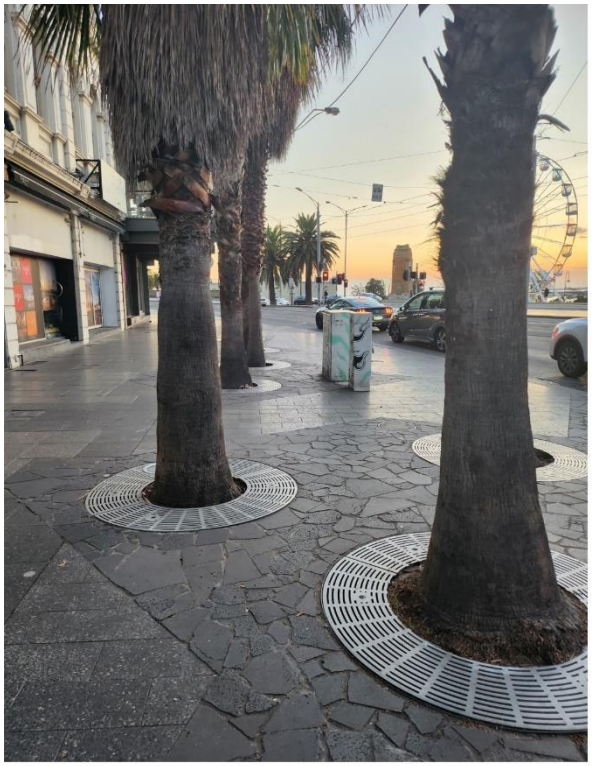
Urban Forest Strategy 2040
Background and Benchmarking Report

June 2023
Prepared for the City of Port Phillip by St Jack & Co



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Cover Images: Top Left: St Kilda Esplanade, Top Right: Bothwell Street Woody Meadow,
Bottom Left: Danks Street Reserve, Bottom Right: Acland Street. Source: Kat Ryan

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1. Executive Summary

The City of Port Phillip is developing a new Urban Forest Strategy to plan for increased urban greening over the coming decades. Knowledge and practice of urban greening has evolved significantly since the City of Port Phillip adopted its first greening strategy, Greening Port Phillip, in 2010 (GPP 2010). This Background & Benchmarking Report synthesises the current strategic context, knowledge and best practice, to provide a cohesive evidence base for the new strategy.

Collectively, all trees and plants on public and private land make up our urban forest. This includes trees, shrubs and groundcovers in home gardens, on green roofs, walls and facades, on nature strips, medians and roundabouts, in parks and reserves, and in shopping strips, car parks and industrial areas.

Port Phillip has an established heritage of parks, public and private gardens, and tree-lined streets that contribute to mature canopy and greening across most neighbourhoods. From boulevards of Plane Trees to thriving indigenous plantings in biolinks, from Canary Island Date Palms along the foreshore to backyards and community gardens – our urban forest is an integral part of the Port Phillip identity.

We want to protect the greening we already have, help it thrive, and take practical action to expand our urban forest within the complexities of our urban environment.

1.1. Background

The evidence is comprehensive and clear – the urban forest offers a multitude of benefits to people, economies and nature in cities. Greener cities promote happiness, health, physical activity, and community connectedness. Water use, stormwater management costs and flood risks reduce. Air quality is better, and neighbourhoods are cooler. Soil productivity, local food security, private and biodiversity improve. House prices rise and commercial strips thrive. Urban forests also sequester carbon, reduce emissions, and mitigate climate change risks. There are risks to manage too, with diverse views on aesthetics, solar panel shading, debris and limb drop, vandalism, and grey infrastructure conflicts.

Urban forestry is also well-supported in terms of strategic and community alignment. In recent years, the Port Phillip **community has consistently raised greening as a major priority** for the City. Over the last decade, **urban forestry has become well-integrated in local, regional, state and global strategies and policy** – from global goals to reach nature-positive and net zero, to local strategies like the *Council Plan 2021-2031*, *Act and Adapt: Sustainable Environment Strategy* and *Places for People: Public Space Strategy*. Council has set a range of indicators and targets relating to the urban forest, including direct measures of increased greening (eg. canopy cover, trees planted), and indirect measures of greening benefits (eg. pollutants removed, reduction in hotspots).

In the public realm, the **City of Port Phillip manages approximately 46,000 trees**, 75% of which are street trees. Tree species and genus diversity in the tree population is generally good, with only one species, the London Plane, above 5% of the total tree population. Biodiversity values remaining in the City are significant, and require protection and enhancement for future generations.

Since 2010, **the City of Port Phillip has delivered substantial greening action, investment, research and planning to integrate greening into Council plans and operations**. There has been an increased focus on biodiversity and biolinks, more understorey plantings, engineered solutions for passive watering, increased soil volume and greening on buildings, and community-led produce and verge gardening.

There is still room to grow, and strong collaboration between Council, community, State Government and other stakeholders will be essential for success.

Tree canopy cover of the City of Port Phillip was **17.17% in 2022, down from 17.86% in 2012**. The City has increased its overall canopy cover on roads and public land (+0.39%), but not enough to outpace the overall loss on private land (-1.09%). With about half of the City area being privately owned, it is clear that **greening on private land will need to play a greater role in increasing the urban forest**.

1.2. Benchmarking

Port Phillip is not alone in its efforts to expand and improve its urban forest. Ten neighbouring and peer Councils with urban forest or greening strategies have been benchmarked alongside Greening Port Phillip 2010 to identify common themes, individual highlights, and opportunities for Port Phillip to improve. Alongside the benchmarking is a review of global and local urban forestry guidance, the latest research, and other contemporary tree strategies and case studies. The key findings on common themes, emerging evidence-based best practice, and how to measure success, are outlined below.

There is **widespread agreement on the importance of increasing tree canopy cover**, creating new green spaces, and establishing green corridors to connect and enhance existing green spaces. Councils most commonly cited the benefits of urban cooling, carbon capture, stormwater benefits and improved air quality. Councils also emphasise the need for community engagement, partnerships, and ongoing monitoring and evaluation to ensure the success and sustainability of urban greening initiatives. Most strategies had around a 20-year lifespan. A long-term strategic outlook is typical because trees are often slow growing, with decades needed to measure success against absolute canopy cover targets. For practicality, shorter-term action plans and regular monitoring can complement long-term goals.

The most commonly cited challenges for urban forestry cover four key themes:

- ***Climate change*** – Trees are long-lived assets, so tree populations need to be diverse and well-managed to resist extreme heat, drought, pests and diseases. Greening is an important tool to prepare our communities for these changed conditions, especially through carbon capture, urban cooling and flood risk reduction.
- ***Contested urban spaces*** – Plants need soil, water, nutrients, space, air and light to grow and thrive. New development, utilities and infrastructure, limited water access, compacted soils, pollution, heat, and direct damage all threaten greening. Public space is scarce, with trade-offs and smart design needed to address all desired objectives.

- ***(un)Healthy tree populations*** – Urban forests can be at risk long-term without 'defensive diversity' through a mixture of species, age, sizes and functions. They need proactive management including good design, site and soil preparation, passive irrigation, young tree care, health audits, pest treatments, risk management, and other ongoing maintenance.
- ***Community values*** – Perceptions on urban greening can have a large impact on the quality and quantity of the urban forest. For example, communities who value trees and actively engage in greening are likely to retain trees and increase greening, whereas, in communities where trees are not valued, they may not be well-funded or prioritised in capital works. Fears and concerns, both real and perceived, all threaten the urban forest.

It is now widely accepted that all cities should have an urban forestry or greening strategy. At a minimum, these should include actions to protect existing trees, increase tree canopy against a target, manage and maintain healthy tree populations, and collect data on Council's urban forest and canopy.

For Councils going beyond the baseline, best practice and emerging strategic themes are listed below.

These themes are discussed in this report, supported by case studies.

- Spatially prioritised greening for climate adaptation and social equity
- Outcome-oriented targets, with proactive monitoring and promotion of progress
- Strengthened tree protections
- Defensive diversity and biodiversity sensitive urban design (BSUD)
- Engineered solutions to recover space and support thriving trees
- Community education, stewardship and engagement
- Greening on private land
- Manage trees as assets, reflecting their true economic value
- Systematic integration of greening across Council and beyond
- Proactive innovation, including R&D partnerships.

Well-considered monitoring can support adaptive management, bolster high-level support, and minimise unexpected costs, waste and distractions from on-ground delivery. Greening targets are commonly used to set a specific ambition. The most commonly used targets are for percentage canopy cover and number of trees planted, but there is a growing global trend towards targets that are outcome-based (eg. equal access, health & wellbeing, active transport) or specific to land use types (residential, commercial, industrial) or tenures (public and private).

2. Growing a greener Port Phillip

Port Phillip was an early adopter of urban forestry, being one of the first Australian Councils to develop an Urban Forest Strategy in 2010, called Greening Port Phillip. This document recognised that a healthy and diverse urban forest enhances the community's daily experience, generating environmental, economic, cultural and social benefits, both now and into the future.

The policy-driven Greening Port Phillip helped to change the way public trees were managed in the City, and it sparked community recognition of the importance of greening for liveability, prosperity and sustainability. The associated Street Tree Planting Program 2017-2022 set canopy increase targets for each neighbourhood, and identified priority streets to increase street tree planting.

A number of key shifts have occurred since 2010:

- Increased community awareness, interest and advocacy for urban greening
- Stronger evidence of the many benefits of greening, especially for public health and wellbeing
- Recognising that most vegetation is on private land, contemporary urban forestry now addresses all vegetation, and is not restricted to street trees
- Accelerated canopy loss on private property due to redevelopment, densification and lifestyle preferences
- There is an increasing focus on electrical line clearance compliance
- Large canopy trees have been lost due to their age and other health factors
- COVID lockdowns have led to more people enjoying green spaces, with a rise in community-led greening, including nature strip gardening and depaving
- More sophisticated spatial data and smart technology have changed the way urban greening is measured, monitored and managed.

It is now time for a new Urban Forest Strategy to be developed, to build on the achievements so far and incorporate contemporary best practice. Port Phillip is well-placed to lead in urban greening. Good planning in the past has left a legacy of green historic parks, public and private gardens, and tree-lined streets that contribute to mature canopy and greening across most neighbourhoods.

In recent years, the Port Phillip community has consistently raised greening as a major priority for the City, including in consultation on the Council Plan 2022-2031 and other Council strategies and initiatives[1]. The community has said that trees and greening are central to their desire for beautiful public spaces, parks and streetscapes, for supporting biodiversity, cooling neighbourhoods, and mitigating against the impacts of a changing climate. The underlying message is to protect what greening we already have, and to plant more.

Importantly, Council cannot green Port Phillip alone. All landowners play an important role in greening our neighbourhoods, as do the many local environmental advocates and groups, who partner with Council to care for and green spaces for the benefit of the whole community.

[1] Including CoPP (2018) *Move, Connect, Live: Integrated Transport Strategy 2018-2028*, CoPP (2018) *Act and Adapt: Sustainable Environment Strategy 2018-2028*, CoPP (2022) *Places for People: Public Space Strategy 2022-32*, CoPP (2021) *South Melbourne Structure Plan*, and CoPP (2022) *Nature Strip and Street Gardening Guidelines*.

2.1. Summary of Greening Port Phillip 2010

Greening Port Phillip – An urban forest approach 2010 (GPP 2010) is a key document guiding the creation of a sustainable, resilient and biodiverse City.

The two objectives of GPP 2010 are:

1. Enhancing liveability – Creating a sense of place, shaping the future of Port Phillip and caring for our natural environment
2. Adapting and sustaining – Preparing the Port Phillip's community and council assets for a different climatic future.

Many of the principles of GPP 2010 still stand up with contemporary urban forest practice. These include urban cooling, equitable access to trees, biodiversity and wildlife corridors, healthy and sustainable tree populations, amenity and urban character, 'alternative greening' (eg. nature strips, WSUD, depaving), and integrating greening with urban planning and capital works.

The key components of Greening Port Phillip's integrated approach are:

- A Tree Policy (see below)
- A Street Tree Planting Guide (see below)
- Tree Management Guidelines (not formally adopted, see below)
- Strategic/Master Plans (external urban planning mechanism).

GPP 2010 did not set a canopy target, because at the time, no data was available to determine the baseline tree canopy cover[2]. However, it did set five indicators to measure success (see below).

Table 1. Indicators to measure success, from Greening Port Phillip 2010.

Indicator	Desired outcome	Measure – reported every 5 years
Number of hot spots*	A reduction in the total number of hot spots contributing to the heat island effect	Total % reduction in hot spots and % increase in cooling and temperature control in treated hot spot areas
Tree canopy cover	An increase in the total area of tree canopy cover in the City of Port Phillip	Total tree canopy cover
Number of trees	An increase in the number of trees in streets and parks in the City of Port Phillip	Total number of trees in streets Total number of trees in parks
Alternative greening activity	New greening initiatives undertaken where trees are not an option	Number of alternative greening activities undertaken in streets that cannot be planted with trees
Community satisfaction with trees	The City of Port Phillip community are satisfied with the action being undertaken by council to maintain the urban forest	Levels of satisfaction with council action being taken

*Hot spots - sites that show up as hotter than surrounding areas using thermal imaging.

[2] Multiple measurements of canopy cover have been taken since. In 2023, the City of Port Phillip has commissioned new canopy mapping to document the status of Port Phillip's canopy and to develop a Tree Ledger database for further targeted analysis.

2.1.1. Tree Policy

The Tree Policy is integrated in Greening Port Phillip. It is divided into eight key policy areas:

1. Tree protection
2. Tree planting and selection
3. Tree removal and replacement
4. Climate change adaptation
5. Tree root management
6. Tree asset management
7. Trees and the urban character
8. Community consultation and involvement.

Having been largely converted to business as usual[3], many of the policies and ongoing actions could be retained in a separate tree policy, to ensure they are not lost when the new strategy is created.

2.1.2. Street Tree Planting Program 2017-2022

The Street Tree Planting Program 2017-2022 (mentioned in GPP 2010 as a 'Guide') brought a systematic, neighbourhood-based approach to prioritising street tree replacement and upgrade works in the annual capital works budget.

The Program's four objectives are to: improve amenity, increase biodiversity, reduce the Urban Heat Island effect, and increase canopy cover.

The Program's four strategies are to:

- Maintain a balance of young, semi mature and mature trees across the municipality
- Undertake planting to replace street trees that have died or been removed
- Increase the overall number and canopy cover of trees in the municipality
- Maximise the use of street trees to enhance the character of areas experiencing urban renewal and development intensification.

The Program outlines the street tree population in each neighbourhood, including canopy cover targets, current species and age mix of the street tree population. It prioritises each street for planting, based on the extent they are covered by tree canopy[4]. The document also recommends a palette of species for each precinct, but does not prescribe where and what each tree will be[5].

2.1.3. Tree Management Guidelines

The Tree Management Guidelines referred to in GPP 2010 were intended to detail all the tree planting and management processes used by the City of Port Phillip, with all activities by Council staff and contractors to be undertaken in accordance with the Guidelines. However, these were never formally adopted. There is a one-page Tree Protection Guideline[6], which applies to street trees in the vicinity of construction sites.

2.1.4. Nature Strip and Street Gardening Guidelines

These Guidelines (2022) set out how to plan, plant and maintain the nature strip or street garden outside a home or business. Approvals or permits are not required for residents gardening in accordance with the guidelines. An action under the *Places for People: Public Space Strategy 2022-32*, the Guidelines are an important step in enabling community-led greening.

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[3] CoPP (2017) *Greening Port Phillip: Summary of Actions*, January 2017, accessed at: https://www.portphillip.vic.gov.au/media/1k1je4tb/e87946_17_attach_1_key_policy_summary_of_implementation_actions.pdf

[4] Prioritisation is based on an independent assessment of the status and condition of trees in each street, undertaken in 2009 by TreeLogic. Only streets with sufficient space for trees are prioritised.

[5] Final location and species-specific decisions are the subject of further detailed assessment.

[6] CoPP (2008), *Tree Protection Guidelines*, accessed at: https://www.portphillip.vic.gov.au/media/3kogbd40/tree-protection-guidelines.pdf

3. Greening highlights since 2010

3.1. Recent on-ground and investment highlights

Council has delivered substantial greening action and investment since 2010. For example, Council has:

- Increased public tree canopy coverage by 0.39%.
- Allocated almost $3.2 million in 2022/23 alone for greening-related investment via the Council Plan 2021-2031[7].
- Achieved goals of increasing tree canopy cover and the number of trees in public areas, including by:
    - Shifting everyday tree management towards best practice
    - Using tree species more suited to hotter and drier climates
    - Improving soil conditions for street trees
    - Managing the quality of new tree stock purchases.
- Collected improved data for improved tree asset management, with trees now visually inspected at least once a year.
- Planted more trees in park construction projects, as a result of improved collaboration within Council.
- Partnered with the University of Melbourne in a 4-year research program, creating a Woody Meadow in Balaclava to create a high amenity green space with low maintenance and watering costs.
- Planted sunflower and tillage radish seeds on the Cruickshank Street Reserve, to determine if the contaminated soil could be remediated to support healthy tree planting. The Cruikshank Street sunflowers were very well-received on social media, reaching over 7,700 people on Facebook. Soil samples indicate an improvement in soil quality, and trees and native wildflowers are now growing at the site.
- Rolled out more water sensitive urban design, including kerb inlets for passive irrigation.
- Mapped biodiversity corridors, and enhanced their connectivity by planting in some streetscapes.
- Continued to plant a diverse structure of plants, not just trees (e.g. Danks Street median and Liardet Street median).
- Participated in a collaborative national Council Tree Trial[8] , and independently trialled some climate resilient species.

[7] $3.193M total funding commitments include: Enhance urban forests as identified in Greening Port Phillip and Act and Adapt Strategies $1.340m; Improve irrigation practice and efficiency $349k; Assess feasibility of stormwater harvesting projects $160k; Design and deliver best practice water sensitive urban design including raingardens $764k; Continue Elster Creek Catchment Partnership and contribute to Elsternwick Park Nature Reserve $430k; Develop permeability requirements for new developments $150k.

[8] Specialty Trees (2023*) Tree Species Trialling*, accessed at https://www.specialitytrees.com.au/blog/tree-species-trialling-47nd8

3.2. Recent strategic highlights

In recent years, Council has also undertaken substantial research and planning to understand the challenges and opportunities for greening, and to prioritise its integration into Council plans and operations. For example, Council has:

- Set greening-relevant targets, including to:
  - increase canopy cover for both street trees and private land by 10% by 2027/28[9]
  - increase the number of trees on Council land by 0.5% by 2022/23[10]
  - achieve Net Zero greenhouse gas emissions by 2021[11]
  - increase the daily number of walking and biking trips by 36% and 151% respectively by 2028/28[12]
  - increase the proportion of residents satisfied with parks and open space to 85% by 2022/23[13].
- Integrated greening objectives and actions across Council strategies, including the *Council Plan 2021-2031*, *Move, Connect, Live: Integrated Transport Strategy 2018-2028*, *Act and Adapt: Sustainable Environment Strategy 2018-2028*, and *Places for People: Public Space Strategy 2022-32*.
- Adopted guidelines on how to plan, plant and maintain nature strips and street gardens[14].
- Commissioned a biodiversity study that detailed actions to increase biodiversity across the City, which are now being integrated into Council strategies and workplans[15].
- Committed to creating a Biodiversity Plan, Water Sensitive City Plan, and Movement and Place Guidelines that include green infrastructure, for internal use to guide Council works.
- Nominated areas in each neighbourhood for open space upgrades, proposed new open spaces, landscaping plans, street tree plantings and greening[16].
- Prioritised action on enhancing biodiversity, reducing flood risk and urban heat, and increasing greening on private land.
- Undertaken a range of research to address those priorities, including: identifying vegetation values, fauna values and significant trees across the City[17]; investigating permeability rates across the City, and identifying potential mechanisms to increase them[18]; investigating the comparative effectiveness of urban cooling interventions[19]; and investigating potential options to better protect greening on private land[20].

[9] CoPP (2018) *Act and Adapt: Sustainable Environment Strategy 2018-2028*
[10] CoPP (2021) *Council Plan 2021-2031*
[11] CoPP (2018) *Act and Adapt: Sustainable Environment Strategy 2018-2028*
[12] CoPP (2018) *Move, Connect, Live: Integrated Transport Strategy 2018-2028*
[13] CoPP (2021) *Council Plan 2021-2031*
[14] CoPP (2022) *Nature Strip and Street Gardening Guidelines*
[15] Arcadis (2020) *Port Phillip Biodiversity Study*
[16] CoPP (2022) *In Places for People: Public Space Strategy 2022-32* and the CoPP (2017) *Street Tree Planting Program 2017-2022*
[17] Arcadis (2020) *Port Phillip Biodiversity Study*
[18] CoPP (2019) *Permeability Baseline Assessment and Tool Development*), CoPP (2022) *Permeability in the Private Realm*
[19] UNSW & CoPP (2020) *Cooling South Melbourne, Impact Analysis of Cooling interventions*
[20] CoPP (2022) *Protecting Vegetation in the Private Realm*)

3.3. Greening Port Phillip Evaluation (2020)

Greening Port Phillip 2010 has been subject to a mid-term (2020[21]) and full-term (2023) review. Key findings of the 2023 review are summarised below. The full 2023 review is published along with this report to support consultation on the new strategy.

Successes	Challenges	Opportunities
Strategic integration Recent additions to the Planning Scheme (12.01-1L) for retention and protection of significant trees, encouraging biodiversity, climate ready tree species, and innovation in landscape design. Heritage overlays for significant trees in the public realm. New definition proposed under the 2022/23 local law review for significant trees in the private realm. Integration of urban forest actions into key strategies and plans. **Research collaborations** Collaborating on research projects with universities – Woody Meadows project, Walk Quality project. Participating in street tree species trials. **Tree planting** Two five-year streetscape planting programs completed. Signature trees planted in public spaces including Point Ormond, Light Rail reserve, Kerford Road. Many actions converted into business as usual: tree removal and replacement practices, amenity tree value charges, tree protection, pest, disease and animal monitoring and management, and community planting days. **Biodiversity** Biodiversity Study and Discussion Paper. Habitat planting increased along the light rail corridor, the foreshore, Danks St and Bothwell St. **Climate change adaptation** Business as usual actions include climate resilient tree species being identified and used, WSUD program, and raingarden installations. 2017-2022 street tree planting program focused on streets with low canopy cover. Greening and Cooling South Melbourne Study. Commenced depaving projects.	**Targets** Current tree canopy targets are complicated and confusing. **Alternative greening** Implementation of alternative greening options is challenging. **Private land** Most loss of canopy is occurring on private land with little protection, aside from significant trees. **Tree planting** The easiest vacant street and park tree sites have largely been completed. Additional planting will now occur in more difficult sites that are likely to need engineered solutions and considerations for contested space. **Tree maintenance and compliance** Increasing tree planting requires more water. Disability Discrimination Act (DDA) compliance can be difficult with some trees in some areas. There are space constraints for tree planting and tree growth, with overhead and below ground infrastructure. Working with power companies on engineered solutions is costly and time consuming. Much of the existing tree population has had no formative pruning, leading to increased ongoing maintenance. **Industry** Australia wide arborist shortage is affecting the workforce.	**Targets and indicators** Baseline data for indicators and targets is being developed to support development of new indicators and targets. **Alternative greening** MOU to use the City of Melbourne's Green Factor Tool is in place, to work with and build on. **Tree asset management** Ongoing improvement to activate capabilities of new asset management system for trees, including data quality, reporting on tree condition, and reporting on indicators and targets. A method for ascribing a monetary value to urban trees was explored in Year 1 of Greening Port Phillip and found unsuitable at that time; this could be revisited. **Tree planting for performance** Maximise tree performance by improving the quality of tree planting and including best practice plantings in Council's design standards. Continue to explore increasing diversity in tree size and layered plantings. **Community information, education and support** Communication and information on trees, urban greening and biodiversity can be improved. There are opportunities for greater collaboration with community, and support for community groups. **Tree protection** Tree protections could be stronger. Planning compliance could be improved.

[21] City of Port Phillip Urban Forest Mid-Term Review and Report, Urban Forest Consulting, February 2020

4. Strategic and policy context

Over the last decade, urban greening has become well-integrated in local, regional, state and global strategies and policy. These policies widely accept and promote the importance of greening for liveability, prosperity and sustainability in urban environments. The strategic hierarchy is summarised in the infographic on this page, and the relevant high-level priorities for each strategy are listed in this section below.

Level 1 documents

The United Nations SustainableDevelopment Goals
UN Convention on Biodiversity

Australia's Strategy for Nature 2019-2030
- Goal 1: Connect all Australians with nature
- Goal 2: Care for nature in all its diversity
- Goal 3: Share and build knowledge
- Objective 9: Enrich cities and towns with nature

Level 2 documents

Victoria's Climate Change Act 2017
Net-zero emissions by 2050

Biodiversity 2037 (2017)
Net gain in extent and condition of habitats

Water for Victoria (2016)
Healthy and resilient urban landscapes

Open Space for Everyone (2021)
Health & wellbeing; biodiversity; climate resilience; economic and social benefits

Plan Melbourne 2017-2050
- 20-min neighbourhoods (shady and green)
- Resilient, liveable, cooler, greener

Living Melbourne, Our Metropolitan Urban Forest 2019
Healthy People, Abundant Nature, Natural Infrastructure

Level 3 documents

Council Plan 2021-31
Primary strategic direction link to the Urban Forest Strategy

Liveable Port Phillip
A City that is a great place to live, where our community has access to high quality public spaces, development and growth are well-managed, and it is safer and easy to connect and travel within.

Sustainable Port Phillip
A City that has a sustainable future, where our environmentally aware and active community benefits from living in a bayside city that is greener, cooler, cleaner and climate resilient. Council activities that address the climate emergency is **Greening – Commence Update of the Greening Port Phillip Strategy**.

Level 4 documents

Places for People – Public Spaces Strategy 2022-2032
Sets the vision for the future of public space, outlining the challenges, outcomes and actions required to realise the full potential of our public space network of parks, gardens, streets, the foreshore, and urban spaces.

Move, Connect, Live - Integrated Transport Strategy 2018-28
Sets the key priorities to ensure a well-connected transportation future for our City, with a transport network, streets and places that cater for our growing, health and safe community.

Act and Adapt - Sustainable Environment Strategy 2018-28
Establishes Council's commitment to environmental sustainability for the organisation and the wider community, ensuring we are continuing to increase greening, biodiversity and using water efficiently in our public spaces.

Don't Waste It - Waste Management Strategy 2018-28
Provides the blueprint for how Council and the community will work together to create a more sustainable future for our City, ensuring our streets, public spaces and foreshore areas are kept to a high standard.

Asset Management Strategy 2021-24
Sets the approach to asset management through five objectives to ensure sustainable management and development of Council's infrastructure and assets to meet current and future community needs.

Level 5 documents

Urban Forest Strategy

Accessibility Action Plan 2022 - 2024 (draft)
Formalises Council's commitment to improving the equitable participation and inclusion for people with disability within our community.

Foreshore Management Plan 2012
Establishes the long term strategic vision and direction for the Port Phillip foreshore, providing a framework for future use of the foreshore considering the range and complexity of coastal issues.

Getting our Community Active: Sport and Recreation Strategy 2015 - 2024
Establishes
a shared Council and community vision to guide the planning, provision and maintenance of high quality sport and recreation infrastructure across our City.

Playspace Strategy 2011
Sets the vision, policy context and framework to ensure Council continues to provide an equitable distribution of existing and new play spaces for children, young people, carers and the local community to play, socialise and relax together.

Image 1: Strategy and Policy Context (Source City of Port Phillip 2023)

4.1. Local

Urban greening has been integrated in several related strategies by the City of Port Phillip. They all recognise the importance of urban greening in delivering benefits to the community, and seek to maximise the positive impact of urban greening through coordinated and strategic planning and management.

The leading strategic priorities for urban greening already integrated in current City of Port Phillip strategies can be summarised as:

- **Climate resilient people and property** – mitigating urban heat and flood risk (eg. by increasing permeability), especially for vulnerable people
- **Biodiverse and climate-ready nature** – climate-suitable species, vegetation and wildlife diversity
- **Liveable and attractive city** – walking and bike riding, high-quality spaces, greening on private land, protecting mature trees.

The most relevant strategies are listed below, including their pertinent high-level objectives (in bold), areas of focus and actions (in brackets), and any relevant sub-plans (○ dot points). A full list of Council's greening-related targets and indicators is also provided below (see section 11.1).

Council Plan 2021-31

- **Liveable** (high quality public space; safer; connected)
- **Sustainable** (active community; greener, cooler, cleaner and climate resilient)

Act and Adapt: Sustainable Environment Strategy 2018-2028

- **Greener, cooler and more liveable** (diverse and resilient species; prioritise action to mitigate heat, flooding and social disadvantage; protect and increase vegetation on private land)
    - Biodiversity Study (2020) and internal implementation plan
- **Adapting and resilient to climate change** (blue-green infrastructure to mitigate flooding and sea level rise)
- **Water Sensitive City** (place-based permeability targets; more permeable private land)
    - Water Sensitive City internal implementation plan

Places for People: Public Space Strategy 2022-32

- **Diverse, attractive and inclusive** (laneway gardening; shade)
- **Blue-green spaces** (WSUD; biodiversity; protect mature trees; canopy for bikes and pedestrians; climate-suitable species; repurposing roads for greening; cooling, irrigation, greening and WSUD in private developments)
    - Nature Strip and Street Gardening Guidelines (2022)
- **Sustainable** (nature; soil remediation; climate resilience)

Move, Connect, Live: Integrated Transport Strategy 2018-2028

- **Catering for our growing community** (10-minute walking neighbourhoods; street design priorities of safety and comfort)
- **Healthier and connected community** (spaces for walking, socialising and play; boosting bike riding).

4.2. Regional and state

The most relevant regional[22] and state strategies are listed below, including their urban greening related high-level objectives and targets, and any linked sub-plans (○ dot points).

Victoria's Climate Change Act 2017

- Net-zero emissions by 2050

Biodiversity 2037 (2017)

- Net gain in extent and condition of habitats

Water for Victoria (2016)

- Healthy and resilient urban landscapes

Open Space for Everyone (2021)

- Health & wellbeing; biodiversity; climate resilience; economic & social benefits

Plan Melbourne 2017-2050

- 20-min neighbourhoods (shady and green)
- Resilient, liveable, cooler, greener
    - Trees for Cooler and Greener Streetscapes - Guidelines for Streetscape Planning and Design (2019)

Living Melbourne, Our Metropolitan Urban Forest (2019)

- Healthy People, Abundant Nature, Natural Infrastructure

Plan Melbourne Action 91

Plan Melbourne 2017-2050 recognises the urban heat island effect, the role of climate change, the benefits of urban greening, and the challenge of greening a rapidly growing and densifying city. The Plan highlights the need to plan for green infrastructure in the same way as grey infrastructure. It identifies that liveability outcomes can be achieved by protecting existing green spaces, creating new greening opportunities, improving water sensitive urban design, greening buildings, and increasing permeable surfaces.

The Plan Melbourne Implementation Plan commits to developing a whole-of-government approach to cooling and greening Melbourne (Action 91).

Action 91 sets out a short- to medium-term (0-5 year) work program to expand and enhance Melbourne's urban forest. This includes improving spatial data, supporting councils with their urban forest strategies, setting regional targets, establishing a green infrastructure grants program, developing new guidelines and regulations to support greening subdivisions and developments, creating green infrastructure demonstration projects, greening state-owned land, and investigating how alternative water sources can support greening initiatives.

[22] The Inner Melbourne Action Plan 2015-2025 has not been included in this section because of uncertainty over its continuing implementation.

4.3. National and global

4.3.1. Australia's Strategy for Nature 2019-2030

Australia's national biodiversity strategy and action plan[23] recognises that all tiers of government play a part in regulating, funding and managing nature conservation. It aims to support healthy and functioning biological systems through three overarching goals:

- Goal 1: Connect all Australians with nature
- Goal 2: Care for nature in all its diversity
- Goal 3: Share and build knowledge.

The strategy includes an objective for urban areas, Objective 9: Enrich cities and towns with nature. This objective recognises the benefits of urban greening, and promotes improving tree canopy and alternative greening options, integrating urban ecology and biodiversity into urban policies, sharing knowledge, and encouraging individual and community participation.

4.3.2. Global goals

Access to urban nature is increasingly seen as an essential service that cities should provide to their residents, and has been conceptualised as a basic human right[24].

The United Nations Sustainable Development Goals include Goal 11 *Make cities and human settlements inclusive, safe, resilient and sustainable*; and indicator 11.7 *By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities*.

Global Goals

- SDG 11. Sustainable Cities and Communities
- Net Zero by 2050
- Nature Positive by 2030

Under the UN Convention on Biodiversity, global governments are seeking to negotiate a goal for the world to be nature-positive by 2030 – a world where species and ecosystems are restored and regenerating rather than declining.

There is a global goal to reach net zero carbon emissions by 2050. In March 2023, UN Secretary General António Guterres was unequivocal: "In short, our world needs climate action on all fronts – everything, everywhere, all at once." Urban trees are sometimes referred to as a 'silver bullet' for climate, as they both reduce the cause (sequester carbon) and adapt to the impacts (eg. by mitigating heat and flooding). The latest Intergovernmental Panel on Climate Change (IPCC) report found that "Ecosystem-based adaptation approaches such as urban greening… have been effective in reducing flood risks and urban heat (high confidence)."[25]

Cities all over the world have invested heavily in urban greening for these reasons, along with the myriad other benefits urban greening provides, such as improved amenity, cultural connection, cleaner air and water, healthier and more active people, lower crime rates, enhanced biodiversity, reduced energy use, reduced infrastructure maintenance costs, higher property values, and more prosperous main streets.

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[23] Commonwealth of Australia (2019), *Australia's Strategy for Nature 2019-2030,* accessed at: https://www.australiasnaturehub.gov.au/national-strategy

[24] Miles, Ellen (2022), *Nature Is A Human Right: Why We're Fighting for Green in a Grey World*, Dorling Kindersley

[25] Synthesis Report of the IPCC Sixth Assessment Report (AR6): Summary for Policymakers (2023), accessed at: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

4.4. Industry capacity building

Increasingly, a number of global initiatives support cities to celebrate and scale best practice urban greening, including:

- **Tree Cities of the World**[26] – Created by Arbor Day Foundation and the FAO in 2019. Global cities can be recognised if they meet five core standards showing a commitment to trees.
- **CitiesWithNature**[27] – A joint ICLEI, The Nature Conservancy and IUCN program recognising almost 180 global cities to date. ICLEI Oceania launched the Australian chapter in 2020.
- **Resilient Cities Network**[28] – Now expanding from the 100 Resilient Cities program, this network seeks to 'build safe and equitable cities for all'. Melbourne is a founding member.
- **National Park Cities**[29] – Started in London in 2019, the program aspires to have 25 National Park Cities by 2025. Adelaide is the second, awarded in 2021.

A number of Australian research programs and bridging organisations play a critical role in building urban forestry capability nationally (in addition to those by global leaders like USDA Forest Service, American Forests, FAO, and the European Commission), noting that some have concluded but leave a legacy of relevant research outputs. They include:

- **Greener Spaces Better Places**[30] – A national initiative funded by Hort Innovation, with over 400 members across sectors (originally 202020 Vision). Promoted the first analysis of Australia's urban canopy trends[31], and publishes influential guides and reports.
- **TREENET**[32], a national urban tree research and education cluster dedicated to improving the urban forest, which runs an annual Street Tree Symposium.
- **Which Plant Where**[33], a five-year research program funded by Hort Innovation and delivered by Macquarie University and Western Sydney University, investigating how current landscaping species will cope under more extreme climates, and identifying new varieties.
- **Green Infrastructure Research Group**[34] at University of Melbourne, where the well-known 'Burnley Method' for tree valuation was created.
- **Centre for Urban Research**[35] at RMIT runs a number of relevant research programs, focusing on health and wellbeing, liveability and climate resilience[36].
- **Low Carbon Living CRC**[37] (for urban cooling guides) and **CRC for Water Sensitive Cities**[38]**.**
- **Clean Air and Urban Landscapes (CAUL) Hub**[39] developed research and guides in urban environmental management, with a biodiversity and climate resilience focus.

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[26] https://treecitiesoftheworld.org/

[27] http://www.citieswithnature.org/

[28] https://resilientcitiesnetwork.org/

[29] https://www.nationalparkcity.org/

[30] https://www.greenerspacesbetterplaces.com.au/

[31] Greener Spaces Better Places (2016), *Where should all the trees go?* accessed at: https://www.greenerspacesbetterplaces.com.au/media/163130/wsattg.pdf

[32] https://treenet.org/

[33] https://www.whichplantwhere.com.au/

[34] https://girg.science.unimelb.edu.au/

[35] https://cur.org.au/research-programs/

[36] Current RMIT projects of interest include Onsets not offsets for real biodiversity gains, Communities for Walkability (citizen science), a scorecard for liveable cities, and a questionnaire for cities to assess if they have the success factors to deliver greening.

[37] http://www.lowcarbonlivingcrc.com.au/ (from 2012 to 2019)

[38] https://watersensitivecities.org.au/ (est. 2012)

[39] https://nespurban.edu.au/research-projects/urban-greening/ (from 2015 to 2021)

5. Community values

5.1. Port Phillip – the place and its people

Located on the northern shore of Port Phillip Bay, south of Melbourne's city centre, the City of Port Phillip is one of the oldest areas of European settlement in Melbourne. Port Phillip is known for its urban village feel, with heritage buildings, strip shopping, tree-lined streetscapes and artistic expression. Good planning in the past has left a legacy of beautiful and green historic parks, public and private gardens, and many tree-lined streets that contribute to a mature tree canopy and greening across most neighbourhoods. [40]

A city of neighbourhoods, Port Phillip is made up of:

- Albert Park / Middle Park
- Balaclava / St Kilda East
- Elwood / Ripponlea
- Port Melbourne
- South Melbourne
- Montague
- St Kilda Road
- St Kilda / St Kilda West.

Port Phillip is multicultural. The people of the Kulin Nation were the first people of the Port Phillip area. Station Pier was the first landfall in Australia for many new arrivals, with almost one in three of Port Phillip's residents born overseas.[41]

About fifty-five per cent of residents are aged 18 to 49 years, and there is a growing number of people aged over 60, suggesting many residents will retire and age in the City. Forty-one per cent of households live alone and there is a high proportion of renters (44 per cent). Residents are generally highly educated, physically active, and self-report their health as good. Thirty-six per cent of households have a total gross weekly income of more than $2,500, and more young families and young professionals are expected to move into the City. Several pockets of disadvantage exist, with some members of the community experiencing disadvantage for the first time as a result of Covid.[42]

At approximately 21 square kilometres, the City of Port Phillip is one of the smallest municipalities in Victoria, with the highest inner urban population density, at 5,029 persons per square kilometre[43]. The 2021 population of 103,000 people is forecast to grow to 176,000 people by 2041, with much of the growth focused in the urban renewal area of Fishermans Bend. The City is a dynamic and rapidly changing area, with several major urban redevelopment areas either currently underway or recently completed, including Fishermans Bend (480ha of urban renewal focused on innovation and sustainability), South Melbourne Market (major expansion and modernisation of an iconic market over 150 years old), St Kilda Triangle (prime waterfront location being transformed into a new cultural and entertainment precinct), Waterfront Place (aiming to transform a popular waterfront destination into a world class one), and the Port Phillip EcoCentre (a brand new building for the 19,000 plus annual EcoCentre participants, and Australia's first Citizen Science Lab).

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[40] CoPP (2010) *Greening Port Phillip – An Urban Forest Approach*

[41] CoPP (2021) *Council Plan 2021-2031*

[42] CoPP (2021) *Council Plan 2021-2031*

[43] City of Port Phillip Community Profile, id. community, accessed at: https://profile.id.com.au/port-phillip

As well as many active individuals, the City hosts numerous community groups actively contributing to urban greening, including: First Nations groups; 'Friends of' groups in Alma Park, Elster Creek, St Kilda Botanical Gardens and Westgate; community gardening groups; the Port Phillip Emergency Climate Action Network (PECAN) and its member organisations; other local groups like the Environmental Leaders Action Network (ELAN), Jewish Climate Network, Jewish Ecological Coalition (JECO), Protect our Planes (POP), South Melbourne Sustainability Group, Yarra Riverkeeper Association, Earthcare St Kilda (operating since 1989), Westgate Biodiversity (Bili Nursery & Landcare Inc), and Port Phillip Pickers; and of course the Port Phillip EcoCentre, a not-for-profit, community-managed environment group, operating since 1999, with thousands of local members.

5.2. What we have heard from the Port Phillip community

In recent years, the Port Phillip community has consistently raised greening as a major priority for the City, including in consultation on the *Council Plan 2022-2031* and other Council strategies and initiatives[44].

When it comes to urban greening, the Port Phillip community is passionate, well-informed, highly engaged and active on-ground. It is clear that, since Greening Port Phillip was released in 2010, parts of the community have raised their support for and expectations of urban greening, and have a high level of ambition to green the City. They also highly value the ability to proactively engage in improving the public realm through greening. They are a strength of the City, and offer an opportunity for community partnerships to deliver common goals.

Key themes raised in consultation as community priorities include:

- Increasing permeability and becoming a **water sensitive city**
- Mitigating **urban heat**, using more shade trees
- Providing **more trees and vegetation**, including tree-lined streets, maximising greening in existing public space, and setting aside more land for public green space
- Enhancing **biodiversity**
- Increasing Council influence on **private realm** greening, including ensuring that housing provides for nature and gardening
- Balancing **on-street car parking provision** with tree planting
- Supporting **community stewardship** or 'mobilisation' (including tree planting events, community gardens, nature strips, and initiatives like the Bee Pollinator Program in South Melbourne).

During consultations, people also raise the risks that can arise when people and property co-exist with greening. These are described in the next section.

[44] Including Move, Connect, Live: Integrated Transport Strategy 2018-2028, Act and Adapt: Sustainable Environment Strategy 2018-2028, Places for People: Public Space Strategy 2022-32, South Melbourne Structure Plan 2021, and Nature Strip and Street Gardening Guidelines 2022.

5.3. Co-existing with urban greening

While there are many benefits of greening in urban environments (see section 6 below), there are also risks to navigate when people and property co-exist with greening. People have diverse views and experiences of urban greening. In some cases, people feel differently about greening depending on its context – whether it is in their yard, the local park, or on their street.

In a 2019 national survey, 85% of respondents said that the benefits of urban green spaces are important to them, and 12% found them a nuisance[45]. The most highly rated benefits of greening mentioned in the survey were aesthetics, relaxation, health and wellbeing, and wildlife. The most common concern about urban green spaces was whether they would be properly maintained. Some commonly cited concerns in Port Phillip and elsewhere are examined below.

5.3.1. Green and grey infrastructure

The interface between green and grey and infrastructure is a common concern. This includes below ground (eg. roots entering broken pipes), at ground level (eg. roots lifting footpaths), and at the canopy level (eg. canopy trimming for electrical line compliance).

Councils regularly manage and maintain both their green and grey infrastructure to minimise risks, including monitoring for and repairing trip hazards. Risk mitigation strategies for trees include:

- **Appropriate species selection** (eg. species with non-invasive root systems, smaller trees under powerlines)
- **Risk treatments** (eg. root barriers, adequate soil capacity or structural cells, installing passive watering, replacing concrete, bitumen and pavers with permeable surfaces)
- **Healthy tree management** (eg. adequate watering).

Roots are highly unlikely to break a water pipe – they will only enter pipes that are already broken, seeking access water. It is also important to acknowledge that trees and vegetation can extend the life of built assets, including by stabilising soil, shading (eg. reducing heat-related expansion and contraction of asphalt and other building materials), taking up stormwater (reducing the impact on drainage infrastructure and the risk of flooding), and mitigating wind damage (eg. to powerlines).

5.3.2. Shading of solar panels

An issue gaining interest in recent years is the shading of solar panels. It is understandable that people investing in rooftop solar wish to maximise their power generation potential. However, the cooling, carbon sequestration and other services provided by trees, to both the building occupant and the broader community, are highly likely to outweigh any opportunity cost of reduced generation from shaded solar panels.

There are two factors to consider. One, technology has greatly improved since solar panels were first introduced. More recent solar panel installations are tolerant of partial shade, especially when bypass diodes are used to isolate shaded panels. And two, removing a tree to generate solar energy is likely to increase electricity usage and negate the extra generation, which could be to the economic detriment of the homeowner if they use air conditioning over summer[46].

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[45] Greener Spaces, Better Places (2019), *Who's With Us?*, accessed at: https://www.greenerspacesbetterplaces.com.au/media/163040/whoswithus_small.pdf

[46] Moore, G (2014), *Defending and Expanding the Urban Forest: Opposing unnecessary tree removal requests*, TreeNet Symposium presentation, accessed at: https://treenet.org/resource/defending-and-expanding-the-urban-forest-opposing-unnecessary-tree-removal-requests/

5.3.3. Debris – fruits, flowers, leaves and pollen

Greening can cause concern within the community through the dropping of leaves, flowers and fruit. A number of people in the community also have pollen allergies or other physical reactions which can be exacerbated at particular times of the year by plants in flower. Plants that are valued by some parts of the community for their flowers, the fruit they provide, or the shade and shelter from their canopy, can also be the cause of distress for other parts of the community from the debris that is dropped on their nature strips or in their front yards, or due to allergies being exacerbated.

To manage risks from fallen leaves, flowers and fruits, Councils undertake regular street and footpath sweeping, and monitor for any trip or slip hazards. Gutter clean-outs and yard maintenance are the responsibility of the homeowner. However, some Councils have recently commenced programs to support elderly residents in cleaning up tree debris.

Urban forestry has advanced significantly in recent years in its knowledge and management of appropriate species selection for allergens and other hazards. For example, *Lagunaria patersonia*, also known as the Norfolk Island hibiscus, pyramid tree, or more colloquially as the 'itchy bomb tree' due to the fine hairs released from the tree's seed capsules, is now widely recognised as unsuitable for public planting. Hobsons Bay City Council has introduced a program to replace these trees, prioritised by where they are causing the most discomfort to residents[47].

5.3.4. Branch drop

The fear of limbs dropping and causing injury or death may cause distress to residents. However, Council trees are diligently monitored and maintained to keep risks as low as reasonably practical. The probability of being killed by a tree is extremely low, regardless of the species. A 2019 study found that the annual mortality rate from tree failure in Australia is in the order of 1 in 5 million, with 86% of deaths occurring during or immediately after extremely wet and stormy weather[48]. Residents can manage their risk by not being out under trees during storms. By comparison, Australians are roughly twice as likely to die from being hit by lightning[49], and 220,000 times more likely to die in a car accident[50].

5.3.5. Views and aesthetics

Urban greening provides increased amenity for everyone in the City of Port Phillip. While most people highly value an outlook of trees and vegetation, for some, trees are seen to 'get in the way' of views to other landscape features, like the Bay. There are also differing views on which specific tree species and planting styles are aesthetically preferred. Getting physically active in nature, or involved in one of the active conservation groups in the City, may assist in increasing understanding of and appreciation for greening and biodiversity.

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[47] City of Hobsons Bay (2022) *Lagunarina Replacement Program*, accessed at (https://www.hobsonsbay.vic.gov.au/Services/Trees-Nature-Strips/Growing-a-diverse-and-healthy-urban-forest/Lagunaria-replacement-program)

[48] Hartley et al. (2019), *A review of deaths in Australia from accidental tree failures*, Arborist Network, accessed at: https://arboriculture.org.au/getassets/a2bd3064-7acd-ea11-90fb-00505687f2af/A%20Review%20of%20Deaths%20in%20Australia%20from%20Accidental%20Tree%20Failures.pdf

[49] University of Western Australia (2015) *Electrical Circuits 1: Lightning facts*, accessed at https://www.uwa.edu.au/study/-/media/Faculties/Science/Docs/Lightning-facts.pdf

[50] Department of Infrastructure, Transport, Regional Development and Communications (2022) *Road Fatalities Australia Monthly Bulletin – February 2022*, accessed at https://www.bitre.gov.au/sites/default/files/documents/rda_feb2022.pdf

5.3.6. Vandalism

Unfortunately, a small number of people have chosen to illegally vandalise trees. The City of Port Phillip has a policy that tree vandalism will be assessed for a site-specific response, and the community notified of the illegal activity. Tree vandalism responses may include a police report, erection of signage to notify the community, and leaving the tree in situ or planting a replacement tree.

5.3.7. Car parks, footpaths and bike lanes

Car parking spaces are at a premium in Port Phillip, as a high-density City with many destinations for locals and visitors. Council has prioritised increased canopy cover, as well as increased walking and cycling rates. This is commonly seen as a source of potential conflict or concern. However, greening, accessible walking paths, bike lanes and car parking spaces can all be accommodated with smart streetscape design. One important consideration is to plant the largest canopy tree possible in the space, rather than many smaller trees, to reduce the number of trunks and therefore the on-ground space needed for trees.

5.3.8. Tree life spans

Some community members are concerned that Councils are not planting trees quickly enough, and are highly distressed when a mature tree is cut down. As living infrastructure, trees take a long time to grow, and benefits peak once trees mature. Most of the costs are incurred early in the tree's life, and when it reaches the end of its life. A healthy forest has trees of all ages – uneven age distribution is important for sustainable management (spreading out costs and management activities so they don't all need to happen at once), and for sustainable benefits (ensuring a steady supply of ecosystem services at all times). To ensure a healthy tree population across the City, within resourcing constraints, Council must plant trees every year, care for them when they are young, and manage risks, then replace them, as they reach the end of their useful life. Tree replacement can be particularly distressing to residents, as mature trees become such an integral part of the urban fabric, but it is unfortunately an unavoidable part of managing living infrastructure.

6. Benefits of urban greening

There is now a well-established body of evidence confirming that urban greening offers a multitude of benefits to people, economies and nature in cities[51].

Green cities promote greater happiness, health, physical activity, and community connectedness among their residents. Water is used as a valuable resource, and stormwater management costs and flood risks are reduced. Air quality is improved, urban heat is reduced, and there are more comfortable microclimates. Soil becomes more productive, and locally sourced food is produced. House prices increase, local businesses thrive, and jobs are created. Biodiversity is supported through the provision of habitat. Carbon is sequestered, emissions are reduced, and climate change risks are mitigated.

Cities with ample greening are more resilient, prosperous, and enjoyable places to live.

The benefits of greening have been illustrated in numerous documents, including Plan Melbourne 2017-2050 (see image).

It is worth noting that some of the benefits of trees such as sense of place and aesthetics can be difficult to quantify and are often overlooked in cost benefit analyses.

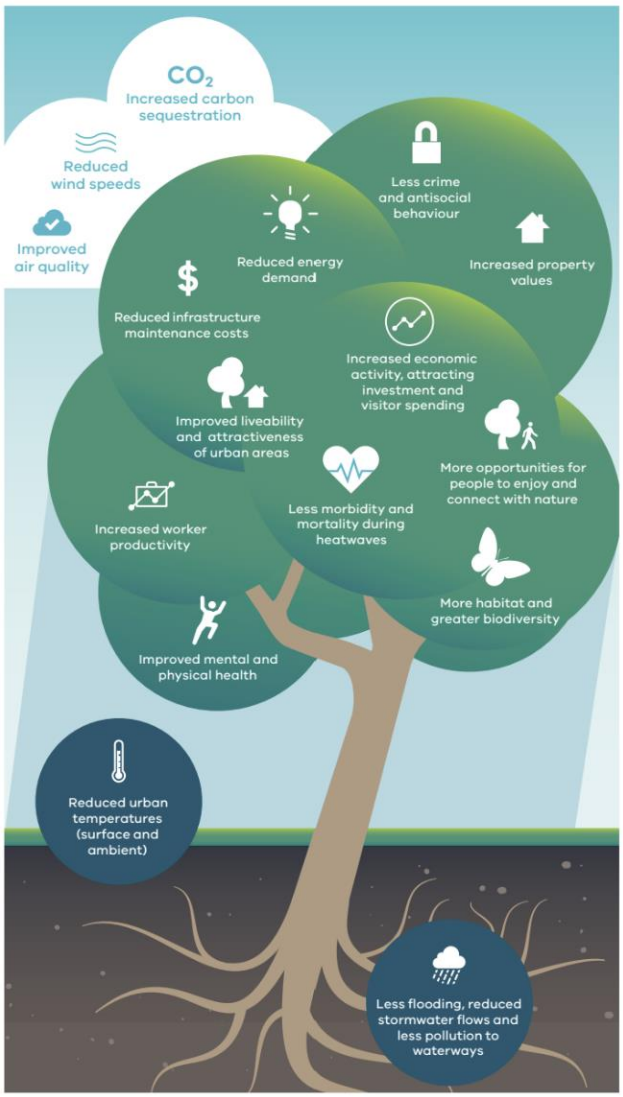

Image 2 Benefits of Urban Greening.
Source Victorian Government (2017), Metropolitan Planning Strategy - Plan Melbourne 2017-2050

In recent years, the growing field of urban greening research has continued to strengthen the argument for greening by confirming and expanding on its many benefits. The COVID-19 pandemic also strengthened the community's understanding of the benefits of urban greening, with global research recording major increases in the appreciation for and recreational use of urban green spaces[52].

The specific benefits in the context of Port Phillip have been included below, combining the comprehensive list described in the City of Port Phillip's *Street Tree Planting Program 2017-2022* with some of the latest evidence.

[51] For example, see Dobbs et al. (2017) Ecosystem services, in Ferrini F, Konijnendijk van den Bosch C, Fini A (eds) *Routledge handbook of urban forestry,* Routledge, London, pp. 51–64.

[52] Weinbrenner H, Breithut J, Hebermehl W (2021) *The forest has become our new living room —The critical importance of urban forests during the COVID-19 pandemic*. Frontiers in Forests and Global Change

6.1. Economic benefits

- **Reducing energy costs** – Major economic benefits come through shading buildings in summer, reducing the need for air-conditioning and, in turn, cutting energy costs. Well-placed shade trees can reduce home energy consumption by as much as 30%[53].
- **Increasing property values** – Street trees enhancing the appearance of the neighbourhood have been proven to increase property values. A 2019 Melbourne study found that street trees increased property values by an average of $16,889 per property[54], while another Melbourne study in 2015 found a 10% increase in tree canopy cover resulted in an increase in property values of up to 1.2%[55].
- **Avoiding costs of infrastructure damage and renewal** – Shading provided by the urban forest can significantly improve the lifespan of roads, footpaths and other assets, preventing damage from heat related swelling and shrinking, as well as the harmful effects of ultraviolet radiation[56]. This delays the need for maintenance and replacement, avoiding costs.
- **Decreasing health costs** – Research suggests that healthy green cities help alleviate the burden on public health systems. While it is difficult to quantify dollar savings, it is likely that urban forests reduce health costs associated with sedentary behaviour, obesity, and mental illness.
- **Marketing the city** – Green spaces play a role in defining the culture and image of a city, with the potential to make a city more competitive, thus expanding its political and economic influence.
- **Nature boosts business** – Research has shown that nature can boost the viability of businesses by drawing shoppers into business districts and encouraging them to spend more. One study found that customers prefer shopping in well-tended streets with large trees. The study also found these customers would pay 9–12% more for goods sold in central business districts with high quality tree canopy, and would travel further to them, visit more often, pay more for parking, and stay longer in a well-treed shopping district.[57, 58]

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[53] Akbari, H., Pomerantz, M., & Taha, H. (2001). *Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas*. Solar Energy, 70(3), 295-310

[54] Stevenson, M., Tapsuwan, S., & Bell, C. (2019). *The value of street trees in residential areas: A matched-pair analysis.* Urban Forestry & Urban Greening, 46, 126425.

[55] Dadvand, P., Nieuwenhuijsen, M. J., Esnaola, M., Forns, J., Basagaña, X., Alvarez-Pedrerol, M., & Sunyer, J. (2015). *Green spaces and cognitive development in primary schoolchildren*. Proceedings of the National Academy of Sciences, 112(26), 7937-7942.

[56] Coelho M., Carrilho J., Galvão, A., (2009) *The effect of tree shading on the deterioration of flexible pavements*, Construction and Building Materials, vol. 23, no. 1, pp. 60-65.

[57] Mullaney J, Lucke T, Trueman SJ. (2015*). A review of benefits and challenges in growing street trees in paved urban environments*. Landscape and Urban Planning 134, 157–166.

[58] Wolf, K, (2003) *Public Response to the Urban Forest in Inner-City Business Districts*. Journal of Arboriculture 29(3) pp 117 – 126

Monetary benefits of greening on private land

An important study was released in August 2022 by Melbourne Water, providing a common understanding of the full range of values and benefits provided by greening on private land. This study addressed a critical knowledge gap by focusing on the costs and benefits to individual landholders, rather than public trees and the public good.

The study itemised monetisable costs and benefits of trees on private land (see image below), and ran two illustrative cost-benefit analyses, finding that the "*benefits of well-maintained trees can be several multiples of the financial cost. It also shows that there are more benefits to be had by retaining existing mature trees compared to establishing new trees. This is because many of the benefits of trees occur towards the second half of a tree's life, but many of the costs occur upfront.*"

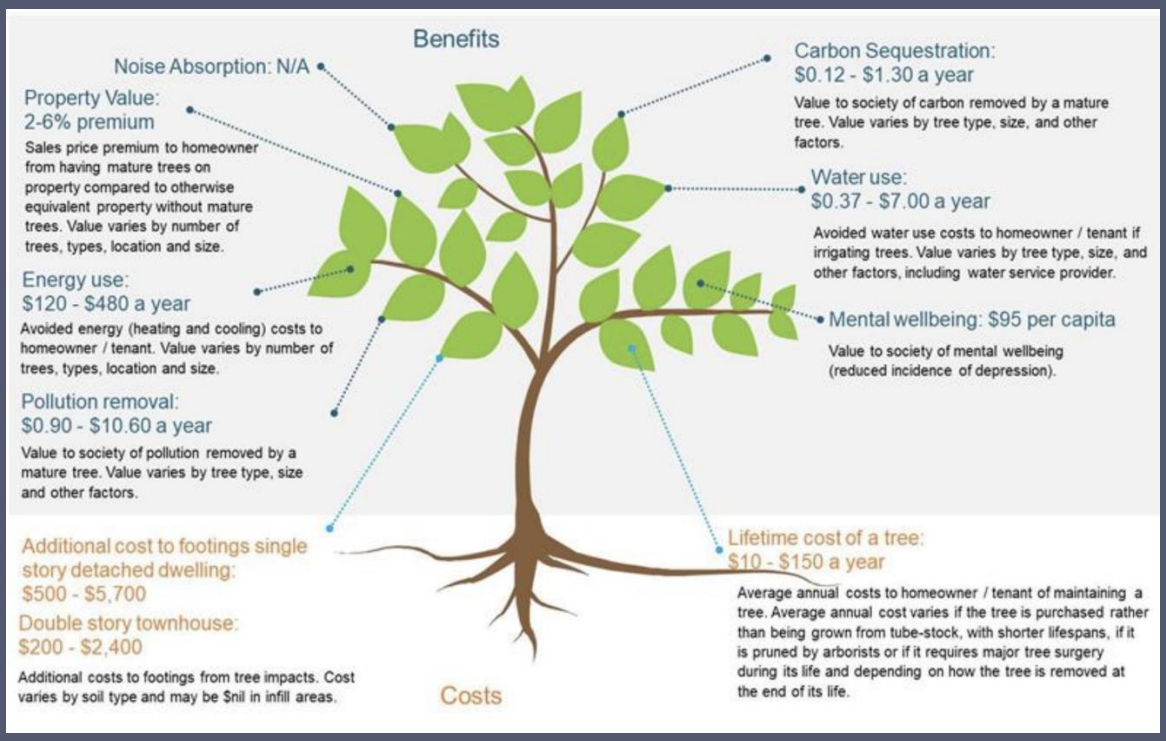

Image 3 Melbourne Water (2022) Value Analysis of trees on private land, accessed at: https://livingmelbourne.org.au/projects/value-analysis-of-urban-greening/

6.2. Ecosystem services

- **Urban cooling** – Urban areas are hotter than surrounding rural areas because hard surfaces that are exposed to the sun absorb large amounts of heat. This 'urban heat island effect' exacerbates heat-related mortality and costs such as increased air-conditioning use. Through shade and transpiration, trees help reduce day- and night-time temperatures in cities, especially during summer. A 2012 Melbourne study found that street trees reduced temperatures by up to 4°C on hot days and that increasing tree canopy cover by 10% could reduce urban temperatures by up to 2.5°C.[59]
- **Cleaning up water and reducing flood risk** – Tree canopies and root systems reduce stormwater flows and nutrient loads that end up in waterways. Broad tree canopies intercept and mitigate the impact of heavy rainfall. Healthy tree roots help reduce the nitrogen, phosphorus and heavy metal content in stormwater, and well as making the soil more porous and absorbent, further slowing stormwater flows into waterways.[60]
- **Reducing air pollution** – Trees produce the oxygen we breathe, and protect us from air pollution, which is a major contributor to ill health and premature death[61]. Through the process of photosynthesis, trees take up carbon dioxide, nitrous oxides, sulphur dioxide, carbon monoxide and ozone. Leaf surfaces capture fine air-borne particulates that can be dangerous to health[62]. A 2018 study in Melbourne showed that an increase of 10% in tree canopy cover resulted in a 3.9% reduction in nitrogen dioxide concentrations in the air[63].
- **Adapting to climate change** – The capacity of urban forests to contribute to climate change adaptation is broad and well-documented[64]. The latest Intergovernmental Panel on Climate Change (IPCC) report found that urban greening has been effective in reducing flood risks and urban heat.[65]
- **Storing carbon** – Trees absorb and store carbon from the atmosphere, making a significant contribution to slowing the causes of climate change. A 2012 study found that trees in the City of Melbourne remove approximately 20,000 tonnes of carbon dioxide from the atmosphere each year, contributing to the city's efforts to combat climate change.[66]
- **Enhancing biodiversity** – A healthy urban forest provides habitat for a variety of wildlife. Urban forests have been shown to support a wide range of species, including endangered animals and other species of high conservation value. Biodiversity can be enhanced by ensuring a range of age, strata and vegetation types, a wider range of habitats, food and other resources, and opportunities for movement.[67, 68]

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[59] Coutts, A. M., White, E. C., Tapper, N. J., & Beringer, J. (2012). *Temperature regulation of urban landscapes: A Melbourne case study*. Landscape and Urban Planning, 107(3), 317-330.

[60] Livesley, S. J., McPherson, E. G. and Calfapietra, C., 2016. *The urban forest and ecosystem services: Impacts on urban water, heat, and pollution cycles at the tree, street, and city scale*. Journal of Environmental Quality, 45(1), 119–124.

[61]Doctors for the Environment Australia (2023) *Trees: The Forgotten Heroes for our Health*

[62] Lovasi, G. S., et al. (2013). "*Urban tree canopy and asthma, wheeze, rhinitis, and allergic sensitization to tree pollen in a New York City birth cohort*." Environmental Health Perspectives, 121(4), 494-500.

[63] Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2018). *Psychological benefits of greenspace increase with biodiversity*. Biology Letters, 14(1), 20170420.

[64] Mullaney J, Lucke T, Trueman SJ. 2015. *A review of benefits and challenges in growing street trees in paved urban environments*. Landscape and Urban Planning 134, 157–166

[65] IPCC (2023) *Synthesis Report of the IPCC Sixth Assessment Report (AR6): Summary for Policymakers*, accessed at: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

[66] City of Melbourne. (2012). *Urban Forest Strategy 2012-2032*. Retrieved from https://www.melbourne.vic.gov.au/SiteCollectionDocuments/urban-forest-strategy.pdf

[67] Ikin, K., Knight, E., Lindenmayer, D. B., Fischer, J., & Manning, A. D. (2013). *The influence of tree cover on the presence of urban-sensitive bird species in a residential landscape*. Urban Ecosystems, 16(4), 871-888.

[68] Lindenmayer, D. (2014). *The anatomy of urban forests: A review*. Landscape and Urban Planning, 129, 1-22.

Benefits of green roofs, walls and facades

In 2019, City of Melbourne released their Valuing Green Guide, documenting all known benefits of green roofs, walls and facades, in the City of Melbourne or similar contexts. It groups benefits into the key themes of water, temperature, biodiversity, health and wellbeing, and collective benefits. Each benefit is identified as flowing to an individual, community, or institution (see table below).

	INDIVIDUAL	COMMUNITY	INSTITUTIONAL
Water	• Increased flash flood safety	• Reduced flood cost and damage • Improved water quality	• Flood safety/damage targets • Water quality targets
Temperature	• Increased indoor comfort • Energy use savings for building occupants	• Lower Urban Heat Island (UHI) • Reduced air pollution production • Improved street-level comfort and amenity	• UHI targets (4°C reduction goal)
Biodiversity	• Enjoyment of flora and fauna • Visual amenity and status • Personal and cultural environmental values	• Environmental education • Citizen science	• Regional conservation targets and status • Reduced climate impacts due to Green House Gas (GHG) reduction
Health and wellbeing	• Improved indoor comfort	• Reduced health costs • Improved air quality • Reduced sound pollution • Increased walkability	• Improved levels of community health • Reduced climate impacts due to GHG reduction
Collective benefits	• Higher property values • Rooftop & courtyard locations for social and business activities	• Stronger neighbourhood identity • Increases in productivity through visual amenity Increased economy through social returns	• Socially responsible investment • City identity (community and government)

Image 4 City of Melbourne (2019), Valuing Green Guide: Green roofs, walls and facades, accessed at: https://www.melbourne.vic.gov.au/sitecollectiondocuments/valuing-green-guide.pdf

6.3. Social, health and wellbeing benefits

- **Providing a sense of place and creation of local identity** – A city's landscape helps define its character and create a sense of connection to place.
- **Improving community cohesion** – Green public space provides places for daily gathering, play, barbecues, picnics, major events, festivals, and celebrations. Events and spaces can bring diverse groups of people together, playing an important role in the integration of minority groups in society and assisting immigrants to adapt to their host country.[69]
- **Encouraging outdoor activity** – Residents living in areas with more trees and green space have been shown to have higher levels of physical activity and better mental health outcomes compared to those living in areas with less green space.[70] This has multiple flow-on benefits such as reduction in obesity and improvement in general physical and mental wellbeing. Increased walkability (and bikeability) also takes cars off the road, thereby reducing greenhouse emissions and other pollution, improving overall amenity, and helping to make streets places for people.
- **Connecting children with nature** – Studies have shown that green spaces allow children creativity of mind, encourage exploration and adventure, promote physical activity, build resilience, and enhance experiential learnings.[71]
- **Reducing sun exposure** – Skin cancer and other sun exposure illnesses highlight the importance of protection from sunlight's UV rays. Shade alone can reduce overall exposure to UV radiation by up to 75%[72].
- **Reducing heat-related illness and mortality** – Heatwaves kill more Australians than any other natural disaster. They have led to many deaths in Victoria, including 204 deaths in the January 2014 heatwave[73]. Urban greening can reduce the mortality risk associated with heat exposure[74].
- **Improving mental wellbeing** – The availability of, access to, and even the ability to view green spaces and trees have positive effects on people's wellbeing[75].

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[69] Troy, A., et al. (2013). *The role of green infrastructure in climate change adaptation in cities*, Ecological Economics, 86, 216-222.

[70] Astell-Burt, T., Feng, X., & Kolt, G. S. (2014). *Green space is associated with walking and moderate-to-vigorous physical activity* (MVPA) in middle-to-older-aged adults: findings from 203 883 Australians in the 45 and Up Study. British Journal of Sports Medicine, 48(5), 404-406.

[71] Wolch, J., M. Jerrett, et al. (2011*) Childhood obesity and proximity to urban parks and recreational resources: A longitudinal cohort study*, Health & Place 17: 207-214.

[72] SunSmart Victoria, (2015), *Shade Guidelines*, Cancer Council Victoria, Melbourne, accessed at: https://www.sunsmart.com.au/downloads/resources/booklets/shade-guidelines.pdf

[73] Steffen, W, Hughes, L, Perkins, S (2014), *Heatwaves: Hotter, Longer, More Often*, Climate Council of Australia, accessed at: https://www.climatecouncil.org.au/uploads/9901f6614a2cac7b2b888f55b4dff9cc.pdf

[74] Murage P. et al. (2020) *What individual and neighbourhood-level factors increase the risk of heat-related mortality? A case-crossover study of over 185,000 deaths in London using high-resolution climate datasets*. Environ Int.

[75] Barton, H., & Rogerson, M. (2017). *The importance of greenspace for mental health*. British Journal of Psychiatry, 211(4), 277-278.

The forgotten heroes of our health

In a March 2023 report, Doctors for the Environment and WWF Australia catalogue and promote the many health and wellbeing benefits of trees.

With only a quarter of the Australian population saying they know a lot about the health benefits of trees, the report's aim is to raise awareness of the vital role trees play in improving physical and mental health outcomes, and in saving people's lives.

Benefits highlighted include that:

- Tree-climbing helps children develop strength, spatial awareness, creativity, imagination and self-confidence
- Trees are integral to Aboriginal and Torres Strait Islander Peoples health and wellbeing, providing connection to Country and lore
- Intact ecosystems help prevent infectious diseases from emerging in humans – up to 70% of emerging infectious diseases (like COVID-19) have jumped from animals to humans due to deforestation and landuse change
- Over one-third of all medicines used today are derived from nature
- Trees are home to a wide range of pollinators, that help ensure a diverse and secure food supply.

Doctors for the Environment and WWF Australia (2023), *Trees: The forgotten heroes of our health*, accessed at: https://dea.org.au/wp-content/uploads/2023/03/WWF_DEA_Trees-Health-Report_FINAL_030323.pdf

7. Port Phillip's urban forest

7.1. What is Port Phillip's urban forest?

The City of Port Phillip's urban forest is made up of:

- Front and backyard gardens
- Balcony gardens
- Rooftop gardens and green roofs
- Vertical gardens – vegetation growing on and up the walls of buildings and fences
- Street trees, shrubs and ground covers on nature strips, median strips and roundabouts
- Trees and gardens in public parks and reserves
- Trees and gardens in other open spaces – shopping strips, industrial properties, etc.

Conceptualising all vegetation in the City as an 'urban forest' enables a united planning and management approach. An urban forest is the sum total of all vegetation growing in an urban area.

Urban forestry is an integrated approach to the management of vegetation in cities. It recognises that vegetation (especially trees) are critical infrastructure, providing a range of services in the same way as grey infrastructure, like buildings, roads, foot and bike paths, utilities, open spaces and activity centres. Green, grey and blue (water-related) infrastructure cannot be managed effectively in isolation from one another.

Image 5: Top Left: St Kilda Esplanade, Top Right: Bothwell Street Woody Meadow, Bottom Left: Danks Street Reserve, Bottom Right: Acland Street. Source: Kat Ryan

A standard definition?

Urban forest, urban greening, green infrastructure, nature-based solutions… these are all terms used to refer to nature in cities, with varying definitions.

Urban Green Infrastructure - Planning and decision framework (2023) represents Standards Australia's attempt to pin down the complexity of urban greening. It states that:

"Urban Green Infrastructure (UGI) includes remnant vegetation, designed and cultivated green spaces, and engineered vegetation systems on public and private land as well as buildings in an urban context. Examples of engineered vegetation systems include green roofs, green walls and raingardens. Some forms of infrastructure, such as bioswales, wetlands or vegetation in stormwater retention basins, include both blue and green elements."

https://store.standards.org.au/product/sa-hb-214-2023

7.2. The urban forest today

The City of Port Phillip attracts millions of visitors annually due to its parks, iconic foreshore, beaches, and tree-lined boulevards. Its network of public open space includes the most sought-after foreshore areas in Melbourne, stretching over 11 kilometres from Elwood in the south to Port Melbourne in the northwest. The City is home to historical and iconic parks like Albert Park, Catani Gardens, St Vincent's Gardens, Gasworks Park, and St Kilda Botanical Gardens. A top priority of the City is optimising the use of all available open space for active and passive recreation, cultural activities, climate change adaptation, and greening opportunities.

Trees are a crucial aspect of the City's landscape, with several well-known native and exotic trees scattered throughout the area, adding to the unique character of the neighbourhoods. For example, the Ngargee Tree in Albert Park holds cultural significance for the Yalukit Willam and the Kulin Nation. The palm trees in Catani Gardens reflect the cultural influences in the area during the early 1900s, when prominent Italian landscape designer Carlo Catani was active in the St Kilda Foreshore Committee.

Boulevards are significant features of Port Phillip's urban landscape – wide streets featuring a median down the centre and higher quality landscaping and scenery. These boulevards include Brighton Road, Queens Road, St Kilda Road, Kerferd Road, Beach Street, Beaconsfield Parade, Jacka Boulevard, The Esplanade, Marine Parade, Ormond Esplanade, Bay Street, and Fitzroy Street. Trees in boulevards are critical to maintaining the distinct urban character of Port Phillip and provide shade for major walking, cycling, and vehicle thoroughfares. The majority of streets in the City are lined with a single species of large deciduous trees or Australian natives. There are also prominent plantings of palm trees, such as the Canary Island Date Palms along Beaconsfield Parade.

The City's urban forest includes diverse garden beds in parks, reserves and along the Bay Trail, on nature strips and medians and in water sensitive urban design interventions throughout the city. These lower storey plantings provide a sense of place and character to parks and neighbourhoods, have ecological value and are an important heritage feature in some historic gardens.

Port Phillip's beaches are the second most visited location in Victoria. Dunes along Port Phillip's coastline provide an essential role in buffering storms and flooding, and the grasses help to bind and hold the sand, acting as a sand reservoir to replenish the beach after severe storms. Several indigenous dune grasses have regional significance, and the dunes are the foundation for the coastal ecosystems and habitats for wildlife and plants.

The City's urban forest also includes trees and other vegetation on private land, including in front and backyards, on rooftop gardens and green walls, and in commercial, retail and industrial properties.

7.3. Tree canopy cover

A common high-level indicator of the urban forest is tree canopy cover. In 2023, the City of Port Phillip commissioned Player Piano Data Analytics to conduct a comprehensive assessment of both the existing and historic tree canopy on private and public land from 2012 to 2022. The analysis measured tree canopy cover on roads, public land (parks and reserves, excluding Albert Park[76]), and private land.

In the ten year period of 2012 to 2022, Port Phillip had a slight decline in canopy cover of 0.69%. In 2022, 17.17% of Port Phillip was covered by canopy from trees that are greater than 3 metres in height, down from 17.86% in 2012.

Overall, roads in Port Phillip have a canopy cover of about 26%, well above the average for inner city Melbourne, making it a unique feature of the city's urban forest. Roads in Port Phillip make up about 27% of the total land area, and contribute about 44% of total canopy cover. By contrast, private land makes up about 49% of the land area and contributes about 33% of the total canopy cover.

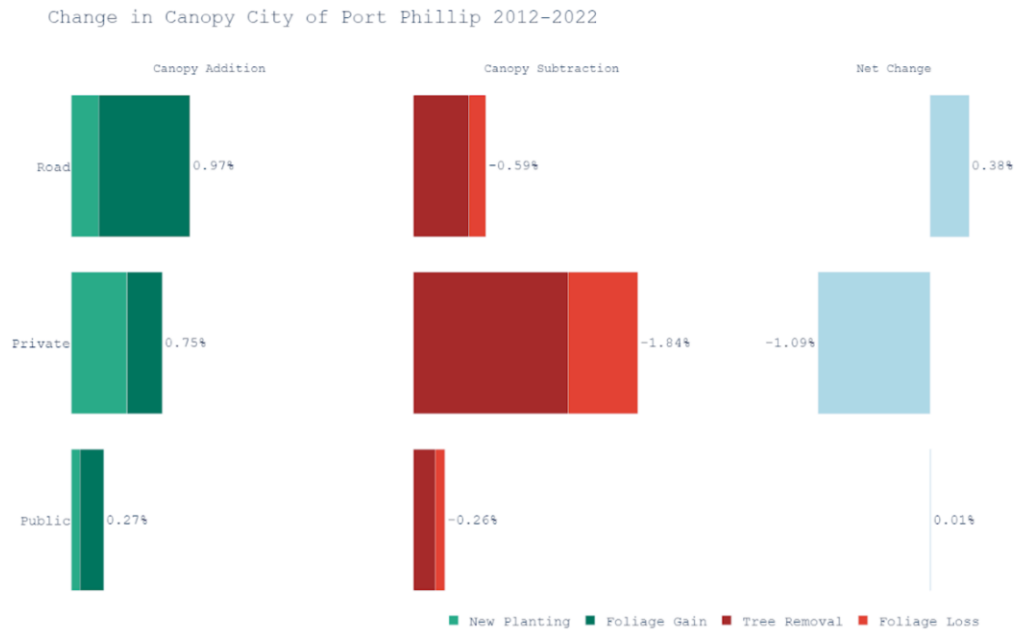

Figure 1. Change in canopy from 2012-2022, Player Piano Data Analytics (2023).

Most of the gain in canopy cover between 2012 and 2022 is from the growth of existing street trees (foliage gain). This growth has offset the street tree canopy loss due to removal, natural loss and pruning. The net canopy change on roads was +0.38%. Street trees contribute 43.68% of total canopy cover over roads, as well as adding to canopy cover over private land.

On public land (parks and reserves, excluding Albert Park), canopy cover did not significantly change (+0.01%). Canopy cover reduction from trees that were removed was ultimately offset by the growth of existing and newly planted trees. Public land contributes 12.69% of total canopy cover. Albert Park contributes an additional 10.83% of total canopy cover.

On private land there was a net tree loss, at -1.09%, which was predominately driven by tree removals. More than half of the canopy gain on private property was attributed to new plantings. As

[76] Albert Park is managed by Parks Victoria, not Council.

new plantings mature, they may offset some of the removals. Private land contributes 32.78% of total canopy cover.

Tree canopy cover is not evenly spread across the city, and canopy gains and losses are also spatially uneven. Elwood, Ripponlea and St Kilda East have canopy cover above 24%, which is exceptional for an inner city suburb.

All suburbs in Port Phillip experienced a net decline in canopy on private land. Elwood, St Kilda, Port Melbourne and St Kilda East showed the greatest loss. These four suburbs also contain 71% of all tree canopy on private land.

Growth of existing street trees in Elwood and Port Melbourne made the largest contribution to the net gain reported council wide, with 82% of the additional canopy over roads attributed to these two suburbs. On public land, there was a slight increase in tree canopy cover in Elwood and Port Melbourne, while other areas remained steady.

Please refer to the Canopy Cover Analysis report for more detail, including per suburb breakdowns.

A note on evolving data capabilities

Spatial data analysis is a rapidly evolving field, including for tree canopy assessments. In 2010, when Greening Port Phillip was published, data was not available to determine the baseline tree canopy cover for Port Phillip. Multiple canopy cover datasets have since been produced[77], from 2013 onwards.

When the City of Port Phillip set out its canopy targets in *Act and Adapt: Sustainable Environment Strategy 2018-2028*, it used the best available data, commissioned by the Victorian Government and produced by RMIT University[78].

The targets are to:

- Increase street tree canopy cover by 10% by 2027/28
- Increase canopy cover on private land by 10% by 2027/28.

The 2015/16 baselines for these targets were 19% and 11%, respectively.

The study commissioned by the City of Port Phillip in 2023 (from Player Piano Data Analytics, described above) shows significantly higher levels of baseline canopy cover. The reasons for this difference are the classification used for tree canopy[79], and the technology used for mapping and analysis[80].[81]

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[77] By Council, Living Melbourne, the Victorian Government, and research bodies.

[78] Hurley et al. (2019) Urban Vegetation Cover Change in Melbourne 2014 - 2018, Centre for Urban Research, RMIT University, Melbourne, Australia, accessed at: https://www.planning.vic.gov.au/guides-and-resources/data-and-insights/melbournes-vegetation-heat-and-land-use-data

[79] In the RMIT study, only vegetation above 3m was included. The study assigned a per pixel height and aggregated canopy cover for all pixels above 3m, which means that only the portion of tree canopy above 3m high is included in the analysis. Any canopy below 3m is excluded, resulting in an underestimate of canopy. Player Piano Data Analytics include the canopy area of the tree if the tree is above 3m, resulting in a more accurate measure of canopy.

[80] The RMIT study used instrumentation and data processing to determine whether a pixel in an image is vegetation or not. Player Piano Data Analytics uses artificial intelligence algorithms trained by human analysts to identify an individual tree and make a measurement of the crown area, repeated for aerial images over time. The RMIT study measured loss and gain in canopy by subtraction. The technology developed by Player Piano Data Analytics provides greater detail of canopy gain and loss including whether a tree was removed, how much retained canopy grew or senesced and how newly planted trees were surviving.

[81] Details about differences in methodology and technology supplied by Player Piano Data Analytics

The results of each study are consistent within the studies themselves, and results are all valid. However, studies using different methodologies cannot be compared. So, although the baselines may have shifted, the ambition to increase canopy by 10% in ten years still stands. It is clear from the latest analysis that more needs to be done, especially on private land, to meet this goal.

7.4. Tree population

The City of Port Phillip manages approximately 46,000 trees, 75% of which are street trees. London Plane Trees (*Platanus X acerifolia*) dominate the public realm, making up 9% of street and park trees. The next three most common species are the Queensland Brush Box (*Lophostemon confertus*), Coastal Banksia (*Banksia integrifolia*) and Drooping Sheoak (*Allocasuarina verticillata*) (4% each)[82].

Having diverse tree species is important for a resilient urban forest (see section 11.2). The US Forest Service provides a recommended rating system to distinguish between 'fair' and 'good' species diversity[83]:

- Fair diversity: No more than 10% of a single species, 20% of a single genus and 30% of a single family. (10/20/30).
- Good diversity: No more than 5% of a single species, 10% of a single genus and 15% of a single family. (5/10/15).

Here the public tree population of Port Phillip is assessed for diversity against the US Forest Service ratings of fair (10/20/30) and good (5/10/15)[84].

Tree species

Fair (**10**/20/30)

- All species ≤ 10%

Good (**5**/10/15)

- Most planted tree is 9% (P. acerifolia – London Plane)
- All other species ≤ 5%

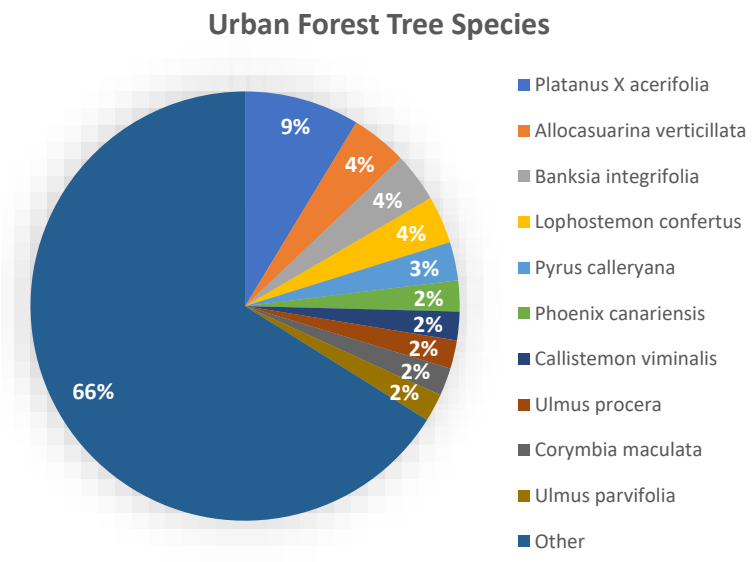

Figure 2. Tree species diversity in the City of Port Phillip 2022

[82] Statistics supplied by the City of Port Phillip, May 2023.

[83] US Forest Service (2016), Sustainable Urban Forest Guide, accessed at https://www.itreetools.org/documents/175/Sustainable_Urban_Forest_Guide_14Nov2016.pdf

[84] Data and analysis supplied by City of Port Phillip, June 2023

Tree Genus

Fair (10/**20**/30)

- All genera ≤ 20%

Good (5/**10**/15)

- All genera ≤ 10%

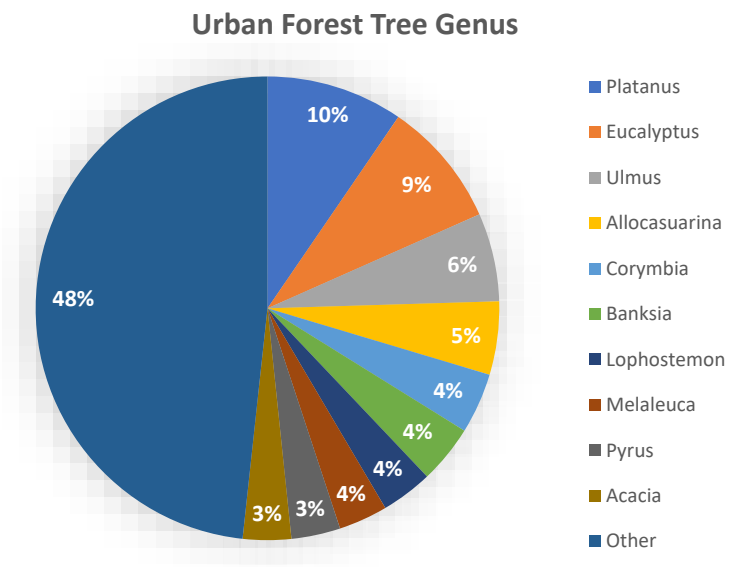

Figure 3. Tree genus diversity in the city of Port Phillip 2022

Tree Family

Fair (10/20/**30**)

- Most planted tree family (Myrtaceae) is > 30%
- All other families ≤ 30%

Good (5/10/**15**)

- Most planted tree family (Myrtaceae) is > 15%
- All other families ≤ 15%

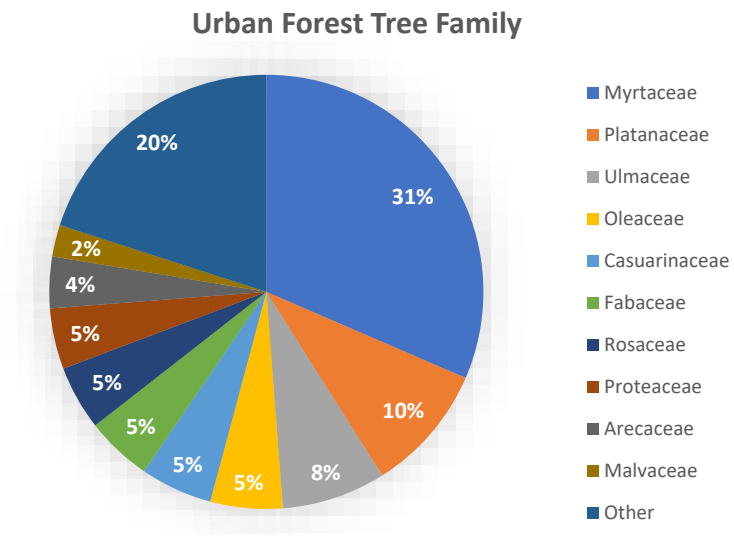

Figure 4. Tree family diversity in the City of Port Phillip 2022

Overall tree diversity in Port Phillip is good. Tree species diversity is generally good. Only one species, the London Plane, is above 5% of the total tree population (at 9%). Tree genera diversity is good, with all tree genera making up ≤ 10% of the total tree population. The Myrtaceae family makes up 31% of trees, slightly above the fair rate of 30%. All other families are in the good range, making up less than 15% each of the tree population. In Australia the Myrtaceae family is large, with over 70 genera and 1,500 species, consisting of eucalyptus, corymbia and angophora (gums), callistemon (bottlebrush), melaleuca (paperbarks and honey myrtles) and syzygium (lily-pillies)[85]. These species are planted widely in the streets in Port Phillip.

[85] Australian Native Plant Society Myrtle Family (Myrtaceae) - Australian Native Plants Society (Australia) (anpsa.org.au)

7.5. Biodiversity, ecology and habitat

The City of Port Phillip is in the 'Sandbelt' area of southeastern Melbourne. For thousands of years the landscape consisted of coastal dunes, extensive swamps (today's Elwood, Albert Park, Port Melbourne, Kingsway), a timbered shale and sandstone ridge (today's St Kilda) that marked the boundary of the Yarra delta, inland sand plains covered in healthy woodland, red gum and tea-tree swamps along the Yarra and the low but prominent grassy basalt plateau of Emerald Hill[86].

The region is now heavily urbanised, with remnant native vegetation now largely restricted to the foreshore and a few parks and reserves. The city has six remnant indigenous flora sites, including Coastal Dune Scrub and Grassy Woodland Plains ecosystems. The six remnant sites are located at Sandridge Beach, Port Melbourne; West Beach, St Kilda; Point Ormond Reserve; HR Johnson Reserve; St Kilda Botanic Gardens; Canterbury Road Urban Forest; Elwood Foreshore; and Tea Tree Reserve.

Point Ormond Reserve is particularly significant as one of the last surviving indigenous remnants in urban Melbourne, with 39 indigenous plant species, five of which are regionally significant, including *Allocasurina vertillicata* (Drooping Sheoak) and *Alyxia buxifolia* (Sea Box). The West Beach dunes, stretching from pier to pavilion along Beaconsfield Parade, has very high local ecological significance. It covers 1.2 hectares and includes 31 indigenous species, five of which are regionally significant, including *Carex pumila* (Strand Sedge) and *Distichlis distichophylla* (Australian Salt-grass).[87]

The Biodiversity Study in 2020 compiled all the available biodiversity records for the City. It found that the biodiversity values remaining in the City are significant and require protection and enhancement for future generations. The study identified:

- 1,059 flora species comprising 102 algae (most of which are marine macroalgae), 32 bryophytes (mosses and liverworts) and 920 vascular plants.
- 1,090 fauna species comprising:
    - 464 vertebrate species including 276 birds, 115 fish, nine frogs, 34 mammal (17 marine mammals) and 30 reptiles
    - 626 invertebrate species, including 23 crustaceans, 424 invertebrates (spiders, insects, worms etc.), 52 marine invertebrates (jellyfish, worms, starfish, tunicates etc.), and 127 molluscs
    - 113 fungal species, including seven lichens
    - 2 protist species of slime mould.
- Rare or threatened species including:
    - Three flora and 30 fauna species listed under the Australian *Environment Protection and Biodiversity Conservation Act 1999*
    - Eight flora and 44 fauna species listed under the Victorian *Flora and Fauna Guarantee Act 1988*
    - 20 flora and 74 fauna species classified as rare or threatened in Victoria by the Department of Environment, Land, Water and Planning.

The study recognises the importance of keystone species in providing important ecological functions like pollination, feeding resources, habitat, sand dune stability, microclimate, etc. The most notable keystone species include Hairy Spinifex, Seagrasses, seasonally flowering canopy species, almost all

[86] CoPP (2010) Greening Port Phillip – An urban forest approach

[87] CoPP, *Native Vegetation Areas*, accessed April 2023 at https://www.portphillip.vic.gov.au/council-services/trees-and-vegetation/native-vegetation-areas

invertebrates (terrestrial, freshwater and marine), the Australian Anchovy (*Engraulis australis*), the pollinator Grey-headed Flying-fox (*Pteropus poliocephalus*), and *Scleroderma cepa*, a type of Puff Ball, for its symbiotic relationship with Eucalypts and other plants.

The study also identifies flagship species as essential nature ambassadors that improve the wider community's connection with and understanding of biodiversity. These include characteristic plants like Eucalypts, Wattles and Banksias, dominant grasses like Hairy Spinifex, Kangaroo Grass, Spear Grass and Wallaby Grass, other culturally or ecologically significant species like Murnongs, Noon-flowers and saltmarsh species, and the recently recorded rare and beautiful Green-staining Coral (*Ramaria abietina*) in Westgate Park. The introduced Canary Island Palm (*Phoenix canariensis*) has been widely planted as an iconic foreshore feature, but was not recommended for further planting. Flagship fauna species include the tourist attracting Little Penguin (*Eudyptula minor*) and the culturally significant Wedge-tailed Eagle (*Aquila audax*) and Australian Raven (*Corvus coronoides*), common species like the Black Swan (*Cygnus atratus*), Grey Fantail (*Rhipidura albiscapa*) and Rakali (Water-rat, *Hydromys chrysogaster*), and iconic fauna species groups such as Dolphins, Whales, Shearwaters, Seagulls, Seahorses and Whiting.

Potential threats to biodiversity noted in the study include climate change (especially for foreshore and estuarine habitats), pet dogs and cats, beachcombing and herbicide spraying. The study recommends the City protect and enhance biodiversity for the benefit of both the environment and the community's connection to nature.

8. Key trends related to Port Phillip's urban forest

8.1. Climate change

The City of Port Phillip declared a climate emergency in 2019, recognising that everyone must play their part in addressing this global challenge. The City is already experiencing the impacts of climate change, and projections show increased risk of flooding (see more below), storm damage, foreshore inundation, water supply issues, and extreme heat (see more below).

Trees are long-lived assets, so urban greening strategies need to consider future climate conditions (see image below). Tree populations need to be diverse to resist extreme heat, drought, pests and diseases. The species selected need to be suited to a different climate than the one we live in now. Greening also plays a crucial role as a climate solution, by drawing down greenhouse gases from the atmosphere and assisting the City and its people to adapt to the changing climate. The City of Port Phillip is reducing its own emissions and preparing its assets and community for a changing environment, including by investing in greening.

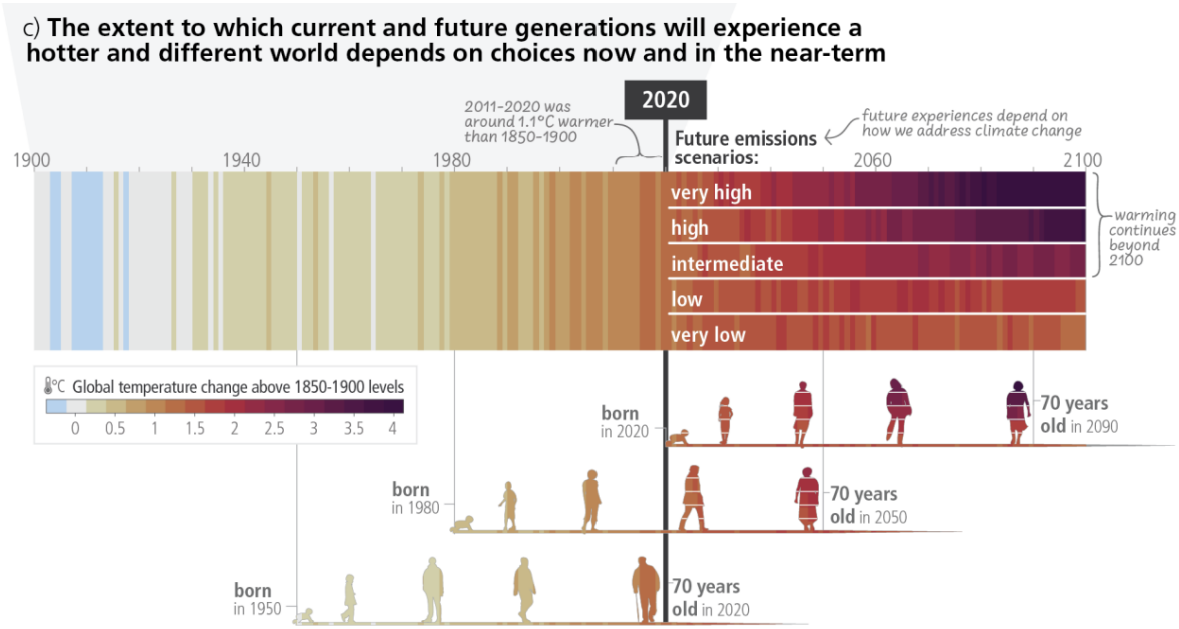

Image 6: Infographic source - Intergovernmental Panel on Climate Change (2023), Synthesis Report of the IPCC Sixth Assessment Report (AR6): Summary for Policymakers, accessed at: https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_SPM.pdf

Specific climate risks the City of Port Phillip has identified that are relevant to greening include[88]:

- Lower than average rainfall, changing rainfall patterns and inconsistent water supply, with an expected overall drop in annual rainfall of 31mm by 2030 and 61mm by 2050, requiring adjustments to water management and irrigation, and potential for greater costs.
- Rising average temperatures and more days of extreme heat will cause heat-related health stress (for people, animals and vegetation). Public spaces will become more important to help cool the City and be places of refuge.
- More frequent extreme weather events (such as heatwaves, storms and floods), combined with increased urbanisation, may impact how public spaces are used and managed.
- Sea level rise and storm surges will make the foreshore vulnerable, and may result in areas of the coast being inundated or eroded.
- The changing climate will impact biodiversity, including through changes to species range, and a rise in pests and diseases, which will require different species choices and management practices.
- Rising groundwater levels will make it more difficult and costly to manage soil contamination and heighten the risk of soil salinity issues.

Sand Motor

Image 7 Climate-ADAPT (2019), Sand Motor Case Study

The Sand Motor is a 'mega-nourishment' coastal management project implemented in 2011 on the coast of the Netherlands. A large artificial sandbar (known as the Sand Motor) was constructed, designed to gradually erode over time and replenish the beach. A large area of coastal vegetation was planted along the dunes and beach, helping to stabilise the dunes and prevent erosion (see image above).

The project has been highly successful in mitigating coastal erosion and protecting against storm surges and sea level rise. New opportunities have been created for recreation such as surfing, swimming, and bird watching, and habitat provided for a range of coastal species.

The project shows how coastal vegetation can be integrated with engineered solutions and natural processes to achieve resilient coastal systems.

[88] City of Port Phillip (2022) *Places for People Public Space Strategy 2022-32*

8.2. Heatwaves and urban heat

As the climate continues to change, cities are getting hotter. Maximum annual temperatures could increase by up to 1.6˚C by the 2030s and up to 2.7˚C by the 2050s under a high greenhouse gas emissions scenario, with the number of extreme heat days (maximum >35˚C) and nights (minimum >20˚C) both projected to more than double by the 2050s (extreme heat days up from 8.3 to 20.4, extreme heat nights up from 5.8 to 18.4)[89] To put this in perspective, Melbourne's climate is expected to be more like Wangaratta's is now by the 2050s (a regional city over 200km inland).

Heatwaves kill more Australians than any other natural hazard[90], and place great pressure on Council assets. Urban heat can have a direct and serious impact on people's health, wellbeing and safety[91]. More specifically, urban heat can increase energy use, peak electricity demand, heat related mortality and morbidity, and levels of harmful pollutants[92], as well as causing significant loss of income for local businesses[93]. Importantly, 24% of all public trees (35% of species) in Australia's cities are at high risk from increased temperatures by 2070 (in the business-as-usual emissions scenario).[94]

A key opportunity for the City of Port Phillip is to manage its future growth in a way that does not limit its ability to mitigate and adapt to increasing urban heat. The City of Port Phillip has set urban heat reduction as a key priority in developing a greener, cooler and more liveable city that is resilient and can adapt to climate change[95]. Many of the City of Port Phillip's strategies, guidelines, plans and policies therefore prioritise the need to minimise the impacts of urban heat.

Biodiverse greening for cooler neighbourhoods

New research indicates that more biodiverse green spaces have a greater urban cooling effect.

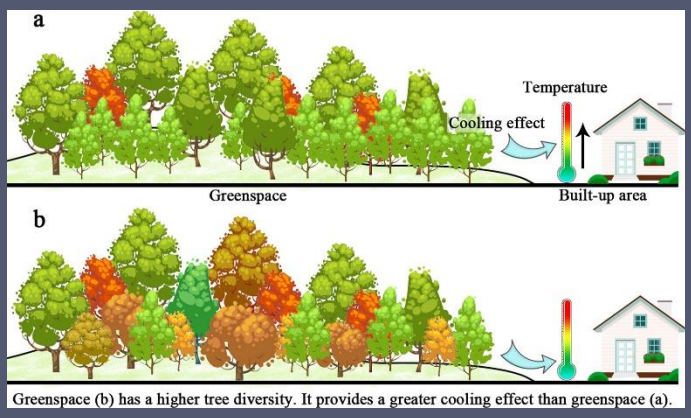

Image 8 Xinjun W. et al. (2021), Tree species richness and diversity predicts the magnitude of urban heat island mitigation effects of greenspaces, Science of the Total Environment, Volume 770, accessed at: https://doi.org/10.1016/j.scitotenv.2021.145211

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[89] Clarke JM, Grose M, Thatcher M, Round V, & C, H. (2019). *Greater Melbourne Climate Projections 2019*. Melbourne, Australia. CSIRO. https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/508/ Vic%20Climate%20Projections%202019%20Regional%20 Report%20-%20Greater%20Melbourne.pdf

[90] Climate Council (2014) '*Heatwaves: Hotter, Longer, More Often*', accessed at https://www.climatecouncil.org.au/resources/heatwaves-report/

[91] Santamouris, M. (2015). *Regulating the damaged thermostat of the cities—Status, impacts and mitigation challenges*. Energy and Buildings, 91, 43-56. https://doi. org/10.1016/j.enbuild.2015.01.027

[92] Santamouris, M. (2020). *Recent progress on urban overheating and heat island research. Integrated assessment of the energy, environmental, vulnerability and health impact. Synergies with the global climate change*. Energy and Buildings, 207, 109482. accessed at: https://doi. org/10.1016/j.enbuild.2019.109482

[93] Sweeney Research, & City of Melbourne. (2014). *A Quantitative Research Report on: 2014 Heatwave Business Impacts* - Social Research. https://www.melbourne.vic.gov. au/sitecollectiondocuments/eco-impact-of-heat-waves-onbusiness-2014.pdf

[94] Kendal, D., Farrar, A., Plant, L., Threlfall, C.G., Bush, J., & Baumann, J. (2017) *Risks to Australia's urban forest from climate change and urban heat*, Clean Air and Urban Landscapes Hub.

[95] CoPP (2018) *Act and Adapt: Sustainable Environment Strategy* 2018-2028

Low Carbon Living CRC's 2017 *Guide to Urban Cooling Strategies*[96] recommended a number of effective strategies for cooling Greater Melbourne. Increasing tree canopy cover was identified as an appropriate strategy to reduce air temperature and improve amenity and thermal comfort at street level.

Building on that work, the City of Port Phillip partnered with the University of New South Wales to determine the most effective cooling strategies for South Melbourne[97]. The study found that increasing urban greenery[98] in the public realm and using cool materials for all streets, footpaths and private hard surfaces would be highly effective at reducing street level air and surface temperatures, especially in business and retail precincts that have wider, unshaded streets. Moderate green infrastructure in the private realm was found to be effective for new buildings, while converting existing roof materials to cool roofs could improve indoor thermal comfort and reduce energy and air conditioning use. The most effective intervention was to combine all strategies – public and private urban greening, cool materials and water misters – resulting in a significant localised cooling impact on street level air and surface temperatures.

Cooling South Melbourne made a number of recommendations to increase urban greening in order to reduce urban heat, including to:

- Maximise green infrastructure in the public realm, primarily through additional street trees and rain gardens, and in the private realm, through green roofs and vertical greenery.
- Provide for moderate private green cover in new developments as a baseline (40-50% of the site area as urban greenery (including vertical) for all new buildings)
- Increase the number of street trees in wider (>28m), unshaded streets, which may include exploring alternatives to existing road and pedestrian networks.
- Improve the amenity of existing and future green public spaces through additional greening, shade structures and water misting systems.
- Use cool and permeable surfaces for all streets and hard surfaces in the public domain, especially in key redevelopment precincts where the street tree canopy is limited.

Turn Down the Heat

Western Sydney is significantly hotter than Sydney's CBD.

In 2018, the Turn Down the Heat project was initiated by the Western Sydney Regional Organisation of Council (WSROC) to build a cooler and more heat-resilient future for Western Sydney.

This collaboration's shared target is to reduce the average peak ambient temperatures in Western Sydney by 1.5°C through water, greening and cool materials strategies by 2023.

Tools delivered by the project include an Urban Heat Planning Toolkit and a 'Cool Suburbs' heat resilience rating and assessment tool to inform development decisions at all scales.

Their climate resilient street trees project set up demonstration sites to test how species selection and passive irrigation can influence successful outcomes for a mature, healthy and cooling canopy. A selection of species with varied climate-risk and cooling benefits were planted with and without access to passive irrigation, and tree performance will be monitored over time (no results are publicly available yet).

https://wsroc.com.au/projects/project-turn-down-the-heat

[96] Osmond P, Sharifi, E, *Guide to Urban Cooling Strategies* (2017), Low Carbon Living CRC, https://www.lowcarbonlivingcrc.com.au/sites/all/files/publications_file_attachments/rp2024_guide_to_urban_cooling_strategies_2017_web.pdf

[97] Ding, L et al.(2020) '*Cooling South Melbourne*', City of Port Phillip and University of New South Wales http://uhimitigationindex.be.unsw.edu.au/static/files/Cooling%20South%20Melbourne%2019-11-20.pdf

[98] A 20% increase in urban greening is highly effective at reducing ambient temperatures during the early hours of the morning (1:00am to 7:00am), with reductions of up to 1.8°C (Cooling South Melbourne, 2020).

8.3. Flooding and permeability

Port Phillip is located at the bottom of the Elster Creek and Yarra River catchments. Over 44% of the City of Port Phillip is less than three metres above sea-level, and is prone to flooding. Sea level rise, increased severity and frequency of storms, and more extreme rainfall are projected to increase the likelihood of flooding of homes, businesses, council buildings, roads, and public spaces.

Sponge Cities

The terms 'water sensitive city' and 'sponge city' describe cities that work with nature to absorb and reuse rainwater, instead of using concrete to channel it quickly away.

Sea level rise and the impacts of in-fill development are anticipated to further exacerbate existing flooding issues. However, increasing permeability can help offset these issues. Permeable surfaces allow water to be absorbed into the soil, and to either infiltrate into groundwater or be released back into the atmosphere through evaporation or plant transpiration. Permeable surfaces include garden beds, lawn, green roofs, permeable pavers, and other unsealed surfaces (see Figure 5 below).

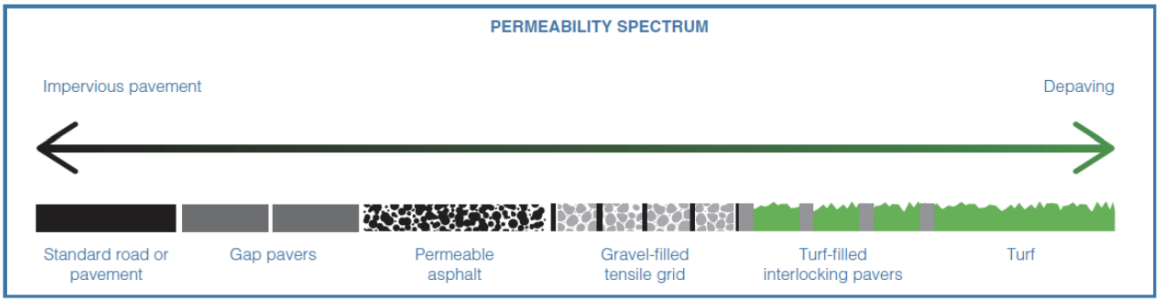

Figure 5. Permeability spectrum, showing typical ground surface treatments in order of least to most permeable.
Source: Supplied by the City of Port Phillip

Increasing permeability in urban areas has multiple benefits for flood protection, water quality, urban cooling, and biodiversity:

- **Flood protection:** By increasing permeability, stormwater can infiltrate close to its source, reducing the need for new or upgraded drainage infrastructure.
- **Stormwater quality:** Green infrastructure can remove pollutants from stormwater, improving downstream water quality and the health of receiving waters like the Bay.
- **Greening and cooling:** Increased permeability and vegetation can retain more soil moisture, provide water for plant growth, and increase shading and evapotranspiration, offsetting urban heat island effects.
- **Biodiversity and habitat:** Permeable green infrastructure like raingardens and green roofs can provide valuable habitat for native species.

The City of Port Phillip is committed to transitioning to a water sensitive city, as expressed in its *Council Plan 2021-2031* and *Act and Adapt: Sustainable Environment Strategy 2018-2028*. As part of this commitment, Council has recognised the need to substantially improve permeability outcomes in the public and private realm. Act and Adapt includes Action 39: '*Update Council policy and engage with the community to achieve greater permeability on private property*'. This is reflected in the Council Plan through the key initiative to *'increase permeability of ground surfaces across public streets and in our public spaces as well as examining ways to support greater permeability on private property'*.

Most catchments in the municipality are 60-80% impervious, with the higher ranges in expected catchments like Fishermans Bend and Southbank. Port Melbourne and Middle Park also have higher impermeability rates in the private realm. Total impermeability across the LGA was estimated to be >60% in 2021 and is expected to increase to >70% by 2050.

As expected in a high density area, the City is very impermeable overall, with higher permeability in the public realm offsetting lower permeability in the private realm. Increasing permeability in the private realm represents a big opportunity for the City to help manage stormwater flows.

Melbourne, a Water Sensitive City

The City of Melbourne is widely considered to be an exemplar water sensitive city. The City kickstarted integrated water management in 2014 with its *Total Watermark: City as Catchment* strategy, and has since developed a *Municipal Integrated Water Management Plan* (2017), aiming to reduce the demand for potable water, reduce flood risk, improve stormwater runoff quality, cool the city, and support urban greening. This strategy integrates with the City's climate adaptation, biodiversity, greening, and open space strategies.

Some of the key initiatives the City of Melbourne has implemented include:

- **Green and blue private development** – Introduced Clause 22.23 in the Melbourne Planning Scheme to require water reuse (rainwater tanks), quality treatments (eg. raingardens), infiltration (eg. permeable paving), and passive irrigation of gardens, with a performance-based assessment tool (eg. STORM or MUSIC). Commenced implementation of the Green Factor Score to encourage green walls, facades and roofs.
- **Green and blue streetscapes** – Installed passive irrigation systems supporting street trees (eg. structural soil trench with smart soaker pits in Flinders Street) and permeable pavers (eg. Collins Street and Eades Place), and converted pavement to green public space.
- **Drought-proofing open spaces** – Implementing a 10-year stormwater harvesting plan to irrigate and cool parks and gardens, including through infiltration and passive irrigation. Six large stormwater harvesting projects now provide for 23% of the Council's water use.

City of Melbourne (2017), *Municipal Integrated Water Management Plan; and City of Melbourne website*

8.4. Sustainable and active transport

If car ownership trends continue, there is predicted to be a 24% increase in the number of cars owned in the City in the ten years to 2028, but the current supply of on-street car parking spaces is barely enough to meet current demand[99]. Recognising this, Council has prioritised increasing choices for healthy, safe, connected and convenient public transport, walking and bike riding in the City.

Improving the uptake of sustainable and active transport modes has many widely accepted benefits, including improving liveability and safety, promoting health and wellbeing, and bolstering the economy, especially through improved visitation and spending in shopping strips. Recognising this, there is now a growing global shift towards an integrated 'movement and place' approach to design cities and streets for people, rather than cars. This approach aims to respond to the local context and the needs of all users, and to optimise positive social, economic and environmental outcomes.

The City of Port Phillip has embraced this approach in its *Move, Connect, Live: Integrated Transport Strategy 2018-28*. The strategy identifies the need to provide better pedestrian facilities such as wider footpaths, seating or kerb extensions, which could require removal of some car parking. This may provide both opportunities and challenges for urban greening, for example[100]:

- Increased greening creates a more enjoyable and safer environment (from UV and extreme heat), encouraging the uptake of walking, biking and public transit.
- Footpaths may be widened for the comfort of more pedestrians, especially to provide for social distancing. Separated bike lanes may be created or expanded. It is possible to deliver on these objectives while protecting trees and increasing greening.
- Streets may be repurposed (temporarily or permanently) to create new public space (eg. parklets and playstreets) and bike and walking routes, which may include the removal of car parking (see Image 9).

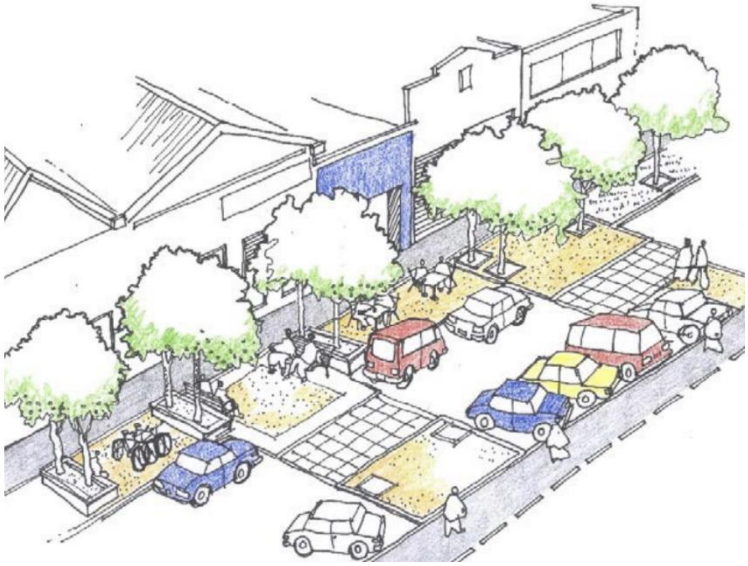

Image 9: Artist impression of repurposed streets with mixed public use. Source City of Port Phillip, & David Lock Associates (2007) South Melbourne Central Urban Design Framework

[99] City of Port Phillip (2018) *Move, Connect, Live: Integrated Transport Strategy 2018-28*

[100] City of Port Phillip (2022) *Places for People: Public Space Strategy 2022-32*,

Walking and cycling meccas

The City of **Vancouver** (Canada) is integrating greening into pedestrian and cycling routes to encourage sustainable transport . With a strategic direction to make two-thirds of all trips in Vancouver by foot, bike, and transit, the City's initiatives include:

- **Greenways** – Six city greenways are under construction, to provide safe and attractive cycling and walking routes that are separated from vehicle traffic. They include improvements like expanded parks, increased landscaping, public art, and drinking fountains (refer Image 10).
- **Complete Streets** – The Complete Streets Policy aims to create streets that are safe and accessible for pedestrians, cyclists, and transit users. It takes an 'outside-in' approach, from building access to the pedestrian realm, to 'between the curbs'. New and reconstructed streets must be designed for all users of all abilities, and seamlessly integrate green infrastructure.
- **Green Streets program** – A volunteer program for locals to green traffic calming spaces.
- **Urban Forest Strategy** – The above initiatives are supported by the City's Urban Forest Strategy, which includes tree planting and community stewardship programs, and policies to protect mature trees.

In another example, the City of **Portland** (United States) has implemented a Neighborhood Greenways program, to create a network of streets that prioritise walking, cycling and 'rolling' over vehicle traffic. The Neighborhood Greenways are designed to be low-traffic, low-speed, and feature traffic calming measures like speed bumps and chicanes. The streets are lined with trees and other vegetation, supported by the City's Green Streets program to install WSUD infrastructure, and its urban forestry program.

Image 10 Users of the mobi bike hire scheme enjoying a leafy street in Vancouver. Source City of Vancouver, accessed 2023 at https://vancouver.ca/streets-transportation/greenways-for-walking-and-cycling.aspx

City of Vancouver (2017) *Complete Streets*, accessed at https://vancouver.ca/files/cov/complete-streets-policy-framework.pdf 2017

City of Portland (2020) *Neighborhood Greenways*, accessed at https://www.portland.gov/transportation/what-are-neighborhood-greenways

8.5. Meeting the outdoor needs of a growing and changing city

The City of Port Phillip is currently Melbourne's most densely populated municipality, with 186m^2 for each resident, more than twice the population density of the metropolitan Melbourne average. The worker population is expected to rise dramatically (especially in Fishermans Bend), and the resident population is projected to grow by 23% by 2027, with new residents likely to be housed in apartments that have little access to private open space[101].

As more people live in apartments, parks are replacing backyards, and public spaces are becoming the 'living rooms' where people meet and interact[102]. Streets and parks will increasingly become central to the City's identity and character, with increased demand for opportunities for relaxation, recreation, social connections, and individual connections with nature.

Each of the City's neighbourhoods has different characteristics. In Albert Park / Middle Park, for example, the population is ageing and many people live in larger houses with backyards. Other neighbourhoods have a larger population of young families with children, and in others, single person households are more common.

Some neighbourhoods have more public space than others. Some have historic 'gaps' where there is not currently public space within a short, easy and safe walking distance. This is particularly true of Balaclava / St Kilda East and South Melbourne. The quality of many of the City's public spaces is high, but some spaces are of a lower quality due to factors like size, diversity of use, and facilities.

The COVID-19 pandemic created new and different demands on urban greening, including a significant increase in the number of people using Port Phillip's public spaces at different times of the day, and a change in the types of activities. This has seen increased community interest in upgrading or changing public spaces, including an increased demand for engagement in nature closer to home.

Some of the key challenges and opportunities of meeting the needs of the City's people include[103]:

- More people will be using public spaces, but there is limited capacity to expand them – new public spaces (including sporting fields) cannot be provided at the rate of population growth (other than within Fishermans Bend).
- Green spaces will need to work harder and be maintained more frequently (including nature strips and community gardens), increasing maintenance costs.
- Public spaces need to be accessible for all people of all abilities.
- As apartment living increases, the community will be more reliant on public space for leisure and recreation.
- As more people live alone, they will rely on public spaces for social connection.

[101] City of Port Phillip (2018) *Move, Connect, Live: Integrated Transport Strategy 2018-28*

[102] City of Port Phillip (2022) *Places for People: Public Space Strategy 2022-32*

[103] City of Port Phillip (2022) *Places for People: Public Space Strategy 2022-32*

8.6. Tree health in the urban environment

Trees need soil, water, nutrients, space, air and light to grow. These can be hard to get in a dense inner urban environment (see Figure 6). Tree health depends on factors including local climate conditions, soil type, nutrients and available volume, soil compaction and contamination, irrigation regimes (including passive irrigation), solar access, pests, diseases and vandalism. These factors may affect both establishment and optimum growth of individual trees. Trees close to the foreshore in Port Phillip also have to contend with salt spray and salty soils, precluding many species from thriving. The City of Port Phillip undertakes careful tree species selection and detailed site assessments to minimise establishment issues and tree loss over time[104].

Figure 6. Illustration of common constraints for trees in urban areas.
Source: Maribyrnong City Council (2018) Urban Forest Strategy.

Poor growing conditions in cities can place trees under stress, which can cause root systems to strain against the surrounding infrastructure in search of adequate nutrients, oxygen and moisture. This can increase maintenance costs, of both trees and infrastructure. There are now a number of resources, including the Victorian Government's *Trees for Cooler and Greener Streetscapes Guidelines for Streetscape Planning and Design* (2017) which provide guidance on how to support healthy trees in streetscapes, to maximise benefits while seamlessly integrating with other streetscape functions and infrastructure. These guidelines emphasise provision of adequate, healthy soil volume and soil moisture, which can deliver[105]:

- Double the growth rate
- Canopy cover which is 8-10 times as large
- An increase in tree lifespan of 13 to 50 years.

[104] City of Port Phillip (2010) Greening Port Phillip

[105] E2Designlab for the Victoria Government Department of Environment, Land, Water and Planning (2019), *Trees for Cooler and Greener Streetscapes Guidelines for Streetscape Planning and Design*, accessed at: https://www.planning.vic.gov.au/__data/assets/pdf_file/0034/439297/Trees-for-Cooler-and-Greener-Streetscapes-21112019.pdf

Trees in challenging spaces

It can be tough for trees to thrive in an urban environment. A range of guidelines now lay out how to achieve quicker, healthier and more vibrant tree growth in challenging spaces – those that are constrained by limited space above ground and below ground, and with limited access to water. Six key principles are:

- **The Roots get the Shoots** – soil volume is critical to successful trees and thriving canopies
- **Happy Trees Happy Infrastructure** – provide for a tree's needs for space, oxygen, nutrients and water to reduce impact on surrounding infrastructure
- **Cost Efficient Solutions Maximise Implementation** – plant trees for short and long term cost efficiency
- **The Right Tree for the Right Location** – consider the tree species' growing needs and potential benefits and impacts for each site
- **Prioritise Trees** – consider trees as essential infrastructure and prioritise them to maximise benefits
- **An Integrated Approach** – equal ownership, engagement and commitment between horticulture, engineering, infrastructure, asset management and other disciplines.

City of West Torrens (2021), Street trees in challenging spaces, accessed at https://www.westtorrens.sa.gov.au/files/sharedassets/public/objective-digitalpublications/external-website/publications/trees-in-challenging-spaces-report.pdf

8.7. Policy and legislation directly impacting the urban forest

The most relevant policy and legislation impacting the urban forest involves tree protection, footpath safety, electrical line clearance, and the planning scheme.

Tree protection

People in the City of Port Phillip are required to seek permission to remove or prune significant trees or palms on their property[106]. This is in addition to any planning approvals. Under the Local Law, a tree or palm on private land is significant if it has a trunk circumference of 150 centimetres or more, measured 1 metre above the base (or at the base if the tree has been removed). Applications are assessed by the Council arborist.

Under the City of Port Phillip's Tree Protection Guidelines[107], public trees cannot be pruned or have branches removed (except by Council and its contractors). Trees on Council owned and managed land must also be protected from construction works and other activities, with a Tree Protection Zone (TPZ)[108] established while any works are undertaken, and a Tree Protection Management Plan prepared if any demolition or construction activity is proposed to encroach a TPZ.

Footpath safety

In line with the Local Law, residents are responsible for ensuring that pedestrian access to paths and traffic sight lines are not blocked by trees and vegetation on their property.

The Australian *Disability Discrimination Act 1992* makes it unlawful to discriminate against a person, in many areas of public life, including in accessing public places, because of their disability. Compliance with this Act can be challenging when managing existing trees, where there is fruit drop, narrow footpaths, and where roots become invasive and interfere with footpaths.

Electrical line clearance

Most of Port Phillip's streets have above ground power and communication cables. Council has legislative clearance requirements for trees around powerlines, under the *Electricity Safety (Electric Line Clearance) Regulations 2005*[109]. As the Responsible Authority under these regulations, Council is required to undertake regular pruning to keep trees a regulated distance away from powerlines. This will result in some trees having large limbs removed and, if there are no viable management options, trees being removed. If Council does not comply with these requirements, it will be penalised[110]. Non-compliant trees pose a risk of fire, power outages, service reliability and electrocution to operators attempting to manage the trees.

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[106] City of Port Phillip (2013) *Local Law No.1 Community Amenity 2013* accessed at https://www.portphillip.vic.gov.au/media/uxyj0vjw/copp-local-law-number-1-community-amenity.pdf

[107] City of Port Phillip (2008), *Tree Protection Guidelines*, accessed at: https://www.portphillip.vic.gov.au/media/3kogbd40/tree-protection-guidelines.pdf

[108] The City of Port Phillip uses the tree protection distance method outlined in the Australian Standard AS 4970-2009 'Protection of trees on development sites' to calculate TPZs. This method provides a TPZ that addresses both tree stability and growth requirements.

[109] The Electric Line Clearance Regulations are made under sections 151, 151A and 157 of the *Electricity Safety Act 1998* and incorporates activities under the *Electricity Safety (Bushfire Mitigation) Regulations 2013*.

[110] As the Responsible Authority for compliance with the ELC regulations, Energy Safe Victoria has notified all Councils that as of 1 July 2022, penalty notices will be issued for non-compliance with the ELC regulations.

Planning Scheme

The Port Phillip Planning Scheme[111] contains policies and provisions that control land use and development. The Scheme states that Council supports:

- *Protecting Port Phillip's natural environment and landscape values*
- *Protecting and enhancing Port Phillip's urban forest, including large canopy trees and vegetation.*
- *Protecting and enhancing Port Phillip's green spaces and corridors to provide habitat to native flora and fauna.*
- *Reducing the environmental impact of urban areas on waterways and receiving bodies by managing stormwater quality and quantity.*
- *Creating a greener, cooler City that reduces urban heat island effect by:*
    - *Increasing canopy cover and diversity of tree species in public open spaces, road reserves and transport corridors.*
    - *Protecting and enhancing vegetation on private land and in development.*

The Scheme includes ordinances on the Protection of biodiversity (12.01-1S), Urban forest (12.01-1L) and Native vegetation management (12.01-2S). These include strategies to:

- *Protect and enhance biodiversity* (including by avoiding landuse impacts, increasing connectivity, and supporting development that enhances urban habitat for native species).
- *Retain significant trees.*
- *Encourage opportunities for landscaping that contribute to biodiversity and provide habitat including the planting of canopy trees and green roofs and walls.*
- *Support tree and plant selection suitable to a drier climate, and resistant to storms.*
- *Ensure development protects significant trees and vegetation through siting and design.*
- *Support innovative approaches to landscape design and construction, including greater use of indigenous plant species and species that benefit biodiversity.*
- *Ensure that there is no net loss to biodiversity as a result of the removal, destruction or lopping of native vegetation.*

The specific polices under these ordinances are:

- Provide for the retention of significant trees greater than 1.5m in circumference[112] (consistent with the Local Law).
- Ensure any decisions that may cause removal, destruction or lopping of native vegetation apply this three-step approach[113]:
    - Avoid the removal, destruction or lopping of native vegetation.
    - Minimise impacts where removal, destruction or lopping cannot be avoided.
    - Provide an offset to compensate for the biodiversity impact.

Spatial protections in overlays

Environmental Significance and Vegetation Protection Overlays can also be used to protect specific trees or areas, which Port Phillip has done for:

- Light Rail Remnant Indigenous Vegetation
- The Ngargee Tree
- West Beach Natural History Reserve
- English Oak at 71 Grey Street, St Kilda

Clause 42.01 and 42.02, Port Phillip Planning Scheme

[111] Department of Transport and Planning Victoria, *Port Phillip Planning Scheme*, accessed 2023 at https://planning-schemes.app.planning.vic.gov.au/Port%20Phillip/ordinance

[112] As measured 1 metre from the tree base, either a single stem tree with trunk circumference greater than 1.5 metres, or a multi-stemmed tree, where the circumference of its exterior stems is equal to or greater than 1.5 metres

[113] In accordance with the Victoria State Government (2017) *Guidelines for the removal, destruction or lopping of native vegetation*

9. Benchmarking recent urban forest strategies

City of Port Phillip is not alone in urban forest management. This is particularly true among inner-metro Councils, including Port Phillip's immediate neighbours. Benchmarking enables Councils to learn from each other, continually improve, and build on what has been achieved before.

The benchmarking review highlighted widespread agreement on the importance of increasing tree canopy cover, creating new green spaces, and establishing green corridors to connect and enhance existing green spaces. They also emphasise the need for community engagement, partnerships, and ongoing monitoring and evaluation to ensure the success and sustainability of urban greening initiatives.

9.1. Benchmarking approach

Ten neighbouring and peer Councils with urban forest or greening strategies have been reviewed, alongside Greening Port Phillip (2010), to identify common themes, trends and individual highlights. A list of the strategies compared for content analysis is included in Table *2*

A number of other Council's strategies were also reviewed beyond this benchmarking process (including interstate and global), with insights and case studies included throughout this report.

Data collection used a content analysis approach where key elements were identified and counted. This included grouping similar meaning words or phrases to count as the same, such as 'climate ready species palette' and a 'climate resilient tree stock'. This approach enabled quantitative analysis, especially to assess frequency of key element use.

The strategies of other peer Councils were also reviewed for insights and case studies.

Table 2. Neighbouring Council urban forest strategies compared in this benchmarking study

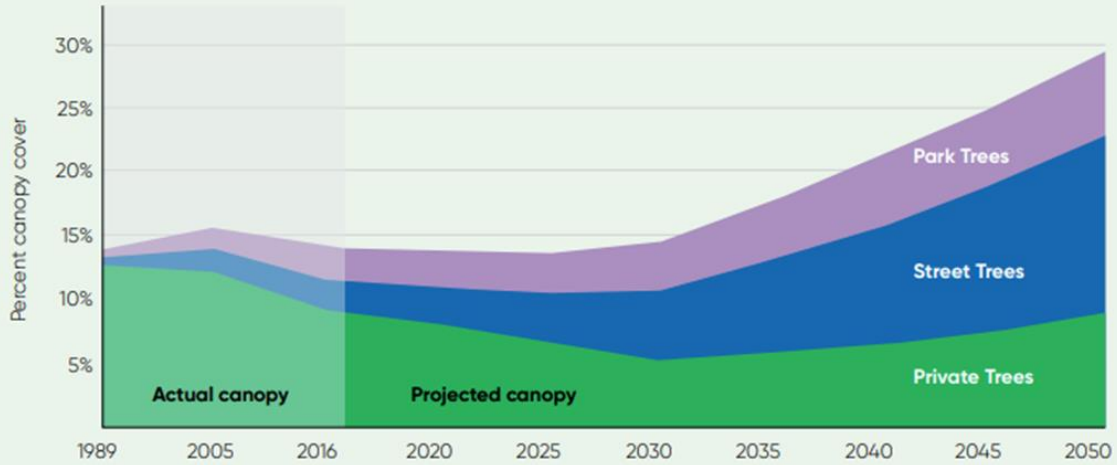
Council	Start Date	End Date	Lifespan (years)
Port Phillip	2010	2020	10
Melbourne	2012	2032	20
Merri-bek	2017	2022	5
Stonnington	2017	2027	10
Yarra	2017	2037	20
Maribyrnong	2018	2040	22
Moonee Valley	2018	2040	22
Hobsons Bay	2020	2040	20
Whittlesea	2020	2040	20
Glen Eira	2021	2040	19
Bayside	2022	2040	18

9.2. Strategy lifespans

Most strategies had around a 20-year lifespan (see Table *2*). A majority of the inner Melbourne Councils' strategies from 2018 on shared an end year of 2040 to align with the recommended targets in Living Melbourne. A long-term strategic outlook is also recommended in the frameworks and guidelines in section 12, as trees are typically slow growing and require decades to measure success against canopy cover targets. For practicality, shorter-term action plans and regular monitoring and reviews (typically 5 years) can complement the long-term goals.

The best time to plant a tree was 20 years ago. The second-best time is now.

From the Merri-bek City Council strategy, the below graph shows projected canopy cover and the long lag time to see outcomes from investment in urban greening. Actions taken around 2020 are not projected to see significant gains in canopy cover until at least 2035.



	1989	2005	2016	2020	2030	2040	2050
Street trees	0.7%	1.9%	2.4%	3.0%	5.5%	9.3%	14.7%
Park trees	0.6%	1.6%	2.6%	2.8%	3.8%	5.6%	6.6%
Private trees	12.7%	12.1%	9.2%	8.0%	5.2%	6.5%	9.0%
Moreland canopy cover	14.0%	15.6%	14.2%	13.8%	14.5%	21.4%	30.3%

Figure 7. Actual and projected tree canopy cover from implementing the Merri-Bek City Council Urban Forest Strategy. *Source: Merri-Bek City Council (2017), Urban Forest Strategy, accessed at: https://www.merri-bek.vic.gov.au/globalassets/areas/strategic-planning/urban-forest-strategy-2017.pdf*

9.3. Common benefits

The reviewed strategies listed many benefits covering social, economic and environmental categories (as in section 6 of this report). Most were backed by the growing evidence base of peer-reviewed scientific research.

Thirty-one unique benefits of urban greening were identified in the review (Figure *8*8). Greening Port Phillip (2010) remains the most comprehensive, with 28 referenced benefits identified (the next closest Council had 19).

The most frequently cited benefits across all assessed Councils were urban cooling, carbon capture, stormwater benefits and improving air quality.

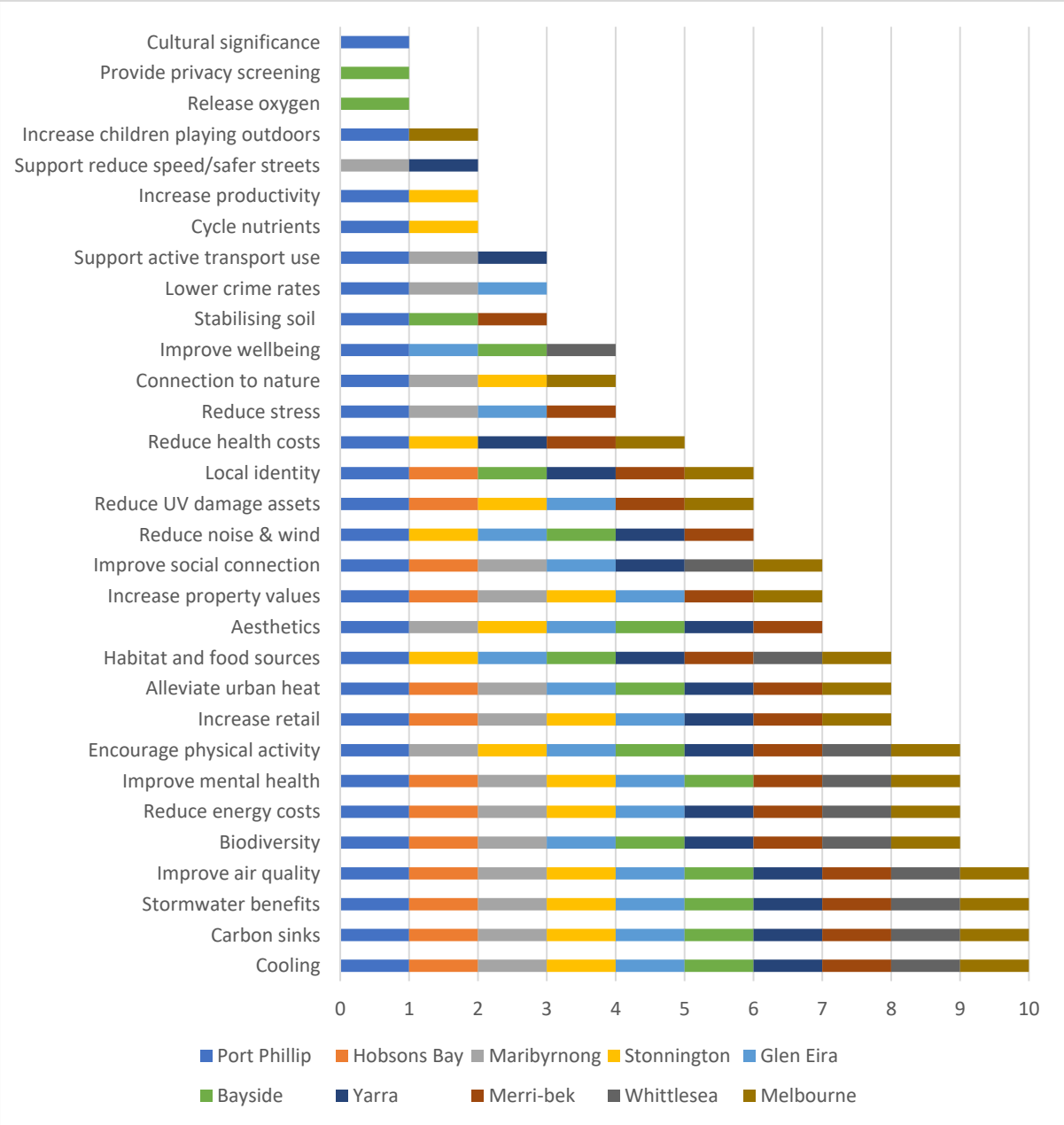


Figure 8. Frequency of benefits cited in the benchmarked urban forest strategies

Note: Moonee Valley did not include a list or section on greening benefits, as its urban forest strategy is part of a larger integrated community strategy.

9.4. Common challenges

Challenges or threats were discussed explicitly in most strategies. Twenty challenges for urban greening were identified in the review (see Table *3*), which also reflects potential common opportunities for improvement that could be worked on together.

Table 3. Frequency of challenges cited in the benchmarked urban forest strategies

	Challenge cited for urban greening Note: those in bold were identified in Greening Port Phillip (2010)	Frequency (%)
1	**Climate change**	**100**
2	New development	89
3	**Conflicts with existing infrastructure**	**89**
4	Population growth	67
5	Species diversity	56
6	**Ageing tree stock**	**56**
7	**Tree health and/or risks from failures**	**56**
8	Limited space	44
9	Urban heat	44
10	**Local conditions for survival and establishment (eg. Soil)**	**33**
11	**Integrated water management**	**33**
12	Trajectory of canopy loss over time	22
13	Community perceptions	22
14	Contested open space (eg. Sporting facilities)	11
15	Historically low canopy	11
16	Public greening removed (eg. Vandalism)	11
17	Maintenance costs for vulnerable residents	11
18	Women's safety and low visibility	11
19	Residents find tree governance confusing	11
20	Pest and disease management	11

The commonly citied challenges can be grouped into four key themes, outlined below. For more detail on current challenges and trends impacting urban forests, refer to sections 8 and 5.3 of this report.

Climate change

- Trees are long-lived assets, so urban greening strategies need to consider future climate conditions.
- Tree populations need to be diverse and well-managed to resist extreme heat, drought, pests and diseases. The species selected need to be suited to a different climate than the one we live in now.
- Greening is an important tool to prepare our communities for these changed conditions, especially through carbon capture, urban cooling and flood risk reduction.

Contested urban spaces

- Trees need soil, water, nutrients, space, air and light to grow and thrive. These can be hard to get in a dense inner urban environment.
- New development, surrounding utilities and infrastructure, impermeable surfaces, limited water access, compacted soils, pollution, heat, and direct damage (eg. Accidental damage by vehicles) are all threats to greening.
- Public space is scarce, with trade-offs and smart design needed to address all desired objectives, including active transport routes, sporting facilities, car parking and greening.

(un)Healthy tree populations

- Urban forest health and survival can be at risk long-term if trees are not managed for 'defensive diversity' through a good mixture of species, age classes, structural sizes, species suitability and functional diversity (eg. Habitat, shade, flowering).
- For short-and medium-term health, urban forests need careful management including regular health audits, pest treatments and risk management, soil preparation and capacity, formative pruning, establishment watering, passive irrigation, root treatments and other ongoing maintenance.

Community values

- Community perceptions on urban greening can have a large impact on the quality and quantity of the urban forest. For example, communities who value trees and actively engage in greening are likely to retain trees and increase greening, whereas, in communities where trees are not valued, they may not be well-funded or prioritised in capital works.
- Fears and concerns, both real and perceived, over allergies, limb failures, loss of parking, maintenance requirements (eg. Gutter cleaning), unwanted shade (eg. Solar panels), aesthetic preferences, and so on, all threaten the urban forest. For example, mature trees may be removed, plans for new greening stopped, and even intentional vandalism (eg. Poisoning) of trees may occur in some instances.

9.5. Common outcomes

All strategies compared included a vision, objectives and actions. The majority of strategies also included outcomes (see Figure *9*). Four did not include outcomes explicitly, but they may be included or inferred through the vision.

The most common desired outcomes were:

- Urban forest that is healthy, resilient and thriving in a changing climate
- Cooler neighbourhoods
- Urban forest that reflects our unique character
- Improved amenity
- Greater tree and vegetation cover
- Greater awareness and care for urban trees.

Outcome is a goal we want to achieve – it may not be reached in the lifespan of the strategy.

Objective is how we reach each outcome – it should be clear, concise, and focused.

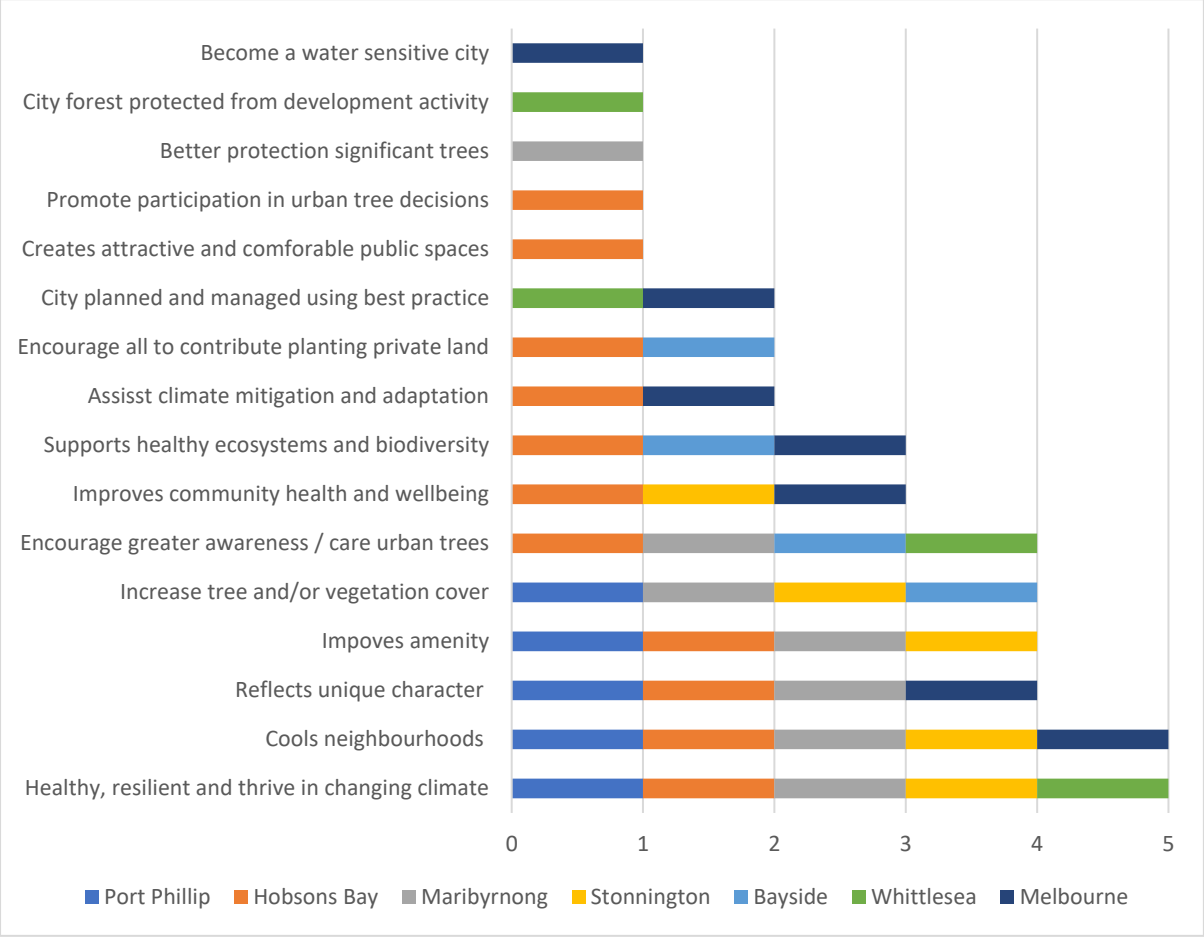


Figure 9. Frequency of desired outcomes cited in the benchmarked urban forest strategies

9.6. Common objectives

There is significant consistency in the underlying intent of the objectives of all strategies compared (despite wording differences). The frequency of objectives is provided in Table *4*[114].

The leading objectives are to:

- Increase tree canopy
- Protect existing trees
- Educate and promote care of urban trees
- Develop a diverse and healthy forest.

Table 4. Frequency of objectives cited in the benchmarked urban forest strategies

	Objectives Note: Those in bold were cited in Greening Port Phillip (2010)	Frequency (%)
1	**Increase canopy**	**91**
2	**Protect existing trees**	**73**
3	Educate and promote care of urban trees	73
4	**Develop a diverse and healthy forest**	**73**
5	**Create habitat/biodiversity**	**55**
6	**Increase alternative vegetation (eg. understorey, green walls, depaving)**	**55**
7	**Adapt to climate change**	**55**
8	Monitor and evaluate urban forest	36
9	**Manage interface of grey and green infrastructure**	**36**
10	**Maximise community health and wellbeing outcomes**	**27**
11	**Reduce heat exposure**	**27**
12	Best practice and evidence-based arboriculture	27
13	Improve tree outcomes on private land	27
14	**Create feature boulevards**	**18**
15	**Value urban forest as a key element of urban space**	**18**
16	Proactive management of risks	9
17	Replace aging trees	9
18	**Enhance and maintain unique character**	**9**
19	Improve soil moisture & water quality	9

[114] There is some repetition in Table 4, for example 'Replace aging trees' could be grouped within 'Develop a diverse and healthy forest'. These have been included as discrete objectives where Councils included both in their strategies. Where Councils grouped multiple objectives into a single objective statement, these were counted in the multiple to enable comparison. For example, City of Port Phillip has 'Minimising the impact of the heat island effect by increasing the number of trees and overall canopy cover in the City of Port Phillip and by seeking other greening opportunities where trees cannot be planted', which was counted against 'reduce heat exposure', 'increase canopy' and 'increase alternate greening'.

10. Best practice and emerging focus areas

Through analysis of the background and benchmarking information, including the guidelines included for further reading in section 12, a number of contemporary standards and emerging focus areas have been identified.

Baseline standard

Before discussing best practice, it is worth noting the common, or baseline standard.

It is now standard for urban greening strategies to at least discuss (if not directly address) three common challenges:

- Climate change (urban heat and flooding resilience, tree species resilience)
- Contested urban space (finding space for greening in urban environments)
- Healthy tree populations (age and species diversity, good management practices).

Urban greening strategies are now expected to include, at a minimum, actions to:

- Protect existing trees
- Increase tree canopy against a target
- Manage and maintain healthy tree populations
- Collect data on Council's urban forest and canopy.

Meanwhile, not every Council has an urban greening strategy, so Councils achieving this baseline are still ahead of others.

Best practice and emerging focus areas

The best practice and emerging themes identified in global and local guidance, research and contemporary tree strategies include:

- Spatially prioritised greening for climate adaptation and social equity
- Outcome-oriented targets, with proactive monitoring and promotion of progress
- Strengthened tree protections
- Defensive diversity and biodiversity sensitive urban design (BSUD)
- Engineered solutions to recover space and support thriving trees
- Community education, stewardship and engagement
- Greening on private land
- Manage trees as assets, reflecting their true economic value
- Systematic integration of greening across Council and beyond
- Proactive innovation, including R&D partnerships.

More detail on these focus areas is included below.

10.1. Spatially prioritised greening for climate adaptation and social equity

It is now widely recognised that higher levels of greening generally correlate with higher levels of wealth and health. Greening is therefore becoming a social equity issue, especially as it relates to people's vulnerability to growing climate risks like urban heat and flooding.

A number of spatial prioritisation frameworks are now in use by cities around the world, that combine greening (eg. canopy and green cover), heat (eg. hotspots), and social vulnerability (eg. age groups, SEIFA index) data. These include the VHHEDA Vulnerability Index and Tree Equity Score. Multi-functional spatial prioritisation frameworks that include, for example, flood risk and air quality, are currently limited (see example at right).

Actions in this focus area may include:

- Regular spatial data capture and analysis to overlay greening, heat, flood risk and social vulnerability data to identify the areas of greatest need.
- Planned, prioritised tree planting to address greening deficits in the areas of greatest need.
- Funding programs that prioritise greening where it is needed most.

Detroit and the GISP

The University of Michigan introduced a Green Infrastructure Spatial Planning (GISP) model, which combined spatial data on stormwater management, social vulnerability, access to green space, air quality, urban heat island, and landscape connectivity, with weightings to help prioritise green infrastructure initiatives in Detroit (United States).

Collaboration between the City and the University is ongoing, but the model does not appear to have been formally adopted yet.

Meerow, S (2017), Prioritising Green Infrastructure in Detroit's Urban Landscape, Proceedings of the Water Environment Federation.

Detroit Water and Sewerage Department (2022), Green Infrastructure Progress Report

For more information on this focus area, see sections 8.1 Climate change, 8.2 Heatwaves and urban heat, 8.3 Flooding and permeability, and 11.2.2 Outcome-based targets.

10.2. Outcome-oriented targets, monitoring and promotion

There is a growing trend towards outcome-based target setting, to focus attention on the specific objectives cities are trying to achieve, rather than just increasing overall canopy cover. For example, a Council may be most interested in delivering enhanced biodiversity, urban cooling, energy savings, stormwater management, active transport, public health and wellbeing, economic development, social equity, or a combination of these.

By proactively monitoring progress, and widely promoting progress, Council can focus the community's attention on the specific benefits that greening is providing (and that the community values). This has the potential to garner greater support in the community for greening.

Actions in this focus area may include:

- Outcome-oriented targets for indicators measured more frequently than canopy change.
- A plan focused on the target, with multiple actions/levers to address the desired outcome.
- Regular, planned promotion and engagement on progress, achievements, and why this target is a priority.

For more information on this focus area, see sections 11.2.2 Outcome-based targets and 11.3 Considerations in setting greening targets.

10.3. Strengthened tree protections

If cities are to increase tree canopy, existing mature trees must be protected wherever possible. It is widely recognised that mature trees provide the most benefits for the least cost. Australian Councils are also confirming (through recent advances in spatial mapping) that there is not enough space on public land to offset greening losses on private land, which emphasises the need to protect against those losses.

Tree protections vary widely across Australia, but the average metropolitan Council protects trees with a circumference of approximately 50 centimetres and above.[115] This is in contrast to the City of Port Phillip, which protects 'Significant Trees' with a circumference of 150 centimetres[116]. Many Councils[117] also protect trees exceeding a certain height (majority between 4-6 metres) or crown spread (majority between 3-5 metres). Some also afford protection via tree registers, or by meeting criteria other than size. At a state level, the maximum penalties for unlawfully damaging or removing a protected tree peak at $1.1 million maximum penalty in New South Wales. At the local level, a number of Councils apply financial penalties under local laws, generally between $100 and $6,000, but up to $500,000 in the City of Sydney. [118]

ACT Urban Forest Bill 2022

With an aim to achieve 30% canopy cover for the ACT, their Parliament introduced a Bill in 2022 to:

- Update the definition of protected trees, including new height, crown and trunk size thresholds (making a lot more trees protected)
- Create a tree register, which anyone can nominate a tree for
- Increase the penalty for damaging a protected tree to $80,000
- Introduce a canopy contribution framework, enabling offset payments or tree planting orders to be issued
- Introduce tree bonds for works near protected trees.

Australian Capital Territory Government (2022) Urban Forest Bill 2022

Actions in this focus area may include:

- Local ordinance that protects more trees, for example with lower height, crown and trunk size thresholds for protection.
- Improved protection during developments, using Planning Scheme Overlays.
- Adjusting zone schedules in the Planning Scheme to encourage buildings to be designed around existing trees in certain areas.
- Aligning the protection of vegetation with permeability and flood mitigation outcomes.
- Financial penalties for damaging or removing a protected tree, at an amount that reflects the lost community benefits (see models from Cities of Sydney and Melbourne).
- Bond system to protect street trees during developments.
- Mandated use of the *Australian Standard (AS4373-2007) for Pruning of Amenity Trees*, and involvement of qualified arborists in tree assessments and works to protect trees.

[115] Belder, R, Delaporte, K, & Caddy-Retalic, S (2022), Urban Tree Protection in Australia, accessed at: https://plan.sa.gov.au/__data/assets/pdf_file/0011/1087886/Urban_tree_protection_in_Australia.pdf

[116] In the above study of 101 capital city Councils, only four had a minimum threshold for tree protection above 100 centimetres.

[117] Over half of those assessed in the above study.

[118] Belder, R, Delaporte, K, & Caddy-Retalic, S (2022), Urban Tree Protection in Australia, accessed at: https://plan.sa.gov.au/__data/assets/pdf_file/0011/1087886/Urban_tree_protection_in_Australia.pdf

10.4. Defensive diversity and biodiversity sensitive urban design (BSUD)

There is now global recognition that the planet is facing dual climate and biodiversity crises (see section 4.3). With growing awareness of its ecosystem services (benefits to people), cities are increasingly focusing greening efforts on restoring and enhancing biodiversity. Urban forestry is about more than just trees – diversity applies to urban tree populations as well as other forms of greening (eg. understorey plantings, green walls, facades and roofs).

It is common practice for urban forest strategies to focus on managing and maintaining healthy tree populations, but this may be limited in scope. Increasingly, there is more widespread recognition (beyond the arboriculture team) that the quality of the urban forest is as important as its quantity. Tree populations that are diverse, healthy and thriving deliver more benefits, and are more likely to survive for longer, reducing costs and risks.

Specific outcomes of biodiversity-sensitive urban design initiatives may include, maintenance and creation of habitat, facilitation of species dispersal, minimisation of threats and human-generated disturbance, facilitation of natural ecological processes, and improved potential for positive interactions between people and nature.

Sydney Green Grid

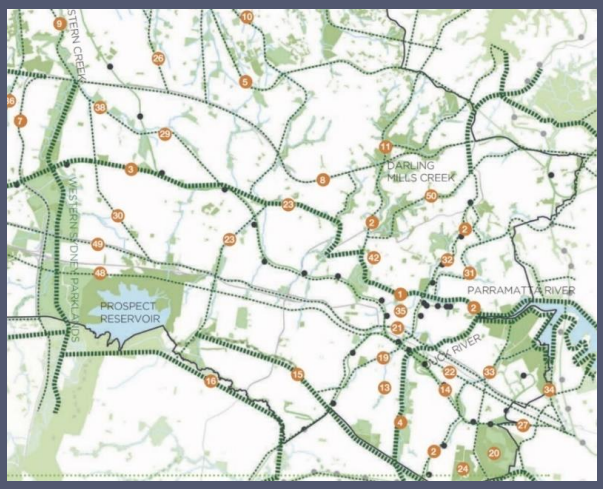


Image 11 Green Grid Project Opportunities, source: Government Architect NSW (2017) Greater Sydney Green Grid

In Sydney, green infrastructure investment is prioritised spatially in the Sydney Green Grid. Green Grid seeks to create a cohesive and connected network, bringing together the hydrological, recreational and ecological fragments of the city. The aim is to connect up strategic, district and local centres, public transport hubs, and residential areas while supporting recreation, biodiversity and waterway health. It is aligned with the New South Wales Greener Spaces Design Guide, which includes 'Bushland and Waterways – for habitat and ecological health' as one of its three priorities.

Government Architect NSW (2017), Greater Sydney Green Grid, and (2020), Draft Greener Spaces Design Guide

Actions in this focus area may include:

- Use of local native plants in capital works and greening projects.
- Identify opportunities to connect wildlife corridors, and prioritise biodiverse greening actions that strengthen those connections.
- Retain dead trees for habitat.
- Design greening sites to be more resilient, including through species selection (eg. drought-tolerant plants), passive irrigation, providing adequate soil, nutrients and light, and managing extreme heat, flooding and pollution.
- Targets for defensive diversity (eg. species, structural and functional diversity, age distribution, species suitability), tree health (eg. new tree survival, tree health rating), and biodiversity (eg. number of bird species, species richness, number of unique ecosystems, and extent of key biodiversity areas).

For more information on this focus area, see sections 7.5 Biodiversity, ecology and habitat, and 8.6 Tree health in the urban environment, and 11.2 Greening target types and trends.

10.5. Engineered solutions to recover space and support thriving trees

Trees need soil, water, nutrients, space, air and light to grow and thrive. These can be hard to get in a dense inner urban environment. Compounding this, the 'low hanging fruit' of tree planting opportunities have now been largely picked in many cities (especially those, like Port Phillip, that have practiced proactive urban forestry for over a decade). Further opportunities to increase greening on public land rely on engineered solutions to recover space and support thriving trees.

Examples of engineered solutions include:

- Depaving (eg. in-road tree pits, pocket parks, traffic islands, street entry and exits)
- Daylighting waterways (restoring natural creeks from covered concrete drains)
- Bundling services to create more space roots and branches to thrive
- Living infrastructure (eg. vine trees, green roofs, walls and facades)
- Passive watering treatments (eg. tree inlets, raingardens, permeable surfaces)
- Engineered soil preparations to maximise species-specific healthy soil volume (eg. structural cells, drainage, microbe treatments, remediating contaminated or compacted soil)
- Solutions to minimise infrastructure conflicts (eg. tree guards and cages, root barriers, flexible paving).

Actions in this focus area may include, for example:

- Exemplar engineered solutions in all Council facilities.
- Recognition that engineered solutions can cost more upfront, but can minimise maintenance costs and maximise benefits over the life of the greening asset.
- Proactive plans and budget to incorporate engineered solutions for greening in all streetscape renewals and capital works.
- Internal capacity building and process improvement to better integrate green and grey infrastructure.
- Retrofitting of engineered solutions to help existing trees thrive (especially passive watering).

For more information on this focus area, see sections 5.3 Co-existing with urban greening and 8.6 Tree health in the urban environment.

From parking lots to paradise

Image 12: From the futuristic Supertrees in Singapore (left), to raingardens in Sydney car parks (middle), to structural cells holding pavement off tree roots (right), engineered solutions are being more widely adopted to create more space and support thriving greening.

Sources from (L-R):Gardens by the Bay, accessed 2023 https://www.gardensbythebay.com.sg/en/things-to-do/attractions/supertree-grove.html , Western Sydney Regional Organisations of Councils, accessed 2023 https://wsroc.com.au/, City Green, Structural cells, accessed 2023 https://citygreen.com/structural-soil-sand-vs-soil-cells-whats-the-better-choice/

10.6. Community education, stewardship and engagement

While community education and engagement programs are not new, it is clear that communities are increasingly aware of and engaged in urban greening issues, and are seeking new ways to participate. Engaging with local communities to ensure that green spaces meet their needs and preferences, and that they have a sense of ownership and stewardship over these spaces, is increasingly critical to the success of urban greening strategies.

Actions in this focus area may include:

- Partner with First Nations to identify and protect culturally significant trees, and to support their own greening objectives.
- Generate wonder and joy through greening projects (eg. City of Port Phillip's Cruikshank Street Reserve sunflowers project and Woody Meadows trial).
- Ad hoc education and engagement opportunities (eg. Tree Tags[119], tree fan mail[120]).
- Encourage urban food growing, including productive trees and community gardens.
- Community-led performance criteria for green spaces (see Edinburgh case study in section 11.2.2).
- Community stewardship of nature strips, transit corridors, round-abouts and traffic-calming areas.
- Streetscape visualisations to support community engagement.
- Technology that streamlines community tree planting requests.
- Tree planting events and groups on Council land.

For more information on this focus area, see sections 5 Community values and 9.4 Common challenges.

Toronto, Champion of Trees

Canada's largest urban centre, Toronto was awarded the 2020 Champion of Trees Award by the Arbor Day Foundation. In three years, the City invested $4.1M and leveraged an additional $9M, to plant 53,325 trees and shrubs and engage 154,504 people.

The City's community engagement initiatives are many and varied. They include tree planting events hosted by volunteer Tree Planting Captains, Nature Ambassadors who interpret the natural features of parks for visitors, an urban farm dedicated to teaching, community engagement and research, backyard tree giveaways, and free advice from Council arborists on the best species and planting location for backyards.

An important community partnership since 2018 is Nikibii Dawadinna Giigwag (see image). Guided by Elders, professionals and practitioners, Indigenous youth gain employment opportunities, an introduction into environmentally sustainable design, and hands-on ecological learning opportunities. Participants explore traditional teachings of the land, and learn about potential career paths in fields such as architecture, urban design, conservation and filmmaking.

Image 13. City of Toronto (2018), Nikibii Dawadinna Giigwag community partnership, accessed https://www.toronto.ca/business-economy/partnerships-sponsorships-donations/partner-2/parks-environment/urban-forestry-grants-and-incentives/

[119] Kat Ryan & Jenni Garden (2016), Benefits of Trees, 17th National Street Tree Symposium accessed at https://cdn.treenet.org/wp-content/uploads/2021/10/BENEFITS_OF_TREES_%E2%80%93_Combining_science_community__asset_management.pdf

[120] City of Melbourne, Urban Forest Visual, accessed 2023 at http://melbourneurbanforestvisual.com.au/

Cool Streets©

Image 14: Infographic on different benefits projected by different street tree planting scenarios. Source Gallagher Studio, (2016) Cool Streets accessed at https://www.coolstreets.com.au/

Cool Streets© uses a software model to show residents different street tree planting scenarios (different tree sizes, native vs. deciduous, single species vs. mixed species, planting layouts), and the effects each scenario would have on CO_2 emissions and energy costs. Starting from a pilot in Blacktown (Sydney) in 2016, the initiative takes a street-by-street approach, using street parties, resident education, tree planting parties and giveaways to engage people while delivering improved environmental, social and economic outcomes.

10.7. Greening on private land

With increasingly dense urban environments and changing lifestyle preferences, cities everywhere are grappling with escalating losses of trees and greening on private land. These losses cannot be offset by greening on public land – there is simply not enough space. Seventy-five per cent of the land in Port Phillip is privately owned, so all landowners play an important role in urban greening. The intersection between urban forestry and urban planning is increasingly important.

Community Canopy Program

Image 15: Participants from Community Canopy program.
Source Arbor Day Foundation (USA), Community Canopy Program accessed at https://www.arborday.org/programs/community-canopy/

Through the Community Canopy program, cities in the United States can partner with the Arbor Day Foundation for their residents to be able to reserve free trees and use an online mapping tool that takes the guesswork out of where to plant a tree on their property. The mapping tool ensures that they plant the right tree in the right place, and identifies the ideal planting location to help maximize the air, water, energy, and carbon benefits of their new tree.

Actions in this focus area may include:

- Encourage or regulate infill that provides space for greening (see, for example, the CRC for Water Sensitive Cities' Infill typologies catalogue[121]).
- Performance-based assessment tools that encourage greening (eg. City of Melbourne's Green Factor Score – see section 11.2 Greening target types and trends), applied either voluntarily or through regulation.
- Local Laws to protect more trees (see section 10.3 Strengthened tree protection).
- Use planning zones and overlays that apply place-responsive protections and greening requirements.
- Changes to Planning Scheme, education and compliance to reduce 'moon-scaped blocks'.
- Economic disincentives for tree removal (eg. penalties for illegal removal).
- Economic incentives like free or discounted arborist assessments and tree pruning for those with significant trees.
- Compliance to ensure planting conditions for planning approvals are met.
- Volunteer programs to prune and maintain trees and gardens on private land.
- Grants or subsidies for older people and people with a disability to prune and maintain trees and gardens on private land.
- Tree giveaways and incentives.
- Layer controls, compliance, education and incentives to maximise outcomes.

For more information on this focus area, see sections 5 Community values, 9.4 Common challenges and 11.2 Greening target types and trends.

[121] CRC for Water Sensitive Cities (2020), *Infill typologies catalogue*, accessed at: https://watersensitivecities.org.au/content/infill-typologies-catalogue/

10.8. Manage trees as assets, reflecting their true economic value

Historically, trees and other greening have been treated as either a risk, or an operational project, often with reactionary maintenance and management. With increased recognition and quantification of greening benefits, accompanied by advances in technology, more and more Councils are shifting their treatment of urban forests to be more aligned with traditional asset management. Treating trees as assets includes maintaining a comprehensive inventory of trees and a proactive maintenance and management program, including regular condition audits.

If trees are truly treated as assets, they must also be economically valued. This presents challenges for traditional accounting systems, which do not recognise 'appreciating assets' (the value of trees increases as they grow). But, by accurately valuing and accounting for urban trees on financial statements, cities can make more informed decisions about how to invest in their urban forest to maximise outcomes and efficient use of funds and staffing resources.

There are now a range of widely supported and readily available tree valuation tools (eg. Burnley Method, Thyer Tree Evaluation Method, i-TreeEco) that can factor in amenity value and ecological services value – and, in the case of a tree proposed for removal, the removal and reinstatement costs (eg. City of Melbourne method).[122] Reflecting a tree's true economic value in planning, asset management, investment and removal decisions can greatly assist in prioritising trees as critical urban infrastructure.

A whole of life cycle approach provides Councils with the best chance of long-term success, ensuring that young plant care (eg. soil preparation, establishment watering, formative pruning), ongoing maintenance, and a gradual succession program for trees at the end of their useful life are all accounted and budgeted for. Proactive management of tree assets may appear to have a high cost per tree, but across the urban forest, costs can be far less due to reduced risks of tree failure and grey infrastructure conflicts.

Actions in this focus area may include:

- Quantify expected economic returns of greening in project proposals for funding.
- Raise community and stakeholder awareness of the true value of trees, including their ability to raise property values[123].
- Set tree removal fees and tree bonds that reflect the true value of trees.
- Explore potential to enter the carbon offset market and receive income for greening.
- Proactive asset management, including a standalone Tree Asset Management Plan.
- Merge tree inventory with asset management system to include whole-of-lifecycle maintenance predictions.
- Protective fencing and tree bonds to protect street tree assets during developments, with tree damage fees and tree bonds that reflect the true value of trees.
- Embed trees in financial accounting systems.
- Invest in compliance resources to support adherence to private tree asset management.

[122] City of Melbourne, *Tree Valuations in the City of Melbourne*, accessed 2023 at: https://www.melbourne.vic.gov.au/sitecollectiondocuments/tree-valuations.doc

[123] Martinez, A., Z. Bachar, and M. Allen (2019). *Monetising the benefits of water sensitive urban design and green infrastructure features. Technical report for Resilient East*, accessed at: https://www.resilienteast.com/resources

10.9. Systematic integration of greening across Council and beyond

There is now increasing appreciation for the need to integrate greening across Council business, and through partnerships with external stakeholders. Council urban forestry practitioners cannot achieve greening targets by working alone. Greening can provide many benefits, including to climate change mitigation and adaptation, active transport, stormwater management, biodiversity, air quality, public place activation, and economic development. Greening can and should be designed to be both multi-functional (ie. maximising delivery of those multiple benefits) and integrated across Council business and other stakeholder activities (eg. conservation groups, community gardens, private backyards, green roofs, schools, etc.).

Actions in this focus area may include:

- Close inter-departmental collaboration to deliver integrated greening outcomes in capital works, asset renewal, maintenance and community engagement programs.
- Include greening as an essential element from the concept stage of every capital investment, including a greening target and budget.
- Enhance Council staff resourcing and capability to enable increased greening and integration.
- ABlue and green infrastructure integration.
- Funding and assistance for schools, social housing and aged care providers to plant more trees on their land.

10.10. Proactive innovation

Urban forestry is a rapidly evolving field, accelerated through recent advances in engineered solutions (eg. tree inlets, structural cells), smart data (eg. spatial mapping, sensors, online inventories, analytics, engagement and reporting platforms), and research. There are numerous opportunities for practitioners to engage in peer-to-peer learning, to apply recent advances in engineering and technology (including in creative ways), and to partner with research bodies to bolster the evidence base for change and to test new solutions devised locally.

Actions in this focus area may include:

- Proactively retrofit engineered solutions to greening in all streetscape renewals.
- Sensors and data analytics for effective green space management, such as by monitoring plant health and smart irrigation (eg. combining soil moisture with weather forecasts).
- Robust data collection and publication system to transparently monitor and manage the urban forest, with live updates from annual tree inspections and maintenance work.
- Harness the creativity and passion of Council people and the community to generate ideas, try new things and accept the risks.
- Partner with other Councils, State Government and organisations to share learnings, research and continue to improve.
- Use allotment-scale canopy data to target community engagement and incentives (see below).

How much canopy at your place?

The City of Unley uses spatial canopy mapping and change detection as part of its urban forest management. In 2021 it applied this dataset down to individual property level, creating a publicly available interactive map and, for the initial launch, listed the property's tree canopy cover on quarterly rates notices. This information was also used to prioritise an $80 tree voucher competition to those suburbs with the lowest canopy cover. The City is currently exploring other financial measures to influence canopy cover on private land.

Figure 10. Demonstration of the My Canopy App, showing canopy cover change over an individual property.
Source: City of Unley (2021), My Canopy App, accessed at https://mycanopy.unley.sa.gov.au/

11. Urban forest indicators and targets

11.1. City of Port Phillip's existing greening indicators

Council has set a range of indicators and targets relating to urban greening. Some are direct measures of increased greening (eg. canopy cover, trees planted), others are indirect measures of greening benefits (eg. pollutants removed from stormwater, community satisfaction with open space, reduction in hotspots). The indicators and targets in each strategy and plan are listed below.

Greening Port Phillip 2010: An Urban Forest Approach

- Reduction in the number of hotspots contributing the urban heat island effect
- Increase in the total area of tree canopy cover
- Increase in the number of trees in streets and parks
- New greening initiatives undertaken where trees are not an option (eg. depaving)
- Community satisfaction with the action being undertaken to maintain the urban forest

Greening Port Phillip Street Tree Planting Program 2017-2022

- Increase street tree canopy in neighbourhoods by 2027 as follows:
    - St Kilda by 2%
    - East St Kilda by 3%
    - Elwood/Ripponlea by 1%
    - Middle Park/Albert Park by 3%
    - Port Melbourne by 4%
    - South Melbourne by 4%
    - St Kilda Road by 2%

Places for People: Public Space Strategy 2022-2032

- Number of open spaces rated good or high quality (target 60-100% by 2032)
- Percentage of municipality within a safe walking distance of parks, gardens and reserves (target 90% by 2032)
- Resident satisfaction with open space through Customer Satisfaction Survey and Neighbourhood Conversations (target 90% by 2032)

Act and Adapt: Sustainable Environment Strategy 2018-2028

- Increase street tree canopy cover by 10% by 2027/28
- Increase canopy cover on private land by 10% by 2027/28
- Reduce mains water use by Council by 15% by 2027/28
- Increase pollutants removed from stormwater by 2027/28 (suspended solids by 27%, phosphorous by 20%, nitrogen by 15%)
- Reduce the number of hotspots
- Reduce GHG emissions (tCo2-e) to Net Zero by 2021 (and 2027/28)

Move, Connect Live: Integrated Transport Strategy 2018-2028

- Increase number of daily walking trips by 36% by 2028/28
- Increase number of daily bike riding trips by 151% by 2027/28

Council Plan 2021-31

- Proportion of residents satisfied with parks and open space (target 85% by 2022/23)
- Net tree increase on Council land (target 0.5% or 231 by 2022/23).

11.2. Greening target types and trends

Greening targets[124] are commonly used to set a specific ambition for more urban trees and greening. The most commonly used targets are for percentage canopy cover and number of trees planted, but there is a growing global trend towards targets that are outcome-based (eg. equal access, health & wellbeing, active transport) or specific to land use types (residential, commercial, industrial) or tenures (public and private).

11.2.1. Output-based targets

Canopy and green cover

The percentage of land covered by tree canopies (canopy cover) is the most commonly used metric in urban greening strategies. Urban tree canopy is ideal for goal setting because it can represent the complex distribution and benefits of an urban forest within a single, simple metric[125]. It is readily assessed and tracked, easily communicated, and very persuasive. One of the first tree canopy cover goals was set in Baltimore, USA in 2009[126], and since then, the technology available to map canopy and evaluate its change over time has rapidly improved, resulting in widespread adoption of canopy targets.

The new Standards Australia document *Urban Green Infrastructure - Planning and decision framework* supports the use of tree canopy and green cover targets[127]. The European Commission's latest Urban Greening Plans guidance and Green City Accord both recommend measuring tree canopy (at a minimum) as one of three core targets[128].

Place-based canopy cover

In some cases, an overall canopy cover goal for the municipality is broken down into specific, context-based targets, such as neighbourhoods, land tenure (public or private) and land use type (suburban, medium or high density residential, open space, commercial, industrial). This can help to guide formulation of specific policies and projects that deliver appropriate and realistic outcomes for the different contexts. The City of Port Phillip's Street Tree Planting Program 2017-2022 set tree canopy increase targets for each neighbourhood. Some other examples include:

- The City of Sydney's previous canopy targets were influenced by American Forests guidelines which suggest the City's overall target should be at least 22.3%, based on the breakdown of land use types – 15% canopy in the CBD and industrial areas, 25% in urban residential and

[124] An indicator is a measure of something (eg. canopy cover), but a target is a numerical objective of the desired performance of that indicator (eg. increase tree canopy cover over the City of Port Phillip to 30% by 2040). To be effective, targets should be SMART – specific, measurable, attainable, relevant, and time bound.

[125] Canopy cover is easy to track, but when setting targets, be aware that absolute canopy change is made up of gain (trees planted, natural regeneration, existing tree canopy growth), minus loss (trees removed for development or risk management, natural mortality, and maintenance reductions).

[126] USDA Forest Service (2019) *Urban Tree Canopy Assessment: A Community's Path to Understanding and Managing the Urban Forest*, accessed at https://www.fs.usda.gov/sites/default/files/fs_media/fs_document/Urban%20Tree%20Canopy%20paper.pdf

[127] Standards Australia (2023) *Urban Green Infrastructure - Planning and decision framework*, accessed at https://www.standards.org.au/standards-catalogue/sa-snz/building/pc-002/sa--hb--214-colon-2023

[128] Under the European Commission's Urban Greening Plans guidance (2022), the three core targets recommended are: 1. Percentage of urban green space (public and private) in the city and its municipality; 2. Percentage of tree canopy cover in the municipality and numbers of newly planted trees; and 3. Percentage of protected natural areas on public land in the municipality. The Green City Accord's Mandatory Indicator Set (2022) includes: 1. Percentage of protected natural areas, restored and naturalised areas on public land in municipality; 2. Percentage of tree canopy cover within the city; and 3. Change in number of species of birds in urban area/built-up areas in the city.

light commercial areas, and 50% in suburban residential areas. Although these targets don't precisely add up to the overall target, they were adopted for each land use type.

- The City of Melbourne has a target of doubling canopy cover to 40% by 2040, but this relates to tree cover in the public realm only – not the more difficult to influence private realm.
- The 30-Year Plan for Greater Adelaide has a target of increasing overall canopy by 20% by 2045, but this is only applied to LGAs with existing cover under 30% – for LGA's with existing canopy over 30%, the target is no net loss.

Tree planting

Setting a target for the number of trees Council will plant is a practical, easily measured metric. It helps to ensure direct action by Council. However, it may lack context (scale of contribution to the problem) and outcome-orientation (it may be unclear if it will result in net tree or canopy gain). The European Commission has recommended that the number of new trees planted be included in a city's core greening targets[129]. Examples include:

- The City of Mitcham (SA) has a goal of no net tree loss, and calculated it would need to increase annual tree planting from 1,000 to 1,800 trees to achieve this.
- New York City created its MillionTreesNYC program – aiming to plant 220,000 street trees, 480,000 park trees, and 300,000 trees on private land in a decade – in order to increase tree canopy by 20%.

Defensive diversity for healthy tree populations and optimal ecosystem services

Defensive diversity in the urban forest is important because it reduces risks from pests, diseases and climate change, and improves resilience in the supply of ecosystem services (like shade)[130]. Many urban streets, especially boulevards, are lined with single species, often all planted at the same time. These kinds of tree populations are most at risk, especially when the species is not suited to the changing climate.

Defensive diversity metrics to help ensure healthy tree populations and optimal ecosystem service provision over time could include species diversity, structural diversity (ie. size and shape), functional diversity (ie. shade, habitat, food, etc.), age distribution, and species suitability. Species suitability is becoming increasingly important as the climate continues to change.

10/20/30 species diversity rule

The 10/20/30 species diversity rule of thumb proposed by Santamour in 1990 has had widespread acceptance. It states that urban forests should comprise of no more than 10% of any particular species, 20% of any one genus or 30% of any single family. This rule of thumb has been adopted and adapted over time, with diverging views on the ideal mix.

Kendal et al. (2014), Global patterns of diversity in the urban forest: Is there evidence to support the 10/20/30 rule?, Urban Forestry & Urban Greening, accessed at: https://doi.org/10.1016/j.ufug.2014.04.004

[129] Under the European Commission's Urban Greening Plans guidance, the three core targets recommended are: 1. Percentage of urban green space (public and private) in the city and its municipality; 2. Percentage of tree canopy cover in the municipality and numbers of newly planted trees; and 3. Percentage of protected natural areas on public land in the municipality.

[130] Kendal et al. (2014), *Global patterns of diversity in the urban forest: Is there evidence to support the 10/20/30 rule?,* Urban Forestry & Urban Greening, accessed at: https://doi.org/10.1016/j.ufug.2014.04.004

According to the US Forest Service's Sustainable Urban Forest Guide (2016)[131]:

- The ideal **age distribution** of trees is 40% juvenile, 30% semi-mature, 20% mature and 10% senescent; and
- A 'good' **tree species diversity** target is that no single species represents more than 5% of the total population; no genus more than 10%; and no family more than 15%; and
- A 'good' **tree species suitability** target is that more than 75% of trees are suitable for the area.

Other delivery and management targets to ensure healthy tree populations could include:

- **New tree survival rate** (85% is a common target among CoPP's neighbouring Councils)
- **Proportion of healthy trees** (90%+ assessed as healthy in a tree audit is a common target among CoPP's neighbouring Councils).

Some examples of targets related to healthy tree populations include:

- To improve biodiversity outcomes, Barcelona (Spain) has committed to no single tree species accounting for more than 15% of the total population within the urban area.
- The Town of Walkerville (SA) has a target of at least 90% of the trees on public land being maintained at a useful life expectancy of more than 20 years, to protect the overall tree population from threats and loss.
- The City of Melbourne has a target to increase urban forest diversity, with no more than 5% of any one tree species, 10% any genus and 20% any family.
- The City of Unley (SA) has a goal for street and park tree populations to not comprise more than 10% any one species, 30% any genus and 40% any family.

[131] US Forest Service (2016), *Sustainable Urban Forest Guide*, accessed at https://www.itreetools.org/documents/175/Sustainable_Urban_Forest_Guide_14Nov2016.pdf

Green infrastructure in private developments

Green roofs, walls and facades, as well as water sensitive urban design features like permeable paving and raingardens, can be installed to cool a building, reduce stormwater runoff and increase biodiversity, especially in high density areas where there is less room for traditional greening.

The new Standards Australia document *Urban Green Infrastructure - Planning and decision framework* supports the use of sustainability rating tools to promote the inclusion of urban green infrastructure in development projects[132]. The standard also supports the concept of 'no net loss' as a minimum for greening in development, with 'net gain' being the preferred outcome.

The City of Melbourne launched its Green Factor Tool in 2020. The calculation is a weighted area of greening on a site, as a proportion of the site area. This is currently a voluntary tool, but the City of Melbourne is currently working towards regulating its use for new developments. Melbourne partnered with the City of Port Phillip, Merri-bek City Council and City of Yarra in 2021 to establish trials that enable developers and designers in those areas to use the Green Factor tool freely, including user technical support.

A target for private green cover could be, for example:

- No net loss of green cover in new developments by 2040.
- All new developments achieve an average of 55% private green site coverage (including vertical area) by 2040.
- All new developments achieve a minimum Green Factor Score of 0.55 by 2040.

Green Factor

Image 16. Example from Bo01, an industrial redevelopment project in Sweden. Source Kruuse, A (2011), *GRaBS Expert Paper 6: The Green Space Factor and the Green Points System*, accessed at: https://tcpa.org.uk/wp-content/uploads/2021/11/EP6_FINAL.pdf

Green Factor Score is a globally proven sustainability rating tool. This concept started in the 1980's with Berlin's Biotope Area Factor, and was popularised by Malmo, Sweden, which created its Green Space Factor in 2001 for an exemplar industrial redevelopment project called Bo01. In the Malmo tool, different types of green spaces including trees, green roofs, and water elements come with a specific score based on their extent and number, and developers are required to meet a score threshold. Due to the Green Space Factor's success, it has now been rolled out to all new developments in Malmo and Lund (Sweden), and adapted and adopted by other cities including Helsinki (Finland), London (UK) and Melbourne.

[132] Standards Australia (2023) Urban Green Infrastructure - Planning and decision framework, accessed at https://www.standards.org.au/standards-catalogue/sa-snz/building/pc-002/sa--hb--214-colon-2023

Council delivery and asset management

Targets focused on how Council manages its urban greening assets and delivers the greening strategy could also be included. These kinds of targets were introduced in 2008 and 2010 by the municipalities of Oakville and Ajax (respectively) in Canada[133], and due to their success, have been recommended as a model by the US Forest Service and Davey Institute[134]. Management indicators and targets could include, for example:

- GIS-based tree inventory is complete, including age distribution, species mix, detailed tree condition and risk ratings.
- Greening policy is implemented by formal interdepartmental working group on all Council projects.
- All capital works projects include a greening budget line.
- Council staff have the capability and capacity to implement all of the actions and principles of the strategy within set timeframes.
- All trees are planted in sites with adequate soil quality and quantity, and with sufficient growing space and site conditions to deliver their maximum ecosystem services potential.

[133] Food and Agriculture Organization of the United Nations (FAO) (2016) *Guidelines on urban and peri-urban forestry*, accessed at https://www.fao.org/3/i6210e/i6210e.pdf

[134] US Forest Service (2016), *Sustainable Urban Forest Guide*, accessed at https://www.itreetools.org/documents/175/Sustainable_Urban_Forest_Guide_14Nov2016.pdf

11.2.2. Outcome-based targets

There is now a growing trend towards outcome-based targets, which are specific to the drivers for change and the objectives Councils are trying to achieve. For example, a Council may be most interested in delivering enhanced biodiversity, urban cooling, energy savings, stormwater management, active transport, public health and wellbeing, economic development, social equity, or a combination of these. Understanding the desired outcomes can influence how much greening is needed, which species should be planted, and where to plant them. Some examples of outcome-based indicators and targets are provided in this section.

Table 5. Questions to consider when determining which greening outcomes could be measured, as recommended by the World Health Organisation.

Impacts	Suggested questions to pose to establish the information
Environmental/ ecological impacts	▪ What is the impact of the urban green space on air quality, noise or urban heat exposure? ▪ Does it support water management and reduce risk of flooding? ▪ Does it support contact to nature? ▪ Does it enhance biodiversity?
Lifestyle impacts	▪ Does the urban green space support/increase physical activity levels? ▪ Does it enable active transport by foot or bike? ▪ Does it increase the time people spend outdoors? ▪ Are more people using the urban green space? ▪ Does it support healthy lifestyles and active recreation?
Social impacts	▪ Does the urban green space support or enhance social cohesion? ▪ Does it promote social interaction and exchange? ▪ Does the development of a green space support gentrification processes leading to displacement of local residents?
Equity impacts	▪ Do all population groups make use of and benefit from the urban green space? ▪ If not, who are those groups that benefit least or even face disadvantages? ▪ Does the urban green space enable different functions for different user groups?

Source: World Health Organisation (2017) Urban Green Spaces: A brief for action, accessed at https://apps.who.int/iris/handle/10665/344116.

Equitable access to greening

Aligned with the global concept of the 15-minute city[135] or Plan Melbourne's 20-minute neighbourhoods[136], there is broad agreement that everyone should live within a short walk of public green space. There has been substantial debate over the specifics[137], but the most widely accepted indicator has been set by the World Health Organisation (WHO), stipulating that people should live within 300m (around 5 minutes' walk) of public green space at least 0.5-1.0 hectares in size[138]. Building on the 'Six Acre Standard' introduced in England in the 1930s, Natural England also recommends provision of at least 2 hectares of public green space per thousand population[139].

3-30-300 equitable green access rule

A new 3-30-300 rule of thumb, proposed by Prof. Cecil Konijnendijk, has caught considerable widespread attention, including from those outside 'green' professions, including planners, engineers, and politicians. The rule states that everybody should be able to see 3 trees from their home, live in a neighbourhood with at least 30% tree canopy (or vegetation) cover, and be no more than 300 metres from the nearest green space that allows for multiple recreational activities (see infographic below). Note that by the author's own admission, this rule of thumb is designed to promote action, but may not be applicable in every context.

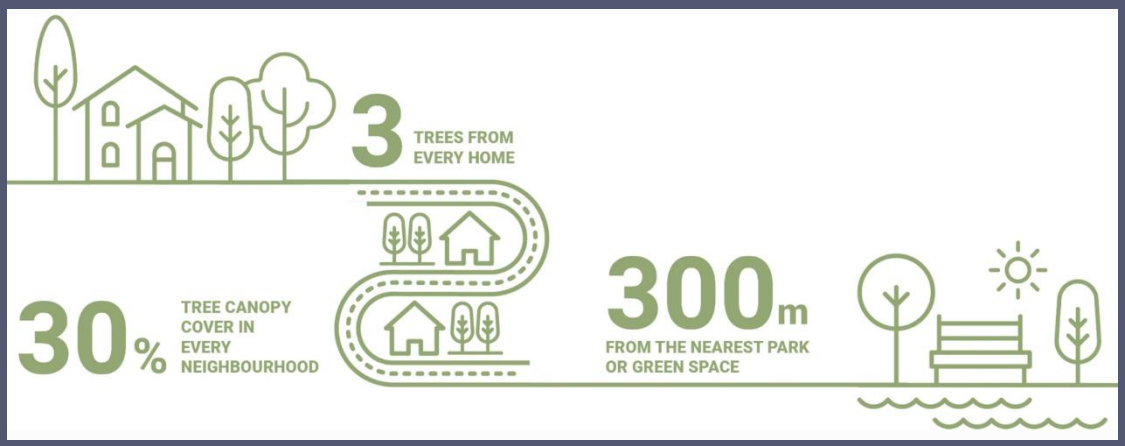


Image 17. Visualisation of the 3-30-300 rule for urban forestry.
Source: Konijnendijk, C (2022) Evidence-based guidelines for greener, healthier, more resilient neighbourhoods: Introducing the 3–30–300 rule, Journal of Forestry Research 34, 821-830.

[135] C40 Knowledge Hub (2021) *Why every city can benefit from a '15-minute city' vision*, accessed at https://www.c40knowledgehub.org/s/article/Why-every-city-can-benefit-from-a-15-minute-city-vision?language=en_US

[136] Victorian Government (2017), Metropolitan Planning Strategy - Plan Melbourne 2017-2050

[137] Copenhagen: WHO Regional Office for Europe (2016) *Urban green spaces and health*.

[138] WHO Regional Officer for Europe, (2017) *Urban green spaces: a brief for action*.

[139] Natural England (2003) Accessible Natural Green Space Standards in Towns and Cities: A Review and Toolkit

Some examples of targets to make greening access more equitable include:

- Quito (Ecuador) has a target of at least 20m^2 of green area per resident by 2030, with a focus on the equitable distribution of green space between neighbourhoods.
- Los Angeles (USA) has a target of at least 65% of residents living within half a mile (800m) of a park or open space. This target rises to 75% by 2035 and 100% by 2050.
- Lisbon (Portugal) has a target for 90% of the population to be less than 300m from a green space bigger than 2000m^2 by 2030.
- Mayors from 31 cities including Sydney have signed C40's Urban Nature Declaration committing to 70% of residents accessing green (vegetation-based) or blue (water-based) public spaces within a 15-minute walk or cycle, and to green or permeable spaces making up 30% to 40% of the total built-up city surface area by 2030.
- With health and accessibility as key objectives, a target of the City of Vancouver's (Canada) Greenest City Action Plan is to ensure that every person lives within a 5-minute walk of a park, greenway, or other green space by 2020.
- The City of Frederiksberg (Denmark) has a target that it should be possible to see at least one tree from every residence.

Social justice and vulnerability to heat

Social justice is a critical greening issue because higher levels of disadvantage are generally correlated with lower levels of greening and higher levels of urban heat. As tree canopy mapping has improved, Councils have increasingly been overlaying social vulnerability and urban heat data on canopy data to better understand the priority areas to target more greening.

Indicators of social vulnerability include, for example, elderly population, people needing assistance due to a disability, English as a second language, median rent, and SEIFA score[140].

There are two examples of potential indicator frameworks that could have targets set against them – the VHHEDA Vulnerability Index and the Tree Equity Score (see below). These approaches are particularly useful where there are significant disparities between advantage and disadvantage in a City.

Prioritising cooler neighbourhoods

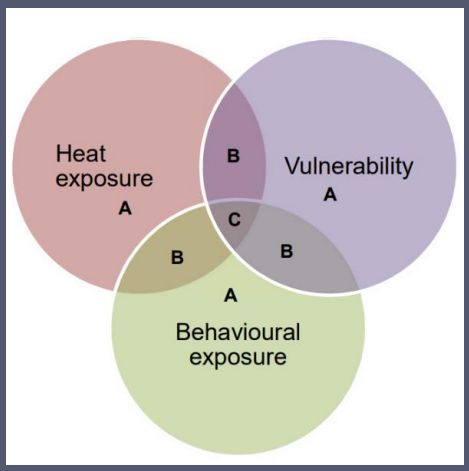


Figure 11. Prioritising cooler neighbourhoods, from high (C) to medium (B) and moderate (A).

To mitigate urban heat, greening and cooling should be prioritised in areas where it will address the key factors of surface temperature (heat exposure), more vulnerable members of society (vulnerability to heat), and areas with high pedestrian activity (behavioural exposure).

Source: Norton et al., (2015). Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes Landscape and Urban Planning, v134, 127-138.

[140] AdaptWest (2017) *Western Adelaide Urban Heat Mapping Project*, accessed at https://www.adaptwest.com.au/sites/adaptwest/media/pdf/western_adelaide_urban_heat_mapping_report-(2).pdf

VHHEDA Vulnerability Index

RMIT has analysed urban Australian Councils against their VHHEDA Vulnerability Index. This tool compared the vulnerability of Councils on a scale of 1 to 5, based on heat (how hot does it get on hot days), health (are the people living there healthy and resilient to heatwaves), and greening trends (is the area gaining, losing or retaining greening). The City of Port Phillip was ranked 3.0, not in the top 50 priority Councils. To be effective as a management tool for a City, the index would need to be applied at a more granular scale.

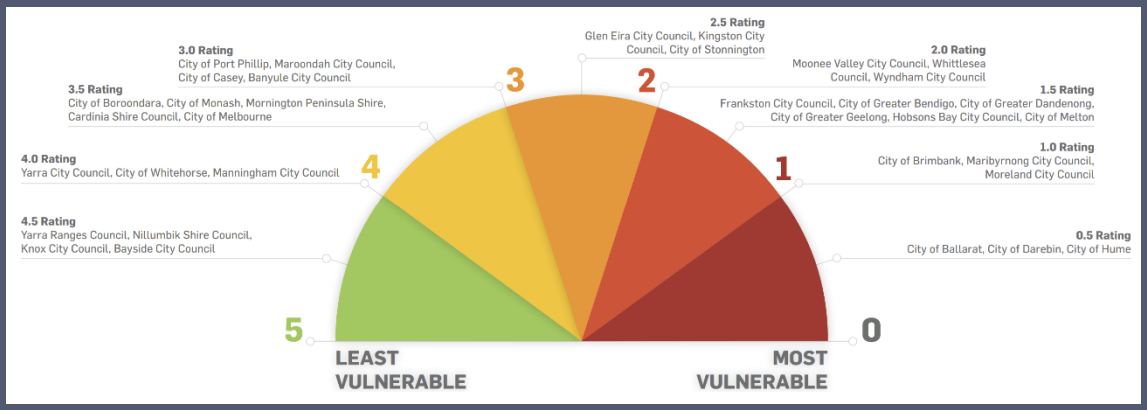


Figure 12. Vulnerability of Councils on the VHHEDA scale of 1-5. *Source: Greener Spaces Better Places (2017), Where Should All the Trees Go? accessed at: https://www.greenerspacesbetterplaces.com.au/guides/where-should-all-the-trees-go/*

Tree Equity Score

In the United States, American Forests has recently introduced a Tree Equity Score to help greening planners address social inequities. This tool gives each neighbourhood in the United States a score out of 100, with 100 showing that Tree Equity has been achieved.

The score's methodology combines tree canopy data (modified for climate zone and density) with data on income (% of population below 200% of poverty), employment (unemployment rate), race (percentage of people who are not white non-Hispanic), age (ratio of seniors and children to working-age adults), climate (urban heat island severity), health (composite index of poor mental, physical, respiratory and cardiac health).

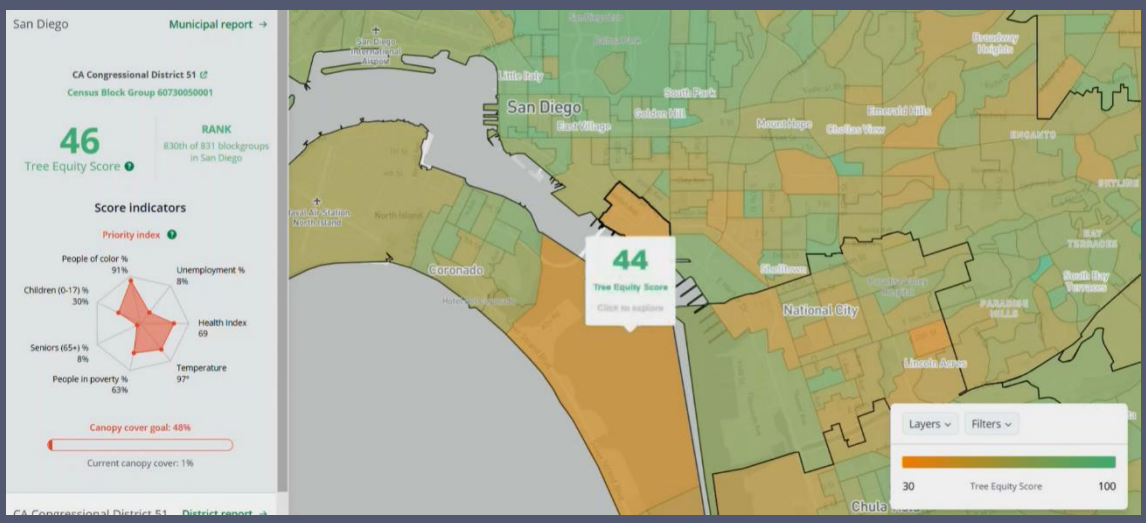


Figure 13. Example of Tree Equity Score mapping from the City of San Diego.
Source: American Forests (2021), Tree Equity Score

Active transport

There is a growing trend towards prioritising greening in active transport routes, to provide a more comfortable, enjoyable and safe environment for people. For example, Councils may preferentially increase plantings near commercial centres, schools, parks, playgrounds, foreshores and watercourses, and other known areas of high pedestrian activity. In the past, a canopy cover target for active transport routes has not been readily measurable at scale. However, as canopy mapping tools have improved, so has the potential to set targets and measure progress. For example:

- To achieve the outcome of encouraging healthy, outdoor lifestyles, Brisbane City Council has a tree canopy goal of 50% for footpaths and bikeways in residential areas by 2031.
- The Greater Sydney Green Grid aims to connect communities to the landscape. Over the long-term, the aim is to deliver high quality greening along priority corridors to connect centres, public transport and public spaces to green infrastructure and landscape features. It includes enhanced waterway corridors, transport routes, suburban streets, footpaths and cycleways.
- The South Australian Department for Transport and Infrastructure's Green Infrastructure Commitment (2021) set targets including a 20% increase in canopy cover on department managed land (eg. road and rail reserves), 50%+ tree shade cover on footpaths and bikeways, and 50%+ local native species in new landscape plantings in transport projects[141].

[141] South Australian Department for Transport and Infrastructure, (2021) *Green Infrastructure Commitment*, accessed at https://www.dit.sa.gov.au/__data/assets/pdf_file/0006/958236/DOCS_AND_FILES-17839389-v4-Technical_Services_-_Green_Infrastructure_Commitment.pdf

Biodiversity

Biodiversity is complex, and difficult to capture in a single indicator. However, there are examples of cities using indicators based on flagship species or groups, like the number of birds, pollinators, native fauna species or native flora species present in the city. For example, the European Commission's Green City Accord includes a mandatory indicator of 'Change in number of species of birds in urban area/built-up areas in the city'[142]. Other metrics could include species richness, number of unique ecosystems, and extent of key biodiversity areas[143].

Singapore Index

For a more comprehensive approach, the Singapore Index, also known as the City Biodiversity Index, is a self-assessment tool for cities to evaluate their performance on 23 metrics across four categories. The categories are:

- Availability of urban nature (such as amount of green space, configuration of green and blue space, etc.)
- Biodiversity (such as bird species richness, plant species richness, proportion of invasive species, etc.)
- Ecosystem services (such as water regulation, climate regulation, etc.)
- Administration of nature (such as funding, number of policies in place, etc.).

The assessment provides a score out of a possible 92. The Singapore Index has been applied in 50 cities globally to track current levels of urban biodiversity, nature, and ecosystem services.

Chan et al. (2021) Handbook on the Singapore Index on Cities' Biodiversity, Secretariat of the Convention on Biological Diversity and Singapore National Parks Board

Community experience

Greening has substantial community benefits, and community experiences of greening provide a number of potentially measurable outcomes. Some examples of potential indicators include[144]:

- Perceived quality of urban blue-green spaces (accessibility, amenities, natural features, incivilities and recreational facilities)
- Place identity or 'sense of place'
- Recreational value of public green space.

[142] European Commission (2022) Green City Accord Mandatory Indicator Set, accessed at https://environment.ec.europa.eu/system/files/2022-04/Green%20City%20Accord%20-%20Indicator%20overview.pdf

[143] The World Bank and the Global Platform for Sustainable Cities, (2021) *Urban Nature and Biodiversity for Cities*, accessed at https://www.thegpsc.org/sites/gpsc/files/final_urban_nature_and_biodiversity_for_cities.pdf

[144] European Commission, (2021) *Evaluating the impact of nature-based solutions: A handbook for practitioners*, accessed at https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-05-06_en

Community-driven performance standards for parks

The City of Edinburgh (Scotland) uses community measures to guide its greening efforts. The Council's Open Space Strategy (2016) aims to maximise the number of homes with sufficient access to good quality public spaces. In 2010, the Council engaged with residents to understand their needs, set agreed standards for how green space should meet those needs, and on a five-yearly cycle, they audit the performance of public spaces against the standards, and plan and implement actions to improve performance. The standards include benefit and quality indicators (eg. access to space, appearance of space, diversity of habitats, and degree of connectivity), use indicators (the types of uses occurring, eg. informal sports, wildlife watching, picnics) and contextual appropriateness (eg. size, location, adjacent use).

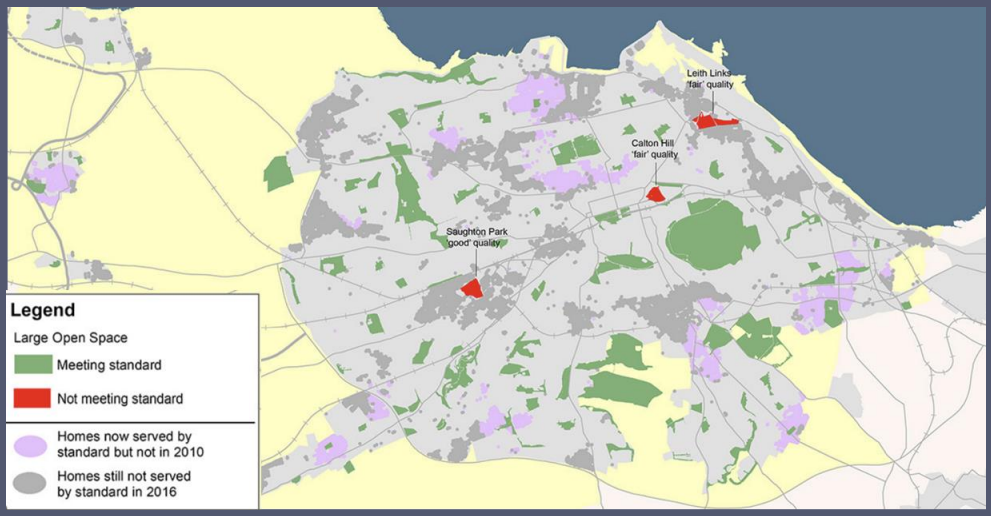


Figure 14. Access to Large Greenspaces in 2016 compared to 2010, Edinburgh.
Source: City of Edinburgh (2021) Open Space Strategy, accessed at https://www.edinburgh.gov.uk/downloads/file/22616/open-space-2021

In 2010, twenty green spaces did not meet the standards. By 2016, that number was down to three, with over 30 new local green spaces created within 400 metres of homes (see image). The City of Edinburgh has measured its progress in detail, finding that:

- 82% of Edinburgh's citizens are satisfied with parks and greenspaces compared to 76% nationally.
- Around 71% of residents have taken part in 30 minutes physical activity each week.
- Every £1 spent on Edinburgh's parks delivers £12 of social, economic and environmental benefits.
- Cycling increased by over 50% in five years, and almost one third of journeys are on foot. Much of this activity takes place on the off-road network, passing through the city's greenspaces.

11.3. Considerations in setting greening targets

11.3.1. Integrating indicators and targets with policy and practice

An indicator is a measure of something (eg.tree canopy cover %), while a target is a quantified objective of the desired performance of that indicator (eg. increase tree canopy cover over the City of Port Phillip to 30% by 2040).

Target setting is widely recommended as a tool to support the delivery of strategic objectives. When set and used well, targets can be very persuasive in compelling action. They can be even more effective when they are actively monitored, reported, and integrated into adaptive management. This could include using the data to actively inform decision-making, such as prioritising where greening occurs and how resources are invested. It can also include evaluating the effectiveness of interventions, and changing course if needed.

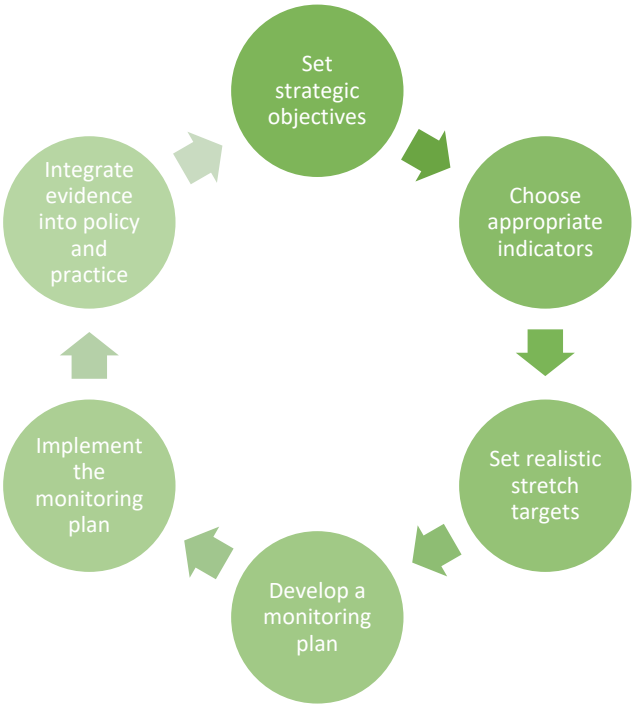


Figure 15. Process of integrating indicators and targets with policy and practice.

Source: Adapted from the Connecting Nature Impact Assessment Framework (2021) Framework Programme of the European Union Grant Agreement

11.3.2. Setting indicators and targets

Principles

When setting greening indicators and targets, there are a number of important principles to consider[145]:

- **Aligned** – Align targets with those in existing strategies (from local to global, where relevant).
- **Strategic** – Be clear on why the target is being set, with a clear link between strategic objectives and the selected indicators (only measure progress towards your desired goal).
- **A realistic stretch** – Balance the local context (including the baseline and constraints) with the desired outcomes and ambition (see more on this below).
- **Compelling** – Set indicators and targets that are easily understood and can be used to inform, engage and inspire stakeholders.
- **Transferable** – Gather indicator data that is useful for multiple purposes, including adaptive management that prioritises action and investment where it is needed most.
- **Cost-effective** – Be pragmatic and practical by only setting targets that can be measured using data that is already collected, or that can be collected in a cost-effective manner (including cost of staff time).
- **Credible** – Use indicators, targets and data collection methods that are widely accepted and supported by scientists and experts.
- **Long and short-term** – Balance indicators with long and short timescales (eg. canopy cover and tree planting).
- **SMART targets** – Specific, measurable, attainable, relevant, and time bound.

[145] Inspired by European Commission, (2021) Evaluating the impact of nature-based solutions: A handbook for practitioners, accessed at https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-05-06_en

Setting realistic stretch goals

What makes a good green cover goal? Some research states that canopy cover of 30% and above will maximise benefits[146], but international guidance recommends adopting a target to reflect local factors like baseline canopy, local climate, built form and landuse patterns, and so on[147]. For example, in the US, where urban forestry and goal setting is advanced, canopy cover goals range from 19% to 60%[148].

Setting an ambitious green cover target does have advantages – such as communicating a simple message, engaging the public, motivating leaders, and inspiring funding and stewardship. However, higher ambitions are generally riskier and more resource intensive. Instead, the target should be a realistic stretch.

> "Many cities set goals — some based on careful study of current canopy, community needs, and availability of planting space. They follow the principle of 'right tree, right place'.
>
> Others, based on the principle that more trees are better than fewer, set ambitious campaign goals, then work to mobilize efforts to meet it."
>
> *Source: Canopy Goals for US Cities, Vibrant Cities Lab, 2014*

To be attainable and sustainable, tree canopy targets should consider:

1. Baseline canopy (percentage over each land use / land tenure)
2. The projected effects of threats and trends (eg. development, natural die-off, climate)
3. Potential planting areas[149] (eg. uncontested verges and parks, not ovals)
4. Priority planting areas[150] (eg. high flood risk, urban heat, foot traffic, social disadvantage)
5. Whether potential priority planting areas are on public (local or state) or private land
6. How much direct impact Council can have by planting and maintaining trees on public land (planting and maintenance budgets, timeframes, available public land), under different scenarios (no change, no net loss, small gain, large gain)
7. How much indirect influence Council can have by encouraging planting and retaining trees (stewardship, incentives, education and other levers) in non-Council settings (state land and projects, residential land, commercial land)
8. Maintenance budgets and other resources.

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[146] For example, Astell-Burt and Feng (2019) *Association of Urban Green Space with Mental Health and General Health Among Adults in Australia*, AMA Netw Open;2(7):e198209. and, Ziter et al. (2019) *Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during summer*, PNAS vol116, n15.

[147] American Forests recommended a universal 40% goal in 1997, but has since rescinded this advice, stating that the research does not support it. It now uses a baseline canopy goal of 40% for 'forest' climates, 20% for 'grassland' climates, and 15% for 'desert' climates, adjusted for the specific location based on population density (adjustment factor of 1.2 for very low density (<2K ppl/km2), 1 for low (2K-4K), 0.8 for moderate (4K-8K) and 0.5 for high (>8K)). Source: Leahy I (2017) *Why we no longer recommend a 40% Urban Tree Canopy Goal*, American Forests, accessed at https://www.americanforests.org/article/why-we-no-longer-recommend-a-40-percent-urban-tree-canopy-goal/

[148] US Forest Service (2016), Sustainable Urban Forest Guide, accessed at https://www.itreetools.org/documents/175/Sustainable_Urban_Forest_Guide_14Nov2016.pdf

[149] 'Plantable space', as defined in spatial studies, can be a poor indicator. Even if public space appears to be plantable (eg. verges and parks), it is generally constrained by overhead services, underground services, safety requirements (eg. sight lines), access, amenity, recreational uses, etc. In the case of apparently plantable space on private land, this is constrained by other open space demands such as amenity landscaping, food production and child play areas. Plantable space statistics tend to significantly overstate actual opportunities, and must be used with caution. They also imply that existing hardscaped surfaces can never be reclaimed for greening opportunities.

[150] Most actual tree canopy benefits are derived under or in close proximity to the canopy. The spatial distribution of tree canopy is therefore important to understand, particularly when considering the effects on factors like urban heat, social disadvantage, mobility and attractiveness of retail areas.

Other considerations

What's the baseline? – Every quantifiable goal needs a baseline. If limited baseline data is available, it can be difficult to set a realistic target. However, a best-guess target could be set, with gathering of baseline data assigned as an early action in the monitoring plan.

To or by? – Some strategies aim to increase canopy ***to*** a certain percentage (outcome-oriented), other aim to increase ***by*** a certain percentage (action-oriented). For example, the City of Hobart aims to increase canopy cover in urbanised areas **to** 40% by 2045 (from a 2017 baseline of 16.7%) – an ambitious canopy cover goal. Meanwhile, Greater Adelaide has a target to increase tree canopy cover by 20% by 2045 – a more realistic, but less memorable canopy cover goal of 26.7%[151].

Being specific about greening types – When setting greening cover targets, it is important to differentiate between trees, shrubs and grassed areas (as well as vertical greening like green walls and facades), and to set baselines and targets accordingly. For example, the City of Sydney has a target for overall green cover of 40% by 2050, including 27% tree canopy cover[152]. This is because the derived benefits and management strategies differ between them, as do the techniques used to monitor change. The definition of 'tree' for target-setting purposes is widely accepted as vegetation over 3m in height.

Different canopy cover targets can suit different objectives – The target should also reflect the desired greening objectives. Australian researchers Profs. Astell-Bert and Feng have found in numerous studies that a canopy cover of at least 30% resulted in higher health benefits (sleep patterns, mental health and overall health)[153]. Meanwhile, Ziter et al. (2019) found that local tree canopy should be at least 40% before substantial cooling effects are noted[154].

Quality is as important as quantity – A canopy cover target is a stand-in metric for the benefits or ecosystem services provided by that magnitude of trees. However, to actually deliver those benefits, the quality of the urban forest is just as important as the number of trees that comprise it. 'Quality' can cover factors like tree health, age and species diversity, and strategic location (eg. hotspots, vulnerable populations, commercial strips).

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[151] State Planning Commission (2020) 30-Year Plan for Greater Adelaide, 2017 Update Report Card, accessed at https://dit.sa.gov.au/__data/assets/pdf_file/0011/893927/30-Year_Plan_for_Greater_Adelaide_-_2017_Update_Report_Card_-_2020-21.pdf

[152] City of Sydney (2022) *Sustainable Sydney 2030-2050* accessed at https://www.cityofsydney.nsw.gov.au/sustainable-sydney-2030-2050

[153] Astell-Burt and Feng (2019) *Association of Urban Green Space with Mental Health and General Health Among Adults in Australia*, AMA Netw Open;2(7):e198209

[154] Ziter et al. (2019) *Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during summer*, PNAS vol116, n15

11.3.3. Developing a monitoring plan

With some astute consideration and planning from the outset, monitoring can support adaptive management, bolster high-level support, and minimise unexpected costs, waste and distractions from on-ground delivery.

Some questions to ask and answer when developing a monitoring plan include[155]:

- Do we have baseline data for this indicator? If not, what is the plan to obtain it?
- Is the method used to establish the baseline repeatable (can we monitor change over time)?
- Do we (or someone else, like the Australian Bureau of Statistics) already regularly collect this data? If not, can it be collected in a cost-effective manner?
- What channels are already available to us to collect this data (eg. annual Business Plan survey, quarterly Neighbourhood Conversations)?
- At what timescale can/should the data be acquired? Consider cost-benefit of data capture, acquisition channels (eg. survey schedules, five-yearly Census), and length of time for benefits to be realised (eg. trees to grow)
- Is the data capture method credible (eg. widely adopted, agreed by scientists and experts)?
- Who can undertake the data capture and analysis, and how will that be resourced?
- Who will own the data? Who will store it?
- How will the data be accessed, and by whom? How will they make sense of it (eg. do we need FAQs or briefings)?
- When will progress against targets be reported, how and to whom?
- When do we need the data to inform or prioritise planned actions and investments?
- How and when will data be used to evaluate the effectiveness of interventions, and inform adaptive management?

[155] Inspired by European Commission, (2021) Evaluating the impact of nature-based solutions: A handbook for practitioners, accessed at https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-05-06_en

12. Global and local guidance

Urban greening research and practice has advanced significantly since Greening Port Phillip was adopted in 2010. There is now substantial, high-quality guidance available both locally and globally, especially from the European Union and United States. These guides provide advice on the planning process, common and emerging opportunities and threats, and how to measure success. They are not templates, but guides to be adapted and integrated according to the local context.

Some of the key local and global guidance documents include (in reverse chronological order):

- **Urban Greening Plan Guidance** (European Union, 2022)
- **Trees for Cooler and Greener Spaces: Guidelines for Streetscape Planning and Design** (Victorian DELWP, 2019)
- **Planning a Green-Blue City** (Victorian DELWP, 2017)
- **Urban Green Infrastructure Planning – a Guide for Practitioners** (EU, 2017)
- **The Sustainable Urban Forest: A Step-by-Step Approach** (Davey Institute & USDA Forest Service, 2016)
- **Guidelines on urban and peri-urban forestry** (FAO, 2016)
- **How to Grow an Urban Forest** (Greener Spaces Better Places, 2015)
- **Planning the Urban Forest: Ecology, Economy, and Community Development** (APA, 2009)

Brief summaries of these guides are provided below for further reading.

European Union Urban Greening Plan Guidance[156]

The European Union Biodiversity Strategy for 2030[157] calls on cities with over 20,000 inhabitants to develop Urban Greening Plans (UGP). To help cities implement this strategic direction, the European Commission worked with Eurocities and ICLEI to develop draft Urban Greening Plan Guidance (2022), based on discussions with local authorities that have implemented successful UGPs. This short paper guides municipalities through the process of developing, implementing and monitoring a UGP. A toolkit is also being developed.

Key takeaways from European cities

Successful implementation of urban greening plans requires:

- commitment and support from elected members
- consistent messaging to enable stakeholder buy-in
- prioritisation of nature over competing land uses, and integration with the entire city planning process
- close inter-departmental co-creation and collaboration
- financing mechanisms that recognise co-benefits and potential revenue generation
- a concrete plan for delivery, with timeframes, responsibilities, and budget estimates assigned.

Vision should be long-term (20-50 years), with interim greening goals (10-15 years), allowing time for trees to grow.

Objectives and actions should target the ecosystem services (benefits) the city wants to prioritise.

Targets should be SMART and include (at least): % of green space (public and private), % of canopy cover, number of newly planted trees, and % of protected natural areas on public land.

[156] European Commission (2022), *European Union Urban Greening Plan Guidance*, accessed at: https://environment.ec.europa.eu/topics/urban-environment/urban-greening-platform_en

[157] European Union (2021), *Biodiversity Strategy for 2030*, accessed at: https://data.europa.eu/doi/10.2779/677548

Trees for Cooler and Greener Spaces: Guidelines for Streetscape Planning and Design[158]

Guidelines developed to help councils, road project managers, and streetscape designers overcome the challenges associated with prioritising trees in streetscapes, to encourage adequate growing conditions for tree health and longevity.

The guidelines include:

- Guidance on strategic planning to prioritise trees in streets, create healthy growing conditions, and tailor design solutions to site conditions
- Solutions for common streetscapes including pedestrian zones, urban streets, neighbourhood zones, suburban and activity streets, boulevards, major thoroughfares and freeways (see Table *6*)
- A design component catalogue to guide implementation.

Table 6. Design response matrix, providing guidance on greening solutions for common streetscapes.

Green = Suitable Yellow = May be suitable [–] = Unlikely to be suitable

Increasing space for green infrastructure →

Generally increasing movement significance ↓ / Generally increasing place significance ↑

	A. Grated tree pits	B. Trees with permeable paving	C. Open tree pits	D. Infiltration trenches and wells	E. Trees in raingardens	F. Trees in grass verges	G. Sheet flow* to grass and trees
1. Pedestrian zone	Green	Green	–	–	Yellow	–	–
2. Neighbour-hood zone	Yellow	Green	Green	–	Green	–	–
3. Urban street	Green	Yellow	Yellow	–	–	–	–
4. Suburban street	–	–	Yellow	Green	Yellow	Green	–
5. Activity street	Yellow	Yellow	–	–	Green	Yellow	–
6. Boulevard	–	–	–	Green	Yellow	Green	–
7. Major thoroughfare	–	–	–	Green	–	Green	Yellow
8. Freeway	–	–	–	–	–	Yellow	Green

* Sheet flow refers to wide shallow movement of water across a surface, as distinct from concentrated overland flow in channels or narrow flow paths. In this context, sheet flow refers to water that spreads across the length of the roadway into the adjacent verge, rather than flowing through dedicated channels, inlets and entry points.

Source: DELWP (2019), Trees for Cooler and Greener Spaces

[158] E2Designlab for the Victoria Government Department of Environment, Land, Water and Planning (2019), *Trees for Cooler and Greener Streetscapes Guidelines for Streetscape Planning and Design*, accessed at: https://www.planning.vic.gov.au/__data/assets/pdf_file/0034/439297/Trees-for-Cooler-and-Greener-Streetscapes-21112019.pdf

Planning a Green-Blue City[159]

This Victorian Government guide makes the case for integrating planning of 'green' (trees, parks, gardens) and 'blue' infrastructure (WSUD, drainage areas and flood storage), in order to enhance delivery of ten shared objectives (see Image 18) while benefiting from more efficient infrastructure and greater collaboration. It provides step by step guidance for Councils in how to develop and structure a Green-Blue Infrastructure Plan, including workshop tools and key questions to discuss.

The guide provides a useful set of objectives. However, integration of green and blue infrastructure planning does not appear to have occurred widely in Greater Melbourne Councils.

Healthy – making the best of our local environment

1. To support year-round passive and active recreation
2. To protect and enhance local waterways and aquatic environments
3. To support urban biodiversity

Prosperous – making changes to better our city

4. To improve the amenity of the urban environment
5. To create stronger connections between communities and nature
6. To improve the functionality of urban places
7. To drive increased tourism and visitation

Resilient – making sure we are ready for challenges

8. To make use of alternative water supplies locally to prepare for drought
9. To reduce the impacts of flooding
10. To provide pleasant and cooling environments during hot weather

Image 18. Ten shared objectives from Planning a Green Blue City, DELWP 2017

Urban Green Infrastructure Planning – a Guide for Practitioners[160]

Approachable and easily digestible guidance combining well-structured concepts and practical steps, supported by case studies, checklists and a toolkit. Guidance is based on extensive research on best practice urban green infrastructure (UGI) planning and implementation in 20 European cities, and has been refined through a round of field testing. Developed under the EU's Green Surge project.

The planning approach outlined is based on four core principles, which have been reflected in the New South Wales Green Places Framework[161]:

1. **Green-grey integration** – combining green and grey infrastructures
2. **Connectivity** – creating green space networks
3. **Multifunctionality** – delivering and enhancing multiple functions and services
4. **Social inclusion** – collaborative and participatory planning

Useful guidance is provided on how to structure the strategic thinking process, cross-referencing the four core principles with four core urban challenges (climate change, biodiversity, green economy and social cohesion), as well as a useful planning checklist (pp61-67).

[159] Victorian Department of Energy, Environment and Climate Action (then DELWP) (2017), Planning an Green-Blue City, accessed at: https://www.water.vic.gov.au/__data/assets/pdf_file/0029/89606/Green-blue-Infrastructure-Guidelines-Feb17.pdf

[160] Hansen et al. (eds.), Green Surge (EU FP7) (2017), Urban Green Infrastructure Planning – a Guide for Practitioners, accessed at: https://ign.ku.dk/english/green-surge/rapporter/D5_3_Urban_GIP_-_A_guide_for_practitioners.pdf

[161] Government Architect New South Wales (2020) *Greener Places Framework*, accessed at https://www.governmentarchitect.nsw.gov.au/policies/greener-places

The Sustainable Urban Forest: A Step-by-Step Approach[162]

A comprehensive and step-by-step guide for municipalities developing urban forest strategies, covering trees in both public and private realms. While US-focused, its detailed advice, checklists, case studies and resources are also useful for Australian Councils. This guide's particular contribution is detailed guidance on how to measure success, including recommended performance indicators across three categories: tree quantity and quality; stakeholder perceptions, engagement and collaboration; and how the urban forest is managed.

Vibrant Cities Lab

The US Forest Service and American Forests also has an online toolkit providing guides, research and case studies for all the outcomes trees provide (better health, equity, transport, etc), as well as a limited and US-focused step-by-step urban forestry toolkit for councils.

https://www.vibrantcitieslab.com/

Guidelines on Urban and Peri-Urban Forestry[163]

This FAO report takes a global approach, covering urban forestry in developed and developing contexts. This dense but useful guide's major contribution is the list of practical ideas to consider on an issue-by-issue basis. It provides guidance on:

- The **types and benefits** of urban forests.
- Establishing the **enabling environment** (governance, policy, legal framework, planning–design–management continuum).
- **Key actions, monitoring criteria, competencies, knowledge gaps and helpful facts** for advocacy under each key urban issue. The issues covered are health & wellbeing, climate change, biodiversity & landscapes, economic benefits & the green economy, risk management, mitigating land & soil degradation, water & watersheds, food & nutrition security, water security, wood security, and sociocultural values.
- **Support measures** (communication and awareness-raising, community engagement, alliances and partnerships, and identifying research needs and perspectives).

How to Grow an Urban Forest[164]

A basic, practical ten-step workbook guiding Australian Councils through the process of urban forest planning. The guide attempts to synthesise a how-to guide of best practice urban forest planning in Australia – based principally on Melbourne's 2012 Melbourne's Urban Forest Strategy, alongside other leading Australian Councils (now a little dated).

[162] Leff, M., Davey Institute & USDA Forest Service (2016), *The Sustainable Urban Forest: A Step-by-Step Approach*, accessed at: https://urbanforestrysouth.org/resources/library/ttresources/the-sustainable-urban-forest-guide-a-step-by-step-approach

[163] Food and Agriculture Organisation of the United Nations (2016), *Guidelines on Urban and Peri-Urban Forestry*, accessed at: http://www.fao.org/3/i6210e/i6210e.pdf

[164] Greener Spaces Better Places (2015), *How to Grow and Urban Forest*, accessed at: https://202020vision.com.au/media/41948/urban-forest-strategy-workbook.pdf

Planning the Urban Forest: Ecology, Economy, and Community Development[165]

Seminal work outlining the what, who, why and how of urban forestry, with guiding principles and extensive US case studies. Based on a two-day symposium in 2006 (between invited experts and four partner organisations the APA, American Forests, the International Society of Arboriculture, and the U.S. Department of Agriculture's Forest Service), the guide defines a suite of principles to guide planners. While the document is now a little dated, the principles remain largely relevant.

The strategic principles are:

1. Get trees to the forefront of the planning/visioning process
2. Know where you came from to know where you are going
3. Seek out private and civic partners
4. Investing in trees makes economic sense
5. Urban forestry must be sustainable financially.

Planning Principles

1. Incorporate the tree ordinance (local policy) in the development code and ensure consistency with other codes
2. Collaborate with developers, environmentalists, and other stakeholders to draft ordinances
3. Planned Unit Development regulations should include an urban forestry evaluation checklist or guidelines
4. Ordinances must include provisions for enforcement personnel
5. Take an adaptive management approach to resources
6. Plan for long-term maintenance of trees.

Design Principles

1. Use urban forestry to support other planning goals
2. Include a green infrastructure element in the local comprehensive plan, but link it to other elements in the plan
3. The natural environment makes neighbourhoods more liveable
4. Make the place right for trees and then pick the right trees.

The report also makes five recommendations based on the case studies:

1. Create stable and adequate funding
2. Identify a big enough vision
3. Make the urban forest an asset
4. Pay attention to the details
5. Seize the opportunities of the day.

[165] American Planning Association (J. Schwab) (2009), *Planning the Urban Forest: Ecology, Economy, and Community Development*, accessed at: https://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/research/forestry/pdf/555.pdf

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