT households have a rainwater tank. Installing a rainwater tank could save you money by reducing water bills. For more information refer to the ACTSmart: Sources of Water fact-sheet as well as Rainwater Tanks: Guideline for residential properties in Canberra



WSUD Hierarchy of initiatives for development scales. Source: ACT Practice Guidelines for Water Sensitive Urban Design - Module 2

B Design

Many of the elements that will help you achieve your WSUD targets or objectives are integral parts of the open space design and are an essential part of a climate wise landscape. They can also add significantly to the landscape quality, have cooling benefits and increase habitat value.

Rainwater capture: Installing a rainwater tank captures a free supply of rainwater that falls on your roof. Using rainwater for irrigation and outdoor uses like washing the car can reduce the demand and cost of using your potable water supply. Other considerations include capturing grey water from your bathroom and laundry.

Passive irrigation: Plan your design to optimise passive irrigation by directing runoff from impervious surfaces to areas of deep soil and porous paving rather than into stormwater drains.

Permeable areas: A climate wise landscape is aiming for a minimum of 30% permeable surfaces, so the design should maximise areas of vegetation, mulch, gravel and other similar materials that allow rainwater to permeate into the soil. Refer to section **2.8 Materials** for more information.

Water retention and treatment: Elements such as ponds, wetlands, rain-gardens and swales are typical methods of retaining water on your site to enable it to naturally infiltrate into the ground. Terracing and landform can also be used to divert water, slow it down and allow it to infiltrate the soil. These also have the advantage of providing potential habitat for local species as well as improving site amenity.

Natural water elements: Where natural waterways or drainage areas are present on your site, consider conservation and rehabilitation methods to improve the quality and aesthetics of these elements. Where larger buried channels are present, consider daylighting and restoring these water channels and riparian areas to a more natural state.

Refer to the ACT Practice Guidelines for Water Sensitive Urban Design - Module 2: Designing Successful Solutions in the ACT for more detailed design guidelines.

Passive irrigation

Ponds and wetlands

Stormwater harvesting and re-use

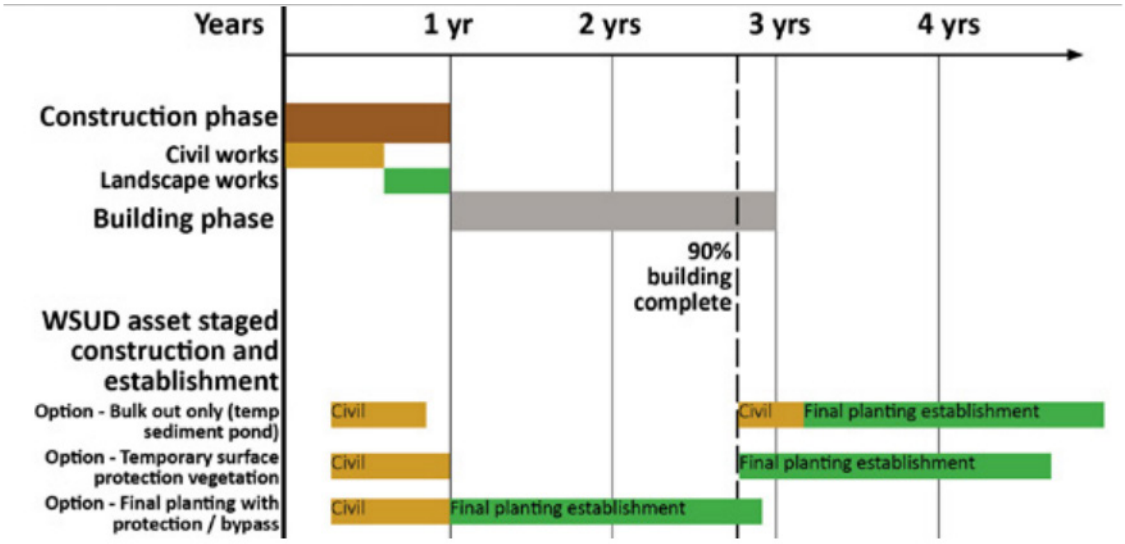
Water efficient fittings and fixtures

Grey-water harvesting and reticulated recycled water

Raingardens and swales

C Construction + maintenance

The construction methodology will vary depending on the scale and complexity of your landscape water strategy and design. For larger developments, the ACT Practice Guidelines for Water Sensitive Urban Design - Module 2: Designing Successful Solutions in the ACT provides detailed guidance on requirements.



Overview of typical construction and building phases of urban development with recommended staging options for WSUD assets. Source: ACT Practice Guidelines for WSUD - Module 2

Most water elements will require a degree of regular maintenance to ensure they are functioning efficiently:

Rainwater tanks: These should be maintained regularly to ensure high water quality. This may include checking for corrosion, cleaning gutters, de-sludging and cleaning.

Water elements, basin and swales: Monitor for invasive weeds, ensuring outlets are clear of leaves and debris.

WSUD: For larger sites, consider the preparation of a WSUD maintenance plan for your site to ensure your assets are being maintained consistently and on a regular basis.

Irrigation: Will need regular inspections and flush through to ensure removal of debris and silt.

Reference tools and technical guides

Below are additional resources and technical guidelines for help on how to plan, design for and maintain water quality and usage:

- ACTsmart: Creating a Water Efficient Garden gives advice on creating a great garden using minimal water.
- ACTSmart WaterRight Gardens Webtool assists in providing accurate watering schedules and save money for your garden.
- Irrigation Australia provides a breakdown of different types of irrigation systems.
- CRC For Water Sensitive Cities provides information on a Water Sensitive City, including resources, tools, and case studies.
- SA Government, Technical Manual for WSUD in Greater Adelaide provides technical information and manuals.
- YourHome provides an Australian guide to environmentally sustainable homes, including a section on water.

2.7 Vegetation

A Preparation

There are many things to consider when planning the trees, shrubs and ground covers for a site:

Local ecological communities: Visit ACTmapi Significant Species, Vegetation Communities & Registered Trees to review what is relevant to your site. These will help inform your decision making around landscape character and species selection.

Existing trees: If existing trees are well established and in good health it is important to ensure their root system is allowed for in the new design. An arborist should be consulted if there are safety concerns and to advise on earthworks within the drip-line of existing trees to ensure minimal damage. Tree protection areas are to be provided during construction.

Canopy cover: Work out what 30% of your site area is and what the current canopy coverage is from existing trees. Then calculate how many new trees at what canopy size will be required to achieve that area.

Planning for new planting: A minimum of 30% of the site needs to be permeable (vegetation or porous surfacing). Work out how much of this will be planting or lawn and where these areas will be located.

Watering requirements: Consider how /if you are going to water the planting. Ideally, if planting can be hand watered/irrigated during establishment using recycled water, planting should then be able to thrive on natural rainfall only. Refer to section **2.6 Water** for more information.

Sustainable lawn and alternatives: The installation of traditional turf lawns should be carefully considered in a climate-wise landscape. Consider the use of lawn alternatives such as small clumping grasses or spreading ground covers.

Food production: This can be applied to differing scales of development, whether a backyard veggie patch, community garden or urban farm. They can provide a sustainable food source and social benefits. There are many online resources such as the Canberra Organic Growers Society to help you get started. Introducing bush tucker into your garden can also be a great way to encourage native species as well as connect to Indigenous culture.

Bushfire risk: Check the ACTmapi Bushfire viewer to see if your property is within a bushfire prone area. There may be limitations placed on your site in terms of density of tree planting and proximity of planting to buildings and structures that may need to be adhered to.

The benefit of a mature tree

It can take anywhere between 10–30 years for a tree to grow and mature in size. Large mature trees are of great importance in our urban environments for both the environment and climate. Older trees store more carbon, have greater photosynthesis processes, usually provide greater canopy cover and essential hollows for animals and birds. They also provide soil stability and can act as significant wind breaks.

Urban tree canopy tips

Urban tree canopy plays a critical role in the health and comfort of our urban landscapes. As Canberra's urban tree canopy ages, new trees need to be planted to ensure the canopy % is maintained. Any new tree plantings need:

1. To be passively watered from an appropriately sized catchment or actively irrigated
2. Be provided with an adequate rootzone volume of appropriate media to enable somewhere near optimum growth.

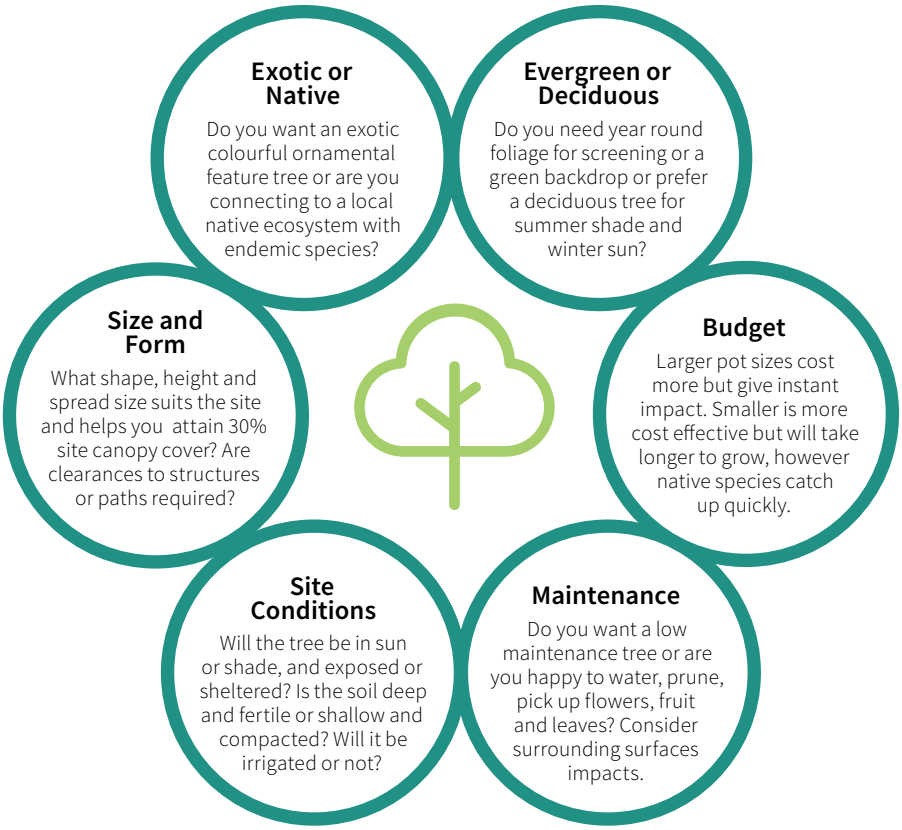
Failure to do this could be a waste of money if the new trees due not thrive. This then jeopardises future landscape initiatives to mitigate climate change impacts.

B Design

Considerations for the local condition such as shade, drought, frost tolerance and water requirements are all elements that need to be considered when selecting trees and plants.

Planting structure: Map out what type of plant you want to locate where in your landscape. Match plants to the micro-climates so they are happy in their environment. Think about where you might want taller plants to screen unwanted views or shelter from prevailing winds. Trees can be used to frame views and taller plants to protect smaller ones. Consider using ground covers instead of lawn. Refer to the Climate Wise Garden Designs and the Municipal Infrastructure Standards 24 - Soft Landscape Design and 25 - Plant species for urban landscape projects for detailed guidance.

Species selection: To achieve a successful planting outcome across your site it is important to choose plants wisely. See the infographic below for a summary of the key elements to consider when choosing tree species. Write a "shopping list" of the plant types that you want to include, including preferred height, form, function, time of year for flowering etc. Ensure that watering requirements are considered carefully - refer to the ACTSmart WaterRight Gardens Webtool. If possible, ensure trees and plants serve more than one purpose. For instance, some fruiting trees may provide shade as well as edible fruit. Visit your local nursery or use the ACTSmart Plant Selector online tool to assist in selecting tree and plant species that are compatible for your needs and local conditions.



Choosing a tree species involves making important decisions.

The importance of biodiversity

The plants you include on your site directly influence broader ecological diversity. The best ways to support increased biodiversity are:

- Avoid mono-culture planting (just using one or two types of plants)
- Use plants that attract birds and insects that aid the pollination process and help the health of ecological communities outside your site
- Use trees and plants that provide safe habitat for animals

A lack of biodiversity in your garden will leave it more susceptible to climate changes over time, particularly if the mono-culture you have used fails in the new climate.

What is a weed?

A weed is a plant not local to the area which competes with and can dominate local species.

Familiarise yourself with tree and plant species that are classified as weeds or invasive species here: Pest Plants and Animals Declaration 2015.

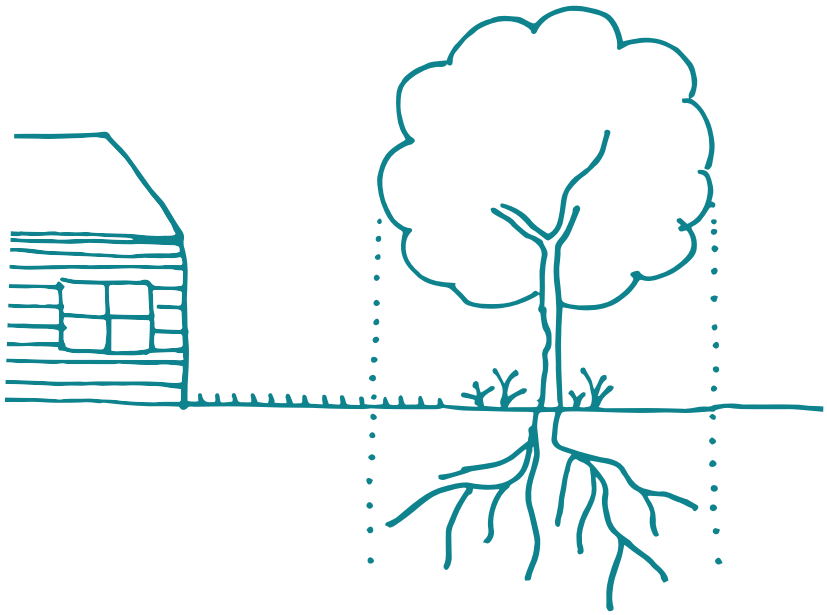
Although weeds can often be hardy and appear to thrive, they have detrimental impacts on native plant species, waterway health, soil health and do not provide appropriate food and habitat for local animals.

The balance between bushfire risk and increased canopy cover: It is important to acknowledge the balance required between increasing the number of trees in our landscapes, and managing the bushfire risk the canopy brings. Tree and vegetation generally do add more fuel to the landscape. Therefore, it is important to provide not just green, but fire-safe neighbourhoods. There can be a balance between green/cool and fire safe. Some examples of considerations are:

- strategic planning of Urban Green Infrastructure or UGI (position, arrangement, species selection and maintenance)
- enhancing natural fire breaks
- raising the importance of water provision and blue infrastructure.

Tree planting considerations: There are three key issues or constraints to consider when working with either existing trees to be retained, or deciding the location of new tree plantings. The below explains these considerations, with the diagram representing the zone of influence of a tree in the landscape:

- A protection zone (fencing) around an existing tree to be retained, at a minimum, should align the extent of the canopy with adjacent construction works are being undertaken.
- When deciding how close to a building or structure to plant a new tree, make sure you consider the mature size of the tree and plant far enough away so that the canopy and root zone will not impact the building.
- When locating paths or hard surfaces near trees, try as much as possible to avoid compaction or excavation to the tree root zone otherwise the stability and health of the tree will be impacted.



A general rule of thumb is that the roots of a tree extend to approximately the same distance as the canopy.

Sustainable plant sources

Investigate sourcing plants from alternative methods such as buy/swap/sell sites to promote the circular economy and reduce unnecessary disposal of unwanted plants and promote local propagation.

Tree removal

Many tree removal applications in private property are as a result of poor planning and understanding of the mature tree size and form. As a guide, know that the root system generally mimics the extent of the canopy. If the canopy reaches your house, the roots will also reach your house!

If tree removal is required, consider how that tree could be re-used in your landscape. Can is be turned into mulch for the garden, use the trunk for habitat etc?

Is my tree protected?

A protected tree is a regulated or registered tree under the ACT Tree Protection Act 2005.

Pruning or removal of a protected tree requires an application for approval. Refer to the ACT City Services Trees page or the ACT Single Residential Development Fact Sheet.

Green buildings: One way to maximise the landscape opportunities, particularly on constrained sites, is by greening buildings and structures. This can be done in many way to assist in providing shade, creating improved micro-climates, improving plant diversity and habitat creation. There are several ways in which green buildings and structures can be integrated into your site.

Living architecture includes green roofs, green walls but also implementing green structures on balconies. Where space is limited, increasing green cover where possible does not only have aesthetically benefits, it provides many health benefits. Exposure to green spaces has proven to enhance thermal comfort, reduce stress and improve overall mental wellbeing.

Things to consider when designing your living architecture

- Micro-climate
- Waterproofing requirements
- Specialised growing medium
- Structural capacity
- Watering requirements
- Indigenous plant species
- New build or retrofit
- Fire safety requirements in accordance with the National Construction Code

Please seek professional advice from a building certifier when designing your living infrastructure.

For more information on living architecture visit The Australian Government's YourHome Green Roofs and Walls web page.

Understanding living architecture

Extensive green roof
Growing medium typically up to 200mm deep. Typically does not support general access.

Intensive green roof
Growing medium typically greater than 200mm deep. Can support access and potentially vegetation including trees.

Green wall
Vegetated system grown on a vertical facade that utilises soil/growing medium on the wall, applicable to single dwelling housing and individual apartment units (not connected to more than one level).

Green facade
Utilisation of climbing plants growing directly on the wall or a support system (e.g. trellis/ wire cable) typically planted in ground or at the facades base.

Planting integrated into balconies and façades through planter boxes

Green walls can provide many benefits

A green roof can be an oasis in the city landscape - Source: YourHome website

Deciduous vine over pergola for winter sun and summer shade

Green roofs can provide cooling, habitat, biodiversity and aesthetic benefits

C Construction + maintenance

The landscape character you have chosen will inform the level of maintenance required. Generally, installing a primarily native garden, with plants that are established in the Australian climate, are lower maintenance.

Pruning: Choosing the right tree for the right place will minimise maintenance requirements, however branch pruning may be needed from time to time.

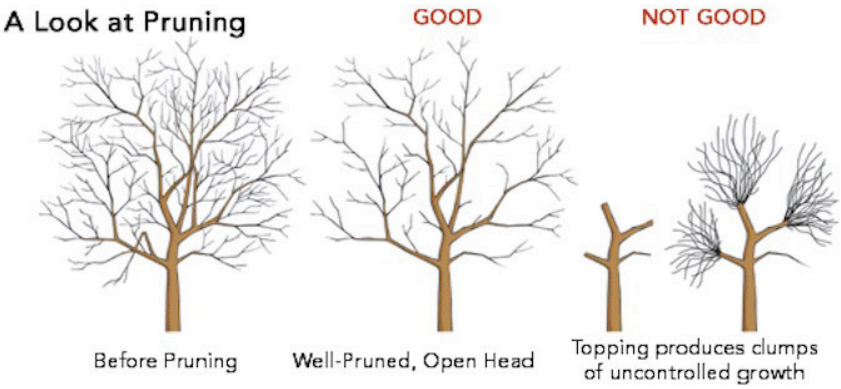
Irrigation: Passive irrigation and ensuring your trees and plants are properly watered will improve longevity in urban environments. Supplementary watering may be required during establishment period (3-6 months).

Feeding: Regular annual fertilising during early years may be required, depending on the type of plant. Ensure to use organic and efficient processes wherever possible.

Leaf litter and fuel load management: Regular raking and collection of leaf litter is important in maintaining the health of your garden, ensuring waterways are kept clear of excessive litter, and possible bushfire fuel loads are reduced. Consider if the leaf litter can be reused as mulch for garden areas to maintain the moisture levels and contribute to organic content of soils over time.

Asset protection zones: In bushfire prone areas, adhere to the ACT Strategic Bushfire Management Plan for removal of leaf litter and regular lawn maintenance.

Should you have a large site, consider engaging an arborist for an annual maintenance check to prepare a plan of action on maintaining the health of your trees on site.



Ensure the pruning regime does not reduce the benefits provided by the tree

Fuel management

Cultural Burning is a traditional practice developed by Aboriginal peoples to preserve and enhance the health of the land, plants, animals and its people. In contrast to a hazard reduction burn, traditional cool or cultural burning is a cooler low-intensity burn that is applied more frequently, and is more labour intensive. Cultural burns have a focus on maintaining the health of country, as well as for fuel management.

Managing extremes

With a changing climate even well designed, climate resilient gardens will encounter extreme events which damage vegetation. It is important to plan and budget for unexpected climate events.

To mitigate the risk of frost damage in particular, ensure use the Frost Tolerance tool on the ACTSmart Plant Selector website.

Extreme frost at Googong, NSW

Planting: Whether it is exotic or native, edible or ornamental, there are certain times of year that are best to get your plants in the ground, and times best to avoid if possible. Ideally, avoid significant planting:

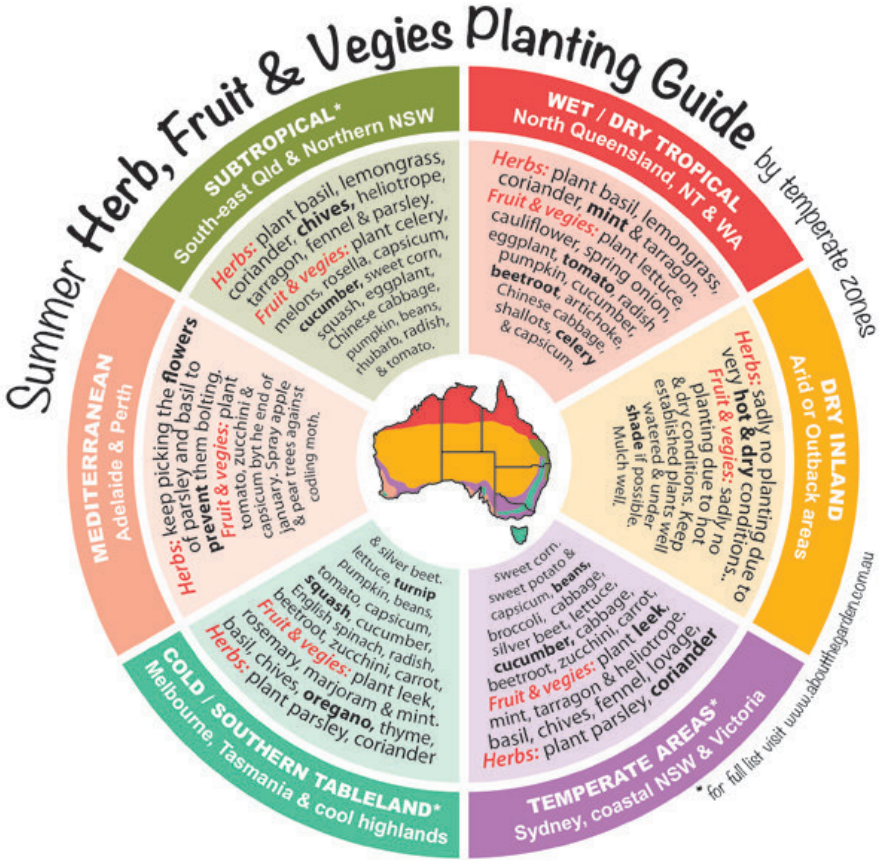
- In summer: when the temperature maximums are greater, the soil is drier, and you will need to use more water to get plants to establish well
- In winter: when the temperature minimums are greater, the soil colder and micro-organisms not as active, and the risk of frost damage is increased.

For non-edible plants speak to your local nursery about the best planting times to minimise plant failures in your landscape.

Vegetables, herbs and other edible plants can be sown and grown all year round. It is important to understand the best planting time for your climate to maximise your growth rates and crops. Below is an example of a planting calendar for Canberra. There are various online resources available.

Top three actions

1. Retain existing trees
2. Maximise tree canopy (minimum 30%)
3. Enhance nature and biodiversity



Australian planting calendar. Source: About the Garden.

Reference Tools and Technical Guides

Below are additional resources for help on how to plan, design for and maintain trees and other planting:

- Municipal Infrastructure Design Standards These provide technical specification guidance for various aspects of landscape and the urban environment such as tree planting, paving etc
- ACT Government's Urban Forest Strategy provides a framework for maintaining and growing a healthy and sustainable urban forest within Canberra
- ACT Government City Services Trees for the ACT Tree Register and more information about trees in Canberra.
- ACT Government Tree Protection Advice fact sheet provides guidance for proposed single residential development
- Yarralumla Nursery is an ACT Government owned plant nursery. The website provides many useful hints for Canberra gardeners ranging from how to attract butterflies to your garden to types of shrubs for hot dry spots
- ACTSmart Creating a Fire-wise Garden fact sheet provides design and plant selection tips for your home
- ACT Strategic Bushfire Management Plan provides a strategic framework to protect the ACT community from bushfires
- Field Guide to Plants of the Molonglo Valley provides information on 394 native and exotic plant species in the Molonglo Valley and lowland grasslands and woodlands across the region
- City of Melbourne, Sustainable Gardening Booklet (2012) gives practical advice on gardening in private spaces such as roof tops, balconies and smaller front and back yards
- Country Fire Authority Victoria Landscaping for Bushfire web page provides garden design and plant selection for high-risk bushfire areas
- ACT for Bees Resource (2017) provides advice on bee attracting species in the ACT
- Canberra Ornithologists Group Canberra Birds website provides information on what makes a garden attractive to birds
- Ngunnawal Plant Use field guide provides information on the native plants of the ACT region and their many Ngunnawal uses
- ACT Government Invasive Plants web page provides information on reporting and control
- ACTSmart Controlling Pests without pesticides This guide provides some sustainable pest control strategies
- Canberra Organic Growers Society Seasonal Planting Calendar provides an interactive planting calendar for the Canberra region
- Australian National University ACT Urban Trees Species Research identifies trees suitable to Canberra's future climate in 2030, 2070 and 2090
- ACT Suburban Land Agency Climate Wise Garden Designs Booklet (2021) contains visual information and advice for residents to design their own climate wise, low-maintenance and edible gardens that are ideal for Canberra's changing climate

Relevant Australian Standards

AS 4970 (2009) Protection of trees on development sites

AS 4373 (2007) Pruning of amenity trees

2.8 Materials

A Preparation

Planning your areas and types of paving and other built elements is an important part of the design process to ensure that the site meets its objectives in term of usability and sustainability.

Permeability: A minimum of 30% of the site needs to be permeable (vegetation or porous surfacing). Vegetated surface is always preferred over an open surface made from engineered materials. However, where vegetated areas are not able to achieve this target, other permeable surfacing options such as permeable paving, crushed rock or pebbles will need to be used. Increasing surface permeability through vegetation or softer/more permeable materials allows natural hydrological processes to take place, allowing water to drain through the surface, which will reduce stormwater runoff and allow water to find its way to adjacent tree roots and planting. Materials that have increased permeability also store less heat and reduce the surrounding temperature.

Site access and users: Consider what parts of the site need to be hard paved areas such as paths, patios and seating areas. You will need to understand who will be the end user and accessibility; for instance an elderly person may need a more stable surface for safety. Parking areas and driveways are often the largest impermeable paved area on a residential block, but there are many ways that this can be designed to make it more climate wise. This might be with permeable pavers, gravel, plants or reinforced turf. If you have a sloping site then steps and walls may be needed, consider what look and feel you want to achieve with these and what type of materials might be suitable.

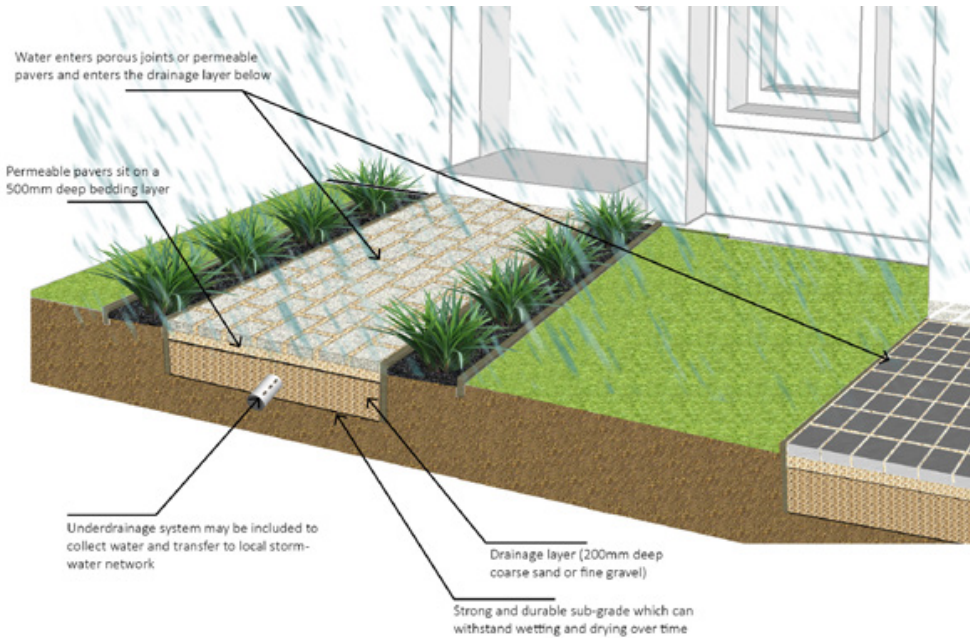
Cool paving

Paved surfaces are ubiquitous elements of urban space. Paving covers 25-50% of a typical urban setting. Pavements such as asphalt, concrete and compound paving have low solar reflectance of 5% to 20%. Asphalt can reach a peak surface temperature of 48°C to 67°C on a hot summer day.

Source: CRC Guide to Urban Cooling Strategies 2017

However, some porous surfaces should be carefully considered in climate-wise landscapes due to their heat retaining characteristics and other adverse impacts. These include:

- synthetic turf
- unshaded black asphalt
- rubber wet-pour surfaces



Typical Porous Pavement Features - Source: ACT Practice Guidelines for Water Sensitive Urban Design

B Design

There are some principles that will assist in sustainable material selections. For more information on choosing sustainable materials visit The Australian Government: YourHome Materials web page.

Recycled materials: Reduce material use in the first instance, then look to use reused and recycled materials. Are you able to reuse or recycle any materials already on site or available to you? This assists in minimising waste as well as the reducing the demand for new materials.

Minimise carbon emissions: Where a recycled option is not available, the next step is to select a material with a low environmental impact. Try to choose locally sourced materials and avoid those that need to be transported long distances. An eco-product database, such as Ecospecifier can be used to access the sustainability credentials of a broad range of materials.

Cooling materials: Selecting materials that are 'cool' can have significant health, wellbeing and resilience benefits and help to reduce urban heat. Lighter coloured roofs or surfaces help reduce heat build-up as they reflect sunlight. Where possible consider lighter coloured or reflective surfaces and materials to improve the thermal comfort of your landscape.

Think long term: For larger developments, a Life Cycle Assessment (LCA) is an analysis report that assesses the environmental impacts associated with all staged of the life cycle of a product or material.

Things to consider when selecting recycled materials

- Previous use of product
- Longevity
- Toxicity
- Potential dangers such as rusty nails
- Transportation
- Maintenance requirements

Reinforced grass

Gravel seating area

Permeable pathway

Site sourced materials

Recycled tumbled glass mulch

Recycled timber sleepers

C Construction + maintenance

Maintenance is determined by your material selection and its intended purpose. Depending on your selection, certain measures can be implemented at different stages of the design, planning and construction process. Prior to selecting your materials, it is important to understand the on-going maintenance requirement each product has; however several overarching principles apply to the installation and regular upkeep of materials:

Recycled/Reused: Treat product appropriately for its intended use to reduce future maintenance requirements.

Hardscape: Apply appropriate stain, sealer or additive to ensure longevity and protection from the elements.

Drainage: Regular sweeping/cleaning of permeable surface to ensure voids and drainage holes are kept clear.

Reference tools and technical guides

Below are additional resources for help on how to plan, design for and maintain materials and surfacing:

- Low Carbon Living CRC, Guide to Urban Cooling Strategies 2017 provides practical guidance for built environment professionals and regulatory agencies in moderating urban micro-climates and urban heat island effects in major urban centres across Australia.
- CSIRO - Mapping surface urban heat in Canberra 2017 provides spatial pattern mapping of urban heat in Canberra to inform climate adaptation actions.
- EPD Australasia provides Environmental Product Declarations (EPD) which are independently verified and registered documents that communicate transparent and comparable data and other relevant environmental information about the life-cycle environmental impact of a product.
- Global Greentag is an eco products certification website.

Relevant Australian Standards:

- **AS1428:2009** Design for Access and Mobility

Lighting

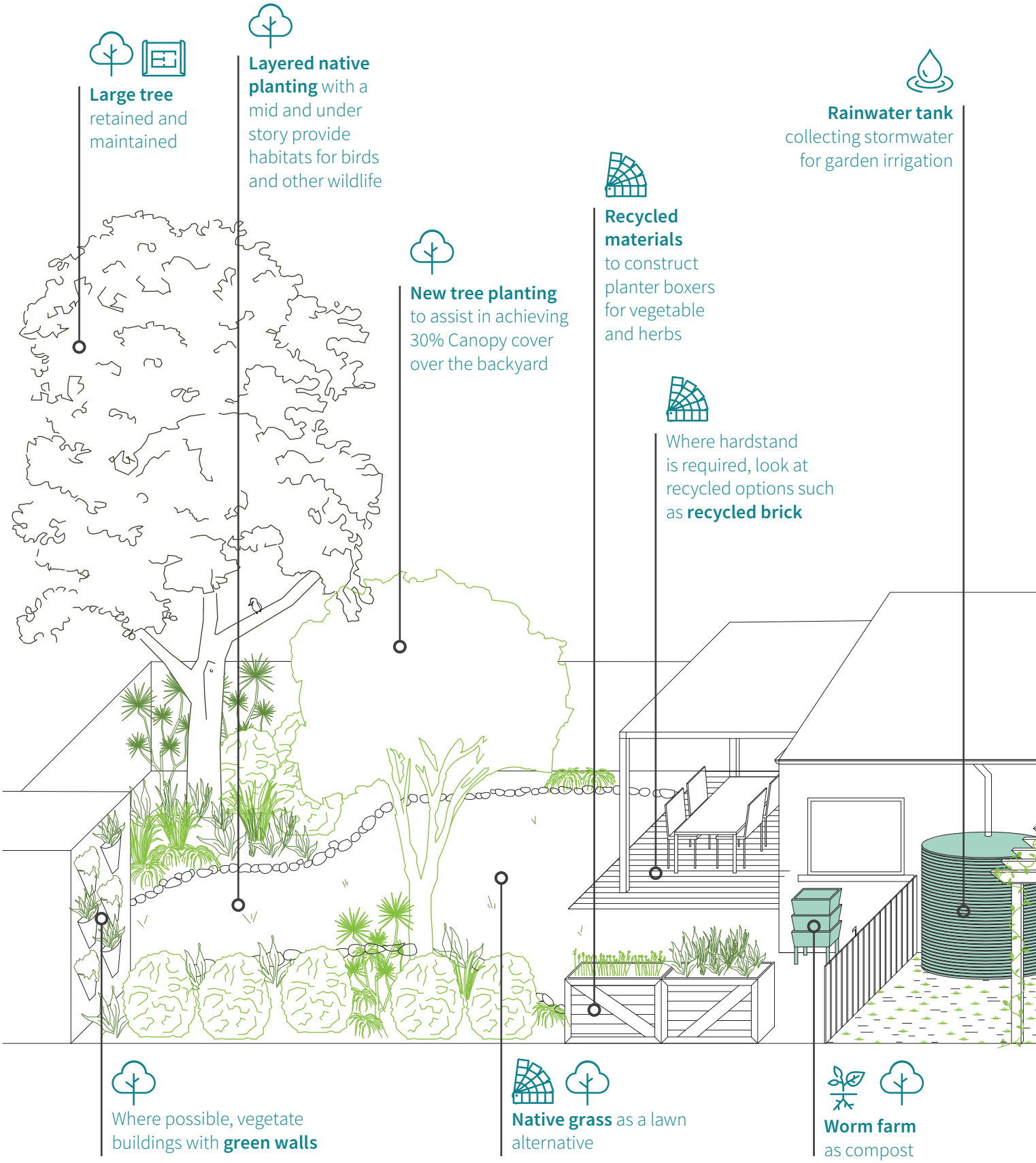
Lighting up your landscape can be beautiful, but there are steps to create a more climate-wise approach in order to mitigate the adverse effects of light pollution. Not only does lighting increase carbon emissions and costs as a result of energy use, lights in the landscape can affect our sleep patterns and the health of native nocturnal animals as they rely on the darkness as part of their behavior and habitat. Steps such as switching to solar powered lighting, considering fixtures that direct lighting downwards rather than upwards, reducing glare, avoiding cool light hues and eliminating unnecessary lighting are all measures that reduce your impact on light pollution within your climate-wise landscape.

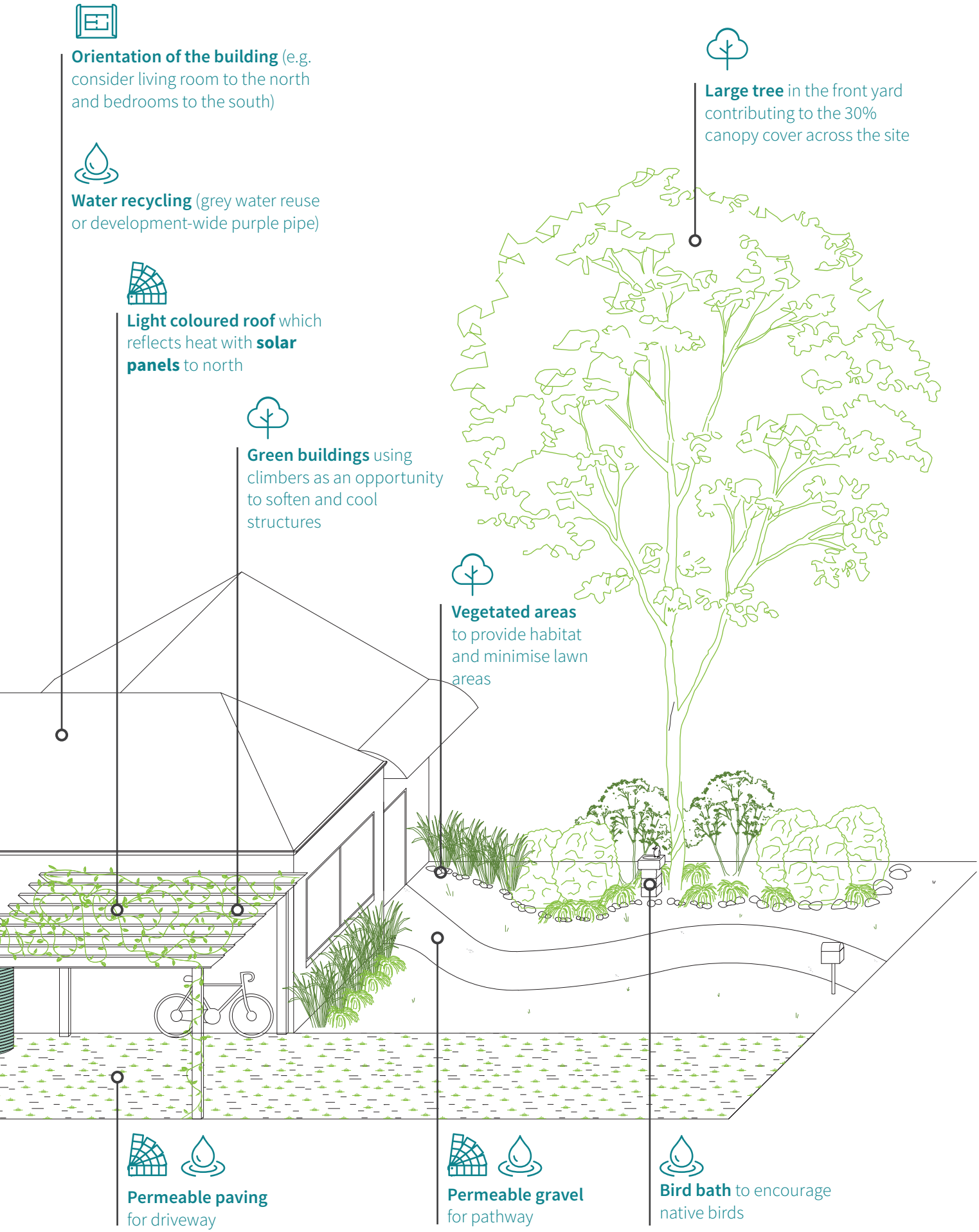
Top three actions

1. Maximise permeable surfaces (minimum 30%)
2. Source from local suppliers
3. Use recycled materials

03 Case studies

3.1 Residential
Typical example climate-responsive design




Orientation of the building (e.g. consider living room to the north and bedrooms to the south)
Water recycling (grey water reuse or development-wide purple pipe)
Light coloured roof which reflects heat with **solar panels** to north
Green buildings using climbers as an opportunity to soften and cool structures
Large tree in the front yard contributing to the 30% canopy cover across the site
Vegetated areas to provide habitat and minimise lawn areas
Permeable paving for driveway
Permeable gravel for pathway
Bird bath to encourage native birds

Case study 1: Josh's House, Hilton, WA

Josh Byrne And Associates

See Josh's House website for videos, plans and other resources.

Climate-wise features:

- In depth site analysis
- Localised compost, worm farm and food production area
- Use of rainwater irrigation system
- Stormwater management initiatives i.e. soakwell
- Native species arranged for hydro-zoning
- Permeable (gravel) surfaces (driveway, paths and gathering area).

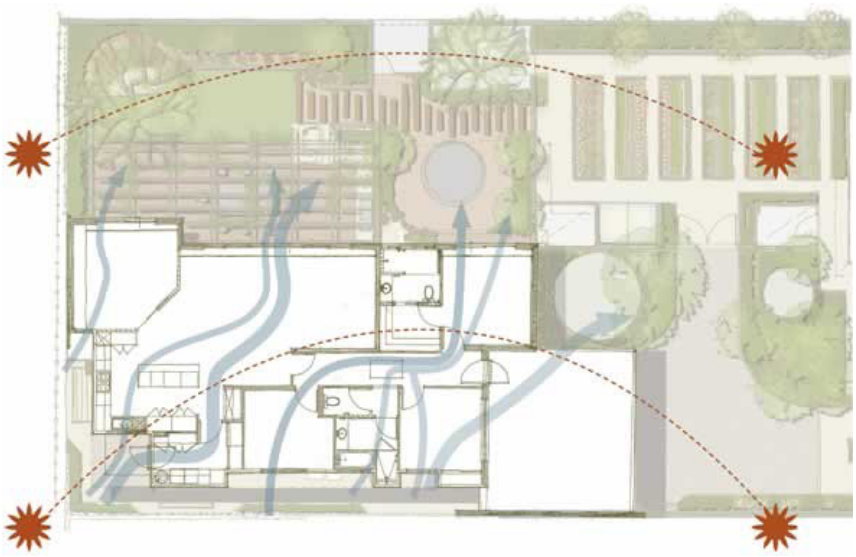
The features are designed to suit Western Australia's warm temperate climate.

Composting areas are co located with vegetable garden

Hydro-zoned native planting bordering permeable gathering area

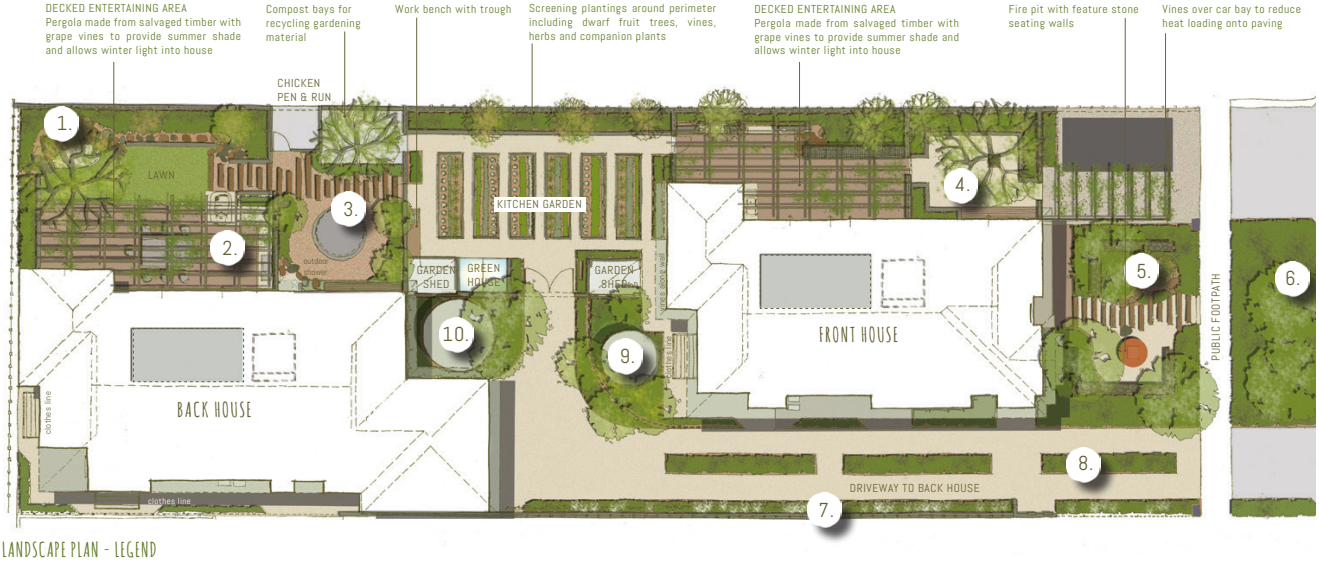
Small scale Living Architecture: Deciduous vine over pergola

Reused/locally sourced natural elements



Key solar passive design features include:

- East-west orientation with maximum glazing to the north for winter solar gain (shaded in summer by grape vine clad pergolas and shade sails) and minimal glazing to the east and west to minimise summer heat entry
- High insulation value to roof and walls to minimise uncontrolled heat loss/gain
- Landscape primarily to north to optimise plant growth.



LANDSCAPE PLAN - LEGEND

1. Children's play area with climbing nets, ropes and sand pit.
2. Outdoor kitchen with built in barbeque and wood fired oven.
3. Children's trampoline and outdoor shower area.
4. Walled courtyard with raised planters and bench seating.
5. Winter wetland with feature stone walls.
6. Native verge planting providing swathes of colour and texture.
7. Trellised fruit trees along north facing fence line provides seasonal fruit to both houses.
8. Driveway with permeable surface for stormwater infiltration.
9. 12kL rainwater tank supplies all internal uses and garden taps with mains water back up to front house.
10. 20kL rainwater tank supplies all internal uses and garden taps with mains water back up to back house.

This is a sample of plans and elevations, more detail is available on the website

Case Study 2: The Empire Garden, Canberra

Austin Maynard Architects & Bush Projects

Climate-wise actions/outcomes:

- Indigenous plants
- Established deciduous trees, shrubs and climbers are preserved and maintained
- Indigenous meadow grass, native grasses and thyme uses as ground cover among Jasper stepping stones
- Gravel as permeable surface
- Underground water tanks included where water is collected from the roof and toilets to irrigate the garden.

Significant tree retained: Enhances thermal comfort

Maximised planting area

Adaptable gravel driveway/gathering area

Ground cover with stepping stones

Case study 3: Jones Residence, Adelaide, SA

TCL

Climate-wise actions/outcomes:

- Regeneration of creek on site to ensure habitat and water ecosystem health
- Significant trees retained
- Passive irrigation
- Permeable surfaces (driveway and paths to protect tree roots and allow passive irrigation through infiltration)
- Light paving material
- Layered planting
- House set back to maximise front garden area.

House setback to maximise garden area. Significant trees retained

Layered planting with permeable gravel path. Planting connects to existing creek ecosystem

Light paving with passive irrigation

Case Study 4: Roogulli Farm, Bywong, NSW

Fresh Landscape Design

Key site climate issues:

- Large degraded grazing site with minimal mature trees and introduced grass species
- Canberra climate of freezing winters, hot and dry summers, wind exposure and inconsistent rainfall
- Site erosion and soil degradation due to prolonged period of drought.

You can read more about this sustainable property here: https://www.roogulli.com.

Climate-wise actions/outcomes:

- Wicking beds increase food production and minimise water use
- Shelter belts were planted early in the development process to provide mature protection for future built form earlier
- New dam was constructed, mimicking natural form, to provide water source and permanent water body for evaporative cooling
- Extensive native grass planting was undertaken to replace introduced species
- Integrated approach to landform, buildings and landscape design
- Building is set into the landform to provide shelter from winds. The buildings northerly aspect maximises solar capture
- Varying grazing animals (including poultry) help to control the grasslands and provide manure for the vegetable gardens
- Materials found or created on site such as shale, mudbricks and mulch have been utilised in the built form and open space.

Constructed dam with island provides water source, habitat and evaporative cooling

Paths made from recycled materials with adjacent native grasses

Shelter belt tree planting provides protection to buildings from dominant winds

Wicking bed research:

Roogulli Farm is developing and testing innovative wicking bed types that are the focus of an Honours project with Charles Sturt University.

Wicking beds have the following benefits at any scale:

- They hold water for longer therefore requiring watering less often
- Reduced evaporation as they water from the bottom up which prevents evaporation on the surface
- Provide improved drainage during large rainfall events
- Inclusive elevated design for people with less mobility.

Market garden and wicking beds supply the property and local farmers market with produce year round

Produce grown in experimental wicking beds

Grazing animals control grassland growth. This assists with maintaining a healthy ecosystem as well as fire fuel load management

3.2 Mixed Use / Commercial / Industrial

Case study 1: Arkadia Apartments, Alexandria, NSW

DKO, Breathe, Oculus + Defence Housing Australia

Key site climate issues:

- Minimal soil depth on podium for healthy planting
- Site highly exposed to sun, wind
- Development type traditionally results in minimal at-grade open space
- Urban Heat Island effect and impacts due to central city location and adjacent significant road ways with dark asphalt surfacing.

Climate-wise actions/outcomes:

- Greater than minimum soil depth supports greater plant growth
- Retained existing street trees provides shade for open lawn park
- Layered planting with indigenous species
- Use of recycled bricks for built form and open space lowers the embodied energy of the project, thereby reducing its carbon footprint
- Communal green roofs and balconies which include veggie patches, a chicken coop with integrated chook run which provides fresh eggs, and rooftop beehives for residents
- Offset of built form footprint by greenery to combat the urban heat island effect and ensure a more comfortable climate
- North-facing park collects rainwater for passive and active irrigation of drought-resilient plants.
- Compost bins in each communal garden which reduces outgoing waste and provides the raised garden beds with additional nutrients. Food scraps are also provided to the chickens.

Green Building principles prioritised (green roofs/balcony). Existing trees shading communal open space and orientation of built form and open space

Drought tolerant/indigenous planting with borrowed landscape

Deep podium planting with recycled bricks

Intensive green roof with gravel path

Rooftop community gardens with integrated green waste management system

Chicken coop and architecturally designed chicken run

Arkadia resident chickens

Urban farming and social sustainability:

A key focus of this project was developing a strong sense of community with the residents. One key way this has been achieved is through the implementation of various urban farming initiatives which the residents take ownership of.

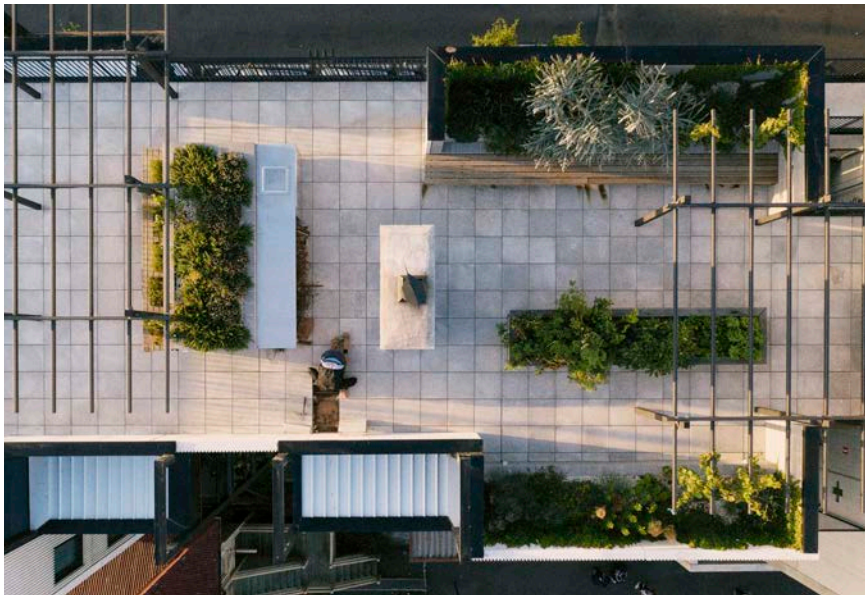
The community gardens, green waste management and composting, chicken coop providing fresh eggs, and rooftop beehives have allowed an appreciation of the whole food cycle and visibility of the process of food production which is rare in high-density living. Bringing people in urban areas closer to natural processes strengthens their understanding and appreciation for the greater environmental and climatic challenges facing cities.

Case study 2: Nightingale 2.0, Fairfield, VIC

SBLA Studio

Climate-wise actions/outcomes:

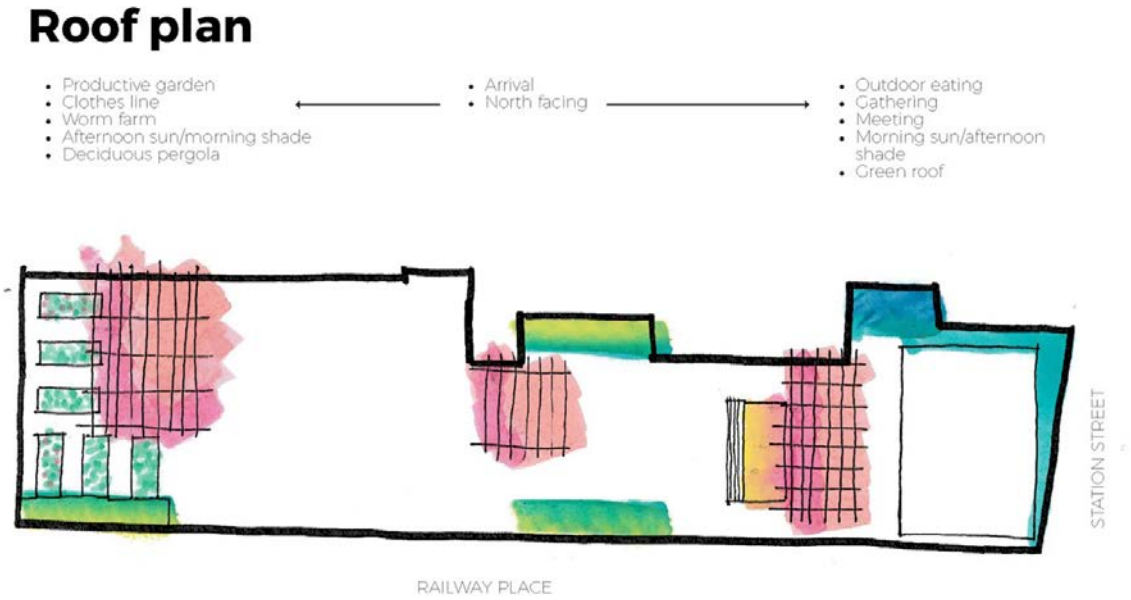
- Rooftop gardens assist with insulation of apartments below reducing heating/cooling costs
- Planting chosen to 'mimic' similar natural conditions i.e. windy hilltops, embankment planting and arid mountain tops become green walls + exposed green roof
- 90% native plants
- Rooftop worm farms and external contractor who processes organic waste and returns to site as compost for gardens.



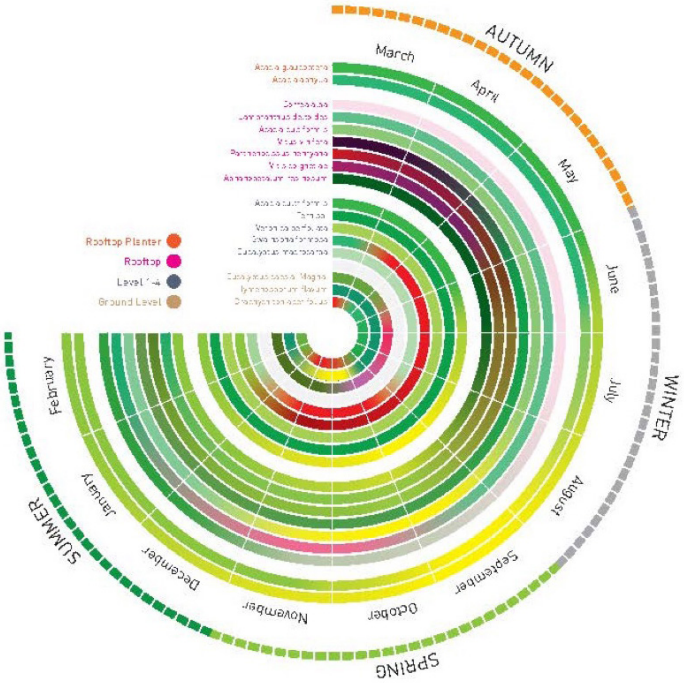
Intensive green roof with light coloured paving. Deciduous vine planting to pergola provides shade in summer and warming sun access in winter

Native green roof planting mimics natural windy hilltop conditions

Alternate green wall suit shaded micro-climate



Rooftop concept plan demonstrating multiple climate-wise design characteristics



Careful consideration of the seasonal planting variation and diversity. Source: Landezine-award.com

Plant selection innovation:

"SBLA examined naturally occurring landscape systems that exist on windy hilltops, embankment planting and arid mountain tops. This thinking was applied to the way we can select plant species for multi-storey buildings and gave us comfort as to what plants could potentially thrive at varying altitude. Acacia species grown from seed such as clay wattle, leafless rock wattle and cascading cultriformis were all planted to the rooftop and southern façade. Sturt desert pea and Eucalyptus species are planted between apartment balconies and smoke bush and grapevine sit on the rooftop. This project is ground breaking in that 90% of the plants are native and are not typically planted in an urban setting nor in development projects." Source: Landezine.

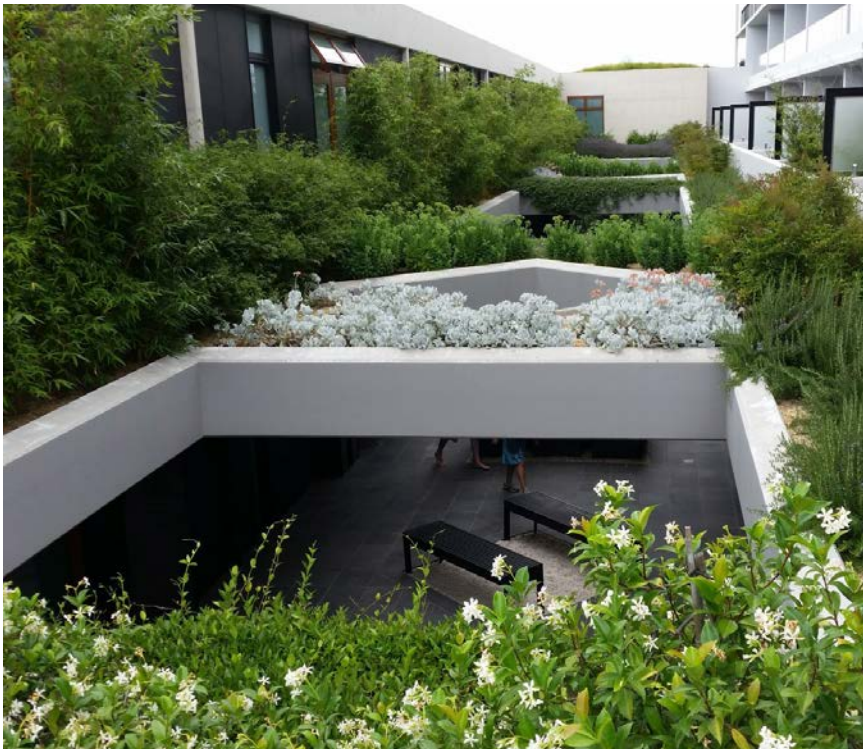
Case study 3: Bridge Point Apartments, Kingston, ACT

Harris Hobbs Landscapes / Junglefy

Climate-wise actions/outcomes:

- Intensive and extensive green roof provides natural insulation to apartments below, lowering heating/cooling costs, providing habitat to animals, and reducing heat island effect by greening what would be a hard surface
- Permeable surfaces increases water infiltration for plant growth and run-off management
- Plants have been carefully selected to thrive in an exposed site with reduced soil depth.

Utilisation of intensive/extensive green roof increase aesthetic value of apartments



Intensive green roof

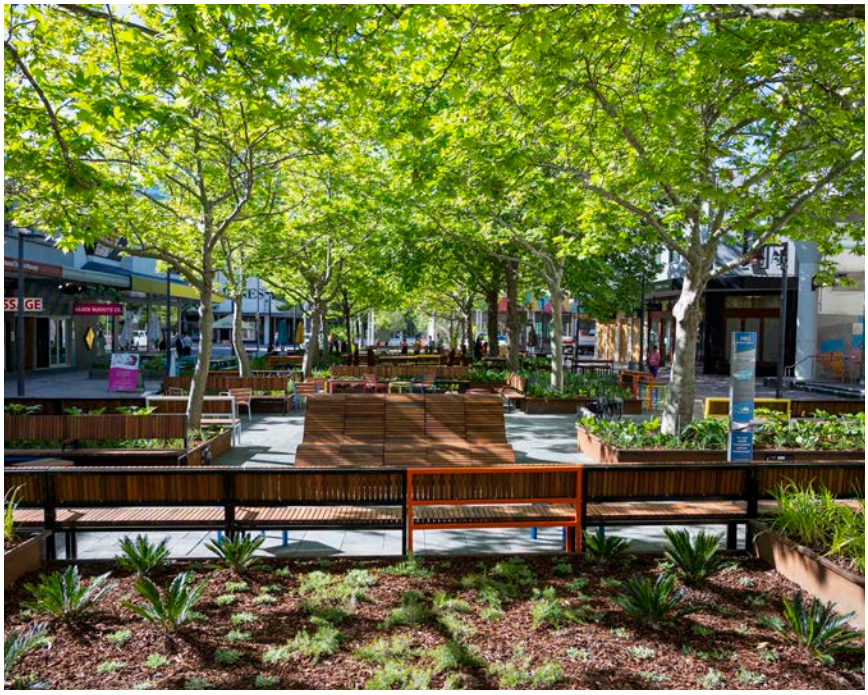
Extensive green roof with permeable surface

Case study 4:
City Walk upgrade project, Canberra, ACT

City Renewal Authority / TCL

Climate-wise actions/outcomes:

- Underplanting of 22 mature Plane trees improves soil condition
- Planting has significantly increased biodiversity through species diversity, habitat creation and soil health.
- 55%+ of the project area is now water permeable, lifting 700m2 of pavers and replacing with lawn 645m2 of lawn and 444m2 garden beds
- 50% of all species planted are native
- All seating placed under shade of trees to maximise thermal comfort.



Thermal comfort maximised by reduction of hard surfaces, placement of furniture under trees and increased groundplane planting. Source: City Renewal Authority

Replacement of hard surfaces with permeable lawn and gardens beds has improved water management, increased biodiversity and created a more pleasant environment for people to spend time in. Source: ACT Government

Raised garden beds and art installations. Source: City Renewal Authority

City Walk pre improvement works with extensive impermeable hardscape which increased urban heat island effect and reduced infiltration of surface water for healthy tree growth. Source: Google

3.3 Precinct / Campus

Case study 1: Fenner School of Environment + Society (ANU), Canberra, ACT

Harris Hobbs Landscape

Climate-wise actions/outcomes:

- Prioritisation of natural drainage principles for water management
- Detention of rainwater to slow percolation and improve soil moisture content
- Swales and raingardens collect, direct and detain water. Large rainfall events captured and stored in constructed wetland
- Rainwater tank irrigation
- Significant tree retention
- Native + drought tolerant plant species.

Native drought tolerant planting

Integrated WSUD maintains excess on-site stormwater

Constructed wetland with retained trees

Case study 2: Downer Micro-forest, Canberra, ACT

The Climate Factory / Downer Community / ACT Govt / Local businesses

Climate-wise actions/outcomes:

- Simple water harvesting methods get water into the soil at plant roots where its needed most
- Sand infiltration points provide areas to top up trenches during dry periods
- Water shedding mounds re-sculpted so they capture water in dry periods
- Dense planting of 3-4 plants pm2 based on *Miyawake* method leads to faster growth rates
- Soil ripped with organics and beneficial fungi prior to planting
- Multiple vegetation layers combined with water harvesting acts like natural evaporative cooler
- Climate-ready species chosen as they will likely thrive in the future climate, rather than some popular native species.

Community partnership:

The Downer Micro-Forest was a collaboration between social enterprise The Climate Factory, the Downer community, local businesses and the ACT Government. Together they funded and built a 1800 plant, micro-forest in 2020, the first of its kind in Canberra.

The community are engaged at every step—new micro-forests at Watson, Holt and Casey are led by volunteer community leaders.

Existing site conditions. Source: Edwina Robinson

During construction. Source: Edwina Robinson

During construction. Source: Edwina Robinson

Case study 3: The Commons, Radford College Bruce, ACT

Enviro Links Design (ELD)

Climate-wise actions/outcomes:

- Stormwater management addresses drainage and flooding issues
- Retention of existing significant trees
- Native planting.

Hydro-zoned native planting

Detailed focus on stormwater management with existing drainage channels utilised

Retention of significant trees

Case study 4: Springbank Rise, ACT

Redbox Design Group and Lend Lease

Climate-wise actions/outcomes:

- Retention of significant trees
- High priority to stormwater management
- Landscape as placemaking.

Water body creates a valuable landscape feature and improves amenity

Planting used to soften edges and provide habitat

Shade tree planting to lake edge

3.4 Glossary

Terms	Definition
ACT	Australian Capital Territory
Biodiversity	Biodiversity describes the variety of life in all its forms and at all levels of organisation, as well as the ecological and evolutionary processes through which genes, species and ecosystems interact with one another and with their environment.
Canopy cover	The equivalent cover and ecosystem benefits associated with a tree canopy cover.
Carbon sink	A natural or artificial reservoir that accumulates and stores carbon for an indefinite period. Examples of natural carbon sinks include forests, oceans and soils.
Climate change adaptation	Actions taken to help communities and ecosystems adjust to changing climate conditions and their effects.
Climate change mitigation	Efforts to reduce or prevent the release of greenhouse gas emissions into the atmosphere.
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.
Ecosystem services	The benefits people obtain from functioning ecosystems. These include provisioning services such as food and water; regulating services such as urban cooling and flood control; cultural services such as recreational and cultural benefits; and supporting services such as nutrient cycling.
EPSDD	Environment, Planning and Sustainable Development Directorate
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.
Impermeable surfaces	Hard surfaces introduced by urban infrastructure which restrict or limit the permeability of surface layers of the landscape.
Liveability	A measure of quality of life used to benchmark cities around the world. It includes socio-economic, environmental, transport and recreational measures.
Living infrastructure	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.
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.

Terms	Definition
Resilience	The capacity of individuals, communities, businesses and systems in a region to survive, adapt and thrive, no matter what chronic stresses and acute shocks they experience.
Sustainable development	Forms of development that meet the needs of the present without compromising the ability of future generations to meet their needs.
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	The geographic extent of the existing urban area.
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 due to heat retention caused by 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.