REDGUM Horticultural
Arboriculture & Horticulture Consultants

REPORT:

ARBORICULTURAL IMPACT ASSESSMENT

Prince of Wales Hospital
Mental Health Intensive Care Service
POWH - MHICS
Avoca Street,
Randwick NSW

Prepared 20 December 2010

Ref. No. 6083

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PREFACE

Redgum Horticultural has prepared this report for BVN Architecture Pty Ltd *(the architect)* on behalf of Prince of Wales Hospital – Mental Health Intensive Care Services (POWH – MHICS) (*the client),* Avoca Street, Randwick NSW.

Mr. Neville Shields (*the author*) attended Prince of Wales Hospital – Mental Health Intensive Care Services (POWH – MHICS), NSW (*the site*), on 17 December, 2010, the trees and their growing environment were examined. The site is subject to a Development Application and this report and any works recommended herein, that require approval from the consenting authority, forms part of that development application.

INTRODUCTION

The land is located in the Randwick Council (*the Council)* Local Government Area (*LGA*) and the trees are protected under Councils Tree Preservation Order. The Council is the consenting authority for development works on the site. This report involves 25 trees (*the trees*), as indicated on Site Plan A - Survey of Subject Trees (Appendix H) and considers the removal of 13 trees and the retention of 12 trees within the property, neighbouring properties and adjacent on the road reserve. There was 1 missing tree and 1 tree which had been removed prior to inspection by Redgum Horticultural within the site. The trees will be considered as 1 stand to encompass all trees within and immediately adjacent to the site, where appropriate, as marked on Appendix H, Site Plan A – Survey of Subject Trees. ***Tree Protection Zone*** fencing or works are marked on the Appendix I, Site Plan B - Trees to be Retained and Tree Protection Zones.

The site is comprised of a large block where the existing building was demolished and to be replaced with a new complex, requiring the removal of thirteen existing trees within the site. As part of the Landscape Plan where appropriate, the tree cover on the site will be enhanced by planting with advanced specimens/s of appropriate tree species for the space available above and below ground being soil volumes available and to prevent future conflict between trees and built structures.

The proposed building design and its configuration and infrastructure were arrived at prior to the undertaking of an arboricultural assessment of the trees on the site to determine their significance by Redgum Horticultural.

The setbacks for the new works and its infrastructure should provide sufficient space to protect the existing growing environments both above and below ground for trees to be retained, and so that trees within the property and on adjoining properties will not be adversely affected.

The proposed design has considered the spatial requirements for the trees to be retained based on the information available or provided at the time of compiling this report, and those areas to be protected will be discussed further. The Summary lists the general condition of each tree in Table 1.0, a summary of works in Table 2.0. In section 5.0 each individual tree is described in greater detail including protective or remedial works. Tree maintenance works including pruning, removal or transplantation are detailed in section 4.0.

SUMMARY

This report considers 25 trees and recommends the retention of 12 trees and removal of 13 trees. There was one tree missing and one which had been removed prior to our assessment. The trees to be retained are comprised of trees 1, 2, 14, 15, 16, 17, 18, 19, 22, 23, 24 & 25 and to be removed are comprised of trees 3-13, 20 & 21 as they are located too close, unstable or within the building envelopes or other infrastructure.

Table 1.0 General condition and Schedule of works of trees. Trees described in greater detail in section 5.0.

Tree No.	*Genus and species*	Common name	Condition G = Good, F = Fair P = Poor, D = Dead	Description of work to be done
1	*Eucalyptus botryoides*	Bangalay Gum	G	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
2	*Eucalyptus botryoides*	Bangalay Gum	G	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
3	*Angophora costata*	Sydney Red Gum	G	Remove and replace with by new plantings as per Landscape Plan
4	*Banksia integrifolia*	Coastal Banksia	F	Remove and replace with by new plantings as per Landscape Plan
5	*Banksia integrifolia*	Coastal Banksia	F	Remove and replace with by new plantings as per Landscape Plan
6	*Angophora costata*	Sydney Red Gum	F	Remove and replace with by new plantings as per Landscape Plan
7	*Eucalyptus botryoides*	Bangalay Gum	F	Remove and replace with by new plantings as per Landscape Plan
8	*Missing*			Removed prior to inspection and replace with new planting as per Landscape Plan
9	*Banksia marginata*	Silver Banksia	F	Remove and replace with by new plantings as per Landscape Plan
10	*Banksia marginata*	Silver Banksia	F	Remove and replace with by new plantings as per Landscape Plan
11	*Eucalyptus botryoides*	Bangalay Gum	F	Remove and replace with by new plantings as per Landscape Plan
12	*Pittosporum undulatum*	Native Daphne	F	Remove and replace with by new plantings as per Landscape Plan
13	*Eucalyptus botryoides*	Bangalay Gum	G	Remove and replace with by new plantings as per Landscape Plan
14	*Pittosporum undulatum*	Native Daphne	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
15	*Pittosporum undulatum*	Native Daphne	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
16	*Pittosporum undulatum*	Native Daphne	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
17	*Pittosporum undulatum*	Native Daphne	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
18	*Pittosporum undulatum*	Native Daphne	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
19	*Eucalyptus botryoides*	Bangalay Gum	G	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan

Tree No.	*Genus and species*	Common name	Condition G = Good, F = Fair P = Poor, D = Dead	Description of work to be done
20	*Populus deltoides*	Eastern Cottonwood	G	Remove and replace with by new plantings as per Landscape Plan
21	*Eucalyptus botryoides*	Bangalay Gum	G	Remove and replace with by new plantings as per Landscape Plan
22	*Eucalyptus botryoides*	Bangalay Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
23	*Eucalyptus botryoides*	Bangalay Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
24	*Eucalyptus botryoides*	Bangalay Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
25	*Eucalyptus botryoides*	Bangalay Gum	F	Retain and protect within a Tree Protection Zone (TPZ) as per the Tree Protection Plan
26	*Missing*			Removed prior to inspection and replace with new planting as per Landscape Plan

Table 2.0 This table only applies to trees being retained. Tree Protection Zone fencing locations as measured from the centre of each tree and the recommended distances for the side closest to the building construction works e.g. excavation (see explanatory notes below). Tree Protection Zone fences and setbacks where applicable are indicated in Appendix I.

1. Redgum Tree No. / Redgum Stand No.	2. **T**runk **D**iameter at **B**reast **H**eight **DBH** 1.4m above ground, AS4970 2009, or mm or m above ground where indicated. # = average.	3. **S**tructural **R**oot **Z**one **SRZ** From centre of trunk (COT) above root buttress AS4970 2009 Section 3, 3.3.5 (see Appendix D) where applicable	4. **T**ree **P**rotection **Z**one (TPZ) = **12 x DBH** From centre of trunk (COT) in metres AS4970 2009 Section 3 (see Appendix C)	5. Distance of fence with TPZ setback **reduced by 10%** on one side of tree only, in metres. As per AS4970 2009 Section 3, 3.3	6. Proposed distance of tree protection fence/works on the side closest to building construction[2], in metres by Redgum Horticultural.
1	760	2.5	9.1	8.2	8.2
2	800	2.6	9.6	8.6	8.6
14	170	0.6	2.0	1.8	1.8
15	160	0.5	1.9	1.7	1.7
16	160	0.5	1.9	1.7	1.7
17	170	0.6	2.0	1.8	1.8
18	170	0.6	2.0	1.8	1.8
19	330	1.1	4.0	3.6	3.6
22	530	1.7	6.4	5.7	5.7
23	400	1.3	4.8	4.3	4.3
24	360	1.2	4.3	3.9	3.9
25	480	1.6	5.8	5.2	5.2

Descriptors for modified setbacks in Column 6.

1 Special conditions apply to protect the roots of trees generally, see Appendix E.
2 Additional protective fencing information is detailed in Appendices E and I.
3 Acceptable due to the good relative tolerance of the species to development impacts.
4 Range of setbacks for the trees at each end of a linear stand, see Appendix I.
5 Acceptable as fence located at a substantial distance beyond dripline, or may also include the location of a smaller tree in proximity to a larger tree to be retained and the smaller tree being protected well within the protective fencing for that larger tree.
6 Acceptable due to additional special protection works, see Section 5.0 for this tree.
7 Acceptable as pre-existing site conditions were conducive to having restricted the development of root growth in this direction.
8 Street tree with protective fencing of minimal width to allow for pedestrian access along road reserve.
9 Acceptable as tree transplanted reducing the area of the root zone.
10 Acceptable as not effected by development works.
11 Young tree not expected to have established a substantially expansive root system and able to re-establish or modify growth to be sustainable due to age and good vigour.
12 Set back prescribed by the consent authority.
13 Acceptable as tree growing on a lean and encroachment on compression wood side where root growth is of reduced structural importance.
14 Acceptable as root mapping has indicated extent of structural woody roots with a diameter of 20 mm or more.
15 Acceptable as a specimen of palm taxa tolerant of encroachment.
16 Acceptable as excavation on down slope or across slope side of tree.
17 Acceptable as encroachment into growing area below ground minor, with one corner of building or excavation works extending to within the radius of the dripline.
18 Acceptable as encroachment by pier, including screw piles, with minimal disturbance.
19 Acceptable as encroachment above grade without excavation or sub-base compaction.
20 Acceptable as located within 0.5 m from edge of dripline.
21 Acceptable as encroachment with gap graded fill that can accommodate gaseous exchange between roots/soil and the atmosphere and ongoing root growth.
22 Minimum setback 2 m, AS4970 (2009) section 3, 3.2.
23 Maximum setback 15 m, AS4970 (2009) section 3, 3.2.
24 Tree is a palm, other monocot, cycad or tree fern TPZ is to be 1 m outside crown projection AS4970 (2009) section 3, 3.2.
25 Minimum Structural Root Zone (SRZ) for trees less than 0.15 m diameter is 1.5 m, AS4970 (2009) section 3, 3.5.

Explanatory notes for Table 2.0.

This table is based upon Australian Standard AS4970 2009 *Protection of trees on development sites*, Section 3 Determining the protection zone of the selected trees (see Appendix C), where the approved building works should be no closer, including excavation, than the dimensions stated above.

"3.3 Variations to the TPZ

3.3.2 Minor Encroachment

If the proposed encroachment is less than 10% of the area of the TPZ and is outside the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ.

3.3.3 Major Encroachment

If the proposed encroachment is greater than 10% of the area of the TPZ or inside the SRZ the project arborist must demonstrate that the tree(s) would remain viable. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ."

Refer also to sections 3.4 and Appendix F, 1.1.3 for further explanation of modifications to these setbacks.

1.0 AIMS

1.1 Detail the condition of the trees on the site or on adjoining sites where such trees may be affected by the proposed works, by assessment of individual specimens or stands, and indicate remedial works or protection measures for their retention in a safe and healthy condition, or a condition not less than that at the time of initial inspection for this report, or in a reduced but sustainable condition due to the impact of the development but ameliorated through tree protection measures able to be applied, and will consider the location and condition of the trees in relation to the proposed building works, or recommend removal and replacement where appropriate.

1.2 Provide as an outcome of the assessment, the following: a description of the trees, observations made, discussion of the effects the location of the proposed building works may have on the trees, and make recommendations required for remedial or other works to the trees, if and where appropriate. *(See section 5 - Tree Assessment.)*

1.3 Determine from the assessment as detailed in 1.2 a description of the works or measures required to ameliorate the impact upon the trees to be retained, by the proposed building works or future impacts the trees may have upon the new building works if and where appropriate, or the benefits of removal and replacement if appropriate for the medium to long term safety and amenity of the site.

2.0 OBJECTIVES

2.1 Assess the condition of the subject trees.

2.2 Determine impact of development on the subject trees.

2.3 Provide recommendations for retention or removal of the subject trees.

3.0 METHODOLOGY
Note: Individual methodologies applied as applicable.

3.1 The method of assessment of tree/s applied is adapted from the principles of visual tree assessment undertaken from the ground, which considers:

1. Tree health and subsequent stability, both long and short term
2. Sustainable Retention Index Value (SRIV) Version 4 (IACA 2010)©
3. Hazard potential to people and property
4. Amenity values
5. Habitat values
6. Significance

3.2 This assessment is undertaken using standard tree assessment criteria for each tree based on the values above and is implemented as a result of at least one comprehensive and detailed site inspection to undertake a visual tree assessment from the ground of each individual tree, or stand of trees, or a representative population sample. Any dimensions recorded as averages, or by approximation are noted accordingly.

3.3 This report adopts Australian Standard AS4970 2009 *Protection of trees on development sites* as a point of reference and guide for the recommended minimum setbacks (Appendix C) from the centre of a tree's trunk to development works and the distances may be increased or decreased by the author in accordance with AS4970 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. Root mapping,
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.

3.4 Trees in groups may be referred to as stands and a stand may exclusively contain specimens to be either retained or removed or a combination of both. A stand may be used to discuss all the trees on a given site to expedite their assessment, or refer to trees growing proximate to one another or within a defined space. Stands may be comprised by mass boundary or screen plantings, to form a group of the same or a mixture of taxa. Each stand is considered as a single unit with each component tree assessed and expressed in tabular form, or indicated by a given percentage as a population sample of each stand. Where it is appropriate for a stand of trees to be retained in full or part, the location and setback of Tree Protection Zone fences or works, are prescribed to provide for the preservation of the stand or selected component trees, in a condition not less than that at the time of initial inspection for its incorporation into the landscape works for the site, or in a reduced but sustainable condition due to the impact of the development but ameliorated through tree protection measures.

3.5 The meanings for terminology used herein are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009. An extract from the IACA Dictionary forms a glossary of terms included as Appendix G.

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, Tree Work, 2007.

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).

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.

5.0 TREE ASSESSMENT – Assessment of a stand of Trees

Tree No.	Tree Assessment ***Genus & Species*** **Common Name**	**Age** Y = Young M = Mature O = Overmature	**Vigour** GV = Good Vigour LV = Low Vigour	**Condition** G = Good F = Fair P = Poor D = Dead	**1. SRIV** Age, Vigour, Condition / Index Rating www.iaca.org.au / **2. Estimated Life Expectancy** 1. Long 2. Medium 3. Short	**Crown Form** D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	**Ht.** Approx. metres	**Crown Spread** approx. metres / **Orientation** R = Radial, or other	**Crown Symmetry** 1 = symmetrical 2 = asymmetrical / **Orientation**	**Crown Cover** % / **Crown Density** % / D = dormant	**DBH** in mm @ 1.4m, or other, as indicated / **Trunk Orientation** other than R = radial, e.g. N/S	**Trunk Lean** 1 = Upright-Slight 2 = Moderate 3 = Severe 4 = Critical. 5 = Acaulescent / **Orientation** / ST = Static P = Progressive Sc = Self-correcting	**Roots Evident at Root Crown** 1. = None 2. = Adventitious 3. = Basal Flare 4. = Buttresses 5. = First Order Roots (FOR), No. & distribution e.g. R = radial, or one each to N, S, E and W	**Pests & Diseases** No or Yes If Yes see comments	**Branch Bark Included** No or Yes or N/A	**Form** G = Good Form P = Poor Form	**Significance scale** 1=High 2=Medium 3=Low / **Retention Value** 1=High 2=Medium 3=Low 4=Remove
1	*Eucalyptus botryoides*	M	GV	G	MGVG - 10 1	C	20	15X9 E/W	2 W	70 70	760@900 R	1/R St	1	No	No	G	1 1
	Bangalay Gum	Comment: Trunk to 1.5 metres, crown deliquescent, orientation E/W, asymmetrical bias to west.															
2	*Eucalyptus botryoides*	M	GV	G	MGVG - 10 1	C	20	15X15 R	1 R	70 70	800 R	2/N St	1	No	No	G	1 1
	Bangalay Gum	Comment: Trunk to 3 metres, crown deliquescent, orientation radial, symmetrical.															
3	*Angophora costata*	M	GV	G	MGVG - 10 2	C	10	9X5 N/S	2 W	70 70	470@700 R	1/R St	1	No	No	G	1 1
	Sydney Red Gum	Comment: Trunk to 1 metre, crown deliquescent, orientation N/S, asymmetrical bias to west.															
4	*Banksia integrifolia*	M	GV	F	MGVF - 9 2	C	7	7X4 N/W	2 W	70 70	250@800 R	3-W St	5 5-S	No	No	P	2 2
	Coastal Banksia	Comment: Trunk erect, straight, gradually tapering & continuous, orientation N/W, asymmetrical bias to west, crown excurrent.															
5	*Banksia integrifolia*	M	GV	F	MGVF - 9 2	C	7	7X5 E/W	2 N	70 70	800@g R	2-N St	5 4-S	No	No	P	2 2
	Coastal Banksia	Comment: Acaulescent or short trunk @ or near ground, crown deliquescent, orientation E/W, asymmetrical bias to north.															
6	*Angophora costata*	M	GV	F	MGVF - 9 2	C	12	7X3 E/W	2 W	70 70	640 R	2-W St	1	No	No	P	1 1
	Sydney Red Gum	Comment: Trunk erect, straight, gradually tapering & continuous, orientation E/W, asymmetrical bias to west, crown excurrent.															
7	*Eucalyptus botryoides*	M	GV	F	MGVF - 9 2	C	15	9X5 E/W	2 W	70 70	1000 R	2-W St	1	No	No	P	1 1
	Bangalay Gum	Comment: Trunk to 7 metres, crown deliquescent, orientation E/W, asymmetrical bias to west.															
8	*Missing*																
		Comment: Missing at time of inspection															
9	*Banksia marginata*	M	GV	F	MGVF - 9 2	C	3	4X4 R	1 R	70 70	320 R	1/R St	1	No	No	P	2 2
	Silver Banksia	Comment: Trunk to 1 metre, crown deliquescent, orientation radial, symmetrical.															
10	*Banksia marginata*	M	GV	F	MGVF - 9 2	C	10	12X4 N/S	2 W	70 70	870 R	1/R St	1	No	No	P	2 2
	Silver Banksia	Comment: Trunk to 1 metre, crown deliquescent, orientation N/S, asymmetrical bias to west.															

Tree No.	Tree Assessment ***Genus & Species*** **Common Name**	**Age** Y = Young M = Mature O = Overmature	**Vigour** GV = Good Vigour LV = Low Vigour	**Condition** G = Good F = Fair P = Poor D = Dead	**1. SRIV** Age, Vigour, Condition / Index Rating www.iaca.org.au / **2. Estimated Life Expectancy** 1. Long 2. Medium 3. Short	**Crown Form** D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	**Ht.** Approx. metres	**Crown Spread** approx. metres / **Orientation** R = Radial, or other	**Crown Symmetry** 1 = symmetrical 2 = asymmetrical / **Orientation**	**Crown Cover** % / **Crown Density** % / D = dormant	**DBH** in mm @ 1.4m, or other, as indicated / **Trunk Orientation** other than R = radial, e.g. N/S	**Trunk Lean** 1 = Upright-Slight 2 = Moderate 3 = Severe 4 = Critical. 5 = Acaulescent / **Orientation** / ST = Static P = Progressive Sc = Self-correcting	**Roots Evident at Root Crown** 1. = None 2. = Adventitious 3. = Basal Flare 4. = Buttresses 5. = First Order Roots (FOR), No. & distribution e.g. R = radial, or one each to N, S, E and W	**Pests & Diseases** No or Yes If Yes see comments	**Branch Bark Included** No or Yes or N/A	**Form** G = Good Form P = Poor Form	**Significance scale** 1=High 2=Medium 3=Low / **Retention Value** 1=High 2=Medium 3=Low 4=Remove
11	*Eucalyptus botryoides*	M	LV	F	MLVF – 4 3	C	7	7X3 NE/SW	2 SW	50 50	360 R	1/R St	1	No	No	P	2 3
	Bangalay Gum	Comment: Trunk to 2 metres, crown deliquescent, orientation NE/SW, asymmetrical bias to south west.															
12	*Pittosporum undulatum*	M	GV	F	MGVF - 9 2	C	6	4X2 E/W	2 N	70 70	160 R	1/R St	1	No	No	G	2 3
	Native Daphne	Comment: Trunk to 1.5 metres, crown deliquescent, orientation E/W, asymmetrical bias to north.															
13	*Eucalyptus botryoides*	M	GV	G	MGVG - 10 1	C	15	12X7 E/W	2 W	60 60	700 R	1/R St	1	No	No	G	2 2
	Bangalay Gum	Comment: Trunk to 3 metres, crown deliquescent, orientation E/W, asymmetrical bias to west.															
14	*Pittosporum undulatum*	M	GV	F	MGVF - 9 2	C	6	4X2 E/W	2 N	70 70	170 R	1/R St	1	No	No	P	2 2
	Native Daphne	Comment: Trunk to 500mm, crown deliquescent, orientation E/W, asymmetrical bias to north.															
15	*Pittosporum undulatum*	M	GV	F	MGVF - 9 2	C	6	4X2 E/W	2 N	70 70	160 R	1/R St	1	No	No	P	2 2
	Native Daphne	Comment: Trunk erect, straight, gradually tapering & continuous, orientation E/W, asymmetrical bias to north, crown excurrent.															
16	*Pittosporum undulatum*	M	GV	F	MGVF - 9 2	C	6	4X2 E/W	2 N	70 70	160 R	5-N St	1	No	No	P	2 2
	Native Daphne	Comment: Acaulescent or short trunk @ or near ground, crown deliquescent, orientation E/W, asymmetrical bias to north.															
17	*Pittosporum undulatum*	M	GV	F	MGVF - 9 2	C	6	4X2 E/W	2 N	70 70	170 R	1/R St	1	No	No	P	2 2
	Native Daphne	Comment: Trunk erect, straight, gradually tapering & continuous, orientation E/W, asymmetrical bias to north, crown excurrent.															
18	*Pittosporum undulatum*	M	GV	F	MGVF - 9 2	C	6	4X2 E/W	2 N	70 70	170 R	5-N St	1	No	No	P	2 2
	Native Daphne	Comment: Acaulescent or short trunk @ or near ground, crown deliquescent, orientation E/W, asymmetrical bias to north.															
19	*Eucalyptus botryoides*	M	GV	G	MGVG - 10 2	C	10	6X6 R	1 R	60 60	330 R	1/R St	1	No	No	G	2 2
	Bangalay Gum	Comment: Trunk to 3 metres, crown deliquescent, orientation radial, symmetrical.															
20	*Populus deltoides*	M	GV	G	MGVG - 10 2	D	25	20X20 R	1 R	70 70	1500 R	1/R St	1	Yes	No	G	2 2
	Eastern Cottonwood	Comment: Trunk to 7 metres, crown deliquescent, orientation radial, symmetrical.															

Tree No.	Tree Assessment ***Genus & Species*** **Common Name**	**Age** Y = Young M = Mature O = Overmature	**Vigour** GV = Good Vigour LV = Low Vigour	**Condition** G = Good F = Fair P = Poor D = Dead	**1. SRIV** Age, Vigour, Condition / Index Rating www.iaca.org.au / **2. Estimated Life Expectancy** 1. Long 2. Medium 3. Short	**Crown Form** D = Dominant C = Co-dominant I = Intermediate S = Suppressed F = Forest E = Emergent	**Ht.** Approx. metres	**Crown Spread** approx. metres / **Orientation** R = Radial, or other	**Crown Symmetry** 1 = symmetrical 2 = asymmetrical / **Orientation**	**Crown Cover** % / **Crown Density** % / D = dormant	**DBH** in mm @ 1.4m, or other, as indicated / **Trunk Orientation** other than R = radial, e.g. N/S	**Trunk Lean** 1 = Upright-Slight 2 = Moderate 3 = Severe 4 = Critical. 5 = Acaulescent / **Orientation** / ST = Static P = Progressive Sc = Self-correcting	**Roots Evident at Root Crown** 1. = None 2. = Adventitious 3. = Basal Flare 4. = Buttresses 5. = First Order Roots (FOR), No. & distribution e.g. R = radial, or one each to N, S, E and W	**Pests & Diseases** No or Yes If Yes see comments	**Branch Bark Included** No or Yes or N/A	**Form** G = Good Form P = Poor Form	**Significance scale** 1=High 2=Medium 3=Low / **Retention Value** 1=High 2=Medium 3=Low 4=Remove
21	*Eucalyptus botryoides*	M	GV	G	MGVG - 10 1	C	25	15X9 E/W	2 S	50 60	820 R	1/R St	1	No	No	G	2 2
	Bangalay Gum	Comment: Trunk erect, straight, gradually tapering & continuous, orientation E/W, asymmetrical bias to south, crown excurrent.															
22	*Eucalyptus botryoides*	M	LV	F	MLVF - 4 2	C	20	9X5 N/S	2 N	70 70	530 R	1/R St	1	No	No	G	2 2
	Bangalay Gum	Comment: Trunk erect, straight, gradually tapering & continuous, orientation N/S, asymmetrical bias to north, crown excurrent.															
23	*Eucalyptus botryoides*	M	GV	F	MGVF - 9 1	C	15	4X4 R	1 R	50 50	400 R	1/R St	1	No	No	G	2 2
	Bangalay Gum	Comment: Trunk erect, straight, gradually tapering & continuous, crown excurrent. Basal trunk wound to west. Corymbia maculata (Spotted Gum) underneath.															
24	*Eucalyptus botryoides*	M	LV	F	MLVF - 4 2	C	8	5X3 E/W	2 W	60 60	360 R	1/R St	1	Yes	No	P	2 2
	Bangalay Gum	Comment: Trunk to 3 metres, crown deliquescent, orientation E/W, asymmetrical bias to west. Trunk wound to west.															
25	*Eucalyptus botryoides*	M	GV	F	MGVF - 9 1	C	15	9X5 E/W	2 E	70 70	480 R	1/R St	1	No	No	P	2 2
	Bangalay Gum	Comment: Trunk erect, straight, gradually tapering & continuous, orientation E/W, asymmetrical bias to east, crown excurrent.															
26	*Missing*																
		Comment: Tree removed prior to inspection.															

Observations

5.2 A stand of planted non-locally indigenous and exotic evergreen shrubs and trees.

5.3 The site has a combination of mature trees and oversized shrubs within the current proposal. There are a number of specimens considered significant for their contribution as landscape elements to the property. The retention of these twelve (12) trees allows them as components of the current curtilage to be transferred to the new proposal, maintaining elements of a continuous landscape, providing a more harmonious integration and transition of the use of the land. The other specimens were within the proposed building envelope and are not able to be retained. They are to be replaced additionally to the landscaping component with advanced specimens of similar or same species.

Tree Significance

5.4 See Appendix A for Assessment Criteria. Trees 1-25 are a mix of high and low significance due to their dimensions and screening along the common side boundary while the street trees are mainly of moderate significance due to their small sizes, prominence and good condition.

Significant Trees as established by the Rating System for Tree Significance – IACA Stars (2010), Appendix A.

Significant Scale

1 – High
2 – Medium
3 – Low

Significance Scale	1	2	3
Redgum Tree No.	1,2,3,6,7	4,5,9,10,11,12,13,14, 15,16,17,18,19,20,21, 22,23,24,25,26	

Tree Retention Value

5.5 See Appendix A for Retention Value Matrix.

Retention Value

High – Priority for Retention
Medium – Consider for Retention
Low – Consider for Removal
Remove - Priority for Removal

Retention Value	High Priority for Retention	Medium Consider for Retention	Low Consider for Removal	Remove Priority for Removal
Redgum Tree No.	1,2,3,6,7	4,5,9,10,13,14, 15,16,17,18,19, 20,21,22,23,24, 25	11,12	

* Trees located within the neighbouring property and should be retained and protected. Consent required from owner if removal required.

Discussion

5.6 AS4970 (2009) section 3 requires a Tree Protection Zone (TPZ) setback of 12 x DBH from center of trunk (COT) but allows for a 10% reduction of area equal to a reduction of 30% of radius on one side only with the setbacks as shown in Table 2.0. AS4970 (2009) section 3, 3.3.3 requires the Project Arborist to demonstrate that where a retained tree is subject to a major encroachment (>10% of area of TPZ) it can be protected to remain viable.

5.7 The proposed design requires the removal of 13 of 25 trees from within the site and a shrub on the street frontage and retention of 12 trees within the proposed development.

General – Tree Protection works – Prior to Demolition and Tree Removal

5.8 The Tree Protection Zone for each tree/s is to be incorporated into the construction works for the site and the protection fencing or works to be located as indicated on the Appendix I – Tree Protection Plan. The setbacks from building works on the side closest to each tree are to be carried out as indicated in Table 2.0, and Tree Protection Zones be constructed as described here and detailed in Appendices B and I. The trees will be sustained within the constraints of the modifications to the site by the proposed development works. Attention is drawn specifically to Appendix F for the protection of all tree/s to be retained and particular parts as indicated for all retained tree/s being 1.0, 1.2.0, 1.2.1, 1.2.2, 1.3.0, 1.3.1, 1.3.2, 1.4.0, 1.4.1, 1.4.1.1, 1.4.2, 1.4.2.1, 1.4.2.2, 1.4.2.3, 1.4.4.2 and 1.4.6.

5.9 Trees 1, 2, 14, 15, 16, 17, 18, 19, 22, 23, 24 & 20 are to be retained and protected and incorporated into the landscape works for the site, and Tree Protection Zone fencing to be marked accordingly on the Landscape Plan, where appropriate and installed prior to any demolition or construction.

5.10 Where applicable, any excavation for the establishment of a batter slope or benching for reasons of safety and to comply with Work Cover Authority safety regulations should be restricted as far as is safely possible near to trees to be retained to prevent root damage. 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 and they may need to be revised and possibly removed.

Specific - Tree Protection Works - Prior to Demolition and Tree Removal

5.11 All other trees/shrubs; prior to demolition and tree removal works these tree/s are to be placed within a Tree Protection Zone with protective fencing and maintained and retained until the completion of all building works. Protective fencing is to be installed as shown in Appendices E - Tree Protection Zone - Standard Procedure and I - Tree Protection Plan.

Demolition and Tree Removal/s

5.12 Trees 3-13, 20 & 21 are to be removed as they are located within the site in a position where they cannot be retained due to the proposed building envelopes and its infrastructure such as excavation of the basement where encroachment will have an adverse impact on its roots and crown for viability and stability.

Specific - Tree Protection works – Post Demolition and Prior to Construction

5.13 Location of underground utilities within a Tree Protection Zone of a retained specimen.
Any utility services to be located underground within the TPZ are to be undertaken utilising excavation techniques that prevent or minimise damage to structural roots (roots greater than >20 mm diameter). Such works should be conducted with non-motorised hand tools of with an air knife or water knife and vacuum truck or with directional drilling to prevent soil compaction and root damage.

Specific - Tree Protection works – During Construction

5.14 Where any structural roots (roots with a diameter of greater than >20 mm) encountered by excavation are to be pruned and it is to be undertaken with clean sharp pruning tools, with a final cut to undamaged wood to prevent infestation by pathogens and assist continued root growth and undertaken in consultation with the Consulting Arboriculturist. Tree Protection Zone fences are to be maintained during these works. Ground protection in accordance with AS4970 section 4, 4.5.3 may require steel plates to protect the ground surface from compaction to protect roots between the stages of demolition and construction of the new pavement (Appendix F, 1.2.2).

5.15 Trees to be removed are to be replaced with advanced specimens being mindful of the space limitations of the new use of the site. The advanced trees should be located in areas along the boundaries of the site. The planting in these locations will provide the maximum benefit to the surrounding properties by screening views to and from the site and the plantings included in the proposed landscape plan. The replacement trees will be located in positions where they may grow to maturity unhindered and will not conflict with built structures or utility services and in greater numbers than the trees removed should provide a net increase in the local amenity.

5.16 All Tree Protection Zones of retained trees are to be monitored for the duration of the construction phase of the development. The three main areas requiring monitoring are; *mulching* - mulch must be maintained to a depth of 50–100 mm using material that complies with AS 4454. Where the existing landscape within the TPZ is to remain unaltered (e.g. garden beds or turf) mulch may not be required, *Watering* - soil moisture levels should be regularly monitored by the project arborist. Temporary irrigation or watering may be required within the TPZ. An above-ground irrigation system could be installed and maintained by a competent individual and *weeding* - weeds should be removed by hand without disturbing soil or should be controlled with weedicide.

Post Construction - Landscaping

5.17 ***Excavation for landscape plantings within the tree protection zones*** should be undertaken manually, to prevent damage to structural roots. Existing soil grades should be maintained with plant container size restricted to a maximum size of 5 litres. No more than 2 plants per square metre for 5 litre and 5 plants per square metre for 150 mm pot size.

6.0 CONCLUSION

Thirteen trees are nominated for removal and replacement with species in accordance with the associated Landscape documentation for the development. The twelve 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 this report. Where appropriate, the Landscape Plan will include planting with new trees including street tree/s.

It is often a consequence of redevelopment, and subject to the nature of the proposed land use that some or all of the trees present on the site prior to that redevelopment may be required to be removed and replaced with new tree plantings in different locations. This may be dependent upon the type of development and its design constraints and the requirements of the local planning instruments and any Landscape Design Codes if existing. Where tree removal is required for this development, it is considered that those trees identified within this report are not sustainable within the context of the proposed development. Where tree retention has been considered, those trees are expected to survive the redevelopment process and remain stable and viable. The retention and protection of existing trees on site is a significant aspect of the development process, allowing those trees as components of the current curtilage to be transferred to the new dwellings for incorporation into the landscaping works for the site. The retention of some or all of the existing trees contributes to: the preservation of local amenity, screening of views to and from the site, and a balance to the scale and bulk of buildings, while maintaining elements of a continuous landscape, providing a more harmonious integration and transition of the use of the land.

If all the recommendations and procedures detailed herein are adhered to, some or all of the trees the subject of this report will continue, or will be replaced with more appropriate plantings in suitable locations, or enhanced by additional new plantings, and will grow to develop as important landscape components providing elements of long term amenity for the property and its owners or occupants, and the local community.

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 Trees1, 2, 14, 15, 16, 17, 18, 19, 22, 23, 24 & 20 are to be retained in situ within the site and are to be protected as detailed in 5.6 - 5.8, and sections 4.0, and Appendices E and F. Tree protection fences, or works, to be located in accordance with *Site Plan B - Trees To Be Retained And Tree Protection Zones* (Appendix I).

7.2 Where Tree Protection Zone fences are to be moved or relocated this must be undertaken in consultation with the Consultant Arboriculturist for the project to ensure that tree protection is maintained. If areas are impeding access is to be mulched in accordance with section 1.2.2 of Appendix F of this report.

7.3 Tree Protection Zones are to be adhered to minimise damage to retained crowns. This must be undertaken in consultation with the Consultant Arboriculturist for the project to ensure that tree protection is maintained. Minor pruning may be required if damage occurs from asphalt installation, work to undertaken in accordance with section 4 of this report.

7.4 Trees 3-13, 20 & 21 are to be removed which is to be undertaken in accordance with section 4.0, parts 4.1 - 4.3.

7.5 Tree removal near retained specimens is to be undertaken in accordance with Appendix F section 1.3.3 of this report.

7.6 Any work to be undertaken within Tree Protection Zones is to be undertaken in accordance with Appendix E section 1.2.2 of this report.

7.7 No building supplies to be stored within Tree Protection Zones for the duration of the development.

7.8 Each of the replacement are to be a vigorous specimen with a straight trunk, gradually tapering and continuous, crown excurrent, symmetrical, with roots established but not pot bound in a volume container or approved similar and be maintained by an appropriately qualified and experienced landscape contractor for up to one (1) year after planting, or as appropriate.

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1. Draper BD and Richards PA 2009, *Dictionary for Managing Trees in Urban Environments*, Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.
2. IACA 2005, Sustainable Retention Index Value, *Institute of Australian Consulting Arboriculturists*, Australia, www.iaca.org.au .
3. Standards Australia 2007, *Australian Standard 4373 Pruning of amenity trees*, Standards Australia, Sydney, Australia.
4. Standards Australia 2009, *Australian Standard 4970 Protection of trees on development sites*, Standards Australia, Sydney, Australia.
5. Work Cover NSW 2007, *Code of Practice Tree Work*, New South Wales Government, Australia.

Appendix A

IACA Significance of a Tree, Assessment Rating System (STARS) © (IACA 2010)©

In the development of this document IACA acknowledges the contribution and original concept of the Footprint Green Tree Significance & Retention Value Matrix, developed by Footprint Green Pty Ltd in June 2001.

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria* and *Tree Retention Value - Priority Matrix*, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

This rating system will assist in the planning processes for proposed works, above and below ground where trees are to be retained on or adjacent a development site. The system uses a scale of *High*, *Medium* and *Low* significance in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined.

Tree Significance - Assessment Criteria

1. High Significance in landscape

- The tree is in good condition and good vigour;
- The tree has a form typical for the species;
- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age;
- The tree is listed as a Heritage Item, Threatened Species or part of an Endangered ecological community or listed on Councils significant Tree Register;
- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity;
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values;
- The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa *in situ* - tree is appropriate to the site conditions.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour;
- The tree has form typical or atypical of the species;
- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street,
- The tree provides a fair contribution to the visual character and amenity of the local area,
- The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa *in situ*.

3. Low Significance in landscape

- The tree is in fair-poor condition and good or low vigour;
- The tree has form atypical of the species;
- The tree is not visible or is partly visible from surrounding properties as obstructed by other vegetation or buildings,
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area,
- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation orders or similar protection mechanisms and can easily be replaced with a suitable specimen,
- The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa *in situ* - tree is inappropriate to the site conditions,
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms,
- The tree has a wound or defect that has potential to become structurally unsound.

Environmental Pest / Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties,
- The tree is a declared noxious weed by legislation.

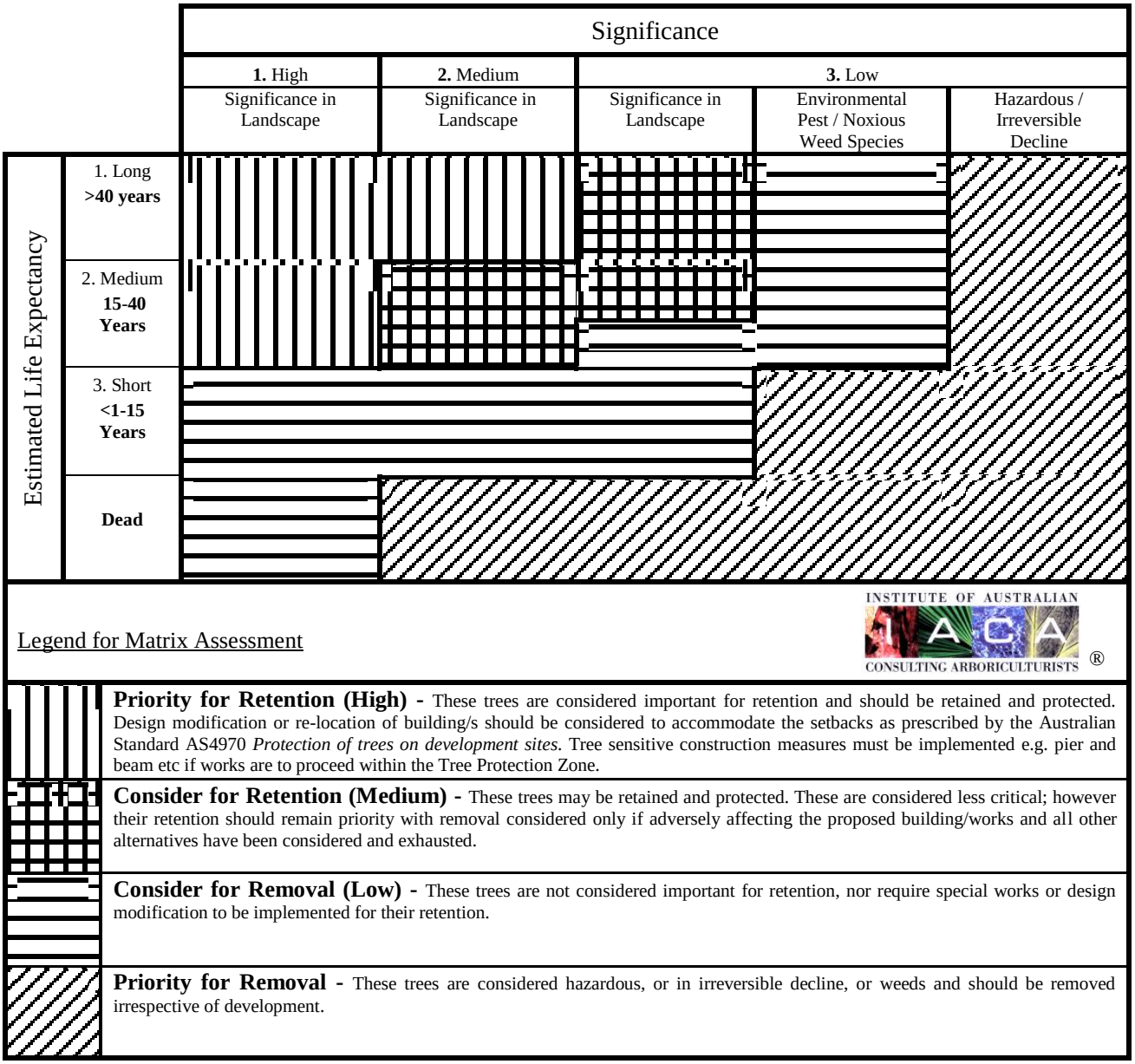
Hazardous/Irreversible Decline

- The tree is structurally unsound and/or unstable and is considered potentially dangerous,
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.

Note: The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety e.g. hedge.

Table 1.0 Tree Retention Value - Priority Matrix.



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Draper BD and Richards PA 2009, *Dictionary for Managing Trees in Urban Environments*, Institute of Australian Consulting Arboriculturists (IACA), CSIRO Publishing, Collingwood, Victoria, Australia.

Footprint Green Pty Ltd 2001, *Footprint Green Tree Significance & Retention Value Matrix*, Avalon, NSW Australia, www.footprintgreen.com.au

Appendix B

Matrix - Sustainable Retention Index Value (SRIV) ©

The matrix is to be used with the value classes defined in the Glossary for Age / Vigour / Condition.
An index value is given to each category where ten (10) is the highest value.

Age Class	Vigour Class and Condition Class					
	Good Vigour & Good Condition (GVG)	Good Vigour & Fair Condition (GVF)	Good Vigour & Poor Condition (GVP)	Low Vigour & Good Condition (LVG)	Low Vigour & Fair Condition (LVF)	Low Vigour & Poor Condition (LVP)
	Able to be retained if sufficient space available above and below ground for future growth. No remedial work or improvement to growing environment required. May be subject to high vigour. Retention potential - Medium – Long Term.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work may be required or improvement to growing environment may assist. Retention potential - Medium Term. Potential for longer with remediation or favourable environmental conditions.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work unlikely to assist condition, improvement to growing environment may assist. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. No remedial work required, but improvement to growing environment may assist vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment may assist condition and vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	Unlikely to be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment unlikely to assist condition or vigour. Retention potential - Likely to be removed immediately or retained for Short Term. Potential for longer with remediation or favourable environmental conditions.
(Y) Young	**YGVG - 9** **Index Value 9** Retention potential - Long Term. Likely to provide minimal contribution to local amenity if height <5 m. High potential for future growth and adaptability. Retain, move or replace.	**YGVF - 8** **Index Value 8** Retention potential - Short – Medium Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium-high potential for future growth and adaptability. Retain, move or replace.	**YGVP - 5** **Index Value 5** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVG - 4** **Index Value 4** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium potential for future growth and adaptability. Retain, move or replace.	**YLVF - 3** **Index Value 3** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVP - 1** **Index Value 1** Retention potential - Likely to be removed immediately or retained for Short Term. Likely to provide minimal contribution to local amenity if height <5 m. Low potential for future growth and adaptability.
(M) Mature	**MGVG - 10** **Index Value 10** Retention potential -Medium - Long Term.	**MGVF - 9** **Index Value 9** Retention potential - Medium Term. Potential for longer with improved growing conditions.	**MGVP - 6** **Index Value 6** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVG - 5** **Index Value 5** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVF - 4** **Index Value 4** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVP - 2** **Index Value 2** Retention potential - Likely to be removed immediately or retained for Short Term.
(O) Over-mature	**OGVG - 6** **Index Value 6** Retention potential - Medium - Long Term.	**OGVF - 5** **Index Value 5** Retention potential - Medium Term.	**OGVP - 4** **Index Value 4** Retention potential - Short Term.	**OLVG - 3** **Index Value 3** Retention potential - Short Term. Potential for longer with improved growing conditions.	**OLVF - 2** **Index Value 2** Retention potential - Short Term.	**OLVP - 0** **Index Value 0** Retention potential - Likely to be removed immediately or retained for Short Term.

Appendix C

Extract from Australian Standard AS4970 2009 Protection of trees on development sites

Section 3, Determining the tree protection zones of the selected trees

3.1 Tree protection zone (TPZ)

"The tree protection zone (TPZ) is the principal means of protecting trees on development sites. The TPZ is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable.

The TPZ incorporates the structural root zone (SRZ) (refer to Clause 3.3.5)."

3.2 Determining the TPZ

The radius of the TPZ is calculated for each tree by multiplying its DBH x 12.

TPZ = DBH x 12

where

DBH = trunk diameter measured at 1.4 m above ground

Radius is measured from the centre of the stem at ground level.

Appendix D

Extract from Australian Standard AS4970 2009 Protection of trees on development sites

Section 3, Determining the protection zones of the selected trees

3.3.5 Structural root zone (SRZ)

"The SRZ is the area required for street stability. A larger area is required to maintain a viable tree. The SRZ only needs to be calculated when a major encroachment into a TPZ is proposed. Root investigation may provide more information on the extent of these roots."

Determining the SRZ

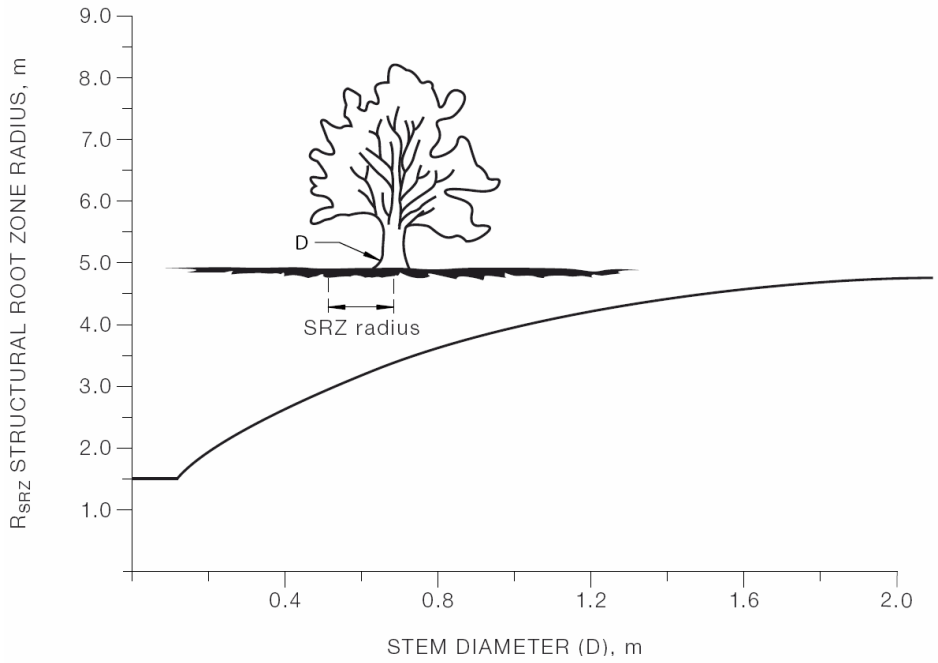
The radius of the TPZ is calculated for each tree by multiplying its DBH x 12.

SRZ radius = $(D \times 50)^{0.42} \times 0.64$

where

D = trunk diameter, in metres, measured above the root buttress.

Note: The SRZ for trees with trunk diameters less than 0.15 m will be 1.5 m (see Figure 1).



The curve can be expressed by the following formula:
$R_{SRZ} = (D \times 50)^{0.42} \times 0.64$

NOTES:

1 R_{SRZ} is the structural root zone radius.
2 D is the stem diameter measured immediately above root buttress.
3 The SRZ for trees less than 0.15 m diameter is 1.5 m.
4 The SRZ formula and graph do not apply to palms, other monocots, cycads and tree ferns.
5 This does not apply to trees with an asymmetrical root plate.

FIGURE 1 STRUCTURAL ROOT ZONE

Appendix E

1.0 TREE PROTECTION ZONES - STANDARD PROCEDURE

1.1 The Protective fencing where required may delineate the ***TPZ*** and should be located as determined by the project arborist in accordance with AS4970 *Protection of trees on development sites*, Section 4, 4.3. *"Fencing should be erected before any machinery or materials are brought onto the site and before the commencement of works including demolition. Once erected, protective fencing must not be removed or altered without approval by the project arborist. The TPZ must be secured to restrict access. AS4687 Temporary fencing and hoardings specifies applicable fencing requirements. Shade cloth or similar should be attached to reduce the transport of dust, other particulate matter and liquids into the protected area. Fence posts and supports should have a diameter greater than 20 mm and be located clear of roots. Existing perimeter fencing and other structures may be suitable as part of the protective fencing."*

AS4970 Section 4, Tree protection measures, Figure 3 Protective fencing shows examples of such fencing.

"Legend:

1 Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.
2 Alternative plywood or wooden paling fence panels. The fencing material also prevents building materials or soil entering the TPZ.
3 Mulch installation across surface of TPZ (at the discretion of the project arborist). No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.
4 Bracing is permissible within the TPZ. Installation of supports should avoid damaging roots. "

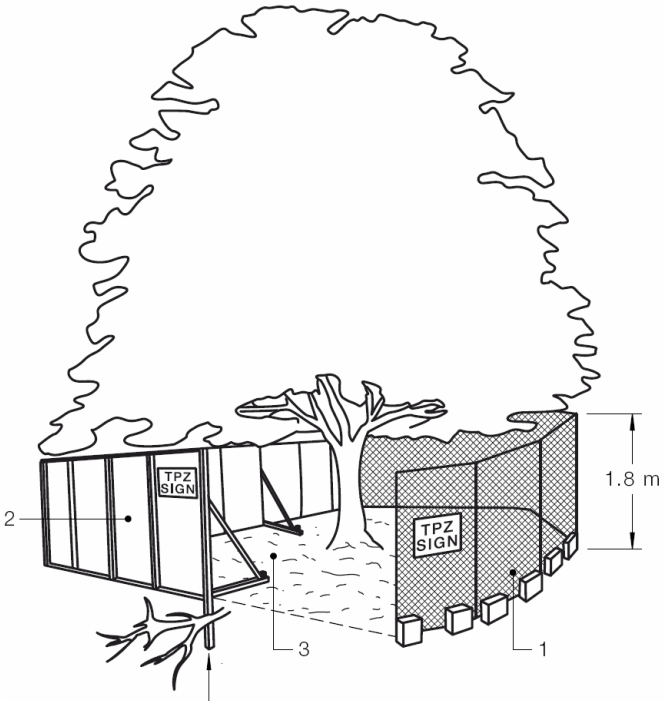


Diagram - Extract from Australian Standard

1.2 AS4970 Section 4, Tree protection measures, 4.2 Activities restricted within the TPZ

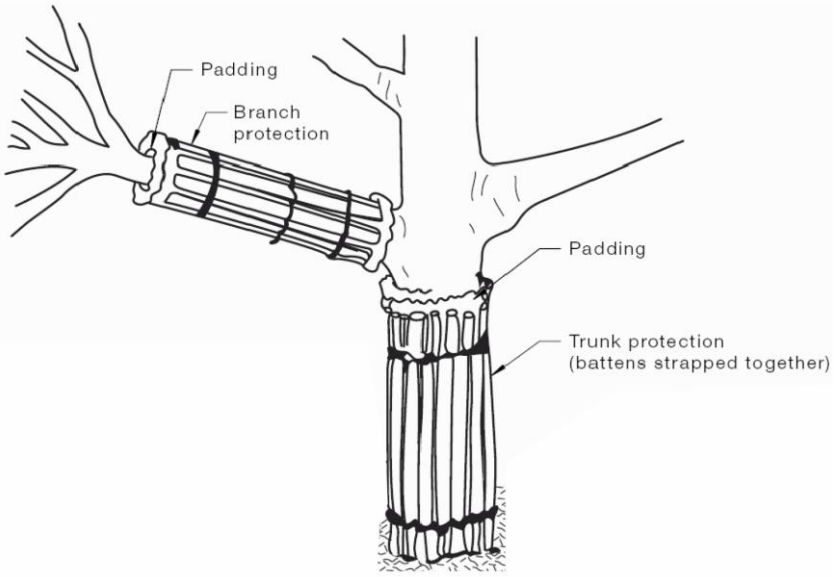
"Activities generally excluded from the TPZ included but are not limited to-

(a) Machine excavation including trenching;
(b) Excavation for silt fencing;
(c) cultivation;
(d) storage;
(e) preparation of chemicals, including preparation of cement products;
(f) parking of vehicles and plant;
(g) refuelling;
(h) dumping of waste;
(i) wash down and cleaning of equipment;
(j) placement of fill;
(k) lighting of fires;
(l) soil level changes;
(m) temporary or permanent installation of utilities and signs, and
(n) physical damage to the tree."

1.3 Tree Protection signage is to be attached to each ***Tree Protection Zone*** and displayed from within the development site in accordance with AS4970 2009 *Protection of trees on development sites*, Section 4.4 and example Appendix C1 (as shown) and lettering to comply with AS1319.

FIGURE C1 TREE PROTECTION ZONE SIGN

1.4 Where a tree is to be retained and a ***Tree Protection Zone*** cannot be adequately established due to restricted access e.g. tree located along side an access way, the trunk and branches in the lower crown will be protected by wrapping 2 layers of hessian or carpet underfelt around the trunk and branches for a minimum of 2 m or as lower branches permit, then wire or rope secures 75x50x2000 mm hardwood battens together around the trunk (do not nail or screw to the trunk or branches). The number of battens to be used is as required to encircle the trunk and the planks are to extend to the base of the tree (AS4970 2009 *Protection of trees on development sites*, Figure 4 Examples of Trunk, Branch and ground protection).



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 mm 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. Where deep excavation will expose the soil profile to drying out the root plate is to be protected by pegging jute matting across the ground surface 2 m back from the edge of the profile and 2 m down the face of the profile and is to be in one continuous sheet or layers up to 5 mm thick and overlapped 300 mm and pegged. Pegs are to be a minimum length of 200 mm and spaced at 500 mm increments in a grid pattern. Once installed mulch is to be placed on top of the jute matting previously described.

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 is 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 F

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, Australian Standard AS4970 2009 *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 for the effective protection of trees on development sites (see Appendix E). 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 **Installing underground services within TPZ**

If an underground utility service is to be located within the area of the TPZ Australian Standard AS4970 2009 *Protection of trees on development sites*, Section 4, 4.5.5 Installing underground services within TPZ provides the following:

"All services should be routed outside the TPZ. If underground services must be routed within the TPZ, they should be installed by directional drilling or in manually excavated trenches.

The directional drilling bore should be at least 600 mm deep. The project arborist should assess the likely impacts of boring and bore pits on retained trees.

For manual excavation trenches the project arborist should advise on roots to be retained and should monitor the works. Manual excavation may include the use of pneumatic and hydraulic tools. Refer Clause 4.5.3."

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.

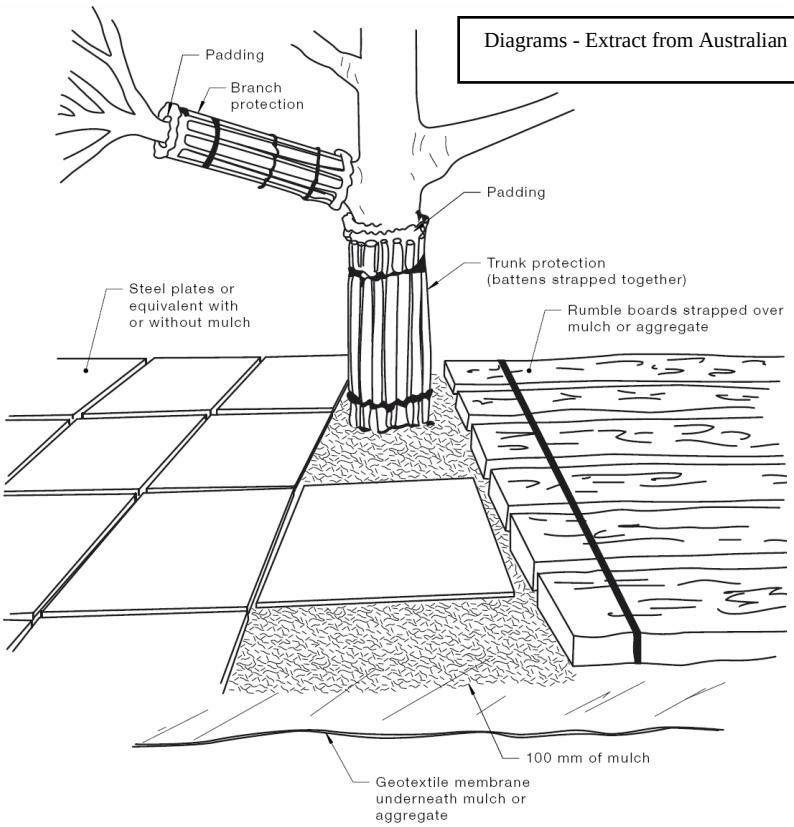
1.2.2 **Precautions in respect of temporary work**

For Precautions in respect of temporary work, Australian Standard AS4970 2009 *Protection of trees on development sites*, Section 4, Tree protection measures, 4.5 Other tree protection measures, provides the following:

"4.5.3 Ground protection

If temporary access for machinery is required within the TPZ ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Measures may include a permeable membrane such as geotextile fabric beneath a layer of mulch or crushed rock below rumble boards as per Figure 4. These measures may be applied to root zones beyond the TPZ."

Diagrams - Extract from Australian Standard



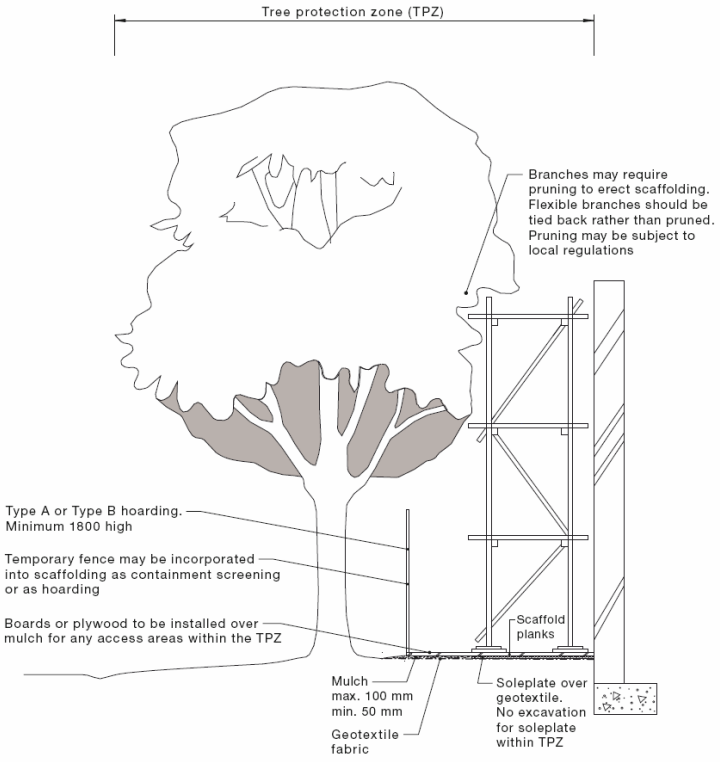
"4.5.6 Scaffolding

Where scaffolding is required it should be erected outside the TPZ. Where it is essential for scaffolding to be erected within the TPZ, branch removal should be minimized. This can be achieved by designing scaffolding to avoid branches or tying back branches. Ground below the scaffolding should be protected by boarding (e.g. scaffolding board or plywood sheeting) as shown in Figure 5. Where access is required, a board walk or other surface material should be installed to minimise soil compaction. Boarding should be placed over a layer of mulch and impervious sheeting to prevent soil contamination. The boarding should be left in place until the scaffolding is removed."

"Notes:

1 For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.

2 Rumble boards should be a suitable thickness to prevent soil compaction and root damage."



NOTE: Excavation required for the insertion of support posts for tree protection fencing should not involve the severance of any roots greater than 20 mm in diameter, without the prior approval of the project arborist.

Diagrams - Extract from Australian Standard

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 100 mm 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 1.2.2.

1.3.2 **Demolition of landscape structures**

The demolition of walls, driveways retaining walls, paths and pools etc. within 6 m 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 1 m 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 6 m 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 20 mm 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 20 mm 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 20 mm (*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 100 mm 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 100 mm, or further as required to allow for future and ongoing growth.

1.4.2.2

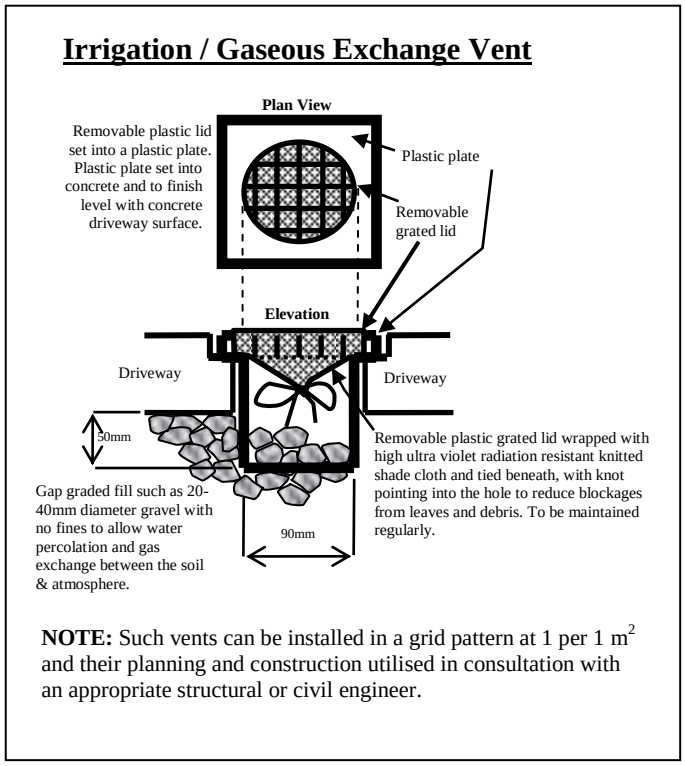
Where a driveway or footpath is to pass by the tree a suspended slab is to be constructed or approved similar, to protect the roots that may be encountered at, near, or above ground, and may be constructed on gap graded fill. Where such a driveway or footpath is to be constructed the edge of the structure closest to the tree is to terminate no closer than 0.5 m from the closest edge of 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. The side of the driveway closest to a tree is to be edged with a concrete kerb of minimum dimensions of 150 x 150 mm, 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.

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.



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 1.3.2, 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 1.4.2 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 20 mm 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 100 mm 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 100 mm 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 20 mm 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 20 mm or greater, a gap graded fill with no fines such as gravel 40 mm 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 G

Glossary

From
Dictionary for Managing Trees in Urban Environments
Institute of Australian Consulting Arboriculturists (IACA) 2009.

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. *dormant*, deciduous or semi-deciduous trees. Vigour can be categorized as *Normal Vigour, High Vigour*, *Low Vigour* and *Dormant Tree Vigour*.

Good Vigour *Ability of a tree to maintain and sustain its life processes. This may be evident by the* typical *growth of leaves,* crown cover *and* crown density*, branches, roots and trunk and* resistance *to* predation. *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.*

High 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; or some trees may achieve an extended lifespan from continuous *pollarding* practices over the life of the tree.

Low Vigour *Reduced ability of a tree to sustain its life processes. This may be evident by the* atypical *growth of leaves, reduced* crown cover *and reduced* crown density*, branches, roots and trunk, and a deterioration of their functions with reduced* resistance *to* predation*. 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.*

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* extension growth *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.*

Age of Trees

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 and can be categorized as *Young*, *Mature* and *Over-mature* (British Standards 1991, p. 13, Harris *et al*, 2004, p. 262).

Young Tree aged less than <20% of life expectancy, *in situ*.

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

Over-mature Tree aged greater than >80% of life expectancy, *in situ,* or *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 can be categorized as *Immediate*, *Short Term*, *Medium Term* and *Long Term*.

Immediate An *episode* or occurrence, likely to happen within a twenty-four (24) hour period, e.g. tree failure or collapse in full or part posing an imminent danger.

Short Term A period of time less than <1 – 15 years.

Medium Term A period of time 15 – 40 years.

Long Term A period of time greater than >40 years.

Trunk

Trunk A single stem extending from the *root crown* to support or elevate the *crown*, terminating where it divides into separate *stems* forming *first order branches*. A trunk may be evident at or near ground or be absent in *acaulescent* trees of *deliquescent* habit, or may be continuous in trees of *excurrent* habit. The trunk of any *caulescent* tree can be divided vertically into three (3) sections and can be categorized as *Lower Trunk*, *Mid Trunk* and *Upper Trunk*. For a *leaning* tree these may be divided evenly into sections of one third along the trunk.

Acaulescent A *trunkless* tree or tree growth forming a very short *trunk*. See also *Caulescent.*

Caulescent Tree grows to form a *trunk*. See also *Acaulescent*.

Condition of Trees

Condition A tree's *crown form* and growth habit, as modified by its *environment* (aspect, suppression by other trees, soils), the *stability* and *viability* of the *root plate*, trunk and structural branches (first (1st) and possibly second (2nd) order branches), including structural defects such as wounds, cavities or hollows, *crooked* trunk or weak trunk/branch junctions and the effects of predation by pests and diseases. These may not be directly connected with *vigour* and it is possible for a tree to be of *normal vigour* but in *poor condition*. Condition can be categorized as *Good Condition*, *Fair Condition*, *Poor Condition* and *Dead*.

Good Condition Tree is of good habit, with *crown 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 Condition 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 Condition 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 be sustained. 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 root system to take up water);
Turgidity (the ability of the plant to sustain moisture pressure in its cells);
Epicormic shoots or *epicormic strands* in Eucalypts (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a *lignotuber*);
Symptoms
Permanent leaf loss;
Permanent wilting (the loss of turgidity which is marked by desiccation of stems leaves and roots);
Abscission of the *epidermis* (bark desiccates and peels off to the beginning of the sapwood).

Removed No longer present, or tree not able to be located or having been cut down and retained on a site, or having been taken away from a site prior to site inspection.

Leaning Trees

Leaning A tree where the *trunk* grows or moves away from upright. A lean may occur anywhere along the *trunk* influenced by a number of contributing factors e.g. genetically predetermined characteristics, competition for space or light, prevailing winds, aspect, slope, or other factors. A *leaning* tree may maintain a *static lean* or display an increasingly *progressive lean* over time and may be hazardous and prone to *failure* and *collapse*. The degrees of leaning can be categorized as *Slightly Leaning*, *Moderately Leaning*, *Severely Leaning* and *Critically Leaning*.

Slightly Leaning A leaning tree where the trunk is growing at an angle within 0^{o}-15^{o} from upright.

Moderately Leaning A leaning tree where the trunk is growing at an angle within 15^{o}-30^{o} from upright.

Severely Leaning A leaning tree where the trunk is growing at an angle within 30^{o}-45^{o} from upright.

Critically Leaning A leaning tree where the trunk is growing at an angle greater than $>45^{o}$ from upright.

Progressively Leaning A tree where the degree of *leaning* appears to be increasing over time.

Static Leaning A leaning tree whose lean appears to have stabilized over time.

Form of Trees

Crown Form 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 and can be categorized as *Good Form* or *Poor Form*.

Good Form Tree of *typical* crown shape and habit with proportions 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 Codominant Crowns of trees restricted for space and light on one or more sides and receiving light primarily from above e.g. constrained by another tree/s or a building.

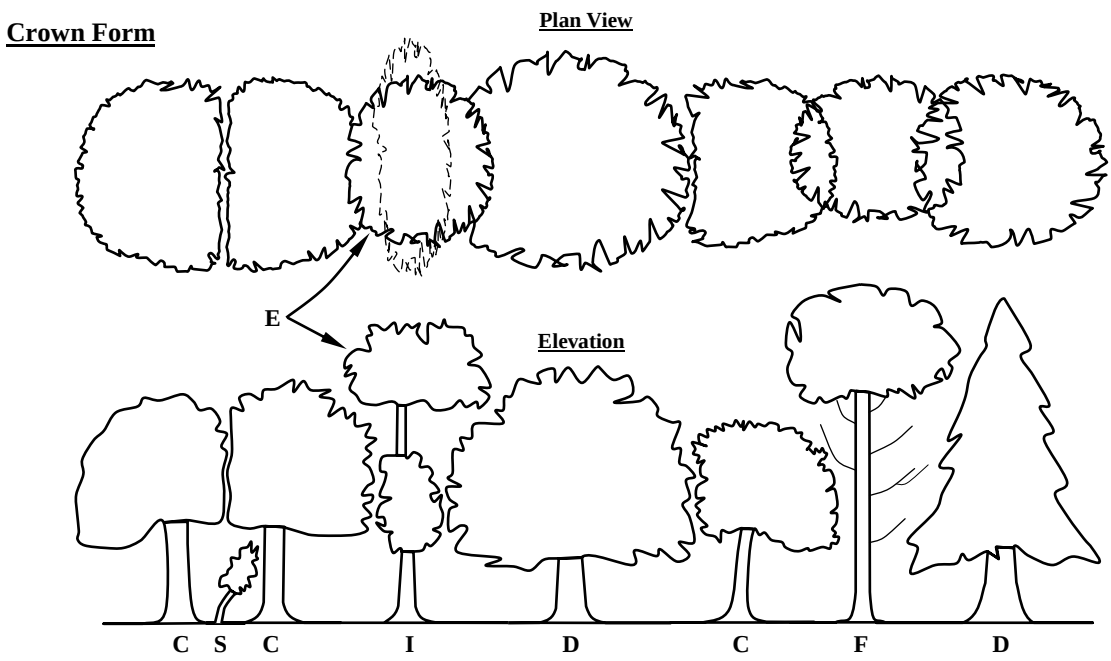
Crown Form Dominant Crowns of trees generally not restricted for space and light receiving light from above and all sides.

Crown Form Emergent Crowns of trees restricted for space on most sides receiving most light from above until the *upper crown* grows to protrude above the canopy in a stand or forest environment. Such trees may be *crown form dominant* or transitional from *crown form intermediate* to *crown form forest* asserting both *apical dominance* and *axillary dominance* once free of constraints for space and light.

Crown Form Forest Crowns of trees restricted for space and light except from above forming tall trees with narrow spreading crowns with foliage restricted generally to the top of the tree. The trunk is usually erect, straight and continuous, tapering gradually, crown often excurrent, with first order branches becoming structural, supporting the live 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 space and light in the *lower crown*.

Crown Form Intermediate Crowns of trees restricted for space on most sides with light primarily from above and on some sides only.

Crown Form Suppressed Crowns of trees generally not restricted for space but restricted for light by being *overtopped* by other trees and occupying an understorey position in the canopy and growing slowly.



(Source: **D**, **C**, **I** and **S**, and Elevation, Matheny and Clark 1998, **E**, **F** and Plan View, IACA 2005)

D. Dominant, **F.** Forest, **C.** Codominant, **E.** Emergent, **I.** Intermediate, **S.** Suppressed

Symmetry

Symmetry Balance within a *crown,* or *root plate,* above or below the *axis* of the trunk of branch and foliage, and root distribution respectively and can be categorized as *Asymmetrical* and *Symmetrical*.

Asymmetrical Imbalance within a crown, where there is an uneven distribution of branches and the foliage *crown* or *root plate* around the vertical *axis* of the trunk. This may be due to *Crown Form Codominant* or *Crown From Suppressed* 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.

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 *Crown Form Dominant* or *Crown Form Forest*. An example of an expression of this may be crown symmetrical.

Crown Spread Orientation Direction of the *axis* of *crown spread* which can be categorized as *Orientation Radial* and *Orientation Non-radial*.

Crown Spread Orientation Non-radial Where the crown extent is longer than it is wide, e.g. east/west or E/W. Further examples, north/south or N/S, and may be *Crown Form Codominant*, e.g. **A** or **B**, *Crown Form Intermediate* e.g. **A**, or *Crown Form Suppressed* e.g. **B**, *and* crown symmetry is *symmetrical* e.g. **A**, or *asymmetrical* e.g. **B**.

Crown Spread Orientation Radial Where the *crown spread* is generally an even distance in all directions from the trunk and often where a tree has *Crown Form Dominant* and is *symmetrical.*

Significant Important, weighty or more than ordinary.

Significant Tree A tree considered important, weighty or more than ordinary. Example: due to prominence 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, *crown 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.

Substantial A tree with large dimensions or proportions in relation to its place in the landscape.

Sustainable Retention Index Value (SRIV) A visual tree assessment method to determine a qualitative and numerical rating for the viability of urban trees for development sites and management purposes, based on general tree and landscape assessment criteria using classes of *age*, *condition* and *vigour*. SRIV is for the professional manager of urban trees to consider the tree *in situ* with an assumed knowledge of the *taxon* and its growing environment. It is based on the physical attributes of the tree and its response to its environment considering its position in a matrix for age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property. This also factors the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement. SRIV is supplementary to the decision made by a tree management professional as to whether a tree is retained or removed (IACA - Institute of Australian Consulting Arboriculturists 2005).

Diameter at Breast Height (DBH) Measurement of trunk width calculated at a given distance above ground from the base of the tree often measured at 1.4 m. The trunk of a tree is usually not a circle when viewed in cross section, due to the presence of *reaction wood* or *adaptive wood*, therefore an average diameter is determined with a *diameter tape* or by recording the trunk along its narrowest and widest axes, adding the two dimensions together and dividing them by 2 to record an average and allowing the orientation of the longest axis of the trunk to 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. Where a tree branches from a trunk that is less than 1.4m above ground, the trunk diameter is 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 located on sloping ground the DBH should be measured at half way along the side of the tree to average out the angle of slope. Where a tree is *acaulescent* or *trunkless* branching at or near ground an average diameter is determined by recording the radial extent of the trunk at or near ground and noting where the measurement was recorded e.g. at ground.

Crown Projection (CP) Area within the *dripline* or beneath the lateral extent of the *crown* (Geiger 2004, p. 2). See also *Crown spread* and *Dripline*.

Dripline A line formed around the edge of a tree by the lateral extent of the *crown*. Such a line may be evident on the ground with some trees when exposed soil is displaced by rain shed from the crown. See also *Crown Projection*.

Deadwood

Deadwood Dead branches within a tree's crown and considered quantitatively as separate to *crown cover* and can be categorised as *Small Deadwood* and *Large Deadwood* according to diameter, length and subsequent *risk* potential. The amount of dead branches on a tree can be categorized as *Low Volume Deadwood*, *Medium Volume Deadwood* and *High Volume Deadwood*. See also *Dieback.*

Deadwooding Removing of dead branches by *pruning*. Such pruning may assist in the prevention of the spread of *decay* from *dieback* or for reasons of safety near an identifiable target.

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 may require *removal*.

Medium Volume Deadwood Where 5-10 dead branches occur that may require *removal*.

High Volume Deadwood High Volume Deadwood Where >10 dead branches occur that may require *removal*.

Dieback

Dieback The death of some areas of the *crown*. Symptoms are leaf drop, bare twigs, dead branches and tree death, respectively. This can be caused by root damage, root disease, bacterial or fungal canker, severe bark damage, intensive grazing by insects, *abrupt changes* in growth conditions, drought, water-logging or over-maturity. Dieback often implies reduced *resistance, stress* or *decline* which may be temporary. Dieback can be categorized as *Low Volume Dieback*, *Medium Volume Dieback* and *High Volume Dieback*.

Low Volume Dieback Where <10% of the *crown cover* has died. See also *Dieback*, *High Volume Dieback* and *Medium Volume Dieback*.

Medium Volume Dieback Where 10-50% of the *crown cover* has died.

High Volume Dieback Where >50% of the *crown cover* has died.

Epicormic shoots

Epicormic Shoots Juvenile shoots produced at branches or trunk from *epicormic strands* in some Eucalypts (Burrows 2002, pp. 111-131) or sprouts produced from dormant or latent buds concealed beneath the bark in some trees. Production can be triggered by fire, pruning, wounding, or root damage but may also be as a result of *stress* or *decline*. Epicormic shoots can be categorized as *Low Volume Epicormic Shoots*, *Medium Volume Epicormic Shoots* and *High Volume Epicormic Shoots*.

Low Volume Epicormic Shoots Where <10% of the c*rown cover* is comprised of live *epicormic shoots*.

Medium Volume Epicormic Shoots Where 10-50% of the *crown cover* is comprised of live *epicormic shoots*.

High Volume Epicormic Shoots Where >50% of the *crown cover* is comprised of live *epicormic shoots*.

Roots

First Order Roots (FOR) Initial woody roots arising from the *root crown* at the base of the *trunk*, or as an *adventitious root mass* for structural support and *stability*. Woody roots may be buttressed and divided as a marked gradation, gradually tapering and continuous or tapering rapidly at a short distance from the root crown. Depending on soil type these roots may descend initially and not be evident at the root crown, or become buried by changes in soil levels. Trees may develop 4-11 (Perry 1982, pp. 197-221), or more first order roots which may radiate from the trunk with a relatively even distribution, or be prominent on a particular aspect, dependent upon physical characteristics e.g. leaning trunk, *asymmetrical* crown; and constraints within the growing *environment* from topography e.g. slope, soil depth, rocky outcrops, exposure to predominant wind, soil moisture, depth of *water table* etc.

Orders of Roots The marked divisions between woody roots, commencing at the initial division from the base of the trunk, at the *root crown* where successive branching is generally characterised by a gradual reduction in root diameters and each gradation from the trunk and can be categorized numerically, e.g. *first order roots*, second order roots, third order roots etc. Roots may not always be evident at the *root crown* and this may be dependent on species, age class and the growing environment. Palms at maturity may form an adventitious root mass.

Root Plate The entire root system of a tree generally occupying the top 300-600mm of soil including roots at or above ground and may extend laterally for distances exceeding twice the height of the tree (Perry 1982, pp. 197-221). Development and extent is dependent on water availability, soil type, *soil depth* and the physical characteristics of the surrounding landscape.

Root Crown Roots arising at the base of a trunk.

Zone of Rapid Taper The area in the *root plate* where the diameter of *structural roots* reduces substantially over a short distance from the *trunk.* Considered to be the minimum radial distance to provide structural support and *root plate* stability. See also *Structural Root Zone (SRZ)*.

Structural Roots Roots supporting the infrastructure of the *root plate* providing strength and *stability* to the tree. Such roots may taper rapidly at short distances from the *root crown* or become large and woody as with gymnosperms and dicotyledonous angiosperms and are usually 1st and 2nd order roots, or form an *adventitious root mass* in monocotyledonous angiosperms (palms). Such roots may be crossed and grafted and are usually contained within the area of *crown projection* or extend just beyond the *dripline*.

Appendices H & I

Appendix H – Survey of Subject Tree/s
Appendix I – Tree Protection Plan

Trees the subject of this report are marked on the plans in the following appendices and are numbered as listed below.

Redgum Tree No.	*Genus and species*	Common name
1	*Eucalyptus botryoides*	Bangalay Gum
2	*Eucalyptus botryoides*	Bangalay Gum
3	*Angophora costata*	Sydney Red Gum
4	*Banksia integrifolia*	Coastal Banksia
5	*Banksia integrifolia*	Coastal Banksia
6	*Angophora costata*	Sydney Red Gum
7	*Eucalyptus botryoides*	Bangalay Gum
8	*Missing*	
9	*Banksia marginata*	Silver Banksia
10	*Banksia marginata*	Silver Banksia
11	*Eucalyptus botryoides*	Bangalay Gum
12	*Pittosporum undulatum*	Native Daphne
13	*Eucalyptus botryoides*	Bangalay Gum
14	*Pittosporum undulatum*	Native Daphne
15	*Pittosporum undulatum*	Native Daphne
16	*Pittosporum undulatum*	Native Daphne
17	*Pittosporum undulatum*	Native Daphne
18	*Pittosporum undulatum*	Native Daphne
19	*Eucalyptus botryoides*	Bangalay Gum
20	*Populus deltoides*	Eastern Cottonwood
21	*Eucalyptus botryoides*	Bangalay Gum
22	*Eucalyptus botryoides*	Bangalay Gum
23	*Eucalyptus botryoides*	Bangalay Gum
24	*Eucalyptus botryoides*	Bangalay Gum
25	*Eucalyptus botryoides*	Bangalay Gum
26	*Missing*	

This report has relied upon the following plan/s and documents:

1. Survey Plan, Sheet 1 of 1, Ref. 096-10, Date 23/082010, scale 1:200 by Craig & Rhodes Surveyors, 16 – 18 Cambridge Street, Epping NSW 2121 ph: 9869-1855

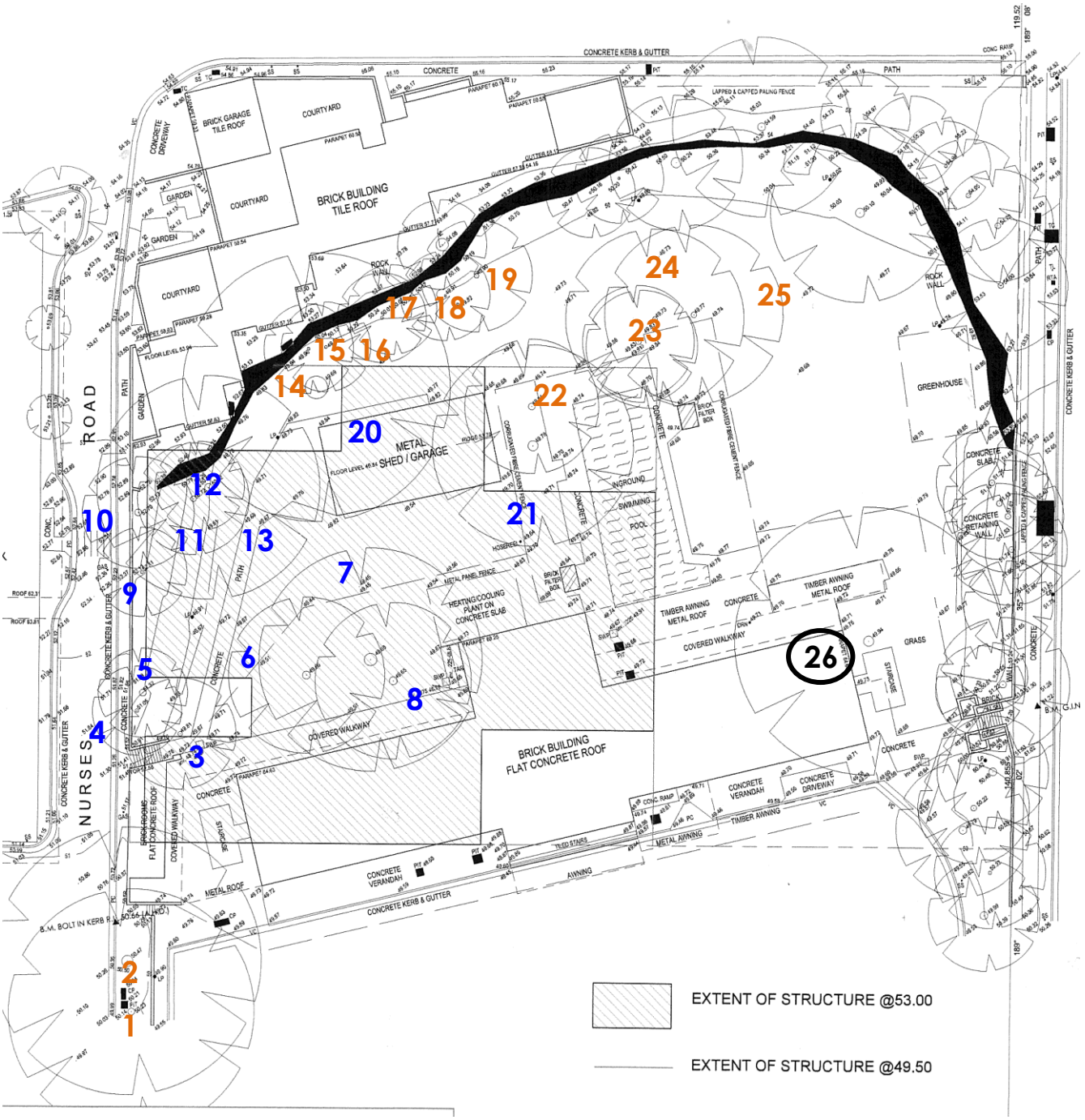
Appendix H - Site Plan A – Survey of Subject Trees

Plan reproduced from a facsimile transmission and further by electronic scanning and no longer to original scale of 1:100. For other tree protection measures see sections 5.0, 6.0 and 7.0.

Legend

10. Trees numbered in **orange** or surrounded by an unbroken line are recommended for **retention**.
11. Trees numbered in **blue** or surrounded by a broken line are recommended for removal.
12. Trees numbered in black and bold or surrounded by an unbroken line were found to be removed or dead at inspection.

O Note: circles indicated, unnumbered are either shrubs, or trees of species, of dimensions, or condition class not protected by the Tree Preservation Order or trees not affected by the proposed works or missing at time of inspection.



Appendix I - Site Plan B -
Survey of Trees to be Retained and Tree Protection Plan

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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.
Subject trees represented by the approximate location of the trunk.