



Arboricultural Impact Assessment Report Revision A

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1. INTRODUCTION

- 1.1 Hugh the Arborist have been instructed by Peter Princi Architecture on behalf of the client Sydney Water to provide an Arboricultural Impact Assessment Report for trees located on and adjoining the site in relation to a proposed development.
- 1.2 Below is a list of all documents and information provided to by the client to assist with preparing this report.

Table 1: Documents provided for the assessment

Title	Author	Date	Reference on document
Architectural Plans and Section	RJK Architects	3/9/2022	2216_ DA02, DA08, DA90
Survey Plan	S. Davey and Associates	July 2019	SJD/020719/A

- 1.3 The site and tree inspection was carried out on 12th July 2019. Access was available to the subject site and adjoining public areas only. The site and trees were reviewed for the purpose of this revision on 12th October 2022.

2. SCOPE OF THE REPORT

- 2.1 This report has been undertaken to meet the following objectives.
 - 2.1.1 Conduct a visual assessment from ground level of all significant trees within 5 metres of proposed development works. For the purpose of this report, a significant tree is a tree with a height equal to or greater than 5 metres.
 - 2.1.2 Determine the trees estimated contribution years and remaining, useful life expectancy and award the trees a retention value.
 - 2.1.3 Provide an assessment of the potential impact the proposed development is likely to cause to the condition of the subject trees in accordance with AS4970 Protection of trees on development sites (2009).
 - 2.1.4 This impact assessment is based on a concept architectural design only.
 - 2.1.5 Provide pragmatic recommendations for the management of trees and mitigation of construction impacts on retained trees.
- 2.2 Specify tree protection measures for trees to be retained in accordance with AS 4970-2009.

3. LIMITATIONS

- 3.1 The observations and recommendations are based on the site inspections identified in section 1 only. The findings of this report are based on the observations and site conditions at the time of inspection.
- 3.2 All of the observations were carried out from ground level. The accuracy of the assessment of the subject trees structural condition and health is limited to the visibility of the tree at the time of inspection.
- 3.3 The tree inspections were visual from ground level only. No soil or tissue testing was carried out as part of the tree inspection. None of the surrounding surfaces adjacent to trees were lifted or removed during the tree inspections.
- 3.4 Root decay can sometimes be present with no visual indication above ground. It is also impossible to know the extent of any root damage caused by mechanical damage such as underground root cutting during the installation of services without undertaking detailed root investigation. Any form of tree failure due to these activities is beyond the scope of this assessment.
- 3.5 The report reflects the subject tree(s) as found on the day of inspection. Any changes to the growing environment of the subject tree, or tree management works beyond those recommended in this report may alter the findings of the report. There is no warranty, expressed or implied, that problems or deficiencies relating to the subject tree, or subject site may not arise in the future.
- 3.6 Tree identification is based on accessible visual characteristics at the time of inspection. As key identifying features are not always available the accuracy of identification is not guaranteed. Where tree species is unknown, it is indicated with a spp.
- 3.7 All diagrams, plans and photographs included in this report are visual aids only, and are not to scale unless otherwise indicated.
- 3.8 Hugh The Arborist neither guarantees, nor is responsible for, the accuracy of information provided by others that is contained within this report.
- 3.9 While an assessment of the subject trees estimated useful life expectancy is included in this report, no specific tree risk assessment has been undertaken for any of trees at the site.
- 3.10 The ultimate safety of any tree cannot be categorically guaranteed. Even trees apparently free of defects can collapse or partially collapse in extreme weather conditions. Trees are dynamic, biological entities subject to changes in their environment, the presence of pathogens and the effects of ageing. These factors reinforce the need for regular inspections. It is generally accepted that hazards can only be identified from distinct defects or from other failure-prone characteristics of a tree or its locality.

3.11 Alteration of this report invalidates the entire report.

4. METHODOLOGY

- 4.1 The following information was collected during the assessment of the subject tree(s).
 - 4.1.1 Tree common name
 - 4.1.2 Tree botanical name
 - 4.1.3 Tree age class
 - 4.1.4 DBH (Trunk/Stem diameter at breast height/1.4m above ground level) - millimetres.
 - 4.1.5 Estimated height - metres
 - 4.1.6 Estimated crown spread (Radius of crown) - metres
 - 4.1.7 Health
 - 4.1.8 Structural condition
 - 4.1.9 Amenity value
 - 4.1.10 Estimated remaining contribution years (SULE)¹
 - 4.1.11 Retention value (Tree AZ)²
 - 4.1.12 Notes/comments
- 4.2 An assessment of the trees condition was made using the visual tree assessment (VTA) model (Mattheck & Breloer, 1994).³
- 4.3 Tree diameter was measured using a DBH tape or in some cases estimated. All other measurements were estimations unless otherwise stated. The other tools I used during the assessment were a digital camera, Japanese made 170mm blade digging knife and a Leica DistoD410 digital laser tape.
- 4.4 All DBH measurements, tree protection zones, and structural root zones were calculated in accordance with methods set out in AS4970 Protection of trees on development sites (2009). See appendices for more information.
- 4.5 Details of how the observations in this report have been assessed are listed in the appendices.

¹ Barrell Tree Consultancy, *SULE: Its use and status into the New Millennium*, TreeAZ/03/2001, <http://www.treeaz.com/>.

² Barrell Tree Consultancy, *Tree AZ version 10.10-ANZ*, <http://www.treeaz.com/>.

³ Mattheck, C. & Breloer, H., *The body language of trees - A handbook for failure analysis*, The Stationary Office, London, England (1994).

5. SITE LOCATION



Site location and approximate boundary ⁴

- 5.1 The site is located in the suburb of North Narrabeen, New South Wales, which is located in the Northern Beaches Council area. All trees at the site are subject to protection under the Pittwater Local Environmental Plan (LEP) 2014⁵, Pittwater 21 Development Control Plan (DCP) 2014.⁶
- 5.2 The site is a vacant block divided south (front) to north (rear). This site increases in grade from front to rear and contains several mature native tree species and grass area.
- 5.3 The site is not located inside a Heritage Conservation Area and does not form part of a heritage item in the LEP heritage maps.⁷ None of the site is identified as 'biodiversity' in the LEP maps.⁸

⁴ <https://www.google.com.au/maps/place/4+Bellara+Ave,+North+Narrabeen+NSW+2101>

⁵ Pittwater Local Environmental Plan 2014 <https://legislation.nsw.gov.au/#/view/EPI/2014/320/historical2017-08-25/full>.

⁶ Pittwater 21 Development Control Plan, <https://eservices.northernbeaches.nsw.gov.au/ePlanning/live/pages/plan/book.aspx?exhibit=PDGP>, accessed 29 October 2018.

⁷ Pittwater LEP Heritage map - Sheet HER_013, https://www.legislation.nsw.gov.au/maps/1ff3467d-6645-44d6-9956-9dcc31fd90c2/6370_COM_HER_013_010_20150325.pdf, accessed 29 October 2018.

⁸ Pittwater LEP Biodiversity map - Sheet BIO_013, https://www.legislation.nsw.gov.au/maps/9406f916-2ca4-4089-8319-3cb2c7fd35c5/6370_COM_BIO_013_010_20140217.pdf, accessed 29 October 2018.

6. OBSERVATIONS AND GENERAL INFORMATION IN RELATION TO PROTECTING TREES ON DEVELOPMENT SITES

- 6.1 **Tree information:** Details of each individual tree assessed, including the observations taken during the site inspection, can be found in the tree inspection schedule in appendix 2, where the indicative tree protection zone (TPZ) and Structural Root Zone (SRZ) has been calculated for each of the subject trees. The TPZ and SRZ should be measured in radius from the centre of the trunk. Each of the subject trees have been awarded a retention value based on the observations using the Tree AZ method. Tree AZ is used to identify higher value trees worthy of being a constraint to development and lower value trees that should generally not be a constraint to the development. The Tree AZ categories sheet (Barrell Tree Consultancy) has been included in appendix 3 to assist with understanding the retention values. The retention value that has been allocated to the subject trees in this report is not definitive and should only be used as a guideline.
- 6.2 **Site plan:** In appendix 1 an existing site plan has been prepared, appendix 1A contains a proposed site plan where the tree information including canopy spread, TPZ and SRZ have been overlaid.
- 6.3 **Tree protection zone (TPZ):** The TPZ is the principle means of protecting trees on development sites and is an area required to maintain the viability of trees during development. It is commonly observed that tree roots will extend significantly further than the indicative TPZ, however the TPZ is an area identified in AS4970-2009 to be the area where root loss or disturbance will generally impact the viability of the tree. The TPZ is identified as a restricted area to prevent damage to trees either above or below ground during a development. Where trees are intended to be retained proposed developments must provide an adequate TPZ around trees. The TPZ is set aside for the tree's root zone, trunk and crown and it is essential for the stability and longevity of the tree. The TPZ also incorporates the SRZ (see below for more information about the SRZ). The TPZ is calculated by multiplying the DBH by twelve, with the exception of palms, other monocots, cycads and tree ferns, the TPZ of which have been calculated at one metre outside the crown projection.

- 6.4 **Structural Root Zone (SRZ):** This is the area around the base of a tree required for the trees stability in the ground. An area larger than the SRZ always needs to be maintained to preserve a viable tree. The SRZ is calculated using the following formula; $(DAB \times 50)^{0.42} \times 0.64$. There are several factors that can vary the SRZ which include height, crown area, soil type and soil moisture. It can also be influenced by other factors such as natural or built structures. Generally, work within the SRZ should be avoided. Soil level changes should also generally be avoided inside the SRZ of trees to be retained. Palms, other monocots, cycads and tree ferns do not have an SRZ.
- 6.5 **Minor encroachment into TPZ:** Sometimes encroachment into the TPZ is unavoidable. Encroachment includes but is not limited to activities such as excavation, compacted fill and machine trenching. Minor encroachment of up to 10% of the overall TPZ area is normally considered acceptable, providing there is space adjacent to the TPZ for the tree to compensate and the tree is displaying adequate vigour/health to tolerate changes to its growing environment.
- 6.6 **Major encroachment into TPZ:** Where encroachment of more than 10% of the overall TPZ area is proposed the project Arborist must investigate and demonstrate that the tree will remain in a viable condition. In some cases, tree sensitive construction methods such as pier and beam footings, suspended slabs, or cantilevered sections, can be utilised to allow additional encroachment into the TPZ by bridging over roots and minimising root disturbance. Major encroachment is only possible if it can be undertaken without severing significant size roots, or if it can be demonstrated that significant roots will not be impacted. Root investigations may be required to identify roots that will be impacted during major TPZ encroachment.

7. ASSESSEMENT OF CONSTRUCTION IMPACTS

7.1 **Table 2:** In the table below the impact of proposed development impact to all trees included in the report has been assessed.

Tree ID	Species	Retention value	TPZ radius (m)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
1	Cook Island Pine	A1	4.9	2.4	Major	The proposed driveway will encroach into the Tree Protection Zone and the Structural Root Zone by up to 40%. This is a major encroachment that has the potential to impact the health and stability of the tree. If the tree is to be retained in a viable condition root mapping should be carried out to determine the location of significant roots that may be impacted. Alternatively design modifications to mirror the proposed driveway to allow a greater setback from the tree and avoid encroachment into the SRZ area and reduce the level of impact. See the recommendations section for further detail.	Root mapping or design amendments required.
2	Sydney Blue Gum	A2	5.8	2.8	Minor	The proposed structures will encroach into the Tree Protection Zone by less than 10% which is of low impact.	Retain and protect
3	Sydney Blue Gum	A1	4.4	2.4	Minor	The proposed structures will encroach into the Tree Protection Zone by less than 10% which is of low impact.	Retain and protect
4	Tallowood	A1	8.0	3.0	Major	The proposed structures will encroach into the Tree Protection Zone and the Structural Root Zone by up to 27%. This is a major encroachment and consists of a combination of cut into the natural ground and fill which is likely to impact the trees health and structural condition, Tree roots require air, water and nutrients to function properly. Increasing the soil level in the TPZ can impact the trees by reducing the availability of water, nutrients and air to the trees underlying root system and can cause the decline of a trees health and vigour. Placing fill directly against the trunk of a tree can potentially cause collar rot. In addition, proposed cut will sever all feeder and transport roots reducing the trees capacity to mobilize water.	Remove



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Tree ID	Species	Retention value	TPZ radius (m)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
						In addition the tree currently holds a canopy ground clearance of approximately six metres and will require canopy modification to allow for the proposed building. This will further contribute to the level of impact proposed. The tree is not considered to be retainable under the proposal.	
5	Sydney Blue Gum	A1	9.8	3.2	Footprint	Tree located within the footprint of the proposed works and is not retainable under the proposal.	Remove
6	Swamp Oak	A2	2.9	1.9	Footprint	Tree located within the footprint of the proposed works and is not retainable under the proposal.	Remove
7	Sydney Blue Gum	A1	4.0	2.7	None	Tree located on an adjoining site and is situated on a higher level than the subject site. Less than 10% of the TPZ area may extend within the site and the development is likely to be of negligible impact.	Retain and protect
8	Mexican Fan Palm	Z3	3.0	0.0	Major	Tree located on an adjoining site. The proposed stairs will encroach into the Tree Protection Zone by up to 27% which is a major encroachment under AS4970 Protection of Trees on Development Sites (2009). The tree is a palm species (monocot) with a simple fibrous root system. Studies conducted by Broschat and Donselman (1984,1990) in regard to the severing of palm roots for the purpose of transplanting state, "most of a mature palms roots are found within 30cm of the trunk", and in conclusion found that most mature palms need only a root ball of 30cm radius from the trunk and 30cm soil depth to survive. Therefore, providing the 30cm setback is maintained the proposed works are unlikely to significantly impact the tree and the tree can be retained in a viable condition.	Retain and protect

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Tree ID	Species	Retention value	TPZ radius (m)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
9	Bangalow Palm	Z3	3.0	0.0	Major	Tree located on a neighboring site. The proposed stairs and ancillary structures may encroach into the Tree Protection Zone by up to 19%. The tree is a palm species (monocot) with a simple fibrous root system. Studies conducted by Broschat and Donselman (1984,1990) in regard to the severing of palm roots for the purpose of transplanting state, "most of a mature palms roots are found within 30cm of the trunk", and in conclusion found that most mature palms need only a root ball of 30cm radius from the trunk and 30cm soil depth to survive. Therefore, providing the 30cm setback is maintained the proposed works are unlikely to significantly impact the tree and the tree can be retained in a viable condition.	Retain and protect
10	Bangalow Palm	Z3	3.0	0.0	None	Tree located on an adjoining site. No encroachment is proposed.	Retain and protect
11	Kentia Palm	Z3	3.0	0.0	Minor	Less than 10% encroachment is proposed. This is of low impact.	Retain and protect
12	Kentia Palm	Z3	3.0	0.0	None	Tree located on an adjoining site. No encroachment is proposed.	Retain and protect
13	Kentia Palm	Z3	3.0	0.0	None	Tree located on an adjoining site. No encroachment is proposed.	Retain and protect
14	Broad Leaved Paperbark	A1	1.9	1.7	None	Tree located on an adjoining site. No encroachment is proposed.	Retain and protect
15	Swamp Mahogany	A1	3.0	2.1	None	Tree located on an adjoining site. No encroachment is proposed.	Retain and protect

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Tree ID	Species	Retention value	TPZ radius (m)	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
16	Lilly Pilly	A1	3.0	1.6	None	Tree located on an adjoining site. No encroachment is proposed.	Retain and protect

8. CONCLUSIONS

8.1 **Table 3:** Summary of the impact to trees during the development;

Impact	Reason	Category A	Category Z
		A	Z
Trees to be removed	Building/landscape construction, new surfacing and/or proximity, or trees in poor condition.	4,5,6 Three Trees	None
Trees to be retained subject to acceptable development impact	Removal of existing surfacing/structures and/or installation of new surfacing/structures will not significantly impact the tree	2,3 Two trees	8,9,11 Three Trees
Trees not subject to encroachment	Located outside of the construction envelope	7,14,15,16 Four trees	10,12,13 Three Trees
Trees requiring design amendments or root mapping to enable their retention	Removal of existing surfacing/structures and/or installation of new surfacing/structures will significantly impact the tree	1 One tree	None

9. PHOTOGRAPHS



Photo a: Looking north up the subject site and trees 3, 4 and 5.



Photo b: Tree 1 at the front of the site.

11. RECOMMENDATIONS

Refer to Table 2 and 3 for individual tree identification.

- 11.1 This report assesses the impact of a proposed development at the site to all significant trees within 5 meters of proposed development works. Sixteen trees have been identified and assessed.
- 11.2 The proposed works will require the removal of three category A trees.
- 11.3 One category A tree (T1) that is proposed to be retained will be subject to major encroachment that is likely to cause the tree to decline in health. To ensure the tree is not adversely impacted by the construction, either of the two following points should be implemented to reduce the level of impact.
 - 11.3.1 **Design modifications.** The level of impact may be significantly reduced and the tree retained if the proposed curved driveway were to be mirrored and the curve positioned to avoid the Structural Root Zone. The updated plans should be reviewed by an AQF Level 5 Arborist to confirm the amendments will reduce the impact to a tolerable level.
 - 11.3.2 **Root investigations:** Where major TPZ encroachments require demonstrating the viability of trees the following method for root investigations is to be used. Non-destructive excavations are to be carried out along the outer edge of proposed or existing structures within the TPZ (excavation methods include the use of pneumatic and hydraulic tools, high-pressure air or a combination of high-pressure water and a vacuum device). Excavations generally consist of a trench to a depth dictated by the location of significant roots, bedrock, unfavourable conditions for root growth, or the required depth for footings up to 1 metre. The investigation is to be carried out by AQF5 consulting Arborist who is to record all roots greater than 30 millimetres in diameter and produce a report discussing the significance of the findings. No roots 30 millimetres in diameter are to be frayed or damaged during excavation and the trench is to be backfilled as soon as possible to reduce the risk of roots drying out. In the event roots must be left exposed, they are to be wrapped in hessian sack and regularly irrigated for the duration of exposure.
- 11.4 Five trees will be subject to low or tolerable levels of development impact providing excavations are carried out in accordance with section 12.9 of this report. These trees consist of two category A trees and three category Z trees.
- 11.5 The remaining seven trees consisting of four category A trees and three category Z trees will not be subject to encroachment from the proposed works.

- 11.6 Minor canopy pruning is likely to be required for trees 2 and 3 at the south eastern corner of the proposed dwelling. Pruning should consist of crown raising of less than 10% live foliage only, be supervised by the project Arborist and comply with Australian Standard 4373 Pruning of Amenity Trees (2007)
- 11.7 In appendix 1 a site plan has been prepared, where the tree information including canopy spread, TPZ and SRZ have been overlaid onto the proposed site plan.
- 11.8 No services plan has been assessed in this report, all services plans should be subject to review by a consulting Arborist. Where possible underground services should be located outside the TPZ of trees to be retained. All underground services located inside the TPZ of any tree to be retained must be installed via tree sensitive techniques. This should include either directional drilling methods or manual excavations to minimise the impact to trees identified for retention.
- 11.9 No landscape plan has been assessed in this report. See section 12.11 for general guidance in relation to minimising the impact of proposed landscaping to retained trees.

12. ARBORICULTURAL WORK METHOD STATEMENT (AMS) AND TREE PROTECTION REQUIREMENTS

- 12.1 **Use of this report:** All contractors must be made aware of the tree protection requirements prior to commencing works at the site and be provided a copy of this report.
- 12.2 **Project Arborist:** Prior to any works commencing at the site a project Arborist should be appointed. The project Arborist should be qualified to a minimum AQF level 5 and/or equivalent qualifications and experience, and should assist with any development issues relating to trees that may arise. If at any time it is not feasible to carry out works in accordance with this, an alternative must be agreed in writing with the project Arborist.
- 12.3 **Tree work:** All tree work must be carried out by a qualified and experienced Arborist with a minimum of AQF level 3 in arboriculture, in accordance with NSW Work Cover Code of Practice for the Amenity Tree Industry (1998) and AS4373 Pruning of amenity trees (2007).

12.4 Initial site meeting/on-going regular inspections: The project Arborist is to hold a pre-construction site meeting with principle contractor to discuss methods and importance of tree protection measures and resolve any issues in relation to tree protection that may arise. In accordance with AS4970-2009, the project Arborist should carryout regular site inspections to ensure works are carried out in accordance with this document throughout the development process. I recommend regular site inspections on a frequency based on the longevity of the project, this is to be agreed in the initial meeting.

12.5 Site Specific Tree Protection Recommendations:

Table 4: Protection Requirements: See appendix 1A for indicative fencing location. See section 12 for specifications of tree protection.

Tree Number	Protection Specification
1	- Remove, root mapping or design modifications.
2,3	- Fencing to isolate TPZ area.
4,5,6	- Remove.
7,8,9,10,11	- Site fencing will isolate trees.
12,13,14,15,16	- Fencing to isolate TPZ areas.

12.6 Tree protection Specifications: See section 12.5 for site/tree specific requirements. It is the responsibility of the principle contractor to install tree protection prior to works commencing at the site (prior to demolition works) and to ensure that the tree protection remains in adequate condition for the duration of the development. The tree protection must not be moved without prior agreement of the project Arborist. The project Arborist must inspect that the tree protection has been installed in accordance with this document and AS4970-2009 prior to works commencing.

12.6.1 Protective fencing: Where it is not feasible to install fencing at the specified location due to factors such restricting access to areas of the site or for constructing new structures, an alternative location and protection specification must be agreed with the project Arborist. Where the installation of fencing in unfeasible due to restrictions on space, trunk and branch protection will be required (see below). The protective fencing must be constructed of 1.8 metre 'cyclone chainmesh fence'. The fencing must only be removed for the landscaping phase and must be authorised by the project Arborist. Any modifications to the fencing locations must be approved by the project Arborist.

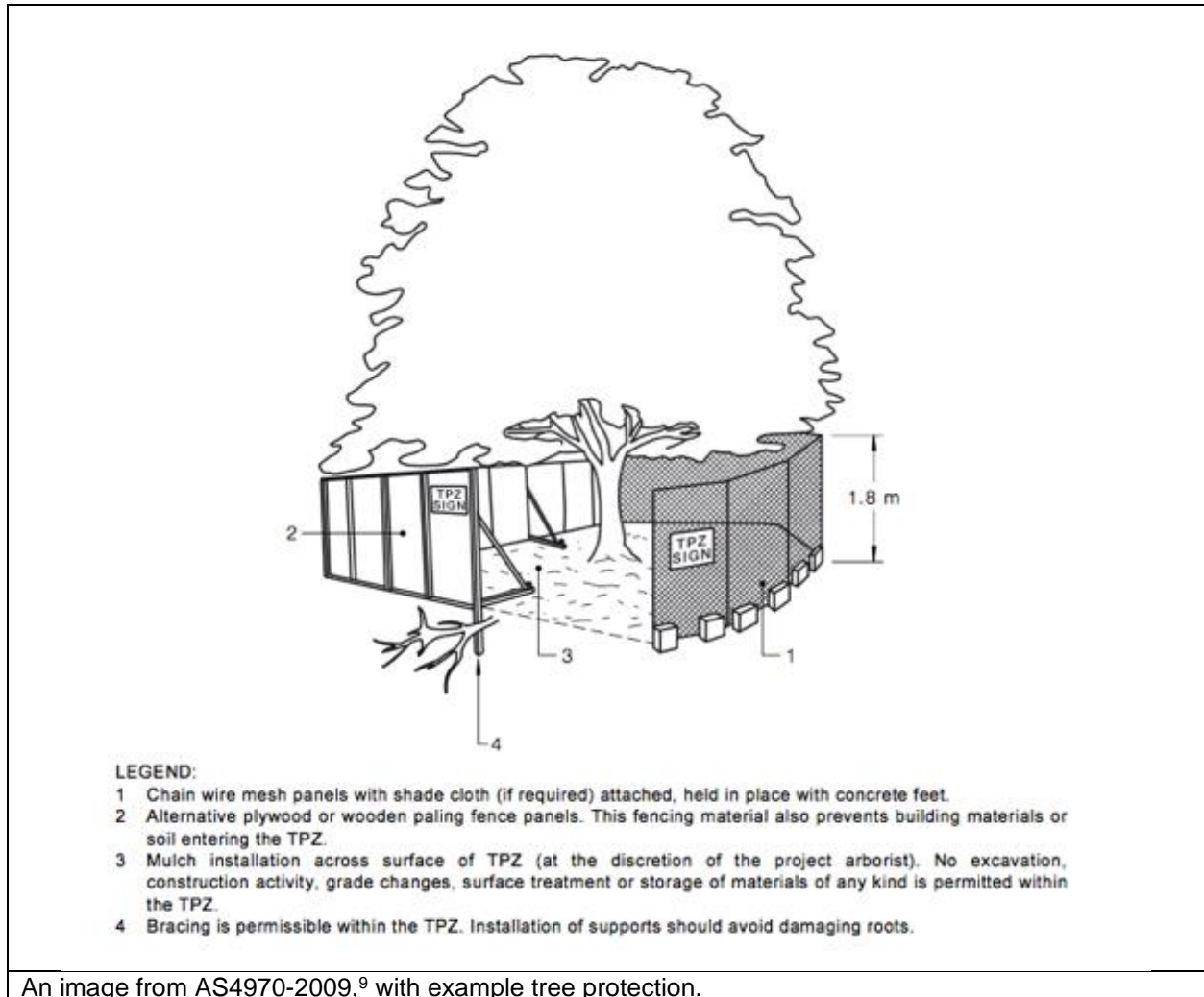
12.6.2 TPZ signage: Tree protection signage is to be attached to the protective fencing, displayed in a prominent position and the sign repeated at 10 metres intervals or closer where the fence changes direction. Each sign shall contain in a clearly legible form, the following information:

- Tree protection zone/No access.
- This fence has been installed to prevent damage to the tree/s and their growing environment both above and below ground. Do not move fencing or enter TPZ without the agreement of the project Arborist.
- The name, address, and telephone number of the developer/builder and project Arborist

12.6.3 Trunk and Branch Protection: The trunk must be protected by wrapped hessian or similar material to limit damage. Timber planks (50mm x 100mm or similar) should then be placed around tree trunk. The timber planks should be spaced at 100mm intervals, and must be fixed against the trunk with tie wire, or strapping and connections finished or covered to protect pedestrians from injury. The hessian and timber planks must not be fixed to the tree in any instance. The trunk and branch protection shall be installed prior to any work commencing on site and shall be maintained in good condition for the entire development period.

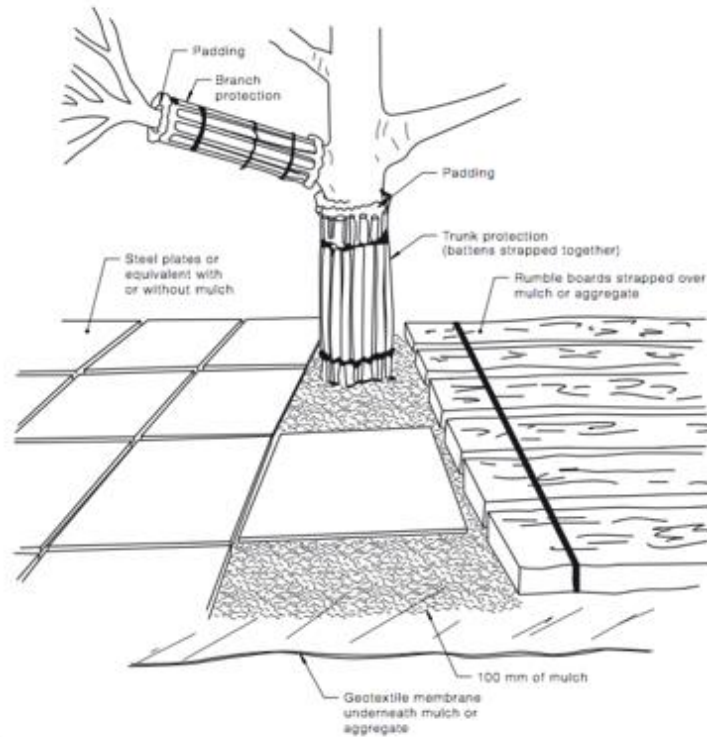
12.6.4 Mulch: Any areas of the TPZ located inside the subject site (only trees to be retained directly adjacent to site works must be mulched to a depth of 75mm with good quality composted wood chip/leaf mulch.

12.6.5 Ground Protection: Ground protection is required to protect the underlying soil structure and root system in areas where it is not practical to restrict access to whole TPZ, while allowing space for construction. Ground protection must consist of good quality composted wood chip/leaf mulch to a depth of between 150-300mm, laid on top of geo textile fabric, overlaid with durable timber boards/plywood. If vehicles are to be using the area, additional protection will be required such as rumble boards or track mats to spread the weight of the vehicle and avoid load points. Ground protection is to be specified by the project Arborist as required.



An image from AS4970-2009,⁹ with example tree protection.

⁹ Council of Standards Australia, *AS4970 Protection of trees on development sites* (2009), page 16.



NOTES:

- 1 For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.
- 2 Rumble boards should be of a suitable thickness to prevent soil compaction and root damage.

An image from AS4970-2009,¹⁰ with example tree protection.

12.7 Restricted activities inside TPZ: The following activities must be avoided inside the TPZ of all trees to be retained unless approved by the project Arborist. If at any time these activities cannot be avoided an alternative must be agreed in writing with the project Arborist to minimise the impact to the tree.

- A) Machine excavation.
- B) Ripping or cultivation of soil.
- C) Storage of spoil, soil or any such materials
- D) Preparation of chemicals, including preparation of cement products.
- E) Refueling.
- F) Dumping of waste.

¹⁰ Council of Standards Australia, *AS4970 Protection of trees on development sites* (2009), page 17.

- G) Wash down and cleaning of equipment.
- H) Placement of fill.
- I) Lighting of fires.
- J) Soil level changes.
- K) Any physical damage to the crown, trunk, or root system.
- L) Parking of vehicles.

12.8 **Demolition:** The demolition of all existing structures inside or directly adjacent to the TPZ of trees to be retained must be undertaken in consultation with the project Arborist. Any machinery is to work from inside the footprint of the existing structures or outside the TPZ, reaching in to minimise soil disturbance and compaction. If it is not feasible to locate demolition machinery outside the TPZ of trees to be retained, ground protection will be required. The demolition should be undertaken inwards into the footprint of the existing structures, sometimes referred to as the 'top down, pull back' method.

12.9 **Excavations:** The project Arborist must supervise and certify that all excavations and root pruning are in accordance with AS4373-2007 and AS4970-2009. For continuous strip footings, first manual excavation is required along the edge of the structures closest to the subject trees. Manual excavation should be a depth of 1 metre (or to unfavourable root growth conditions such as bed rock or heavy clay, if agreed by project Arborist). Next roots must be pruned back in accordance with AS4373-2007. After all root pruning is completed, machine excavation is permitted within the footprint of the structure. For tree sensitive footings, such as pier and beam, all excavations inside the TPZ must be manual. Manual excavation may include the use of pneumatic and hydraulic tools, high-pressure air or a combination of high-pressure water and a vacuum device. No pruning of roots greater 30mm in diameter is to be carried out without approval of the project arborist. All pruning of roots greater than 10mm in diameter must be carried out by a qualified Arborist/Horticulturalist with a minimum AQF level 3. Root pruning is to be a clean cut with a sharp tool in accordance with AS4373 Pruning of amenity trees (2007).¹¹ The tree root is to be pruned back to a branch root if possible. Make a clean cut and leave as small a wound as possible.

12.10 **Landscaping:** All landscaping works within the TPZ of trees to be retained are to be undertaken in consultation with a consulting Arborist to minimize the impact to trees. General guidance is provided below to minimise the impact of new landscaping to trees to be retained.

¹¹ Council Of Standards Australia, AS 4373 *Pruning of amenity trees* (2007) page 18

- 12.11 **Landscaping:** All landscaping works within the TPZ of trees to be retained are to be undertaken in consultation with a consulting Arborist to minimize the impact to trees. General guidance is provided below to minimise the impact of new landscaping to trees to be retained.
- Level changes should be minimised. The existing ground levels within the landscape areas should not be lowered by more than 50mm or increased by more 100mm without assessment by a consulting Arborist.
 - New retaining walls should be avoided. Where new retaining walls are proposed inside the TPZ of trees to be retained, they should be constructed from tree sensitive material, such as timber sleepers, that require minimal footings/excavations. If brick retaining walls are proposed inside the TPZ, consider pier and beam type footings to bridge significant roots that are critical to the trees condition. Retaining walls must be located outside the SRZ and sleepers/beams located above existing soil grades.
 - New footpaths and hard surfaces should be minimised, as they can limit the availability of water, nutrients and air to the trees root system. Where they are proposed, they should be constructed on or above existing soil grades to minimise root disturbance and consider using a permeable surface. Footpath should be located outside the SRZ.
 - Where fill/sub base is used inside the TPZ, fill material should be a coarse granular material that does not restrict the flow of water and air to the root system below. This type of material will also reduce the impact of soil compaction during construction.
 - The location of new plantings inside the TPZ of trees to be retained should be flexible to avoid unnecessary damage to tree roots greater than 30mm in diameter.
- 12.12 **Sediment and Contamination:** All contamination run off from the development such as but not limited to concrete, sediment and toxic wastes must be prevented from entering the TPZ at all times.
- 12.13 **Tree Wounding/Injury:** Any wounding or injury that occurs to a tree during the construction process will require the project Arborist to be contacted for an assessment of the injury and provide mitigation/remediation advice. It is generally accepted that trees may take many years to decline and eventually die from root damage. All repair work is to be carried out by the project Arborist, at the contractor's expense.

- 12.14 **Completion of Development Works:** After all construction works are complete the project Arborist should assess that the subject trees have been retained in the same condition and vigour. If changes to condition are identified the project Arborist should provide recommendations for remediation.

13. HOLD POINTS

13.1 Hold Points: Below is a sequence of hold points requiring project Arborist certification throughout the development process. It provides a list of hold points that must be checked and certified. All certification must be provided in written format upon completion of the development. The final certification must include details of any instructions for remediation undertaken during the development.

Hold Point	Stage	Responsibility	Certification	Complete Y/N and date
Project Arborist to hold pre construction site meeting with principle contractor to discuss methods and importance of tree protection measures and resolve any issues in relation to feasibility of tree protection requirements that may arise.	Prior to work commencing.	Principle contractor	Project Arborist	
Project Arborist to assess and certify that tree protection has been installed in accordance with section 12 and AS4970-2009 prior to works commencing at site.	Prior to development work commencing.	Principle contractor	Project Arborist	
In accordance with AS4970-2009 the project arborist should carryout regular site inspections to ensure works are carried out in accordance with the recommendations. I recommend site inspections on a monthly frequency.	Ongoing throughout the development	Principle contractor	Project Arborist	
Project Arborist to supervise all manual excavations and demolition inside the TPZ of any tree to be retained.	Construction	Principle contractor	Project Arborist	
Project Arborist to certify that all pruning of roots greater than 30mm in diameter has been carried out in accordance with AS4373-2007. All root pruning must be carried out by a qualified Arborist/Horticulturalist with a minimum AQF level 3.	Construction	Principle contractor	Project Arborist	
Project Arborist to certify that all underground services including storm water inside TPZ of any tree to be retained have been installed in accordance with AS4970-2009.	Construction	Principle contractor	Project Arborist	
Project arborist to approve relocation of tree protection for landscaping. All landscaping works within the TPZ of trees to be retained	Landscape	Principle contractor	Project Arborist	

are to be undertaken in consultation with the project Arborist to minimize the impact to trees.				
After all construction works are complete the project Arborist should assess that the subject trees have been retained in the same condition and vigor and authorize the removal of protective fencing. If changes to condition are identified the project Arborist should provide recommendations for remediation.	Upon completion of construction	Principle contractor	Project Arborist	
Any wounding or injury that occurs to a tree during the demolition/construction process will require the project arborist to be contacted for an assessment of the injury and provide mitigation/remediation advice. All remediation work is to be carried out by the project arborist, at the contractor's expense.	Ongoing throughout the development	Principle contractor	Project Arborist	

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15. LIST OF APPENDICES

The following are included in the appendices:

- Appendix 1 - Existing Site Plan
- Appendix 1A – Proposed Site Plan and Tree Protection Plan
- Appendix 2 - Tree inspection schedule
- Appendix 3 – Health
- Appendix 4 – Amenity Value
- Appendix 5 – Age Class
- Appendix 6 – Structural Condition
- Appendix 7 – SULE Categories
- Appendix 8 – Retention Values
- Appendix 9 – Trees AZ
- Appendix 10 – TPZ Encroachment

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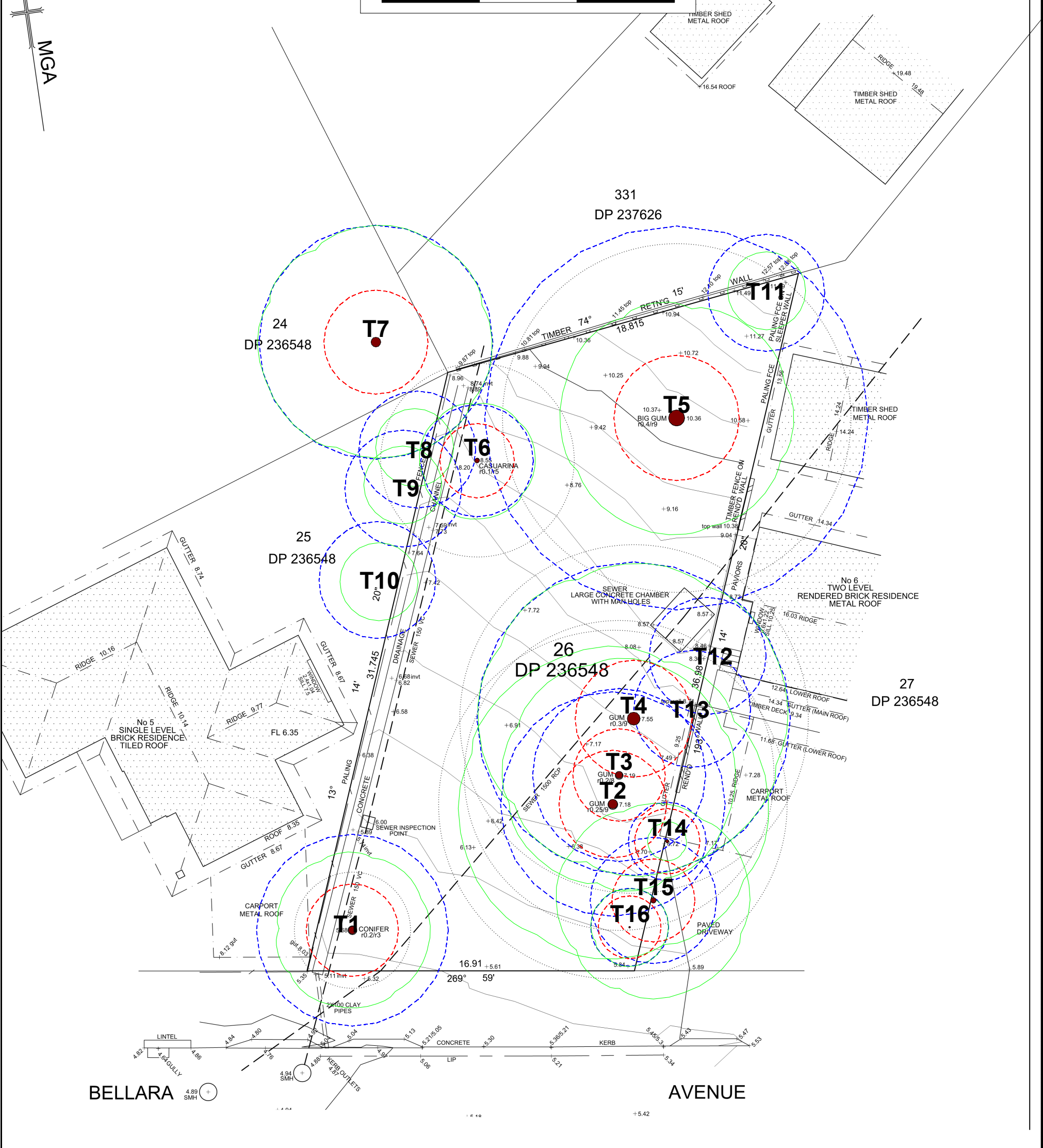
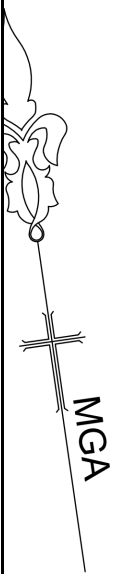
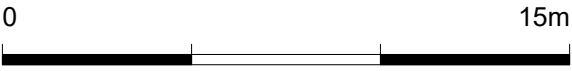
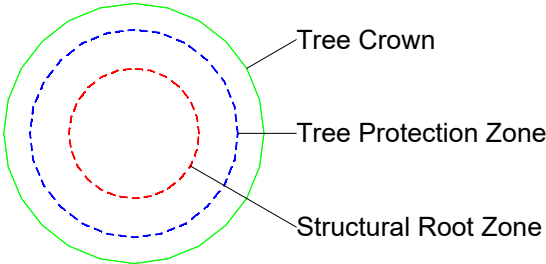
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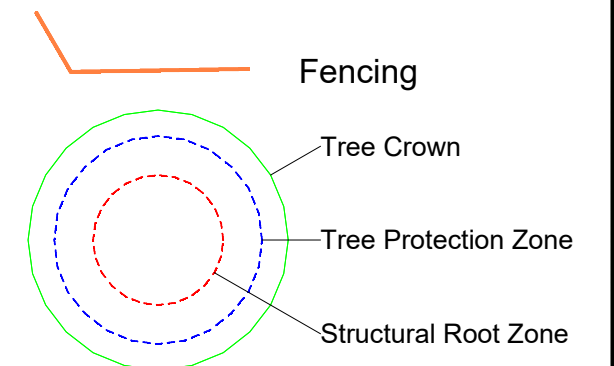
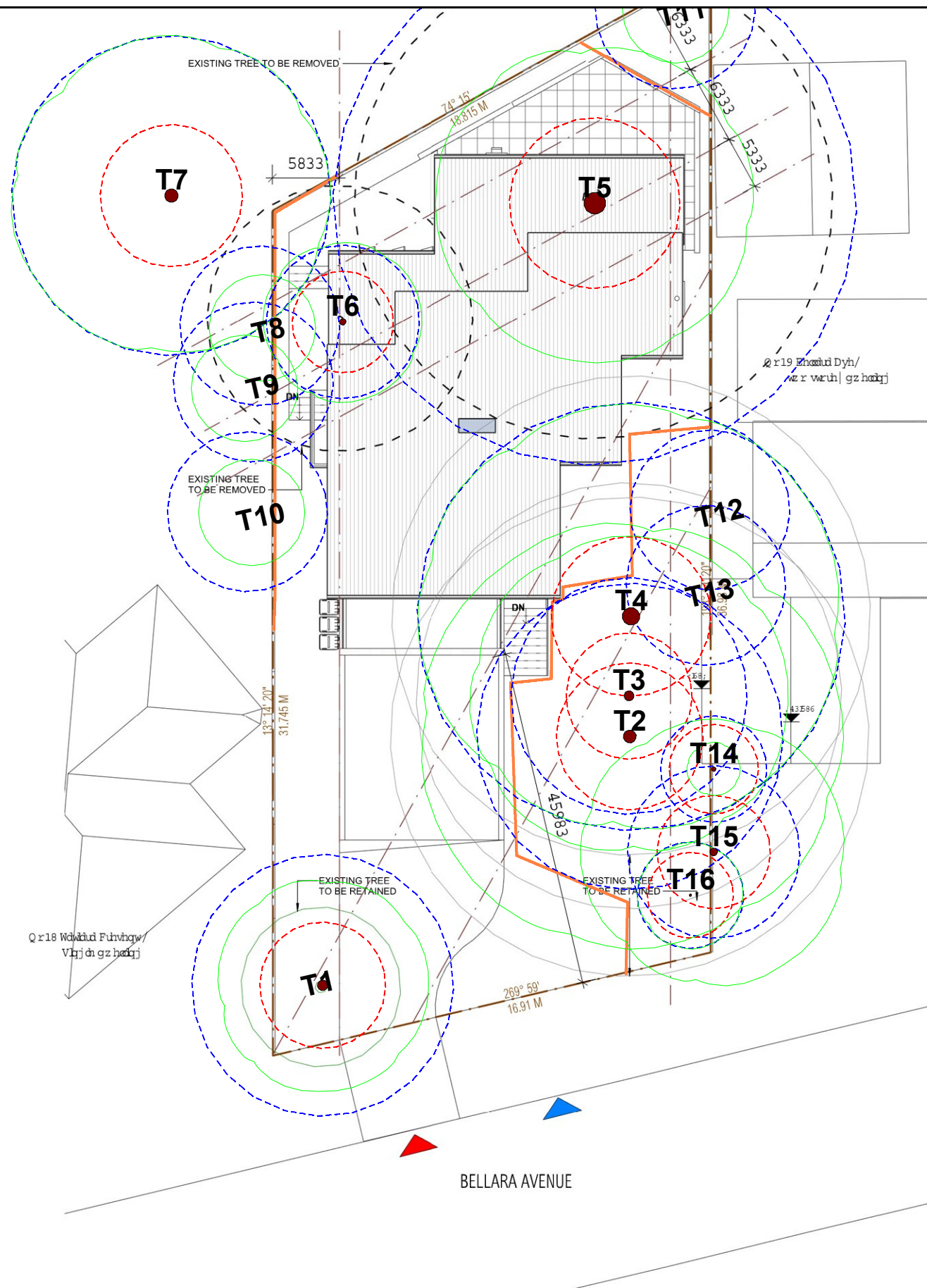
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Appendix 1 - Existing Site Plan




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Prepared by Hugh Millington

Appendix 2 - Tree Inspection Schedule

Tree ID	Common Name	Botanical Name	Age Class	Height (m)	Canopy Spread Radius (m)	Stem 1 (mm)	Stem 2 (mm)	DBH (mm)	DAB (mm)	Health	Structure	Amenity Value	SULE	Retention Value	TPZ Radius (m)	SRZ Radius (m)	Notes
1	Cook Island Pine	<i>Arucaria columnaris</i>	Mature	10	4	410		410	450	Good	Good	High	1. Long	A1	4.9	2.4	None.
2	Sydney Blue Gum	<i>Eucalyptus saligna</i>	Mature	16	8	480		480	650	Good	Good	High	1. Long	A2	5.8	2.8	Some canker growth in canopy.
3	Sydney Blue Gum	<i>Eucalyptus saligna</i>	Mature	17	6	370		370	450	Good	Good	High	1. Long	A1	4.4	2.4	Slight cambial decline at base on western side.
4	Tallowood	<i>Eucalyptus microcorys</i>	Mature	19	8	670		670	790	Good	Good	High	1. Long	A1	8.0	3.0	None.
5	Sydney Blue Gum	<i>Eucalyptus saligna</i>	Mature	20	6	820		820	930	Good	Good	High	1. Long	A1	9.8	3.2	None.
6	Swamp Oak	<i>Casuarina glauca</i>	Mature	8	3	240		240	270	Good	Good	Medium	2. Medium	A2	2.9	1.9	Sparse canopy.
7	Sydney Blue Gum	<i>Eucalyptus saligna</i>	Mature	18	6	500		500	600	Good	Good	High	1. Long	A1	4.0	2.7	Neighboring tree.
8	Mexican Fan Palm	<i>Washingtonia robusta</i>	Mature	11	2	400		400	0	Good	Good	Medium	1. Long	Z3	3.0	0.0	Neighboring tree.
9	Bangalow Palm	<i>Archontophoenix cunninghamiana</i>	Mature	7	2	170		170	0	Good	Good	Medium	1. Long	Z3	3.0	0.0	Neighboring tree.
10	Bangalow Palm	<i>Archontophoenix cunninghamiana</i>	Mature	7	2	170		170	0	Good	Good	Medium	1. Long	Z3	3.0	0.0	Neighboring tree.
11	Kentia Palm	<i>Howea forsteriana</i>	Mature	5	2	150		150	0	Good	Good	Medium	1. Long	Z3	3.0	0.0	Exempt species.
12	Kentia Palm	<i>Howea forsteriana</i>	Mature	5	2	150		150	0	Good	Good	Medium	1. Long	Z3	3.0	0.0	Exempt species.
13	Kentia Palm	<i>Howea forsteriana</i>	Mature	5	2	150		150	0	Good	Good	Medium	1. Long	Z3	3.0	0.0	Exempt species.
14	Broad Leaved Paperbark	<i>Melaleuca quinquenervia</i>	Semi-mature	6	1	158		158	200	Good	Good	Medium	1. Long	A1	1.9	1.7	None.
15	Swamp Mahogany	<i>Eucalyptus robusta</i>	Mature	10	5	270		270	350	Fair	Good	High	2. Medium	A1	3.0	2.1	None.
16	Lilly Pilly	<i>Acmena smithii</i>	Semi-mature	5	2	50	50	71	180	Good	Good	Medium	1. Long	A1	3.0	1.6	None.

Explanatory Notes

Tree Species - Botanical name followed by common name in brackets. Where species is unknown it is indicated with an 'spp'.

Age Class - Over mature (OM), Mature (M), Early mature (EM), Semi mature (SM), Young (Y), Dead (D).

Diameter at Breast Height (DBH) - Measured with a DBH tape or estimated at approximately 1.4m above ground level. Where DBH has been estimated it is indicated with an 'est'.

The (1) indicates the stem number and the (t) indicates the total DBH when calculated in accordance with AS4970-2009 definition.

Diameter Above root Buttresses (DAB): Measured with a DBH tape or estimated above root buttresses (DAB) for calculating the SRZ.

Height - Height from ground level to top of crown. All heights are estimated unless otherwise indicated.

Spread - Radius of crown at widest section. All tree spreads are estimated unless otherwise indicated.

Tree Protection Zone (TPZ) - $DBH \times 12$. Measured in radius from the centre of the trunk. Rounded to nearest 0.1m. For monocots, the TPZ is set at 1 metre outside the crown projection.

Structural Root Zone (SRZ) - $(DAB \times 50)^{0.42} \times 0.64$. Measured in radius from the centre of the trunk. Rounded up to nearest 0.1m.

Health - Good/Fair/Poor/Dead

Structure - Good/Fair/Poor

Safe Useful Life Expectancy (SULE) - 1. Long (40+years), 2. Medium (15 - 40 years), 3. Short (5 - 15 years), 4. Remove (under 5 years), 5. Small/young.

Amenity Value - Very High/High/Medium/Low/Very Low.

(x) Indicates the measurement taken for the diameter at tree base above the buttress roots.

(E) Indicates estimated measurements.

Appendix 3 - Health/Physiological condition

<u>Category</u>	<u>Example condition</u>	<u>Summary</u>
Good	<ul style="list-style-type: none">• Crown has good foliage density for species.• Tree shows no or minimal signs of pathogens that are unlikely to have an effect on the health of the tree.• Tree is displaying good vigour and reactive growth development.	<ul style="list-style-type: none">• The tree is in above average health and condition and no remedial works are required.
Fair	<ul style="list-style-type: none">• The tree may be starting to dieback or have over 25% deadwood.• Tree may have slightly reduced crown density or thinning.• There may be some discolouration of foliage.• Average reactive growth development.• There may be early signs of pathogens which may further deteriorate the health of the tree.• There may be epicormic growth indicating increased levels of stress within the tree.	<ul style="list-style-type: none">• The tree is in below average health and condition and may require remedial works to improve the trees health.
Poor	<ul style="list-style-type: none">• The may be in decline, have extensive dieback or have over 30% deadwood.• The canopy may be sparse or the leaves may be unusually small for species.• Pathogens or pests are having a significant detrimental effect on the tree health.	<ul style="list-style-type: none">• The tree is displaying low levels of health and removal or remedial works may be required.
Dead	<ul style="list-style-type: none">• The tree is dead or almost dead.	<ul style="list-style-type: none">• The tree should generally be removed.

Appendix 4 - Amenity value

To determine the amenity value of a tree we assess a number of different factors which include but are not limited to the information below.

- The visibility of the tree to adjacent sites.
- The relationship between the tree and the site.
- Whether the tree is protected by any statutory conditions.
- The habitat value of the tree.
- Whether the tree is considered a noxious weed species.

Appendix 5 - Age class

If can be difficult to determine the age of a tree without carrying out invasive tests that may damage the tree, so we have categorised there likely age class which is defined below.

<u>Category</u>	<u>Description</u>
Young/Newly planted	<ul style="list-style-type: none">• Young or recently planted tree.
Semi Mature	<ul style="list-style-type: none">• Up to 20% of the usual life expectancy for the species.
Early mature/Mature	<ul style="list-style-type: none">• Between 20% - 80% of the usual life expectancy for the species.
Over mature	<ul style="list-style-type: none">• Over 80% of the usual life expectancy for the species.
Dead	<ul style="list-style-type: none">• Tree is dead or almost dead.

Appendix 6 - Structural condition

<u>Category</u>	<u>Example condition</u>	<u>Summary</u>
Good	<ul style="list-style-type: none">• Branch unions appear to be strong with no sign of defects.• There are no significant cavities.• The tree is unlikely to fail in usual conditions.• The tree has a balanced crown shape and form.	<ul style="list-style-type: none">• The tree is considered structurally good with well developed form.
Fair	<ul style="list-style-type: none">• The tree may have minor structural defects within the structure of the crown that could potentially develop into more significant defects.• The tree may have a cavity that is currently unlikely to fail but may deteriorate in the future.• The tree is an unbalanced shape or leans significantly.• The tree may have minor damage to its roots.• The root plate may have moved in the past but the tree has now compensated for this.• Branches may be rubbing or crossing.	<ul style="list-style-type: none">• The identified defects are unlikely to cause major failure.• Some branch failure may occur in usual conditions.• Remedial works can be undertaken to alleviate potential defects.
Poor	<ul style="list-style-type: none">• The tree has significant structural defects.• Branch unions may be poor or weak.• The tree may have a cavity or cavities with excessive levels of decay that could cause catastrophic failure.• The tree may have root damage or is displaying signs of recent movement.• The tree crown may have poor weight distribution which could cause failure.	<ul style="list-style-type: none">• The identified defects are likely to cause either partial or whole failure of the tree.

Appendix 7 - Safe Useful Life Expectancy (SULE), (Barrel, 2001)

A tree's safe useful life expectancy is determined by assessing a number of different factors including the health and vitality, estimated age in relation to expected life expectancy for the species, structural defects, and remedial works that could allow retention in the existing situation.

Category	Description
1. Long	Useful life expectancy over 40 years
2. Medium	Useful life expectancy 15 to 40 years
3. Short	Useful life expectancy 5 to 15 years
4. Remove	Useful life expectancy under 5 years
5. Small/Young	Trees that could be transplanted or replaced with similar specimen.
6. Unstable	Tree has become hazardous or structurally unstable.

Appendix 8 - Retention value

The retention value that has been allocated to each tree in this report is not definitive and should only be used as a guideline by the client. We have assigned the retention value after assessing the combined SULE, structural condition, health, and amenity value of the tree. Any heritage listing that may apply to the tree has not been considered in this value, although if it has been identified it is included in the notes for the tree. Each tree has been assessed individually and consideration has not been given to value of the tree within a group.

<u>Category</u>	<u>Example recommendation</u>
Very high	Every effort should be made to preserve and retain trees in this category.
High	The trees in this category should be retained if it is reasonably possible.
Medium	The trees in this category should be retained if they do not constrain the development on the site.
Low	The trees in this category should not cause a constraint on the development proposals. They should be retained only if they do not or will not cause a risk to people or property.
Very low	The tree should generally be removed unless they do not or will not cause a risk to people or property.

TreeAZ Categories (Version 10.04-ANZ)

CAUTION: TreeAZ assessments must be carried out by a competent person qualified and experienced in arboriculture. The following category descriptions are designed to be a brief field reference and are not intended to be self-explanatory. They must be read in conjunction with the most current explanations published at www.TreeAZ.com.

Category Z: Unimportant trees not worthy of being a material constraint

Local policy exemptions: Trees that are unsuitable for legal protection for local policy reasons including size, proximity and species

Z1	Young or insignificant small trees, i.e. below the local size threshold for legal protection, etc
Z2	Too close to a building, i.e. exempt from legal protection because of proximity, etc
Z3	Species that cannot be protected for other reasons, i.e. scheduled noxious weeds, out of character in a setting of acknowledged importance, etc

High risk of death or failure: Trees that are likely to be removed within 10 years because of acute health issues or severe structural failure

Z4	Dead, dying, diseased or declining
Z5	Severe damage and/or structural defects where a high risk of failure <u>cannot</u> be satisfactorily reduced by reasonable remedial care, i.e. cavities, decay, included bark, wounds, excessive imbalance, overgrown and vulnerable to adverse weather conditions, etc
Z6	Instability, i.e. poor anchorage, increased exposure, etc

Excessive nuisance: Trees that are likely to be removed within 10 years because of unacceptable impact on people

Z7	Excessive, severe and intolerable inconvenience to the extent that a locally recognized court or tribunal would be likely to authorize removal, i.e. dominance, debris, interference, etc
Z8	Excessive, severe and intolerable damage to property to the extent that a locally recognized court or tribunal would be likely to authorize removal, i.e. severe structural damage to surfacing and buildings, etc

Good management: Trees that are likely to be removed within 10 years through responsible management of the tree population

Z9	Severe damage and/or structural defects where a high risk of failure can be <u>temporarily</u> reduced by reasonable remedial care, i.e. cavities, decay, included bark, wounds, excessive imbalance, vulnerable to adverse weather conditions, etc
Z10	Poor condition or location with a low potential for recovery or improvement, i.e. dominated by adjacent trees or buildings, poor architectural framework, etc
Z11	Removal would benefit better adjacent trees, i.e. relieve physical interference, suppression, etc
Z12	Unacceptably expensive to retain, i.e. severe defects requiring excessive levels of maintenance, etc

NOTE: Z trees with a high risk of death/failure (Z4, Z5 & Z6) or causing severe inconvenience (Z7 & Z8) at the time of assessment and need an urgent risk assessment can be designated as ZZ. ZZ trees are likely to be unsuitable for retention and at the bottom of the categorization hierarchy. In contrast, although Z trees are not worthy of influencing new designs, urgent removal is not essential and they could be retained in the short term, if appropriate.

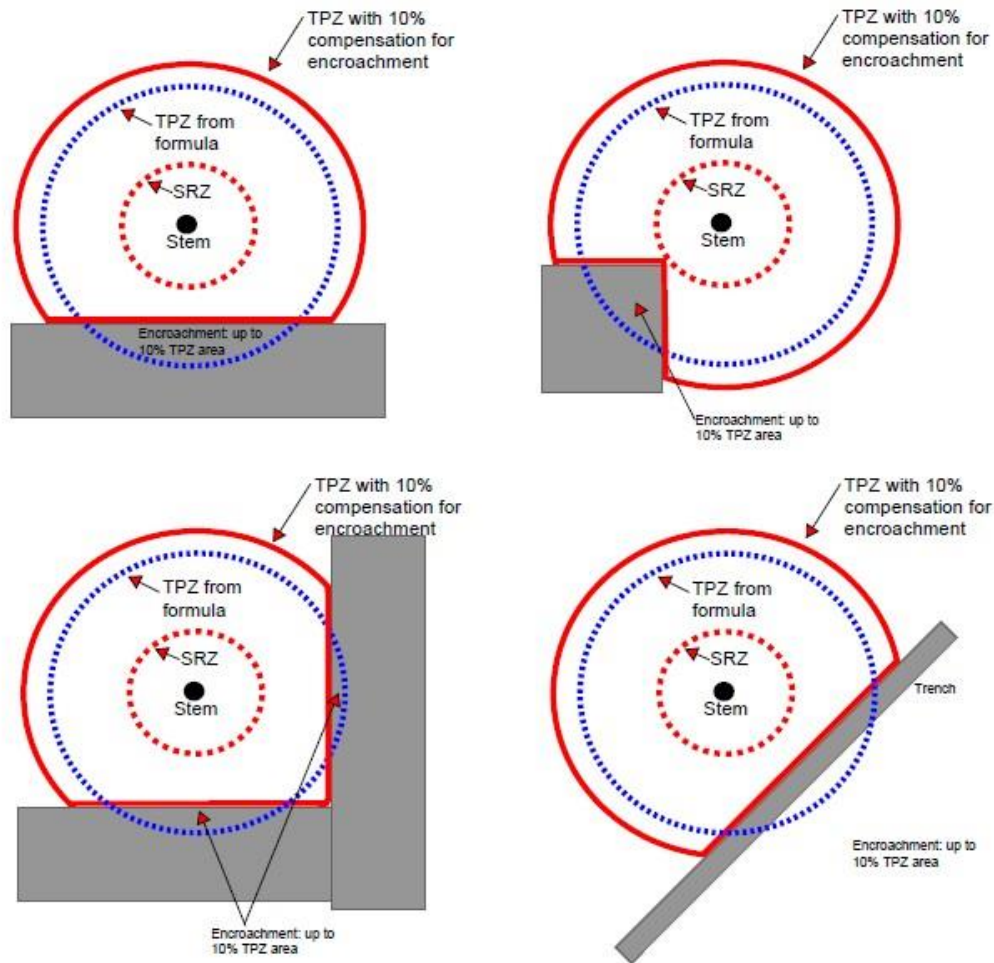
Category A: Important trees suitable for retention for more than 10 years and worthy of being a material constraint

A1	No significant defects and could be retained with minimal remedial care
A2	Minor defects that could be addressed by remedial care and/or work to adjacent trees
A3	Special significance for historical, cultural, commemorative or rarity reasons that would warrant extraordinary efforts to retain for more than 10 years
A4	Trees that may be worthy of legal protection for ecological reasons (Advisory requiring specialist assessment)

NOTE: Category A1 trees that are already large and exceptional, or have the potential to become so with minimal maintenance, can be designated as AA at the discretion of the assessor. Although all A and AA trees are sufficiently important to be material constraints, AA trees are at the top of the categorization hierarchy and should be given the most weight in any selection process.

Appendix 10 – Examples of TPZ Encroachment

Encroachment into the Tree Protection Zone is sometimes unavoidable. The following diagram shows examples of acceptable levels of encroachment and how they may be compensated for by providing additional space contiguous to the TPZ area.



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