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# Arboricultural Impact Assessment Report

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## **Site location:**

87 Alexandra Crescent  
Bayview NSW

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## **Prepared for:**

Lindsay Little & Associates Pty Ltd

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## **Prepared by:** Bryce Claassens

Urban Arbor Pty Ltd

**Date Prepared:** 30 March 2022

**Ref:** 220330-87 Alexandra Cres-AIA

**Rev:** 1

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## **1. INTRODUCTION**

- 1.1 Urban Arbor have been instructed by Lindsay Little & Associates Pty Ltd to provide an Arboricultural Impact Assessment Report for one tree located within the site in relation to a proposed development.
- 1.2 Below is a list of all documents and information provided to assist in preparing this report;
- A) Architectural Plan Set, Lindsay Little & Associates Pty Ltd, Job No. 1281/19, Including drawings, A02, A03, A04, A05, A06, A07, A08, A09, A10 and A11, Issue C, 14 March 2022.
  - B) Carport Sketch, Lindsay Little & Associates Pty Ltd, 5 November 2019.
  - C) Arboricultural Root Investigation Report, Urban Arbor Pty Ltd, Ref: 20/02/27/87ACB, 27 February 2020 (Appendix 4).
- 1.3 The site/tree inspections and root investigations were carried out on 27 February 2020. Access was available to the subject site and adjoining public areas only. All tree data contained in this report was collected during this site inspection.

## **2. SCOPE OF THE REPORT**

- 2.1 This report has been undertaken to meet the following objectives.
- 2.1.1 Conduct a ground level visual assessment of one significant tree located within the site.
  - 2.1.2 Determine the trees estimated contribution years and remaining useful life expectancy and award the tree 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 tree in accordance with AS4970 Protection of trees on development sites (2009).
  - 2.1.4 Specify tree protection measures in accordance with AS4970-2009 for any tree to be retained during the development.

### 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 inspection was 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 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.
- 3.6 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.
- 3.7 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 an *spp.*
- 3.8 Urban Arbor neither guarantees, nor is it responsible for, the accuracy of information provided by others that is contained within this report.
- 3.9 All diagrams, plans and photographs included in this report are visual aids only, and are not to scale unless otherwise indicated.
- 3.10 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) - 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)<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 Trunk diameter was measured using a DBH tape or in some cases estimated. The trunk diameter of all trees in adjoining sites has been estimated. Tree height and tree canopy spread was measured with a clinometer or in some cases estimated. All other measurements were estimations unless otherwise stated. The other tool used during the assessment was a digital camera.

4.4 All information was imported into (GIS) PT-mapper pro software. This software was used to measure/calculate all encroachment estimates included in this report.

4.5 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) in a Microsoft Excel spreadsheet .<sup>4</sup>

4.6 Details of how the observations in this report have been assessed are listed in the appendices.

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<sup>1</sup> Barrell, J. (2001), 'SULE: Its use and status in the new millennium' in *Management of Mature Trees proceedings of the 4th NAAA Workshop*, Sydney, 2001. Barrell.

<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).

<sup>4</sup> Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009).

## 5. SITE LOCATION AND BRIEF DESCRIPTION

- 5.1 The subject site is located in the Northern Beaches Local Government Area (LGA), and all trees at the site are subject to protection by the Pittwater Local Environmental Plan (LEP) 2014<sup>5</sup> and Pittwater 21 Development Control Plan (DCP)<sup>6</sup>. The site is not located inside a Heritage Conservation Area and does not form part of a heritage item/listed as environmental heritage in the LEP heritage maps.<sup>7</sup> The site is identified as containing 'terrestrial biodiversity' in the Pittwater LEP Biodiversity maps.<sup>8</sup>
- 5.2 Proposed development works include alterations and additions to the existing dwelling, an extension to the existing carport, excavations for an underground tunnel, the installation of a lift, hard surfacing and additional structures.

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

- 6.1 **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.

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<sup>5</sup> Pittwater Local Environmental Plan 2014, <http://www.legislation.nsw.gov.au/>

<sup>6</sup> Pittwater 21 Development Control Plan, <https://www.northernbeaches.nsw.gov.au/planning-and-development>

<sup>7</sup> Pittwater LEP Heritage map - Sheet HER\_011, [https://eplanningdlprod.blob.core.windows.net/pdfmaps/6370\\_COM\\_HER\\_011\\_010\\_20160118.pdf](https://eplanningdlprod.blob.core.windows.net/pdfmaps/6370_COM_HER_011_010_20160118.pdf), accessed 30 March 2022.

<sup>8</sup> Pittwater LEP Biodiversity map - Sheet BIO\_011, [https://eplanningdlprod.blob.core.windows.net/pdfmaps/6370\\_COM\\_BIO\\_011\\_010\\_20140217.pdf](https://eplanningdlprod.blob.core.windows.net/pdfmaps/6370_COM_BIO_011_010_20140217.pdf), accessed 30 March 2022.

- 6.2 Structural Root Zone (SRZ):** This is the area around the base of a tree required for the tree's 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.
- 6.3 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.

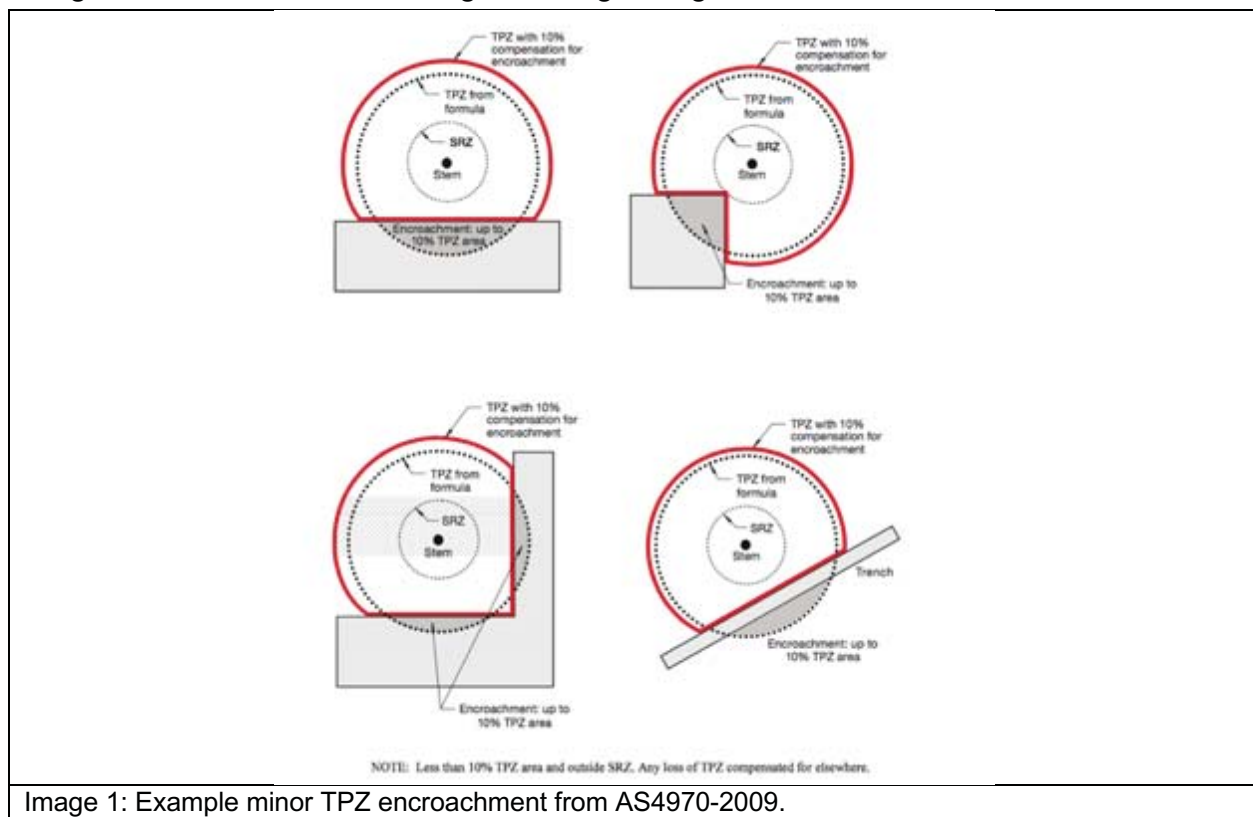


Image 1: Example minor TPZ encroachment from AS4970-2009.

**6.4 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. OBSERVATIONS, DISCUSSION AND CONCLUSIONS**

**7.1 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) for the subject tree has been calculated. The TPZ and SRZ should be measured in radius from the centre of the trunk. The subject tree has been awarded a retention value based on the observations during the site inspection. The system 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 Tree AZ categories sheet (Barrell Tree Consultancy) has been included in the appendices to assist with understanding the retention values. The retention value that has been allocated to the subject tree in this report is not definitive and should only be used as a guideline. This information has been summarised below.

**7.2 Site Plan:** A site plan has been included in appendix 1, where the indicative TPZ/SRZ of the tree assessed has been overlaid onto received proposed plan provided by the client to assist with understanding tree constraints at the site and how the impact to the tree has been assessed.

### **7.3 Tree 1**

**7.3.1 Tree 1 Observations:** Tree 1 is a mature Sydney Red Gum (*Angophora costata*) which is a locally occurring species. The tree has an approximate height of 17m, a crown spread (radius at widest section of crown) of 7m, a DBH of 770mm and a DAB of 820mm. At the time of inspection, the tree was displaying good health and vigour for the species. Tree 1 has a long useful life expectancy of more than forty years (SULE category 1a) and an increased high retention value of AA1. Tree 1 has a TPZ of 9.2 metres and an SRZ of 3.0 metres. See appendix 4 for the Arboricultural Root Investigations Report.



### 7.3.2 **Tree 1: Assessment of Construction Impacts:**

The root investigations completed by Urban Arbor Pty Ltd identified three significant roots in the location of the original design proposal for the carport extension. The design has been modified to allow for the retention of the three identified roots. See appendix 4, Arboricultural Root Investigation Report, for more information.

The existing brick stone/retaining wall and carport within the TPZ are to be retained (Image 1), with the exception of a small area of excavations for the new retaining wall/staircase. The proposed tunnel, retaining wall and staircase excavations will encroach into the TPZ by 10% (26.1m<sup>2</sup>) but not into the SRZ. This is considered to be a minor and acceptable TPZ encroachment. The proposed excavations will be set back significantly from the roots that were identified in the root investigations report (appendix 4). Therefore, the identified roots can be retained and the proposed works will not significantly impact the condition or stability of the tree.

The tree can be retained in a viable condition providing adequate tree protection is installed and maintained throughout the development. See section 9 for tree protection requirements. To maintain tree health, the installation of a temporary irrigation system is also recommended. See section 7.4 for details.

### 7.3.3 Photographs Tree 1



**Photo 1:** Looking South towards tree 1 from the roof of the existing carport. Showing the existing retaining wall.

**7.4 Temporary Irrigation Tree 1:** To reduce the impact to the tree, temporary irrigation is recommended prior to and during the development, including the following;

- Temporary irrigation should be installed at minimum one month prior to the commencement of development works.
- The irrigation should be maintained in adequate functional condition for the duration of the development.
- The irrigation should remain in adequate functional condition for at least one year post completion of the development.
- The irrigation should be installed to distribute water throughout the whole of the TPZ area (with the exception of areas of the TPZ occupied by existing or proposed structures).
- The irrigation should be set to a soil moisture monitoring system.
- The irrigation should be installed and maintain by qualified arborist/horticulturalist with a minimum AQF level 3.
- Timing of the irrigation should ensure that the water is not lost to evaporation. Avoid irrigating in the middle of the day when evaporative demand is highest.
- The project Arborist should carryout monthly inspections of the irrigation to ensure that it is maintained in adequate functional condition. During these inspections, the soil moisture in the TPZ should be monitored and adjustments to the rate of watering should be modified as required. The soil moisture should be maintained at no less than 60% of the field capacity of the soil.

## **8. RECOMMENDATIONS**

- 8.1 This report assesses the impact of a proposed development at the subject site to one significant tree.
- 8.2 A site plan has been included in appendix 1, where the indicative TPZ/SRZ of the tree assessed has been overlaid onto received proposed plan provided by the client to assist with understanding tree constraints at the site and how the impact to the tree has been assessed.
- 8.3 Tree 1 can be retained in a viable condition. To maintain tree health, the installation of a temporary irrigation system is recommended, see section 7.4 for detailed information.
- 8.4 Tree 1 must be protected in accordance with AS4970-2009, details of which are included in section 11.
- 8.5 No landscape plan has been assessed in this report. See section 11.10 for general guidance in relation to minimising the impact of proposed landscaping to retained trees.
- 8.6 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 11.11 for more information.
- 8.7 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 the development application.

## 9. TREE PROTECTION REQUIREMENTS

- 9.1 **Use of this report:** All contractors must be made aware of the tree protection requirements prior to commencing works at the site. This report and a copy of the site plans (Appendix 1) drawing must also be made available to any contractor prior to works commencing and during any on site operations. Appendix 1 includes the recommended location of tree protection overlaid onto the proposed site plan.
- 9.2 **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.
- 9.3 **Tree work:** All tree work should 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).
- 9.4 **Initial site meeting/on-going regular inspections:** The project Arborist is to hold a pre-construction site meeting with principal 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. Site inspections are recommended on a monthly frequency throughout the development.
- 9.5 **Site Specific Tree Protection Recommendations:** It is the responsibility of the principal 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. See section 11.6 for requirements of tree protection. See appendix 1 for indicative tree protection location.

Tree ID	Tree Species	TPZ Radius (m)	SRZ Radius (m)	Recommendations
1	<i>Angophora costata</i>	9.2	3.0	Retain and protect. Trunk protection is required and must be installed in accordance with section 11.6.3. Chainwire mesh fencing will not be practical due to the steep topography of the site. Star pickets and orange bunting will be required as temporary fencing which must encompass as much of the TPZ area as practical adjacent to the tree. The temporary fencing must be set back from the proposed excavation area by 0.5m. Mulch and irrigation will be required within the fenced area. The tree protection can only be removed upon the approval of the project arborist.

Site Address: 87 Alexandra Crescent, Bayview, NSW.

Prepared for: Lindsay Little & Associates Pty Ltd.

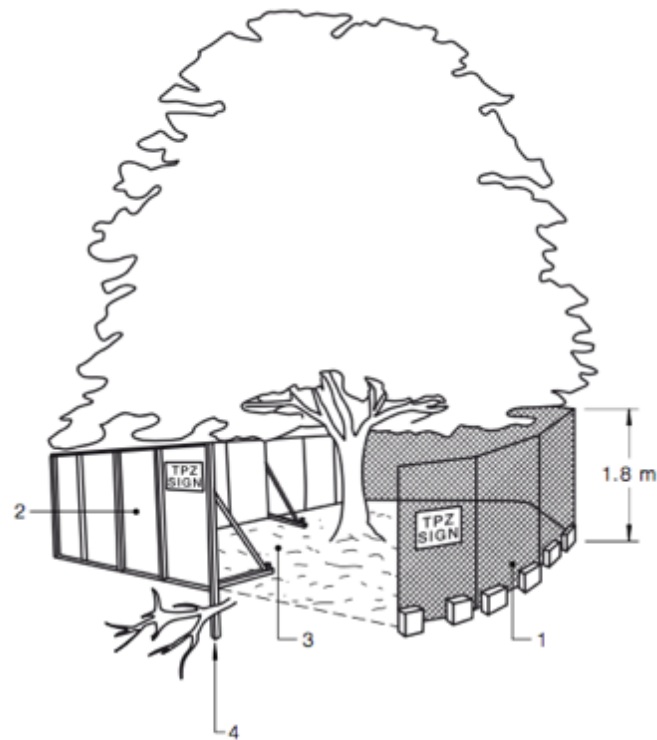
Prepared by: Bryce Claassens, Urban Arbor Pty Ltd, sales@urbanarbor.com.au, (02) 8004 2802.

Date of prepared: 30 March 2022. Rev: 1.

## 9.6 Tree Protection Specifications:

- 9.6.1 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.
- 9.6.2 Protective fencing: The protective fencing must be constructed of 1.8 metre 'cyclone chainmesh fence'. Where steep topography does not allow for the installation of chainmesh fencing, star pickets and orange bunting will be an acceptable substitute. The fencing should only be removed for the landscaping phase and this should be approved by the project Arborist. Where it is not feasible to install fencing at the specified location due to factors such as 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. Any modifications to the fencing locations must be approved by the project Arborist.
- 9.6.3 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
- 9.6.4 Mulch: Any areas of the TPZ located inside the subject site must be mulched to a depth of 75mm with good quality mulch. Mulch must not be built-up around the trunk of the trees as it can cause collar rot.
- 9.6.5 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, with timber/plywood boards overlaid. 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 and approved by the project Arborist as required.
- 9.6.6 Temporary irrigation: Temporary irrigation should distribute water evenly throughout the area of the TPZ. See section 7.4 for detailed information.



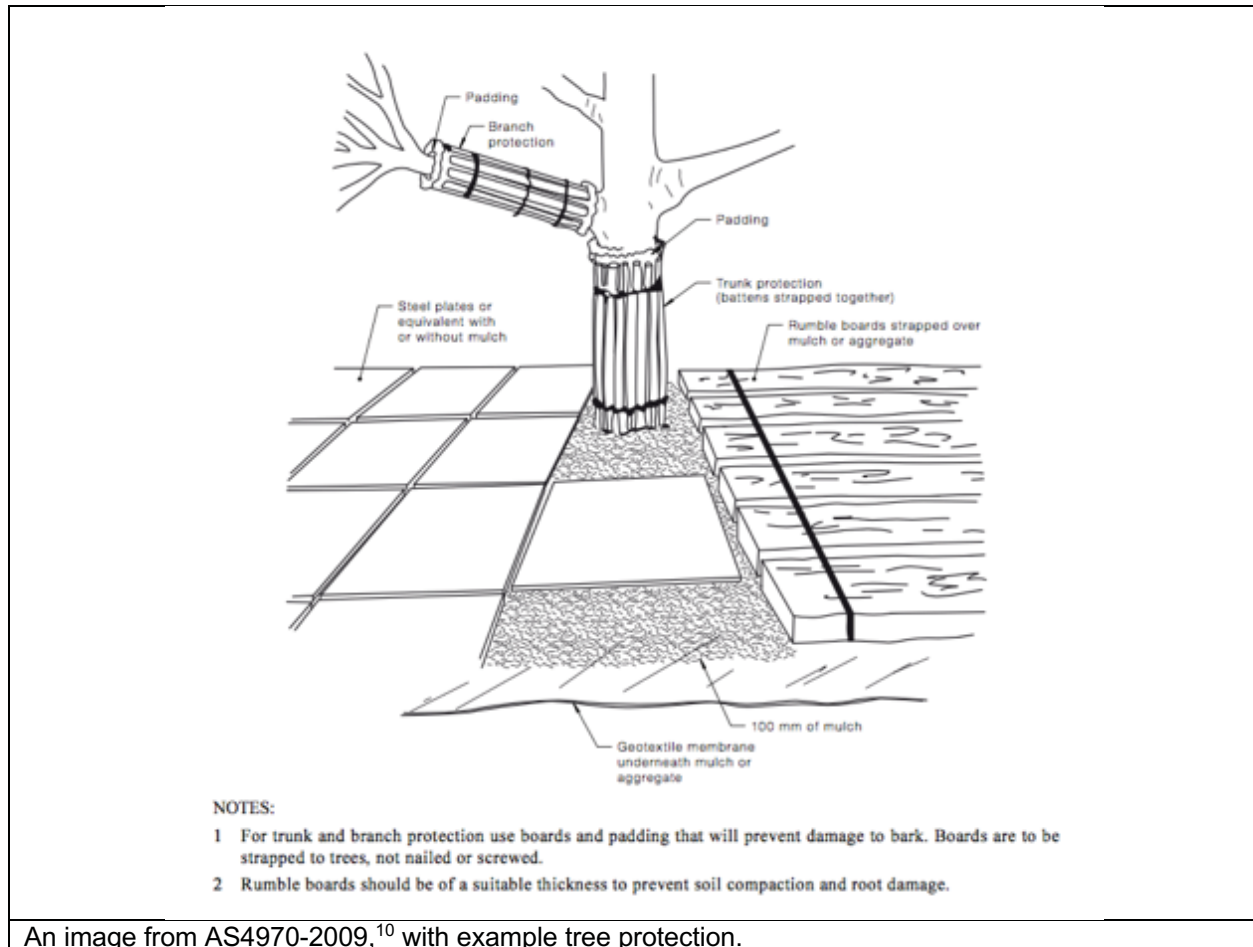


**LEGEND:**

- 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>9</sup> with example tree protection.

<sup>9</sup> Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009), page 16.



**9.7 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) Refuelling.
- F) Dumping of waste.
- 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.

<sup>10</sup> Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009), page 17.

- 9.8 **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.
- 9.9 **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 30mm 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>11</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.
- 9.10 **Landscaping:** All landscaping works within the TPZ of trees to be retained are to be undertaken in consultation with a consulting Arborist to minimise the impact to trees. General guidance is provided below to minimise the impact of new landscaping to trees to be retained.
- All excavations for landscaping works should be manual and in accordance with section 11.9.
  - Replacement planting for all trees recommended for removal should be incorporated into the landscape plan. It is recommended that at minimum one tree for each tree proposed to be removed are planted to maintain/increase overall canopy cover at the site when mature. Any replacement tree must be selected in accordance with AS2303-2015 Tree stock for landscape use.
  - 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 40mm in diameter.

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<sup>11</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 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, considerer 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. Footpaths 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.
  - Any new fencing in the TPZ of trees should constructed carefully to avoid impacting significant roots. The location of fence posts should be flexible to allow for the retention of root greater than 40mm in diameter. The base of fence panels should be located above existing soil grades.
- 9.11 **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.
- 9.12 **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.
- 9.13 **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.
- 9.14 **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.

## 10. CONSTRUCTION HOLD POINTS FOR TREE PROTECTION

**10.1 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. The principal contractor should be responsible for implementing all tree protection requirements.

Hold Point	Stage	Date Completed and Signature of Project Arborist Responsible
Project Arborist to hold pre construction site meeting with principal 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. Project Arborist to mark all trees approved for removal under DA consent.	Prior to development work commencing	
Project Arborist to assess and certify that tree protection has been installed in accordance with AS4970-2009 prior to works commencing at site.	Prior to development work commencing.	
In accordance with AS4970-2009 the project arborist should carryout regular site inspections to ensure works are carried out in accordance with the recommendations. Site inspections are recommended on a monthly frequency.	On-going throughout the development	
The removal of existing structures inside the TPZ of any tree to be retained, such as the existing buildings and hard surfaces must be supervised by the project Arborist.	Demolition	
Project Arborist to supervise all manual excavations and root pruning inside the TPZ of any tree to be retained. Project Arborist to approve all pruning of roots greater than 30mm inside TPZ. All root pruning of roots greater than 30mm in diameter must be carried out by a qualified Arborist/Horticulturalist with a minimum AQF level 3.	Construction	
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	
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.	Construction/ Landscape	
After all demolition, construction and landscaping 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.	Upon completion of development	

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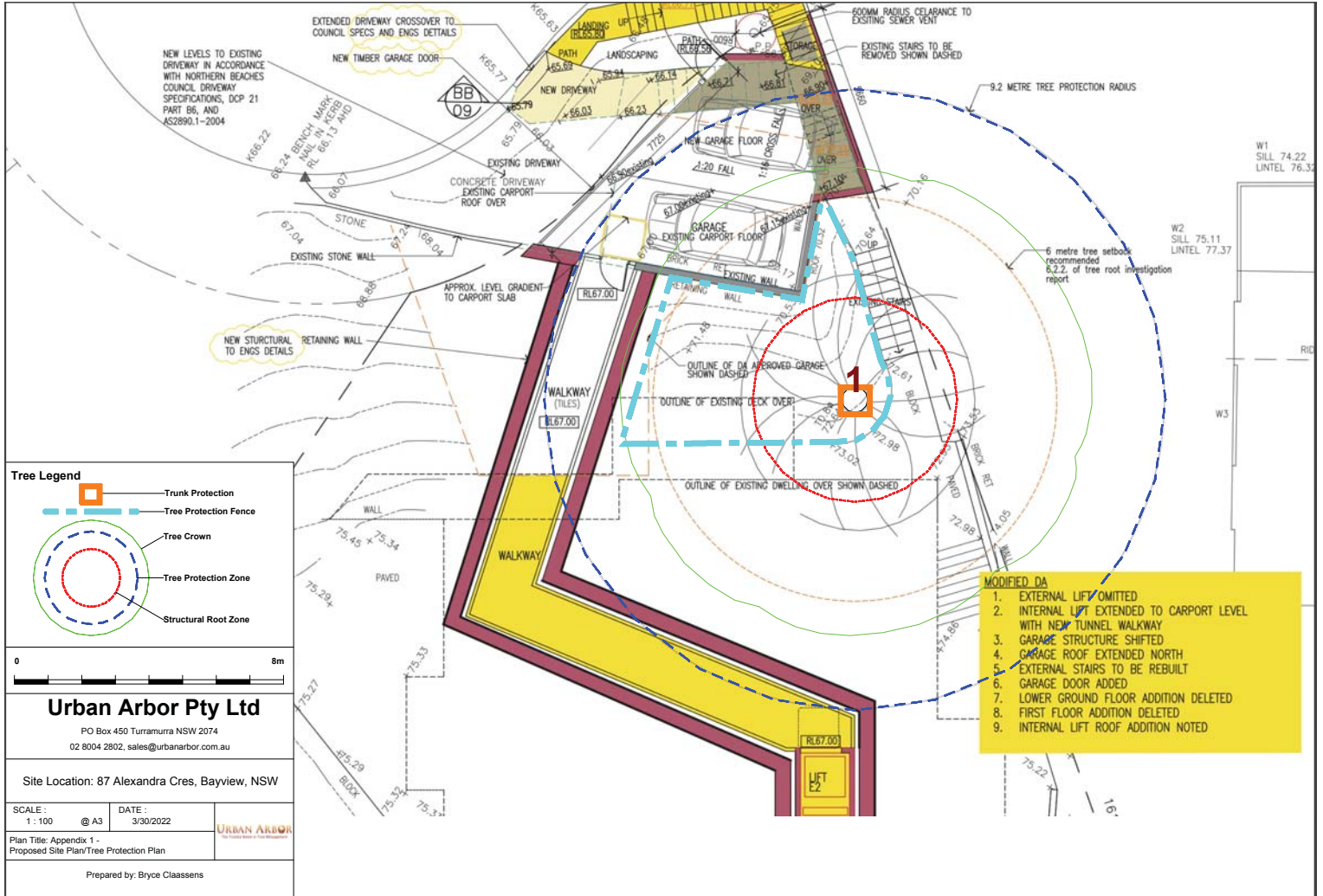
## 12. LIST OF APPENDICES

The following are included in the appendices:

- Appendix 1: Proposed Site Plan/Tree Protection Plan
- Appendix 2: Tree Inspection Schedule
- Appendix 3: Further Information of Methodology
- Appendix 4: Arboricultural Root Investigation Report



Bryce Claassens  
Diploma of Arboriculture (AQF5)  
Cert III Landscape Construction  
Member Arboriculture Australia  
Quantified Tree Risk Assessment (QTRA)  
ISA Tree Risk Assessment Qualification (TRAQ)



## 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	Stem 5	DBH (mm)	DAB (mm)	Health	Structure	Amenity Value	SULE	Retention Value	TPZ Radius (m)	SRZ Radius (m)	Notes
1	Sydney Red Gum	<i>Angophora costata</i>	Mature	17	7	770					770	820	Good	Good	Very High	1. Long	AA1	9.2	3.0	The trunk of the tree is located 2.0m from the existing dwelling (outside trunk).

### Explanatory Notes

**Tree Species** - Common name followed by botanical name. 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)** -  $(DAB \times 50)^{0.42} \times 0.64$ . Measured in radius from the centre of the trunk. Rounded up to nearest 0.1m.

**Health** - Good/Fair/Poor/Dead

**Structure** - Good/Fair/Poor

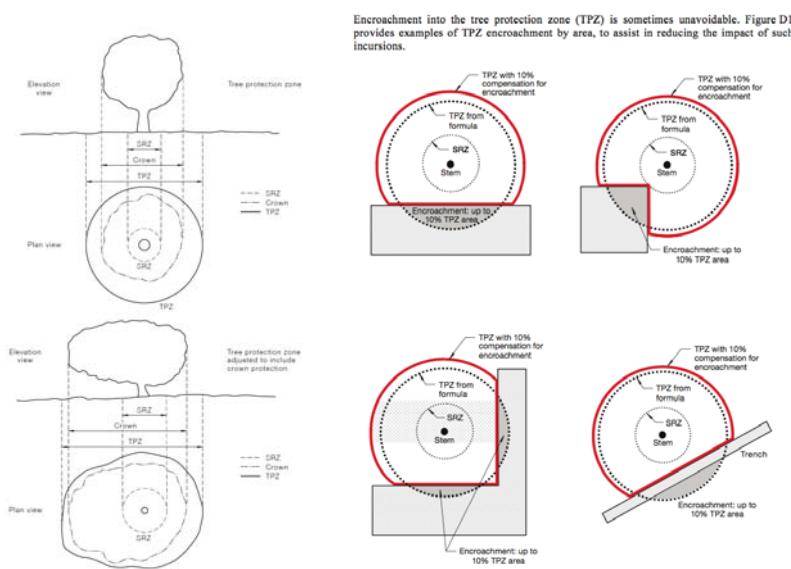
**Safe Useful Life Expectancy (SULE)** - 1. Long (40+years), 2. Medium (15 - 40 years), 3. Short (5 - 15 years), 4. Remove (under 5 years), 5. Small/young.

### 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.
  - Early mature/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> </ul>	<ul style="list-style-type: none"> <li>• The tree is in above average health and condition and no remedial works are required.</li> </ul>
Fair	<ul style="list-style-type: none"> <li>• The tree may be starting to dieback or have over 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 early signs of 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> </ul>	<ul style="list-style-type: none"> <li>• The tree is in below average health and condition and may require remedial works to improve the trees health.</li> </ul>
Poor	<ul style="list-style-type: none"> <li>• The tree may be in decline, have extensive dieback or have over 30% 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> </ul>	<ul style="list-style-type: none"> <li>• The tree is displaying low levels of health and removal or remedial works may be required.</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> </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 minor structural defects within the structure of the crown that could potentially develop into more significant defects.</li> <li>• The tree may have 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> </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.</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> </ul>	<ul style="list-style-type: none"> <li>• The identified defects are likely to cause either partial or whole failure of the tree.</li> </ul>

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 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.

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 30mm 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 (manual excavations). 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

<b>Local policy exemptions:</b> Trees that are unsuitable for legal protection for local policy reasons including size, proximity and species	
<b>Z1</b>	Young or insignificant small trees, i.e. below the local size threshold for legal protection, etc
<b>Z2</b>	Too close to a building, i.e. exempt from legal protection because of proximity, etc
<b>Z3</b>	Species that cannot be protected for other reasons, i.e. scheduled noxious weeds, out of character in a setting of acknowledged importance, etc
<b>High risk of death or failure:</b> Trees that are likely to be removed within 10 years because of acute health issues or severe structural failure	
<b>Z4</b>	Dead, dying, diseased or declining
<b>Z5</b>	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
<b>Z6</b>	Instability, i.e. poor anchorage, increased exposure, etc
<b>Excessive nuisance:</b> Trees that are likely to be removed within 10 years because of unacceptable impact on people	
<b>Z7</b>	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
<b>Z8</b>	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
<b>Good management:</b> Trees that are likely to be removed within 10 years through responsible management of the tree population	
<b>Z9</b>	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
<b>Z10</b>	Poor condition or location with a low potential for recovery or improvement, i.e. dominated by adjacent trees or buildings, poor architectural framework, etc
<b>Z11</b>	Removal would benefit better adjacent trees, i.e. relieve physical interference, suppression, etc
<b>Z12</b>	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

<b>A1</b>	No significant defects and could be retained with minimal remedial care
<b>A2</b>	Minor defects that could be addressed by remedial care and/or work to adjacent trees
<b>A3</b>	Special significance for historical, cultural, commemorative or rarity reasons that would warrant extraordinary efforts to retain for more than 10 years
<b>A4</b>	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.

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## 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



# Arboricultural Root Investigation Report

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## Site location:

87 Alexandra Crescent  
Bayview NSW

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## Prepared for:

Lindsay Little & Associates Pty Ltd

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## Prepared by: Bryce Claassens

Urban Arbor Pty Ltd PO Box 450  
Turrumurra NSW 2074

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## **1. INTRODUCTION**

- 1.1 Urban Arbor have been instructed by Lindsay Little & Associates Pty Ltd to carryout root investigations to determine if significant roots are located within an area of proposed construction adjacent to one tree located within the site.
- 1.2 Below is a list of all documents and information provided to assist in preparing this report;
  - A) Architectural Plan Set, Lindsay Little & Associates Pty Ltd, Including drawings, A03, A04, A05, A06 and A07, 19 December 2019.
  - B) Carport Sketch, Lindsay Little & Associates Pty Ltd, 5 November 2019.
- 1.3 Urban Arbor carried out a site inspection and completed the root investigations on 27 February 2020. Access was available to the subject site and adjoining public areas only. The tree information used in this report was collected during this site inspection.

## **2. SCOPE OF THE REPORT**

- 2.1 This report has been undertaken to meet the following objectives.
  - 2.1.1 Conduct root investigations to identify if significant woody roots are present in the location of an area of proposed works within the Tree Protection Zone (TPZ) of tree 1.
  - 2.1.2 The proposed works within the TPZ of tree 1 include excavations for the proposed car port extension (trench 1).
  - 2.1.3 For the purpose of the investigations, a significant root is a root with a diameter equal to or greater than 40mm.



### 3. LIMITATIONS

- 3.1 The observations and recommendations are based on one site inspection. The findings of this report are based on the observations and site conditions at the time inspection.
- 3.2 The report reflects the subject tree 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.
- 3.3 All diagrams, plans and photographs included in this report are visual aids only, and are not to scale unless otherwise indicated.
- 3.4 No specific tree risk assessment has been undertaken for the trees at the site.
- 3.5 Alteration of this report invalidates the entire report.

### 4. METHODOLOGY

- 4.1 The following information was collected during the assessment and root investigations of the subject tree.
  - 4.1.1 Tree common name
  - 4.1.2 Tree botanical name
  - 4.1.3 DBH (Trunk/Stem diameter at breast height/1.4m above ground level) - millimetres
  - 4.1.4 Location of roots
  - 4.1.5 Diameter of roots
  - 4.1.6 Depth of roots
  - 4.1.7 Notes/comments
- 4.2 Tree diameter was measured using a DBH tape or in some cases estimated. 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) <sup>1</sup> and in some cases estimated.
- 4.3 Non-destructive root investigations were undertaken by the means of hand excavation, using digging shovels, small trowels and a digging knife. Root investigations took place in an area of proposed works within the TPZ of tree 1 (see appendix 1).
- 4.4 Tree root diameter was measured using a DBH tape or in some cases estimated. The other tools used during the assessment were a nylon mallet, compass, camera, steel tape, wheel tape and a steel probe.

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<sup>1</sup> Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009).

## 5. TREE INFORMATION

### 5.1 Tree 1 Information

#### 5.1.1 Tree 1 Observations – Sydney Red Gum

Tree 1 is a mature Sydney Red Gum (*Angophora costata*) located within the site. The tree has a DBH of 770mm and a DAB of 820mm. Tree 1 has a TPZ of 9.2m and an SRZ of 3.0m, both measured in radius from the centre of the trunk.

## 6. TRENCH 1 OBSERVATIONS & CONCLUSIONS

**6.1 Trench 1 Information:** Root investigations were completed in the location of the proposed carport extension excavations within the TPZ of tree 1 and is referred to as trench 1 (Image 1). Trench 1 was set back from the centre of the trunk of tree 1 by 3.1m at its closest point. Trench 1 was 2.4m in length, 300mm in width and 1000mm in depth. It was not possible to excavate to the finished depth of the proposed carport extension due to the steep slope and existing root structures.

#### 6.1.1 Trench 1 Root Observations

Three significant roots were identified within root investigations trench 1, including root 1, 2 and 3 (Image 2, 3 and 4). Root 1, 2 and 3 appeared to be emanating from tree 1 and had cambium consistent with that of tree 1. The identified roots are located within the TPZ of tree 1 but not the SRZ.

**6.1.2 Table:** All roots identified in trench 1 have been listed in the table below (see section 7 Trench 1 Photographs for root images and locations).

Root No.	Diameter (mm)	Depth of root (mm)	Location along trench (m)	Distance from centre tree (m)
1	130	400	0.55	3.1
2	120	500	0.68	3.1
3	75	800	1.1	3.2

**Notes:**

- Root diameter measured adjacent to side of trench closest to tree.
- Depth of root measured from top of root to existing grade.
- Location along trench measured from East side of trench to West side of trench.



## 6.2 Trench 1 Conclusions

- 6.2.1 To conclude, three significant roots were identified within root investigations trench 1, including root 1, 2 and 3 (Image 2, 3 and 4). The identified roots appeared to be emanating from tree 1 and had cambium consistent with that of tree 1. The identified roots are located within the TPZ of tree 1 but not the SRZ.
- 6.2.2 If the identified roots are severed to accommodate the proposed carport excavations, the condition of the tree could potentially be impacted. Under the current proposed development, the tree will not be viable for retention and design modifications are recommended. To reduce the encroachment to an acceptable level, the proposed carport excavations should be set back from the centre of tree 1 by 6.0m minimum.

## 7. TRENCH 1 PHOTOGRAPHS



**Image 1:** Looking South to root investigation trench 1, showing the existing carport, length of trench and tree 1.





**Image 2:** Looking South West along root investigation trench 1. Showing location of root 1, 2 and 3.



**Image 3:** Looking North East along root investigation trench 1. Showing location of root 1, 2 and 3.





**Image 4:** Looking South to root investigation trench 1. Showing a close up of root 1, 2 and 3.

## 8. BIBLIOGRAPHY/REFERENCES

- Council Of Standards Australia, *AS4970 Protection of trees on development sites* (2009).

## 9. LIST OF APPENDICES

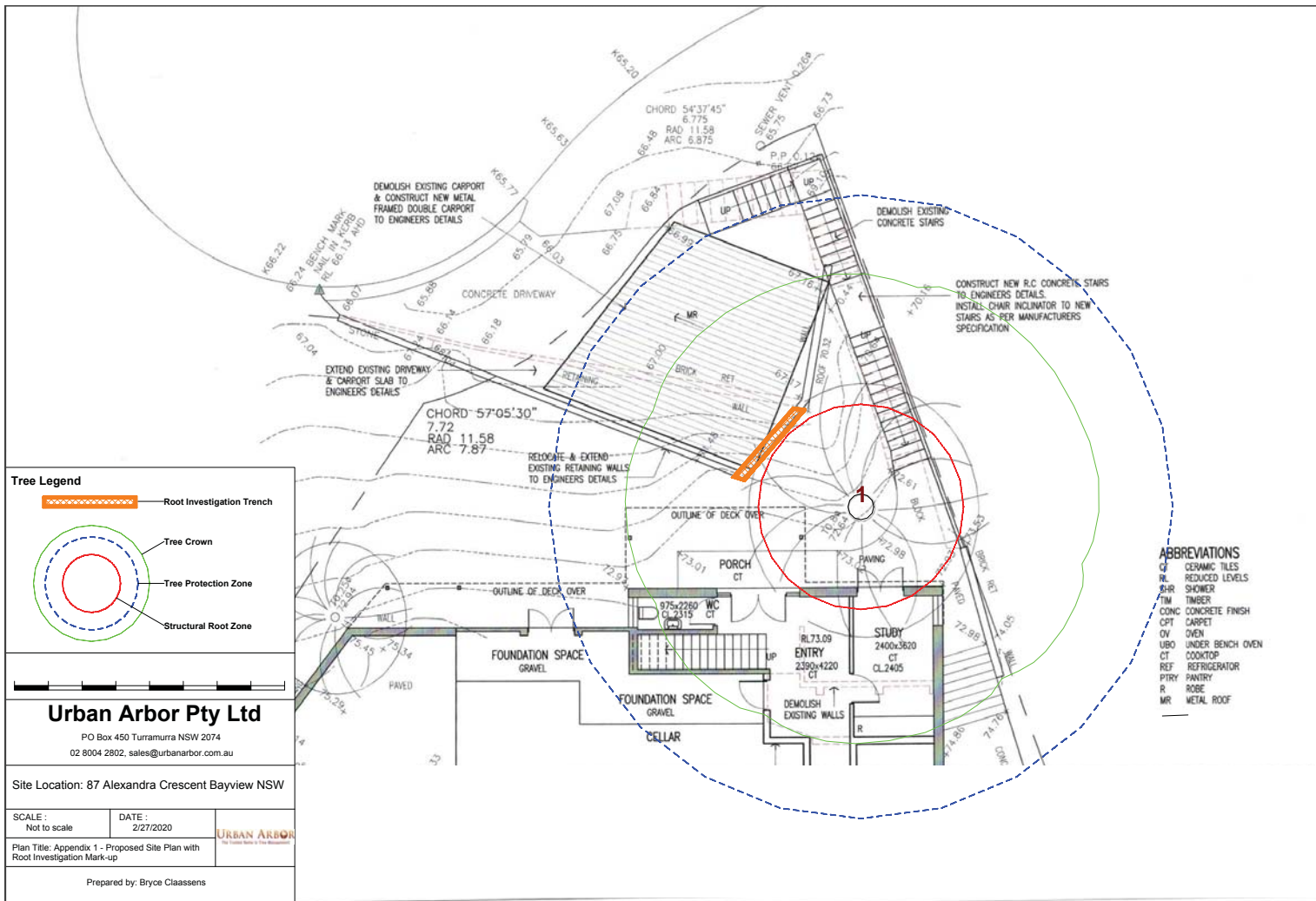
The following are included in the appendices:

Appendix 1 - Proposed Site Plan – Root Investigation Mark Up

Appendix 2 - Further Information of Methodology

A handwritten signature in black ink, appearing to read 'Bryce Claassens'.

Bryce Claassens  
Diploma of Arboriculture (AQF5)  
Cert III Landscape Construction  
QTRA Registered User  
Member Arboriculture Australia

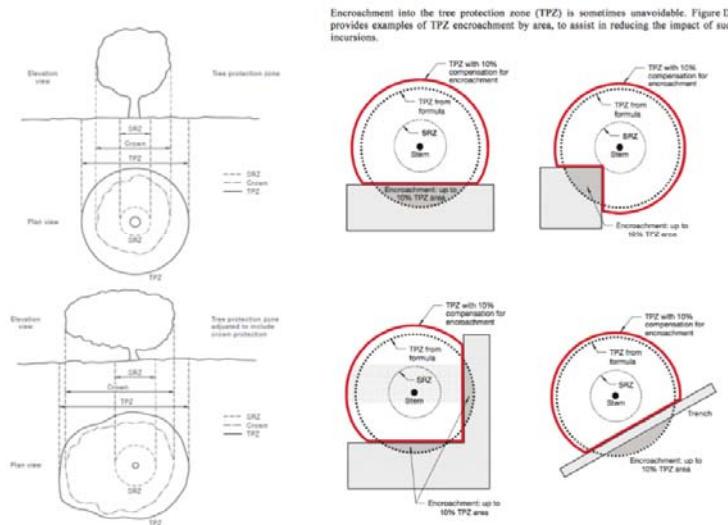


## Appendix 2 - Further Information of Methodology

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).