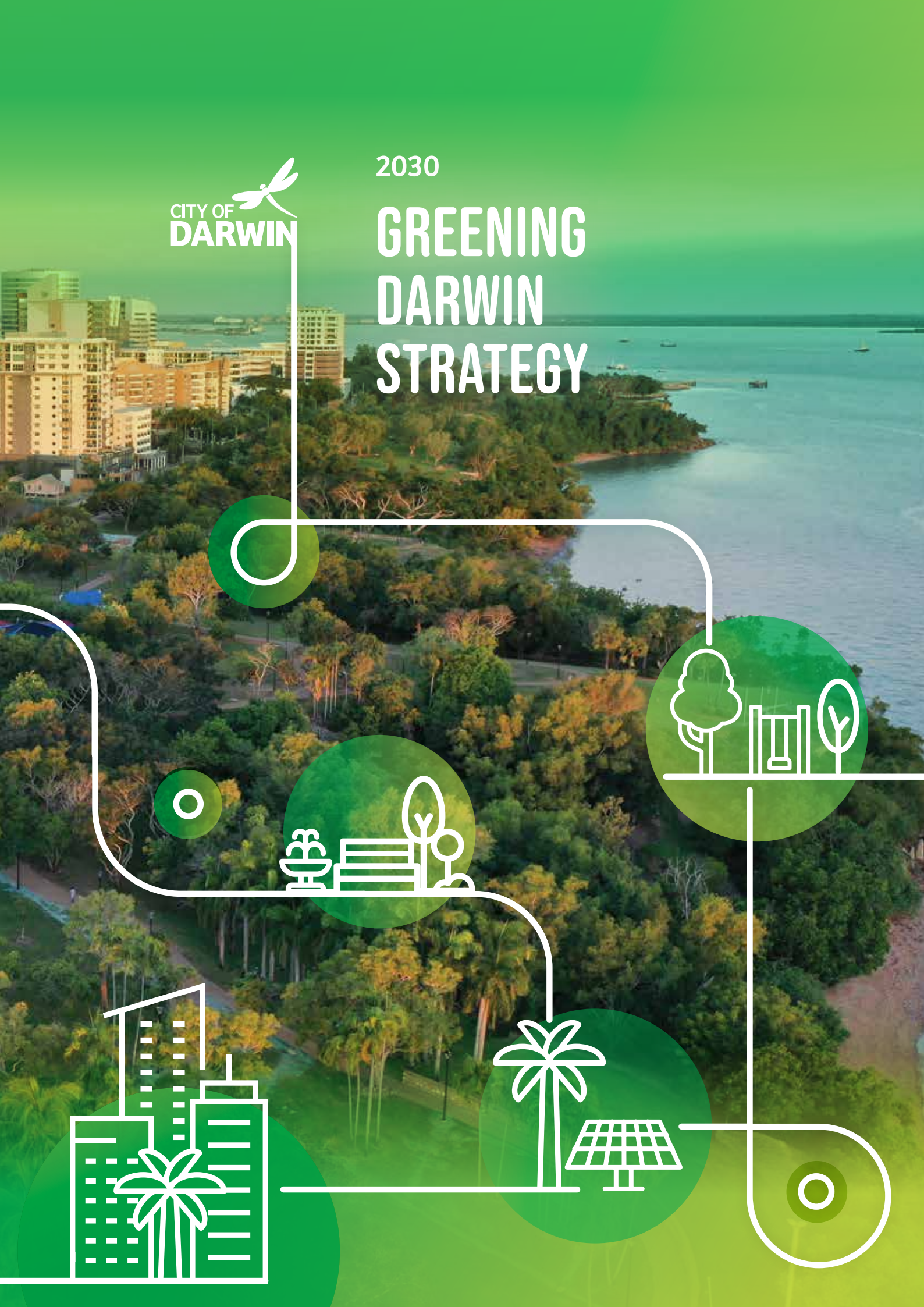




2030

GREENING DARWIN STRATEGY







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Acknowledgement of Country

City of Darwin acknowledges the Larrakia people as the Traditional Owners of all the land and waters of the Greater Darwin region.

To the Larrakia, Darwin is known as Garramilla. The original language of the Larrakia is Gulumirrgin (pronounced Goo-loo-midgin).

Often referred to as “Saltwater People”, the Larrakia lived, loved, birthed, hunted and survived a life on pristine coastal and inland areas. Established ‘song lines’ connecting Larrakia people to Country penetrate throughout their land and sea, allowing stories and histories to be told and retold for future generations. Scientific evidence dates Aboriginal presence in northern Australia to 60,000 years.

The Larrakia culture and identity is rich and vibrant. In the footsteps of the Larrakia people, City of Darwin will continue to foster this culture and identity by creating a vibrant community together.

PHOTO COURTESY OF LARRAKIA NATION





Lord Mayor's Message

I am pleased to present to you City of Darwin's first ever 2030 Greening Darwin Strategy.

Community engagement has been at the forefront of developing this Strategy. This engagement has highlighted that the top priority our community wants to see across the Darwin municipality is a cool, clean and green city. This Strategy will help City of Darwin achieve this.

City of Darwin already has a strong focus on looking after our natural environment. We work with all levels of government, the non-government sector and the community, to improve our public spaces.

Since the devastating effects on our natural environment from Tropical Cyclone Marcus in 2019, City of Darwin has planted in total over 12,500 trees across the municipality. In 2020, The Green Army was initiated as a COVID-19 stimulus package to provide employment to people experiencing hardship. The Green Army helped in beautifying Darwin through tidying up our verges and footpaths, landscaping and irrigation along Daly Street, revitalising parks and planting trees, tidying up median strips and general removal of rubbish, mulching, pruning and weeding.

The City is looking better than ever through tree planting, shading and beautification projects, and this Strategy will help to build on what has already been started.

This Strategy provides an overarching framework for enhancing, preserving and protecting the natural environment of Darwin City over the next ten years. It provides the community with details of the challenges for Greening Darwin but most importantly, how Council can inspire you with visions of a 'greener future'. This can be achieved with sensible, steady and continuous improvements to make Darwin's natural environment healthier for our future generations.

THE HON. LORD MAYOR KON VATSKALIS



City of Darwin's Strategic Planning Framework

City of Darwin's strategic planning framework provides the basis for the setting and delivery of Council's priorities. The 2030 Greening Strategy (Strategy) informs the delivery of programs within this strategic planning framework.





Darwin 2030 *City for People. City of Colour.*



A capital city with best practice and sustainable infrastructure



A safe, liveable and healthy city



A cool, clean and green city



A smart and prosperous city



A vibrant and creative city

Underpinned by City of Darwin's Governance Framework

Vision and Culture

Roles and Relationships

Decision Making and Management

Accountability

Our Strategic Direction – A Cool, Clean and Green City

**TARGET: BY 2030,
DARWIN WILL BE
RECOGNISED AS A CLEAN
AND ENVIRONMENTALLY
RESPONSIBILITY CITY.**

City of Darwin already has a strong focus on looking after our natural environment. Our public spaces will increasingly offer shade to encourage increased use of our parks, ovals, walkways and cycling paths. Working with all levels of government and the community, Council is committed to long-term environmental sustainability through planning and engagement.





SD3 – A cool, clean and green city



Council has put in place three key strategies that will guide the actions and targets Council aims to achieve by 2030 as it strives for a cool, clean and green city. The strategies are outlined below and through their implementation will deliver on strategic direction 3 as outlined in the *Darwin 2030 City for People. City of Colour. Strategic Plan*.



**CLIMATE
EMERGENCY
STRATEGY**



**Greening
Darwin
Strategy**



**Waste and
Resource
Recovery
Strategy**

Environmental Management System
Innovate Reconciliation Action Plan
Darwin City Centre Master Plan
Movement Strategy

Benefits of Greening Darwin

The greening of Darwin through the ongoing development of our urban forest provides such an important role in creating a cool, clean and green city. Darwin's urban forest is at the heart of our vibrant character and is a core asset in attracting people to the region to live, work and visit. The urban forest is comprised of all trees and vegetation that grow within the municipality, including those in streets, parks, conservation reserves, along walkways and those that occupy private and other public property.

A wide array of benefits can be unlocked with a healthy and resilient urban forest, such as providing shade and cooling, supporting biodiversity, capturing and storing carbon, developing streetscape amenity, mitigating stormwater flows, increasing cyclone resilience and improving community connection to nature. A range of trees and other plantings of varying ages and attributes are needed to create diverse plantings. Such a diverse collection is an important aspect of a resilient urban forest.

GREENING DARWIN CAN DELIVER MULTIPLE BENEFITS:



Environmental

Reduce heat in Darwin, which results in decreased energy use, urban heat island effect and risk of heat stress

Intercept stormwater, which reduces nutrient loading within the stormwater, as well as the amount of run-off during storm events. This eases stormwater flows into streets, waterways and stormwater infrastructure

Trees create wind breaks during extreme weather events

Capture and store greenhouse gas emissions and other pollutants

Establish a resilient habitat for Darwin's rich biodiversity

Enhance ecosystem connectivity and functionality





Social and cultural



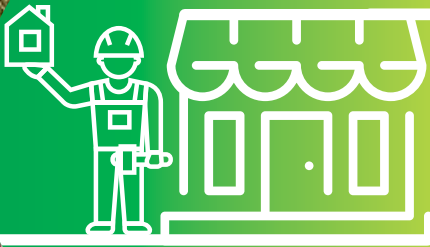
Encourage active transport such as walking and cycling

Improve mood, and decrease levels of stress, anxiety and depression

Provide places for community connection and gathering

Provide a sense of place and local identity

Economic



Create jobs through the establishment and maintenance of the urban forest

Increase surrounding property values

Attract industry and economic benefit by encouraging people to stay longer in a well-vegetated commercial, retail and recreational areas

On Saturday 17 March 2018 Tropical Cyclone Marcus impacted Darwin and its environs with extensive damage to the urban forest. The City of Darwin's public open space and road reserve areas were significantly impacted. As a result, the opportunity was undertaken to identify the risks to our natural assets and understand the tree species that were most resilient in the Darwin municipality in re-establishing the urban forest. This was achieved through the establishment of the Tree Reestablishment Advisory Committee (TRAC) to provide recommendations on suitable tree species for replanting and best practice in re-establishing trees in the municipality. The recommendations included the identification of 194 species of trees on a preferred planting list for Darwin.

As part of the Darwin 2030 Strategic Plan, City of Darwin conducted extensive community consultation about what makes Darwin's CBD and suburbs unique, vibrant, welcoming and enjoyable. The consultation included a Place Score, which helped identify what people in the community believe make a city and its suburbs great places to visit and spend time in. The Care Factor requires respondents to prioritise the place attributes that are most important to them and the Place Experience (PX) assessments asks users of an area to assess each place attribute in terms of its impact on their personal enjoyment of the space.

A key result of the Place Score was that Darwin residents have a high priority for a cool, clean and green city and that increased greening can enhance place experience and modal diversity. By understanding the community values and the role of the urban forest in fostering these values, Council can set priorities on where to focus on enhancing urban forest initiatives. The following graphics show the outcomes of the place score survey in relation to where the City of Darwin should invest in vegetation and protecting natural features in order to maximise town centre place experience.





The objective of this section is to answer the research question...

In which town centre catchments should the City of Darwin invest in vegetation and protecting natural features in order to maximise town centre place experience?

The following table ranks town centre catchment to plant in to improve place experience and community satisfaction:

	CF Rank	PX Rank
Darwin LGA	3	19
1 City Centre	4	27
2 Casuarina	4	26
3 Nightcliff	3	25
4 Rapid Creek	2	24
5 Fannie Bay	4	20
6 Karama	5	18
7 Malak	3	14
8 Parap	3	13
NATIONAL	3	23

PRIORITIES BY CENTRE

The table compares the ranking of town centre catchments by order of priority for investment based on community values and performance. These planting priorities are determined by the 1,125 CF and 449 PX responses collected from the Darwin community relating to nature and vegetation and the public realm. The higher the Care Factor and the lower the PX rank the higher the priority for investment and the more likely investment is to have a positive impact on place experience.

Priorities by Town Centre Catchment: The map illustrates the hierarchy of nature and vegetation community priorities for catchments across the Local Government Area (LGA).



Outcome of Place Score Surveys

The below graphics highlight the three main themes that came out of the Place Score Survey, being:

- An abundance of unique green spaces and natural features
- Attractive and well maintained public spaces
- Social and safe shared environments.

Of the six top priorities identified through the survey, three related to greening.

CF	PRIORITY
7	Maintenance of public spaces and street furniture
1	Cleanliness of public space
3b	General condition of vegetation, street trees and other planting
3c	Vegetation and natural elements (street trees, planting, water etc.)
8	Outdoor restaurant, cafe and/or bar seating
2	Elements of the natural environment (views, vegetation, topography, water etc.)

2019 Values

Based on the Care Factor survey results, three main themes were identified as being an essential part of the Darwin community's ideal town centre:

An abundance of unique green spaces and natural features

Three of the Darwin LGA's top 5 Care Factors are related to nature and greenery. Your community highly values elements of the natural environment and how humans look after them.



Attractive and well maintained public spaces

Cleanliness is Darwin's #1 Care Factor. The Darwin community also identified the maintenance of public spaces and street furniture as being important to them.



Social and safe shared environments

The Darwin community values spaces where everyone can feel safe and welcomed. Public events and outdoor trading play a strong role in the community's ideal town centre.



In 2019 Council declared a climate emergency. Following this, a Climate Emergency Roundtable, was held which contributed to building a shared understanding of, and pathways for, a city-wide response to the impacts of climate change. Many of the identified concerns are in part addressed by achieving the objectives in this Strategy, including issues relating to keeping people cool through rising temperatures, resilience to changing climate-related conditions and enhancing biodiversity. Following the round table City of Darwin developed a discussion paper and draft Climate Emergency Response Strategy that went through extensive community and stakeholder consultation which has highlighted the need to nurture rich biodiversity in Darwin's urban forest.



Natural Environment

The urban forest is at the heart of Darwin's Natural environment and is a core asset in attracting people to the region to live, work and visit.

Canopy Cover

Canopy cover is one of the most effective indicators to measure the extent of Darwin's urban forest. Canopy cover can be measured by suburb or by land use and ownership. As shown in Figure 1 and Table 1, canopy cover varies considerably across land-use types in Darwin.

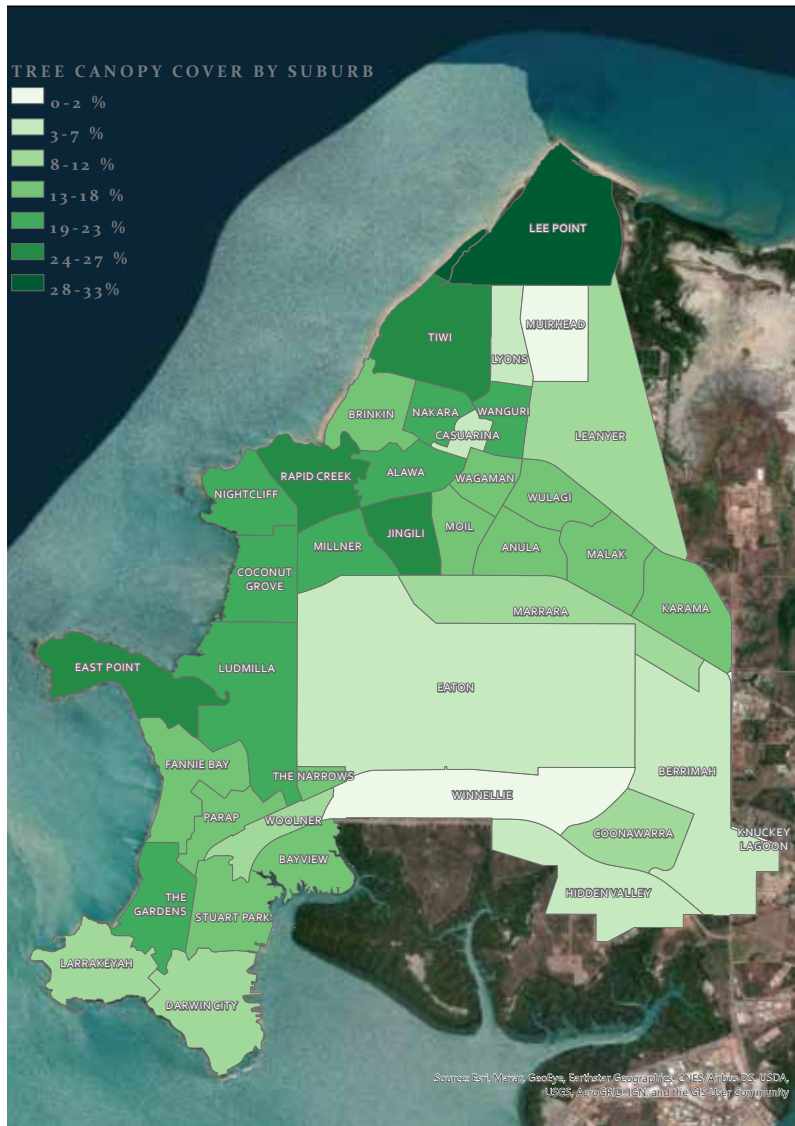


Figure 1: Tree canopy cover by suburb



Table 1 shows Darwin's tree canopy cover by various land uses and ownership based on 2020 data. It is noted that the suburbs of Holmes and Buffalo Creek are not captured in this dataset.

Table 1: Tree canopy cover across Darwin

Land Use/Town planning zone	Total Area (m2)	Canopy Cover (m2)	% Canopy Cover
All Public land	41,003,460	5,693,832	14%
All Private land	38,745,912	6,363,276	16%
Total Municipal Area	90,446,732	13,211,020	15%
Open Space	7,825,240	1,860,104	24%
Roads (all)	8,959,684	746,048	8%
Footpaths (all)	965,908	138,296	14%
Residential zone	22,822,532	4,479,976	20%
Residential Roads	5,380,240	479,796	9%
Darwin City (Suburb)	2,722,976	310,840	11%
Darwin City Roads	408,624	37,804	9%



Habitat and Biodiversity

Biodiversity refers to the variety of the life around us. Darwin's rich ecosystems, of which the urban forest is a fundamental component, host a unique and diverse variety of plants, animals and insects. Maintaining this diverse variety of species is vital to support Darwin's rich ecosystems. In Darwin, maintaining a rich biodiversity is influenced by the ability of wildlife to move from one area of the urban forest to another. Ecosystems that are interlinked facilitate the movement of wildlife. These biodiversity corridors are sprawled across the Darwin municipality (Figure 2).



Figure 2: Major biodiversity corridors in Darwin.



Heat Mitigation Benefits

Darwin is hot and is getting hotter (Figure 3). Increasing temperatures primarily compromise human health and wellbeing in Darwin through heat stress.

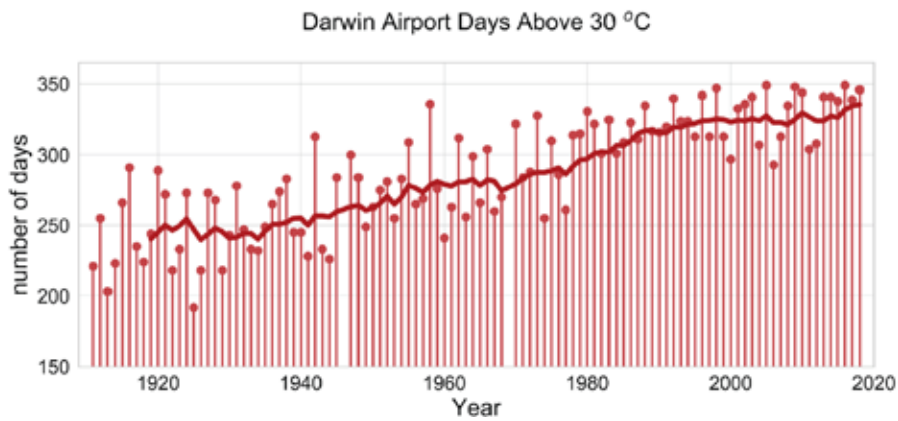


Figure 3: Days above 30°C Each Year in Darwin¹.

Increasing temperatures, exacerbated by Darwin’s Urban Heat Island effect, impacts different areas of Darwin at varying levels of intensity (Figure 4). Darwin’s urban forest plays a major role in cooling through shade and evapotranspiration. Dense and expansive canopies cool nearby areas as cooler air from green spaces is drawn into hotter areas by rising air currents, which generate breezes.

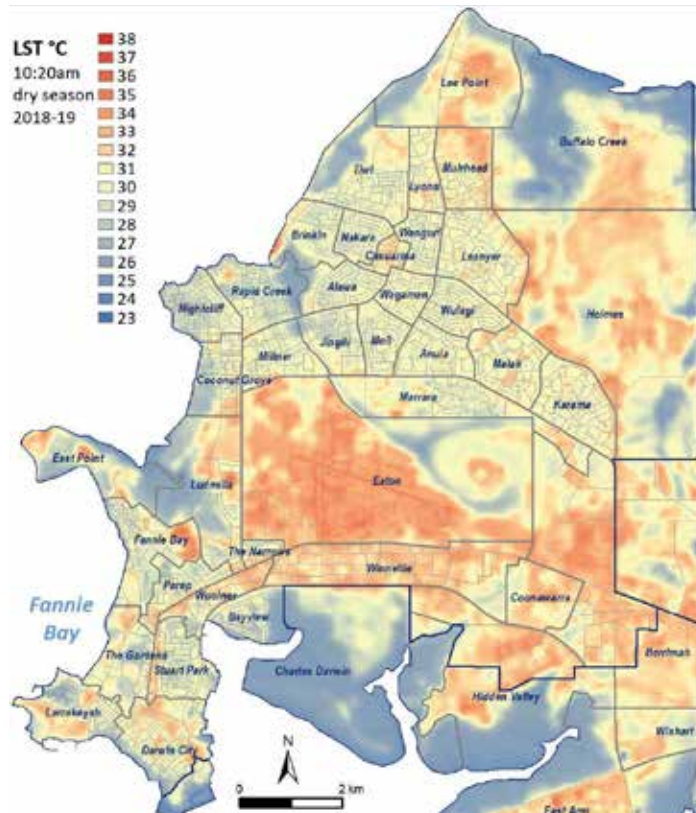


Figure 4: Dry season land surface temperatures at 10:20 a.m. from Jun–Aug 2018–19².

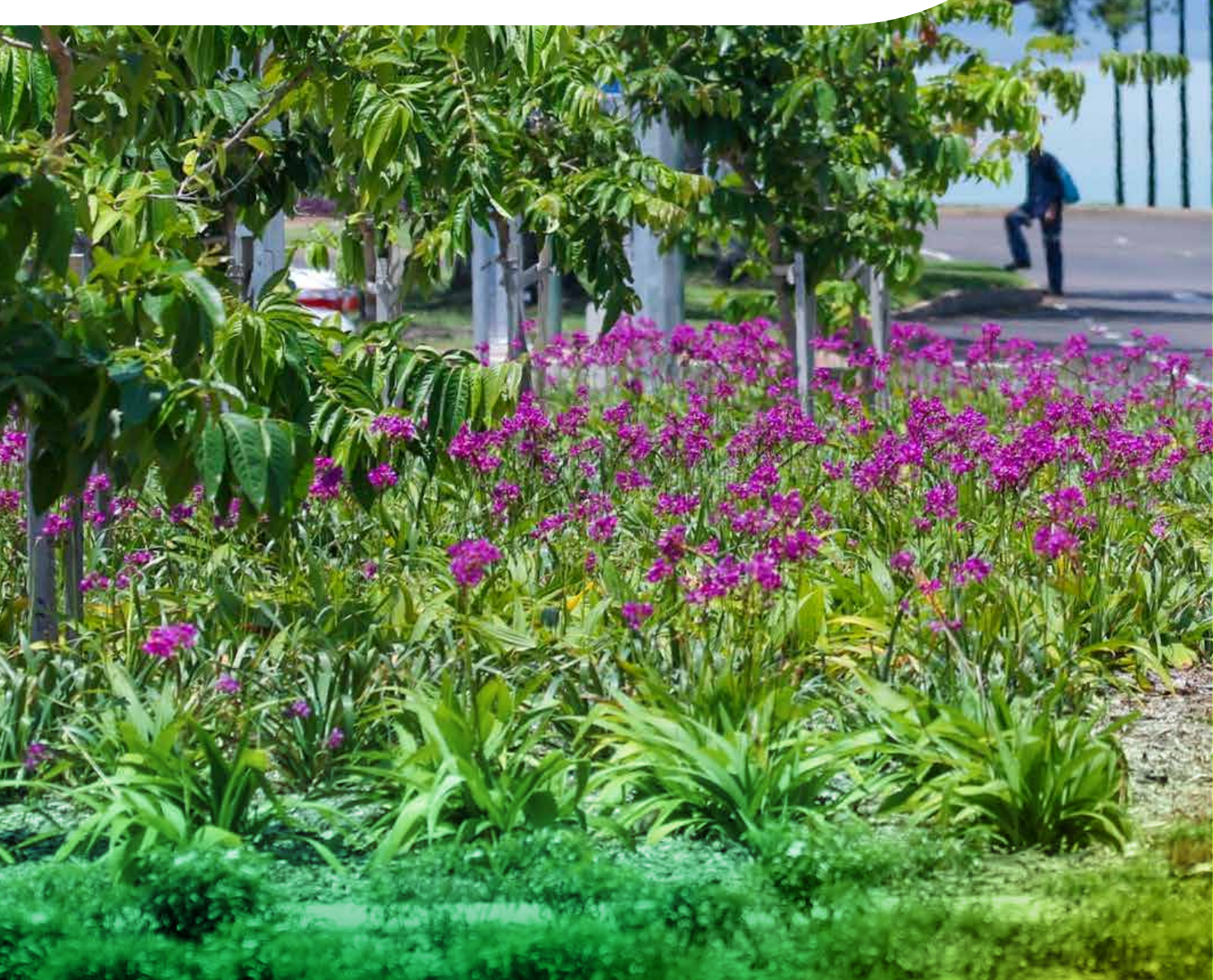
¹ Source: Bureau of Meteorology, & CSIRO. (2019). *Regional Weather and Climate Guide: Top End, Northern Territory*.
² Source: Meyers et al. (2020). *Mapping land surface temperatures and heat vulnerability in Darwin*. CSIRO.

Delivering Economic Benefits

Darwin's urban forest delivers colossal ecosystem services with measurable economic benefits. These benefits were reported within a study conducted in 2019 using i-Tree Eco model using a dataset of 3617 of Council's trees located throughout the Darwin municipality. Results revealed that these 3617 trees within Darwin's urban forest:

- Have a total structural value of \$80.5m
- Store 14 million tonnes of carbon worth \$317,000
- Sequester an additional 228 tonnes of carbon each year worth \$5,000
- Remove 3 tonnes of other air pollutants each year worth \$7,000
- Avoid 11,000 cubic metres of stormwater run-off, worth \$24,000.

Extrapolating this data across Council's urban forest, which is comprised of more than 100,000 trees, means that Council is likely to be managing a living asset worth hundreds of millions of dollars.





Key Challenges for Greening Darwin

Darwin's urban forest faces existing and emerging challenges that have historically constrained the potential of our tropical urban ecosystem.

Historic Net-loss of Canopy Cover

In recent years, Darwin's urban forest has been undergoing a consistent net-loss of canopy cover. A key driver of this net-loss is that removal of trees (approximately 500 per year) has marginally outweighed planting of new trees (approximately 450 per year). Compounding this, Tropical Cyclone Marcus severely diminished canopy cover in 2018 in every Darwin suburb. Canopy cover analysis conducted by Council revealed a significant decrease between 2017 and 2018. These historic declining trends were reversed in 2019 with the planting of over 7000 trees. Since Cyclone Marcus City of Darwin has planted in total over 12,500 trees.

Climate Change

Darwin's urban forest, like all ecosystems will continue to be impacted by a changing climate. Environmental changes include:

- Increasing temperatures
- Longer, more frequent and more intense dry spells and heat waves
- Changes in the timing, frequency, extent and intensity of annual rainfall
- Increased evapotranspiration (the process by which water is transferred from the land to the atmosphere by evaporation from the soil and transpiration from plants)
- Changes in the frequency and severity of wildfires.

These changes, which are projected to intensify, affect every aspect of life and are already causing a range of challenges including impacts on:

- Public health and wellbeing
- Environmental health, including biodiversity in Darwin's urban forest
- Water availability.

In addition to environmental changes, people that are already marginalised, vulnerable and often bear the brunt of these climate-related impacts as they are disproportionately exposed and are constrained in their capacity to respond to environmental extremes. Of particular concern, in Darwin, heat stress disproportionately impacts a range of population groups, including those that are elderly, very young, living with chronic illnesses and those who are homeless.

Fluctuating Water Availability

Water is life. Without sufficient water, Darwin's urban forest would wither thus decreasing the important benefits it provides. Water availability in Darwin is strongly influenced by the seasonal nature of rainfall in the wet/dry tropics, the variability of rainfall from year to year, climatic drivers and changes associated with climate change. Driven by climate change, consecutive poor wet seasons could result in insufficient recharge to the region's principal water supply source, the Darwin River Dam. Compounding these changes, if population and urban densification increases, this will continue to place further pressure on Darwin's water systems. The implications for increased water scarcity range from the short-term inability to meet community expectations of a 'green' municipality if the urban forest withers, to the longer-term decimation of the urban forest as irrigation needs surpass water availability for extended periods.

Conflicts between the Urban Forest and the Built Environment

Conflicts between Darwin's urban forest and built environment are common. Historically, the urban forest has felt the brunt of these conflicts. There are several reasons for this, including:

1. The City of Darwin Municipality is in a state of constant flux, which demands that urban development accommodates the infrastructure and service needs of Darwin's transforming landscape
2. Today's city has inherited the consequences of sustained poor urban forest management decisions such as, poor planting locations and species selection
3. The urban forest is currently treated as a liability, not an asset, in terms of infrastructure cost benefit assessments. As a result the multiple benefits that Darwin's urban forest deliver are not captured and factored effectively into decision making
4. Urban forest protection mechanisms within the public realm are currently inadequate
5. Gaps in community understanding of the vital importance and benefits of Darwin's urban forest.

As a result, Darwin's urban forest has been left fragmented, which isolates biodiversity and compromises the ability of different species to fulfil their role in the ecosystem and support other species.



Knowledge Gaps

Robust datasets are invaluable management tools. They pave the way for evidence-based decision making, proactive management of trees and vegetation, and highlight valuable opportunities to improve existing programs. While City of Darwin holds various parcels of data for our urban forest, there are numerous gaps in knowledge that still exist including:

- Which species are vulnerable to environmental change and how they are distributed among Darwin's urban forest
- Where to prioritise tree planting to effectively cool areas for Darwin's most vulnerable populations
- Additional datasets on how different user groups in Darwin interact with green spaces and how their needs and preferences for amenities and benefits vary.

These knowledge gaps create barriers to nurturing Darwin's urban forest of the future. Bridging these knowledge gaps will assist in fully realising this Strategy.

Resource Constraints

Resource constraints are tightly coupled with gaps in evidence based decision making. In order to implement this Strategy, Council must allocate sufficient funds and staffing resources to improve its existing program. Darwin's urban forest has not historically been prioritised because the true costs and benefits are not well integrated into decision making. A key factor of this is that the urban forest is currently conceptualised as a financial liability, which creates difficulties in allocating appropriate investment.

Weed Infestation

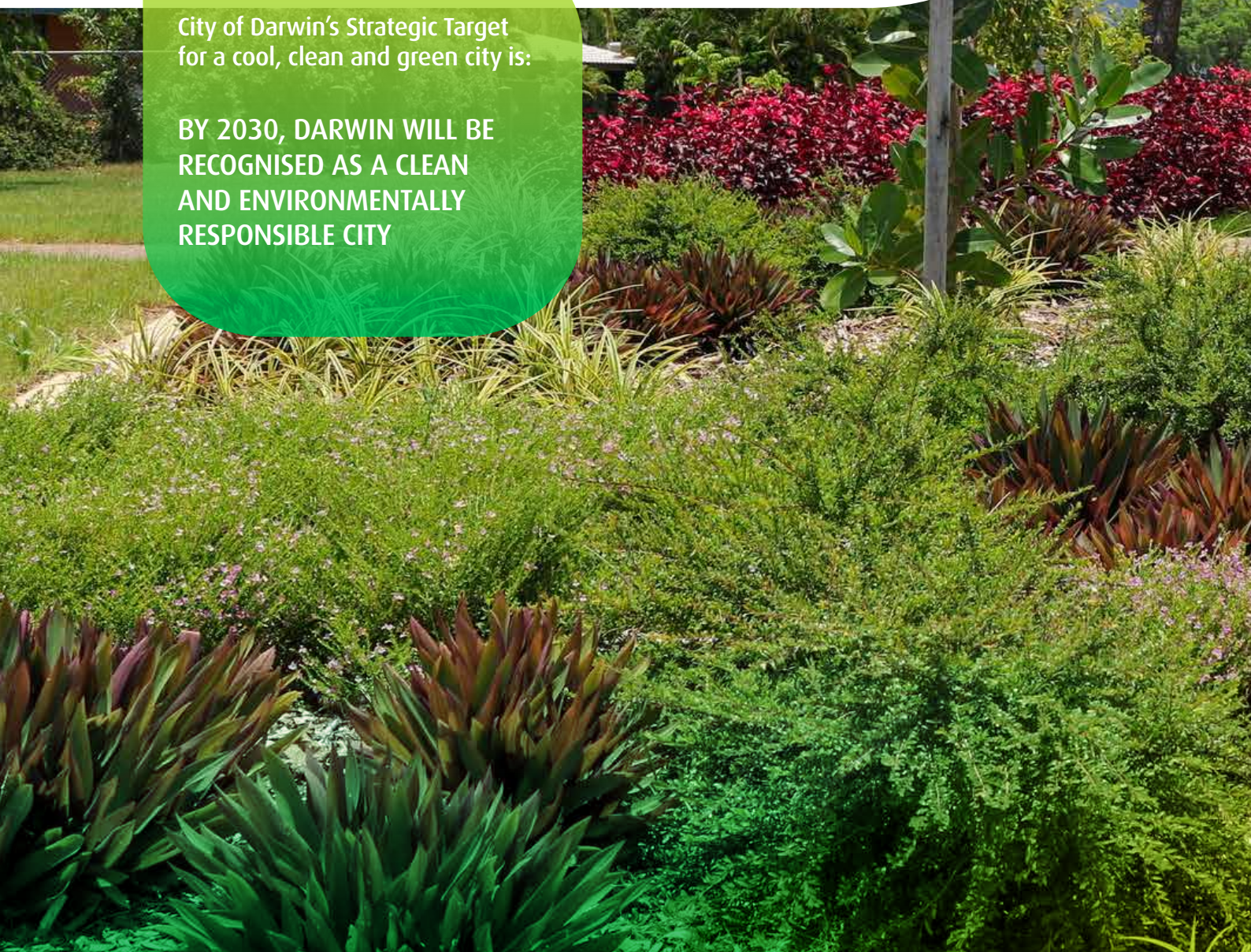
Weeds in the Darwin region present challenges to the successful implementation of the 2030 Greening Darwin Strategy. A 2013 review of weeds in East Point Reserve, for example, revealed that 77 species of weeds were present in the area, including one weed of national significance – Bellyache Bush (*Jatropha gossypifolia*) and two Class B species – coffeeweed (*Senna obtusifolia*) and Hyptis (*Hyptis suaveolens*), that require growth and spread to be controlled. Gamba Grass (*Andropogon gayanus*), is also widespread. These and other weeds undermine the health and resilience of Darwin's urban forest.

Greening Darwin Key Deliverables and Priority Actions

City of Darwin's framework to achieve a cool, clean and green city is integrated as shown in the diagram on page six. This means that one initiative or action may contribute to the achievement of deliverables, targets or outcomes outlined in other City of Darwin strategy and planning documents.

City of Darwin's Strategic Target
for a cool, clean and green city is:

**BY 2030, DARWIN WILL BE
RECOGNISED AS A CLEAN
AND ENVIRONMENTALLY
RESPONSIBLE CITY**





The strategic target will be achieved by delivering a number of strategic and operational actions which will provide measurable outcomes for people, place and environment. Operational actions are outlined in the 2030 Greening Darwin Strategy Action Plan. The action plan is a flexible document that will be updated from time to time over the 10 year life of this Strategy.

The two most common ways to set measurable targets for greening strategies are to set targets based on canopy coverage and/or a net-gain of trees and other plantings planted across the municipality. City of Darwin will use a combination of both methods throughout the life of this Strategy. Key benefits for using a net gain of trees and other plantings as a key methodology is because City of Darwin:

1. Maintains direct control over the amount of trees planted and removed; in contrast, we maintain less control over the outcome (i.e. canopy coverage), particularly due to environmental events such as tropical cyclones which have the potential to decimate canopy coverage outcomes
2. Knows the requirements for amount of trees planted assists in understanding and allocating appropriate resources to achieve measurable targets
3. Understands that nurturing an urban forest is a long-term effort. Indeed, many of the trees and other plantings planted within the timeline of this Strategy won't fully realise their place in Darwin's canopy until after this Strategy has expired. Setting targets based on net-gain of trees planted therefore recognises the long-term effort required to nurture a strong and resilient urban forest in Darwin.

Changes in canopy cover, however, remains an important metric to understand and monitor. City of Darwin will use a mix of methods, including satellite imagery and scenario modelling, to understand actual and projected changes in canopy cover over time.

There are a number of headline actions for the City of Darwin to implement to achieve our strategic directions (Table 2).

Table 2: Headline Actions for the 2030 Greening Darwin Strategy

Headline Actions
Net gain of 18,000 street and park trees over 10 years.
Net gain of 900 shading trees near key transit routes over 10 years.
Net gain of 225 city centre hardscape trees over 10 years.
Increase in canopy cover over 10 years.
Collaborate with Larrakia Nation to combine Traditional Ecological Knowledge with western science to enhance knowledge and decisions to support biodiversity.
Develop a two-year prioritised planting plan by December 2022.
Develop scenario model to understand canopy coverage projections though time.
Deliver a long term scenario model to inform future tree canopy across Darwin.
Develop a prioritised planting plan with considerations for ecosystem diversity.
Further develop the list of priority species that have a broad resilience to a range of environmental extremes.

The following describes key strategic and innovative solutions to implement through the Strategy.

Challenges:
Climate Change,
Fluctuating Water
Availability

Plant for a Future Climate

Solution: Trees that are planted in the coming years as part of this Strategy will need to thrive in a rapidly changing climate. In the context of Darwin's urban forest, key environmental changes include; increased severity and prolonged periods of heat and water scarcity and increased intensity of cyclones.

As such, Darwin's urban forest needs to be resilient to a broad range of environmental conditions. Strong on-going management including risk management, care and maintenance will underpin a far more resilient urban forest in the future. Care also needs to be taken to select species that will continue to perform under changing climatic conditions. Species that are vulnerable to stress and decline in a changing climate must be identified and planned for renewal to ensure that trees live for many decades, fulfilling their role in Darwin's urban forest.

Challenge:
Resource
Constraints

Define Darwin's Urban Forest as an Asset

Solution: Defining Darwin's urban forest as an asset and recognising the myriad of social, environmental, cultural and economic benefits that the urban forest delivers will help to overcome the challenge of allocating appropriate resources to grow and maintain Darwin's urban forest. To do this, City of Darwin will update and integrate available datasets into the forthcoming Asset Management System. This will allow the economic values of the urban forest to be considered alongside a tree's whole-of-life costs to ensure long term sustainability. This consideration will incorporate cost differences among various planting areas (the costs associated with planting trees in the CBD are a lot more expensive than a tree in a park, for example). Ultimately, re-conceptualising Darwin's urban forest as an asset will allow appropriate allocation of resources to undertake activities required to nurture a thriving and robust ecosystem.

Challenge:
Knowledge
Gaps, Resource
Constraints

Deploy Smart Technologies

Solution: Increased efforts to close knowledge gaps, coupled with rapid advancements in technology, will produce a wealth of biophysical, social and economic information to enhance evidence-based decision-making for Darwin's urban forest. City of Darwin has already deployed a variety of smart technologies through the Switching on Darwin program, which represents the transition to a data-driven, people-oriented city.



Solution in the Spotlight:

Develop a Digital Twin of Darwin to Monitor and Navigate Change

Led by CSIRO through the Darwin Living Lab, the development of a Digital Twin project will enable City of Darwin to monitor change and explore interactions among key indicators and test the impact of changes in assets, systems and processes. Existing datasets will be collated, integrated and modelled to estimate a baseline distribution of living and built infrastructure in Darwin. The initial application of the Digital Twin will involve evaluating the economic value and return on investments of cooling and greening initiatives, specifically around establishing and maintaining Darwin's urban forest.



Challenge: Knowledge Gap

Incorporate Traditional Ecological Knowledge and western scientific knowledge to enhance Decisions

Solution: To mobilise City of Darwin's *Innovate Reconciliation Action Plan* and Article 7 of the Paris Agreement within the United Nations Framework Convention on Climate Change, City of Darwin will enhance our decision-making for Darwin's urban forest by integrating Traditional Ecological Knowledge (TEK) and western scientific knowledge. In line with international best practice, incorporating both knowledge systems allows for an enhanced knowledge base to achieve the outcomes of this Strategy. City of Darwin emphasises the importance of bringing Aboriginal and Torres Strait Islander voices to the forefront in decision making processes and will make use of cutting-edge technologies to develop rich datasets, which will facilitate strong, evidence based decisions for Darwin's urban forest.

Solution in the Spotlight:

Larrakia-led Darwin Biodiversity Values Research Project

In collaboration with CSIRO through the Darwin Living Lab, Larrakia Traditional Owners and Larrakia Rangers are compiling a working list of Larrakia biodiversity values, habitats and native plant species that should be considered for Darwin urban greening and protection. This collaborative study of Darwin's biodiversity will serve as a baseline assessment and provide recommendations enhance biodiversity in Darwin through implementing this Strategy.





Generate Darwin-specific Solutions

Solution: While drawing lessons from our southerly neighbours provides invaluable insights, Darwin's urban forest exists in a unique climatic context for an Australian capital city. As a result, City of Darwin must employ a unique combination of solutions to achieve the objectives of this Strategy. Little information exists about urban greening in a savanna ecosystem so City of Darwin must heavily engage in the research and development required to strengthen our urban forest in our unique and changing context.

Challenge:
Knowledge
Gaps

Create a Resilient Urban Forest

Solution: Darwin's urban forest is a living organism, forever changing. Some changes happen slowly, such as the aging and the inevitable end-of-life of trees, others happen fast, such as tropical cyclone events that can decimate extensive sections of the urban forest in an afternoon. These events, whether they occur fast or slow, present opportunities to build back better. An important activity is to identify which species were lost and why. This will help to reveal solutions forward, including replacing lost species with species that are more resilient, or implementing changes to infrastructure, such as tree cells to support root systems.

Challenges:
Historic Net-loss
Canopy Cover,
Climate Change,
Fluctuating Water
Availability,
Conflicts between
the Urban Forest
and the Built
Environment

Enhance Collaboration with Stakeholders

Solution: Darwin's urban forest expands across a mosaic of public and private realms. City of Darwin must therefore perform a variety of roles to enhance the whole urban forest through both direct and indirect influence. To carry out these roles, City of Darwin must work across all agencies, with all levels of government and the educational and private sectors. City of Darwin will continue to collaborate with a broad variety of stakeholders, including private land owners, NT Government, Larrakia Nation and community-driven environmental management and advocacy groups.

Challenges:
Knowledge
Gaps, Resource
Constraints,
Conflicts between
the Urban Forest
and the Built
Environment

City of Darwin already engages in crucial collaborations such as with the Darwin Living Lab (a collaboration between the CSIRO, Australian Government, NT Government, and the City of Darwin), which is an initiative of the Darwin City Deal. The Darwin Living Lab was established to foster improvements to the liveability, sustainability and resilience of Darwin and aims to:

1. Accelerate the development and validation of innovative approaches for heat mitigation in Darwin;
2. Improve urban design for the dry tropics; and
3. Build the city's resilience to the current and future climate.

Solution in the Spotlight:

Gardens for Wildlife

Gardens for Wildlife is an education-based voluntary program for Darwin land owners who are interested creating wildlife habitat on their property. City of Darwin works with participants to investigate ecosystem options to enhance habitats for a variety of wildlife. The program contributes to increasing:

1. Connectivity of wildlife corridors across Darwin
2. Local understanding of our unique environment and wildlife.

ANOTHER HAPPY GARDENS FOR WILDLIFE PARTICIPANT





Solution in the Spotlight:

East Point Advisory Committee

The East Point Reserve is a significant public open space in the Darwin urban area managed by the City of Darwin. The reserve is subject to range of interacting management concerns for multiple different stakeholders. As part of City of Darwin's East Point Reserve Biodiversity Plan 2019-2024, an *East Point Advisory Committee* was established to:

1. Bring together stakeholders to share knowledge and experience, whilst identifying opportunities to enhance the reserve and improve collaboration
2. Inform and advise Council of issues within and around the reserve
3. Monitor the implementation of the East Point Reserve Biodiversity Management Plan 2019-2024.



Figure 5: Assets and services at East Point Reserve

Reforest Residences

Challenges:
Conflicts between
the Urban Forest
and the Built
Environment,
Historic Net-loss
of Canopy Cover

Solution: Darwin's urban forest expands across a mosaic of public and private realms. While each individual residential property only hosts a small fraction of Darwin's total municipality, these pockets make up almost one quarter of Darwin's municipality. It is, therefore, imperative to support Darwin residents to nurture their individual pockets of Darwin's urban forest. City of Darwin plays an indirect influence in this realm and can carry out several functions such as provision of educational advice and native plants to enhance our outcomes.

Solution in the Spotlight:

Native Plant Giveaway

To enact City of Darwin's influence on the urban forest in the private realm, a Native Plant Giveaway Program will be delivered to the Darwin community. Planting local native plants has many benefits including the provision of food sources and habitat to support local biodiversity. Local native plant species also generally require less water than introduced plant species, which will increase resilience in times of extended drying periods.





Connect Biodiversity Corridors

Solution: In Darwin, maintaining a rich biodiversity is influenced by the ability of wildlife to move from one area of the urban forest to another. Interlinked ecosystems that facilitate movement of wildlife (biodiversity corridors) sprawl across the Darwin municipality. Darwin's mosaic of public-private ownership, however, has resulted in the fragmentation of biodiversity corridors, which compromises ecosystem resilience. Reconnecting, protecting and managing these corridors with a variety of resilient species is fundamental to implementing this Strategy.

Challenges:
Conflicts between the Urban Forest and the Built Environment, Historic Net-loss of Canopy Cover

Solution in the Spotlight:

Land Acquisition to Connect Biodiversity Corridors

For City of Darwin to appropriately reconnect, protect and manage biodiversity corridors in the Darwin municipality, options to strategically acquire parcels of land required to reconnect biodiversity corridors will be investigated. This activity reflects ongoing trends from councils across Australia that are acquiring land for conservation purposes. Biodiversity corridors unlock major opportunities to develop recreation and eco-tourism initiatives throughout the Darwin municipality. Options for raising funds for land acquisition in Darwin will be investigated.



Equitably Distribute the Urban Forest

Challenge: Climate Change

Solution: Investigations into the impacts of heat stress among Darwin's population have been carried out using physical and socioeconomic characteristics. A Neighbourhood Heat-Health Vulnerability Index (Figure 6) was generated to identify which neighbourhoods have a higher risk of heat-related illness, have fewer economic resources to cool their homes and are exposed to higher urban temperatures. This revealed that strategically prioritising planting of trees offers an equitable solution to heat stress in Darwin. Such analysis will be expanded to ensure that Darwin residents have equitable access to the urban forest and the services that they provide.

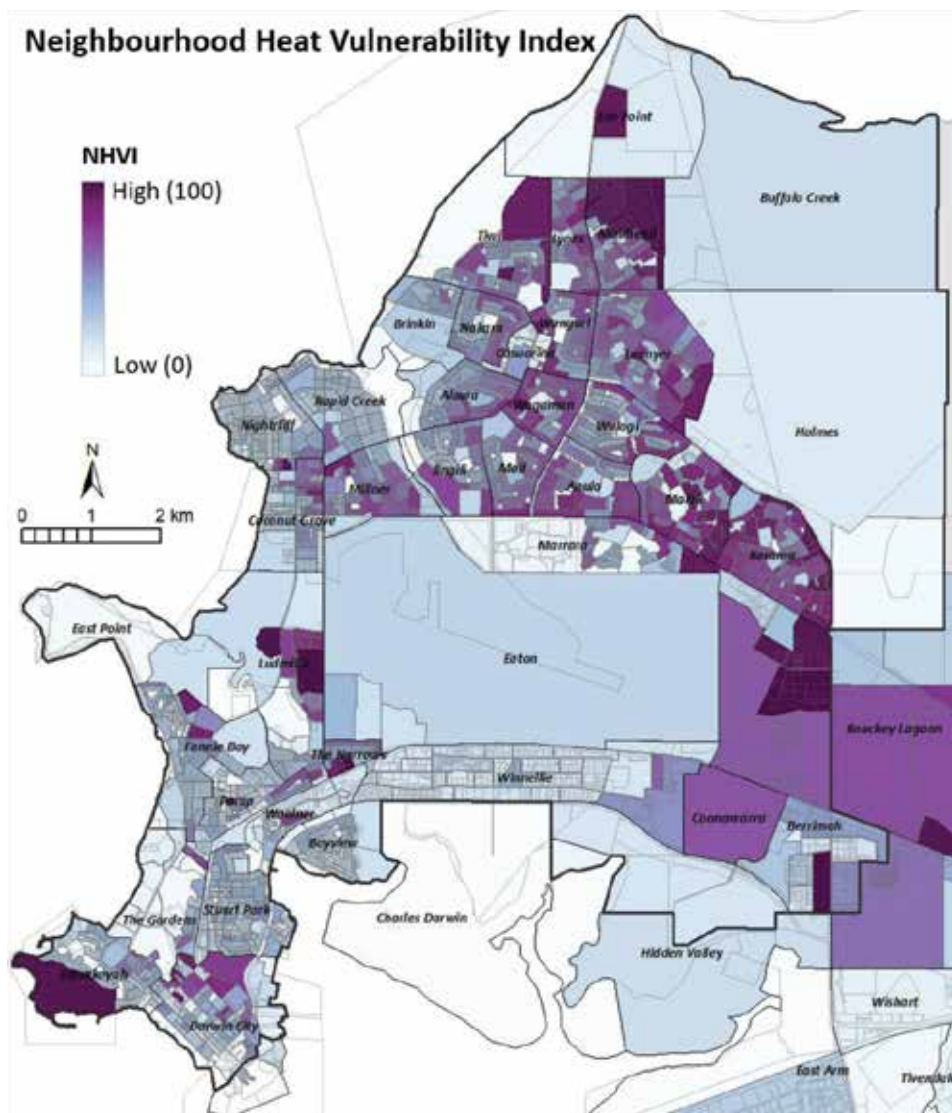


Figure 6: Neighbourhood Heat-Health Vulnerability Index in Darwin³.

³ Source: Meyers et al. (2020). Mapping land surface temperatures and heat vulnerability in Darwin. CSIRO.



Solution in the Spotlight:

Enhanced Understanding of Community Needs for Darwin's Green Spaces

Led by CSIRO through the Darwin Living Lab, research is currently being undertaken to understand how different user groups in Darwin interact with green spaces and how their needs and preferences for amenities and benefits vary. Complementing previous community engagement activities, this research will inform decision-making to reflect the diversity of community values and needs in Darwin.





ACTIONS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Collect tree data from various sample sites around Darwin to inform a profile of Darwin's urban forest, including tree valuations.	✓	✓								
Ensure City of Darwin's website includes updated urban forest data and shows progress against the Strategy deliverables.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Develop and implement a Native Plant Giveaway Program.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Through the Darwin Living Lab program, collaborate with Larrakia Nation and CSIRO to develop a baseline vulnerability assessment of biodiversity.	✓	✓	✓							
Collaborate with key stakeholders to develop a 10-year urban forest planting plan for the CBD.	✓	✓	✓							
Review and update the City of Darwin publication titled: <i>Creating Habitats for Darwin Gardens</i> .		✓	✓							
Investigate options to strategically acquire parcels of land required to reconnect biodiversity corridors.		✓	✓							
Review and update the works permits process to ensure the protection and audit of trees during development works.		✓	✓							
Introduce requirements for Project Management Plans to assess and disclose potential damages to vegetation.		✓	✓							

ACTIONS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Undertake a risk assessment for trees across the municipality, implement treatment plans and include provisions for regular review of outcomes.		✓	✓			✓				✓
Work with Larrakia Nation to expand on the TRAC Committee preferred trees list to include trees that are of cultural significance.		✓	✓							
Develop a prioritised 10-year urban forest planting plan.		✓	✓							
Develop Best Practice Urban Forest Management Technical Guidelines.		✓	✓							
Include trees as a defined asset class within the Asset Management Framework to:		✓	✓							
• Undertake a condition assessment and valuation of trees across the municipality			✓	✓						
• Factor renewal, replacement and maintenance costs into the long term financial plan;				✓						
• Review City of Darwin's insurance coverage for trees and natural disaster impacts.				✓						
Investigate a partnership with community groups to enhance the urban forest in areas not owned by City of Darwin or the NT Government.			✓	✓						
Develop a Best Practice Tree Management Guide for Developers.				✓	✓					
Review of Strategy deliverables.					✓					✓



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