City of Wanneroo

Urban Forest Strategy
2022

Mayors Message

The City of Wanneroo is one of Perth's largest local government areas, encompassing 684 square kilometres and spanning from Two Rocks in the north to Koondoola in the south.

The City is a blend of urban and natural spaces, with residential and industrial zones set alongside a diverse landscape of bushland, wetland and coastal areas.

Our northern corridor has and will continue to experience substantial development and population growth. By 2041, it is anticipated that the City of Wanneroo's population will exceed 370,000.

The challenge is that urban expansion and infill can often encroach on various habitats and natural systems, resulting in the removal of vegetation and reduction in natural tree canopy cover.

The Urban Forest Strategy 2022 demonstrates the City's ongoing commitment to our urban forest – by detailing how we aim to protect, maintain and improve canopy cover and vegetation across our City, as our population continues to grow.

The City's streetscapes and reserves are important to the community, and we are committed to working with our community, stakeholders and developers to enhance the sustainability and liveability of our City and ensure our urban forest is preserved and protected for future generations.

Mayor Linda Aitken
City of Wanneroo

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EXECUTIVE SUMMARY

Trees are an integral part of the built environment due to the many benefits they provide to amenity, health and well-being, and biodiversity protection. A healthy Urban Forest can provide a range of environmental, social, and economic benefits to a City and its community, in addition to sustaining important ecosystem functions.

The City's *Strategic Community Plan 2021 - 2031* aspires to achieve a sustainable natural, built and healthy environment. In response to this community vision, the City's *Corporate Business Plan 2021 - 2031* includes an action to prepare an Urban Forest Strategy (UFS).

The UFS outlines the City's Vision and Principles for maintaining and improving its Urban Forest, and the Strategies that will be undertaken in order to reach that Vision.

The purpose of the UFS is to enhance the sustainability and liveability of the City by:

- Mapping the extent of canopy and vegetation cover across the City, and identify the benefits and challenges associated with increasing coverage;
- Measuring the extent of canopy and vegetation that can be retained and enhanced through current urban design;
- Setting objectives for the City to undertake that aim to improve canopy cover in developed areas; and
- Identifying a wide range of future opportunities for the enhancement of the City's urban forest in the public and private realms.

The Strategy provides detail on the extensive data analysis that was undertaken utilising Department of Planning, Lands and Heritage tree canopy and vegetation data in order to establish a base line for the City's urban forest. This allows the City to determine the extent that its Urban Forest can be protected, where further canopy and vegetation loss can be reduced, and finally, where the City's Urban Forest can be improved through planting and other initiatives. Objectives are provided as a precursor to further assessment and subsequent confirmation of what will constitute realistic and achievable levels of Urban Forest retention, management and enhancement.

1.   INTRODUCTION

Australia-wide local governments in metropolitan areas are recognising the importance of urban forest planning and increasing community interest in tree canopy cover in the urban environment. An urban forest is an interconnected, living network of green canopy and vegetation cover that provides habitat, improves health and well-being, and increases amenity within urban areas.

Significant urban growth and increased urban density, as well as social factors such as differing community attitudes towards trees, are placing significant pressure on the City's ability to retain and potentially expand its canopy cover.

The effective management of the City's urban forest can address broader issues such as climate change, heat island effects (temperature in urban environments), conservation, streetscape amenity, community health and wellbeing, as well as contribute to the financial benefits of reduced energy consumption.

The protection of a healthy, resilient and diverse urban forest 'ecosystem' is a shared responsibility across State and Local governments, landowners, the development industry, business and the community. There are opportunities for all stakeholders to contribute to improving the urban forest by retaining trees and by planting more trees and by promoting the value of trees.

What is an Urban Forest?

An urban forest refers to all substantial vegetation growing in an urban environment, both native and non-native vegetation, and inclusive of vegetation on both private and public land that exists prior to development, retained during development or introduced.

The urban forest can be divided into two categories:
  i.   Shrubs and undergrowth less than three metres in height; and
  ii.   Vegetation over three metres in height.

(Ref: Department of Planning, Lands and Heritage 2018b, 42).

The City of Wanneroo defines urban forest as:

> *An ecosystem of green canopy across the whole City creating a connectivity of green corridors to soften the elements of hardscape, built form, providing shade and cooling effects.*

Vision and Goals

The City's urban forest vision is:

To protect and grow an urban forest where the community loves trees and values living amongst the benefits they provide.

The goals and strategy elements outlined below provide clarity around the intent of the Urban Forest Strategy and how the City will approach initiatives to reach the City's objectives for the retention and enhancement of the urban forest.

The City's goals for an urban forest are:

1. **Maintain a resilient urban forest –** by retaining existing urban canopy where there is risk of loss due to development;

2. **Provide/ increase amenity with canopy and vegetation cover –** by revegetating urban areas where opportunities exist, such as public open space, streetscapes, activity centres, civic spaces and drainage sumps;

3. **Plan for community health and wellbeing** – by creating places of landscape amenity that incorporate cooling and shading effects of trees and providing opportunities for the community to be involved in planting projects;

4. **Reduce the urban heat island effect –** by prioritising planting to cool "hot spots" and designing our public spaces, streetscapes and civic areas to feature less pavement and more trees; and

5. **Design for water sensitivity, sustainability and liveability** – by exploring options for innovative design in future urban areas to maximise opportunities for urban canopy.

Strategy Elements

The following strategy elements will help the City meet the goals outlined above:

1. **Keep canopy and vegetation**
   a. Incorporate local natural area protection and canopy retention into the subdivision assessment process in line with the City's Local Biodiversity Plan and Urban Forest Strategy; and
   b. Ensure that the City's planning mechanisms include environmental provisions for tree protection and canopy enhancement.

2. **Manage the City's vegetation and canopy assets**
   a. Introduce and maintain protection mechanisms for tree canopy on City managed land;

    b.   Apply a valuation system for tree assets and document their economic value for the purpose of establishing the asset value of vegetation and canopy; and

    c.   Continue street tree audits to identify planting opportunities and provide condition assessment to street tree assets as appropriate.

3.   Plant canopy and vegetation

    a.   Expand the street tree planting program to focus on heat islands and areas with low percentage canopy cover, and include areas of opportunity identified through the street tree audit process;

    b.   Consider opportunities to vegetate the City's drainage sumps through programs such as 'Drains for Liveability' or similar; and

    c.   Identify potential planning mechanisms that allow or require the planting of one tree per lot in new developments.

4.   Bring the community along

    a.   Investigate partnerships with Schools;

    b.   Create community awareness and improve public education through key messages and programs; and

    c.   Conduct planting programs.

5.   Work with stakeholders

    a.   Learn from other local governments and share the City's experiences;

    b.   Influence industry through sound policy and stakeholder engagement; and

    c.   Drive change in the planning and development process to allow greater consideration of tree protection throughout.

Terms and Definitions

Urban Forest

An ecosystem of green canopy across the whole City, creating a connectivity of green corridors to soften the elements of hardscape, and built form providing shade and cooling effects

Heat Island

Created by hardstand and concrete a heat island is an uninviting place to live that creates uncomfortable heat conditions (i.e. micro-climate), less attractive areas for community and exacerbates the need for increased cooling and corresponding energy consumption.

Climate Change

Uncertain climatic conditions resulting in increased of heat, fire, flood, and storms which are a challenge to manage. Establishing tree cover is a simple and proven way to demonstrate an effective response to climate change impacts in the City in conjunction with a suite of other mitigation measures.

Typology

Typology in regards to the Urban Forest Strategy is the term applied to different density development and urban design in subdivision. It is the look and feel of the subdivision, as well as the descriptive metrics (e.g. R Codes, lot size, street widths, and subdivision layout).

Vegetation Cover

In this Strategy, the vegetation cover is measured 0-3m, 3-8m and 8-15m and 15m and above, and includes the canopy cover.

Tree Canopy

In this Strategy, the tree canopy relates to trees that are greater than 3m in height. This definition has been used when analysing data for tree canopy.


Strategic Context

The UFS is informed and guided by the City's Strategic Community Plan (SCP) and Local Environmental Strategy (LES). The SCP sets out the community's expectations and priorities for the City, while the LES provides the direction for strategic environmental planning projects across the City. Both of these documents identify the need for the City to investigate ways to enhance and protect its urban forest.

The UFS aims to achieve the City's vision set out in its high level strategic documents by optimising the retention of significant vegetation and habitat thereby improving local amenity by retaining and complementing natural landscapes within the built environment.

The City has a number of strategies, plans, policies and procedures that aim to achieve retention and enhancement of tree-scapes in the City's urban areas. Some of these documents inform the strategy, whilst others assist in its implementation.

These key relationships between the UFS and related strategies, plans, policies and documents are illustrated in **Figure 1**.
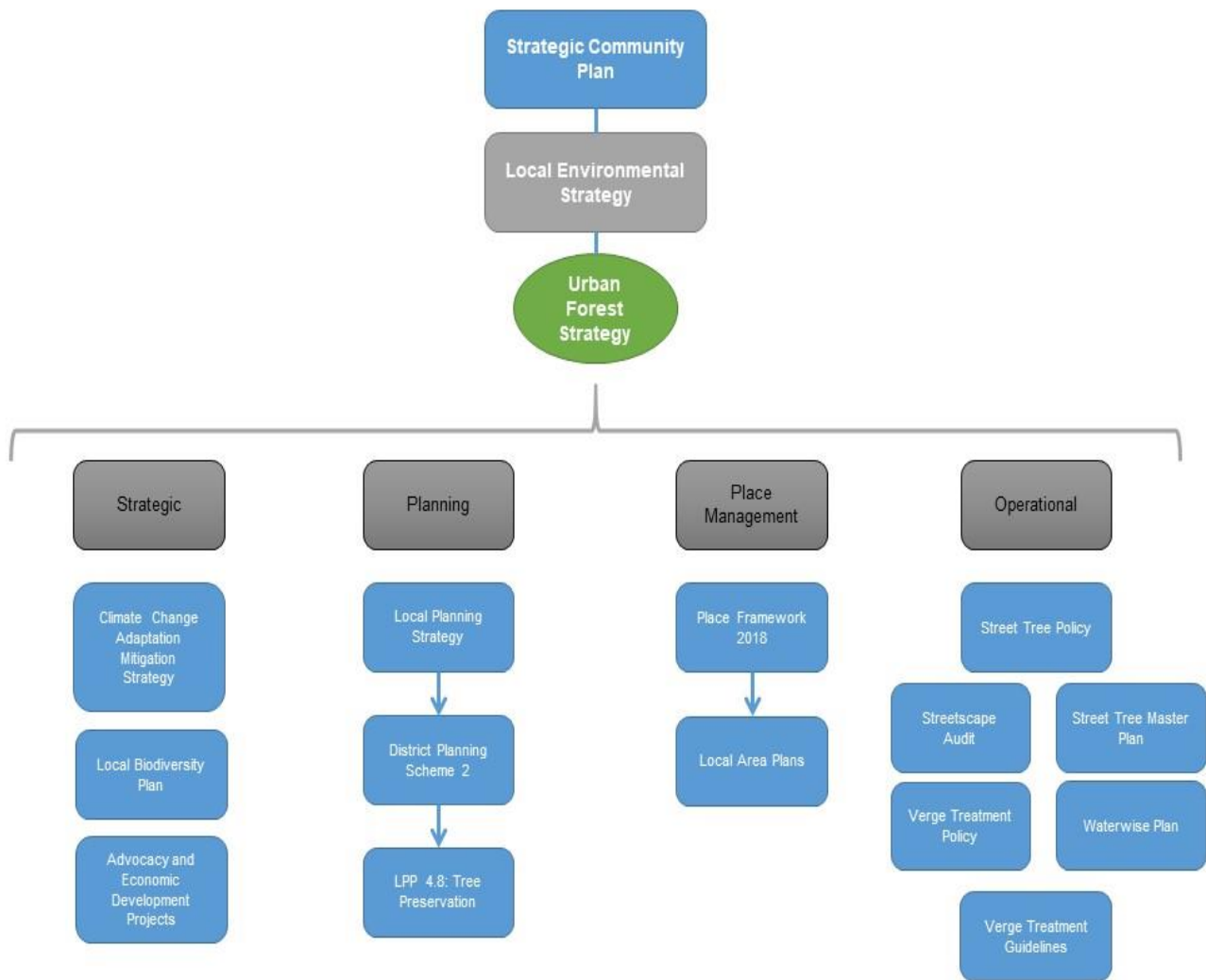
Figure 1 – Urban Forest Strategy Document Linkages

2.   THE BENEFITS OF AN URBAN FOREST

The community has a strong relationship with the natural environment and it is recognised that nature and vegetation are essential to human wellbeing. In addition to human intuitive connection with trees, there are proven economic, psychological, physical as well as environmental benefits.

Social Benefits:

- Contributes positively to the visual aesthetics, character and sense of place;
- Provides sensory and recreational experiences, such as exploring, climbing and being present amongst nature – thereby creating stronger connections between people and their environment;
- Provide a physical connection to culture, history and spirituality through the retention of native flora, sacred trees and educating others on their significance to the local community;
- Improves air quality providing further health benefits through reducing temperatures and cleaning the air;
- Promotes outdoor activity, exercise, increased walkability and contributes to overall mental and physical wellbeing;
- Assists in cooling the physical/built environment, which in turn helps prevent heat-related illness; and
- Boosts the resilience of the local environment by providing food, habitat and other ecosystem functions.
- Contribution to amenity, liveability, Crime Prevention through Environmental Design (CPTED).

Environmental Benefits:

- Establishing 'green corridors' of urban forest supports wildlife species retention, migration and genetic resilience of flora and fauna through connectivity. Green corridors also minimise the need for fauna to travel on roadways and reduce incidents with vehicles;
- Shade from canopy creates cooling effects mitigating the impacts of climate change and creation of urban heat islands. This can reduce energy demand for cooling of buildings, which in turn supports the City's contribution to climate change mitigation;
- Established vegetation can reduce water demand and even enhance water availability through micro-climate modification through reduced evaporation and transpiration;
- Green corridors from the coast landwards can function as 'breeze-ways' and facilitate urban ventilation through allowing cooler air to penetrate into the more densely built areas; and
- Certain choices of vegetation can help reduce noise pollution.
- Urban Forests contribute substantial ecosystem service benefits such as diversity of animals, birds, reptiles and insects to an urban environment.

Economic Benefits:

- Creates cooler urban environment which results in reduced energy consumption and cooling costs for buildings and homes;
- Potential for reduced medical costs to both individuals and the State Government arising from heat-related illness; and
- Trees have monetary value as assets to the local government and this value can increase over time; as well as potential increased property values due to an attractive urban environment and street trees.

3.   CHALLENGES

The retention of trees in the City involves many significant challenges. Although each Local Government in Perth is unique with respect to its canopy retention approaches and outcomes, there are particular challenges associated with a Growth Council such as the City.

The following section outlines each of the key constraints for the City to effectively establishing and maintaining the urban forest.

Climate Change

Climate change is resulting in a shift to hotter summer conditions, and possibly milder but much drier winters. Perth is losing its dependable wet winters and consequent replenishment of the groundwater system, while facing a greater occurrence of extreme heat events in summer.

These facts bring a greater degree of urgent focus into the UFS than would previously have been the case. Some of the urban, residential subdivision and housing design in City over the last two decades has been inappropriate for the climatic conditions found in Western Australia: smaller single-storey houses taking up a greater percentage of smaller residential lots, with narrower road reserves and reduced verge widths.

In addition, there is a significant risk of existing/mature trees declining, dying, or not performing well, due to the increase in the number of stressors arising from climate change. These stressors include increased temperatures, reduced water table and availability, and increase in and introduction of new pests and diseases with shifting climatic zones. Newly planted trees are also at risk due to the higher temperatures and shifting climatic patterns, hence species diversity is paramount to the successful establishment of an urban forest.

It is essential that urban design and development respond effectively to the challenges of climate change in terms of both adaptation and mitigation.

Fire Risk

The State's *Planning for Bushfire Protection Guidelines* provide justification to reduce vegetation and canopy cover by clearing for fire protection. Unjustified clearing of vegetation due to perceived fire risk, or landowners misinterpreting guidance documents and advice, is also a challenge to the retention of tree canopy in larger rural residential lots in the City.

In addition, loss of vegetation and canopy cover due to actual fire happens as urbanisation proximity to conservation areas increases. Species selection can play a crucial role in mitigating bushfire impacts in areas between conservation reserves with potentially high fuel loads and populated urban areas. In order to achieve a sustainable and viable urban forest, there must be a balance between urban forest objectives with the need for bush fire mitigation.

Heat Island Effect

The urban heat island effect refers to the noticeable difference in the increased temperature levels within urban areas where vegetation is replaced by roads, car parks, buildings and dominant hardscapes. These measurable increases in temperature can be linked to increased heat-related mortality and morbidity.

Increasing the City's tree canopy will contribute to cooling of the urban climate/micro-climate which will help mitigate heat island effects in our suburbs, reduce the energy consumption costs of cooling residences, and reduce heat related illness (i.e. morbidity and mortality rates).

The UFS will address heat islands issues and seek to reduce the heat island impacts on the City.

Planning Legislation and Policies

Due to the significant growth of the City and the substantial areas yet to be urbanised, it is inevitable that the overall vegetation cover in the City will change and reduce over time if development is left unchecked. The UFS aims to protect, retain and increase vegetation cover as part of the planning and development process; however, this will require the

introduction of a number of mechanisms such as environmental provisions in the City's Local Planning Strategy, Planning Scheme and relevant policies.

The relevant planning legislation associated with the subdivision approvals process is determined by the WAPC which often means that local governments are unable to address key design issues affecting tree retention. As a result, vegetation and trees are often removed during development to facilitate subdivision. The UFS aims to influence planning outcomes by serving as a basis for the City to advocate with State Government and the development industry to maximise tree and vegetation cover through better design at the structure planning and subdivision stages.

The City considers that addressing the urban planning issues associated with greenfield development to better retain existing remnant vegetation within new broad-acre developments ahead of the development front, is a high priority. The issues involved are complex and will involve engagement with many stakeholders, including the development industry sector, Urban Development Institute of Australia (UDIA), WAPC and WALGA. Bringing about change and improved outcomes will take considerable time, but the City considers this matter to be so important, action to engage relevant stakeholders is a matter of the highest priority.

Urban Design

The City is exposed to rapid expansion as well as large greenfield areas that will be subject to future development. This presents challenges for urban design regarding density, infill development and zoning when looking to retain tree canopy and vegetation. The need to increase urban density to accommodate population growth, results in urban planning and design that is effectively designing trees out of the urban environment. Key factors contributing to this outcome include:

- Increased density and decreasing lot sizes;
- Limited space for trees in streetscapes and exacerbated by generic engineering design approaches to infrastructure provision in road reserves;
- Decreasing road reserve widths;
- Smaller public open space with changes in use and function of parks (i.e. drainage); and
- Bushfire management considerations;

- Smaller to zero residential private open space.

These design challenges for development in the City result in fewer trees and reduced canopy cover. Where trees are retained, they are often subjected to physical disturbance, reduced or damaged roots, and a lack of space for above ground canopy.

Increasingly the City's amenity is becoming defined by roof-scapes, summer glare, lack of wildlife corridors, reduced opportunity for comfortable day-time summer outdoor exercise, obstruction to sea-breeze ventilation, all contributing to a diminished sense of place and reduced liveability and sustainability for residents.

A specific area of opportunity is associated with road and street design, particularly those road/street assets constructed and maintained by the City. The City recognises there is a need to better incorporate early design and forward budgeting of capital works to accommodate 'retention of urban canopy' into road and street design that is within the control of the City. This is both a challenge and an opportunity.

Attitudes

Not everyone loves trees or appreciates their value. Where development has created small verges and inevitable competition for various needs (e.g. vehicle parking), trees are sometimes considered to conflict with those competing uses for this limited space. Trees and vegetation are often viewed as inconvenient, dispensable and replaceable. This is particularly problematic in the case of certain species that do not propagate well, are part of a Threatened Ecological Community, or take years to replace to the same size and equivalent amenity value.

Equally, both research and practice establish that once residents are made fully aware of the value of trees/tree canopy and the range of benefits they provide, attitudes can change. Key is that the time and effort must be made to change negative attitudes.

The need to strengthen and reinforce recognition of and respect for 'indigenous heritage values' associated with significant trees is recognised by the UFS.

4. CAPTURING THE CITY'S URBAN FOREST

Methodology

The City utilised the 2018 release of Urban Forest Parcel Data and Urban Heat Island imagery from the Department of Planning, Lands and Heritage (DPLH) to create baseline measurements of its canopy and vegetation coverage and assess heat island effect.

A complete series of maps showing the canopy and vegetation cover, as well as the heat island effect for each suburb can be found on the City's website.

To enable targeted decision making the City also undertook a mapping exercise to categorise land parcels and urban residential areas into land use typologies clarifying locations where the City has direct control versus indirect influence over the management of vegetation in different areas of the City.

Typologies & Urban Forest

The City contains diverse land use typologies with direct implications for tree canopy retention, including loss of canopy in older suburbs experiencing infill development and inadequate verge widths in new subdivisions. There are therefore numerous urban design factors influencing establishment and retention of canopy and vegetation cover:

- *Age* – the older the suburb, the bigger the road reserves and lot sizes and potential for urban infill and therefore loss of tree canopy. New subdivisions and suburbs have smaller lot sizes and therefore less ability to retain canopy through their design;
- *Lot sizes* – larger lots can better retain and support more vegetation than smaller lots;
- *Road Layout* – there is often opportunity to save larger trees within certain road layouts. Engineering design should include overlay tree surveys to identify opportunities for tree plantings/positioning, as standard practice;
- *Road Reserve Widths* – a good streetscape design with opportunity for tree canopy can be realised with wider road reserves to integrate service infrastructure with tree

planting requirements, and allowing sufficient space for below ground 'living root zones' and above ground 'canopy volume';

- *Verge Width* – With multiple service alignments, footpaths, kerbing, drainage and smaller lot sizes, verge widths play as important a role as overall road reserve widths. Sufficient space for street trees should have at least equal priority to all other placements (i.e. service infrastructure);

- *Infrastructure requirements* – ground level changes with cut and fill, drainage requirements, road construction and disturbance footprints all contribute to a loss of pre-existing tree canopy and should henceforth factor in tree retention as an essential objective; and

- Urban density and land zoning – differences in density and zoning are relevant to the above points. These differences result in land use typologies

The following typologies are considered the most critical categories, each with particular or unique UFS challenges and solutions. It is noted that the range of UFS initiatives (Section 6) provided in this document reflect the diversity of these land use typologies.

Typologies Explained

Residential Lots:

Strata/Lots <400 m^2:
- Often result from dense infill developments.
- Typically lot sizes of 400 m^2 or less.
- Lot frontages ~ 10m.
- Road reserves ~ 14m.
- Unlikely to be subdivided any further, tendency to have very little green space available and small verge widths.
- Retaining or reintroducing tree canopy is frequently very difficult with current urban and architectural design approaches.

Lot sizes of 400-700 m^2:
- Development that falls between lot sizes 400 – 700 m^2;
- lot frontages ~10 – 20 m;
- Road reserves ~14 – 18 m.
- Some opportunity to enhance vegetation and canopy cover at these locations, both on private property and in streetscapes.

Lots >700 m^2:

- In the City, most of these lots were developed in the 1970's and 80s where the minimum lot size was 680 m^2. These locations have relatively large lots resulting in large size private gardens.
- Wide frontages (typically ~20m) providing opportunity for lengths of verge free of driveways.
- Wide road reserves (typically ~18m) that provide opportunity for street trees.
- This lot size category is further divided into three 'sub-types', depending on how they may be affected by R-coding increases:
  - Standard Lot >700 m^2;
  - Lots >700 m^2 + proposed for Infill;
  - Lots >700 m^2 + approved for Infill.
- In theory, large lots greater than 700 square metres are appropriate for retaining and establishing urban canopy, however, this typology faces the risk of urban infill and redevelopment to higher densities which will inevitably remove canopy.

Special Residential:

- Lots generally between 2,000 - 4,000 m^2.
- Existing controls in place to enhance vegetation retention and minimise clearing (e.g. specified building envelopes).
- The risk with special residential is that there is a progressive loss of canopy cover and vegetation due to poor property maintenance, illicit activities and clearing by land owners, and potential for subdivision over the long term despite current Planning Scheme provisions.

Special Rural & Rural:

- Locations zoned rural or special rural with no plans for subdivision or urbanisation in future.
- Some controls in place to prevent clearing of vegetation and encourage retention.
- The greatest risk to existing vegetation cover in this typology is a fundamental change in zoning based on changing land use planning strategies in the future.

Undeveloped – with structure plan

- Proposed for residential subdivision development with structure plans in place allocating locations for vegetation retention via POS allocation.
- Successful retention or reinstatement of urban canopy is dependent on final subdivision and urban design outcomes.

Undeveloped – without structure plan

- Proposed for residential subdivision development with no structure plan in place, locations for vegetation retention or revegetation not yet determined.
- As above, but with greater potential to make provision for the protection of remnant vegetation.

Schools

- Include expanses of active open space and often retained bushland; and
- Potential for enhancing vegetation through programs, e.g. Sustainable Schools.

Commercial/ Retail/ Industrial

- Feature large areas of hardstand and building footprint with opportunities for retaining and planting vegetation.
- To retain or establish urban canopy in such areas requires a significantly different approach to the urban design of commercial, retail and industrial areas.

Public Lands

- Incorporates all state, federal and local government authority owned or managed land and can be further sub-categorized into:
  - City managed land; and
  - Land owned or managed by the State (including Crown land), State or Commonwealth agencies and utility providers, and includes the following types of properties:
    - parks;
    - road reserves;
    - public or pedestrian access ways;
    - drainage sumps; and
    - land adjacent to public and community buildings.

The Urban Forest Parcel data and Urban Heat Island imagery was then assessed against each of the land use typology categories to provide baseline information on the current state of canopy, vegetation cover within the City.

Street Tree Audit Data

In 2018 the City commenced its Street Tree Audit Program to collate information on the City's tree assets. The program has focussed on the southern sections of the City with audits completed for the following suburbs:

Wanneroo (part)	Marangaroo
Hocking	Alexander Heights
Pearsall	Girrawheen
Wangara	Koondoola
Landsdale	Butler
Madeley	Mindarie
Darch	

The audit costs are budgeted within the City's annual operating budget. The audit comprises all street trees within residential verges and streetscapes.

Assumptions and Limitations

The Urban Forest Parcel Data provided by the DPLH is a snapshot in time of estimated vegetation and canopy cover. In the suburbs of Yanchep and Pinjar several hectares of undeveloped land were not included in the parcel data. In Mariginiup the parcels extended slightly beyond the suburb boundary. These variations will need to be considered in future years when comparing future Urban Forest Parcel data to this release.

Urban Heat Island imagery is a derived image comprised of collated images over the 2015-16 summer. As such this provides only an estimate of locations subject to urban heat island effects due to urbanisation.

The Street Tree Audit, commenced in 2018, currently extends across the southern portion of the City and more work will be required to complete the project and be able to provide comprehensive information on the City's tree assets, importance and value, as well as identifying opportunities for forward planting.

Land use typologies have been derived by the City's planners. It provides a generic overview of the different forms of development across the City. It should be noted that the typology does not represent or equate to the City's District Planning Scheme No. 2 zoning.

Finally, implementation of the plan can only be as successful as the resources made available to undertake the strategy. Resourcing the Urban Forest Strategy will require long term financial budget commitments and a whole-of-organisation approach.

Data Analysis and Discussion

Total Tree Canopy Cover

The City's overall tree canopy cover is 9.88%. Tree canopy is defined as vegetation greater than 3m in height. However, older suburbs tend to have taller vegetation, while coastal suburbs tend to feature vegetation less than 3m in height. The latter is particularly under pressure from development being located in a major urban zoned corridor.

The following table shows the highest to lowest tree canopy cover in the City. For each suburb a map and chart presenting canopy cover is provided on the City of Wanneroo's website.
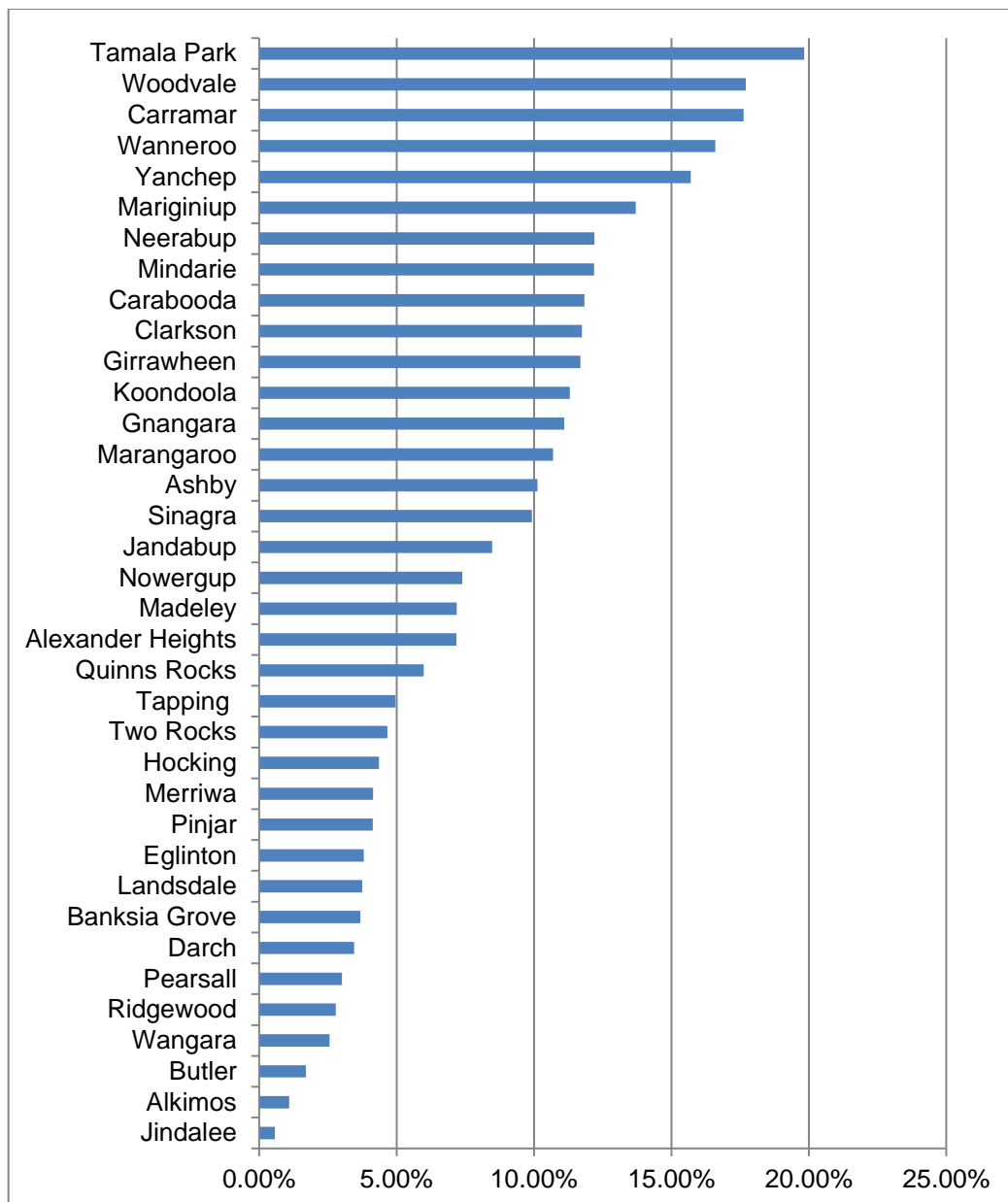
Figure 2 – Tree Canopy by Suburb

Generally, older suburbs have more tree canopy cover due to trees being retained on larger lots, with a combination of older and more established street trees, and greater degree of canopy in public open space.
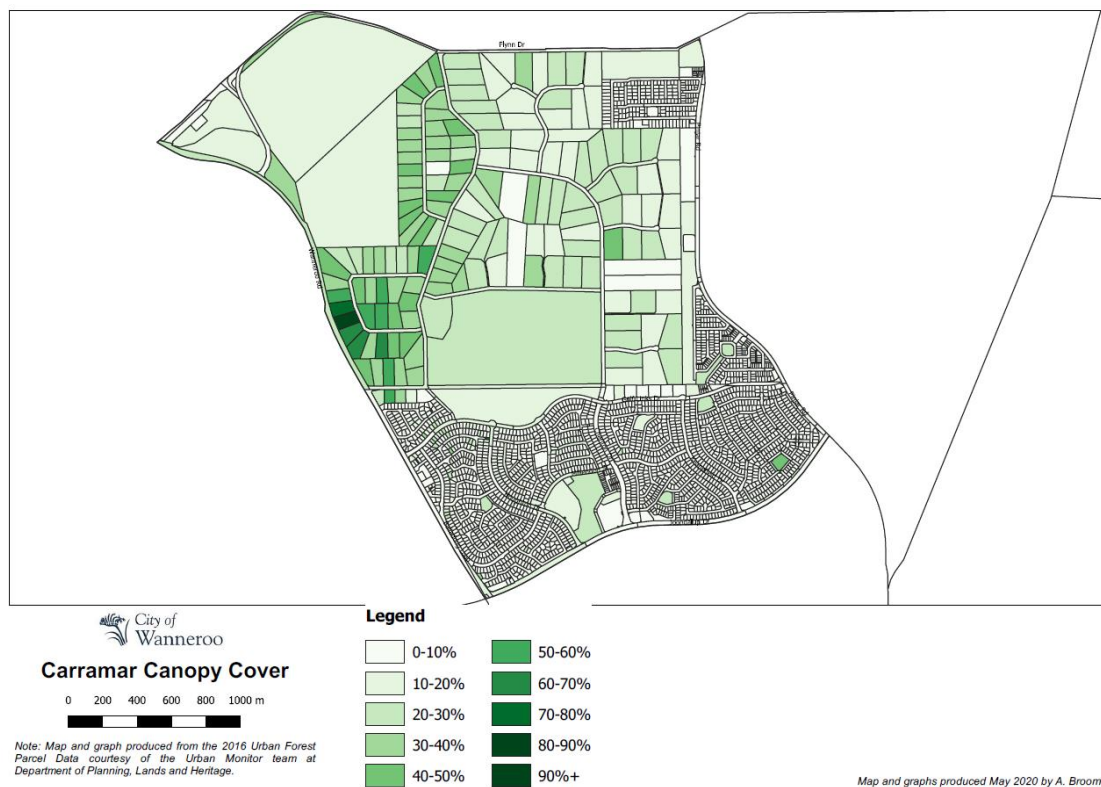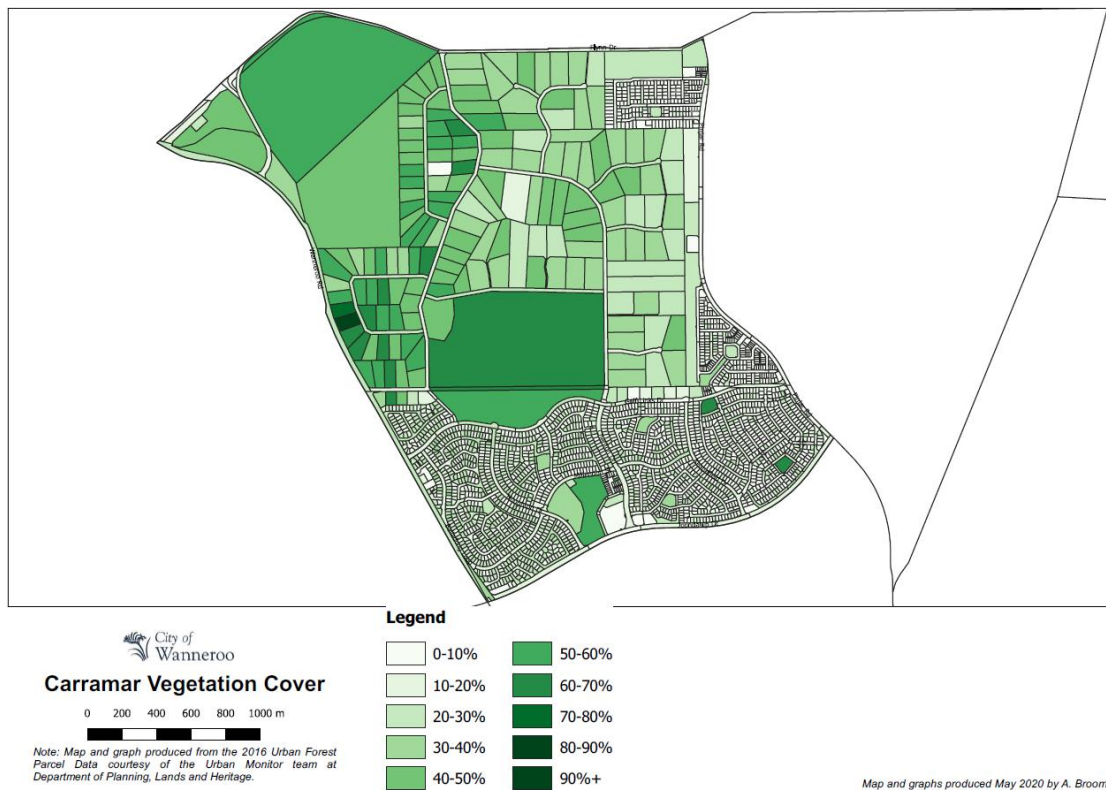
The newer suburbs in the City comprising higher density typologies feature less tree canopy cover (i.e. 3m+ trees). There are many reasons for this, particularly the predominant engineering practice of large-scale earthworks and clearing prior to creation of lots and roadways, which increasingly leaves insufficient room for tree plantings. New trees planted at less than 3m in height tends to result, particularly in new coastal suburbs.

The Urban Forest Strategy needs to consider more than just tree canopy. Vegetation cover is also critical in addressing heat island effects and the retention of biodiversity.

Total Vegetation Cover

In this strategy vegetation cover includes all vegetation and is measured in increments of 0-3m, 3-8m and 8-15m and 15m and above. Vegetation cover also includes canopy cover. The City's website provides detailed maps illustrating the existing vegetation cover for all of the City's suburbs.

The City has substantial areas of vegetation types at less than 3m in height, most noticeably the vegetation towards the coastal suburbs. While this vegetation contributes to total vegetation cover, it does not add to the City's total canopy cover (which is 3 metres and over). Figure 3 below provides an example of the distinction between canopy versus vegetation cover in the suburb of Carramar. This illustrates Carramar as a suburb that is rich in vegetation cover but relatively poor in total canopy.

Legend

	0-10%		50-60%
	10-20%		60-70%
	20-30%		70-80%
	30-40%		80-90%
	40-50%		90%+

City of Wanneroo

Carramar Vegetation Cover

0 200 400 600 800 1000 m

Note: Map and graph produced from the 2016 Urban Forest Parcel Data courtesy of the Urban Monitor team at Department of Planning, Lands and Heritage.

Map and graphs produced May 2020 by A. Broome

Legend

	0-10%		50-60%
	10-20%		60-70%
	20-30%		70-80%
	30-40%		80-90%
	40-50%		90%+

City of Wanneroo

Carramar Canopy Cover

0 200 400 600 800 1000 m

Note: Map and graph produced from the 2016 Urban Forest Parcel Data courtesy of the Urban Monitor team at Department of Planning, Lands and Heritage.

Map and graphs produced May 2020 by A. Broome

Figure 3 - Comparison Example of the Suburb of Carramar showing a difference between Tree Canopy Cover and Vegetation Cover

Urban Heat Islands

Heat islands can be created by hardstand and concrete and they are characterised by uncomfortable and potentially life threatening heat conditions, less attractive areas for community and an increased need for increased cooling and corresponding energy consumption.

The Commonwealth Scientific and Industrial Research Organisation thermal imagery indicates the approximate temperature change since urbanisation to be in a range from 'no change' to more than 8°C hotter in Australian urban environments. Maps illustrating the urban heat island effect for each suburb in the City are available on the City's website.

It is now widely accepted that increased housing density and design correlates to warmer urban environments, for instance higher densities result in increased hard surfaces that reflect heat, and buildings with dark rooftops generally result in increased temperatures.

By contrast, areas with sufficient vegetation cover show up as cool-to-no change since being urbanised, but as vegetation is removed or land remains as open pasture, temperatures increase significantly. This emphasises the need for the UFS to increase canopy and vegetation cover to help mitigate temperature increases resulting from urbanisation. The data also helps guide where retaining or re-establishing plant canopy and vegetation should be focussed, and the areas that should be prioritised through the City's tree planting program.

City of Wanneroo
Urban Heat Islands

Note: Map produced from the 2015/16 Urban Heat Island data courtesy of the Commonwealth Scientific and Industrial Research Organisation

Approximate temperature change since urbanisation ° C

| <0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8+ |
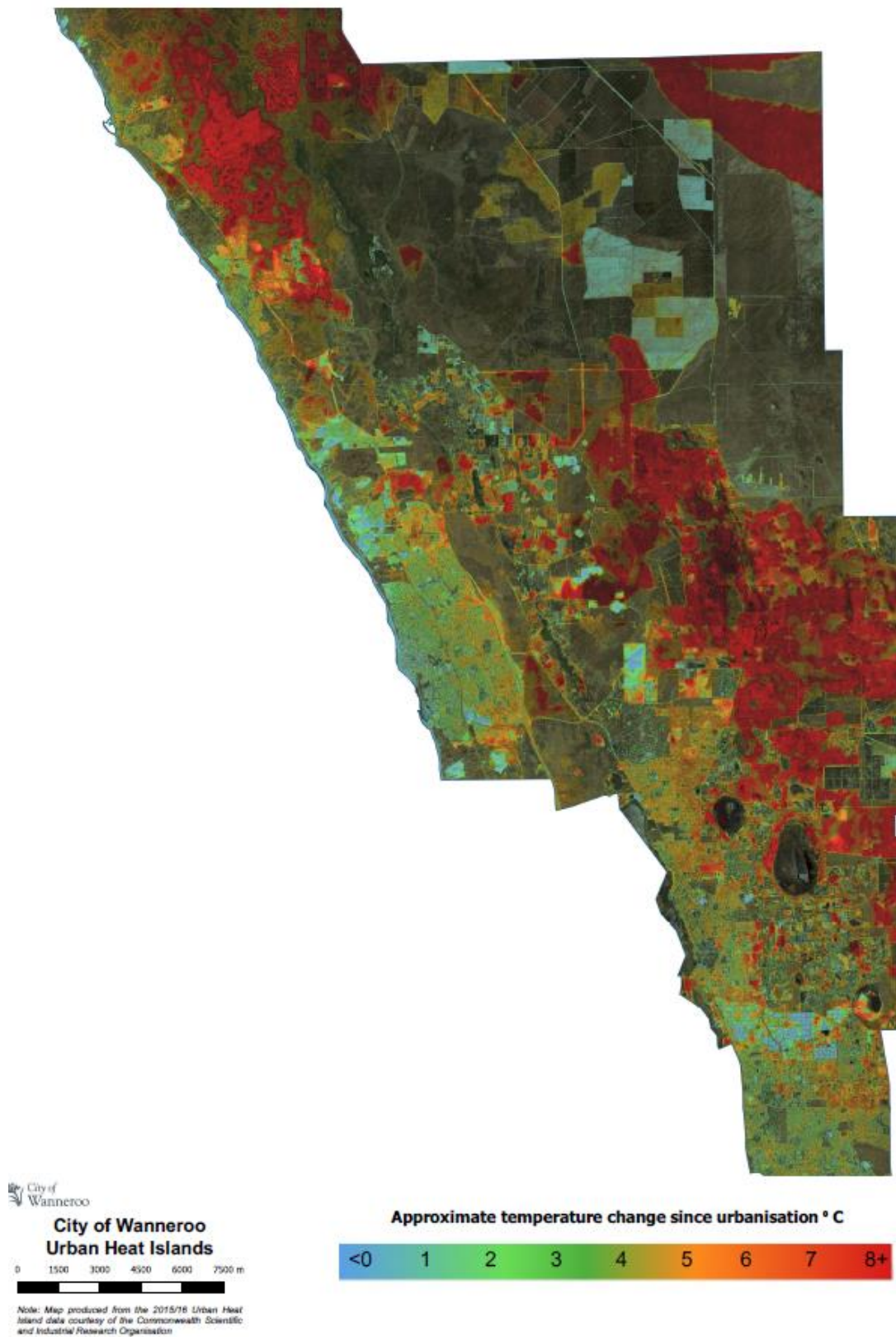
Figure 4 – City of Wanneroo Urban Heat Island Map

The overview map of the City shows large temperature increases where there has been vegetation removal by urbanisation, fire and pine harvesting. Older suburbs are typically

cooler than newer suburbs due to the presence of established tree canopy and vegetation. Rural residential areas, irrigated market gardens and public open spaces show very little temperature increase. Areas immediately adjacent to the coast show a zero increase in temperature given the cooling effect of the proximity to the ocean. Industrial areas with large lighter roofed buildings and the use of heat reflective coating reflect heat very well, resulting in these areas being cooler, demonstrating the cooling effect that some design elements can achieve.
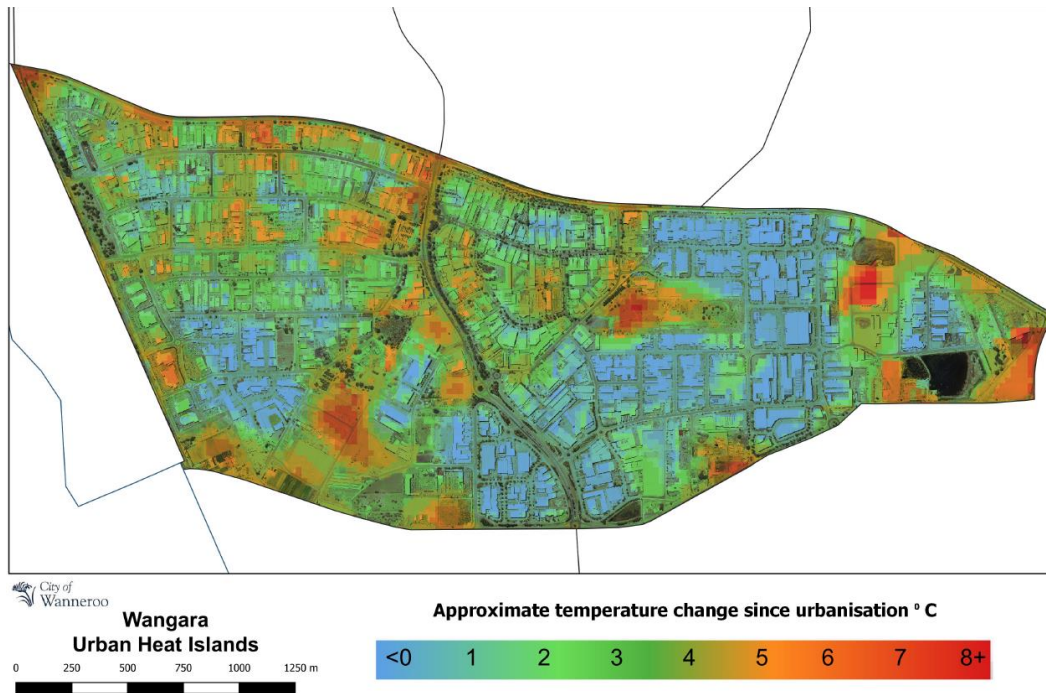
Figure 5 – Wangara Urban Heat Island Map

Figure 5 shows Wangara temperature increases since urbanisation, and also demonstrates the cooling effect of reflective roofing in industrial areas.
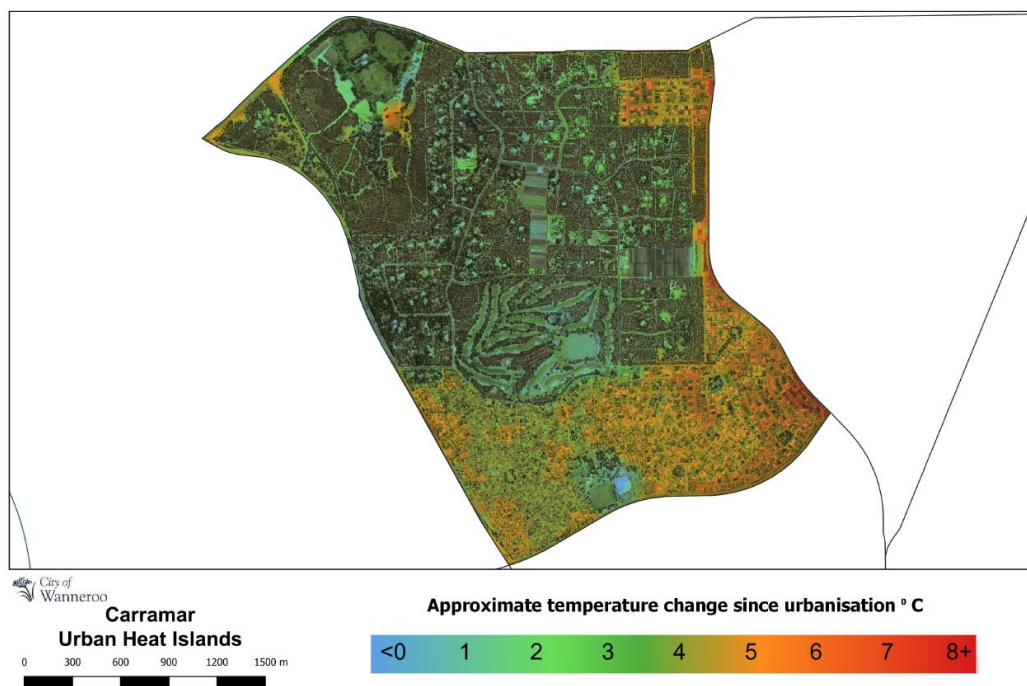
Figure 6 – Carramar Urban Heat Island Map

Figure 6 shows the contrast between highly vegetated areas within Carramar special rural zone and the increased temperatures where urban development has been introduced in the south of the suburb.
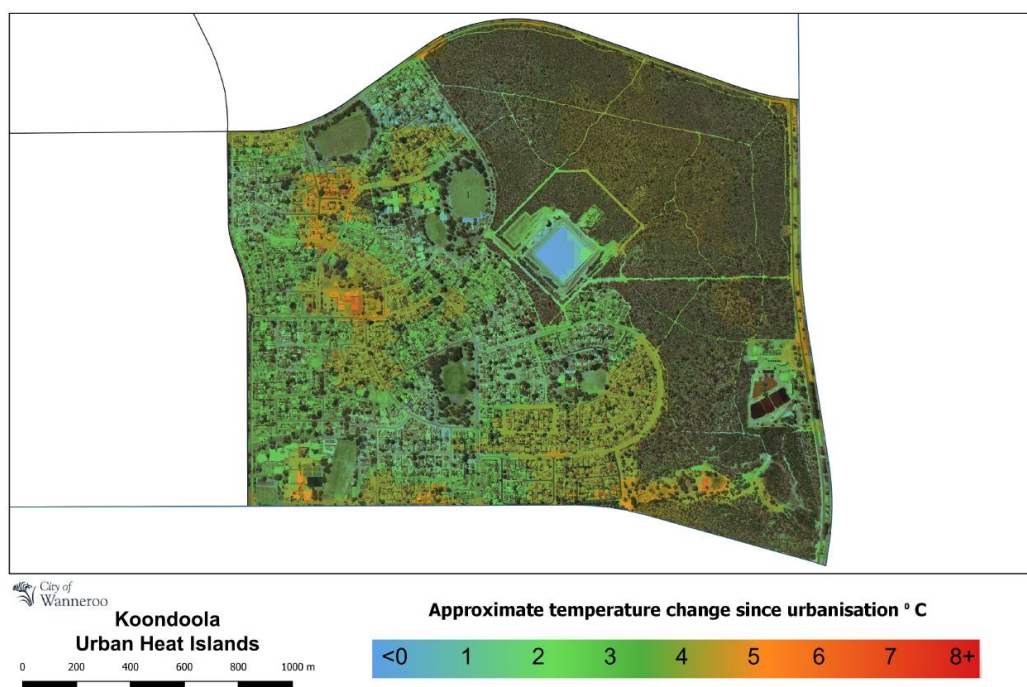
Figure 7 – Koondoola Urban Heat Island Map

Older suburbs such as Koondoola (shown in Figure 7) are shown as being relatively cooler than newer suburbs, but have the potential to increase in temperature due to infill urbanisation. Koondoola also benefits from the buffer around Water Corporation land and regional reserve.

Street Tree Audit

Through the City's Street Tree Audit, 30,344 trees have been audited to date and 14,099 opportunities for planting trees within streetscapes identified and mapped. It is estimated that the audited trees represent a combined valuation of $132 million based on Halliwell evaluation.

The City plants approximately 3000 trees annually of which approximately 1000 are requested by ratepayers for street verges and the rest of the tree planting locations chosen by the City. Species selection involves a number of factors including location, species requirements, amenity and preferences such as themed streetscapes or feature trees. Once planted the trees are watered over at least two summers.

The Street Tree Audit Data, along with the City's LPP 4.8 Tree Preservation and Street Tree Policy, will inform the City's efforts in establishing green corridors and the potential retention of significant trees as part of the planning and development process.

Figure 8 – Street Tree Audit: Example of Resident Requested Verge Trees

Continuation of the Street Tree Audit into the future will allow the City to track its progress on UFS targets and actions, and will provide further weight to decision making when it comes to prioritising future tree planting locations.

Culturally Significant Trees

Trees recognised as being potentially significant may be of outstanding size and appearance; may be rare for the site, or have a historical association within the community (which includes trees of Aboriginal and European significance). At this time, trees are only noted for being potentially significant. This can be the basis for a future significant tree register.

Planting Opportunities

The City is far more able to retain, protect and enhance vegetation and tree canopy over land that it has direct ownership or control.

One example of City managed land is drainage sumps. There are 316 drainage sumps under the City's management that, in the majority of cases, comprise of unvegetated bare ground which contributes significantly to heat island effects. Looking for opportunities to plant tree canopy into sumps can help strengthen green corridors to enhance biodiversity, provide bird habitat, increase local amenity and improve neighbourhood character, contribute to overall tree canopy and help lower temperature in the surrounding environment.

While it is acknowledged the prime purpose of sumps is for managing surface drainage, it is worth investigating opportunities to integrate of tree plantings into drainage areas such a way that effective maintenance of sumps is not compromised.

An example of a number of sumps in the suburb of Alexander Heights (Figure 9) illustrates opportunities for establishing a green connecting corridor by planting trees in a series of appropriately located sumps. Opportunistic planting in drainage areas (where appropriate) may compliment planting of trees within parks and streetscapes, contributing to an enhanced urban forest.

Figure 9 – Alexander heights – Drainage sump connectivity

5. OBJECTIVES

To protect and improve its urban forest in line with the vision set out in the UFS the City will endeavour to measure its progress and relative success against a range of appropriate objectives. These objectives would be met through the undertaking of recommended initiatives set out in Section 6.

Due to the complex and diverse land use typologies and geographies in the City specific targets are yet to be confirmed, despite the detailed assessment of data referred to in the previous section. Future work will be undertaken to set specific and achievable targets that align with 'on-ground' realities and the City's financial and resource capacity. This further work will be undertaken in future reviews of the Strategy.

Each objective is outlined below:

1. Achieve no net loss of canopy cover in established suburbs

It is proposed that the following suburbs in the City either increase their canopy cover, or demonstrate no net loss, by 2040. The suburbs selected include the City's more established residential areas (i.e. establish/ developed suburbs with over 5% canopy cover) and align with the larger lot 'typologies' examined in Section 4. Table 1 indicates current tree canopy cover levels in each of these selected suburbs, and illustrates the significant variability.

SUBURB	% TREE CANOPY (APPROX.)
Alexander Heights	7.17%
Ashby	10.13%
Carabooda	11.84%
Carramar	16.34%
Clarkson	5.68%
Girrawheen	12.64%
Gnangara	5.10%
Jandabup	8.47%
Koondoola	11.30%

Madeley	7.19%
Marangaroo	10.69%
Mariginiup	13.71%
Mindarie	16.39%
Neerabup	12.20%
Nowergup	7.39%
Quinns Rocks	5.98%
Sinagra	9.92%
Tamala Park	19.83%
Wanneroo	16.59%
Woodvale	17.70%
Yanchep	15.71%

*Table 1 – Suburbs where the City aims to achieve no net loss in total tree canopy by 2040*

2. Progressively increase total canopy cover for the City within a range of 15-20% by 2040

The current total percentage of canopy cover for the City is 9.88%, which is less than optimal. As such, the City aims to increase this to 15-20% canopy cover by 2040. This objective is based on the City's existing land uses as well as the opportunities and constraints that are presented by the City's environment and setting.

Importantly, the objective considers the City's status as a 'growth council' which experiences substantial development in line with significant population growth.

3 Progressively increase canopy cover to a minimum of 5% for identified suburbs by 2040

This objective focuses on City managed land, specifically through the City's Street Tree Planting Program. The following methodology has been used to determine the priority for street tree planting in the City:
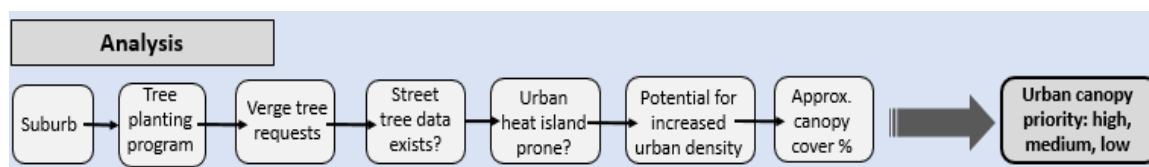
Figure 10 – Proposed Street Tree Planting Prioritisation

The program will firstly focus on suburbs of less than 5% tree canopy cover for which street tree survey data is available. Secondly, once an overall minimum of 5% tree canopy cover has been achieved in each of the identified suburbs, that the focus then change to addressing larger heat island areas outside of these suburbs. Beyond this, the UFS will aim for a gradual increase in tree canopy up to 15-20% over the long term.
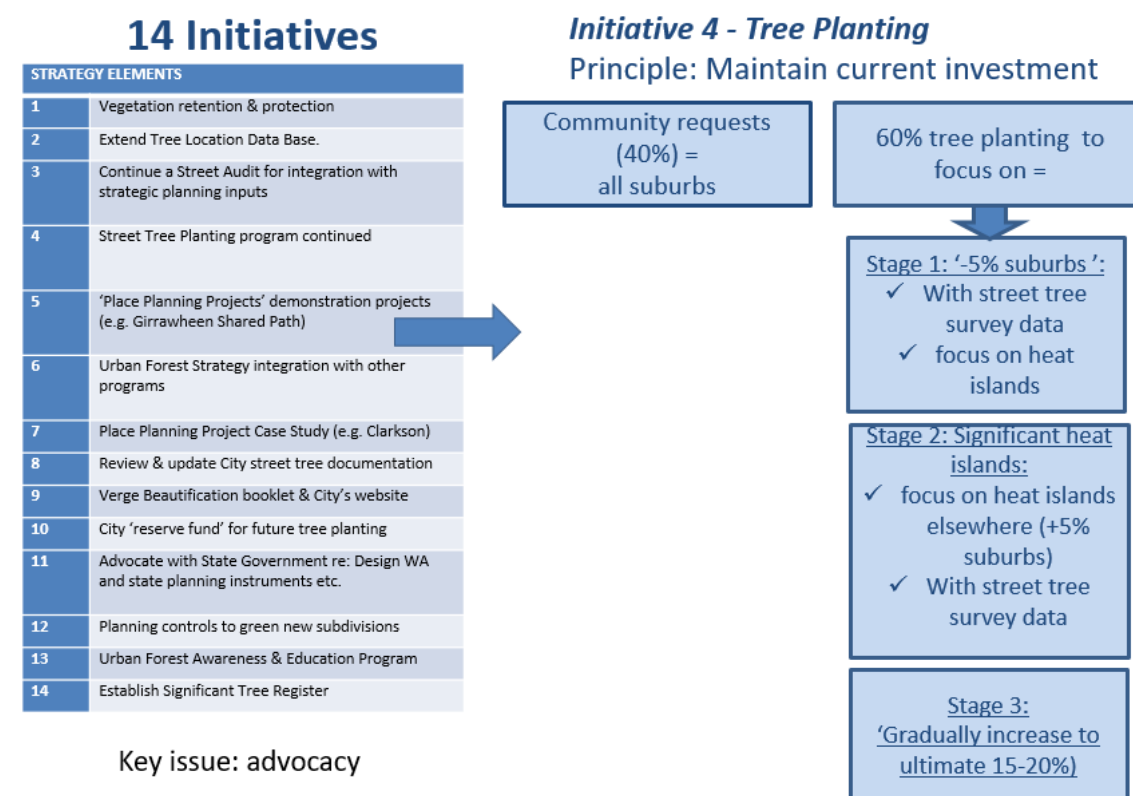
Figure 11 – Staged approach to increasing canopy cover over time through tree planting.

Appendix 1 provides a more detailed explanation of the methodology for determining priority locations for applying UFS initiatives including street tree planting, the ultimate aim being retention and reinstatement of urban canopy.

The following table identifies key suburbs that the criteria for tree planting will be applied to.

SUBURB	% TREE CANOPY
Banksia Grove	3.68%
Butler	1.71%
Darch	3.45%
Hocking	4.36%
Landsdale	3.74%
Merriwa	4.14%
Pearsall	3.01%
Ridgewood	2.79%
Tapping	4.96%

Table 2 – Suburbs where the City aims to achieve more than 5% total tree canopy by 2040

City managed land within these areas is a priority for tree planting as they currently display the lowest canopy cover across the City, which is largely due to ongoing development in these areas as a result of population growth.

4.   Progressively increase canopy cover on City managed land to approximately 10% by 2040

The City manages 6942.3ha of land which includes street verges and public open space where tree assets can be supported. The total tree canopy cover for City managed lands is 7.74% (the total canopy for all land in the City is 9.88%). Given the City's direct control over such land areas, there is exceptional opportunity to increase canopy in road reserves (street landscaping), public open space, public access ways and drainage sumps. Attention will be given to avoiding any conflict between retention of trees versus useable recreational space, in designated public open space.

Monitoring and review

A review of the Plan will be undertaken over the first 5 to 10 years of UFS implementation, depending on the availability of new data, confirmation of targets (where applicable), and progress made towards the objectives set out in Section 5. The review will re-examine objectives and recommended initiatives as required to meet refined targets.

6. RECOMMENDED INITIATIVES

The following initiatives have been developed to achieve the objectives of the UFS. All initiatives listed in the following table aim to improve and protect canopy cover across the City over the short, medium and long term. They are diverse in nature to meet the various contexts and challenges identified in this UFS.

While some initiatives are current and ongoing, or can be undertaken in the short term, others are long term initiatives and in many cases still need to be developed and refined.

Table 3 - Initiatives

	RECOMMENDED INITIATIVE	DESCRIPTION/ EXPLANATION	TIMING / PRIORITY	TASK AND PROGRAM IMPLICATIONS
1	Vegetation retention & protection	Incorporate vegetation protection strategies (e.g. UFS, LBP etc.) into the City's urban planning instruments & procedures.	Ongoing	Will require effective translation of provisions in the Urban Forest Strategy, Local Biodiversity Plan, etc. into several of the City's key instruments and procedures in order to achieve the key aims of this strategy element. These instruments include: scheme provisions, development approval procedures, coordination of developer agreements and handover of assets, etc.
2	Extend Tree Location Data Base	Essential data to be able to provide inputs & metrics to tree protection retention, establishment & maintenance initiatives.	Ongoing	Trees are a very diverse resource with varied characteristics (e.g. type/species, age, physical dimensions above and below ground, water regime dependency, lopping/pruning needs, pest/infestation issues, etc.) and therefore have differing value and maintenance requirements, etc. This resource can be better managed if its various characteristics are appropriately documented.
3	Continue a Street Audit for integration with strategic planning inputs	Essential data to be used in combination with various strategic planning inputs, e.g. urban heat island mapping, urban residential density patterns, urban infill intentions, urban airway ventilation, local biodiversity plan objectives, water sensitive urban design objectives, etc.	Ongoing	The tree planting program is guided by reliable survey data: i.e. tree location, where planted to date, where there are vacant sites suitable for planting trees, etc. The data-base enables identification of KPIs of achievement to date, progress throughout the City, shortfalls in the program, etc. This data-base can therefore assist the overall urban forest program, in combination with other analytics (urban lot density, street/road reserve widths, heat islands, etc.) to guide a 'strategic approach' to street tree planting (i.e. where most needed and most practical).
4	Street Tree Planting program continued & expanded	Continue & expand the existing street tree planting program, as data becomes available, & urban development proceeds.	Ongoing	Continuation of an essential program at agreed levels of expenditure, in accordance with the City's annual budgeting process and dependant on water availability.
5	'Place Planning Projects' demonstration projects (e.g. Girrawheen Shared Path)	Place Planning Projects provide opportunity for excellent demonstration projects: for 'urban greening' & urban canopy retrofit in hardscape dominated precincts (commercial, industrial,	Short term	This initiative involves the use of existing 'place management' initiatives as 'demonstration projects' to convey the advantages of 'good design', and is intended to take advantage of existing 'place-making' activities underway in the City.

			infrastructure, residential) & engaging key stakeholders (land owners, institutions, Developers).
6	Urban Forest Strategy integration with other programs	Urban Forest Strategy to utilise & integrate with various other allied initiatives, e.g. City Waterwise program, Climate Change Adaptation & Mitigation Strategy, Sustainable Schools Program, etc.	Short term	The UFS is a key 'sub-program' to the Local Environmental Strategy and an allied program to the City's Climate Change Adaptation and Mitigation Strategy, the City Waterwise Program, and other initiatives. The UFS therefore supports other programs the City is committed to.
7	Place Planning Project Case Study (e.g. Clarkson)	Opportunity for specific urban greening & canopy retrofit in the Clarkson Railway Precinct development.	Medium term	A specific 'demonstration project' of an existing site almost entirely devoid of trees/planting, provides the opportunity to explore the practicalities and opportunities for retrofitting tree plantings, and re-establishing much needed urban canopy to counter the excessive occurrence and health impacts of urban heat islands.
8	Review & update City street tree documentation	Integration, update & implementation of relevant policies, guidelines etc. (e.g. street verge guidelines, street tree species list etc. and Tree Preservation Policy).	Medium term	Sufficient data to be gathered and available, to help achieve more effective design outcomes through improved guidelines policies and regulatory instruments.
9	Verge Beautification booklet & City's website	A finalised Verge Beautification booklet to be combined with interactive GIS mapping & published (with other relevant materials) on City's website.	Medium term	Agreed landscape design guidelines for street verges to guide an agreed approach to acceptable design for verges and streetscapes. This will involve effective communications and promotion of final guidelines, appropriate to location, conditions and setting – hence suggested publication on the website. Finalised guidelines are intended to be made available on the City's website in due course.
10	City 'reserve fund' for future tree planting	Establishing a 'reserve fund' for tree planting & landscaping in new developments, in consultation with developers and stakeholders.	Medium term	To be pursued through discussion and negotiation with key stakeholders. This is an extension of strategy element 5 (above).
11	Advocate with State Government re: Design WA and state planning instruments etc.	Investigate & advocate to State Government & other stakeholders changes to Design WA and the WAPC requirements for subdivision & development, & incorporating any changes into a suitable planning mechanism or design guideline for the City.	Long term	A significant UFS strategic initiative relevant to all the extensive areas designated for future 'urbanisation' in the City. The intent is to counter the unintended impact of contemporary 'urban design' that too often is resulting in 'DESIGNING TREES OUT OF THE URBAN ENVIRONMENT'. The initiative will require an advocacy program with the state government/WAPC, the UDIA and all major developers, HIA and other relevant sectors. The core challenge is to address the deficiencies of existing adopted guidelines, such as the Residential Design Codes, and to address the current approach to residential subdivision design and housing architecture. Two primary issues are involved: (i) the prevailing industry, community and institutional 'culture' or value system that accepts current outcomes of limited or non-existent urban canopy: (ii) prevailing business practice that militates against innovation and vital urban design and architectural adaptation to climate change trends and scenarios. This initiative will require a sustained effort over a considerable period.

12	Planning controls to green new subdivisions	Investigate and establish mechanisms / TPS provisions to ensure all developers install & maintain a minimum of 1 tree per lot in all new residential subdivision developments.	Long term	Installing and maintaining 1 tree per lot is a clear objective, but will require engagement with key stakeholders to achieve a range of pre-requisites to enable success. These include the addressing the issues of road reserve widths, road carriageway design, sub-surface infrastructure installation in road reserves and road verges, vehicle cross-overs, useable private 'open space' at varying lot size and residential densities, etc.).
13	Urban Forest Awareness & Education Program	To address the vital aspect of 'community awareness' with relevant educational & advisory material/information. This is key to the success of any urban forest strategy (e.g. changing attitudes to trees, etc.).	Long term	Research and practice throughout Australia indicates that 'education and awareness raising programs' are an essential aspect of successful urban forest/urban canopy strategies, plans and programs. There are varied positive and negative community attitudes to street trees. These include misconceptions around health and safety issues, as well as practical issues for trees in close proximity to built structures (i.e. perceived nuisance factors e.g. leaves in gutters, bird droppings on parked cars, root damage to below ground pipe-work, etc.). An education program is important to convince residents that the tangible benefits of urban canopy far outweigh the perceived negatives. This initiative will be ongoing.
14	Establish Significant Tree Register	Include Significant Tree Register in LPP No.3 & other planning instruments (e.g. LPS, LPPs etc.).	Long term	There are grounds for special protection of notable 'trees or stands of trees' in their own right, and where they make a significant contribution to the quality of urban and non-urban landscapes. There is additionally the significance of 'eco-system services' notable trees or stands of trees contribute to the built as well as natural environment (e.g. shade, habitat, micro-climate modification, etc.). The challenges in achieving this initiative include: developing sound or defensible criteria for nominating a 'significant tree or trees'; defining meaningful intent of registering significant trees; and, enforcing/monitoring a Significant Tree Register.

7.   KEY MESSAGES

A key component of the Urban Forest Strategy is to present a series of messages for the City to incorporate into a communications plan for all stakeholders which includes the community, Council and the development industry. Behaviour change towards trees, design changes for development and increased canopy cover will only occur if all stakeholders have an understanding of what the UFS is trying to achieve and the science and messages behind the Strategy's objectives.

Examples of messages, or what may be called 'tag-lines', include:

Community

- Trees improve our health and wellbeing;
- This is for everyone, for the good of all;
- What's in it for the resident;
- Convey the CRC Water Sensitive Cities research findings;
- Urban forest can reduce the cost of living, improve quality of life and wellbeing (there is evidence from studies on mental health and trees/greenery), improve air quality and combat the effects of those causing climate change; and
- Trees make ordinary places great.

Council

- Everyone loves trees and being in leafy places – why wouldn't we want that for Wanneroo?
- An urban forest is a complicated ecosystem and needs to include more than just trees to be healthy and productive;
- It won't work unless everyone is on board – residents through to State Government must drive change and empower LGA's and the community to achieve better outcomes;
- Without trees we cannot move into sustainable, innovative, Smart City ways of living that we urgently need in the face of climate change – once trees are gone it's a long and expensive process to replant and replace them;
- The City takes this seriously and we mean what we say, and are going to act;
- Key – urban forest is strategically planned (location and distribution) to create effective canopy cover and green connectivity – and not just plant randomly wherever possible; and
- Without a plan/strategy we risk losing the canopy cover we have.

Development

- Wanneroo has lots of great trees – we need to protect them but also plant more;
- Vegetation has far more positives than negatives;
- Think about the last time you sat under a tree – places to do so are fewer and far between, yet it's the by far the highest community priority in our engagement for Local Area Planning to date;
- We need to use what influence/power/financial resources are available to retain trees, buy trees, and secure natural landscapes and nature – we cannot rely on market forces to provide it; and
- Look at Wellard and other examples of successful new developments in WA where urban forest and 'green amenity' is happening (more meaningful than overseas examples).

8. REFERENCES

202020 Vision – How to grow an urban forest

Australian Standard 4970- 2009 – *Protecting trees on development sites*

City of Wanneroo – *Local Biodiversity Plan 2018/19-2023/24*

City of Wanneroo – *Local Environmental Strategy 2019*

City of Wanneroo - *Strategic Community Plan 2017-2027*

Department of Planning Lands and Heritage - *Perth and Peel Green Growth Plan for 3.5 million.* Released March 2018
CRC for Water Sensitive Cities - *Impacts of water sensitive urban design solutions on human thermal comfort*

Dept. PLH, WAPC and WALGA – *Better Urban Forest Planning – A guide to support the enhancement of urban forest in Western Australia.*

Dept. of Planning and WAPC - *The Urban Forest of Perth and Peel Statistical Report (CSIRO 2009 Urban Monitor)*

Dr. Roel Plant The University of Technology Sydney (2017) *Measuring Urban Green Space in Australia (MUGS)*

K. Murugesan, "Extreme Heat Events: Extreme heat events adaptation for activity centres through built form and landscape" (Yanchep, City of Wanneroo case study), Master Research Thesis, 2019, AUDRC, UWA.

Playscapes – *Tree Routes – A community based project to grow greener streets in the City of Wanneroo*

Appendix 1: UFS Street Tree Planting Priority Assessment

The street tree planting program is a City wide initiative, undertaken according to available budget and street tree audit program to identify sites suitable for planting. Identifying the most appropriate locations for new street tree planting in any given time is necessary. The following table and text provides an explanation of the approach to identifying the highest priority suburbs and most practical locations for establishing urban canopy through ongoing street planting program, at any given time. It is a guide, only. Note that the Verge Tree Request program is additional to this.

1	2	3	4	5	6	7	8
SUBURB	Tree Planting Program	Verge Tree Requests	Street Tree Data Exists	Urban Heat Island Prone? [extensive High to Moderate risk]	Increase in Residential Density? [<400m^2 lots exist]	Approx. Canopy Cover % [< 5%]	URBAN CANOPY Priority High Medium Low
Alexander Heights	yes	yes	yes	20% Low		21%	Low
Darch	yes	Yes	Yes	40% Mod to High	<400m^2	3.5%	High
Girrawheen	yes	Yes	Yes	5% Low	Yes	12%	Medium
Gnangara		Yes		5% Mod to High		11%	Low
Koondoola	yes	Yes	Yes	5% Low	Yes	11%	Medium
Landsdale	yes	Yes	Yes	50% Mod to High	<400m^2	3.7%	High
Madeley	yes	Yes	Yes	15% Mod		7.2%	Medium
Marangaroo	yes	Yes	Yes	2% Low		11%	Medium
Woodvale	Yes	Yes	Yes	59% High (v small)		18%	Medium
Wanneroo	Yes	Yes		10% Mod to High	Yes	17%	Medium
Tapping		Yes		95% Mod to High		5%	High
Carramar		Yes		30% Mod		16%	Medium
Sinagra		Yes		60% High	<400m^2	10%	High
Pearsall	Yes	Yes	Yes	50% Mod to High	<400m^2	3%	High
Mariginiup		yes		60% Very High		14%	Medium
Jandabup		Yes		40% Very High		8.5%	High
Hocking	Yes	Yes	Yes	40% Mod to High	<400m^2	4%	High
Banksia Grove		Yes		90% Mod to High	<400m^2	4%	High
Ashby		Yes		60% Mod to High		10%	High
Butler	Yes	Yes	Yes	15% Mod	<400m^2	2%	Medium
Mindarie	Yes	Yes	Yes	90% Low	<400m^2	4%	Medium
Quinns Rocks		Yes		95% Low	Yes	6%	Low

Suburb							
Clarkson	Yes (part of)	Yes		40% **Mod to High**	**<400m²**	7%	**Medium**
Ridgewood		Yes		20% Low	**<400m²**	3%	**Medium**
Merriwa		Yes		90% Low		4%	**Low**
Alkimos		Yes		n/a	Substantial Urban or Rural zones yet to be developed	1%	n/a
Eglinton		yes		n/a (90% Low)		4%	n/a
Yanchep		Yes		n/a		16%	n/a
Jindalee		Yes		n/a (90% Low)		0.6%	n/a
Two Rocks		Yes		n/a (90% Low)		5%	n/a
Carabooda		Yes		n/a		12%	n/a
Pinjar	Predominantly undeveloped rural, public purposes, natural environment/regional parks, or industry – i.e. Generally A MINOR PROPORTION CURRENTLY DEVELOPED AS URBAN RESIDENTIAL therefore street tree planting opportunities limited.					4%	n/a
Tamala Park						20%	n/a
Neerabup						12%	n/a
Nowergup						7%	n/a
Wangara						3%	n/a

Table 4 - Suburb Comparison of Relevant Criteria.

The table summarises a range of key attributes relevant to any consideration of forward Street Tree planting and, by virtue of various implications forward thinking to guide Urban Forest strategy initiatives. All 36 suburbs are included in the table.

Suburbs highlighted in grey (column 1) are those only partly developed with substantial 'greenfield' areas yet to planned in detail, or with substantial rural and natural (regional park/ROS) land areas. They will generally be subject to future strategic urban forest initiatives, yet to be formulated. An issue in all cases is future detailed urban residential planning to make provision for retention of urban canopy, and to avoid 'designing trees out of the urban setting' resulting from small lot, high density residential areas with inadequate street verges and insufficient road reserve dimensions.

Suburbs highlighted in yellow (column 1) are mainly developed urban areas. The current street tree data audit (column 4) coverage and street tree planting program (column 2) apply to these suburbs. The data includes existing street trees (and their condition etc.) and vacant sites suitable for planting additional trees. Both data sets are included in the City's Intramaps. This is essential data.

Column 3 indicates the 31 suburbs subject to requests for street trees. The number of requests from suburbs ranges significantly. This is a separate program to the Street Tree Planting Program.

Columns 5, 6 and 7 provide an analysis of relevant attributes of the suburbs to help inform future priorities for establishing urban canopy and, by association, programming of future street tree planting and other 'urban greening' initiatives (e.g. trees on private property and City owned or controlled land, etc.). It is noted that various other criteria may be just as important.

A 'coarse' assessment of areas prone to Urban Heat Island Effects (UHIE) indicates suburbs most prone to UHIE (highlighted in purple). Those identified have large areas or proportion of the total suburb with moderate to high temperature thermal mapping

characteristics. Those highlighted are mainly older, developed suburbs located further inland and to the south of the City. Coastal residential suburbs tend to have lower temperature UHIE characteristics.

Urban density is a key issue. Column 6 identifies suburbs with higher residential (R-Code) density changes and likely to experience 'urban infill'. Similarly, suburbs with residential lots at 400m2 or less are identified. A shift to increased densities in older 'leafier' suburbs will see loss of urban canopy (on private lot and streetscape). Existing small lot areas have less street trees and less opportunity for additional planting.

Column 7 provides a summary of existing urban canopy cover (i.e. trees on private land, in parks/open space, and streets, etc.) as a percentage of each suburb. The data is 'coarse' and interpreted with caution. Thermal mapping imagery has been 'ground-truthed' against on-ground conditions and land use typologies. The resulting analysis is consistent with anticipated correlation between: areas of lower percentage canopy and with more recently developed small lot/higher density residential subdivisions, and being UHIE prone.

On the basis of the above, column 8 identifies the relative priority (high, medium, low) for expanding urban canopy in 25 suburbs. Initiatives to achieve this will focus on tree planting and tree retention, and additionally a range of other urban forest/urban canopy approaches will be required to address a range of issues and challenges. The latter includes: urban subdivisional design, residential development controls, urban ventilation and breeze-ways, solar access, street and lot orientation, verge design and infrastructure placement, community education and awareness raising, etc.

The remaining 11 suburbs (highlighted grey) all require application of various urban forest strategy initiatives to ensure sufficient future urban canopy is secured, but this will be largely over time as future development occurs. Given the forward planning context involved the most effective tools or approaches in each case are yet to be determined.

Overall Methodology – Assessment for Identifying Priority Locations for Urban Vegetation and Urban Canopy Initiatives

The following graphic illustrates the overall methodology for prioritising locations for urban forest strategy initiatives over time.

This methodology has been developed to address the particular characteristics of outer metropolitan councils, where there are a wide range of land use typologies from rural, to current urbanisation, through to developed suburbs.
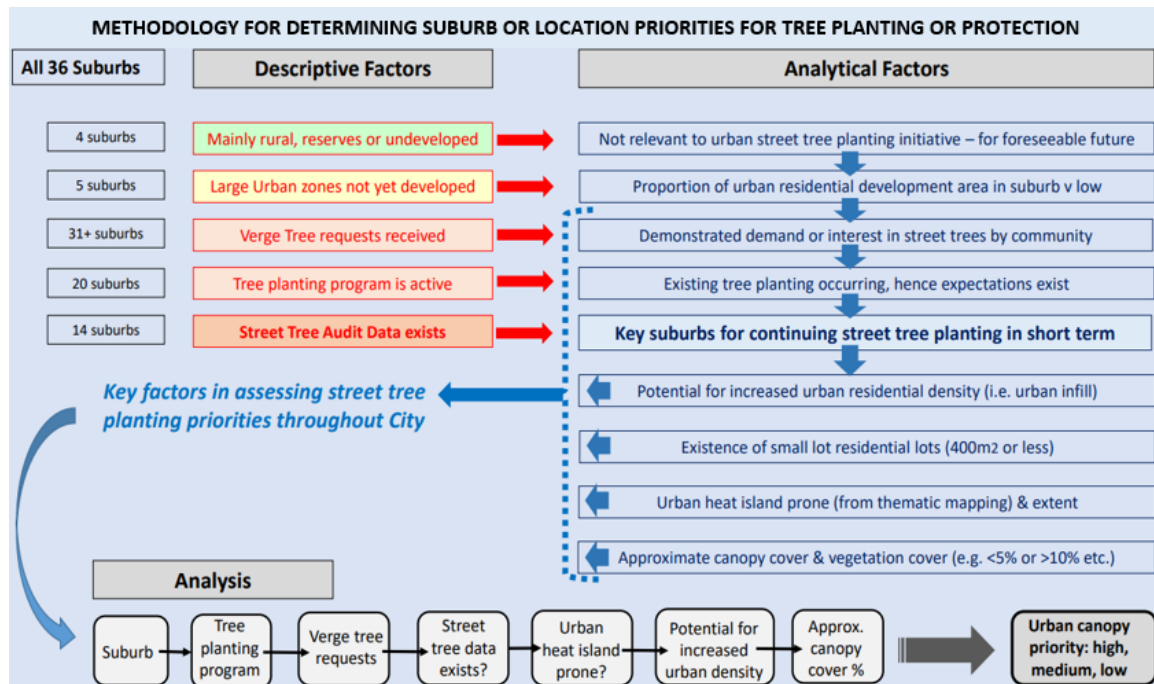

Figure 12 - General Methodology for Determining Priority Locations
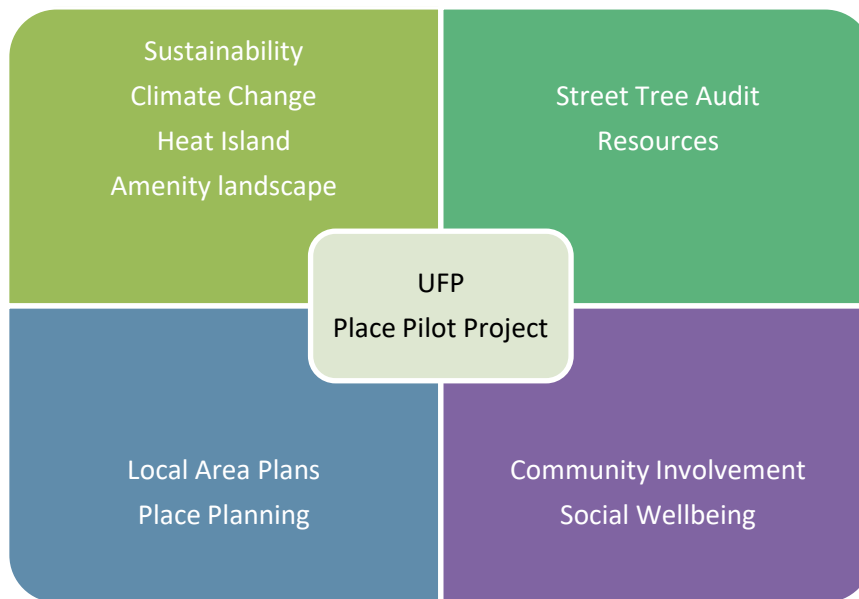
Appendix 2: Place Management & Urban Forest

The City of Wanneroo developed a Place Framework in 2017/18 to guide the initial implementation of a place approach here at the City. Place development shapes the vision for the look and feel of a place, creating and enhancing distinctive spaces on identity. Trees and vegetation are integral to shaping the feel of a community, and thus there is a strong connection to place management and the Urban Forest Strategy.

The City's Place Management Team conducts Community Place Profiles (surveys) that inform Local Area Plans. These community surveys provides clear advice on what the community believes are priorities for their area.

The Local Area Plan – Girrawheen and Koondoola shows the community values trees and parks as a priority, and the strong support for protection and improvement of an urban forest in the local area. Because they are older suburbs, Girrawheen and Koondoola will experience infill development and therefore opportunities must be sought to minimise canopy loss and identify the potential for canopy replacement and enhancement.

Community workshops and surveys conducted by Place Management for the suburb of Wanneroo showed sustainability, parks and trees as the key priority for what the community demonstrates is most important to them.

The Urban Forest Strategy significantly aligns with Town Teams, a Place Management Project which is a model for sustainability and longevity to space activation. An example of this space activation is Clarkson business precinct that would benefit from tree canopy planting in its street revitalisation project.

Figure 13 - Integrated elements to Place Management and Urban Forest

Appendix 3: Case Studies

Place Case Study One – Girrawheen Avenue Shared Path Project

The City's Strategic Community Plan focusses on improving the distinctiveness of neighbourhoods, strengthening local character and improving awareness of features, priorities and needs. Council has adopted a 'place approach' across the City to guide this challenge, and the Girrawheen Koondoola Local Area Plan (2019) is one example of this approach.

In this example, multiple priorities (e.g. accessibility, legibility, safety, sense of place, etc.) are involved with the Girrawheen shared path to run along Girrawheen Avenue and Hudson Avenue, connecting two important activity areas. The route identified, with direct community engagement, connects Girrawheen Senior High School, two primary schools, shopping and commercial centres and community facilities. There will be further exploration of tree planting and place activation opportunities with residents and stakeholders.

Main project findings to date are that substantial 'on-ground' opportunities to protect notable trees and reinstate new tree plantings with sensitive and response landscape design/civic design treatments exist, and for multiple functional and amenity outcomes to be achieved. This will include a focus on the introduction and care of native trees that would provide much needed shade, attract birds, allow potential introduction of fruit trees that could be cared for and harvested by local residents, and planting of under-storey to support habitat and diverse eco-systems.

The City will apply a multi-disciplinary approach to the initiative, and community involvement will involve numerous organizations, interests groups and residents.

Figure 14 – Mature trees along the shared path route

Place Case Study Two – Clarkson Train Station Precinct

Clarkson Train Station precinct comprises the eastern portion of Ocean Keys Boulevard from Clarkson Train Station to Connolly Drive.

The planning framework for the Clarkson Train Station precinct dates back to 2003. The project adopted the principles of the Western Australian Planning Commission's Liveable Neighbourhoods policy and intended to be innovative in various ways.

The development sought to be a best practise example of Transport Oriented Development and walkable communities. It attempted to demonstrate the following qualities:

- Diversity of housing with medium-density residential development designed around the main street commercial area;
- Providing a focal point and sense of place for the new community; and
- Public open space and landscaped areas distributed throughout the estate to support passive and active recreation.

The outcome is a predominantly residential development, in an 800m radius of the train station precinct with the environment for pedestrians and walkability being limited. Trees continue to fail in this environment, the local main street precinct is deteriorating, and there is limited quality public realm.

This project presents a number of opportunities from street scape revitalisation; further enhancement of main street function; train station precinct enhancement, and a demonstration project to address the impacts of 'environmental/landscape' poor design.

The City's Place Management team is currently driving this project, working directly with key stakeholders in the community and bringing in external partners as required. While the City's Master planning process is a mechanism for betterment in the long term, the community want changes in the short term and direct involvement.

The Urban Forest Strategy aligns with the project, and is a case study for the following:

- Measure and analyse urban heat island effects and mitigate their impacts;
- Identify the costs of bad design – e.g. to plant out streets for a quality public realm; and retrofit street scapes not developed correctly in the first place;
- Lessons learnt – how to avoid sub-standard urban environments in the future; and
- Document the social and economic benefits of enhanced streetscapes for local communities.

Figure 15 – Looking East on Ocean Keys Boulevard towards the train station