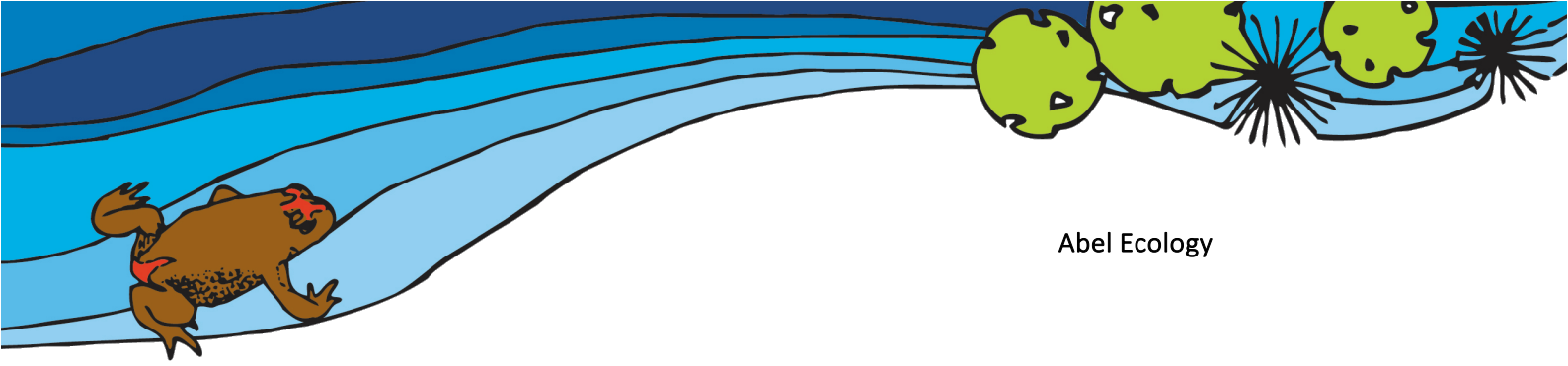

Abel Ecology

Arboricultural Impact Assessment

for

1H Hospital Road, Concord West NSW 2319

Lot 2, DP 1280788

Proposed: Site demolition

Prepared for:	Ibrahim Rizvi of bd infrastructure
Report No:	AE23-2608-REP-ISS-3
Prepared by:	Abel Ecology
Date:	17 January 2024

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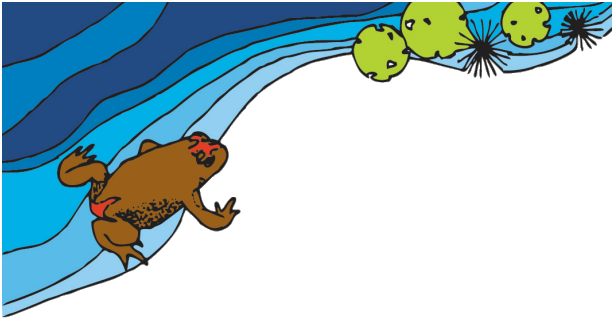

Disclaimer

No tree is entirely without hazard potential. No responsibility is accepted for any damage or injury that may be caused by any trees on the site. All measures outlined should minimise damage inflicted on the trees if carefully implemented.

This report does not provide an assessment of risk of harm posed from tree hazards. Information may be provided about the structure, function, defects or tree pests and/or diseases, vitality, condition and life expectancy. However, no assessment of targets, frequency of use by potential targets or guidance of risk of harm is included in this report.

This report is an arboricultural impact assessment; it is not a risk assessment.

No internal examination of any kind has been undertaken on any tree described in this report, unless expressly stated. On occasions, a mallet may be used as an auditory guide to assist in determining the presence of internal hollows.

I confirm that I have read the NSW Land and Environment Court Practice Note commencing on 14 May 2007, Division 2, Part 31 of the Uniform Civil Procedure Rules 2005 and the Expert Witness Code of Conduct in Schedule 7 to the Uniform Civil Procedure Rules 2005. I have prepared this advice in accordance with the requirements of the Practice Note and Code of Conduct and believe this report is consistent with the requirements of the Practice Note and the Code of Conduct. I agree to be bound by the Practice Note and Code of Conduct.

Document History

Report	Version	Prepared by	Technical Review by	Proofread by	Submission	
					Method	Date
Report	Draft A	Jesse Cass	Dr Danny Wotherspoon	Corinna Campbell	Dropbox	07 September 23
Report	Issue 1	Jesse Cass		Corinna Campbell	Dropbox	06 October 23
Report	Issue 2	Jesse Cass		Nicholas Tong	Dropbox	16 November 23
Report	Issue 3	Jesse Cass	Nicholas Tong	Janelle Merry	Dropbox	17 January 24

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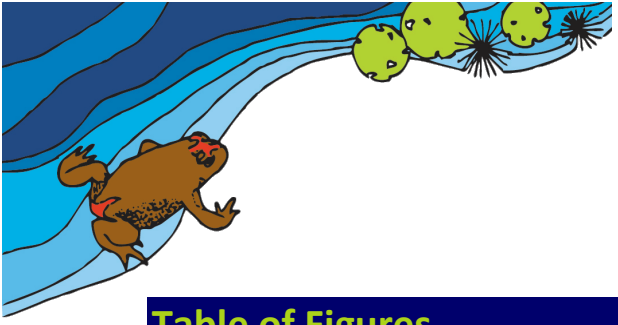

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List of Abbreviations

DBH	Diameter at breast height (~1.4 metres)
DAB	Diameter at base/root junction
SRZ	Structural Root Zone
TPZ	Tree Protection Zone
VTA	Visual Tree Assessment

Note regarding maps in this report

The diagrams/site maps used in this report have been supplied by and are used with the permission of the client.

With regard to maps provided by the Land Information Centre, Topographic maps used with the permission of © Land and Property Information, NSW.

Glossary

Explanation of Tree assessment terminology and rationale:

Amenity - Trees with recreational, functional, environmental, ecological, social, health or aesthetic value rather than for production purposes (Standards Australia 2007).

A desirable or useful feature or facility of a building or place; the pleasantness or attractiveness of a place (Google Dictionary 2017). An assessment of amenity value is to some extent subjective and qualitative, however it also includes Arboricultural assessments of structure and health of the tree.

Arborist - A person with training to AQF Level 3 in Arboriculture, or above, or equivalent recognized and relevant experience that enables the person to perform the tasks required by the Australian Standards for Arboricultural practice (AS4373-2007 Pruning of amenity trees and AS4970-2009 Protection of trees on development sites).

Australian Qualification Framework (AQF) - A national framework for all educational and training purposes in Australia.

Codominant stems - Stems or trunks of about the same size originating from the same position from the main stem.

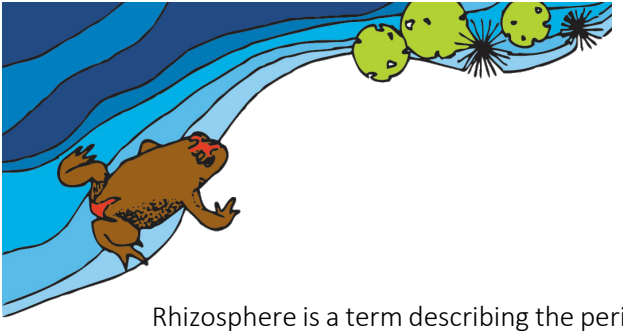
Condition - An evaluation of the structural status of the tree including defects that may affect the useful life of an otherwise healthy specimen. Such influencing factors include cavities and decay, weak unions between scaffolds (major branches) or trunks and faults of form or habit.

Coppiced - Cutting a trunk close to ground level in order to stimulate the production of multiple new stems (epicormic shoots).

DBH (Diameter at breast height) –A standard Arboricultural measurement used to calculate the Tree Protection Zone (TPZ), taken at 1.4 metres from the ground.

Epicormic Growth - The production of epicormic growth from dormant buds is a response to stress, fire and damage, including poor pruning methods. 'Epi's' can occur on branches, stems and from the rhizome base of the tree. Arising from the cambium (actively growing bark region) they are often weakly attached. Epicormic shoots arising from rhizomes is an adaptive strategy in many Australian native plants including Eucalypts and plants in the Proteacea family, occurring commonly after fire, damage or drought.

Mycorrhizae/Rhizosphere - Mycorrhizae are fungi that grow in symbiotic association with tree roots (especially the fine root hairs) and are attributed with increasing the uptake of nutrients, particularly phosphorus, and reducing infection from soil borne pathogens. They greatly increase the surface area of a tree's root system. Mycorrhizae require aerobic soil conditions and are reduced in number by compaction, waterlogging and overuse of soil fertilisers. Forest litter or similar mulch provides ideal conditions for the proliferation of Mycorrhizae.



Rhizosphere is a term describing the peripheral area of a tree's root system where this symbiotic association most commonly occurs.

Remedial (restorative) pruning - Removing damaged, diseased, or lopped branches, taking the cut back to undamaged tissue, in order to induce the production of shoots from latent or adventitious buds, from which a new crown will be established.

Stem - Organ supporting the branches, leaves, flowers and fruit, and connecting the upper parts of the tree to the root system; may also be referred to as 'the trunk'.

Visual Tree Assessment (VTA) - using external characteristics as indicators of the internal conditions and structural stability of a tree. It is described by Mattheck and Breloer (*1994*), the first step of the method is to visually examine a tree to find external symptoms of internal defects. It is generally used in some form by Arborists in Australia for tree assessment.

A full VTA is comprised of three steps. This report does not undertake a full VTA. Only the first step, a visual inspection is described in this report. No internal examination was be undertaken. On occasions, a mallet may be used as an auditory guide for the presence of internal hollows. The assessment described in this report is ground based assessment. No climbing of any tree was done as part of an assessment.

Vitality - Indicates the energy reserves of the tree and is determined by the observed crown colour and density, the percentage of dead/dying branches and epicormic growth, and the tree's response to wounding, disease and decay pathogens. Poor vitality compromises the tree's ability to initiate internal defence systems (including compartmentalisation of damage or decay) is reduced and it can also become predisposed to attack by insects and pathogens. Often used synonymously in Arboricultural writing with 'vigour' or 'health'.

Tree Hazard Potential - An assessment of the risks associated with retaining a tree in its existing or proposed surroundings. Factors to consider are the growth characteristics of the species, tree vitality, condition and the frequency and type of potential targets. The impact the proposed works can have on any individual tree can only be assumed from general principals about trees.

This report does not provide an assessment of risk of harm posed from tree hazards. Information may be provided about the structure, function, defects or tree pests and/or diseases, vitality, condition and life expectancy. However, no assessment of targets, frequency of use by potential targets or guidance of risk of harm is included in this report.

Tree Protection Zone (TPZ) – Based on the DBH measurement of the tree. It specifies an area around the tree to protect the upper parts as well as the underground root system from impacts of development works. Specifications for TPZ may include maintenance actions such as application of mulch and irrigation.

Executive summary

Abel Ecology carried out a tree assessment survey at 1H Hospital Road, Concord West on behalf of Health Infrastructure on 31st July 2023, to assess the likely impacts of **twenty-seven (27) trees** on the site, and to address issues pertaining to tree protection.

The proposed is a new purpose-built Low and Medium secure forensic mental health unit within the Sydney Local Health District.

All trees on site were of good condition and health. The twenty-six (26) native and one (1) exotic species of trees on site were all planted landscape trees.

A total of twenty-three (23) trees will be removed for this proposal. Of the trees marked for removal, a total of thirteen (13) trees have been identified as likely candidates to survive transplantation. These trees are recommended to be assessed by an arborist to ascertain transplantation suitability. However, transplantation suitability is an unknown element and these trees are considered removed.

Four (4) trees will be retained on site.

This report **does not** authorise tree removal on the site or on the neighbouring properties.

AS4970 Protection of trees on development notes in Table 1 that a preliminary development design can be undertaken. During this stage, the following action is described: "Design modifications to minimize impact to trees"

This AIA addresses the development submission stage described in Table 1 of AS4970. A matter for consideration at the submission stage is: "Identify trees for retention through comprehensive arboricultural impact assessment of proposed construction."

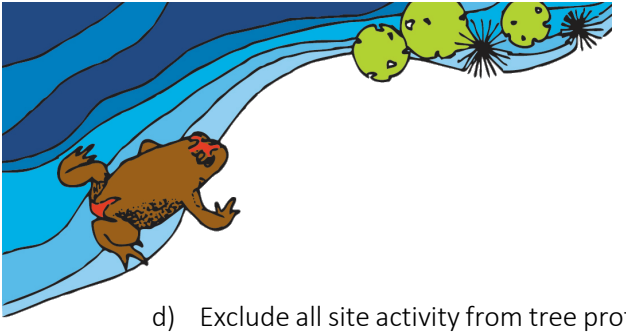
The following recommendations apply:

Tree Protection

a) Show tree locations and protective fencing on all construction plans used on site.

b) Engage a project arborist to ensure and certify that tree protection measures such as tree protection fencing and ground protection (mulch) are satisfactorily implemented and to provide advice as applicable. The arborist will inspect the site after tree protection measures are in place and before any construction/excavation works are conducted. The arborist will then attend the site at least once within every six months during construction, and once upon completion of demobilisation.

c) Construct tree protection fences at a minimum radius distance(s) measuring the TPZ from the centre of the tree, prior to construction to prevent unnecessary root damage. Construct tree protection fences using chain wire mesh panels to a height of 1.8 metres high. Fences are to be held in place with secure footing (Figure 4).



d) Exclude all site activity from tree protection zones during demolition, construction and demobilisation phases (see 'Tree protection guidelines' in Appendix 3).

e) Do not remove tree protection fences until construction is completed, at which time the arborist will sign-off on fence removal and provide further advice as applicable.

f) The list of trees in Table 2 are to be addressed by an accredited arborist for relocation and transplantation suitability within a suitable area on site or in the surrounding areas. Any trees deemed suitable are to be relocated and transplanted within a suitable area.

Root Management

a) Apply mulch 100-150 mm deep with a radius of at least 2 metres, (or to the edge of the calculated tree protection zone where possible) around retained trees prior to construction to stimulate growth of absorbing roots. For trees that will be located beneath fill, apply mulch on top of fill soils.

b) Re-apply mulch annually to compensate for root loss.

c) Advice must be sought from a suitably skilled and experienced project arborist wherever roots over 40 mm diameter are encountered during excavation near trees to be retained. The tearing of roots of retained trees must be avoided and root pruning undertaken as directed by the nominated arborist

d) Cleanly cut any roots with a thickness of 2 cm or more encountered during excavation to reduce damage to roots from tearing, splitting and cracking.

e) Route any potential trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.

f) If trenching excavation is to occur within the TPZ of trees to be retained, hydraulic methods utilising a Vacuum Truck and trained operator to minimise damage to roots. These works are also to be conducted with the supervision of the Project Arborist

g) Route all trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.

Crown Management

a) Limb/canopy protection and management may be required if high level parts of plant machinery is to be in close proximity of retained trees. Advice must be sought from a suitably skilled and experienced project arborist (AQF3 and above) to determine what measure are required.

b) If protection measures are unsuitable, crown pruning may be required. Crown pruning must comply with the appropriate class of pruning described in AS4373-2007 Pruning of amenity trees and be undertaken by a qualified arborist practising modern arboricultural methods.

Certification by an arborist

a) A project Arborist must inspect the site following the installation of the TPZ fencing, trunk protection and placement of the mulch. The project Arborist must then provide compliance documentation to be retained on the project file records. Tree protection compliance is to be checked before any tree related or earthworks occur on the site. Tree protection measure must be reviewed when development design changes occur and at construction hold points as outlined in AS4970-2009 – Protection of Trees on Development Sites, Table 1. The hold points occur at the start of various construction phases which includes – Site Establishment, Construction work, Implement Hard and Soft Landscape Works and Practical Completion.

Fauna Management

a) Relocate the Ring-tailed Possum on site and its drey to an area of suitable foraging and roosting habitat for this species. This is to ensure the appropriate management/relocation of existing protected fauna located at the site, under *Environmental Protection and Conservation Act (1999)* and *Biodiversity and Conservation Act (2016)* before the commencement of any works.

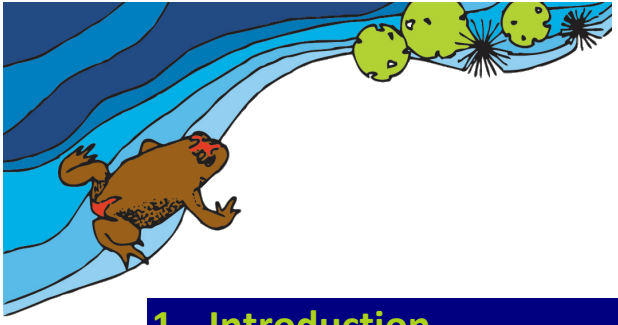
Post-development Landscape Plantings

a) As part of any landscape planting establishment program, all soil areas and plots for proposed plantings are to be decompacted and amended with organic matter. Decompaction and the addition of organic matter must be undertaken to 30 – 60 cm in depth. The soil decompaction area and the related soil volume must be sufficient to support the expected mature size of the proposed street trees. Additional guidance can be provided by a AQF level 5 arborist/horticulturalist.

b) A tree maintenance program is to be created by an AQF5 (or above) Horticulturalist/Aboriculturalist and implemented for the landscape plantings to ensure establishment and increase survivability.

c) Mitigation measures are recommended to include post-development landscape plantings. Advanced stock of 50cm pot diameter or >100L pot volume area to be planted to replaced removed trees at a ratio of 1:1. For every tree removed, one (1) tree should be planted using locally native species (these trees must not be planted within nominated tree protection areas so as to avoid disrupting the critical root zone of protected trees). Suggested species, below, are adapted to local climate conditions and are likely to have a long span of usefulness for the site while providing a net ecological benefit. Other locally native species may be used if desired, providing that they are appropriate for the long-term use of the site. Some suggested locally native species are:

Allocasuarina torulosa	*Eucalyptus crebra*	*Eucalyptus tereticornis*
Allocasuarina littoralis	*Eucalyptus fibrosa*	*Melaleuca decora*
Eucalyptus amplifolia	*Eucalyptus longifolia*	*Melaleuca styphelioides*



1 Introduction

1.1 Scope

A survey of the proposed development site at 1H Hospital Road, Concord West (Figure 1) was undertaken on 31st July 2023.

The aim of this survey was to assess the trees on the site and prepare a report that addresses issues pertaining to the proposal and tree management.

This report will provide a description of individual trees and assess the anticipated impact of the development to the trees on the site.

Introductory information is provided in Section 1. Methods are provided in Sections 2, 8 and the Appendices.

This aim of this assessment is to support the submission of a Review of Environmental Factors (REF) process.

The Australian Standard (AS 4970-2009) *Protection of trees on development sites* describes five stages in planning (Section 2.3 of AS 4970-2009). Each stage from Section 2.3 is listed below. The relationship between sections from this report and the Australian Standard are provided below.

AS 4970-2009 Section 2.3.1 Site Survey – When required - Section 3 and Appendix 1 of this report

AS 4970-2009 Section 2.3.2 Preliminary tree assessment and *AS 4970-2009 Section 2.3.3 Preliminary arboricultural report* – Section 4 and Appendix 2 of this report

AS 4970-2009 Section 2.3.4 Development design and review – the proposal can be viewed from the respective REF report.

AS 4970-2009 Section 2.3.5 Arboricultural impact assessment – Sections 5 and 0; and Appendix 3, Appendix 4 and Appendix 5 of this report

The preparation of this report has been guided by the Australian Standard (AS 4970-2009), local council legislation and related policies as well as the scope of works discussed with the client.

1.2 Proposal description

The proposed project is a new purpose-built Low and Medium secure forensic mental health unit within the Sydney Local Health District. The proposal incorporates the Functional Brief and Model of care principles and is planned to have 18 Medium secure forensic beds, 24 low secure forensic beds, as well as clinical support spaces, outdoor secure courtyard spaces and amenities.

Comprised of Ground Floor, Level 1 and Level 2, the team identified locations for critical components of the program, testing adjacencies and the interrelationship of spaces within the following fundamental design decisions:

Ground Floor:

- Front of House – Shared Entry
- Admissions Secure Entry
- Medium Inpatient Unit – including accommodation pods, General Consumer Area and Clinical Support Area, Outdoor Area
- Back of House

First Floor:

- Centralised Clinical Support Area and General Consumer Areas
- Low Secure Inpatient Units arranged along perimeter of the building
- Proximity of staffed areas to entry from lift lobby to facilitate patient entry/ exit

Second Floor:

- Consolidated Shared Staff Zone Medium and Low (ABW) areas
- Engineering plant zone

1.2.1 Proposal Impacts

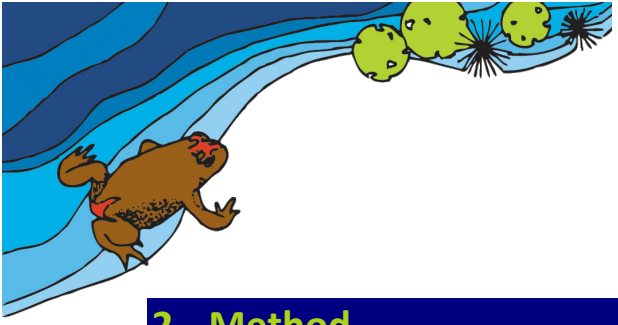
This proposal area overlaps an area of existing vegetation. The vegetation within the proposal area consists of planted native and exotic landscape trees. Impacted trees are listed in section 4 and section 5, detailing trees for removal, retention and relocation.

1.3 Information and Documentation Provided

Abel Ecology has been provided the following documents from the client:

NBRS Architectural drawings (drawing reference 22071-NBRS-DD-DR-LA-0300; revision 1)

NBRS Schematic Design Report (22071-NBRS-AR-RPT-SD-0001[4])



2 Method

Tree assessments were undertaken by Abel Ecology on 31st July 2023.

The vitality and condition of trees were assessed from ground level using a modified VTA (Visual Tree Assessment) method (*Mattheck & Breleor, 1994*). No internal investigations of the tree were undertaken. On occasions a nylon hammer may be used for sounding to test if hollows may be present. Tree heights were determined by visual estimation. Trees were marked using nails and numbered aluminium tags, which correspond with the tree identification numbers used in this report.

The Tree Protection Zone (TPZ) of each tree was determined using the formula "TPZ = DBH x 12", and Structural Root Zone (SRZ) was calculated using the formula "SRZ radius = (Base Diameter X 50) $^{0.42}$ x 0.64". Formulae used to calculate TPZs and SRZs are provided in the Australian Standard for Protection of Trees On Development Sites AS4970-2009 (*Standards Australia, 2010*).

The term 'health' in this document is used synonymously with other words such as 'vigour 'and 'vitality'.

The term 'structure' is synonymous with the word 'condition'.

Tree locations are shown in Figure 3. Trees are individually described in Appendix 2.

2.1 Plotted Tree Locations

Tree locations were recorded using GPS data collected on site and then input on georeferenced maps using Geographic Information Systems program (QGIS). Inherit margins of error of GPS units and the density of obstructions at various locations on Site may result in variations of recorded tree locations and true tree locations on site. As such it is recommended that for more accurate location data, a surveyor should plot tagged trees on site.

2.2 Limitations

DBH and DAB may be estimated for trees when access is difficult. The access difficulties may be due to proximity to structures, materials, hazardous fauna and flora, overgrown vegetation or located on neighbouring properties. When an estimate is recorded the abbreviation "est" is included in the table.

No soil, root or other below ground investigations were done as part of this assessment.

No aerial inspections were undertaken as part of this assessment.

No access was provided for trees on neighbouring properties.

3 Site Survey

3.1 Site description

For the purpose of this report the site is defined as 1H Hospital Road, West Concord (Figure 1).

The site is approximately 0.35 ha in size and the elevation is approximately 5 metres above sea level.

The trees are positioned around existing infrastructure, including a car park, roads, and hospital buildings.

3.2 Site Plans

Figure 1 is a locality map, highlighting the area of study.

Figure 2 highlights the proposed area of redevelopment.

Figure 3 is an aerial photo, outlining the boundaries of the site and the trees to be removed or retained.

4 Observations

4.1 Assessed Trees

Data for twenty-seven **(27) trees** assessed at the time of the survey is further outlined in Appendix 2.

All trees assessed are defined by City of Canada Bay council as trees under sB6 in DCP. A protected tree is defined as:

a) any tree with a height equal to or greater than 5 metres above ground level (existing); or

d) any tree that is under 5 metres in height that has a trunk diameter of more than 300mm at ground level (existing); or

b) has a canopy spread of over 4m; or

c) a native palm, cycad, or mangrove, irrespective of its dimensions.

The trees on site are predominantly planted natives, with only one (1) planted exotic species.

Species identified within and adjacent to the site include the following (Table 1):

Table 1. Tree species identified

Species name	Common name	Count
Callistemon sp,	Unidentified Callistemon	1
Corymbia maculata	Spotted Gum	1
Cupaniopsis anacardioides	Tuckeroo	15
Eucalyptus tereticornis	Forest Red Gum	2
Lophestemon confertus	Brush Box	1
Melaleuca quinquinervia	Broad-leaved Paperbark	1
Melaleuca styphelloides	Prickly-leaved Paperbark	4
Triadica sebifera	Chinese Tallow	1
	Unidentified	1
	Total	27

5 Arboricultural impact assessment

5.1 Tree Retention

The proposal indicates the retention of the following trees within the property:

396, 1236, 1237.

5.2 Tree removal

The proposal indicates the removal of the following trees that occur within the proposal footprint:

101, 393, 397, 398, 759, 758, 1229, 1230, 1231, 1232, 1233, 1234, 1235, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1245, 1246, 1247, 1248.

5.3 Tree transplantation

Survivability of tree transplantation decreases as trees become larger and older. Generally, trees above 10 m are far less likely to survive transplantation than those under 10 m tall. Therefore, the list of trees in Table 2 include trees which are to be removed and are likely to survive a transplantation event (trees that are marked for retention are not included in Table 2). The following are trees marked for removal are to be assessed by an accredited arborist for relocation and transplantation suitability within a suitable area on site or in the surrounding areas. Any trees deemed suitable should be relocated and transplanted within a suitable area. However, as this is an unknown element these trees are considered removed.

Table 2. Trees for possible transplantation

Tree no.	Tree Species
758	*Eucalyptus tereticornis*
1229	*Cupaniopsis anacardioides*
1230	*Cupaniopsis anacardioides*
1231	*Cupaniopsis anacardioides*
1232	*Cupaniopsis anacardioides*
1233	*Cupaniopsis anacardioides*
1234	*Cupaniopsis anacardioides*
1235	*Cupaniopsis anacardioides*
1239	*Cupaniopsis anacardioides*
1240	*Cupaniopsis anacardioides*
1241	*Cupaniopsis anacardioides*
1242	*Cupaniopsis anacardioides*
1243	*Cupaniopsis anacardioides*

5.4 Tree Significance

The significance of trees on site were assessed in line with the 'STARS' method as shown in Appendix 6.

All trees assessed on site were determined to be of 'medium landscape significance'. While all trees were of good health and vigour, all trees on site were planted and not remnant (naturally occurring) of a native ecological community. The trees on site were all known to have a lifespan of more than forty (40) years and therefore have a 'high' priority for retention.

Trees 758 and 1229–1243, while planted, are native to the original ecological community which existed on site prior to European colonisation and development of the local area. However, the landscape has been significantly modified and cleared, and conditions in which these trees occur are now unsuitable to promote natural growth, forms, and lifespans of the trees. While these trees are therefore appropriate for removal, they are also a suitable size for translocation. While translocation has a historically low success rate, translocation should be carried out for these trees to avoid unnecessary 'destruction' of natural vegetation.

Trees 101, 396, 397 and 1244 are exotic species or are not native to the original ecological community which existed on the site prior to European colonisation and development of the local area. These trees solely provide aesthetic value to the site with little to zero ecological value. These trees are appropriate for removal, with species of native trees to be planted as mitigation and provide aesthetic and ecological values.

Trees 393, 398, 759 and 1245–1248, while planted, are native to the original ecological community which existed on site prior to European colonisation and development of the local area. These trees are suitable to the environmental conditions that occur on site, provide ecological value to the area, and provide aesthetic appeal to the location. While these trees are of high retention value, they are positioned within the impact footprint and will be significantly impacted by the proposal, with a very low chance of survival if retained. Therefore, it is recommended that these trees are removed. Furthermore, it is recommended that landscape trees be planted to mitigate the impacts associated with removal of native trees.

6 Discussion

A single tree on site was observed to be a fauna roosting location. When surveying tree 1246, a Ring-tailed Possum drey was observed in the lower branches, with the Ring-tailed Possum visible from the ground. It is recommended that the possum is safely relocated to an area of suitable roosting and foraging habitat prior to tree removal works. These obligations and requirements have been set by the *Environmental Protection and Conservation Act (1999)* and *Biodiversity Conservation Act (2016)* in order to protected native fauna species.

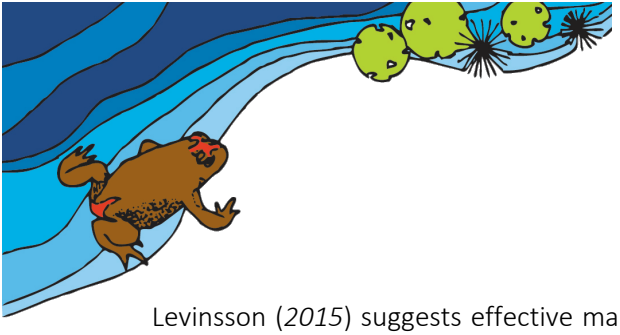
Dead or damaged roots such as those resulting from mower damage or vehicle access may indicate increase failure potential. Excavation across a tree's root crown decreases stability by severing roots. Trees can usually survive with only a small operational root system, however their ability to respond to stress and environmental factors is reduced depending on the extent of root loss (*Matheny & Clark, 1994*).

Roots cannot grow without oxygen, and they cannot survive in compacted soils. Any activity that buries or cuts roots such as a soil stockpile or service trench will result in death of a corresponding portion of the canopy (*Perry, 1982*). It follows, then, that a large soil stockpile near the base of the tree will remove oxygen for a significant proportion of the root system, and thus impact the live crown. The vast majority of roots are found within the top metre of soil, though this is highly dependent on the soil type. Roots systems are shallow in poorly aerated clay soils, deep in well-aerated sandy soils, and widespread in desert environments, all according to the availability of oxygen, water, and soil nutrients (*Dobson, 1995*).

Trees are commonly observed to survive when more than 50% of their roots are severed (*Hamilton, 1989*). The root ball size of transplanted trees is usually as little as 3-5 times trunk diameter (*Solfjeld & Hansen, 2004; Levinsson, 2015*), which means that a loss of more than 50% root zone is standard practice in the transplant industry. Transplanted trees are managed quite differently to the way established trees are managed on construction sites. Transplanted trees are valuable commodities purchased at great cost, attracting much care, and that level of care can be the difference between a tree that survives construction and one that is killed by it.

Section 3.3.3 of the Australian Standard for tree protection (*Standards Australia, 2010*) says the following with regard to encroaching in TPZs by more than 10%:

> *3.3.3 Major encroachment*
>
> *If the proposed encroachment is greater than 10% of the TPZ or inside the SRZ (see Clause 3.3.5), 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. This may require root investigation by non-destructive methods and consideration of relevant factors listed in Clause 3.3.4.*



Levinsson (*2015*) suggests effective management may be more valuable to tree survival than beginning with a vigorous specimen. In the context of trees on or adjacent to development sites, effective management is simply a matter of adequate protection, mulching, and regular irrigation, as this satisfies the most commonly limiting factors for tree growth (*Harris et al., 2004; Mauseth, 2009*). Additionally, wood chip and leaf litter mulches are effective and cost-efficient methods for stimulating new root growth and improving soil quality in compacted urban soils (*Scharenbroch, & Watson, 2014).*

Root loss will be compensated by applying mulch to a depth of approximately 100-150 mm around the base of retained tree at least 3 months prior to trenching, and by regularly watering the trees (*Roberts et al, 2006*). This will boost vitality and stimulate the growth of new absorbing roots.

Mycorrhizae are fungi that grow in symbiotic association with tree roots (especially the fine root hairs) and are attributed with increasing the uptake of nutrients, particularly phosphorus, and reducing infection from soil borne pathogens. They greatly increase the surface area of a tree's root system. Mycorrhizae are reduced in number by compaction, waterlogging and overuse of soil fertilisers, as they require aerobic soil conditions, that is, they need oxygen. Forest litter or similar mulch provides ideal conditions for the proliferation of Mycorrhizae (*Harris et al., 2004*).

Adequately insulated soils allow small absorbing roots to grow in the upper 150 mm of soil, whereas exposed soils are prone to become hot enough that roots are restricted to greater depths because absorbing roots cannot survive in the upper layer of soil (*Harris et al., 2004*).

7 Recommendations

The following recommendations apply:

Tree Protection

a) Show tree locations and protective fencing on all construction plans used on site.

b) Engage a project arborist to ensure and certify that tree protection measures such as tree protection fencing and ground protection (mulch) are satisfactorily implemented and to provide advice as applicable. The arborist will inspect the site after tree protection measures are in place and before any construction/excavation works are conducted. The arborist will then attend the site at least once within every six months during construction, and once upon completion of demobilisation.

c) Construct tree protection fences at a minimum radius distance(s) measuring the TPZ from the centre of the tree, prior to construction to prevent unnecessary root damage. Construct tree protection fences using chain wire mesh panels to a height of 1.8 metres high. Fences are to be held in place with secure footing (Figure 4).

d) Exclude all site activity from tree protection zones during demolition, construction and demobilisation phases (see 'Tree protection guidelines' in Appendix 3).

e) Do not remove tree protection fences until construction is completed, at which time the arborist will sign-off on fence removal and provide further advice as applicable.

f) The list of trees in Table 2 are to be assessed by an accredited arborist for relocation and transplantation suitability within a suitable area on site or in the surrounding areas. Any trees deemed suitable are to be relocated and transplanted within a suitable area.

Root Management

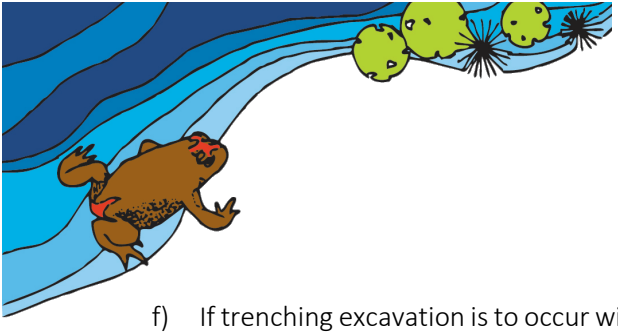
a) Apply mulch 100-150 mm deep with a radius of at least 2 metres, (or to the edge of the calculated tree protection zone where possible) around retained trees prior to construction to stimulate growth of absorbing roots. For trees that will be located beneath fill, apply mulch on top of fill soils.

b) Re-apply mulch annually to compensate for root loss.

c) Advice must be sought from a suitably skilled and experienced project arborist wherever roots over 40 mm diameter are encountered during excavation near trees to be retained. The tearing of roots of retained trees must be avoided and root pruning undertaken as directed by the nominated arborist

d) Cleanly cut any roots with a thickness of 2 cm or more encountered during excavation to reduce damage to roots from tearing, splitting and cracking.

e) Route any potential trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.



f) If trenching excavation is to occur within the TPZ of trees to be retained, hydraulic methods utilising a Vacuum Truck and trained operator to minimise damage to roots. These works are also to be conducted with the supervision of the Project Arborist

g) Route all trenching for underground services outside the TPZs of retained trees. If any underground service installation or underground boring will occur within TPZs, engage an arborist to supervise the activity.

Crown Management

a) Limb/canopy protection and management may be required if high level parts of plant machinery is to be in close proximity of retained trees. Advice must be sought from a suitably skilled and experienced project arborist (AQF3 and above) to determine what measure are required.

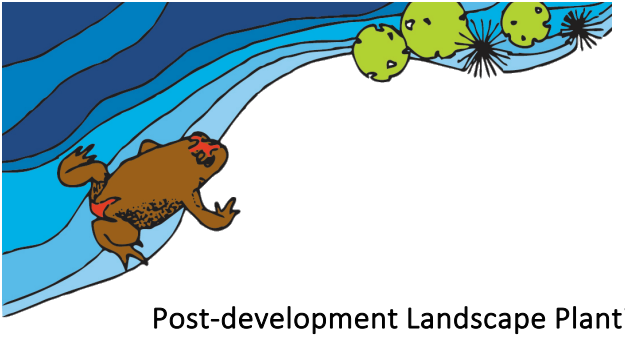
b) If protection measures are unsuitable, crown pruning may be required. Crown pruning must comply with the appropriate class of pruning described in AS4373-2007 Pruning of amenity trees and be undertaken by a qualified arborist practising modern arboricultural methods.

Certification by an arborist

a) A project Arborist much inspect the site following the installation of the TPZ fencing, trunk protection and placement of the mulch. The project Arborist must then provide compliance documentation to be retained on the project file records. Tree protection compliance is to be checked before any tree related or earthworks occur on the site. Tree protection measure must be reviewed when development design changes occur and at construction hold points as outlined in AS4970-2009 – Protection of Trees on Development Sites, Table 1. The hold points occur at the start of various construction phases which includes – Site Establishment, Construction work, Implement Hard and Soft Landscape Works and Practical Completion.

Fauna Management

b) Relocate the Ring-tailed Possum on site and its drey to an area of suitable foraging and roosting habitat for this species. This is to ensure the appropriate management/relocation of existing protected fauna located at the site, under *Environmental Protection and Conservation Act (1999)* and *Biodiversity and Conservation Act (2016)* before the commencement of any works.



Post-development Landscape Plantings

a) As part of any landscape planting establishment program, all soil areas and plots for proposed plantings are to be decompacted and amended with organic matter. Decompaction and the addition of organic matter must be undertaken to 30 – 60 cm in depth. The soil decompaction area and the related soil volume must be sufficient to support the expected mature size of the proposed street trees. Additional guidance can be provided by a AQF level 5 arborist/horticulturalist.

c) A tree maintenance program is to be created by an AQF5 (or above) Horticulturalist/Aboriculturalist and implemented for the landscape plantings to ensure establishment and increase survivability.

d) Mitigation measures are recommended to include post-development landscape plantings. Advanced stock of 50cm pot diameter or >100L pot volume area to be planted to replaced removed trees at a ratio of 1:1. For every tree removed, one (1) tree should be planted using locally native species (these trees must not be planted within nominated tree protection areas so as to avoid disrupting the critical root zone of protected trees). Suggested species, below, are adapted to local climate conditions and are likely to have a long span of usefulness for the site while providing a net ecological benefit. Other locally native species may be used if desired, providing that they are appropriate for the long-term use of the site. Some suggested locally native species are:

Allocasuarina torulosa	*Eucalyptus crebra*	*Eucalyptus tereticornis*
Allocasuarina littoralis	*Eucalyptus fibrosa*	*Melaleuca decora*
Eucalyptus amplifolia	*Eucalyptus longifolia*	*Melaleuca styphelioides*

8 References

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Scharenbroch, B. C., & Watson G. W. (2014) Wood Chips and Compost Improve Soil Quality and Increase Growth of *Acer rubrum* and *Betula nigra* in Compacted Urban Soil, *Arboriculture & Urban Forestry*, 40(6) 319-331

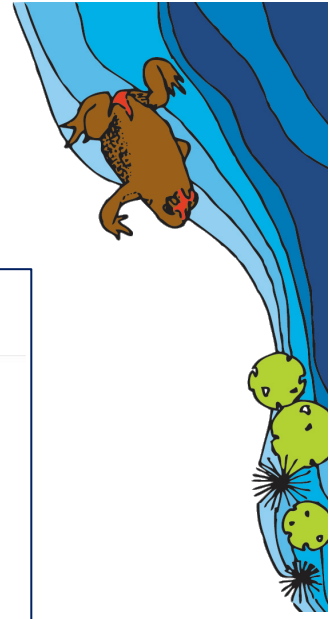
Solfjeld, I. and Hansen, O.B. (2004), Post-transplant growth of five deciduous nordic tree species as affected by transplanting date and root pruning, *Urban Forestry & Urban Greening*, 2, 129–137

Standards Australia (2007) *Pruning of amenity trees* (AS 4373 – 2007)

Standards Australia (2010) *Protection of trees on development sites* (AS 4970-2009 – incorporating Amendment No. 1).

Appendix 1. Figures

Figure 1. Locality map for the site.



4.0 Development Proposal

4.2.1 MASTER PLAN

The Masterplan has been developed and coordinated, with main scope including:

-New access road to the rear of the building, connecting into the existing road.

-Existing Pedestrian walkway to the North to be retained

-New pedestrian access along the East end of the building

-New pedestrian access to the South, connecting into the existing pedestrian walkway, and creating the main access point into the Front of House/Reception.
This walkway will also serve as 24hour maintenance access of the existing generator and substation. Footpath finish will be trafficable.

Figure 2. Proposal plan.

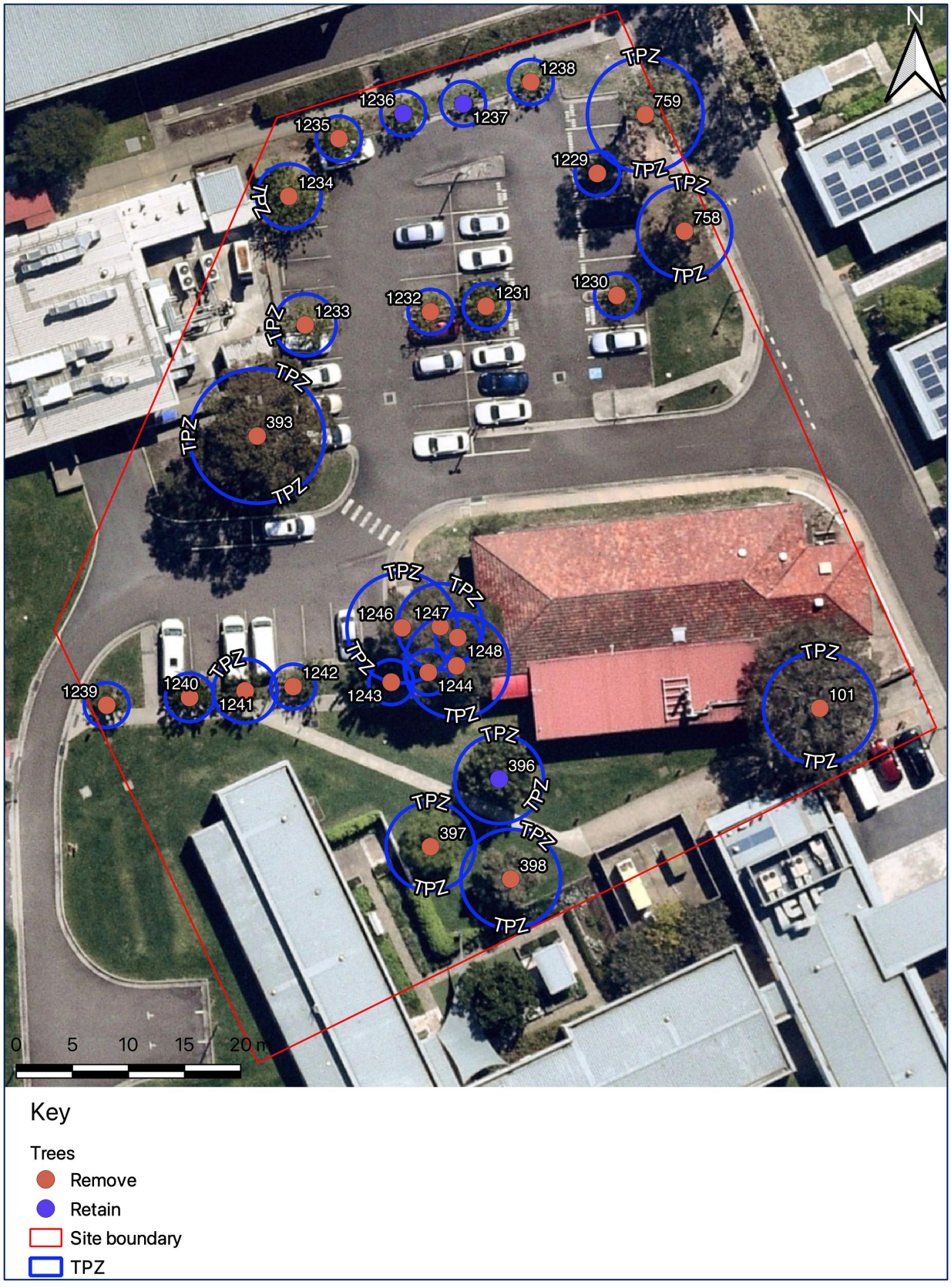
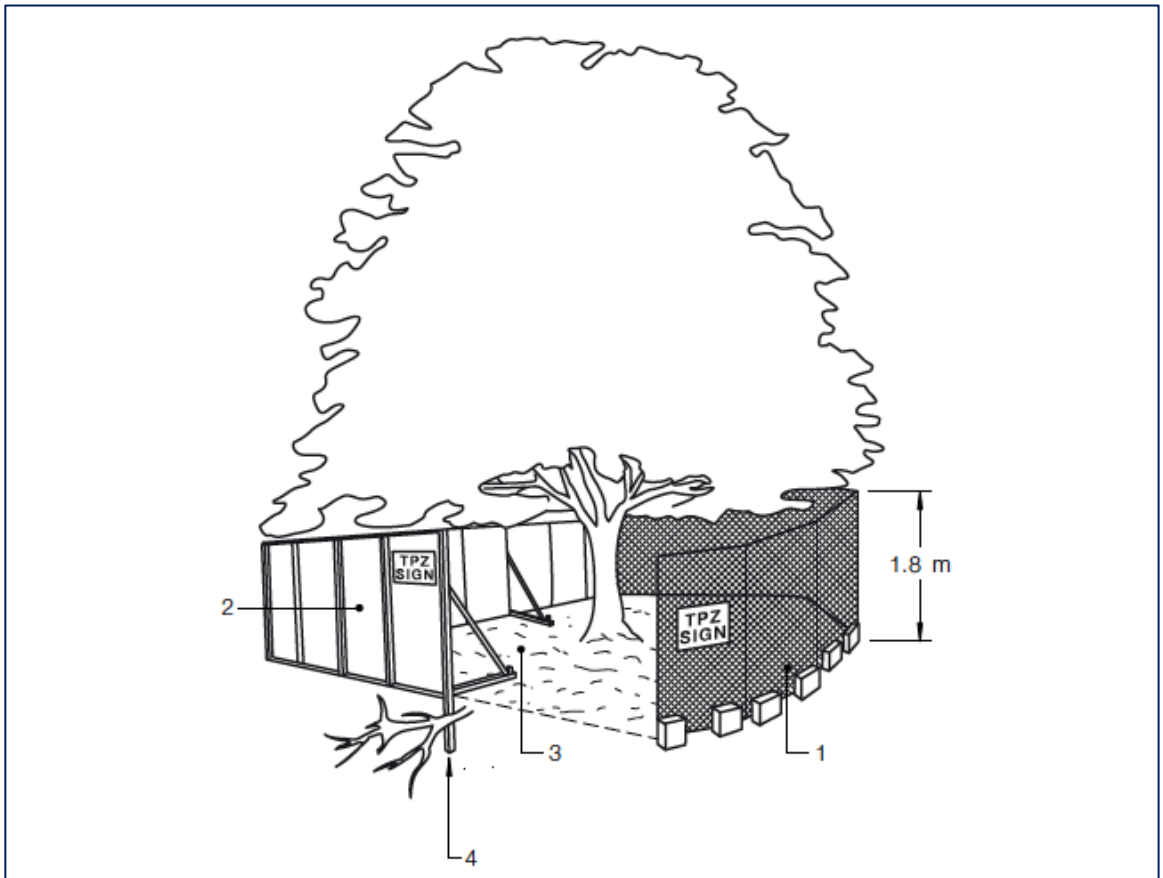


Figure 3. Aerial photograph of site with tree retention/removal plan.



LEGEND:

1 Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.

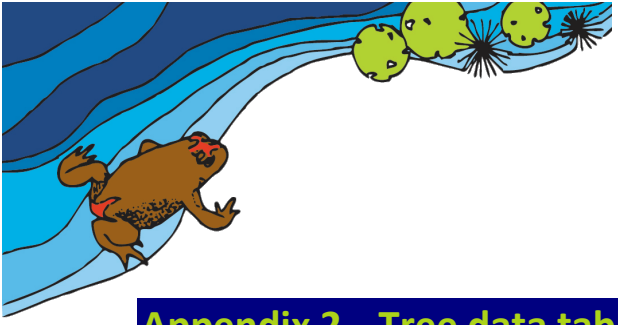
2 Alternative plywood or wooden paling fence panels. This fencing material also prevents building materials or soil entering the TPZ.

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.

Figure 4. Extract from Section 3 of AS 4970-2009: Protective fencing.

Source: Standards Australia (2010) *Protection of trees on development sites* (AS 4970-2009 – incorporating Amendment No. 1).

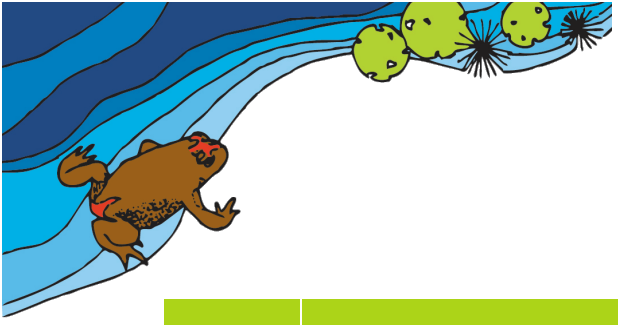


Appendix 2. Tree data table

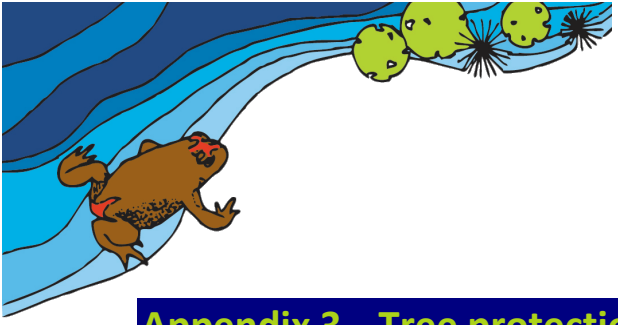
The following tree schedule (Table 3) describes the numbered trees shown in (Figure 3).

Table 3. Tree Data and Comments

Tree No.	Species	DAB (cm)	DBH (cm)	TPZ (m)	SRZ (m)	Remove / retain
101	Unidentified	65	45	5.00	2.76	Remove
393	*Corymbia maculata*	73	50	6.00	2.90	Remove
396	*Lophestemon confertus*	41	33	3.96	2.28	Retain
397	*Triadica sebifera*	43	33	3.96	2.32	Remove
398	*Melaleuca quinquinervia*	46	37	4.44	2.39	Retain
758	*Eucalyptus tereticornis*	43	35	4.20	2.32	Remove
759	*Eucalyptus tereticornis*	51	43	5.16	2.49	Remove
1229	*Cupaniopsis anacardioides*	12	10	2.00	1.50	Remove
1230	*Cupaniopsis anacardioides*	18	10	2.00	1.61	Remove
1231	*Cupaniopsis anacardioides*	21	17	2.04	1.72	Remove
1232	*Cupaniopsis anacardioides*	18	9	2.00	1.61	Remove
1233	*Cupaniopsis anacardioides*	27	23	2.76	1.91	Remove
1234	*Cupaniopsis anacardioides*	26	24	2.88	1.88	Remove
1235	*Cupaniopsis anacardioides*	23	15	2.00	1.79	Remove
1236	*Cupaniopsis anacardioides*	20	11, 5, 5	2.00	1.68	Retain
1237	*Cupaniopsis anacardioides*	16	7, 5, 6	2.00	1.53	Retain
1238	*Cupaniopsis anacardioides*	16	13	2.00	1.53	Remove
1239	*Cupaniopsis anacardioides*	18	12	2.00	1.61	Remove
1240	*Cupaniopsis anacardioides*	27	15, 5, 5, 7	2.16	1.91	Remove
1241	*Cupaniopsis anacardioides*	29	22, 9	2.85	1.97	Remove
1242	*Cupaniopsis anacardioides*	25	13, 6	2.00	1.85	Remove
1243	*Cupaniopsis anacardioides*	22	11, 10, 6	2.00	1.75	Remove



Tree No.	Species	DAB (cm)	DBH (cm)	TPZ (m)	SRZ (m)	Remove / retain
1244	*Callistemon sp.*	32	7, 8, 7, 8	2.00	2.05	Remove
1245	*Melaleuca styphelloides*	50	39	4.68	2.47	Remove
1246	*Melaleuca styphelloides*	56	41	4.92	2.59	Remove
1247	*Melaleuca styphelloides*	43	32	3.84	2.32	Remove
1248	*Melaleuca styphelloides*	24	5, 6, 8, 3, 3	2.00	1.82	Remove



Appendix 3. Tree protection guidelines

A Pre-construction/Demolition phase

The following methods are to be implemented to minimise potential damage to retained trees, e.g. from soil compaction and site activity. Trees are to be protected at all stages of the development, and growing conditions are to be improved within the Tree Protection Zone (TPZ). These guidelines are consistent with AS4970-2009 Protection of trees on development sites.

A 1. All site workers are to be aware of relevant tree protection requirements. Nominated trees will be removed or transplanted as per the tree protection plan. An arborist is to supervise tree removal, pruning and transplanting and certify the completed works.

A 2. All trees not nominated for retention are to be removed prior to any construction activity. Approved tree pruning and removal operations near retained trees are to be carried out in a way that avoids soil compaction and damage to canopy, trunk or roots. Works are to be supervised by an arborist or the person responsible for site management.

A 3. Stumps are to be ground, not dozed or dug out, if in the vicinity of retained trees. Machinery (other than stump machines) is to be kept beyond the nominated protection zones of retained trees during all operations.

A 4. Tree protection fencing is to be in place before the introduction of machinery or other materials to the site and before commencement of works. Fencing is to be located to at least the canopy dripline, be of sturdy construction and retained in-situ during works unless altered by the project arborist. All site activities are excluded from this zone. Refer to Appendix 2 for specific minimum setback distances. AS4687 specifies applicable fencing requirements.

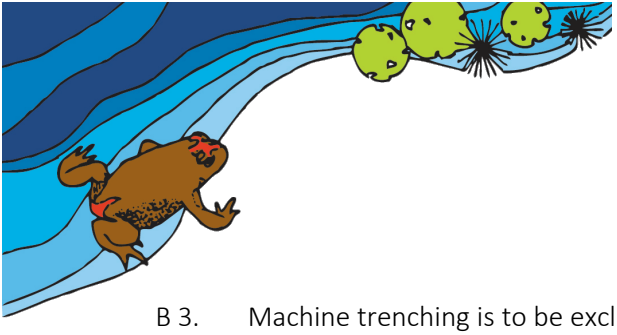
A 5. The TPZ is to be mulched using material compatible with 'AS4454-2003 Composts, soil conditioners and mulches', e.g. decomposed leaf litter, and maintained at 50-100 mm depth. Some areas, e.g. turf, may not require mulch. Temporary irrigation may be required. Weeds are to be removed and controlled.

A 6. Pruning is to be undertaken by suitably qualified, skilled and insured people to comply with AS4373-2007, Australian Standard: Pruning of Amenity Trees. Initial pruning provides adequate clearances and general crown maintenance. Flexible branches are to be tied back, not pruned.

B Construction phase (Maintain tree protection fencing)

B 1. Where access is required within a TPZ, temporary ground protection measures will be required (e.g. metal plates, rumble boards or exterior-grade ply over aggregate) capable of supporting the required load without deflection. Trunk protection may be required, e.g. battens wrapped around the trunk to a height of 2 metres.

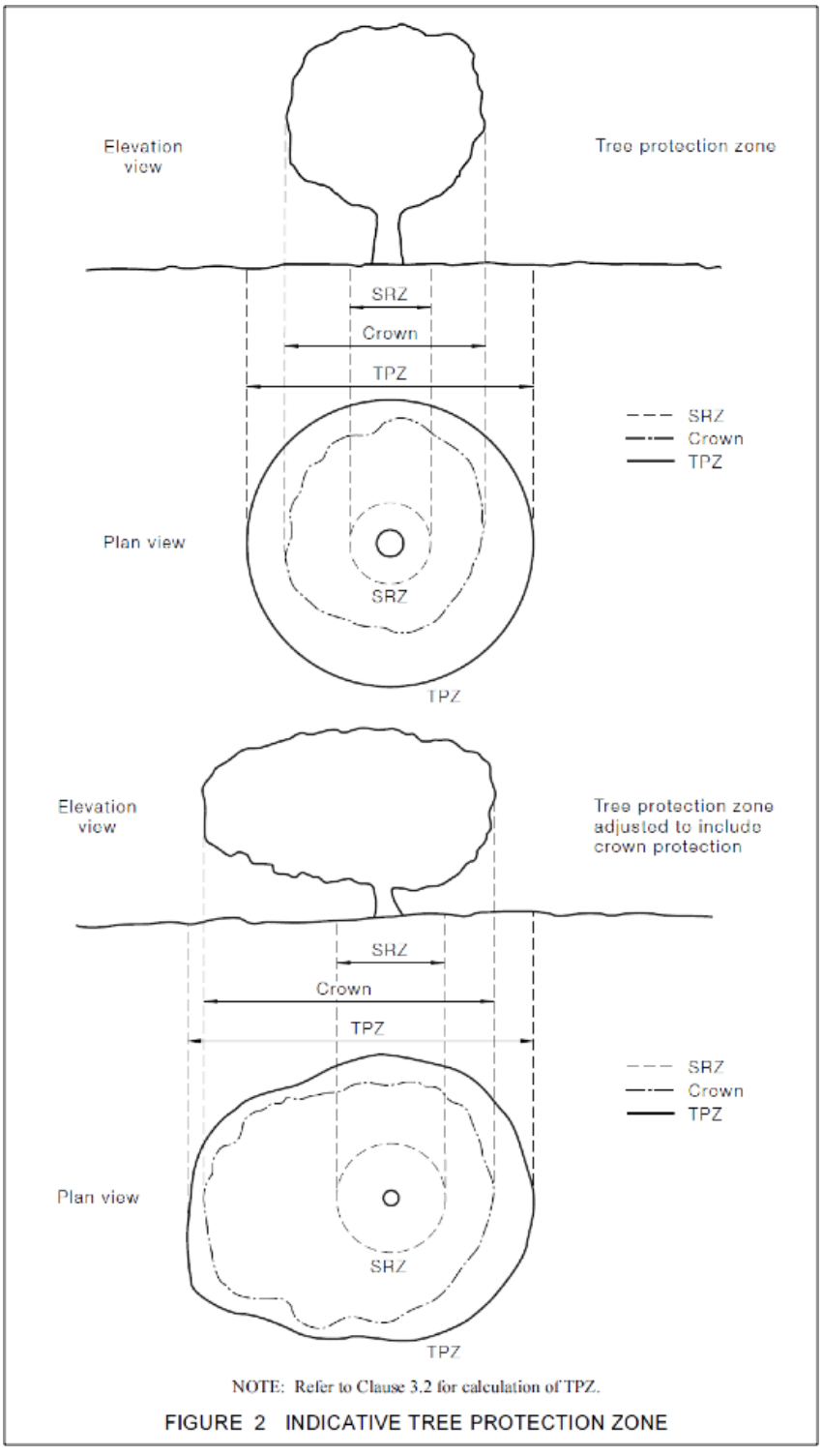
B 2. Material stockpiles or dumps, parking, excavation, site sheds, preparation of chemicals, fires, wash down areas or similar are to be located clear of TPZs. Areas designated for such requirements are not to divert drainage water into tree protection areas.



B 3. Machine trenching is to be excluded from the TPZ of retained trees. Any required root excavation inside a TPZ is to be done by hand and intact roots >40 mm in diameter are to be retained. Services are to be installed 100 mm clear of such roots. Damaged roots **must** be cut cleanly with sharp implements (backhoe blades and similar are excluded), with no root dressings or paints. Trenches are to be backfilled promptly to minimise soil desiccation. Underbore if no suitable alternative location is possible. All works within the TPZ are to be supervised by an arborist.

Appendix 4. Tree protection zone and structural root zone

Extract from Section 3 of AS 4970-2009



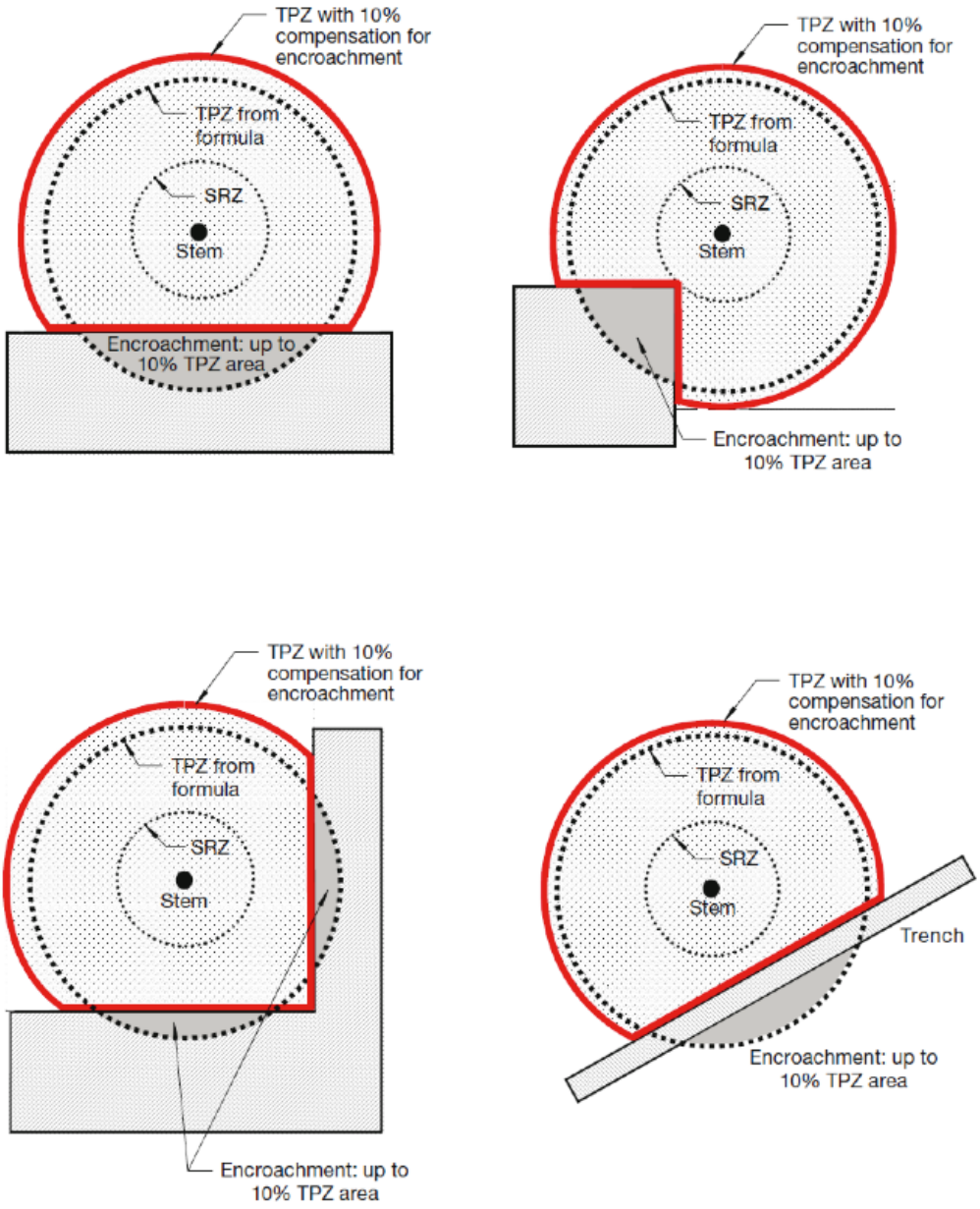
NOTE: Refer to Clause 3.2 for calculation of TPZ.

FIGURE 2 INDICATIVE TREE PROTECTION ZONE

Appendix 5. Encroachment into tree protection zones

Extract from Appendix D of AS 4970-2009

Encroachment into the tree protection zone (TPZ) is sometimes unavoidable. Figure D1 provides examples of TPZ encroachment by area, to assist in reducing the impact of such incursions.



NOTE: Less than 10% TPZ area and outside SRZ. Any loss of TPZ compensated for elsewhere.

FIGURE D1 EXAMPLES OF MINOR ENCROACHMENT INTO TPZ

Appendix 6. IACA Significance of a Tree, Assessment Rating System (STARS)© (IACA)©

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. An example of its use in an Arboricultural report is shown as Appendix A.

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

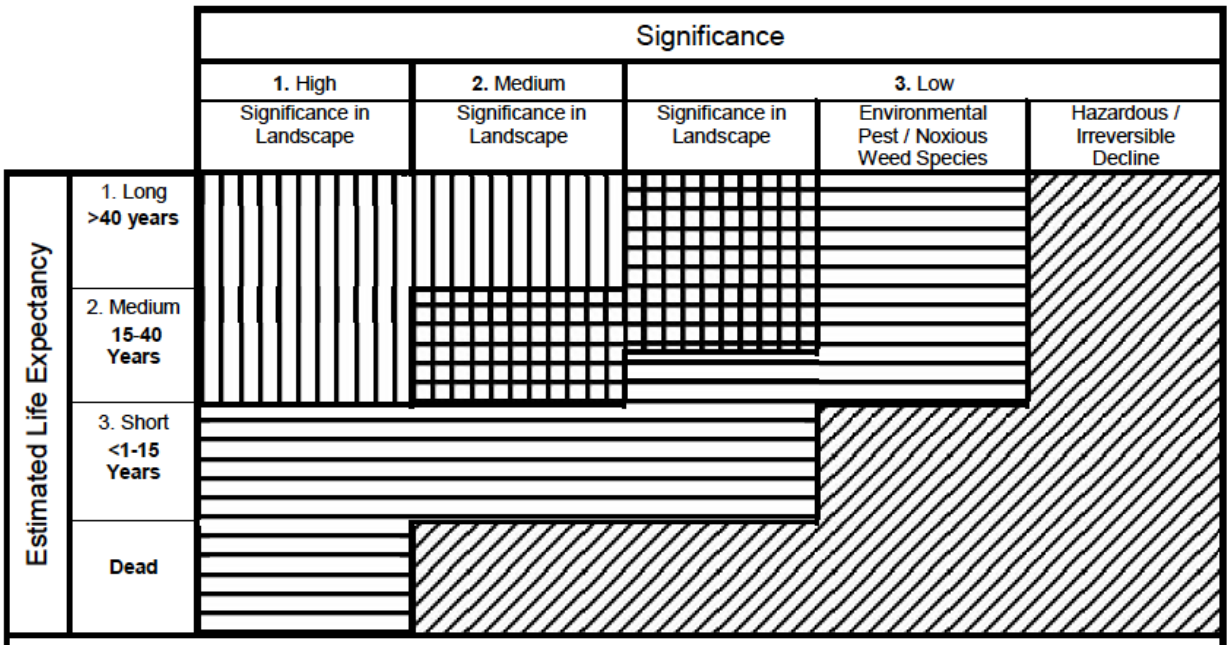
- The tree is structurally unsound and/or unstable and is considered potentially dangerous,
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

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.

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

Table 1.0 Tree Retention Value - Priority Matrix.



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 e.g. pier and beam etc 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 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.

Priority for Removal - These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

USE OF THIS DOCUMENT AND REFERENCING

The IACA Significance of a Tree, Assessment Rating System (STARS) is free to use, but only in its entirety and must be cited as follows:

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

REFERENCES

Australia ICOMOS Inc. 1999, *The Burra Charter – The Australian ICOMOS Charter for Places of Cultural Significance*, International Council of Monuments and Sites, www.icomos.org/australia

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

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

Appendix 7. Company Profile

Abel Ecology has been in the flora and fauna consulting business since 1991, starting in the Sydney Region, and progressively more state wide in New South Wales since 1998, and now also in Victoria. During this time extensive expertise has been gained with regard to Master Planning, Environmental Impact assessments including flora and fauna, bushfire reports, Vegetation Management Plans, Management of threatened species, Review of Environmental Factors, Species Impact Statements and as Expert Witness in the Land and Environment Court. We have done consultancy work for industrial and commercial developments, golf courses, civil engineering projects, tourist developments as well as residential and rural projects. This process has also generated many connections with relevant government departments and city councils in NSW. Our team consists of five scientists and two administrative staff, plus casual assistants as required.

Licences

NPWS s132C Scientific licence number is SL100780

NPWS GIS data licence number is CON95034.

DG NSW Dept of Primary Industries Animal Care and Ethics Committee Approval

DG NSW Dept of Primary Industries Animal Research Authority

The Consultancy team

Dr Danny Wotherspoon

BSc, DipEd, MA, PhD, Grad Dip Bushfire Protection,
MECA NSW, MEPLA, MNELA, MESA, MEIANZ, White card.

Danny has practised as an ecological and bushfire consultant since 1991. He is a consulting ecologist to private developers, State Government agencies and various City Councils on a regular basis, for development applications, government projects, and as expert witness in the NSW Land and Environment Court.

Danny's PhD researched fragmented vegetation and fauna habitat use. He has special expertise in fauna habitat use. Danny has presented invited papers at international conferences since 2001 in Australia, China, South Africa, Sri Lanka and Israel on his PhD and other research, including golf course habitat management. Danny's scientific papers have been published in both international and Australian academic journals.

Mark Mackinnon

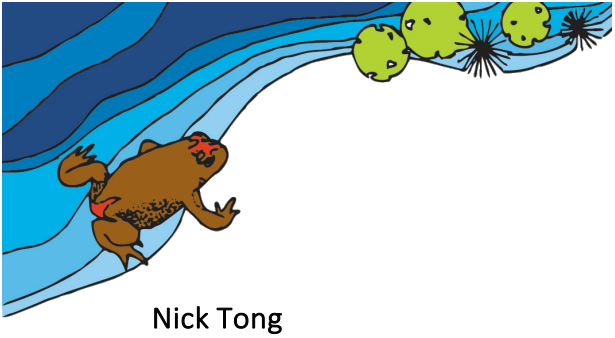
B Env. Sci. (Hons); Grad. Dip. in Bushfire Protection
Bushfire Planning & Design (BPAD), Accredited Practitioner Level 3. Accreditation number 36395.
MEIANZ, White Card

Mark is a passionate and enthusiastic scientist who thrives in the field of natural resource management. In the last 6 years, Mark has worked for a number of inter-state government agencies and environmental consultancies. He has experience in threatened species, fire ecology, bushfire management, pest plant and animals, and landscape restoration. In particular he specializes in ornithology and bushfire management. Mark has a number of specialized field-based skills including: simple and complex tree climbing, working at heights, general firefighter departmental fire accreditation, venomous snake and reptile handling, immunization to handle bat species, and an A - class bird banding license with mist-net endorsement. Mark is also skilled in ArcGIS mapping, first-aid, four -wheel-driving.

Mark Sherring

BM, MAABR, Cert. Hort., Cert. Bush Regen, Cert. Rural Ops, White Card.
Member of the Australian Association of Bush Regenerators

Mark has extensive knowledge and experience of plant species in New South Wales. He has built up his expert knowledge on NSW native plant species over the many years that he has practised as a Botanist. He is regularly asked to contribute to the extensive (ongoing) flora surveys of the Sydney Basin and Blue Mountains carried out by the Royal Botanic Gardens, Sydney. Mark has extensive field survey experience, having worked for over ten years in various plant-related roles. His role in Abel Ecology is to provide expert advice on flora and on the full range of flora management issues encountered and in the design and management of environmental monitoring projects.



Nick Tong

BSc (Biology), MPhil (Ecology), Cert. III CLM
BAM Accredited Assessor (BAAS22012),
MECA NSW, Snr First Aid, White card.

Nicholas is an experienced ecologist with expertise in fauna, plant species identification, vegetation assessment and ecological restoration. In the last six years, he has been a consulting ecologist to private developers and large corporations, for a variety of projecting including State Significant Developments. Nick has extensive field work experience in Sydney, the Blue Mountains and Central West NSW. His Master's project investigated the impacts of exotic predators on herpetofauna in the arid zone. His role at Abel Ecology is to provide expert advice on fauna and the application of the Biodiversity Offset Scheme.

Jesse Cass

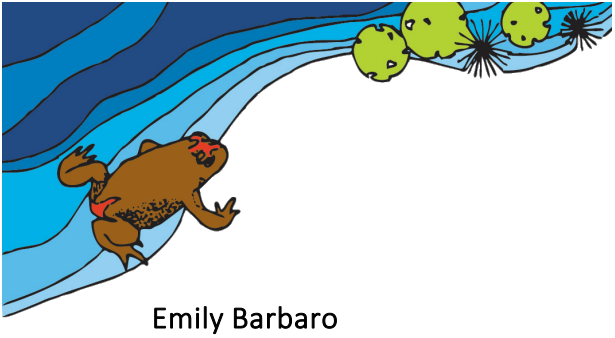
BSc (Zoology), MEScM
White Card, Working Safely at Heights.
CASA accredited drone pilot.
Botanist

Jesse has a Masters of Environmental Science and Management. He is a practicing botanist with a special interest in Eucalyptus and native grass species. His Masters Thesis was completed in restoration ecology for the NSW National Parks and Wildlife Service.

Carna Feldtmann

BEnvSys *USYD.*,DipCLM (enrolled).
AMEIANZ, ECA (NSW), White Card.
Botanist/Ecologist.

Carna is a Graduate Environmental Scientist with a strong background in environmental systems, having graduated from the University of Sydney. With a particular interest in conservation, she is committed to contributing to the sustainable management of natural resources. She brings a range of skills, including fieldwork experience, enabling her to develop well informed strategies and recommendations. Her current research interests involve investigating how the fragmentation of natural habitats affects the distribution, abundance, and intersections of fauna and flora species, as well as the overall resilience of the ecosystem. Carna also has experience in management and monitoring of Koala populations.



Emily Barbaro

BA, MPublishing, Grad. Cert. EnvSc, MEScM (enrolled).
Junior Ecologist

Emily has completed a Graduate Certificate in Environmental Science and is currently enrolled in a Masters of Environmental Science and Management. Emily has worked as a Bush Regenerator and currently volunteers with Bushcare for Blue Mountains City Council. She is passionate about learning more about her local Blue Mountains flora and fauna.

Dr Stephanie Clark

B Sc (Hons), PhD

Stephanie has over 30 years experience in the collection, identification and taxonomy of marine, estuarine, freshwater and terrestrial molluscs. She has conducted numerous targeted surveys for endangered and threatened species (particularly land and freshwater molluscs) in both Australia and the United States. She is particularly interested in the systematics, taxonomy, morphology (external and internal), population and conservation genetics and conservation of molluscs particularly terrestrial (especially the Helicoidea) and freshwater (especially the Hydrobiidae and related families) groups.