Urban Forest
Diversity Guidelines

2011 Tree Species Selection Strategy for the City of Melbourne











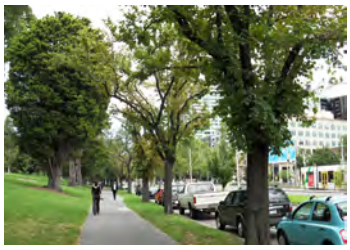




Prepared on behalf of City of Melbourne by ASPECT Studios and Tree Logic.

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Executive Summary

The Urban Forest Diversity Guidelines is a subsidiary document to the City of Melbourne Urban Forest Strategy. The guidelines are intended to inform the Tree Precinct Plans that in turn will determine locations for street tree plantings. Park trees will be planted using existing Masterplans and site specific plans.

The urban forest is a significant asset for the City of Melbourne and to protect that asset it is necessary to diversify its content. Urban forest diversity will make a more resilient and robust forest, help protect the forest as a whole from pests and pathogens, streamline maintenance programs, and even out annual budgetary requirements.

Without diversity, the urban forest is at greater risk from extreme events such as drought and climate change, and from the urban heat island effect.

The urban Forest Diversity Guidelines recommend that by 2040 no more than 5 percent of the forest is to be of any single species, no more than 10 percent is to be of any one genus, and no more than 20 percent is to be of any one Family.

The current profile of the urban forest contains an overproportion of the Family *Myrtaceae*, as well as the genus *Eucalyptus*. Regular annual tree planting to 2040 is proposed to reduce this predominance, and to create a forest with greater age spread.

This document also recommends a full review of the City's Elm and Plane Tree populations, to determine best locations to grow these species.

The Urban Forest Diversity Guidelines provide a non-subjective, scientifically based set of criteria for establishing what tree species are suitable for the urban conditions found in the City of Melbourne.

The Master List of Street and Park Trees provides a broad selection of trees that can meet all of the needs of the City in terms of adaptability, heritage and character.

Trees that are suitable for one location may not be suitable to another location. In order to find the right tree for the right place, a typology of street and park tree locations has been developed, with each Location Type accompanied by minimum criteria necessary for successful tree growth in that location.

By crossreferencing The Master List of Street and Park Trees with the Location Types, a set of tree lists for the diverse locations across the City of Melbourne has been established.

These Location Type Tree Lists can be further refined according to additional criteria such as neighbourhood character, heritage, and degree of shade, and it is such site specificity that will be investigated in the Precinct Street Tree Master Plans.

The Urban Forest Diversity Guidelines are considered a live document, for regular review, and capable of being updated as new knowledge and understanding of the City's requirements develops.

How to use this document

The information in this document is structured to facilitate clear decision making for street tree selection.

Chapter 1 – Introduction

The introduction outlines the relationship between the Urban Forest Strategy and the Urban Forest Diversity Guidelines.

It also summarises some of the key issues facing the growth of trees in Melbourne both today and in the future.

Chapter 2 – Tree Species Selection Criteria

This chapter outlines the selection criteria that have been chosen to identify which tree species are most suitable for the City of Melbourne's diverse types of streets and parks.

Chapter 3 – Tree Planting in Melbourne

This chapter identifies the typical tree growing conditions across the types of street and park environment in Melbourne, with a focus on street trees and streetscapes.

Chapter 4 – Choosing the Right Tree

This chapter identifies the process for selecting the most appropriate tree species for a particular location.

1. Introduction

This chapter outlines the relationship between the Urban Forest Strategy and the Urban Forest Diversity Guidelines. It also summarises some of the key issues facing the growth of trees in Melbourne both today and in the future.

1.1 Overview

The City of Melbourne's Urban Forest Strategy sets out the blueprint for achieving our vision of a resilient, healthy and diverse urban forest that will contribute to the health and wellbeing of our community and to the creation of a liveable city. A series of challenges currently faces our urban forest, and the City of Melbourne must now manage and transform our urban forest in a holistic and multidisciplinary manner in order to achieve our vision. The challenges we face include the fact that many boulevard and specimen trees are reaching the end of their natural life. Coupled with the effects of drought, increasing intensity of heat during summer, and water restrictions, this decline has been accelerated and in many cases is irreversible. The opportunity now exists to transform our public and private urban forest into a healthy, diverse, resilient and well designed forest that will enable our City to adapt to a changing climate, mitigate urban heat island effects and provide protection and wellbeing to the community.

The work that this opportunity provides will be guided by 6 principles developed to ensure all future work contributes to achieving our vision. These are:

- Adapt to climate change.
- Mitigate urban heat island effects.
- Create a water sensitive city.
- Create healthy ecosystems.
- Design our urban landscapes for community health, wellbeing and liveability.
- Position Melbourne as a leader in urban forestry.

As part of this process, a need has been identified to produce a scientifically based suite of tree species lists that highlight suitable tree species to suit various Location Types in Melbourne. This document will form the basis for ensuring diversity within our urban forest: diversity in species, age and growth rates. The scientifically based approach will ensure that overall tree selection is fit for purpose, within the context of individual sites and also of the municipality as a whole. Building the urban forest as a living ecosystem will rely on smart species selection to deal with issues such as improving biodiversity, improving soil moisture retention, reducing stormwater flows, increasing shade and canopy cover, reducing infrastructure conflicts and ensuring our urban forest provides the maximum benefits for our communities. This work will further inform species selection within all future park masterplans, precinct plans and capital works and renewal programs.

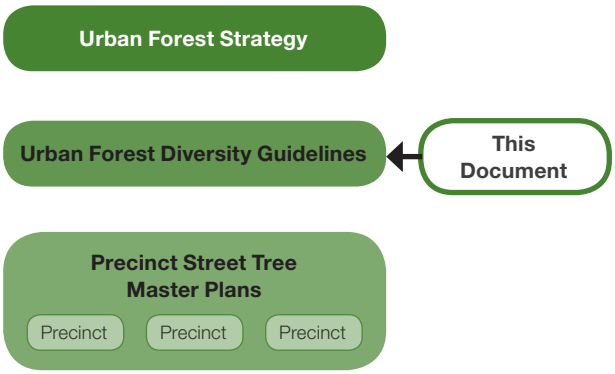


Figure 3: Relationship of this document to the Urban Forest Strategy and Precinct Street Tree Master Plans.

Objectives of the Urban Forest Diversity Guidelines

- Ensure urban forest diversification in age, species and health across the municipality.
- Provide scientifically based criteria for selecting tree species in urban Melbourne.
- Mitigate risk of pest and disease attacks.
- Develop a typology of City of Melbourne street and park locations and allocate relevant species for each Location Type.
- Ensure that nominated species are likely to survive and succeed in the face of predicted climate change.

Values of Diversity

To mitigate the risk of economic loss, financial advisors recommend asset diversification. The same principle applies for an environmental asset such as an urban forest. The greater the diversification within a forest, the lower the risk of losing the entire forest in one event, such as a pest and disease attack or an extreme heat event. By diversification we mean a variety of:

- Tree species.
- Ages of trees.
- Growth rates of trees.

By ensuring that these types of diversity are fostered in our urban forest, we are able to reduce overall vulnerability of our tree population.

History of Species Diversity

Adapted from Carver (1989), Spencer (1986), and Yau (1982).

After the initial settlement of Melbourne, when indigenous bushland was cleared to make way for a burgeoning township, trees were given little priority. In the early days they were seen as a resource to be utilised and little emphasis was given to the beautification of the town.

By the 1850s, Blue Gums were the main planting along the Yarra and St Kilda Rd due to their quick growing nature and their ability to withstand the extremes of Melbourne's cool wet winters and hot dry summers. Avenues of Silky Oak, *Grevillea robusta*, were also planted between the Botanic Gardens and Princes Bridge. Plane trees, American Ash and *Pinus radiata* were all trialled throughout this period as avenues, proving themselves to be hardy specimens for the Melbourne landscape. Conifers also played a large role in forming the larger Victorian landscape around this time, with over 355,000 plants being custom grown at the Botanic Gardens for distribution to Governmental public reserves, schools, cemeteries, and churches throughout the state. Peppercorns were also favoured due to their lush foliage and heritage values.

Interestingly, by the 1870s, through Baron Von Mueller's influence, the gentleman of society – including Municipal Mayors – fully recognised the benefits of street tree plantings in the city and in principal towns. Many of Melbourne's reserves and parks were laid out at this time and many still reflect the preference for Conifers. By the 1880s however, Pines and Blue Gums had lost their popularity and replacement with other species had begun. Blue Gums in Victoria Parade were ringbarked by a local gardener, and many considered both Pines and Blue Gums too gloomy and dense. The Peppercorns also fell out of favour due, their large weeping habit considered inappropriate for successful street trees. The nature of deciduous trees' shading during summer and allowing sunlight in winter was a new way of thinking in urban streetscape design to allow for the comfort of people. This was the beginning of the planting of Elms as shade trees.

By the early twentieth century, Planes, Elms, Oaks, Poplars, *Lagunarias*, Chestnuts and *Phoenix canariensis* were prescribed for the boulevards, streets and parks of Melbourne. For the drier areas north of Melbourne, Kurrajongs, Silky Oaks, Moreton Bay Figs, She-oaks and Golden Wattles were recommended. This period shows a much more diverse range of trees used in the more cultivated areas and highlights the thought that was given to trees environmental benefits and their abilities to withstand the Melbourne climate.

The rapid expansion of Melbourne's suburbs after the First and Second World Wars saw bushland retreat and small scale trees being planted along the streets. Trees such as the Red Flowering Gum, *Pittosporum*, *Lophostemon confertus* and *Prunus* were popular, gracing newer suburbs. Particularly after the Second World War, natives had a resurgence in popularity with more *Eucalypts*, *Melaleucas* and *Callistemons* being introduced into Melbourne as street trees. Plane trees were particularly favoured for the ability to withstand harsh urban conditions such as air pollution and poor soil conditions. Planes replaced the St Kilda Poplars during the 1960s. During the 1980s, there was another wave of indigenous tree species selection and they were encouraged as plantings to promote native ecosystems and attract wildlife. Such trees included *Eucalyptus maculata*, *E. nicholii*, *E. leucoxylon*, *E. sideroxylon* and *E. citriodora*.

Melbourne's climate, hydrology patterns and soil types provide the opportunity for many species of trees, both native and exotic, to grow well. The many types of space within our urban fabric further provide opportunity for various species such as park specimens, smaller fastigiates for narrow laneways and streets, large shade trees for medians, specimens for boulevards and natives for our indigenous landscapes. Compared to the northern hemisphere our history of species diversity amongst our urban forest appears to be relatively short, however various articles certainly highlight the changes in cultural trends, succession of tree species trials, and the recognition of the importance of diversity.

Given the immense value of Melbourne's existing tree population, and the potential vulnerability to the future challenges such as climate change and the urban heat island effect, working towards greater species diversity is a high priority.

Measures of Diversity

In Melbourne's existing stock of trees, Elms and Planes each represent 10% of our total tree population. Frequently cited, though not scientifically based, rules of thumb in the United States suggest:

- Plant no more than 30% of a family.
- Plant no more than 20% of a genus.
- Plant no more than 10% of a species.

These rules predate the rise of concern about impacts of climate change, which is likely to increase the risk of planting urban monocultures. They also omit any consideration given to the use of cultivars and clones. Clones are genetically identical to their mother stock and therefore further increase the risks associated with planting monocultures.

The rules above are therefore best seen as conservative guides only within the City of Melbourne context. The emphasis should be on a diversity greater than that suggested by these rules.

Given the immense value of Melbourne's existing tree population, and its potential vulnerability to such future challenges as climate change and the urban heat island effect, working towards greater species diversity is a high priority.

Species Diversity

If we cumulate the planes and elms:

Table 1: Top ten species within the City of Melbourne

Species	%
Platanus acerifolia and *P. orientalis*	12
Ulmus spp., *U. procera* and *U. parvifolia*	12
Eucalyptus camaldulensis	11
Corymbia maculata	6
Eucalyptus melliodora	3
Eucalyptus leucoxylon	3
Corymbia citriodora	3
Allocasuarina verticillata	3
Angophora costata	2
Lophostemon confertus	2

Genus Diversity

Table 2: Top ten genera within the City of Melbourne

Genus	%
Eucalyptus	24
Ulmus	13
Platanus	12
Corymbia	9
Acacia	4
Quercus	3
Allocasuarina	3
Melaleuca	2
Ficus	2
Angophora	2

Family Diversity

Table 3: Top ten Families within the City of Melbourne

Family	%
Myrtaceae	43
Ulmaceae	14
Platanaceae	12
Mimosaceae	4
Casuarinaceae	4
Fagaceae	3
Moraceae	2
Rosaceae	2
Pinaceae	1
Salicaceae	1

Having a large representation of any one particular family leaves Melbourne's urban forest vulnerable to pest and disease outbreaks that are family specific. The *Myrtaceae* family accounts for forty three per cent of Melbourne's tree base, a proportion which could potentially be devastated if plant pathogens targeting this family, such as Myrtle rust, take hold.

There is a noted high percentage of the genus *Eucalyptus* and the Family *Myrtaceae* within our tree population. This is due in part to the fact that many different species make up this genus and Family, many of which are native to Victoria and also to the fact that these species have proven successful as urban trees. It should be noted that Royal Park, Melbourne's largest park at 170 hectares and maintained primarily as native bushland, houses many of these *Eucalypts* and *Myrtaceae* Family, including a large proportion of our 5,400 *Eucalyptus camaldulensis*. Whilst we note the level of vulnerability amongst the tree population due to these high percentages of one genus and one Family, they form very important indigenous landscapes within our municipality that are healthy, robust and iconic for Melbourne.

Useful Life Expectancy of Melbourne's Trees

Table 4: Life expectancy of trees within the City of Melbourne Based on an assessment of 50% of the tree population	
Time Until Senescence	**%**
< 1 year	3
1-5 years	11
6-10 years	15
11-20 years	18
21-30 years	17
31-60 years	24
61+ years	12

Useful Life Expectancy is a year bracket attributed to each tree for which we expect that tree to remain as a healthy robust specimen in the landscape. During the assessment, the age of the tree, and its health, form and growth patterns, are taken into account to determine its life expectancy. From this analysis we can derive that approximately thirty percent of Melbourne's tree population will not survive in the landscape for another 10 years and forty eight percent will not last 20 years.

Useful Life Expectancy Of Melbourne's Elms

Table 5: Life expectancy of Elm trees within the City of Melbourne	
Time Until Senescence	**%**
< 1 year	6
1-5 years	22
6-10 years	26
11-20 years	21
21-30 years	11
31-60 years	10
61+ years	4

Fifty five percent of Melbourne's Elm population will not remain in the landscape after ten years due to their age.

In a cumulative analysis of our species diversity, Elms make up just over twelve percent of our tree population. Of these Elms, approximately fifty five percent are coming to the end of their natural lives and will senesce in the next 10 years. That means that 3000 elms will need to be removed from our parks and streets within the next 10 years; 700 of these will be lost within one year.

Conclusions

It is clear then that the City of Melbourne's current urban forest is vulnerable. Elms and Planes dominate our boulevards and CBD streets and we hold a high percentage of the genus *Eucalyptus* and the *Myrtaceae* Family, all of which contributes to an uneven spread of tree types within our urban forest. This makes our urban forest vulnerable to pest and disease attacks, mass senescence of certain species is likely to occur, and can magnify the deleterious effects of specific weather conditions such as heat waves: and all of which can contribute to large costs in removals and replacements.

As a result the City of Melbourne proposes to implement the following benchmarks to reduce vulnerability:

Species:

By 2040 the urban forest will be composed of:

- No more than 5% of any one Species.
- No more than 10% of any one Genus.
- No more than 20% of any one Family.

Age and growth rates:

- Diversity of tree age and growth rates will be encouraged through regular plantings each year to 2040. These regular plantings are to be much greater than the numbers of trees removed each year.

Health:

- No more than 10% of our tree population will be in poor health by 2040.

Whilst this analysis looks at the City's urban forest as a whole and sets strategic targets for managing vulnerability, the implementation of diversity actions at street and park level must reflect the larger vision.

The concept of reducing the percentage of the *Myrtaceae* Family from forty three percent to twenty percent of the entire population may seem drastic, but it is a long term benchmark that spans the life of a tree, not that of an electoral cycle. By increasing street and park tree plantings each year, the City of Melbourne intends to increase the overall population of trees incrementally over a number of years, whilst ensuring that the *Myrtaceae* Family dominate the total percentage less and less each year.

Therefore, operational plans, such as the precinct planting plans will be reviewed and developed to bridge the gap between strategic targets and day to day management of tree removal and planting. These precinct plans, along with supporting research papers and landscape implementation plans, will help us to determine how to best replace declining trees and increase street and park plantings within our targets that all align with the broader Urban Forest Strategy principles.

Key Outcomes from this Report

- A full review will be conducted of Melbourne's Elm and Plane populations, determining best locations within the city to grow each species, with each species comprising no more than 5% of the total tree population. An historical and character review of each of our prominent Boulevards should also be conducted to ensure we maintain their integrity and identity through specimen plantings.
- Over time and through increased planting regimes, the percentage of *Myrtaceae* will be required to be gradually reduced to encompass no more than twenty percent of Melbourne's total tree population.
- Regular tree planting each planting season until 2040 will ensure the number of mature trees within the overall population is reduced to a more even spread of ages.
- The review of each Council Tree Precinct Plan in conjunction with overall targets will determine the spread of species, genus and Family down to individual streets and parks. These precinct plans will also highlight opportunities for increased plantings.

1.2 Project Process

The Development of the Urban Forest Diversity Guidelines to Date

Project consultants ASPECT Studios and Tree Logic developed a tree list of potential future-proof street and park trees. The Preliminary Tree Selection List needed to provide a diverse range of species options that work alongside the principles set out in the City of Melbourne's Urban Forestry Strategy.

There was no use of subjective criteria such as personal taste, aesthetic and cultural values, perceptions, design requirements or any site based constraint, in the development of the initial tree selection list.

The Preliminary Tree Selection List was large, informed by Tree Logic's experience as one of Victoria's leading arboricultural companies.

An internal committee at the City of Melbourne contributed information including success rates of tree species growing within the existing urban forest.

The extensive Preliminary Tree Selection List was reduced to make it more workable and enable critical evaluation of suitable species.

Species that did not meet the urban forestry criteria, for instance drought tolerance, heat tolerance, wind tolerance or susceptibility to pathogens, were removed.

Figure 4: Process and outcomes in developing the tree selection process for the Urban Forest Diversity Guidelines.

1.3 Status of document

A 'live' document

This document is envisaged as a live document with the ability to be updated as more data and information becomes available.

It is a requirement that this document be interactive and flexible for the user. Street tree management and urban forestry is a concept that is quickly developing, both from practical experience and scientific research. As a consequence the limitations of the tree selection process are carefully considered. The document will be updated as information, data and research become available.

Following are some examples:

- Potential tree pathogens may affect a particular selected species. If this is unmanageable then the tree species will be taken off the list. Similarly new cultivars and selections that are more disease resistant may be added.
- Species with reduced litter drop may be included at a later time.
- Climate change results in further extremes in weather and the status and suitability of species needs to be updated.
- Reassessment of on-site conditions such as greater incorporation of 'positive' planting innovations including structural soil beneath porous paving, infiltration, pits, and WSUD basins, may lead to species additions.

Formal review

A formal review will take place every five years. The next review should analyse the following aspects:

- Diversity Guidelines objectives: including how diversity targets are distributed amongst the Precinct Planting Design Plans and the distribution of percentage based targets.
- The Diversity Guideline's relationship to the Urban Forest Strategy and other City of Melbourne policies.
- The ten base criteria used to establish suitability to urban conditions. These criteria are not fixed.

In addition, changing community perceptions can be incorporated, including any community consultation outcomes.

1.4 Overview of Urban Forest Diversity Issues within the City of Melbourne

There are a number of issues confronting diversity of tree species in Melbourne. These issues have directly informed the selection criteria by which the preferred tree species have been identified. Species age, health and growth rates are key issues.

Species Diversity

Tree diversity within an urban forest landscape provides functional and aesthetic benefits as well as biological and ecological advantages. "A common tenet of popular ecology is that high species diversity contributes to the stability of ecosystems by reducing hazards of catastrophic loss of a particular species" (Richards, 1983). However, there is much evidence from plant ecological studies that relationships between diversity and stability cannot be as simply expressed as this premise suggests.

Whilst street tree species do not occur in monocultures to the same extent as agricultural crops or forest plantations, the presence of grand boulevards, and neighbourhood heritage and character can mean that urban areas are dominated by relatively few species. Whilst these species have proven adaptable to changing urban environs there is an inherent risk in planting few species throughout a city.

Miller and Miller (1991) recommend that "liberal use" of a species should not exceed 10% of the total tree population. Jaenson et. al. (1992) suggest that city foresters should use species percentages derived from rapid, sample surveys to "reassess their recommended species lists to achieve a 5%-10% ceiling on any one tree species". Whilst these simple numerical limits have no scientific basis they form a well used rule of thumb for essentially not putting all of your eggs in one basket.

As discussed, the 10% rule may appear to be outdated when considering the enormity of climate change issues and the increased use of clones and cultivars.

The following factors will dictate species diversity:

- Existing landscape character.
- Proven adaptability and tolerances of species.
- Availability.
- Ability to fulfil functional requirements.

In street tree populations, stability depends primarily on the longevity of individual trees and sufficient numbers of successfully planted replacements.

Age Diversity

Good age diversity is essential for future population stability. Most importantly, species that have been proven to be adapted should be stabilised through ensuring the population of that species has a good age range. When replacing older trees, this is more important than encouraging species diversity. As Richards (1983) states, to do otherwise "is a misuse of ecological concepts. Species diversity contributes to the stability of a street tree population only to the extent that individual species or cultivars prove successful".

On an economic level, diversity of age means that maintaining the urban forest becomes a more evenly paced process. Extremes – for instance those associated with sudden mass senescence – are minimised, allowing for budgets to be more easily managed and regulated.

Size Matters

A strategically located large-stature tree has a bigger impact on conserving energy and mitigating the urban heat island effect than a corresponding quantity of smaller trees. Larger trees do more to:

- Reduce stormwater run off.
- Extend the life of street surfaces.
- Improve local air, soil and water quality.
- Reduce atmospheric carbon dioxide.
- Provide wildlife habitat.
- Increase property values.
- Enhance the attractiveness of an area.
- Promote human health and well being.

The bigger the tree, the larger the benefits and, ultimately, the better the community's quality of life.

Planting Sites

Species diversity may be constrained by the range and availability of planting sites. In particular, the number and type of planting sites that allow plantings to attain larger sizes needs to be addressed.

An optimal planting site allows space for uninhibited root growth (in volume, surface area and shape of surface area), provides uncompacted soil, good solar access, sufficient space away from adjacent structures such as walls and from vehicular traffic, and is not limited by overhead conditions (e.g. power lines).

New planting sites can be developed within established avenues and landscapes to allow the planting of species different to the established species. In addition to increasing species diversity, such plantings may provide a highlight (for instance at roundabouts, medians, or in kerb outstands), or additional aesthetic value.

Above and below ground restrictions mean there will always be sites in the City of Melbourne that require the use of small stature trees.

Genetic Diversity and the Use of Cultivars

Plant breeding is the science of adapting the genetics of plants for the benefit of humankind and has been in practice since the beginning of civilisation. The overall aim of plant breeding is to improve the quality and performance of plants with the objective, in this case, of developing trees better adapted to the urban environment and ultimately for the benefit of the community.

The London Plane (*Platanus* x *acerifolia*) and Dutch Elm (*Ulmus* x *hollandica*) growing in Melbourne are cloned populations, so the concept of plant breeding it is not a new occurrence to Melbourne's streets.

Genetic diversity means a population is comprised of a broad range of individuals expressing different characteristics.

Genetic diversity is important because:

- Through artificial selection for specific characteristics, for instance quick growth, we may unintentionally select against other desirable characteristics, for example disease resistance. Wild populations provide a gene bank that can reinvigorate and strengthen domesticated populations.
- Ecosystem diversity requires species diversity.
- Adaptability can only occur in diverse populations and ecosystems. Diversity is essential for survival. Diversity is the basis for a robust and resilient population.
- Local wild populations are more likely to be adapted to local conditions than populations from elsewhere.

The maintenance of wild relatives of domesticated species is essential to plant breeding and sustainable agriculture and horticulture.

Cultivars – specially bred and domesticated varieties of wild populations – are bred because they possess desirable characteristics. While this can be good, in doing so we reduce the overall population's genetic diversity, leaving it less adaptable in the longer term.

Cultivars developed and grown in areas where the local conditions are different to those of the City of Melbourne must be regarded as unproven until they have been adequately tested under local site and cultural conditions.

Cloning is an extreme example of cultivation. Cloned populations have in the past been encouraged by some because the individuals "all look the same", hence present more neatly, are all guaranteed to have the same characteristics of disease resistance and so on. Cloned populations however, because their genetic diversity is nil, are more at risk, and minimise the adaptability and survivability of the urban forest.

A balance needs to be maintained between the use of cultivars (and clones) and stock grown from wild populations of local provenance.

Climate Change

Climate change requires consideration in the tree selection process. Climate model projections for the coming decades indicate an increasing risk of below average rainfall for southern and eastern mainland Australia, higher temperatures and evaporation, and below average runoff. In particular there is a significant projected increase in frequency of extremely hot years and extremely dry years (CSIRO, 2010). The selection of species more suited to extended dry periods and high heat will be beneficial. Other stresses caused by warming will include more pests, pathogens and fires.

In urban environments reducing the effects of climate change, for example the heat island effect, can be achieved by planting more trees. Not only do trees supply shade, reducing ground temperatures, but also trees evapotranspire – that is they release water into the air – which not only reduces urban temperatures but also improves the quality of the microclimate. Water needs to be retained in the landscape in order for evapotranspiration to occur and for the benefits of the urban forest to be maximised. Incorporating water sensitive urban design initiatives is another strategy that can be incorporated into tree planting systems.

Native and Exotic Species

Urban areas are highly contrived and very little of the original landscape – including soil and water conditions – remains. Just because a plant is indigenous to a site does not necessarily mean that the current site conditions are optimal for its growth. Urban soils and other conditions are often very different to the conditions in which both indigenous and exotic trees are found in the wild.

The focus should be on tree species adapted to a site and with acceptable characteristics relative to the desired purpose.

Non-local Australian species, and exotic species, can make positive contributions to the landscape. In some cases, these species are better adapted to the conditions of the highly modified urban environment. They may have positive attributes and are able to fulfil specific landscape functions.

The planting of the wrong choice of species, and planting in inappropriate locations, is an indication of poor planning rather than poor tree selection. In many instances the requirements set out by policy or the brief prevent the selection of suitable site-tolerant species.

Much of the character of the City of Melbourne is created by the presence of iconic exotic trees.

Remnant, indigenous and native vegetation has an important role to play in urban landscapes. It should be noted, however, that the maturity of existing vegetation is impossible to replace and the diversity of natural plant communities is difficult to replicate. Preservation of existing natural and remnant vegetation is the most efficient way to incorporate biodiversity in urban landscapes.

The use of indigenous tree species in streets will have greater impact and benefit when used adjacent to open space that has significant remnant vegetation.

Vulnerability to Pathogens and Pests

Pest and diseases are a component of the urban landscape and the City of Melbourne recognises that control measures will be required at times to maintain healthy and aesthetically pleasing landscapes.

The City of Melbourne will focus on problem prevention through appropriate tree selection, planting and tree maintenance.

When selecting tree species for Melbourne's streets all effort will be made to select species that are known to be pest and disease resistant.

We do not know, however, the extent of pest and disease resistance in many tree species, especially within the urban environment.

Moreover, there will be situations where the existing street tree species may be under threat but their ongoing use is imperative considering the strong landscape character or cultural importance they represent.

It is not possible to select a palette of tree species for urban streets that are immune from potential infestation from pathogens, particularly when some potential threats could impact on entire plant families such as *Myrtaceae* (*Eucalyptus* spp., *Corymbia* spp., *Callistemon* spp., *Melalueca* spp., *Tristaniopsis* spp., and *Lophostemon confertus*).

A number of approaches will help minimise the impact of pests and disease on the urban forest, for instance: constant monitoring of the urban forest and including the involvement of the Department of Primary Industries in that monitoring, ensuring the general health and vitality of urban forest, providing greater diversity, building a database of pest and disease, making sure of hygiene controls during maintenance, and ensuring good communication and working links with bordering councils.

Table 7: Existing pathogens and pests affecting trees within the City of Melbourne

Pathogen	Species Affected	Comment
Armillaria luteobubalina	A soil-borne fungus that causes root rot in a wide variety of plants including many native plants and introduced ornamental plants.	At present there is no one simple method for controlling *Armillaria*. A combination of sanitation measures, good horticultural management and the addition of organic matter to soils can be expected to retard the activity of *Armillaria*.
Brushtail Possums	A range of native and exotic tree species.	Possums, flying foxes and other native animals are protected species under the *Wildlife Act 1975*. A possum management strategy will be developed to manage the possum population on the particular site.
Elm Leaf Beetle (*Pyrrhalta luteola, Xanthogaleruca luteola* (Müller, 1766))	Most species of *Ulmus*, also *Zelkova serrata*. Chinese Elm (*U. parvifolia*) is relatively resistant.	A range of management options are utilised in the control of Elm Leaf Beetle.
Elm Bark Beetle (*Scolytus multistriatus*)	*Ulmus* spp. particularly English Elm (*U. procera*) and Wych Elm (*U. glabra*).	The Elm Bark Beetle causes no serious damage to elms. However, it is the carrier of Dutch Elm Disease.
Exotic nematodes (microscopic worm like organisms, or eelworms), belonging to the *Aphelenchoididae* Family of nematodes such as *Bursaphelenchus hunanensis*	Pine trees. An infestation by a pathogenic *Aphelenchoididae* species may result in a rapid decline in tree health, with the needles turning yellow to brown and the twigs becoming dry and brittle. Symptoms first appear in late spring/early summer. Dead pines killed by the nematode tend to retain their needles for six to twelve months.	The only available control is removal of the tree and either burning the wood or deep burial well away from other trees, to kill the nematode and any potential vectors. Not known to be an ongoing threat to pines in Victoria.
Fusarium Wilt (*Fusarium oxysporum* f.sp. *canariensis*)	*Phoenix* spp., *Washingtonia filifera*.	Management is dependent upon rapid and accurate diagnosis. Once correctly diagnosed appropriate management can be implemented.
Fig Psyllid (*Mycopsylla fici*)	Periodic defoliation of Moreton Bay Fig trees (*Ficus macrophylla*).	Council will continue to support Fig Psyllid research.
Phytophthora cinnamomi	Causes root rot of a wide variety of plant species including many native plants and introduced plants.	Implement model of national best practice guidelines for management (http://www.environment.gov.au/biodiversity/invasive/publications/p-cinnamomi.html).
Psyllid (*Cardiaspina* spp.)	*Cardiaspina* cause the most damage to eucalypt foliage, especially to *Eucalyptus camaldulensis*.	Outbreaks occur periodically. Most native species of psyllids require no management; even when psyllid populations are abundant, plants can tolerate substantial feeding and psyllid populations will decline naturally. Develop integrated program for badly infested trees; monitor, cultural and chemical (imidacloprid stem or soil inject).

Table 8: Potential pathogens and pests that may affect trees within the City of Melbourne

Pathogen	Species Affected	Comment
Dutch Elm Disease (*Ophiostoma ulmi (Buism.)* Nannf., *Ophiostoma novo-ulmi*)	*Ulmus* spp., Asian elms more resistant.	Need to constantly monitor the elm population and be aware of diseases presence. Implement Dutch Elm Disease Contingency Plan for Australia.
Eucalyptus rust or guava rust (*Puccina psidii*)	A very wide host range in the plant family *Myrtaceae*. The disease is particularly severe on susceptible eucalypt seedlings, cuttings, young trees, coppiced or damaged mature trees.	Highly susceptible trees may be grossly malformed or even killed. Growth rates of infected trees are diminished. It is currently not present in Australia.
Fire Blight (*Erwinia amylovora*)	Causes disease mostly on plants belonging to the *Maloideae* (e.g. apple, pear, cotoneaster, hawthorn, quince and loquat).	Draft Contingency Plan for Fire Blight 1996: the diagnostic protocol is considered to represent best practice for the isolation and identification of *Erwinia amylovora*. Disease present in New Zealand.
Myrtle rust (*Uredo rangelii*)	A very wide host range in the plant family *Myrtaceae*. Myrtle rust produces lesions on young, actively growing leaves and shoots as well as on fruits and sepals. Leaves may become buckled or twisted as a result of infection.	Closely related to Eucalyptus rust. Myrtle rust typically attacks young plants and new growth on established plants. Can be controlled in commercial operations with the use of fungicides.
The Sycamore lace bug, *Corythucha ciliata* (Say)	*Platanus* spp., Planes or Sycamore. The Sycamore Lace Bug feeds on the underside of leaves. This initially causes white stippling, progressing to bronzing, chlorosis and eventually, premature leaf drop. Severe infestation in late summer can cause defoliation.	Can be controlled with trunk injectable imidacloprid. Symptoms worse in drought stressed trees.

Tree Maintenance

Sustainable urban forests require human intervention in order to regenerate and maintain them in a safe and aesthetically pleasing manner. The City of Melbourne maintains trees on Council managed land to fulfil its legislative and management obligations to residents and visitors to the area. The key to maintaining and enhancing the urban forest is ensuring quality tree maintenance. Maintenance work performed on Melbourne's trees aims to manage tree health and enhance the quality of the treed landscape across the city as well as reducing the inherent risks associated with trees in an urban area.

Council undertakes routine maintenance on publicly managed trees to:

- Reduce the risk to public safety.
- Decrease potential damage to property.
- Provide adequate clearances for pedestrians, vehicles, private property and sight lines.
- Provide clearances around services and utility lines.
- Manage tree health.
- To formatively shape young trees.

Regular maintenance also includes activities such as monitoring soil moisture, mulching, decompacting soils, upgrading irrigation and making health assessments.

Maintenance work on trees will also occur in response to unexpected events or emergencies, such as tree or branch failure resulting from severe storms.

Certain trees within the municipality may require specialist maintenance work. Palms also require specific maintenance works and some trees may require specialised tree surgery works.

Australian Standards and known best practice relating to tree management will be implemented and any operation known to be detrimental to long-term tree health is not appropriate.

Tree selection will consider a tree's ability to be pruned in order to meet the above ground site constraints presented by the tree's location. Tree selection will endeavour to utilise tree size and form (shape of the canopy) in order to reduce maintenance requirements.

Tree Litter

All trees will shed litter – leaves, bark, flowers, fruit – at some time during a given growing season. Tree selection will aim to avoid the use of trees that drop excessive litter, particularly fruit, which can cause trip hazards.

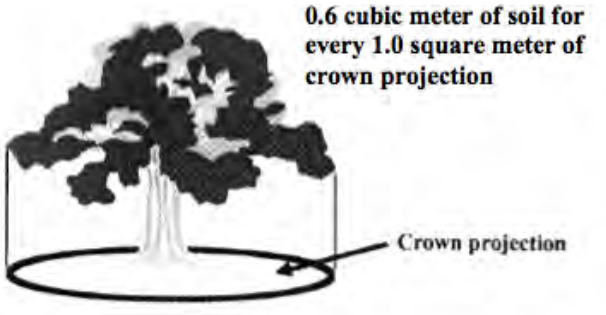


Figure 6: How much soil does a tree need? Diagram adapted from Grabosky, Bassuk & Towbridge (2002).

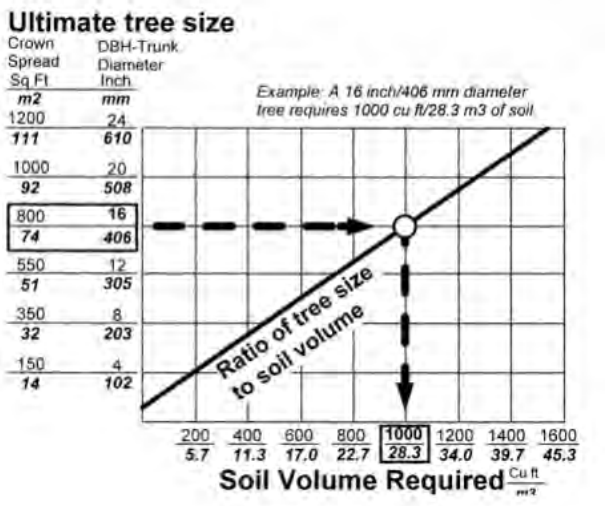


Figure 5: Soil volume and ultimate tree size relationships (Urban, 2008).

Containerisation and Tree Vaults

Containerisation is the practice of growing trees within structures that limit tree root growth to within a constrained volume of soil. It is not horticultural best practice to have street trees in containers and within vaults. This type of planting is not encouraged as it does not allow for long-term and sustainable street tree performance. The limited soil volumes will require either early replacement of trees when they have 'exhausted' their limited resources or intensive maintenance, such as root pruning and soil treatment. Trees in vaults and containers are heavily reliant on supplementary irrigation and effective drainage.

There are instances in the public domain where planting over structures is unavoidable. In these instances containerisation and vaults are unavoidable to allow street tree planting. In these instances maximizing soil volume is imperative. This soil volume needs to be provided in a 'plate' volume not as depth. This is to enable healthy root growth and adequate gaseous exchange. In these scenarios a tree's soil volume may need to be a combination of below and above grade. This can provide urban design opportunities, for example using the raised edge of a container as a strong seating edge. In such instances, it will also be necessary for City of Melbourne's arborists to advise on tree species selection, planting methodology and ongoing maintenance regimes.

Successful urban tree planting depends on the consideration of many features including species selection, site constraints, planting procedure, and post-planting maintenance. One essential site component directly affecting tree growth and performance is open soil area and soil volumes. If trees are expected to continue to maintain high levels of health and vigour (growth performance) post-planting they need to be able to access large volumes of soil as they continue to grow and their need for resources increases.

A plant grown in a container has limited root growth due to the volume of available soil. Crown growth will slow as a result, but not necessarily stop (Watson & Himelick, 1997). The same principal applies to trees planted in urban sites. Trees that have limited root space develop smaller root systems in proportion to canopy growth. This results in water stress that can subsequently predispose the tree to secondary pest and disease problems (Watson & Himelick, 1997).

Soil type, and irrigation are equally important considerations for successful containerisation.

See Appendix 6.

Water

Water stress affects most of the physiological processes involved in plant growth. As well as physical space, air and nutrient availability, a tree's moisture requirements need to be addressed in order to allow it to realise its full potential.

Strategies to maximise plant water availability include:

- Water Sensitive Urban Design (WSUD) initiatives, such as storm water harvest systems.
- Porous and permeable pavements.
- Bioretention basins (smaller areas like kerb outstands) and swales (for larger areas such as centre medians).
- Tree selection focussed on species that can tolerate extended dry periods and exposure to heat and wind.
- Supplementary irrigation systems.

In order to establish and successfully manage a tree in the urban landscape, it is important to have an appreciation of both the peak daily demand and the total amount of water required by the tree (Connellan, 2008). Any applied irrigation must be based on a planned approach with defined landscape outcomes.

Character, Community Values and Urban Design

The City of Melbourne has a long tradition of successful urban street and park characteristics that are highly valued and identifiable by the community.

This character includes the substantial avenues of Elms in Royal Parade, for example, heritage-style plantings within parks such as the Carlton Gardens, and the indigenous woodland of Royal Park.

The developed Master List of Street and Park Trees provides the substantial diversity of trees, and enough scope, to support the objectives of these valued "character streets and parks".

In developing selection criteria for street trees and the main avenue trees in parks, intelligent consideration must be given to both horticultural issues and urban character. While this report is limited to identifying the most appropriate tree species for Melbourne, the final choice of tree species is highly dependant on the existing and desired streetscape or park character and existing heritage controls.

The Precinct Street Tree Master Plans will be the primary documents through which this local character will be explored and balanced with the urban forest diversity needs of the City of Melbourne.

Strategies and Technologies for Improving Tree Growth

There are a number of strategies and technologies that are being investigated by land managers around the globe to improve the performance of urban trees. Some significant approaches are outlined in the table below.

This document has not sought to consider the effect of new tree planting technologies on the appropriate selection of the City's trees. The City of Melbourne's urban forestry principles do not rely on improvements in planting technologies as a determinant of street tree performance. It is however expected that such technologies will only improve and build upon existing street tree performance.

Table 6: Strategies and technologies for improving tree growth

Objective	Technology
Increasing useable soil root volumes to maximise tree growth.	Street kerb extensions and blisters. Use of structural soil tree pits.
Increase opportunities for gaseous exchange of water and oxygen to maximise tree growth.	Use of porous or permeable pavements over structural soil.
Reduce conflicts between tree growth and providing free pedestrian access.	Use of porous or permeable pavements over structural soil.
Enable opportunities for passive irrigation in the street from stormwater drainage.	Use of tree pit kerb inlets.

Other Tree Planting Technologies

- Genetic selection, manipulation and tissue culture.
- Cultural treatments.
- Retrofitted growing systems.
- Structural soils and the use of structural cells.
- Planting site preparation.

Formal Street Tree Trials

Formal street tree trials enable new tree species to be tested and reduce the risk of trees planted within streetscapes failing. There has been little increase in the diversity of street tree species trialing since the formative street tree planting that gained traction with Clement Hodgkinson in the 1860s and with others in the early twentieth century. With the decline in the overall urban forest population and the onset of climate induced challenges, the selection of vigorous new species from around the world is urgent. Factors to consider in such evaluations should include:

- The evaluation of 'trial' trees after growing in street conditions. Can they be upgraded or downgraded? Growing of trial trees can be carried out in conjunction with university research.
- The reason for trees either succeeding or failing can be carefully monitored and recorded to eliminate anecdotal or subjective information. While interactive web pages such as TREENET and AUSTEP can be useful, their inputs cannot be qualified easily.

Trialling will be conducted in small and industrial streets to minimise impacts of any unsuccessful trials.

A Master List of Trial Trees is provided in Appendix 7.

2. Tree Species Selection Criteria

This chapter outlines the selection criteria that have been chosen to identify which tree species are most suitable for the City of Melbourne's diverse types of streets and parks.

2.1 There is No Perfect Tree

Selection criteria was developed to provide a quantitative and qualitative basis for the Master List of Street and Park Trees for the City of Melbourne.

It should be noted that the City of Melbourne has many constraints on, and requirements of, its trees. No one tree can manage these constraints and meet all of these requirements in a perfect way.

There is no one perfect urban tree.

It is also important to understand that there is no one type of urban environment. The urban environment is a varied conglomeration of microclimates and heterogeneous soil conditions. Above ground or below ground site conditions can change dramatically within the space of a few metres.

Consequently, a site analysis of each planting site will aid appropriate tree selection.

Climate change and increases in temperatures will also require consideration when selecting tree species.

The most successful strategy is to match the planting site limitations with the right tree for that site.

Appropriate site assessment and tree selection can have the following benefits:

- Minimised conflict between tree roots and adjacent infrastructure and buildings.
- Reduced incidence of pest and disease outbreaks. This can be achieved through selecting resistant varieties of trees and increasing species diversity through the City.
- Increased plant performance.
- Improved drought survival.
- Increased tree longevity so that tree benefits exceed costs. The benefit of an urban tree is directly proportional to its crown size or volume and longevity in the landscape.
- Reduced maintenance costs, particularly pruning. Pruning requirements can be reduced by selecting smaller trees under powerlines or narrow canopy form for main roads.
- Increased attractiveness of streetscapes, reinforcing the pervading landscape and architectural character.
- Reduced environmental demand – trees that have tolerance of drought and generally do not require additional resource inputs, such as irrigation or fertiliser, in order to perform satisfactorily.

Tree selection will take into account relative plant tolerances and adaptability, and integration into surrounding planting themes.

The basic issues regarding tree selection can be summarised as follows:

- Biological requirements relate to a tree's ability to tolerate urban conditions. The species selected should have high tolerance levels that will allow establishment and sustained growth while producing desired benefits with low management inputs. Biological requirements also relate to available root space to sustain the potential tree size.
- Ecological issues include tree diversity, maintaining and enhancing existing significant areas of native and remnant indigenous vegetation, selecting plants that do not have the potential to become woody weeds that impact on natural systems.
- Functional and spatial issues include the trees' ability to be pruned to provide required clearances, the trees root system and the degree of its impact on adjacent infrastructure, and above ground and below ground restrictions.
- Aesthetic issues consider the ability for trees to enhance the visual or other sensory (for example, olfactory) amenity of a streetscape or area.
- Tree longevity: the longer a tree is allowed to grow in a site the greater the benefits to the landscape and return on initial investment.
- Availability: selected trees will need to be commercially available in the desired numbers and size for planting programs.
- Litter drop: leaves, flowers, fruit and bark can cause maintenance issues and trip hazards.
- Structural integrity: stock should be known to have received appropriate formative treatment whilst in the production nursery.

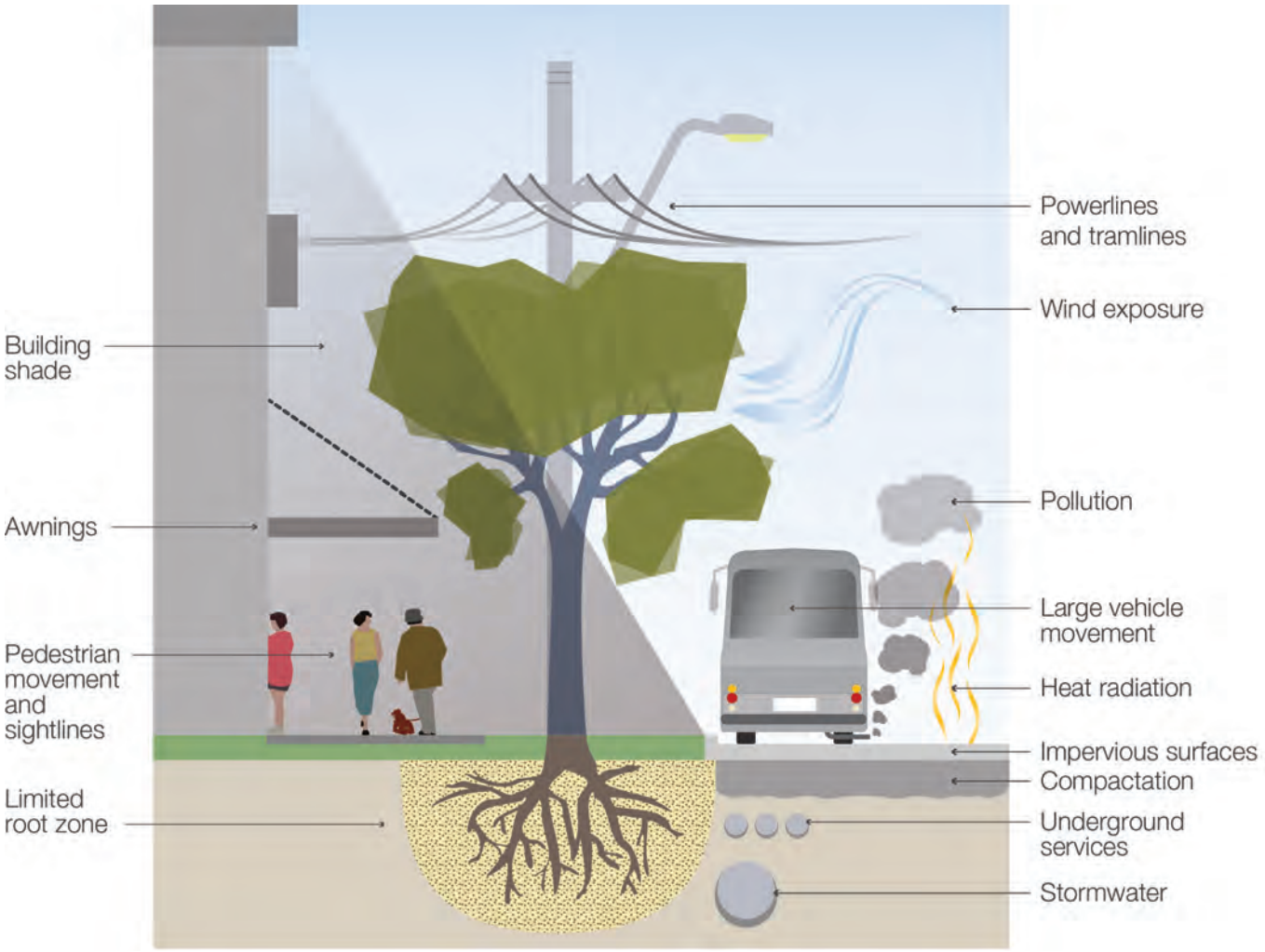


Figure 7: There is no perfect tree. The many constraints a tree must contend with to grow in inner Melbourne.

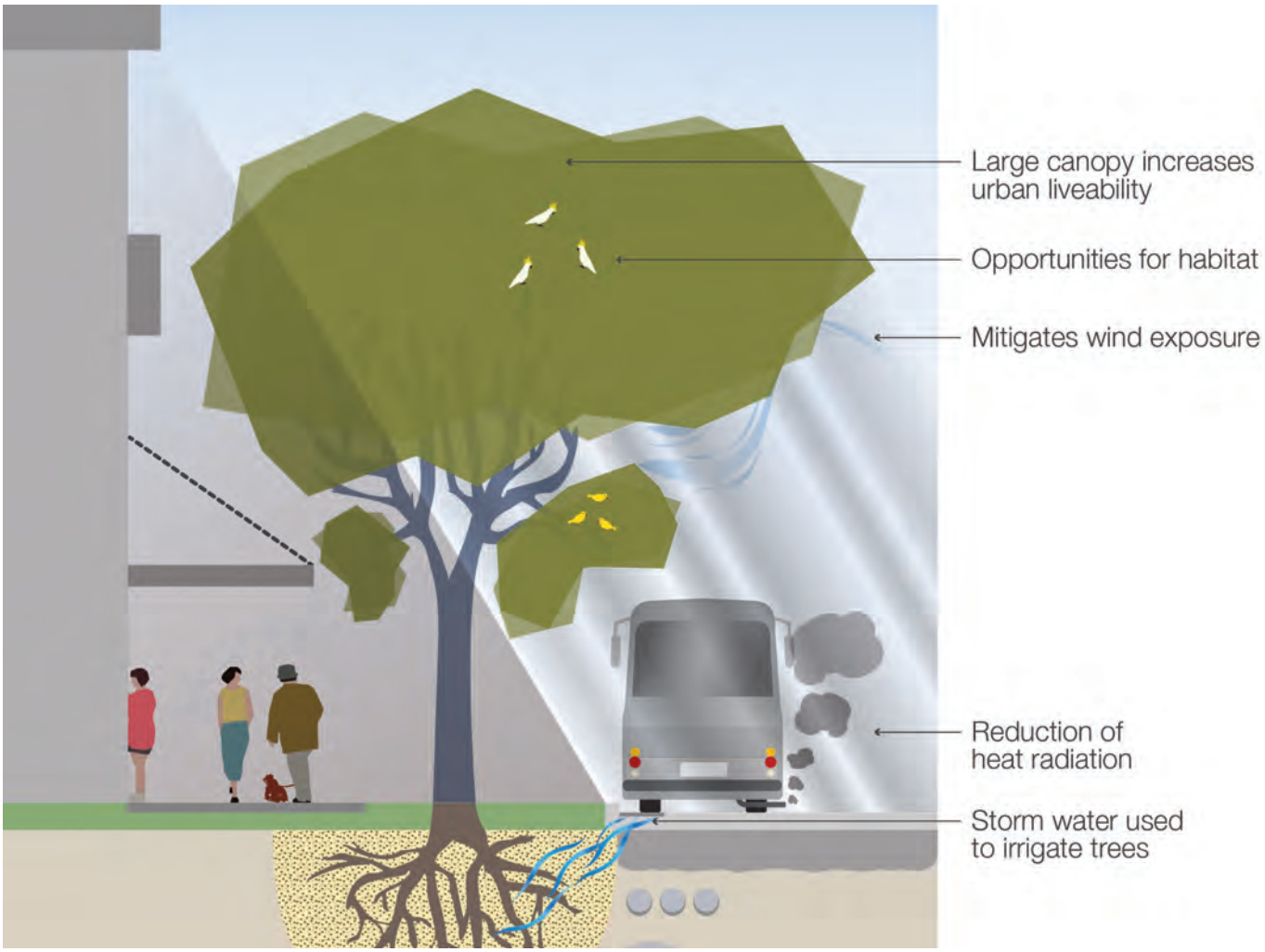


Figure 8: Tree opportunities. The preferred growing conditions and benefits of large canopy street trees.

2.2 Overview of Selection Criteria

The base selection criteria for determining the suitability of a street tree in Melbourne's urban environment and changing climatic conditions are those that affect its ability to adapt to urban conditions.

A broad range of species from varied habitats have been tested against these base selection criteria to ensure the best possible outcome given specific individual site outcomes and constraints.

Ten base selection criteria for adaptability to urban conditions

Ten base selection criteria for adaptability to urban conditions have been identified. They reflect the species' ability to respond to drought, heat, wind and pollution the species' lifespan, pathogen and pest susceptibility and manageability, affect on community health and allergies, the degree and quality of shade cast, maintenance requirements and extent of tree litter produced.

These 10 criteria that affect a species' adaptability to urban conditions are discussed more fully in the following pages.

As an aid to decision making, each species is given an overall numerical score from 1 to 50. This score is derived by assigning a value of 1 (low) to 5 (high) for each of the 10 base criteria.

While there is no such thing as the 'perfect street tree', a score of 50 points represents a highly adaptable and useful species.

The ten criteria were selected after lengthy discussion and review. The number of criteria was not selected as a neat '10'. Further review (in 5 years, or sooner if required) may conclude that the number and nature of these criteria can change. The higher the number of criteria the more accurate the scoring.

The ten identified base criteria are strictly performance or adaptability based.

Species that did not rank well against the ten base selection criteria were removed from the Master List of Street and Park Trees – the list of trees adaptable to urban conditions.

The Master List of Street and Park Trees includes all species that ranked well for being adaptable to urban conditions.

The highest scoring tree for urban adaptability is the Kurrajong (*Brachychiton populneus*).

As a street tree the Kurrajong may not be to everyone's aesthetic tastes or provide the streetscape amenity that other lesser scoring trees can provide.

Moreover, it may not be suitable for many specific locations within the City of Melbourne – for instance in a shady laneway.

Additional criteria are needed to choose a street tree.

Additional criteria

These criteria guide selection of the 'right tree for the right place'. They consider a trees suitability for being grown beneath power lines, in building shade, being pruned to allow vehicular and pedestrian movement, adaptability to waterlogged soils, and tolerance of soil compaction.

These additional criteria are discussed more fully in the following pages.

Location Types

This strategy identifies 13 street location types and 2 park location types within the City of Melbourne.

Each of the 15 Location Types is associated with a set of minimum conditions necessary for the success of a street tree in that environment. Species can be rated for their suitability against each of the 15 Location Types. Tree lists for each of the 15 Location Types can thus be generated.

These species lists for each Location Type can be used by Council in precinct plan applications in which further considerations are then overlaid on this these general and more specific species selection criteria.

The City of Melbourne Street and Park Location Types are discussed more fully in Section 3.

Non-rated Criteria

Additional considerations that may be used to further refine the selection of a street tree include, for example, heritage, biodiversity goals, microclimate goals, aesthetics and character. This strategy does not rate tree species against these criteria.

Park Trees

While most street trees can be grown in parks, the reverse is not always possible. Park trees include species that require greater root volumes than those generally achievable in the streetscape environment, and species of large size.

The list of park trees considered adaptable to urban conditions is different to the list of street trees considered adaptable to urban conditions. Not all of the ten base criteria for adaptability to urban conditions have been applied to determine an appropriate Master List of Park Trees. The criteria for selection do not include pollution tolerance, potential as allergen, and tree litter.

Park trees are generally larger tree species and cultivars suitable for planting in larger open spaces with reduced above and below ground constraints. Trees are generally able to develop natural form.

2.3 The Ten Base Selection Criteria Affecting Adaptability to Urban Conditions

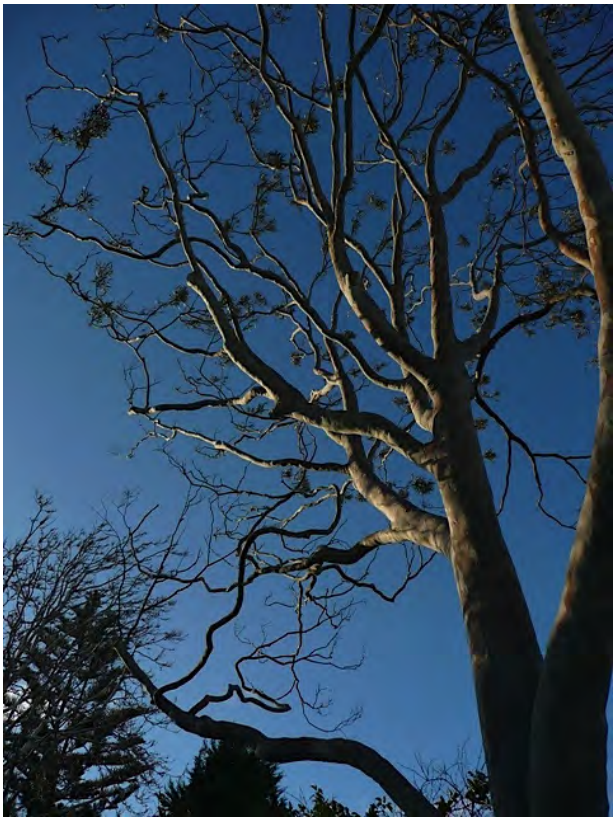
Adaptability to urban conditions is a culmination of various plant tolerances that make a particular species or cultivar more or less suited to planting in urban landscapes, and here specifically the urban landscape of the City of Melbourne.

Each species' adaptability to urban conditions was given an overall numerical score from 1 to 50. This score was derived by assigning a value of 1 (low) to 5 (high) for each of the 10 base criteria.

The ten base criteria are:

- **Drought tolerance**
- **Heat tolerance**
- **Wind tolerance**
- **Longetivity**
- **Pollution tolerance**
- **Pathogen and pest susceptibility and manageability**
- **Potential as allergen**
- **Shade cast**
- **Maintenance required**
- **Tree litter**

Anthracnose infected leaf.



Possum grazing.

Drought Tolerance

Drought tolerance is defined as the ability of a species to withstand extended dry periods. Generally plants that require less water (once they are established) are drought tolerant because they are adapted to regions with frequent drought or to soils with low water-holding capacity.

Value rating:
1 = not tolerant of extended dry periods.
5 = Highly tolerant of extended dry periods

Heat Tolerance

Heat stress can be defined as the rise in temperature beyond a threshold level for a period of time sufficient to cause irreversible damage to plant growth and development. Transitory or constantly high temperatures cause an array of changes to plant growth.

Value rating:
1 = Low = not tolerant of transitory or constantly high temperatures.
5 = High = Highly tolerant of transitory or constantly high temperatures.

Wind Tolerance

Degree to which species/variety is susceptible to limb breakage.

Value rating:
1 = Low tolerance to wind loads and generally resistant to limb breakage.
3 = Moderate tolerance to wind loads and generally resistant to limb breakage.
5 = High tolerance to wind loads and generally resistant to limb breakage.

Longevity

Expected life span that a tree species can be retained in a safe and aesthetically pleasing manner in the situation (providing site conditions remain unchanged). Most urban trees have reduced life spans compared to those found in natural habitats.

Value rating:
1 = short lived (< 50 years).
2 = Moderate life span (50-100 years).
3 = Moderate to long-lived species (100-150 years).
what about 5?
4 = Long-lived species (> 150 years).

Pollution Tolerance

Air pollutants can harm trees by two means; by being absorbed as chemical contaminants through stomata, and by being absorbed as dust and particulate matter on the surface of the leaf. Virtually all of the pollutants to trees are airborne, and include fluorides, oxidants, sulfur dioxide and carbon monoxide. Sunlight reacts with oxidants to form tree pollutants, like ozone and PAN (peroxyl acetyl nitrate). The effects of pollutants on trees can cause the tree to weaken and die.

The tolerance of species to pollution is largely related to their avoidance (or not) of uptake of pollutants by the leaves or in a biochemical tolerance of pollutants. Some plants can metabolize pollutants into less toxic substances. There is enormous variability between species as to their tolerance to pollution.

Pollution ratings are primarily based on referenced literature and experience.

Value rating:
5 = High = Highly tolerant of pollution
3 = Moderate = Moderately tolerant of pollution
1 = Low = poorly tolerant of pollution).

Heat stress.

Plastic bags trapped by tree branches: visual pollution.

Pathogen and Pest Susceptibility and Manageability

This rating considers a particular species susceptibility to pests and pathogens. Major pests currently requiring management input are listed in Table 7. Potential pathogens that currently are not present but could impact on species have also been listed (see Table 8).

Value rating:
1 = High susceptibility to pathogens or pests, with control difficult.
5 = Low susceptibility to pathogens and pests, and control easy.

Potential as Allergen

Of the 50,000 different kinds of trees, less than 100 have been shown to cause allergies. Most allergies are specific to one type of tree or to the male cultivar of certain trees. The degree of allergic reaction, and the physical origin of the allergen (for instance, sap) known to cause allergic reaction, are indicated on the tree matrix.

Value rating:
1 = High potential as an allergen.
5 = Low potential as an allergen.

Shade Cast

This rating represents a qualitative estimate of the degree of shade cast projected by a tree. This rating also considers the form of the tree, for instance a broad tree will cast greater shade compared to a fastigiate tree.

Value rating:
1 = low shade cast.
2 = Moderate to low shade cast.
3 = Moderate shade cast.
4 = Moderate to high shade cast.
5 = Heavy shade cast.

Maintenance Required

This rating assumes typical pruning maintenance works such as pruning for sight clearances and clearance of powerlines. Maintenance activities are generally higher in a younger tree in order to attain the form to suit site constraints. This rating also indicates any specific maintenance requirements that may be required.

Levels:
5 = Low – Due to size or growth habit of the plant the degree of maintenance required would be less than the perceived maintenance inputs.
3 = Moderate – Typical assumes current cyclic pruning programs to meet site constraints, risk management and legislative requirements.
1 = High – Expected maintenance levels are higher than current maintenance standards, representing greater potential impacts with infrastructure or additional seasonal requirements.


Moderate to Heavy Shade: Eg. *Ulmus procera*


Moderate Shade: Eg. *Melia azaderach* and *Celtis australis*


Moderate to Light Shade: Eg. *Angophora costata*


Light Shade: Eg. *Corymbia citriodora*


Heavy Shade: Eg. *Ficus microcarpa* 'Hillii' and Waterhousia

Tree Litter

All trees will shed litter, leaves, bark, flowers or fruit at some time during a given growing season. As far as is possible the tree selections generally do not drop excessive litter. There are exceptions however, such as Magenta Brush Cherry, as these trees have other characteristics which make them suitable for certain planting situations.

Where excessive litter is a known for a particular species or cultivar, it has been noted on the tree matrix.

Value rating:
1 = Produces a considerable amount of troublesome litter.
5 = produces little troublesome litter.

2.4 Additional Criteria

Street type criteria are a further set of criteria that determine the tree selection for a specific type of street. Various types of street have specific affects on light availability, or restrictions such as the presence of overhead powerlines. These criteria guide selection of the 'right tree for the right place'.

Shade Tolerance

Most tree species require full sun. There are some species that will tolerate lower light levels of part shade. There are no species selected in the matrix that tolerate full shade (less than 6 hours of filtered sunlight per day).

Categories:
Full sun – More than 6 hours of direct sunlight.
Full sun to part-shade – Either more than 6 hours of direct sunlight a day or filtered light for most of the day. (These species would be more suitable for streets that have low direct sun through a day.

Power Lines

Tree species were rated as being suitable for planting under power lines without pruning, with pruning (if specifically known, for instance Smooth-barked Apple (*Angophora costata*), or not suitable.

Soil Compaction Tolerance

Tree species were rated for their ability to withstand the highly compacted soils that often occur in the urban environment.

Waterlogged Soil Tolerance

Trees that can tolerate waterlogged soils are particularly useful for WSUD applications. Soils temporarily inundated with water lead to poor aeration. Species tolerant of waterlogged soils are often also tolerant of compacted soil conditions.

Value rating:
1 = not tolerant of periodic inundation.
3 = Moderate tolerance of periodic inundation.
5 = Highly tolerant of periodic inundation (and of low oxygen in soils).

Prunability for Vehicle Clearance

Trees often need to be pruned to allow clear passage of adjacent vehicular traffic.

Trees in laneway that must withstand heavy shade

Trees pruned heavily around power lines

Small, Medium and Large Planting Sites

Small, medium and large sites relate to the size of the potential tree planting sites. Note that a smaller site could sustain a larger tree species if the site and soils (planting system) were modified to allow a larger tree size.

Table 10 provides general guidelines for planting site sizes.

Table 9: Planting site size and dimensions and maximum tree size at maturity (adapted from Gilman, 1997)

Planting site	Total planting area (lawn, island, or soil strip)	Planting strip width	Distance from trunk to pavement or wall	Maximum tree size at maturity
Small	Less than 9.5m2	1.0m to 1.3m	0.6m	Small (less than 9m tall)
Medium	9.5m2 to 18.5m2	1.3m to 2.5m	1.2m	Medium (less than 15m tall)
Large	More than 18.5m2	> 2.5m	> 1.5m	Large (taller than 15m)

3. Tree Planting in Melbourne

This chapter identifies the typical tree growing conditions across the types of street and park environment in Melbourne, with a focus on street trees and streetscapes.

3.1 Introduction

The streets of Melbourne support a robust urban forest of approximately 22,800 trees. The streets have been planned with the intention of trees being an integral component. The street geometries of Melbourne have traditionally allowed for relatively generous growing areas. During the 1860s when Melbourne rapidly expanded, boulevards, wide medians and verges within the city areas and the main thoroughfares into the city were intentionally set out to allow tree planting to contribute to the streetscape character. Surveyor Robert Hoddle, at odds with Governor King, managed to ensure that every second north-south street be 95 feet (28.96m) wide.

The north-south and east-west grid has allowed strong linear avenue planting of consistent species that gives Melbourne a particular character not achieved in other Australian capitals.

There have been a number of spikes of diversification of street and park trees in Melbourne's history. These spikes in experimentation were championed by a number of motivated directors of the Royal Botanic Gardens and landscape designers. In most of these instances a desire for botanical experimentation and trialing resulted in higher species diversity. Trees that were grown in the parks were used in the streetscapes. Curious botanists like Ferdinand von Mueller experimented with a number of conifers from around the world. With climatic change and more extreme weather events expected in Melbourne, it is interesting to note how well conifers are adapted to such extremes.

In the 1920s and 1930s there was experimentation with Australian rainforest species and myrtaceous species. Deciduous trees were also extensively planted, including many of the Elms currently part of the urban forest. This period of planting has contributed to many of the mature trees that are now in decline within the city and parks. During the 1970s the resurgence of interest in native and endemic plants contributed greater species diversity to the streetscape. Ironically, some of the earlier plantings of *Melaleucas* were also condemned in the same period, blamed for infrastructure damage. Retrospectively, the damage that these smaller *Melaleucas* have caused is in dispute. This strategy recommends that some *Melaleucas* species continue contributing to the urban forest.

Platanus x *acerifolia* is a tree species that is fast growing, deciduous, and adaptable, and has been perceived as close to being the 'perfect street tree'. As a consequence huge numbers of Plane trees were planted in Melbourne in the 1980s and 1990s in Melbourne and across the globe in temperate climate cities.

The risk of creating an urban forest monoculture is becoming apparent in Melbourne with increasingly frequent

droughts. In Sydney, the combination of Sycamore Lacebug and *anthracnose* infestation results in the uban forest of Plane tress developing a distinct khaki haze in February-April. It is as characteristic a seasonal event as the November purple haze of the Jacarandas in the suburbs.

The City of Melbourne Urban Forest Strategy and Urban Forest Diversity Guidelines aim to create another spike of diversification and trialing in the history of Melbourne's park and street trees.

Central Activity District (CAD), Mixed Use, and Commercial Streets

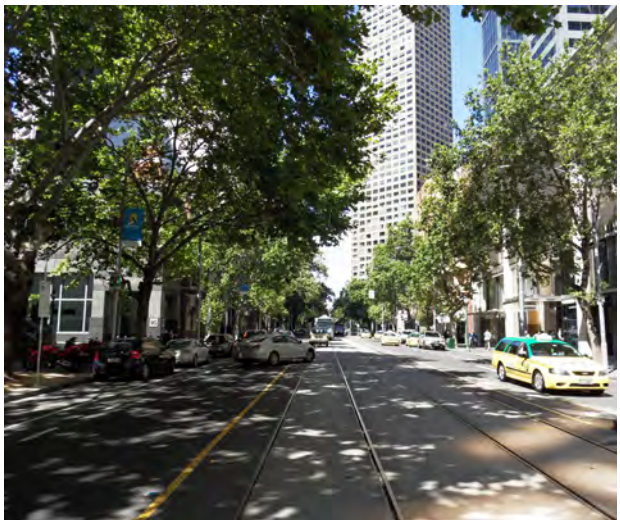
The city streets and boulevards, surveyed by Hoddle, have space for growing street trees. As development has increased post World War Two there is greater pressure for space in the street. Space for advertising, and increase in the amount of services conduits and car parking, have created greater competition with tree growing space. An increase in building height has also resulted in longer periods of overshadowing, and increased building density has produced hotter microclimates.

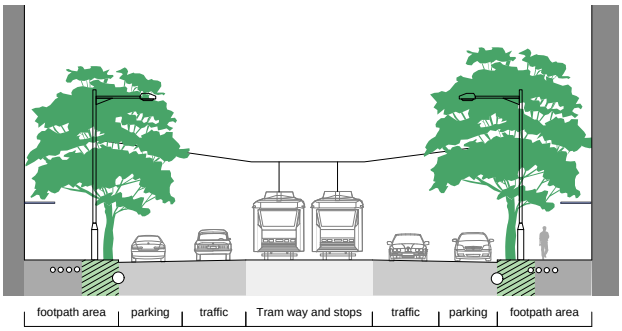
Generally, medians where they exist provide more space for growing trees in than the street's verges. Verge trees compete more for space than median trees, and so verge trees are more in conflict with human needs. Fortunately most of the overhead powerlines have been undergrounded, and while such undergrounding can cause restrictions to root growth area, it has eliminated canopy conflicts and so the potential for large trees is maintained.

The laneways are very narrow, and it is generally agreed that tree planting opportunities in these environments are limited due to space restrictions, low light, conflict with access requirements and commercial uses. Certain opportunities may still occur and the right tree species for the site will need close scrutiny.

Unfortunately, it is the trees in verges that are the most important for creating street tree amenity and shade. The north-south wide streets are congenial to large street tree planting, the east west streets and narrow streets have greater challenges, such as overshadowing and limited space. There are increasingly more opportunities for street tree planting as urban designers, politicians and Council planners are now prepared to change the internal geometries of streets to make them both more liveable and allow new opportunities for tree planting. Greater street tree diversity enables trees to be selected that can adapt to a variety of growing conditions, constraints and opportunities.

Refer to Chapter 4 for fact sheet on each Location Type.





Residential Streets

The residential streets of the City of Melbourne have huge potential for species diversification.

While more overhead services exist, particularly Optus cables, and in some instances the verges are narrower, the conditions for growing street trees in general provide greater opportunities than in the CAD.

Many residential streets have wide verges with no power lines, and have traffic calming 'blisters', parking lanes with lower frequency usage, little soil compaction from pedestrian traffic, and good solar access year round.

Medians are well populated with trees, but there is considerable potential for verge street tree diversification and better tree growth generally.

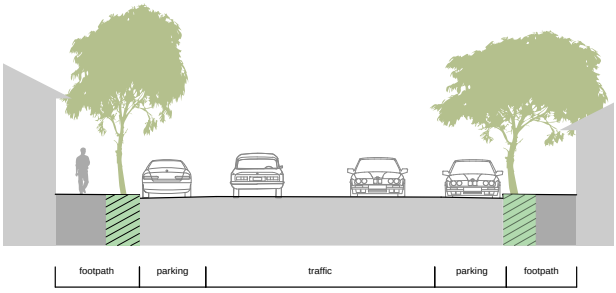
As with the city streets and boulevards, it is the street verges that are the most inhabited, so ideally this is where tree canopy cover should be located.

Residential streets provide a range of street conditions and types. The street geometry and width, overhead services or not, aspect, building awnings, access to adjacent soil volumes, parking arrangements, precinct character, water sensitive urban design opportunities, the age of the suburb, and streetscape design provide a multitude of scenarios.

Consequently, a large selection of tree species is required to reflect this broad range of planting situations.

Shorter streets and more diverse streetscape characters both enable and suit a finer grain of species implementation than is possible within the CAD.

Refer to Chapter 4 for fact sheet on each Location Type.



Park Types

The parks of Melbourne have a strong 'Victorian' era character that defines the city. The parks were opportunities for trialling Australian species, new species from other Botanical gardens, and recently discovered species from plant hunting expeditions. Fashions, environmental awareness, heritage, architectural styles and aesthetics have also influenced the composition of the City's tree species population.

In marked contrast to these 'Victorian' parks, parks such as Royal Park have a character with greater emphasis on ecological goals, habitat provision, preservation of the remnant vegetation, and a celebration of space.

Refer to Chapter 4 for fact sheet on each Location Type.

4. Choosing the Right Tree

This chapter identifies the process for selecting the most appropriate tree species for a particular location.

4.1 Introduction

To successfully choose a street tree it is necessary to determine the type of location in which the tree is to be grown.

The right choice of species for a street tree will depend on a number of factors. Consideration needs to be given to:

- Zoning: whether the tree is in a residential area or the CAD.
- The street's form and use: Is the street wide or narrow, does it have powerlines? What type of vehicles use the street?
- The location within the street: Is the tree on the street's edge or does the street have a median in which the tree is to be positioned.
- Desired qualities: How much maintenance can be provided? How long-lived is the desired tree? How drought tolerant should the tree be? Pollution tolerant? How much shade is to be provided by the tree?

As discussed in Section 3, this strategy identifies 13 street location types and 2 park location types within the City of Melbourne.

Each of the 15 Location Types is associated with a set of minimum conditions necessary for the success of a tree in that environment.

For instance, the criteria for a tree in the wide verge of a CAD street are: canopy > 8m, height > 10m, shade rating > 2, pollution rating > 2, no overhead powerlines.

Species have been rated for their suitability against each of the 15 Location Types.

Tree lists for each Location Type can be found in the following pages.

These species lists for each Location Type can be used by Council in precinct plan applications in which further considerations are then overlaid on this these general and more specific species selection criteria.

The choice of tree can then be refined by considering additional criteria such as heritage and neighbourhood character.

Step 1 — Use the diagram on the following page to determine which of the 13 Street and 2 Park Location Types best describes the location.

Step 2 — Look up the list of species appropriate to location

Step 3 — Consider additional criteria that might refine the species selection, for instance heritage or neighbourhood character

Step 4 — Choose from the tree/s species

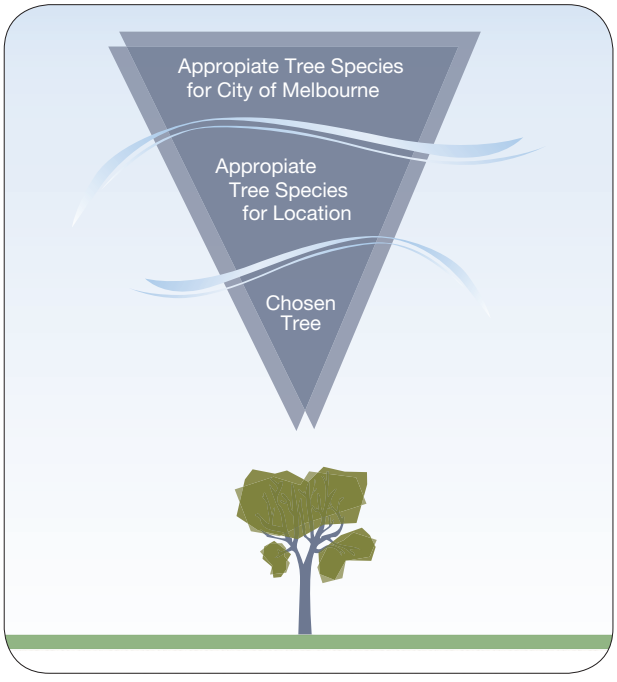
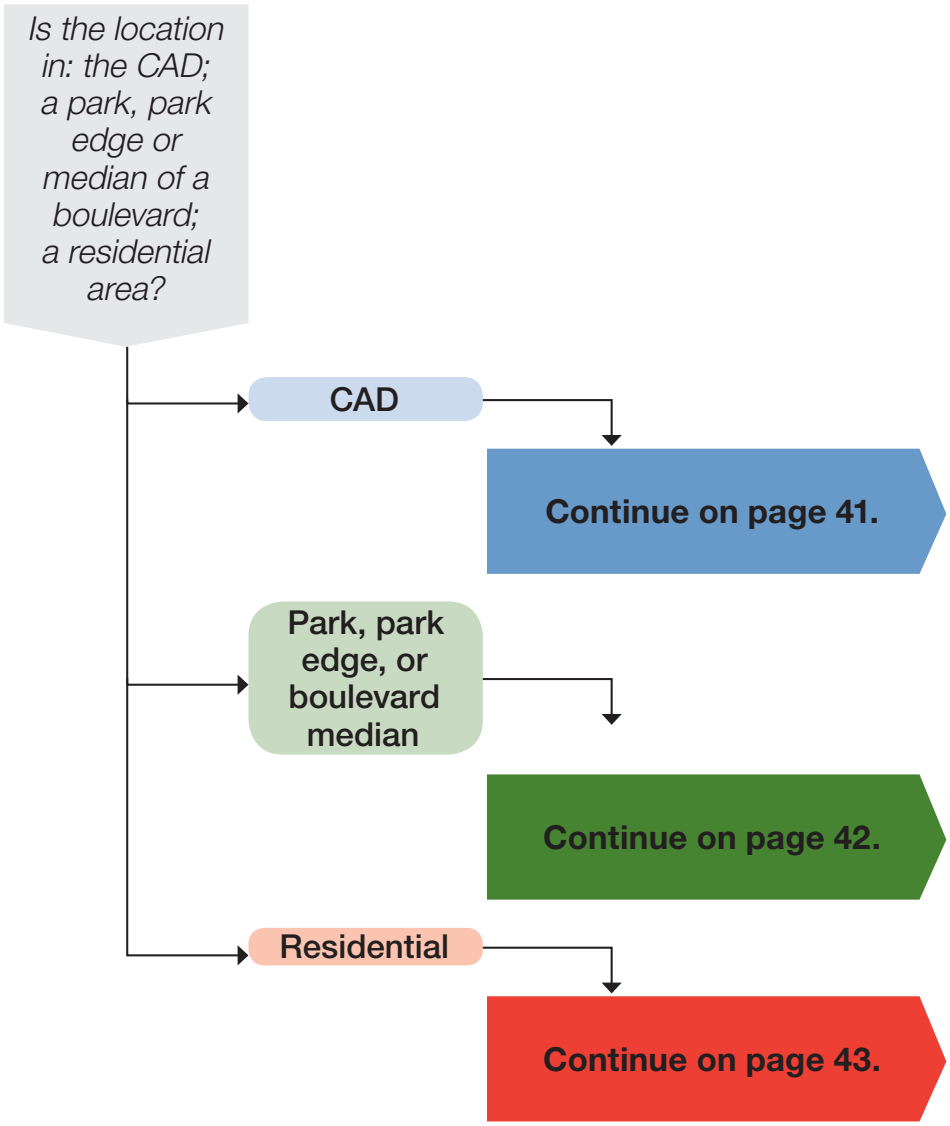


Figure 9: How to choose the right tree for the right location.

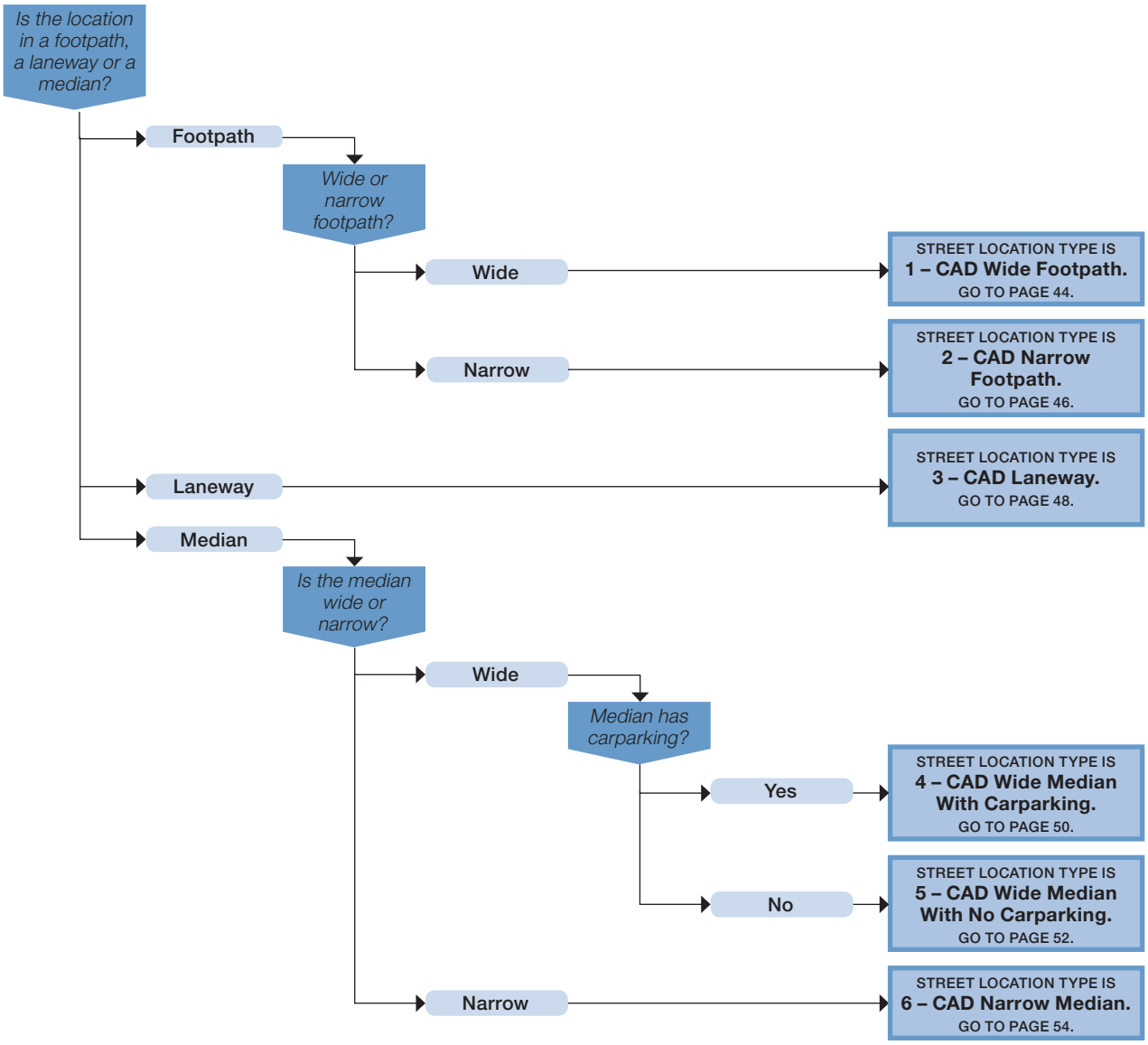
4.2 Determining Location Type

To determine the type of location in which the tree is to be grown, follow the diagram on this page and over the following 3 pages.

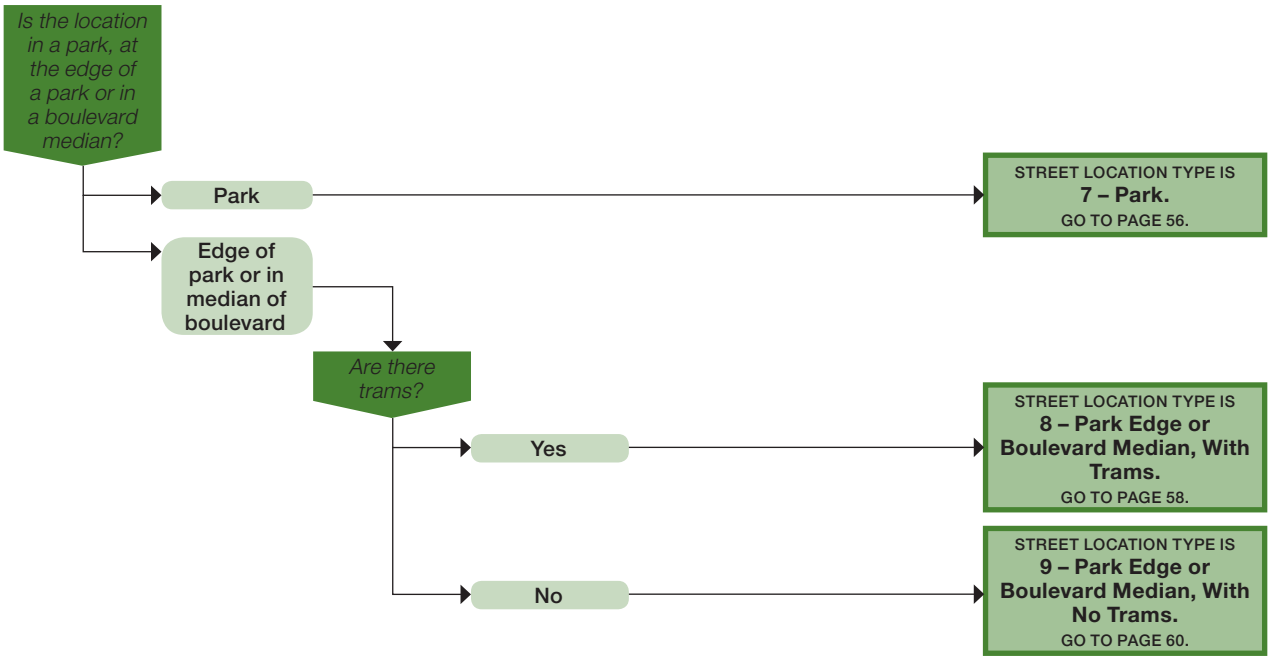
Zoning of Street or Park Location



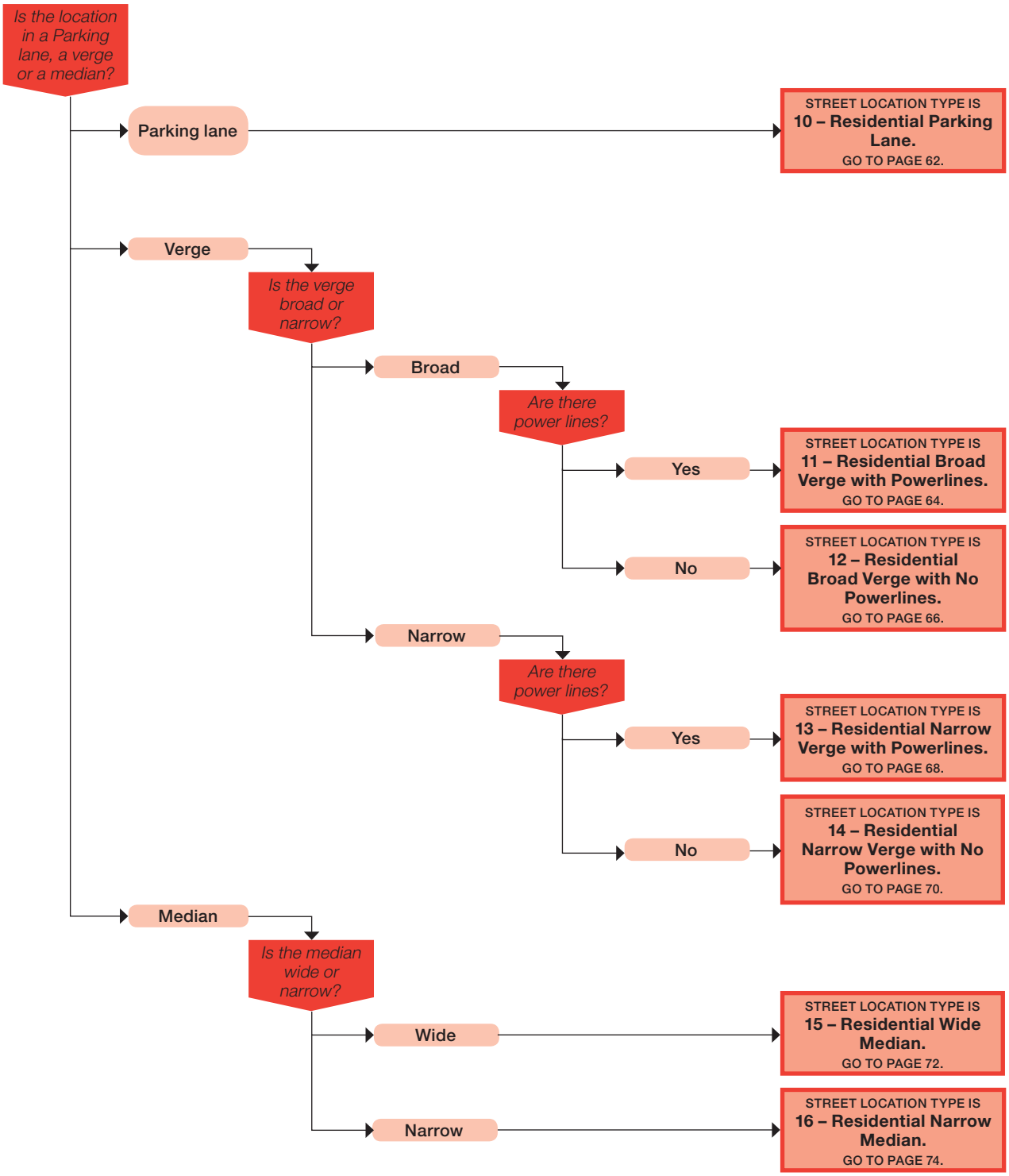
CAD Street Type Location



Park, Park Edge, or Boulevard Median Type Location

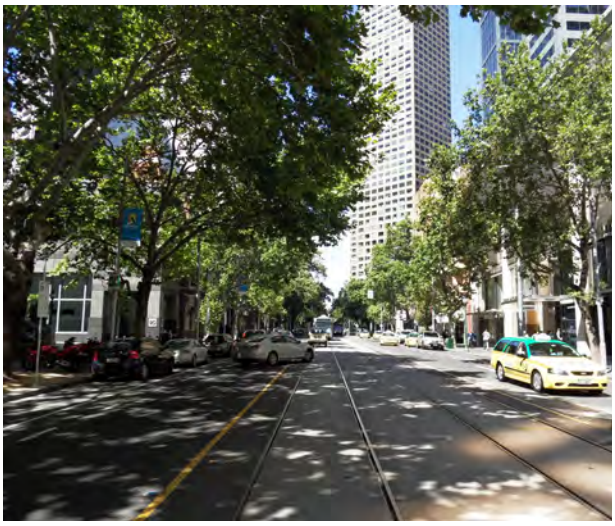


Residential Street Type Location



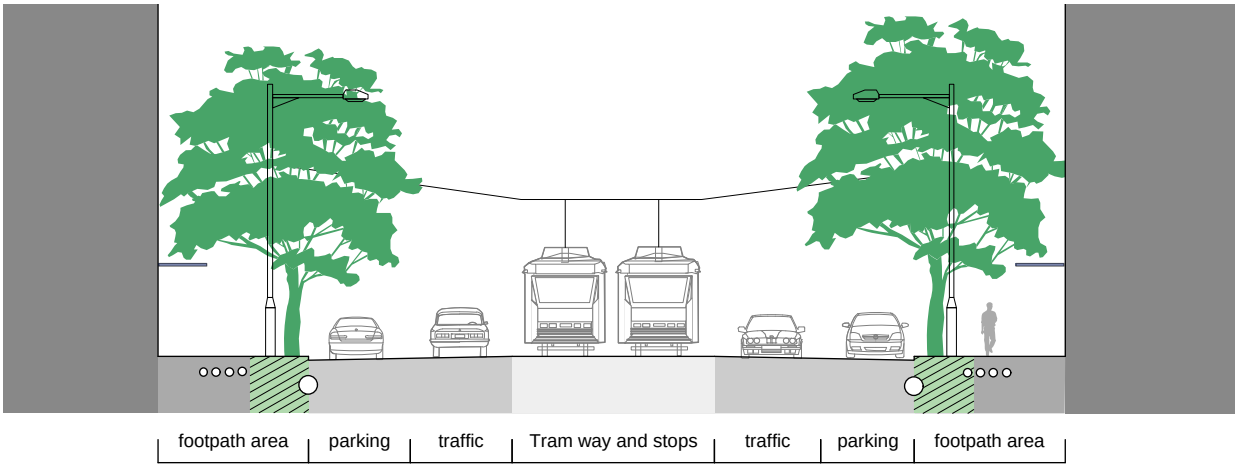
4.3 Location Types and Tree Selection Lists

Location Type 1 – CAD Wide Footpath

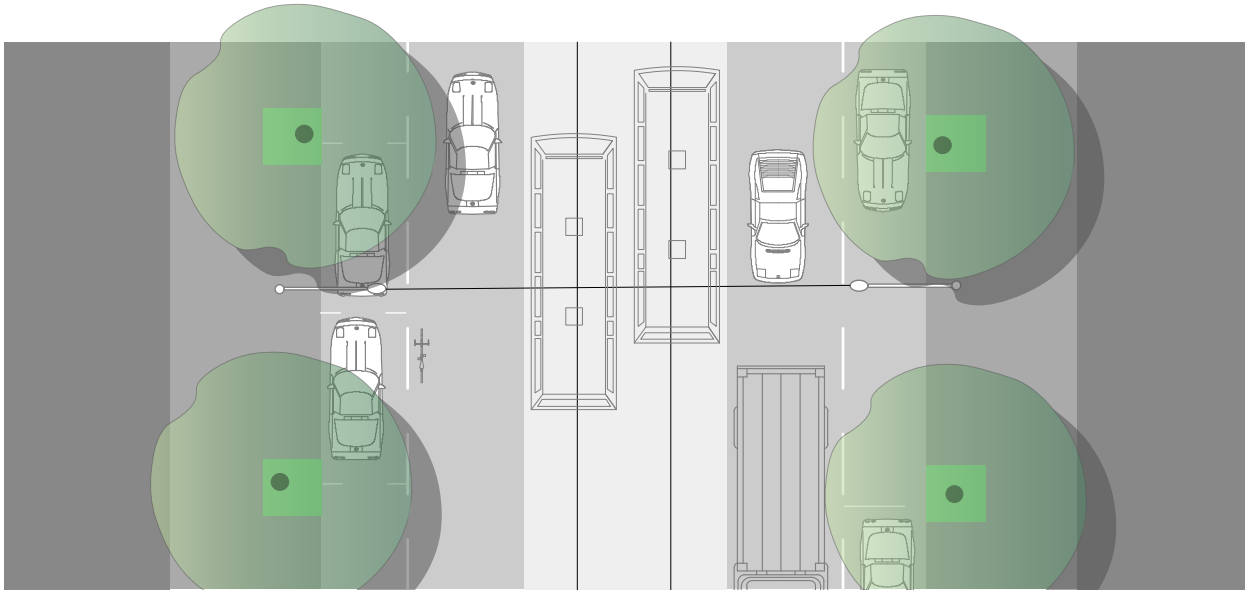


Description of Key Characteristics

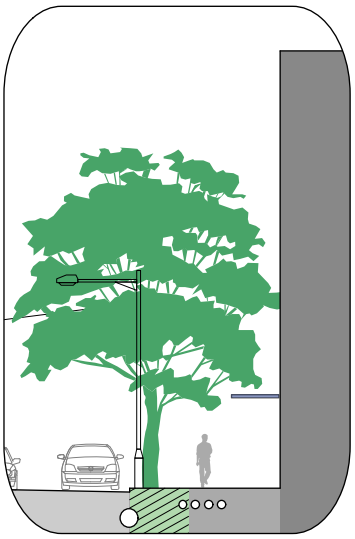
Street Width	30 metres
Traffic Lanes	2 lanes with central tramway, and bike lanes. Predominantly running east/west
Overhead	Powerlines, tram cabling
Buildings	High, awnings
Parking	Parallel kerbside
Road centre	Tramway
Pathways	5.4 metre footpath
Trees	Kerb edge avenue
Examples	Collins Street, Bourke Street



Typical Section



Typical Plan



Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy > 8m
Height > 10m
Shade rating >2
Pollution rating >2
No powerlines

Street Tree Considerations

Requires formative pruning
Minimum height clearance of 4.6 m on road
Minimum height clearance of 2.5 m on footpath
Requires shade rating greater than 3
Requires high maintenance
Low litter drop

Successful Tree Application

Problematic Tree Application

Recommended Trees

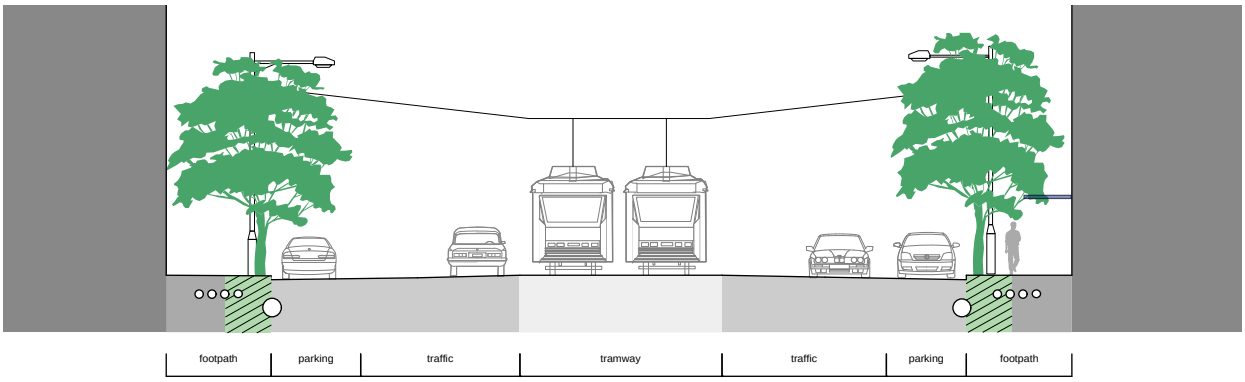
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Allocasuarina torulosa
Angophora costata
Angophora floribunda
Araucaria cunninghamii
Araucaria heterophylla
Banksia integrifolia subsp. integrifolia
Banksia serrata
Casuarina cunninghamiana
Cedrus atlantica
Cedrus deodara
Celtis australis
Celtis occidentalis
Corymbia maculata
Cupressus glabra (syn. C. arizonica)
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus leucoxylon
Eucalyptus melliodora
Eucalyptus polyanthemos
Eucalyptus scoparia
Eucalyptus sideroxylon
Ficus macrophylla
Ficus microcarpa var. hillii
Fraxinus excelsior 'Aurea'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Ginkgo biloba
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Metasequoia glyptostroboides
Paulownia tomentosa
Pinus canariensis
Pinus halepensis
Pinus patula
Pinus pinaster
Pinus pinea
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus canariensis
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Syzygium paniculatum
Taxodium distichum
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Ulmus x hollandica
Waterhousea floribunda
Zelkova serrata 'Green Vase'

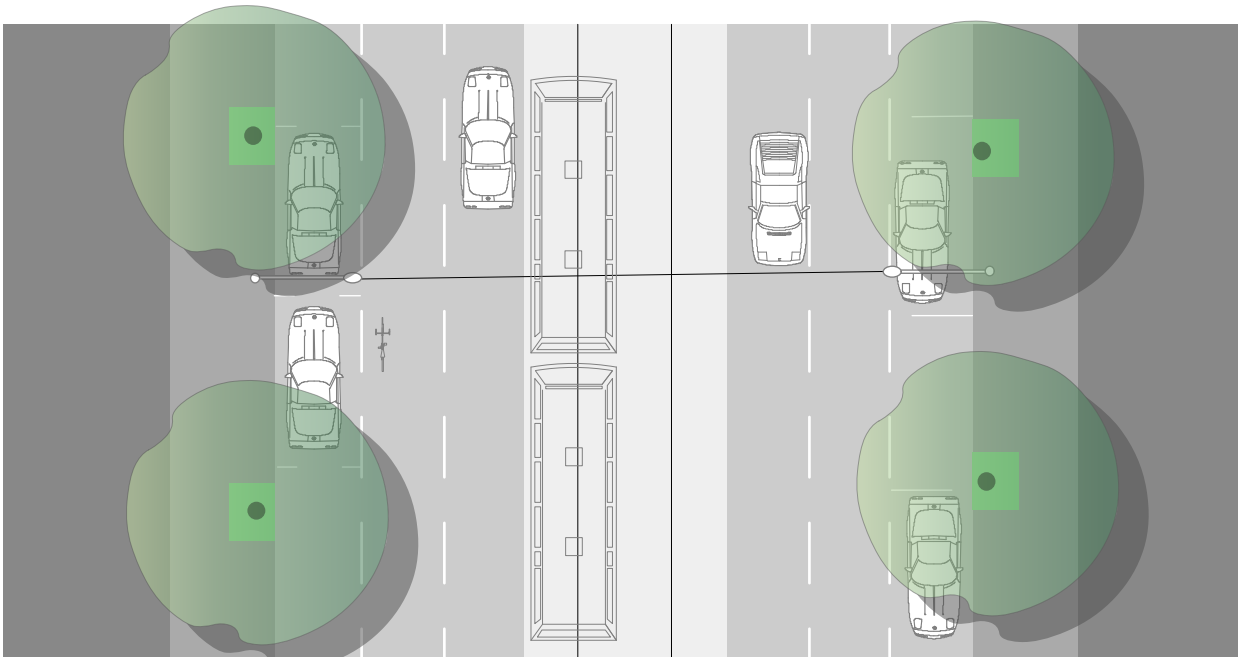
Location Type 2 – CAD Narrow Footpath

Description of Key Characteristics

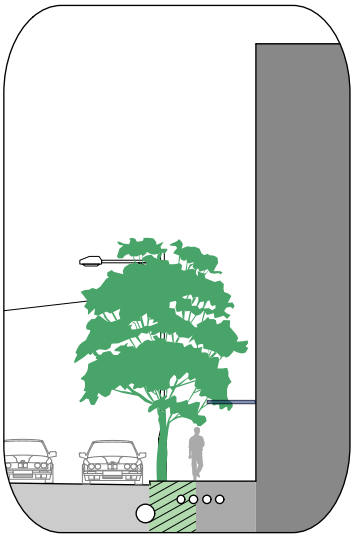
Street Width	30 metre
Traffic Lanes	4 lanes with central tramway, and bike lanes. Predominantly running east/west.
Overhead	Street lights, tram cabling
Buildings	Medium to high buildings at footpath edge
Parking	Parallel kerbside
Road centre	Tramway
Pathways	3.6 metre footpath
Trees	Footpath avenue
Example	Latrobe Street



Typical Section



Typical Plan



Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy < 10m
Height any
Shade rating >2
Pollution rating >2
No powerlines
Litter drop >2

Street Tree Considerations

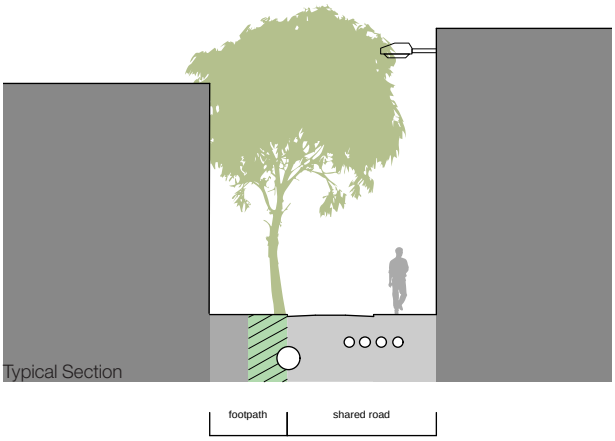
Requires formative pruning
Limited canopy spread 5-12 m (close to buildings/awnings)
Minimum height clearance of 4.6 m on road
Minimum height clearance of 2.5 m on footpath
Requires shade rating greater than 3
Requires high maintenance
Cope with part shade from building
Low litter drop

Recommended Trees

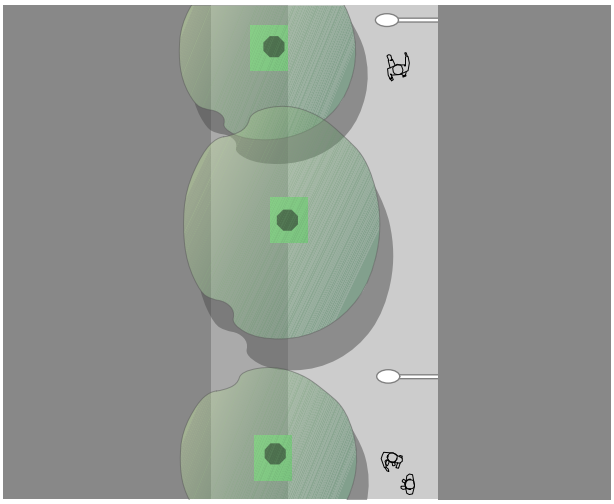
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer buergerianum
Acer campestre 'Elsrijk'
Acer campestre 'Evelyn'
Acer platanoides 'Crimson Sentry'
Acer platanoides 'Globosum'
Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Agonis flexuosa
Allocasuarina littoralis
Allocasuarina verticillata
Brachychiton acerifolius
Brachychiton populneus
Brachychiton rupestris
Brachychiton x roseus
Callistemon 'Harkness'
Callistemon salignus
Callistemon viminalis
Casuarina glauca
Catalpa bignonioides 'Nana'
Celtis occidentalis
Cercis siliquastrum
Cinnamomum camphora
Corymbia ficifolia
Cupaniopsis anachardioides
Cupressus glabra (syn. C. arizonica)
Cupressus sempervirens
Eucalyptus bancroftii
Eucalyptus cosmophylla
Eucalyptus gregsoniana
Eucalyptus leucoxylon dwarf form
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus mannifera subsp. maculosa
Eucalyptus melliodora
Eucalyptus nicholii
Eucalyptus pulchella
Eucalyptus sideroxylon
Eucalyptus spathulata
Eucalyptus stoatei
Ficus microcarpa var. hillii
Ficus platypoda
Ficus rubiginosa
Fraxinus excelsior 'Aurea'
Fraxinus ornus
Fraxinus ornus 'Meczek'
Fraxinus pennsylvanica 'Aerial'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Geijera parviflora
Ginkgo biloba 'Princeton Sentry'
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Lagerstroemia indica x L. fauriei varieties
Leptospermum petersonii
Liquidambar formosana
Lophostemon confertus
Magnolia grandiflora 'Exmouth'
Melia azedarach
Metasequoia glyptostroboides
Phoenix canariensis
Pistacia chinensis
Pyrus calleryana varieties
Quercus robur 'Fastigiata'
Robinia pseudoacacia (Varieties)
Schinus areira
Sophora japonica 'Princeton Upright'
Stenocarpus sinuatus
Syzygium australe 'Pinnacle'
Syzygium paniculatum
Tilia cordata 'Greenspire'
Trachycarpus fortunei
Tristaniopsis laurina
Ulmus parvifolia
Ulmus procera
Ulmus x hollandica
Washingtonia filifera
Washingtonia robusta
Waterhousea floribunda

Location Type 3 – CAD Laneway



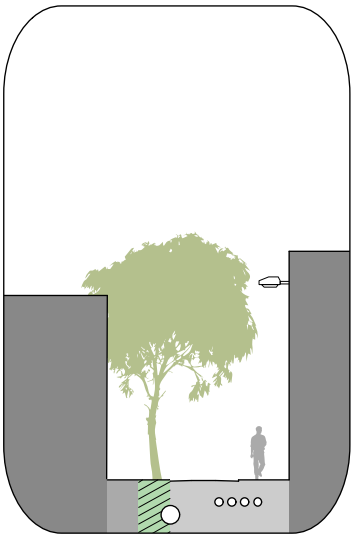
Typical Section



Typical Plan

Description of Key Characteristics

Street Width	6-8 metre
Traffic Lanes	Single lane, often running south/north. Often shared with pedestrians and bike lane
Overhead	
Buildings	Medium to high
Parking	None
Road centre	–
Pathways	1-2 metre footpath, building
Trees	Mostly on single side
Example	Royal Lane, Hardware Lane



Street Tree Considerations

Limited canopy spread 6-8 m
Tolerate shade
Minimum height clearance of 4.6 m

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy < 10m
Height any
Pollution rating >2
No powerlines
Litter drop >2
Building shade tolerance -yes

Recommended Trees

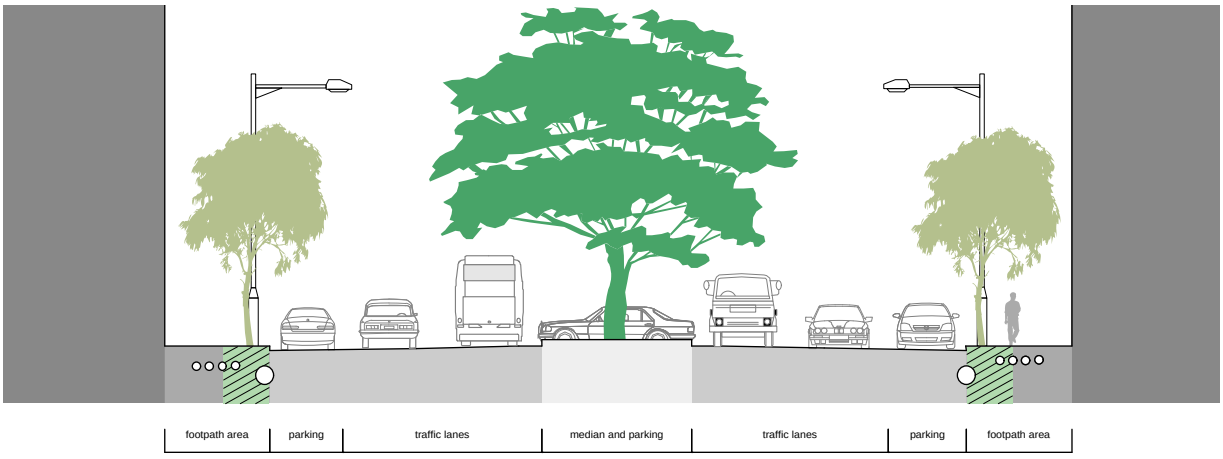
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer campestre 'Elsrijk'
Acer campestre 'Evelyn'
Catalpa bignonioides 'Nana'
Cercis siliquastrum
Cupaniopsis anachardioides
Eucalyptus leucoxylon dwarf form
Ficus rubiginosa
Ginkgo biloba 'Princeton Sentry'
Gleditsia triacanthos var.inermis Varieties
Koelreuteria paniculata
Liquidambar formosana
Magnolia grandiflora 'Exmouth'
Melia azedarach
Robinia pseudoacacia (Varieties)
Sophora japonica 'Princeton Upright'
Syzygium australe 'Pinnacle'
Tilia cordata 'Greenspire'
Trachycarpus fortunei
Washingtonia filifera
Washingtonia robusta

Location Type 4 – CAD Wide Median With Carparking

Description of Key Characteristics

Street Width	30 metre
Traffic Lanes	4 lanes with central median, and bike lanes. Predominantly running north/south
Overhead	Lighting
Buildings	Medium to high. Awnings
Parking	Parallel kerbside. Central median
Road centre	5m median with intermittent parking and trees
Pathways	3.6 metre footpath
Trees	Kerb edge. Central median
Example	Russell Street, Lonsdale Street



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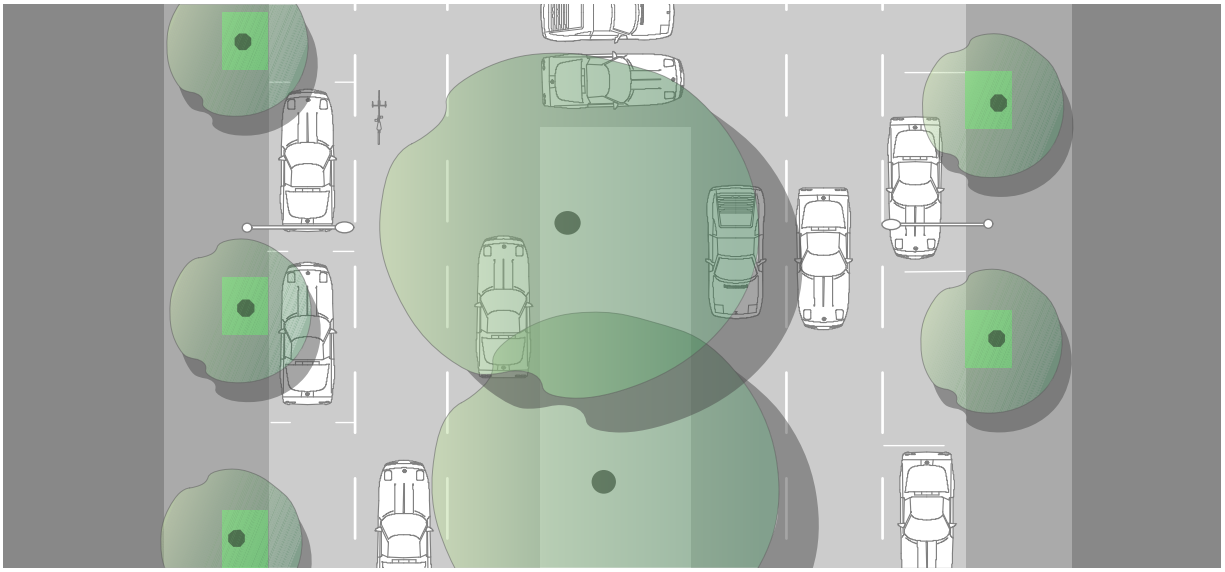
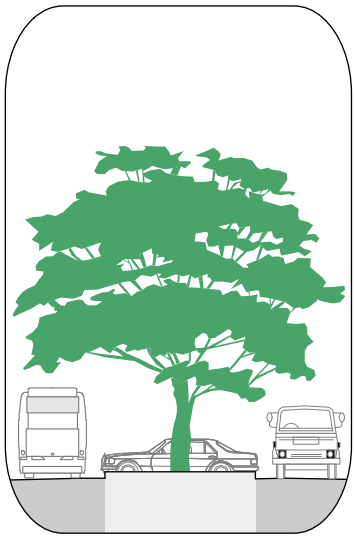


Typical Plan



Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy > 8m
Height > 10m
Shade rating any
Pollution rating >2
No powerlines
Litter drop >2

Street Tree Considerations

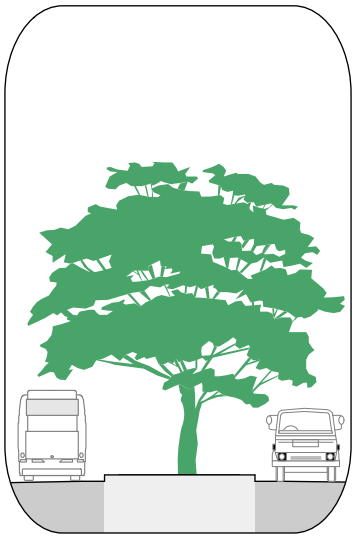
Tolerate full sun
High Crown/ large canopy spread required
Minimum height clearance of 4.6 m
Longevity

Recommended Trees

(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer buergerianum
Acer campestre 'Elsrijk'
Acer platanoides 'Crimson Sentry'
Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Allocasuarina torulosa
Angophora costata
Araucaria cunninghamii
Banksia integrifolia subsp. integrifolia
Brachychiton acerifolius
Brachychiton populneus
Brachychiton x roseus
Casuarina cunninghamiana
Casuarina glauca
Cedrus atlantica
Celtis australis
Celtis occidentalis
Corymbia citriodora
Corymbia maculata
Cupressus glabra (syn. C. arizonica)
Cupressus sempervirens
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus leucoxylon
Eucalyptus mannifera subsp. maculosa
Eucalyptus melliodora
Eucalyptus polyanthemos
Eucalyptus pulchella
Eucalyptus scoparia
Eucalyptus sideroxylon
Ficus microcarpa var. hillii
Ficus platypoda
Ficus rubiginosa
Fraxinus excelsior 'Aurea'
Fraxinus ornus
Fraxinus pennsylvanica 'Aerial'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Geijera parviflora
Jacaranda mimosifolia
Lagerstroemia indica x L. fauriei varieties
Leptospermum petersonii
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Magnolia grandiflora 'Exmouth'
Melia azedarach
Metasequoia glyptostroboides
Olea europea
Paulownia tomentosa
Phoenix canariensis
Pinus canariensis
Pinus halepensis
Pinus patula
Pinus pinaster
Pinus pinea
Pistacia chinensis
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Syzygium paniculatum
Taxodium distichum
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Waterhousea floribunda
Zelkova serrata 'Green Vase'

Location Type 5 – CAD Wide Median With No Carparking



Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy > 8m
Height > 10m
Shade rating >2
Pollution rating >2
No powerlines
Litter drop >2

Street Tree Considerations

Tolerate full sun
High Crown/ large canopy spread required
Minimum height clearance of 4.6 m
Longevity

Recommended Trees

(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Allocasuarina torulosa
Angophora costata
Angophora floribunda
Araucaria cunninghamii
Araucaria heterophylla
Banksia integrifolia subsp. integrifolia
Banksia serrata
Casuarina cunninghamiana
Cedrus atlantica
Cedrus deodara
Celtis australis
Celtis occidentalis
Corymbia maculata
Cupressus glabra (syn. C. arizonica)
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus leucoxylon
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus melliodora
Eucalyptus polyanthemos
Eucalyptus scoparia
Eucalyptus sideroxylon
Ficus macrophylla
Ficus microcarpa var. hillii
Fraxinus excelsior 'Aurea'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Ginkgo biloba
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Metasequoia glyptostroboides
Paulownia tomentosa
Pinus canariensis
Pinus halepensis
Pinus patula
Pinus pinaster
Pinus pinea
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus canariensis
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Syzygium paniculatum
Taxodium distichum
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Ulmus x hollandica
Waterhousea floribunda
Zelkova serrata 'Green Vase'

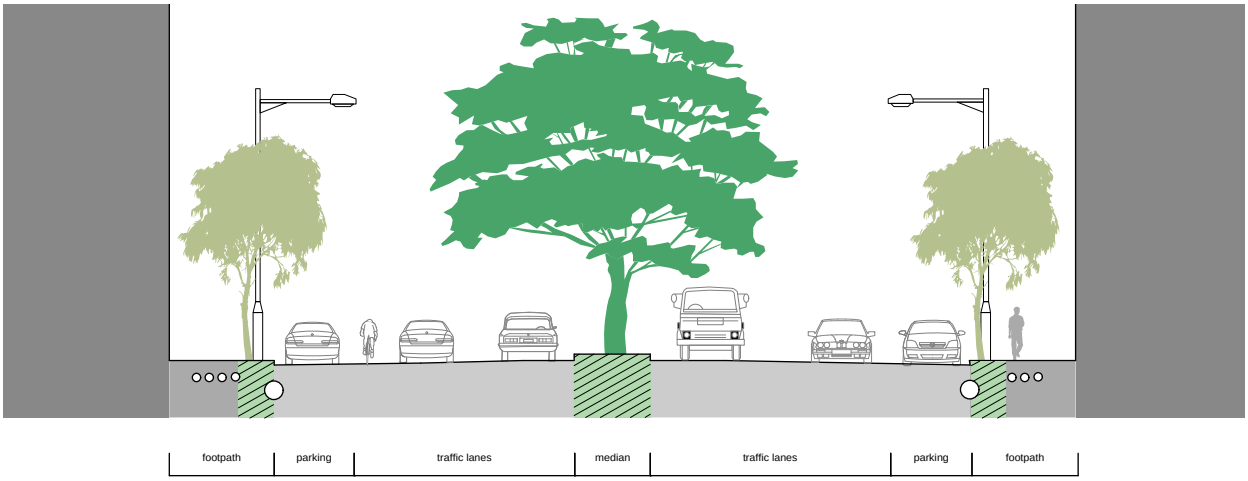
Successful Tree Application

Problematic Tree Application

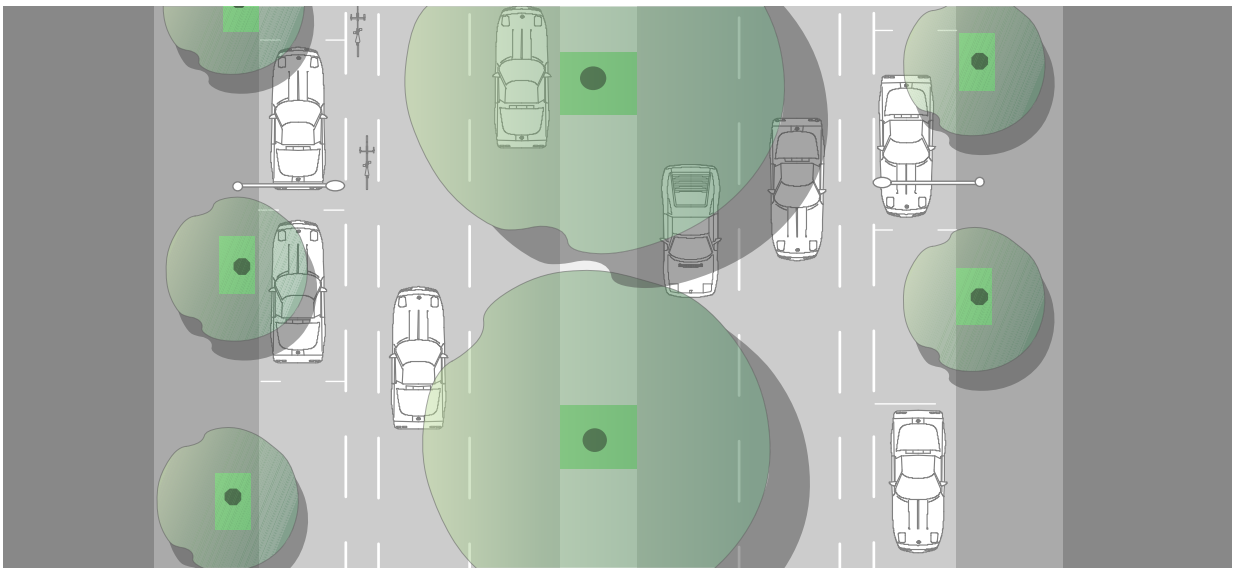
Location Type 6 – CAD Narrow Median

Description of Key Characteristics

Street Width	30 metre
Traffic Lanes	4 lanes with central median, and bike lanes. Predominantly running north/south.
Overhead	Lighting
Buildings	Medium to high. Awnings
Parking	Parallel kerbside
Road centre	2.5m planted median
Pathways	3.6 metre footpath
Trees	Kerb edge and central median
Example	King Street



Typical Section



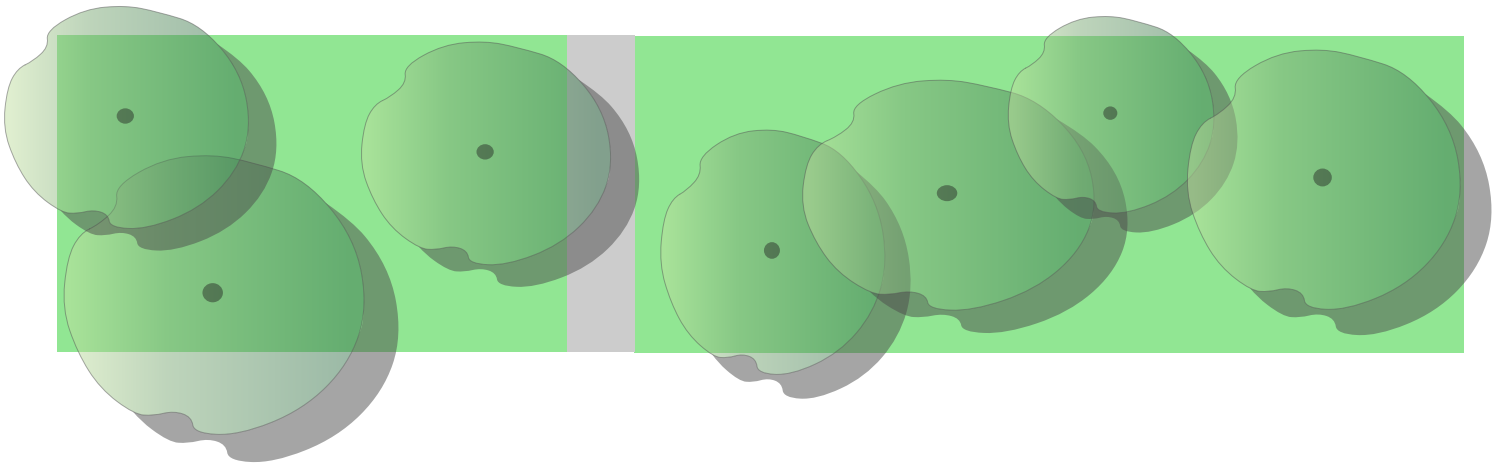
Typical Plan

Location Type 7 – Park

Description of Key Characteristics

Street Width	–
Traffic Lanes	–
Overhead	None
Buildings	–
Parking	Varied
Road centre	–
Pathways	Various pathways from road
Trees	Specimen plantings, mixed
Example	Botanic Park

Typical Section



Typical Plan

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy > 8m
Height > 10m

Street Tree Considerations

Unlimited canopy spread
Tolerate full sun
Longevity
Biodiversity potential – foraging habitat

Recommended Trees

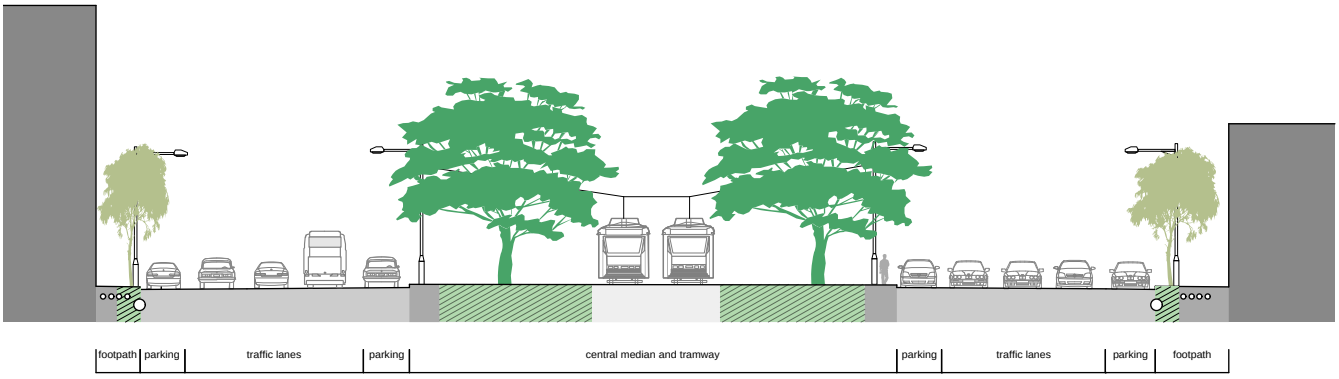
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer rubrum 'October Glory'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Agathis robusta
Angophora costata
Angophora floribunda
Araucaria cunninghamii
Araucaria heterophylla
Brachychiton acerifolius
Catalpa bignonioides
Cedrus atlantica
Cedrus deodara
Corymbia citriodora
Corymbia maculata
Cupressus torulosa
Ficus macrophylla
Fraxinus pennsylvanica 'Cimmaron'
Liquidambar styraciflua 'Rotundiloba'
Metasequoia glyptostroboides
Phoenix canariensis
Pinus canariensis
Pinus patula
Pinus pinea
Podocarpus falcatus
Quercus coccinea
Quercus phellos
Taxodium distichum
Ulmus parvifolia
Washingtonia filifera
Washingtonia robusta
Zelkova serrata 'Green Vase'

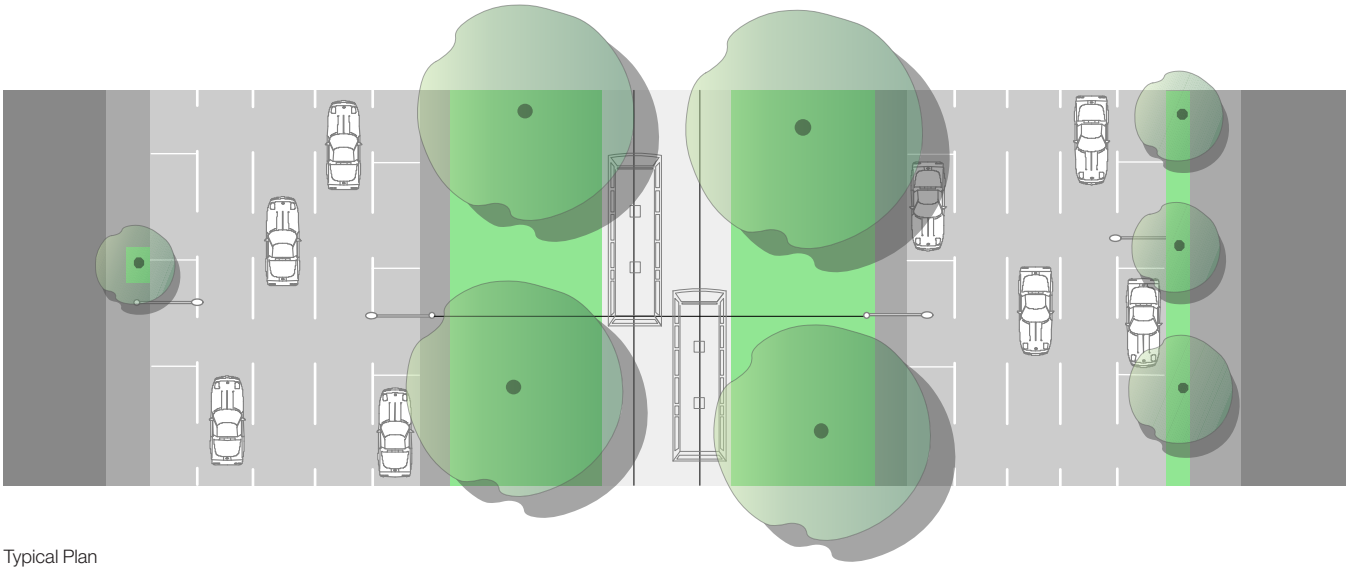
Location Type 8 – Park Edge or Boulevard Median, With Trams

Description of Key Characteristics

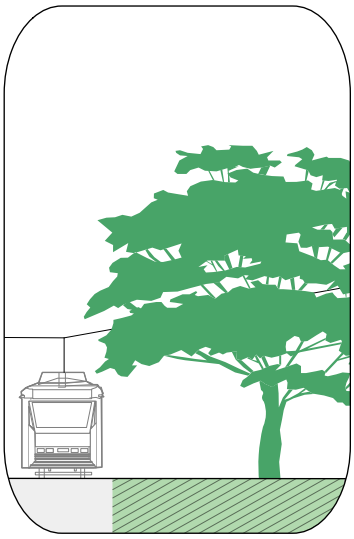
Street Width	60 metres
Traffic Lanes	6 lanes with central boulevard and tramway
Overhead	Lighting, Tram cabelling
Buildings	Medium to high
Parking	Parallel kerb and median edge
Road centre	25m wide with tramline, footpath and median tree avenue
Pathways	3.6m roadside footpaths, narrow along median
Trees	Key central avenue, kerbside
Example	Victoria Parade



Typical Section



Typical Plan



Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy > 8m
Height > 10m
Shade rating any
No powerlines

Street Tree Considerations

Tolerate crown pruning to tram wires
Tolerate full sun
Longevity

Recommended Trees

(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer platanoides 'Crimson Sentry'
Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Allocasuarina torulosa
Angophora costata
Angophora floribunda
Banksia integrifolia subsp. integrifolia
Banksia serrata
Casuarina cunninghamiana
Casuarina glauca
Cedrus atlantica
Cedrus deodara
Celtis occidentalis
Cercis siliquastrum
Cinnamomum camphora
Corymbia citriodora
Corymbia maculata
Cupaniopsis anachardioides
Cupressus sempervirens
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus cosmophylla
Eucalyptus gregsoniana
Eucalyptus leucoxylon
Eucalyptus mannifera subsp. maculosa
Eucalyptus melliodora
Eucalyptus nicholii
Eucalyptus polyanthemos
Eucalyptus pulchella
Eucalyptus scoparia
Eucalyptus sideroxylon
Eucalyptus spathulata
Ficus macrophylla
Ficus microcarpa var. hillii
Ficus platypoda
Ficus rubiginosa
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Geijera parviflora
Ginkgo biloba 'Princeton Sentry'
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Lagerstroemia indica x L. fauriei varieties
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Metasequoia glyptostroboides
Paulownia tomentosa
Pinus canariensis
Pinus pinea
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus canariensis
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Zelkova serrata 'Green Vase'

Location Type 9 – Park Edge or Boulevard Median, With No Trams

Street Tree Considerations

Tolerate full sun
Unlimited canopy spread
Minimum height clearance of 4.6 m over road

Successful Tree Application

Problematic Tree Application

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy > 8m
Height > 10m
Shade rating >3

Recommended Trees

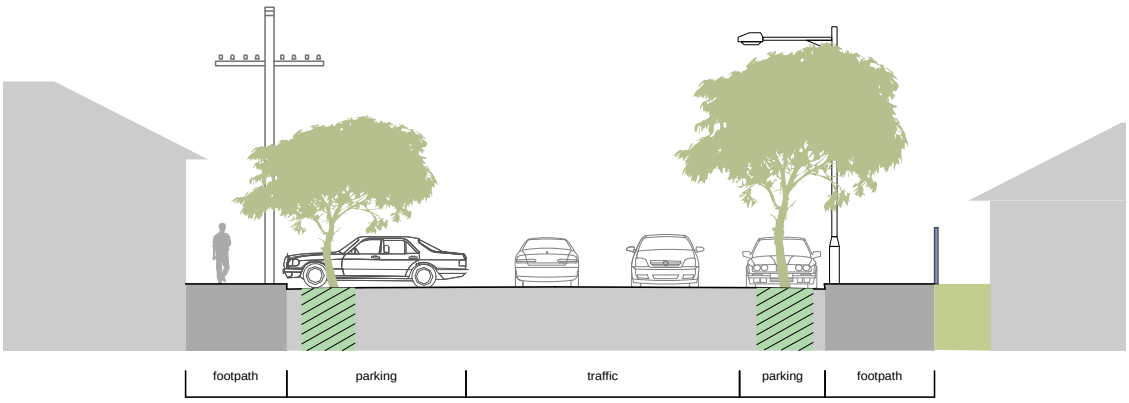
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer rubrum 'October Glory'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Agathis robusta
Araucaria cunninghamii
Catalpa bignonioides
Cedrus atlantica
Cedrus deodara
Corymbia citriodora
Corymbia maculata
Cupressus torulosa
Fraxinus pennsylvanica 'Cimmaron'
Liquidambar styraciflua 'Rotundiloba'
Metasequoia glyptostroboides
Phoenix canariensis
Pinus canariensis
Pinus patula
Pinus pinea
Podocarpus falcatus
Quercus coccinea
Quercus phellos
Taxodium distichum
Ulmus parvifolia
Zelkova serrata 'Green Vase'

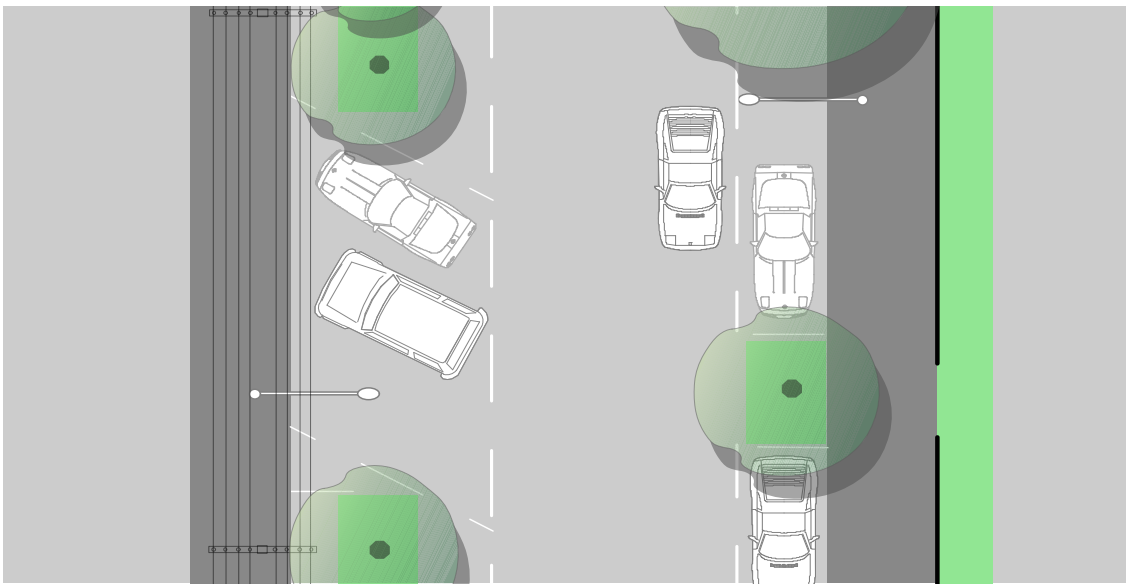
Location Type 10 – Residential Parking Lane

Description of Key Characteristics

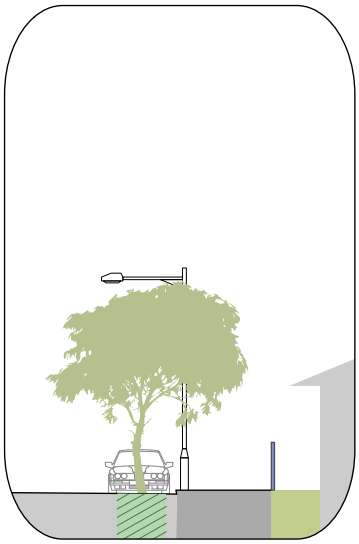
Street Width	20 metre
Traffic Lanes	2 lane
Overhead	Powerlines, lighting
Buildings	Residential, setback
Parking	Mixed
Road centre	–
Pathways	< 2.5 metre footpath
Trees	In roadway between parking bays. Occasional WSUD
Example	Acland Street South Yarra, George Street East Melbourne



Typical Section



Typical Plan



Street Tree Considerations

Potential large and high canopy
Minimum height clearance of 4.6 m
Tolerate full sun
Variety of shade rating
Potential tolerance to water logging (WSUD)

Successful Tree Application

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

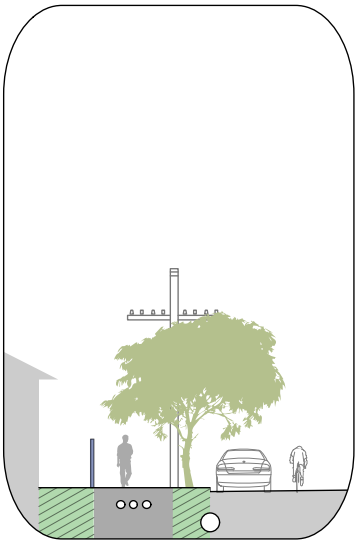
Canopy > 8m
Height > 10m
Shade rating any
WSUD > 3
Pollution rating >3
No powerlines
Litter drop >3
Maintenance >3

Recommended Trees

(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer x freemanii 'Autumn Blaze'
Allocasuarina torulosa
Angophora costata
Araucaria cunninghamii
Banksia integrifolia subsp. integrifolia
Celtis australis
Celtis occidentalis
Cupressus glabra (syn. C. arizonica)
Eucalyptus bancroftii
Eucalyptus leucoxylon
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus melliodora
Eucalyptus platypus
Eucalyptus polyanthemos
Eucalyptus scoparia
Eucalyptus sideroxylon
Ficus microcarpa var. hillii
Fraxinus excelsior 'Aurea'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Jacaranda mimosifolia
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Metasequoia glyptostroboides
Olea europea
Paulownia tomentosa
Pinus canariensis
Pinus halepensis
Pinus patula
Pinus pinaster
Pinus pinea
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus rubra
Syzygium paniculatum
Taxodium distichum
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Waterhousea floribunda
Zelkova serrata 'Green Vase'

Location Type 11 – Residential Broad Verge With Powerlines



Street Tree Considerations

Tolerate crown pruning to powerlines
Tolerate full sun
Minimum height clearance of 2.5 m
Restricted height under powerlines
Tolerate crown pruning to powerlines

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy <10m
Height any
Shade rating >2
Powerlines

Recommended Trees

(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer buergerianum
Acer campestre 'Elsrijk'
Acer campestre 'Evelyn'
Acer platanoides 'Globosum'
Acer truncatum x A. platanoides 'Keithsform'
Agonis flexuosa
Allocasuarina littoralis
Allocasuarina verticillata
Angophora hispida (Syn. A. cordifolia)
Banksia integrifolia subsp. integrifolia
Banksia serrata
Brachychiton populneus
Brachychiton rupestris
Callistemon 'Harkness'
Callistemon salignus
Callistemon viminalis
Catalpa bignonioides 'Nana'
Celtis australis
Celtis occidentalis
Cercis siliquastrum
Corymbia eximia
Corymbia ficifolia
Cupaniopsis anachardioides
Eucalyptus cosmophylla
Eucalyptus gregsoniana
Eucalyptus leucoxylon dwarf form
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus platypus
Eucalyptus stoatei
Ficus platypoda
Fraxinus excelsior 'Aurea'
Fraxinus ornus
Fraxinus ornus 'Meczek'
Fraxinus pennsylvanica 'Urbanite'
Geijera parviflora
Hakea francisiana
Jacaranda mimosifolia
Koelreuteria paniculata
Lagerstroemia indica x L. fauriei varieties
Leptospermum petersonii
Liquidambar formosana
Lophostemon confertus
Magnolia grandiflora 'Exmouth'
Melia azedarach
Olea europea
Pistacia chinensis
Pyrus nivalis
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Tilia cordata 'Greenspire'
Tristaniopsis laurina
Ulmus x hollandica
Zelkova serrata 'Green Vase'

Location Type 12 – Residential Broad Verge With No Powerlines

To come

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy >6m
Height > 10m
Shade rating >2
No powerlines

Street Tree Considerations

Tolerate crown pruning to powerlines
Tolerate full sun
Minimum height clearance of 2.5 m

Recommended Trees

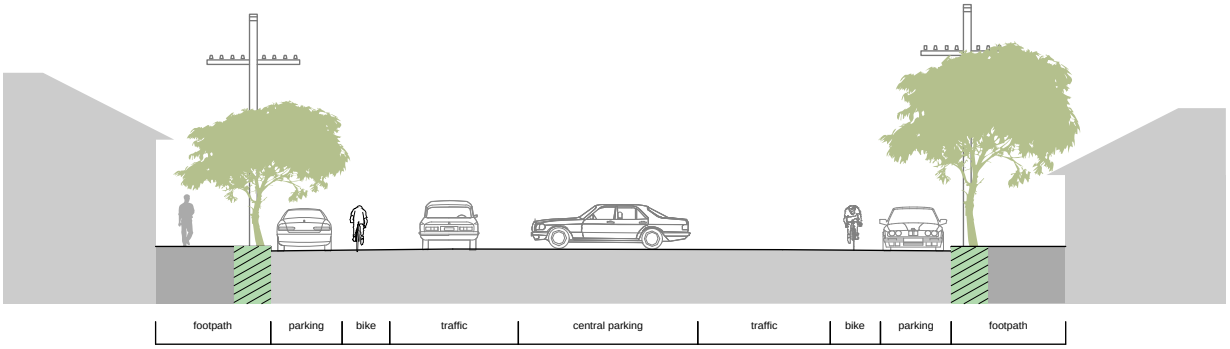
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Allocasuarina torulosa
Allocasuarina verticillata
Angophora costata
Angophora floribunda
Banksia integrifolia subsp. integrifolia
Banksia serrata
Brachychiton populneus
Brachychiton rupestris
Brachychiton x roseus
Casuarina cunninghamiana
Casuarina glauca
Cedrus atlantica
Cedrus deodara
Celtis australis
Celtis occidentalis
Cinnamomum camphora
Corymbia eximia
Corymbia ficifolia
Corymbia maculata
Cupaniopsis anachardioides
Cupressus glabra (syn. C. arizonica)
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus cosmophylla
Eucalyptus leucoxylon
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus melliodora
Eucalyptus platypus
Eucalyptus polyanthemos
Eucalyptus pulchella
Eucalyptus scoparia
Eucalyptus sideroxylon
Eucalyptus spathulata
Ficus macrophylla
Ficus microcarpa var. hillii
Ficus rubiginosa
Fraxinus excelsior 'Aurea'
Fraxinus pennsylvanica 'Aerial'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Ginkgo biloba
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Koelreuteria paniculata
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Magnolia grandiflora 'Exmouth'
Metasequoia glyptostroboides
Olea europea
Phoenix canariensis
Pinus canariensis
Pinus halepensis
Pinus patula
Pinus pinaster
Pinus pinea
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus canariensis
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Syzygium paniculatum
Taxodium distichum
Tilia cordata 'Greenspire'
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Ulmus x hollandica
Waterhousea floribunda
Zelkova serrata 'Green Vase'

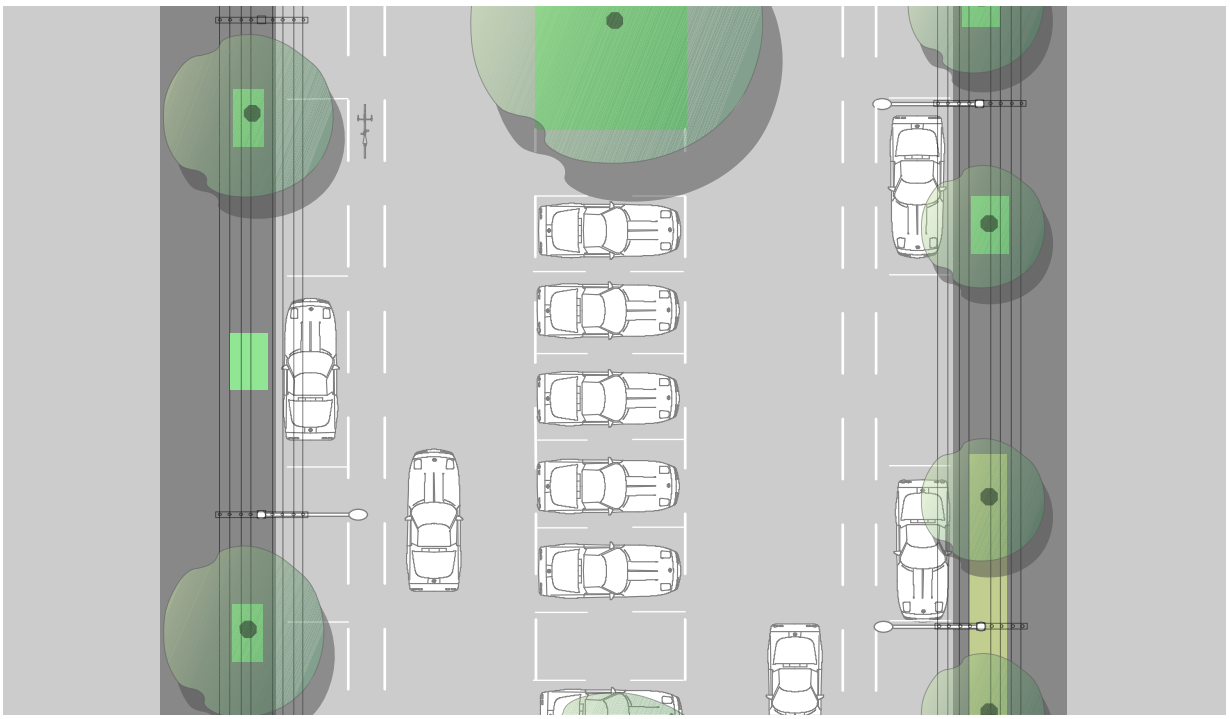
Location Type 13 – Residential Narrow Verge With Powerlines

Description of Key Characteristics

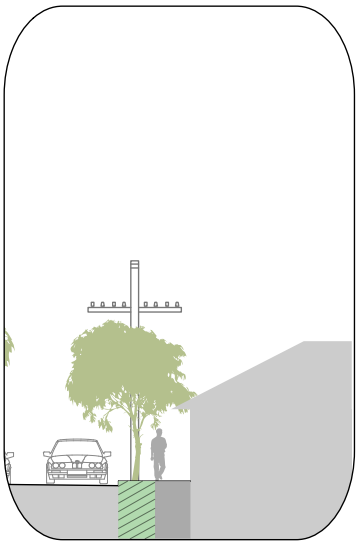
Street Width	30 metre
Traffic Lanes	2 lane with central parking/median area, and bike lanes
Overhead	Powerlines, lighting
Buildings	Residential, setback
Parking	Parallel kerb and perpendicular median parking
Road centre	Median parking. Occasional planting
Pathways	< 3.6 metre footpath
Trees	Kerb edge
Example	Faraday Street, Carlton



Typical Section



Typical Plan



Street Tree Considerations

Limited canopy spread
Tolerate part shade to full sun
Minimum height clearance of 2.5 m
Restricted height under powerlines
Tolerate crown pruning to powerlines

Problematic Tree Application

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy <10m
Height any
Shade rating >2
Community health >3
No powerlines

Recommended Trees

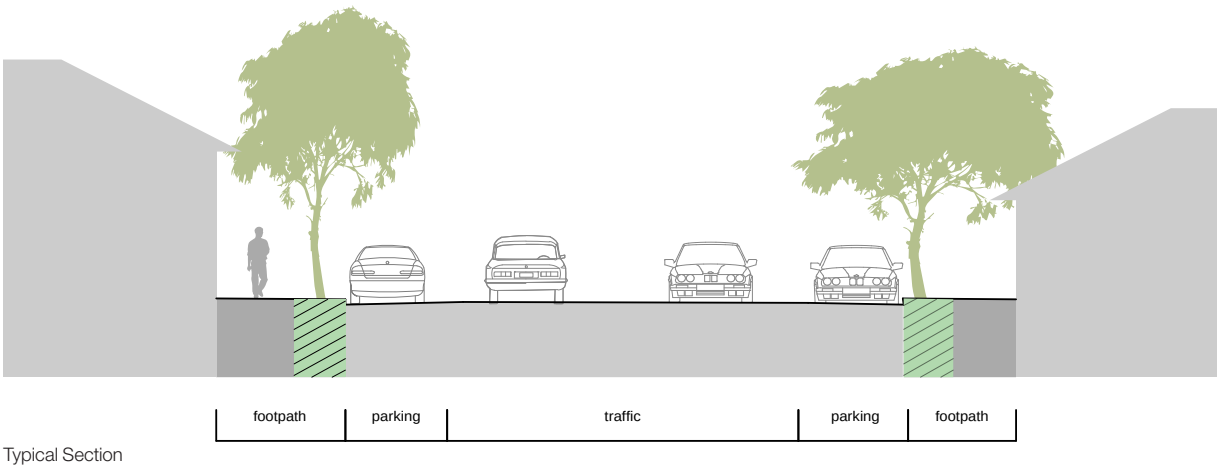
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer buergerianum
Acer campestre 'Elsrijk'
Acer campestre 'Evelyn'
Acer platanoides 'Globosum'
Acer truncatum x A. platanoides 'Keithsform'
Agonis flexuosa
Allocasuarina littoralis
Allocasuarina verticillata
Angophora hispida (Syn. A. cordifolia)
Banksia integrifolia subsp. integrifolia
Banksia serrata
Brachychiton populneus
Brachychiton rupestris
Callistemon 'Harkness'
Callistemon salignus
Callistemon viminalis
Catalpa bignonioides 'Nana'
Celtis australis
Celtis occidentalis
Cercis siliquastrum
Corymbia eximia
Corymbia ficifolia
Cupaniopsis anachardioides
Eucalyptus cosmophylla
Eucalyptus gregsoniana
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus platypus
Eucalyptus stoatei
Ficus platypoda
Fraxinus excelsior 'Aurea'
Fraxinus ornus
Fraxinus ornus 'Meczek'
Fraxinus pennsylvanica 'Urbanite'
Geijera parviflora
Jacaranda mimosifolia
Koelreuteria paniculata
Lagerstroemia indica x L. fauriei varieties
Leptospermum petersonii
Liquidambar formosana
Lophostemon confertus
Magnolia grandiflora 'Exmouth'
Melia azedarach
Olea europea
Pistacia chinensis
Pyrus nivalis
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Tilia cordata 'Greenspire'
Tristaniopsis laurina
Ulmus x hollandica
Zelkova serrata 'Green Vase'

Location Type 14 – Residential Narrow Verge With No Powerlines

Description of Key Characteristics

Street Width	20 metre
Traffic Lanes	2 lane
Overhead	Powerlines, lighting
Buildings	Residential, setback
Parking	Parallel or perpendicular kerb parking
Road centre	–
Pathways	2.5 metre footpath
Trees	Kerb planting
Example	Stawell Street North Melbourne



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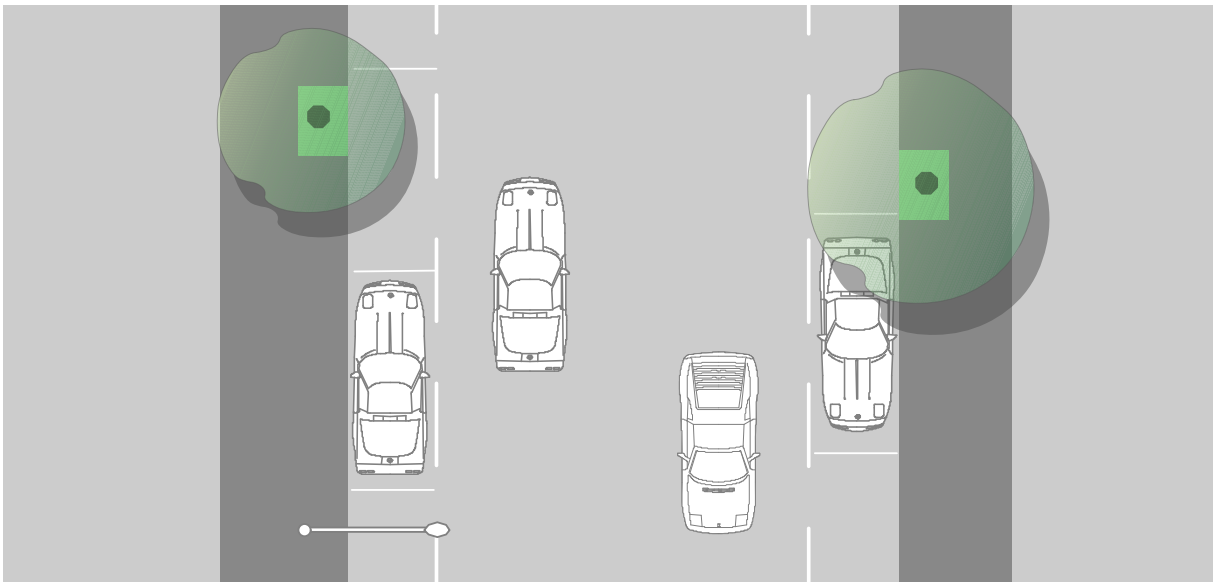
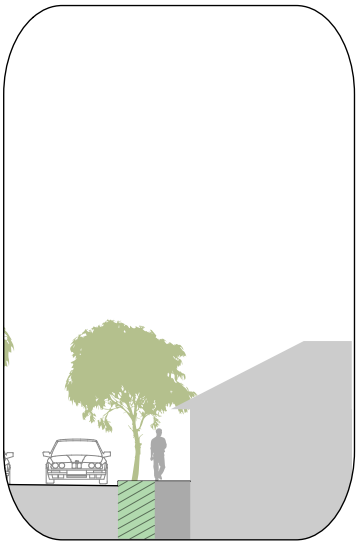


Typical Plan



Street Tree Considerations

Limited canopy spread
Tolerate part shade to full sun
Minimum height clearance of 2.5 m

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy 5-10m
Height 5-20m
Shade rating >3
Community health >3
No powerlines

Recommended Trees

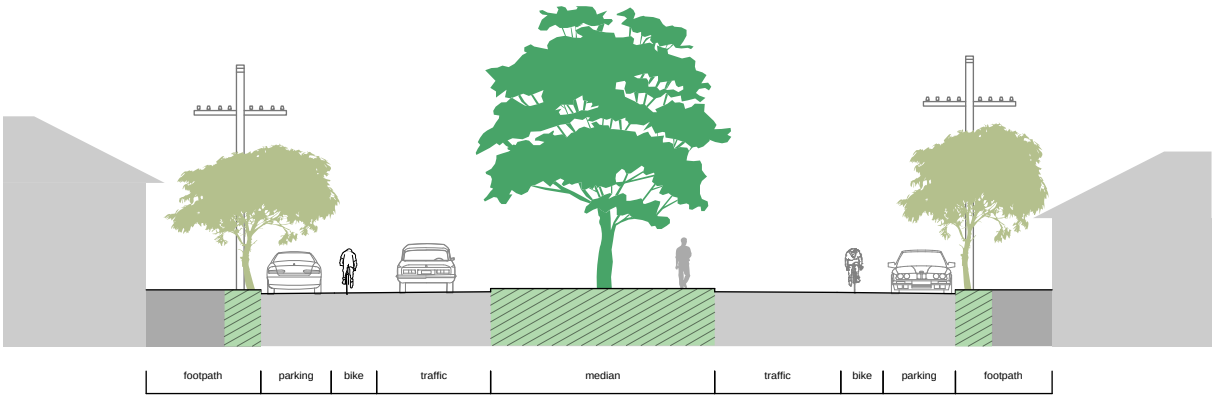
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer buergerianum
Acer campestre 'Elsrijk'
Acer campestre 'Evelyn'
Acer platanoides 'Crimson Sentry'
Acer platanoides 'Globosum'
Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Agonis flexuosa
Allocasuarina littoralis
Allocasuarina torulosa
Allocasuarina verticillata
Angophora costata
Angophora floribunda
Angophora hispida (Syn. A. cordifolia)
Araucaria cunninghamii
Araucaria heterophylla
Banksia integrifolia subsp. integrifolia
Banksia serrata
Brachychiton acerifolius
Brachychiton populneus
Brachychiton rupestris
Brachychiton x roseus
Callistemon 'Harkness'
Callistemon salignus
Callistemon viminalis
Casuarina cunninghamiana
Casuarina glauca
Catalpa bignonioides 'Nana'
Cedrus atlantica
Cedrus deodara
Celtis australis
Celtis occidentalis
Cercis siliquastrum
Cinnamomum camphora
Corymbia eximia
Corymbia ficifolia
Corymbia maculata
Cupaniopsis anachardioides
Cupressus glabra (syn. C. arizonica)
Cupressus sempervirens
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus cinerea
Eucalyptus cosmophylla
Eucalyptus gregsoniana
Eucalyptus leucoxylon
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus mannifera subsp. maculosa
Eucalyptus melliodora
Eucalyptus nicholii
Eucalyptus platypus
Eucalyptus polyanthemos
Eucalyptus pulchella
Eucalyptus scoparia
Eucalyptus sideroxylon
Eucalyptus spathulata
Eucalyptus stoatei
Ficus macrophylla
Ficus microcarpa var. hillii
Ficus platypoda
Ficus rubiginosa
Fraxinus excelsior 'Aurea'
Fraxinus ornus
Fraxinus ornus 'Meczek'
Fraxinus pennsylvanica 'Aerial'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Geijera parviflora
Ginkgo biloba
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Koelreuteria paniculata
Lagerstroemia indica x L. fauriei varieties
Leptospermum petersonii
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Magnolia grandiflora 'Exmouth'
Melia azedarach
Metasequoia glyptostroboides
Olea europea
Phoenix canariensis
Pinus canariensis
Pinus halepensis
Pinus patula
Pinus pinaster
Pistacia chinensis
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus bicolor
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus robur 'Fastigiata'
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Sophora japonica 'Princeton Upright'
Stenocarpus sinuatus
Syzygium paniculatum
Taxodium distichum
Tilia cordata 'Greenspire'
Trachycarpus fortunei
Tristaniopsis laurina
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus x hollandica
Waterhousea floribunda
Zelkova serrata 'Green Vase'

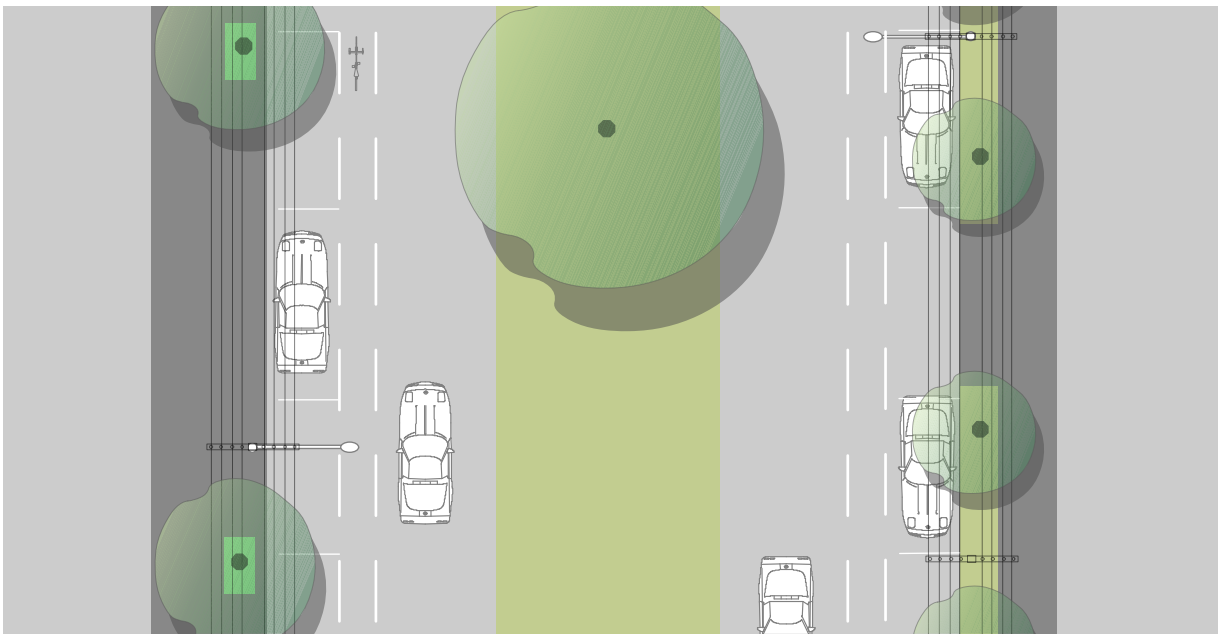
Location Type 15 – Residential Wide Median

Description of Key Characteristics

Street Width	30 metre
Traffic Lanes	2 lane with central median, and bike lanes
Overhead	Powerlines, lighting
Buildings	Residential, setback
Parking	Parallel kerb
Road centre	3-8m wide planted median
Pathways	< 3.6 metre footpath
Trees	Kerb edge and central median
Example	Canning street, Drummond Street, Carlton



Typical Section



Typical Plan

Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy > 8m
Height > 10m
Shade rating any
Community health >3
No powerlines

Street Tree Considerations

Potential large and high canopy
Tolerate full sun
Minimum height clearance of 2.5m
Variety of shade rating

Recommended Trees

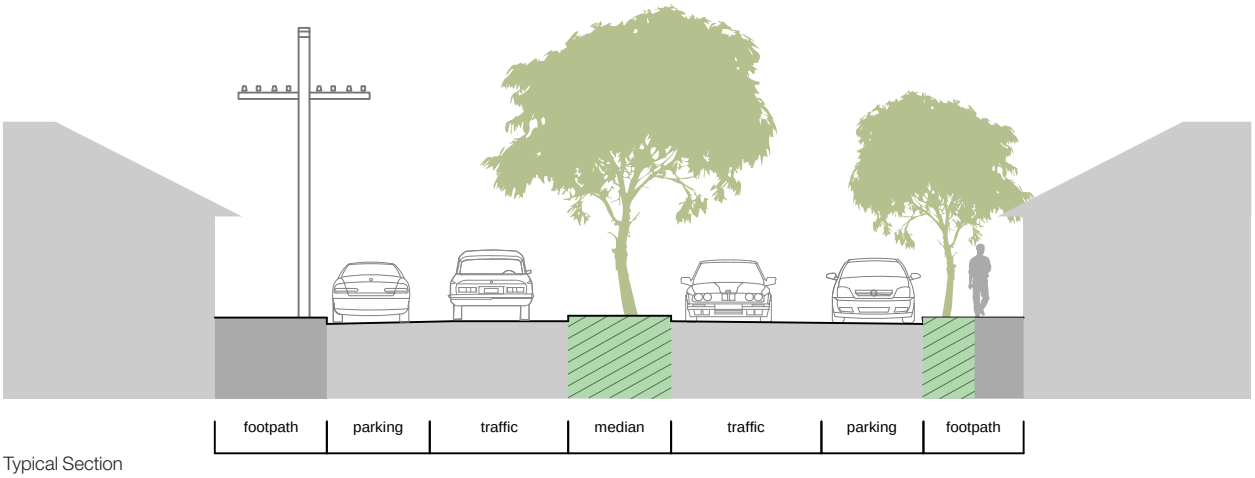
(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer platanoides 'Crimson Sentry'
Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Allocasuarina torulosa
Angophora costata
Angophora floribunda
Araucaria cunninghamii
Araucaria heterophylla
Banksia integrifolia subsp. integrifolia
Casuarina cunninghamiana
Casuarina glauca
Cedrus atlantica
Cedrus deodara
Celtis occidentalis
Cercis siliquastrum
Cinnamomum camphora
Corymbia citriodora
Corymbia maculata
Cupaniopsis anachardioides
Cupressus sempervirens
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus cosmophylla
Eucalyptus gregsoniana
Eucalyptus leucoxylon
Eucalyptus mannifera subsp. maculosa
Eucalyptus melliodora
Eucalyptus nicholii
Eucalyptus polyanthemos
Eucalyptus pulchella
Eucalyptus scoparia
Eucalyptus sideroxylon
Eucalyptus spathulata
Ficus microcarpa var. hillii
Ficus platypoda
Ficus rubiginosa
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Geijera parviflora
Ginkgo biloba 'Princeton Sentry'
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Lagerstroemia indica x L. fauriei varieties
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Metasequoia glyptostroboides
Paulownia tomentosa
Pinus canariensis
Pinus pinea
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus canariensis
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Tilia cordata 'Greenspire'
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Zelkova serrata 'Green Vase'

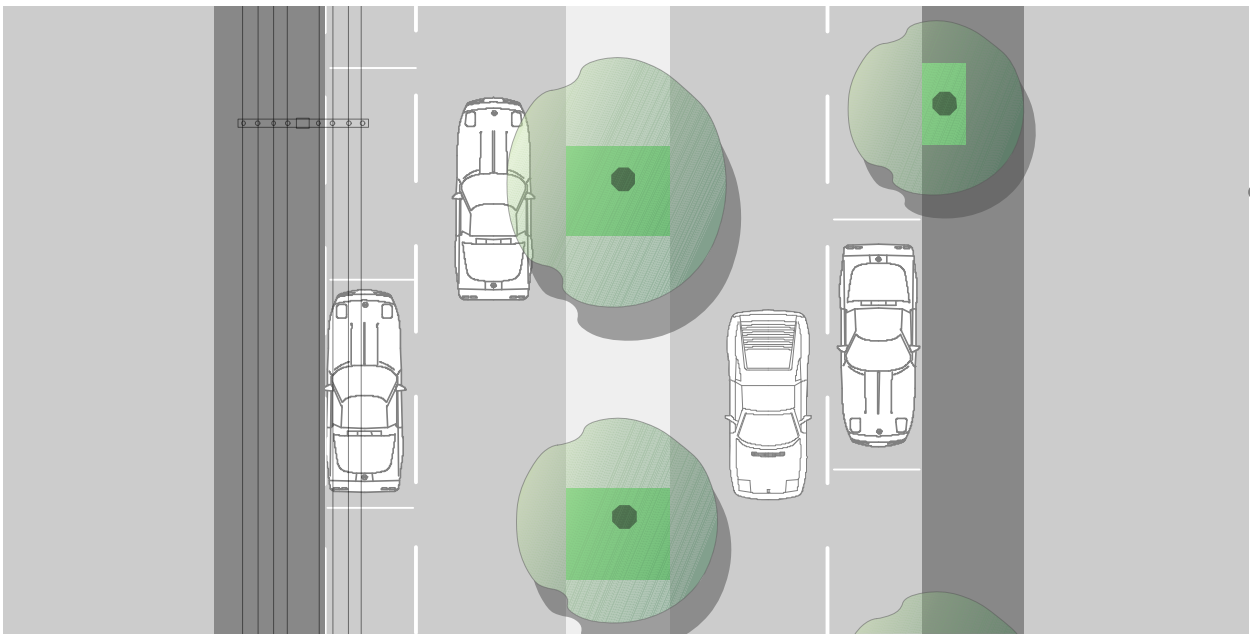
Location Type 16 – Residential Narrow Median

Description of Key Characteristics

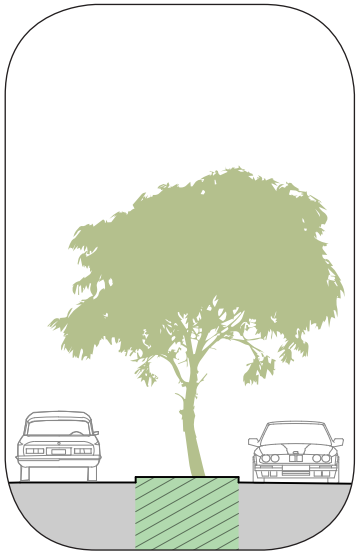
Street Width	20 metre
Traffic Lanes	2 lane with central median
Overhead	Powerlines, lighting
Buildings	Residential, setback
Parking	Parallel kerb
Road centre	2-3m planted/infill median or intermittent parking/median
Pathways	2.5 metre footpath
Trees	Larger median planting, kerb planting
Example	Pitt Street Carlton, Lothian Street North Melbourne



Typical Section



Typical Plan



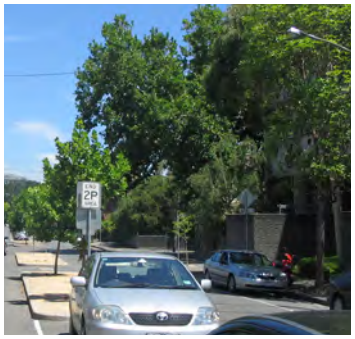
Tree Selection Criteria

(Key requirements for generating suitable street trees from matrix)

Canopy <15
Height > 10m
Shade rating any
No powerlines

Street Tree Considerations

Potential large and high canopy
Tolerate full sun
Minimum height clearance of 4.5m
Variety of shade rating



Recommended Trees

(Based on Tree Selection Criteria relevant to Street Tree Considerations)

Acer buergerianum
Acer campestre 'Elsrijk'
Acer campestre 'Evelyn'
Acer platanoides 'Crimson Sentry'
Acer platanoides 'Globosum'
Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Agonis flexuosa
Allocasuarina littoralis
Allocasuarina torulosa
Allocasuarina verticillata
Angophora costata
Angophora floribunda
Brachychiton acerifolius
Callistemon salignus
Callistemon viminalis
Casuarina glauca
Cedrus deodara
Corymbia citriodora
Corymbia maculata
Cupressus sempervirens
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus leucoxylon
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus mannifera subsp. maculosa
Eucalyptus melliodora
Eucalyptus nicholii
Eucalyptus platypus
Eucalyptus polyanthemos
Eucalyptus pulchella
Eucalyptus scoparia
Eucalyptus sideroxylon
Eucalyptus spathulata
Ficus microcarpa var. hillii
Fraxinus pennsylvanica 'Aerial'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Ginkgo biloba 'Princeton Sentry'
Gleditsia triacanthos var.inermis Varieties
Jacaranda mimosifolia
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Maclura pomifera 'Wichita'
Metasequoia glyptostroboides
Paulownia tomentosa
Phoenix canariensis
Pinus pinea
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus canariensis
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus phellos
Quercus robur
Quercus robur 'Fastigiata'
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Sophora japonica 'Princeton Upright'
Stenocarpus sinuatus
Tilia cordata 'Greenspire'
Tristaniopsis laurina
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Washingtonia filifera
Washingtonia robusta

Appendices

Appendix 1: References

Asterisked references refer to works not mentioned within the body of the document.

* Dirr, M. A. (1998) Manual of woody landscape plants. Fifth edition. Stipes Publishing.

Gilman, E. F. (1997) Trees for urban and suburban landscapes. Delmar Publishing.

* Hitchmough, J.D. (1992) Landscape Plant Manual Volumes 1-4. Victorian College of Agriculture and Horticulture, Melbourne.

Jaenson, R., Bassuk, N., Schwager, S., and Headley, D. (1992). A statistical method for the accurate and rapid sampling of urban street tree populations. Journal of Arboriculture 18: 171-183.

* Konijnendijk, C. C., Nilsson, K., Randrup, T. B. & Schipperijn, J. (2005) Urban forests and trees. Springer

* Lindsay, P., & Bassuk, N. (1991) Specifying soil volumes to meet the water needs of mature urban street trees and trees in containers. Journal of Arboriculture. 17 (6), 141-149. International Society of Arboriculture

Miller, R.H. and Miller, R.W. (1991). Planting survival of selected street tree taxa. Journal of Arboriculture 17:185-191

Richards, N.A., (1983). Diversity and stability in a street tree population. Urban Ecology., 7: 159.. 171.

*Richards, N.A., (1993). Reasonable guidelines for street tree diversity. Journal of Arboriculture 19(6). 344-350.

Urban Horticulture Institute – Cornell University http://www.hort.cornell.edu/department/faculty/bassuk/uhi/walk5.html

Urban, J. (2008) Up by roots. Healthy soils and trees in the built environment. International Society of Arboriculture.

Watson, G. W. & Himelick, E. B. (1997). Principals and Practices of Planting Trees and Shrubs International Society of Arboriculture.

Carver T. (1989). *Tree Cover Type and History in Inner Suburban and Outer Suburban Melbourne.* Melbourne: Victorian College of Agriculture and Horticulture.

Spencer R. (1986) Fashions in Street Tree Planting in Victoria. In *Landscape Australia (4)*, 304-309.

Yau D.P. (1982). Street Trees of Melbourne. In *Aboricultural Journal (6)*, 95-105.

The following texts are mentioned within the body of the document but are not yet detailed within the references.

CSIRO, 2010. Seen at: http:// www.csiro.au/science/climate-and-drought-in-eastern-Australia.html.

Müller, 1766

Grabosky, Bassuk, & Towbridge (2002).

(Connellan, 2008)

(Rich, P.M. 1990. Characterizing plant canopies with hemispherical photographs.)

Appendix 2: The Tree Selection Matrix as Interactive Tool

The Urban Forest Tree Diversity Guidelines employ a tree selection matrix as the interactive tool for tree species selection.

It is this interactive tool that has produced the tree lists by Location Type.

However, because the Tree Selection Matrix can be used interactively, it is able to generate additional specific tree lists for a wide range of criteria above and beyond those used to produce the tree lists presented within the main body of this report.

The Tree Selection Matrix provides an effective was of organising, sorting and prioritising tree species characteristics, tolerances and susceptibilities so as to provide informed and useful tree species selections.

The Tree Selection Matrix requires the user to determine the characteristics required for tree species within a given environment – for instance the verge of a busy east-west CAD street – thus encouraging a relationship to be established between tree selection and site specifics across the City's streetscapes and parks.

In order to aid the City of Melbourne's objectives, the Tree Selection Matrix provides three distinct tree lists from which appropriate tree selections can be made. The range of selection criteria across the three tree species lists is consistent. The three tree species lists are:

- Street trees: The principle component of the urban forest within the public domain.
- Park trees: These contribute significant avenues of tree planting to the cities greenery. While most street trees can be grown in parks, the reverse is not always possible. The park tree list includes species that require greater root volumes than those generally achievable in the streetscape environment, and species of large size.
- Trial trees: Included to expand the diversity of the tree species population, through streetscape trialing. Once the performance of these trees can be determined the matrix can be updated to reflect this new knowledge – the Tree Selection Matrix is a 'live' tool, intended to be reviewed on a regular basis.

Detailed instructions on how to use the Tree Selection Matrix follow.

Using the Matrix

To understand how to use the matrix as an interactive tool, these Guidelines demonstrate a simple staged process of producing the street tree list for one Location Type (in the example the location is Location Type 1 – CAD Wide Footpath), and then further refining that list (in the example, the list is refined to show only trees suitable for shady conditions).

The matrix is a highly flexible tool able to generate plant lists for effectively all locations and conditions throughout the City of Melbourne.

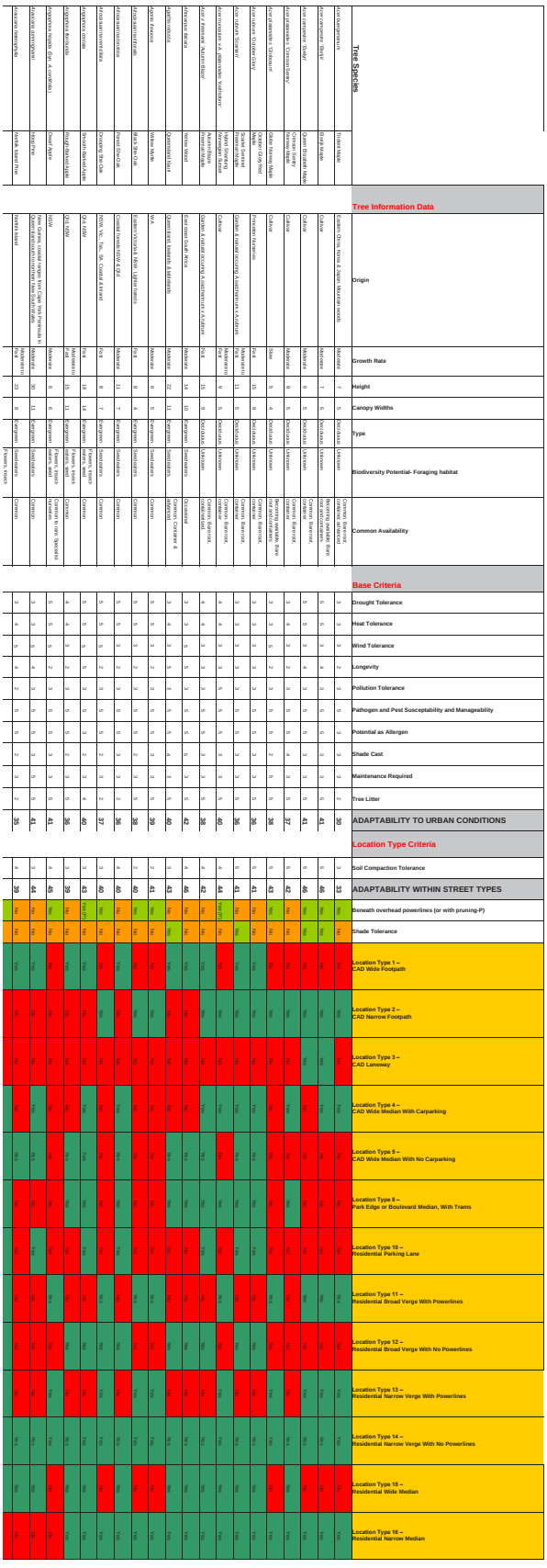
A profile of a typical street can be constructed using the type parts much like a mix and match book. This can help profile any typical scenario in a street type and provide a tree list that is flexible to cover differing scenarios such as powerlines, narrow verge, median planting opportunities. Therefore a truly diverse list of trees can be generated for any given street. This list can then be filtered further in the precinct plans.

Dimensional criteria are probably the most important, and the best place to start when refining tree lists. Remember trees may fail the criteria by being, for example, 1 metre too short or narrow. It is up to the discretion of Council to change the field to capture trees that are perceived as still being useful in this application and satisfying the objectives.

The selection criteria are supplemented by further information included in the Tree Selection Matrix that can be used by Council to scrutinise the tree candidates for the application after initial sorting and refining.

It is anticipated that this matrix will be supported by the graphic cross sections and that a street cross section can be generated to cover most variables found in the extent of a street, such as awnings, powerlines that switch verges, etc. The inclusion of such Location Types is a future exercise that may be explored.

The Matrix at a Glance



Tree Species
Botanical and common name

Tree Information Data
Botanical and horticultural information

Base Criteria for Adaptability to Urban Conditions
The criteria by which each street species must fulfill to be acceptable for planting in City of Melbourne.

Adaptability to Urban Conditions Rating

Additional Selection Criteria

Location Types
Showing which trees are suitable.

Example

Demonstrating how to produce a street tree list for Location Type 1 – CAD Wide Footpath, and refine that list to sho only trees suitable for shady conditions.

Step 1

Identify the column on the Tree Selection Matrix that shows Location Type 1 – CAD Wide Footpath

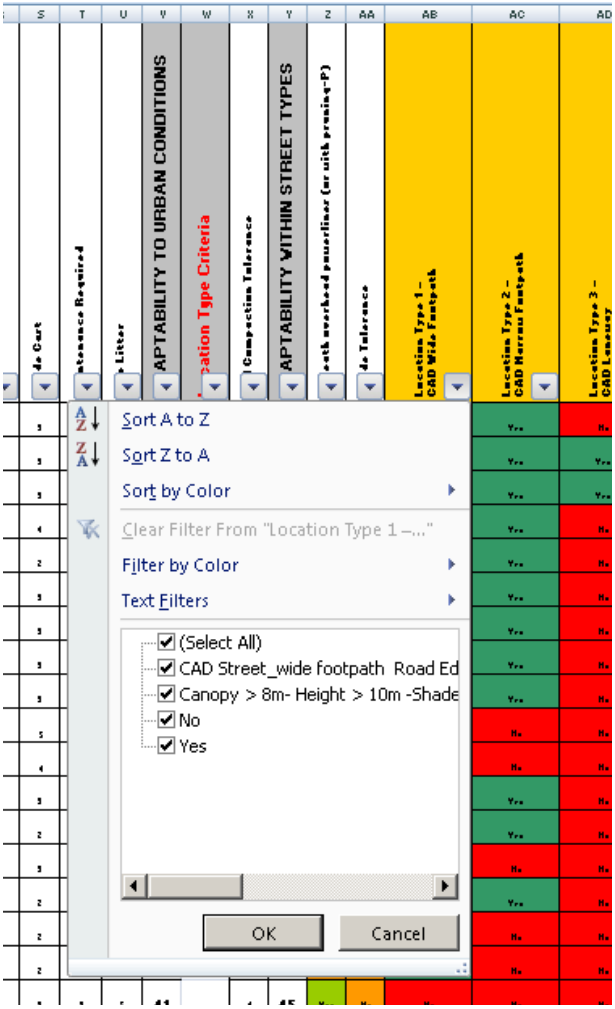
Step 2

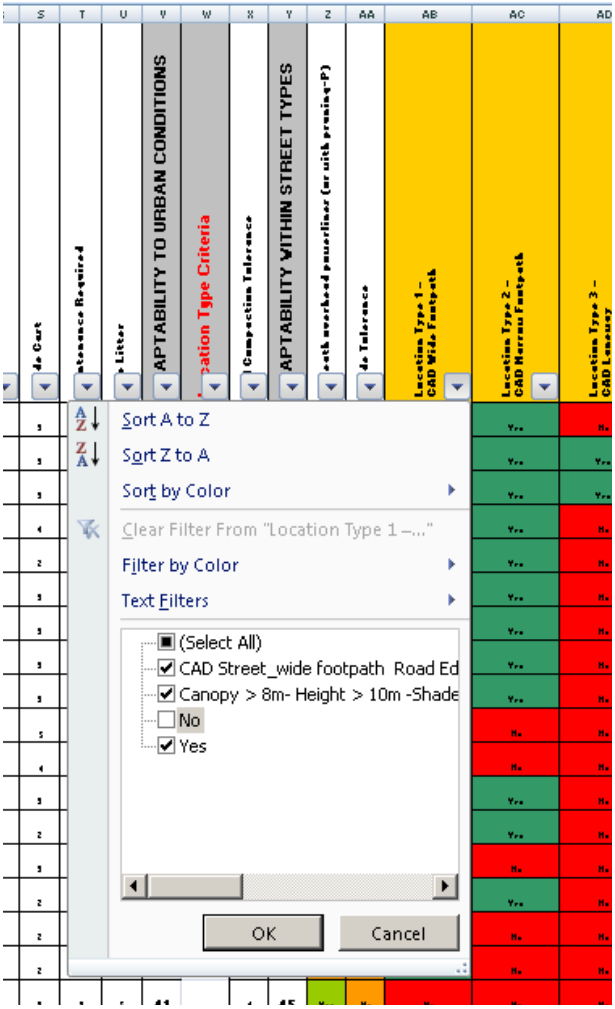
Alter the sort criteria for this column of the Matrix to exclude all trees maked “No”.

To do this click on the ▾ symbol in the top cell of the Location Type 1 – CAD Wide Footpath column. Click on the checkbox next to “No” to deselect that sort option and thus exclude all trees marked “No” from being displayed. Click OK to finish this step.

Note that here you can identify the selection criteria used to establish which trees are marked suitable (yes) and unsuitable (no).

In this example the criteria are Canopy >8m, Height > 10m, Shade rating > 2, Pollution rating > 2, and suitable for growing where there are no powerlines.





Step 2 continued

You can see here that only trees marked "Yes" in the Location Type 1 – CAD Wide Footpath column are being displayed.

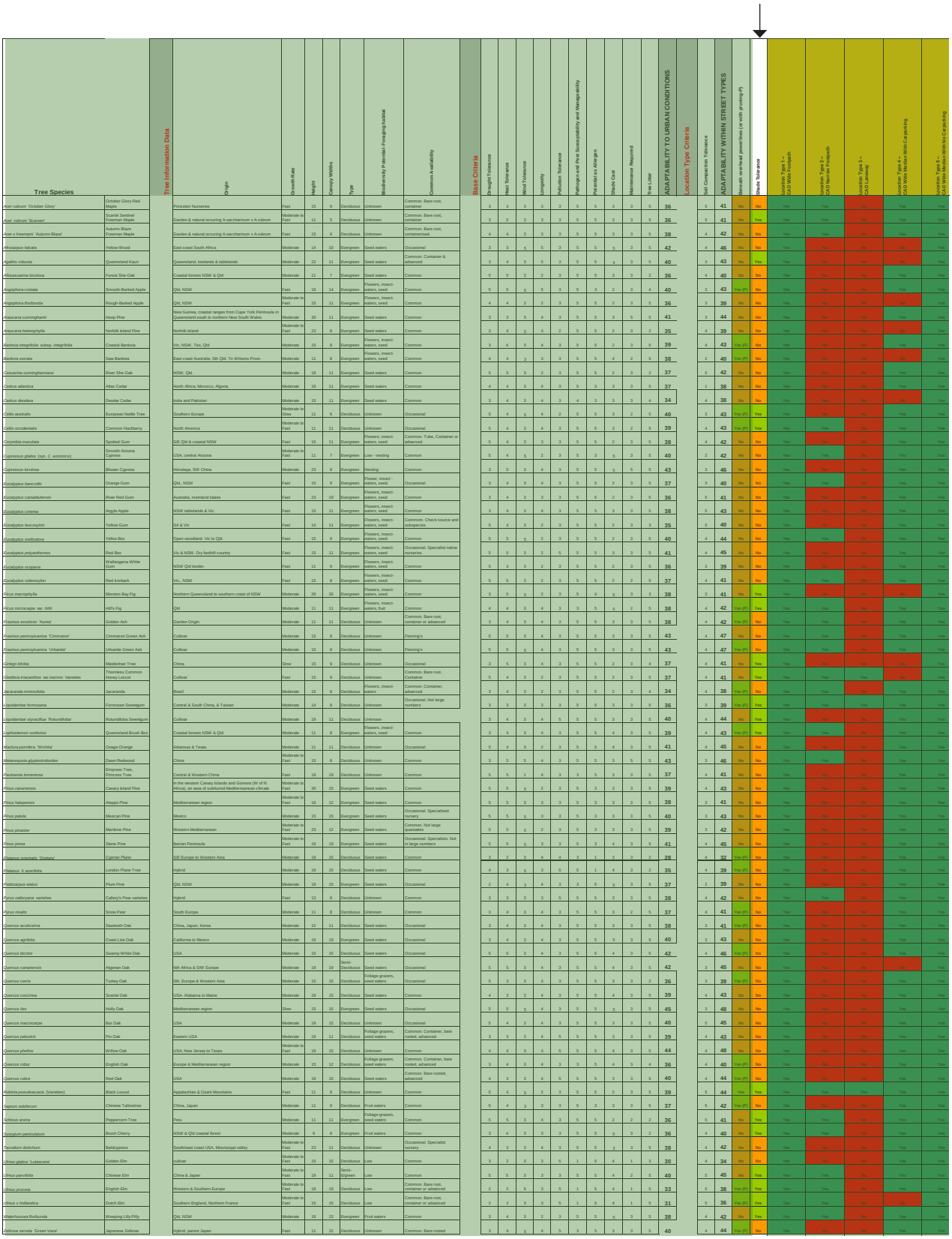
This is the list of trees considered adaptable to urban conditions and suitable to Location Type 1 – CAD Wide Footpath, and shown on page 45.

Tree Species		Tree Information Data	Origin	Growth Rate	Height	Canopy Widths	Type	Biodiversity Potential- Foraging habitat	Common Availability
Acer rubrum 'October Glory'	October Glory Red Maple		Princeton Nurseries	Fast	15	9	Deciduous	Unknown	Common. Bare root, container
Acer rubrum 'Scarsen'	Scarlet Sentinel Freeman Maple		Garden & natural occuring A.saccharinum x A.rubrum	Moderate to Fast	11	5	Deciduous	Unknown	Common. Bare root, container
Acer x freemanii 'Autumn Blaze'	Autumn Blaze Freeman Maple		Garden & natural occuring A.saccharinum x A.rubrum	Fast	15	9	Deciduous	Unknown	Common. Bare root, containerised.
Afrocarpus falcata	Yellow Wood		East coast South Africa	Moderate	14	10	Evergreen	Seed eaters	Occasional
Agathis robusta	Queensland Kauri		Queensland, lowlands & tablelands	Moderate	22	11	Evergreen	Seed eaters	Common. Container & advanced
Allocasuarina torulosa	Forest She-Oak		Coastal forests NSW & Qld	Moderate	11	7	Evergreen	Seed eaters	Common
Angophora costata	Smooth-Barked Apple		Qld, NSW	Fast	19	14	Evergreen	Flowers, insect-eaters, seed	Common
Angophora floribunda	Rough-Barked Apple		Qld, NSW	Moderate to Fast	15	11	Evergreen	Flowers, insect-eaters, seed	Common
Araucaria cunninghamii	Hoop Pine		New Guinea, coastal ranges from Cape York Peninsula in Queensland south to northern New South Wales	Moderate	30	11	Evergreen	Seed eaters	Common
Araucaria heterophylla	Norfolk Island Pine		Norfolk Island	Moderate to Fast	23	8	Evergreen	Seed eaters	Common
Banksia integrifolia subsp. *integrifolia*	Coastal Banksia		Vic, NSW, Tas, Qld	Moderate	15	8	Evergreen	Flowers, insect-eaters, seed	Common
Banksia serrata	Saw Banksia		East coast Australia, Sth Qld. To Wilsons Prom.	Moderate	11	8	Evergreen	Flowers, insect-eaters, seed	Common
Casuarina cunninghamiana	River She-Oak		NSW, Qld.	Moderate	19	11	Evergreen	Seed eaters	Common
Cedrus atlantica	Atlas Cedar		North Africa; Morocco, Algeria	Moderate	19	11	Evergreen	Seed eaters	Common
Cedrus deodara	Deodar Cedar		India and Pakistan	Moderate	15	11	Evergreen	Seed eaters	Common
Celtis australis	European Nettle Tree		Southern Europe	Moderate to Slow	11	6	Deciduous	Unknown	Occasional
Celtis occidentalis	Common Hackberry		North America	Moderate to Fast	11	11	Deciduous	Unknown	Occasional
Corymbia maculata	Spotted Gum		S/E Qld & coastal NSW	Fast	15	11	Evergreen	Flowers, insect-eaters, seed	Common. Tube, Container or advanced
Cupressus glabra (syn. *C. arizonica*)	Smooth Arizona Cypress		USA, central Arizona	Moderate to Fast	11	7	Evergreen	Low - nesting	Common
Cupressus torulosa	Bhutan Cypress		Himalaya, SW China	Moderate	23	8	Evergreen	Nesting	Common
Eucalyptus bancroftii	Orange Gum		Qld., NSW	Fast	15	9	Evergreen	Flower, insect - eaters, seed.	Occasional
Eucalyptus camaldulensis	River Red Gum		Australia, mainland states	Fast	23	19	Evergreen	Flowers, insect-eaters, seed	Common
Eucalyptus cinerea	Argyle Apple		NSW tablelands & Vic.	Fast	15	11	Evergreen	Flowers, insect-eaters, seed	Common
Eucalyptus leucoxylon	Yellow Gum		SA & Vic	Fast	14	11	Evergreen	Flowers, insect-eaters, seed	Commom. Check source and subspecies
Eucalyptus melliodora	Yellox Box		Open woodland. Vic to Qld.	Fast	15	9	Evergreen	Flowers, insect-eaters, seed	Common
Eucalyptus polyanthemos	Red Box		Vic & NSW. Dry foothill country	Fast	15	11	Evergreen	Flowers, insect-eaters, seed	Occasional. Specialist native nurseries
Eucalyptus scoparia	Wallangarra White Gum		NSW Qld border.	Fast	11	9	Evergreen	Flowers, insect-eaters, seed	Common
Eucalyptus sideroxylon	Red Ironbark		Vic., NSW	Fast	15	8	Evergreen	Flowers, insect-eaters, seed	Common
Ficus macrophylla	Moreton Bay Fig		Northern Queensland to southern coast of NSW	Moderate	26	26	Evergreen	Flowers, insect-eaters, seed	Common
Ficus microcarpa var. *hillii*	Hill's Fig		Qld	Moderate	11	11	Evergreen	Flowers, insect-eaters, fruit	Common
Fraxinus excelsior 'Aurea'	Golden Ash		Garden Origin	Moderate	11	11	Deciduous	Unknown	Common. Bare root, container or advanced
Fraxinus pennsylvanica 'Cimmaron'	Cimmaron Green Ash		Cultivar	Moderate	15	8	Deciduous	Unknown	Fleming's
Fraxinus pennsylvanica 'Urbanite'	Urbanite Green Ash		Cultivar	Moderate	15	8	Deciduous	Unknown	Fleming's
Ginkgo biloba	Maidenhair Tree		China	Slow	15	9	Deciduous	Unknown	Occasional
Gleditsia triacanthos var.inermis Varieties	Thornless Common Honey Locust		Cultivar	Fast	15	9	Deciduous	Unknown	Common. Bare root. Container
Jacaranda mimosifolia	Jacaranda		Brazil	Moderate	15	8	Deciduous	Flowers, insect-eaters	Common. Container, advanced
Liquidambar formosana	Formosan Sweetgum		Central & South China, & Taiwan	Moderate	14	8	Deciduous	Unknown	Occasional. Not large numbers
Liquidambar styraciflua 'Rotundiloba'	Rotundiloba Sweetgum		Cultivar	Moderate	19	11	Deciduous	Unknown	
Lophostemon confertus	Queensland Brush Box		Coastal forests NSW & Qld	Moderate	11	8	Evergreen	Flowers, insect-eaters, seed	Common
Maclura pomifera 'Wichita'	Osage Orange		Arkansas & Texas	Moderate	11	11	Deciduous	Unknown	Occasional
Metasequoia glyptostroboides	Dawn Redwood		China	Moderate to Fast	15	8	Deciduous	Unknown	Common
Paulownia tomentosa	Empress Tree, Princess Tree		Central & Western China	Fast	19	19	Deciduous	Unknown	Common
Pinus canariensis	Canary Island Pine		In the western Canary Islands and Gomera (W of N Africa), an area of subhumid Mediterreanean climate	Moderate to Fast	30	15	Evergreen	Seed eaters	Common
Pinus halepensis	Aleppo Pine		Mediterranean region	Moderate to Fast	19	12	Evergreen	Seed eaters	Common
Pinus patula	Mexican Pine		Mexico	Moderate	15	15	Evergreen	Seed eaters	Occasional. Specialised nursery
Pinus pinaster	Maritime Pine		Western Mediterranean	Moderate to Fast	23	12	Evergreen	Seed eaters	Common. Not large quantaties
Pinus pinea	Stone Pine		Iberian Peninsula	Moderate to Fast	19	19	Evergreen	Seed eaters	Occasional. Specialists. Not in large numbers
Platanus orientalis 'Digitata'	Cyprian Plane		S/E Europe to Western Asia	Moderate	19	15	Deciduous	Seed eaters	Common
Platanus X *acerifolia*	London Plane Tree		Hybrid	Moderate	19	15	Deciduous	Seed eaters	Common
Podocarpus elatus	Plum Pine		Qld, NSW	Moderate	18	15	Evergreen	Seed eaters	Occasional
Pyrus calleryana varieties	Callery's Pear varieties		Hybrid	Fast	13	8	Deciduous	Unknown	Common
Pyrus nivalis	Snow Pear		South Europe	Moderate	11	8	Deciduous	Unknown	Common
Quercus acutissima	Sawtooth Oak		China, Japan, Korea	Moderate	12	11	Deciduous	Seed eaters	Occasional
Quercus agrifolia	Coast Live Oak		California to Mexico	Moderate	19	19	Evergreen	Seed eaters	Occasional
Quercus bicolor	Swamp White Oak		USA	Moderate	15	15	Deciduous	Seed eaters	Occasional
Quercus canariensis	Algerian Oak		Nth Africa & S/W Europe	Moderate	19	19	Semi-Deciduous	Seed eaters	Occasional
Quercus cerris	Turkey Oak		Sth. Europe & Western Asia	Moderate	15	15	Deciduous	Foliage grazers, seed eaters	Occasional
Quercus coccinea	Scarlet Oak		USA- Alabama to Maine	Moderate	19	15	Deciduous	Seed eaters	Common
Quercus ilex	Holly Oak		Mediterranean region	Slow	15	15	Evergreen	Seed eaters	Occasional
Quercus macrocarpa	Bur Oak		USA	Moderate	19	15	Deciduous	Unknown	Occasional
Quercus palustris	Pin Oak		Eastern USA	Moderate	19	11	Deciduous	Foliage grazers, seed eaters	Common. Container, bare rooted, advanced.
Quercus phellos	Willow Oak		USA; New Jersey to Texas	Moderate to Fast	19	15	Deciduous	Unknown	Common
Quercus robur	English Oak		Europe & Mediterranean region	Moderate	15	12	Deciduous	Foliage grazers, seed eaters	Common. Container, bare rooted, advanced
Quercus rubra	Red Oak		USA	Moderate	19	15	Deciduous	Seed eaters	Common. Bare rooted, advanced
Robinia pseudoacacia (Varieties)	Black Locust		Appalachian & Ozark Mountains	Fast	11	8	Deciduous	Unknown	Common
Sapium sebiferum	Chinese Tallowtree		China, Japan	Moderate	11	9	Deciduous	Fruit eaters	Common
Schinus areira	Peppercorn Tree		Peru	Moderate	11	11	Evergreen	Foliage grazers, seed eaters	Common
Syzygium paniculatum	Brush Cherry		NSW & Qld coastal forest	Moderate	9	8	Evergreen	Fruit eaters	Common
Taxodium distichum	Baldcypress		South/east coast USA, Mississippi valley	Moderate to Fast	23	11	Deciduous	Unknown	Occasional. Specialist nursery
Ulmus glabra 'Lutescens'	Golden Elm		cultivar	Moderate to Fast	15	15	Deciduous	Low	Common
Ulmus parvifolia	Chinese Elm		China & Japan	Moderate to Fast	19	11	Semi-E/green	Low	Common
Ulmus procera	English Elm		Western & Southern Europe	Moderate to Fast	19	19	Deciduous	Low	Common. Bare root, container or advanced
Ulmus x hollandica	Dutch Elm		Southern England, Northern France	Moderate to Fast	15	15	Deciduous	Low	Common. Bare root, container or advanced
Waterhousea floribunda	Weeping Lilly Pilly		Qld, NSW	Moderate	18	15	Evergreen	Fruit eaters	Common
Zelkova serrata 'Green Vase'	Japanese Zelkova		Hybrid, parent Japan	Fast	11	15	Deciduous	Unknown	Common. Bare rooted

Tree Species	Base Criteria	Drought Tolerance	Heat Tolerance	Wind Tolerance	Longevity	Pollution Tolerance	Pathogen and Pest Susceptability and Manageability	Potential as Allergen	Shade Cast	Maintenance Required	Tree Litter	ADAPTABILITY TO URBAN CONDITIONS	Location Type Criteria	Soil Compaction Tolerance	ADAPTABILITY WITHIN STREET TYPES	Beneath overhead powerlines (or with pruning-P)	Shade Tolerance	Location Type 1 – CAD Wide Footpath	Location Type 2 – CAD Narrow Footpath	Location Type 3 – CAD Laneway	Location Type 4 – CAD Wide Median With Carparking	Location Type 5 – CAD Wide Median With No Carparking
Acer rubrum 'October Glory'		3	3	3	3	3	5	5	3	3	5	36		5	41	No	No	Yes	Yes	No	Yes	Yes
Acer rubrum 'Scarsen'		3	3	3	3	3	5	5	3	3	5	36		5	41	No	Yes	Yes	Yes	No	Yes	Yes
Acer x freemanii 'Autumn Blaze'		4	4	3	3	3	5	5	3	3	5	38		4	42	No	No	Yes	Yes	No	Yes	Yes
Afrocarpus falcata		3	3	5	5	3	5	5	5	3	5	42		4	46	No	No	Yes	No	No	No	Yes
Agathis robusta		3	4	3	5	3	5	5	4	3	5	40		3	43	No	Yes	Yes	No	No	No	Yes
Allocasuarina torulosa		5	5	3	2	3	5	5	3	3	2	36		4	40	No	No	Yes	No	No	Yes	Yes
Angophora costata		5	5	5	5	3	5	3	2	3	4	40		3	43	Yes (P)	No	Yes	No	No	Yes	Yes
Angophora floribunda		4	4	3	2	3	5	5	2	3	5	36		3	39	No	No	Yes	No	No	No	Yes
Araucaria cunninghamii		3	3	5	4	3	5	5	3	5	5	41		3	44	No	No	Yes	No	No	Yes	Yes
Araucaria heterophylla		3	4	5	4	2	5	5	2	3	2	35		4	39	No	No	Yes	No	No	No	Yes
Banksia integrifolia subsp. *integrifolia*		3	4	5	4	3	5	5	2	3	5	39		4	43	Yes (P)	No	Yes	No	No	Yes	Yes
Banksia serrata		4	4	3	3	3	5	5	4	2	5	38		2	40	Yes (P)	No	Yes	No	No	No	Yes
Casuarina cunninghamiana		5	5	5	2	3	5	5	2	3	2	37		5	42	No	No	Yes	No	No	Yes	Yes
Cedrus atlantica		4	4	3	4	3	5	3	3	3	5	37		1	38	No	No	Yes	No	No	Yes	Yes
Cedrus deodara		3	4	3	4	3	4	3	3	3	4	34		4	38	No	No	Yes	No	No	No	Yes
Celtis australis		5	4	5	4	2	5	5	3	2	5	40		3	43	Yes (P)	Yes	Yes	No	No	Yes	Yes
Celtis occidentalis		5	4	3	4	3	5	5	3	2	5	39		4	43	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Corymbia maculata		5	4	3	3	3	5	5	2	3	5	38		4	42	No	No	Yes	No	No	Yes	Yes
Cupressus glabra (syn. *C. arizonica*)		5	4	5	2	3	5	3	5	3	5	40		2	42	No	No	Yes	Yes	No	Yes	Yes
Cupressus torulosa		3	5	3	4	3	5	5	5	5	5	43		3	46	No	No	Yes	No	No	Yes	Yes
Eucalyptus bancroftii		3	4	3	4	3	5	5	2	3	5	37		3	40	No	No	Yes	Yes	No	Yes	Yes
Eucalyptus camaldulensis		3	4	3	3	3	5	5	2	3	5	36		5	41	No	No	Yes	No	No	Yes	Yes
Eucalyptus cinerea		3	4	3	4	3	5	5	3	3	5	38		5	43	No	No	Yes	No	No	Yes	Yes
Eucalyptus leucoxylon		5	4	3	2	3	5	5	2	3	3	35		5	40	No	No	Yes	No	No	Yes	Yes
Eucalyptus melliodora		5	5	5	2	3	5	5	2	3	5	40		4	44	No	No	Yes	Yes	No	Yes	Yes
Eucalyptus polyanthemos		5	5	3	2	5	5	5	3	3	5	41		4	45	No	No	Yes	No	No	Yes	Yes
Eucalyptus scoparia		5	3	3	2	3	5	5	2	3	5	36		3	39	No	No	Yes	No	No	Yes	Yes
Eucalyptus sideroxylon		5	5	3	2	3	5	5	2	2	5	37		4	41	No	No	Yes	Yes	No	Yes	Yes
Ficus macrophylla		3	5	5	2	3	5	4	5	3	3	38		3	41	No	Yes	Yes	No	No	No	Yes
Ficus microcarpa var. *hillii*		4	4	3	4	3	3	5	5	2	5	38		4	42	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Fraxinus excelsior 'Aurea'		3	4	3	4	3	5	5	3	3	5	38		4	42	Yes (P)	No	Yes	Yes	No	Yes	Yes
Fraxinus pennsylvanica 'Cimmaron'		5	5	5	4	3	5	5	3	3	5	43		4	47	No	No	Yes	Yes	No	Yes	Yes
Fraxinus pennsylvanica 'Urbanite'		5	5	5	4	3	5	5	3	3	5	43		4	47	Yes (P)	No	Yes	Yes	No	Yes	Yes
Ginkgo biloba		3	5	3	4	3	5	5	2	3	4	37		4	41	No	Yes	Yes	No	No	No	Yes
Gleditsia triacanthos var.inermis Varieties		5	4	3	2	3	5	5	2	3	5	37		4	41	No	Yes	Yes	Yes	Yes	No	Yes
Jacaranda mimosifolia		3	4	3	2	3	5	5	2	3	4	34		4	38	Yes (P)	No	Yes	Yes	No	Yes	Yes
Liquidambar formosana		3	3	3	3	3	5	5	3	3	5	36		3	39	Yes (P)	Yes	Yes	Yes	Yes	Yes	Yes
Liquidambar styraciflua 'Rotundiloba'		3	4	3	4	5	5	5	3	3	5	40		4	44	No	Yes	Yes	No	No	Yes	Yes
Lophostemon confertus		3	4	3	4	3	5	5	4	3	5	39		4	43	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Maclura pomifera 'Wichita'		5	4	5	2	3	5	5	4	3	5	41		4	45	No	No	Yes	No	No	Yes	Yes
Metasequoia glyptostroboides		3	5	5	4	3	5	5	3	5	5	43		3	46	No	No	Yes	Yes	No	Yes	Yes
Paulownia tomentosa		5	5	1	4	3	3	5	3	3	5	37		4	41	No	No	Yes	No	No	Yes	Yes
Pinus canariensis		5	5	5	2	3	5	3	3	3	5	39		4	43	No	No	Yes	No	No	Yes	Yes
Pinus halepensis		5	5	3	3	3	5	3	3	3	5	38		3	41	No	No	Yes	No	No	Yes	Yes
Pinus patula		5	5	5	3	3	5	3	3	3	5	40		3	43	No	No	Yes	No	No	Yes	Yes
Pinus pinaster		5	5	5	2	3	5	3	3	3	5	39		3	42	No	No	Yes	No	No	Yes	Yes
Pinus pinea		5	5	5	3	3	5	3	4	3	5	41		4	45	No	No	Yes	No	No	Yes	Yes
Platanus orientalis 'Digitata'		3	2	3	4	4	3	1	3	3	2	28		4	32	Yes (P)	No	Yes	No	No	Yes	Yes
Platanus X *acerifolia*		4	3	5	3	5	5	1	4	3	2	35		4	39	Yes (P)	No	Yes	No	No	Yes	Yes
Podocarpus elatus		2	4	3	4	3	3	5	5	3	5	37		2	39	No	No	Yes	No	No	Yes	Yes
Pyrus calleryana varieties		3	3	3	3	5	5	5	3	3	5	38		4	42	No	No	Yes	Yes	No	Yes	Yes
Pyrus nivalis		3	4	3	4	3	5	5	3	2	5	37		4	41	Yes (P)	No	Yes	No	No	Yes	Yes
Quercus acutissima		3	4	3	4	3	5	5	3	3	5	38		3	41	Yes (P)	No	Yes	No	No	Yes	Yes
Quercus agrifolia		3	4	3	4	3	5	5	5	3	5	40		3	43	No	No	Yes	No	No	Yes	Yes
Quercus bicolor		5	5	3	4	3	5	5	4	3	5	42		4	46	Yes (P)	No	Yes	No	No	Yes	Yes
Quercus canariensis		5	5	3	4	3	5	5	4	3	5	42		3	45	No	No	Yes	No	No	No	Yes
Quercus cerris		5	3	3	4	3	5	5	3	3	2	36		3	39	Yes (P)	No	Yes	No	No	Yes	Yes
Quercus coccinea		4	3	3	4	3	5	5	4	3	5	39		4	43	No	No	Yes	No	No	Yes	Yes
Quercus ilex		5	5	5	4	3	5	5	5	3	5	45		3	48	No	No	Yes	No	No	Yes	Yes
Quercus macrocarpa		5	4	3	4	3	5	5	3	3	5	40		5	45	No	No	Yes	No	No	Yes	Yes
Quercus palustris		3	3	3	4	5	5	5	3	3	5	39		4	43	No	No	Yes	No	No	Yes	Yes
Quercus phellos		4	4	5	4	5	5	5	4	3	5	44		4	48	No	No	Yes	No	No	Yes	Yes
Quercus robur		3	4	3	4	3	3	5	4	3	4	36		4	40	Yes (P)	No	Yes	No	No	Yes	Yes
Quercus rubra		4	3	3	4	5	5	5	3	3	5	40		4	44	Yes (P)	No	Yes	No	No	Yes	Yes
Robinia pseudoacacia (Varieties)		5	4	5	2	3	5	5	2	3	5	39		5	44	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sapium sebiferum		5	4	3	3	3	5	3	3	3	5	37		5	42	Yes (P)	No	Yes	No	No	Yes	Yes
Schinus areira		5	5	3	4	3	5	5	2	2	2	36		5	41	No	Yes	Yes	Yes	No	Yes	Yes
Syzygium paniculatum		3	4	3	3	3	5	5	5	3	2	36		4	40	No	Yes	Yes	Yes	No	Yes	Yes
Taxodium distichum		4	3	3	4	3	5	5	3	3	5	38		4	42	No	No	Yes	No	No	Yes	Yes
Ulmus glabra 'Lutescens'		3	2	3	3	5	1	5	4	1	3	30		4	34	No	No	Yes	No	No	Yes	Yes
Ulmus parvifolia		5	5	3	3	3	5	5	4	2	5	40		5	45	No	Yes	Yes	Yes	No	Yes	Yes
Ulmus procera		2	2	5	3	5	1	5	4	1	5	33		5	38	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Ulmus x hollandica		2	2	3	3	5	1	5	4	1	5	31		5	36	Yes (P)	Yes	Yes	Yes	No	No	Yes
Waterhousea floribunda		3	4	3	2	3	5	5	5	3	5	38		4	42	No	Yes	Yes	Yes	No	Yes	Yes
Zelkova serrata 'Green Vase'		3	4	5	4	5	3	5	3	3	5	40		4	44	Yes (P)	No	Yes	No	No	Yes	Yes

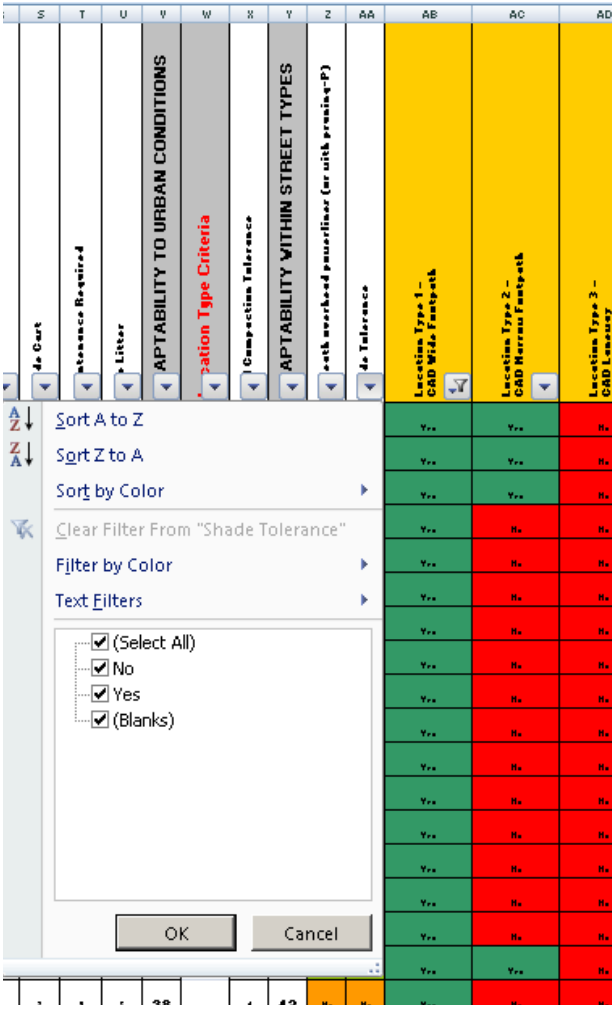
Step 3

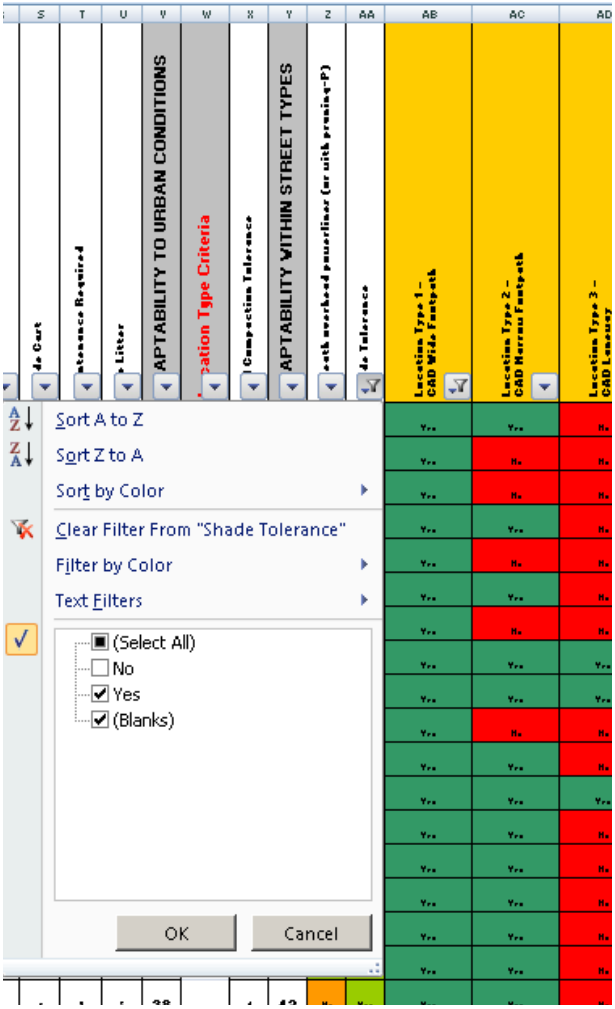
To further refine this list to show only trees suitable to shady conditions, it is necessary now to sort the Matrix by the column “Shade Tolerance”



Step 3 Continued

To sort the Shade Tolerance column click on the ▾ symbol in the top cell of the Shade Tolerance column. Click on the checkbox next to “No” to deselect that sort option and thus exclude all trees marked “No” from being displayed. Click OK to finish this step.

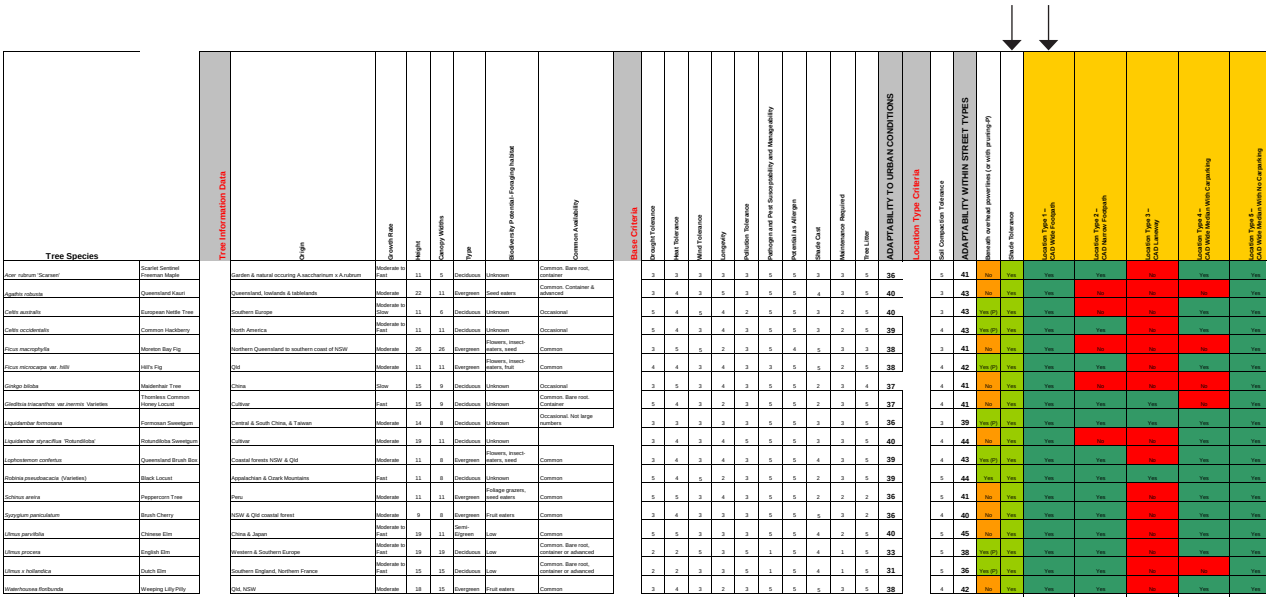




Step 3 Continued

You can see here that only trees both marked “Yes” in the Shade Tolerance column and in the Location Type 1 – CAD Wide Footpath column are being displayed.

This is the list of trees considered adaptable to urban conditions and suitable to Location Type 1 – CAD Wide Footpath, and suitable for being grown in shady conditions.



Tree Species		Tree Information Data	Origin	Growth Rate	Height	Canopy Widths	Type	Biodiversity Potential: Foraging habitat	Common Availability	Base Criteria	Drought Tolerance	Heat Tolerance	Wind Tolerance	Longevity	Pollution Tolerance	Pathogen and Pest Susceptability and Manageability	Potential as Allergen	Shade Cast	Maintenance Required	Tree Litter	ADAPTABILITY TO URBAN CONDITIONS	Location Type Criteria	Soil Compaction Tolerance	ADAPTABILITY WITHIN STREET TYPES	Shade Tolerance (or with pruning?)	Shade Tolerance	Location Type 1 – CAD Wide Footpath	Location Type 2 – CAD Narrow Footpath	Location Type 3 – CAD Laneway	Location Type 4 – CAD Wide Median With No Carparking	Location Type 5 – CAD Wide Median With Kc Carparking
Acer rubrum 'Scarsen'	Scarlet Sentinel Freeman Maple		Garden & natural occuring A.saccharinum x A.rubrum	Moderate to Fast	11	5	Deciduous	Unknown	Common. Bare root, container		3	3	3	3	3	5	5	3	3	5	36		5	41	No	Yes	Yes	Yes	No	Yes	Yes
Agathis robusta	Queensland Kauri		Queensland, lowlands & tablelands	Moderate	22	11	Evergreen	Seed eaters	Common. Container & advanced		3	4	3	5	3	5	5	4	3	5	40		3	43	No	Yes	Yes	No	No	No	Yes
Celtis australis	European Nettle Tree		Southern Europe	Moderate to Slow	11	6	Deciduous	Unknown	Occasional		5	4	5	4	2	5	5	3	2	5	40		3	43	Yes (P)	Yes	Yes	No	No	Yes	Yes
Celtis occidentalis	Common Hackberry		North America	Moderate to Fast	11	11	Deciduous	Unknown	Occasional		5	4	3	4	3	5	5	3	2	5	39		4	43	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Ficus macrophylla	Moreton Bay Fig		Northern Queensland to southern coast of NSW	Moderate	26	26	Evergreen	Flowers, insect-eaters, seed	Common		3	5	5	2	3	5	4	5	3	3	38		3	41	No	Yes	Yes	No	No	No	Yes
Ficus microcarpa var. hillii	Hill's Fig		Qld	Moderate	11	11	Evergreen	Flowers, insect-eaters, fruit	Common		4	4	3	4	3	3	5	5	2	5	38		4	42	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Ginkgo biloba	Maidenhair Tree		China	Slow	15	9	Deciduous	Unknown	Occasional		3	5	3	4	3	5	5	2	3	4	37		4	41	No	Yes	Yes	No	No	No	Yes
Gleditsia triacanthos var.inermis Varieties	Thornless Common Honey Locust		Cultivar	Fast	15	9	Deciduous	Unknown	Common. Bare root, Container		5	4	3	2	3	5	5	2	3	5	37		4	41	No	Yes	Yes	Yes	Yes	No	Yes
Liquidambar formosana	Formosan Sweetgum		Central & South China, & Taiwan	Moderate	14	8	Deciduous	Unknown	Occasional. Not large numbers		3	3	3	3	3	5	5	3	3	5	36		3	39	Yes (P)	Yes	Yes	Yes	Yes	Yes	Yes
Liquidambar styraciflua 'Rotundiloba'	Rotundiloba Sweetgum		Cultivar	Moderate	19	11	Deciduous	Unknown			3	4	3	4	5	5	5	3	3	5	40		4	44	No	Yes	Yes	No	No	Yes	Yes
Lophostemon confertus	Queensland Brush Box		Coastal forests NSW & Qld	Moderate	11	8	Evergreen	Flowers, insect-eaters, seed	Common		3	4	3	4	3	5	5	4	3	5	39		4	43	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Robinia pseudoacacia (Varieties)	Black Locust		Appalachian & Ozark Mountains	Fast	11	8	Deciduous	Unknown	Common		5	4	5	2	3	5	5	2	3	5	39		5	44	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schinus areira	Peppercorn Tree		Peru	Moderate	11	11	Evergreen	Foliage grazers, seed eaters	Common		5	5	3	4	3	5	5	2	2	2	36		5	41	No	Yes	Yes	Yes	No	Yes	Yes
Syzygium paniculatum	Brush Cherry		NSW & Qld coastal forest	Moderate	9	8	Evergreen	Fruit eaters	Common		3	4	3	3	3	5	5	5	3	2	36		4	40	No	Yes	Yes	Yes	No	Yes	Yes
Ulmus parvifolia	Chinese Elm		China & Japan	Moderate to Fast	19	11	Semi-Elgreen	Low	Common		5	5	3	3	3	5	5	4	2	5	40		5	45	No	Yes	Yes	Yes	No	Yes	Yes
Ulmus procera	English Elm		Western & Southern Europe	Moderate to Fast	19	19	Deciduous	Low	Common. Bare root, container or advanced		2	2	5	3	5	1	5	4	1	5	33		5	38	Yes (P)	Yes	Yes	Yes	No	Yes	Yes
Ulmus x hollandica	Dutch Elm		Southern England, Northern France	Moderate to Fast	15	15	Deciduous	Low	Common. Bare root, container or advanced		2	2	3	3	5	1	5	4	1	5	31		5	36	Yes (P)	Yes	Yes	Yes	No	No	Yes
Waterhousea floribunda	Weeping Lilly-Pilly		Qld, NSW	Moderate	18	15	Evergreen	Fruit eaters	Common		3	4	3	2	3	5	5	3	3	5	38		4	42	No	Yes	Yes	Yes	No	Yes	Yes

Tree information data

Tree name

Provides botanical name, (genus, species, variety and cultivar) according to accepted international code of taxonomic classification, and common name.

Origin

Country or region where tree species grows naturally. Cultivated plants (cultigens) have been listed as cultivars – plants bred or selected for certain characteristics.

Rate

Estimated growth rate of particular tree species. Based on expected extension growth; slow 100mm to 300mm per annum, moderate 300mm to 500mm per annum, fast up to or greater than 500mm per annum.

Height and width

Estimated canopy height and width, in metres, of the species or cultivar growing in urban landscapes in Melbourne. Estimation based on referenced literature and experience.

Tree form

Broad domed = Broad spread, rounded.

Generally crown is as wide as it is high.

Sub form – Broad domed, pendulous. As above with pendulous branchlets.

Broad domed, ascending. As above with ascending, upright branches

Narrow domed = narrow spread, oval, ovoid.

Generally crown taller than it is wide.

Sub form – Narrow domed, pendulous. As above with pendulous branchlets.

Narrow domed, ascending. As above with ascending, upright branches

Pyramidal = conical.

Crown generally wider at base than at apex.

Sub form – Pyramidal, tiered. Branches layered or arranged in whorls

Columnar = fastigiate, spired

Vase = ascending branches, fanning out from trunk. Crown wider at top than at base.

Palm. Generally, one straight stem and crown of large evergreen leaves that are either palmately ('fan-leaved') or pinnately ('feather-leaved').

Availability

Indicates whether species or variety is commonly available from commercial nurseries in sufficient numbers, or is rarely available from specialist nurseries. This may indicate whether a desired species or cultivar should be contract grown. Also indicates different production methods.

Biodiversity Potential

The study of urban ecology is relatively recent, with research on how living organisms interact with each other in cities relatively limited. Climate change and the planning of the built environment have resulted in shifts within the urban ecology. Urban ecology research has, as an example, been able to explain the presence of the normally warm temperate and subtropical Grey Headed Flying Fox set up in permanent camps in the city. Research by the Australian Research Centre for Urban Ecology has shown that the heat island effect, reduction in frosts, increased planting of flowering eucalypts (whose flowering is stimulated by irrigation and a lack of natural pests) has allowed these mammals to colonise Melbourne. It is information such as this that can inform how planning for the urban forest can be beneficial in achieving biodiversity goals. As with research input generally, more data is required to better define these goals. Information has been provided in the tree selection that does provide some guidance on trees that have a value for food or foraging.

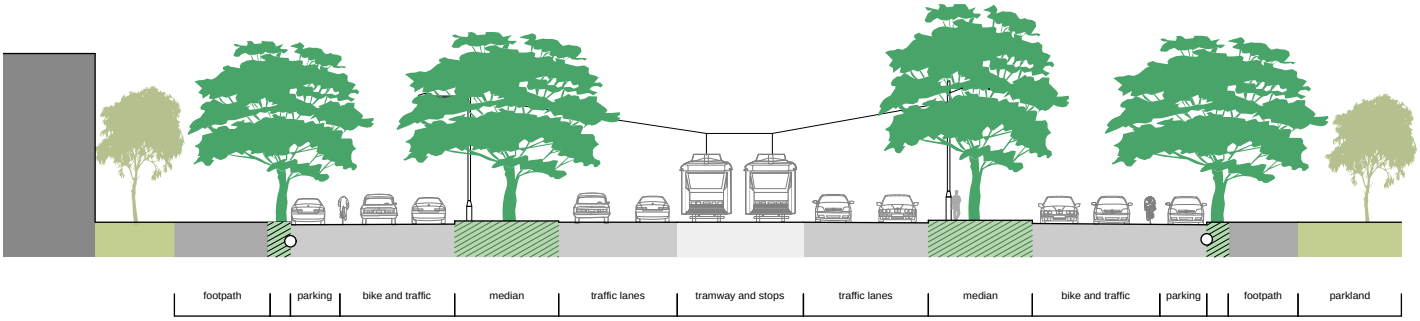
Appendix 3: Location Typology – Additional Location Types

The following pages show Location Types considered for, but not included in, the final Location Typology for Trees Within City of Melbourne Streets and Parks.

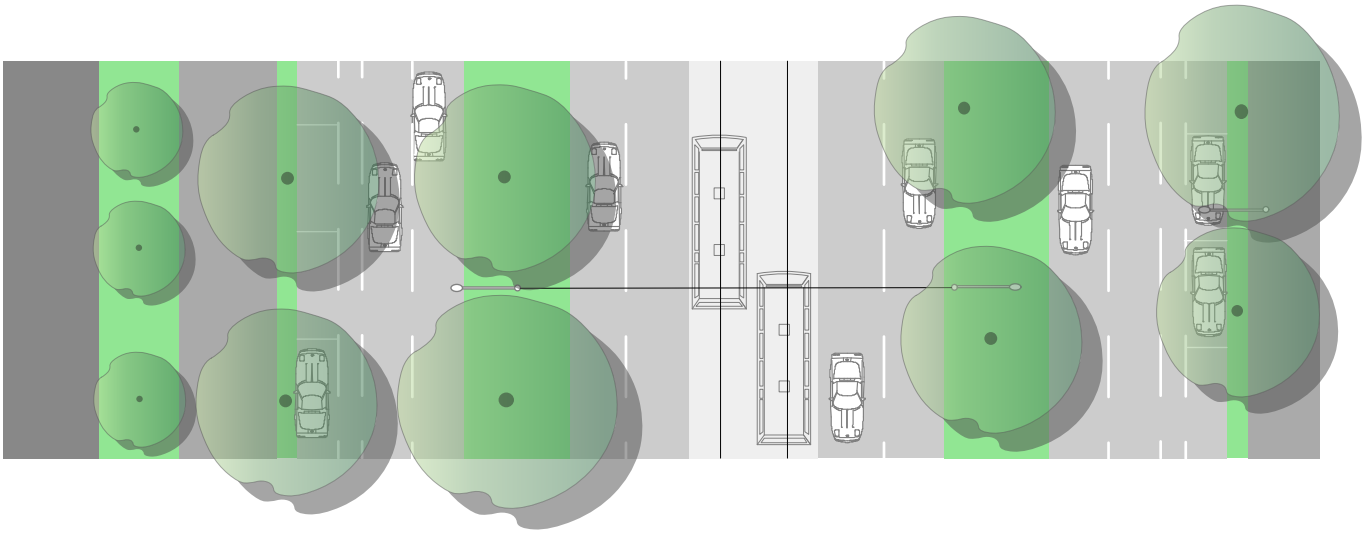
CAD Boulevard Median With No Trams near Median Planting

Description of Key Characteristics

Street Width	60 metre
Traffic Lanes	8 lane boulevard with double medians and central tramway. Bike lanes at road edge.
Overhead	Lighting, Tram cabelling in centre
Buildings	Medium and/or parkland
Parking	Parallel kerbside
Road centre	Two planted and grassed medians
Pathways	3 metre/various width footpath. Setback from road edge
Trees	4 main avenues
Example	St Kilda Road, Royal Parade, Flemington Road



Typical Section

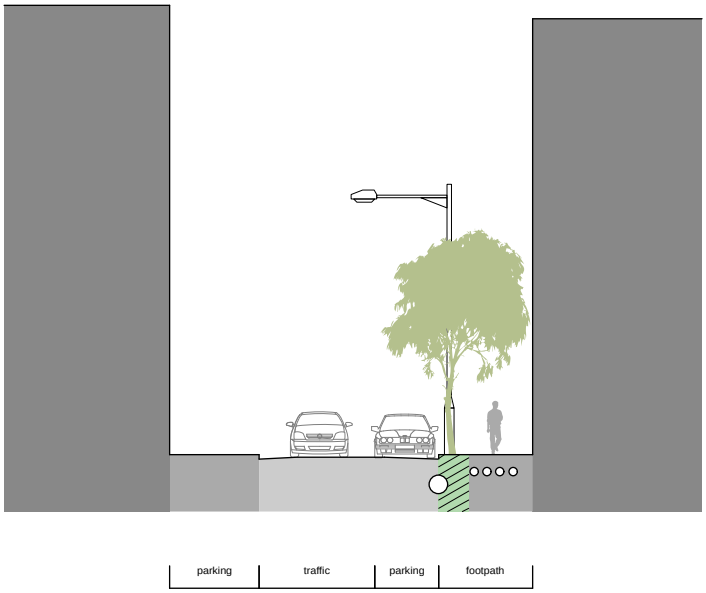


Typical Plan

CAD Laneway Wide

Description of Key Characteristics

Street Width	10-12 metres
Traffic Lanes	Mostly single lane. Often running east/west
Overhead	Lighting
Buildings	Medium to high at footpath edge
Parking	Parallel kerbside mostly on one side
Road centre	–
Pathways	< 3 metre footpath at roadside
Trees	Often on one side of street
Example	Little Collins Street, Flinders Lane



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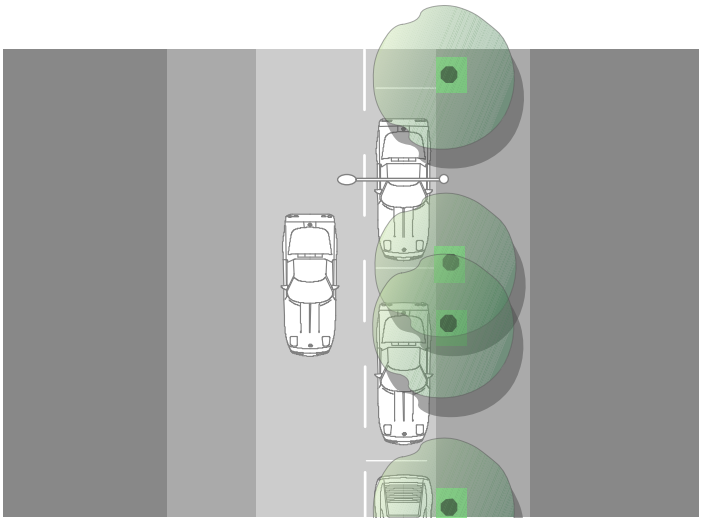
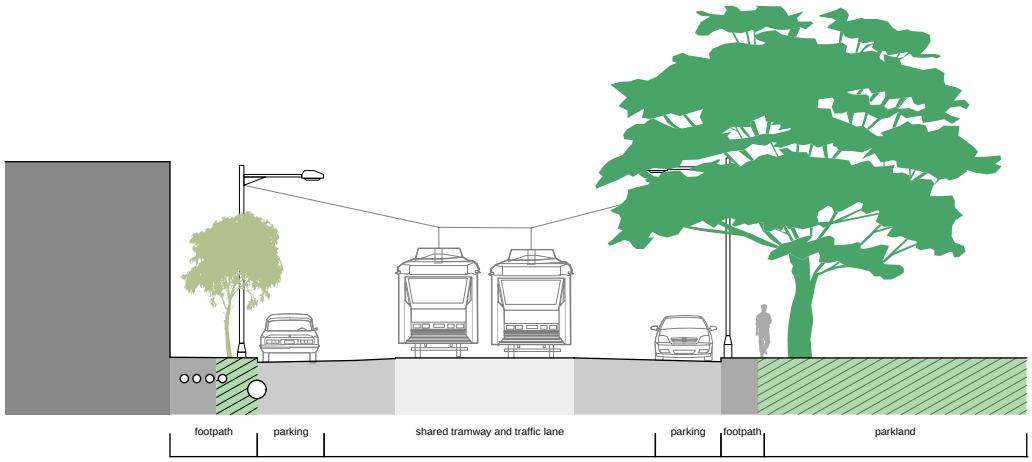


Typical Plan

Park and Road

Description of Key Characteristics

Street Width	20 -30 metres
Traffic Lanes	2 lane shared with tramway
Overhead	Lighting, tram cabling
Buildings	Medium height and parkland
Parking	Parallel kerbside
Road centre	May have tramway
Pathways	Narrow to wide. Often setback off road
Trees	Larger trees in park
Examples	The Avenue Parkville, Rathdowne Street, Domain Road



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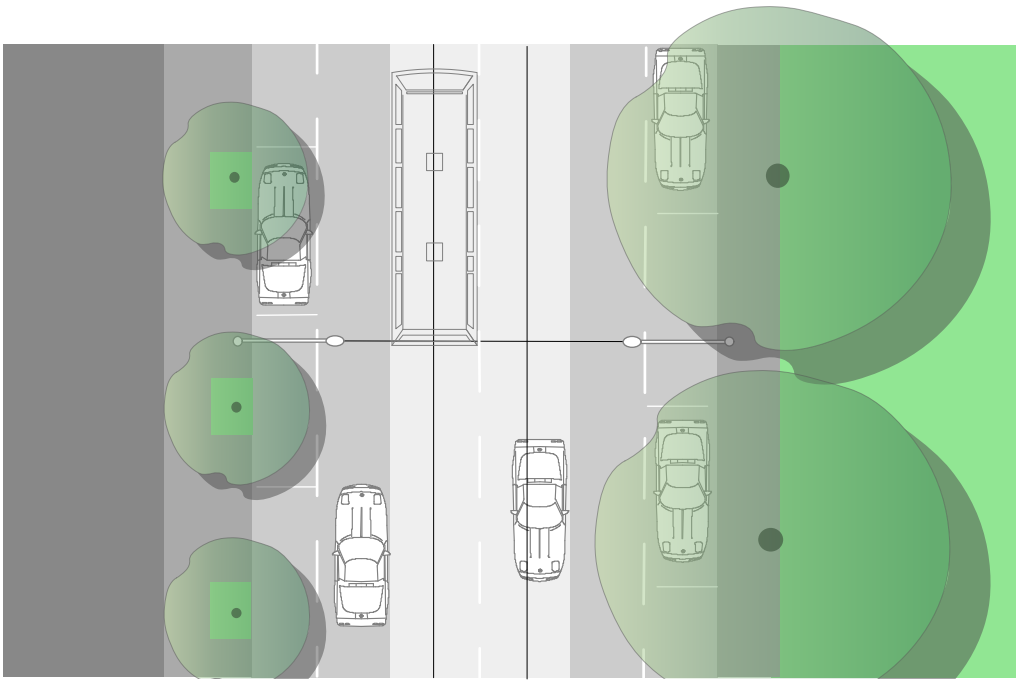
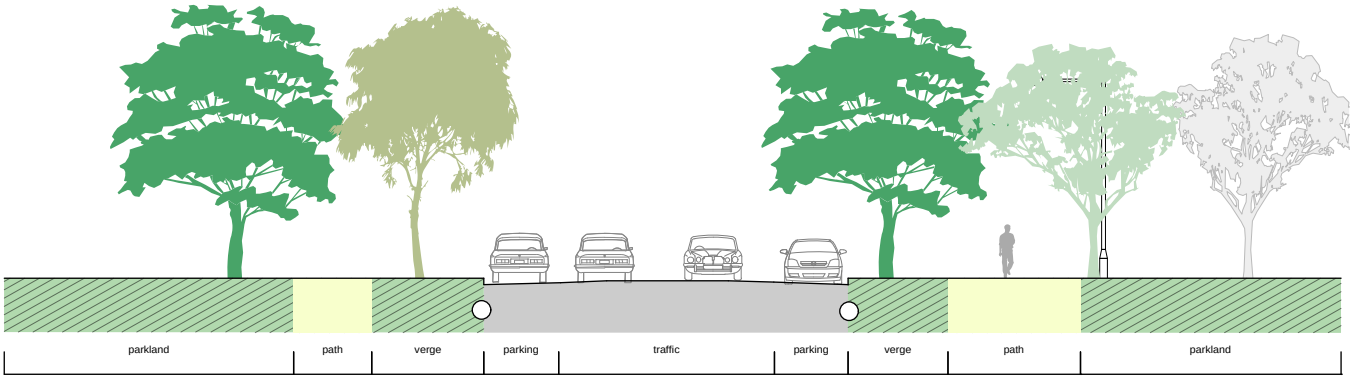


Typical Plan

Park Road Through

Description of Key Characteristics

Street Width	20 metre
Traffic Lanes	2 lane
Overhead	Lighting
Buildings	None
Parking	Varied or none
Road centre	–
Pathways	Varied pathways, with setback from road edge
Trees	Avenues along road and pathways
Example	Birdwood Avenue



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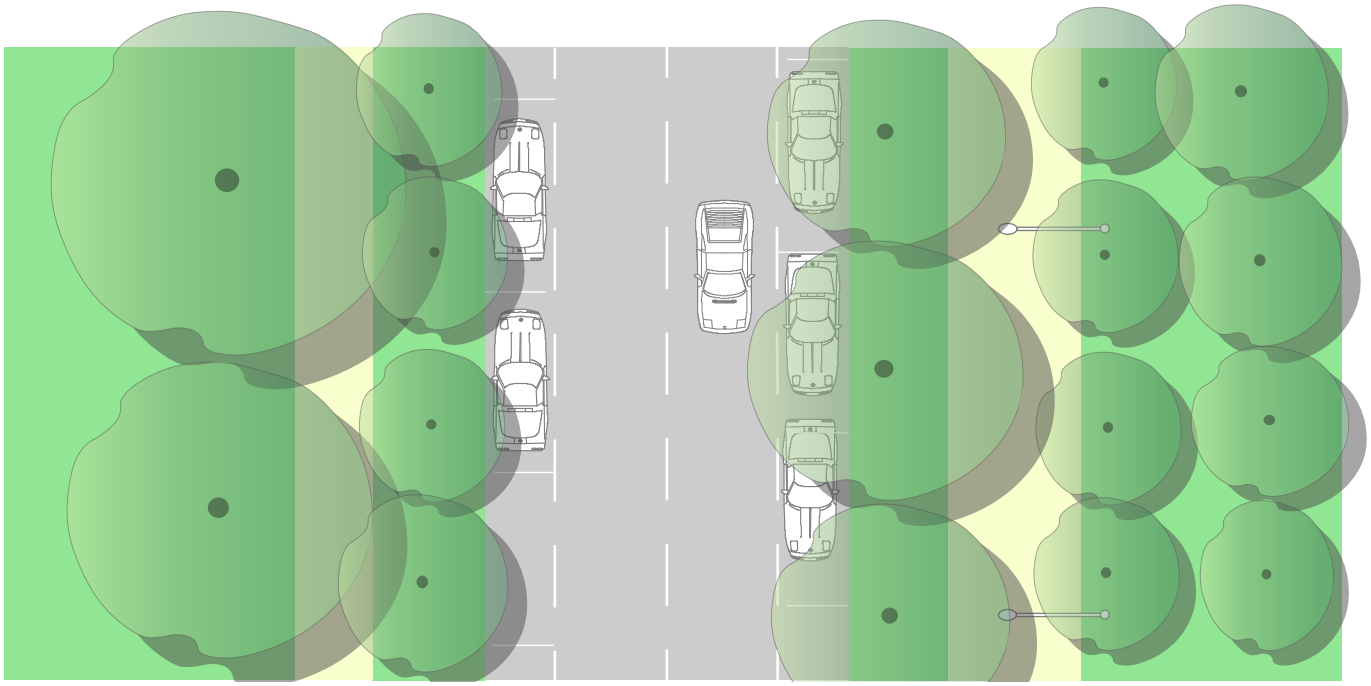
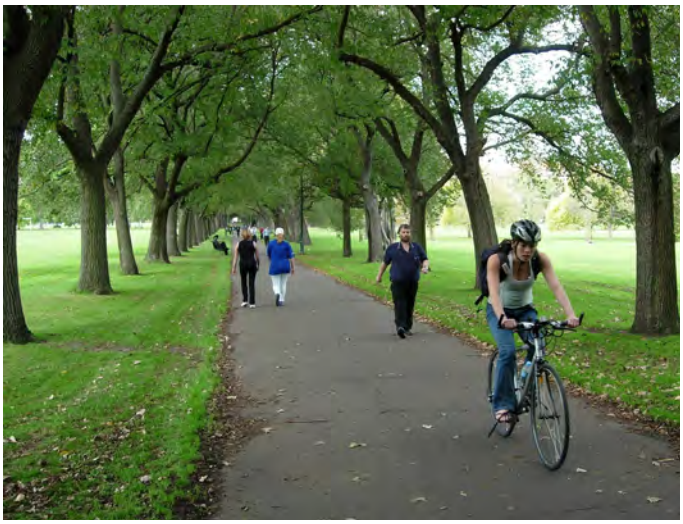


Typical Plan

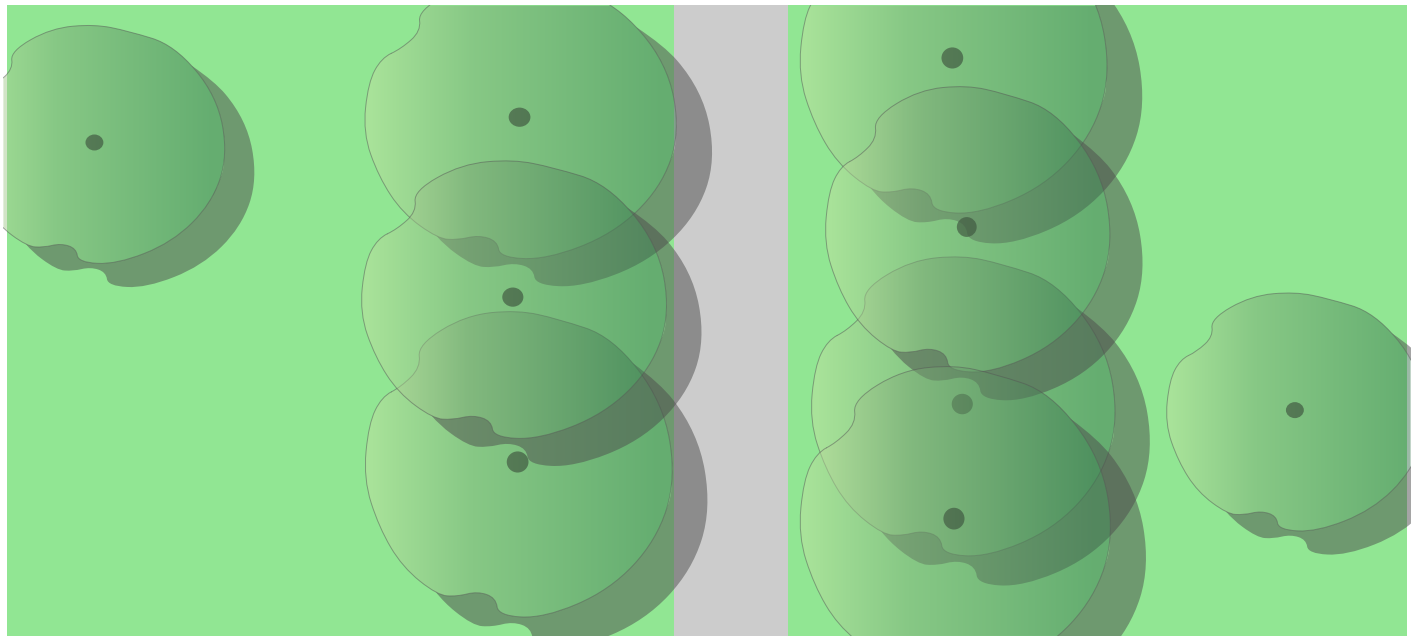
Park Avenue



Description of Key Characteristics

Street Width	–
Traffic Lanes	–
Overhead	–
Buildings	–
Parking	–
Road centre	–
Pathways	Narrow to wide pedestrian pathway network
Trees	Avenue plantings
Example	University Square

Typical Section

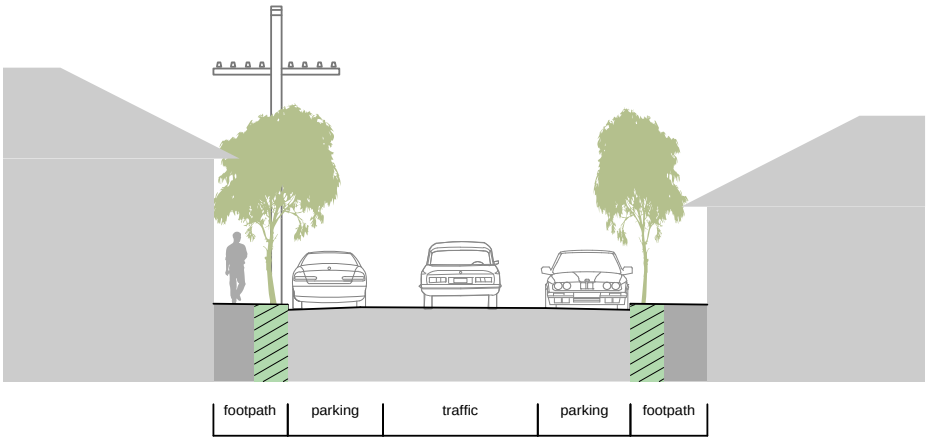


Typical Plan

Residential Narrow Street

Description of Key Characteristics

Street Width	12-15 metres
Traffic Lanes	Single lane, or shared
Overhead	Powerlines, lighting
Buildings	Residential
Parking	Parallel kerb
Road centre	–
Pathways	< 2.5 metre footpath at road edge
Trees	Kerb edge
Example	Bayswater Road Kensington



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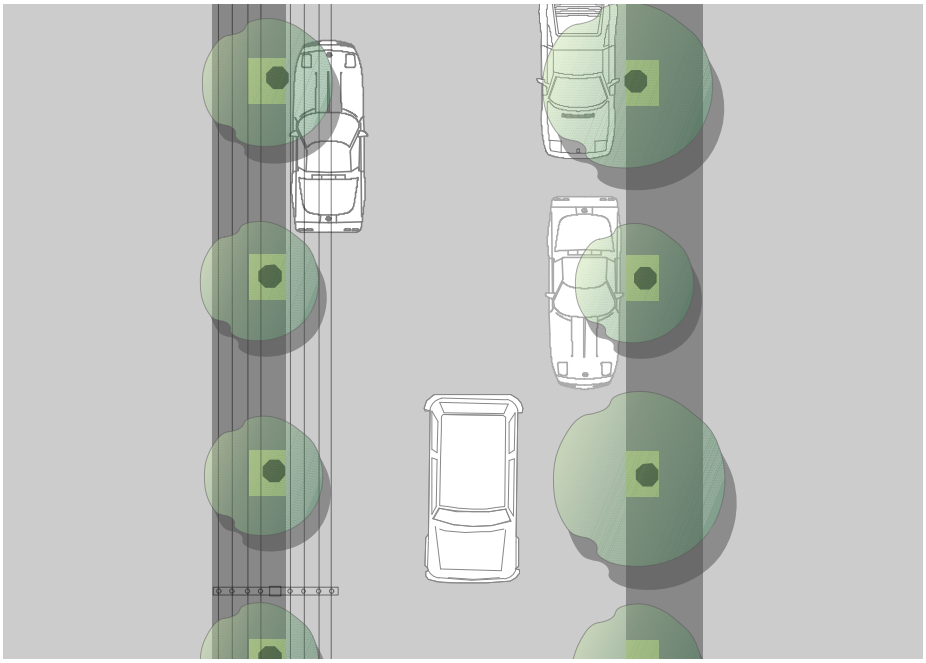
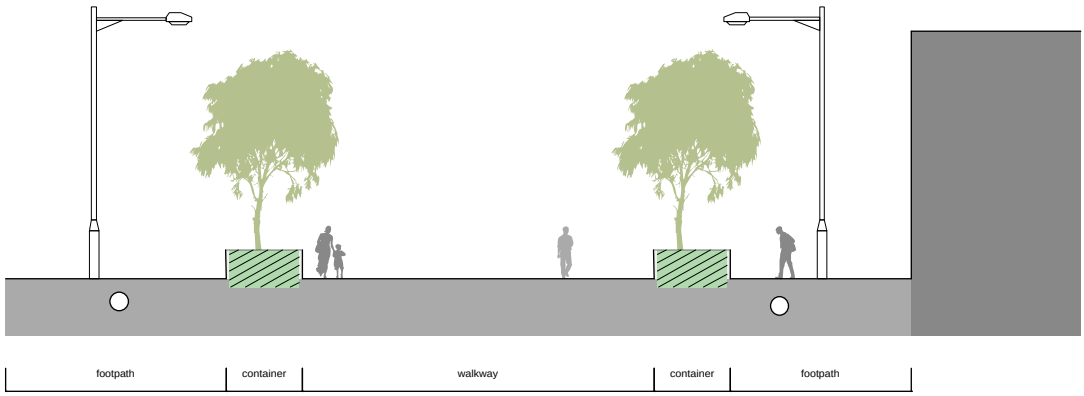


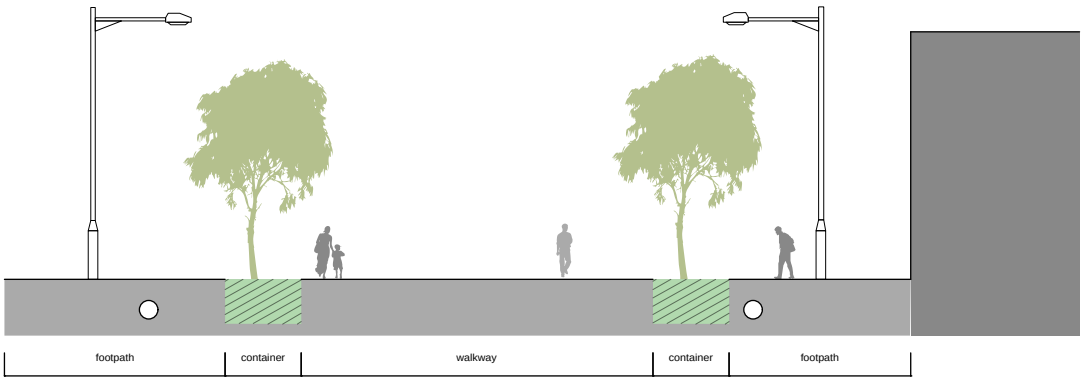
Typical Plan

Container

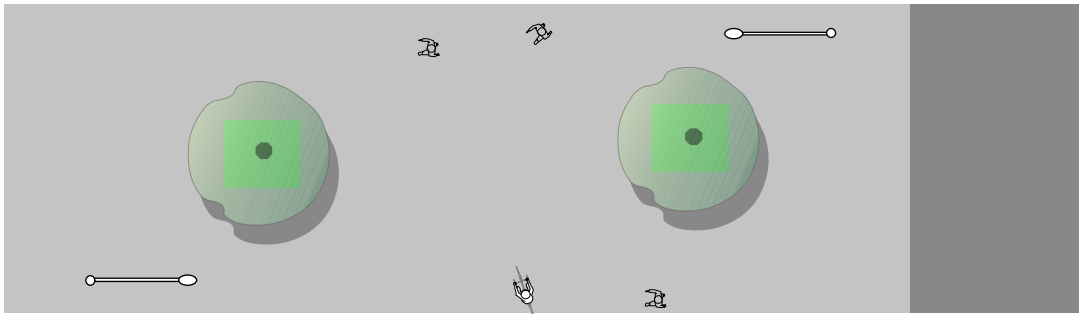
Description of Key Characteristics

Street Width	Varied
Traffic Lanes	Pedestrian traffic primarily
Overhead	Lighting
Buildings	Varied heights
Parking	–
Road centre	–
Pathways	Varied width pathway and open space
Trees	Container plantings
Example	Bourke St Mall, Docklands, Roof Gardens, Southbank.





Typical Sections



Typical Plan

Appendix 4: Adaptability and Vigour

What makes a useful street tree for Melbourne according to the tree selection matrix ?

An adaptable street tree that is vigorous is desirable in Melbourne's future urban forest. The scoring of the Base Criteria shows that careful consideration of the species was considered initially. All the 148 species pass. There are no trees that can be considered as having a low adaptability as they have been culled in the first instance. All trees have a moderate adaptability or higher. The trees can be given intervals of adaptability to help analyse the list and determine which trees can be used in priority tree replacement streets.

Intervals for analysis can include:

1) Moderate Adaptability: 25-33. Examples of species in this lower ranking bracket that comprises 10% of the list include:

- Trident Maple
- Lilly Pilly
- Norfolk Island Pine
- Moreton Bay Fig
- Pistachio
- *Stenocarpus*
- Golden, English and Dutch Elms

There are no clear patterns, as there are many genera found in the moderate adaptability found in the next higher. However trees that benefit from water and shelter such as the cool climate Maples, Australian rainforest species and Elms tend to be found in this range.

2) Moderate to High Adaptability: 33-41. Examples of species in this median range bracket comprising 71% of the list include:

- Norway Maple
- She-Oak
- Coastal Banksia
- Common Hackberry
- Bottlebrush
- *Corymbia* sp.
- *Eucalyptus* sp.
- Port Jackson Fig
- Ash
- *Melaleuca*
- Pines
- Pears
- Oaks
- Fan Palms
- Weeping Lilly Pilly

A large representation of the Australian myrtaceous trees such as *Eucalypts*, *Corymbias* and *Melaleucas*. There are also number of hardier deciduous trees from Asia, southern Europe, the Mediterranean and America. Piles also dominate.

3) High Adaptability: 42-50. Examples of species in this higher range bracket comprising 5% of the list include:

- Kurrajong
- Cypress Pines
- Cypress
- Liquidamber
- Holly Oak

An eclectic group of trees, this includes Australian native trees from the interior and dry slopes, the Cypress from USA and the Middle East and evergreen oaks. All trees from harsh dry climates.

Appendix 5: Limitations, Qualitative Judgments and Research Data

The assessment criteria for the street tree diversity list have been developed with expert technical opinion that covers arboricultural experience, from landscape architectural advice and also from Council's own experience and input. The application of urban forest management practice within Australian cities is relatively recent. There is a lack of critical data and research. As a consequence, to make the assessment of the tree selection criteria the limitations need to be identified to define qualitative judgment.

Research Data

The performance of street trees in Melbourne is based on what has been growing in the City's streets over time and what has been growing in similar climates in adjoining Council Local Government Areas with similar climates. There are horticultural factors such as frosts, soil types and planting methods and practices that vary across the Greater Melbourne area. The tree diversity list is intentionally 'live' to allow trialing of new species and consequent research data to be incorporated. Research from universities and technical institutes is limited by funding provided both publicly and privately. It is unfortunate in Australia that such funding is limited, though it is hoped that this will change. Research data is critical for Council to manage the urban forest effectively.

Shade Rating

The quality of shade that trees provide in the city is an important attribute. The quality and extent of shade has a direct impact on street microclimate, personal comfort and ultimately the liveability and success of our streets. Shade rating like biodiversity potential is an important goal for planning the urban forest. However the methods for determining shade quality are not easily qualified by scientific data. While the Leaf Area Index (LAI) is a measurement of leaf area per unit ground surface area, it is not a determinant for shade quality. LAI is used in agriculture and forestry to predict crop and tree growth for production. Other techniques include hemispherical (or fisheye) photography. This technique involves analyzing tree canopy photography, however is applicable to ecological or canopy forest cover. It measures the amount of solar penetration in the canopy, not for individual street trees. Light sensors can be used for individual trees, however data would need to be logged over time to determine solar radiation levels and canopy architecture. (Rich, P.M. 1990. Characterizing plant canopies with hemispherical photographs.)

For this study the shade quality is determined by what we assess to be a comfortable shade level. The shade levels were defined in intervals from heavy to light. These patterns of shade have been identified with photographs as a gauge of shade intensity.

Appendix 6: Crown Projection Method

To calculate how much soil is needed for a given size tree, the Urban Horticulture Institute (2003) based at Cornell University in the United States has developed a step-by-step methodology. The following is a shortcut version of that methodology that can be used to approximate soil volume requirements.

1. Measure the distance from the tree's main trunk to the dripline, or consult a reference book to find the optimum mature spread of the tree you are considering. Estimate that the tree will reach 75% of the optimum. Take half of the realistic spread, which is the radius, r.
2. Calculate 3.1416 x r2. That's the crown projection, the area under the dripline of the tree.
3. For every square meter of crown projection, provide 0.6m3 of soil.

Example: *Platanus x acerifolia* (London Plane) has the ability to reach 20m height x 18m canopy width (avg.) with a trunk diameter of 45cm measured at 1.4m from ground level. Tree is growing in Melbourne with no irrigation. The canopy radius would be 9.0m.

The crown projection would be (3.14)x(9.0 x 9.0)= 254.46m2

254.46m2 x 0.6 = 152.68 cubic meters of soil volume needed.

Tree roots generally will not be found deeper than one meter; consequently one meter is used as a depth dimension (unless you know the planting site will be shallower). 15270cm/100cm = 152.7m2; the area of useable soil in your planter (equivalent to a planting site that's approximately 12.3 meters wide, 12.3 meters long, and 1.0 meter deep).

(http://www.hort.cornell.edu/department/faculty/bassuk/uhi/walk5.html)

Watson & Himelick (1997) also use the crown projection method and suggest as a general guide that root space should be 60cm deep within the projected crown area. This method is also supported in part by the notion that fine root density is usually greater beneath the canopy than beyond (Gilman, 1997).

Appendix 7: Master Lists of All Street Trees, Park Trees and Trial Trees

Master List of Street Trees

Acer buergerianum
Acer campestre 'Elsrijk'
Acer campestre 'Evelyn'
Acer platanoides 'Crimson Sentry'
Acer platanoides 'Globosum'
Acer rubrum 'October Glory'
Acer rubrum 'Scarsen'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Afrocarpus falcata
Agathis robusta
Agonis flexuosa
Allocasuarina littoralis
Allocasuarina torulosa
Allocasuarina verticillata
Angophora costata
Angophora floribunda
Angophora hispida (Syn. A. cordifolia)
Araucaria cunninghamii
Araucaria heterophylla
Banksia integrifolia subsp. integrifolia
Banksia serrata
Brachychiton acerifolius
Brachychiton populneus
Brachychiton rupestris
Brachychiton x roseus
Callistemon 'Harkness'
Callistemon salignus
Callistemon viminalis
Casuarina cunninghamiana
Casuarina glauca
Catalpa bignonioides 'Nana'
Cedrus atlantica
Cedrus deodara
Celtis australis
Celtis occidentalis
Cercis siliquastrum
Cinnamomum camphora
Corymbia citriodora
Corymbia eximia
Corymbia ficifolia
Corymbia maculata
Cupaniopsis anachardioides
Cupressus glabra (syn. C. arizonica)
Cupressus sempervirens
Cupressus torulosa
Eucalyptus bancroftii
Eucalyptus camaldulensis
Eucalyptus cinerea
Eucalyptus cosmophylla
Eucalyptus gregsoniana
Eucalyptus leucoxylon
Eucalyptus leucoxylon dwarf form
Eucalyptus leucoxylon ssp. megalocarpa
Eucalyptus mannifera subsp. maculosa
Eucalyptus melliodora
Eucalyptus nicholii
Eucalyptus platypus
Eucalyptus polyanthemos
Eucalyptus pulchella
Eucalyptus scoparia
Eucalyptus sideroxylon
Eucalyptus spathulata
Eucalyptus stoatei
Ficus macrophylla
Ficus microcarpa var. hillii
Ficus platypoda
Ficus rubiginosa
Fraxinus excelsior 'Aurea'
Fraxinus ornus
Fraxinus ornus 'Meczek'
Fraxinus pennsylvanica 'Aerial'
Fraxinus pennsylvanica 'Cimmaron'
Fraxinus pennsylvanica 'Urbanite'
Fraxinus velutina
Geijera parviflora
Ginkgo biloba
Ginkgo biloba 'Princeton Sentry'
Gleditsia triacanthos var.inermis Varieties
Hakea francisiana
Jacaranda mimosifolia
Koelreuteria paniculata
Lagerstroemia indica x L. fauriei varieties
Leptospermum petersonii
Liquidambar formosana
Liquidambar styraciflua 'Rotundiloba'
Lophostemon confertus
Maclura pomifera 'Wichita'
Magnolia grandiflora 'Exmouth'
Melia azedarach
Metasequoia glyptostroboides
Olea europea
Paulownia tomentosa
Phoenix canariensis
Pinus canariensis
Pinus halepensis
Pinus patula
Pinus pinaster
Pinus pinea
Pistacia chinensis
Platanus orientalis 'Digitata'
Platanus X acerifolia
Podocarpus elatus
Pyrus calleryana varieties
Pyrus nivalis
Quercus acutissima
Quercus agrifolia
Quercus bicolor
Quercus canariensis
Quercus cerris
Quercus coccinea
Quercus ilex
Quercus macrocarpa
Quercus palustris
Quercus phellos
Quercus robur
Quercus robur 'Fastigiata'
Quercus rubra
Robinia pseudoacacia (Varieties)
Sapium sebiferum
Schinus areira
Sophora japonica 'Princeton Upright'
Stenocarpus sinuatus
Syzygium australe 'Pinnacle'
Syzygium paniculatum
Taxodium distichum
Tilia cordata 'Greenspire'
Trachycarpus fortunei
Tristaniopsis laurina
Ulmus glabra 'Lutescens'
Ulmus parvifolia
Ulmus procera
Ulmus x hollandica
Washingtonia filifera
Washingtonia robusta
Waterhousea floribunda
Zelkova serrata 'Green Vase'

Master List of Park Trees

Acer rubrum 'October Glory'
Acer truncatum x A. platanoides 'Keithsform'
Acer x freemanii 'Autumn Blaze'
Agathis robusta
Angophora costata
Angophora floribunda
Araucaria cunninghamii
Araucaria heterophylla
Brachychiton acerifolius
Catalpa bignonioides
Cedrus atlantica
Cedrus deodara
Corymbia citriodora
Corymbia maculata
Cupressus torulosa
Ficus macrophylla
Fraxinus pennsylvanica 'Cimmaron'
Liquidambar styraciflua 'Rotundiloba'
Metasequoia glyptostroboides
Phoenix canariensis
Pinus canariensis
Pinus patula
Pinus pinea
Podocarpus falcatus
Quercus coccinea
Quercus phellos
Taxodium distichum
Ulmus parvifolia
Washingtonia filifera
Washingtonia robusta
Zelkova serrata 'Green Vase'

Master List of Trial Trees

Abies pinsapo 'Glauca'
Acer monspessulanum
Alnus cordata
Callitris glaucophylla (formerly C. columellaris)
Callitris preissii
Carpinus betulus 'Fastigiata'
Cercis canadensis 'Forest Pansy'
Eucalyptus curtisii
Eucalyptus gardneri
Eucalyptus haemastoma
Eucalyptus polybractea
Eucalyptus risdonii
Eucalyptus wimmerensis 'Honey Pots'
Flidersia maculosa
Flindersia australis
Fraxinus americana var.
Lithocarpus densiflorus
Phellodendron amurense
Pyrus betulaefolia 'Southworth'
Dancer™
Searsia pendulina
Tilia tomentosa 'Sterling'
Tipuana tipu