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Trees as Markers in the Cultural Landscape

Introduction

Have you ever wondered about the lonely clump of fruit trees or the solitary pine, often a Bunya, standing alone and sad in a paddock as you speed along the country road? Who planted them and when? Did the gardener have hopes for a long occupation of this site?
Despite the first arrivals reporting on the drabness of the Australian forest—or bush as it was soon called—individual trees were admired. On Cook's voyage of discovery in 1770, Sir Joseph Banks and Daniel Solander collected plants at every landfall and the brilliant artist Sydney Parkinson could not keep up with the detailed technical drawings required —412 in all. Naturalists like the surgeon John White on the First Fleet sketched trees and made detailed botanical drawings including his 'Peppermint Tree' (*Eucalyptus piperita*) (Finney, 1984:54-58), while the first blue gum (*E globulus*) was collected by Jacques La Billardiere in Adventure Bay, Tasmania in 1792 on the French expedition under Admiral Bruni d'Entrecasteaux.

Bernard Smith believed that the intense preoccupation of Australian artists with the landscape was an endeavour to create an authentic description of it: problems of tone and colour; drawing a 'real gum tree'; capturing the subtle hues drenched in blinding sunlight (Smith, 1979:40). It took nearly a century until Tom Roberts and Arthur Streeton achieved valid artistic solutions to these problems. In the meantime, we have the topographical drawings of Thomas Watling (1790s), William Westall (1810s), Joseph Lycett (1820s), John Glover (1830s), Conrad Martens (1840s), Eugene Von Guerard (1850s) and Nicholas Chevalier (1860s) who produced what Tim Bonyhady calls 'art as information' balancing romantic landscapes with useful records of topography, objects of scientific interest and potential places of residence or occupation (Bonyhady, 1991:87-106).

Photography enabled a more accurate recording of trees and an early photograph by Fauchery-Daintree in 1858 was of a Red Gum (*E camaldulensis*) with the annotation:

> *The common tree of the country is the red gum…in some districts this monarch of the Australian forest attains to a prodigious size, and, from his slow growth, must have reached the age of some hundreds of years…*
> (Reilly and Carew, 1988:76)

The similar concern of painters and photographers for picturesque landscape views of gum trees, fern gullies, sylvan glades and bush tracks forged a strong link between art and photography even though the Victorian Academy of the Arts found these monotonous in the 1870s and 1880s. In 1857 Eugene von Guerard had exhibited his acclaimed oil painting *Ferntree Gully, Dandenong Ranges, Victoria* and in 1858 Fauchery photographed the same scene. The *Argus* critic admired the photograph, "…so far as form and detail are concerned, the instantaneous limning of the sun is more minute than the patient pencil of the laborious artist." The Fauchery-Daintree studio also produced other scenes along the Yarra and its tributaries which show the condition of the vegetation and landscape in 1857. On the gold fields photography captured migrants' cottage gardens, growing food and ornamental plants, many brought from 'home' countries.

The Australian bush as we now know had been manipulated by Aboriginal people for millennia with fire to produce a mosaic of small areas of plants, shrubs and trees of different age classes. They burnt to 'care for country' for ensuring supplies of food resources, clearing pathways, signalling, ceremonial activities and marking boundaries (Gammage, 2011). Many gum trees remain from pre-European times and show evidence of being used by Aboriginal people as their marker trees.

Cultural landscapes

Cultural landscapes are those where human interaction with the natural systems over a long time has formed a distinctive landscape. These interactions arise from and may cause cultural values to develop resulting in deep social attachments to the place. For example, *Woodland*s was taken up by the first Europeans as a grazing property in 1843, at Tullamarine, Victoria. The Greenes established a country house par excellence and farm with dairying, vineyard, cattle and horses for hunting while leaving the ancient red gums lining the Moonee Moonee chain of ponds. This property with its Aboriginal scar trees (*E.camaldulensis*) along the creek, the oldest documented garden plantings (*Magnolia grandiflora* from 1843) in the homestead courtyard with peppercorns (*Shinus molle*) around the stable and barn, paddocks cleared for grass for dairying until 1870s, then cattle grazing and horse studs and its box trees (*E.microcarpa*) and she-oaks (*Casuarina stricta*) scattered on the rising rocky ground is a good example of an evolving cultural landscape (Lennon, 1993).

Woodlands Historic Park, cultural landscape at Tullamarine, Victoria (Jane Lennon)

In accordance with the principles and guidelines for establishing the cultural significance of places as developed by Australia ICOMOS in its Burra Charter, cultural heritage landscapes are 'places that have aesthetic, historic, scientific or social value for past, present and future generations are the basis of cultural heritage.'
http://australia.icomos.org/publications/burra-charter-practice-notes/
Values are seen in a place's physical features, but also associated with intangible qualities such as people's associations with or feelings for a place. Values are what make a place significant. A landscape is a place.

> Cultural landscapes … represent the 'combined works of nature and of man'…illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment … (UNESCO, 2012, paragraph 47)

In 1992 the *Operational Guidelines for the Implementation of the World Heritage Convention* outlined (Annex 3, paragraph 10) for the first time Cultural Landscape categories, namely:

(i) The most easily identifiable is the clearly defined **landscape designed and created intentionally by man**. This embraces garden and parkland landscapes constructed for aesthetic reasons which are often (but not always) associated with religious or other monumental buildings and ensembles, for example Melbourne's Exhibition Gardens.

(ii) The second category is the **organically evolved landscape**. This results from an initial social, economic, administrative, and/or religious imperative and has developed its present form by association with and in response to its natural environment. Such landscapes reflect that process of evolution in their form and component features. They fall into two sub-categories:
- a relict (or fossil) landscape is one in which an evolutionary process came to an end at some time in the past, either abruptly or over a period. Its significant distinguishing features are, however, still visible in material form. The Castlemaine Diggings National Historic Park has many landscapes in this category
- a continuing landscape is one which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time. *Brickendon* and *Woolmers* in Tasmania are good examples.

(iii) The final category is the **associative cultural landscape**. The inscription of such landscapes on the World Heritage List is justifiable by virtue of the powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent. Uluru is an excellent example.

Cultural landscape has been used for different purposes in a wide range of disciplines such as arts, geography, history, anthropology, politics and most recently environmental management. Cultural landscape as a concept has been used since the early 1890s as a means of artistic expression, an historical record and a now as a tool for conserving landscapes especially those containing important natural and cultural values.

Marker trees, Culmerran Creek, northern NSW, October 2013 (Jane Lennon)

Trees as markers

Within many cultural landscapes trees, naturally occurring or planted, are visually dominant elements and so it is not surprising that they are used as markers to give special significance. Here are some examples.

Aboriginal carved trees or scar trees

These were once common along waterways in non-arid regions such as the Yarra, Murray and Darling rivers and may still be found edging backwaters. The scars might reveal whether the bark was used for tribal marking, for shields, canoes, roofing for gunyahs or for coolamons for carrying goods. One of the most famous is a collection of carved trees around Yuganigh's grave, 4kms south of Molong. Yuranigh, a Wiradjuri man, accompanied explorer and surveyor, Sir Thomas Mitchell, on an expedition into the tropical interior of Australia in 1846. When Yuranigh died four years later, he was buried within a circle of carved trees, according to traditional tribal custom. Out of respect, Mitchell also had a headstone placed over his grave. As a result, the gravesite contains a unique combination of Aboriginal and European burial features that is not known of anywhere else in Australia. Such carved trees were once quite widespread in NSW but due to their vulnerability to land clearing, fire and natural deterioration there are now thought to be only about 20 living carved trees left (www.environment.nsw.gov.au/NationalParks/parkHeritage.id=N0211).

At Lake Victoria, a major water storage and cultural landscape in the south west of NSW, many scar trees have died due to regular inundation since the 1930s but they have been recorded and annual inspections reveal how many are still standing (MDBA, 2013).

Survey trees

The first surveyors marked out land to be alienated from the Crown for occupation and development or reserved for public purposes like roads, timber or school reserves. They chose a tree, marked it and then ran a line of measuring chain, so many links long from this tree to the next mark so as to measure out sections of land. Surveyors' field books have many examples, such as 'commenced at marked she oak at back of tent' (Surveyor William Darke, 5 December 1836, in HRV, vol. 5, 1988:25) and later he gives his chainage along the Werribee River 'from an old gum tree' (p.73).

Finding these marked trees or blazed trees is still common in some areas although time, weather and bush fires have destroyed many. The blazed 19th to mid 20th century survey trees are now replaced by a continuous electronic recording system using satellites. Famous blazed trees include those of early explorers, such as those marking the camp sites of Burke and Wills near Birdsville; more common were those marking reserves for forest such as the Mt Lindesay State Forest in northern NSW.

Property delineation and access

Trees form 'ribbons across the landscape' and many people subconsciously navigate by trees either due to local familiarity or because of the nature of the tree cover as in the ironbark country in Queensland. In Victoria the Lands Department requirement to plant sugar gums (*E cladocalyx*) on leasehold led to the landscape of windbreaks in the Western Victorian plains. While in windswept areas planted trees forming windbreaks give a chequerboard effect to the landscape even if it has remnant native trees in the paddocks such as north east of Tullamarine, Victoria.

There are many thousands of unmade or unused surveyed road reserves containing mature trees forming the ribbons through the landscape. Where original road alignments have been altered, the cut off sections now often form treed roadside stops for motorists. Farmers have often planted their driveways leading from a public road into the housing area of the farm, such as the spectacular Hoop pines (*Araucaria cunninghamii*) near Murwillumbah, NSW and Date palms *(Phoenix dactylifera*) at Merbein, Victoria. Thousands of cypresses (*Cupressus sempervirens*) have been planted as boundary markers around irrigated farms –a reflection of the Italian heritage of the planters and the quick growing nature of the tree.

Place names

Many towns and suburbs have arboreal names which often reflect the original vegetation or later plantings such as Gumdale (Qld), Ironbark (SA and Qld), Casuarina (NT and WA) or Apple Tree Flat (NSW) and Willow Grove (Vic). Perth suburbs illustrate this - Peppermint Grove, Whitegum Valley, Tuart Hill, Orange Grove (which still has some orchard feel to it), Jarrahdale (on the outskirts) and further away Karridale and Salmon Gums.

Public commemoration

Trees were commonly planted on civic occasions or marked a political event such as the Separation Tree, a pre European River Red Gum (*E. camaldulensis*) in the Royal Botanic Gardens, Melbourne where the citizens of Victoria gathered on 15 November 1850 to celebrate the news of the separation of Victoria from New South Wales. The Tree of Knowledge was a ghost gum (*Eucalyptus papuana* now reclassified as *Corymbia aparrerinja*) growing in the main street in Barcaldine in front of the Railway Station and it was believed that in 1891 a group of protesting shearers founded the Australian Labor Party under the tree. Its preserved trunk has been incorporated into a large new art installation over the site.

Separation tree, Royal Botanic Gardens, Melbourne (Jane Lennon)

Between 1860 and 1866 Ferdinand Von Mueller distributed 360,000 conifers from the Royal Botanic Gardens Melbourne to regional gardens, schools, cemeteries and private owners; they were mainly Bunyas (*Araucaria bidwillii)*, hoop pine (*A. cunninghamii*), Norfolk Island pine (*A. heterophylla*) and Queensland kauri (*Agathis robusta)*.
Cemeteries are public places with major symbolic plantings. In Victoria, Bunya Pines and Deodar Cedars (*Cedrus deodara*) are linked with von Mueller's distribution. Chusan Palms *(Trachycarpus fortunei)* , Ash (*Fraxinus spp.*), Cedar and Algerian Oak (*Quercus canariensis*) also were common. Funereal cypresses *(C. sempervirens)* remain an evocative planting.

Tree plantings were common activities for visiting royalty and Heads of State and every major botanic garden has such trees. Our famous avenues of honour such as the elms (*Ulmus spp.)* from Ballarat commemorating men and women who served in World Wars are well documented. Many have been replanted in the last few years, demonstrating the value communities place on these trees, for their commemorative values and their beauty.

Trees are planted for the opening of new town parks, schools, to shade bikeways and many magazines especially trade magazines in the plant nursery and landscaping businesses illustrate these. In maturity they have often become community marker trees.

Coastal marker trees

Norfolk Island pines collected from their original setting in the 1790s quickly became a signature tree along urban coastlines on mainland Australia. An avenue of Norfolk Island pines was planted at Annandale, NSW, in 1796. Today they may be found from Fremantle to Port Albert and strikingly in the two Manlys—Sydney and Brisbane seaside suburbs.

Norfolk Island pines mark the shoreline at Port Albert, Victoria (Jane Lennon)

Fashion

Garden historians appreciate that the planting of significant marker or feature trees such as Bunya pines, began when the nurseries distributed them commercially. They then became fashionable around homesteads.

Bunya Pines were of immense cultural significance to the life and food security of the Aboriginal peoples in SE Queensland. Every year the trees would produce a small yield of nuts and every three years or so a bumper crop so large as to support clan gatherings of hundreds and possibly thousands of Aboriginal people over the harvesting months. It was at these gatherings, feasting on the nuts, that they would perform activities such as extra-tribal ceremonies, settle disputes, trade goods and arrange marriages. The value of the nut as food was not lost on the settling Europeans, reminding them of the chestnuts from home.

Other trees have had phases of being in or out of fashion. Nostalgia for ‘Home’ led to early plantings of English oaks, elms, and conifers and larches in colder places. The fern craze of the 1860s had many home gardeners trying their hand at cultivating native ferns while the trade in tree ferns continued (Bonyhady, 2002:113). Sub-tropical exotica like palms and figs especially Moreton Bay Fig (*Ficus macrophyllla*), rainforest species and New Zealand plants especially Palm lily (*Cordyline australis*) came into fashion. Then gum trees from the western side of the continent became popular on the eastern side due to their hardiness and bright flowers, especially *Corymbia ficifolia* or the red flowering gum also known as Albany red flowering gum.

Community action

A quick glance at the indexes to the AGHS journal (http://www.gardenhistorysociety.org.au/uploaded_files/userfiles/files/index%202012_1-20final.pdf) and to the Australian Forest History Society conference proceedings (http://www.foresthistory.org.au/publications.html) will show how much ha**s** been written about community action to protect and expand planting, initially of native species such as for Wattle Day and Arbor Day. There are many mature trees surviving as markers of these Arbor Days and often to be found around old schoolyards.

Landcare established in 1989 has grown to a national network of 4000 community Landcare groups, 2000 Coastcare groups and many thousands of volunteers across the country. More than 40 per cent of farmers are involved in Landcare. Landcare plantings have created new rural cultural landscapes with the designed plantings obvious in the cleared agricultural landscape—Landcare markers!

Personal commemoration

Australian family and property histories are replete with examples of plantings to celebrate momentous family events from birthdays, deaths, weddings, moving into a new house, burying a loved pet or just a present from a friend. A poignant commemoration is found in a John Glover landscape of Patterdale farm and Mills Plains captured in his painting *My Harvest Home* (1835) where the western hillsides remain unchanged except for the solitary pine (*Pinus radiata*) planted on the peak by Mr Pinner in 1914 for his son departing to World War 1 and never to return (Oakman, 2010:69).

Even felling trees causes the owner/feller to commemorate his deed as when the monstrous stump of a tallow wood was donated by a property owner, Gordon Page to local museum at Caboolture, Queensland; it weighed 10 tons, was 65 m tall and 10.5m girth when cut down in 1952 by fellers using cross cut saw. There are numerous other examples in folk museums across the country.

Trees in the designed landscape

Gardeners use trees to highlight their gardens whether it was Dame Elisabeth Murdoch with her avenue of lemon scented gums (*Corymbia citriodora*) leading to her house at Cruden Farm or countless other private avenues on properties across the continent. Botanic gardens have designed placement of trees to highlight the land sloping to a focal point like a lake or mountain. Trees here may mature and provide fun—trunks for children to climb on. Other trees are planted with education in mind as at the new Cranbourne Botanic Garden with the mallee eucalpyt interpretation sign.

Relict landscapes or ongoing?

The Macleay Valley river flats were once rich dairying and maize growing areas. *Ficus* as large remnant trees in paddocks are a signature of this landscape. But it is now changing in use to soybean or waiting for rural residential development. Prime sheep country in box woodland south of Yass is now changing to cattle with changes in the plant composition due to cattle grazing selectively and not keeping down weedy ground covers. Rich landscape of volcanic flows down valleys south of Mt Buninyong, Victoria had sheep grazing and forests on older sediments but cattle are taking over.

Convict planted landscape of hawthorn hedges and an oak paddock tree, *Brickendon*, Tasmania (Jane Lennon)

Three layers in the Red Hill, Victoria, cultural landscape: original native vegetation, Pinus windbreaks, vineyards (Jane Lennon)

In Millstream National Park, WA in the 1920s Ah Koon's Chinese garden was watered by the stream creating an oasis fringed by date palms *(P. dactylifera*). It has a paddock of deep furrows where rice and cotton once grew. This open space and remnant trees are clues to former productive gardens.

The World Heritage listed Brickendon Estate, Tasmania, is convict-made sheep country from 1816 with not a native tree remaining in the paddocks now lined with 60kms of 'living fence'—hawthorn hedges *(Crataegus monogyna)*.

Many cultural landscapes contain layers of evidence of all categories over time—designed, evolving, relict sections and associations with significant landmarks or natural features. On Victoria's Mornington Peninsula, vineyards are the third layer in this landscape at Red Hill after the original vegetation, then orchards with *Pinus* windbreaks. Creek flats in the upper Clarence River catchment of NSW were cleared of cedar and associated rainforest trees in the 1860s then later 'improved' for dairying, then abandoned to cattle grazing and now native hardwood plantation landscapes.

Threats to trees in the rural landscape

- Climate change and variable cycles leading to frequent wild fires which will change the distribution of some species as in the former ash forest of northern Gippsland, Victoria, or salting of plains due to over irrigation or excessive clearing of tree cover.
- Rural property subdivision often to take advantage of distant views or just town sprawl leading to loss of farmland and its paddock trees as well as mature trees on the site of 'green fields' development.
- Wind farms have threatened the design integrity of historic gardens with their mature trees like *Mawallok* in western Victoria or whole rural landscapes like that with the Waubra wind farm outside Ballarat.
- Other utility lines—for electricity, gas pipelines, telecommunications—have cut swathes through the rural landscape and destroyed trees.

Conclusion

Trees are indicators of landscape types showing the natural distribution in response to environmental factors—topography, slope, aspect, soils, fire, rainfall—over time. There are remnant trees after clearing, agricultural use and regrowth, roadsides, mining and abandonment and there are planted trees for amenity, for timber, orchards, urban parks. All these are celebrated in art, poetry, literature and photography and you have a rich trove in WA in response to the distinctive flora. Look at the changed tree distribution since Garling's painting *Red bank 30 mls up the Swan,* 1827 and today or around Augusta in Thomas Turner's *Albion House, Augusta*, 1836. But here the remnant trees are markers of the cultural landscape as are the clump of fruit trees and the solitary pine on the hill crest. For much of rural Australia where trees are markers of previous activity, the following lines are apt:

> *if a landscape had a voice*
> *and nihilistic words, it might explain*
> *how much is accident and*
> *how much is choice.*
> (R.A. Simpson, *Landscape*, 1981)

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Valuing and Maintaining the Urban Forest

Introduction

Urban forests are significant assets to our environment and our society regardless of where they occur or whether they consist of native or exotic trees. A great deal of effort has gone into establishing, managing, conserving and preserving them. Considerable human labour and time have been expended on the trees as well as real energy in the form of fossil fuel that has underpinned their maintenance. Significant quantities of water have been allocated to their growth and development. Society has invested resources in their establishment and management, and they have matured as assets and are providing many and diverse benefits to society in return (Moore, 1997). They are community assets in every sense.

While costs, damage and nuisance values attributed to trees are widely known, the benefits they provide are often subtle and under-appreciated. It is a great pity that so many of our citizens think of our parks, gardens, streetscapes and urban landscapes only in terms of their aesthetics. While they are beautiful and decorative, these attributes often mask the many functions that urban forests serve in our cities to the point where their economic and environmental benefits are often overlooked. Such benefits will be even more important as Australia faces significant climate changes due to global climate change (Table 1).

Table 1: Likely outcomes from climate related changes in south eastern Australia (Moore 2009)

Generally warmer winters and hotter summers
A more tropical climate extending southward
More easterly winds leading to summer storms
More frequent major storm events
More days of extreme fire risk weather
More bushfire prone regions, extending to peri-urban parts of major cities
Changed weather and fire patterns
Fewer frosts, and in some places elimination of frosts completely
Many more days above 30C and double the number of days above 35c
Higher summer rainfall with more intense rainfall events
Flooding of lowland coastal areas – probably minor
For every one degree temperatures rise, the snowline rises 100m
Agricultural productivity will change, in some cases improving
Some crops will not be grown but others become viable
Housing and building construction processes will change
Energy demands and patterns of use will alter

Urban forests like all ecosystems will be affected by climate changes that include increases in global air temperatures, increases in atmospheric CO2 concentrations, changes in the patterns and amounts of annual precipitation, more frequent and intense storms and changes in the frequency and severity of wildfires that may affect peri-urban parts of cities (IPCC, 2007). However, it is difficult to predict the impact that these change might have on species that constitute urban forests (Moore, 2011).

The most significant factors likely to impact on species making up urban forests are increased temperatures, changes to rainfall patterns, greater storm intensities and droughts. In some places the impacts of severe storms and altered fire frequencies, particularly in peri-urban areas, will be profound (Moore, 2011). In most parts of the world temperature-increases over the next two decades will be modest, but towards the end of the century temperature rises in

Table 2. Projected future temperature rises (ºC) for different geographic regions for 2020-9 and 2090-9 for low and high emission growth scenarios (IPCC 2007)

North America and northern Europe could approach 8ºC (Table 2).

Emission Scenario	Low Emission Growth	Low Emission Growth	High Emission Growth	High Emission Growth
Projection Date	**2020-9**	**2090-9**	**2020-9**	**2090-9**
REGION				
North America	1.0	2.0-3.5	1.0-1.5	4.0-7.0
South America	0.5-1.0	2.0	1.0	3.0-4.0
Northern Europe	1.0-1.5	3.0	1.5-2.5	5.0-8.0
Mediterranean	1.0	2.0	1.0-1.5	4.0-4.5
Africa	1.0-1.5	1.5-2.5	1.0-1.5	2.5-4.0
Asia	0.5-1.0	2.0-3.0	1.0	3.5-4.5
Australia	1.0	2.0-2.5	1.0	4.0-4.5

The impacts of climate change on urban forests will not be uniform on either a national or global scale. This will make decisions related to planning and managing urban forests difficult as there will be few, if any, approaches that will apply globally, across a continent or even across a nation. At a time of climate change, it is worrying that both private and public open spaces in Australian cities are threatened by urban renewal and development that put at risk long term sustainability (Moore, 2009). In many of these situations there is insufficient open space—public or private—for the planting of large trees and so the opportunities for the role of vegetation in ameliorating the heat island effect, reducing wind speed, providing shade and reducing energy use are reduced, which raises questions about the economic viability of such developments, as well as their long term environmental sustainability.

The Benefits of Trees:

Trees in streets, parks and gardens provide many environmental and climatic services and benefits, which also have significant economic value, but most people do not know of these benefits that urban forests provide and even fewer know of the real economic benefits that trees provide (Table 3). The trees in streets and gardens can shade buildings from the hot summer sun, especially in the afternoons. This can cool a building by up to 8ºC which means that there may be no need for the use air conditioners, or they may be used less often and for shorter periods of time.

Electricity tariffs vary widely across the different states from an average of about 26 or 27 cents per kilowatt hour (kWh) in Victoria and New South Wales to about 35 cents per kWh in South Australia. Air conditioners also vary greatly in their size and the power they consume, but Table 4 gives an idea of how much shade from trees might save electricity by reducing your use of air conditioning.

Table 3. Some of the benefits provided by vegetation in the urban forest

Shade can reduce roof temperatures by up to 8C. This cools the house in summer and reduces air conditioner use and electricity consumption	Vegetation cools the area around your home. This reduces the urban heat island effect (UHI), cools cities and saves on water and electricity consumption
Trees can reduce storm wind speeds reducing the damage to roofs and other structures during storms	Absorption of water can reduce the risks of local flooding and removes the need for larger storm water gutters and pipes
Trees stabilise soil on steeply sloped blocks of land reducing building cost by thousands of dollars	Plants help off-set your carbon emissions and so reduce your contribution to the greenhouse effect and global warming
Trees remove airborne pollutants and humidify air, which can help reduce the effects of hayfever and asthma	Vegetation increases urban biodiversity so that there is more urban wildlife
Vegetation provides many human health benefits, such as reducing blood pressure, and improving the quality and longevity of life	Vegetation provides social benefits. Green and leafy suburbs tend to have lower rates of vandalism, violence and graffiti
Vegetation, especially trees, encourages both active a passive recreation by residents and so lower health costs	The shade provide by trees lowers water evaporation from the soil saving water and helping to further reduce the UHI

Furthermore, if electricity is generated from coal, potable water is often used in the processes of generating electricity. In Victoria, for example, about 96L of water is used to generate every kilowatt hour of electricity from brown coal, so by not using air conditioners you save not only electricity but also water (Fisher, 2009). These water savings can be significant during droughts and water is valued at about $1.50 per kilolitre. Across a city, a great deal of electricity and water can be saved (Moore, 2012). For cities with one hundred thousand mature trees, such as the inner city parts of Melbourne, Sydney, Adelaide, Perth and Brisbane this amounts to over a million dollars per annum and that does not include the suburbs.

Table 4. Costs of running an air conditioner over summer and the savings in electricity due to shade from trees in your garden

Power (Size) of Air Conditioner (kW)	6
Hours of use in an unshaded home over summer	200
Electricity tariff (an off peak general average) (cents per kWh)	30
Total air conditioner electricity bill ($)	360
Reduction due to one tree shading the afternoon sun (kWh)	50
Saving in electricity bill ($)	90
Reduction due to two trees shading the afternoon sun (kWh)	100
Saving in electricity bill ($)	180

The shade from trees also reduces the urban heat island (UHI) effect. In cities made of tar and cement, the temperature in the city centre is often 5-8ºC higher than surrounding farmland or open space. Health authorities are increasingly worried about rising city temperatures and the large numbers of deaths, hospitalisations and ambulance call outs associated with heat waves. In the heat wave that surrounded the Black Saturday fires that killed 172 people in Victoria in 2009, 374 mostly elderly people died (Table 5). Recent studies (Tapper 2010) have suggested that the wise use of water and vegetated urban landscapes could reduce excess deaths during heat waves such as those experienced in Melbourne in the summer of 2008-9. Parts of cities, such as the western suburbs of Melbourne, are hotter as they are drier and less well vegetated, and it was in these suburbs that excess deaths of people over 65 years of age were greatest. One of the simplest and cheapest solutions to this problem is to plant more trees and have more open space in suburbs that are currently deprived of street trees, parks and gardens. Furthermore both active and passive recreation are more likely in vegetated suburbs, especially where there are trees that provide shade for walking, running and active recreation in summer months. The urban forest can save millions per year from State health care budgets simply by encouraging 1-2% more of the population to recreate.

Table 5: Heatwave deaths and health related benefits from urban forests

Heatwaves	Definition	BoM: "prolonged period of excessive heat" (no formal definition)
	Examples	Melbourne, Jan 26 - Feb 1, 2009 - 374 excess deaths
	Where deaths occur	Western and northern suburbs of Melbourne - 66% of such deaths in 75+ age group
Recreation	In Victoria an increase of 1-2% in active or passive recreation wuold save about $274 million per annum in health care costs	
	The most cost effective means of achieving the outcome is to provide vegetated urban forest that foster active or passive recreation.	
Heat related hospitalisations	Over 1999-2004, 210 admissions due to heat	
	Average stay in hospital 5 days at $8000 per day	
	This is a total of $8.4 million	
	There is predicted to be a 142% increase in heat related cardiovascular disease over the next two decades	

Trees are also good at filtering, slowing and deflecting strong winds. While everyone is familiar with the damage that may be done to property and the injuries that may occur when trees or large branches fall during storms, few recognise that the moderating influences of large trees reduce the likelihood of houses being unroofed. Even in the fiercest storm, fallen trees are the exception and the good work of the standing, silent sentinels that deflect, filter and abate the force of the wind goes largely unnoticed.

On steep suburban house blocks, the roots of large trees can provide a stabilising influence on soils that might otherwise be prone to landslip. After Black Saturday, many land owners cleared their blocks of all trees and ground out the stumps. In at least one case (Moore 2012), the owner was then unable to get building insurance to rebuild as the site was declared unstable by the insurance company (Table 6). Five large trees had been removed and the engineering solution of piling to reinforce the site was estimated at about $50,000. So these trees had been providing a very valuable service over their life times.

Trees provide great recreational shade in backyards, sporting grounds, schools and public buildings. The value of this shade can easily be estimated by considering the value of shade sails that provide equivalent shade. A high quality shade sail that provides 50m2 of shade costs about $5000 and has a useful life of about a decade (Moore 2012). It costs about $500 per annum so the shade of a tree in a similar situation provides about the same value (Table 6). However, some trees provide a shade area of between two and four times that covered by a shade sail so they are providing between $1-2,000 value per annum and may do so for a century or more.

Table 6. Savings from other functions and services provided by the trees in your garden

Factor	Economic situation	Value
Electricity savings from street tree shade	For 100,000 mature trees, 30 kWh saved per tree at 30 cents per kWh	$900,000 per annum
Water savings from street tree shade	For 100,000 mature trees, 100L water per kWh saved at $1.50 per KL	$450,000 per annum
Carbon sequestered in a single tree	Large trees sequester between 10 and 20t of carbon. Carbon value $23	$230-460
Pruning single tree canopy	Pruning 30% of the canopy removes between 1.7 and 3.4t of carbon for every pruning cycle	$39-78
Single tree canopy providing direct shade	A shade sail providing 50m2 of shade costs $5000 and lasts 10 years. A tree shading the same area has the same value	$500 per annum
Tree roots stabilising steep house block	Five large trees stabilised a suburban block. Their removal required piling cosing $50,000 so the trees provide the equivalent value over their 50 year life spans	$200 per annum for each tree

Most people are aware of the problem of tree roots causing cracking and lifting in tarmac and roads, but very few are aware of the benefits that trees can provide such surfaces. Bitumen is a super-cooled liquid like glass and in the hot Australian sun the solvents contained in it are evaporated over time. This leads to the surface crumbling and the need for replacement. Shade from trees that overhang roads and playgrounds can significantly extend the life of bitumen by a factor of 2-3 times that of the exposed useful life expectancy.

Table 7. Economic value of shade for an urban street lined by 100 trees prolonging the life of bitumen

Approximations used	**Value**
Estimated length of street (m)	500
Width of road surface (m)	7
Area of Bitumen road surface (m2)	3500
50 trees on each side of the street so total number of trees	100
Shade from an individual tree canopy (m2)	75
Area of bitumen shaded by tree canopy, estimated at 33% of total (m2)	37.3
Total area of bitumen shaded by tree population of 100 trees (m2)	3,730
Cost of removing, profiling and resheeting bitumen per m2 (AUD$)	111
Total value of extending the life of the shaded bitumen from 20 to 30 years due to the 33% shade from 100 trees (AUD$)	414,030

Consider a tree-lined avenue of 500m length with about 50 large trees on either side of the road at spacing of about 10m. These are dense enough to completely shade the bitumen road and footpaths. If the shade extends the life of the bitumen by a very conservative 50% this represents a saving of nearly $414,000.00 (Table 7), which more than compensates for minor root cracking or damaging. Such large savings are only possible when the shade provided is continuous as the whole road surface will be replaced when unshaded parts crumble. However, at an urban forestry level, the savings in shade may run to the many millions of dollars per annum and it should be noted that overseas estimates are based on prolonging the life of bitumen by two or three times (McPherson and Muchnick, 2005), rather than the conservative estimate of 50% used in this paper.

The carbon sequestered in urban trees is significant and contributes to reductions in carbon footprints and contributions to the greenhouse effect and climate change. A large mature tree in a street or front or back yard, such as a mature eucalyptus, silky oak, blackwood, liquidambar, oak, or elm will contain somewhere between 10 and 20t of carbon with about the same amount of carbon in the root system as there is in the trunk and canopy (Moore, 2012). Currently this carbon is valued at $23 per tonne through the Australian carbon tax. In most Australian cities, there are hundreds of thousands of mature trees in the inner parts of the cities alone which are storing millions of dollars worth of carbon (Table 6).

Natural turf is quite a complex ecosystem and has a significant effect on ambient temperatures. Turf can reduce the urban heat island effect, and if properly managed also sequesters a considerable amount of carbon. Perhaps it is not quite the villain that it has been portrayed by water authorities and politicians during years of drought or low rainfall when they consider only the water component of a much more complex equation. No one is advocating a return to emerald green lawns, but the use of native grasses, efficiently irrigated when necessary, captures the recreational health benefits from a vegetated surface while confronting the problem of children kids lacking exercise and becoming obese.

When street trees are pruned for power-line clearing, the branches removed contain sequestered carbon. If these branches are burned or mulched then the carbon is released as carbon dioxide back into the atmosphere (Table 6). As an example, if 100 mature street trees lose 30% of their canopies to power-line clearing this removes about 200t of carbon that is valued at about $4500 (Moore, 2012). However, it should be remembered that such trees are often pruned on a cycle of about 5 years so that the value of carbon lost accumulates quite rapidly to the point where it would be more viable to underground such services (boring under the trees, of course, to minimise root damage). This illustrates that placing a value on the services and functions of vegetation could, or more correctly should, influence the current economic algorithms that are applied to urban infrastructure.

Urban forests also play a very important role in flood mitigation. They are important in pumping water from city low spots and so reducing local flooding and the volumes of water entering stormwater drains. This could be very important as climate change brings more intense rain events despite a lower annual rainfall. Trees can also slow the speed of floodwaters, reducing the damage that they do and the erosion of river banks. Here the urban forest provides an invaluable service as part of a city’s infrastructure.

Conclusion

Little real scientific or economic research work has been done in Australia on the benefits provided by vegetation. There is even less economic data to inform decisions. The planting of 11 million trees in the Los Angeles basin is calculated to save US$50million per annum on air conditioning bills and in other US studies there is a cost/benefit ratio of 1 to 6 in favour of urban trees and landscapes. In the only study of its kind, economists noted that an Adelaide street tree provides a minimum annual benefit of about $200 per year and that it was a gross under-estimate of the real value (Killicoat et al, 2002). The cost of maintaining an Adelaide street tree was about $20 per annum and so there was a 10 fold return to the people of Adelaide in terms of benefits against costs of their street trees. For an urban forest of one hundred thousand trees these benefits add up to tens of millions of dollars per annum.

Urban vegetation and trees have never just been decorative or ornamental, but have always performed functions or provided services, even if these have been unrecognised. These functions and services mean that urban forests have real economic value. The task of calculating the real economic value that urban forests provide to modern communities is now beginning. So when one of the trees in the urban forest causes some problems, its benefits must be considered as well as the costs of its maintenance or rectification of the problem. Such expenditure is not wasted as trees and urban landscapes provide far more economically and ecologically than they use and in any comprehensive and fair calculation urban trees and landscapes are worth more than they cost. It is amazing how well trees do in a proper cost benefit analysis.

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Australia's Public Trees

This paper is an attempt to present a broad history of tree planting in Australia within public spaces which reflects significant chronological periods of use of particular tree species that became fashionable through either cultural association or the influence of different people. They represent a variety of different disciplines such as, Botany, Horticulture, Landscape design, Architecture, Engineering, Forestry, Agriculture and Biology. The fashionable use of particular species is evident throughout Australia however, as the Forum is taking place in Western Australia, I am making particular reference to examples in Western Australia.

All public tree planting is a form of compensation for loss. Loss of environment, loss of humans and possibly loss of culture. Sometimes the tree plantings represent "ornamentation" as an expression of wealth and the conquest of nature. I consider that there are three major themes evident in the history of public planting which are by association in nature and two minor themes which involve aesthetics.

The major associational themes are:

1. The cult of nostalgia and the recreation of the familiar.
2. The desire for tropical foliage as part of the cult of romanticism.
3. The cult of the gum tree in an attempt to establish a distinctive Australian identity.

The minor aesthetic themes are:

1. Contrast:
    (i) Evergreen dark foliage.
    (ii) Bright and colourful autumn foliage.
    (iii) Bright and colourful flowers.
    (iv) Colour, pattern and line of trunk and branches.

2. The use of Australian plants as a substitution for more familiar environments (usually northern hemisphere environments).

The choice of plants falls into distinct eras of influence associated with the sources of advice and supply of plants. Sources typically emanated initially from the urban environments of the larger Australian cities; Sydney, Melbourne, Brisbane and Adelaide, reflecting the different fashions and the personal bias of individual persons of influence. Actual species selection was often limited to the availability of plants. Persons of influence included, but are not limited to, botanists, directors and superintendents of Botanic Gardens, foresters, nurserymen and politicians.

One enduring trend was the use of plants discovered by explorations in the early years of the colonies and some tree species have continued to be used to the present, irrespective of chronological periods. A good example of this is the planting of Norfolk Island Pines (*Araucaria heterophylla*). The tree of hope to some and the tree of despair to others.

Following its sighting on Norfolk Island in 1770 by Captain Cook, Joseph Banks and Daniel Solander, the Norfolk Island Pine's presumed potential for use as ship's masts contributed to the decision to establish a British colony on the east coast. Despair followed elation of the upright formal qualities of this species when the structural strength of the tall vertical trunks was found to be unsuitable for masts and a blow to the concept of creating a vast armada situated in the Pacific Ocean to defeat the threat of the Spanish navy and the political games of world domination of resources. The tree however became strongly associated with a maritime context and traditions with its planting along the coastline to not only mark particular settlements but as a navigation device to locate suitable entrance points for shipping and along developed beach areas from the middle of the nineteenth century to the present throughout Australia.

The first use of the Norfolk Island Pine outside of Norfolk Island appears to have been its planting within the Government House Grounds, Sydney Cove. Its inclusion along with bamboo and Stone Pines meant that incoming free colonists tended to replicate the Governor's selection within their own land grants and estates. The relative size and formal composition of the Norfolk Island Pine was such that by virtue of its scale, compared with the indigenous vegetation, it became a landmark tree, perceived visually as part of the larger landscape setting.

The first private avenue of Norfolk Island Pines planted appears to be by Major Johnson, a former Superintendent of the Norfolk Island Penal establishment, along the main drive into his Annandale Farm. This remained as a conspicuous avenue well into the late nineteenth century. It was a dominant landscape element within the indigenous tree cleared lands known as the Kangaroo Grounds. It was easily seen from Sydney and visually formed part of the seen public landscape.

Norfolk Island Pines were planted in 1854 along the Esplanade of Henry Gilbert Smith's Pleasure Garden development at Manly Beach on the sand dunes formed between the Sydney Harbour estuary and the Tasman Sea. This set the precedent for similar plantings throughout coastal Australia. Three rows of Norfolk Island Pines were planted in parallel rows along the beachfront and returned along the Corso alignment alternating with Moreton Bay Figs (*Ficus macrophylla*).

Western Australian examples of this kind of planting can be found at the Esplanade Park in Fremantle circa 1908. Norfolk Island Pines can also be seen in 1920s beachside suburb of Cottesloe and throughout Esperance on the southern coast.

Norfolk Island Pines have also been frequently planted in pairs or singularly as a commemorative tree planting. Such was the case when Sir John Forrest planted a Norfolk Island Pine in August 1895 to commemorate the naming of the Mount Eliza Reserve as Perth Park (later Kings Park). The former Rottnest Gaol (Native Establishment) entrance is marked by a pair of Norfolk Island Pines but they are remnants of a more extensive planting of the same species between the main entrance and Thompsons Bay. There are numerous examples of Norfolk Island Pine plantings to mark the site of Government institutions throughout Australia in the latter half of the nineteenth century.

Norfolk Island Pines, The Esplanade Manly, NSW

Norfolk Island Pines, Rottnest Island, WA

Public trees can include the following:
1. Remnant indigenous trees
2. Trees related to Stock routes (both indigenous and planted)
3. Trees planted originally in private estates and now public
4. Trees planted in Government Domains, parks, reserves and streets
5. Trees planted to commemorate important community structures or events
6. Trees planted as commemorative avenues
7. Trees planted for purely aesthetic consideration
8. Trees planted for purely functional considerations

The history of public tree planting in Australia is divided into eleven chronological periods some of which overlap in terms of their time extent. A very brief summary of each period is given below together with the use of indicative tree species representing each period.

1. Dreaming: New Holland to Terra Australis; ongoing indigenous cultures
2. The First Settlements Period 1629 – 1838
3. Colonial Period 1810 – 1850
4. Gold Rush Period 1850 – 1899; ongoing mining ventures
5. Victorian Period 1835 – 1889
6. Edwardian and Federation Period 1890 – 1919
7. Inter War Period 1920 – 1939
8. Modern Period 1940 – 1962
9. National Identity Period 1963 – 1979
10. Late Twentieth Century Period 1980 – 1999
11. Early Twenty First Century Period 2000 – present

1. Dreaming: New Holland to Terra Australis; ongoing indigenous cultures

The Dreaming is concerned with the ever present indigenous cultures throughout Australia and is by its nature timeless. There is a strong bond between Aboriginal people and plants both as sacred plants and for practical use. The nature of these bonds vary in different cultural areas and country where some trees harbour spirits and are to be warily respected whilst in other places trees represent Dreaming ancestors that offer shelter, a source of food and a range of practical uses to sustain continuity of life.

Evidence of sacred trees include the Figs (*Ficus sp.*), Eastern Kurrajong (*Brachychiton populneus*), Western Kurrajong (*Brachychiton gregorii*), Baobab (*Adansonia gregorii*), Bat's Wing Coral Tree (*Erythrina vespertilio*), White Cedar (*Melia azederach*), Bombax (*Bombax ceiba*) and Bunya Pine (*Araucaria bidwillii*).
Macassan traders as visitors to the sub-tropical Australian northern coastline established regular campsites and planted Tamarind trees (*Tamarindus indica*) for shade, shelter and food. Many of these trees remain at particular sites along the coast stretching from Western Australia to Cape York.

2. The First Settlements Period 1629 – 1838

The First Settlements Period covers the time from accidental Dutch settlement through shipwrecks on the West Australian coast in the seventeenth century to the planned settlement of Adelaide in 1837 and Port Essington in 1838. With British colonisation of the east coast in 1788 and subsequently New South Wales. This period is dominated by the use of Oaks (*Quercus robur*) and Pines (*Araucaria heterophylla* and *Pinus pinea*).

The earliest tree planting is possibly a 1796 avenue of White Cedar (*Melia azederach*) planted from Andrew Thompson Square to Government House in Windsor N.S.W. This is followed by an avenue of unidentified palm trees leading from a landing place in the Brisbane River up to the Government precinct located on the flood free ridge which is illustrated in an 1835 lithograph.

This illustrates the further influence of regional climates within Australia when selecting apparently suitable tree species. The subtropical and tropical climates of northern Australia contrast with the cool temperate south and the dry interior. The White Cedar, also known as the Indian Bead Tree, was found growing along the alluvial riverbanks of the Hawkesbury-Nepean River system at the time of British colonisation and was adapted for local use because of its local availability and environmental fit at the time.

White Cedar (*Melia azederach*) was also introduced to Western Australia as a street tree, where it has the common name ‘Cape Lilac’. It grew in Calcutta, India and was thought to be imported via immigration of Aboriginal people to Australia many thousands of years ago. The ‘Cape Lilac’ was sent to Cape Town as an ornamental tree in the early nineteenth century, from where it found its way to Perth.

Figs, Bridge Street, Sydney

Moreton Bay Fig, Fremantle Foundation Tree

The palms in the early Brisbane avenue were most probably local species and promoted a sub-tropical context. This was a practical solution in Brisbane as in Western Australia, as an Oak avenue possibly would have been more fitting but none were available other than acorns brought with the First Fleet. Many acorns were systematically sown by Governor Phillip on his exploratory journeys through the landscape of Sydney's Cumberland Plain but few survived. The oaks survived best in Tasmania where the cool climate and some of the soils were compared to the familiar environments of the British Isles.

3. Colonial Period 1810 – 1850

The Colonial Period was dominated by Moreton Bay Figs (*Ficus macrophylla*), Pines (*Pinus pinea, Pinus halapensis, Pinus radiata, Araucaria heterophylla and Araucaria cunninghamii*). The increase in the variety of species in this period was a reflection of the establishment of Botanic Gardens in the different colonies and the influence of explorers, botanical collectors, nurserymen and the personal bias of different Governors. Governor Macquarie continued the practice of planting Oak trees (*Quercus robur*) both in N.S.W. and Van Diemens Land in this period.

4. Gold Rush Period 1850 – 1899; ongoing mining ventures

The Gold Rush Period tree planting was dominated by Monterey Pine (*Pinus radiata*) and Pepper trees (*Schinus areira*). To some extent the inclusion of remnant indigenous trees was typical in this period due to the informal and sudden growth of settlements following gold discoveries. The wealth generated from the goldfields helped to pay for the development of public parks, street tree planting and heralded the development of the suburb.

5. Victorian Period 1835 – 1889

During the Victorian Period the growth of towns and cities escalated at the expense of the indigenous environment and people. Extensive tree planting was carried out in country towns along with public works programmes such as ports, railways, water supply schemes, regional botanic gardens, cemeteries, public parks and reserves. Forest Conservancy Branches established together with a rural expansion and land clearances.

The indicative tree planting was a mixture of coniferous plants contrasted with broad leaved deciduous plants and included: Moreton Bay Figs (*Ficus macrophylla*), Cypress (*Cupressus species*), Redwood (*Sequoia sempervirens*), Kauri Pine (Agathis robusta), Pines (*Pinus radiata, Pinus pinea, Pinus halapensis, Pinus roxburghii, Araucaria species,* Elm *(Ulmus procera , Ulmus americana),* Maples (*Acer* species)*,* Willows (*Salix species*)*,* Mango (*Mangifera indica*)*,* Brush Box (*Lophostemon confertus*)*,* Jacaranda (*Jacaranda mimosifolia*)*,* Plane Trees (*Platanus species*) and Palms (numerous species).

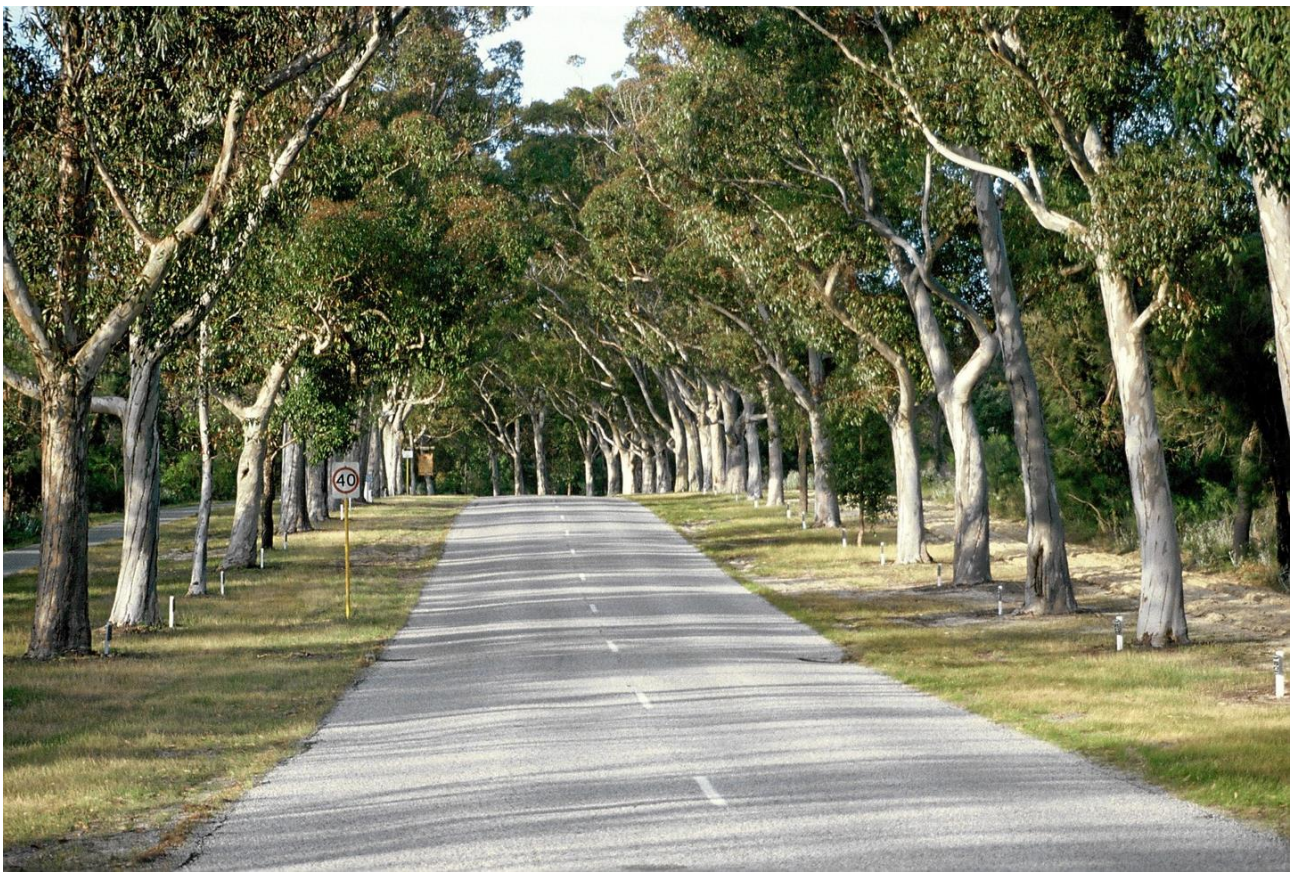
6. Edwardian and Federation Period 1890 – 1919

The Edwardian Period was a transition from the romanticism of the Victorian Period to the nationalism of the Federation Period and an engagement with the Bush myth as a possible identity for Australia moving into the twentieth century. An understanding of the naturalism of scenic landscapes contrasted with the realities of suburbia and the differences between the town and the bush. There was expressed a desire for tropical imagery and flowering plants as a compensation to the impacts of the Great Drought, Shearer's Strike, the Sudan War, the Boer War and the Great War and equally the role of the gum tree was promoted as an essentially Australian image of identity.

The most typical trees that represented this period were: Gums (*Eucalyptus species*), Port Jackson Figs (*Ficus rubiginosa*), Peppers (*Schinus areira*), W.A. Peppermints (*Agonis flexuosa*), Silky Oak (*Grevillea robusta*), Black Bean (*Castanospermum australe*), Bunya Pine (*Araucaria bidwillii*), Frangipani (*Plumeria species*), Red Cedar (*Toona ciliata*), Himalayan Cedar (*Cedrus deodara*) and Palms (many species but particularly *Phoenix dactylifera* and *Phoenix canariensis*).

7. Inter War Period 1920 – 1939

The Inter War Period is characterised with public tree planting species such as Lemon Scented Gums (*Corymbia citriodora*), Sugar Gums (Eucalyptus cladocaylx), Hills Fig (*Ficus hillii*), Illawarra Flame tree (*Brachychiton acerifolius*),Red Flowering Gum (*Corymbia ficifolia*), Camphor Laurel (*Cinnamomum camphora*), Poplars (*Populus species*), Native Cypress (*Callitris species*) and Palms (*Trachycarpus species and Phoenix canariensis*).



Sugar Gums, Kings Park, WA

8. Modern Period 1940 – 1962

The Modern Period offered post war optimism with a mixture of Australian plants, conifers and deciduous trees used such as Kurrajongs (*Brachychiton populeneus*), Eurabbie (*Eucalyptus St Johnii*), Plane Trees (*Platanus hybrida*), Jacaranda (*Jacaranda mimosifolia*), Tamarisk (*Tamarisk aphylla*), Ash (*Fraxinus species*), Pin Oak (*Quercus palustris*) and Liquidamber (*Liquidambar styraciflua*).

9. National Identity Period 1963 – 1979

The National Identity Period was a time when the search for identity was intensified through the use of Australian plants including, Eucalypts (*Eucalyptus species*), Casuarina (*Allocasuarina species*) and Paperbarks (*Melaleuca species*).

10. Late Twentieth Century Period 1980 – 1999

The Late Twentieth Century was a period of reaction to the National Identity Period and was involved in nostalgic romanticism and corporate imagism. Trees included Port Jackson Figs (*Ficus rubiginosa*), Planes (*Platanus hybrida*), Palms (*Livistona australis)*, (*Phoenix canariensis*), Bottle Brush (*Callistemon species*) and Evergreen Alder (*Alnus jorullensis*).

11. Early Twenty First Century Period 2000 – present

The Early Twenty First Century Period continued the imagism of the late 1980s and is represented by weird and wonderful plants such as Bottle Trees (*Brachychiton rupestris*), Baobab (*Adansonia gregorii*), Dragon Blood Tree (*Dracaena draco*), Screw pine (*Pandanus species*), Tuckeroo (*Cupaniopsis anacardioides*), Cabbage Tree Palm (*Livistona australis*) and Bismarck Palm (*Bismarckia nobilis*).

Many designed places in Australia contain a composite of plants from all or some of the above periods with few having structural integrity nor ecological relevance.

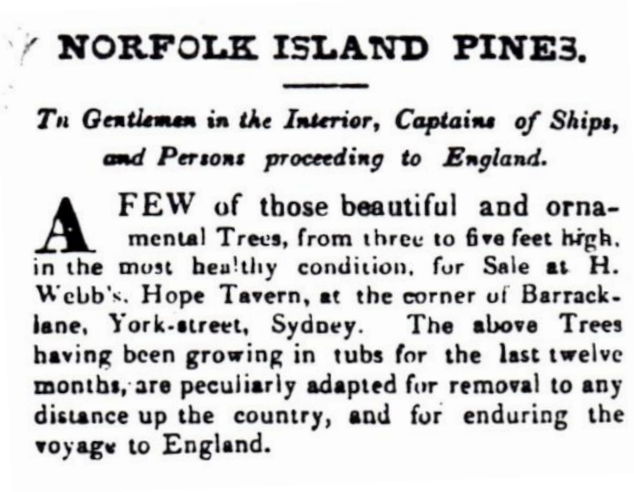
John Viska (AGHS WA) and Greg Keighery (Department of Environment and Conservation)

John Viska: The Norfolk Island Pine, *Araucaria heterophylla*: an historical perspective

When asked to nominate a tree that is special and has significance to W.A. I selected the Norfolk Island pine as its symmetry and vertical form is a distinctive feature of the skyline. In group plantings it extends well above the canopy of the surrounding trees making a major landscape statement and it has an interesting planting history as well.

This Australian member of the conifers was formerly known as *Altingia excelsa* and is endemic to Norfolk Island. It was in cultivation in England by 1796. Its strong geometrical form and distinctive shape was admired by the early settlers. It suited the purpose for formal use in the gardenesque style of gardening and was utilised early as a specimen to plant for special events.

Sydney Herald, 1836



NORFOLK ISLAND PINES.

To Gentlemen in the Interior, Captains of Ships, and Persons proceeding to England.

A FEW of those beautiful and ornamental Trees, from three to five feet high, in the most healthy condition, for Sale at H. Webb's, Hope Tavern, at the corner of Barrack-lane, York-street, Sydney. The above Trees having been growing in tubs for the last twelve months, are peculiarly adapted for removal to any distance up the country, and for enduring the voyage to England.

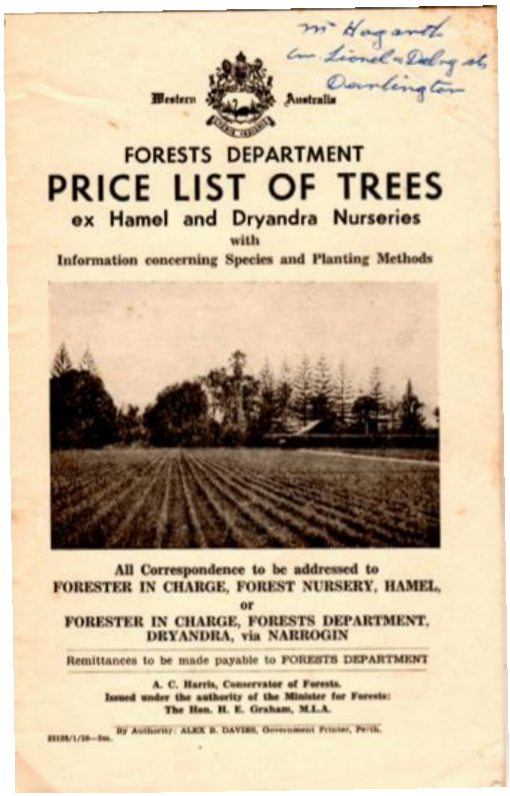
Plants were available to the colonies from New South Wales by the 1830's as seen by the advertisement that appeared in the *Sydney Herald* of 1836. A specimen in the grounds of the National Trust's Albany property, the Old Farm Strawberry Hill, was planted by Sir Richard Spencer in this early period of our state. An article that appeared in *The Albany Advertiser* in 1930 recorded that a Norfolk pine that was in the grounds of St John's Church when felled, this tree was calculated to be about a century old.

The Norfolk Island Pine was a popular tree to celebrate special occasions. A specimen in the Stirling Gardens was one of a batch that was imported by Henry Trigg from Sydney in the 1860's, which he subsequently presented to the Public garden. The tree existing today is a replacement. To mark the official opening of Perth Park in 1895, John Forrest planted a Norfolk Island Pine. As this tree was damaged in a storm the one that is seen today is a replacement.

Old Farm Strawberry Hill, Albany (Photo: John Viska)

Post card: In Government Gardens, Perth WA (State Library Western Australia)

The first time they became commercially available in Perth was when Joseph Wylde, a colonial nurseryman, advertised in the *Inquirer* newspaper of the 1870's that he had araucarias for sale from his premises in North Perth and encouraged visitors to inspect them. The earliest extant W.A. nursery catalogue we have that lists the Norfolk Island pine, is the 1896 Jacques Hawter's Darling Nursery that operated from Sawyers Valley. He sold them for 5 shillings each and ten years later they were still an expensive tree. C.F.Newman and Son's in their 1905/6 Manual for Garden and Farm listed them from 2/6 to 3/6. This high price suggests there was limited viable seed available or they were hard to propagate. For comparison eucalypts such as the Sugar Gum, Lemon-scented and Red Flowering ranged from 1shilling to 2/6!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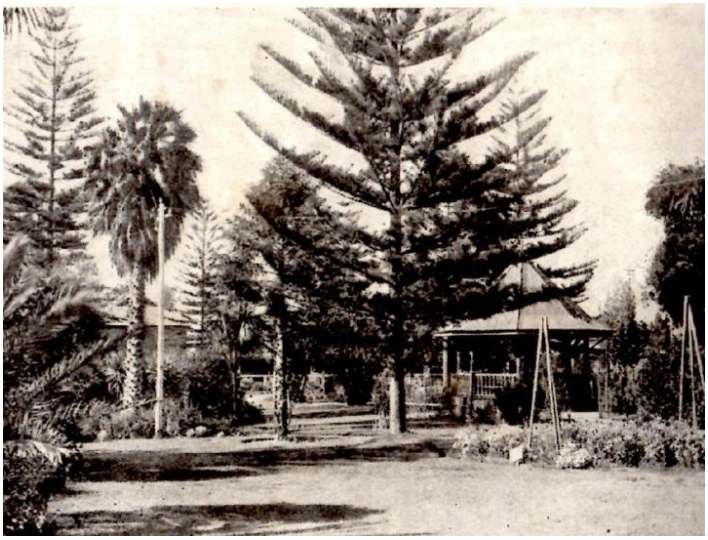
Hamel Nursery Catalogue (John Viska Collection)


Rankin Gardens, circa 1928

The State nursery at Hamel was established in 1896 and published in the Woods and Forests Annual Reports the number of plants raised each year. The first time they offered Norfolk Island pines was in 1899 of which they had 1254 available in pots; none for 1900; 392 in 1901; 120 in 1902; none in 1903; 1260 in 1904; 630 in 1905; 320 in 1906; 225 in 1907.

With the development of parks, due to the effect of extra revenue generated by the 1890's gold rush, its use as a park specimen tree became established and mature examples can be seen in Kings Park, Hyde Park and Robertson Park North Perth and Subiaco's Rankin Gardens.

Emanating from an island habitat they have proved to be successful in maritime situations such as John Street, Cottesloe. The first plantings here are dated to about 1905, as well as at the Esplanade Fremantle and Esperance.

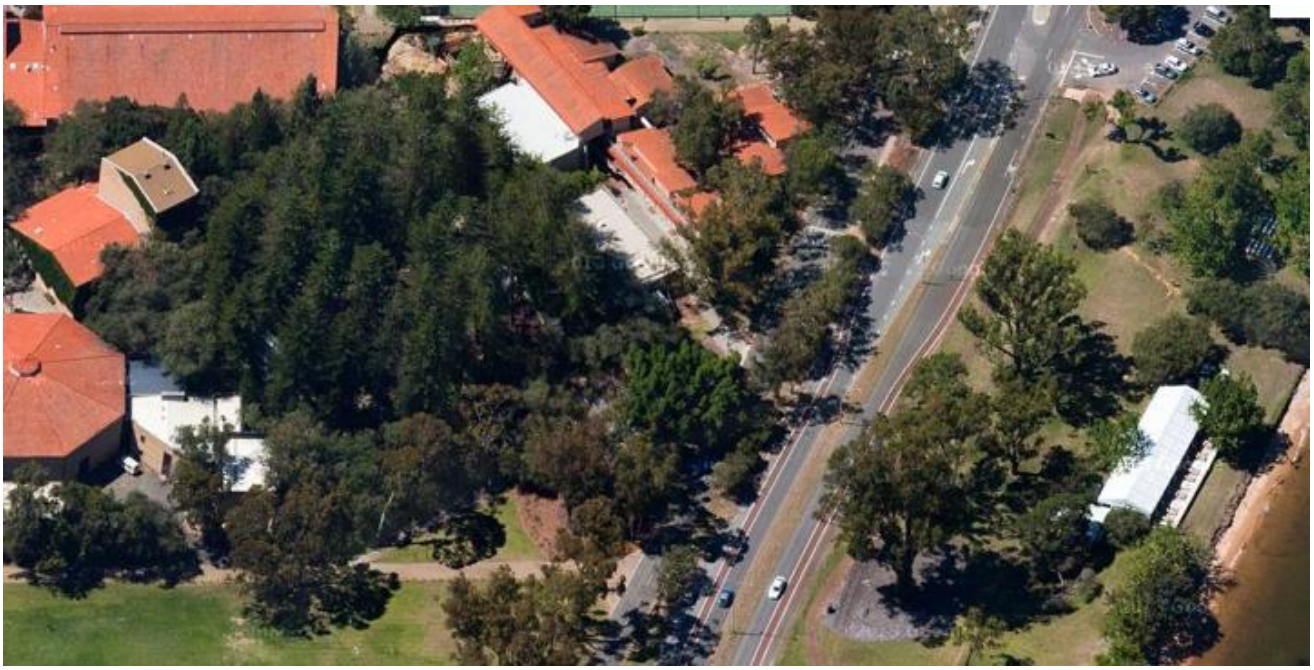
Planting in pairs made a good entry statement such as can be seen in the front garden of Samson House Fremantle and the Good Shepherd Convent, West Leederville. Solitary specimens are now annually illuminated with coloured lights during the festive season such as the one growing in the grounds of the Old Mill, South Perth.

Their use in street tree planting in the twentieth century has left us some impressive avenues such as Lake Monger Drive, West Leederville, Broome Street Cottesloe, and Oceanic Drive Floreat Park.

Good Shepherd Covent, West Leederville. (Photo: John Viska)

Lake Monger Drive. (Photo: John Viska)

The most original use of them has to be the planting at the Somerville Auditorium here on the grounds of the university. It was designed in a cathedral form and named “A Temple of Nature”. It was later renamed the Somerville Auditorium after a senate member Mr. W Somerville whose inspiration it was.



Somerville Auditorium. Photo from Google Earth

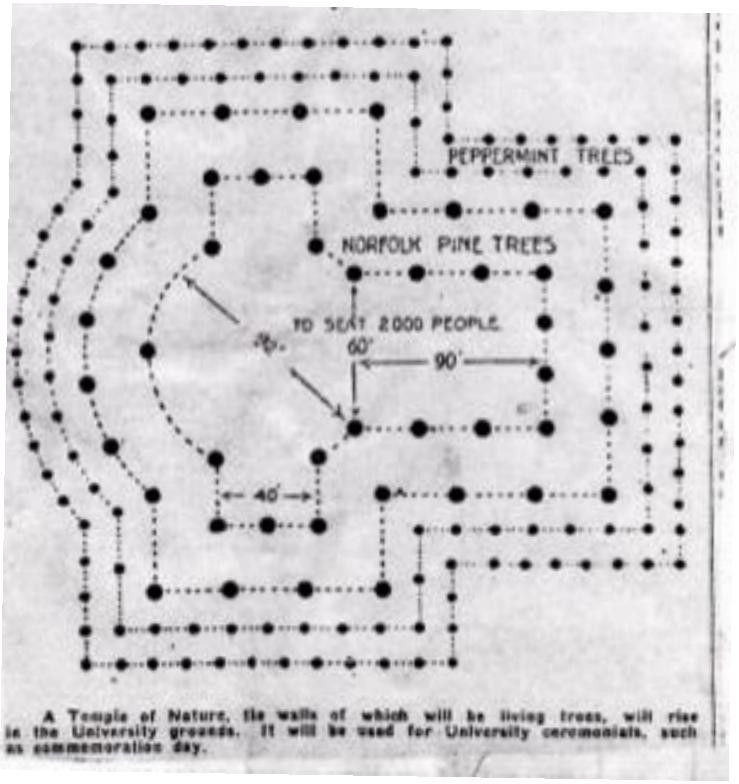


Image from John Braithwaite’s Scrapbook

As the tree grows by expansion in two directions due to a strong apical dominance their height at maturity can be up to 30 metres with a spread of 10 metres. As the tree ages the weight of the expanding branches produces a distinctive downward angle whereas in young trees they are upright.

They are not so frequently planted these days due to their eventual size and habit of building up litter from the shedding branchlets that suppresses any growth around the base. Recently fungal diseases have started to take their toll on advanced specimens and the damage done by extreme weather conditions such as the severe hail storm a few years ago are having a marked effect on the population.

The habit of using the Cook Island Pine, *Araucaria columnaris,* with its darker foliage and denser branching habit in replacement plantings especially in avenues is also compromising the integrity of the existing plantings. The Norfolk Island pine with its close association with the planting history of the state and its impressive form at maturity is worthy of being recorded as a significant tree.

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Greg Keighery: The Urban Forest: Tuart, the Tree and the Forest

As part of the discussion on determining significance of trees it was thought useful to compare how a native, commonly cultivated tree (Tuart, *Eucalyptus gomphocephala*) was determined to be significant.

Background

Formal Protection of Tuart as a Native Plant

There are three very large differences between determining the significance of native and exotic plants. The first is that native plants normally occur in self-perpetuating populations of several to numerous individuals and significance is assigned to these populations rather than individuals, which is the norm for exotic trees. The second follows from this point in that Tuart, being a large tree, is part of a distinct self-perpetuating plant community, which is not true of planted exotics. The tree Tuart is found in a wide variety of habitats and as part of 13 distinct plant communities on the Swan Coastal Plain, but dominates only 2 of these.

The understory of Tuart woodlands varies greatly due to soil types (Quindalup compared to Spearwood Dunes) or inundation and this defines a series of distinct plant communities associated with Tuart. Some Ecological communities are considered to be so reduced by a variety of means (clearing, disease, etc.) that they are formally listed as threatened ecological communities either federally under the *Environmental Protection and Biodiversity Conservation Act* or at the State level. Two plant communities in which Tuart occurs have been either listed (Sedgelands in Holocene Dunes at Yanchep and Rockingham) or proposed (Tuart/Yate woodlands near Busselton) as threatened. These communities have statutory protection under the appropriate acts.

Finally unlike exotic species, as a native Western Australian tree species Tuart is protected under the Wildlife Conservation Act. However, this is complicated with Tuarts on private freehold land, where the issue of determining significance of Tuarts as a plant community, populations and individual trees remains.

Tuart, the Species

Tuart is a medium to large tree confined to the Swan Coastal Plain with a range of 400 kilometres, between Jurien Bay and Busselton. The tree and the plant community it forms occur on the western side of the Plain in a near coastal strip 5-10 kilometres wide. Tuart occurs on near shore Quindalup Sands and the adjacent Spearwood Sands over limestone. Perth, the capital city of Western Australia, is in the centre of the range of this imposing plant, which is the tallest tree of the coastal plain.

In Western Australia during the preparation of the conservation plan for Perth (*Bush Forever* Government of Western Australia, 2000 a and b) and subsequently for the Regional Forests Agreement (Hearn et al., 2003) considerable thought was given to developing significance criteria applicable to all native species rather than those that were deemed rare and threatened and which were already formally listed.

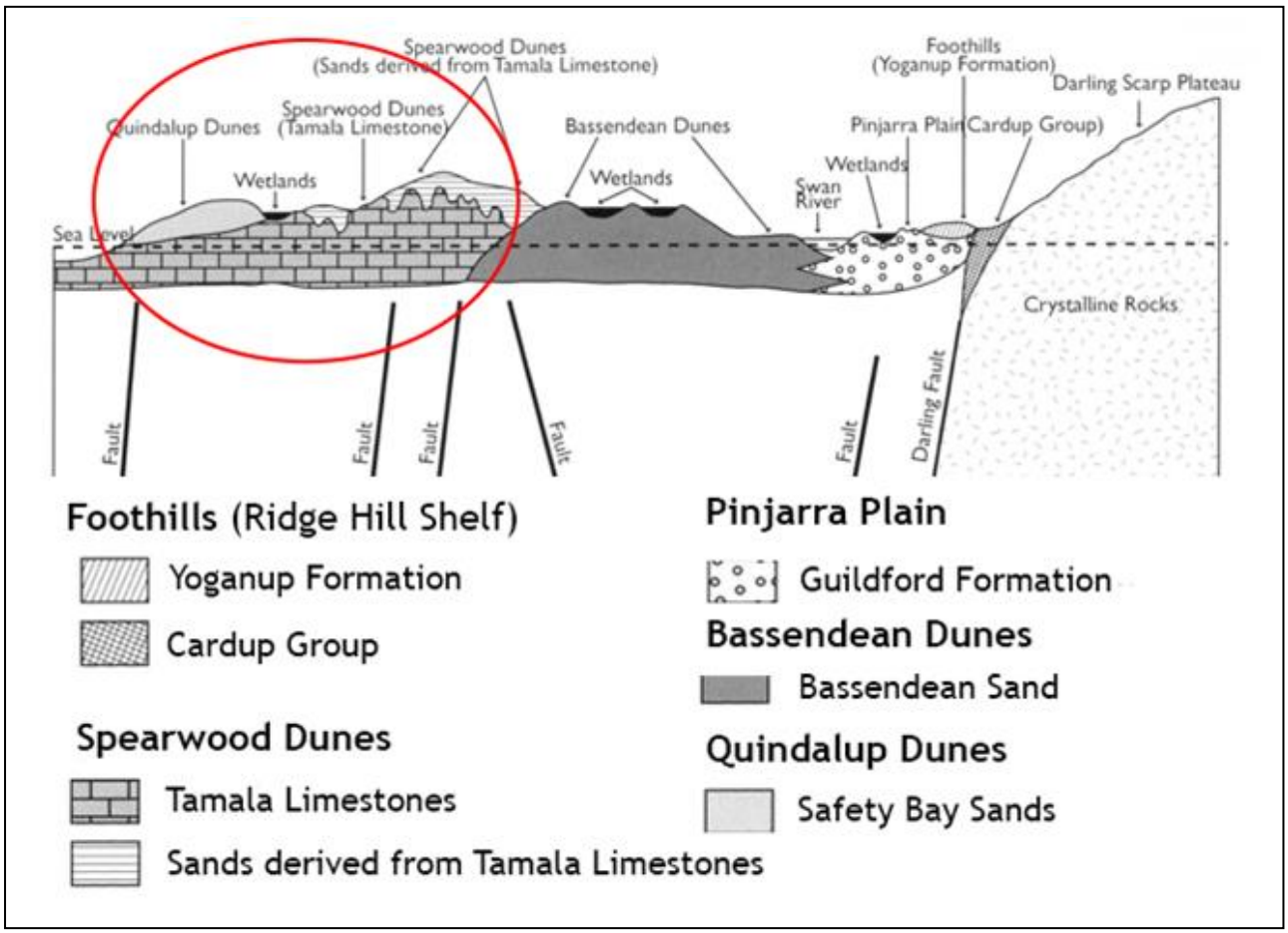
The criteria developed were:

- geographical
- ecological
- morphological
- genetic
- rarity
- cultural

To understand how these work we will apply them to Tuart.

Geographical significance

This relates to range ends and outlying or disjunct populations of a species. Tuart as we have noted grows near the coast but does penetrate inland along rivers. Populations are found along the Moore, Swan, Serpentine, Pinjarra and Harvey Rivers. Several of these are outlying populations are disjunct from the main range, especially at Guildford (Swan) and Lowlands (Serpentine). These are geographically significant populations. The northern most population near Jurien Bay is also listed as geographically significant.



Adapted with permission from Fact Sheet 15. The Geology of Perth.
Department of Mineral Sands and Energy, WA

Ecological significance

This relates to having distinct forms that grow in very different habitats compared to that normally associated with the species, ie wetland forms of species that normally grows in dry sites. There are no examples recorded for Tuart.

Morphological significance

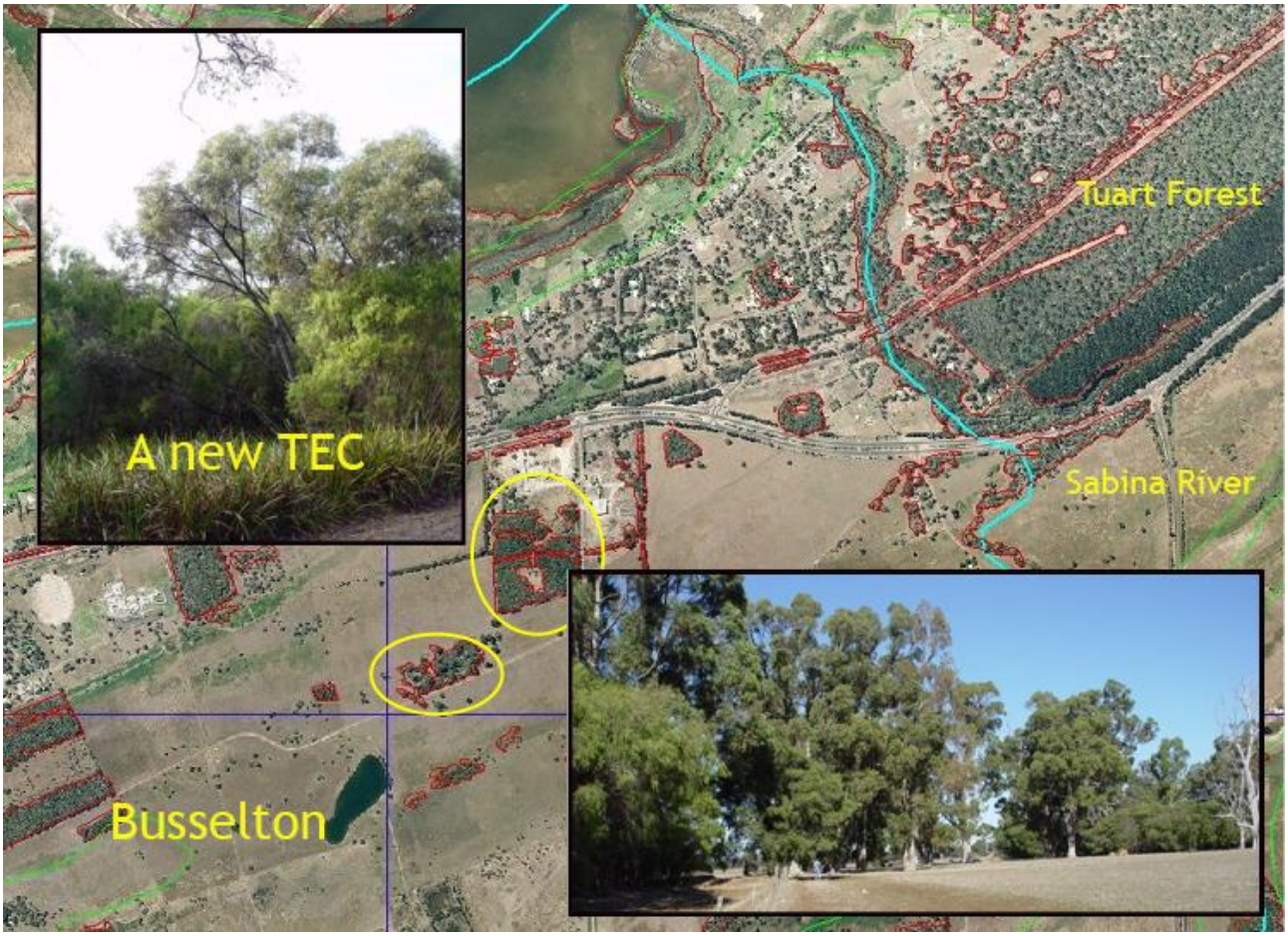
Tuart is thought of a single trunked tall tree (Powell, 2009) but there are also a series of mallee forms recorded for Tuart normally on the western margins of the species range on the Quindalup Dunes.

Quindalup Dunes (Photo: Greg Keighery)

Genetically significance

Like many large forest trees Tuart shows little observable genetic variation over its range. However, there has been little provenance testing of Tuart to determine if the observed difference in the form of Tuart in the near coastal dunes (dense low branched tree or Mallee) compared to the large forest trees at Capel is genetically fixed.

Tuart also readily hybridises with many other eucalypts and some of these long-lived hybrids have been named (*Eucalyptus x gomphocornuta* and *E. x mundijonensis*). The latter being previously listed as a rare species. These hybrids are somewhat comparable to distinctive cultivars of cultivated plants.



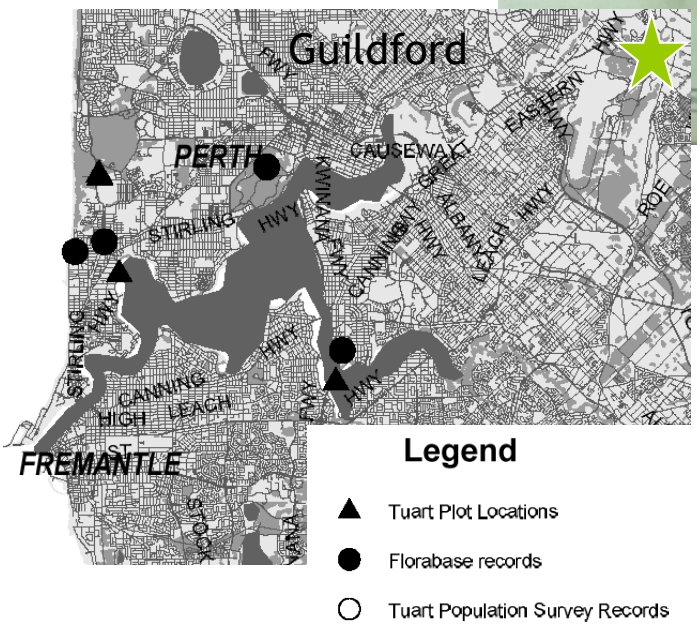
Tuart, Moore River (Photo: Greg Keighery)

Eucalyptus gomphocephala forms a mallee in the Quindalup Dunes
in patches from Guilderton (Moore River) to Bunbury (Photo: Greg Keighery)

Rarity

A unique form of tuart growing around Pyrton (near Guildford), which had red not yellow heartwood, was named as *E. gomphocephala* var. *rhodoxylon*. This variant now appears to be extinct having not been recorded for over 90 years.

Eucalyptus gomphocephala var. *rhodoxylon*



Cultural significance

Tuart trees and woodlands were of considerable significance to the Noongar people, being the source of food, both plant (bracket fungi, bulbs and tubers) and animal.

As an iconic tree for Perth, there have been many publications on Tuart. The major ones are the proceedings of a Tuart and Tuart Communities workshop (Keighery, BJ and Longman, VM 2002), the Tuart Atlas (Tuart Response Group, 2004), and books on Perth (Powell 2009) and Western Australian Trees (Cunningham, 1998).

The tree has obviously a special place in the public's mind as when Tuarts were observed dying south of Mandurah. Public pressure caused the then Minister of the Environment Judy Edwards to establish a special ministerial taskforce (Tuart Response Group) to undertake research into the issue.

Large Tuart trees were noted by all early settlers, resulting in series of locality names (White Gum Valley, Tuart Hill) around Perth. Tuart wood was a very early export and instrumental in the Forests Department at Ludlow establishing timber reserves and a concept of sustainable harvest.

Tuarts are frequently the major native tree listed in inventories of significant trees within their native range, eg several are listed for Mandurah as part of their significant tree register. Interestingly Tuarts, because of their ability to tolerate poor soils and coastal salty winds, feature most strongly as a feature tree outside of Perth at Geraldton, Esperance in eastern Australia, overseas in South Africa and around the Mediterranean. Perhaps the single most significant planted Tuarts in Western Australia are found at Eucla where they were planted at the overland telegraph station last century.

Conclusion

Tuarts illustrate, in a way few other native trees can, the interaction and differences between protection of and recording significance of native species. This largely occurs at a population level compared to protection of exotic trees, which largely occurs through the listing of individuals.

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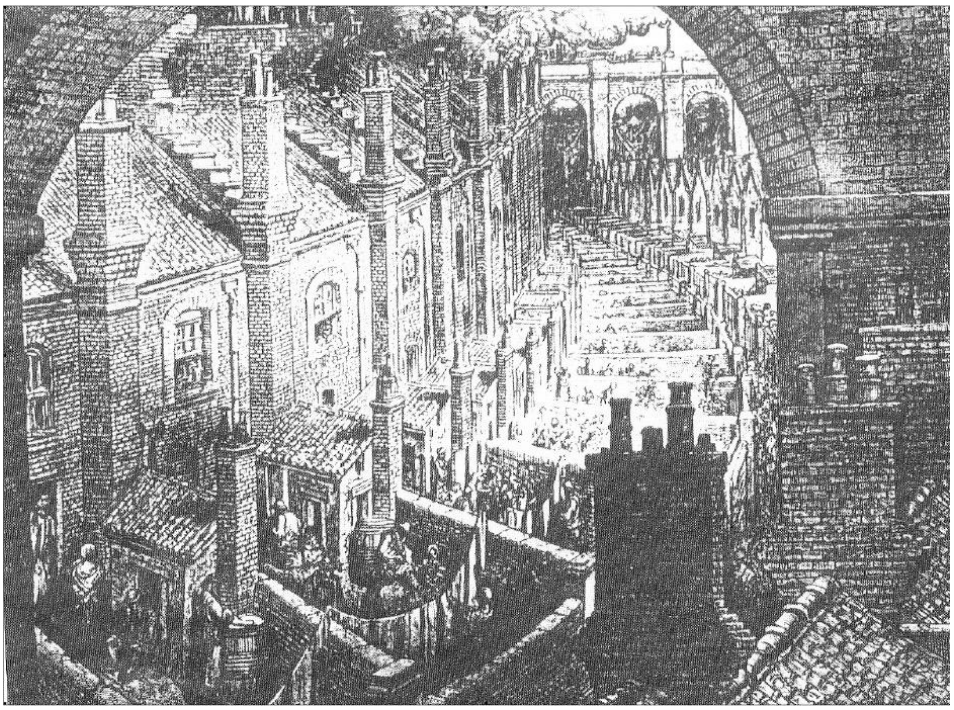
Don Newman & Peter Ciemitis
Creating Urban Forests in Perth (Green Space in WA Town Planning)

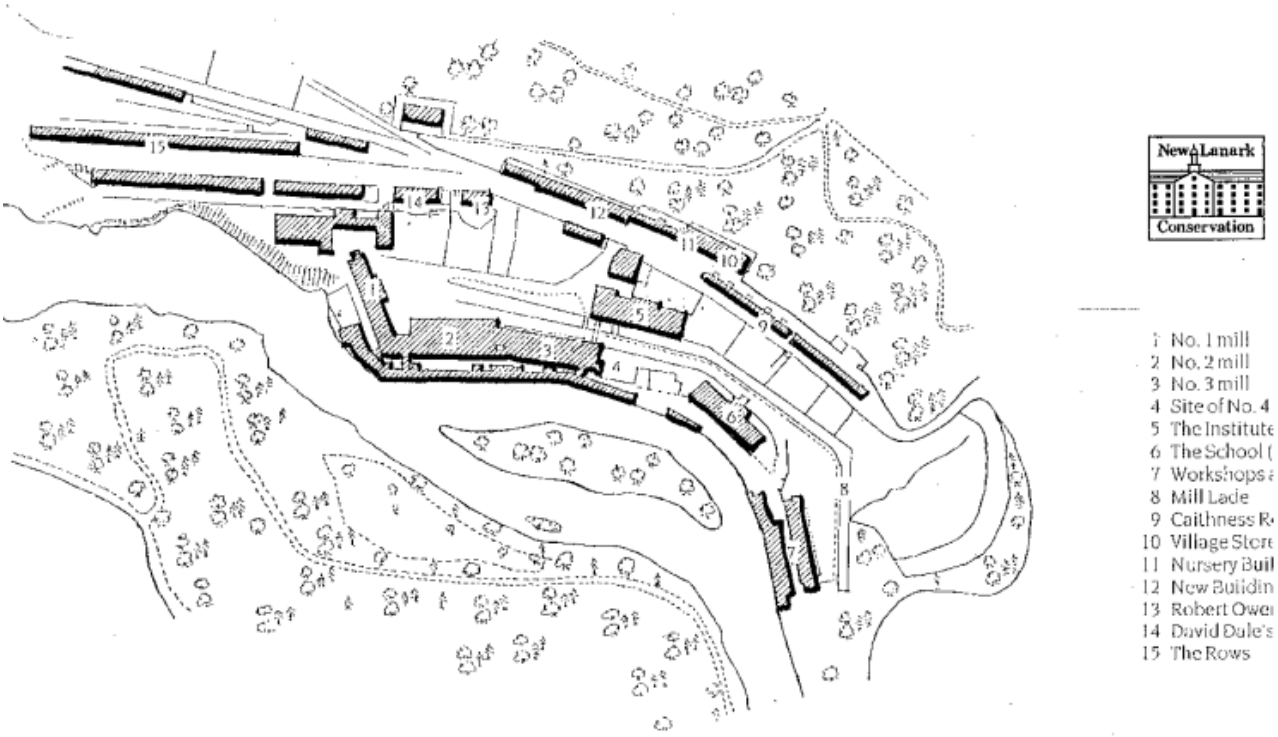
Don Newman: The Emergence of Green Space in Town Planning

I hold the strong view that the modern town planning movement emerged from the time of the Industrial Revolution and was a response to the terrible conditions of the majority of the 18th century population in Europe.



The first notable place where housing and working conditions were vastly improved was New Lanark, Scotland in 1784. David Dale, and later his son-in-law Robert Owen, created an idyllic village and industrial complex on the banks of the river Clyde using the water power from the falls nearby. The elements of this place were good housing, healthy and safe working conditions, no child labour, education for children up to the age of 16, a cooperative society general store, architectural design of the space and buildings, resident allotments for food and places of relaxation and recreation that we would now broadly describe as parks.

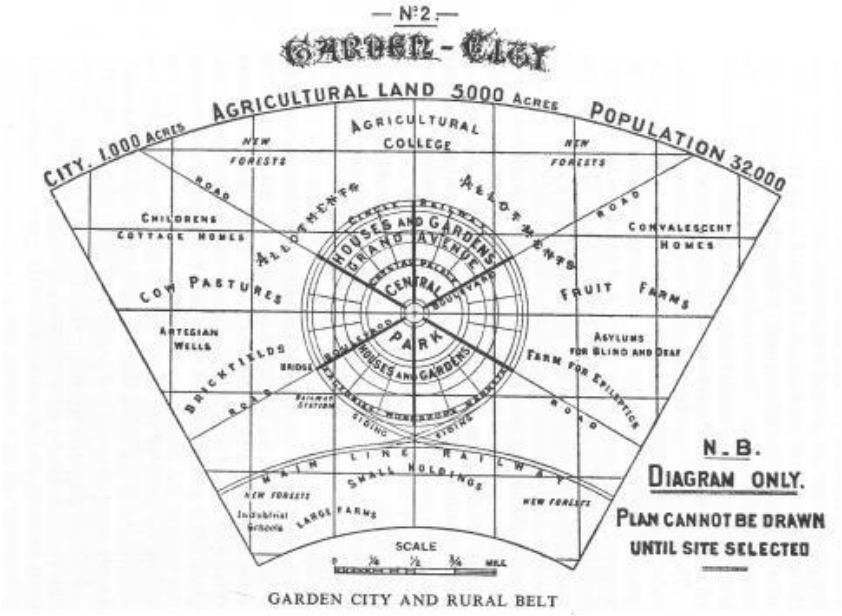
Dale recognised the ills of living and working conditions and believed that a happy and healthy workforce would provide a profitable enterprise. He demonstrated his belief in New Lanark, which by 1800 was the largest cotton mill in Scotland.


New Lanark
Conservation
1 No. 1 mill
2 No. 2 mill
3 No. 3 mill
4 Site of No. 4
5 The Institute
6 The School (
7 Workshops a
8 Mill Lade
9 Caithness R
10 Village Store
11 Nursery Buil
12 New Buildin
13 Robert Owe
14 David Dale's
15 The Rows

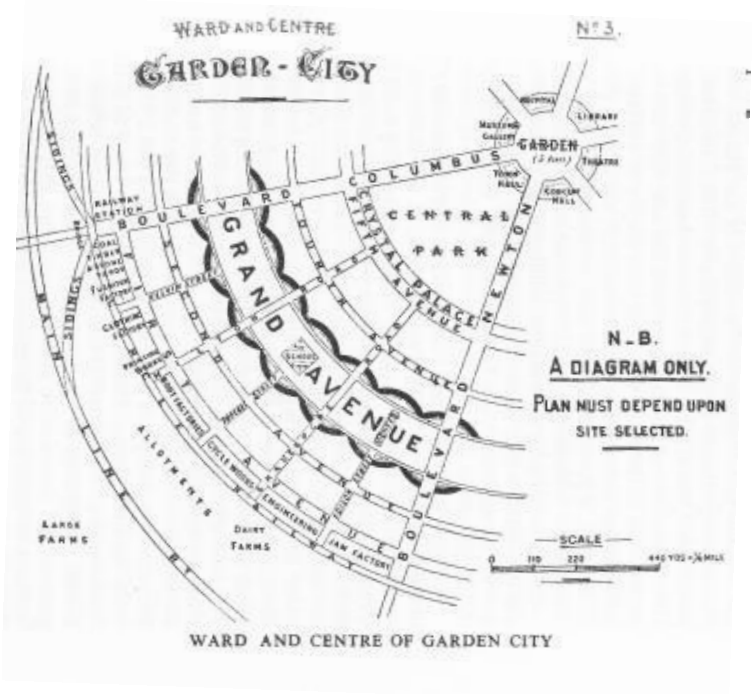
The setting was one of great beauty as the Clyde Valley was blessed with trees and grassed land in a narrow winding valley. At the time it was largely untouched and would have attracted Dale by its natural beauty.

By setting aside areas of fertile land for allotments and places of natural beauty for recreation and relaxation, he applied aesthetics and nature to his creation thus bringing out an appreciation of such places in his residents and workforce. Throughout the nineteenth century, his example was followed with individual industrialists putting their beliefs to the test of profitability. None failed. Today we can visit these places such as Bromborough, Port Sunlight, Bourneville and New Earswick, and wonder why more did not follow nor why government remained aloof from this reality.

It was left to the people with strong belief and determination to bring gardens and parks into town planning. Building on the previous century examples, the Garden City movement led by Ebenezer Howard, Lord Levehulme (William Hesketh Lever), the Cadbury brothers and Joseph Rowntree. The movement burst upon the scene when Howard published the principles of the Garden City in his book "Tomorrow! A path to real reform" in 1898.



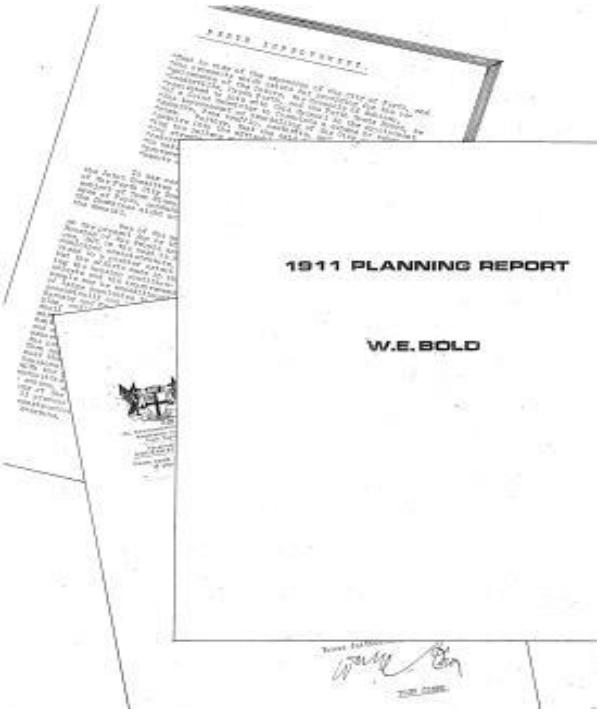
GARDEN CITY AND RURAL BELT



WARD AND CENTRE OF GARDEN CITY

It was republished four years later as Garden Cities of Tomorrow and gave the movement the impetus to persuade the government of the day to pass the Housing and Town Planning Etc., Act 1909.

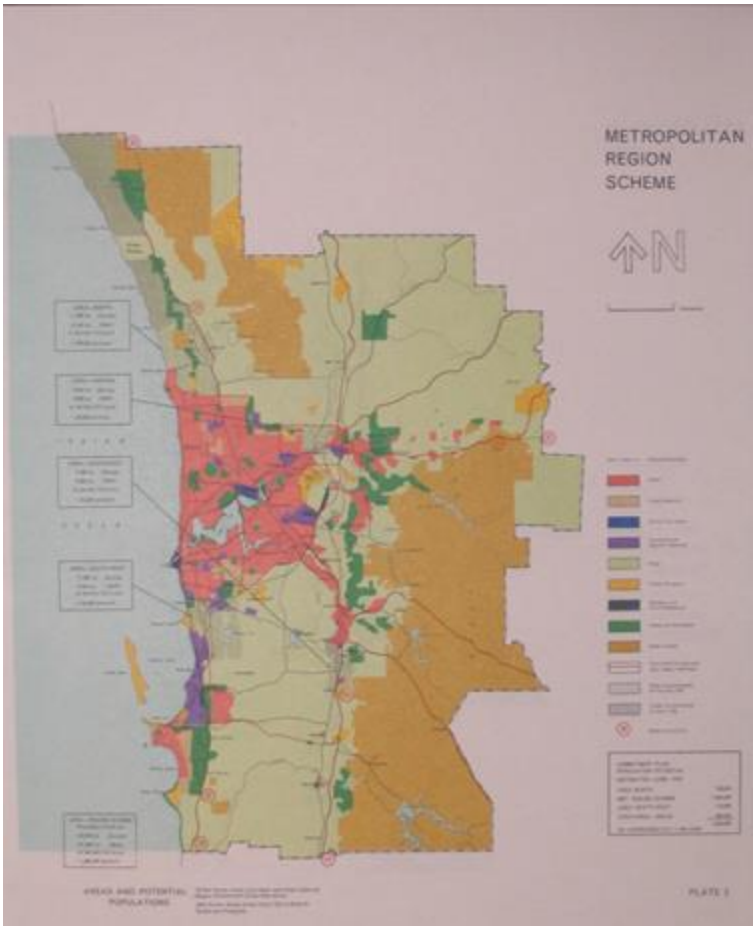
And now we see Western Australia enter the domain of town planning. W E Bold writes a report on planning for the City of Perth in 1911. The report was so persuasive that Council granted him leave in 1914 to travel abroad and research modern town planning. The First World War curtailed his tour but he brought back significant information and increased enthusiasm to strongly advocate for town planning legislation in WA. He was especially interested in the British based Garden City and the American City Beautiful movements. Success in 1928-9 saw the Town Planning and Development Act and the Metropolitan Town Planning Commission Act.



W.E. Bold

The TP&D Act set out the basis of town planning requirements for all local government planning schemes. In the schedules of responsibilities was a provision for parks and gardens. Due to the onset of the Great Depression little was done in preparing local schemes. It was not until the post-war era that the post-war boom brought home to the government that town planning for a peacetime economy was desperately needed.

Due to the lack of town planning expertise in WA, the fortunate accident of a loss of a job in USA, left Gordon Stephenson available to come to Perth. In conjunction with the WA Town Planning Commissioner, Alistair Hepburn, he drafted a regional plan for Perth and Fremantle. This in turn was morphed into a series of legislative acts that formed the Metropolitan Region Scheme (MRS) in 1963. It became the model for town planning practice in statewide planning.



A key element bought to WA by Stephenson was ensuring the provision of parks and gardens for public enjoyment. Thus a 10% Open Space provision was locked into all town planning and, as a result, not only have parks and gardens sprinkled throughout our suburbs but also the grand open spaces of the river foreshores, Bold Park, Whiteman Park, Piney Lakes, Beeliar Wetlands, Herdsman Lake, Champion Lakes and many more.

This reinforced the need for amenity considerations as open space (as it is often referred to) provides amenity for the public depending on its urban context. Amenity is a variable thing to pinpoint unless a defined space is discussed. This amenity has as a core attribute the presence of trees and green space. Other aspects/attributes related to trees could include rarity, benefits such as summer shade or winter sun, screening, wind breaks, contrasting visual texture and aesthetics, history of the place, association with a person or event or, a simple memory of the ever changing local community. We are fortunate to have such core aspects of urban greening contributing to the planning dialogue in WA.

It is now time to look at how these matters have been developed in recent times and Peter Ciemitis will assume the role of captain and steer us through more modern times!

Peter Ciemitis: Challenges to Establishing Urban Tree Cover in the 21st Century

Peter Ciemitis
Senior Associate, Robertsday [design]

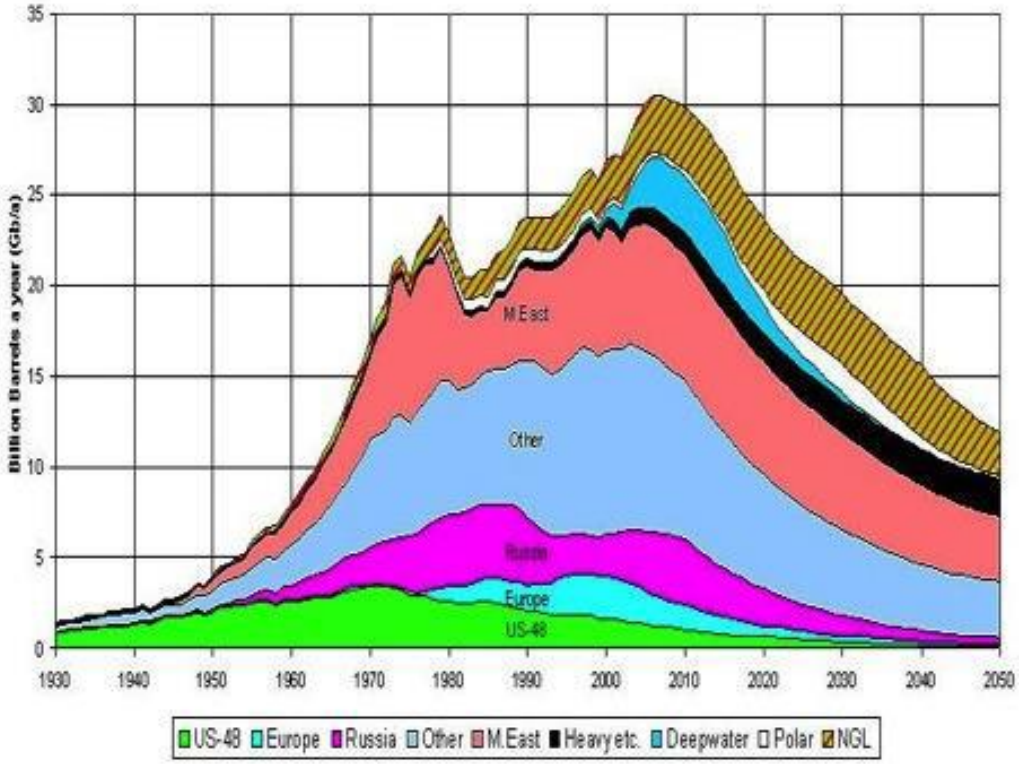
Introduction - Times have Changed

The Garden City and City Beautiful Movements that Don Newman has described left a significant footprint in the Perth landscape, not only through the suburbs of the early-mid 20th Century that aspired to their vision, but also the philosophies that were to permeate through the next half century thereafter. Since then however, we have seen an erosion of tree cover in our new communities (and even in older ones).

A common argument is that house blocks are becoming too small to accommodate trees. The real reasons however are complex, and I hope to touch on just a few of those today. By way of disclosure, I should mention that I live in a townhouse, effectively on a 270m2 site. I have four trees, one of which one is about ten metres in height. I personally do not buy the popular argument that blocks are too small for trees!

In the 1970s, What Did We Expect the 21st Century to Look like?

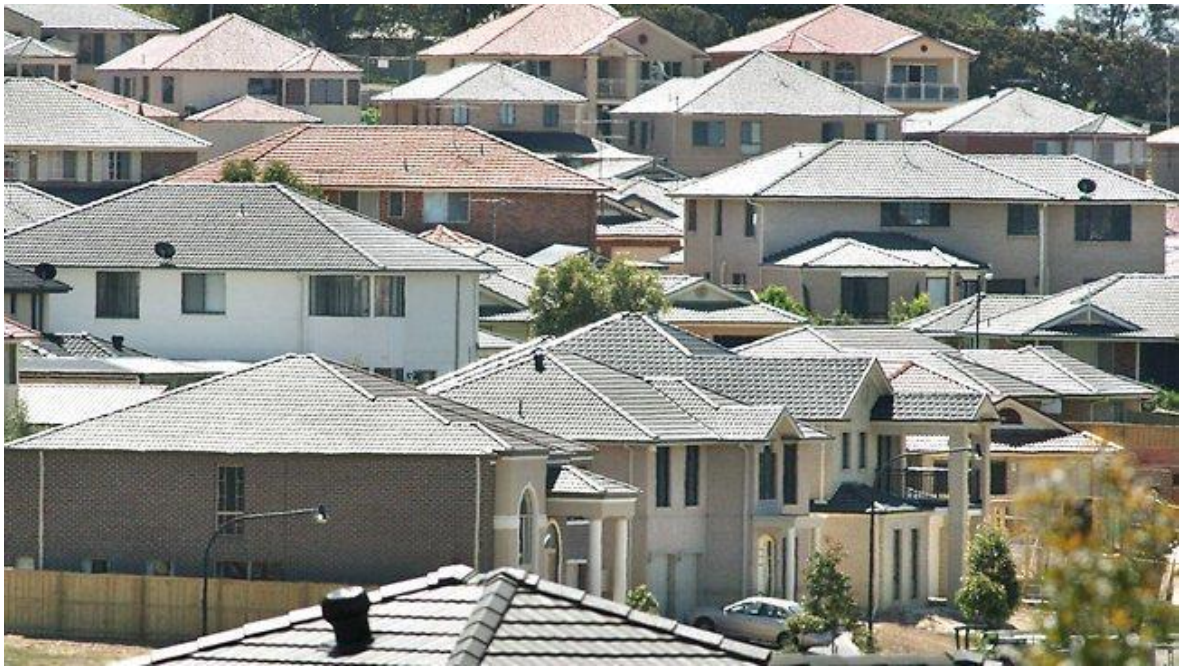
Putting aside flying cars, we knew that several major trends would begin to play out by the beginning of the 21st Century. Birth rates were contracting, and we knew household sizes (and therefore homes) would diminish in size.



We had just experienced the first Energy Crisis, and knew that in the future we would be using solar energy, and driving small cars…maybe electric cars. We knew we would need to encourage compact communities, smaller blocks and walkable communities. We knew that conservation of ecosystems, and the greening of urban environments was crucial, and we would all be playing a part. The least we could do was plant a tree.

How did the 21st Century Actually Turn Out?

In the intervening four decades, we have seen some of these trends come to fruition. However, several haven't. Blocks became smaller and communities are becoming more compact. Household sizes shrank, but houses became bigger (and emptier). Cars became bigger. We lost trees in our urban landscape.



Trees progressively disappeared from the urban landscape

How Did This State Arise?

The loss of trees in the urban landscape seems entirely counter to expectations from the perspective of the earlier part of the last Century. We came to love and include trees in our suburb design and, if anything, we knew that trees would become more important, not less. The reasons for their decline then is difficult to pinpoint, and seems quite complex.

- Community values have changed
- Industry responses to changing community values (i.e. industry has responded to 'market drivers')
- Environmental Imperatives have sometimes had unanticipated effects, and
- Governance responses have been incremental rather than holistic.

Exploring These Reasons Further…

- **Community values**

Community values (or individual lifestyle preferences) have become more inwardly focussed. Home comforts, space and quality have become increasingly important. Home sizes have increased in response to these values, despite actual need for space diminishing.

The Community appears increasingly anxious about the outside world. Children are encouraged to remain home, or be chaperoned when outside (unstructured, unsupervised play has diminished and is even feared). Our own use of the 'outside' is as an extension of indoors; courtyards and backyards are used more for entertaining, rather than cricket or gardening. As a consequence, the trend to larger houses has been accompanied by less focus on the garden, and a disinterest in the public domain (streets and parks).

- **Industry Responses**

Industry Responses have been quite straightforward. Builders are in a vicious spiral to deliver larger homes (only just starting to change). In turn, they need flat sites, at the lowest cost. Developers and subdividers have responded by preparing entire estates compliant with these requirements. In the 1970's and 1980's, subdividers generally worked with natural contours, and homeowners individually earthworked their own blocks and constructed their own retaining if necessary. This is rare today.

In delivering flat blocks, developers must reshape entire landscapes, and retain lots themselves. They must not exceed particular grades in doing so, which generally runs counter to working with the vagaries of natural landform.

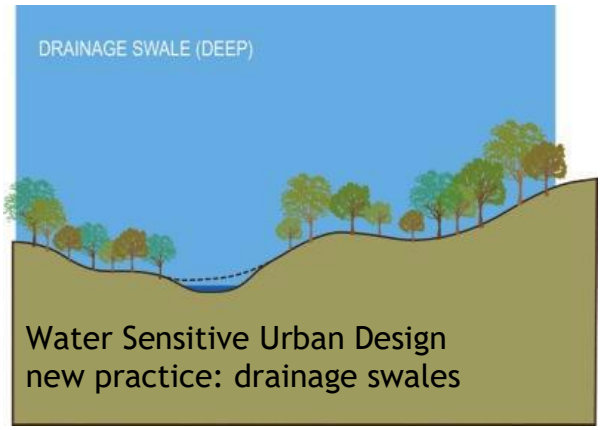
Current practice results in broad-scale denudation of landscape, with tree retention possible in only a few strategic locations in an earthworks plan. From the development industry perspective, there is still an appetite to work with existing landform to retain vegetation, and deliver sloping blocks. But this can often be met with resistance by both Local Government and by builders.

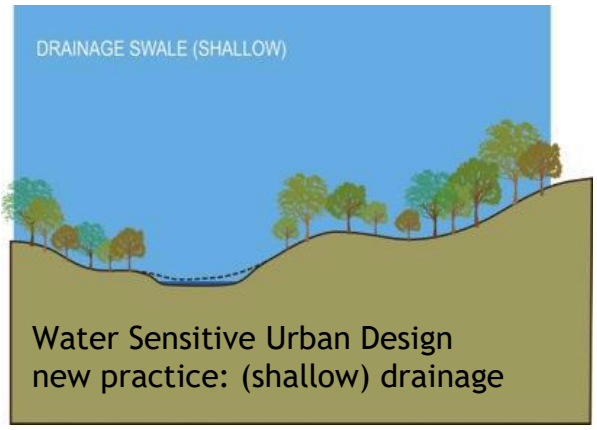
- **Environmental Imperatives**

The Environmental Response has seen numerous initiatives unfold, some of which significantly benefit vegetation retention, but others have had an unanticipated negative effect.

By one example, the practice of accommodating drainage in sumps has been superseded by the use of water sensitive urban design practices; mainly involving the use of retention and infiltration basins. These initially delivered a mutually positive outcome, but removing the presence of unsightly sumps (and associated social problems) often wove swales and basins into natural landforms. More recently however, design standards are requiring increasingly shallower basins, with (unintentionally) larger footprints. When used in undulating treed country, this technique has occasionally led to unnecessary tree clearing, and therefore to diminished environmental outcomes.

On other occasions, it is becoming evident that tree planting where it occurs in new estates is influenced by preferences for species selection, rather than the functional objectives such planting needs to fulfil.





- **Governance Response**

These are some examples of the Governance Response to development and environmental protection and its effects on appropriate tree cover in the City.

Further major drivers for public sector responses (especially Local Government) revolve around maintenance, liability and approvals management. In terms of the latter for example, current development practice has become so embedded within governance structures that there is little knowledge and experience of past practices. For instance the managing of “individual retaining by owners will be a nightmare…we won’t do it” is real response received in relation to proposals to retain natural contours in a project.

Liability, and the invisible hand of insurance requirements has become an unanticipated inhibitor to the inclusion of trees and landscaping in the built environment. Safety protocols often associated with routine maintenance alone is increasingly becoming a leading discouragement for Local Authorities to accept dispersed open space and landscaping within new estates. And we haven't started talking about bushfire planning in urban areas.

Some Steps Forward

So the 'smoking gun' is held by many hands, with few silver bullets. However, some initiatives and strategies are worthy of exploration, not all of which are planning or industry related:

- The greater use of strata titles (or community title) for land development to circumscribe overly onerous design and management requirements (e.g. Frasers Landing)
- Greater encouragement of lightweight housing, which doesn't require pads, nor flat sites
- carbon trading credits as a financial driver for Local Authorities to maximise tree cover
- the funding and advocating of major risk research as a part of representations to the Insurance Sector to review standards
- the continued evolution (despite increased complexity) of land-sensitive urban design practices.

Stuart Read (AGHS NSW)
Tree Success Stories and Strategies – NSW and elsewhere

This paper highlighted a couple of successful case studies with community action in NSW where a good result with public trees had come by engaging more stakeholders early in the process.

Stuart showed how all cultures in NSW value trees, from the beginning. For instance, Aboriginal people cutting canoes, bark for cloaks or shelter, wood for tools, symbols for ceremonies and ongoing traditional cultural practices such as birthing trees, initiation places, and bora rings for gatherings etc. Settlers had, as well as cutting down trees for timber or profit, lobbied to put them back in, for instance 1903 Wahroonga in northern Sydney, where dusty streets and poor air had locals pushing for new street tree planting of brush boxes and planes – what make up the 'leafy North Shore suburbs' of today.

Garden Suburbs such as Haberfield in Sydney's inner-west and Burwood's Appian Way used street trees (again brush box) as key elements in 'greening' and 'branding' their better-living-environments, something any real estate agent or aspiring purchaser is well aware of today. In 1926 garden designer Edna Walling was railing in her magazine column in 'Australian Home Beautiful' Are Melbourne's elms being slaughtered? – in protest against thoughtless Council lopping on main streets.

A NSW Heritage Office guideline on Street Trees in NSW makes the point that street trees have a long history and many fashions (of species, use and type) over time—with native species as well as exotic, conifers, etc—on country roads, avenues public and private, sale yards, Council pride and more.

Stuart pointed out how colonial farm homesteads were often marked out by singular tree plantings: of signal Araucaria pines (Bunya, hoop, Norfolk, Cook's), or groves of trees, in sharp contrast to cleared paddocks or landscape surrounds – this, as well as driveway plantings, makes them distinctive still.

In NSW's Southern Tablelands, the country town of Braidwood is bisected by the Kings Highway – it forms the town's two major road approaches. A number of fatal car crashes forced the NSW

Braidwood Kings Highway fatalities. (Leigh Trevitt)

Roads & Maritime Authority to prepare a hazards report and plan for the future. The whole town is listed on the NSW State Heritage Register as an example of Georgian grid town planning with deliberate road approaches and views to and from it, across cleared agricultural land.

The golden and Lombardy poplar trees lining the road were planted by the community in 1936 to commemorate King George V and are all held in high esteem by the local community. Additional pin oaks were added in 1984 to fill gaps. Other tree-lined streets planted later use eucalypts and other species such as Monterey pines.

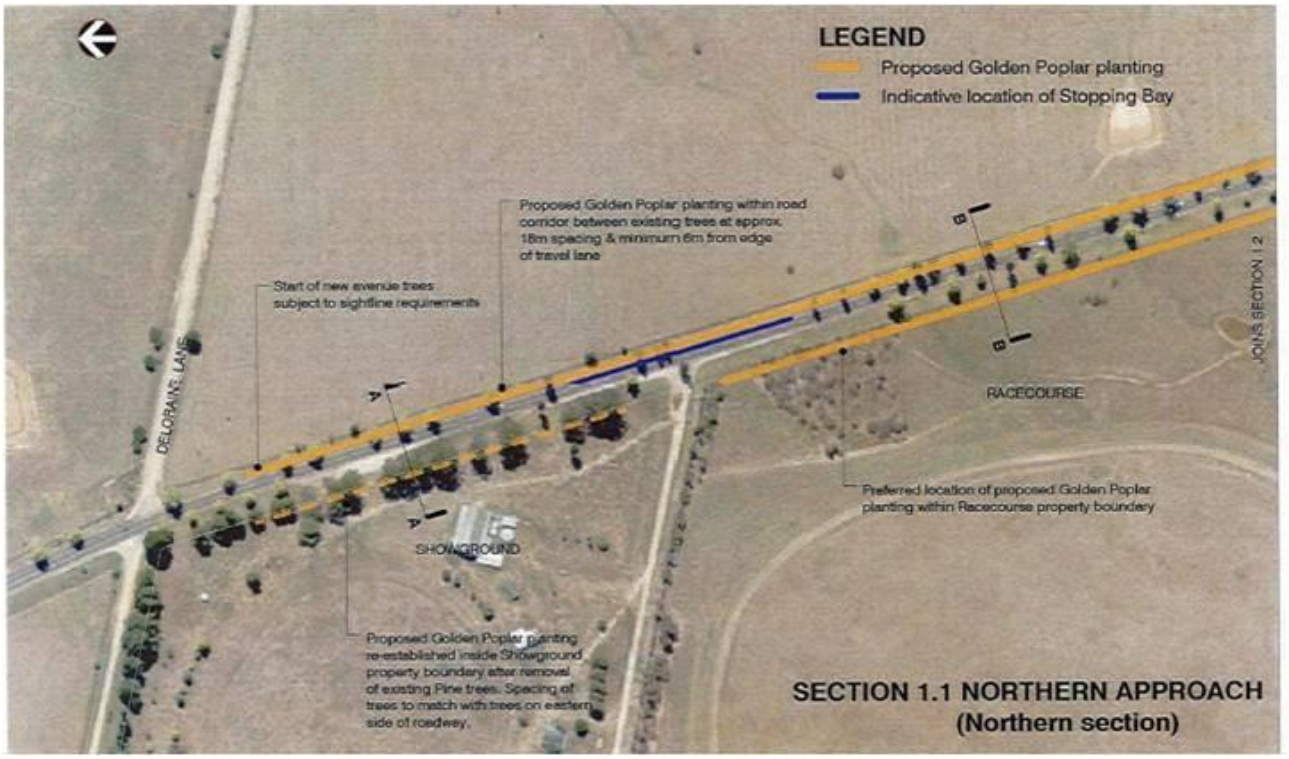
Braidwood Kings Highway golden and Lombardy poplars (Leigh Trevitt)

Regarding the management of the Kings Highway trees, crashes and road fatalities, the community were approached by Roads & Maritime Services in NSW staff directly through community workshops and open days, to explain the relevant safety issues (speed, trees close to the road, driver behaviour, varying road environment, increased traffic volume), look at road and verge design and treatment options for replacement, the best tree species (for the climate, soil, conditions, low ongoing branch drop and maintenance habits), staging of new plantings, best spacing of planting distances, etc. These formats allowed calm(er) discussion of the issues, explanation of options, a voicing of public attachment and valuing of the trees and their commemoration or other values. It also allowed concentration on the trees' current condition(s) and their heritage significance(s).

Working cooperatively led to a better understanding and ownership of various options for renewal and replanting, a high take-up and support for an ongoing tree management plan, involving the community in the tree replanting stages, but also ongoing tree or verge maintenance and public celebrations. Options such as wider spacing, further distance of new trees from the road edge, planting inside or in places outside the road corridor (on private land, with the owners' agreement) were canvassed and agreed. Variations where conditions required it to accommodate ditches, culverts, driveways etc were agreed. A tree management plan by

Corkery Consulting covered propagation, planting and after-care over a long time period. The final report is online at
http://www.palerang.nsw.gov.au/environment/tree-management/draft-tree-management-plan-kings-highway-braidwood

Braidwood Kings Highway replanting Eastern section
(Roads and Maritime Services, NSW Government)



Braidwood Kings Highway replanting Northern section
(Roads and Maritime Services, NSW Government)

Tamworth King George V Memorial Avenue, quiet enjoyment
(Christine McKinnon)

Tamworth's King George V Memorial Avenue of oaks lines the Old Nemingha Road (the former New England Highway entrance into town on its eastern side). Planted with community tribute to a well-loved late King in 1936, it comprises English oak (Quercus robur), planted closely to form a tunnel over the road, on a flood plain in good soil. This has resulted in fairly magnificent trees and effect, although the highway has been rerouted in recent decades, leaving this as a back country road now. Council was considering approving semi-rural subdivisions of land at the end of the avenue, flanking the growing town. Their enthusiasm to approve subdivision required (the advocates claimed) road widening of the impressive avenue to enable two cars and trucks to pass safely.

Tamworth King George V Memorial Avenue, trucks passing
(Christine McKinnon)

Given the public's love of this quiet, idyllic rural road, for running, walking, horse riding and quiet enjoyment, this proposal raised ire: it seemed to require removal of one half of the avenue at least. Options such as splitting a new road around the trees and planting a third (new) line were rejected. A lack of consideration of alternative access roads (meaning no need for such widening) led to a lively community backlash campaign to force Council to rethink before it rushed into any approval.

The community used social media tools Facebook, You Tube, WordPress web-blogs, online petitions (www.communityrun.org/petitions/save-king-george-v-avenue) and local (radio and print) media—including local celebrities Troy Cassar-Daley and Keith Urban, to bring Council around to re-look at options for retention, alternative access and more. They nominated the avenue for NSW State heritage register-listing (which has now come to pass, happily).

Stuart also showed how a bunch of ratbag kids in Bondi Junction had 'brought (Waverley) Council to its knees' over keeping their loved paperbark trees in the childcare centre playground—so the moral is, start young, activists!

He noted how trees form the character of some of our best-loved (and internationally-recognised) parks, such as World-Heritage-Area Carlton Gardens flanking Melbourne's CBD. Like any living plant, their ageing and dying is a major issue for managing heritage places like historic cemeteries. All trees have a life span and urban conditions can shorten this. Planning for their staged removal and replanting were major challenges for all land owners and interested people. Otherwise we face a bare future.

Rookwood Palm Avenue, staged replanted needed (Stuart Read)

He noted that professional arborists often gave factual information on tree condition, age and structural integrity but were shy or silent on their significance or community attachment. Heritage consultants and historians can help fill these gaps: who planted them? Do they represent a fashion or period of style? Do they have heritage significance of their own and why? Should they have a conservation policy: e.g. to propagate from the same source and replant before they ail and die to ensure continuity of intent? If old trees are too close to neighbours, roads, sensitive areas, should new ones be planted further away?

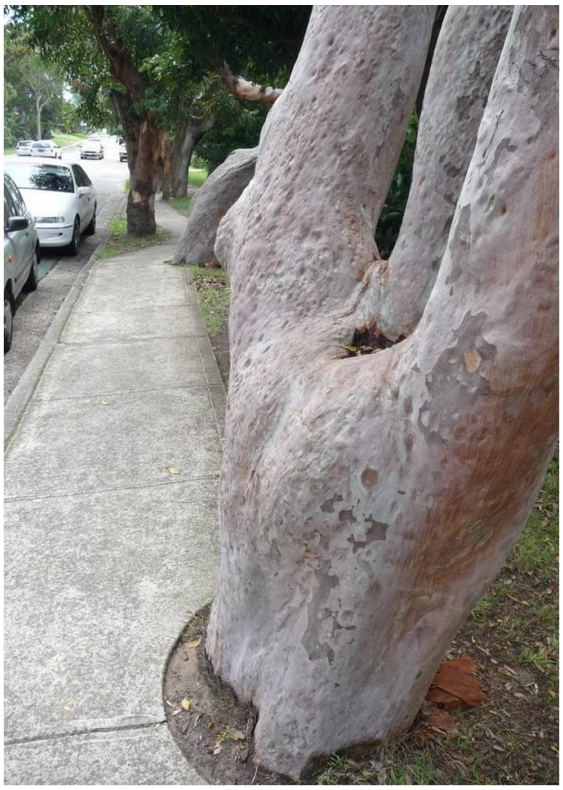
Stuart pointed out sources of information on trees, tools such as 'exemptions' to speed-up necessary pruning or maintenance without undue bureaucratic delay. He showed examples such as Parramatta Park (another World Heritage Area) where a landscape master plan proposed staged replanting of significant trees such as River Road's oak avenue – which is being done without any further approvals needed. Buda Historic House and Garden in Castlemaine, Victoria's massive Monterey cypress hedge had got so high and old it had had to be removed, but thanks to funding from the Australian Garden History Society, a new hedge had been planted in its stead which will in time recreate its desired effect in the garden.

He outlined tools Councils use to identify and manage significant trees. These can be general such as a Tree Protection Order (a blanket protection for all trees over a certain size). They can be specific, such as a survey of significant trees (expert study or community-driven), a significant tree register (for specific trees), or heritage-listing trees, individually, in groups or as part of a larger park, garden or place. Development Control Plans could provide owners with guidelines on appropriate new trees to plant to complement (and in time, replenish) an historic area's tree character, etc.

Parramatta Park exempted new oaks are planted (Stuart Read)

New Monterey cypress hedge at Buda Historic House and Garden, Castlemaine (Jessica Hood)

Stuart showed some examples of trees taking pride of place: Mona Vale (Pittwater, Sydney)'s footpaths snaking slalom-like around massive Sydney red gum trunks too lovely to remove. Barcelona footpath plaques, bilingual, telling pedestrians what trees lined the street they were in and where this species came from. Barcelona's c.1890-1920 example suburb's renewal of 'green cores' to lot-line medium density apartment blocks – re-opening up and re-creating green hearts to every block so children could safely play off-street; parents could meet up and talk; birds could sing.



Mona Vale footpath flexibility (Stuart Read)

Barcelona tree plaque. (Stuart Read)

Some Councils are publishing Urban Forest Policies, seeking to boost the canopy of our cities to lower the urban heat effect and bring so many other benefits to city-dwellers. Sydney, Mosman, North Sydney and Orange in rural NSW are examples of this. Barcelona and Valencia are two Spanish examples. Some authorities are publishing tree master plans online – worth a look: Centennial Parklands; Sydney Harbour Foreshore Authority's Rocks & Circular Quay TMP.

Stuart outlined how to write conservation policies: conserve, reinstate, reconstruct, propagate and replace were key verbs these need to use—to ensure ailing, aging, dying trees get replaced and not lost. He ended by listing some online resources, such as NSW Land & Environment Court neighbour dispute guidance over tree disputes; Australian Institute of Landscape Architects' 2005 Urban Tree Management Forum papers; and the Street Trees in NSW: guidelines for conservation and management and Technical Note: Managing Risk with Heritage Trees, both published on www.heritage.nsw.gov.au. The Australian Garden History Society's website has useful resources, such as the List of Avenues of Honour, Memorial Avenues etc nation-wide, see www.gardenhistorysociety.org.au
Australia ICOMOS's Burra Charter is online at:
www.icomos.org/australia.

He ended by appealing that we create a future landscape full of trees that we want our children to inhabit: one of beauty that is responsive to place, culture and climate. Not an 'anywheres-ville' suburbia of no trees at all, dominated by buildings and wires and requiring air conditioning. Perhaps Walter Burley and Marion Mahony Griffin had it all worked out in the 1920s with their Castlecrag vision: living close to nature in smaller houses with larger 'nature' all around. Go figure!

Professor Tony Blackwell (University of Western Australia; Blackwell and Associates)

Streets as Open Space

Tony Blackwell
Winthrop Professor & Head of Discipline – Landscape Architecture (ALVA - UWA)
Managing Director (Blackwell & Associates – Landscape Architects & Urban Designers)

Introduction

Whilst the issues referred to in this paper apply globally[1] 'the approach' to dealing with them needs to be considered in a local context.

Global Context

Population Growth Predictions

"Between 2012 and 2050, the world population is expected to increase by 2.3 billion, passing from 7.0 billion to 9.3 billion."[2]

Urbanisation Growth Predictions

"For the first time ever, the majority of the world's population lives in a city, and this proportion continues to grow."[3]

By 2050 over 67% of the world's population are predicted to live in urban areas, or 86% in developed regions."[4]

"Aside from city states like Singapore and Monaco, Australia is the most urbanised nation on earth."[5] "77% of our community live in 'major cities', ie with populations greater than 100,000 people."[6]

Percentages of Our Cities Devoted to Roads

"In a motorized city, on average 30% of the surface is devoted to roads while another 20% is required for off-street parking. In North American cities, roads and parking lots account (for) between 30 and 60% of the total surface."[7]

Heat Island Effect

It has long been established that "Air temperatures in densely built urban areas are higher than the temperatures of the surrounding rural country. The phenomenon

[1] UHI is really only a 'problem' in regions that experience temperate to hot climates.
[2] United Nations Department of Economic and Social Affairs/Population Division 2011, "World Urbanization Prospects - The 2011 Revision, Highlights" published 2012, p1.
[3] The World Health Organisation (WHO) - Global Health Observatory (2012) http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/
[4] United Nations Department of Economic and Social Affairs/Population Division 2011, "World Urbanization Prospects - The 2011 Revision, Highlights" published 2012, p2.
[5] Department of Infrastructure & Transport – "The Australian Government's State of Australian Cities Report 2013" p9.
[6] Department of Infrastructure & Transport – "The Australian Government's State of Australian Cities Report 2010"
[7] The Geography Of Transport Systems by Dr Jean-Paul Rodrigue https://people.hofstra.edu/geotrans/eng/ch6en/conc6en/ch6c1en.html

known as the 'heat island' was first noticed by meteorologists more than a century ago and is the most well documented phenomenon of climatic modification. The intensity of the heat island is mainly determined by the thermal balance of the urban region and can result in a temperature difference of up to 10 degrees."

Means of Measuring Heat Island Effect

Terrestrial

When the UHI phenomenon was first observed measurements were taken terrestrially.

Satellite - Landsat

Subsequent to this, more sophisticated technology such as Landsat imagery has become available. However, to date, this technology has only allowed a maximum level of accuracy approximately 50m, ie readings on plan measure about 50m by 50m square. This level of accuracy was useful when comparing urban areas to non-urban areas or even when comparing the UHI effects from one land-use type to another, such as undertaken by Professors Jusuf, Wong, Hagen and Anggoro at NUS[8]. Further work undertaken in Singapore has determined the amount of time that it takes for the heat build up in high thermal mass materials to re-radiate into the urban environment[9]. Interestingly this research shows that Singapore experiences its highest diurnal ambient temperature around 11.00pm each night.

Low-Level Thermal Aerial Photography/Imagery

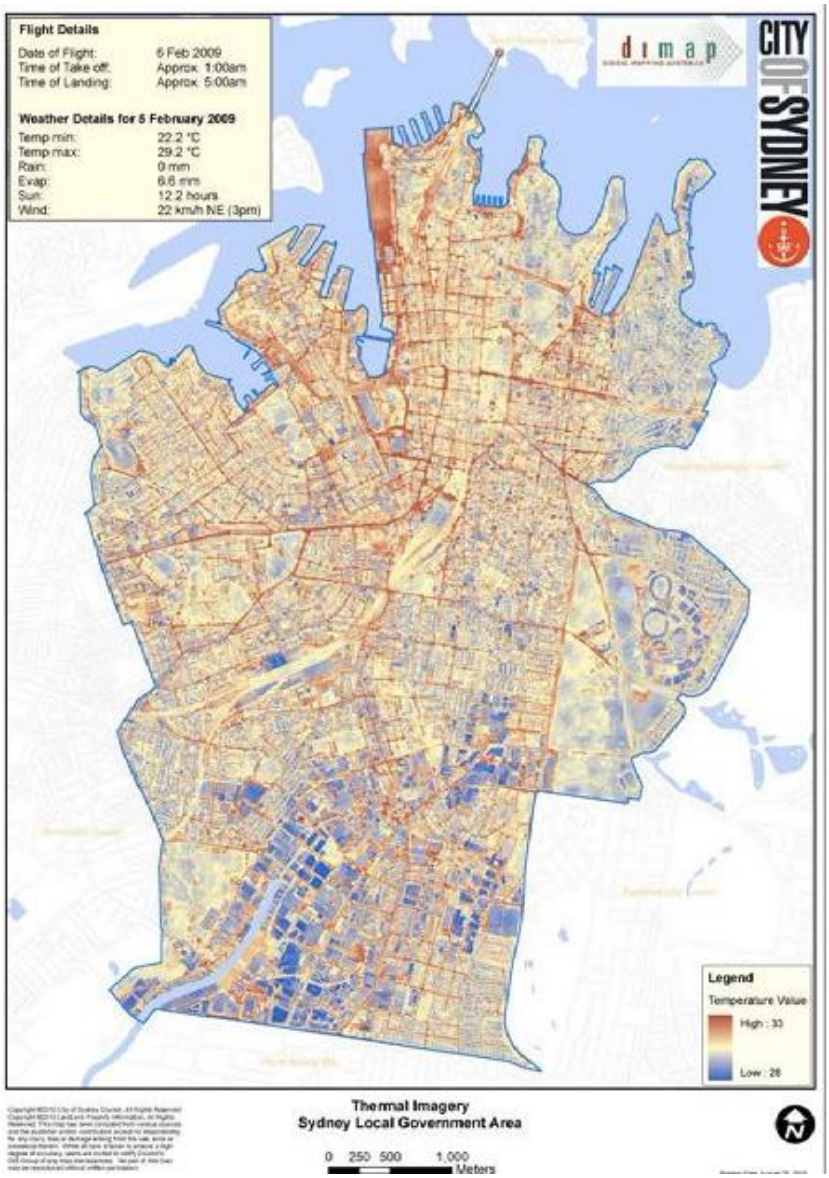
More recently low-level thermal aerial photography/imagery and more sophisticated ground-proofing has allowed an even greater level of accuracy.

Some Local Examples - Sydney

The example below from Sydney[10] clearly illustrates the disproportionate impact that streets have on the urban heat island effect. They are by far the most obvious collectors and re-radiators within Sydney's inner city area.

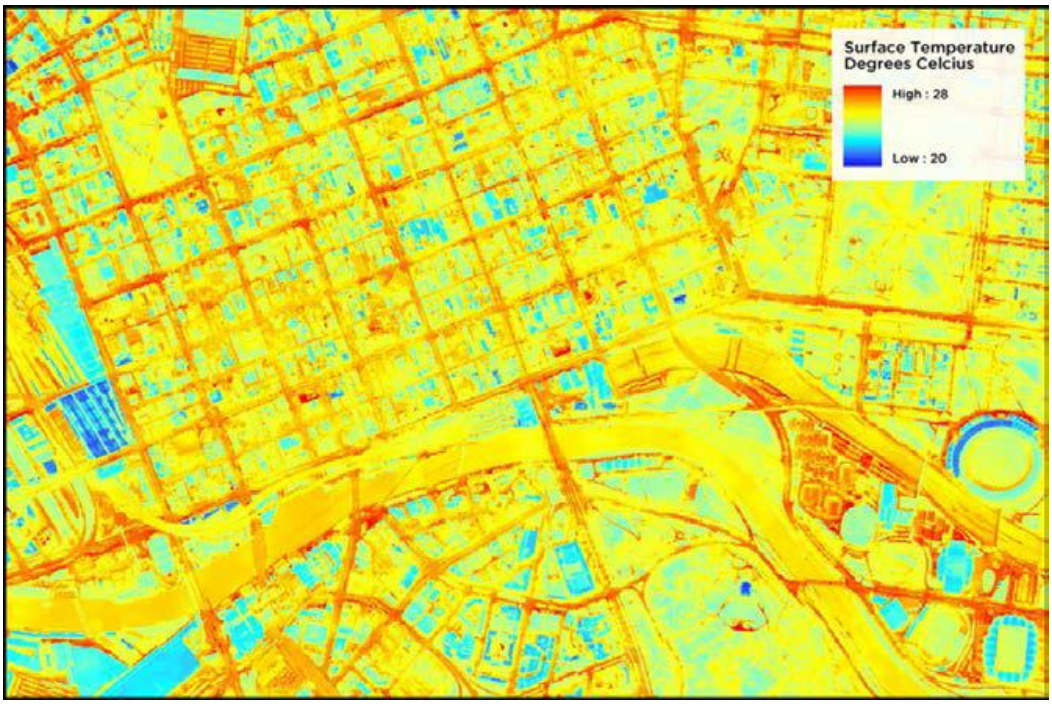
The Barangaroo site, which at the time that this image was taken was a vast stretch of hardstand (ie concrete and bitumen), also features prominently in this example. Interesting the factory buildings and warehouses in Alexandria are comparatively low emitters. Whilst a good number of these buildings may have been unoccupied at the time this is a testament to the beneficial effects of the use of white painted roofs (and presumably insulation).

[8] Steve Kardinal Jusuf, NH Wong, Emlyn Hagen, Roni Anggoro, Yan Hong – NUS *Influence of land use on urban heat island in Singapore*.
[9] Reuben Li Mingguang "Spatio-Temporal Dynamics of the Urban Heat Island in Singapore" (pp 115-116)
[10] Source: http://www.cityofsydney.nsw.gov.au/vision/sustainability/sustainable-city-living/urbanheat-island - This image was taken between the hours of 1.00am and 4.00nm in the morning.



Source: City of Sydney

Some Local Examples - Melbourne



Source: City of Melbourne, Melbourne Urban Forest Visual: http://melbourneurbanforestvisual.com.au/contentimages/UF_HD_thermal.jpg

Local Perth Context

Local Geographic & Climatic Context

Perth has a hot dry[11] Mediterranean type climate with a very high level of "sunshine hours". Combatting heat is one of our major climatic concerns in terms of making our environment more comfortable to live in.

Local Cultural & Planning Context

Established in 1829, Perth has developed following the invention of the internal combustion engine powered car. This is probably the single most defining factor that has shaped all of our cities in Australia as it has with all other recently established cities including many of those in the USA.

Being a capital city in a 'commonwealth country', Perth's planning has been derived primarily from British and to a lesser degree North American planning precepts. Our British heritage largely accounts for why we have mandated requirements to provide 10% minimum public open space in our developments at all. We can mostly thank the ordeals suffered by those living in the squalor of post-industrialised London for this and many other aspects of our current planning.

Other countries, especially those 'non-former-British-empire' countries, do not have the same considerations for the wellbeing of their citizens built into their planning or any other legislation.

However, a more sobering figure is that by contrast, in Perth we typically dedicate 25% or more of the surface area of any new sub-division to road reserve. The actual area is not mandated, rather this is simply the outcome of applying conventional engineering and planning practices.

These figures are seldom known or discussed outside 'immediate planning circles'. Yet what they do indicate is the huge contribution that such road corridors could make in terms of improving the public realm, thereby turning a weakness in our planning system into a strength.

Historic Precedents

Perth did not start on a particularly positive environmental note.

"On August 12, the Foundation of Perth took place. As Mrs Stirling was unable to make the journey, Mrs Helen Dance, wife of the Captain of the Sulphur performed the Foundation ceremony by cutting down a Sheoak tree. The ceremony took place near where the Perth Town Hall now stands."[12]

[11] or more accurately "highly seasonal rainfall".
[12] www.constitutionalcentre.wa.gov.au/175thAnniversary/BriefHistory

Current Practices

New Developments - Greenfields Sub-divisions

Unfortunately the above celebration seems to have established a strong precedent with regard to Perth cultural mores. The following examples demonstrate the poor understanding by the planning profession of the three dimensional and social implications of their otherwise well-intentioned statutory planning decisions.

“Well intentioned”: in so far as they are responding to the clear and present need to increase the density of development in Perth.

“Poor understanding”: in so far as (we trust that) they could not predict that this would be the outcome from their decisions, ie with virtually nowhere to plant a single tree either in the private realm or in the public realm.

Ridgewood, WA. Source: Google Maps 2013
Note the irony in the names of the streets: Banksia Way and Callistemon Way

Stirling Highway near Broadway Nedlands, 2013

It is sad to note that the areas devoted to driveways for each house are, in most cases above, more than the total area of the backyards.

At least in the last example their roofs are white.

These erstwhile supposed TOD's (Transit Oriented Developments) may very well be destined to become our ghettoes of the future.

Existing Development - MRS Amendment to Stirling Hwy

Don Newman commented that the Stirling Highway is the "greenest highway in Perth". Yet it is currently under threat of an MRS amendment that will effectively widen[13] it to 40m along the whole length between Broadway in Nedlands and its intersection with Canning Highway in Fremantle.

It is estimated that about 90-95% of the foliage visible from the highway will be lost if this goes ahead which will have a devastating effect.

Not only this but some 200 perfectly functional buildings will also be lost in the process, including roughly 40 heritage-listed buildings. These buildings include the Windsor Theatre; the Claremont Fire Station; the Albion Hotel (which is not heritage listed); the Old Cottesloe Police Station (currently Blackwell & Associates' office) and many of the shops in Queen Victoria Street North Fremantle. In an age where we are supposed to be looking at sustainable solutions this beggars belief.

All photographs Tony Blackwell.

[13] In actuality the proposal will reduce the planned reserve width from 80.0m to 40.0m between Broadway in Nedlands and Jarrad Street in Cottesloe. However, since the 1990's the 80m reserve has largely been ignored when assessing any planning approvals and rather a nominal 5.0m setback has typically been applied.

Stirling Highway near The Rose Gardens Nedlands, 2013

Stirling Highway near Bay View Terrace Claremont, 2013

Stirling Highway near The Old Fire Station Claremont, 2013

Other Threats & Hindrances

Health Implications

Recently undertaken research by Professor Nigel Tapper (Personal Chair in Environmental Science at Monash University) and others has established that only small increases in temperature, i.e. in the order of two to three degrees above what we are used to, can have a significant detrimental effect upon our health.

"This study identified threshold temperatures for all Australian capital cities, developed a spatial index of population vulnerability, and used climate model output to predict changes in the number of days exceeding temperature thresholds in the future, as well as changes in risk related to changes in urban density and an ageing population."[14]

On 7 February 2009 in Victoria 173 people died in the Black Saturday fires.

Whilst this is a devastating statistic what is far less known is another statistic from the same time and location:

During the same heatwave there were 374 more deaths state wide than would be expected for that week when comparing data over the past 5 years.[15]

Lack Of Education/Understanding

Anecdotally the main issue in people understanding the need to create greater amenity in our streets is simply the lack of recognition that there is a problem, ie "We've always done things like this and why should we change?".

As an example one local authority, who shall remain anonymous, recently informed a

[14] Loughnan, ME, Tapper, NJ, Phan, T, Lynch, K, McInnes, JA 2013, A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities, National Climate Change Adaptation Research Facility, Gold Coast p 1.
[15] The Age, 17 January 2014 "Melbourne city centre a death trap as heat-island effect takes its toll."

landscape architect that he had to locate a 2.0m wide footpath at the back of all kerbs and observe the local authority's 1.0m minimum set-back from any fixed objects (including paths) when considering the location of any trees. Nor was any deviation from the standard tree alignment (of 2.3m to 3.0m from the property boundary) to be considered. This meant that in a typical 4.5m wide verge the path would extend to 2.5m from the property boundary and as trees can only be planted in a range of 2.3m to 3.0m from the property boundary with a 1.0m minimum set-back from any paths this effectively eliminated the opportunity to plant any trees whatsoever in any of the streets. When this problem was pointed out to the responsible officer the officer gleefully advised my friend that yes this was a "win-win" situation for council, i.e. no trees which meant no complaints about falling leaves and debris and no associated maintenance costs.

MRWA has a blanket policy of setting trees back specified distances from the edge of their roads dependant upon the designated road speed limit. This policy gives no consideration of the "cautionary effect" that trees (and other objects) have on drivers when they are close to the edge of the road. Nor does it pay any heed to the reduced severity of impact that a tree in a median would have as opposed to hitting a car coming in the opposite direction in the case of a head on collision.

In the case of the proposed MRS amendment to Stirling Highway this will mean that, despite the promise of median and verge trees as shown in the WAPC drawings none of these will actually be allowed to be planted based on these policies. So the 'generously planted' 5.0m plus wide medians and verges, as shown on the plans issued to the public, will actually be devoid of any trees making this whole road corridor one massive, unsightly, heat sink.

Benefits of Urban Trees

Research into the benefits of trees has determined that "Individual urban trees, on average, contain approximately four times more carbon than individual trees in forest stands."[16]

"Planting trees in strategic locations near buildings can reduce building energy usage via enhanced shading and evaporative cooling in summer, and by wind speed reduction in winter, which phenomena lower the demand for electricity needed for cooling and heating and, in most cases, offset the burning of a certain amount of coal, gas or oil.

Nowak and Crane note that the atmospheric CO2 "avoidance" provided by such strategically planted trees is approximately four times greater than the amount of CO2 they physically remove from the air. Hence, it can be appreciated that the average urban tree, which is four times more effective in physically removing carbon from the atmosphere than the average non-urban tree, is fully sixteen times more effective than the average non-urban tree in mitigating global warming when planted in places designed to reduce the cooling and heating costs of buildings."18

Further significant health benefits are to be gained by reducing the Urban Heat Island effect and also in simply making our streets more attractive for people to use, both as pedestrians and cyclists, thus helping reduce morbidity and in particular cardio-vascular disease caused through obesity.

[16] Nowak, D.J. and Crane, D.E. 2002. Carbon storage and sequestration by urban trees in the USA. Environmental Pollution 116: 381-389.

The multiple, direct and indirect health benefits of trees and public open spaces are well documented and do not need to be cited in detail here. Many of these same benefits could be achieved through treating our streets such that they become an extension to our public open space system.

Propositions

In the context of the above evidence it appears to be obvious that our streets represent an excellent, largely untapped, opportunity to extend at least some of the benefits offered by parks and significantly improve our environmental conditions and credentials.

As such it is suggested that a new paradigm should be adopted when considering the nature of urban development in Perth if not all of Australia.

On this basis the following propositions are put forward:

1. With the possible exception of major arterials, streets should be designed as an extension to the public open space system.
2. Energy saving guidelines, similar to those that apply to all new buildings in Australia, such as NatHERS, NABERS, BASIX, should be developed and trialled for our streets based on aiming to reduce temperatures in urban areas by 3-5 degrees Celsius. More research should be funded to establish what parameters should apply to establish and then meet such criteria.
3. The retention of any beneficial existing vegetation (as well as other important cultural assets) should be a mandatory consideration in the assessment of any planning amendments or development applications.

Some Good Examples from Europe

Whilst many European countries have, historically, had less to worry about with regard to the Urban Heat Island effect the impact of global warming may soon change all of that.

Lago d'Orta Northern Italy, 2012

The Road Carriageways - Champs-Élysées, Paris, France, 2007

The Footpath - Champs-Élysées, Paris, France, 2007

The Verge - Champs-Élysées, Paris, France, 2007

Even highways can be well treed - Provence, France, 2009

St Jean de Luz, France, 2007

Leon, Spain, 2005

Some Good Examples from the USA

Form Based Codes

Examples from the USA which highlight the benefits of thinking about appropriate design solutions at each different level of intensity of urban development, i.e. across the range of development transects as they are called in New Urbanist creeds.

Prospect, Denver, USA, 2010

Prospect, Denver, USA, 2010

Kentlands, Washington, USA, 2010

Kentlands, Washington, USA, 2010

Kentlands, Washington, USA, 2010

Some Good Examples from Singapore

Thanks to the foresight of the former Prime Minister the honourable Lee Kuan Yew and his son and current Prime Minister the honourable Lee Hsien Loong there are many examples of good streetscapes in Singapore. Here are just a few.

Scotts Road, Singapore, 2014

Scotts Road, Singapore, 2014

Merchant Road, Singapore, 2014

Merchant Road, Singapore, 2014

Orchard Road, Singapore - the main shopping street, 2011

Some Good Examples from Australia

Melbourne, VIC, 2013

Canberra, ACT, 2013

Sydney, NSW, 2012

Subiaco, WA, 2012

Nedlands, WA, 2012

Cannington, WA, 2012

Cannington, WA, 2012

Additional Benefits

More attractive tree lined streets offer many of the same benefits provided by parks as well as a raft of other supplementary benefits for example:

The presence of trees close to roads:

- is known to help reduce traffic speeds, largely due to the perceived risks
- helps protect pedestrians from cars
- increases the shade for pedestrians and hence makes walking a far more acceptable, if not enjoyable, transport proposition
- reduces the amount of direct sunlight falling on roads and hence the amount of heat build-up and re-radiation, and by inference should help reduce the heat island effect.

The presence of trees in medians:

- helps reduce the likelihood of head on collisions, which are far more dangerous than hitting a tree.

Methodology

In order to implement the above proposals we need to first establish where we currently stand. This will best be done by commissioning comprehensive thermal imagery as a datum for the whole of Perth. The City of Vincent is currently investigating this, but they are reported to need other local authorities as partners to make this financially viable. This should be a State lead initiative if it is beyond the financial resources of individual councils.

From here it would be relatively simple to ascertain what level of tree planting or canopy cover and consequent shade has a measurable benefit, i.e. initially in the order of a 3-5 degrees Celsius improvement.

Some attention may also be paid to the use of paler aggregates and/or oxides in asphalt mixes or the use of alternative technologies such as concrete.

Recommendations

1. Ensure that our streets are designed to meet the requirements of pedestrians (and cyclists) not just cars and services. This will provide incentives for people to walk and ride for short to medium distance commutes and recreation purposes. This in turn will add considerably to making us a healthier nation and help to reduce obesity.
2. Establish and adopt energy compliance standards for streets. This process should start with establishing which streets are the worst offenders using thermal imaging. These should be measured against comparative streets, i.e. similar material, width and extent of pavement but which have much better thermal performance, i.e. display less heat island effect. Both street types should be accurately recorded and compared through ground-proofing and through this methodology performance criteria and typical models can be developed. Using this datum a set of minimum compliance standards should be adopted for all of our streets and road network.
3. Make it mandatory on all development applications to explicitly show all existing trees over 200mm diameter at 1.0m above ground height and encourage the retention of all such existing vegetation and any other significant cultural assets.

Simon Kilbane (University of Technology, Sydney)
Beautiful TREES: An Interactive Tool to Safeguard Our Urban Forest

Simon Kilbane (University of Technology Sydney)
Tammy Hanson (Tammy Hanson Consulting, Central Coast, NSW)
Andrew Moore (Life Cycle Logic, Fremantle, WA)

Abstract

'Beautiful Trees' aims to highlight the benefits of trees in the urban environment through a citizen-science focused online and application-based mapping tool. Beautiful Trees hopes to sidestep current deficits in current planning policies which do not adequately protect trees and instead focusses upon engaging citizens in regarding the potential ecological, economic and cultural benefits offered by trees and the greater urban forest. This is includes provision of ecosystem services, mitigation of the urban heat island effect, biodiversity retention, increased amenity, property values and aesthetics. While numerous similar schemes exist globally, this is the first known instance in Australia and the preliminary results have been very encouraging.

Background

Trees are widely recognised as a crucial ingredient of successful urban landscapes. Worldwide, cities such as San Francisco (Figures 1-4) and applications such as *opentreemap.org* are engaging with citizens in the cataloguing of urban trees, frequently through use of new technologies. Benefits include a more engaged community, reduced costs for authorities who oversee such inventory; and, importantly high retention of trees and an enhanced tree canopy. Growing in part as a response to higher awareness of environmental issues at local and global scales (such as climate change) such initiatives also reflect to a large degree the aesthetic preference for trees in urban and suburban contexts. In the absence of adequate protection mechanisms—as it the instance of many Australian cities—a reduction of urban tree canopy and the loss of individual trees has been attributed to a rise in the urban heat island with corresponding health impacts. Furthermore, areas that have endeavoured to retain and enhance tree cover have higher property values. A lack of understanding in the potential ecological, economic and cultural benefits offered by individual trees and the larger urban forest means that neighbourhoods are being locked into unsustainable land-use practices. Furthermore, decisions regarding subdivision of urban and suburban areas and growth at city peripheries could benefit from access to the knowledge that such a mapping system can offer.

The objective of this organisation is to identify and locate both individual trees and entire bushland areas in the urban landscape that are considered to have significant value. This significant value is defined by the community to have either environmental, cultural, recreational or aesthetic importance.

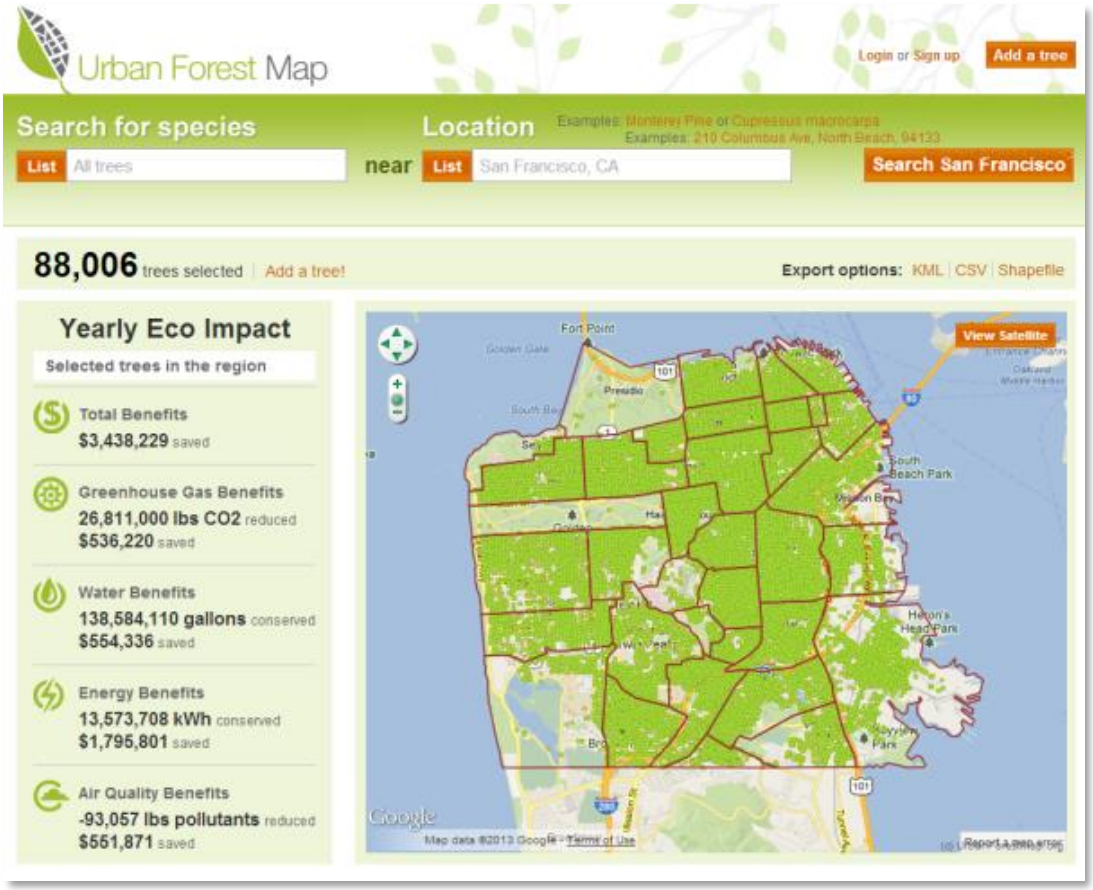


Figure 1

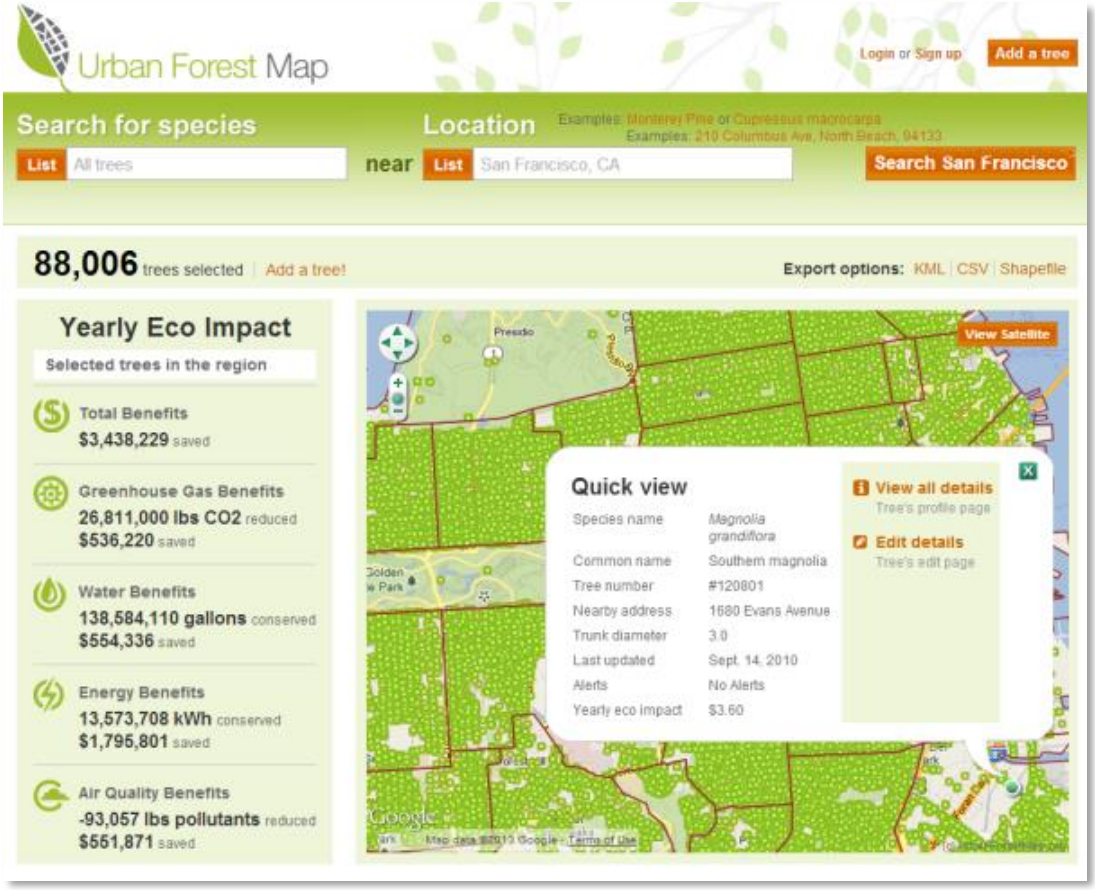


Figure 2

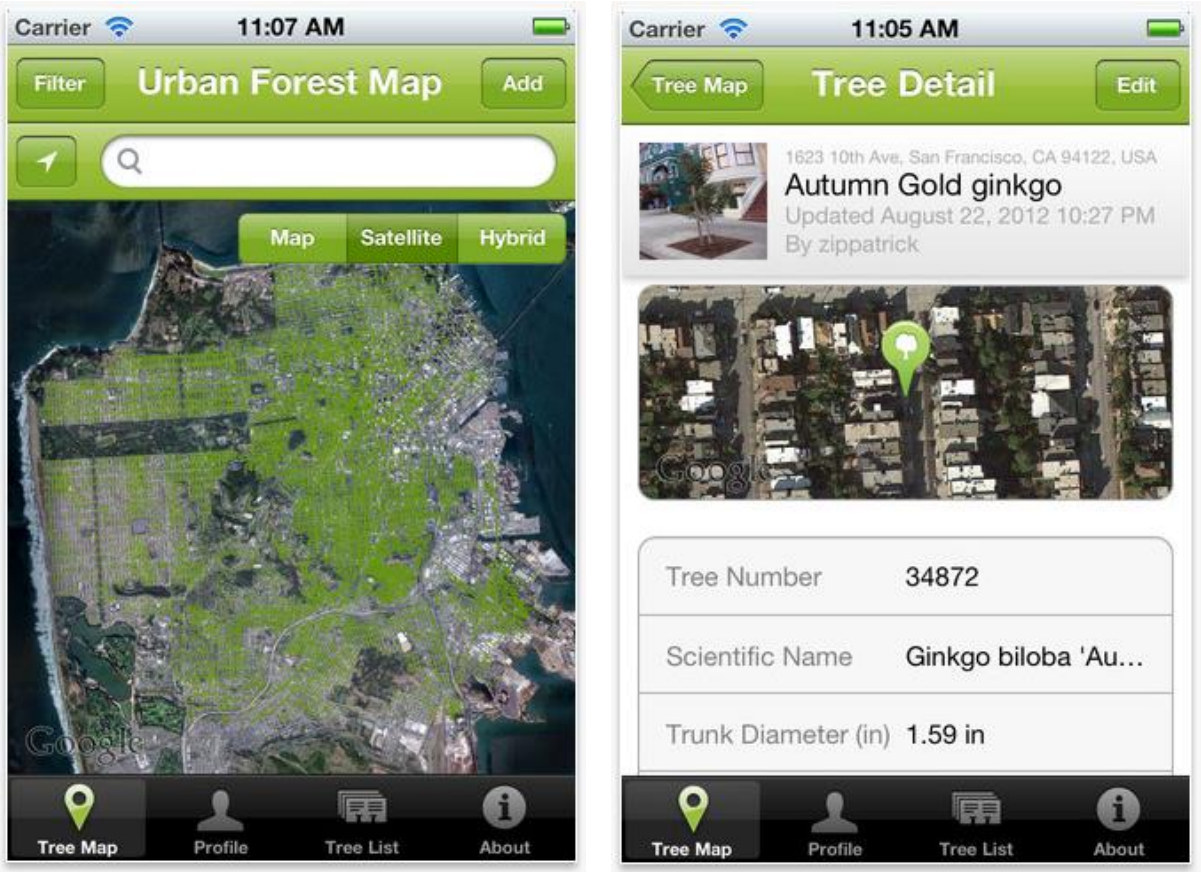


Figure 3

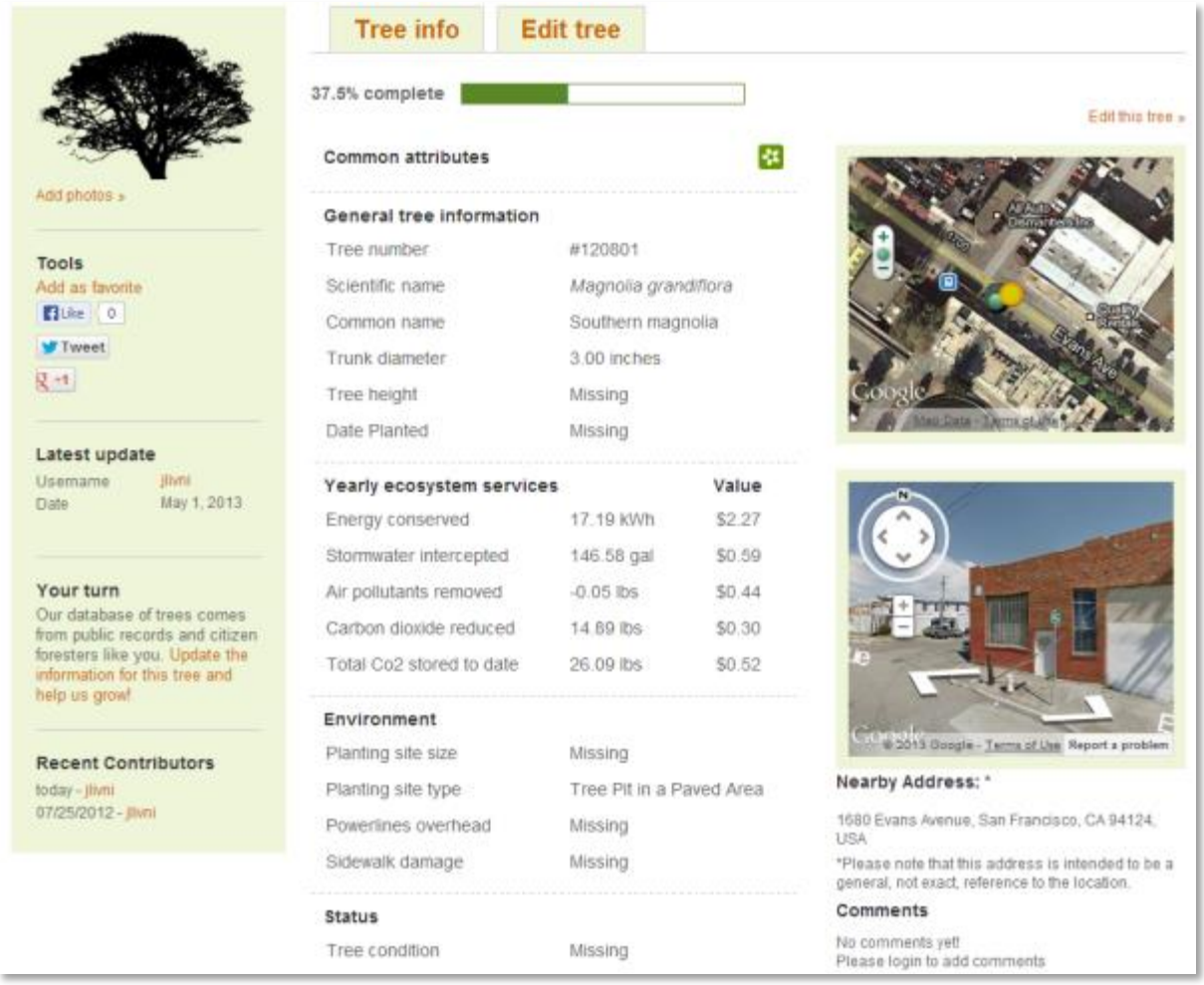


Figure 4

Information will be collected and collated through citizen science and will address the current lack of knowledge of values of these trees to the community. Furthermore it will address the deficiencies in planning by Federal, State and Local Government to protect individual trees. This included issues regarding urban trees in Australia such as:

- Many separate tree lists with limited or no spatial component
- Lack of access to such databases/lists
- Difficulty of use
- Ecosystem services not included
- Accountability: are trees actually being conserved?
- Lack of legislation: no national protection for individual trees, nor often at state level.
- Lack of recognition of exotic or culturally valued trees (trend of local councils to remove exotics)

The central idea behind Beautiful Trees is that you can't protect what you don't measure.

Aims

Three aims summarise the Beautiful Trees mandate: *Engagement, Inventory and Advocacy*

Engagement

To engage with the broader community for the benefit of the community. This is through an easy-to-use app and website. Anyone with an interest in their local tree population is able to record trees: their physical measurements, checklist of benefits and other criteria. Simple instructions and help screens guide users to identify trees and in turn can help educate users regarding tree benefits.

Inventory: Documentation/Inventory/Collation of trees

Documentation of the location of individual trees in real spatial location and with significant metadata. *Beautiful Trees* can document existing urban trees and helps to understand and quantify their contribution, both local and global. This includes ecosystem services such as temperature control/urban heat island, carbon sequestration, amenity values, maintaining a resilient biodiversity, enhancing property values.

Advocacy: To give trees a voice

Urban trees and tree canopy continues to be under threat and trees in urban and suburban contexts are constantly threatened with removal across both private and public lands. These trees are often removed without public consultation and consideration of the larger impact. Although some council require pre-approval prior to their removal, there is minimal protection/legislation which leads to their loss. There is a lack of understanding by the government and community of the value of trees both financially and intrinsically. Beautiful Trees advocates the improvement to current legislation and policies at a local, state and federal level to ensure trees are protected.

Beautiful Trees is about cross collaboration and citizen science and aims to develop an interactive mapping tool freely available to citizens to collect and collate trees of significance. This will be achieved by collaborating with councils and community to implement the first phase of this project. Training sessions will be held in various locations to demonstrate how the device can be used and data collected.

Useful resource for decision-makers in local government and the for the wider community to be engaged with their environment (citizen science/crowd-source).

Benefits are calculated by the software including CO2 sequestration potential as well as a data set that could be used for further referencing and research (for instance plotting property values with tree presence, or ambient temperature).

Method

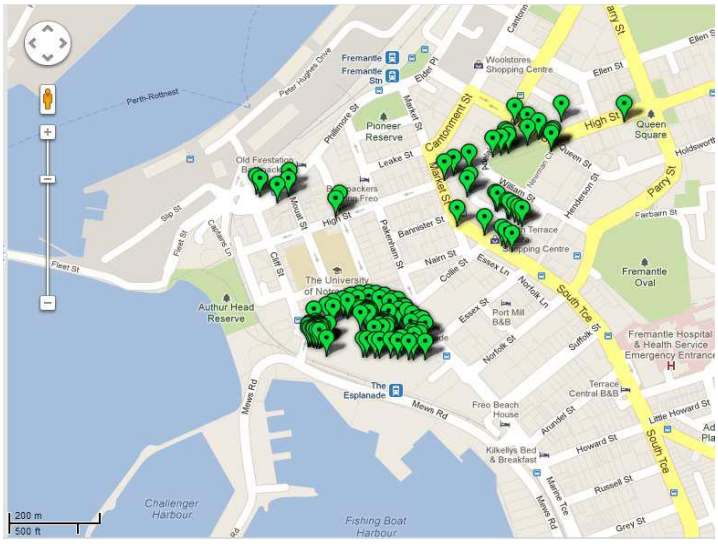
Drawing upon the participation potential citizen science audience, *Beautiful Trees* seeks to carry out its charge in three ways.

1. Mapping interface + Mobile app.
    a. Open Source
    b. Crowd sourcing/Citizen Science
    c. Social media
    d. Click and add – easy to use on map, drop down menus, photograph (possibly incorporating identification such as 'plantnet' (French app)
    e. Username and demographic details (potentially through Facebook or Google login)
    f. Ability to instantly generate summary of benefits: quantify species, carbon, biomass, reliant biodiversity.
2. Website
    a. Information about the initiative
    b. Sample reports/summaries
    c. Mapping interface
    d. Contact details/help
3. Workshops and advocacy (indirect and direct)

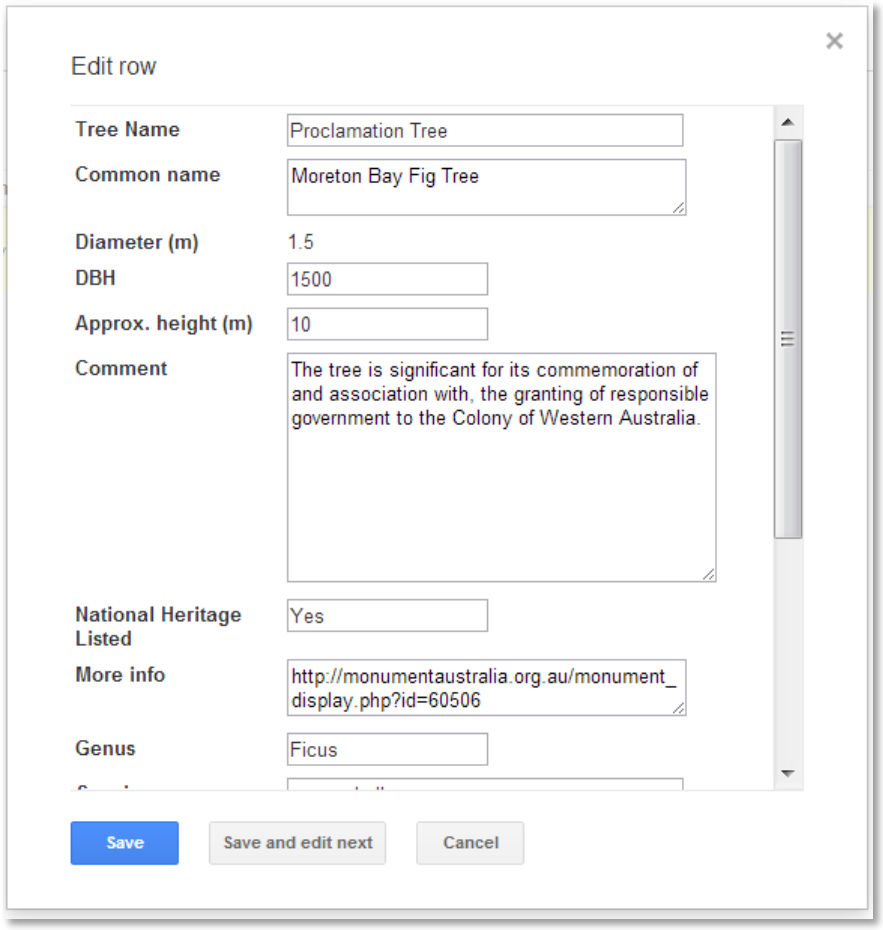
Through representation and engagement with a diverse set of stakeholders including NGOs and local and state governments and government departments.

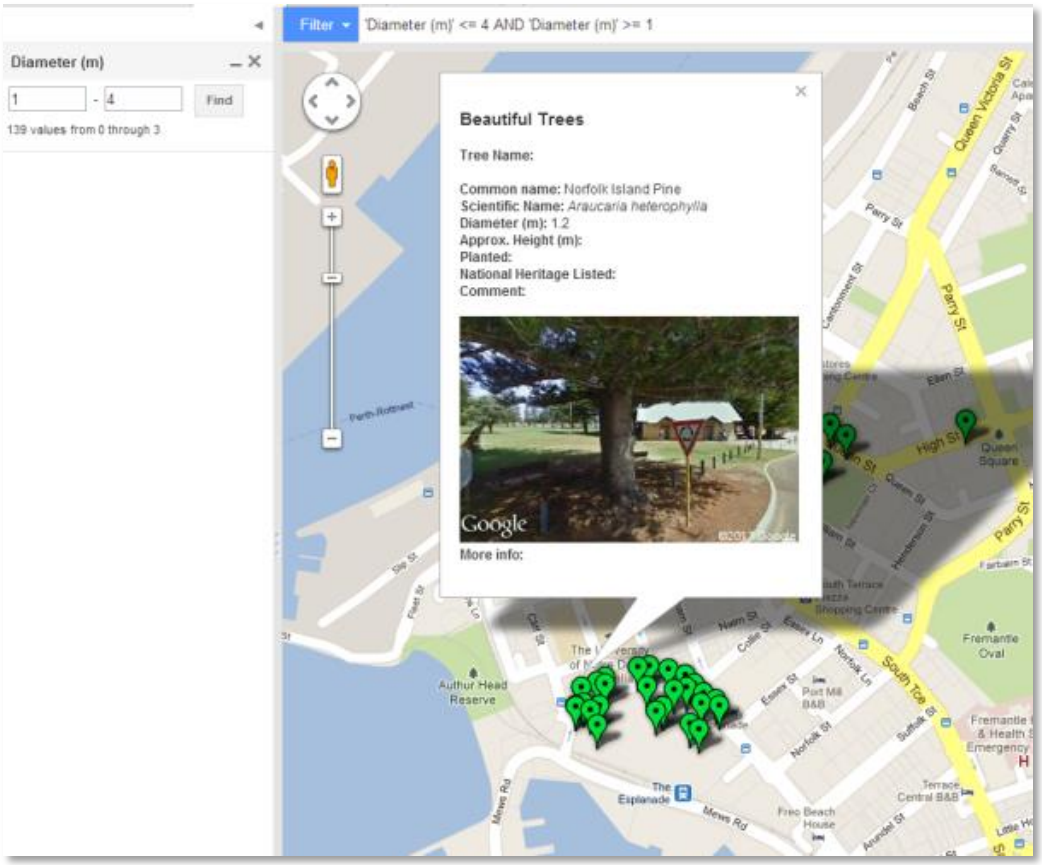
Progress thus far: an example
Fremantle trees

- To show what can be done
- To promote discussion and further idea development
- To generate interest and partnerships



Some Fremantle Trees


Edit row
Tree Name
Proclamation Tree
Common name
Moreton Bay Fig Tree
Diameter (m)
1.5
DBH
1500
Approx. height (m)
10
Comment
The tree is significant for its commemoration of and association with, the granting of responsible government to the Colony of Western Australia.
National Heritage Listed
Yes
More info
http://monumentaustralia.org.au/monument_display.php?id=60506
Genus
Ficus
Save
Save and edit next
Cancel


Diameter (m)
1
4
Find
139 values from 0 through 3
Filter
'Diameter (m)' <= 4 AND 'Diameter (m)' >= 1
Beautiful Trees
Tree Name:
Common name: Norfolk Island Pine
Scientific Name: Araucaria heterophylla
Diameter (m): 1.2
Approx. Height (m):
Planted:
National Heritage Listed:
Comment:
More info:
Google

Where to from here?

The implementation of Beautiful Trees will require cross collaboration with community groups and government departments. We believe every tree has a value whether it be economic, health, environmental, cultural, recreational or aesthetic. The organisation envisages that citizen science can express these values through collecting information on Beautiful Trees and submitting it through a spatially explicit online database (app).

It I hoped that this information will be recorded and used to better understand the value of trees in our community and advocate the protection of urban trees at a Local, State and Federal level.

References

Nowak, D., & Crane, D. (2002). 'Carbon storage and sequestration by urban trees in the USA.' *Environmental Pollution*, 116: 381–389.