



# Arboricultural Impact Assessment

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## **1. INTRODUCTION**

- 1.1 Hugh the Arborist have been instructed by Jonathan Agar 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;
  - A) Detail and Level Survey, C.M.S Surveyors Pty Ltd, 27 August 202.
  - B) Architectural Drawings, Hot House Architects, Revision A - 23 November 2022.
- 1.3 The site and tree inspections were carried out on 3 December 2022. Access was available to the subject site and adjoining public areas only.

## **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 in height.
  - 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 Provide pragmatic recommendations for the management of trees and mitigation of construction impacts on retained trees.
  - 2.1.5 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

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- 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)<sup>1</sup>
- 4.1.11 Retention value (Tree AZ)<sup>2</sup>
- 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).<sup>3</sup>
- 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.

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

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

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

## 5. SITE LOCATION & BRIEF DESCRIPTION OF DEVELOPMENT WORKS ASSESSED

- 5.1 The site is located in the suburb of Seaforth, New South Wales, which is located in the Northern Beaches Local Government Area (LGA). All trees at the site are subject to protection under the Manly Local Environmental Plan (LEP) 2013<sup>4</sup> and Manly Development Control Plan (DCP) 2013.<sup>5</sup> The site is not listed as a heritage item or located within a heritage conservation area in the LEP heritage maps.<sup>6</sup>

## 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 a site plan has been prepared, where the tree information including canopy spread, TPZ and SRZ have been overlaid onto the proposed site plan.

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<sup>4</sup> Manly Local Environmental Plan 2013, <http://www.legislation.nsw.gov.au/~view/EPI/2013/140/full>.

<sup>5</sup> Manly Development Control Plan 2013, <http://www.manly.nsw.gov.au/planning-and-development/lep-dcp-policies/>.

<sup>6</sup> Manly LEP Heritage map - Sheet HER\_001, [https://eplanningdlprod.blob.core.windows.net/pdfmaps/5150\\_COM\\_HER\\_001\\_010\\_20151023.pdf](https://eplanningdlprod.blob.core.windows.net/pdfmaps/5150_COM_HER_001_010_20151023.pdf), accessed 7 December 2022.

- 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. Additional information about the TPZ is included in appendix 3.
- 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. See the appendices for more information about the 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.

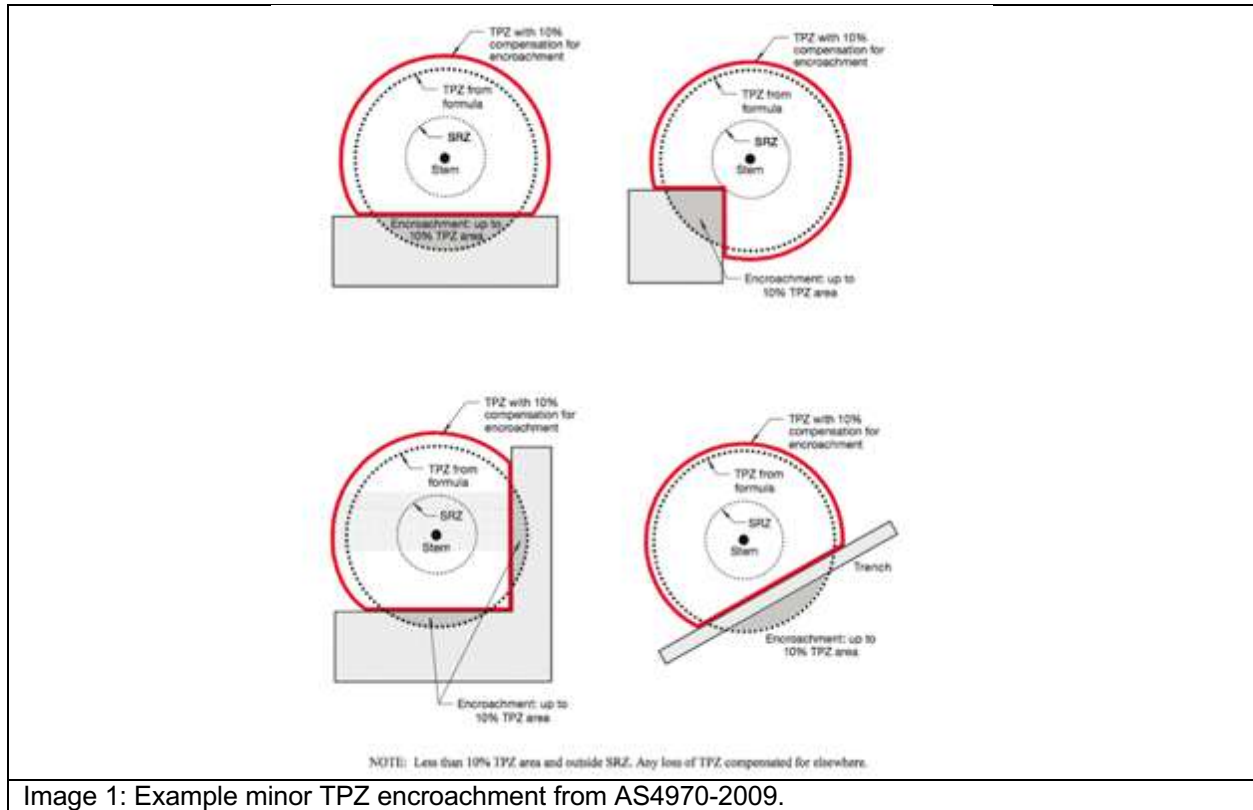


Image 1: Example minor TPZ encroachment from AS4970-2009.

- 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 (see appendix 3 for more information in relation to root investigations).



## 7. ASSESSMENT OF CONSTRUCTION IMPACTS

7.1 **Table 1:** In the table below, the impact of the proposed development has been assessed for all trees included in the report. The assessed TPZ encroachments include proposed structures and hard landscaping only. All soft landscaping should be completed in accordance with section 10.10.

Tree ID	Species	Retention value	TPZ radius (m)	TPZ area (m <sup>2</sup> )	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
1	<i>Pittosporum undulatum</i>	Z1	2.0	12.6	1.7	None	No proposed encroachment into the TPZ.	Retain and protect
2	<i>Pittosporum undulatum</i>	Z1	2.7	22.9	2.1	None	No proposed encroachment into the TPZ.	Retain and protect
3	<i>Callistemon viminalis</i>	Z10	2.8	24.6	2.2	Minor	The proposed parapet encroaches into the TPZ by less than 5% (<1m <sup>2</sup> ) but not into the SRZ, which is minor TPZ encroachment and indicates that the tree will not be impacted.	Retain and protect
4	<i>Callistemon salignus</i>	Z1	2.0	12.6	1.5	None	No proposed encroachment into the TPZ.	Retain and protect
5	<i>Hymenosporum flavum</i>	Z1	2.0	12.6	1.6	None	No proposed encroachment into the TPZ.	Retain and protect
6	<i>Archontophoenix cunninghamiana</i>	Z3	2.5	19.6	N/A	None	No proposed encroachment into the TPZ.	Retain and protect
7	<i>Cyathea cooperi</i>	A1	2.0	12.6	N/A	None	No proposed encroachment into the TPZ.	Retain and protect
8	<i>Pittosporum undulatum</i>	Z1	2.0	12.6	1.7	None	No proposed encroachment into the TPZ.	Retain and protect
9	<i>Banksia integrifolia</i>	Z1	2.0	12.6	1.5	None	No proposed encroachment into the TPZ.	Retain and protect
10	<i>Casuarina cunninghamiana</i>	Z1	3.0	28.3	1.8	None	No proposed encroachment into the TPZ.	Retain and protect



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Tree ID	Species	Retention value	TPZ radius (m)	TPZ area (m <sup>2</sup> )	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
11	<i>Banksia integrifolia</i>	Z1	2.0	12.6	1.5	None	The tree has not been identified on the survey. Based on the trees estimated location, there is no proposed encroachment into the TPZ.	Retain and protect
12	<i>Banksia integrifolia</i>	A1	2.4	18.1	1.9	None	The tree has not been identified on the survey. Based on the trees estimated location, there is no proposed encroachment into the TPZ.	Retain and protect
13	<i>Banksia integrifolia</i>	Z10	2.2	15.2	1.8	Footprint	The trunk is located within the footprint of the proposed garage.	Remove
14	<i>Cyathea cooperi</i>	Z1	2.0	12.6	N/A	Footprint	The trunk is located within the footprint of the proposed driveway.	Remove
15	<i>Cyathea cooperi</i>	Z1	2.0	12.6	N/A	Footprint	The trunk is located within the footprint of the proposed driveway.	Remove
16	<i>Cyathea cooperi</i>	Z1	2.0	12.6	N/A	Footprint	The trunk is located within the footprint of the proposed driveway.	Remove
17	<i>Howea forsteriana</i>	Z3	2.0	12.6	N/A	Major	The tree is located in an adjoining site. The proposed boundary retaining wall and excavations encroach into the TPZ by 17% (2.1m <sup>2</sup> ), which is major TPZ encroachment. However, the tree is a palm (monocot) species. Palms have an adventitious root system composed of numerous, simple fibrous primary roots that arise independently and periodically from the root initiation zone (RIZ) at the base of the trunk. Research by Broschat and Donselman (1984,1990) in relation 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. The proposed TPZ encroachment is on one side of the root ball/TPZ only, and will be set back by approximately 600mm from the trunk. The proposed TPZ	Retain and protect

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Tree ID	Species	Retention value	TPZ radius (m)	TPZ area (m <sup>2</sup> )	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
							encroachment from the driveway should therefore have minimal impact on the long-term viability of the palm.	
18	<i>Glochidion ferdinandi</i>	A1	5.7	102.1	2.5	Minor	The proposed garage and excavations encroaches into the TPZ by less than 5% (5.3m <sup>2</sup> ) but not into the SRZ, which is minor TPZ encroachment and indicates that the tree will not be impacted. All other development in the TPZ are not at the same ground level of the tree and will not impact the tree.	Retain and protect
19	<i>Cyathea cooperi</i>	Z1	2.0	12.6	N/A	Footprint	The trunk is located within the footprint of the proposed garage.	Remove
20	<i>Cyathea cooperi</i>	Z1	2.0	12.6	N/A	Footprint	The trunk is located within the footprint of the proposed garage.	Remove
21	<i>Elaeocarpus reticulatus</i>	Z1	2.0	12.6	1.5	Footprint	The trunk is located within the footprint of the proposed garage.	Remove
22	<i>Archontophoenix cunninghamiana</i>	Z3	2.0	12.6	N/A	Major	The tree is located in an adjoining site. The proposed boundary retaining wall and excavations encroach into the TPZ by 25% (3.1m <sup>2</sup> ), which is major TPZ encroachment. However, the tree is a palm (monocot) species. Palms have an adventitious root system composed of numerous, simple fibrous primary roots that arise independently and periodically from the root initiation zone (RIZ) at the base of the trunk. Research by Broschat and Donselman (1984,1990) in relation 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. The proposed TPZ encroachment is on one side of the root ball/TPZ only, and will be set back by approximately 800mm from the trunk. The proposed TPZ	Retain and protect

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Tree ID	Species	Retention value	TPZ radius (m)	TPZ area (m <sup>2</sup> )	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
							encroachment from the driveway should therefore have minimal impact on the long-term viability of the palm.	
23	<i>Archontophoenix cunninghamiana</i>	Z3	2.0	12.6	N/A	Minor	The tree is located in an adjoining site. The proposed boundary retaining wall and excavations encroach into the TPZ by less than 5% (<1m <sup>2</sup> ), which is minor TPZ encroachment and indicates that the tree will not be impacted.	Retain and protect
24	<i>Syragrus romanzoffianum</i>	Z3	3.5	38.5	N/A	Minor	The tree is located in an adjoining site. The proposed boundary retaining wall and excavations encroach into the TPZ by 5% (1.8m <sup>2</sup> ), which is minor TPZ encroachment and indicates that the tree will not be impacted.	Retain and protect
25	<i>Waterhousia floribunda</i>	A1	2.3	16.6	1.8	Major	The proposed lift encroaches into the TPZ by 3% (0.5m <sup>2</sup> ) and into the SRZ, which is major TPZ encroachment due to the SRZ encroachment and indicates that the stability of the tree will potentially be impacted. The proposed shoring work methodology report indicates that additional excavation will be required for piles in the SRZ.	Remove
26	<i>Waterhousia floribunda</i>	A1	2.5	19.6	1.8	Major	The proposed lift encroaches into the TPZ by 6% (1.1m <sup>2</sup> ) and into the SRZ, which is major TPZ encroachment due to the SRZ encroachment and indicates that the stability of the tree will potentially be impacted. The proposed shoring work methodology report indicates that additional excavation will be required for piles in the SRZ.	Remove
27	<i>Waterhousia floribunda</i>	A1	2.0	12.6	1.6	None	No proposed encroachment into the TPZ.	Retain and protect
28	<i>Waterhousia floribunda</i>	A1	2.0	12.6	1.6	None	No proposed encroachment into the TPZ.	Retain and protect
29	<i>Waterhousia floribunda</i>	A1	2.4	18.1	1.8	None	No proposed encroachment into the TPZ.	Retain and protect

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Tree ID	Species	Retention value	TPZ radius (m)	TPZ area (m <sup>2</sup> )	SRZ radius (m)	TPZ encroachment	Discussion/ Conclusion	Recommendation
30	<i>Waterhousia floribunda</i>	A1	2.2	15.2	1.7	None	No proposed encroachment into the TPZ.	Retain and protect
31	<i>Angophora costata</i>	Z10	4.6	66.5	2.3	None	All development in the TPZ are not at the same ground level of the tree and will not impact the tree.	

## 8. CONCLUSIONS

8.1 **Table 2:** 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 condition	25, 26	13, 14, 15, 16, 19, 20, 21
Trees to be retained	Removal of existing surfacing/structures and/or installation of new surfacing/structures will not impact the tree	7, 12, 18, 27, 28, 29, 30	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 17, 22, 23, 24, 31

## **9. RECOMMENDATIONS**

- 9.1 This report assesses the impact of a proposed development at the site to all significant trees within ten metres of proposed development works. Thirty-one trees have been identified and assessed.
- 9.2 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.
- 9.3 Nine trees have been recommended to be removed to accommodate the development works, including tree 13, 14, 15, 16, 19, 20, 21, 25 and 26. See section 8.1 for a list of the trees by retention value.
- 9.4 All other trees can be retained in a viable condition, including tree 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 17, 18, 22, 23, 24, 27, 28, 29, 30 and 31.
- 9.5 All trees to be retained must be protected in accordance with AS4970-2009 for the duration of the demolition and development works, see section 10 for more information.
- 9.6 No landscape plan has been assessed in this report. See section 10.10 for general guidance in relation to minimising the impact of proposed landscaping to retained trees.
- 9.7 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 in accordance with AS4970-2009, see section 10.11 for more information.
- 9.8 This report does not provide approval for tree removal or pruning works. All recommendations in this report are subject to approval by the relevant authorities and/or tree owners. This report should be submitted as supporting evidence with any tree removal/pruning or development application

## **10. ARBORICULTURAL WORK METHOD STATEMENT (AMS) AND TREE PROTECTION REQUIREMENTS**

- 10.1 **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.
- 10.2 **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 carryout works in accordance with this, an alternative must be agreed in writing with the project Arborist.
- 10.3 **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).
- 10.4 **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.



### 10.5 Site Specific Tree Protection Recommendations:

**Table 4: Protection Requirements:** See appendix 1 for indicative fencing location. See section 10.6 for specifications of tree protection.

Tree Number	Protection Specification
Tree 1 and 2	- Trunk protection only. Fencing will not be practical.
Tree 3, 4, 5 and 6	- No tree protection required, no development works are proposed near the trees.
Tree 7, 8, 9, 10, 11, 12 and 18	- Fencing should be aligned as close as practical to the existing retaining wall on the nature strip and adjacent to the driveway/excavations. - TPZ signage on fencing.
Tree 26, 27, 28, 29 and 30	- Protective fencing should be aligned at the at the North of the extent of the TPZ of tree 27. - TPZ signage on fencing.
Tree 31	- No tree protection required, no ground level works are proposed near the tree.

**10.6 Tree protection Specifications:** See section 10.5 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.

**10.6.1 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.

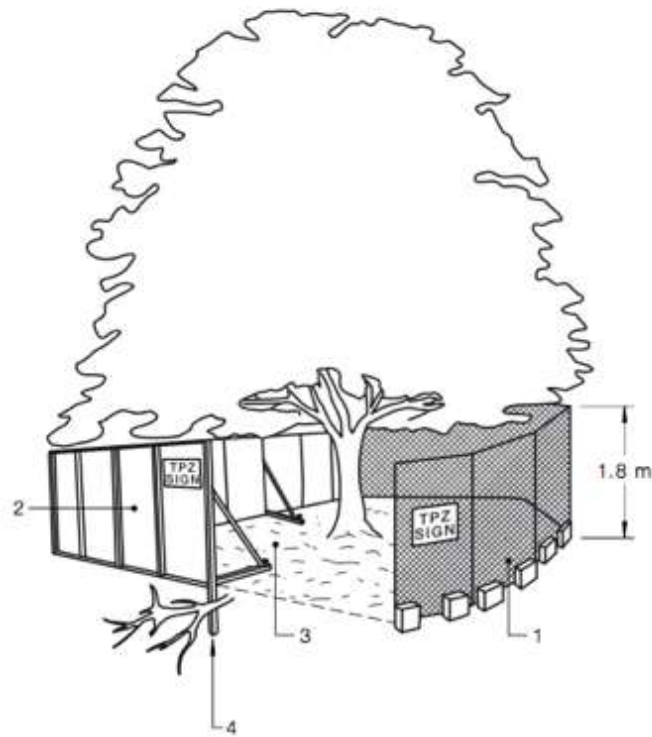
**10.6.2 TPZ signage:** Tree protection signage is to be attached to the protective fencing, displayed in a prominent position and the sign repeated at 10 metres intervals or closer where the fence changes direction. Each sign shall contain in a clearly legible form, the following information:

- 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

**10.6.3 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.

**10.6.4 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.

**10.6.5 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.

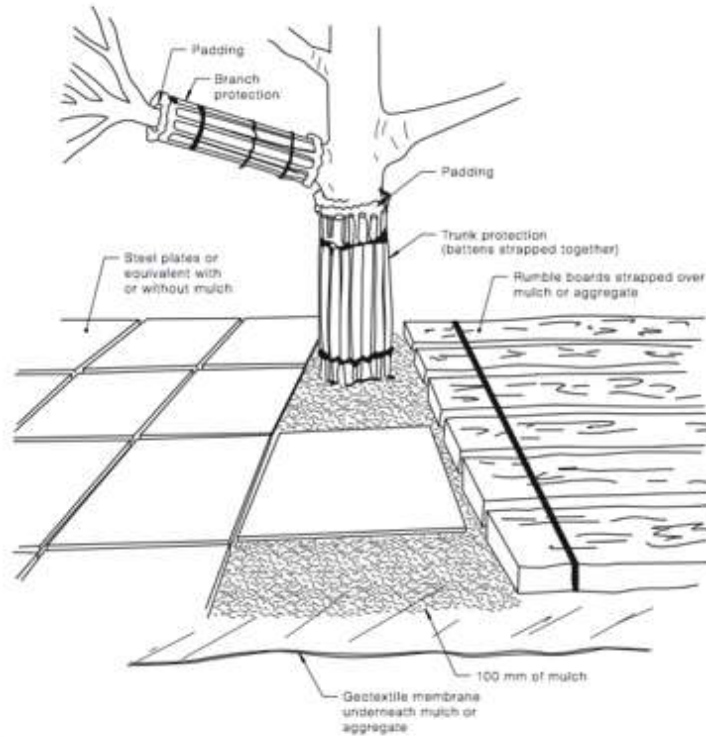


**LEGEND:**

- 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.

An image from AS4970-2009,<sup>7</sup> with example tree protection.

<sup>7</sup> 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,<sup>8</sup> with example tree protection.

**10.7 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.

<sup>8</sup> 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.

- 10.8 **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.
- 10.9 **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).<sup>9</sup> 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.
- 10.10 **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.

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<sup>9</sup> Council Of Standards Australia, *AS 4373 Pruning of amenity trees* (2007) page 18

- 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 than 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.

- 10.11 **Underground Services:** 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. No roots greater than 30mm in diameter should be severed during the installation of service pipes unless approved in writing by the project Arborist.
- 10.12 **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.

- 10.13 **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.
- 10.14 **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.

## 11. HOLD POINTS

**11.1 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.

**11.2 Hold points applicable to the development have been shaded in grey.**

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 10 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 are to be undertaken in consultation with the project Arborist to minimise the impact to trees.	Landscape	Principle contractor	Project Arborist	
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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- *Manly Development Control Plan 2013*, <http://www.manly.nsw.gov.au/planning-and-development/lep-dcp-policies/>.

## 13. LIST OF APPENDICES

The following are included in the appendices:

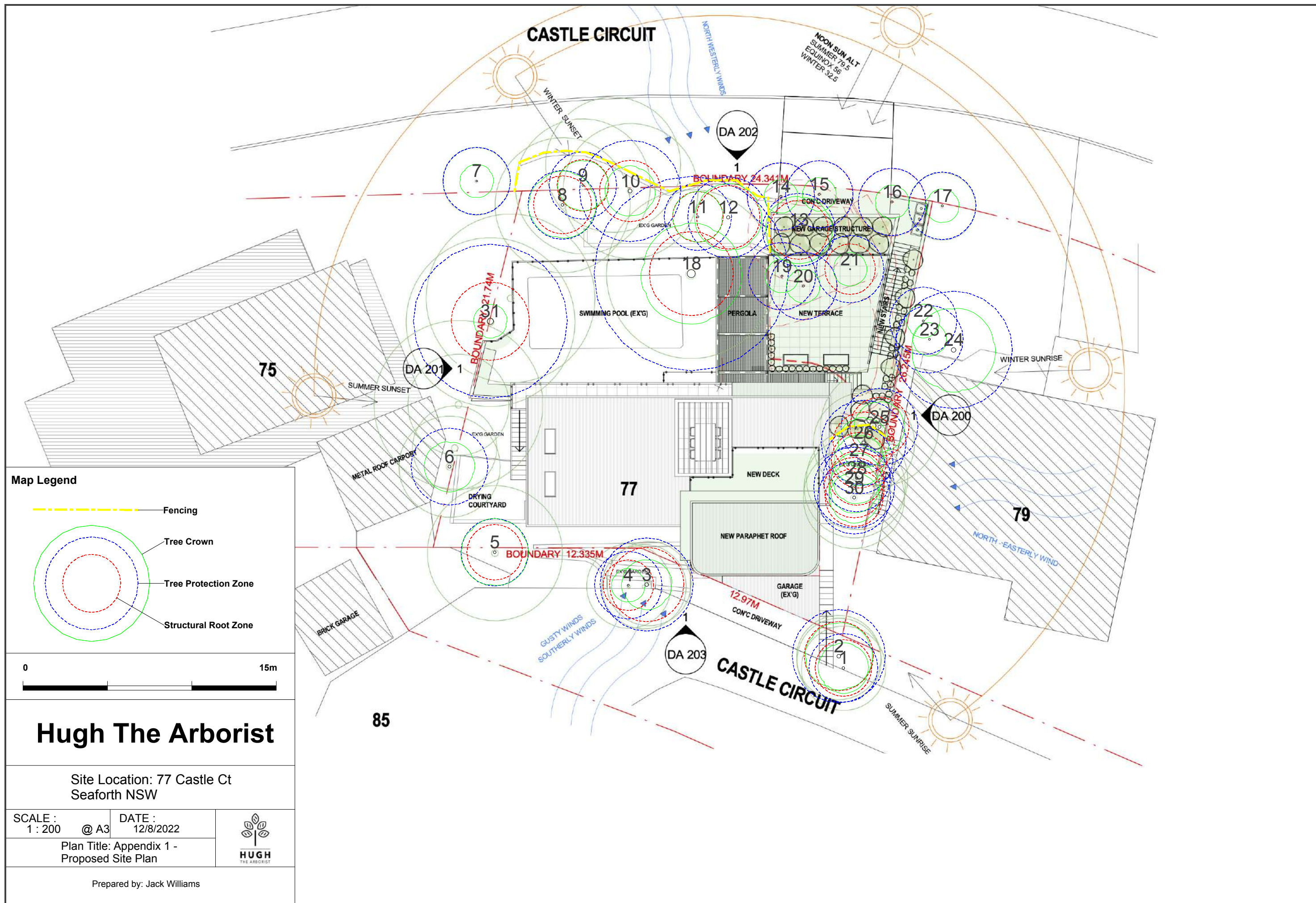
Appendix 1: Site Plans

Appendix 2: Tree inspection schedule

Appendix 3: Further Information of Methodology



Jack Williams  
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## Appendix 2 - Tree Inspection Schedule

Tree ID	Common Name	Botanical Name	Age Class	Height (m)	Canopy Spread Radius (m)	Stem 1	Stem 2	Stem 3	Stem 4	DBH (mm)	DAB (mm)	Health	Structure	Amenity Value	SULE	Retention Value	TPZ Radius (m)	SRZ Radius (m)	Notes
1	Sweet Pittosporum	<i>Pittosporum undulatum</i>	Semi-mature	4	1.5	150	70			166	200	Fair	Fair	Low	2. Medium	Z1	2.0	1.7	None.
2	Sweet Pittosporum	<i>Pittosporum undulatum</i>	Mature	6	2	170	150			227	320	Good	Fair	Low	2. Medium	Z1	2.7	2.1	None.
3	Weeping Bottlebrush	<i>Callistemon viminalis</i>	Semi-mature	6	1.5	160	110	130		234	380	Fair	Fair	Low	2. Medium	Z10	2.8	2.2	Asymmetric crown shape.
4	Willow Bottlebrush	<i>Callistemon salignus</i>	Semi-mature	5	1	130				130	150	Good	Good	Low	1. Long	Z1	2.0	1.5	None.
5	Native Franjipani	<i>Hymenosporum flavum</i>	Semi-mature	4	2	160				160	190	Fair	Fair	Low	3. Short	Z1	2.0	1.6	Low foliage density for species.
6	Bangalow Palm	<i>Archontophoenix cunninghamiana</i>	Mature	7	1.5	180				180	N/A	Good	Good	Low	1. Long	Z3	2.5	N/A	Exempt species.
7	Coin-spot Tree Fern	<i>Cyathea cooperi</i>	Mature	5	1	140				140	N/A	Good	Good	Medium	1. Long	A1	2.0	N/A	None.
8	Sweet Pittosporum	<i>Pittosporum undulatum</i>	Mature	5	2	170				170	210	Fair	Fair	Low	3. Short	Z1	2.0	1.7	Low foliage density for species.
9	Coastal Banksia	<i>Banksia integrifolia</i>	Semi-mature	4	1.5	130				130	160	Good	Good	Low	1. Long	Z1	2.0	1.5	None.
10	River She Oak	<i>Casuarina cunninghamiana</i>	Semi-mature	6	1.5	180	170			248	240	Good	Fair	Low	1. Long	Z1	3.0	1.8	None.
11	Coastal Banksia	<i>Banksia integrifolia</i>	Semi-mature	5	1.5	120				120	150	Good	Fair	Low	5. Small/Young	Z1	2.0	1.5	Not marked on survey.
12	Coastal Banksia	<i>Banksia integrifolia</i>	Mature	6	2	200				200	260	Good	Good	Medium	1. Long	A1	2.4	1.9	Not marked on survey.
13	Coastal Banksia	<i>Banksia integrifolia</i>	Semi-mature	5	2	180				180	220	Good	Fair	Medium	2. Medium	Z10	2.2	1.8	Asymmetric crown shape.
14	Coin-spot Tree Fern	<i>Cyathea cooperi</i>	Mature	4	1	100				100	N/A	Good	Good	Low	1. Long	Z1	2.0	N/A	None.
15	Coin-spot Tree Fern	<i>Cyathea cooperi</i>	Mature	5	1	130				130	N/A	Good	Good	Low	1. Long	Z1	2.0	N/A	None.
16	Coin-spot Tree Fern	<i>Cyathea cooperi</i>	Mature	5	1	140				140	N/A	Good	Good	Low	1. Long	Z1	2.0	N/A	None.
17	Kentea Palm	<i>Howea forsteriana</i>	Semi-mature	4	1	70	80			106	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species.
18	Cheese Tree	<i>Glochidion ferdinandi</i>	Mature	6	3	370	300			476	510	Good	Fair	Medium	2. Medium	A1	5.7	2.5	Asymmetric crown shape.
19	Coin-spot Tree Fern	<i>Cyathea cooperi</i>	Semi-mature	4	1	120				120	N/A	Good	Good	Low	1. Long	Z1	2.0	N/A	None.
20	Coin-spot Tree Fern	<i>Cyathea cooperi</i>	Semi-mature	4	1	110				110	N/A	Good	Good	Low	1. Long	Z1	2.0	N/A	None.
21	Blueberry Ash	<i>Elaeocarpus reticulatus</i>	Semi-mature	5	1	90				90	100	Good	Good	Low	5. Small/Young	Z1	2.0	1.5	Not marked on survey.
22	Bangalow Palm	<i>Archontophoenix cunninghamiana</i>	Mature	10	1	200				200	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species.
23	Bangalow Palm	<i>Archontophoenix cunninghamiana</i>	Mature	10	1	200				200	N/A	Good	Good	Low	1. Long	Z3	2.0	N/A	Exempt species.
24	Cocos Palm	<i>Syragrus romanzoffianum</i>	Mature	10	2.5	250				250	N/A	Good	Good	Low	1. Long	Z3	3.5	N/A	Exempt species.
25	Weeping Lilly Pilly	<i>Waterhousia floribunda</i>	Semi-mature	9	1.5	190				190	220	Good	Good	Medium	1. Long	A1	2.3	1.8	None.
26	Weeping Lilly Pilly	<i>Waterhousia floribunda</i>	Semi-mature	9	1.5	210				210	240	Good	Good	Medium	1. Long	A1	2.5	1.8	None.
27	Weeping Lilly Pilly	<i>Waterhousia floribunda</i>	Semi-mature	9	1.5	160				160	190	Good	Good	Medium	1. Long	A1	2.0	1.6	None.
28	Weeping Lilly Pilly	<i>Waterhousia floribunda</i>	Semi-mature	9	1.5	160				160	180	Good	Good	Medium	1. Long	A1	2.0	1.6	None.

## Appendix 2 - Tree Inspection Schedule

Tree ID	Common Name	Botanical Name	Age Class	Height (m)	Canopy Spread Radius (m)	Stem 1	Stem 2	Stem 3	Stem 4	DBH (mm)	DAB (mm)	Health	Structure	Amenity Value	SULE	Retention Value	TPZ Radius (m)	SRZ Radius (m)	Notes
29	Weeping Lilly Pilly	<i>Waterhousia floribunda</i>	Semi-mature	9	1.5	200				200	230	Good	Good	Medium	1. Long	A1	2.4	1.8	None.
30	Weeping Lilly Pilly	<i>Waterhousia floribunda</i>	Semi-mature	9	1.5	180				180	210	Good	Good	Medium	1. Long	A1	2.2	1.7	None.
31	Smooth Barked Apple	<i>Angophora costata</i>	Semi-mature	7	1	380				380	430	Poor	Poor	Medium	4. Remove	Z10	4.6	2.3	Whole crown area failed, foliage formed from epicormic growth only.

### Explanatory Notes

**Tree Species** - 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).

**Diameter at Breast Height (DBH)** - Measured with a DBH tape or estimated at approximately 1.4m above ground level.

**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 x 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 x 50)<sup>0.42</sup> x 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.

**Retention Value**: Tree AZ, see appendix 3 for categories.

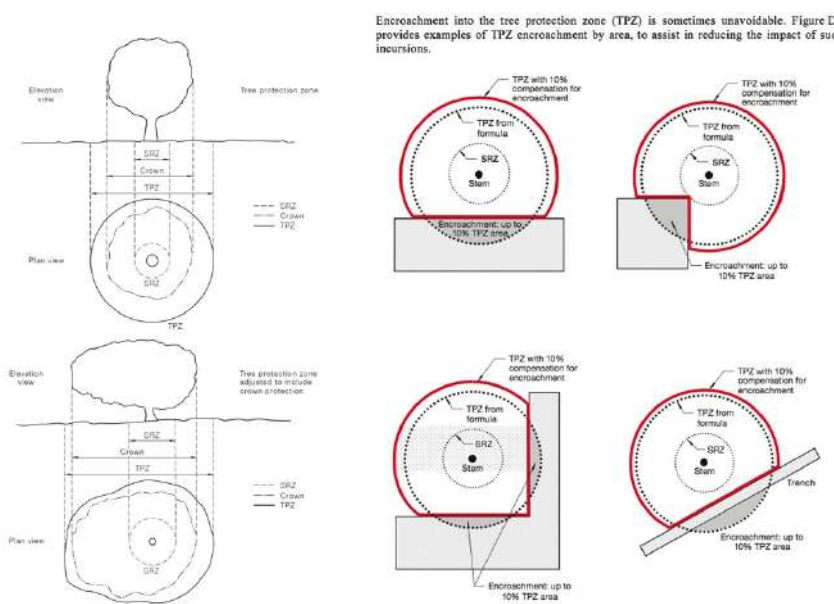


### Appendix 3 - Further Information of Methodology

1. **Tree Protection Zone:** The tree protection zone (TPZ) is the principle means of protecting trees on development sites. The TPZ is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable. The radius of the TPZ is calculated for each tree by multiplying its DBH x 12. The derived value is measured in radius from the centre of the stem/trunk at ground level. A TPZ should not be less than 2.0 metres nor greater than 15 metres (except where crown protection is required). It is commonly observed that tree roots will extend significant further than the indicative TPZ, however the TPZ is an area identified AS4970-2009 to be extent where root loss or disturbance will generally not 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 tree protection also incorporates the SRZ (see below for more information about the SRZ). I have calculated the TPZ of palms, other monocots, cycads and tree ferns at one metre outside the crown projection. See appendices for additional information about the TPZ including information about calculating the TPZ and examples of TPZ encroachment.

**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.

**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.



2. **Structural Root Zone:** 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 need to be maintained to preserve a viable tree as it will only have a minor effect on the trees vigour and health. There are several factors that determine 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.

An indicative SRZ radius can be determined from the diameter of the trunk measured immediately above the root buttresses. Root investigation could provide more information about the extent of the SRZ. The following formula should be used to calculate the SRZ.

SRZ radius =  $(D \times 50)^{0.42} \times 0.64$  (D = Diameter above root buttress).

3. **Tree 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;
  - Young/Newly planted: Young or recently planted tree.
  - Semi Mature: Up to 20% of the usual life expectancy for the species.
  - Mature: Between 20%-80% of the usual life expectancy for the species.
  - Over mature: Over 80% of the usual life expectancy for the species.
  - Dead: Tree is dead or almost dead.

4. **Health/Physiological Condition:** Below are examples conditions used when assigning a category for tree health.

<u>Category</u>	<u>Example condition</u>	<u>Summary</u>
Good	<ul style="list-style-type: none"> <li>• Crown has good foliage density for species.</li> <li>• Tree shows no or minimal signs of pathogens that are unlikely to have an effect on the health of the tree.</li> <li>• Tree is displaying good vigour and reactive growth development.</li> <li>• Trees that have a life expectancy 40 or more years.</li> </ul>	<ul style="list-style-type: none"> <li>• The tree is in average or above average health and condition and no remedial works are required except general maintenance.</li> </ul>
Fair	<ul style="list-style-type: none"> <li>• The tree may be starting to dieback or have over up to 25% deadwood.</li> <li>• Tree may have slightly reduced crown density or thinning.</li> <li>• There may be some discolouration of foliage.</li> <li>• Average reactive growth development.</li> <li>• There may be signs of infection pathogens which may further deteriorate the health of the tree.</li> <li>• There may be epicormic growth indicating increased levels of stress within the tree.</li> <li>• Trees that may only live between 15 and 40 more years</li> </ul>	<ul style="list-style-type: none"> <li>• The tree is in below average health and vigour and may require remedial works to improve the trees health.</li> </ul>
Poor	<ul style="list-style-type: none"> <li>• The may be in decline, have extensive dieback or have over 25% deadwood.</li> <li>• The canopy may be sparse or the leaves may be unusually small for species.</li> <li>• Pathogens or pests are having a significant detrimental effect on the tree health.</li> <li>• Trees that have useful life expectancy of less than 5 years.</li> </ul>	<ul style="list-style-type: none"> <li>• The tree is displaying low levels of health and remedial action are unlikely to be sufficient to improve the health of the tree.</li> </ul>
Dead	<ul style="list-style-type: none"> <li>• The tree is dead or almost dead.</li> </ul>	<ul style="list-style-type: none"> <li>• The tree should generally be removed.</li> </ul>

5. **Structural Condition:** Below are examples conditions used when assigning a category for structural condition.

<u>Category</u>	<u>Example condition</u>	<u>Summary</u>
Good	<ul style="list-style-type: none"> <li>• Branch unions appear to be strong with no sign of defects.</li> <li>• There are no significant cavities.</li> <li>• The tree is unlikely to fail in usual conditions.</li> <li>• The tree has a balanced crown shape and form.</li> <li>• Trees that have a life expectancy 40 or more years.</li> </ul>	<ul style="list-style-type: none"> <li>• The tree is considered structurally good with well developed form.</li> </ul>
Fair	<ul style="list-style-type: none"> <li>• The tree may have structural defects.</li> <li>• The identified defects could potentially develop into more significant defects.</li> <li>• The tree may a cavity that is currently unlikely to fail but may deteriorate in the future.</li> <li>• The tree is an unbalanced shape or leans significantly.</li> <li>• The tree may have minor damage to its roots.</li> <li>• The root plate may have moved in the past but the tree has now compensated for this.</li> <li>• Branches may be rubbing or crossing.</li> <li>• The tree may have suppressed form.</li> <li>• Trees that may only live between 15 and 40 more years</li> </ul>	<ul style="list-style-type: none"> <li>• The identified defects are unlikely cause major failure.</li> <li>• Some branch failure may occur in usual conditions.</li> <li>• Remedial works can be undertaken to alleviate potential defects.</li> </ul>

Poor	<ul style="list-style-type: none"> <li>• The tree has significant structural defects that cannot be alleviated.</li> <li>• Branch unions may be poor or weak.</li> <li>• The tree may have a cavity or cavities with excessive levels of decay that could cause catastrophic failure.</li> <li>• The tree may have root damage or is displaying signs of recent movement.</li> <li>• The tree crown may have poor weight distribution which could cause failure.</li> <li>• Trees that have useful life expectancy of less than 5 years.</li> </ul>	<ul style="list-style-type: none"> <li>• The identified defects are likely to cause either partial or whole failure of the tree and cannot be alleviated.</li> </ul>
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6. **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 size/dimensions of the tree.
  - The visibility of the tree to adjacent sites and visual prominence of the tree.
  - The age, growth rate and longevity of the tree.
  - The relationship between the tree and the site, including heritage and biodiversity status, or cultural/commentative trees.
  - Whether the tree is protected by any statutory conditions.
  - Whether tree is native, locally occurring or exotic.
  - The habitat value of the tree.
  - Whether the tree is considered a noxious weed or exempt species.

The amenity value is rated using one of the following values.

- Very High
- High
- Moderate
- Low
- Very Low



7. **Safe Useful Life Expectancy (SULE), (Barrel, 2001):** A trees 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 - Over 40 years	(a) Structurally sound trees located in positions that can accommodate future growth. (b) Trees that could be made suitable for retention in the long term by remedial tree care. (c) Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long term retention.
2. Medium - 15 to 40 years	(a) Trees that may only live between 15 and 40 more years. (b) Trees that could live for more than 40 years but may be removed for safety or nuisance reasons. (c) Trees that could live for more than 40 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. (d) Trees that could be made suitable for retention in the medium term by remedial tree care.
3. Short - 5 to 15 years	(a) Trees that may only live between 5 and 15 more years. (b) Trees that could live for more than 15 years but may be removed for safety or nuisance reasons. (c) Trees that could live for more than 15 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. (d) Trees that require substantial remedial tree care and are only suitable for retention in the short term.
4. Remove - Under 5 years	(a) Dead, dying, suppressed or declining trees because of disease or inhospitable conditions. (b) Dangerous trees because of instability or recent loss of adjacent trees. (c) Dangerous trees because of structural defects including cavities, decay, included bark, wounds or poor form. (d) Damaged trees that are clearly not safe to retain. (e) Trees that could live for more than 5 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. (f) Trees that are damaging or may cause damage to existing structures within 5 years. (g) Trees that will become dangerous after removal of other trees for the reasons given in (a) to (f). (h) Trees in categories (a) to (g) that have a high wildlife habitat value and, with appropriate treatment, could be retained subject to regular review.
5. Small/Young	(a) Small trees less than 5m in height. (b) Young trees less than 15 years old but over 5m in height. (c) Formal hedges and trees intended for regular pruning to artificially control growth.

8. **Root investigations:** The root investigations should identify roots greater than 40mm in diameter that are located along the edge of the structures footprint or in the location of footings. Root investigations must be carried out using non-invasive methods, such as manual excavations or ground penetrating radar (GPR). Any excavations for the root investigations must be carried out manually to avoid damaging the roots during excavations. Manual excavation may include the use of a high-pressure air/air knife, or a combination of high-pressure water and a vacuum device. When hand excavating carefully work around roots retaining as many as possible. Take care to not fray, wound, or cause damage to any roots during excavations as this may cause decay or infection from pathogens. It is essential that exposed roots are kept moist and the excavation back filled as soon as possible. The root investigations should be carried out by a qualified Arborist minimum AQF3. Once roots are exposed, a visual assessment can be carried out by a consulting Arborist to evaluate the potential impact of the proposed root loss on the health and stability of the tree. A root map/report should be prepared identifying the findings of investigations, including photographs as supporting evidence in the report.

9. **Retention Value:** The system I have used to award the retention value is Tree AZ. 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 table below provides a brief description of each category.

### 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](http://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 cannot 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
- Z7** **Excessive nuisance:** Trees that are likely to be removed within 10 years because of unacceptable impact on people
- Z8** 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
- Z9** 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

- Z10** Severe damage and/or structural defects where a high risk of failure can be temporarily reduced by reasonable remedial care, i.e. cavities, decay, included bark, wounds, excessive imbalance, vulnerable to adverse weather conditions, etc
- Z11** Poor condition or location with a low potential for recovery or improvement, i.e. dominated by adjacent trees or buildings, poor architectural framework, etc
- Z12** Removal would benefit better adjacent trees, i.e. relieve physical interference, suppression, etc
- Z13** 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.

TreeAZ is designed by Barrell Tree Consultancy ([www.barrelltreecare.co.uk](http://www.barrelltreecare.co.uk)) and is reproduced with their permission

## Glossary of Terms

**Abiotic** - Pertaining to non-living agents; e.g. environmental factors

**Adventitious shoots** - Shoots that develop other than from apical, axillary or dormant buds; see also 'epicormic'

**Anchorage** - The system whereby a tree is fixed within the soil, involving cohesion between roots and soil and the development of a branched system of roots which withstands wind and gravitational forces transmitted from the aerial parts of the tree

**Bark** - A term usually applied to all the tissues of a woody plant lying outside the vascular cambium, thus including the phloem, cortex and periderm; occasionally applied only to the periderm or the phellem

**Branch:**

- **Primary.** A first order branch arising from a stem
- **Lateral.** A second order branch, subordinate to a primary branch or stem and bearing sub-lateral branches
- **Sub-lateral.** A third order branch, subordinate to a lateral or primary branch, or stem and usually bearing only twigs

**Branch collar** - A visible swelling formed at the base of a branch whose diameter growth has been disproportionately slow compared to that of the parent stem; a term sometimes applied also to the pattern of growth of the cells of the parent stem around the branch base

**Brown-rot** - A type of wood decay in which cellulose is degraded, while lignin is only modified

**Buckling** - An irreversible deformation of a structure subjected to a bending load

**Buttress zone** - The region at the base of a tree where the major lateral roots join the stem, with buttress-like formations on the upper side of the junctions

**Cambium** - Layer of dividing cells producing xylem (woody) tissue internally and phloem (bark) tissue externally

**Canker** - A persistent lesion formed by the death of bark and cambium due to colonisation by fungi or bacteria

**Compartmentalisation** - The confinement of disease, decay or other dysfunction within an anatomically discrete region of plant tissue, due to passive and/or active defences operating at the boundaries of the affected region

**Compressive loading** - Mechanical loading which exerts a positive pressure; the opposite to tensile loading

**Condition** - An indication of the physiological condition of the tree. Where the term 'condition' is used in a report, it should not be taken as an indication of the stability of the tree

**Crown/Canopy** - The main foliage bearing section of the tree

**Crown lifting** - The removal of limbs and small branches to a specified height above ground level

**Crown thinning** - The removal of a proportion of secondary branch growth throughout the crown to produce an even density of foliage around a well-balanced branch structure

**Crown reduction/shaping** - A specified reduction in crown size whilst preserving, as far as possible, the natural tree shape

**DAB (Diameter Above Buttress)** - Trunk diameter measured above the root buttress

**Defect** - In relation to tree hazards, any feature of a tree which detracts from the uniform distribution of mechanical stress, or which makes the tree mechanically unsuited to its environment

**Dieback** - The death of parts of a woody plant, starting at shoot-tips or root-tips

**Disease** - A malfunction in or destruction of tissues within a living organism, usually excluding mechanical damage; in trees, usually caused by pathogenic micro-organisms

**Dominance** - In trees, the tendency for a leading shoot to grow faster or more vigorously than the lateral shoots; also the tendency of a tree to maintain a taller crown than its neighbours

**Dormant bud** - An axial bud which does not develop into a shoot until after the formation of two or more annual wood increments; many such buds persist through the life of a tree and develop only if stimulated to do so

**Dysfunction** - In woody tissues, the loss of physiological function, especially water conduction, in sapwood

**DBH (Diameter at Breast Height)** - Stem diameter measured at a height of 1.4 metres or the nearest measurable point. Where measurement at a height of 1.4 metres is not possible, another height may be specified

**Deadwood** - Branch or stem wood bearing no live tissues. Retention of deadwood provides valuable habitat for a wide range of species and seldom represents a threat to the health of the tree. Removal of deadwood can result in the ingress of decay to otherwise sound tissues and climbing operations to access deadwood can cause significant damage to a tree. Removal of deadwood is generally recommended only where it represents an unacceptable level of hazard

**Epicormic shoot** - A shoot having developed from a dormant or adventitious bud and not having developed from a first year shoot

**Flush-cut** - A pruning cut which removes part of the branch bark ridge and or branch-collar

**Girdling root** - A root which circles and constricts the stem or roots possibly causing death of phloem and/or cambial tissue

**Habit** - The overall growth characteristics, shape of the tree and branch structure

**Hazard beam** - An upwardly curved part of a tree in which strong internal stresses may occur without being reduced by adaptive growth; prone to longitudinal splitting

**Heartwood/false-heartwood** - The dead central wood that has become dysfunctional as part of the aging processes and being distinct from the sapwood

**Heave** - A term mainly applicable to a shrinkable clay soil which expands due to re-wetting after the felling of a tree which was previously extracting moisture from the deeper layers; also the lifting of pavements and other structures by root diameter expansion; also the lifting of one side of a wind-rocked root-plate

**Included bark (ingrown bark)** - Bark of adjacent parts of a tree (usually forks, acutely joined branches or basal flutes) which is in face-to-face contact

**Lever arm** - A mechanical term denoting the length of the lever represented by a structure that is free to move at one end, such as a tree or an individual branch

**Lignin** - The hard, cement-like constituent of wood cells; deposition of lignin within the matrix of cellulose microfibrils in the cell wall is termed Lignification

**Lions tailing** - A term applied to a branch of a tree that has few if any side-branches except at its end, and is thus liable to snap due to end-loading

**Loading** - A mechanical term describing the force acting on a structure from a particular source; e.g. the weight of the structure itself or wind pressure

**Mycelium** - The body of a fungus, consisting of branched filaments (hyphae)

**Occlusion** - The process whereby a wound is progressively closed by the formation of new wood and bark around it

**Pathogen** - A micro-organism which causes disease in another organism

**Photosynthesis** - The process whereby plants use light energy to split hydrogen from water molecules, and combine it with carbon dioxide to form the molecular building blocks for synthesizing carbohydrates and other biochemical products

**Probability** - A statistical measure of the likelihood that a particular event might occur

**Pruning** - The removal or cutting back of twigs or branches, sometimes applied to twigs or small branches only, but often used to describe most activities involving the cutting of trees or shrubs

**Radial** - In the plane or direction of the radius of a circular object such as a tree stem

**Reactive Growth/Reaction Wood** - Production of woody tissue in response to altered mechanical loading; often in response to internal defect or decay and associated strength loss (cf. adaptive growth)

**Ring-barking** - The removal of a ring of bark and phloem around the circumference of a stem or branch, normally resulting in an inability to transport photosynthetic assimilates below the area of damage. Almost inevitably results in the eventual death of the affected stem or branch above the damage

**Root-collar** - The transitional area between the stem/s and roots

**Sapwood** - Living xylem tissues

**Soft-rot** - A kind of wood decay in which a fungus degrades cellulose within the cell walls, without any general degradation of the wall as a whole

**Stem/s** - Principle above-ground structural component(s) of a tree that supports its branches

**Stress** - In plant physiology, a condition under which one or more physiological functions are not operating within their optimum range, for example due to lack of water, inadequate nutrition or extremes of temperature

**SRZ (Structural Root Zone)** - The area around the base of the tree required for the tree's stability in the ground.

**Subsidence** - In relation to soil or structures resting in or on soil, a sinking due to shrinkage when certain types of clay soil dry out, sometimes due to extraction of moisture by tree roots

**Taper** - In stems and branches, the degree of change in girth along a given length

**Targets** - In tree risk assessment (with slight misuse of normal meaning) persons or property or other things of value which might be harmed by mechanical failure of the tree or by objects falling from it

**Topping** - In arboriculture, the removal of the crown of a tree, or of a major proportion of it

**Transpiration** - The evaporation of moisture from the surface of a plant, especially via the stomata of leaves; it exerts a suction which draws water up from the roots and through the intervening xylem cells

**TPZ (Tree Protection Zone)** - A specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development.

**Understory** - This layer consists of younger individuals of the dominant trees, together with smaller trees and shrubs which are adapted to grow under lower light conditions

**Veteran tree** - Tree that, by recognised criteria, shows features of biological, cultural or aesthetic value that are characteristic of, but not exclusive to, individuals surviving beyond the typical age range for the species concerned. These characteristics might typically include a large girth, signs of crown retrenchment and hollowing of the stem

**Vigour** - The expression of carbohydrate expenditure to growth (in trees)

**White-rot** - A range of kinds of wood decay in which lignin, usually together with cellulose and other wood constituents, is degraded

**Wind exposure** - The degree to which a tree or other object is exposed to wind, both in terms of duration and velocity

**Wind pressure** - The force exerted by a wind on a particular object

**Windthrow** - The blowing over of a tree at its roots