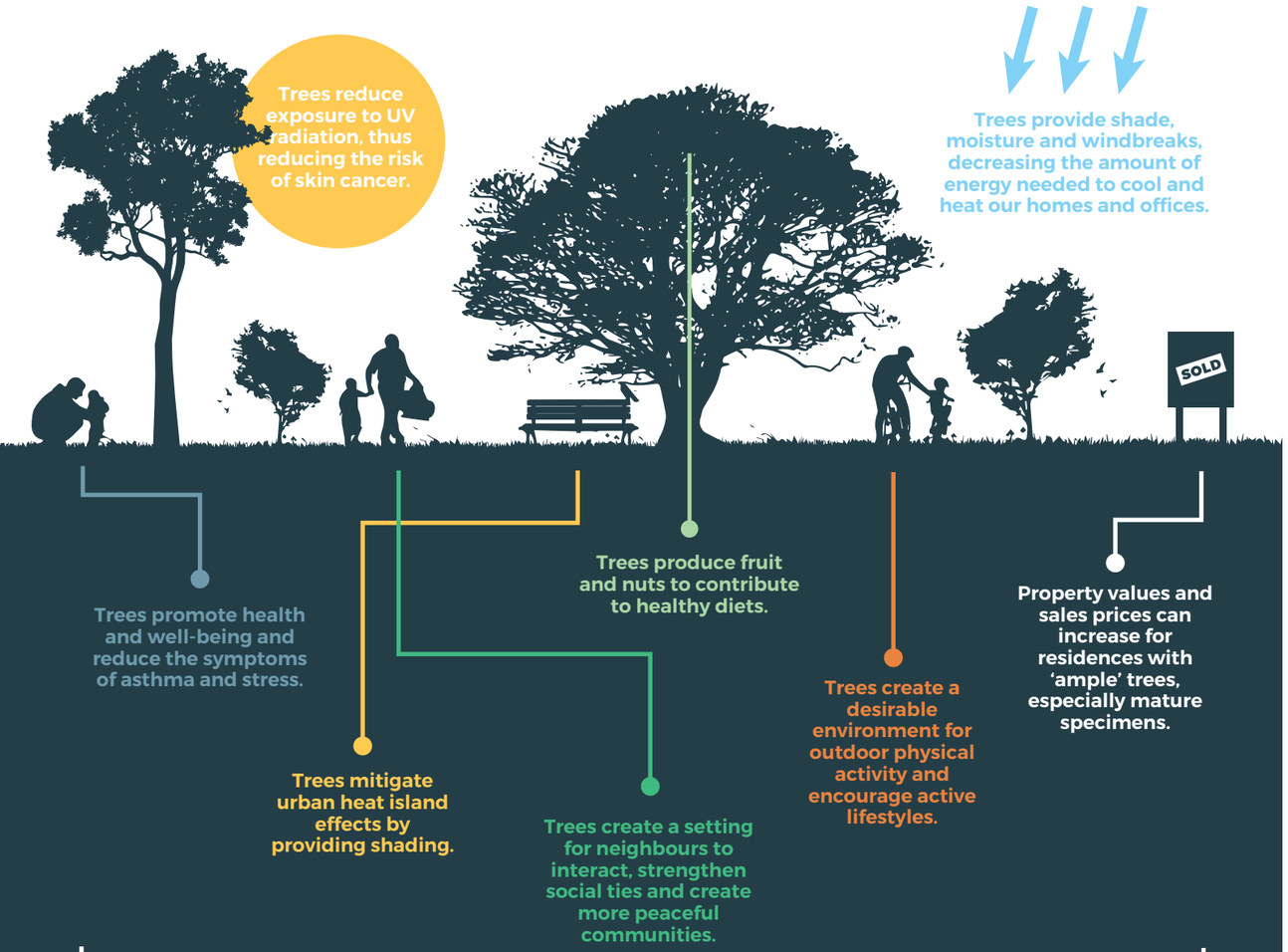
City of Fremantle

City of Fremantle
Urban Forest Plan

Trees for Public Health



Trees contribute to the overall physical, mental, and social well-being of individuals and communities.

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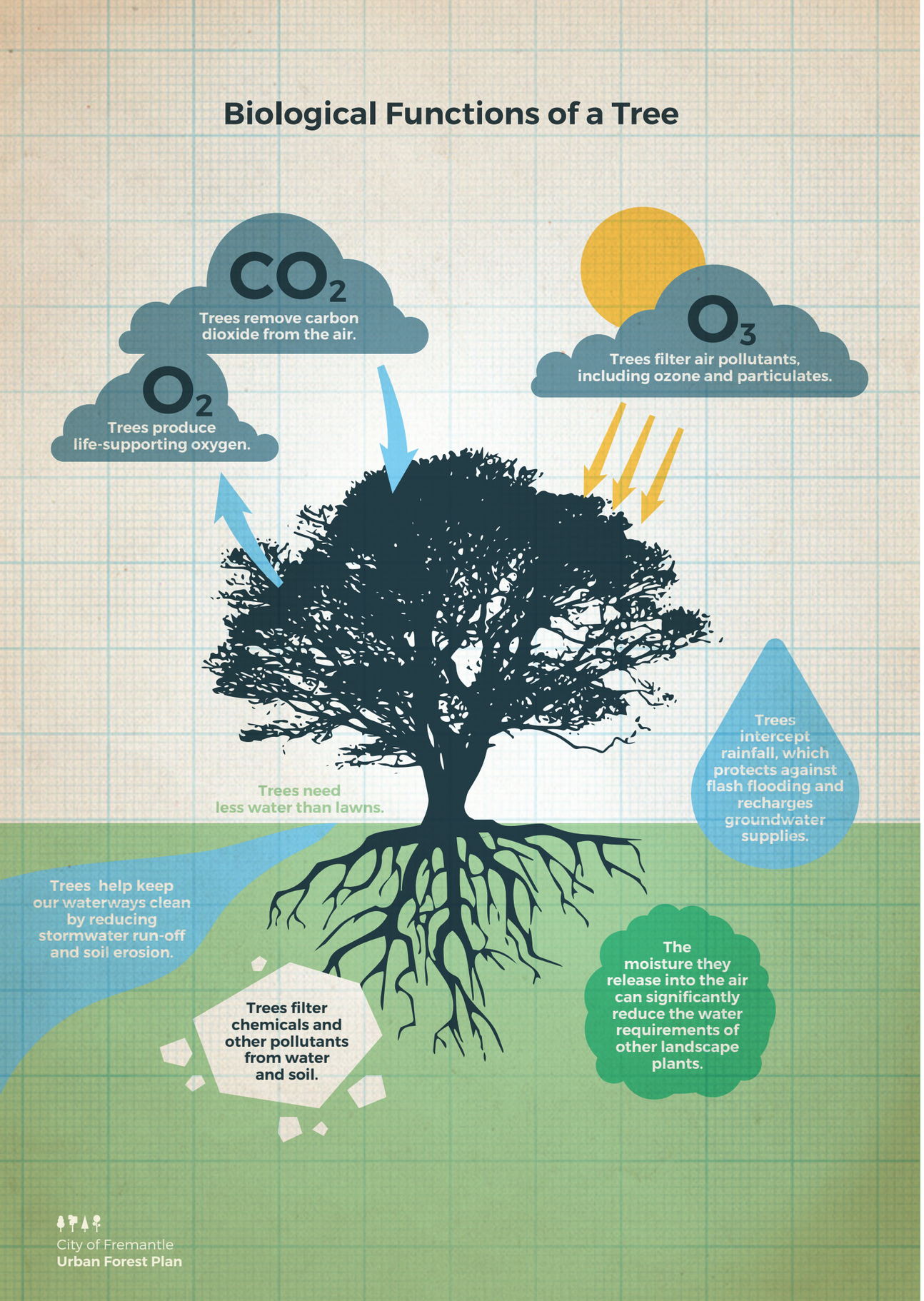


PART A

City of Fremantle Urban Forest Plan

What is an urban forest?

An urban forest has many community, economic & environmental benefits; it comprises all trees and other vegetation within the city and the soil and water that supports it. It incorporates vegetation in:

- streets
- parks and gardens
- plazas
- campuses
- river embankments
- railway corridors
- community and residential gardens
- green walls
- balconies and roofs.

Urban forestry, as distinct from arboriculture and horticulture, considers the cumulative benefits of an entire tree population, as well as other urban greenery across a town or city.

202020 Vision – How to Grow an Urban Forest

Why do we need an Urban Forest Plan?

Although the City of Fremantle (City) maintains and plants trees every year, there is no overall comprehensive plan for the long term management and establishment for city trees.

According to the 2014 Urban Forest of Perth and Peel mapping prepared by the Department of Planning WA, Fremantle was rated as having one of the lowest rated Urban Forests - between 5 - 10%. This result is very low, in comparison to other Perth City centres such as Booragoon 10-15%, Subiaco 10-15% or Claremont which has a rating of 15-20%. The mapping clearly demonstrated the most urban (the Perth CBD and surrounding LGA's) and the outlying suburbs of the Perth Metropolitan Area as having the lowest ranking Urban Forests.

The innovative and interactive Fremantle 2029 Community Visioning process identified a clear long-term vision to be a sustainable, liveable and vibrant place over the coming decades. A key value identified is the City of Fremantle (City)'s green spaces and places, with a fundamental responsibility to protect and enhance the natural environment, green spaces and heritage features of the City.

An Urban Forest Plan (UFP) will provide an opportunity to contribute to achieving this core community wellbeing and environmental value. An urban forest provides residents and the City's community with critical ecosystem services such as air and water filtration, shade, cooling, habitat, oxygen, carbon sequestration and nutrient cycling. Holistically an urban forest and its associated ecosystem services allows for consideration of the broader issues of climate change, the urban heat island effect and population growth within the Perth Metropolitan Area; a number of the benefits are described in the graphic on page 2.

Strategic Context

Greening Fremantle: Strategy 2020

Green spaces and places are important to our community and have been identified as valued assets through the Fremantle 2029 Community Visioning process as:

"... a City that values its environment and heritage and the protection and enhancing the natural environment, green spaces and heritage features".

To achieve this vision, the Greening Fremantle: Strategy 2020 (GFS) has six focus areas to maintain and enhance green spaces, increase quality and distribution of green spaces, increasing and improving biodiversity, water efficiency and encouraging the greening of private property.

The GFS provides the background, rationale and framework to deliver projects and programs over five years. Key initiatives and targets include:

- Every resident and worker to be within walkable distance to public open space.
- Progressively increase tree planting across the City to achieve at least 20% canopy coverage.
- Design adaptable open space that allows for future flexibility as the community and open space function and needs change over time.
- Planning for future water security to identify opportunities for best available water sources for existing and new open space.
- Develop links that increase the amount of flora/vegetation and increase habitats for native fauna and encourage their movement between green spaces and to increase and improve biodiversity areas.

Key projects include:

- Investigation and identification for accessing public open space in the priority areas of Hilton, O'Connor and White Gum Valley.
- Investigation and identification of options to improve and/or expand public open space and its proximity to future high density areas.
- Undertaking an Urban Forest Strategy (title changed to Urban Forest Plan to reflect relationship with the retitled GFS) to manage and guide tree and vegetation population across the public and private realm, to increase canopy and biodiversity and to mitigate the Urban Heat Island Effect.
- Undertaking water demand modelling to inform future fit for purpose water supply options.
- Prepare landscaping/planting plans for green links and develop a biodiversity plan.

Existing City Relevant Plans and Policies

- SG28 Tree Planting And Preservation Policy
- 2.10 Landscaping Or Development And Existing Vegetation On Development Sites
- 2.12 Planning Applications Impacting On Verge Infrastructure And Verge Trees
- 2.9 Residential Streetscape
- LP.P 2.2 Split Density Codes And Energy Efficiency And Sustainability Schedule
- LP.P 2.13 Sustainable Buildings Design Requirements
- Foreshore Reserves And Management Plans
- Local Planning Scheme No. 4
- Local Area Design Policies & Urban Design
- Verge Beautification Program.

What is the City of Fremantle doing to contribute to the UFP?

- Allocated funding to commence initial tree survey to establish detailed data and health.
- Invite people to participate in a number of community planting days.
- Integrating new trees where possible in road and path upgrades.
- Funded establishment of baseline data of the various urban forest features within Fremantle (UFP).
- The City shall also invite people to participate in a number of community planting days to achieve a minimum of 1,000 trees planted every year.
- Verge beautification program – Encourages residents to develop native verge gardens, supplemented with access to free mulch and subsidised plants.
- Revegetation Programs - Revegetation of Arthur Head, railway link, and coastal reserves, ongoing tree planting program, ongoing street tree program, ongoing natural area protection and restoration.
- Planning Scheme and Policy provisions - Range of Scheme and Policy requirements to retain and encourage retention of vegetation and mature trees on developable land.

City Area Definition

Place-based analysis, planning and design is a way to shape the future of our towns and Cities by concentrating on the look and feel of places, their form and their character, instead of focusing only on conventional standards across all places. The UFP recognises that the City is made up of many precincts, communities or places and proposes to assess, engage and make recommendations based on three key urban environment components:

- street hierarchy
- places / nodes
- precincts (Distinct Areas).

The first step in the preparation of the UFP was the identification of four distinct Areas as defined on above. The Areas were initially defined through anaylsis of the baseline biophysical mapping. Key characteristics used to define the Areas were topography and geology as these two aspects greatly influence tree species form and diversity. Landuse typologies were also considered as well as ensuring each Area contained a community group. The City has a number of well-defined existing and proposed Green Links connecting Green Areas as well places / nodes.

The Areas are networked by a well defined street hierarchy and the proposed Green Links provide an overarching structure to further refine the needs of each Area and consequently guide the implementation and prioritisation of works to implement the UFP vision.

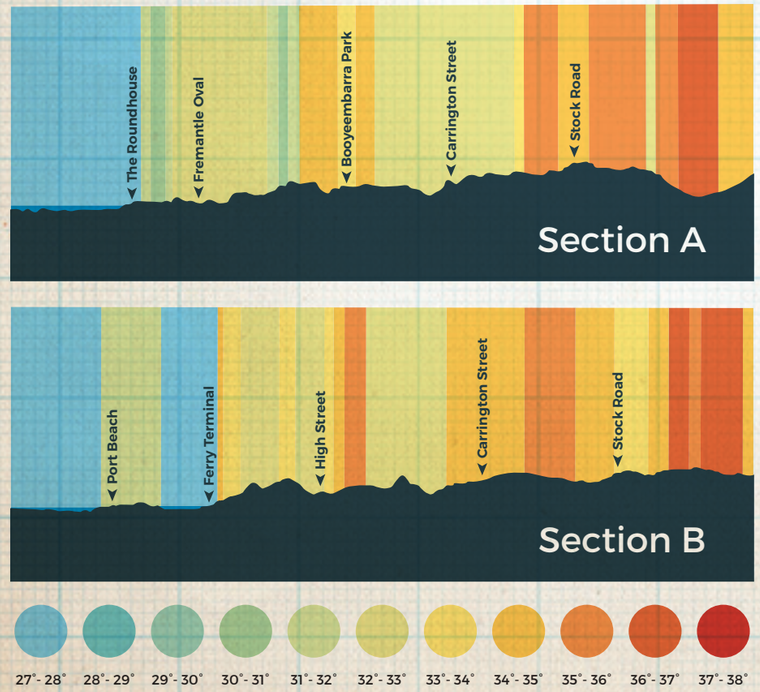
Fremantle Thermal Patterns

Thermal Blocks (Jan 2015)
Degrees in Celcius

- 27°- 28°
- 28°- 29°
- 29°- 30°
- 30°- 31°
- 31°- 32°
- 32°- 33°
- 33°- 34°
- 34°- 35°
- 35°- 36°
- 36°- 37°
- 37°- 38°

Source: City of Fremantle/Arbor Carbon 2015

Average Maximum Surface Temperature & Topography January 2015



Strategic placement of trees in urban areas can cool the air by between 2˚C & 4˚C.

Benefits of Urban Trees, Food and Agriculture Organization of the United Nations

"The liveability of Australia's cities will be affected by how their sustainability is managed."

Department of Infrastructure & Regional Development, State of Australian Cities 2013

Urban Heat Island Effect

Reducing Urban Heat Island Effect (UHIE) stress is the main objective behind the federal government's plan to set tree canopy targets for Australian cities. (https://theconversation.com/why-green-cities-need-to-become-a-deeply-lived-experience-65566) Green areas and tree planting in urban areas reduce the social and economic impacts associated with heatwaves and also, reduce heat-related deaths.

As average temperatures continue to rise, and the number of extreme heat days increase annually, methods to cool our cities are becoming increasingly important. With over three-quarters of Australians now living in urban areas, combating the UHIE within our cities is becoming a major public health issue. (Cooling Cities – Urban Heat Island Effect, AILA 2016)

The "Fremantle Doctor" plays a critical role in the UHIE in our city. The sea breeze occurs because of the major temperature difference between the land and sea; which is the strongest predominantly in December and January based on the greatest temperature difference in the water and the land. It is known to consistently blow from the southeast starting between noon and 3pm daily and depending on the landform, penetrates inland as far as 100km. This phenomenon cools Fremantle by several degrees and days when the wind fails to transpire; the afternoon temperatures are considerably higher and often exceed 40˚C which is commonly attributable to the influence of a strong easterly wind from the east over the desert.

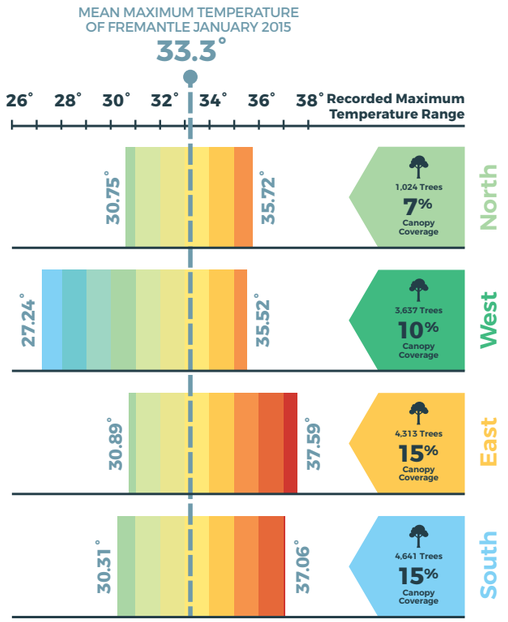
Green areas are increasingly recognised as useful for moderating the UHIE of urban areas. This helps cities adapt to and reduce the consequences of climate change associated with the pressures on essential infrastructure services because many of these systems are reliant on each other. For example, electricity is essential to multiple systems, and a failure in the electrical grid can affect water treatment, transportation services, and public health.

The City has mapped the Green areas which include canopy cover of trees over 3 meters in height, native bushland and the City's parks and recreational areas. The City has a total Green Area of 413Ha or 23% of the total land area. The remaining balance consists of a high % of hardstand (roofs, roads, paving etc) and bare ground. The City has a high diversity in land use including dense urban development, residential, green areas, natural bushland areas and a high proportion of light industrial land use to the south and east of the City. The City has a unique summer urban heat island effect in that its proximity to natural coastal processes, land use and the geological and topographical nature of the City's landscape have resulted in a number of urban cooling intricacies dependent on the sea breeze and where you are in the City.

The continued densification of the City has led to the increase in heat absorbing hard surfaces to network the commercial and residential components that make up the City. According to "Where are all the Trees? An analysis of tree canopy cover in urban Australia" the City was classified as predominantly a 'Hard surface heavy" local government authority. Hard surfaces were defined as built elements including asphalt, buildings, car parks, footpaths, train lines and groynes as well as natural elements including sandy beaches, rocky coastlines and water.

The UHIE occurs because of the capacity (thermal mass) of these darker surfaces to absorb the sun's energy, converting up to 80 per cent of sunlight into heat that is stored and then released, raising local temperatures. As development occurs, these darker, absorbent surfaces and materials will increase, while the overall extent of vegetation, shade and open spaces will decrease. (Cooling Cities – Urban Heat Island Effect, AILA 2016)

Maximum Surface Temperature Variations January 2015



PART B

What does the City want to achieve?

What's our Vision?

Extreme temperatures associated with global warming are significantly impacting on our cities and our health and wellbeing. The most effective way of combating this trend is to promote the greening of our cities, particularly through tree cover. The vision of the UFP is:

To protect the existing green spaces and trees and progressively grow and diversify the City's tree population for adaptive climate management and amenity; to collaborate effectively to plant, plan, design and sustainably fund programs to create a resilient urban forest.

A green city is an inviting city. The UFS vision aligns with the Strategic Community Plan vision of Fremantle: a destination city, a compassionate city that cares for the wellbeing of our people and the environment we share. The UFS best aligns with these three strategic focus areas; Environmental responsibility – Develop environmentally sustainable solutions for the benefit of current and future generations, Places for people – create great spaces for people through innovative urban and suburban design and Health and happiness – creating an environment where it is easy for people to lead safe, happy and healthy lives.

Objectives

A core objective of the UFP is to work towards increasing the amount of tree cover up to 20% and encourage landowners to retain vegetation, including protecting trees on private property by implementing a range of policy review and update and potential incentives. The UFP will:

- assist in maintaining and enhancing green areas / trees
- increase quality and distribution of green areas / trees
- increase and improve biodiversity
- encourage the greening of private property
- encourage the greening of urban hard surfaces such as car parks
- apply a coordinated approach through the City's strategies, policy, plans and development applications and operations to target a reduction in UHIE
- manage and guide tree and vegetation populations across the public and private realm
- increase canopy cover and biodiversity to mitigate the UHIE.

Key Issues

Without this vision, issues such as maintenance, funding and uneven distribution of trees and urban forest expansion will not be effectively addressed. Community awareness coupled with a number of City policy and approvals process changes will be the primary drivers in ensuring the City can meet the objectives of the UFP. The City will need to address a number of critical challenges.

Protection and Retention

Currently in the front and back yards of the city's residential areas there are a great number and variety of trees and vegetation that contribute to the overall environmental and social benefits of having green areas. The City will need to engage with residents and major land holders of those areas to achieve acceptance and ultimately ownership of any tree planting efforts.

There are several ways to protect important trees on private property. These vary from state to state but include Tree Preservation Orders, Significant Tree registers, planning controls, incentive programs and education. The City's Local Planning Scheme No. 4 and associated planning policies encourage the retention of trees and/or significant vegetation. Trees listed under the Heritage Register also help identify and preserve important and large trees in the City.

UFP Challenge:

Engagement and ownership by the community, large land holders and major developers of the natural environment.

A 5% fall in urban tree cover can lead to a 1-2˚C rise in air temperature, leaving these communities more exposed to extreme heat. This really matters for community health and well-being, especially for the vulnerable among us – the elderly, young children and those with existing health issues. There's also mounting evidence that exposure to greenery and nature improves community mental health and well-being.

(https://theconversation.com/fewer-trees-leave-the-outer-suburbs-out-in-the-heat-33299)

Imbalance of Person to Tree Ratio

Currently the City has a ratio of approximately one tree to every two people, refer graphic on page 11. An article written in 2015 by Science Focus, states that each person requires at least 7 mature trees to meet the annual oxygen needs of a healthy adult. (http://www.sciencefocus.com)

Trees not only provide oxygen they provide a myriad of other vital biological and social functions that all make up a healthy environment. The graphic on page 2 describes the biological functions of a tree. The social benefits are enormous; the following are some of the key benefits:

» A reduction in power and energy bills: Trees near buildings can reduce the demand for heating and cooling, which results in lower power bills and less carbon emissions from Western Australia's largely coal-based electricity industry. Deciduous trees planted on the north side of homes can reduce air-conditioning running costs by as much as 12-15 % and will provide shade in summer and allow sunlight during winter.

» Strengthen a sense of place: The unique characteristics of different tree species assist in visually defining Australia's urban and bush landscapes. People appreciate the beauty of trees – whether in their back yards, the street, parks and reserves, or in bushland.

» Improve health and wellbeing: Being outdoors and amongst trees can have a restorative effect on people through helping to create a sense of wellbeing. Getting in touch with nature has been known to assist with people's ability to recover from stress, illness and injury.

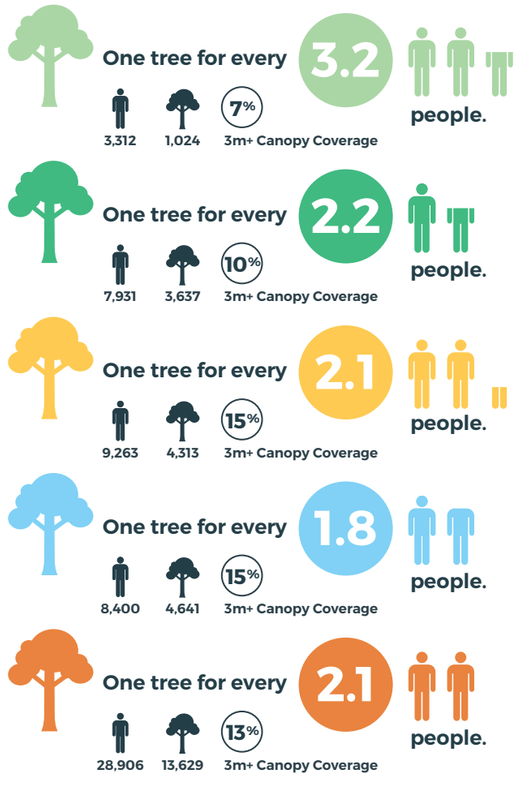
» Trees improve property value: Trees can soften the harsh lines of buildings and screen unsightly views. Research has shown that properties in leafy streets have been valued at 30 % higher than less leafy streets in other parts of a similar suburb. An attractive and appropriate tree planted in the right location can complement the architectural built form and increase the net worth of the property.

Suburbs with the fewest trees shading roads and pavements should be prioritised in the UFP, because they will get the greatest cooling benefit from planting more trees. The UFP will need to ensure that everyone has an equal opportunity to be resilient to the mental pressures of urban living and the hazards of heat waves.

UFP Challenge:

To increase the ratio of trees per person across the City and provide an equal opportunity to be resilient to the mental pressures of urban living and the hazards of UHIE.

Existing Person to Tree Ratio



Source: ABS 2016

Adaptive Climate Management Practices

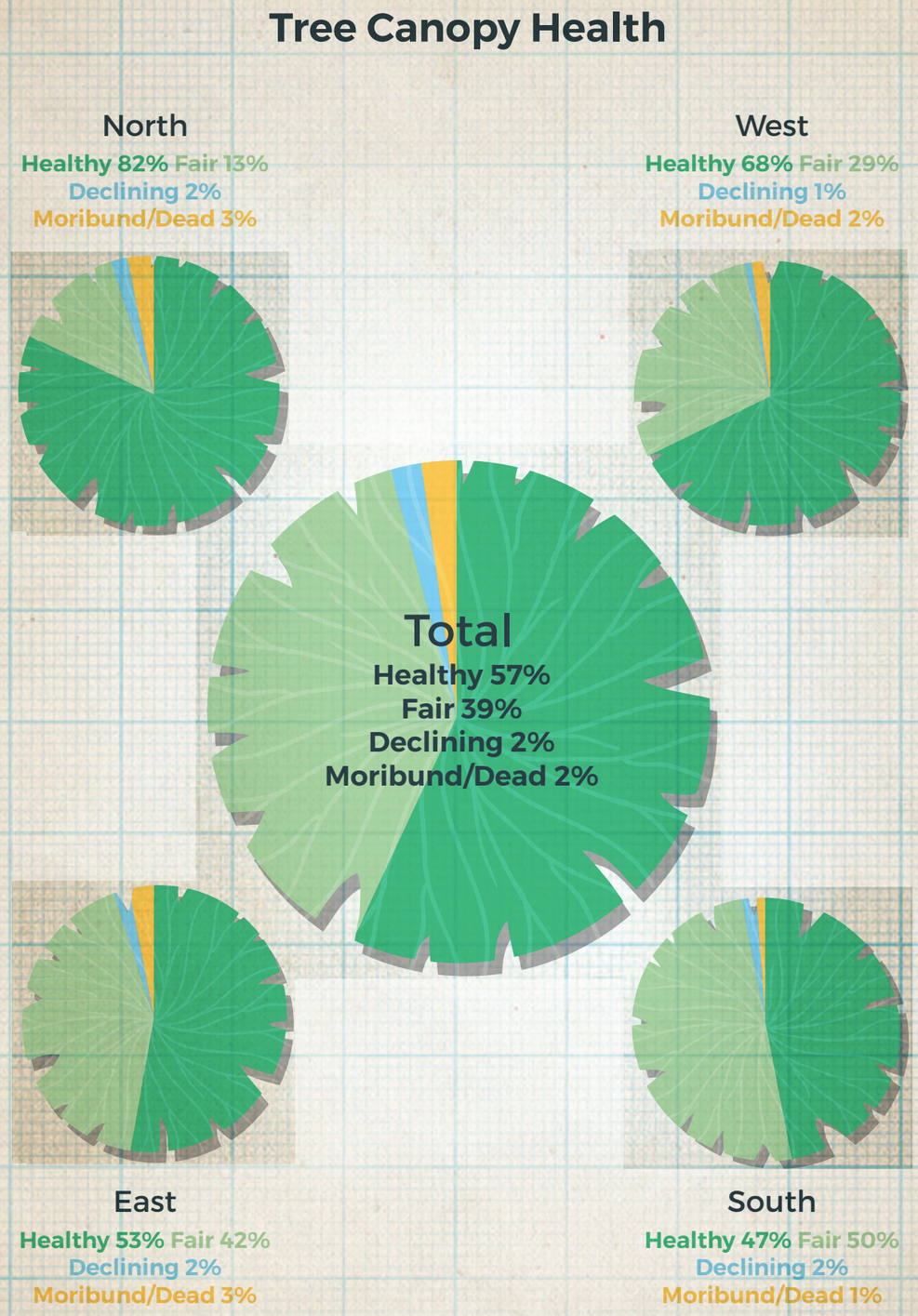
"Important ecological considerations for species selection are often narrowed down to a debate on whether or not native trees should be systematically preferred. Such framing diverts attention away from a balanced approach considering both ecological value and resilience."

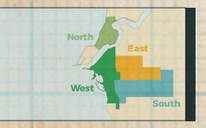
(Trees & Design Action Group, 2012)

There are benefits for both WA native and non-native tree species. WA native species provide opportunities for nature conservation through connectivity with remnant bushland areas as well as the provision of habitat for native fauna. WA native species will also require significantly less water requirements in the long term and will have better growth and form due to a preference for the lack of nutrients in the Fremantle soil profile.

On a number of projects the City has led with an instinctive preference for planting WA native trees, this will influence the overall resilience of the urban forest and result in a number of unmitigated risks. Increasing species diversity and a layer of complexity of species composition can allow for adaptive management in addressing the implications of climate change with respect to the UFP. Additionally, the application of WA native and non-native tree diversity can assist in mitigating disease spread and lessen the distribution of environmental pests.

Research suggests that large-canopied, broadleaf trees, with thick or denser foliage can be more effective in urban cooling. A recent study comparing the different cooling effects of three common street tree species in Australia (London Plane, European Elm and River Gum) indicates that the higher the canopy quality and density, the cooler the midday microclimatic conditions under that canopy in summer. Conditions were significantly hotter under the River Gum, due





City of Fremantle
Urban Forest Plan

Mature trees regulate water flow and improve water quality.

Benefits of Urban Trees, Food and Agriculture Organization of the United Nations

to its thin, open canopy architecture and more pendulous leaf structure, in comparison to the denser, rounder canopy architecture of the European Elm and London Plane trees. (Sanusi & Livesley, 2014) It should be noted that a number of exotic tree species also provide habitat and fauna foraging such as pine trees for the Carnaby's Cockatoo.

The City is fortunate to have a diverse mix of WA native and non-native species throughout private and public land holdings. The majority of new planting within the City has been WA native. Most of the existing trees are considered to be appropriate in terms of species for the location they have been planted. However there are a number of instances where scale, form and root growth have not been considered and resulted in maintenance issues, removal due to clashes with other essential services. The most common issues are:

- utility and services clashes
- pavement heave
- root control
- clashes of location with new construction works
- clashes with overhead power utilities.

This has led to a number of maintenance issues or in the worst case scenario removal of an otherwise healthy tree. An educational process for the public on verge and trees within their own land holdings will aid in the management of existing trees.

UFP Challenge:

Establish a process for city work to adapt to climate change by ensuring:

- tree species diversity
- appropriate selection species to suit the location
- structural health and risk assessments of mature tree specimens in public and private land holdings
- pest and disease management
- short and long term maintenance funding and education for City maintenance crews
- education of the public regarding the value of trees.

Water Availability

Vegetation plays a critical role in the natural water cycle, modifying rainfall inflows, soil infiltration and groundwater recharge. Urbanisation has seen the natural water cycle replaced by an artificial 'urban water cycle', with extensive impervious surfaces and highly efficient drainage systems, which dramatically increase the quantity, while reducing the quality, of urban storm water runoff. This negatively impacts on the natural aquatic ecosystems receiving this runoff and also removes a valuable water resource for the City.

There a number of best practice water management philosophies in urban environments. Green Infrastructure provides efficient and effective contributions, including alternatives, to conventional engineering infrastructure in the process of integrated water cycle management and Water Sensitive Urban Design (WSUD). (Green Infrastructure Evidence Base)

The City takes seriously its duty to manage irrigation water responsibly. It is important for the City to consider ways in which water for green spaces will be managed in light of reduced rainfall, finite groundwater resources, a drying climate, atmospheric moisture deficits and increasing water demand (GFS). In 2013, the City adopted the Water Conservation Strategy to manage the City's water resources, this included:

- Implementing staged water management actions for all City properties and recreation facilities.
- Set clear targets for reduced water usage and improved water health in accordance with the State Water Strategy (Water Forever).

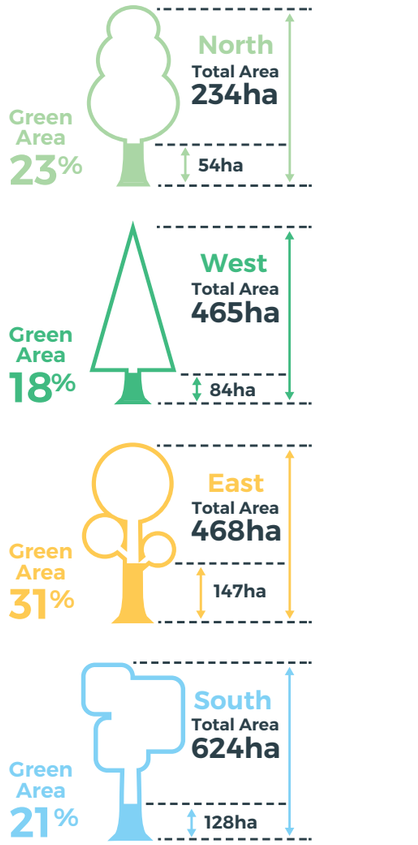
The Water Conservation Strategy also specifically detailed options to use water efficiently in the City's green spaces, these included:

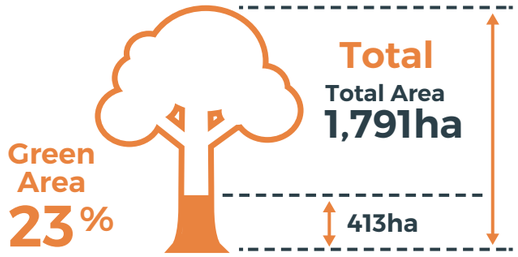
- Water requirement investigation for future urban trees, open space and vegetation.
- Opportunities for water re-use and savings.
- Water Sensitive Urban Design street planting infrastructure.
- Overview analysis of water use and water cycles.

UFP Challenge:

To ensure adequate water availability to irrigate new tree plantings and the high proportion of young trees recently planted by the City.

Green Areas





Green Areas includes canopy cover of 3m+, native bushland and City of Fremantle parks & recreational areas.

The Current City Forest

In the preparation of the UFP, the City performed a baseline analysis and assessment of the City's biophysical and social structure to inform the recommendations and priorities within the City.

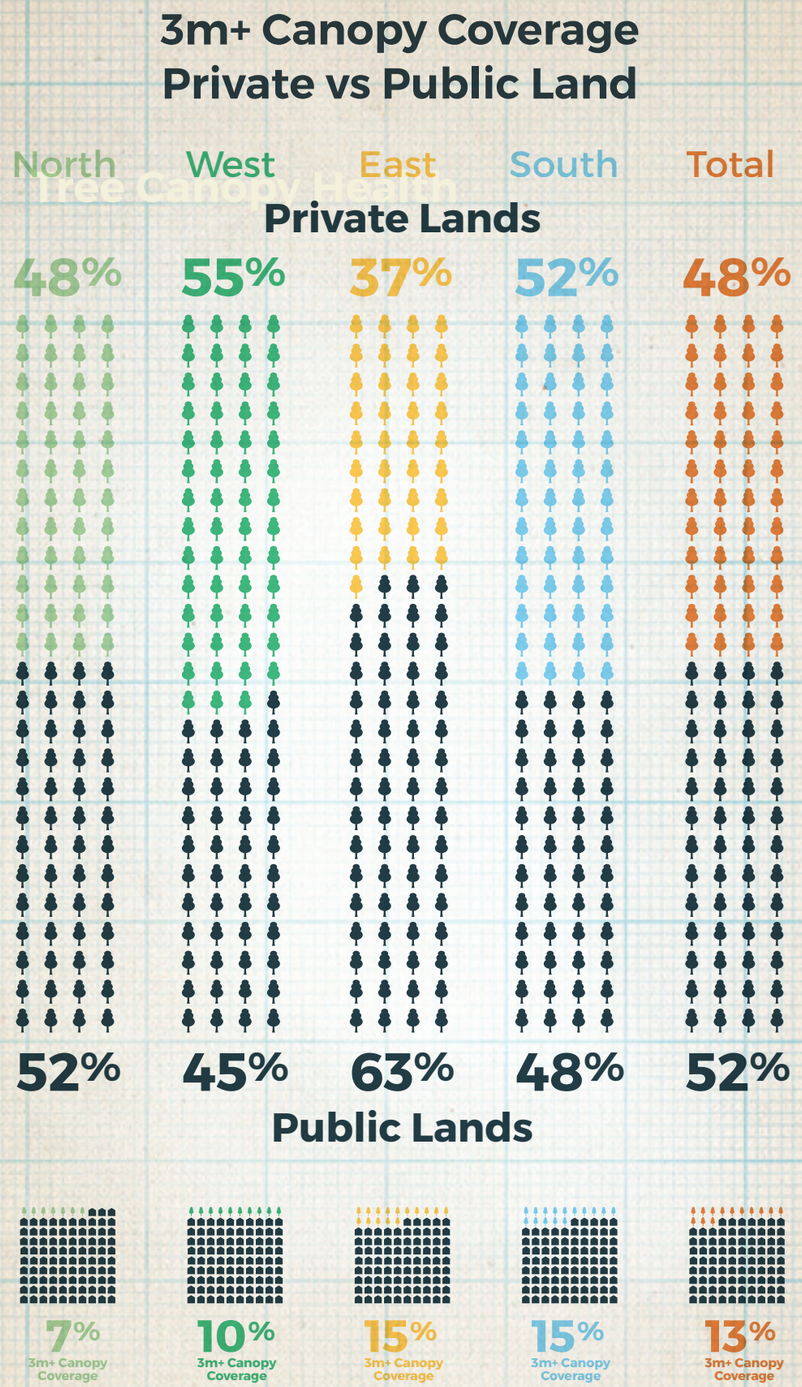
Statistics - City of Fremantle

- 13% Canopy Coverage
- 23% Green Area
- 13,629 trees
- 14.28 people / Ha

The infographics throughout the report, detail the statistical analysis of the most recent baseline data for each Area as well as City averages for comparison. In addition to the physical baseline data, recent available thermal imaging has been assessed in comparison with socio-economic data. This assessment has highlighted a number of key areas that should be targeted as priority areas for tree planting to reduce UHIE and heat related death risk. Refer page 6 for thermal imaging.

Each of the Areas has been analysed reviewing:

- Biophysical including soil type, topography and local climatic aspects
- Cultural Demographics
- Heritage
- Population Density
- Planning and Infrastructure
- Landscape Character Profile
- Priority Areas.



Public Lands includes parks, reserves and open space available to the public including Clontarf Hill, Fremantle Oval, both public and private golf courses, Fremantle Hospital, Fremantle Prison, museums and spaces along Fishing Boat Harbour.

Private lands is the remainder after subtracting public areas from the total city area and also includes Fremantle Harbour land area.

City of Fremantle
Urban Forest Plan

Source: City of Fremantle 2015

Area 1: North

Key Statistics - City of Fremantle

- 7% canopy coverage
- 11.65 people per hectare
- 23% green area
- 1,024 trees

Biophysical

- Majority of the existing tree planting is on the eastern portion of the Area and has been classified as young to semi mature and in a healthy to fair condition.
- 85% of the 1,024 trees in the northern Area are over 15m in height.
- Large proportion of the Area has a sand soil type.
- Some Reclaimed / disturbed land closer to the port environs and limestone to the north eastern corner.
- Limestone ridge to the north eastern corner with a dominant elevation of below 5.3m Above Mean Sea Level (AMSL).
- Maximum recorded temperature in January 2015 was approximately 2.4˚C warmer than the average.
- High saline content in ground water.

Cultural

- Approximately 75% of the population are between 25-60yrs with an increasing trend of retirees moving into the area.
- Majority of the population identify their heritage as Australian / English.
- The eastern corner of the Area is the most populated and the western side is the least due to land use and infrastructure.

Planning and Infrastructure

- Majority of the Area is zoned R25 with small pockets of R35, R40 and R60.
- Three main Development sites including Leighton Marshalling Yards, McCabe Street and Stirling Highway and one small site at the Rose Hotel.
- High bushfire prone sites on both the eastern and western edges of the Area.
- Large portions of land on the foreshore and river fringe have been classified as sites for Priority Conservation Action and some sites classified as having native vegetation.
- Proportionally the Area has a lot of City owned and managed parks.
- This Area has one primary school – North Fremantle PS and many commercial businesses, with only a small portion of residential dwellings.
- Majority of the overhead power network (28% coverage) is in the residential landzone on the eastern and southern fringe edge adjacent the river.
- This area has the highest ranking in terms of economic capital per Area Ha of the four Areas
- Majority of the City Green Links have fragmented to nil canopy cover.

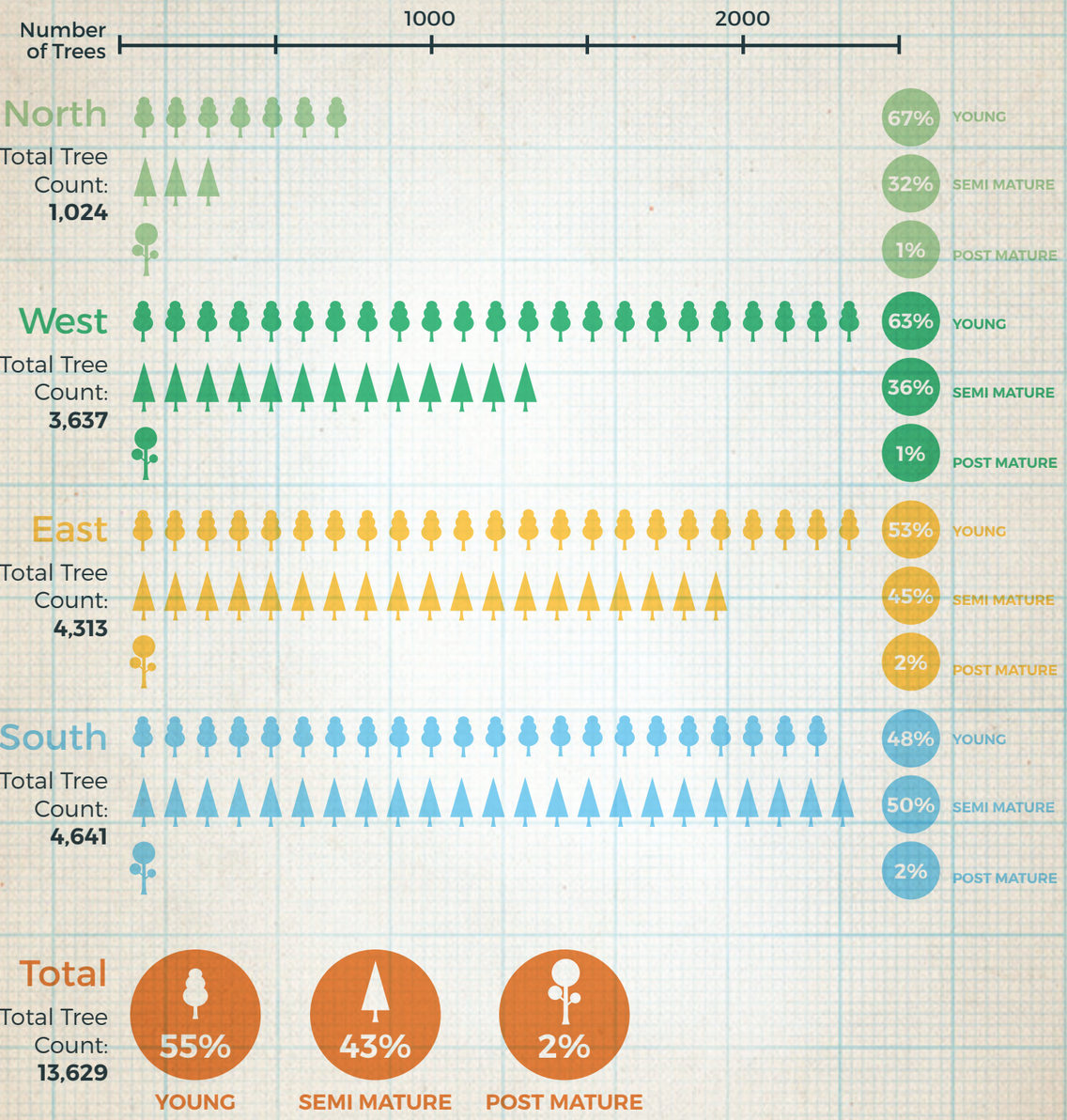
Landscape Character Profile

- Industrial port landscape.
- Between coast and river.
- Mix of residential / commercial and mixture of private and government owned land.
- Generally flat with high point to east adjacent river.
- Heavily dissected by infrastructure (train / roads / port).

Area 1 Priorities

- Δ Fragmented to nil canopy cover along identified City Green Links.
- Δ Western edge and Southern portion of Area in mostly in government owned land.
- Δ Port interface is harsh and has high percentages of hard surfaces.
- Δ Major infrastructure alignments lack mature vegetation.

Combined Number of Trees and Age

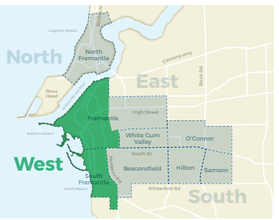


Young = Newly planted.
Semi Mature = Nearly at mature growth.
Post Mature = Aging / or potentially in decline.

City of Fremantle
Urban Forest Plan

Source: City of Fremantle 2008

Area 2: West



Key Statistics - City of Fremantle

- 10% canopy coverage
- 12.36 people per hectare
- 18% green area
- 3,637 trees

Biophysical

- Majority of the existing tree planting is in the southern portion of the Area and has been classified as young to semi mature and in a healthy to fair condition. The northern section of the Area has a higher percentage of semi mature trees and less in number but in a similar condition healthy to fair.
- 78% of the 3,637 trees in the western Area are over 15m in height.
- Approximately 50% of the Area has a sand soil type, and the remainder is a mix of disturbed to the northern river boundary, chalky sand to the southwestern fringe and limestone ridge to the eastern boundary.
- There is a distinct limestone ridge to the north eastern corner and a small limestone outcrop to the western point.
- Elevation is predominately below 5.3m AMSL with the western boundary reaching over 47.8m at a peak high point.
- Maximum recorded temperature in January 2015 was approximately 2.2˚C warmer than the average and had the lowest minimum of over 6˚C cooler.
- The City has undertaken a number of bulk tree planting activities in this Area.

Cultural

- South Fremantle has a high percentage of families with young children.
- The residential area of Fremantle in this precinct also has a high percentage of families with young children as well as a higher percentage of retirees.
- Majority of the population identify their heritage as Australian / English and in Fremantle there is a high percentage of Irish, Scottish and Italian.
- This Area has many educational facilities, hospital grounds and a number of friends groups for specific open space locations.
- This Area has the highest density of population across the four Areas.

Planning and Infrastructure

- This Area has the highest land development densities and also encompasses the Fremantle City centre the remainder of the Area is predominantly R25-R35 with small pockets of R40.
- There are a number of large open green spaces in the north and along the western coast of the area and many small pocket parks in the middle and south of the Area.
- There are a number of small areas within City parks that have been classified for Priority Conservation Action and sites classified as having native vegetation.
- Four main Development sites including a Department of Housing site, City of Fremantle site and two significant private developments.
- Most land holdings in this precinct are privately owned.
- This Area has the second highest ranking in terms of economic capital per Area Ha of the four Area.
- Majority of the overhead power network is located within the residential land type of the Area in the middle and southern sections approximately 31% coverage.
- Majority of the City Green Links have fragmented to nil canopy cover.

Landscape Character Profile

- Urban / City centre.
- Harbour and Esplanade parkland, beach front.
- Mixture of commercial and residential.
- Dense residential with narrow streets and laneways.

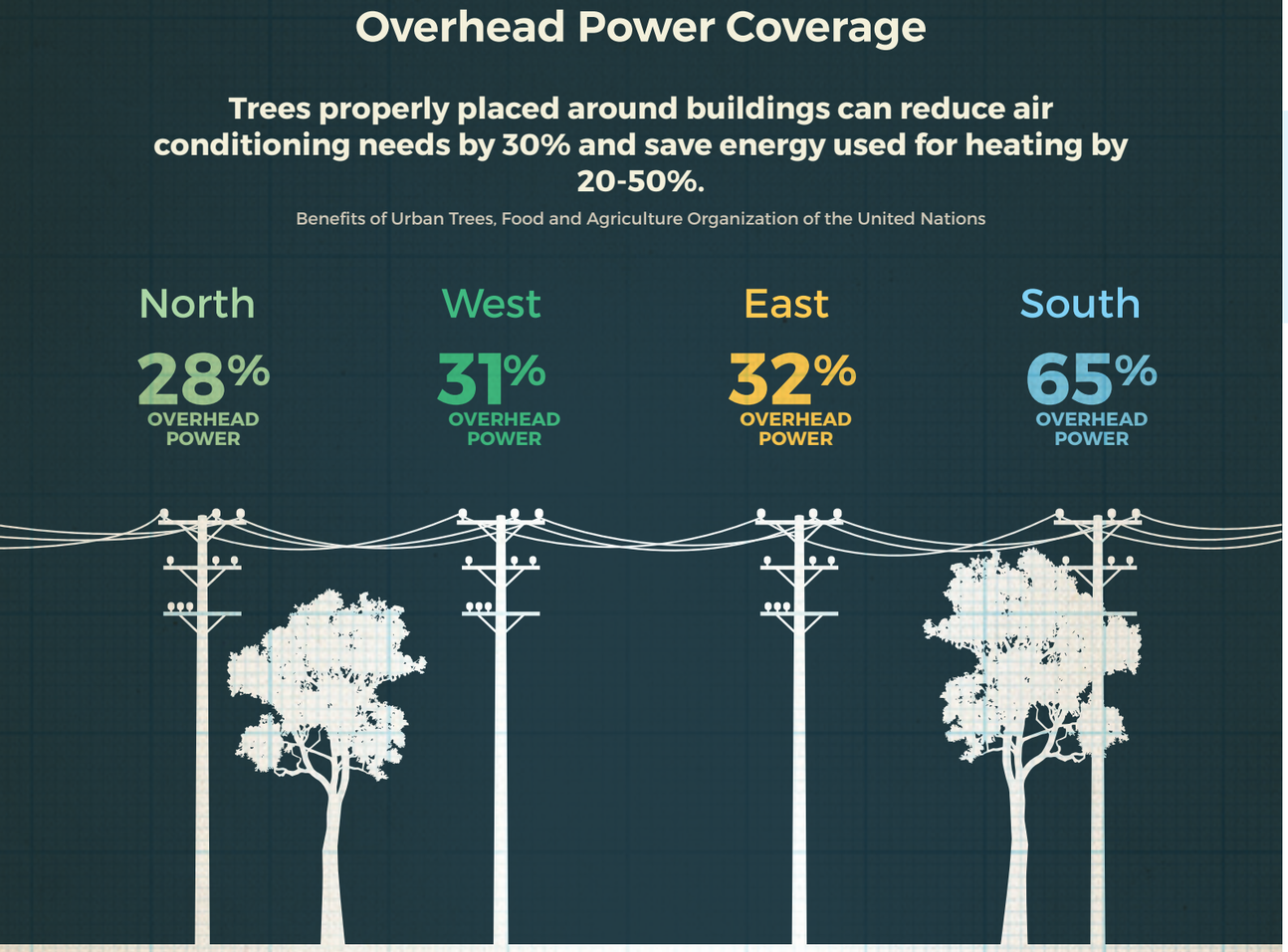
Area 2 Priorities

- Δ Fragmented to nil canopy cover along identified City Green Links
- Δ The northern section of the Area adjacent the river where there are large expanses of hard surfaces.
- Δ Southern fringe in new development sites.

Overhead Power Coverage

Trees properly placed around buildings can reduce air conditioning needs by 30% and save energy used for heating by 20-50%.

Benefits of Urban Trees, Food and Agriculture Organization of the United Nations



North	West	East	South
Precinct Total Area 234ha	Precinct Total Area 465ha	Precinct Total Area 468ha	Precinct Total Area 624ha

39% OVERHEAD POWER

Total Area 1791ha

Of the city's total land area – 39% has overhead power – a significant factor in programming where trees are planted and future underground power projects.

City Average Totals

City of Fremantle
Urban Forest Plan

Source: City of Fremantle 2015

Area 3: East

Key Statistics - City of Fremantle

- 15% canopy coverage
- 21.30 people per hectare
- 31% green area
- 4,313 trees

Biophysical

- Majority of the existing tree planting is located in residential zoning with only a small percentage in the industrial. The majority of the trees have been classified as young to semi mature and in a healthy to fair condition. The southern section of the precinct has a higher percentage of semi mature and post mature trees.
- 64% of the 4,313 trees in the Eastern Area are over 15m in height.
- Approximately 50% of the western side of the Area has a limestone soil and the eastern side has a sand soil type.
- A dominant limestone ridge extends towards the east into O'Connor; connecting a number of high points in the landscape.
- The Area contains a number of small areas classified as contaminated sites, with the majority associated with the Swanbourne Street Development site.
- Elevation ranges from 11.5-31m AMSL except for limestone ridges which elevate to over 47.8m.
- Maximum recorded temperature in January 2015 was approximately 4.3˚C warmer than the average.
- The City has undertaken a number of bulk tree planting activates in this Area associated with Green Areas.

Cultural

- The area of Fremantle in this Area and White Gum valley has a high percentage of families with young children.
- Majority of the population identify their heritage as Australian / English and in White Gum Valley there is a high percentage of Italian.
- This Area has two educational facilities and one friends group for Booyeembara Park.
- The majority of the population is clustered on the western side of the Area and the least on the east due to the industrial land use.

Planning and Infrastructure

- The Area has a diverse mix of zoning densities primarily consisting of R25-R30. There is also a large portion which is industrial in the east.
- Three main Development Areas include Knutsford Street East, Swanbourne Street and the LandCorp White Gum Valley Site.
- The majority of the landownership is private with a number of small pockets of government, WAPC and City ownership.
- This Area has the largest Green Area, comprised of Booyeembara Park; the Fremantle Public Golf Course and Royal Fremantle Golf Course.
- The largest Green Area has been classified as areas for Priority Conservation Action and one small area classified as having native vegetation and high bushfire prone on the western boundary in Development Area 4 – Swanbourne Street.
- There are a number of small areas within City parks that have been classified for Priority Conservation Action and sites classified as having native vegetation.
- Majority of the overhead power network is located within the residential areas of the Area in the middle and southern sections.
- This Area is ranked fourth in terms of economic capital per Area Ha of the four Areas.
- Majority of the City Green Links other than the ones adjacent to Green Areas such as Booyeembara Park and the Golf Course have fragmented to nil canopy cover.

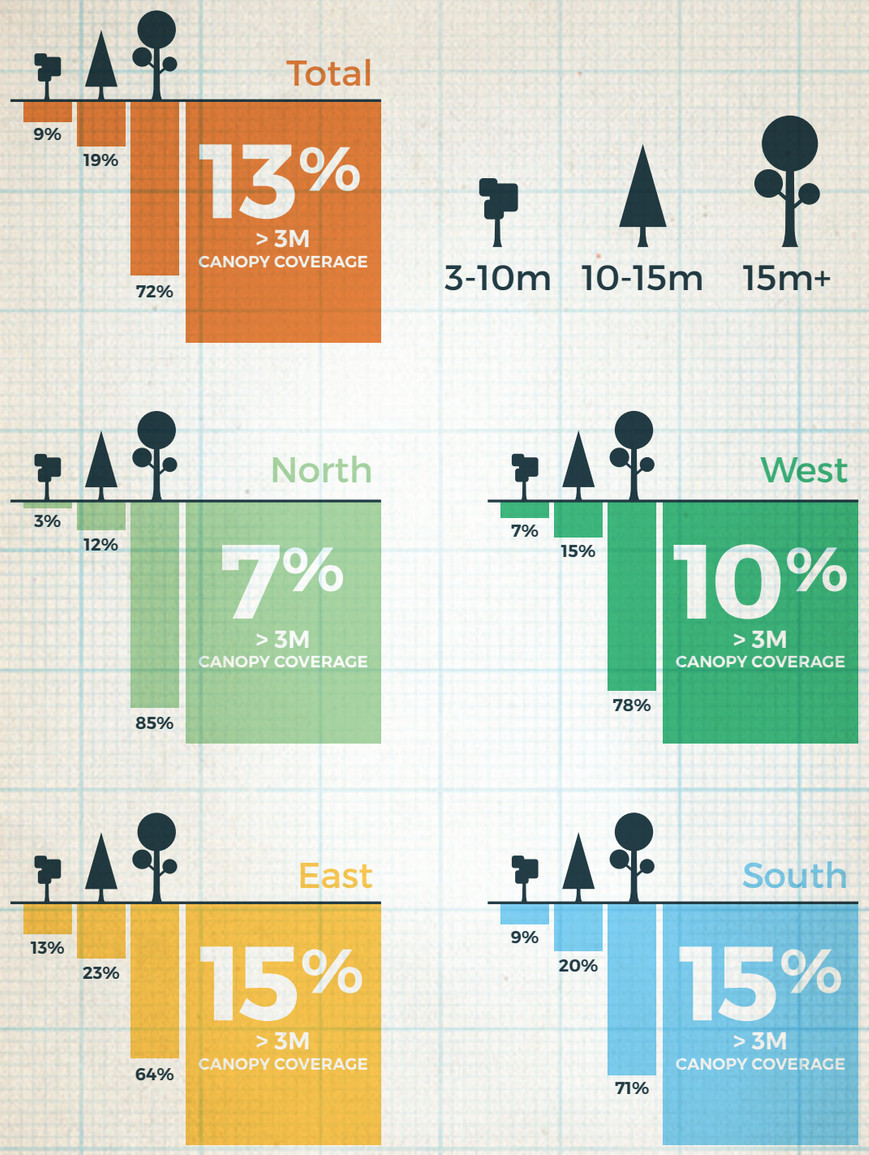
Landscape Character Profile

- Residential with wide verges and well treed landscape.
- Dominated by parklands and open spaces.
- Industrial landscape with minimal to no tree cover to the eastern boundary.
- Major infrastructure corridors.

Area 3 Priorities

- Δ Fragmented to nil canopy cover along identified City Green Links.
- Δ Industrial zoned areas.
- Δ New development sites.

Canopy Heights (3m+) & Canopy Coverage



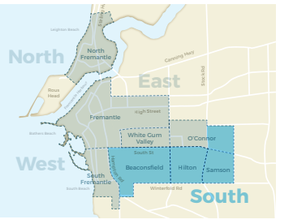
Large urban trees are excellent filters for urban pollutants and fine particulates.

Benefits of Urban Trees, Food and Agriculture Organization of the United Nations

City of Fremantle
Urban Forest Plan

Source: Arbor Carbon 2015

Area 4: South



Key Statistics - City of Fremantle

- 15% canopy coverage
- 13.04 people per hectare
- 21% green area
- 4,641 trees

Biophysical

- Majority of the existing tree planting is located in the residential areas. The majority of the trees have been classified as young to semi mature and have been classified as fair condition. Beaconsfield and Hilton both have a higher percentage of semi mature and post mature trees and a much higher percentage of fair condition than healthy.
- 71% of the 4,641 trees in the southern Area are over 15m in height.
- Approximately 80% of the western side of the Area has a sand soil type and the western fringe has a limestone outcrop.
- Elevation is predominantly above 30m AMSL with a number of areas over 47.8m with some minor valleys to the western edge down to 5.4m AMSL.
- The Area contains two areas classified as contaminated sites, both adjacent to the Lefroy Road Quarry Development Area.
- Maximum recorded temperature in January 2015 was approximately 3.8˚C warmer than the average.
- The City has undertaken a number of bulk tree planting activities in this precinct associated with Green Areas.

Cultural

- Beaconsfield, Hilton, Samson have a high percentage of families and young people up to 34.
- Majority of the population identify their heritage as Australian / English however Beaconsfield has the highest percentage of Italian ancestry.
- The eastern and south western corners are the least populated areas and the western side has similar population densities to Area Two.
- This Area has a number of educational facilities and two friends groups for Samson Park and Clontarf Hill.

Planning and Infrastructure

- This Area has a diverse mix of zoning with higher densities R25-R30 to the west and R15 in the east.
- Two main Development areas including Lefroy Road Quarry and Clontarf Hill.
- The majority of the landownership is private with a many small blocks of government, WAPC and City ownership.
- High bushfire prone areas on both the south eastern and south western fringes of the Area associated with Stock Road and Green Areas.
- This Area has two large Green Areas, comprised of Samson Park and Hilton Park. In addition to this space there are also a number of other small Green Areas creating 21% total Green Area.
- Samson Park, Stock Road and Clontarf Hill have been classified as having native vegetation and both Samson Park and Clontarf Hill have been classified as areas for Priority Conservation Action.
- This Area is ranked third in terms of economic capital per precinct Ha of the four precincts.
- Majority of the City Green Links other than the ones adjacent to Green Areas have fragmented to nil canopy cover.
- Majority of the overhead power network is located within the residential areas of the Area in the middle and southern sections; approximately 65% coverage which is the highest ratio of all the precincts.

Landscape Character Profile

- Residential with wide verges and a mixture of densities of tree cover.
- Industrial landscape with minimal to no tree cover to the southwestern boundary.
- Major infrastructure corridors.

Area 3 Priorities

- Δ Fragmented to nil canopy cover along identified City Green Links.
- Δ Residential Areas in Hilton, Samson and Beaconsfield.
- Δ New development areas.
- Δ Industrial zoned areas.

PART C
Communication

Focus and Consultation Objectives

To ensure community and key stakeholders are informed about collaboration opportunities and implemetnation of the UFP, the Project Team prepared a Communication Plan to complement the UFP. It identifies key stakeholders and communication tools to be used and to develop communications deliverables.

- To pro-actively and effectively deliver informative communications around the UFP at key preparation milestones to ensure community and key stakeholders are fully informed.
- To ensure through project communications there is awareness established around the broader plans, procedure and initiatives related the Greening Fremantle Strategy.
- To ensure there is opportunity built into the approach to enhance the level of information required by community should the level of interest demand it.

Whilst the communication approach is centred on Informing, should the community express a high level of interest in the project, then the City of Fremantle may consider running more specialised and targeted community engagement.

Target Audience

By identifying the key stakeholders with an interest or impact in the Urban Forest Plan the appropriate methods are employed to meet the communication needs of different individuals and groups.

There are two distinct target audience types that are identified for this project:

Key Decision makers

- Elected members
- Executive Leadership Team
- City staff
- Potential implementation partners
- Approval & servicing authorities
- Adjacent LGA's

Community Groups

- Precinct groups
- Friends of' groups
- Community garden groups
- Traditional Owners
- Property owners/residents

Communication Channels

The following is a list of the different channels and approaches used to communicate the project to key stakeholder and the broader community.

Councilor updates

Key members of the City's staff to provide information at key milestones in project programs.

Frequently Asked Questions

Frequently Asked Questions (FAQs) be developed specifically for this project, to address anticipated questions related to the preparation of the Urban Forest Plan.

Media/advertising

Preparation of a project announcement to community and stakeholders on website, social media and direct communication (identified community interested). Media release on completion and approval of the UFP.

Communication Materials

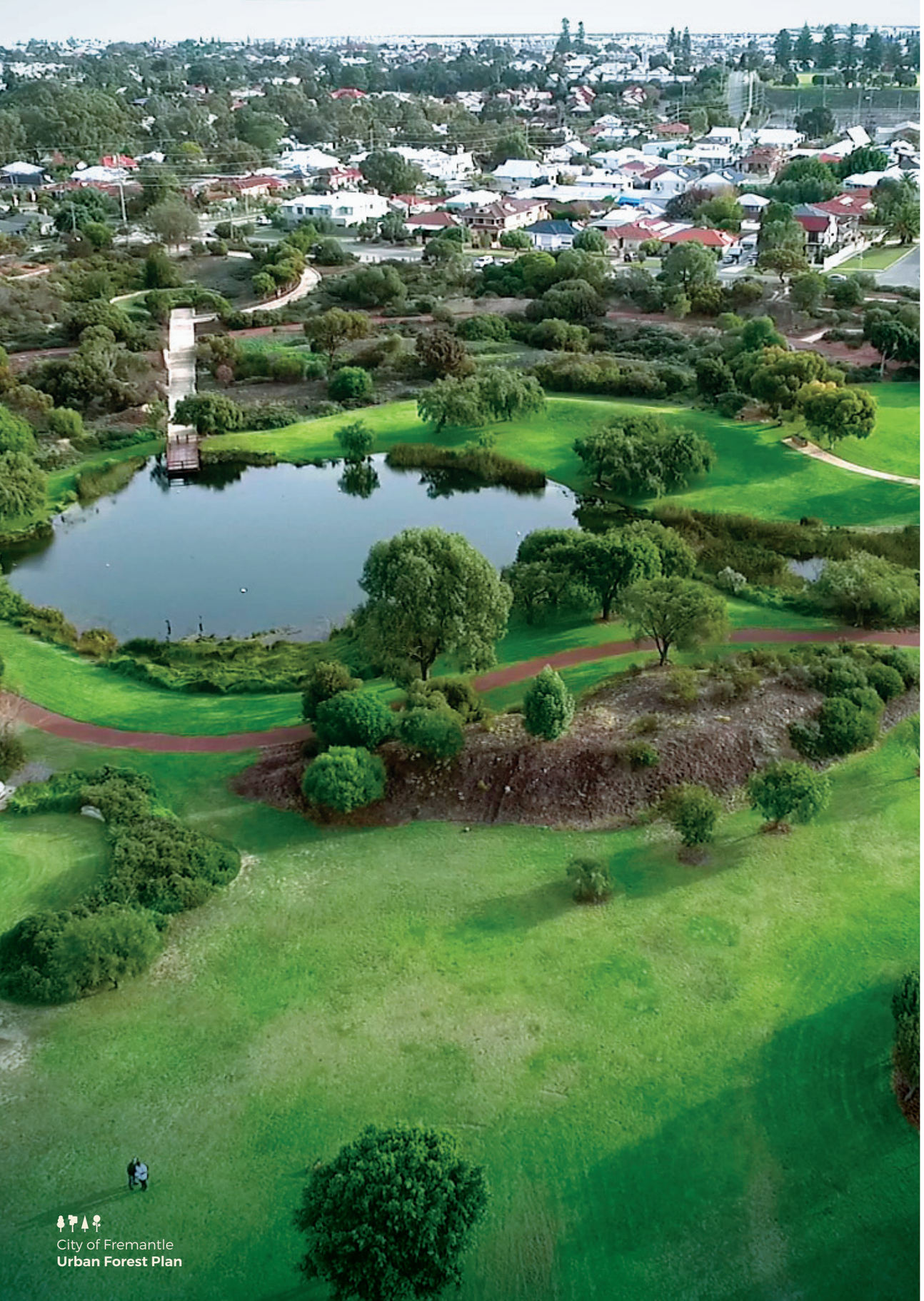
Direct communication via correspondence with key stakeholders will ensure key agencies; community groups and known interested people are informed about the preparation of the Urban Forest Plan. Dissemination of this information be at key milestones in the project based on the relevance of the information. The use of info graphics to assist with project understanding is recommended.

Online Project Information

Online information about UFP programs will be provided (via My Say Freo), to ensure a broad cross section of the community are well informed.

Direct Enquiries

To ensure general questions can be asked a project email is established to coordinate queries and ensure there is a consistent approach to responses.



PART D

Urban Forest Action Plan

Action Plan

The baseline assessment and analysis led to the development of the following five key goals and subsequent actions required to achieve the UFP Vision.

Vision

To protect the existing green spaces and trees and progressively grow and diversify the City's tree population for adaptive climate management and amenity; to collaborate effectively to plant, plan, design and sustainably fund programs to create a resilient urban forest.

Goals

#1 – Engage

Engage residents, businesses, community groups and government agencies in educating and facilitating ownership of the urban forest.

#2 – Protect

Protect the existing and future urban forest from economic and environmental threats.

#3 – Grow

Grow the urban forest towards the target of 10,000 new trees in 10 years and increase the ratio of trees per person across the City to ensure equal opportunities to maximise the social, economic and environmental benefits of trees and urban greening.

#4 – Diversify

Diversify and promote resilience in urban greening and the urban forest.

#5 – Manage

Manage urban greening through the development of a coordinated and comprehensive adaptive climate management and funding strategy to ensure the long term health and sustainability of the City urban forest.

Targets

AREAS	CURRENT STATISTICS						TARGET		
	Population	Area (Ha)	# Trees	Green Area (Ha)	People / Tree Ratio	Canopy Cover	# Trees by 2027	People / Tree Ratio	Canopy Cover
Area 1: North	3,312	234	1,024	54	3.2 / tree	7%	**3,024**	**1.1 / tree**	**14%**
Area 2: West	7,931	465	3,637	84	2.2 / tree	10%	**6,387**	**1.2 / tree**	**18%**
Area 3: East	9,263	468	4,313	147	2.1 / tree	15%	**6,063**	**1.5 / tree**	**21%**
Area 4: South	8,400	624	4,641	128	1.8 / tree	15%	**8,141**	**1.0 / tree**	**26%**
TOTALS	**28,906**	**1,791**	**13,615**	**413**	**2.1 / tree**	**13%**	**23,615**	**1.2 / tree**	**20%**

Goal #1 – Engage

Engage residents, businesses, community groups and government agencies in educating and facilitating ownership of the urban forest.

- Promotion, support and facilitation of education on the benefits of urban greening.
- Encourage participation in local, Area and City wide activities.
- Encourage innovation and versatility in greening the City.

Goal #2 – Protect

Protect the existing and future urban forest from economic and environmental threats.

- Protect existing trees within public realm through increased awareness and conduct a value assessment of their worth to deter removal and encourage creative design solutions for retention.
- Policy and motivation for tree retention on privately owned lots.
- Policy of development areas to consider solar access, prevailing winds, over shadowing and utilisation of other natural systems to reduce the long term requirements for mechanical heating and cooling systems.
- Application of Green Star ratings for all private and government Development Areas to improve built form environmental efficiencies improving the health and well-being of the City.

Goal #3 – Grow

Grow the urban forest towards the target of 10,000 new trees in 10 years and increase the ratio of trees per person across the City to ensure equal opportunities to maximise the social, economic and environmental benefits of trees and urban greening.

- Undertake equitable distribution of new streetscape greening to priority residential, industrial and commercial Areas.
- Undertake infill planting to strengthen City Green Links and provide links to green spaces enhancing connectivity between Green Areas and Areas.

Goal #4 – Diversify

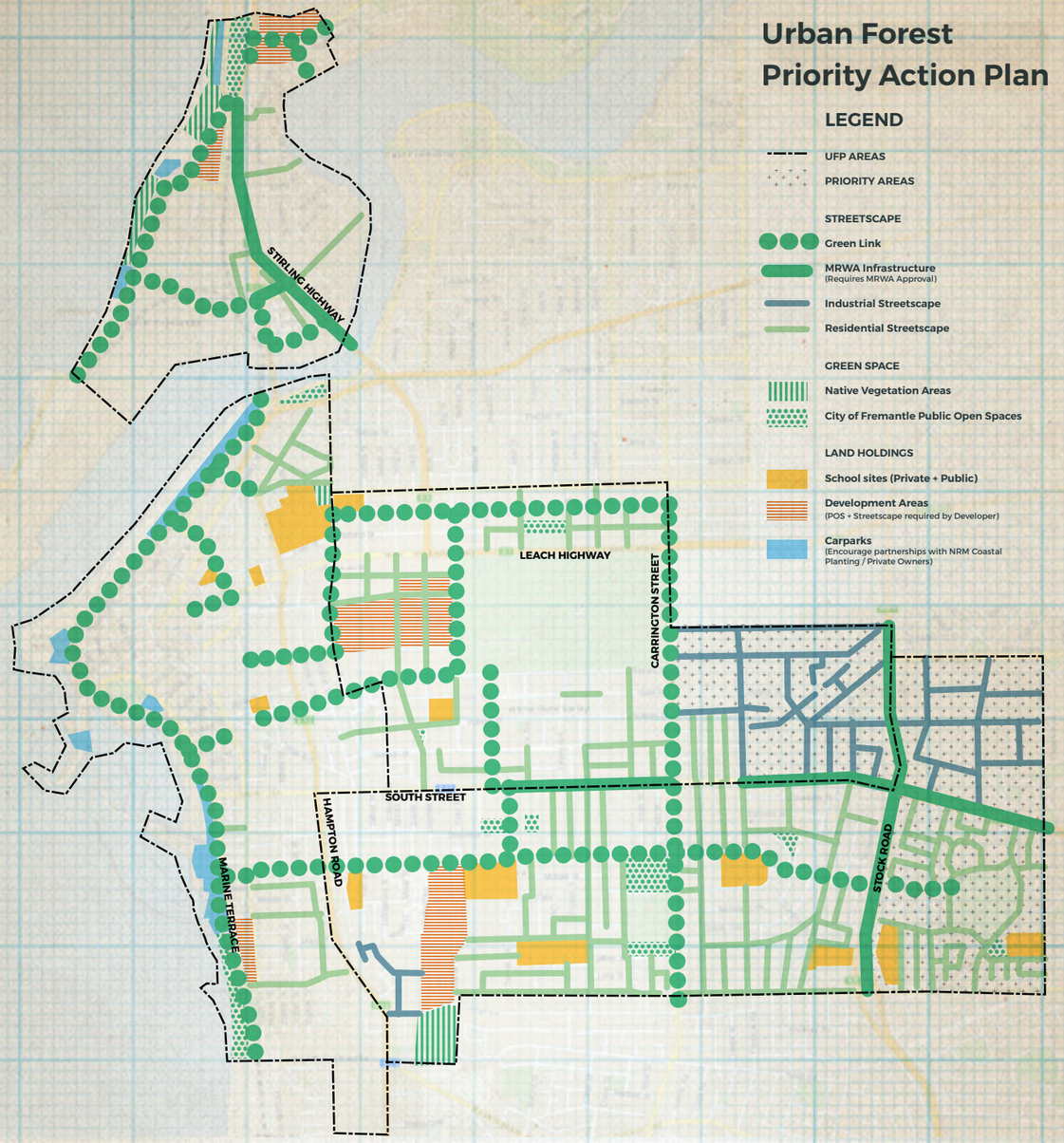
Diversify and promote resilience in urban greening and the urban forest.

- Encourage and regulate tree species diversity to meet environmental and social resilience in an urban environment.
- Encourage creative urban greening solutions to contribute to the urban forest target in complex urban environments including green roofs and green walls in new urban developments and maximise opportunities to retrofit into existing sites.
- Regulate appropriate selection of species to suit the location and context.

Goal #5 – Manage

Manage urban greening through the development of a coordinated and comprehensive adaptive climate management and funding to ensure the long term health and sustainability of the City urban forest.

- Prepare a dynamic urban forest register connected to the City's Intramaps and encourage community input to update tree information within private land holdings to collate and assess data of the urban forest.
- Undertake structural health and risk assessments of mature tree specimens in the public realm. Encourage assessments within private landholdings as a planning development requirement.
- Develop and educate the community on strategies to manage pest and disease impacts on trees within their Areas.
- Ensure adequate water availability to irrigate new tree plantings and the high proportion of young trees.
- Secure funding each financial budget to facilitate tree planting, establishment, maintenance and monitoring in public and City landholdings.
- Seek private funding/partnerships from major stakeholders and other sources to facilitate the growth and management of the urban forest.



Priority Implementation

The UFP provides a guide for the City for the implementation of Goals #1 - Engage, #3 - Grow and #4 - Diversify.

Goal #1 - Engage will be required to occur across all of the phases of planning, implementation and management.

The implementation of Goal #3 - Grow is described and detailed for each Precinct over the next couple of pages. Following the outline of how the City will go about growing the urban forest, a detailed schedule of how to achieve Goal #4 - Diversify is outlined on page 37. This table details proposed species, appropriate locations and other relevant information for each Area.

To implement Goal #2- Protect and Goal #5 - Manage; the City will need to make policy changes to embrace the required strategies to ensure the long term health and sustainability of the City urban forest.

The implementation of the UFP is intended to be dynamic and will take into account other City projects such as road and path upgrades, natural resource management and public space development.

City Targets

CITY TARGETS	YEAR 1	2	3	4	5	6	7	8	9	10	TOTAL TREES OVER 10 YEARS
TREE POPULATION	13,615	14,515	15,265	15,765	16,515	17,265	18,765	19,915	21,315	22,465	
NEW TREES REQUIRED	900	750	500	750	750	1,500	1,150	1,400	1,150	1,150	**10,000**
REPLACEMENT TREES REQUIRED*	272	290	305	315	330	345	375	398	426	449	**3,508**
TOTAL TREES REQUIRED PER YEAR	1,172	1,040	805	1,065	1,080	1,845	1,525	1798	1,576	1,599	**13,508**
TOTAL TREES IN THE URBAN FOREST	**14,515**	**15,265**	**15,765**	**16,515**	**17,265**	**18,765**	**19,915**	**21,315**	**22,465**	**23,615**	

* Assumes an annual 2% mortality / removed tree rate.

Approach to new and replacement tree planting distribution in City owned tenure

The distribution of new tree planting has been undertaken in application of the following key criteria and mapped on page 30.

- Residential areas that are mapped as above the baseline temperature average (based on thermal imaging) to ensure equitable distribution of green infrastructure.
- Linking green spaces through infill planting of City nominated Green Links to provide improve the green infrastructure network across the four Areas.
- Identification of expansive hard stand areas with the capacity to provide canopy cover and urban greening.
- Identification of additional major streetscapes/ infrastructure areas with the capacity to provide canopy cover and urban greening.
- Green spaces that require infill planting or replacement planting to maintain healthy active communities.
- Native vegetation areas identified as Priority Conservation Action Areas that require infill planting.
- Linking road, path and underground power works programs.
- Annual tree planting program.

Approach to New and Replacement tree planting distribution in non-City owned tenure

There are a number of landholdings which are not City owned that have the potential to have a substantial influence on meeting the targets and Goals of the UFP. The following should be considered for all development areas which are still subject to review / approval by the City or where possible if past this point in the approvals process open discussions with land holders to encourage urban greening:

- Ensure protection of existing trees within new development.
- Maximise opportunities to increase tree densities and area of green space where appropriate.
- Encourage and support applications for roof gardens and vertical gardens.
- Maximise WSUD principles to maximise runoff catchment in high density areas.

Area 1: North

Priorities

- Fragmented to nil canopy cover along identified City Green Links.
- Western edge and Southern portion of precinct in mostly in government owned land.
- Port interface is harsh and has high percentage of pavement areas.
- Major infrastructure alignments lack mature vegetation.

Targets

AREA 1	YEAR										TOTAL TREES OVER 10 YEARS
	1	2	3	4	5	6	7	8	9	10	
TREE POPULATION	1,024	1,024	1,024	1,024	1,274	1,524	1,774	2,024	2,524	2,774	
NEW TREES REQUIRED	0	0	0	250	250	250	250	500	250	250	**2,000**
REPLACEMENT TREES REQUIRED*	20	20	20	20	25	30	35	40	50	55	**1,206**
TOTAL TREES PER YEAR	20	20	20	270	275	280	285	540	300	305	**3,206**
TOTAL TREES IN URBAN FOREST	**1,024**	**1,024**	**1,024**	**1,274**	**1,524**	**1,774**	**2,024**	**2,524**	**2,774**	**3,024**	

* Assumes an annual 2% mortality / removed tree rate.

Implementation Approach

YR	1	2	3	4	5	6	7	8	9	10
N	0	0	0	250	250	250	250	500	250	250
Priority	· N/A	· N/A	· N/A	· Industrial streetscapes · Industrial streetscapes · Native Vegetation areas	· Green link (Curtin Ave)	· Green link (McCabe Street) · Stirling Highway verge / median planting	· Residential streetscapes · Green link (Tydeman Road)	· Green link (Tydeman Road) · Stirling Highway verge / median planting · Green Spaces	· Green Spaces · Foreshore carparks	· Green Spaces · Foreshore carparks
R	20	20	20	20	25	30	35	40	50	55
Priority	· Green links	· Green links	· Green links	· Green links	· Residential streetscapes · Green Spaces	· Foreshore carparks	· Foreshore carparks	· As required across Area	· As required across Area	· As required across Area

N - New tree plantings.
R - Replacement tree installations.

Note:

- MRWA approval required to Stirling Highway verge/median proposed works.
- Future road planning requirements to proposed Green Link "Curtin Ave" and Green Link "Tydeman Road"

Area 2: West

Priorities

- Fragmented to nil canopy cover along identified CoF Green Links
- The northern section of the precinct adjacent the river where there are large areas of hard surfaces.
- Southern fringe in new development areas.

Targets

AREA 2	YEAR										TOTAL TREES OVER 10 YEARS
	1	2	3	4	5	6	7	8	9	10	
TREE POPULATION	3,637	3,637	3,637	3,637	3,637	3,637	4,237	4,837	5,387	5,887	
NEW TREES REQUIRED	0	0	0	0	0	600	600	550	500	500	**2,750**
REPLACEMENT TREES REQUIRED*	73	73	73	73	73	73	85	97	108	118	**843**
TOTAL TREES PER YEAR	73	73	73	73	73	673	685	647	608	618	**3,593**
TOTAL TREES IN URBAN FOREST	**3,637**	**3,637**	**3,637**	**3,637**	**3,637**	**4,237**	**4,837**	**5,387**	**5,887**	**6,387**	

* Assumes an annual 2% mortality / removed tree rate.

Implementation Approach

YR	1	2	3	4	5	6	7	8	9	10
N	0	0	0	0	0	600	600	550	500	500
Priority	· N/A	· N/A	· N/A	· N/A	· N/A	· Green links (from East Fremantle to Fremantle City Centre)	· Residential streetscapes (South Fremantle) · Green links (Fremantle City Centre to Lefory Road)	· Harbour edge carparks and industrial areas · Green Spaces (South Fremantle)	· Green link (Lefory Road to southern boundary) · Residential streetscapes (Fremantle)	· Foreshore edge, carparks and industrial areas to South Fremantle · Residential streetscapes (White Gum Valley)
R	73	73	73	73	73	73	85	97	108	118
Priority	· Urban streetscapes in Fremantle City Centre	· Urban streetscapes in Fremantle City Centre	· Residential Streetscapes (South Fremantle)	· Green Spaces	· Native Vegetation areas (Clontarf Hill)	· School Site (Fremantle PS)	· Native Vegetation areas · School Site (JCCOTA)	· Native Vegetation areas · School Site (JCCOTA)	· As required across Area	· As required across Area

N - New tree plantings.
R - Replacement tree installations.

Area 3: East

Priorities

- Fragmented to nil canopy cover along identified City Green Links.
- Industrial areas.
- New development areas.

Targets

AREA 3	YEAR										TOTAL TREES OVER 10 YEARS
	1	2	3	4	5	6	7	8	9	10	
TREE POPULATION	4,313	4,313	4,313	4,313	4,313	4,313	4,613	4,913	5,263	5,663	
NEW TREES REQUIRED	0	0	0	0	0	300	300	350	400	400	**1,750**
REPLACEMENT TREES REQUIRED*	86	86	86	86	86	86	92	98	105	113	**927**
TOTAL TREES PER YEAR	86	86	86	86	86	386	392	448	505	513	**2,677**
TOTAL TREES IN URBAN FOREST	**4,313**	**4,313**	**4,313**	**4,313**	**4,313**	**4,613**	**4,913**	**5,263**	**5,663**	**6,063**	

* Assumes an annual 2% mortality / removed tree rate.

Implementation Approach

YR	1	2	3	4	5	6	7	8	9	10
N	0	0	0	0	0	300	300	350	400	400
Priority	• N/A	• N/A	• N/A	• N/A	• N/A	• Residential streetscapes (O'Connor) • Residential streetscapes (White Gum Valley)	• Residential streetscapes (White Gum Valley) • Green link (east/west alignments)	• Industrial streetscapes (O'Connor) • Green Spaces	• Residential streetscapes (Fremantle - south of High Street & north of Stevens St) • Green Spaces	• Residential streetscapes (Fremantle - north of High St) • Green link (north/south alignments)
R	86	86	86	86	86	86	92	98	105	113
Priority	• O'Connor industrial and residential streetscapes	• Residential streetscapes (White Gum Valley)	• Residential streetscapes (White Gum Valley)	• Green Spaces	• Green Spaces	• Residential streetscapes (Fremantle)	• As required across Area	• As required across Area	• As required across Area	• As required across Area

N - New tree plantings.
R - Replacement tree installations.

Area 4: South

Priorities

- Fragmented to nil canopy cover along identified City Green Links
- Residential Areas in Hilton, Samson and Beaconsfield.
- New development areas.

Targets

AREA 3	YEAR										TOTAL TREES OVER 10 YEARS
	1	2	3	4	5	6	7	8	9	10	
TREE POPULATION	4,641	5,541	6,291	6,791	7,291	7,791	8,141	8,141	8,141	8,141	
NEW TREES REQUIRED	900	750	500	500	500	350	0	0	0	0	**3,500**
REPLACEMENT TREES REQUIRED*	93	111	126	136	146	156	163	163	163	163	**1,418**
TOTAL TREES PER YEAR	993	861	626	636	646	506	163	163	163	163	**4,918**
TOTAL TREES IN URBAN FOREST	**5,541**	**6,291**	**6,791**	**7,291**	**7,791**	**8,141**	**8,141**	**8,141**	**8,141**	**8,141**	

* Assumes an annual 2% mortality / removed tree rate.

Implementation Approach

YR	1	2	3	4	5	6	7	8	9	10
N	900	750	500	500	500	350	0	0	0	0
Priority	• Residential streetscapes (Samson) • Green links (Carrington and Lefroy)	• Residential streetscapes (Hilton) • Green Spaces	• Green links (east of Carrington) • Residential streetscapes (Beaconsfield - west)	• Residential streetscapes (Beaconsfield - east)	• Green Spaces (Beaconsfield - east) • Industrial streetscapes (O'Connor)	• South Street • Hampton Road	• N/A	• N/A	• N/A	• N/A
R	93	111	126	136	146	156	163	163	163	163
Priority	• Residential streetscapes (Samson)	• School Site (Hilton PS)	• Residential streetscapes (Hilton)	• School Site (Beaconsfield PS)	• Residential streetscapes (Beaconsfield)	• School Site (South Fremantle HS and Tafe)	• Native vegetation areas	• Native vegetation areas	• As required across Area	• As required across Area

N - New tree plantings.
R - Replacement tree installations.

Species List

BOTANICAL NAME	COMMON NAME	HT	LOC.	TYPE	AREA			
					1	2	3	4
Agonis flexuosa	WA Peppermint	15m	R1.R2. U1.P	En/N/E	x	x	x	x
Allocasuarina fraseriana	Common Sheoak	15m	R1.U1.P	En/N/E			x	x
Araucaria columnaris	Cook Island Pine	60m	U1.U3.P	N/E	x	x		
Araucaria cunninghamii	Hoop Pine	60m	U1.U3.P	Ex/E	x	x		
Araucaria heterophylla	Norfolk Island Pine	60m	U1.U3.P	Ex/E	x	x		
Brachychiton acerifolius	Illawarra Flame Tree	15m	R1.U1. U2.U3	N/E			x	x
Callitris priessii	Rottnest Island Pine	10m	R1.R2.P	En/N/E	x	x	x	x
Casuarina equisetifolia	Coastal Sheoak	6m	R1.R2.P	N/E	x	x		
Citrus aurantifolia	Sweet Lime	2-4m	R2.U2	F/Ex/E			x	x
Citrus x limon	Lemon	2-4m	R2.U2	F/Ex/E			x	x
Citrus x sinensis	Sweet Orange	4-6m	R2.U2	F/Ex/E			x	x
Corymbia calophylla	Marri	40m	R1.P	En/N/E			x	x
Corymbia ficifolia	Red Flowering Gum	6m	R1.R2. U1.U2.P	N/E			x	x
Erythrina indica	Flame Tree	8m	R1.U1. U2.U3	Ex/D	x	x		
Eucalyptus caesia	Silver Princess	8m	R1.R2.P	N/E			x	x
Eucalyptus decipiens	Red Heart	15m	R1.R2.P	En/N/E	x	x		
Eucalyptus erythrocorys	Illyarrie	4m	P	N/E	x	x		
Eucalyptus foecunda	Fremantle Mallee	5m	R1.R2.P	En/N/E	x	x		
Eucalyptus forrestiana	Fuchsia Gum	5m	R1.R2.P	N/E			x	x
Eucalyptus gomphocephala	Tuart	40m	R1.P	En/N/E	x	x	x	x
Eucalyptus leucoxylon rosea	White Ironbark	20m	R1.R2.P	N/E			x	x
Eucalyptus marginata	Jarrah	40m	R1.P	En/N/E			x	x
Eucalyptus spathulata	Swamp Mallet	8m	R1.R2.P	N/E			x	x
Eucalyptus stoatei	Scarlet Pear Gum	7m	R1.R2.P	N/E			x	
Eucalyptus todtiana	Prickly Bark	10m	R1.R2.P	En/N/E	x	x	x	x
Eucalyptus torquata	Coral Gum	6m	R1.R2.P	N/E			x	x
Eucalyptus utilis	Round Leaf Moort	8m	R1.R2.P	En/N/E	x	x		
Eucalyptus victrix	Dwarf Ghost Gum	8m	R1.R2.P	N/E			x	x
Ficus carica	Fig	7m	U2	F/Ex/D	x		x	x
Ficus macrocarpa ssp hillii	Hills Fig	15m	U1.P	Ex/E	x	x	x	x
Ficus macrophylla	Morton Bay Fig	20m	U1.P	N/E	x	x	x	x
Ficus rubiginosa	Port Jackson Fig	30m	U1.P	N/E	x	x	x	x
Gleditsia triacanthos	Honey Locust	20m	R1.P	F/Ex/D	x		x	x
Hakea francisiana		4m	R1.R2.P	N/E			x	x
Jacaranda mimosaefolia	Jacaranda	20m	R1.U1. U3.P	Ex/D			x	x
Liquidamber styraciflua	Liquidamber	15m	U1.U2. U3	Ex/D			x	x
Melaleuca argentea	Silver Weeping Melaleuca	4m	R1.R2.P	N			x	x
Melaleuca lanceolata	Moonah or Rottnest Island Tea Tree	6m	R1.R2.P	N/E	x	x	x	x
Olea europaea	Olives	8m	R2	En/N/E	x	x	x	x
Phoenix canariensis	Canary Island Palm	10m	U1.U2. U3.P	Ex/E	x	x	x	x
Platanus acerifolia	London Plane	14m	U1.U2. U3	Ex/D			x	x
Plumeria rubra	Frangipani	3m	R2	Ex/D	x	x	x	x
Prunus cerasifera nigra	Purple Leaf Flowering Plum	5m	R2.U1. U2.U3	F/Ex/D			x	x

BOTANICAL NAME	COMMON NAME	HT	LOC.	TYPE	AREA			
					1	2	3	4
Prunus dulcis	Almond	3m	R2	F/Ex/D	x	x	x	x
Pyrus calleryana	Callery Pear	5m	R2	F/Ex/D			x	x
Sapium sebiferum	Chinese Tallow	15m	R1.R2. U1.U2	Ex/D	x	x	x	x
Schefflera actinophylla	Queensland Umbrella	4m	R2	N/E	x	x	x	x
Szygium smithii	Lilly Pilly	8m	R1.R2. U1.U2	N/E			x	x
Washingtonia robusta	Fan Palm	25m	U2.U3.P	N/E	x	x	x	x
Ulmus chinensis	Chinese Elm	10m	R1.R2	Ex/D	x	x	x	x

LEGEND

LOCATION

- R1 - Residential Street Verge +3m width
- R2 - Residential Street Verge -3m width
- U1 - Urban Street Verge +3m width
- U2 - Urban Street Verge -3m width
- U3 - Urban Street Median
- P - Park

TYPE

- E - Evergreen
- Ex - Exotic
- En - Endemic
- F - Fruit
- D - Deciduous
- N - Native

Implementation Costs

The following chart tables the expected expanses to implement the proposed tree planting program to Grow the Fremantle urban forest over 10 years.

CAPITAL COST PER ANNUM	YEAR										TOTAL TREES OVER 10 YEARS
	1	2	3	4	5	6	7	8	9	10	
AREA 1 - NORTH											
TOTAL TREES REQ.	20	20	20	270	275	280	285	540	300	305	**2,320**
COST OF TREES	$2K	$2K	$2K	$27K	$28K	$28K	$29K	$54K	$30K	$30K	**$232K**
COST OF WATERING	$1K	$2K	$2K	$13K	$24K	$25K	$25K	$37K	$37K	$27K	**$192K**
TOTAL COST AREA 1	**$3K**	**$4K**	**$4K**	**$40K**	**$52K**	**$53K**	**$54K**	**$91K**	**$67K**	**$57K**	**$424K**
AREA 2 - WEST											
TOTAL TREES REQ.	73	73	73	73	73	673	685	647	608	618	**3,593**
COST OF TREES	$7K	$7K	$7K	$7K	$7K	$67K	$69K	$65K	$61K	$62K	**$359K**
COST OF WATERING	$5K	$6K	$6K	$6K	$6K	$33K	$60K	$59K	$55K	$54K	**$293K**
TOTAL COST AREA 2	**$12K**	**$13K**	**$13K**	**$13K**	**$13K**	**$100K**	**$129K**	**$124K**	**$116K**	**$116K**	**$652K**
AREA 3 - EAST											
TOTAL TREES REQ.	86	86	86	86	86	386	392	448	505	513	**2,677**
COST OF TREES	$9K	$9K	$9K	$9K	$9K	$39K	$39K	$45K	$51K	$51K	**$268K**
COST OF WATERING	$6K	$7K	$7K	$7K	$7K	$21K	$35K	$37K	$42K	$45K	**$217K**
TOTAL COST AREA 3	**$15K**	**$16K**	**$16K**	**$16K**	**$16K**	**$60K**	**$75K**	**$82K**	**$93K**	**$96K**	**$484K**
AREA 4 - SOUTH											
TOTAL TREES REQ.	993	861	626	636	646	506	163	163	163	163	**4,918**
COST OF TREES	$99K	$86K	$63K	$64K	$65K	$51K	$16K	$16K	$16K	$16K	**$492K**
COST OF WATERING	$67K	$82K	$66K	$56K	$57K	$51K	$30K	$15K	$15K	$15K	**$451K**
TOTAL COST AREA 4	**$166K**	**$168K**	**$129K**	**$120K**	**$122K**	**$102K**	**$46K**	**$31K**	**$31K**	**$31K**	**$943K**
TOTAL COST	**$195K**	**$202K**	**$163K**	**$190K**	**$203K**	**$314K**	**$302K**	**$327K**	**$307K**	**$301K**	**$2.5M**

NOTE:

- * Assumes an annual 2% mortality / removed tree rate.
- # Supply and install 30L tree stock as per the total required per annum / Allow $100/tree ex GST
- Costs could be saved through the installation of smaller stock and planting during autumn months.
- Costs do not assume for the other works such as road cutting, kerbing, grating etc.
- Costs for watering assume watering for 2 years per tree (only over 4 summer months at $133 / tree).

Adaptive Management

To ensure the long term success and viability of the urban forest, the City will need to undertake the preparation of a Comprehensive Adaptive Climate Management and Funding Plan (the Plan).

The Plan will call for new forms of adaptive urban governance that go beyond the conventional notions of urban planning. This will involve improvement of City planning tools and governance processes and the exploration of how existing structures and new development can influence the urban green.

The Plan will aim to achieve an improved integration of different types of approaches to tree measurement, monitoring and review as well as formal and informal funding through the budget process. At a minimum the Plan should detail the following key aspects.

Approvals Processes

Changes are required by the City to ensure Development areas, particularly those not in City ownership are actively contributing to meeting the City wide targets and Goals. The following are some approaches which could assist:

- Regulation and motivation for tree retention on privately owned lots.
- Regulation of development areas to consider solar access, prevailing winds, over shadowing and utilisation of other natural systems to reduce the long term requirements for mechanical heating and cooling systems.
- Application of Green Star ratings for all private and government Development Areas to improve built form environmental efficiencies improving the health and well-being of the City.

Measurement

Prepare a dynamic urban forest "database" connected to the City's Intramaps; which can be updated by City GIS officers and made available to the community via the City website. The City can also encourage community input to update tree information within private land holdings to collate and assess data. This will be a valuable resource in measuring the success and targets of the urban forest.

Protection of existing trees within public realm using an accredited assessment criteria of their worth to deter removal and encourage creative design solutions for retention should be explored and data attributed to the dynamic mapping on the Intramaps.

Another key issue in measurement will be ensuring adequate water availability to irrigate new tree plantings and the long term success of the high population proportion of young trees. The following will need to be considered:

- review of existing water sources to irrigate
- ensure WSUD principles are integrated into new development design in non-City and City owned tenure.

Implementation

The previous section details the implementation areas and priorities. Based on the numbers and recommendations, the City will need to either invest in forward growing contracts with reputable and accredited nurseries in WA to supply the tree stock in the sizes and species nominated.

To minimise the loss of stock planting should occur in Autumn to maximise winter rain fall and cooler climatic conditions.

Monitoring

Critical success of the urban forest will be the continuing professional development and education of best practice management for trees and urban green spaces for City decision makers as well as City contractors. A City management/ property tree survey is required for critical base data for future planting and current management to ensure a proactive rather than reactive tree management approach. Base tree data for monitoring and management could include:

- structural health and risk assessments of mature tree specimens in public realm and private landholdings
- pest and disease management
- pruning, removal and storm management
- Tree Protection Zone enforcement during construction
- identification of opportunities to recycle / salvage trees for reuse for play opportunities or habitat should always be considered when a tree is removed.

Funding

Funding can be allocated with each City financial budget to facilitate tree planting, establishment, maintenance and monitoring in public and City landholdings. The UFP provides an outline on page 39 of the expected costs for increasing the tree population by 10,000 trees.

Collaboration and partnerships with major stakeholders and state and federal grants and programs is also an opportunity to facilitate the growth and management of the urban forest.

Review

An annual review of the processes, policies and targets should be undertaken. These results can be reported to the community and used to seek additional funding if required.

Glossary of Terms

Adaptive Management
Adaptive management is a systematic approach for improving resource management by learning from management outcomes andreducing uncertainty over time via system monitoring.

Biodiversity
Biodiversity is a term used to describe all living things and the variation within and between them. It includes plants, animals, fungi, and micro-organisms, and can be considered at various levels of complexity. (Roetman and Daniels, 2008)

Canopy cover
The percentage of area covered by the vertical projection of tree crowns when assessed from above.

Ecosystem services
An ecosystem is a dynamic community comprising populations of plants, animals, microorganisms and the non-living environment interacting together as a functional unit. Environmental factors, such as soil type, position in the landscape, climate and water availability, determine the presence and distribution of ecosystems. The main inputs to ecosystems are sunlight, soil, nutrients and water, while wastes from one part of the system form fuel for other parts. A key output is biomass (or carbon-based life) regenerating itself. An ecosystem functions by continually cycling energy and materials through living organisms that grow, reproduce and then die. This cycling of energy and materials through living organisms has evolved in response to a mix of disturbances (e.g. fires or floods), stresses (e.g. droughts or diseases) and ecological interactions (e.g. competition or predation) over millions of years. (Commonwealth of Australia, 2010) http://www.environment.gov.au/system/files/resources/b53e6002-4ea7-4108-acc8-40fff488bab7/files/ecosystem-services.pdf)

Linked green spaces
In this approach Green Infrastructure emphasizes the importance of retaining and linking green spaces, nature corridors and drainage networks in cities to enhance ecosystem functioning (Benedict and McMahon, 2002). In this sense the network of Green Infrastructure is seen as analogous to the network of conventional engineering infrastructure underlying the functioning of a city. Green Infrastructure networks can provide a 'green' framework for more sustainable urban development.

Urban forest
The urban forest has been defined as 'the sum of all publicly and privately owned trees within an urban area, including street trees, trees on private property, and remnant stands of native vegetation' (Nowak et al., 2001; Miller, 2007)

Urban Heat Island Effect
The rise in temperature of any man-made area, resulting in a well-defined, distinct "warm island" among the "cool sea" represented by the lower temperature of the area's nearby natural landscape. (http://www.urbanheatislands.com/)

Useful Life Expectancy
Useful life expectancy is the estimated lifespan of a tree.

Urban greening
Urban greening is the creation and maintenance of new and existing green space, such as parks; planting and care of trees; and the creation of green infrastructure such as rain gardens and green roofs.

Well-being
Well-being comprises not just the benefits gained from psychological and physical health, but is also related to specific aspects of well-being such as favourable thoughts and feelings, satisfaction with life, ability to be self-sufficient and proactive, possessing a sense of happiness, and a positive evaluation of life in a general sense (Diener et al., 1999).

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PLACE MATTER

ecoscape

City of Fremantle