CITY OF MELBOURNE: AN URBAN GREENING PERSPECTIVE

Ian Shears
Team Leader Tree Planning, City of Melbourne

Introduction

Over the past 10 years there has been a significant shift in the way that the City of Melbourne regards the role that trees play within its urban fabric. In a period of time well short of the life span of a long-lived urban tree, there has been a significant shift from trees being viewed from predominantly aesthetic and heritage perspectives to an understanding that trees are an integral component of the complex green infrastructure of the city. This new perspective looks at the 'urban forest' from a range of environmental, economic and social parameters that can be measured in benefits to the health of the community, in energy savings, air quality improvement and carbon sequestration.
The changing perspective of trees has been motivated largely by the imperative to respond to a changing environment. Drought, climate change, urban densification and sustainability have been fundamental drivers in shifting the comprehension of and commitment to the role of trees in the urban environment.

Aesthetics and heritage

Heritage landscapes and ageing trees

Using Council's 'tree amenity valuation formula' the total value of the City of Melbourne's trees is estimated to be over $600 million. The overall age distribution of the City's tree population is skewed to older age trees, leading to potential loss of large numbers of trees over the next 10-20 years. Loss of such a large number of trees could have a devastating effect on the amenity of parks, gardens, streets and public spaces. This asset is irreplaceable in the short term and the tree population requires close monitoring and management to ensure its continued good health.

Melbourne has some of the most significant stands of mature Elm trees remaining in the world following the destruction of many of the Elm populations in the Northern Hemisphere by Dutch Elm Disease. The Elms lining the major boulevards of Victoria Parade and Royal Parade, along with the avenues of trees in the Fitzroy Gardens are listed on the National Trust Significant Tree Register. Most of the city's boulevard and avenue trees however, were planted between the late 1800s and early 1900s and are nearing the end of their lives.

Strategy for the Replacement of Ageing, High Risk and Drought-Affected Trees (2003)

In 2003 it was estimated that 30% of the existing tree population would require replacement over the next decade as a result of declining health due to ageing, drought or other factors. A sustainable and progressive replacement program for Melbourne's tree assets was developed to ensure that the trees are systematically replaced, rather than to allow large numbers of trees to die at any one time thus causing a rapid degradation of the City's majestic parks and boulevards.

This strategy represents a sustainable and progressive replacement program for Melbourne's mature trees. The key components of the strategy are: to implement a progressive planting and replacement program for trees in boulevards, streets and parks; to increase the robustness, diversity and viability of tree species with selection responding to local climate conditions, urban context and desirable community outcomes; ensuring that tree species are selected and managed to minimise resource inputs; and to ensure that tree species are selected to preserve the heritage and amenity values of Melbourne's parks, gardens and streetscapes. Two key components of the Strategy were the Precinct Tree Planting Plans and the Boulevard and Avenue Replacement Program:

Precinct Tree Planting Plans

Eight separate precinct tree planting plans were developed in 2003 for Melbourne's 'local areas' (Southbank, South Yarra, Kensington, East Melbourne and Jolimont, Carlton, Fisherman's Bend, North and West Melbourne, and Parkville). These plans were created to strategically guide new tree planting and the replacement of existing trees where in decline, and were developed through extensive consultation with local residents and residents' associations. The development of the plans has provided a vehicle to engage with the community and provide a sense of active participation in

decisions about the public realm by residents. In developing these plans, the aim was to preserve and foster the local character and 'sense of place' of each precinct by ensuring that a range of distinctive species were identified and selected. These ten year plans involved planting an additional 5,482 trees in 182 streets across the local areas. By 2008 (mid-way through this ten year plan), the City had already achieved 96 per cent of this goal.

Boulevards and Major Avenues Replacement Strategy
This guides the City of Melbourne's approach to ensuring the perpetuation of these principal city structuring features for future generations. The significance and value of the overall boulevard or avenue is far greater than the collective value of single trees in the boulevard or avenue. Replacing trees in the major boulevards such as St Kilda Road, Flemington Road, Victoria Parade and Royal Parade, and the major avenues in gardens such as Fitzroy, Treasury, Flagstaff and Carlton Gardens, and Fawkner and Yarra Parks, presents particular challenges. As individual trees die they generally can not be effectively replanted with new individual trees, as the new trees are unable to compete adequately for light and water from their neighbouring mature trees. Thus interposed plantings seldom develop into healthy, fully developed mature trees in keeping with the overall character of an avenue.

The only effective way to genuinely achieve an avenue or boulevard of long-term high visual and environmental integrity is to remove and replant sections or groups of trees. This preferred solution, however, is likely to cause considerable community concern as some of the trees that need to be removed may appear to be healthy. Tree issues have a very high profile in the community and all tree issues require extensive stakeholder and resident consultation, and achieving community consensus is a highly time-consuming process. This underlines the role of negotiation to get real outcomes on the ground, particularly as there are limited windows of opportunity when plantings can occur. To date, Council has successfully replaced avenues in Fitzroy, Carlton and Treasury Gardens and Fawkner Park and street sections in Swan Street and Princes Park Drive. Replacement of sections of the St Kilda Road boulevard is anticipated for winter 2010 following approval (jointly by City of Melbourne and City of Port Phillip) and public release of the St Kilda Road Master Plan.

For avenues in parks where limited future lifespan is anticipated, planting of suitable single species trees in adjoining areas can be undertaken, therefore when the avenue is replaced in its segment or entirety, the loss of amenity will be minimised because there will be advanced trees already growing nearby.

The cumulative impact of implementation of these strategies has resulted in the formative revitalisation of Melbourne's urban streetscapes and landscapes. In 2003, Council endorsed the strategy to replace 14,290 ageing trees within ten years. By 2008 (mid-way through this ten year plan), the City had achieved 67 per cent of this goal.

Heritage vs Sustainability issues
A prominent arena in which heritage and future landscapes in a climate changed environment can collide is in the management of culturally-significant heritage-listed landscapes. Where decision-making around tree planting and replacement in these landscapes previously largely consisted of a spatial and/or temporal response to tree planting motivated by replacing 'like with like' species, it is now acknowledged that the climate in which these original landscapes were established is very different from today and vastly different from future climate conditions.

A number of previously planted tree species are no longer suited to a drier climate likely to involve extremes of weather and less available supplementary water. In these situations it is appropriate that sound horticultural decision-making carries greater weight than perceived cultural or heritage values in order to provide sustainable landscapes into the future.

A case in point has been the culturally significant Birdwood Avenue adjacent to the Shrine Reserve where an avenue of Lombardy Poplars required replanting. The 'heritage' requirements led to a 'like with like' replacement a little over five years ago. Today over 60 % of the replanted trees have again failed, leading to further replacement of the avenue in which current discussions are lending appropriate weight to use of an alternate species such as Lemon-Scented Gum with a more suitable range of tolerances.

Carlton Gardens Tree Conservation Strategy (2006)
The World Heritage listed Carlton Gardens has provided an excellent opportunity to examine the complexity of layers of significance related to the various planting periods and to develop a list of species, distribution and spatial layouts that will guide tree planting over the next 15-20 years. Studies of existing trees, early plans, early correspondence, nursery lists and early photographs have led to a good understanding of the location and timing of planting of individual species This information has then been related to existing conditions which, when combined with current knowledge of species performance and the range of attributes recognised as positive in an urban sense, will guide future species selection.

Drought and climate change

One of today's primary challenges revolves around the delivery of water to existing trees that have grown for many years under high irrigation regimes, higher rainfall and cooler temperatures. With predicted hotter and dryer conditions including increased extremes of weather, this means that species selection and sophisticated management of limited water resources will be a key to the successful and sustainable provision of urban greening.

Drought
Melbourne's drought is now in its twelfth year following its onset in 1997. These conditions have negatively impacted on the long-term health of many of the City's trees and have accelerated the decline of many ageing trees and consequently hastened the need for tree replacement. Recently observed trends in climate change have identified rainfall reduction as 17% over long-term data. This reflects a projection set by the CSIRO and used in the City of Melbourne's 'City as a Catchment' strategy (refer below). It is also supported by analysis of the rainfall of the last 10 years at the Melbourne Regional Office of the Bureau of Meteorology.

Council initiated water reduction strategies in 2000, and since 2007 Stage 3a water restrictions and Council's Water Management Plan have been in place. The City negotiated with the water authorities (City West Water and South East Water) and obtained exemptions within an approved Water Conservation Plan to use up to 50 per cent of the water used in the base year 2005/2006. The water was earmarked for the city's trees because they represent the most valuable and irreplaceable horticultural assets. Without these agreements in place the City of Melbourne would only have been able to apply less than 10 per cent of the irrigation water used in the base year 2005/2006.

The response to drought in the City of Melbourne has significantly changed the approach to provision of water to trees. Of the city's tree stock approximately 15,000 trees have been grown in turf areas with regular irrigation. These include park trees and those grown in turf medians such as the major boulevards. Irrigation systems in the past have generally been designed to water the park surface, median or nature strip grass using manual or automatic surface sprinklers. Although this method of watering keeps the grass green it is not efficient in watering trees as it encourages them to develop surface root systems. Regardless of the species of trees and because of historical horticultural practices and the perception that water is a limitless commodity, trees have become dependent on regular surface watering and are less drought tolerant. Many of the trees in the City of Melbourne have been stressed over recent years as a result of low soil moisture.

The severity of the problem has increased over the past couple of years. In response to the drought and movement away from using turf sprays to irrigate trees, Council has applied a range of alternative ways to deliver water effectively to tree root systems and maintain soil moisture at levels to maintain trees in a healthy condition:

- Soil moisture readings are taken in the City's main gardens and boulevards in order to inform water application by monitoring the available water for the trees. The City's irrigation systems are being changed in order to ensure that the trees are provided with adequate water.
- Over 170km of sub-surface drip lines have been installed, hooked up to existing infrastructure. These are considered to be a temporary measure and a more permanent and robust system has been developed to deliver water efficiently in a sustainable way (refer below).
- A fleet of water tankers and water-filled barriers have been brought in to supply water to drought stressed trees that cannot be adequately watered using the irrigation systems. The water tankers supply reclaimed water from the Royal Park Wetlands (Trin Warren Tam-boore).

- Recycled mulch has been placed under a large number of tree species in parks and gardens that are more susceptible to the dry conditions.

The City of Melbourne decided, in early 2007, to investigate longer-term watering techniques that could be used to maintain trees located in high profile streets and boulevards in a healthy condition. Restricted root systems, highly variable soils, high levels of traffic and high exposure characterise these trees. Following a trial to investigate a range of techniques including drip watering, tree watering well products and a watering trench, the trench was considered to have the advantage of providing a wider distribution of water, to allow a relatively large volume of water to be delivered rapidly and, if necessary, to allow grass to be grown over the surface. Water distribution from the trench was found to be typically in the range of 500 mm laterally, beyond the edge of the trench, at a depth of 500 mm. The trench watering system has been installed along the majority of Royal Parade, in sections of St Kilda Road and in sections of Birrarung Marr riverside park.

Planning for low water futures
Along with the substantial decrease in rainfall associated with the drought, Melbourne is likely to experience a sustained period of increased temperatures and drier conditions. The City needs to put in place a policy framework and implementation programs to increase resilience to the projected impacts of climate change and extreme climate variability, including water-scarce and possibly even water-abundant conditions, and urban heating.

Responding to climate change calls for the design of landscapes across a spectrum from conservation through to creating urban ecologies (TW: 20). This includes preserving and protecting existing landscape assets; repairing, managing, reinforcing and improving the urban/natural environment interface; and actively integrating new landscape assets (including natural features, built landscapes) into the urban environment.

The role of trees and vegetation in rainwater and stormwater harvesting can not be overstated in terms of the benefits they provide in terms of water retention and therefore savings on using alternative water sources, and improving water quality.

Total Watermark – City as a Catchment strategy (2009)
The 'City as a Catchment' model has been developed by the City of Melbourne as the most strategic way to apply best practice sustainable water management practices in the urban landscape. The strategy promotes a localised water management model to reduce reliance on systems that impact other regions and provides a framework that contributes to climate change adaptation. While it recognises the important role of the natural catchment it works primarily with the artificial city catchment (including its roads, roofs and impermeable surfaces) to minimise water consumption and improve water quality.

The city as a catchment approach explores interactions between supply, the quality and quantity of stormwater and wastewater, land use, climate, social capital and the receiving waterways (rivers and bays). Furthermore, it is an adaptation strategy in response to climate change. It provides the basis for moving towards an informed 'city as an ecosystem' approach that encompasses greenhouse mitigation and habitat protection and stretches beyond single municipal boundaries.

Domain Parklands Estimated Irrigation Requirements Case Study (2009)
In planning for a low water future an estimation of irrigation requirements for parkland has been undertaken by the City of Melbourne. Determining an estimate of irrigation requirements for parkland ensures that we are putting the needs of our landscapes first. This 'demand side' analysis of water needs for the Domain Precinct represents a new, best practice approach to water budgeting and planning. Essentially this involved a case study to determine irrespective of the source the volume of water required by the Domain Parklands to be maintained at a healthy level.

Water Sensitive Urban Design
In addition to changes in irrigation design and practice a number of Water Sensitive Urban Design projects have been implemented to capture and clean stormwater runoff. Primarily sited in street locations, a wide range of pit designs have sought to enhance the below-ground tree environment with successful outcomes in terms of tree growth and reduced reliance on supplementary watering. It has been estimated that trees planted in WSUD pits require about 70% less supplementary water than

trees in traditional tree pits during the establishment phase. Well designed below-ground environments also provide adequate growing space for larger stature trees giving rise to increased environmental benefits and less damage to surrounding infrastructure. WSUD tree pits have been implemented in Acland Street South Yarra, Little Bourke Street and Little Collins Street with excellent results in tree growth.

Raingardens developed in small inner city laneways with resident support not only capture roof runoff and provide planting locations for trees and other vegetation, but have converted otherwise dull surrounds to well used social gathering spots. The increased use of permeable pavements is providing an essential source of water for trees and other vegetation. On a larger scale the Royal Park Wetlands is providing up to 3 million litres of reclaimed water weekly that is directed to parkland, sports grounds and tree watering.

Urban Heat Island effect

There is increasing awareness of the benefits of vegetation in the urban environment to mitigate the effects of the Urban Heat Island. Green spaces and vegetative surfaces provide shading to prevent direct solar radiative energy and create microclimates through evaporative cooling and shading, making the urban environment more comfortable to live in. A city-wide urban heat island management strategy will address the problem from the small scale (e.g. encouraging green walls and roofs) to the large (e.g. linked parklands, environmental corridors).

Thermal imaging is being used to map the surface temperature of the urban environment. This information will be used to guide the planting of trees for shade and introduction of other green infrastructure to reduce urban temperatures. By studying the temperatures of surface treatments we will also inform urban design principles for future urban landscape and built form materials.

It has been estimated that increasing tree cover by 10 per cent will reduce the surface temperature of a city between 3 and 4 degrees Celsius (CABE: 19). The prediction of a long-term hotter and drier climate therefore underlines the imperative to protect existing trees and establish new plantations to mitigate the anticipated increase in extreme heat events.

What has until recently been less well understood is the vital role of water availability to maintain optimum conditions of the landscape assets for heat absorption: ie. not just the spaces and assets themselves, but their ability to absorb and retain heat (Coutts, Beringer, Jimi & Tapper 2008). The increases in vegetation cover to mitigate UHI must be accompanied by water retention strategies in order to enhance the effectiveness of the vegetation. Loss or stress of vegetative cover significantly reduces evapotranspiration underlining the benefits of utilising available stormwater through water retention strategies, stormwater capture and re-use to re-integrate water back into the urban landscape.

Sustainability and TBL outcomes

As we head into a future of increasing urban densities, potential extremes of climate change, and increasing heat island effects, the role of trees and vegetation in the urban environment is increasingly important. In response to these challenges, the Urban Greening Strategy will quantifying the role of trees and other green infrastructure in mitigating these potential effects and responding to a range of social, environmental, planning and economic issues. Analysis of the urban areas through leading technology in thermal imaging and GIS evaluation (e.g. of percentage vegetative cover) will guide tree planting and urban greening over the next decade or so.

The Strategy is intended to form a basis for tree planning, management and planting programs and initiatives such as the **'urban forest', urban agriculture, community gardens, green roofs and green walls** in the city. The greatest benefits will emerge from understanding how the green space network and urban networks interact, and developing a coordinated strategy to integrate them. This represents a genuinely three-dimensional approach in a spatial sense, and requires coordinated inter-disciplinary, public and private, and inter-governmental perspectives and planning.

Urban densification and city structure

'Future Melbourne Community Plan' is Council's strategy for growth of the city by creating more livable and sustainable urban living and to meet our emerging challenges. It supports and promotes more compact, consolidated and higher density development in the inner city. There are challenges in achieving this intensification for living and working in a dense urban structure while maintaining

community liveability. This calls for climate-smart built environments and provision of green space that provides increased social amenity in intense urban landscapes.

'Transforming Australian Cities for a more financially viable and sustainable future' (2009) is a recent joint initiative between the City of Melbourne and Victorian Government that addresses urban infill within the existing infrastructure of the city. The study focuses on increasing densities along road-based transport corridors as key development areas, and also highlights the complementary qualities of the existing suburbs located in between. These areas are intended to effectively become the new 'green wedges' of the future city: greener, capable of collecting and purifying stormwater, generating renewable energy and with more productive landscapes so as to reduce the overall ecological footprint of the city, making it more sustainable (TAC: 23).

Green roofs and walls

Another recent collaborative initiative (between the City of Melbourne and Committee for Melbourne Future Focus Group) has been the 'Growing Up – the blueprint to green-roof Melbourne' competition and research program.

Green roofs and walls are sustainable and regenerative roof landscapes that reduce the impacts of urban development on our communities (FFG: 2). There are many compelling arguments for incorporating green roofs in Melbourne's future development: they reduce energy costs, increase the value of buildings including rentals and resale, support the efficiency and retention of employees, and are very appealing to residents seeking the replacement of green spaces as the nature of property occupancy in Melbourne transforms.

Internationally, green roofs and walls have for some time been integrated into sustainable design and policy initiatives, so while Australia has been comparatively slow to embrace green roof technology, we can now capitalise on this significant body of international expertise (FFG: 1).

Green roofs offer a variety of benefits to building owners and the city which, most significantly, assist in adapting and increasing resilience to climate change while assisting to provide additional amenity spaces and supplementing public open space.

Specific benefits include:

- As 'micro-landscapes' that can retain water, they reduce stormwater volume and water flow, helping to alleviate the pressure on stormwater infrastructure systems
- As thermal insulators they reduce the urban heat island effect by lowering ambient air temperatures
- They offer additional capacity as carbon sinks and sequester this atmospheric carbon dioxide for very long periods of time, thereby improving air quality
- They create sustainable interactive community spaces where people can interact, overcoming problems of 'vertical living' and isolation, and making workers happier by enhancing their surroundings, improving business profitability.

Policy instruments for implementation include:

- Developing industry standards and guidance on green roof implementation technologies
- Recognition of green roofs in planning schemes, including utilising zoning provisions and offering planning incentives
- Offering a range of financial incentives such as offset of public open space contributions, fee incentive models to reduce storm water charges, direct subsidies, density bonuses or other financing schemes

Community gardens

Community engagement and improved biodiversity should be primary objectives from which other benefits in climate change mitigation will flow (CABE: 25). While Council does not yet have a specific policy to guide the development of community gardens in the municipality, demand for community garden space is emerging through a number of Council programs and it is widely acknowledged that community gardening meets a range of social development and environmental objectives: they build community; improve health and social wellbeing; reduce environmental impact; create opportunities for purposeful recreation and social engagement; and maintain and support cultural identity.

Urban green areas can offer a significant source of sustainable food production, and the longer-term aim of Council is to seek to provide allotment land to meet demand and encourage local food production, particularly in areas of significant new development.

Conclusion

In these times of prolonged drought and climate change, it's an extremely complex task to nurture and safeguard Melbourne's urban tree population. The vital role that green infrastructure will play in preparing cities for climate change can not be overstated. 'Mature trees are significant assets to our environment and our society … They are community assets in every sense of the word – society has invested resources in their establishment and management, and they have matured as assets and are now returning great and diverse benefits in return.' (Moore, 2007)

At the 'traditional' end of the spectrum, maintaining historically significant plantings requires balancing the competing interests of passionate residents – looking to maintain our forefathers' vision for Melbourne with its majestic avenues of European trees – with the need to plant sustainable options for future generations.

At the current end, regardless of debates around how to calculate mass and dollar values of carbon sequestration by trees, the recognition of the need for Climate Change Adaptation has greatly increased public awareness of trees in cities, the impact of trees on the urban microclimate, and the opportunity to have the real value of urban value calculated and built into future decision-making processes (Moore, 2007).

CABE's 'Hallmarks of a Sustainable City' aptly identifies that it's therefore not just a responsibility for government and the private sector to take on, but a positive choice for government to make and the community to support. The framework and incentives for developing sustainable urban landscapes should be designed to deliver both climate change adaptation and increased prosperity built upon a sustainable economy.

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