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# REPORT:

# ARBORICULTURAL IMPACT ASSESSMENT

## Site 4B
## Sydney Olympic Park NSW

Prepared 2 November 2006
Reference 9105

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## SUMMARY

This report considers the impact that the proposed development will have on six (6) *Lophostemon confertus* – Brushbox proposed to be retained.

Trees 33, 34, 42, 43, 44 and 45 to be retained will be directly impacted by the proposed development, but the trees will be protected and the impact ameliorated by modified design or special construction works.

The trees to be retained form part of an avenue planting of *Lophostemon confertus* – Brushbox which once formed part of the Homebush Abattoir.

The avenue planting currently supports twenty six (26) Brushbox, of these, twenty (20) are proposed for removal.

The remaining trees on site are proposed for removal as they are located within the building envelope or excavation zone for the site or in situ of the future road and public domain by SOPA.

Compensatory replanting is recommended.

The general condition of each tree to be retained is listed below in Table 1.0 and a summary of works in Table 2.0.

**Table 1.0** General condition of trees. All trees described in greater detail in section 5.0.

| Tree No. | *Genus and species* | Common name | Condition<br>G = Good F = Fair<br>P = Poor D = Dead |
|---|---|---|---|
| 33 | *Lophostemon confertus* | Brushbox | G-F |
| 34 | *Lophostemon confertus* | Brushbox | F |
| 42 | *Lophostemon confertus* | Brushbox | G |
| 43 | *Lophostemon confertus* | Brushbox | F |
| 44 | *Lophostemon confertus* | Brushbox | F |
| 45 | *Lophostemon confertus* | Brushbox | G-F |

**Table 2.0** Schedule of works and trees affected. Trees described in greater detail in the Pre-Development Tree Assessment Report by Earthscapes, dated Sept 2005.

| Tree No. | Common Name | Description of work to be done |
|---|---|---|
| 33 | Brushbox | Retain and protect within a Tree Protection Zone, special protection works during construction required. Garden area to be maximised beneath crowns minimising surface sealing. Paths to be constructed on top of grade; no fill, excavation or compaction within Tree Protection Zone. |
| 34 | Brushbox | As per Tree 33. |
| 42 | Brushbox | As per Tree 33. |
| 43 | Brushbox | As per Tree 33. |
| 44 | Brushbox | As per Tree 33. |
| 45 | Brushbox | As per Tree 33. |

## 1.0 PREFACE

URBAN TREE MANAGEMENT ®© has prepared this report for Ms Lauren Nissen of Aspect Studios Pty Ltd, on behalf of Ms Fleur Mellor of Boris Lend Lease.

The purpose of this report is to determine the impact of the proposed development on the trees to be retained.

Mr Andrew Morton of Earthscapes Horticultural Services has undertaken an arboricultural assessment of the trees on site which has been relied upon as part of this report. This impact assessment is to complement the findings of that report.

Tree Assessment, significance and retention value have not been detailed within this report to prevent duplication, unless variation occurred when compared to that report.

The site is subject to the *Sydney Regional Environmental Plan No 24 – Homebush Bay Area (SREP 24)* in accordance with the Sydney Olympic Park Master Plan and this report and any works recommended herein, that require approval from the consenting authority, is provided for as part of that consideration.

## 2.0 INTRODUCTION

Mr Laurie Dorfer *(the author)* attended Site 4B, Sydney Olympic Park (*the site*), on Thursday 2 November 2006 and the trees and their growing environment were examined.

The trees are indicated in Site Plan A - Appendix A. This report has relied upon the following reports/plan/s:

1. Pre-Development Tree Assessment Report by Earthscapes Horticultural Services dates September 2005,
2. Landscape Concept Preliminary, DWG 02, dated November 2006, sale 1:250 by Aspect Studios.
3. Elevation, DWG 08 & 09, dated 20 September 2006, scale 1:500 @ A3 by BATESSMART.

## 3.0 METHODOLOGY

The inspection was undertaken by a visual assessment from the ground and considers as part of that assessment the Sustainable Retention Index Value (SRIV) (IACA 2005) and the Safe Useful Life Expectancy (S.U.L.E.) of the trees.

The following criteria were checked against the findings of the report by Earthscapes to reflect the current status of the tree/s being: Age class, Condition class, Form class, Dimensions, Crown cover (live foliage as %), Crown density (density of live foliage evident as %), and vigour class, amenity and habitat values and significance.

In the absence of an Australian Standard, the British Standard BS 5837 : 1991 Guide for "Trees in relation to construction." Is applied to trees in this report as a point of reference and guide for the recommended minimum clearances from the centre of trees trunks to development works and is applied as a generalized benchmark and the distances may be increased or decreased by the author as a result of other factors providing mitigating circumstances or constraints as indicated by but not restricted to the following:

1. Condition of individual trees,
2. Tolerance of individual species to disturbance,
3. Geology e.g. physical barriers in soil, rock floaters, bedrock to surface
4. Topography e.g. slope, drainage,
5. Soil e.g. depth, drainage, fertility, structure,
6. Microclimate e.g. due to landform, exposure to dominant wind,
7. Engineering e.g. techniques to ameliorate impact on trees such as structural soil, gap graded fill, lateral boring,
8. Construction e.g. techniques to ameliorate impact on trees such as pier and beam, bridge footings, suspended slabs,
9. Arboriculture e.g. exploration trenches to map location of roots,
10. Physical limitations – existing modifications to the environment and any impact to tree/s by development e.g. property boundaries, built structures, houses, swimming pools, road reserves, utility services easements, previous impact by excavation, or construction in other directions, soil level changes by cutting or filling, existing landscaping works within close proximity, modified drainage patterns,
11. Extraneous factors e.g. potential future impacts from development on adjoining land when the tree is located on or near to a property boundary.

## 4.0 PRUNING STANDARDS

4.1 Any pruning recommended in this report is to be to the Australian Standard® AS4373 'Pruning of amenity trees', and conducted in accordance with the NSW Work Cover Authority Code of Practice for the Amenity Tree Industry, 1998.

4.2 All pruning or removal works are to be in accordance with the appropriate Tree Management Policy where applicable, or Tree Management Order (TMO), or Tree Preservation Order (TPO) or the Sydney Olympic Park Master Plan.

4.3 Tree maintenance work is specialised and in order to be undertaken safely to ensure the works carried out are not detrimental to the survival of a tree being retained, and to assist in the safe removal of any tree, should be undertaken by a qualified arboriculturist with appropriate competencies recognised within the Australian Qualification Framework, with a minimum of 5 years of continual experience within the industry of operational amenity arboriculture, and covered by appropriate and current types of insurance to undertake such works.

**Observations**

5.2 All *Lophostemon confertus* – Brushbox specimens within the avenue planting are showing drought related water stress symptoms to varying degrees. Typical indicators observed were reduced crown cover, reduced crown density, wilting, dieback and increased deadwood.

5.3 Of the trees proposed to be retained, Tree 34, 43 and 44 have or have further declined as compared to the report by Earthscapes with reduced crown densities of 80%, 75% and 85% respectively. Dieback of moderate to high volume was also observed to Trees 34 and 43.

5.4 Of the remaining *Lophostemon confertus* - Brushbox within the avenue planting, Trees 3, 27, 28, 30, 32, 35, 38, 39, and 46 have or have further declined. Whereas, Tree 37 has actually improved in condition and vigour.

5.5 No changes were observed to the remaining trees proposed for removal within the site as compared to the report by Earthscapes.

5.6 Construction of the neighbouring development to the west of the site has commenced with deep excavation expected at approximately 4.5m from the trees to be retained (Trees 42, 43, 44 and 45). Fencing was installed at close proximity to the tree trunks, whereby allowing the storage of building material and parked vehicles within the Tree Protection Zones.

**Discussion**

5.7 Trees 33, 34, 42, 43, 44 and 45 *(the trees)* are proposed to be retained in situ and incorporated into the construction works for the site. The proposed design and its configuration will directly impact on these trees; however this will be ameliorated by tree management procedures and/or modified construction techniques. Deep excavation is proposed for the underground carpark adjacent to Tree 33, 34 and 42, while a hard surface is proposed beneath the canopy of the trees to support pedestrian traffic.

5.8 As *the trees* condition has slightly diminished as compared to the report by Earthscapes, the actual level of impact imposed will be determined by the condition of the trees at the time of construction.

5.9 The current condition and vigour of most *Lophostemon confertus* – Brushbox within the stand is considered fair and low respectively, and is the result of environmental influences i.e. drought. The trees have responded by physiological changes to reduce their rate of evapotranspiration, whereby substantially minimising their water requirement as observed by the symptoms detailed. This however is generally at the expense of the production of sugars by reducing photosynthesis. The crown thinning and terminal dieback observed to most trees are generally the early stages of decline. If the drought continues for an additional extended period, the loss of crown will continue to diminish the trees photosynthetic material due to the reduction in foliage volume, thus impacting on the long term viability. The current condition of the Brushbox's have not yet reached an irreversible state, whereby if artificial irrigation was applied, recovery would be expected. Therefore the current condition of the Brushbox can still be successfully managed by proper and ongoing tree management.

5.10 Also, as this stand of trees is of the same species and at close proximity to one another; root grafting is expected. Once grafted together there is considerable potential for transfer of materials between roots. Therefore, as these trees are likely to be supporting or assisting one another, the removal of adjacent trees within the stand may have additional impact on the proposed trees to be retained if their crown cover and density is already reduced. Therefore, improving the current condition and vigour of the trees to be retained before works commence is mandatory to ensure their long term viability within the site. Simple horticultural requirements such as water and mulch are all that is required.
The deep excavation proposed nearby will also further lead to the accelerated drying out of a soil profile, or modification to ground water flow. Therefore deep root watering thoroughly at least twice a week within the Tree Protection Zones is to be undertaken to irrigate the trees. If an irrigation system is to be installed, consideration must be given to volume, frequency, and drainage of water delivered, and this should be in consultation with a qualified Consulting Arboriculturist.
The areas of the ***Tree Protection Zone*** should be mulched to a depth of 100 millimetres with organic material. The depth of mulch and type as indicated is to be maintained for the duration of the project. The area beneath the crowns is currently mulched; however this is very thin and has not been maintained to provide the benefits. These works should be carried as soon as possible to ameliorate the affects of the drought. Improved changes should be observed within days of implementation such as reduced wilting, whereby vigour and crown density will take several months.

5.11 Additional impact will also occur on Trees 42, 43, 44 and 45 by the neighbouring property which is currently under construction. Deep excavation is expected to commence January 2007 at approx. 4.5m from the edge of the trunks. It is unknown whether this will be piled, supporting shord excavation or a batter whereby further reducing the set back and root network. Pruning of the crowns will also be required to maintain clearance for scaffolding. These works will further reduce the trees ability to absorb water/minerals and manufacture foods, thus accelerating the decline of their current condition. Supplying the mulch and irrigation would also benefit the consequences of these works. Furthermore, the current protection fencing as installed by the neighboring property is not providing the protection of the roots, as the areas beneath the crown are currently used for storage and parked vehicles. This fence is to be re-located away from the trees at 4m to provide the Tree Protection Zone.

5.12 Existing constraints exist alongside Trees 33 and 34, this being the carpark. Root removal and consolidation of sub grade is likely to have limited the volume of root network within the carpark vicinity. However, this depends on the age of the carpark, although conditions have not been favorable for the re-establishment of roots given the continued five year drought in Sydney. Therefore, the 3m set back as proposed from Trees 33 and 34 is expected to be adequate with supplemented irrigation and mulch.

5.13 Reference is made to Appendix C - British Standard BS 5837: 1991 for prescribed setbacks from building works from Tree 42 being 6m. A one third reduction in setback on one side only is allowed providing for a setback from construction of 4m. This set back has been provided which is suitable to maintain the current condition and vigour of the tree.

5.14 The deep excavation adjacent to Trees 33, 34 and 42 should be piled by shord excavation. The 3m set back should not be further reduced as impact will substantially increase. If the excavations cannot be undertaken near to vertical the stability of these trees and their long-term viability may be compromised and their retention in a safe and healthy condition jeopardized. They may need to be revised and possibly removed if works contrary to this occurs.

5.15 The shadowing affect as caused by the proposed dwelling should have minimal impact on the trees to be retained once their condition and vigour improves by supplemented irrigation.

*Trees 33, 34, 42, 43, 44 and 45 - Protection works*

5.16 The hard surface proposed beneath the crowns should be modified to prevent any excavation or filling and compaction which would be detrimental to the trees. The existing grade should be unaltered and the subgrade should not be compacted at any time during construction of the path. As the hard surface area has been reduced and dissected by gardens and support pedestrian traffic only, greater options in construction methods are available. Concrete – Piered or layed on top of grade and may be constructed on gap graded fill to accommodate any level changes. If piers are required these should be undertaken manually to determine the location of structural roots. The construction should be engineered to enable the location of piers to be flexible as the location of the piers should have a minimum clearance above or beside structural roots of 100mm, or further as required to allow for future and ongoing growth. Paving (impervious) – Avoid compaction by using a sand base and geotextile over soil which has been only subjected to smoothing and hand tamping only. Timber/Steel – Piered and elevated above grade with decking surface. Design should provide minimal number of posts with greater span distance to reduce excavation.

5.17 The ***Tree Protection Zone*** for each tree is to be incorporated into the construction works for the site, and the protection fencing or works as indicated on Appendix A - *Survey of Subject Trees and Tree Protection Zones.* The ***Tree Protection Zones*** as described here and detailed in Appendix C, and in Appendix A will sustain the trees within the constraints of the modifications to the site by development works. Attention is drawn specifically to Appendix D for the protection of all trees to be retained and particular parts 1.1.0, 1.2.1, 1.2.2, 1.3.3, 1.4.1.1, 1.4.2.2 and 1.4.6.

5.18 *The trees* are to be retained and protected and incorporated into landscape works for the site, and their ***Tree Protection Zone*** fencing to be marked accordingly on the Landscape Plan, where appropriate.

5.19 The Tree Protection Zone (TPZ) and fencing for Trees 33, 34, 42, 43, 44 and 45 should be established and erected before works commences. On completion of construction works, the TPZ fencing should then only be removed for the commencement of landscaping.

5.20 All services should be diverted away from the Tree Protection Zones or as detailed in part 1.2.1 of Appendix D.

*Pruning*

5.21 Trees 33 and 34 may require minor reduction pruning to south/east to prevent the rubbing or conflict with scaffolding. The pruning is to be carried out to the lower order branches only, no structural branches are to be removed. Initially, these branches are to be secured back using 50mm hessian tie, in a figure eight arrangement between branches and/or trunk. Ties are to be fastened together with staples. Pruning is to be only carried out only once the tying back of branches is secured. Therefore, only minor lower order branches should be required for removal.

*Tree Removal*

5.22 The remaining trees on site are proposed to be removed for the reasons that they are located within the building envelope or excavation zone and are unable to be retained. Trees 14 and 16 are in poor condition and recommended for removal. However these are located within the future road and public domain and are likely to be removed by SOPA.

5.23 The trees are to be replaced with four (4) advanced specimens of ***Lophostemon confertus*** – **Brushbox** which are to be located in positions as per the Landscape Plan. These are to be installed in 600 Litre volume container, and having been propagated to the standards of Natspec Guide to *Specifying Trees* by Ross Clark 2003, or approved similar.

## 6.0 CONCLUSION

This report has examined the impact by the proposed development on the six (6) trees for retention. The trees should not be adversely affected due to their locations and pre-existing site constraints such as a carparking and the implementation of artificial irrigation and mulch. The trees to be preserved will be retained and protected through the implementation of adequate measures for their integration into the development by the application of appropriate technology as detailed in the recommendations of this report.

The recommendations made in this report are subject to approval by the consent authority.

As a renewable and dynamic natural resource the urban tree and the growing environment essential for its survival must be understood and carefully managed to balance its needs with those of people. It is crucial that as required: this resource be planned for, planted, nurtured, protected, maintained and replaced, to ensure appropriateness and suitability of new plantings and trees retained, for safety and viability, so that it remains vital, and is sustainable in continuity.

# 7.0 RECOMMENDATIONS

7.1 Trees 33, 34, 42, 43, 44 and 45 are to be retained and protected within a ***Tree Protection Zone*** and this to be installed as detailed in 5.9 - 5.15 and Appendices C and D and maintained until all building works are completed.

7.2 The existing Tree Protection Zone fencing at the boundary and adjacent to Trees 42, 43, 44 and 45 should be re-located providing a 4m set back.

7.3 Trees to be retained are to be mulched and irrigated as detailed in 5.9 to improve condition and vigour.

7.4 Deep Excavation of the carpark should be carried out by shord construction to maintain vertical excavation.

7.5 Modified construction works of the path should be carried as detailed in 5.15.

7.6 The branches of Trees 33 and 34 should be tied back and/or pruned as detailed in 5.20 and to be undertaken in accordance with section 4.0, parts 4.1 - 4.3.

7.7 The remaining trees are proposed to be removed as detailed in 5.21, and to be undertaken in accordance with section 4.0, parts 4.1 - 4.3.

7.8 The replacement trees as discussed in 5.22 to be planted as per the Landscape Plan.

Laurie Dorfer
Senior Consultant

# REFERENCES

1. Harris W., Clarke J., Matheny N. (2004). Arboriculture: integrated management of landscape trees, shrubs and vines. Pearson Education Inc., Upper Saddle River, New Jersey USA 07458

2. Matheny N. & Clark J. R. (1998), Trees and Development - a Technical guide to Preservation of Trees during Land Development, Published by International Society of Arboriculture, IL 61826-3129 USA.

3. Thomas P. (2000): Their Natural History, Cambridge University Press, United Kingdom.

4. Australian Standard® AS 4373 – 1996 Pruning of amenity Trees.

## DISCLAIMER

The author and Urban Tree Management take no responsibility for actions taken and their consequences, contrary to those expert and professional instructions given as recommendations pertaining to safety by way of exercising our responsibility to our client and the public as our duty of care commitment, to mitigate or prevent hazards from arising, from a failure moment in full or part, from a structurally deficient or unsound tree or a tree likely to be rendered thus by its retention and subsequent deterioration from modification/s to its growing environment either existing or proposed, either above or below ground, contrary to our advice.

# Appendix A

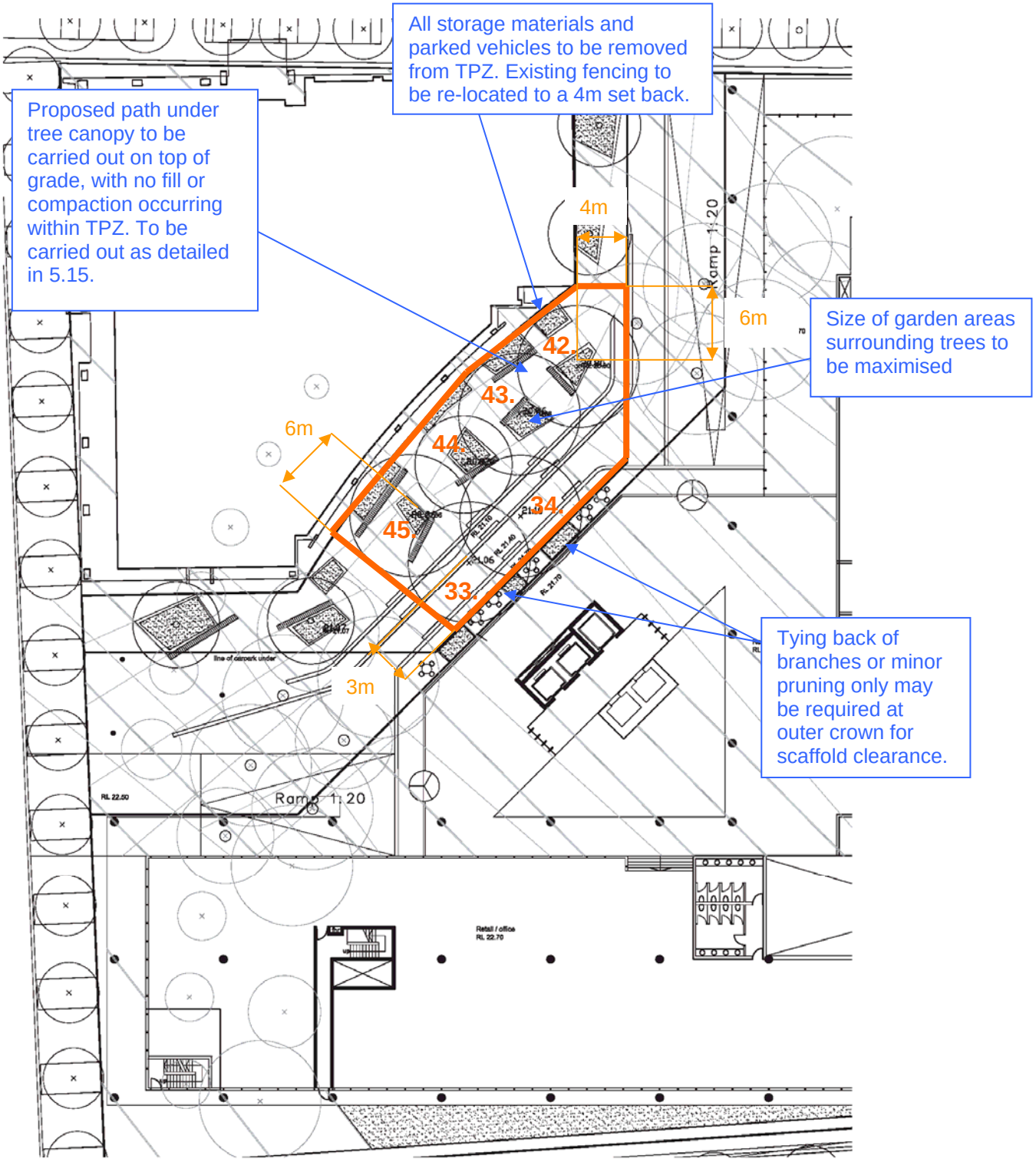
## Survey of Subject Trees and Tree Protection Zone

From Landscape Concept Preliminary Plan by Aspect Studio dated October 2006. Derived from a pdf file no longer to original scale of 1:250.

**Legend**

***Tree Protection Zone (TPZ),*** fencing with setbacks as indicated, or other protection measures or works as indicated.
***Tree Protection Zone,*** area of special protection measures or works outside of fenced area.

**10.** Tree numbers – trees to be retained only.



# Appendix B

## Modified Extract from British Standard BS 5837: 1991 Guide for "Trees in relation to construction."

**Table 1. Protection of trees: minimum distances for protective fencing around trees**

| Tree age | Tree vigour | Trunk diameter | Minimum distance |
|---|---|---|---|
| | | mm | m |
| Young trees (age less than 1/3 life expectancy | Normal vigour | < 200 | 2.0 |
| | | 200 to 400 | 3.0 |
| | | > 400 | 4.0 |
| Young trees | Low vigour | < 200 | 3.0 |
| | | 200 to 400 | 4.5 |
| | | > 400 | 6.0 |
| Mature trees | Normal vigour | < 350 | 4.0 |
| | | 350 to 750 | 6.0 |
| | | > 750 | 8.0 |
| Mature trees and overmature trees | Low vigour | < 350 | 6.0 |
| | | 350 to 750 | 9.0 |
| | | > 750 | 12.0 |

Note 1. It should be emphasized that this table relates to distances from centre of tree to protective fencing. Other considerations particularly the need to provide adequate space around the tree including allowances for future growth (see 6.3), and also working space (see 6.7), will usually indicate that structures should be further away.
Note 2. With appropriate precautions, temporary site works can occur within the protected area, e.g. for access or scaffolding (see 8.3).

# Appendix C

## 1.0 TREE PROTECTION ZONES - STANDARD PROCEDURE

1.1 Each tree to be retained is to have its dripline fenced off, except where otherwise indicated, to create a ***Tree Protection Zone***, and this may include one enclosure to protect a single or multiple tree/s, or multiple enclosures separated over the site. The area contained is the ***Tree Protection Zone***, and is to exclude any activity, except where otherwise stated. ***Tree Protection Zone*** works may extend beyond the fenced area or replace a fence if appropriate. The ***Tree Protection Zone*** is to exclude: modification of existing soil levels, storage of materials including waste, site sheds and machinery; preparation of building materials e.g. concrete, or chemical treatments; the movement of pedestrian or vehicular traffic; or the temporary, or permanent location of services, or the works required for their installation, e.g. trenches, holes or canals. The above list is not meant to be exhaustive, and is intended as a guide to the types of activities that are excluded from within the ***Tree Protection Zone***, except where otherwise stated.

1.2 The Tree Protection Fence that defines the ***Tree Protection Zone*** is to be 1.8m high steel chain link with galvanised steel pipes, or approved similar, located around the dripline of the tree except where otherwise stated, as a minimum distance from the tree for its protection and should be made larger where possible. The perimeter of the ***Tree Protection Zone*** to be further delineated by the attachment of shade cloth material to the outside surface area of the fence facing the inside of the site to reduce the movement of dust and other air borne residue from building activities that may be phytotoxic to plants or plant parts. The fence is to be installed prior to the commencement of any works on site, (except weed removal and tree maintenance, e.g. pruning, irrigation and mulching), and is to be maintained for the duration of the project. The fence must have a lockable opening for access to, and the security of the enclosed area. A temporary TPZ fence or fence section may be required to be established initially, where demolition of existing structures is required to provide an area of sufficient space for the full extent of the Tree Protection Zone to be installed.

1.3 Tree Protection signage is to be attached to each ***Tree Protection Zone*** and displayed in a prominent position and the sign repeated at 10m intervals or closer where the fence changes direction. The lettering for each sign to be a minimum of 72 point and printed in Arial font. The signs to be a minimum size of 600mm x 500mm. Each sign to advise as minimum details, the following:

1. **Tree Protection Zone** (title)
2. (TEXT) “This fence has been installed to prevent damage to the trees and their growing environment both above and below ground, and access is restricted.“
3. (TEXT) “If encroachment or incursion into this Tree Protection Zone is deemed to be essential the Consulting Arboriculturist should be informed prior to the undertaking of such works.”
4. (TEXT) **Name, Address** and **Telephone number** of the *developer* (to enable enquiries concerning the trees to be directed to the developer).

1.4 Where a tree is to be retained and a ***Tree Protection Zone*** can not be adequately established due to restricted access e.g. tree located along side an access way, the trunk will be protected by wrapping 2 layers of hessian or carpet underfelt around the trunk for a minimum of 2m or as lower branches permit, then wire or rope secures 75x50x2000mm hardwood planks to the trunk (do not nail to the trunk). The number of planks to be used is as required to encircle the trunk and the planks are to extend to the base of the tree.

1.5 If a tree is growing down slope from an excavation, a silt fence located along the contours of the site in the area immediately above the ***Tree Protection Zone*** fencing may need to be installed and regularly maintained to prevent burial and asphyxiation of the roots of the tree. To allow for the maintenance of both fences, the silt fence must be constructed separately to the tree protection fence and the 2 fences must be constructed independently of each other and standalone. To reduce competition with the tree the area within the ***Tree Protection Zone*** is to be kept free of weeds. These are best removed by the application of foliar herbicide with Glyphosate as the active constituent. This is the preferred method rather than removal by cultivation of the soil within the dripline, to minimise root disturbance to the tree. The removal of woody weeds such as Privet should use the cut and paint method of herbicide application. Weeds to be controlled within the ***Tree Protection Zone***, for the duration of the project.

1.6 The area of the ***Tree Protection Zone*** to be mulched to a depth of 100 millimetres with organic material being 75% leaf litter and 25% wood, and this being composted material preferably from the same genus and species of tree as that to where the mulch is to be applied, i.e. species specific mulch. The depth of mulch and type as indicated, to be maintained for the duration of the project.

1.7 No services either temporary or permanent are to be located within the ***Tree Protection Zone***. If services are to be located within the ***Tree Protection Zone***, special details will need to be provided by a qualified Consulting Arboriculturist for the protection of the tree regarding the location of the service/s.

1.8 A tree will not be fertilised during its protection within the ***Tree Protection Zone***, as this may hasten its decline if it were to decline. If a tree is to be fertilised this should be in consultation with a qualified Consulting Arboriculturist.

1.9 In the event of prolonged dry periods, or where a tree has been transplanted, or where excavation nearby, especially up slope, leads to drying out of a soil profile, or modification to ground water flow, or flows across an existing ground surface to the tree and its growing environment; deep root watering thoroughly at least twice a week is to be undertaken to irrigate the tree. The need for such watering is determined readily by observing the dryness of the soil surface within the dripline of the tree by scraping back some mulch. Mulch to be reinstated afterwards. In the event of disrupted ground or surface water flows to the tree due to excavation, filling or construction, a reticulated irrigation system may be required to be installed within the ***Tree Protection Zone***. If an irrigation system is to be installed, consideration must be given to volume, frequency, and drainage of water delivered, and this should be in consultation with a qualified Consulting Arboriculturist.

# Appendix D

## 1.0 TREE PROTECTION ON CONSTRUCTION SITES

Note: Individual protection measures to be applied where stated as applicable.

1.1.0 General notes
1.2.0 Cautionary notes for the protection of retained trees
1.3.0 Demolition of built structures - precautions to protect trees
1.4.0 Excavation and construction close to Tree Protection Zones

### 1.1.0 General notes

1.1.1 The application of any measures for the protection of trees on development sites is determined by the species characteristics of the subject tree, and the existing physical constraints of the growing environment on site both above and below ground.

1.1.2 This report considers where applicable, British Standard BS 5837 Guide for "Trees in relation to construction." as no Australian Standard currently exists for the protection of trees on development sites.

1.1.3 This report applies the ***Tree Protection Zone - Standard Procedure*** as developed and continually improved over time by URBAN TREE MANAGEMENT ® © for the effective protection of trees on development sites. (see section 6.0) However, this does not restrict the author from applying additional or alternative conditions where it is deemed appropriate by the author for the protection of trees on development sites. Such additional or alternative conditions may be founded upon professional judgement based on:

- the experience of the Consulting Arboriculturist
- scientific research
- new technology
- industry best practice
- consideration of the individual tree species and its relative tolerance to development impacts
- the individual or cumulative factors present or proposed to impact upon the growing environment essential for the trees' survival

1.1.4 Where this report makes reference to the retention of subject trees it is for their incorporation into the landscaping works for the site, and they are to be documented on a Landscape Plan for the site (*the Landscape Plan*).

## 1.2.0 Cautionary notes for the protection of retained trees

### 1.2.1 Location of services

If a utility service is to be located within the area of the dripline of a protected tree or within the Tree Protection Zone, the British Standard BS 5837 Guide for "Trees in relation to construction." provides the following: "7.5.8 An alternative solution is to excavate a narrow trench passing directly towards the tree along a radius to not closer than 1m from the trunk, tunnel straight beneath the tree, preferably not less than 750mm deep, and exit on the opposite side along another radius (see figure 3, see Appendix E in this report). Provided the trench is kept as narrow as possible, the amount of root severance will be minimal, and will be far less than if a trench passes close beside the tree. It may be necessary to sleeve a service where it passes beneath a tree in order to reduce the risk of damage to the service and facilitate future servicing and repair." The tunneling could be achieved by the use of horizontal directional drilling to link the two trenches, being a horizontal steerable drilling system. Such a system has capabilities of installing pipeline ranging from 100mm, up to 1100mm diameters for lengths of just over 1000m and has little to no disruption to tree roots. Such tunneling is usually undertaken beneath structural woody roots radiating away from the trunk and not just under the center of the tree.

#### 1.2.1.1

**Location of services Option B** (Driveway Construction)

If a service is to be located within the area of the dripline of a protected tree or within the Tree Protection Zone, and site conditions such as shallow bed rock or if mass rooting has occurred from multiple trees growing in close proximity to each other, the service trench is to be elevated and positioned above natural ground level within the new driveway structure. The existing driveway surface is to be scabbled and a reinforced concrete topping is to be provided with down turned thickened edges constructed under the kerb edging to prevent lateral movement. A suitable subgrade material to manufacturers' recommendations is to be utilised if and where appropriate. Construction is to occur in a manner so as not to cause damage to the subject trees root system. All works to be in accordance with engineers' details.

### 1.2.2 Precautions in respect of temporary work

For Precautions in respect of temporary work, British Standard BS 5837 Guide for "Trees in relation to construction." provides the following:

"8.3.1 if temporary vehicle access is required through the protected area, a reinforced concrete slab should be laid over the existing soil surface, with appropriate protection along the road edge.

8.3.2 If it is essential for scaffolding to be erected within a protected area, fencing in accordance with 8.2.2 or 8.2.3 should be erected to provide just sufficient space for scaffolding. The ground between this fence and the building should be protected by boarding (e.g. scaffold boards) as shown in figure 6. (see Appendix D in this report) A single thickness of boarding laid on the soil surface will provide sufficient protection for pedestrian loads, but more substantial boarding sufficient to spread the load should be used for heavier traffic. The ground beneath the boarding should be left undisturbed and should be protected with a porous geotextile fabric. If necessary, sand should be laid on the fabric to level the ground. When required, the building scaffolding should be erected. The boarding should be left in place until the building works are finished."

### 1.3.0 Demolition of built structures - precautions to protect trees

### 1.3.1 Demolition of existing Buildings

The demolition of the buildings should be undertaken with access restricted to the driveway and the building platform for each of the existing buildings, or to areas of the land where no trees are growing within 6m of any tree to be retained. Where access or space for a safe working environment is restricted, or where the area of the 6m set back must be compromised, a 100mm layer of Eucalyptus wood mulch must be laid over the area of encroachment. Where vehicular access is required across the mulch layer further root protection should be provided by laying a temporary pathway over the mulch. The temporary pathway should be constructed of a grated steel material capable of supporting the vehicles used during demolition e.g. similar to ramps used to load vehicles onto the backs of trucks. Trunks of trees are to be protected from vehicular damage as per section 6.4 of this report.

### 1.3.2 Demolition of landscape structures

The demolition of walls, driveways retaining walls, paths and pools etc. within 6m of a tree to be retained should be undertaken manually using hand tools. Where a driveway is to be demolished being of concrete strip or slab type construction, it should be undertaken by working from the end of the driveway closest to the building back towards the street by utilising the driveway as a stable platform to prevent soil compaction. Where a concrete slab driveway passes less than 1m from the base of a tree and the area beneath the driveway is to be undisturbed and incorporated into the landscape works for the site, the volume of space previously occupied by the driveway must be replaced with local top soil from the site or otherwise a loamy sand, to replace the mass of the concrete on the root plate which may be critical to the ballast and centre of mass for the stability of the tree. If the tree becomes unstable immediately contact the Consultant Arboriculturist.

### 1.3.3 Removal of existing trees near trees to be retained

Removal of a tree within 6m of a tree to be retained should be undertaken only by cutting down such a tree without damaging the trees to be retained, and by grinding out its stump. Where possible the structural roots of 20mm diameter or greater of the tree to be cut down should not be removed, to minimise soil disturbance and to reduce the impact on the roots of any tree to be retained nearby. Where structural roots are to be removed this should be undertaken manually by the use of non-motorized hand tools after the stump has been ground out when such roots are often easier to locate from the site of the stump from which they have been severed.

## 1.4.0 Excavation and construction close to Tree Protection Zones

### 1.4.1 Excavation close to Tree Protection Zones

1.4.1.1

Where structural woody roots with a diameter of 20mm or greater are to be pruned outside the area of the Tree Protection Zone, they are to be excavated manually first by using hand tools to determine their location. A Waterknife or Airknife can be used as a mechanised alternative to locate such structural woody roots. Once located those roots to be severed are to be cut cleanly with a final cut to undamaged woody tissue and this will prevent tearing damage to the roots from excavation equipment which can extend beyond the point of excavation back towards the tree.

1.4.1.2

Where a large vigorous tree is to be retained near to built structure, and dependent upon its taxa, age class and propensity for its roots system to regenerate, it may be prudent to install a root barrier immediately adjacent to the footing of the new building, or to deepen and strengthen the footings themselves to act as a root barrier, but for such structural advice an appropriately qualified chartered structural engineer should be consulted.

### 1.4.2 Root location and protection where structures are to be positioned near a retained tree

1.4.2.1

If walls or a driveway or other structures are to be constructed near a protected tree, careful excavation is to be undertaken manually by using non-motorized hand tools to determine the location of first order and lower order structural roots with a diameter of 20mm (*structural woody roots*) or greater, without damaging them. Boundary walls or fences should use columns or posts with in fill panels, or a wall to be constructed with suspended sections 100mm clear above or beside any structural woody root or further as required, or any new wall to be built only to the depth of that existing. Structural woody roots to be further protected by utilising the construction techniques of pier or bridge footings, or screw piles between or over them with a minimum clearance above or beside of 100mm, or further as required to allow for future and ongoing growth.

1.4.2.2

Where a driveway or footpath is to pass by the tree a suspended slab is to be constructed or approved similar, to protect the roots that may be encountered at, near, or above ground, and may be constructed on gap graded fill. Where such a driveway or footpath is to be constructed the edge of the structure closest to the tree is to terminate no closer than 0.5m from the outside edge of the trunk, or further depending on the species and its likely further growth to allow for future development and expansion of the trunk, buttresses, and first order and lower order roots as may be advised by a Consultant Arboriculturist.

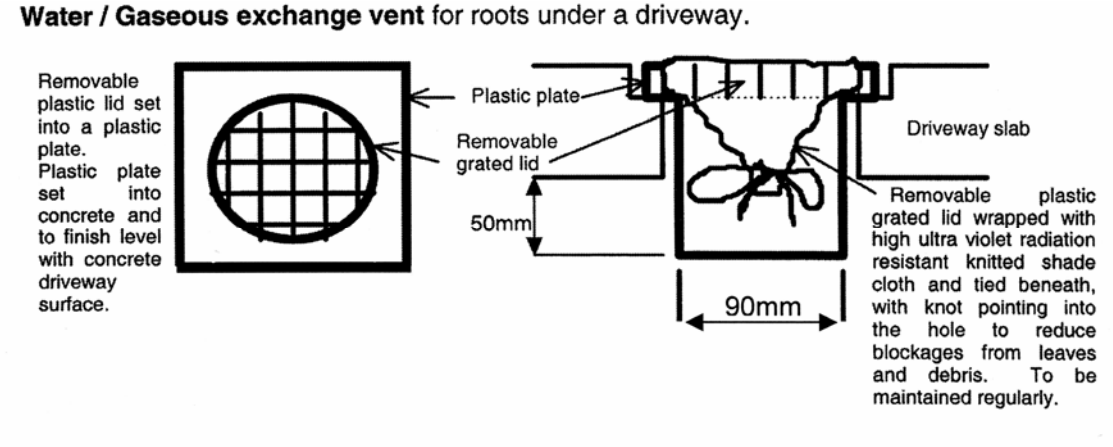
1.4.2.3

Alternatively a footpath or driveway may be constructed at ground level without any excavation, removing turf by raking, having sprayed with herbicide first if time permits. Here the path or driveway section is to extend for a distance past the tree equivalent to the lateral spread of the crown of that tree alongside the footpath, or driveway.

1.4.2.4

Watering / Gaseous exchange vents are to be installed in the area of the driveway that passes within the dripline of the tree or the prescribed ***Tree Protection Zone*** area and the number and location are to be determined by a Consultant Arboriculturist and the driveway design approved by a Certified Engineer. Exposed edges of the path are to be concealed with the finished level beside the path equivalent to the top of the path by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate. On the side of a driveway closest to a tree, a drive way is to be edged with a concrete kerb of minimum dimensions of 150 x 150mm and the driveway edge to terminate 500mm from the trunk of the tree, or approved similar, to prevent vehicular collision with the trunk. Here a W*aterknife* or an A*irknife* can be used as a mechanised alternative to locate first order and lower order structural woody roots.

**Water / Gaseous exchange vent** for roots under a driveway.



1.4.3 ***Root protection where a driveway close to a tree is to be demolished and a new driveway constructed in a similar location to a previous driveway.***

After demolition of an existing driveway as per 5.3.2, the level of the base for the new driveway should be located at the same existing level as that of the base of the previous driveway, and should extend for a distance past the tree equivalent to the lateral spread of the crown of that tree alongside the driveway. To prevent excavation from damaging the existing roots which may be located at, near or above the surface of the soil beneath the base of the previous driveway, the new driveway may need to be raised by constructing it on pier or bridge footings between or over them (see 5.4.2 for minimum clearances), or based on a gap graded fill and the driveway constructed with any exposed edges concealed to the top of the driveway by minimal filling with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation, or other landscape treatments as appropriate. Where roots have grown to occupy the soil between the concrete strips of a concrete, stone or brick strip driveway, they and the soil may be excavated to the level of the base of the concrete strips, but where such roots have a diameter of 20mm or greater, a Consulting Arboriculturist should be contacted prior to such works being undertaken. Where roots are to be severed, they are to be cut cleanly with a final cut to undamaged woody tissue.

1.4.4 ***Root protection where a footpath is to be constructed close to a tree.***

1.4.4.1

A footpath may be constructed at ground level without any excavation, by first killing with herbicide the plants to be removed from the pathway area, and then removing that plant material by cutting the trunks of woody shrubs to ground level and by raking all other plant material to expose the top soil surface without organic matter. This will remove the need for physically disturbing the soil and the roots of the tree. The path section is to extend for a distance past each tree equivalent to the lateral spread of the crown of that tree where it extends alongside the footpath.

1.4.4.2

To prevent excavation from damaging the existing roots which may be located at, near, or above the surface of the soil, a gap graded fill as a fill material of a media as appropriate, to a depth of 100mm above the soil surface, or above the top of the root of any tree to be retained, or above the soil surface may be utilised as a base treatment to construct the foot path. Any exposed edges to be concealed to the top of the edges of the footpath and tapering back to the base of the trunk of each tree by minimal filling at each trunk of no greater than 100mm with a sandy soil and turf, or mulch, or a garden bed with minimal cultivation with ground covers, or other landscape treatments as appropriate. A Consultant Arboriculturist should be contacted prior to such works being undertaken or if any structural roots are considered appropriate to be severed being those roots of 20mm diameter or greater.

### 1.4.5 ***Structural Soil to accommodate load bearing conditions***

A structural soil should only be considered as a new media into which the trees could be planted if the planting was into a new area where the area surrounding was to be load bearing such as a footpath, driveway or road.

### 1.4.6 ***Gap graded fill to accommodate compacted sub grade and root growth***

To further protect woody roots with a diameter of 20mm or greater, a gap graded fill with no fines such as gravel 40mm diameter should only be considered as a fill media above existing grade when soil levels are to be increased near existing trees and the roots can utilise the new media to develop ongoing and future root growth and provide for gaseous exchange between the soil and the atmosphere.

# Appendix E

## Glossary

### ***Vigour***

**Vigour** Ability of a tree to sustain its life processes. This is independent of the condition of a tree but may impact upon it. Vigour can appear to alter rapidly with change of seasons (seasonality) e.g. dormancy of deciduous or semi-deciduous trees.

**Normal Vigour** Ability of a tree to maintain and sustain its life processes. This may be evident by the growth of leaves, branches, roots and trunk. This is independent of the condition of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation.

**Low Vigour** Reduced ability of a tree to sustain its life processes. This may be evident as a decline in the growth of leaves, branches, roots and trunk, and a deterioration of their functions. This is independent of the condition of a tree but may impact upon it.

**Dormant Tree Vigour** Determined by existing turgidity in lowest order branches in the outer extremity of the crown, with good bud set and formation, and where the last growth increment is distinct from those most recently preceding it, evident by bud scale scars. Normal vigour during dormancy is achieved when such growth is evident on a majority of branches throughout the crown.

**Abnormal Vigour** Accelerated growth of a tree due to incidental or deliberate artificial changes to its growing environment that are seemingly beneficial, but may result in *premature aging* or failure if the favourable conditions cease, or promote *prolonged senescence* if the favourable conditions remain, e.g.

- water from a leaking pipe;
- water and nutrients from a leaking or disrupted sewer pipe;
- nutrients from animal waste;
- a tree growing next to a chicken coop, or a stock feed lot, or a regularly used stockyard;
- a tree subject to a stringent watering and fertilising program.

### ***Age***

**Age** Most trees have a stable biomass for the major proportion of their life. The estimation of the age of a tree is based on the knowledge of the expected lifespan of the taxa in situ divided into three distinct stages of measurable biomass, when the exact age of the tree from its date of cultivation or planting is unknown. These increments are Young, Mature and Over-mature.

**Young** Tree aged less than 20% of life expectancy.

**Mature** Tree aged 20-80% of life expectancy.

**Over-mature** Tree aged greater than 80% of life expectancy tending to senescent with or without reduced vigour, and declining gradually or rapidly but irreversibly to death.

### ***Periods of Time***

**Periods of Time** The life span of a tree in the urban environment may often be reduced by the influences of encroachment and the dynamics of the environment and as a result the values of Short Term, Medium Term and Long Term have been applied.

**Short Term** Period of time less than 1 – 15 years.

**Medium Term** Period of time 15 – 40 years.

**Long Term** Period of time greater than 40 years.

## ***Condition***

**Good** Tree is of good habit, a form not severely restricted for space and light, physically free from the adverse effects of predation by pests and diseases, obvious instability or structural weaknesses, fungal, bacterial or insect infestation and is expected to continue to live in much the same condition as at the time of inspection provided conditions around it for its basic survival do not alter greatly. This may be independent from, or contributed to by vigour.

**Fair** Tree is of good habit or misshapen, a form not severely restricted for space and light, has some physical indication of decline due to the early effects of predation by pests and diseases, fungal, bacterial, or insect infestation, or has suffered physical injury to itself that may be contributing to instability or structural weaknesses, or is faltering due to the modification of the environment essential for its basic survival. Such a tree may recover with remedial works where appropriate, or without intervention may stabilise or improve over time, or in response to the implementation of beneficial changes to its local environment. This may be independent from, or contributed to by vigour.

**Poor** Tree is of good habit or misshapen, a form that may be severely restricted for space and light, exhibits symptoms of advanced and irreversible decline such as fungal, or bacterial infestation, major die-back in the branch and foliage crown, structural deterioration from insect damage e.g. termite infestation, or storm damage or lightning strike, ring barking from borer activity in the trunk, root damage or instability of the tree, or damage from physical wounding impacts or abrasion, or from altered local environmental conditions and has been unable to adapt to such changes and may decline further to death regardless of remedial works or other modifications to the local environment that would normally be sufficient to provide for its basic survival if in good to fair condition. Deterioration physically, often characterised by a gradual and continuous reduction in vigour but may be independent of a change in vigour, but characterised by a proportionate increase in susceptibility to, and predation by pests and diseases against which the tree cannot sustain it. Such conditions may also be evident in trees of advanced senescence due to normal phenological processes, without modifications to the growing environment or physical damage having been inflicted upon the tree. This may be independent from, or contributed to by vigour.

**Dead** Tree is no longer capable of performing any of the following processes or is exhibiting any of the following *symptoms*;

Processes
***Photosynthesis*** via its foliage crown (as indicated by the presence of moist, green or other coloured leaves);
***Osmosis*** (the ability of the roots system to take up water);
***Turgidity*** (the ability of the plant to sustain moisture pressure in its cells);
***Epicormic shoots*** (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a lignotuber - an at ground or underground stem)*;*
Symptoms
***Permanent leaf loss***;
***Permanent wilting*** (the loss of turgidity which is marked by desiccation of stems leaves and roots);
***Shedding of the epidermis*** (bark desiccates and peels off to the beginning of the sapwood).

## ***Form of Trees***

**Form of Trees** The shape of the crown of a tree as influenced by the availability or restriction of space and light, or other contributing factors within its growing environment. *Crown Form* may be determined for tree shape and habit generally as *Dominant*, *Codominant*, *Intermediate*, *Emergent*, *Forest* and *Suppressed.* The habit and shape of a crown may also be considered qualitatively as *Good Form* or *Poor Form*.

**Good Form** Tree of typical crown shape and habit with proportion representative of the taxa considering constraints such as origin e.g. indigenous or exotic, but does not appear to have been adversely influenced in its development by environmental factors in situ such as soil water availability, prevailing wind, or cultural practices such as lopping and competition for space and light.

**Poor Form** Tree of atypical crown shape and habit with proportions not representative of the species considering constraints and appears to have been adversely influenced in its development by environmental factors in situ such as soil water availability, prevailing wind, cultural practices such as lopping and competition for space and light; causing it to be misshapen or disfigured by disease or vandalism.

**Crown Form – Dominant** Crowns of trees above the upper layer of the canopy and generally receiving light from above and sides, also known as emergent.

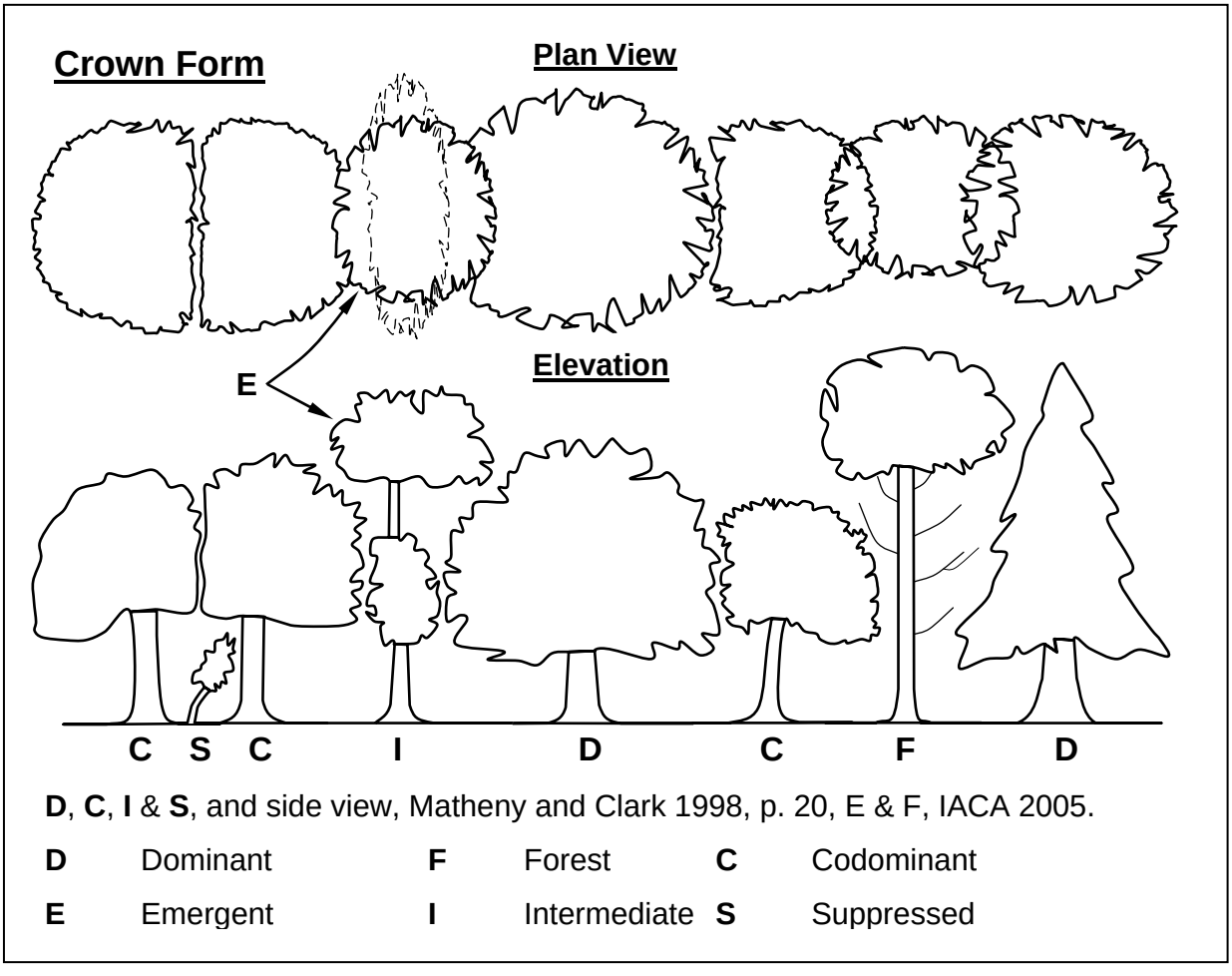
**Crown Form – Codominant** Crowns of trees that define the general upper edge of the canopy, receiving light primarily from above.

**Crown Form – Intermediate** Crowns of trees that have been largely overtopped but may receive some light from above.

**Crown Form – Suppressed** Crowns of trees that have been overtopped occupying an understorey position in the canopy and grow slowly.

**Crown Form – Forest** Crowns of trees where the trunk is usually erect, straight and continuous, tapering gradually, crown often excurrent, with first order branches becoming structural, supporting the live foliage crown concentrated towards the top of the tree, and below this point other first order branches arising radially with each inferior and usually temporary, divergent and ranging from horizontal to ascending, often with internodes exaggerated due to competition for light and space, and branches having a low number of seasonal growth gradations.

**Crown Form – Emergent** Crowns of trees where the upper crown grows to protrude above the canopy in a stand or forest environment. Such form may be Dominant or transitional from Intermediate to Forest asserting both apical and axillary dominance once free of light and spatial constraints.




**D**, **C**, **I** & **S**, and side view, Matheny and Clark 1998, p. 20, E & F, IACA 2005.

| | | | | | |
|---|---|---|---|---|---|
| **D** | Dominant | **F** | Forest | **C** | Codominant |
| **E** | Emergent | **I** | Intermediate | **S** | Suppressed |

## ***Leaning Trees***

**Leaning** A tree growing away from upright either from its base or an area along its stem which may be influenced by a number of contributing factors e.g. genetically determined characteristics e.g. Araucaria columnaris, or from competition for space or light, or affected by prevailing winds, or aspect, slope, or other limiting factors that may or may not affect the stability of the tree depending on it's growing environment in situ, its structural integrity both above or below ground or modifications to its growing environment. Due to the effects of heliotropism and gravitropism many trees will grow slightly leaning and this may remain stable as a static lean. A tree that displays an increasingly progressive lean over time may be hazardous and prone to failure. The degrees of leaning are *Slight Lean*, *Moderate Lean*, *Severe Lean* and *Critical Lean*.

**Slight Lean** A tree growing at a lean within 0-15$^{O}$ from upright.

**Moderate Lean** A tree growing at a lean within 15-30$^{O}$ from upright.

**Severe Lean** A tree growing at a lean within 30-45$^{O}$ from upright.

**Critical Lean** A tree growing at a lean of greater than 45$^{O}$ from upright.

**Progressive Lean** A tree where the degree of leaning appears to be increasing over time.

**Static Lean** A tree where the degree of leaning appears to have stabilized over time.

## ***Symmetry Within The Crown***

**Symmetry** Balance within a *crown,* of trunk, branch and foliage distribution.

**Symmetrical** Balance within a crown, where there is an even distribution of branches and the foliage crown around the vertical axis of the trunk. This usually applies to trees of Dominant or Forest crown form. An example of an expression of this may be crown symmetrical.

**Asymmetrical** Imbalance within a crown, where there is an uneven distribution of branches and the foliage crown around the vertical axis of the trunk. This may be due to co-dominant or suppressed form as a result of natural restrictions e.g. from buildings, or from competition for space and light with other trees, or from exposure to wind, or artificially caused by pruning for clearance of roads, buildings or power lines. An example of an expression of this may be, crown asymmetrical, bias to west.

**Crown Spread Orientation** Orientation of crown spread at its longest, measured using cardinal points e.g. NE/SW, except where spread is even from the trunk in all directions i.e. *radial*.

**Orientation Radial** Where the crown spread is generally even in all directions from the trunk and often where a tree has a dominant crown form and is symmetrical.

**Orientation (non-radial)** Example, north/south or (N/S), where the crown extent is longer than it is wide.

**Significant** Important, weighty or more than ordinary. Examples: prominence, due to exposure of location, or in situ, or contribution as a component of the overall landscape for amenity or aesthetic qualities, or curtilage to structures, or importance due to uniqueness of taxa for species, subspecies, variety, form, or as an historical or cultural planting, or for age, or substantial dimensions, or habit, or as remnant vegetation, or habitat potential, or a rare or threatened species, or uncommon in cultivation, or of aboriginal cultural importance, or is a commemorative planting. *Note: Where a tree is considered significant this must be expressed clearly and attributed to any of the above criteria and balanced against diminishing factors such as nuisance, as any tree will be of some significance but not every tree can be significant.*

**Sustainable Retention Index Value (SRIV)** A visual method of rating the viability of urban trees for development sites and management, based on general tree and landscape assessment criteria. SRIV© is for the professional manager of urban trees to consider the tree in situ with an assumed knowledge of the taxa and its growing environment and is based on the physical attributes of the tree and its response to its environment considering its age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property and the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement.

**Diameter at Breast Height (DBH)** Trunk diameter measurement calculated at 1.4m above ground from the base of the tree. As the trunk of most trees are not circles when viewed in section, due to reaction wood, an average diameter is determined by recording the trunk along its narrowest and widest axis's, adding the two dimensions together and dividing them by 2 to record an average. The orientation of the longest axis of the trunk may also be recorded. Where a tree is growing on a lean the distance along the top of the trunk is measured to 1.4m and the diameter then recorded from that point perpendicular to the edge of the trunk. Where a leaning trunk is crooked a vertical distance of 1.4m is measured from the ground to the underside of the trunk and a diameter recorded at that point perpendicular to the trunk, and the horizontal distance from the vertical point of measurement on the ground to the centre of the tree at its base is also be recorded. Where a tree branches from a trunk that is less than 1.4m above ground the trunk diameter will be recorded perpendicular to the length of the trunk from the point immediately below the base of the flange of the branch collar extending the furthest down the trunk, and the distance of this point above ground recorded as trunk length. Where a tree is trunkless or acaulescent branching at or near ground such as a mallee formed tree or sprout mass as regrowth, an average diameter is determined by recording the radial extent of the trunk at or near ground.

## Deadwood

**Deadwooding** Pruning to remove a dead branch. Such pruning may assist in the prevention of the spread of decay from dieback or for reasons of safety near an identifiable target.

**Deadwood** Branches that have died categorised as *Small Deadwood* and *Large Deadwood* according to diameter, length and subsequent *risk* potential, the volume of dead branches on a tree may be *Low Volume Deadwood*, *Moderate Volume Deadwood* and *High Volume Deadwood*.

**Small Deadwood** A dead branch up to 10mm diameter and usually <2 metres long, generally considered of low *risk* potential.

**Large Deadwood** A dead branch >10mm diameter and usually >2 metres long, generally considered of high *risk* potential.

**Low Volume Deadwood** Where <5 dead branches occur that should be removed.

**Moderate Volume Deadwood** Where 5-10 dead branches occur that should be removed.

**High Volume Deadwood** Where >10 dead branches occur that should be removed.