

Endemic Tree Consultants

ARBORICULTURAL IMPACT ASSESSMENT & TREE PROTECTION PLAN



COMMISSIONED BY: Jeff Ellis - AQUALAND

SITE: 146 Arthur Street North Sydney NSW 2060

WITHIN: North Sydney Council

DATE OF REPORTING: 17 March 2023

VERSION: 1

PREPARED BY: Michael Garton – Diploma of Arboriculture

ASSESSMENT & REPORT UNDERTAKEN BY: Michael Garton – Principal Consultant – Endemic Tree Consultants

Disclaimer

Disclaimer statement. Copyright All rights Reserved © 2024. Endemic Tree Consultants (Publisher) is the owner of the copyright subsisting in this publication. Other than as permitted by the Copyright Act and as outlined in the Terms of Engagement, no part of this report may be reprinted or reproduced or used in any form, copied, or transmitted, by any electronic or by other means (including photocopying, scanning, or otherwise), without the prior written permission of Endemic Tree Consultants. Legal action will be taken against any breach of Copyright. This report is only available in PDF form. No part of it is authorised to be sold, distributed, or offered in any other form. This report has been prepared to provide Horticultural advice to the client and/or their authorised representatives in regard to a particular and specific development proposal as advised by the client. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person including the client then the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be interpreted without reference to the entire report. This report cannot provide a conclusive recommendation regarding any part of a tree, and its root system. This report is the opinion, advice or recommendation based on the information supplied by the client or observation of the author.

For Attention of	Jeff Ellis Senior Strategic Development Manager - AQUALAND 0401 736 400
Prepared by	Michael Garton Principal Consultant of Endemic Tree Consultants Diploma of Arboriculture QTRA – Quantified Tree Risk Assessment TRAQ – Tree Risk Assessment Qualification Certificate IV Environmental Management & Sustainability Certificate IV Government Investigations M: 0422 250 928
Company Details	Endemic Tree Consultants E: michael@endemictrees.com.au T: 0416 014 801 W: www.endemictrees.com.au ABN: 15 102 727 802

Table of Contents

1. INTRODUCTION / AIMS/ OBJECTIVES:	6
1.1 INTRODUCTION	6
1.2 AIMS	6
1.3 OBJECTIVES	6
1.4 LIMITATIONS	7
2. THE SITE	8
3. METHODOLOGY:	10
3.1. VISUAL TREE ASSESSMENT (VTA)	10
3.2. VISUAL TREE ASSESSMENT PARAMETERS	10
3.3. TREE VITALITY	10
3.4. HEALTH & CONDITION	10
3.5. LIMB STRUCTURE	11
3.6. TRUNK FORM	11
3.7. ROOTZONE (SRS & TPZ)	11
3.8. AMENITY SIGNIFICANCE	11
3.9. RETENTION VALUE:	11
3.10. PLANS PROVIDED	12
3.11. TREE NUMBERING SYSTEM	12
3.12. TREE PROTECTION ZONE (TPZ)	12
3.13. STRUCTURAL ROOT ZONE (SRZ)	12
3.14. AMENDMENTS	13
3.15. INCURSIONS	13
3.16. DESTABILISATION	13
3.17. PLANS AND RETENTION VALUE	13
3.18. TREE PROTECTION & SPECIFICATION	13
3.19. ASSUMPTIONS	13
4. TREE ASSESSMENT DATA	14
5. TREE PROTECTION ZONE & STRUCTURAL ROOT ZONE	17
5.1. TREE PROTECTION ZONE (TPZ)	17
5.2. MINOR ENCROACHMENT	17
5.3. MAJOR ENCROACHMENT	17
5.4. STRUCTURAL ROOT ZONE (SRZ)	17
5.5. VARIATIONS OF THE TPZ	18
5.6. ROOT ZONE ENCROACHMENT	19

5.7.	COMPENSATION FOR TREE PROTECTION ZONE ENCROACHMENT	19
5.8.	TREE ROOT MORPHOLOGY	19
5.9.	SOIL & COMPACTION	20
6.	INCURSION CALCULATIONS	21
7.	DISCUSSION	24
7.1.	TREE 1 – PLATANUS × ACERIFOLIA	24
7.2.	TREE 2 – PLATANUS × ACERIFOLIA	24
7.3.	TREE 3 – PLATANUS × ACERIFOLIA	24
7.4.	TREE 4 – PLATANUS × ACERIFOLIA	25
7.5.	TREE 5 – PLATANUS × ACERIFOLIA	25
7.6.	TREE 6 – PLATANUS × ACERIFOLIA	25
7.7.	TREE 7 – PLATANUS × ACERIFOLIA	25
7.8.	TREE 8 – PLATANUS × ACERIFOLIA	26
7.9.	TREE 9 – PLATANUS × ACERIFOLIA	26
7.10.	TREE 10 – PLATANUS × ACERIFOLIA	26
7.11.	TREE 11 – PLATANUS × ACERIFOLIA	26
7.12.	TREE 12 – PLATANUS × ACERIFOLIA	27
7.13.	TREE 13 – FICUS BENJAMINA	27
7.14.	TREE 14 – FICUS BENJAMINA	27
7.15.	TREE 15 – FICUS BENJAMINA	27
7.16.	TREE 16 – FICUS BENJAMINA	27
7.17.	TREE 17 – FICUS BENJAMINA	28
7.18.	TREE 18 – FICUS MICROCARPA VAR. HILLII	28
7.19.	TREE 19 – FICUS BENJAMINA	28
8.	RECOMMENDATIONS	29
8.1.	TREES IDENTIFIED FOR REMOVAL.	29
8.2.	TEES IDENTIFIED TO BE RETAINED.	30
9.	STANDARDS	31
9.1.	OWNERS/BUILDERS RESPONSIBILITIES	31
9.2.	TREE RELATED WORKS	31
9.3.	THE SITE ARBORIST	31
9.4.	CERTIFICATION OF WORKS	31
9.5.	THE SITE ARBORIST	31
9.6.	CONSENT FOR WORKS.	31
10.	TREE PROTECTION PLAN – INFORMATION & SPECIFICATIONS	32

10.1. SPECIFICATION	33
10.1.1. TREE PROTECTION ZONES (TPZ)	33
10.1.2. TREE PROTECTION FENCING	33
10.1.3. TREE PROTECTION - BOARDING	33
10.1.4. TREE PROTECTION - RUMBLE BOARDS OR TRAC MATS AND GEOTEXTILE FABRIC	34
10.1.5. ACTIVITIES	34
10.1.6. MAINTENANCE OF THE TREE PROTECTION ZONES.	34
10.1.7. ADEQUATE SIGNS	34
10.1.8. ALTERATIONS	34
10.1.9. ROOT PRUNING	34
10.1.10. TRENCHING AND BORING UNDERGROUND SERVICES	34
10.1.11. TREE PRUNING	35
10.1.12. HOLD POINTS.	35
11. APPENDICES	37
12. BIBLIOGRAPHY	48
13. GLOSSARY	49

Figures

FIGURE 1 - AERIAL PHOTO OF THE SITE 146 ARTHUR STREET NORTH SYDNEY (SIXMAPS IMAGERY 2018).	8
FIGURE 2 - AERIAL IMAGE OF THE SITE 146 ARTHUR STREET NORTH SYDNEY INCLUDING TREE LOCATIONS.	9
FIGURE 3. LOW MEDIUM AND HIGH IMPACT ZONES IN REFERENCE TO THE TREE.	18
FIGURE 4. STRUCTURAL ROOT ZONE THE AREA REQUIRED FOR TREE STABILITY.	18
FIGURE 5 - TREE REMOVAL PLAN WITHIN THE SITE 146 ARTHUR STREET NORTH SYDNEY	29
FIGURE 6 - TREE LOCATION AND REMOVAL PLAN.	37
FIGURE 7 - EXAMPLE OF TREE PROTECTION MEASURES REQUIRED WITHIN THE SITE.	42
FIGURE 8 - EXAMPLE OF STEM PROTECTION BOARDING REQUIRED ON ALL RETAINED TREES WITHIN THE SITE.	43

Tables

TABLE 1 - OUTLINE OF SITE CONTROL MEASURES LISTED WITH THE SITE OF 146 ARTHUR STREET NORTH SYDNEY	9
TABLE 2. TREE ASSESSMENT DATA FOR TREES LOCATED WITHIN THE SITE OF 146 ARTHUR STREET NORTH SYDNEY. ASSESSMENT WAS CARRIED OUT ON THE 16/3/24.	14
TABLE 3 - INCURSION CALCULATIONS IN ACCORDANCE WITH AS 4970-2009 PROTECTION OF TREES ON DEVELOPMENT SITES	21
TABLE 4 - TREES IDENTIFIED FOR REMOVAL WITHIN THE SITE 146 ARTHUR STREET NORTH SYDNEY.	29
TABLE 5 - TREES IDENTIFIED TO BE RETAINED WITHIN THE SITE 146 ARTHUR STREET NORTH SYDNEY.	30
TABLE 6 - TREES REQUIRING TREE PROTECTION MEASURES.	32
TABLE 7. TREE RETENTION VALUE – PRIORITY MATRIX	41

1. Introduction / Aims/ Objectives:

1.1 Introduction

This Arboricultural Impact Assessment and Tree Protection has been prepared by Michael Garton of Endemic Tree Consultants for the client Jeff Ellis. The report shall assess the existing viability of existing trees located within the assessment area. This report will consider the retention value and risk assessment as viewed on the day of the inspection. An assessment will be in relation to the demolition, design and construction of a multi-use residential high-rise complex.

The trees within the site and have been assessed and given a retention value rating. Trees with low retention value should be considered for removal. Tree with a medium retention value may be removed for the benefit of the outcome and trees with high retention values should be retained where possible.

The trees are located within the site 146 Arthur Street North Sydney 2060, Lot/Section/Plan no:1/-/DP788579. The location will be referred to as the site from here within. The site is located within the North Sydney Council local government area and is subject to the relevant local government and legislative framework.

1.2 Aims

This report shall assess the site trees and advise on acceptable setback distances and impacts within the Tree Protection Zones:

- Methodology used in tree evaluation, retention value and Tree Protection zones & Structural Root Zones.
- Tree data table with retention values.
- A scale plan showing the location of the trees on the subject site, Appendix A.
- Allocation of a number to each tree, .
- Provide canopy spread and diameter at breast height and at ground level of each tree.
- Indicate the tree retention values, Tree Protection Zone (TPZ), Structural Root Zone (SRZ) and assessment of the developable environment.

1.3 Objectives

The Arboricultural Impact Assessment (AIA) and Tree Protection Plan (TPP) objective is to deliver an impartial and objective evaluation of the tree population within the designated survey area. Its primary goal is to assess the viability of trees and anticipate the impacts of proposed works outlined in the provided Design Plans. Through this assessment, all stakeholders will receive comprehensive insights into the potential implications of the planned developments on the existing tree assets.

This AIA and TPP will investigate the following.

- Identify trees within the development site that are likely to be impacted upon by any of the proposed works per the supplied Design Plans.
- Assess the vitality and retention value of these foreseeably impacted trees in situ.
- Assess, calculate, and discuss the impacts with regards to tree retention and foreseeable viability.
- Put forward best practice management recommendations as to effective tree protection and development impact pursuant to Standards Australia AS 4970-2009 Protection of trees on development sites.

1.4 Limitations

All arboricultural reasonings that have been discussed and provided are based on extensive empirical arboricultural knowledge, the internationally recognised Visual Tree Assessment (VTA) methodology (Lonsdale, 2010) (Dunster, 2017) the recognised Institute of Australian Consulting Arboriculturists (IACA, Significance of a Tree, Assessment Rating System (STARS)'. Institute of Australian Consulting Arboriculturists., 2010) and (AU STANDARD 4970 – 2009 Protection of Trees on Development Sites).

Whilst this arboricultural assessment is thorough it should be noted that trees are dynamic living organisms exposed to both unforeseeable biotic and abiotic variables which on occasion can be harsh and severe. Therefore, this arboricultural assessment will consider on the balance of probabilities the most likely outcome(s) as opposed to those which could, may or fancifully occur.

2. The Site

Located in the North Sydney Council local government area, the site is Zoned E2 Commercial Centre. The site has been identified to have non-specific vegetation schedule throughout. This is consistent with urban plantings of the modern era where native and exotic species have been used. Additional vegetation was observed within the site however does not form part of the report. A summary of the control checks for the land can be seen below in Table 1. Information within has been gained from NSW Government e Planning Spatial viewer website 17 March 2024.



Figure 1 - Aerial photo of the site 146 Arthur Street North Sydney (Sixmaps imagery 2018).

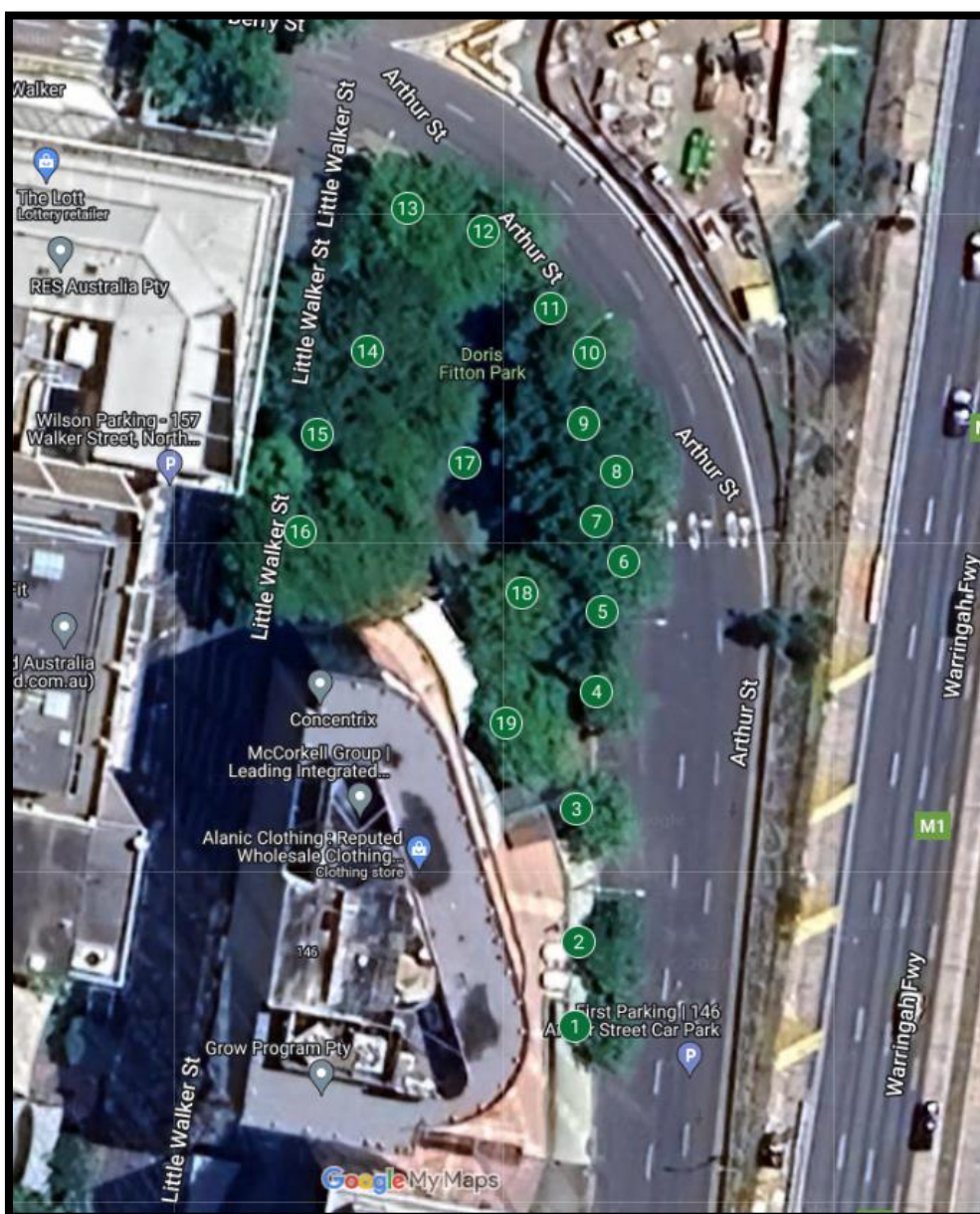


Figure 2 - Aerial image of the site 146 Arthur Street North Sydney including tree locations.

Table 1 - Outline of site control measures listed with the site of 146 Arthur Street North Sydney

Planning Control	Conditioned	Not Conditioned
Zoning	E2 Commercial Centre	
Heritage Listed Property		X
Heritage Conservation Area		X
Terrestrial Biodiversity (CEEC-EEC)		X
Bush Fire Prone Land		X

3. Methodology:

3.1. Visual Tree Assessment (VTA)

A VTA for the site trees was taken from the ground at the base of the tree. No underground investigations, aerial inspections or internal diagnostic testing was undertaken.

The tools used onsite to gather the necessary VTA data were a nylon percussion hammer, mobile phone, and an I-pad. The total tree height(s) and canopy spread(s) measured by Optilogic 400LHA clinometer. The trunk diameter DBH was taken at 1.4m from the ground level using a 10m/3m Dia. Million diameter tape.

For ease of identification all of the subject trees that will be foreseeably impacted upon have been mapped, photographed, individually numbered, and recorded digitally through in house software. No soil analysis, tissue sampling, and/or geological investigations were carried out at that time. Site inspection was undertaken by the author on the 16 March 2024.

3.2. Visual Tree Assessment Parameters

The following information outlines the basic parameters used to assess the subject trees. These parameters relate to the Tree Assessment data in Table 1 below. Comprehensive definitions of the following descriptors are in the Appendices at the end of this document.

3.3. Tree Vitality

Tree Vitality is categorised through a visual determination using:

- leaf, twig or needle size, shape, and colour
- seasonal growth rates
- reaction wood development
- foliage density
- foliage coverage throughout the crown
- branch-tip dieback
- typical branch senescence.

For example, a tree assessed to have an average or fair vitality rating would generally have irregular [minor] leaf or needle shape and/or colour and/or size; and/or irregular foliage density, distribution and/or average growth indicators and/or some tip dieback.

3.4. Health & Condition

Reviewed on the above ground parts of the tree. The individual components of a tree provide unique and integrated support to maintain a trees system. The key functions of a tree include

transportation of water and nutrients, storage of starches for use throughout the life span of the tree and as a support system for the tree.

3.5. Limb Structure

Limb Structure is a general evaluation on the branch union formation, weight balance, growth formation and foliage loss (that may affect branch weight and/or mass damping). This assessment is derived from the typical structure of the species and its typical branch formation.

3.6. Trunk Form

Trunk Form assesses the flare at the base, taper, decay and cavities, formation of multi-stems that develop near or at ground level, girdling roots, and growing angles.

3.7. Rootzone (SRS & TPZ)

Visually assesses the general soil health, soil compaction and growth impediments. For example, growing environments with a high percentage of impervious seal or compaction are likely to be categorised as poor, notwithstanding the health of the tree. TPZ was calculated using the (AU STANDARD 4970 – 2009 Protection of Trees on Development Sites) formula. SRZ was calculated using the Australian standard AS4970 - Protection of Trees on Development Sites formula. Potential destabilization from root severance within the Structural root Zone (SRZ) based on data compiled from findings of (Matteck C.,1994)

3.8. Amenity Significance

The methodology used for determining the subject trees landscape significant has been assessed using: (IACA, Significance of a Tree, Assessment Rating System (STARS)'. Institute of Australian Consulting Arboriculturists., 2010) See Appendix 10

Tree Significance

- Low Significance in landscape
- Medium Significance in landscape
- High Significance in landscape

3.9. Retention Value:

Significance of a Tree, Assessment Rating System (STARS) provides the Retention.

Value of a tree and/or group of trees by balancing a combination of environmental, cultural, physical, amenity and social values. The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the Retention Value for a tree.

A tree retention assessment has been undertaken in accordance with the Institute of Australian Consulting Arborists (IACA, Significance of a Tree, Assessment Rating System (STARS)'. Institute of Australian Consulting Arboriculturists., 2010) The system uses a scale of High, Medium, and Low significance in the landscape. Once the landscape significance of a tree has been defined, the Retention Value can be determined congruent with the trees' abovementioned Estimated Safe Useful Life Expectancy (S.U.L.E) (Barrell J., 1996) Further details and the assessment criteria are in the Appendix.

- Low: These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
- Medium: These trees are moderately important for retention. Their removal should only be considered if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
- High: These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed per Standards Australia AS 4970 Protection of trees on development sites.

3.10. Plans Provided

Assessment of potential impacts on the trees in the immediate vicinity of the development site was based on various PDF plans supplied by the client and include the following:

- W-B WOODS BAGOT, Project 146 Arthur Street, Sheet Title Ground, Project Number 121888, Sheet Number DA-2220, Revision A, 21/02/24
- W-B WOODS BAGOT, Project 146 Arthur Street, SDRP Design Presentation 21/02/24
- W-B WOODS BAGOT, Project 146 Arthur Street, Sheet Title, Demolition Plan, Sheet Number DA-1200, Revision A, 21/02/24

3.11. Tree Numbering System

A tree numbering system was assigned to the trees.

3.12. Tree Protection Zone (TPZ)

TPZ was calculated using the Australian standard AS4970 - "Protection of Trees on Development Sites" formula.

3.13. Structural Root Zone (SRZ)

SRZ was calculated using the Australian standard AS4970 - "Protection of Trees on Development Sites" formula.

3.14. Amendments

Recommendations for amendments to the proposed development were based on Australian Standards for AS 4970 - 2009 "Protection of Trees on Development Sites".

3.15. Incursions

Allowable incursions to Tree Protection Zones were based on Australian Standards for AS 4970 2009 "Protection of Trees on Development Sites" and the author's extensive experience with trees on development sites.

3.16. Destabilisation

Potential destabilization from root severance within the Structural root Zone (SRZ) based on data compiled from findings of Matheck (1994).

3.17. Plans and retention value

Plans showing canopy, retention value, Tree Protection Zone and Structural Root zone and tree protection device locations indicated in .

3.18. Tree protection & specification

Tree protection & specification in accordance with AS4970-2009.

3.19. Assumptions

1. The information provided is accurate and true to the conditions of the site.
2. The information provided has been ground truth or has been otherwise stated.
3. The techniques for excavation, construction boring and dismantling are in keeping with traditional methods unless otherwise stated.

4. Tree Assessment Data

Table 2. Tree Assessment Data for trees located within the site of 146 Arthur Street North Sydney. Assessment was carried out on the 16/3/24.

Number	Species	Height	Width	DBH	DGL	TPZ	SRZ	Age Class	Health	Condition	Amenity	Retention Value	Notes
1	<i>Platanus × acerifolia</i> London Plane Tree	9	5	0.36	0.42	4.3	2.3	Mature	Fair	Fair	High	High	Tree is in fair health with good structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. As a result, the tree has a sparse canopy with minor tip dieback.
2	<i>Platanus × acerifolia</i> London Plane Tree	9	6	0.4	0.51	4.8	2.5	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. Phototropic to the east as a result of the building. Tree is in full vigour. Mechanical trunk damage at 3m and at ground level to 30cm.
3	<i>Platanus × acerifolia</i> London Plane Tree	8	5	0.26	0.37	3.1	2.2	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability with a sparse canopy. Mild phototropism to the east as a result of suppression.
4	<i>Platanus × acerifolia</i> London Plane Tree	10	7	0.39	0.5	4.7	2.5	Mature	Fair	Fair	High	High	Tree has poor shape and form throughout. Phototropic to the east as a result of suppression. Several locations of previous pruning over its lifetime. Sparse canopy with minor tip dieback.
5	<i>Platanus × acerifolia</i> London Plane Tree	11	6	0.39	0.5	4.7	2.5	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. Minor tip dieback with a sparse canopy.
6	<i>Platanus × acerifolia</i> London Plane Tree	11	6	0.32	0.4	3.8	2.3	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Mildly sparse canopy. Good shape and form.
7	<i>Platanus × acerifolia</i> London Plane Tree	11	10	0.61	0.73	7.3	2.9	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Fair structured branches at 3m. Branches are mildly compressed, with a low likelihood of failure. Tree is in high vigour indicating good health.

Number	Species	Height	Width	DBH	DGL	TPZ	SRZ	Age Class	Health	Condition	Amenity	Retention Value	Notes
8	<i>Platanus</i> × <i>acerifolia</i> London Plane Tree	11	9	0.36	0.43	4.3	2.3	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Tree located within small, grassed nature strip. Mildly phototropic due to encroachment and suppression from adjacent trees. Good vigour.
9	<i>Platanus</i> × <i>acerifolia</i> London Plane Tree	14	13	0.64	0.7	7.7	2.8	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. Good shape and form. High vigour. Underground service location markings indicate tree is growing directly on top of water valve, and electricity.
10	<i>Platanus</i> × <i>acerifolia</i> London Plane Tree	8	8	0.34	0.52	4.1	2.5	Mature	Good	Good	High	High	Fair shape and form. Heavily suppressed by adjacent canopy trees. Heavily epicormic canopy.
11	<i>Platanus</i> × <i>acerifolia</i> London Plane Tree	13	10	0.55	0.88	6.6	3.1	Mature	Good	Good	High	High	Tree has been excessively crown raised over its lifetime as a result of its location on the footpath and adjacent to roadway. Fair shape and form. Tree is in good health and structure with no obvious defects.
12	<i>Platanus</i> × <i>acerifolia</i> London Plane Tree	11	8	0.58	0.7	7	2.8	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Mild suppression. Phototropic to north as a result of adjacent canopy trees. Fair shape and form.
13	<i>Ficus benjamina</i> Weeping Fig	12	14	0.87	0.94	10.4	3.2	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Tree has high vigour with typical shape and form for the species.
14	<i>Ficus benjamina</i> Weeping Fig	16	17	1.16	1.13	13.9	3.5	Mature	Good	Good	High	High	Tree is in good health with fair structure. Several locations of compressed branch unions. 2x locations of conflicting branches resulting in wounding on associated stems. Tree is considered typical for the species.
15	<i>Ficus benjamina</i> Weeping Fig	15	15	0.4	0.8	7.6	3	Mature	Good	Fair	High	Medium	Tree is in good health, however, has poor structure throughout. Multi-stemmed at ground level with compressed union. Several locations of included bark within canopy. Conflicting branches throughout. High vigour with poor structure.

Number	Species	Height	Width	DBH	DGL	TPZ	SRZ	Age Class	Health	Condition	Amenity	Retention Value	Notes
16	<i>Ficus benjamina</i> Weeping Fig	14	20	0.93	0.94	7.2	3.2	Mature	Good	Good	High	High	Tree is in good health and structure with no obvious defects. Tree is considered typical for the species. Tree has good shape and form throughout. This tree has far exceeded its available growing space.
17	<i>Podocarpus elatus</i> Brown Pine	7	7	0.15	0.23	1.8	1.8	Mature	Good	Good	Medium	High	Tree is in good health and structure with no obvious defects. Good shape and form and is considered typical for the species.
18	<i>Ficus microcarpa</i> var. <i>Hillii</i> Hills Weeping Fig	8	12	0.7	0.74	8.4	2.9	Mature	Fair	Poor	Medium	Low	Tree is in poor health and structure. Tip dieback in mid and upper canopy. Several branches contain a high amount of stem wounding. Conflicting branches throughout. Heavily epicormic with secondary pest infestation. Poor shape and form.
19	<i>Ficus benjamina</i> Weeping Fig	7	7	0.55	0.63	6.6	2.7	Mature	Good	Good	High	Medium	Tree is in good health and structure with no obvious defects. Tree is growing within a small garden bed at the front stairs of the building. Good shape and form. This tree will exceed its available growing space.

*DBH – Diameter at Breast Height (m); **DGL – Diameter at Ground Level (m) ***TPZ – Tree Protection Zone (m); ^SRZ – Structural Root Zone (m), ~ Approximately. Appendix B – Explanatory notes

DW = Dead wood (%), CS = Clear stem - no branching (m), LC = Live Crown (%)

5. Tree Protection Zone & Structural Root Zone

5.1. Tree Protection Zone (TPZ)

The TPZ is the principal 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 TPZ is calculated using the Australian standard AS4970 - "Protection of Trees on Development Sites" formula. Development encroachments are referred to as: 1) No impact (0%) incursion; 2) Low impact (<10%) of minor consequence; 3) Medium impact (<20%) incursion where the project arborist is to demonstrate the tree(s) remain viable by tree sensitive construction techniques; and 4) High level impact (>20%) where design changes or further information is required to manage tree vitality.

5.2. Minor Encroachment

If the proposed encroachment is less than 10% of the area of the TPZ and is outside the SRZ, Detailed root investigations should not be required. Variations can only be made by an AQF5 Consulting Arborist (Project Arborist).

5.3. Major Encroachment

If the proposed encroachment is greater than 10% of the TPZ or inside the SRZ, the project arborist must demonstrate that the tree(s) would remain viable. this may require root investigation by non-destructive methods and consideration of relevant factors listed in AS4970 Clause 3.3.4.

5.4. Structural Root Zone (SRZ)

The SRZ is the area required for tree stability. A larger area is required to maintain a viable tree. The SRZ only needs to be calculated when major encroachment into a TPZ is proposed. The SRZ calculated using the Australian standard AS4970 - "Protection of Trees on Development Sites" formula. Excavation within the structural root zone should be avoided. In the event this cannot be avoided the site arborist (AQF level 5) must be present. Excavation must be non-destructive such as hand excavation or Airspade® or other.

The trees identified to have a major incursion within the calculated TPZ or SRZ by excavations, disturbance or soil fill will require an assessment of the impact to the tree. The incursion must be assessed and determined in accordance with AS4970 "Protection of Trees on Development Sites". Trees with major incursions may be adversely impacted with long term health and stability problems. Identification of work within the TPZ or SRZ will allow the site Arborist to recommend alternative solutions where possible.

5.5. Variations of the TPZ

It may be possible to encroach into or make variations to the standard TPZ. Encroachment includes excavation, compacted fill, and machine trenching. Encroachment into the tree protection zone (TPZ) is sometimes unavoidable. Any loss of TPZ compensated for elsewhere.

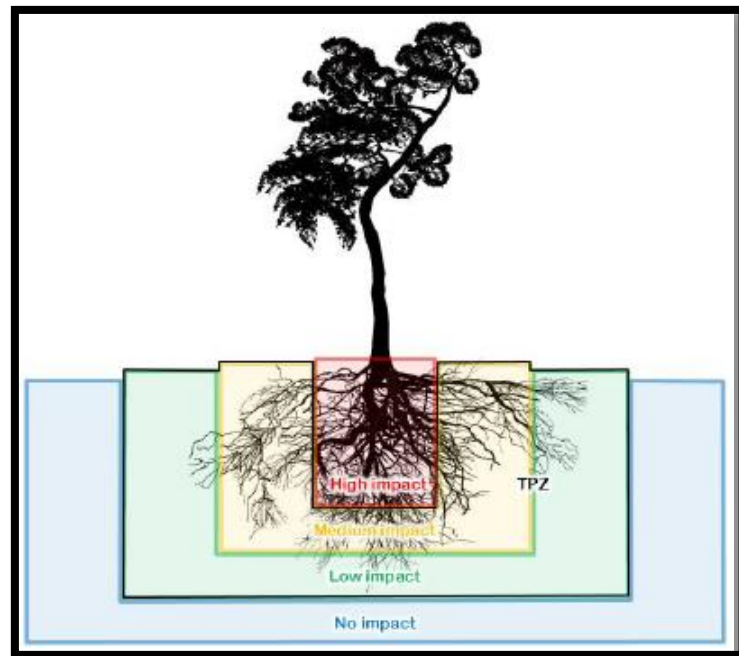


Figure 3. Low medium and high impact zones in reference to the tree.

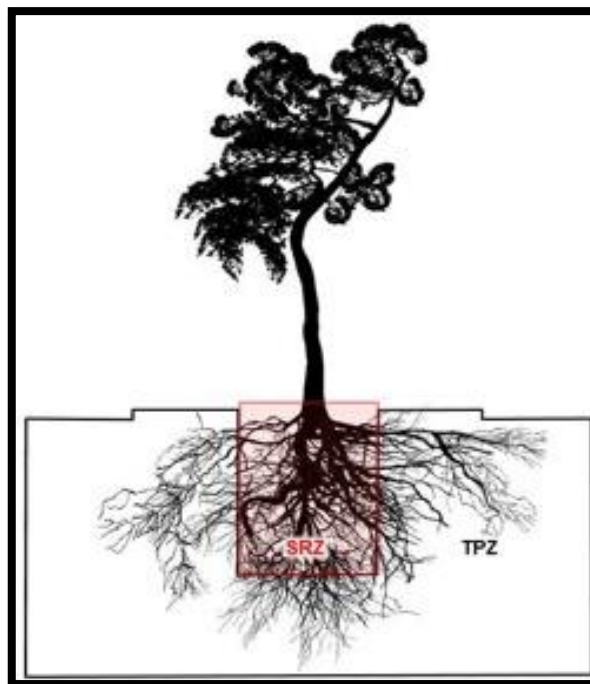


Figure 4. Structural root Zone the area required for tree stability.

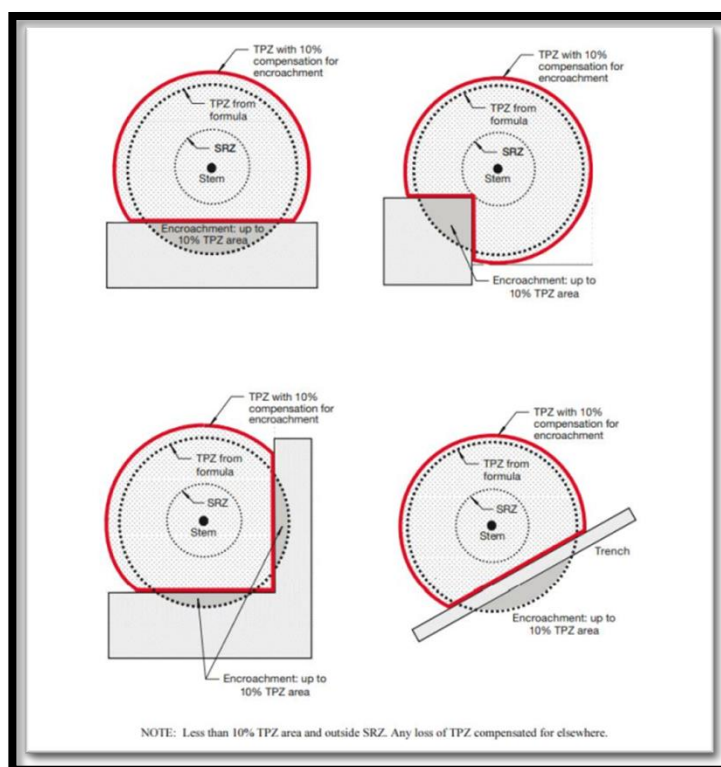
5.6. Root Zone Encroachment

Root depth and extension can be severely limited and highly irregular in urban settings. When root restrictions are minimal, root spread shows a strong relationship with trunk diameter, which is a more reliable predictor than canopy diameter ('dripline') or tree height. Therefore, all arboricultural recommendations and conclusions contained in this PAIA with regards to tree root protection/retention were based upon and determined in accordance with the Australian Standards AS 4970-2009 Protection of Trees on Development Sites.

Destructive Root Exploration must be carried out under the direct supervision of a Project Arborist.

5.7. Compensation for Tree Protection Zone Encroachment

Encroachment into the Tree Protection Zone (TPZ) is sometimes unavoidable. The images above are analogous to the abovementioned plan-set scenario and indicate how encroachment within the tree protection zone can be compensated for elsewhere per AS 4970-2009 Protection of Trees on Development Sites.



5.8. Tree Root Morphology

Trees grow in a delicate balance with their environment and any changes to that balance must be minimised if the tree is to remain healthy and fulfil its potential. It is rarely possible to repair stressed and injured trees, so damage needs to be avoided during all stages of development and construction.

Most tree roots will usually be found in the top 600mm of soil (Harris, Clark & Matheny, 1999). Radiating outwards from the base of the trunk are several large woody roots. These structural roots anchor the tree in the ground. Cutting or affecting those roots is likely to undermine the stability of the tree. The spread of a tree's structural roots, herein termed its Structural Root Zone (SRZ), is generally proportioned to the diameter of its trunk (Mattheck C. &, 1994)

Beyond this zone extends the network of woody transport roots and fine absorbing roots, which absorb and transport water and nutrients. Most of these roots are found in the top 150mm of soil (Richard Wilson Harris, 1998) Trees can lose a portion of their absorbing roots without being significantly affected in the long term. Different species tolerate different amounts of root loss, with most healthy trees able to tolerate losing up to a third of their absorbing roots (Richard Wilson Harris, 1998)

5.9. Soil & Compaction

No soil analysis or compaction testing was completed. There are noticeable compacted areas created as a result of high levels of pedestrian traffic. Soil decompaction contributes to reduced soil moisture retention and impacts on root development. This affects overall tree health and longevity. Consideration should be given to soil decompaction in highly trafficked areas and where tree health is declining, or growth rates are reduced.



6. Incursion Calculations

Table 3 - Incursion calculations in accordance with AS 4970-2009 Protection of trees on development sites

Tree Number	Incursion Percentage TPZ	Incursion Percentage SRZ	Action	Notes
1 <i>Platanus × acerifolia</i> London Plane Tree	21	2	Retain and protect	The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present within the proposed worksite. This tree is expected to sustain minimal impacts by the proposed development. It is to be retained and protected.
2 <i>Platanus × acerifolia</i> London Plane Tree	22	3	Retain and protect	The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected.
3 <i>Platanus × acerifolia</i> London Plane Tree	12	0	Retain and protect	The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected.
4 <i>Platanus × acerifolia</i> London Plane Tree	22	3	Retain and protect	The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected.
5 <i>Platanus × acerifolia</i> London Plane Tree	16	0	Retain and protect	The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected.
6 <i>Platanus × acerifolia</i> London Plane Tree	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.
7 <i>Platanus × acerifolia</i> London Plane Tree	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.

Tree Number	Incursion Percentage TPZ	Incursion Percentage SRZ	Action	Notes
8 <i>Platanus × acerifolia</i> London Plane Tree	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.
9 <i>Platanus × acerifolia</i> London Plane Tree	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.
10 <i>Platanus × acerifolia</i> London Plane Tree	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.
11 <i>Platanus × acerifolia</i> London Plane Tree	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.
12 <i>Platanus × acerifolia</i> London Plane Tree	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.
13 <i>Ficus benjamina</i> Weeping Fig	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.
14 <i>Ficus benjamina</i> Weeping Fig	4	0	Retain and protect	This tree will sustain minimal impacts by the proposed development. It is to be retained and protected.
15 <i>Ficus benjamina</i> Weeping Fig	5	0	Retain and protect	This tree will sustain minimal impacts by the proposed development. It is to be retained and protected.
16 <i>Ficus benjamina</i> Weeping Fig	46	40	Remove	This tree has exceeded its available growing space. For the proposed development to be undertaken. This tree is a priority for removal. This tree will sustain a major incursion in both the TPZ and SRZ.
17 <i>Podocarpus elatus</i> Brown Pine	0	0	Retain and protect	This tree will not be impacted by the proposed development. It is to be retained and protected.

Tree Number	Incursion Percentage TPZ	Incursion Percentage SRZ	Action	Notes
18 <i>Ficus microcarpa</i> var. <i>Hillii</i> Hills Weeping Fig	41	36	Remove	This tree is in declining health and structure. For the proposed development to be undertaken. This tree is considered a priority for removal. This tree will sustain a major incursion in both the TPZ and SRZ.
19 <i>Ficus benjamina</i> Weeping Fig	100	100	Remove	This tree has exceeded its available growing space. For the proposed development to be undertaken. This tree is within the footprint of the proposed development and is a priority for removal. This tree will sustain a major incursion in both the TPZ and SRZ.

7. Discussion

7.1. Tree 1 – Platanus × acerifolia

Tree is in fair health with good structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. As a result, the tree has a sparse canopy with minor tip dieback.

Impacts of the proposed development

The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.2. Tree 2 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. Phototropic to the east as a result of the building. Tree is in full vigour. Mechanical trunk damage at 3m and at ground level to 30cm.

Impacts of the proposed development

The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.3. Tree 3 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability with a sparse canopy. Mild phototropism to the east as a result of suppression.

Impacts of the proposed development

The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.4. Tree 4 – Platanus × acerifolia

Tree has poor shape and form throughout. Phototropic to the east as a result of suppression. Several locations of previous pruning over its lifetime. Sparse canopy with minor tip dieback.

Impacts of the proposed development

The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.5. Tree 5 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. Minor tip dieback with a sparse canopy.

Impacts of the proposed development

The footprint of the proposed structure overlaps with that of the existing structure. It is anticipated that the construction will have a low likelihood of impacting any roots already present. This tree will sustain minimal impacts by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.6. Tree 6 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Mildly sparse canopy. Good shape and form.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.7. Tree 7 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Fair structured branches at 3m. Branches are mildly compressed, with a low likelihood of failure. Tree is in high vigour indicating good health.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

for the protection of lateral roots within the footprint of the proposed construction.

7.8. Tree 8 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Tree located within small, grassed nature strip. Mildly phototropic due to encroachment and suppression from adjacent trees. Good vigour.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.9. Tree 9 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Growing with a paved footpath the tree has limited growing availability. Good shape and form. High vigour. Underground service location markings indicate tree is growing directly on top of water valve, and electricity.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.10. Tree 10 – Platanus × acerifolia

Fair shape and form. Heavily suppressed by adjacent canopy trees. Heavily epicormic canopy.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.11. Tree 11 – Platanus × acerifolia

Tree has been excessively crown raised over its lifetime as a result of its location on the footpath and adjacent to roadway. Fair shape and form. Tree is in good health and structure with no obvious defects.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.



7.12. Tree 12 – Platanus × acerifolia

Tree is in good health and structure with no obvious defects. Mild suppression. Phototropic to north as a result of adjacent canopy trees. Fair shape and form.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.13. Tree 13 – Ficus benjamina

Tree is in good health and structure with no obvious defects. Tree has high vigour with typical shape and form for the species.

Impacts of the proposed development

This tree will not be impacted by the proposed development. It is to be retained and protected using stem protection boarding. Tree protection fencing is not a viable option at this location due to limited space and high pedestrian activity.

7.14. Tree 14 – Ficus benjamina

Tree is in good health with fair structure. Several locations of compressed branch unions. 2x locations of conflicting branches resulting in wounding on associated stems. Tree is considered typical for the species.

Impacts of the proposed development

This tree will sustain minor impacts as a result of the proposed development. It is to be retained and protected using stem protection boarding and tree protection fencing.

7.15. Tree 15 – Ficus benjamina

Tree is in good health, however, has poor structure throughout. Multi-stemmed at ground level with compressed union. Several locations of included bark within canopy. Conflicting branches throughout. High vigour with poor structure.

Impacts of the proposed development

This tree will sustain minor impacts as a result of the proposed development. It is to be retained and protected using stem protection boarding and tree protection fencing.

7.16. Tree 16 – Ficus benjamina

Tree is in good health and structure with no obvious defects. Tree is considered typical for the species. Tree has good shape and form throughout. This tree has far exceeded its available growing space.

Impacts of the proposed development

This tree has exceeded its available growing space. For the proposed development to be undertaken this tree is a priority for removal. This tree will sustain a major incursion in both the TPZ and SRZ.

7.17. Tree 17 – Ficus benjamina

Tree is in good health and structure with no obvious defects. Tree is considered typical for the species. Tree has good shape and form throughout. This tree has far exceeded its available growing space.

Impacts of the proposed development

This tree has exceeded its available growing space. For the proposed development to be undertaken this tree is a priority for removal. This tree will sustain a major incursion in both the TPZ and SRZ.

7.18. Tree 18 – Ficus microcarpa var. Hillii

Tree is in poor health and structure. Tip dieback in mid and upper canopy. Several branches contain a high amount of stem wounding. Conflicting branches throughout. Heavily epicormic with secondary pest infestation. Poor shape and form.

Impacts of the proposed development

This tree is in declining health and structure. For the proposed development to be undertaken this tree is considered a priority for removal. This tree will sustain a major incursion in both the TPZ and SRZ.

7.19. Tree 19 – Ficus benjamina

Tree is in good health and structure with no obvious defects. Tree is growing within a small garden bed at the front stairs of the building. Good shape and form. This tree will exceed its available growing space.

Impacts of the proposed development

This tree is within the footprint of the proposed development. For the proposed development to be undertaken, this tree is a priority for removal. This tree will sustain a 100% incursion in both the TPZ and SRZ.



8. Recommendations

8.1. Trees identified for removal.

Table 4 - Trees identified for removal within the site 146 Arthur Street North Sydney.

Number	Species	Action
16	<i>Ficus benjamina</i> Weeping Fig	Remove
18	<i>Ficus microcarpa</i> var. <i>Hillii</i> Weeping Fig	Remove
19	<i>Ficus benjamina</i> Weeping Fig	Remove



Figure 5 - Tree removal plan within the site 146 Arthur Street North Sydney

8.2. Tees identified to be retained.

Table 5 - Trees identified to be retained within the site 146 Arthur Street North Sydney.

Number	Species	Action
1	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
2	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
3	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
4	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
5	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
6	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
7	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
8	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
9	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
10	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
11	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
12	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
13	<i>Ficus benjamina</i> Weeping Fig	Retain and protect
14	<i>Ficus benjamina</i> Weeping Fig	Retain and protect
15	<i>Ficus benjamina</i> Weeping Fig	Retain and protect
17	<i>Podocarpus elatus</i> Brown Pine	Retain and protect

9. Standards

9.1. Owners/builders responsibilities

It is the responsibility of the owner/builder to make this report available to all contractors associated with the development at the site. The following Tree protection Plan, report version one should be adhered to ensure that the trees are viable into the future.

9.2. Tree related works

All tree related work relevant to this report is to be conducted in accordance with:

- The NSW Workcover Code of Practice: Amenity Tree Industry 1998.
- The AS4970-2007 "Protection of Trees on Development Sites".
- All tree related work must be undertaken by an arborist with an Australian Qualification Framework Level 3 in Arboriculture or above.
- All tree related work carried out in the vicinity of overhead power lines must be undertaken by a qualified arborist with a current Power lines Awareness Certificate.

9.3. The Site Arborist

The site arborist will record tree health prior to commencement of construction and provide a Tree Protection Plan setting out tree protection measures, methods and supervision requirements.

9.4. Certification of works

The site arborist will provide certification at three stages of the project, prior, during and at the final stages for the compliance of tree protection measures. Changes to the tree protection will also be recorded as required.

9.5. The Site Arborist

The arborist will oversee work and provide advice for tree work within the tree protection zone and Structural Root Zone. A report will be required for pruning tree roots greater than 40mm in diameter.

9.6. Consent for works.

All tree related work must have written consent from the relevant control authority (local Council).

10. Tree Protection Plan – Information & Specifications

To achieve the best possible outcome in protecting the relevant trees during the development, compliance with the tree protection measures is crucial in ensuring the long-term success of the site trees.

- The fundamental element for tree protection for this site is tree protection fencing to protect and delineate an area where no development activities occur.
- The trees requiring protection will include:

Table 6 - Trees requiring tree protection measures.

Number	Species	Action
1	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
2	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
3	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
4	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
5	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
6	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
7	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
8	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
9	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
10	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
11	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
12	<i>Platanus × acerifolia</i> London Plane Tree	Retain and protect
13	<i>Ficus benjamina</i> Weeping Fig	Retain and protect
14	<i>Ficus benjamina</i> Weeping Fig	Retain and protect
15	<i>Ficus benjamina</i> Weeping Fig	Retain and protect
17	<i>Podocarpus elatus</i> Brown Pine	Retain and protect

- The Tree protection measures are to be implemented prior to commencement of construction and remain until post construction phases to ensure adequate protection for the retained trees on site.
- Due to the high pedestrian use of the site, modification to the tree protection fencing can be made. The tree protection must be checked and certified by the site arborist prior, during and after construction.

- No materials are to be stored within 3m of the property trees.
- The effectiveness of the tree protection measures recommended depends on the degree of cooperation between the developer, construction contractor, and the site arborist.

Tree Protection Zone (TPZ) – 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 TPZ is calculated using the Australian standard AS4970 - “Protection of Trees on Development Sites” formula.

Structural Root Zone (SRZ) – The SRZ only needs to be calculated when major encroachment into a TPZ is proposed. The SRZ is the area required for tree stability. A larger area is required to maintain a viable tree. The SRZ is calculated using the Australian standard AS4970 - “Protection of Trees on Development Sites” formula.

Tree Protection Measures and Recommendations within this report are in accordance with Australian Standard AS4970-2009 “Protection of Trees on Development Sites”.

Tree protection measures are to be implemented prior to commencement of demolition, during construction and post construction phases to ensure adequate protection for the retained trees on site.

10.1. Specification

10.1.1. Tree Protection Zones (TPZ)

TPZ are to be erected prior to any work or machinery entering the site. The TPZ will remain in place until all site works are complete (refer to).

10.1.2. Tree Protection Fencing

Shall protect the tree from mechanical damage. Ensure no materials are stored at the base of the trees. It is the site foreman’s and owner’s responsibility to ensure this area is maintained throughout the development. The Tree Protection Fencing must be checked and Certified by the Site Arborist.

10.1.3. Tree Protection - Boarding

Trees on a development site can be damaged by vehicles, heavy loaders and bobcats during the demolition and construction phase. Trees are easily protected by installing tree protection which usually consists of cordoning off the trees with temporary fencing panels. Where fencing. Is not possible due to site conditions tree protection boarding will prevent mechanical damage. See figure 8 for an example of stem protection boarding.

10.1.4. Tree Protection - rumble boards or trac mats and geotextile fabric

Soil compaction can be caused by vehicles, heavy loaders and bobcats during the demolition and construction phase. Trees are easily protected by installing tree protection rumble boards or trac mats which cover the ground frequently used by machinery. This will prevent soil compaction and prevent the tree from declining in health.

10.1.5. Activities

No other activity is to take place within the TPZ. This includes and is not restricted to the following: silt fence excavation, soil level changes, storage of material or waste, run off from wash down, slurry etc., refuelling, parking, and various other activities (refer to AS4970-2009 4.2 pg 15)

10.1.6. Maintenance of the tree protection zones.

During construction shall be completed by the site arborist. The site arborist shall make regular checks and maintain the tree protection structures during construction.

10.1.7. Adequate signs

Regarding the delegated areas of "TPZ" shall be clearly visible from within the development site. The area indicates the zone required for protecting trees and all of their parts. The sign shall be made from durable all-weather material and be securely fixed to the outer visible side of the tree protection fencing. The signage shall be visible from all areas of the work site and may include multiple signs.

10.1.8. Alterations

Alteration to the TPZs requires the site arborist approval.

10.1.9. Root pruning

Trees requiring root pruning prior to excavation shall be done under the supervision of the site arborist. Roots equal to 10mm or greater shall require pruning by the site arborist. The root pruning cuts made shall be made at a 90 degree angle and use a clean sharp pruning implement.

10.1.10. Trenching and boring underground services

Trenching and boring within the TPZ shall be done under the supervision of the site arborist. Where possible all services should be routed outside the minimum set back distance. Where this is not possible the underground service should be installed by directional drilling at a depth of no less than 600mm or use manual excavation techniques. When the Structural Root Zone is affected the project arborist must demonstrate that the tree(s) would remain viable.

10.1.11. Tree pruning

Tree pruning, crown lifting, crown reduction, branch removal shall be carried out by an arborist with minimal qualification of certificate 3 (Australian Qualification Framework AQF Level 2) in arboriculture.

10.1.12. Hold points.

Requiring certification by the site arborist include:

- Installation of tree protection and signage.
- Excavation within TPZ/SRZ.
- Various unforeseen changes in the field.
- Mid construction
- Completion of construction works.



Michael Garton
Principal Consultant – Endemic Tree Consultants
Diploma of Horticulture (AQF 5 – Arboriculture)
Certificate IV Environmental Management & Sustainability
Certificate IV Government Investigations
Quantified Tree Risk Assessment (QTRA) Registered User 5426
Tree Risk Assessment Qualification (TRAQ)
Email Address: michael@endemictrees.com.au
Website: www.endemictrees.com.au
Phone: 0422 250 928



QTRA Quantified Tree Risk Assessment

Disclaimer statement. The response of a living tree to its immediate environment is dynamic throughout its entire life cycle due to external influences giving each tree a unique natural variability. A visual tree assessment addresses the external symptoms presented by a tree. This cannot exclude a tree from the potential for failure due to unforeseen circumstances. This report cannot provide a conclusive recommendation regarding any part of a tree root system that is not exposed for visual inspection. Additionally, it cannot not be assumed, that a tree will be safe in all conditions in the future. Appropriate management, assessment, and maintenance aim to mitigate risks to an acceptable level. This report is the opinion, advice or recommendation based on the information supplied by the client or observation of the author.

Copyright Endemic Tree Consultants, all rights Reserved © 2024 Endemic Tree Consultants (Publisher) is the owner of the copyright subsisting in this publication. Other than as permitted by the Copyright Act and as outlined in the Terms of Engagement, no part of this report may be reprinted or reproduced or used in any form, copied or transmitted, by any electronic or by other means (including photocopying, scanning, or otherwise), without the prior written permission of Endemic Tree Consultants. Legal action will be taken against any breach of Copyright. This report is only available in PDF form. No part of it is authorised to be sold, distributed or offered in any other form. This report has been prepared to provide arboricultural advice to the client and/or their authorised representatives in regard to a particular and specific development proposal or tree permit application as advised by the client. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person including the client then the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be interpreted without reference to the entire report.



11. Appendices



Figure 6 - Tree location and removal plan.



Tree Assessment Table Explanatory Notes

Thyer Tree Valuation Method (1996)

AGE CLASS (Modified from *British Standard BS5837-1991*).

Immature (I): Young trees, less than 20% of life expectancy.

Semi-mature (S): Middle aged trees, 20-40% of life expectancy.

Mature (M): Trees between 40-80% of life expectancy.

Over-mature (O): Senescent trees, or those declining irreversibly. Less than 20% of life expectancy.

HEALTH - This evaluates a trees vitality and vigour as indicated by its crown density, leaf size, foliage colour and its ability to withstand wounding, pests, diseases, or changes to the growing environment.

Good: (G) Tree is generally healthy and showing signs of normal vigour and is expected to continue to remain so, provided conditions around the tree required for its survival do not change.

Average: (A) Tree is typical of the species, considering its age, without noticeable decline.

Fair: (F) Tree shows signs of normal vigour but shows some indications of decline due topsets and diseases or changes to its growing environment.

Poor: (P) Tree exhibits symptoms of advanced and irreversible decline due to fungal decay, severe dieback of branch and crown canopy, predation of pests, storm or lightning damage, root damage or instability of the tree and alterations to its growing environment.

STRUCTURAL CONDITION - This refers to the trees form, and growth habit modified by its environment, the state of the trunk and the main structural branches. It includes the presence of defects such as decay, weak branch junctions and other visible abnormalities. Although some trees without defects fail in storms, the presence of any defect will increase the chances of failure.

Good: (G) Trees with a single dominant trunk along which evenly spaced branches are spread. Branches have properly formed collars which provide strong attachment to the trunk and are about 25% of the trunk diameter. Minor structural defects may be present with low failure potential.

Average: (A) Trees which have structural defects and low failure potential.

Fair: (F) Trees with structural defects and medium failure potential, which require monitoring on an annual basis.

Poor: (P) Trees with defects which have failed, or have a high risk of failing soon, and corrective action must be taken as soon as possible.

IACA Significance of a Tree, Assessment Rating System (STARS)

© (IACA2010) ©



In the development of this document IACA acknowledges the contribution and original concept of the footprint green tree significance and retention value matrix, developed by Footprint Green Pty Ltd in June 2001.

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on the site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria* and *Tree Retention Value - Priority Matrix*, are taken from the ACA dictionary for managing trees in urban environments 2009.

This rating system will assist in the planning process for proposed works, above and below ground where trees are to be retained on or adjacent a development site. This system uses a scale of *High*, *Medium*, and *Low* significance in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined.

Tree Significance - Assessment Criteria

1. High Significance in landscape

- The tree is in good condition and good vigor,
- The tree has a form typical for the species,
- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age,
- The tree is listed as a Heritage Item, Threatened Species or part of an Endangered ecological community or listed on Councils Significant Tree Register,
- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity,
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values,
- The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa *in situ* - tree is appropriate to the site conditions.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour,
- The tree has form typical or atypical of the species,
- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area,
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street,

- The tree provides a fair contribution to the visual character and amenity of the local area,
- The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa *in situ*.

3. Low Significance in landscape

- The tree is in fair-poor condition and good or low vigor,
- The tree has form atypical of the species,
- The tree is not visible or is partly visible from surrounding properties as obstructed by other vegetation or buildings,
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area,
- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation orders or similar protection mechanisms and can easily be replaced with a suitable specimen,
- The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxonomy *in situ* - tree is inappropriate to the site conditions,
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms,
- The tree has a wound or defect that has potential to become structurally unsound.

Environmental Pest / Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties,
- The tree is a declared noxious weed by legislation.

Hazardous/Irreversible Decline

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

***The tree is to have a minimum of three (3) criteria in a category to be classified in that group.**

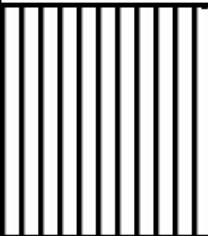
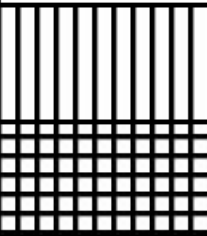
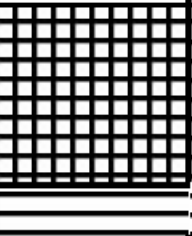
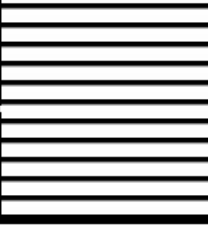
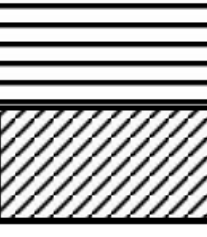
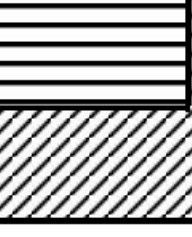
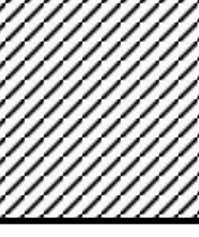
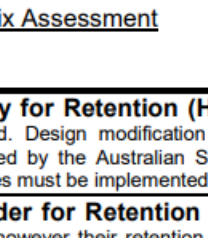
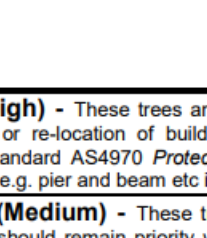
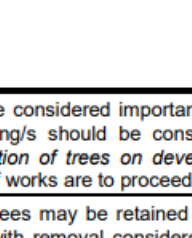
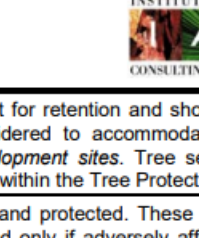
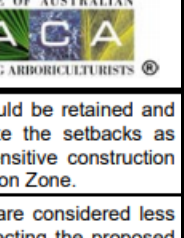
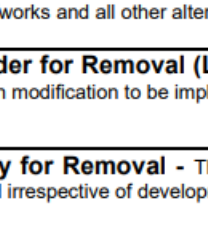
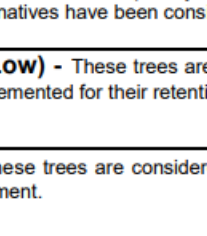
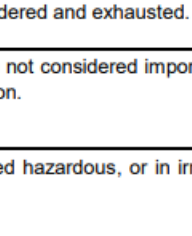
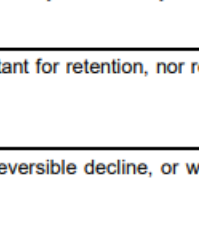
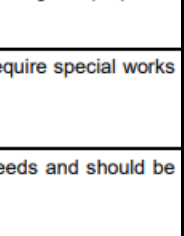
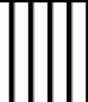
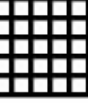
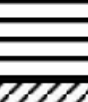
Note: The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety e.g., hedge.

USE OF THIS DOCUMENT AND REFERENCING

The IACA significance of a tree assessment rating system is free to use, but only in its entirety and must be cited as follows:

IACA, 2010 IACA significance of a tree assessment rating systems, institute of Australian consulting arborists, Australia www.iaca.org.au

Table 7. Tree Retention Value – Priority Matrix

		Significance				
		1. High	2. Medium	3. Low		
		Significance in Landscape	Significance in Landscape	Significance in Landscape	Environmental Pest / Noxious Weed Species	Hazardous / Irreversible Decline
Estimated Life Expectancy	1. Long >40 years					
	2. Medium 15-40 Years					
	3. Short <1-15 Years					
	Dead					
<u>Legend for Matrix Assessment</u> 						
	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 <i>Protection of trees on development sites</i> . Tree sensitive construction measures must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.					
	Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.					
	Consider for Removal (Low) - These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.					
	Priority for Removal - These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.					

IACA2010, IACA Significance of a Tree Assessment Rating System (STARS), Institute of Australian Consulting Arborists.
www.iaca.org.au

Tree protection measures

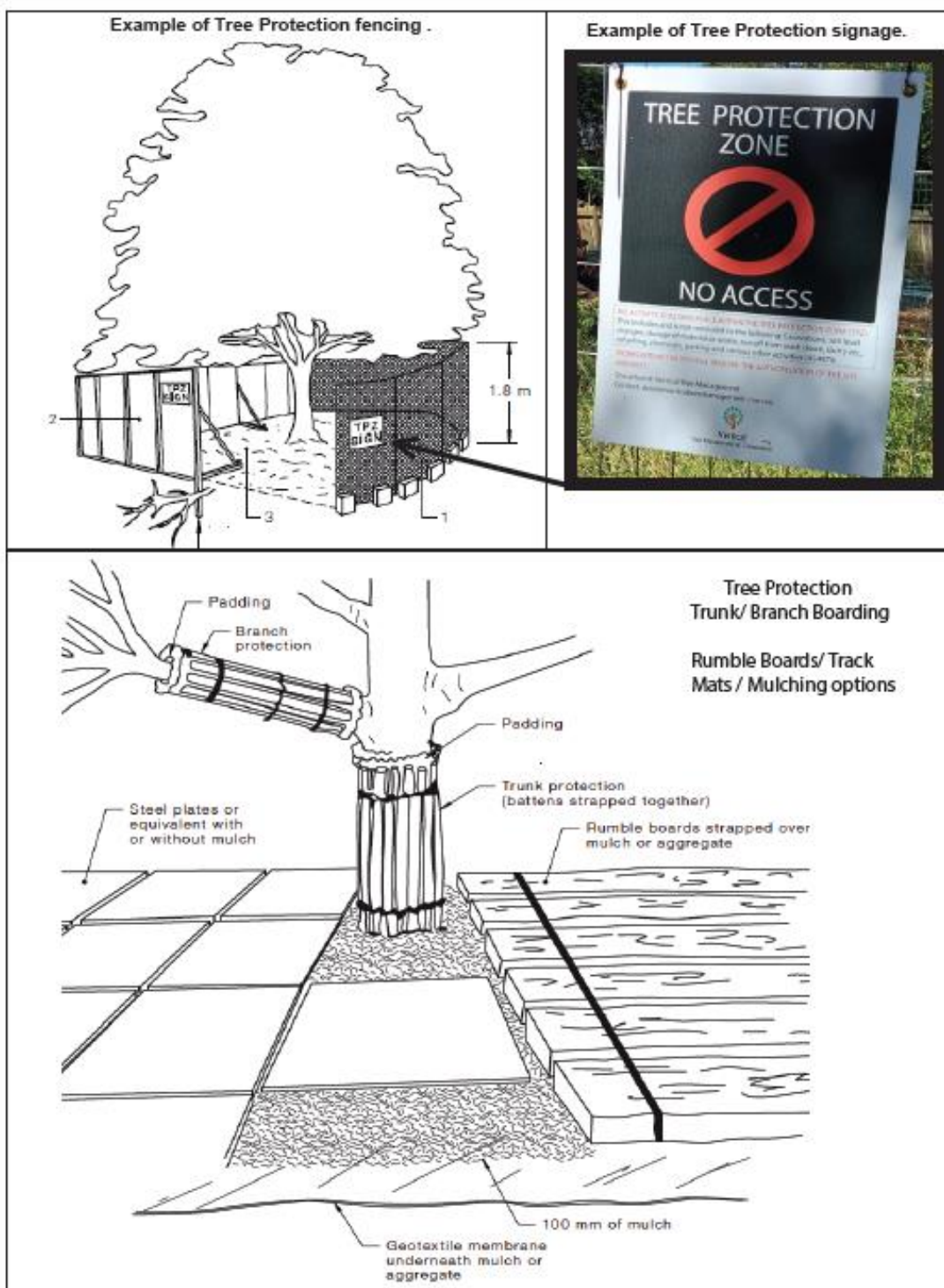


Figure 7 - Example of tree protection measures required within the site.



Figure 8 - Example of stem protection boarding required on all retained trees within the site.

TPZ & SRZ Incursion table

	Requirements under AS 4970-2009	Impact	Mitigation measures
No encroachment (0%)	N/A	No impact (0%)	N/A
Minor encroachment (<10%)	- The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. - Detailed root investigations should not be required.	Low impact (<10%)	- The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. - Tree protection must be installed.
Major encroachment (>10%)	- The project arborist must demonstrate the tree(s) would remain viable. - Root investigation by non-destructive methods may be required. - Consideration of relevant factors including Root location and distribution, tree species, condition, site constraints and design factors. - The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ.	Medium impact (<20%)	- The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. - The project arborist will be required to supervise any work within the TPZ. - Tree protection must be installed.
		High impact (>20%)	- The project arborist must demonstrate the tree(s) would remain viable. - Non-destructive root investigation will be required for any trees proposed for retention. - The project arborist will be required to supervise any works within the TPZ. - Tree protection must be installed.

Tree Risk Assessment Qualification (TRAQ)



This Tree Risk Assessment is the Likelihood Matrix from the risk categorization section of the TRAQ form for Tree Risk Assessment Qualified Arborists 2013. This TRAQ form has been based on the Best Management Practice for Tree Risk Assessment, E. T Smiley, Nelda Matheny, Sharon Lily, published by the ISA 2011.

There are three levels of assessments that an assessor can conduct:

Inspection Type	Inspection Method
Level 1 Limited Visual Inspection	A limited visual walk or drive by inspection to identify certain obvious defects or specified conditions.
Level 2 Basic Visual Inspection	A ground based detailed visual inspection of a tree and its surroundings. Some simple tools may be used to assist in this level of assessment.
Level 3 Advanced Inspection	Further, aerial, or other inspection based on the outcome of the Level 2 Basic Visual Inspection.

The Tree Risk Categorization in this case is a qualitative risk assessment used by qualified tree assessors in combination with a matrix to assign risk. The assessor considers possible targets, the target zone, occupancy rates, site-specific factors, Tree species, noted defects and environmental factors within a specified period. The tree assessor uses this information to Categorize risk for the Likelihood of failure, combined with the Likelihood of impacting a target. These two categories make up the first table (table 1) in the Tree Risk Matrix. The second table assesses the Tree Risk rating by combining the Likelihood of failure and impact in table 1 with the Consequences of the branch or tree failing, refer to table 2. The result is a risk rating of low, moderate, high, or severe.

The Likelihood of failure options,

Improbable- the tree or branch is not likely to fail in normal weather conditions within the specified time period.

Possible- Failure of the tree or branch could occur in normal weather conditions within the specified time period.

Probable- the tree or branch may be expected to fail in normal weather conditions within the specified time period.

Imminent- the tree or branch failure has started and is likely to occur in the near future, even without significant wind or load. This is a rare occurrence for the risk assessor to encounter and immediate action must be taken to prevent harm to people or property.

Matrix 1. Likelihood Matrix. The matrix is used to estimate the likelihood of a tree failure impacting a specified target. Categorizing Consequences of failure

Likelihood of Failure	Likelihood of Impact			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Highly likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

The Likelihood of impacting a target options.

Very low- The chance of the failed tree or branch hitting a target is remote. This would be the case in a site with no targets or a rarely used site or a site that is protected by from impact by other objects.

Low- It is not likely that the failed tree or branch will impact the target. This would be the case in a site which is fully exposed to the tree but is used occasionally, a frequently used area that is partially exposed to the assessed tree.

Medium- The failed tree or branch may or may not hit the target with nearly equal likelihood. This would be the case in a frequently used area that is fully exposed on one side to the assessed tree, or a constantly occupied area that is partially protected for the assessed tree.

High- The failed tree or branch will most likely impact the target. This would be the case when a fixed target is fully exposed to the assessed tree or near a high use road or walkway with an adjacent street tree.

Negligible- consequences are those that involve low value property damage or disruption that can be replaced or repaired and does not involve personal injury.

Minor- consequences are those that involve low – moderate property damage, disruptions in traffic or disruption in communications or minor personal injury.

Significant - consequences that involve property damage of a moderate to high value, considerable disruption, or personal injury.

Severe- consequences that could involve serious personal injury or death, damage to high value property or disruption of important activities.

The four levels of risk as used in the table are defined below and should be used in making recommendations.

Extreme- The extreme risk category applies in situations in which failure is imminent and there is a high likelihood of impacting the target with severe consequences. The tree risk assessor should

recommend mitigation measures to be taken as soon as possible. This may involve immediately restricting the target zone.

High- High-risk situations are those for which consequences are significant and likelihood is very likely or likely or consequences are severe, and likelihood is likely. This combination of likelihood and consequences indicates that the tree risk assessor should recommend mitigation measures. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree owner or risk manager.

Moderate- Moderate risk situations are those in which consequences are minor and likelihood is very likely or likely or likelihood is somewhat likely, and consequences are significant or severe. The tree risk assessor should recommend mitigation and or retaining the tree with monitoring. The decision for mitigation and timing depends upon the risk tolerance of the tree owner or manager.

Low- The low-risk category applies when consequences are negligible, and likelihood is unlikely, or consequences are minor, and likelihood is somewhat likely. Some trees with this level of risk may benefit from mitigation or maintenance measures, but immediate action is not usually required. Tree risk assessors may recommend retaining and monitoring these trees as well as mitigation that does not include tree removal.

Matrix 2. Risk Rating Matrix showing the level of risk as the combination of likelihood of a tree or part failing and impacting a target and severity of the associated consequences.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat Likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

12. Bibliography

- AU STANDARD 4373 – 2007 *Pruning of Amenity Trees*. (n.d.).
- AU STANDARD 4970 - 2009 *Protection of Trees on Development Sites*. (n.d.).
- AU STANDARD 4970 – 2009 *Protection of Trees on Development Sites*. (n.d.).
- Barrell, J. (1996). *Safe Useful Life Expectancy (SULE) is the Natural Progression*’. *Arboricultural*.
- Barrell, J. (2009). *Tree AZ. Detailed guidance on its use*’. Version 10.10 – ANZ. United Kingdom.
- Dunster, J. S. (2017). *Tree Risk Assessment-Manual*’. *International Society of Arboriculture*,
- Harris, R. C. (2004). *Arboriculture: Integrated management of landscape trees, shrubs and vines*,
- IACA. (2010). *Significance of a Tree, Assessment Rating System (STARS)*’. *Institute of Australian Consulting Arboriculturists*.
- IACA. (n.d.). *Sustainable Retention Index Value (SRIV)* –. Retrieved from <https://www.iaca.org.au/>.
- Lonsdale, D. (2010). *Principles of Tree Hazard Assessment and Management*’. 9th impression, TSO, Norwich.
- Matheny, N. &. (1994). *A photographic guide to the evaluation of hazard trees in urban areas*. *International Society of Arboriculture*.
- Matteck, C. (1994). *Visual Tree Assessment Guidelines – VTA Symptoms*.
- Matteck, C. (2022). *Visual Tree Assessment Guidelines – VTA*.
- Mattheck, C. &. (1994). *Field guide for visual tree assessment (VTA)*. *Arboricultural Journal*.
- Mattheck, C. B. (1994). *The body language of trees: a handbook for failure analysis*.
- McDonald, J. (2022). *Forest Health Surveillance Damage Recognition*. Retrieved from <https://plantsurveillancenetwork.net.au/>.
- Nelda P. Matheny, J. R. (n.d.). *Trees and Development a Technical Guide to Preservation of Trees During Land Development*. 1998.
- Pell, S. a. (2016). *A botanist’s vocabulary: 1300 Terms Explained and Illustrated*. *Timber Press*.
- QAA. (n.d.). *Tree Protection Zone*. Retrieved from QAA Queensland Arboricultural Association ink: <https://qaa.net.au/resources/calculations/>.
- Richard Wilson Harris, J. R. (1998). *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines (3rd Edition)*.
- Tree Measurement Guidelines Measuring Tree DBH, Lean, and Drip Line*. (n.d.). Retrieved from <https://tfsweb.tamu.edu/>.

13. Glossary

Aerial inspection - a close inspection of the aerial part of a tree, either by elevated work platform (EWP) or by an AQF level 3 arborist (climbing inspection).

Air spade - equipment providing a jet of compressed air to a hand-held device which helps to excavate roots almost non-destructively.

Amenity tree – a tree grown for purposes other than for production.

AS4373-2007 – Current Australian Standard for the Pruning of Amenity Trees.

AQF – Australian Qualification Framework for all educational and training purposes.

Axiom of uniform stress - is a self-optimizing structure because the growth of new wood tends to eliminate any stress concentrations, maintaining a uniform stress distribution.

Bacteria - one of the five kingdoms of living things. Some cause disease, many are decomposers, and some are beneficial (such as nitrifying bacteria and those in the gut of animals).

Bark cambium (cork cambium, phellogen) - Layers of meristematic cells on the outer side of the phloem that give rise to the bark.

Branch order - The seedling axis, typically giving rise to the main stem, has a branch order of 0. Branches arising from axillary buds on the seedling axis are first-order branches, branches arising from them are second order and so on, the shoots at the periphery of the crown having the highest order.

Callus - cells that forms over an injury or scar, that develops from actively dividing plant tissue.

Canker - A discrete area of dead or malformed bark caused by a pathogen.

Canopy - Of a single tree, its crown, emphasizing its spreading and enclosing character. Of a forest, the crowns of the larger trees considered collectively.

Chlorophyll - The pigment in green plants and a kind of bacteria (cyanobacteria) that permits photosynthesis. Chlorophyll is green because it absorbs light most strongly in the blue and red regions of the visible spectrum, reflecting the green.

Compartmentalization - A form of defense in woody plants, in which barriers resistant to invasion by pathogens or wood decay fungi are laid down while the wood is living (sapwood), and which continue to act passively once the wood is incorporated into heartwood.

Deadwood - Dead and decomposing wood including dead trees (whether standing, snapped or fallen), branches of any size, stumps and roots.

Defect - Any feature of a tree that is likely to make it less safe (in the case of a structural defect) or otherwise to reduce its health, longevity, landscape prominence or conservation value for any other reason.

Diameter - Broadly, the width of a cylindrical object like the main stem of a tree.

dbh – the diameter of a stem measured at breast height i.e. 1000mm.

Dip. Arb. – Diploma in Arboriculture.

Drip zone – the area from one edge of the canopy to the other.

Expert witness - Someone capable of giving an expert opinion, to be relied upon in some official or legal process.

Fastigate - A growth habit with branches strongly ascending, like Lombardy poplar. A common ornamental form.

Fibre buckling A local transverse failure in compression of the outer wood of a stem as it sways in a strong wind. The resulting adaptive growth gives rise to a characteristic ring-like bulge around the stem.

First-order branch – a branch which emanates directly from the trunk, in contrast to a scaffold branch, sometimes referred to as a primary branch.

Flush cut - A pruning cut that removes the branch collar and/or part of the branch ridge, slowing the occlusion of the wound.

Footing - A relatively broad base to a foundation to help spread load and improve the stability of a structure.

Fungi (singular 'fungus') - One of the four main groups (kingdoms) of organisms. There are two groups of higher fungi, the Basidiomycetes and Ascomycetes, while other groups are moulds. Many fungi are decomposers, including the relatively specialized wood decay fungi. Some are plant pathogens, some are symbiotic (see mycorrhiza, lichen) and some are cultivated by insects for food (see ambrosia beetle).

Fungus - Several fungal diseases, sometimes called heart rots, sap rots, or canker rots, decay wood in tree trunks and limbs. Under conditions favoring growth of specific rot fungi, extensive portions of the wood of living trees can decay in a relatively short time (i.e., months to years). Decay fungi reduce wood strength and may kill storage and conductive tissues in the sapwood.

Included bark - Areas of bark on adjacent parts of a tree, typically on the inner faces of a narrow fork, which grow over to occupy part of the internal joint.

Ganoderma spp. - A common wood decay fungus of the selective delignification type, causing root rot and butt rot mainly in broadleaf trees. The fruiting bodies of the fungus are woody brackets, commonly occurring in the flutes between the buttresses of big trees near ground level.

Heartwood - In a branch, main stem or root of sufficient diameter, the non-living inner wood, in contrast to the sapwood in which the xylem parenchyma cells are alive.

Lignin - A constituent of some plant cell walls making them stiff and woody. About 1/3 of the dry weight of wood is lignin.

Lion-tailing - A long branch with a tuft of secondary branches near the tip, a marked form of end loading, either arising naturally or from poor pruning practice.

Mistletoe - A semi-parasite, having green leaves for photosynthesis but growing into the host to obtain water and nutrients.

Mycelium - A network of hyphae making up the vegetative part of a fungus.

Mycelium - A network of hyphae making up the vegetative part of a fungus.

Osmosis - The flow of water across a semi-permeable membrane from a dilute solution to a more concentrated one, as from the soil water into a root cell or from the xylem into a leaf cell.

Quantified tree risk assessment (QTRA) - A refinement of visual tree assessment with emphasis on seeking to quantify the component probabilities of tree risk, particularly the occupancy of the target area, to arrive at an overall numerical or categorical risk.

Root Zone - Area encompassing the tree roots.

Scaffold branch – a branch which emanates from a first-order branch, also known as a second-order branch.

Structural defect - A defect in a structure that makes it less able to withstand the forces applied to it.

t/R ratio - In hollow tree stems, the ratio of the thickness of sound wood to the radius. A criterion helpful in evaluating tree risk developed by Mattheck & Breloer (1994)

Tension wood - The kind of reaction wood found in broadleaf trees which is strong in tension and is characterized by a low lignin content.

Tree risk - The risk that a tree causes damage or injury if it (or part of it) suffers structural failure. Tree risk is a composite of several variables: hazard, probability, target value and occupancy.

Urban forest - Trees and other woody vegetation in the built environment considered collectively over an extensive area (eg. the jurisdiction of a local authority).

Vigour – the genetic capacity (potential) of a tree to resist strain. Vigour can be measured by applying a known stimulus [such as a wound] and then measuring the trees response. Vigour cannot be increased. Vigour is classified as either 'normal' or 'low' (Shigo, 1986, p.120).

Vitality – the ability (dynamic) of a tree to adapt to the conditions in which it finds itself. Vitality can be improved by; watering, mulching, fertilizing, aerating etc. (Shigo, 1986, p. 120). For the purpose of this report vitality shall be classified as either low or good.

VTA - Visual Tree Assessment

Windthrow- The fall of a tree in a high wind, with the breakage of the outer roots, so that the tree is uprooted. There are three main modes of windthrow.