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THE HERITAGE TREES OF 2115:
PLANTING, DESIGN AND ESTABLISHMENT

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Abstract:

This paper summarises the critical stages of managing the heritage landscapes and trees of the future from planning, site analysis, species selection, stock selection, planting, establishment, and maintenance to removal and replacement. This paper focuses on a landscape approach rather than the management of individual trees. It also includes a bibliography that may be a useful resource.

1.0 INTRODUCTION

Across Australia, many of our 19th Century and early 20th Century landscapes and streetscapes are in decline. In Sydney these include Centennial Park, Hyde Park, the Royal Botanic Gardens and the Domain. Usually, the most visually dominant elements in these landscapes are the trees. Many Avenues of Honour have been lost or compromised through radical changes to their environment.

In 2004, the removal of eleven trees, including four 140-year-old Moreton Bay Figs, from Sydney's Domain stimulated a wide-ranging debate within the community. The reason for the removal was to plant 33 new trees. This was the debate that we had to have; as in order to sustain the visual amenity of our landscapes, tree removal and replacement is inevitable. The critical question seems to be when, in the life of a tree or a landscape, should this occur. If future generations are to enjoy the style of landscapes that we have come to know and love, then management decisions must be made for the life of the tree, the life of the landscape and the life of the manager.

2.0 STAGES OF THE TREE

Trees go though a range of physiological stages during which growth rates change and the form of the tree develops. The essential requirements of trees remain the same throughout their life. Trees must have adequate supplies of light, water, nutrients, soil oxygen, carbon dioxide; they must be adequately supported and have a reasonable temperature range in order to maintain health and vigour for as long as possible. In unnatural and constructed landscapes we must provide most of these resources. As trees must continue to grow new leaves, transport tissues and roots in order to stay alive, the provision of these fundamental resources must be ongoing. The ability of a tree to cope with shortages of resources will to a large extent depend on its stage of life.

As trees mature, growth slows. A tree in its late stages of life (over-maturity/ senescence) produces fewer leaves on shorter shoots and hence less sugar is produced by photosynthesis. The cambium becomes less active and fewer transport cells are produced. This has an impact on the volume of sugars and water that can be transported throughout the tree. If injury occurs, the transport system is increasingly vulnerable to disruption. If fewer roots are produced, less water and fewer nutrients will be taken up.

Older trees also become more susceptible to secondary pathogens if injury occurs. Whilst trees have an automatic response to injury, its success depends on stored sugars and the vigour and vitality of the tree. The consequences of wounding are worse if wounds are made into heartwood. As growth slows, less sugar is allocated to storage and to the defence process. Similarly, old trees are more susceptible to drought and compaction, two very common stress factors in urban landscapes, than young vigorous trees.

However, for a tree to get old and make a major contribution to a landscape, it has to live long enough! There are many stages of a tree's life where it is vulnerable to damage. The best and most cost-effective approach to tree and landscape management is to avoid the problems.

3.0 CRITICAL STAGES

3.1 Planning

Perhaps the most critical stage in the long-term success of a landscape is the planning phase. Critical questions to be asked include: What do we want and for how long? The eventual removal of trees should be planned for. As most landscapes outlive the people who design and manage them, the development of tree/ landscape management plans should be an integral part of this process. This requires an inter-disciplinary approach and must consider available resources and elements other than trees that may have an impact on trees.

The Tree Masterplan for the Centennial Parklands[1] is a good example of this approach. It sets out

- principles and strategies for the conservation of the existing tree population
- a framework for the sensitive integration of new tree plantings into the historic fabric of the Parklands, and
- management and maintenance approaches to strengthen and sustain the tree population, and ultimately the Parklands themselves, into the next millennium.

A team of consultants carried out the Tree Masterplan; the team included landscape architects, heritage consultants, an arborist, botanist, fauna specialist and a soil specialist. The project was overseen by a Steering Committee consisting of landscape architects, an arborist, botanist, and members of staff from Centennial Parklands.

Preparation of the Tree Masterplan involved identification and mapping of landscape character types created by trees such as avenues, forests and so on. Detailed studies of the issues that affect the existing and future trees were undertaken. These detailed studies covered heritage, design, environment, age and condition of trees, arboricultural practices and habitat. Management precincts and sub-precincts were determined.

A heritage study provided an historical and cultural assessment of the tree population, including details of significant plantings, a timeline of planting periods and identifying a list of successful and or failed tree species.

1 Centennial Parklands Tree Masterplan 2002, Volume 1: 1.4 Study Process, p. 11

The design study identified significant vistas, species and plantings. It also analysed the major planting types and patterns of tree species in order to generate definitions of the Parklands's landscape character.

A review and analysis of environmental conditions, particularly soils, indicated the way in which the natural forces and human impacts have dictated species selection and the health and performance of existing established plantings.

A Safe Useful Life Expectancy (SULE) analysis of the tree population revealed the precarious physical conditions of many of the Parkland trees and the increasing importance of implementing a tree replacement programme. A brief overview of arboricultural practices highlighted the opportunity and need to improve existing (or implement new) techniques in order to achieve the recommended landscape character.

A review and assessment of the existing habitat values of the Parklands was recommended in order to integrate native fauna priorities with tree management practices.

Tree/ landscape Master plans provide current and future managers with the rationale behind the design and management decisions as well as a guide to implementing appropriate management practices.

3.2 Site analysis

This is a critical stage that is often done very poorly. It is the stage at which constraints and limitations are identified. Most of the constraints will be below-ground including depth of drained soil. Advances in technology and knowledge mean that many of these constraints can be over-come. Some examples would include the use of interconnected planting pits and gap-graded or structural soils. The use of these soils can reduce the impact of compaction.

3.3 Species selection

There are many species of trees that can be used to create a particular landscape character. It is essential that designers work collaboratively with arborists and horticulturalists in the process of species selection. It has become very clear over the years that some of the species selected by some of the most influential figures in Australia's public landscapes such as Charles Moore, Ferdinand von Mueller, Joseph Maiden and Walter Hill, have certain intrinsic problems. Several species of Figs have structural problems, others become infested with insects that cause problems for the trees and site users. The development of problems over time is almost inevitable given the almost non-existence of the domestication of our native species.

Apart from the desirable physical attributes, species must be assessed for structure, susceptibility to pests and diseases, tolerance of urban environments, drought hardiness, growth rates, longevity and maintenance requirements. The latter includes pruning requirements and cleaning-up of shed parts such as leaves, fruit and bark.

3.4 Stock selection

The latest edition of the Natspec publication *Purchasing Landscape Trees: A Guide to Assessing Tree Quality* is to be developed as a new Australian Standard. This is an excellent guide to specifying good quality root systems and above-ground parts that are in balance. It also includes useful guides for ordering trees and working with

growers as well as a compliance checklist. It is not sufficient to specify “as per Natspec”; it must be driven and applied thoughtfully.

Poor quality root systems are still a common cause of failure to establish and perform. Trees must be self-supporting in their containers if they are to stand up by themselves in the ground; hence, trunk taper is another important criterion to specify. Unfortunately, planting and installation specifications almost always detail staking! If self-supporting trees are installed, these details can be omitted, Tree protection may still be required but trees do not need to be attached to stakes or guards.

One strategy in the renewal of landscapes is to use super-advanced trees as replacements. A four or five metre tree cannot be grown overnight so forward ordering of such stock is essential. Where this is well specified and managed, trees of excellent quality can be grown and installed.

3.5 Site preparation

As most limits to tree survival are below ground, it is important to seek advice from a soil scientist when significant landscapes are being developed, especially if the site has had a history of disturbance. Adequate soil volume and good soil drainage are not negotiable, especially if large stock is to be installed in a typically disturbed urban soil.

At this stage, hard landscaping and other infrastructure should be planned for and designed to limit long-term impacts on trees. This is especially important for underground services.

3.6 Planting

One internationally common cause of poor establishment is planting trees too deeply. Unfortunately there are many technically inaccurate planting details doing the rounds of many firms of landscape architects. A common problem with these details is the over-excavation and then backfilling of the planting hole. If trees are planted too deeply in fine-textured soils, water will not penetrate the root ball; this is an example of a “perched water table”. Planting too deeply will also compromise oxygen diffusion to the roots and may cause mechanical damage to the stem.

The outcome of planting must be that the top of the root ball, or better, the root-crown, must be level with the finished level of the soil forever! The best way to ensure this is to state that the depth of the planting hole must be the depth of the rootball. Some useful references for planting details are given in the bibliography attached to this paper.

Another potential cause of failure or poor establishment is the use of excessive amounts of organic matter in the back-fill. Soil organisms compete with roots for oxygen. Advice should be sought from a soil specialist who is familiar with amenity landscapes.

The watering-in of trees, immediately after installation, is an integral part of the planting process. For a guide to determining how much water should be applied, refer to the paper presented by Dr Peter May at the 2004 TREENET Symposium on “Soils, Water and Tree Establishment”. The water must be applied gently through the rootball.

3.7 Establishment

Once trees have been installed, trees must be maintained until they are self-sustaining; although in some highly constructed landscapes, this may be for their entire lives. Watering is a critical component as is the protection of young and vulnerable trunks from mechanical damage. The damage caused by mowers and whipper-snippers is epidemic and completely unnecessary and unacceptable. Where trees are planted into turfed areas, the installation and maintenance of a mulched area around the base of the tree is a useful strategy on many levels – even if tree guards are installed.

Regular inspections should be part of the establishment process as early failures or poor performance should be assessed and addressed sooner rather than later.

3.8 Maintenance/ Management

Monitoring of performance should be ongoing. Regular inspections will also highlight the need for any formative pruning. Pruning is likely to be an on-going process. All pruning must be performed according to the general conditions of AS4373 *Pruning of Amenity Trees* with particular pruning requirements clearly specified.

Changes in the rootzone are the most common causes of stress to established trees. For this reason, all proposed changes such as paving, topdressing, level changes and the installation of underground services should be assessed for their potential impact on the roots of trees. This assessment should involve a consulting arborist.

What is becoming clearer, with some recent major tree failures in very public landscapes, is that mechanical damage, to both roots and root buttresses, is to be avoided at all costs. Wounding damages bark and potentially allows the entry of pathogens. Some genera of wood decay fungi such as *Phellinus* spp and *Ganoderma* spp have been identified as causal agents in the failure of mature trees in Hyde Park, Moore Park and the Royal Botanic Gardens Sydney. These fungi enter through wounds. The wounding of large woody roots as a result of the “upgrading” of hard landscaping can lead to catastrophic failures with major implications for public safety.

The key to the sustainable management of mature trees is to MAINTAIN A STABLE ENVIRONMENT.

3.9 Managing over-mature/ senescent trees

As trees age they are less able to cope with changes in their environment. Inevitably the aging process leads to more dead wood and an increasing susceptibility to wounding and decay. In some species, structural defects become more obvious. As trees age, the critical issue becomes hazard management. In some instances the structural defect may be removed or abated. This is not always possible and if it is important that the tree be retained, the issue becomes target management. This may involve fencing off the tree; clearly there is a limit to how many trees can be fenced off from public access. [A good example is the “Children’s Fig” in the Royal Botanic Gardens Sydney.]

When redevelopment of landscapes containing significant over-mature trees is planned, it is essential that an experienced consulting arborist assess the impact. If trees are a dominant and significant element in the landscape, and they are to retained, they must be seen as a constraint in the process.

3.10 Tree removal and replacement

This is often a sad but inevitable outcome of landscape management. Unfortunately, the people responsible for some of our significant landscapes did not leave behind detailed landscape or tree management plans outlining the design intent and the stage at which the trees should be removed and replaced. When replacement tree planting is planned, so too should the process of replacement. The rationale should be clearly stated however, at best, this could only be a guide to future landscape managers.

Another critical element in the tree removal process is public consultation. The facts should be clearly presented and based on sound arboricultural practices. The replacement of a significant avenue of *Phoenix canariensis* from Centennial Park in Sydney and its eventual replacement with *Agathis robusta* is an example of successful public notification. However, regardless of what maybe a thorough and time-consuming exercise of public consultation, the process may be hijacked by politicians and the media and thus sensationalised.

Removal and replacement allows for the implementation of current best practices and may allow for the planting of species better suited to present conditions.

4.0 THE DOMAIN – A CASE STUDY

The Domain is a 28 ha parcel of land that bounds the Royal Botanic Gardens Sydney. In 1807 it was named as the "Domain of the Governor's Residence" and it was gradually "improved" by successive governors. In 1828 it was identified as a place "reserved for Public Purposes"[2]. In 1848 it was officially placed under the management of the Superintendent of the Botanic Gardens, and finally, in 1980, under the Royal Botanic Gardens and Domain Trust[3]. The Trust is a statutory body brought into existence by the Royal Botanic Gardens and Domain Act, 1980 and reports to the NSW Minister for the Environment.

The Domain contains over 1000 trees, some of which date back to pre-European times. Most of the significant trees are the legacy of two early Directors of the Botanic Gardens, Charles Moore (1848-1896) and Joseph Maiden (1896-1924). One of Charles Moore's signature species was *Ficus macrophylla* (Moreton Bay Fig). Prior to the recent removals, there were 149 Morton Bay Figs, many of which go back to Moore's time. Hence the Domain is a landscape of great horticultural, scientific, and historic significance.

The Domain is divided into a number of management precincts. The trees in question are on the western boundary of the Philip Precinct, between Hospital Road and the playing fields. Hospital Road is largely a service road for Sydney Hospital and Parliament House. [The offices of NSW parliamentarians overlook the Domain.] It is a point of access for pedestrians from Macquarie Street into the Domain. It is the section of the Domain which is used for major concerts and events such as "Opera in the Park" which attract up to 80,000 people.

Managing a cultural landscape is a complex business, especially for an organization such as the Royal Botanic Gardens and Domain Trust. In this context, issues of scientific and botanical interests must be balanced with heritage, aesthetics and risk management in an environment of restricted finances and limited human resources.

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[2] Domain Masterplan (2000) Volume 1, p.31

[3] Domain Masterplan (2000) Volume 1, p.32

Managing a landscape is more than managing trees on an individual basis. An important criterion for landscape management is to maintain a range of plantings of uneven age and of species diversity. It would be financially crippling and aesthetically devastating to have a significant number of old trees failing in a relatively short time.

Where a landscape has had intensive periods of extensive plantings such as the Domain and Centennial Park, the prime positions for plantings are already occupied and other legitimate uses have been established in adjacent areas. For example, the large open spaces in the Domain are used extensively for sport and for major events.

In 2003, a decision was made by the Royal Botanic Gardens and Domain Trust and supported by both the independent Scientific and Horticultural Committees that the renewal of the Domain must be accelerated. Over several decades, the total number of trees had declined and the condition of some of the oldest plantings had deteriorated to the point where they were hazardous. A safe useful life expectancy or SULE analysis of the entire tree population of over 1000 trees was carried out. This process highlighted the least sustainable trees and highlighted the most degraded parts of the landscape. For many of us who knew the trees, it was no surprise that the trees along Hospital Road were identified as the ones that should go.

It was proposed that 11 trees, including 5 Moreton Bay Figs from Moore's time (about 140 years old), should be removed to make way for 33 new trees. The removal of 11 trees represented about 1% of the trees in the Domain. The loss of five Moreton Bay Figs represented 2% of the number of this species in the Domain.

Both committees and the Trust supported this proposal. The community was consulted and each Member of Parliament was written to informing them of the decision, as was Sydney City Council. The wider community was informed through numerous announcements in the press and through signage in the Domain. Unfortunately between the announcements and the implementation, a new Council was elected.

To cut a long story short, the decision was challenged by the new Council of the City of Sydney in the NSW Land & Environment Court. This resulted in a lot of media attention and distracted many senior staff of the Royal Botanic Gardens for months. Expert witnesses were engaged and alternative management options were considered such as reduction pruning to reduce the risk of failure and the inter-planting of the new trees between the old trees. However, it was deemed by the RBG team that removal was the most sensible option. In the end, the court found in favour of the Royal Botanic Gardens and Domain Trust. All but one of the trees was removed and the 33 new trees were planted. The attention given by the media to the planting was almost non-existent.

Despite the drama, the removal and replanting process allowed for the testing and remediation of the soil; the species selected were chosen on a number of criteria including resistance to compaction, low susceptibility to Fig Psyllids and heritage values.

This small but landmark project is the taste of things to come as the public, politicians and landscape managers come to the realisation that landscapes are dynamic and the largest and most conspicuous elements, the trees, don't last forever.

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(For an extended bibliography of arboriculture references, email Judy Fakes on judy.fakes@tafensw.edu.au)