



State Significant Development Application Randwick Campus Redevelopment – Stage 1

Arboricultural Impact Assessment

Prepared for
NSW Health Infrastructure

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All trees have been assessed based on the observations from the site inspection and information presented by the client or relevant parties at the time of inspection. No responsibility can be taken for incorrect or misleading information provided by the client or other parties.

Trees are living organisms. As such, their health and structure may alter, they will grow and their environmental circumstances may change from the time of the site inspection upon which this assessment is based. Trees, as with all living things, pose some level of risk.

Tree risk assessments are valid for 12 months after the date of inspection, unless otherwise stated. Any significant change to the subject tree(s) or surrounding environment, including significant or catastrophic storm/wind events will require the immediate re-inspection and assessment of the tree(s).

Trees fail in ways that the arboricultural community are yet to fully understand. There is no guarantee expressed or implied that failure or deficiencies may not arise of the subject trees in the future. No responsibility is accepted for damage to property or injury/death caused by the nominated trees.

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Abbreviations

Abbreviation	Description
AQF	Australian Qualifications Framework
AS	Australian Standards
DBH	Diameter at Breast Height
ELA	Eco Logical Australia Pty Ltd
m	Metre
mm	Millimetre
Ha	Hectare
HI	NSW Health Infrastructure
NDE	Non-Destructive Excavation
No.	Number
NSW	New South Wales
Sp./	Species
SRZ	Structural Root Zone
TPZ	Tree Protection Zone
VTA	Visual Tree Assessment
LGA	Local Government Area

1 Background

1.1 Introduction

Eco Logical Australia Pty Ltd (ELA) was commissioned by PwC Australia (on behalf of NSW Health Infrastructure) to prepare an arboricultural impact assessment for the proposed Randwick Campus Redevelopment.

The purpose of this report is to:

- Identify the trees within the study area that are likely to be affected by the proposed works and trees to be protected within the study area;
- Assess the current overall health and condition of the subject trees; and
- Evaluate the significance of the subject trees and assess their suitability for retention.

1.2 The proposal

The proposal is State Significant Development (SSD) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and will include:

- a new emergency department
- additional beds
- a new helipad
- a new intensive care unit, and
- new shared operating theatres for the Randwick Campus.

The biodiversity values of the trees discussed in this report have been previously assessed and determined. They are discussed within the following document (Eco Logical Australia, *Request for Waiver of Biodiversity Development Assessment Report (BDAR)* dated 27 March 2018).

Trees that form part of this assessment are those assessed as being able to be retained as part of the proposal. ELA has previously assessed impacted trees along Hospital Road, Botany and Magill Streets as part of the Review of Environmental Factors (REF) and Development Application (DA). Trees located along Eurimbla Avenue will be assessed under a separate REF.

1.3 The study area

The study area is in the suburb of Randwick in Sydney's eastern suburbs, approximately 6 km south-east of the Sydney Central Business District (CBD). The study area forms areas within Botany Street, Hospital Road, Magill Street and part Eurimbla Avenue.

The subject trees for this assessment were inspected on 27th February 2018. The site inspection was limited to areas of public access.

1.4 Documents and plans referenced

The conclusions and recommendations of this report are based on the *Australian Standard – AS 4970-2009, Protection of Trees on Development Sites*, the findings from the site inspection and analyses of the following documents/plans:

- *Randwick Development Control Plan (DCP) 2013;*

- LandArc Pty Limited 2006, *Register of Significant Trees, Volumes 1 – 4* prepared for Randwick City Council viewed 13 February 2018 <http://www.randwick.nsw.gov.au/environment-and-sustainability/trees/significant-tree-register>
- NSW Health Infrastructure, *POW Redevelopment Baker St Randwick NSW Australia, Acute Services Building - Site Plan - RCR-BVN-AR-50-DWG A2-XX-10, Issue T* dated 7.02.2018

This tree retention assessment has been undertaken in accordance with the *Institute of Australian Consulting Arboriculturists (IACA) Significance of a Tree, Assessment Rating System (STARS)*. Further details and assessment criteria are in **Appendix B**.

2 Method

2.1 Visual tree assessment

The subject trees were assessed in accordance with a stage one visual tree assessment (VTA) as formulated by Mattheck & Breloer (1994)¹, and practices consistent with modern arboriculture.

The following limitations apply to this methodology:

- Trees were inspected from ground level, without the use of any invasive or diagnostic tools and testing;
- No trees on adjoining properties were assessed;
- No aerial inspections or root mapping was undertaken;
- Tree heights, canopy spread and diameter at breast height (DBH) was estimated, unless otherwise stated;
- Tree identification was based on broad taxonomical features present and visible from ground level at the time of inspection.

2.2 Retention value

The retention value / importance of a tree or group of trees is determined using a combination of environmental, cultural, physical and social values.

- **High retention value:** These trees are considered important and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by *Australian Standard AS4970 Protection of trees on development sites*.
- **Medium retention value:** These trees are moderately important for retention. Their removal should only be considered if adversely affected by the proposed works and all other alternatives have been considered and exhausted.
- **Low retention value:** These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.

¹ VTA is an internationally recognised practice in the visual assessment of trees as prescribed by Mattheck, C. and Breloer, H. 1994. 'Field Guide for Visual Tree Assessment' *Arboricultural Journal*, Vol 18 pp 1-23.

2.3 Protection zones

- **Tree protection zone (TPZ):** The TPZ is the optimal combination of crown and root area (as defined by AS 4970-2009) that requires protection during the construction process. The TPZ is an area that is isolated from the work zone to insure no disturbance or encroachment occurs into this zone. Tree sensitive construction measures must be implemented if works are to proceed within the TPZ.
- **Structural root zone (SRZ):** The SRZ is the area of the root system (as defined by AS 4970-2009) used for stability, mechanical support and anchorage of the tree. It is critical for the support and stability of the tree, and provides the bulk of mechanical support and anchorage. Severance of roots (>50 mmØ) within the SRZ is generally not recommended as it may lead to the destabilisation and/or decline of the tree.
- **Root investigation:** When assessing the potential impacts of encroachment into the TPZ consideration will need to be given to the location and distribution of the roots, including above or below ground restrictions affecting root growth. Location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as hydro-vacuum excavation (sucker truck), air spade and manual excavation. Root investigation is used to determine the extent and location of roots within the zone of conflict. Root investigation does not guarantee the retention of the tree.

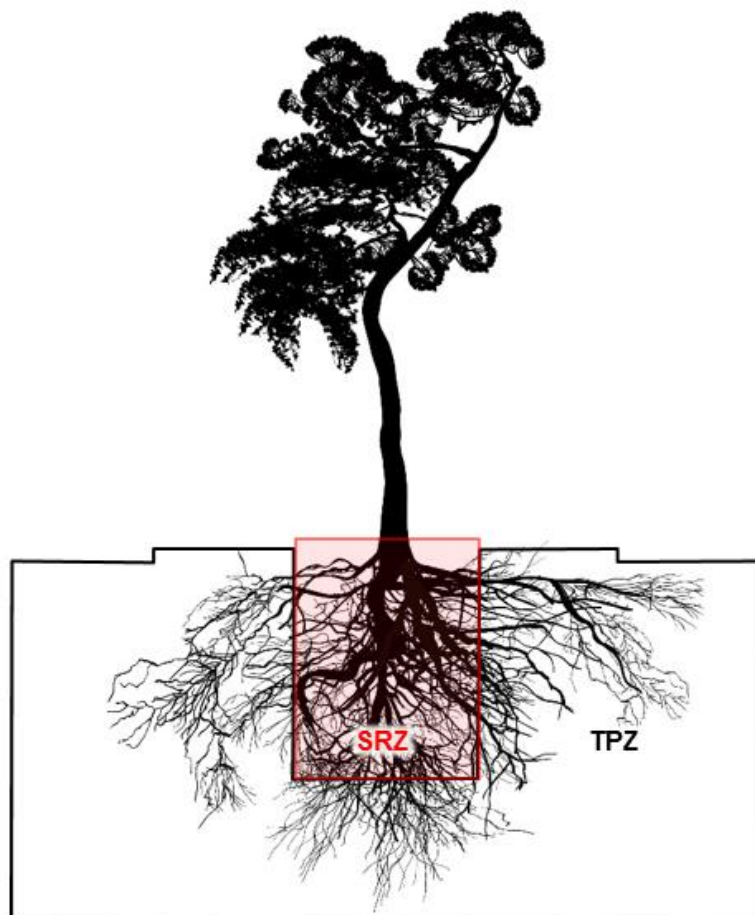


Figure 1: Indicative TPZ and SRZ

2.4 Impacts within the TPZ

- **High impact (>20%):** If the proposed encroachment is greater than 20% of the TPZ the SRZ may be impacted. The project arborist must demonstrate that the tree(s) remain viable. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ. All work within the TPZ must be carried out under the supervision of the project arborist.
- **Medium impact (<20%):** If the proposed encroachment is greater than 10% of the TPZ and outside of the SRZ, the project arborist must demonstrate that the tree(s) remain viable. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ. All work within the TPZ must be carried out under the supervision of the project arborist.
- **Low impact (<10%):** If the proposed encroachment is less than 10% (total area) of the TPZ, and outside of the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ.
- **No impact (0%):** No likely or foreseeable encroachment within the TPZ.

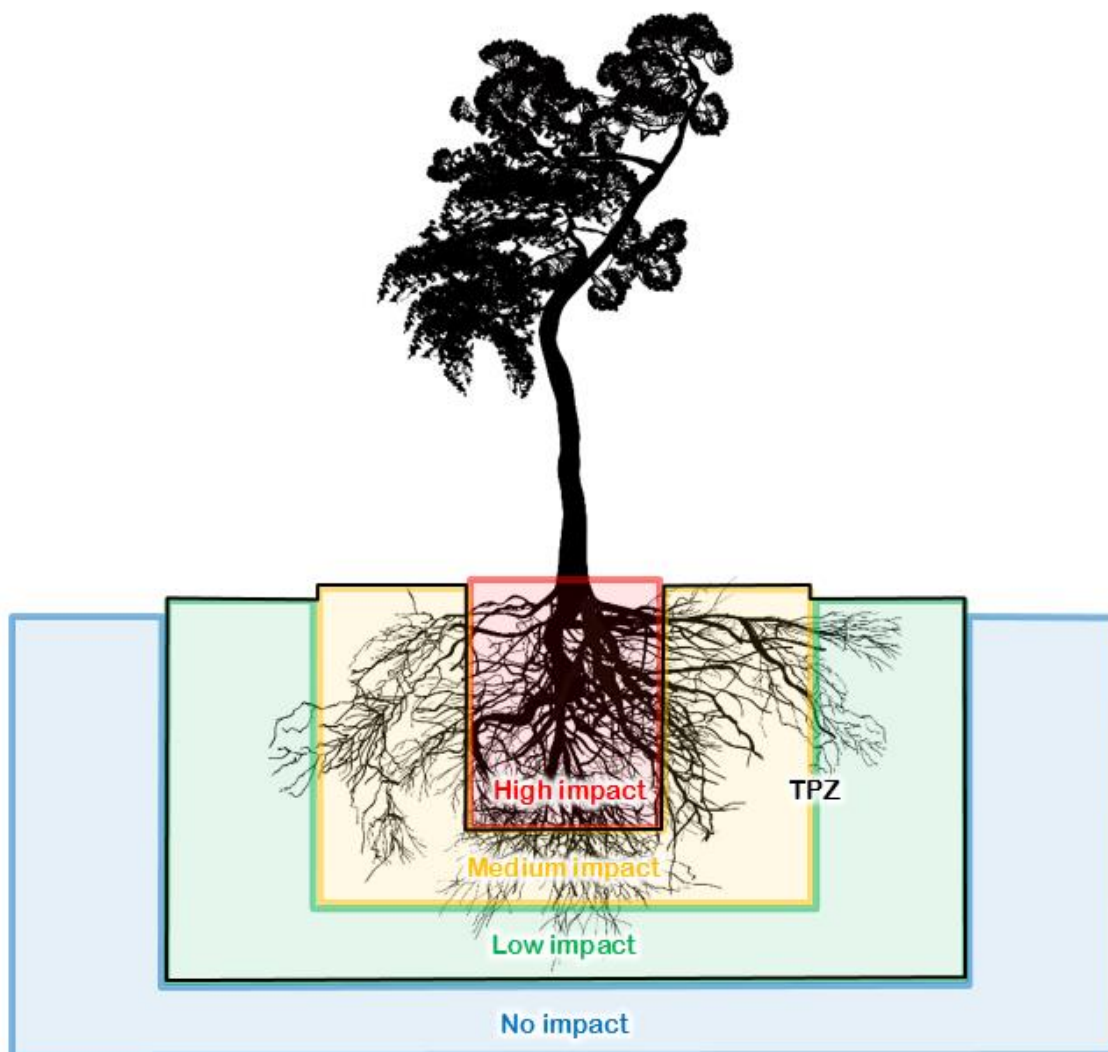


Figure 2: Indicative zones of impact within the TPZ

2.5 Mitigation measures

Encroachment within the TPZ must be offset with a range of mitigation measures to ensure that impacts to the subject tree(s) are reduced or restricted wherever possible. Mitigation must be increased relative to the level of encroachment within the TPZ to ensure the subject tree remains viable. **Table 1** outlines mitigation requirements under AS 4970-2009 within each category of encroachment.

Table 1: Mitigation measures

Impact	Requirements under AS 4970-2009	Mitigation (design phase)	Mitigation (construction phase)
Low impact (<10%)	- The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. - Detailed root investigations should not be required.	N/A	- The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. - Tree protection must be installed.
Medium impact (<20%)	- The project arborist must demonstrate the tree(s) would remain viable. - Root investigation by non-destructive methods may be required. - Consideration of relevant factors including: Root location and distribution, tree species, condition, site constraints and design factors.	The following design changes should be considered to retain trees where practicable, considering the retention value of the tree and the complexity and cost of the change. - Relocate services/pathways outside of tree protection zones - Design services to be installed at a minimum depth of 1200 mm below ground to avoid impact to the root zones of trees. - Design pathways to be installed on or above grade, minimising/eliminating excavation within tree protection zones. - Design pathways using porous materials (eco-paving, porous asphalt, decomposed granite) to allow water and oxygen to reach the root zone. - Design pathways using tree sensitive techniques (pier and beam, suspended slabs). - The area lost to encroachment should be compensated for elsewhere, contiguous with the TPZ.	- The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. - The project arborist would be consulted for any works within the TPZ. - Tree protection must be installed. - Tree sensitive techniques can be used to install services within the TPZ. Horizontal directional drilling (HDD), boring, non-destructive excavation (NDE). - Location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as hydro-vacuum excavation (sucker truck), air spade and manual excavation.
High impact (>20%)	The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ.	- Relocate services/pathways outside of tree protection zones - Design services to be installed at a minimum depth of 1200mm below ground to avoid impact to the root zones of trees. - Design pathways to be installed on or above grade, minimising/eliminating excavation within tree protection zones. - Design pathways using porous materials (eco-paving, porous asphalt, decomposed granite) to allow water and oxygen to reach the root zone. - Design pathway using tree sensitive techniques (pier and beam, suspended slabs). - The area lost to encroachment can be compensated for elsewhere, contiguous with the TPZ.	- As above - Removal of existing hard surfaces should be undertaken manually to avoid root damage. - Tree sensitive techniques can be used to install the services: Horizontal directional drilling (HDD), boring, non-destructive excavation (NDE).

3 Results

Results of the arboricultural assessment are mapped in **Figure 3** and tabulated below. A total of **11** trees were included as part of this assessment. Several adjacent street trees have been shown on the map as No Impact. Additionally, where trees were less than 4m in height, these do not require arborist assessment. The remaining trees located along the road verge of Eurimbla Avenue will be assessed under a separate REF.

Key points are:

- **High impact (>20%):** 2 trees will be subject to a high impact 20% of the TPZ. Of which one has a high and one a medium retention value.
- **Medium impact (<20%):** 8 trees will be subject to a medium impact (<20%). Further detailed assessments will be required to retain these trees. Trees proposed for further detailed assessment have the following retention values:
 - 1 trees with a low retention value
 - 7 trees with medium retention value
- **Low impact (<10%):** 1 tree will be subject to a minor encroachment (<10%). No significant impacts to the subject trees are foreseeable under the current proposal, these trees can be successfully retained.
- **No impact (0%):** 9 trees were identified outside the footprint of the proposed works. No impacts to the subject trees are foreseeable under the current proposal, these trees can be successfully retained.

Tree impacts Map

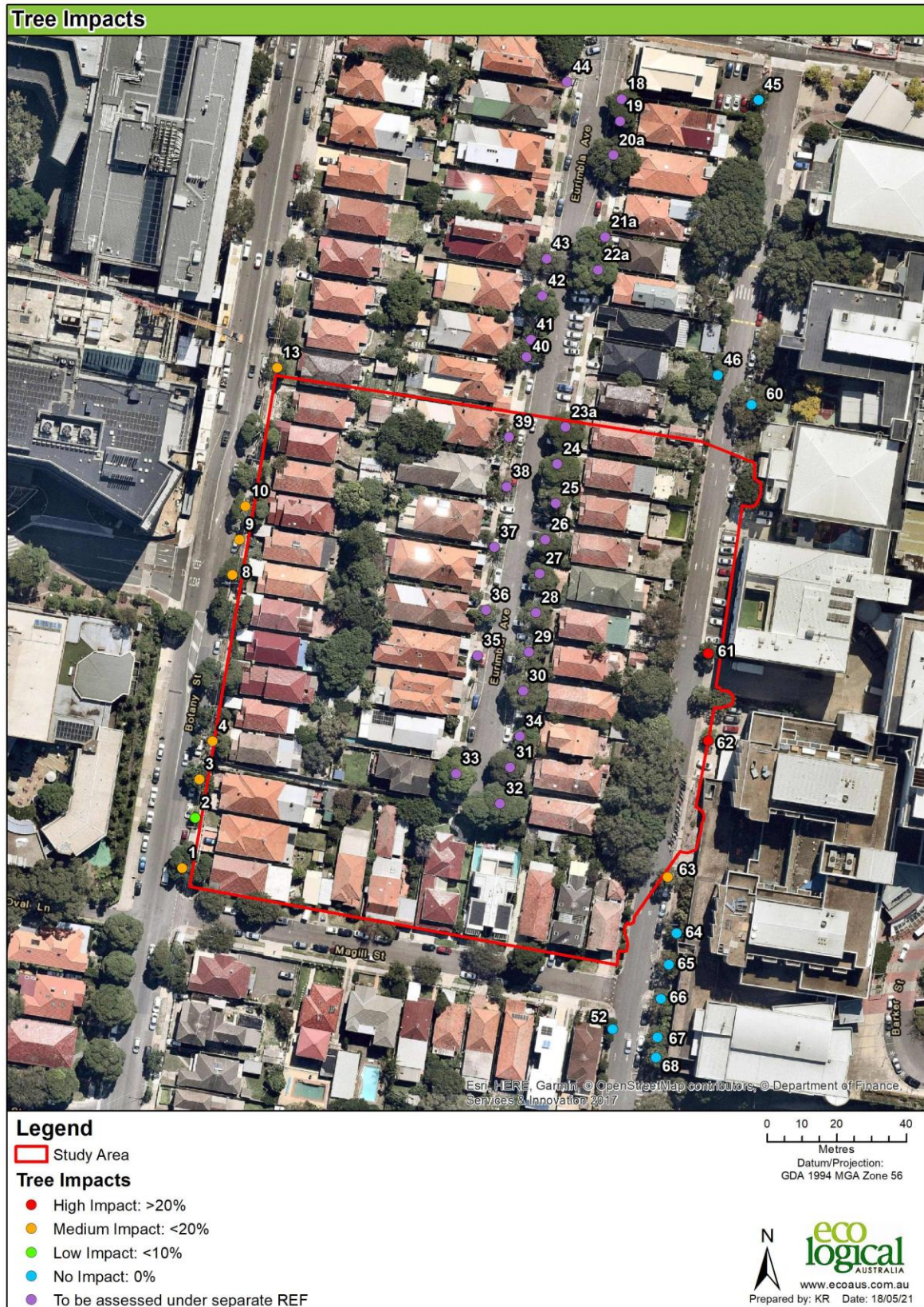


Figure 3: Tree impacts

Table 2: Results of the arboricultural assessment

Tree	Botanical name	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	SRZ (m)	TPZ (m)	Impacts
1	<i>Lophostemon confertus</i>	9	9	Good	Fair	Medium	600	2.7	7.2	Medium: <20%
2	<i>Lophostemon confertus</i>	4	3	Good	Fair	Medium	200	1.7	2.4	Low impact (<10%)
3	<i>Jacaranda mimosifolia</i>	8	7	Good	Fair	Medium	350	2.1	4.2	Medium: <20%
4	<i>Lophostemon confertus</i>	9	8	Good	Fair	Medium	400	2.3	4.8	Medium: <20%
8	<i>Lophostemon confertus</i>	7	7	Fair	Fair	Medium	500	2.5	6	Medium: <20%
9	<i>Unknown species</i>	6	3	Poor	Poor	Low	250	1.9	3	Medium: <20%
10	<i>Lophostemon confertus</i>	10	8	Good	Fair	Medium	450	2.4	5.4	Medium: <20%
13	<i>Lophostemon confertus</i>	8	5	Good	Fair	Medium	300	2.0	3.6	Medium: <20%
61	<i>Angophora costata</i>	11	8	Good	Good	High	300	1.9	3.6	High Impact: >20%
62	<i>Angophora costata</i>	9	6	Good	Good	Medium	250	1.8	3.0	High Impact: >20
63	<i>Angophora costata</i>	8	5	Good	Fair	Medium	250	1.9	3	Medium: <20%

Trees located adjacent to the SSD boundary

Tree	Botanical name	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	SRZ (m)	TPZ (m)	Impacts
46	<i>Tristanopsis laurina</i>	6	2	Fair	Fair	Medium	150	1.5	2	No impact: 0%
52	<i>Tristanopsis laurina</i>	5	2	Good	Fair	Medium	200	1.7	2.4	No impact: 0%

Tree	Botanical name	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	SRZ (m)	TPZ (m)	Impacts
60	<i>Angophora costata</i>	8	6	Good	Fair	Medium	200	1.7	2.4	No impact: 0%
64	<i>Native sp.</i>	4	3	Good	Fair	Medium	150	1.5	2	No impact: 0%
65	<i>Angophora costata</i>	10	7	Good	Fair	Medium	250	1.9	3	No impact: 0%
66	<i>Angophora costata</i>	8	5	Good	Fair	Medium	250	1.9	3	No impact: 0%
67	<i>Angophora costata</i>	8	5	Good	Fair	Medium	250	1.9	3	No impact: 0%
68	<i>Angophora costata</i>	8	6	Good	Fair	Medium	200	1.7	2.4	No impact: 0%

4 Discussion and recommendations

4.1 The subject trees

8 trees subject to a medium impact (<20%), 1 low impact (<10%) and 2 additional trees to high impact (>20%) into the TPZ. Further detailed assessments (root mapping) via non-destructive methods will be required to determine suitability for retention.

4.2 Tree work

- The tree protection plan outlined in **Chapter 5** and **Appendix A** should be implemented for all trees proposed to be retained and trees that fall within 10 m of any construction activities, which are likely to be affected by construction activities.
- All tree work is to be carried out by an arborist with a minimum AQF Level 3 qualification in Arboriculture.
- All tree work must be in accordance with *AS 4373-2007, pruning of amenity trees* and the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998).
- Permission must be granted from the relevant consent authority, prior to removing or pruning of any of the subject trees.

5 Tree protection plan

5.1 Tree protection measures

The following tree protection measures will be required if trees are retained:

- Tree protection fencing must be established around the perimeter of the TPZ. If the protective fencing requires temporary removal, trunk, branch and ground protection must be installed and must comply with *AS 4970-2009 - Protection of trees on development sites*. Existing fencing and site hoarding may be used as tree protection fencing.
- 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. Ground protection may include a permeable membrane such as geotextile fabric beneath a layer of mulch, crushed rock or rumble boards.
- Any additional construction activities within the TPZ of the subject trees must be assessed and approved by the project arborist and must comply with *AS 4970-2009 - Protection of trees on development sites*.

Further information and guidelines on tree protection is in **Appendix A**.

5.2 Hold points, inspection and certification

The approved tree protection plan must be available onsite prior to the commencement of works, and throughout the entirety of the project. To ensure the tree protection plan is implemented, hold points have been specified in the schedule of works below. It is the responsibility of the principal contractor to complete each of the tasks.

Once each stage is reached, the work will be inspected and certified by the project arborist and the next stage may commence. Alterations to this schedule may be required due to necessity, however, this shall be through consultation with the project arborist only.

Table 3: Schedule of works

Pre-construction	Prior to demolition and site establishment indicate clearly (with spray paint on trunks, ribbon or similar) trees marked for removal only.
	Tree protection (for trees that will be retained) shall be installed prior to demolition and site establishment, this will include mulching of areas within the TPZ
During Construction	Scheduled inspection of trees by the project arborist should be undertaken monthly during the construction period.
	Inspection of trees by project arborist after all major construction has ceased, following the removal of tree protection measures.
Post Construction	Final inspection of trees by project arborist.

References

Australian Standard, AS 4373-2007, *Pruning of Amenity Trees*.

Australian Standard, AS 4970-2009, *Protection of Trees on Development Sites*.

Harris, R., Clark, J., Matheny, N. and Harris, V. 2004. *Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines*, Upper Saddle River, N.J.: Prentice Hall, London

Mattheck, C. 2007. *Updated field guide for visual tree assessment*. Karlsruhe: Forschungszentrum Karlsruhe.

WorkCover NSW. 1998. *Code of Practice: Amenity Tree Industry*

Institute of Australian Consulting Arboriculturists (IACA) 2010. *IACA Significance of a Tree, Assessment Rating System (STARS)*. Australia, www.iaca.org.au

Appendix A Tree protection guidelines

The following tree protection guidelines must be implemented during the construction period in the event that no tree-specific recommendations are detailed.

Tree protection fencing

The TPZ is a restricted area delineated by protective fencing or the use of an existing structure (such as a wall or fence).

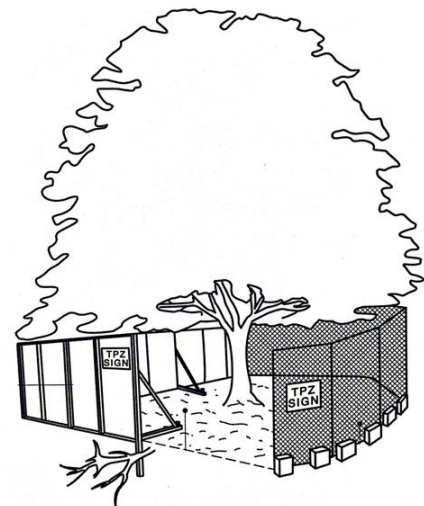
Trees that are to be retained must have protective fencing erected around the TPZ (or as specified in the body of the report) to protect and isolate it from the construction works. Fencing must comply with the *Australian Standard, AS 4687-2007, Temporary fencing and hoardings*.

Tree protection fencing must be installed prior to site establishment and remain intact until completion of works. Once erected, protective fencing must not be removed or altered without the approval of the project arborist.

If the protective fencing requires temporary removal, trunk, branch and ground protection must be installed and must comply with *AS 4970-2009, Protection of Trees on Development Sites*.

Tree protection fencing shall be:

- Enclosed to the full extent of the TPZ (or as specified in the Recommendations and Tree Protection Plan).
- Cyclone chain wire link fence or similar, with lockable access gates.
- Certified and Inspected by the Project Arborist.
- Installed prior to the commencement of works.
- Prominently signposted with 300mm x 450mm boards stating "NO ACCESS - TREE PROTECTION ZONE".



Crown protection

Tree crowns/canopy may be injured or damaged by machinery such as; excavators, drilling rigs, trucks, cranes, plant and vehicles. Where crown protection is required, it will usually be located at least one meter outside the perimeter of the crown.

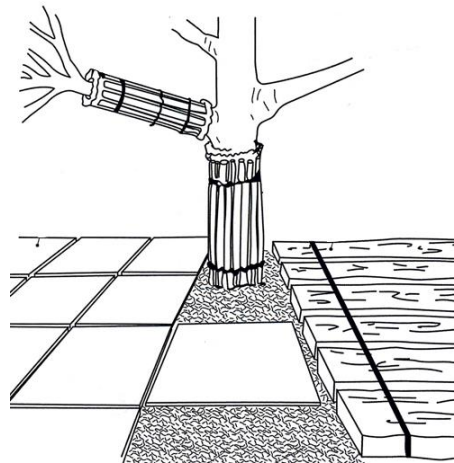
Crown protection may include the installation of a physical barrier, pruning selected branches to establish clearance, or the tying/bracing of branches.

Trunk protection

Where provision of tree protection fencing is impractical or must be temporarily removed, trunk protection shall be installed for the nominated trees to avoid accidental mechanical damage.

The removal of bark or branches allows the potential ingress of micro-organisms which may cause decay. Furthermore, the removal of bark restricts the trees' ability to distribute water, mineral ions (solutes), and glucose.

Trunk protection shall consist of a layer of either carpet underfelt, geotextile fabric or similar wrapped around the trunk, followed by 1.8 m lengths of softwood timbers aligned vertically and spaced evenly around the trunk (with an approx. 50 mm gap between the timbers).



The timbers must be secured using galvanised hoop strap (aluminium strapping). The timbers shall be wrapped around the trunk but not fixed to the tree, as this will cause injury/damage to the tree.

Ground protection

Tree roots are essential for the uptake/absorption of water, oxygen and mineral ions (solutes). It is essential to prevent the disturbance of the soil beneath the dripline and within the TPZ of trees that are to be retained. Soil compaction within the TPZ will adversely affect the ability of roots to function correctly.

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. Ground protection may include existing hard surfaces or a permeable membrane such as geotextile fabric beneath a layer of mulch, crushed rock or rumble boards.

If the grade is to be raised within the TPZ, the material should be coarser or more porous than the underlying material.

Root protection & pruning

If incursions/excavation within the TPZ are unavoidable, exploratory excavation (under the supervision of the Project Arborist) using non-destructive methods may be considered to evaluate the extent of the root system affected, and determine whether or not the tree can remain viable.

If the project arborist identifies conflicting roots that requiring pruning, they must be pruned with a sharp implement such as; secateurs, pruners, handsaws or a chainsaw back to undamaged tissue. The final cut must be a clean cut.

Underground services

All underground services should be routed outside of the TPZ. If underground services need to be installed within the TPZ, they should be installed using horizontal directional drilling (HDD). The horizontal drilling/boring must be at minimum depth of 600mm below grade. Trenching for services is to be regarded as "excavation"

Appendix B – Tree retention assessment method

Tree Significance - Assessment Criteria - STARS®		
Low	Medium	High
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 the surrounding properties or 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 dimensions 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 the potential to become structurally unsound. The tree is an environmental pest species due to its invasiveness or poisonous/allergenic properties. The tree is a declared noxious weed by legislation	The tree is in fair to good condition 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	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.

Tree Significance					
Useful Life Expectancy		High	Medium	Low	
	Long >40 years				
	Medium 15-40 years				
	Short <1-15 years				
	Dead				

Legend for Matrix Assessment	
	Priority for retention (High): These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 Protection of trees on development sites. Tree sensitive construction measures must be implemented if works are to proceed within the Tree Protection Zone.
	Consider for retention (Medium): These trees may be retained and protected. These are considered less critical; however, their retention should remain priority with the removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	Consider for removal (Low): These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
	Consider for removal (Low): These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.

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