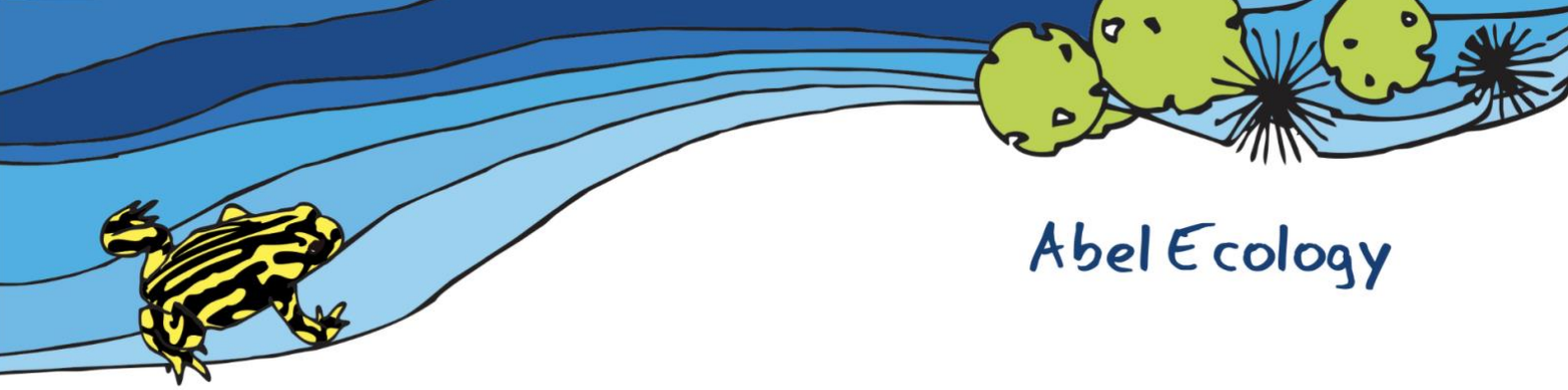

Arboricultural Impact Assessment (ARB)

for

3 Memory Avenue, Crookwell NSW 2583

Lot 2, DP 702788

Proposed Residential Subdivision & Childcare Centre

Prepared for:	Blue Sox Developments Pty Ltd
Report No:	AE24-2765-REP-ISS 2
Prepared by:	Abel Ecology
Date:	15 April 2025

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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	Andy Araya	Mark MacKinnon	Sue Simmons	Dropbox	04 April 2025
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List of Abbreviations

DBH	Diameter at breast height (~1.4 metres)
DAB	Diameter Above Buttress
SRZ	Structural Root Zone
TPZ	Tree Protection Zone
VTA	Visual Tree Assessment
LGA	Local Government Area
APZ	Asset Protection Zone
IPA	Inner Protection Area

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 owner.

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

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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.

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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.

STAG – A dead tree, that often remains standing as a large deadwood. Additionally, STAGS often form hollows and provide habitat for local fauna.

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.

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Executive Summary

Abel Ecology carried out a tree assessment survey at 3 Memory Ave. Crookwell NSW 2583 on behalf of Blue Sox Developments, to assess the likely impacts of 60 on trees on the site, and to address issues pertaining to tree protections.

The proposal is to subdivide the property into 19 residential house lots and one (1) daycare facility.

The property is approximately 2.1 ha and situated approximately 1.2 km north of the main village of Crookwell. The eastern half of the property is relatively flat and the western section slopes to the west. The vegetation on site is predominately exotic grasses and trees with small stands of remnant native trees, particularly at the southwestern area of the lot.

A desktop search identified two (2) Plant Community Types (PCT) near the property. These include PCT-3295 Crookwell-Taralga Basalt Grassy Forest and PCT-3366 Central Tableland Clay Apple Box Grassy Forest.

All but one (1) tree on the site are expected to be impacted by the development and are marked for removal. This is due to their position within the Lot and the anticipated impacts from the proposed development. Tree '2922' (*Fraxinus* sp.) is not expected to be impacted and is therefore recommended for retention. Tree protection measures are required to be established for this tree (Figure 6), before and during the development. Tree 2922 currently has no proposed impacts and is currently proposed for retention. Building envelopes have not been created, therefore, retention of this tree is subject to the final building footprint and civil works.

If trees on neighbouring properties are to be removed, express written permission for removal is required from the landowner. If permission is not obtained, tree protection measures and fencing must be implemented, and reconsideration of the proposed works, may be required.

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

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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 m high. Fences are to be held in place with secure footing (Figure 10).

d) Install trunk protection up to 2 m on trees to be retained that require protection. Using methods such as geofabric and timber battens. Where oversized or tall plant/machinery is to be used, the project arborist must be engaged to determine if canopy pruning, or protection is necessary.

e) Exclude all site activity from tree protection zones during demolition, construction and demobilisation phases (see 'Tree protection guidelines' in Appendix 4).

f) 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.

Root Management

a) Apply mulch 100-150 mm deep with a radius of at least 2 m, (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.

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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) An AQF3 Arborist must inspect the site following the installation of the TPZ fencing, trunk protection and placement of the mulch. The AQF3 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) A hollow clearance survey should be undertaken by an appropriately experienced ecologist prior to tree removal works. 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 high disturbance.

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) Advanced stock (>300 mm pot size) must not be planted within nominated tree protection areas so as to avoid disrupting the critical root zone of protected trees.

d) Use locally native species to replace removed 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.

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1. Introduction

1.1 Scope

A survey of the proposed development site at 3 Memory Ave. Crookwell, NSW ('the site – Figure 1) was undertaken on 18th and 22nd November 2024.

The main 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 on 60 trees on site (Appendix 1).

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

This report includes both a:

1. Preliminary Arboricultural Report (pre-DA); and

2. Arboricultural Impact Assessment (for DA)

Lachlan Shire Council's Tree Management Policy 2023 states that

- Council managed trees, their stems, roots and crown, shall always be protected from construction works, events, development and other activities, reducing where possible the negative impacts that threaten tree condition, health, safety and/or amenity.

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 1 of this report

AS 4970-2009 Section 2.3.4 Development design and review– Section 5 of this report

AS 4970-2009 Section 2.3.5 Arboricultural impact assessment – Sections 5 and 6; and Appendix 4, and Appendix 6 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.

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1.2 Information and Documentation Provided

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

1. Detail and Contour Survey

   Southern Cross Consulting Surveyors

   25/11/2022 Ref: 24884C

2. Markup Plan of Site

   No identifying information provided

3. Preliminary Engineering Advice

   Martens & Associates Pty Ltd

   22/01/2025 Ref: P2410601JC01V01

4. Concept Civil Engineering Plans

   Martins & Associates Pty Ltd

   20/03/2025 Drawing: PS01-D100 C

No further documentation was provided.

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2. Method

Tree assessments were undertaken by Abel Ecology on November 18th and 22nd, 2024.

Upper Lachlan Council DCP 4.2.1 defines a "tree" as being:

- one or more self-supporting trunks, any one of which has a circumference of 30 centimetres or more (at a height of 40 cm above existing ground level), or
- a height of 2.5 m or more, or a branch spread of more than 2.5 m.

Lachlan Shire Council, Tree Management Policy 2023 also defines a tree as:

- a long lived woody perennial plant with one or relatively few main stems with the potential to grow to a height greater than 3 m.

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, using a 5 m measuring pole for reference. Trees were marked using nails and numbered aluminium tags, which correspond with the tree identification numbers used in this report.

Thickets of hawthorn and prunus were present within the survey area of the property. Thickets of hawthorn and prunus were not accessible and considered as shrubs, therefore not assessed as part of this report. Both species are non-native and are considered insignificant in relation to the ecological value of the property.

The Tree Protection Zone (TPZ) of each tree was determined using the formula "TPZ = d.b.h. 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 1.

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.

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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.

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3. Site Survey

3.1 Site description

For the purpose of this report the site is defined as 3 Memory Ave, Crookwell, NSW (Figure 1).

The site is approximately 2.1 ha in size and the elevation is approximately 900 m above sea level.

The property lies to the north of the main township of Crookwell. It is bordered on three sides (north, east and south) by roadways and to the west by neighbouring residential properties. A single storey house, carport and shed are situated on the flat area, near the centre of the site. The eastern side of the site is relatively flat and slopes to the west from the centre of the property (Figure 2).

The Biodiversity Values map indicates that there are no mapped areas within the property boundaries (Figure 4).

The vegetation communities of the local area have been mapped as two (2) Plant Community Types (PCTs) near the property. These include PCT-3295 Crookwell-Taralga Basalt Grassy Forest and PCT-3366 Central Tableland Clay Apple Box Grassy Forest, by the NSW State Vegetation Type Map (SVTM) (Figure 5). These do not occur on the site.

3.2 The proposal

The proposal is to subdivide the property into 20 house lots and one (1) daycare centre off McIntosh Road in the south-west section of the site.

3.3 Site Plans

Figure 1. Locality map

Figure 2. Aerial photo

Figure 3. Proposal Diagram with Tree Numbers

Figure 4. NSW Government Biodiversity Values Map and Threshold Tool

Figure 5. NSW State Vegetation Type Map (STVM)

Figure 6. Tree Retention

Figure 7. Tree Removal

Figure 8. Stormwater/Drainage

Figure 9. Cut and Fill Plan

Figure 10. Extract from Section 3 of AS 4970-2009

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4. Observations

4.1 Assessed Trees

Data for the 60 trees assessed at the time of the survey is further outlined in Appendix 1.

All trees assessed are defined by Upper Lachlan Council as trees under 4.2.1 DCP 2010.

A tree is defined as a plant with:

- one or more self-supporting trunks, any one of which has a circumference of 30 cm or more (at a height of 40 cm above existing ground level), or
- a height of 2.5 m or more, or a branch spread of more than 2.5 m.

One (1) tree contains a hollow (Tree 2955). No other hollows were observed in the remaining trees on site. If the tree-containing hollow is removed, the hollow must be replaced at 3:1 to compensate for the loss of habitat.

Carateagus monogyny (Common hawthorn), regarded as a weed, is present on site as well as fruit trees (plum, apple) have established throughout the property.

The trees on site (Table 1) consist of Australian native species intermixed with exotic tree species (Hawthorn, Plum, Apple, Poplar, Pine, Ash and Cedar).

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

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Table 1. Tree species identified

Species name	Common name	Count
Acacia baileyana	Cootamundra Wattle	1
Crataegus monogyna	Common Hawthorn	3
Eucalyptus albens	White Box	1
Eucalyptus bridgesiana	Apple Box	1
Eucalyptus pauciflora	Snow Gum	17
Fraxinus spp.	Ash	6
Malus pumila	Apple	3
Pinus radiata	Monterey Pine	16
Populus spp.	Poplar	5
Prunus cerasifera	Cherry Plum	1
Prunus spp.	Plum	5
Thuja plicata	Western Red Cedar	1
	Total	60

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4.2 Health and Structure of Assessed Trees

The Tree number, Tree species, Vitality, Condition, Health and Structure for assessed trees are listed in Table 2.

Table 2. Vitality, Condition, Health and Structure of trees on site

Tree Number	*Species*	Vitality	Condition	Health	Structure
2916	*Eucalyptus pauciflora*	Semi-mature	Poor	Poor	Poor
2917	*Populus sp.*	Mature	Good	Good	Good
2918	*Acacia baileyana*	Mature	Good	Good	Good
2919	*Fraxinus sp.*	Mature	Fair	Fair	Fair
2920	*Fraxinus sp.*	Mature	Fair	Fair	Poor
2921	*Fraxinus sp.*	Mature	Good	Good	Good
2922	*Fraxinus sp.*	Mature	Good	Good	Good
2923	*Eucalyptus pauciflora*	Mature	Good	Good	Good
2924	*Populus sp.*	Semi-mature	Good	Good	Good
2925	*Populus sp.*	Mature	Good	Poor	Poor
2926	*Crataegus monogyna*	Mature	Good	Fair	Good
2927	*Populus sp.*	Semi-mature	Good	Good	Good
2928	*Pinus radiata*	Mature	Good	Good	Good
2929	*Prunus spp.*	Mature	Poor	Poor	Poor
2930	*Pinus radiata*	Mature	Good	Good	Fair
2931	*Pinus radiata*	Mature	Good	Good	Fair
2932	*Crataegus monogyna*	Mature	Good	Good	Good
2933	*Pinus radiata*	Mature	Good	Good	Good
2934	*Pinus radiata*	Mature	Good	Good	Good
2935	*Pinus radiata*	Mature	Good	Good	Good

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Tree Number	*Species*	Vitality	Condition	Health	Structure
2936	*Pinus radiata*	Mature	Good	Good	Good
2937	*Pinus radiata*	Dead	Dead	Dead	Dead
2938	*Pinus radiata*	Dead	Dead	Dead	Dead
2939	*Prunus spp.*	Mature	Good	Fair	Good
2940	*Malus pumila*	Mature	Good	Good	Good
2941	*Thuja plicata*	Mature	Good	Fair	Fair
2942	*Malus pumila*	Mature	Good	Good	Good
2943	*Eucalyptus bridgesiana*	Mature	Good	Good	Fair
2944	*Pinus radiata*	Mature	Good	Good	Good
2945	*Prunus sp.*	Mature	Good	Good	Good
2946	*Fraxinus sp.*	Mature	Good	Fair	Good
2947	*Crataegus monogyna*	Mature	Poor	Poor	Poor
2948	*Prunus sp.*	Mature	Good	Good	Good
2949	*Malus pumila*	Mature	Good	Good	Fair
2950	*Eucalyptus pauciflora*	Mature	Good	Fair	Fair
2951	*Eucalyptus pauciflora*	Mature	Good	Fair	Fair
2952	*Eucalyptus pauciflora*	Mature	Good	Fair	Fair
2953	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair
2954	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair
2955	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair
2956	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair
2957	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair
2958	*Eucalyptus pauciflora*	Mature	Poor	Poor	Fair

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Tree Number	*Species*	Vitality	Condition	Health	Structure
2959	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair
2960	*Prunus cerasifera*	Mature	Fair	Fair	Fair
2961	*Prunus sp.*	Mature	Good	Good	Good
2962	*Pinus radiata*	Mature	Good	Good	Good
2963	*Pinus radiata*	Mature	Good	Good	Good
2964	*Pinus radiata*	Mature	Good	Good	Good
2965	*Populus spp.*	Mature	Fair	Fair	Fair
2966	*Pinus radiata*	Mature	Good	Good	Good
2967	*Fraxinus sp.*	Mature	Fair	Fair	Fair
2968	*Eucalyptus pauciflora*	Mature	Good	Good	Good
2969	*Eucalyptus pauciflora*	Mature	Good	Good	Good
2970	*Eucalyptus pauciflora*	Semi-mature	Good	Good	Good
2971	*Eucalyptus pauciflora*	Mature	Good	Good	Good
2972	*Pinus radiata*	Mature	Good	Good	Good
2973	*Pinus radiata*	Mature	Good	Good	Good
2974	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair
2975	*Eucalyptus pauciflora*	Mature	Fair	Fair	Fair

Data and comments for individually assessed trees are recorded in Appendix 1.

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4.3 Trees to Retain/Remove

Assessed trees identified for retention are listed in Table 3 below:

Table 3. Trees to be retained/removed

Tree Number	*Species*	Retain/Remove
2916	*Eucalyptus albens*	Remove
2917	*Populus* sp.	Remove
2918	*Acacia baileyana*	Remove
2919	*Fraxinus* sp.	Remove
2920	*Fraxinus spp.*	Remove
2921	*Fraxinus spp.*	Remove
2922	*Fraxinus spp.*	Retain
2923	*Eucalyptus pauciflora*	Remove
2924	*Populus spp.*	Remove
2925	*Populus spp.*	Remove
2926	*Crataegus monogyna*	Remove
2927	*Populus spp.*	Remove
2928	*Pinus radiata*	Remove
2929	*Prunus spp.*	Remove
2930	*Pinus radiata*	Remove
2931	*Pinus radiata*	Remove
2932	*Crataegus monogyna*	Remove
2933	*Pinus radiata*	Remove
2934	*Pinus radiata*	Remove
2935	*Pinus radiata*	Remove

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Tree Number	*Species*	Retain/Remove
2936	*Pinus radiata*	Remove
2937	*Pinus radiata*	Remove
2938	*Pinus radiata*	Remove
2939	*Prunus spp.*	Remove
2940	*Malus pumila*	Remove
2941	*Thuja plicata*	Remove
2942	*Malus pumila*	Remove
2943	*Eucalyptus bridgesiana*	Remove
2944	*Pinus radiata*	Remove
2945	*Prunus spp.*	Remove
2946	*Fraxinus spp.*	Remove
2947	*Crataegus monogyna*	Remove
2948	*Prunus spp.*	Remove
2949	*Malus pumila*	Remove
2950	*Eucalyptus pauciflora*	Remove
2951	*Eucalyptus pauciflora*	Remove
2952	*Eucalyptus pauciflora*	Remove
2953	*Eucalyptus pauciflora*	Remove
2954	*Eucalyptus pauciflora*	Remove
2955	*Eucalyptus pauciflora*	Remove
2956	*Eucalyptus pauciflora*	Remove
2957	*Eucalyptus pauciflora*	Remove
2958	*Eucalyptus pauciflora*	Remove

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Tree Number	*Species*	Retain/Remove
2959	*Eucalyptus pauciflora*	Remove
2960	*Prunus cerasifera*	Remove
2961	*Prunus spp.*	Remove
2962	*Pinus radiata*	Remove
2963	*Pinus radiata*	Remove
2964	*Pinus radiata*	Remove
2965	*Populus spp.*	Remove
2966	*Pinus radiata*	Remove
2967	*Fraxinus spp.*	Remove
2968	*Eucalyptus pauciflora*	Remove
2969	*Eucalyptus pauciflora*	Remove
2970	*Eucalyptus pauciflora*	Remove
2971	*Eucalyptus pauciflora*	Remove
2972	*Pinus radiata*	Remove
2973	*Pinus radiata*	Remove
2974	*Eucalyptus pauciflora*	Remove
2975	*Eucalyptus pauciflora*	Remove

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5. Arboricultural impact assessment

5.1 Tree Retention

The proposal indicates that one (1) tree is to be retained due to the position in the landscape and distance from the proposed works. Tree Protection Fencing is to be erected prior to construction works. a project ecologist is to inspect and certify tree protection measures are compliant with Australian Standards. The minimum distance to erect fencing around this tree is 2.2 m. (Figure 6)

Tree 2922 currently has no proposed impacts and is currently proposed for retention. Building envelopes have not been created, therefore, retention of this tree is subject to the final building footprint and civil works.

5.2 Tree removal

The proposal indicates the removal of the following 59 trees due to their proximity to the development and associated earthworks. (Figure 7)

Trees that conflict with the plan and are to be considered for removal include:

2916, 2917, 2918, 2919, 2920, 2921, 2923, 2924, 2925, 2926, 2927, 2928, 2929, 2930, 2931, 2932, 2933, 2934, 2935, 2936, 2937, 2938, 2939, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 2948, 2949, 2950, 2951, 2952, 2953, 2954, 2955, 2956, 2957, 2958, 2959, 2960, 2961, 2962, 2963, 2964, 2965, 2966, 2967, 2968, 2969, 2970, 2971, 2972, 2973, 2974, 2975.

5.3 Services

All excavated trenching is to be routed outside the tree protection zone. Where this is not achievable under boring may be an acceptable method after consultation with an arborist.

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6. Discussion

The effect of development on the trees on site is substantial, and therefore all trees are considered for removal due to the impact of the construction on the SRZ and TPZ (greater than 10%) of the trees.

This report recommends all but one (1) tree (2922) to be considered for removal due to the major SRZ and TPZ conflicts with the proposed development. Tree 2922 currently has no proposed impacts and is proposed for retention. Building envelopes have not been created, therefore, retention of this tree is subject to the final building footprint and civil works.

Tree '2922' (*Fraxinus* sp.) is not expected to be impacted by the proposal and therefore, considered for retention. Tree protection measures are to be employed to ensure no damage is caused to the trees or root zones. The minimum distance to erect tree protection fencing around this tree is 2.2 m. (Refer Figure 10, Appendix 2 and Appendix 3). The establishment of generous protection areas and maintenance of stringent site controls are essential in preventing damage during construction. Landscaping must also accommodate existing roots and provide favourable conditions for normal root function.

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*).

In order to create an APZ consistent with the requirements of Inner Protection Area (IPA) conditions, tree canopy cover must be reduced to a maximum of 15% within the APZ (NSW RFS, 2006).

Roots grow opportunistically in response to favourable environments. A favourable environment is one that offers adequate supply of oxygen, water, mineral nutrients, physical support, and warmth (*Perry, 1982*). A large proportion of tree roots are likely to be found south of the tree, nearer to the watercourse.

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.

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.

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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 each 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*).

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*). 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*).

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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 m high. Fences are to be held in place with secure footing (Appendix 3).

d) Install trunk protection up to 2 m on trees to be retained and require protections. Using methods such as geofabric and timber battens. Where oversized or tall plant/machinery is to be used, the project arborist must be engaged to determine if canopy pruning or protection is necessary.

e) Exclude all site activity from tree protection zones during demolition, construction and demobilisation phases (see 'Tree protection guidelines' in Appendix 2).

f) 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.

Root Management

a) Apply mulch 100-150 mm deep with a radius of at least 2 m, (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.

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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) An AQF5 Arborist much inspect the site following the installation of the TPZ fencing, trunk protection and placement of the mulch. The AQF5 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) A hollow clearance survey should be undertaken by an appropriately experienced ecologist prior to tree removal works. 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 high disturbance.

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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) Advanced stock (>300 mm pot size) must not be planted within nominated tree protection areas so as to avoid disrupting the critical root zone of protected trees.

d) Use locally native species to replace removed 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 include:

Allocasuarina torulosa	*Eucalyptus amplifolia*	*Eucalyptus longifolia*
Allocasuarina littoralis	*Eucalyptus baueriana*	*Eucalyptus tereticornis*
Casuarina glauaca	*Eucalyptus fibrosa*	*Melaleuca styphelioides*

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9. Figures

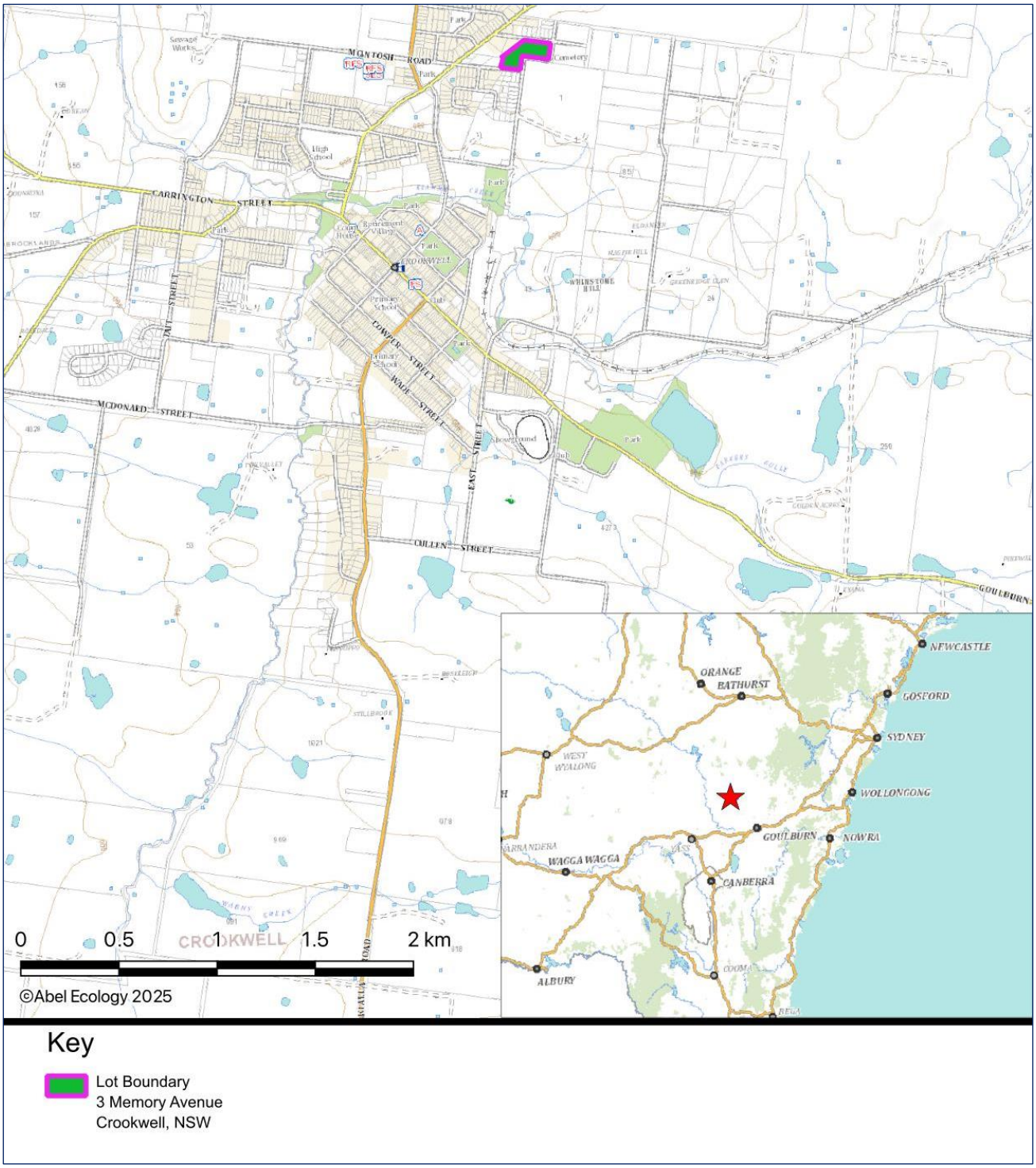

Figure 1. Locality map for 3 Memory Avenue, Crookwell.

Source: Land and property Information NSW. Spatial Information eXchange (SIX) website 2020.

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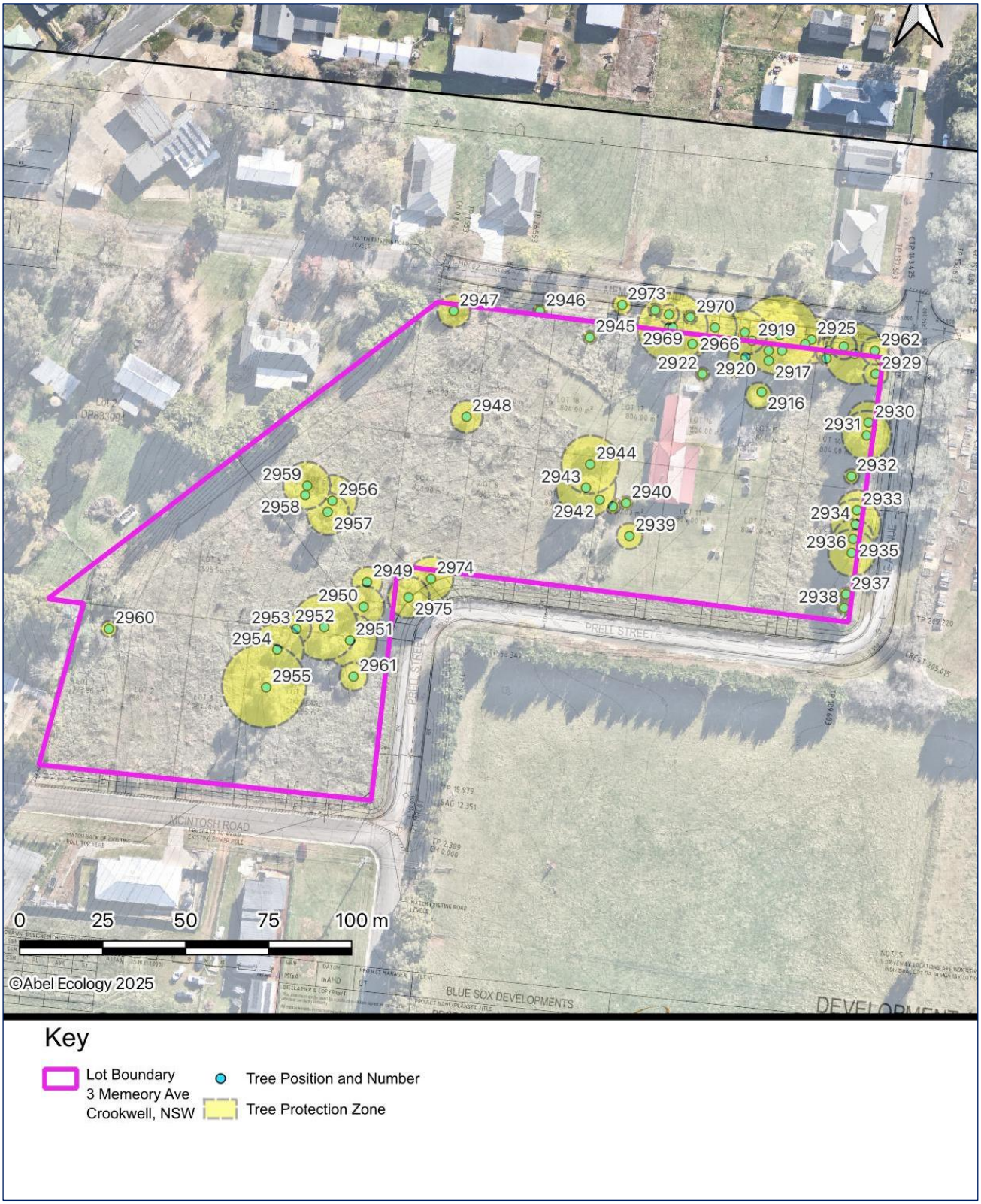

Figure 2. Aerial photograph of site (with numbered trees)

Source: Land and property Information NSW. Spatial Information eXchange (SIX) website 2020.

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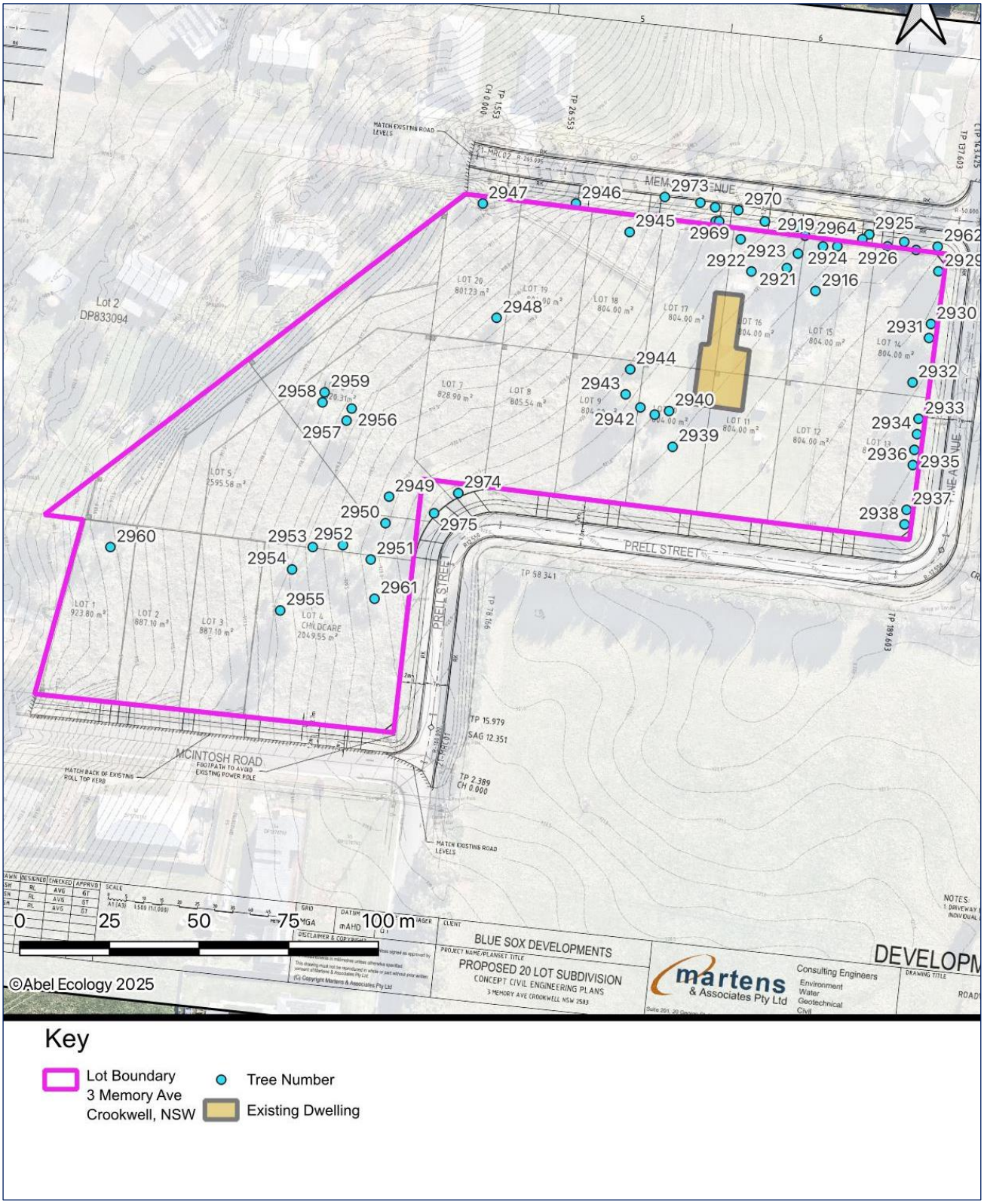

Figure 3. Proposal Diagram (with numbered trees)

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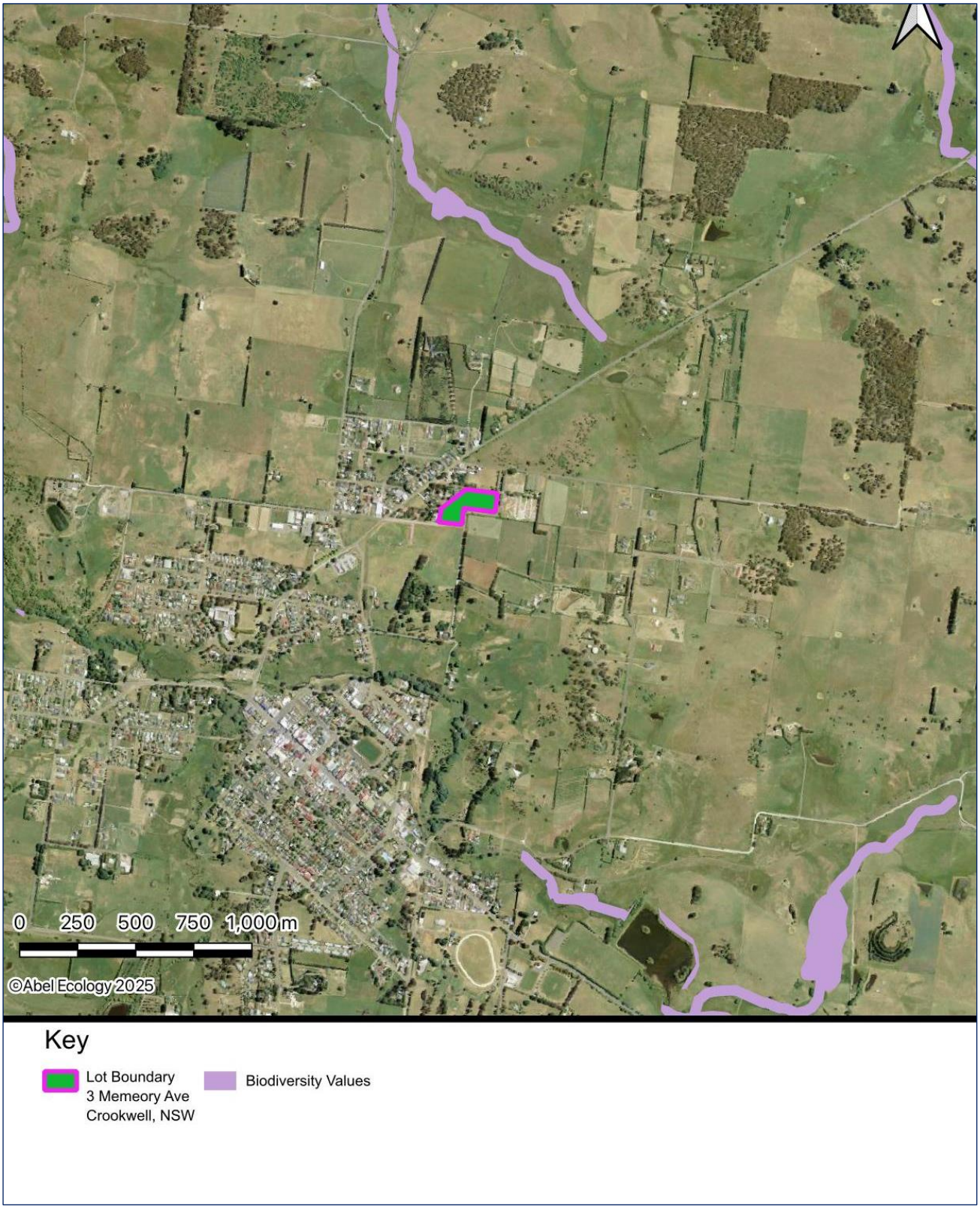

Figure 4. Biodiversity Values Map (SEED)

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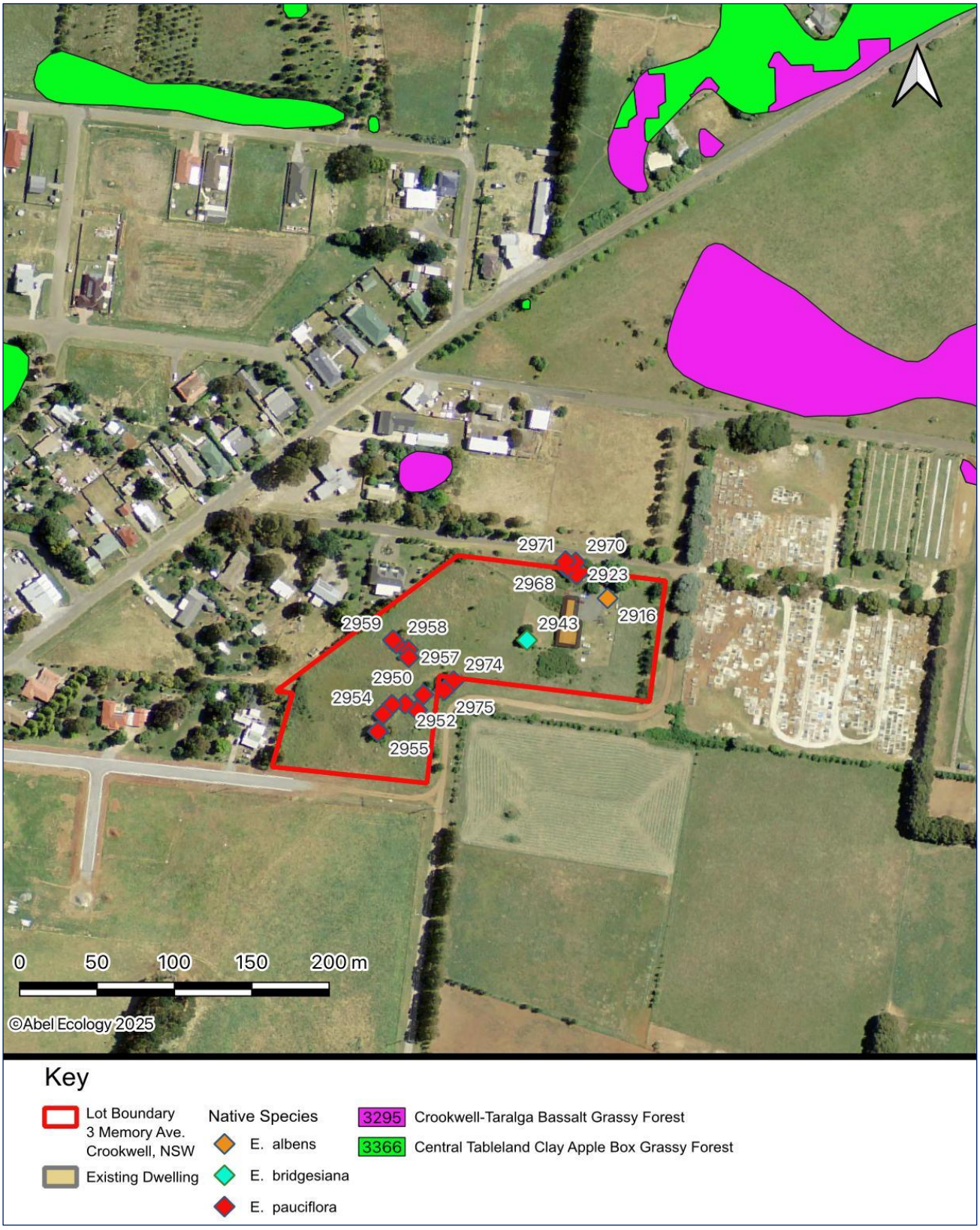

Figure 5. Plant Community Types (PCT) (SVTM, 2024)

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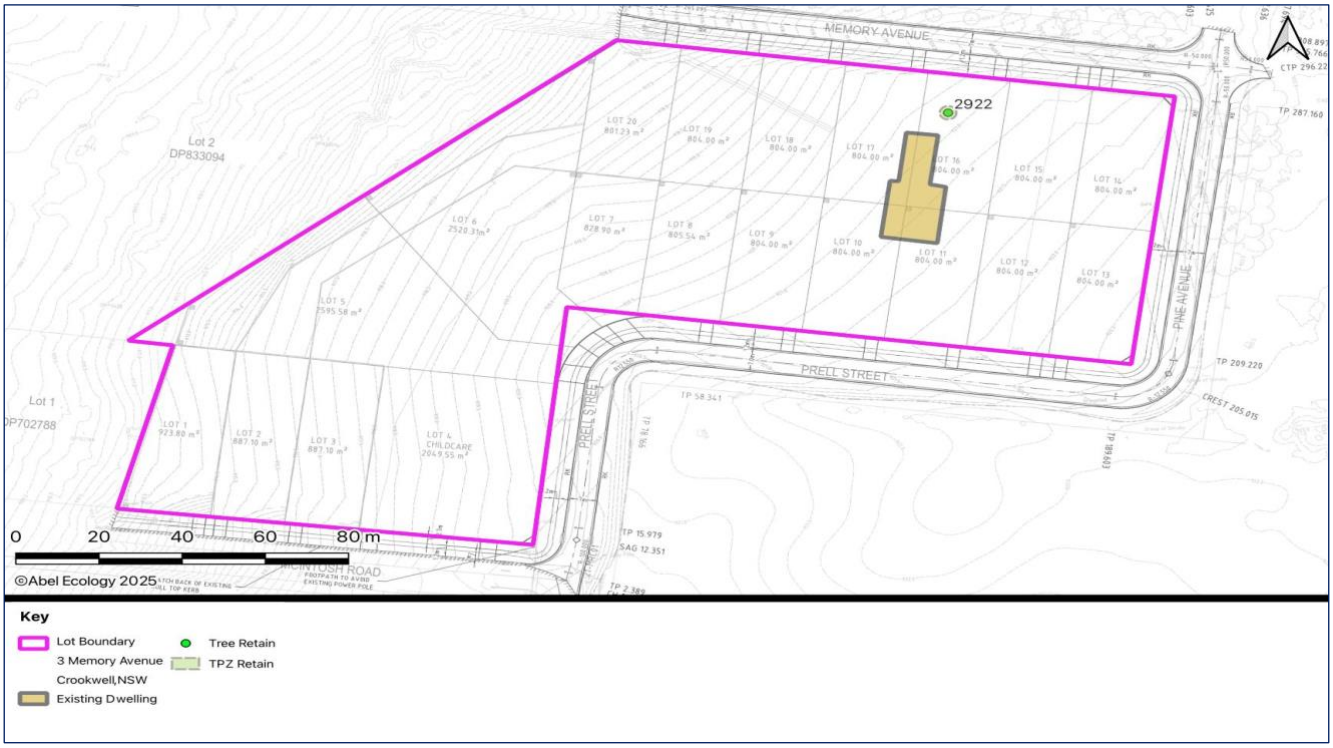

Figure 6. Tree Retention

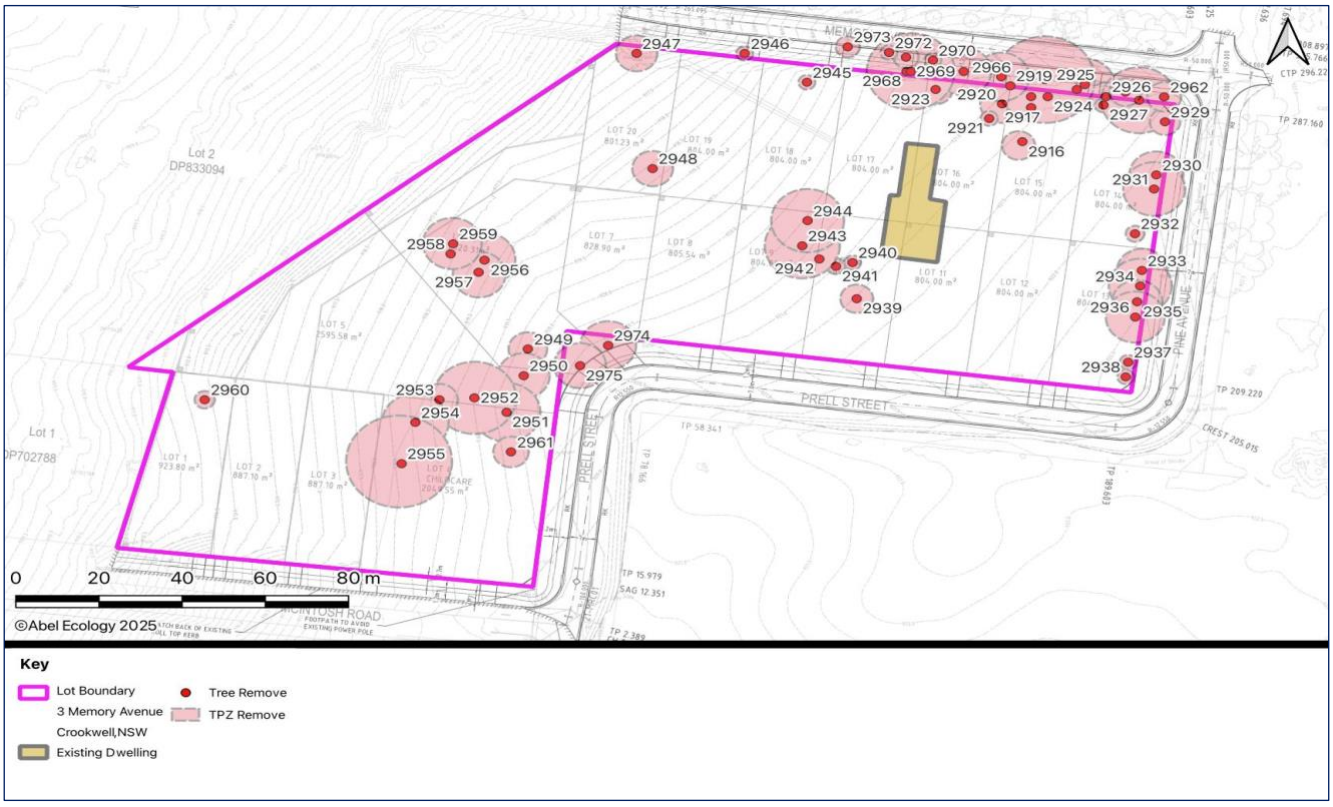

Figure 7. Tree Removal

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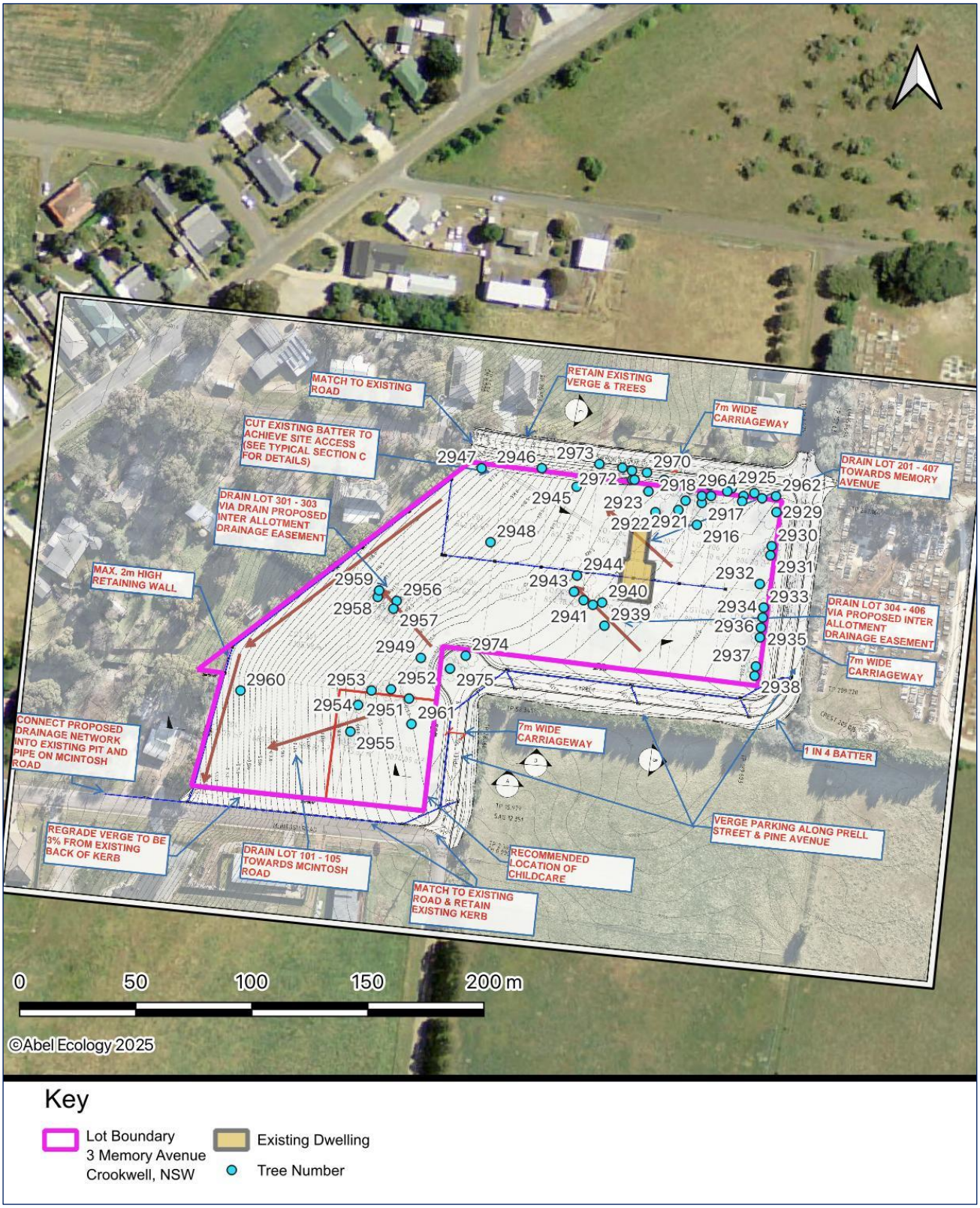

Figure 8. Stormwater/Drainage

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Figure 9. Cut and Fill Plan

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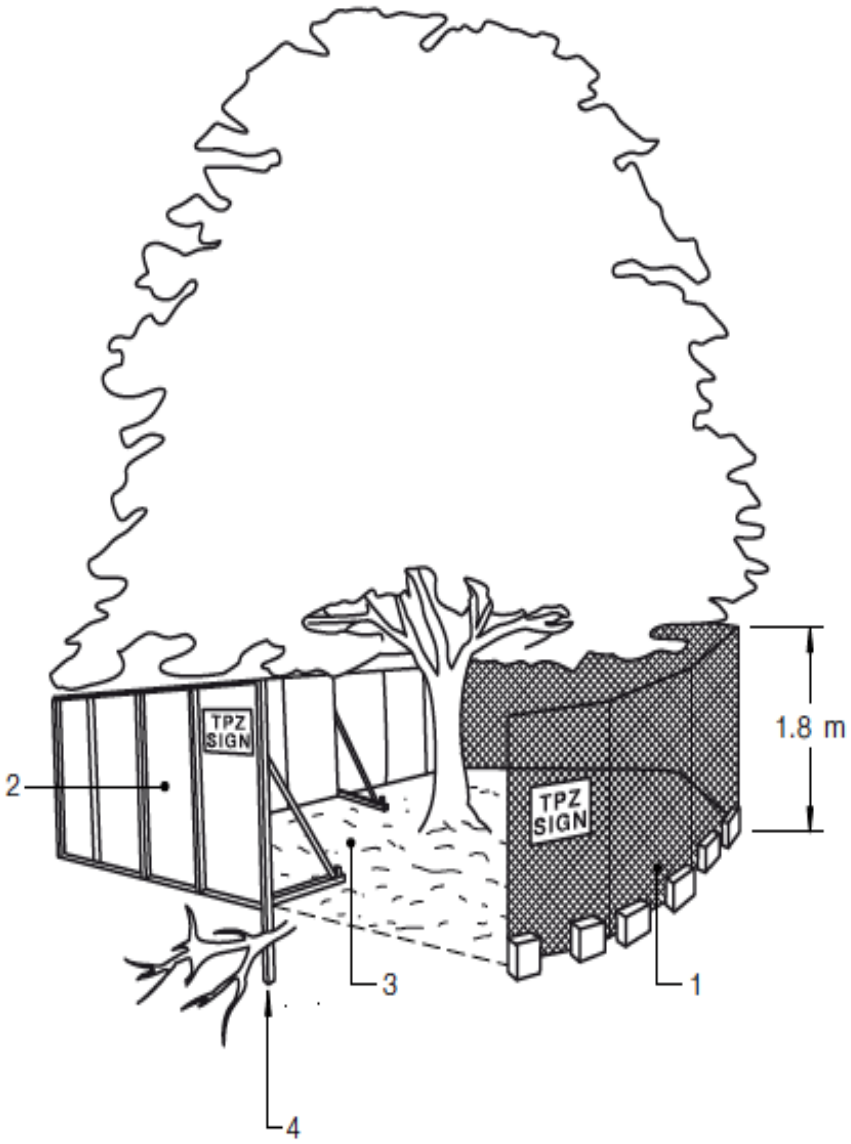

LEGEND:

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

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

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Appendix 1. Tree data table

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

Table 4. Tree Data and Comments

Tree No.	*Species*	DAB (cm)	DBH (cm)	TPZ (m)	SRZ (m)	Comments
2916	*Eucalyptus pauciflora*	48	27	3.96	2.43	Co dominant.
2917	*Populus sp.*	29	15	2.00	1.97	At driveway entrance to east. Coppicing from base. Discolourous leaf.
2918	*Acacia baileyana*	28	20	2.40	1.94	Glauca. Bipinnate leaf. Seed pod. Has lean to south 30deg. Behind gate. Surrounded by bushy shrub
2919	*Fraxinus sp.*	26	17	2.04	1.88	At letterbox on west side of drive.
2920	*Fraxinus sp.*	71	31	5.27	2.87	South of driveway near garage. Has yellow fungus on branches.
2921	*Fraxinus sp.*	28	17	2.04	1.94	7 m Southwest of 2920. Near corner of garage. Slight lean south.
2922	*Fraxinus sp.*	37	13	2.00	2.18	Opposite corner of garage.
2923	*Eucalyptus pauciflora*	47	34	4.08	2.41	Three trunks at 2.4 m. Much larger parent other side of fence. Smooth bark. On fence line centre of garage.
2924	*Populus sp.*	12	9	2.00	1.50	Has red leaf base. Blackberry next to on east side of fence. On fenceline 8m east of big glossy leaf.
2925	*Populus sp.*	70	52	7.18	2.85	On northern fence near gate. Large mature tree with another other side of fence. Has disease present, bark missing from trunk at base. Rot present on branches. Holly plant below.
2926	*Crataegus monogyna*	46	14	3.96	2.39	2 m inside fence. Coppiced from 60 cm.
2927	*Populus sp.*	18	9	2.00	1.61	6 m south of tree 2926.
2928	*Pinus radiata*	96	76	9.12	3.25	NE Corner of paddock.
2929	*Prunus sp.*	38	15	3.66	2.20	Between Pines 5 m off eastern fence. Coppiced from base.
2930	*Pinus radiata*	59	54	6.48	2.65	1 m off fence. 9 m north of gate.

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Tree No.	*Species*	DAB (cm)	DBH (cm)	TPZ (m)	SRZ (m)	Comments
2931	*Pinus radiata*	73	62	7.44	2.90	South of two trees. 5 m north of gate.
2932	*Crataegus monogyna*	38	10	2.22	2.20	3 m off fence. Coppice from base. 6 m south of gate. 4m north of Tree 2933 (Pine).
2933	*Pinus radiata*	59	50	6.00	2.65	2 m off fence.
2934	*Pinus radiata*	71	63	7.56	2.87	4 m south of Tree 2933
2935	*Pinus radiata*	58	50	6.00	2.63	4 m south of Tree 2934.
2936	*Pinus radiata*	63	59	7.08	2.73	4 m south of 2935. Two dead Pine trees on southeast corner of paddock. Also a small shrub.
2937	*Pinus radiata (Dead)*					Dead
2938	*Pinus radiata (Dead)*					Dead
2939	*Prunus sp.*	39	20	3.93	2.23	Multi stem from base. Has spikes. Yellow fungi on branches.
2940	*Malus pumila*	14	8	2.00	1.50	5m west of SW corner of house
2941	*Thuja plicata*	26	10	2.20	1.88	Multi stem from base. Flat leaf/branchlets.
2942	*Malus pumila*	13	10	2.00	1.50	Pear-like fruits. West of house 3m from 2941.
2943	*Eucalyptus bridgesiana*	96	63	9.02	3.25	Beside Pine tree in house yard. West of corner of house at fenceline.
2944	*Pinus radiata*	74	73	8.76	2.92	Opposite stairs of house to the west.
2945	*Prunus sp.*	18	10	2.00	1.61	
2946	*Fraxinus sp.*	18	11	2.00	1.61	At northern fenceline.
2947	*Crataegus monogyna*	100	20	4.97	3.31	Multi-stemmed from base. Very thick vegetation of same plant surrounding this parent. Some Cotoneaster also present. Unable to access thicket. Situated at corner of property next to private pole.
2948	*Prunus spp.*	55	19	4.88	2.57	Multi stem from base. Middle of paddock west of carport/house.
2949	*Malus pumila*	35	22	4.64	2.13	Multi stem from 20 cm. Four more recruits to the south of this parent tree. Old Eucalyptus 8 m south.

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Tree No.	*Species*	DAB (cm)	DBH (cm)	TPZ (m)	SRZ (m)	Comments
2950	*Eucalyptus pauciflora*	121	52	6.24	3.59	Large scar, Trunk damage from base to 2 m. Biased west. Small Apple shrubs around base from close parent tree, 2949.
2951	*Eucalyptus pauciflora*	92	55	8.12	3.20	Large north branch has failed and stuck at 1 m. Two mire trunks to east and west.
2952	*Eucalyptus pauciflora*	122	66	10.01	3.60	6 m west of 2951. Codominant trunk, south trunk failed and left a stump. North trunk doing well. Hollow present at 4 m. Split in western branch. Leading trunk has failed but has a hollow.
2953	*Eucalyptus pauciflora*	39	25	4.42	2.23	Small barks present scar at 2 m on south branch, 1.4 m on western side.
2954	*Eucalyptus pauciflora*	85	51	8.00	3.09	Codominant trunk. Northeast branch has failed and present on ground. Bark scar at base to 1.5 m on north side. Epicormic growth on trunk. No hollows sighted.
2955	*Eucalyptus pauciflora*	156	82	12.74	3.99	Strips of bark present from 4 m to base. Lower branch spreads north to 5 m. Trunk damage has formed new trunks. Possibly two hollows.
2956	*Eucalyptus pauciflora*	69	57	7.47	2.83	Lead trunk has failed. Possible hollow. Much dead wood. Mirabilis (?) surrounding base.
2957	*Eucalyptus pauciflora*	86	22	6.34	3.11	Privet and Hawthorn around it. Trunk split and rotted, new growth from eastern edge.
2958	*Eucalyptus pauciflora*	50	21	3.62	2.47	Tree has fallen over then grown vertical
2959	*Eucalyptus pauciflora*	77	59	7.08	2.97	Bark scar. Possible Echidna den at base - Echidna seen nearby.
2960	*Prunus cerasifera*	23	14	2.41	1.79	Red foliage. Bark scars on trunk.
2961	*Prunus sp.*	60	22	4.25	2.67	Many trunks
2962	*Pinus radiata*	45	34	4.08	2.37	
2963	*Pinus radiata*	41	32	3.84	2.28	
2964	*Pinus radiata*	27	16	2	1.91	
2965	*Populus sp.*	103	100	12	3.35	

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Tree No.	*Species*	DAB (cm)	DBH (cm)	TPZ (m)	SRZ (m)	Comments
2966	*Pinus radiata*	69	56	6.72	2.83	
2967	*Fraxinus sp.*	101	30	6.63	3.32	
2968	*Eucalyptus pauciflora*	57	40	4.8	2.61	
2969	*Eucalyptus pauciflora*	106	69	10.59	3.39	
2970	*Eucalyptus pauciflora*	17	11	2	1.57	
2971	*Eucalyptus pauciflora*	39	25	3	2.23	
2972	*Pinus radiata*	17	12	2	1.57	
2973	*Pinus radiata*	32	24	2.88	2.05	
2974	*Eucalyptus pauciflora*	65	56	6.72	2.76	
2975	*Eucalyptus pauciflora*	60	52	6.24	2.67	

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Table 5. Tree Canopy and Height Data

Tree No.	*Species*	Canopy Spread (m)				Tree Height Estimate (m)
		North	South	East	West	
2916	*Eucalyptus pauciflora*	2	2	2	2	7
2917	*Populus sp. (?)*	0	6	5	3	6
2918	*Acacia baileyana*	4	7	2	4	6
2919	*Fraxinus sp. (A)*	2	4	2	3	7
2920	*Fraxinus sp. (B)*	5	5	3	5	8
2921	*Fraxinus sp. (A)*	2	4	2	2	6
2922	*Fraxinus sp. (A)*	2	2	2	2	5
2923	*Eucalyptus pauciflora*	2	4	3	3	8
2924	*Populus sp. (?)*	2	2	2	2	4
2925	*Populus sp. (?)*	7	9	7	5	11
2926	*Crataegus monogyna*	4	4	4	4	7
2927	*Populus sp. (?)*	2	2	2	2	4
2928	*Pinus radiata*	8	8	8	8	14
2929	*Prunus sp.*	1	4	2	4	6
2930	*Pinus radiata*	4	4	4	4	9
2931	*Pinus radiata*	4	4	4	4	14
2932	*Crataegus monogyna*	2	2	2	2	5
2933	*Pinus radiata*	5	4	4	4	13
2934	*Pinus radiata*	4	4	4	4	14
2935	*Pinus radiata*	4	4	4	4	14
2936	*Pinus radiata*	4	4	4	4	13
2937	*Pinus radiata (Dead)*					
2938	*Pinus radiata (Dead)*					
2939	*Prunus sp.*	4	4	4	4	6
2940	*Malus pumila*	2	2	2	2	5
2941	*Thuja plicata*	3	2	2	2	4

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Tree No.	*Species*	Canopy Spread (m)				Tree Height Estimate (m)
		North	South	East	West	
2942	*Malus pumila*	3	4	3	3	6
2943	*Eucalyptus bridgesiana*	4	5	6	6	14
2944	*Pinus radiata*	4	4	4	4	14
2945	*Prunus sp.*	2	2	2	2	5
2946	*Fraxinus sp. (A)*	2	2	2	2	6
2947	*Crataegus monogyna*	4	4	4	4	5
2948	*Prunus sp.*	3	3	3	3	6
2949	*Malus pumila*	4	4	4	4	6
2950	*Eucalyptus pauciflora*	4	2	1	4	6
2951	*Eucalyptus pauciflora*	3	6	5	3	7
2952	*Eucalyptus pauciflora*	6	4	5	5	9
2953	*Eucalyptus pauciflora*	4	4	4	4	8
2954	*Eucalyptus pauciflora*	4	3	3	3	7
2955	*Eucalyptus pauciflora*	7	4	6	6	11
2956	*Eucalyptus pauciflora*	5	4	4	3	7
2957	*Eucalyptus pauciflora*	3	5	5	3	7
2958	*Eucalyptus pauciflora*	3	4	4	3	6
2959	*Eucalyptus pauciflora*	5	2	2	4	7
2960	*Prunus cerasifera*	2	2	2	2	5
2961	*Prunus sp.*	3	3	3	3	5
2962	*Pinus radiata*	2.5	2.5	2.5	2.5	7
2963	*Pinus radiata*	2.5	2.5	2.5	2.5	7
2964	*Pinus radiata*	2.5	2.5	2.5	2.5	6
2965	*Populus sp. (?)*	9	9	9	9	12
2966	*Pinus radiata*	5	5	5	5	12
2967	*Fraxinus sp. (A)*	5	5	5	3	7
2968	*Eucalyptus pauciflora*	3	2	0	5	6
2969	*Eucalyptus pauciflora*	5	5	5	5	6
2970	*Eucalyptus pauciflora*	2	2	2	2	5

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Tree No.	*Species*	Canopy Spread (m)				Tree Height Estimate (m)
		North	South	East	West	
2971	*Eucalyptus pauciflora*	3	2	2	2	5
2972	*Pinus radiata*	1	1	1	1	5
2973	*Pinus radiata*	2	2	2	2	6
2974	*Eucalyptus pauciflora*	5	5	0	6	7
2975	*Eucalyptus pauciflora*	4	4	1	5	7

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Table 6. Tree Health and Retention Values

Tree No.	*Species*	Live Crown	Age Class	Vitality	Condition	Health	Structure
2916	*Eucalyptus pauciflora*	28	Semi-mature	Poor	Poor	Poor	Poor
2917	*Populus sp. (?)*	42	Mature	Good	Good	Good	Fair
2918	*Acacia baileyana*	51	Mature	Good	Good	Good	Fair
2919	*Fraxinus sp. (A)*	39	Mature	Fair	Fair	Fair	Fair
2920	*Fraxinus sp. (B)*	72	Mature	Fair	Fair	Poor	Fair
2921	*Fraxinus sp. (A)*	30	Mature	Good	Good	Good	Fair
2922	*Fraxinus sp. (A)*	20	Mature	Good	Good	Good	Fair
2923	*Eucalyptus pauciflora*	48	Mature	Good	Good	Good	Good
2924	*Populus sp. (?)*	16	Semi-mature	Good	Good	Good	Fair
2925	*Populus sp. (?)*	154	Mature	Good	Poor	Poor	Fair
2926	*Crataegus monogyna*	56	Mature	Good	Fair	Good	Fair
2927	*Populus sp. (?)*	16	Semi-mature	Good	Good	Good	Good
2928	*Pinus radiata*	224	Mature	Good	Good	Good	Good
2929	*Prunus sp.*	33	Mature	Poor	Poor	Poor	Poor
2930	*Pinus radiata*	72	Mature	Good	Good	Fair	Good
2931	*Pinus radiata*	112	Mature	Good	Good	Fair	Good
2932	*Crataegus monogyna*	20	Mature	Good	Good	Good	Fair
2933	*Pinus radiata*	111	Mature	Good	Good	Good	Good
2934	*Pinus radiata*	112	Mature	Good	Good	Good	Good
2935	*Pinus radiata*	112	Mature	Good	Good	Good	Good
2936	*Pinus radiata*	104	Mature	Good	Good	Good	Good
2937	*Pinus radiata (Dead)*	0	Dead				
2938	*Pinus radiata (Dead)*	0	Dead				
2939	*Prunus sp.*	48	Mature	Good	Fair	Good	Fair
2940	*Malus pumila*	20	Mature	Good	Good	Good	Fair
2941	*Thuja plicata*	18	Mature	Good	Fair	Fair	Fair
2942	*Malus pumila*	39	Mature	Good	Good	Good	Good
2943	*Eucalyptus bridgesiana*	147	Mature	Good	Good	Fair	Fair
2944	*Pinus radiata*	112	Mature	Good	Good	Good	Good
2945	*Prunus sp.*	20	Mature	Good	Good	Good	Good

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Tree No.	*Species*	Live Crown	Age Class	Vitality	Condition	Health	Structure
2946	*Fraxinus sp. (A)*	24	Mature	Good	Fair	Good	Fair
2947	*Crataegus monogyna*	40	Mature	Poor	Poor	Poor	Poor
2948	*Prunus sp.*	36	Mature	Good	Good	Good	Good
2949	*Malus pumila*	48	Mature	Good	Good	Fair	Fair
2950	*Eucalyptus pauciflora*	33	Mature	Good	Fair	Fair	Fair
2951	*Eucalyptus pauciflora*	60	Mature	Good	Fair	Fair	Fair
2952	*Eucalyptus pauciflora*	90	Mature	Good	Fair	Fair	Poor
2953	*Eucalyptus pauciflora*	64	Mature	Fair	Fair	Fair	Fair
2954	*Eucalyptus pauciflora*	46	Mature	Fair	Fair	Fair	Fair
2955	*Eucalyptus pauciflora*	127	Mature	Fair	Fair	Fair	Fair
2956	*Eucalyptus pauciflora*	56	Mature	Fair	Fair	Fair	Poor
2957	*Eucalyptus pauciflora*	56	Mature	Fair	Fair	Fair	Poor
2958	*Eucalyptus pauciflora*	42	Mature	Poor	Poor	Fair	Poor
2959	*Eucalyptus pauciflora*	46	Mature	Fair	Fair	Fair	Poor
2960	*Prunus cerasifera*	20	Mature	Fair	Fair	Fair	Fair
2961	*Prunus sp.*	30	Mature	Good	Good	Good	Good
2962	*Pinus radiata*	35	Mature	Good	Good	Good	Good
2963	*Pinus radiata*	35	Mature	Good	Good	Good	Good
2964	*Pinus radiata*	30	Mature	Good	Good	Good	Good
2965	*Populus sp. (?)*	216	Mature	Fair	Fair	Fair	Fair
2966	*Pinus radiata*	120	Mature	Good	Good	Good	Good
2967	*Fraxinus sp. (A)*	63	Mature	Fair	Fair	Fair	Fair
2968	*Eucalyptus pauciflora*	30	Mature	Good	Good	Good	Fair
2969	*Eucalyptus pauciflora*	60	Mature	Good	Good	Good	Good
2970	*Eucalyptus pauciflora*	20	Semi-mature	Good	Good	Good	Good
2971	*Eucalyptus pauciflora*	23	Mature	Good	Good	Good	Good
2972	*Pinus radiata*	10	Mature	Good	Good	Good	Good
2973	*Pinus radiata*	24	Mature	Good	Good	Good	Good
2974	*Eucalyptus pauciflora*	56	Mature	Fair	Fair	Fair	Poor
2975	*Eucalyptus pauciflora*	49	Mature	Fair	Fair	Fair	Fair

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Appendix 2. 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.

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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. Under bore if no suitable alternative location is possible. All works within the TPZ are to be supervised by an arborist.

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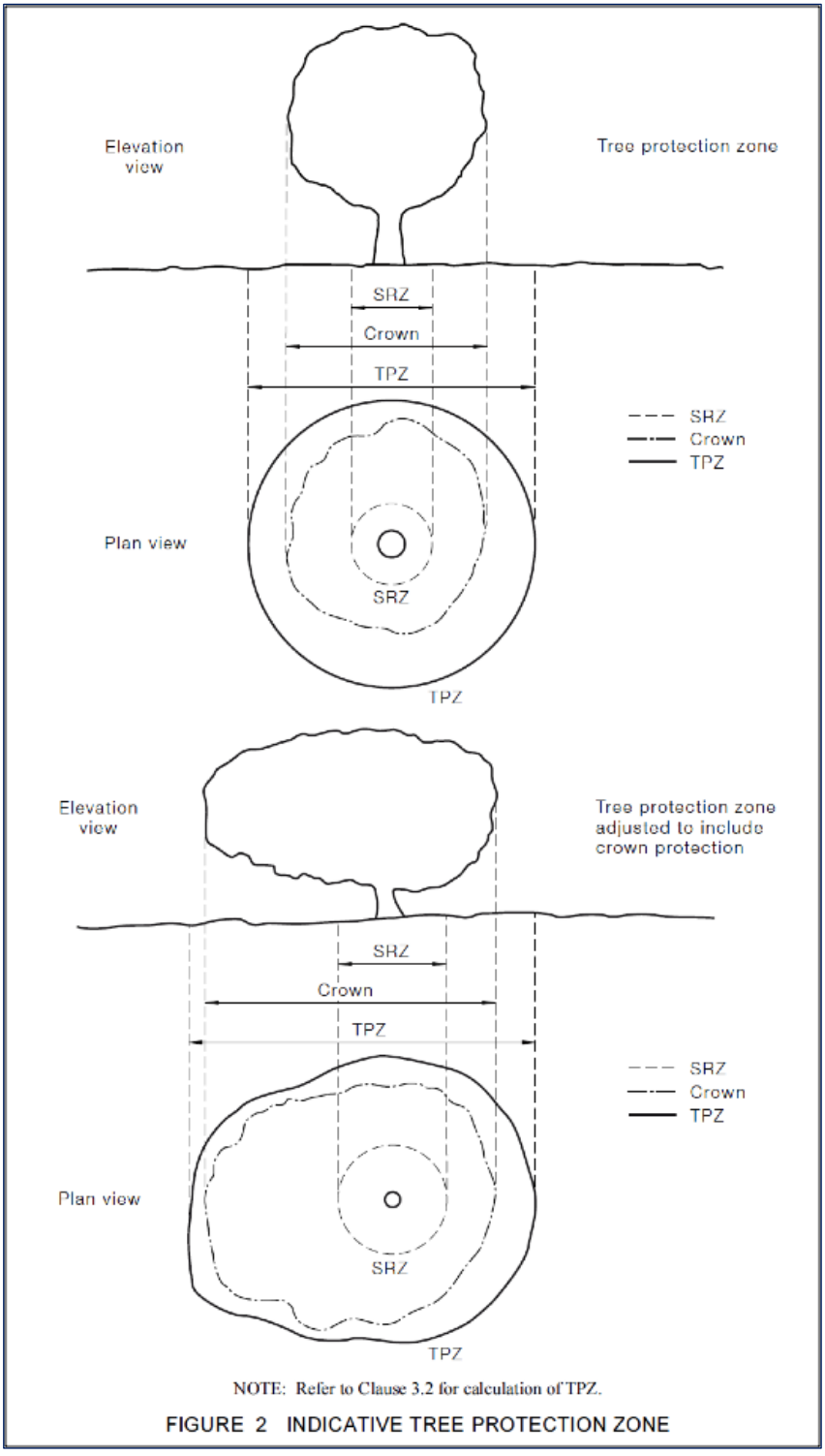
Appendix 3. Tree protection zone and structural root zone

Extract from Section 3 of AS 4970-2009



NOTE: Refer to Clause 3.2 for calculation of TPZ.

FIGURE 2 INDICATIVE TREE PROTECTION ZONE

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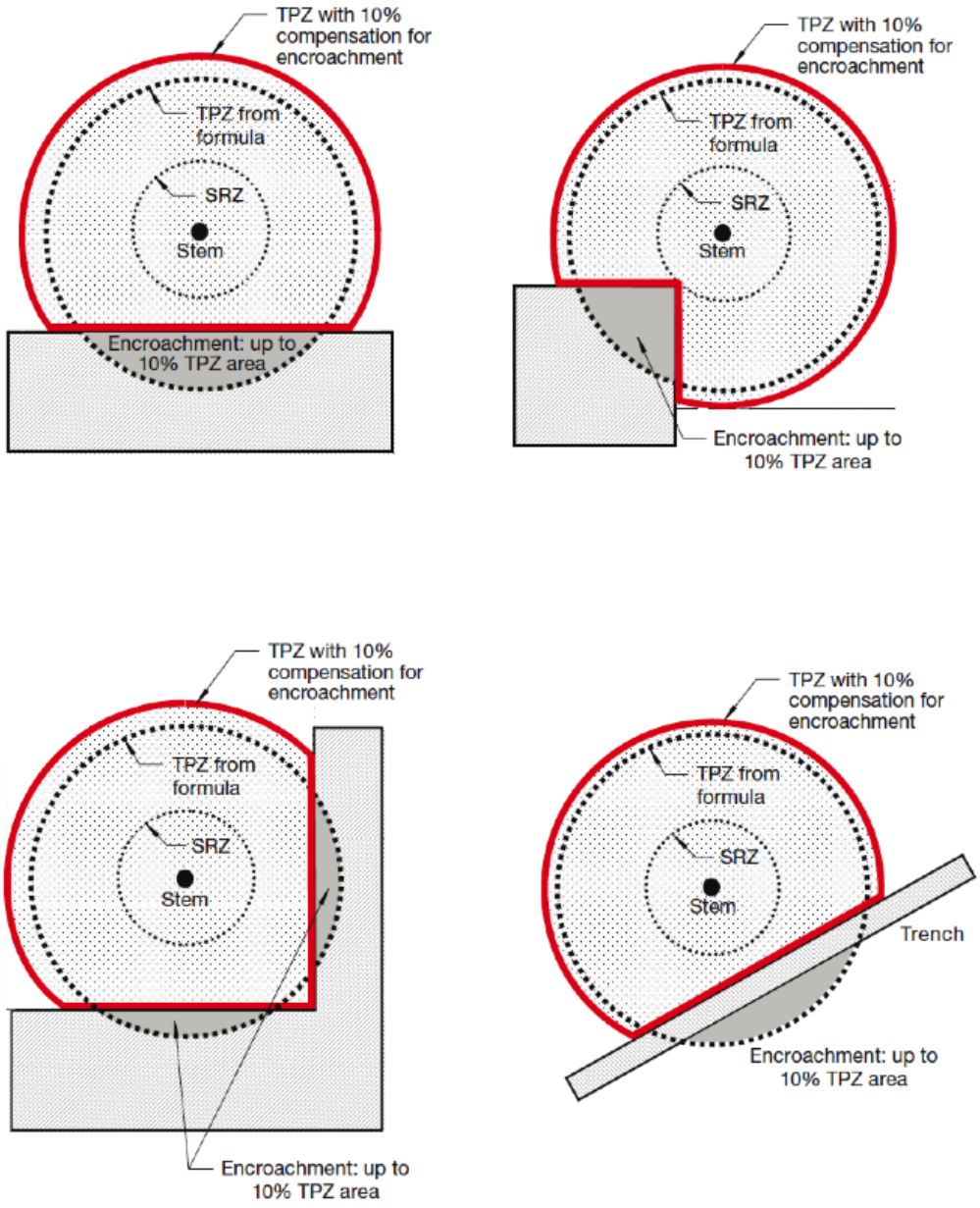
Appendix 4. Encroachment into tree protection zones

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

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Appendix 5. 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

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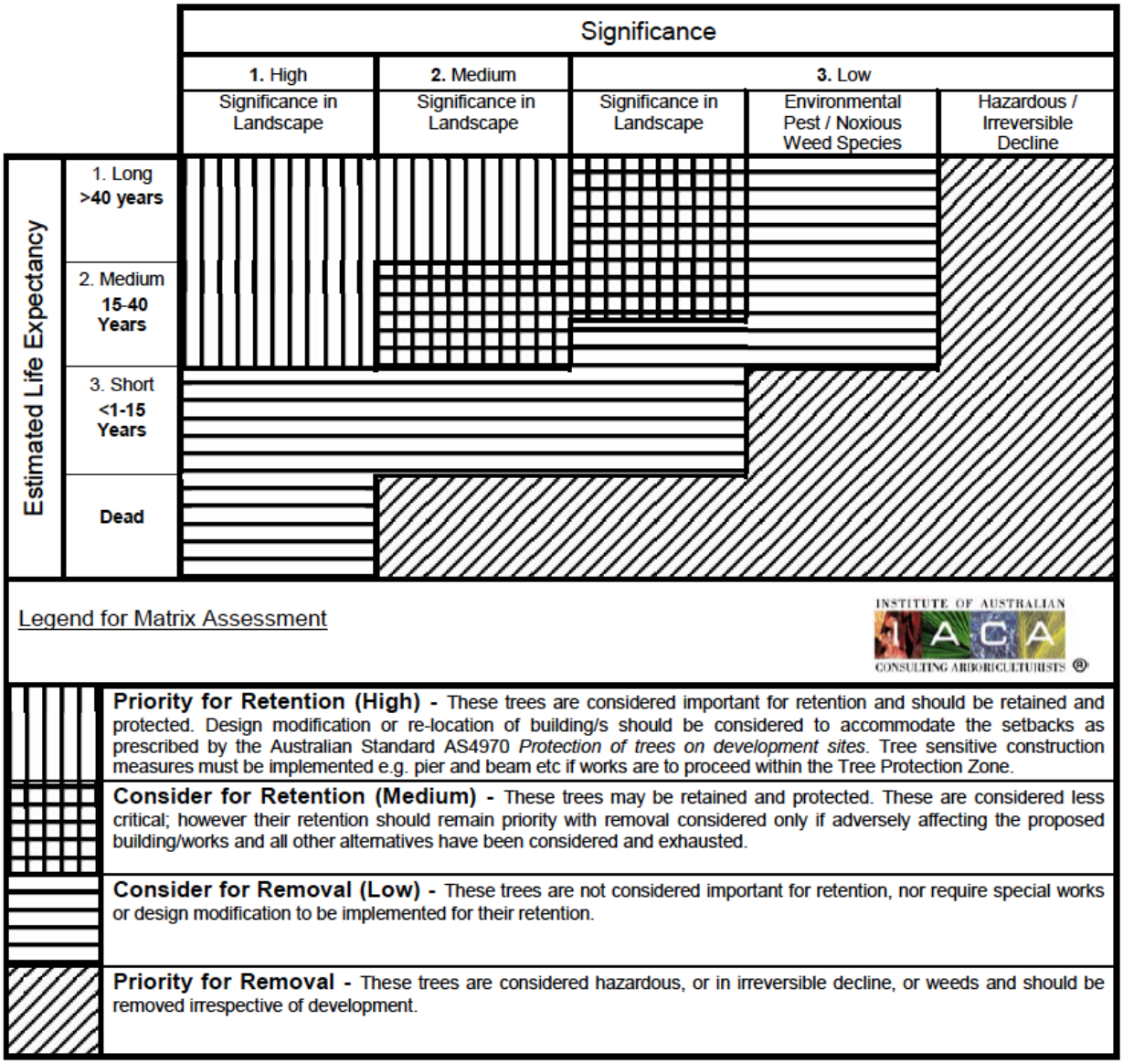
Table 1.0 Tree Retention Value - Priority Matrix.



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

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Appendix 6. 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 seven scientists and four administrative staff, plus casual assistants as required.

Licences

NPWS s132C Scientific licence number is SL100780

NPWS GIS data licence number is CON95034

NSW Dept of Primary Industries Secretary's Animal Care and Ethics Committee Approval: 18/575

NSW Dept of Primary Industries Animal Research Authority. Accreditation No: 84207

The Consultancy team

Dr Danny Wotherspoon

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

Danny has practiced 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.

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Mark Mackinnon

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

Mark is a passionate and enthusiastic scientist who thrives in the field of natural resource management. He has experience in threatened species, fire ecology, bushfire management, pest plant and animals, and landscape restoration. In particular he specialises in ornithology and bushfire management. Mark has several 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 licence with mist-net endorsement. Mark is also skilled in GIS mapping, first-aid and 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 practiced 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.

Nicholas 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.

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Andy Araya

Botanist / Ecologist
B Env. Sci. MTeach (Env., Marine, Agr., Bio., Chem.), Dip. Marine Operations
First Aid Cert. White Card. ACDC Chemical Licence, NSW Boating Licence, Marine Radio Licence, Security Licence, Chainsaw Licence.

Andy has over 15 year's experience as a bush regeneration supervisor working across a number of environments throughout NSW and QLD from EEC of the Cumberland Plain, riparian and wetland areas, sand dunes and rainforests, to the higher elevations of the Blue Mountains National Park. Managing teams of up to 10 staff in remote areas as well as urban environments has allowed Andy to hone his skills of communication and native species identification. Andy's additional experience as a builder in the building and construction industry gives him a solid understanding of the considerations and legal requirements clients face in mitigating environmental and personal harm.

Emily Barbaro

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

Emily has completed a Graduate Certificate in Environmental Science and is a Masters of Environmental Science and Management. Emily has previously worked as a Bush Regenerator and has been volunteering with Bushcare for Blue Mountains City Council for the last three years. She is passionate about learning more about her local Blue Mountains flora and fauna.

Erin Parker

B Biodiversity and Conservation, Macquarie University.
Ecologist

Erin has completed a Bachelor of Biodiversity and Conservation at Macquarie University. Erin has previously worked as a bush regeneration team member while completing her degree. There she was able to develop plant ID skills and understanding of the procedures of weed management and restoration. Erin has also taken part in a casual position assisting with threatened species surveys in the Central West of NSW. This involved various tasks including tree hollow surveys for Glossy Black Cockatoos, preparation for reptile surveys, spotlighting, harp trapping surveys of microbats, and Koala SAT plot surveys. Erin is passionate about furthering her knowledge on native Australian flora and fauna, their ecology and impacts.

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Callista Harris

BPlan (Hons).
Technical Officer

White Card, Apply First Aid, Work Safely at Heights, Maintain and Operate Chainsaws, Operate Elevating Work Platform (scissor lift), High Risk Work Licence - Boom-Type Elevating Work Platform (WP) (over 11 metres), Venomous snake handling certificate, Damage Mitigation Permit for Removal and relocation of protected animals, Operate and maintain 4WD.

Callista has 9 years' experience as an urban planner. She has a strong knowledge of NSW environmental legislation and has secured approvals for a wide range of developments, including housing developments, industrial developments, solar farms, and infrastructure. She has recently changed careers and has gained valuable on the ground experience working as a fauna spotter catcher, ecologist, and botanist on various projects.

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.

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