



Transport Access Program

Petersham Station Upgrade

Supporting Studies



*Artist's impression of the proposed Petersham Station Upgrade,
subject to change during detailed design.*



Arboricultural Impact Assessment Report

For the site address

Petersham Station, PETERSHAM, NSW

Prepared for

Transport for NSW

Level 5, Tower A, Zenith Centre

CHATSWOOD, NSW 2067

AUTHOR

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STATUS

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1.0 Introduction

1.1 Allied Tree Consultancy (ATC) has been commissioned by RPS on behalf of Transport for NSW (TfNSW) to prepare an Arboricultural Impact Assessment for the Petersham Station Upgrade. This proposal includes works related to upgrading the station infrastructure to meet requirements of the Commonwealth *Disability Discrimination Act 1992*. This report includes seven trees located on, and adjacent to the site, and discusses the viability of these trees based on the proposed works.

1.2 This report will address for these trees, the:

- species' identification, location, dimensions, and condition;
- SULE (Safe Useful Life Expectancy) and STARS (Significance of a Tree Assessment Rating System) rating;
- discussion and impact of the proposed works on each tree;
- tree protection zones and protection specifications for trees recommended for retention.

2.0 Standards

2.1 ATC provides an ethical and unbiased approach to all assignments, possessing no association with private utility arboriculture or organisations that may reflect a conflict of interest.

2.2 This report must be made available to all contractors during the tendering process so that any cost associated with the required works for the protection of trees can be accommodated.

2.3 It is the responsibility of the project manager to provide the requirements outlined in this report relative to the Protection Zones, Measures (Section 7.0) and Specifications (Section 8.0) to all contractors associated with the project before the initiation of work.

2.4 All tree-related work outlined in this report is to be conducted in accordance with the:

- Australian Standard – AS4373; Pruning of Amenity Trees.
- Guide to Managing Risks of Tree Trimming and Removal Work¹.
- all tree works must be carried out at a tertiary level (minimum Certificate-level 3) qualified and experienced (minimum five years) arboriculturist.
- for any works in the vicinity of electrical lines, the arboriculturist must possess the ISSC26 endorsement (Interim guide for operating cranes and plant in proximity to overhead powerlines).

¹ Safe Work Australia; July 2016; Guide to Managing Risks of Tree Trimming and Removal Work, Australia

2.5 As a minimum requirement, all trees recommended for retention in this report must have removed all dead, diseased, and crossing limbs and branch stubs to be pruned to the branch collar. This work must comply with the local government tree policy (Inner West Council) and Section 2.4.

2.6 Any tree stock subject to conditions for works carried out in this report must be supplied by a registered Nursery that adheres to the AS 2303; 2015².

- All tree stock must be of at least 'Advanced' size (minimum 75 litre) unless otherwise requested and approved by TfNSW.
- All tree stock requested must be planted with adequate protection. Subject to landowners requirements (including council), this may include tree guards (protect stem and crown) and if planted in a lawn area, a suitable barrier (planter ring) of an area, at least, one square metre to prevent grass from growing within the area adjacent to the stem.

3.0 Disclosure Statement

Trees are living organisms and, for this reason, possess natural variability. This cannot be controlled. However, risks associated with trees can be managed. An arborist cannot guarantee that a tree will be safe under all circumstances, nor predict the time when a tree will fail. To live or work near a tree involves some degree of risk, and this evaluation does not preclude all the possibilities of failure.

4.0 Methodology

4.1 The following tree assessment was undertaken using criteria based on the guidelines laid down by the International Society of Arboriculture.

4.2 The format of the report is summarised below;

4.2.1 Plan 1; Tree Location Relative to Site: This is an unscaled plan reproduced from the Survey Plan as referenced in Section 4.4.1, depicting the area of assessment.

4.2.2 Table 1; This table compiles the tree species, dimensions, brief assessment (history, structure, pest, disease or any other variables subject to the tree), significance, allocation of the zones of protection (i.e., Tree Protection Zone³ ;TPZ and Structural Root

² Australian Standard; 2015, AS2303- Tree stock for landscape use, Australia

³ Australian Standard, 2009, AS4970; – Protection of Trees on Development Sites, Australia

Zone; SRZ) for each tree illustrated in Plan 1, Section 5.0. All measurements are in metres.

4.2.3 Discussion relating to the site assessment and proposed works regarding the trees.

4.2.4 Protection Specification; Section 8.0 details the requirements for that area designated as the Tree Protection Zone (TPZ), for those trees recommended for retention.

4.3 The opinions expressed in this report, and the material, upon which they are based, were obtained from the following process and data supplied:

4.3.1 Site assessment on the 3 August 2019 using the method of the Visual Tree Assessment⁴. This has included a Level 2 risk assessment, being a *Basic Assessment*⁵. The assessment has been conducted by Warwick Varley⁶ on behalf of ATC.

4.3.2 Trees included in this report are those that conform to the description of a prescribed tree by the local government policy.

4.3.3 All measurements, unless specified otherwise are taken from the tree centre.

4.3.4 Raw data from the preliminary assessment including the specimen's dimensions were compiled by the use of a diameter tape, height clinometer, angle finder, compass, steel probes, Teflon hammer, binoculars and recording instruments.

4.4 Documentation provided

The following documentation has been provided to ATC and utilised within the report.

4.4.1 Design

Drawn by *Design Inc. Sydney P/L*

Date: 25 July 2019

Reference: P18-140

Drawing No: 31 sheets, Revision 5

Note 1: See Section 4.5.1

⁴ Mattheck, C. Breloer, H., 1994, The Body Language of Trees – A handbook for failure analysis
The Stationary Office, London

⁵ Dunster J.A., 2013, Tree Risk Assessment Manual, International Society of Arboriculture, 2013, USA

⁶ Consulting Arborist, Graduate Certificate and Diploma of Arboriculture (level 8 and 5)

4.4.2 Document

Urban Design and Public Domain Plan: Petersham Station

Author: *Design Inc. Sydney P/L*

Date: 30 July 2019,

Reference: TAP 3: Package 2A; 50272-PET-AR-REP-35101

Pagination: 28 Pages

4.4.3 Document

Petersham Station; Compound locations

(Proposed laydown / storage area)

Author: *TfNSW*

Date: received 19th August 2019,

Pagination 3 pages

4.4.4 Survey

Drawn by *Cardno P/L*

Date: 8 August 2019

Reference: 8001909902005

Drawing No: Sheets 1-6

4.5 Limitations of the assessment/discussion process

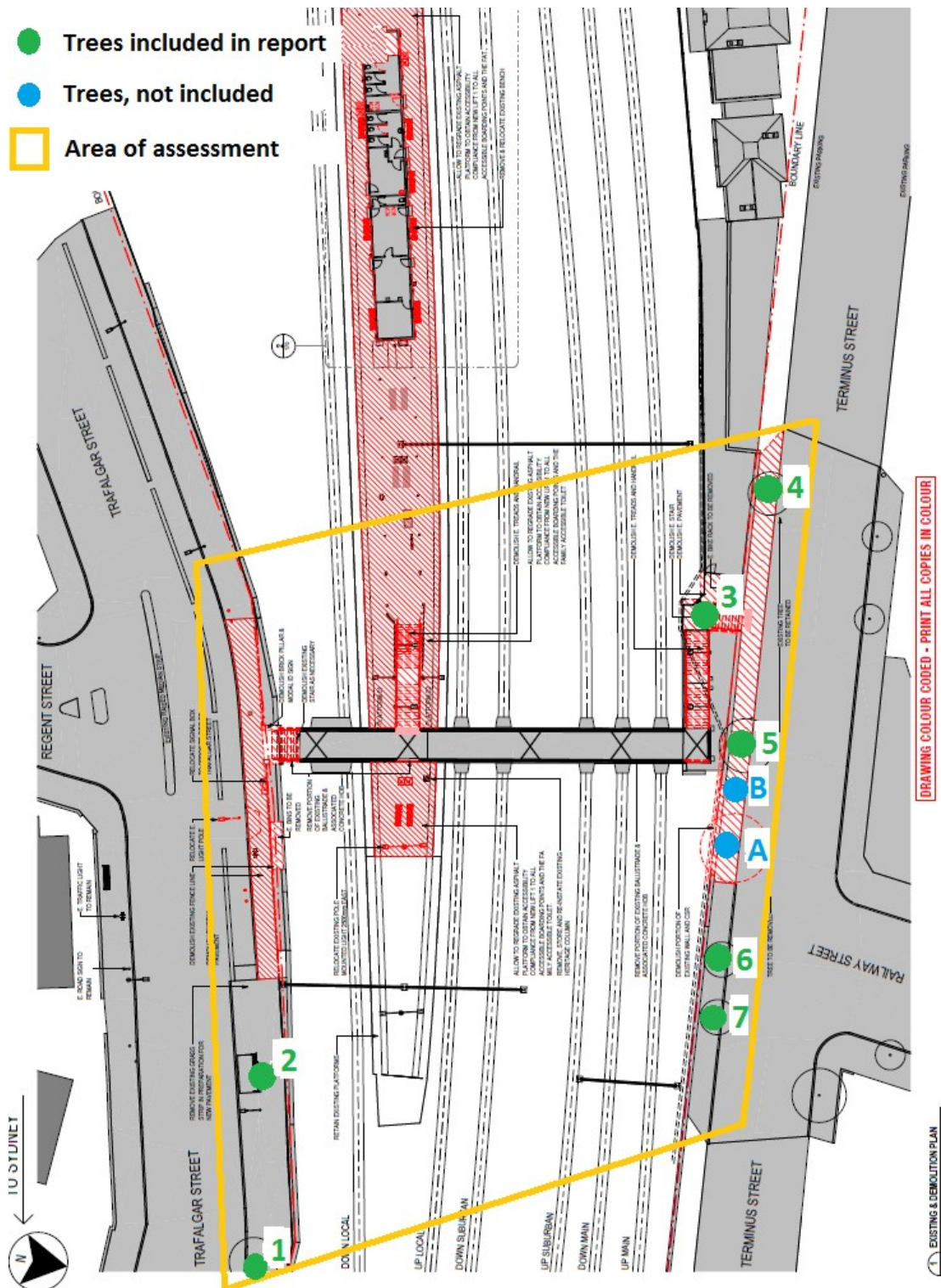
4.5.1 Trees No. 2 and 3 have been omitted from the plans provided, however, are required for inclusion because they conform to the definition of a prescribed tree within the local government tree policy. The tree location has been plotted onto the Plan 1 by ATC. The tree location was established by measuring from known points and scaling onto the drawing. ATC is not a registered surveyor and, however, the accuracy of the survey is attempted; the true position of the trees may marginally deviate. Any such deviation provides the potential for changing the actual impact (encroachment) provided to a tree.

4.5.2 The scope of works requested for inclusion for the tree assessment has been illustrated in Plan 1 by the yellow outline. This provides the trees that fall within the area of works related to the proposed lifts connecting to the footbridge. However, does not include further possible conflict where work may contain trees and areas outlined in the document titled, *Petersham Station; Compound locations* (Section 4.4.3).

4.5.3 The assessment has considered only those target zones that are apparent to the author and the visually apparent tree conditions, during the time of assessment.

- 4.5.4** Any tree regardless of apparent defects would fail if the forces applied to exceed the strength of the tree or its parts, for example, extreme storm conditions.
- 4.5.5** The assessment has been limited to that part of the tree which is visible, existing from the ground level to the crown. Root decay can exist and in some circumstances provide no symptoms of the presence. This assessment responds to all the symptoms provided by a tree, however, cannot provide a conclusive recommendation regarding any tree that may have extensive root decay that leads to windthrow without the appropriate symptoms.

5.0 Plan 1; Area of assessment illustrating tree location



Not to scale

Trees labelled A and B are exempt species, see Section 7.0.

Scope of works (Yellow outline) See Section 4.5.2

Source: Adapted from *Design Inc. Sydney P/L*, Drawing 50272-PET-AR-DRG-35103 (5), see Section 4.4.1

6.0 Table 1 – Tree Species Data

Terminology/references provided in Appendix A.

Tree No.	Botanical Name Common Name	Height (m)	DBH (m)	Crown Spread (m)	Age	Crown Class	Crown Aspect	Vitality	SULE Rating	STARS Rating	TPZ	SRZ
1	<i>Tristania laurina</i> Water Gum	4	0.26	4 x 6	M	D	Sym.	A	A2	MEDIUM	3.2	1.8
Assessment This street tree forms part of an avenue planting on Trafalgar Street comprising solely this species. The tree presents the habit typical of species. Proposed works; See Section 7.1.1												
2	<i>Tristania laurina</i> Water Gum	3	0.16	3 x 2	M	D	Sym.	A	A2	MEDIUM	2.0	1.5
Assessment This street tree forms part of an avenue planting on Trafalgar Street comprising solely this species. The tree presents the habit typical of species. Proposed works; See Section 7.1.1												
3	<i>Phoenix canariensis</i> Canary Island Date Palm	2	0.65	5 x 5	Y	D	Sym.	A	B2	MEDIUM	7.8	2.7
Assessment This self-sown exotic palm is located in a small gated compound adjacent to the footbridge and within the rail corridor. The tree presents the habit typical of species, although will present a mature size that is unlikely to be capable to be accommodated within the area for which it is growing. Proposed works; See Section 7.1.2												
4	<i>Triadica sebifera</i> ^A Chinese Tallow	5	0.21	4 x 2	M	D	Sym.	- ^D	A2	MEDIUM	2.5	1.7
Assessment Syn. <i>Sapium sebiferum</i> This street tree forms part of an avenue planting on Terminus Street comprising mixed species. The tree presents the habit typical of species. Proposed works; See Section 7.1.1												

Tree No.	Botanical Name Common Name	Height (m)	DBH (m)	Crown Spread (m)	Age	Crown Class	Crown Aspect	Vitality	SULE Rating	STARS Rating	TPZ	SRZ
5	<i>Corymbia citriodora</i> Lemon-scented Gum	16	0.74	16 x 16	M	D	Sym.	A	A2	HIGH	8.8	2.9
Assessment This street tree forms part of an avenue planting on Terminus Street comprising mixed species. The tree presents the habit typical of species. Proposed works; See Section 7.1.3												
6	<i>Triadica sebifera</i> ^A Chinese Tallow	5	0.16	3 x 3	M	D	Sym.	- ^D	A2	MEDIUM	2.0	1.5
Assessment Syn. <i>Sapium sebiferum</i> This street tree forms part of an avenue planting on Terminus Street comprising mixed species. The tree presents the habit typical of species. Proposed works; See Section 7.1.1												
7	<i>Eucalyptus nicholii</i> Thin-leaved Black Peppermint	7	0.65 ^B	7 x 7	M	D	Sym.	A	A3	MEDIUM	7.8	2.7
Assessment This street tree forms part of an avenue planting on Terminus Street comprising mixed species. The tree presents an atypical habit and is composed of four leaders that initiate from a 500millimetres high stem. A crossing branch exists, and mechanical wounding, likely related to traffic. Some uplift of the footpath exists. Proposed works; See Section 7.1.1												

- A. Incomplete identification of species due to insufficiently available plant material
- B. Diameter taken below 1.4m due to low stem bifurcation
- C. Estimate due to the overgrown area and/or limited access
- D. Deciduous species, void of foliage at the time of assessment
- E. Level 3 assessment required to determine the accurate rating

7.0 Site assessment

The area of assessment comprises the roadways either side of Petersham Station, being Trafalgar and Terminus Streets. All plantings but the self-sown tree No. 3 are street tree plantings. Trafalgar Street caters for a consistent avenue planting of Water Gum. These are semi-mature and planted in a narrow (<1000 millimetres wide) lawn strip that resides flush with the kerb on the southern side and bounded by a 1200 millimetres wide concrete footpath on the northern side. The trees are likely to exceed an A1 rating other than the close vicinity of the kerb and footpath which has limited the SULE rating based on potential issues related to root uplift for these structures with further maturity.

Terminus Street caters for an inconsistent avenue planting of different species and spaces between these trees. These are all mature trees and planted flush with the sandstone kerb (potentially heritage-listed) and within the verge which is completely sealed by a concrete footpath (1500 millimetres wide), other than the planter squares that range in size and approximately 500 millimetres by 750 millimetres. The southern boundary of the kerb consists of a federation constructed (English cross bond) brick retaining wall, and this extends the length of the area of assessment. The concrete around tree No. 5 has been removed, likely due to related root uplift and respective trip hazard and replaced with asphalt. Three planter spaces occur between trees No. 5 and 6, two of these are empty, although the remains of cut stumps exist. The empty space adjacent to tree No. 6, is estimated to have contained the tree illustrated on the Plan 1, referred to as Tree A. The planter space adjacent to tree No. 5 has a recently planted (estimated within six months) sapling. This tree, labeled tree B on Plan 1, is estimated to be advanced stock (75 Litre) and labeled; *Tristaniopsis confertus*, that is Brush Box. The recent planting is well within the dripline of tree No. 5 and is not considered a viable location for this species, based on the close vicinity and suppressed class by tree No. 5. This will result in an atypical habit and slow growth. The planter spaces towards the east offer more suitable location (outside of the dripline for tree No. 5) and it is recommended that it be transplanted. This transplanting would offer reduced impact upon this tree as a result of the proposed development works.

The trees labeled as A and B that have been included in the survey drawing (Plan 1) however excluded from this report because of the failure to conform to the description of a prescribed tree based on the Inner West Council's Marrickville Development Control Plan.

Tree A: tree removed prior to the assessment

Tree B: tree below five metres in height or less than 300 millimetres in diameter at ground level.

7.1 Proposed development

The proposed development consists of the upgrading of the station infrastructure to meet requirements of the *Disability Discrimination Act 1992*. A list of the scope is follows;

- two new lifts connecting the existing footbridge to Terminus Street station entrance and the station platform
- a new access ramp and stairs from the Trafalgar Street station entrance to the existing footbridge
- upgrade works to the existing footbridge and stairs
- improved amenities such as a new family accessible toilet and a male and a female ambulant toilet in the platform building
- an addition of an external canopy to the family accessible toilet
- new accessible parking space adjacent to the Terminus Street lift
- formalised kiss and ride area on Terminus Street
- new bike parking
- platform resurfacing, CCTV and wayfinding signage
- electrical upgrades for new infrastructure.

This report discusses the potential impact on-site trees, and specifically works to the verge of Terminus and Trafalgar Streets, adjacent to the exit points for the footbridge. No stormwater drawings have been included as part of the document set. The calculations included in the following discussion has not considered subsurface utilities that have not been included in the design, or work methods related to construction⁷ (stockpiling, site sheds, scaffolding) unless otherwise specified. These may also increase the encroachment and impact on the opportunity for tree retention.

Assumption 1: Zones of protection (TPZ, SRZ)

The calculations of the zones of protection (TPZ, SRZ) contained in Table 1 are based on the arbitrary formulae provided in the AS 4970, and this document provides scope for modifying this zone, however with supporting evidence. Regarding trees No. 5-7. The kerb/road provides an area that does not commonly support strong root growth and can act as a barrier or partial barrier, although due to the sandstone kerb and related age, the roots likely extend beneath this structure. However, the wall adjacent and to the south of these trees is likely to contain a deep strip footing based on the structural load as a retaining wall and brick bond used, that is double brick. This would act as a barrier and reduce root extension into the area where the TPZ/SRZ appears to extend into. Therefore suggesting an asymmetrical root zone can exist, which to

⁷ See Section 4.5.2

compensate, would result with increased root extension and biomass along the verge and into the roadway. Therefore any works that encroach on the area of the TPZ that exists within the verge and roadway would likely have more impact than the calculated radius of the zones of protection.

Assumption 2: Grades

Because the grades (RL) for the landscape have not been included in the drawing set, the levels have been assumed to retain the existing grade of the footpath.

This report discusses the impact of the proposed design on the trees. Seven (7) trees have been listed within this report based upon the vicinity of the proposed works. This has included predominately street trees where any part of the zones of protection; Tree Protection Zone (TPZ) and Structural Root Zone (SRZ) to encroach into the area proposed for works. Recommendations based on the tree significance and condition, together with the impact on these trees regarding the development follow.

7.1.1 Trees and zones of protection (TPZ/SRZ) outside of the proposed design

Trees No. 1, 2, 4, 6 and 7

Based on the landscape drawing No. 50272-PET-LA-DRG-35101 (2), none of the proposed works conflict with the location of these trees or respective zones of protection. These trees can be retained without impact by the proposed design.

7.1.2 Trees providing a limited useful life expectancy

Trees No. 3

This tree provides low significance based on the species, habit, and rating, and irrespective of the design could be removed due to the low amenity value and issues related to mature growth.

7.1.3 Tree subject to a major encroachment

Tree No. 5

This tree is directly located in the footprint of the proposed design, and subject to a *major encroachment*, that is, in excess of ten per cent of the TPZ. The extent and type of encroachment for each tree are discussed and the relative implications.

Based on drawing No. 50272-PET-LA-DRG-35101 (2), the entire area surrounding this tree is subject to alterations. This is illustrated in Figure 1, and the areas labelled for discussion.

Area A1; consists of the foundation required for the lift well. Based on Assumption 1, no root system is considered to extend into this area past

the retaining wall (light blue line, Figure 1), therefore does not form part of an encroachment. Although, if this assumption is not valid, then the encroachment has been calculated to be seven per cent and located on the perimeter of the TPZ. This is not considered to render any impact.

Area A2: Consists of a composite of structures, although all based on the extension of the verge into the roadway. The extension of the verge would require a new surface and re-routed kerb. In addition to this, the following additions to the TPZ are;

- installation of a 'New seat' within the SRZ
- installation of a 'new bike hoops' on the perimeter of the TPZ
- 'inground uplights to brick wall' within the SRZ
- 'low shrubs and ground covers' within the SRZ

Proposed verge extension

The extension of the verge into the roadway consists of an area 3000 millimetres wide and approximately 34500 millimetres long. The portion that consumes the TPZ is 54 metres square or 22 per cent of the TPZ area. This would also extend into the SRZ. The grey line illustrated in Figure 1 depicts the line of the existing kerb, where the area bounded by the new kerb constitutes the extension of the verge. The encroachment by this extension will incorporate an increased grade, although based on the existing kerb height of approximately 120 millimetres, would offer a minimal increase, and allowing for the existing seal by the asphalt, no additional impact.

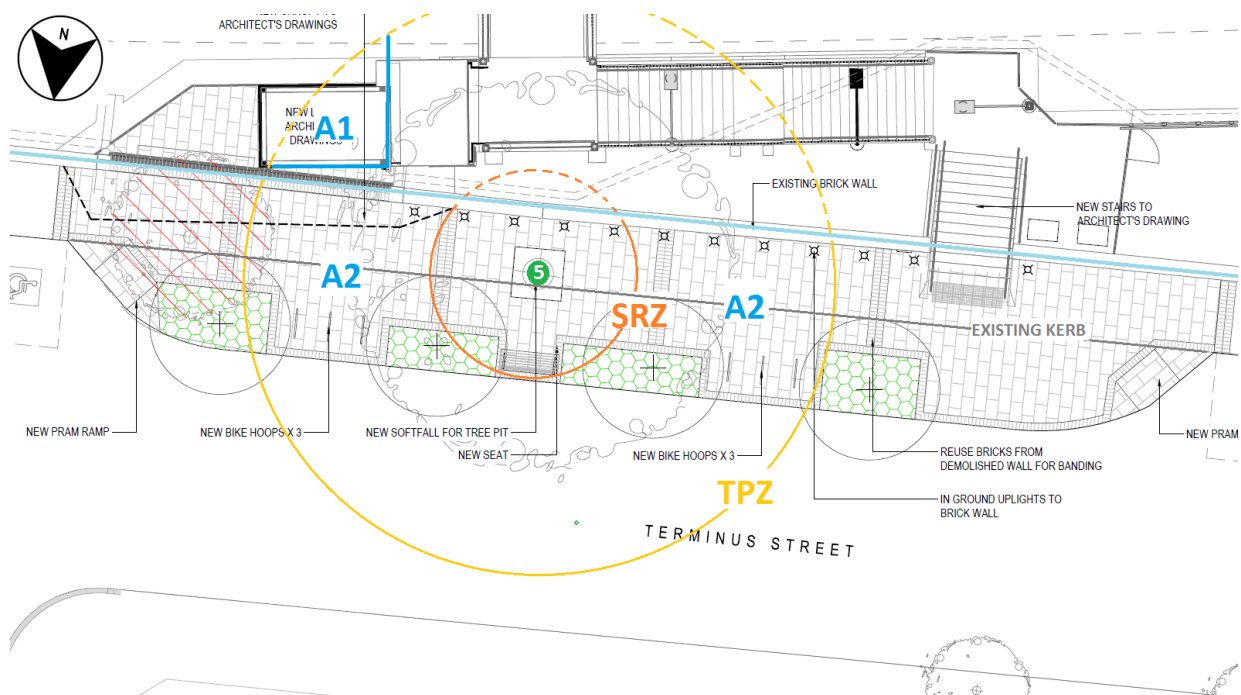


Figure 1; Tree No. 5; Location and respective zones of protection in regard to the proposed works.

Source: Adapted from *Design Inc. Sydney P/L*, Drawing 150272-PET-LA-DRG-35101 (3), see Section 4.4.1

Proposed kerb

The introduction of a new kerb would require a footing, and the depth or type is unknown. That is, would this structure be newly formed concrete and require a footing up to 400 millimetres depth, or reuse the sandstone, therefore likely requiring lesser depth of excavation. Based on Assumption 1, if a significant proportion of root system extends through the roadway, then the route of the new kerb footing could offer an impact on the calculated TPZ of 28 per cent and reside close to the tangent of the SRZ. This could compromise the vitality of this tree. The proposed location would increase the opportunity for such conflict and would require conditions in place for the installation, see Section 7.2.2.

Proposed surface

The landscape drawing refers to the new surface as 'engineered stone paving'. The depth is unknown, however it is, assumed, it would require a paver and foundation up to 250 millimetres in depth from the finished surface.

The increased grade of the verge extension would allow for a surface that can retain a foundation potentially up to 150 millimetres deep, without impacting on any roots. Although the area of the existing verge, is asphalt, and this is due to repair work related to root uplift, therefore supporting significant woody roots to be close to the surface. Due to the surrounding sealed surfaces, the roots are likely shallow and close to flush with these surfaces. Therefore the proposed surface is not considered to allow viable tree retention based on the potential impact placed onto the root system to establish the finished grades and foundation for the paving. The proposed surface would increase the opportunity for such conflict and would require conditions in place for the installation, see Section 7.2.1.

Installation of a 'New seat' within the SRZ

The foundation for this seat is unknown, although is likely to be either one or two pier type footings which would not be considered to render an impact unless significant roots are cut as part of the installation. The proposed location will increase the opportunity for such conflict and will require conditions in place for the installation, see Section 7.2.3.

Installation of a 'new bike hoops' on the perimeter of the TPZ

The foundation for the hoops is unknown, although are likely to be pier type footings which would not be considered to render an impact unless significant roots are cut as part of the installation. Based on the location for these, it is unlikely that such roots are encountered. To avoid the

possibility for conflict the following conditions are in place for the installation, see Section 7.2.3.

Installation of 'in ground-uplights to brick wall' within the SRZ

The electrical conduit servicing these lights would likely require a trench up to 400-600 millimetres deep and flush with the retaining wall. Based on Assumption 1, any roots that have grown across and deflected would be growing along the base of this wall where the conduit is assumed to be installed. This trenching could impact on significant roots. The proposed location would increase the opportunity for such conflict and would require conditions in place for the installation, see Section 7.2.2

Installation of 'low shrubs and ground covers' within the SRZ

The detail referring to these garden beds containing the nominated plantings has not been provided. Although the garden edging would require a footing, and the location within the SRZ could impact on significant roots. The proposed location would increase the opportunity for such conflict and would require conditions in place for the installation, see Section 7.2.2.

7.2 Proposed work conditions

The works and methodology required for tree retention are as follow;

7.2.1 Footpath

The proposed footpath would reside in the existing footpath footprint but with an extension. The footpath crosses the SRZ of this tree, and disturbance of this structure exists, and this may continue with further secondary growth of the support roots. The proposed surface would likely impact on the underlying root system, and still result with trip hazards with mature growth. The following mitigation is recommended to reduce the impact on the tree and mitigation of proposed structures. Alternate methodologies can be adopted subject to agreement with TfNSW and/or the asset owners.

1. Elevate the grade of the proposed footpath over the entire length of the area. This would be limited to the kerb height. If a batter is required for drainage, an angle to allow drainage to fall to the kerb may impact less on underlying roots.
2. The product 'Filtapave'⁸ is recommended for use in the area of the TPZ (8.8 metre radius). This product requires a maximum thickness of 150 millimetres, composed of 100 millimetre road base and 50 millimetres depth in depth of this product.

⁸ <http://www.filtapave.com.au/>

3. Fill material required beneath the proposed footpath is recommended to be a coarse aggregate to alleviate root travel, and areas where substantial roots are retained and exposed, are required to have a cover of extruded closed-cell foam (>10 millimetres thick) placed over the surface of the root to separate the finished surface from the root. The expanding root growth crushes the foam in preference to uplifting the concrete⁹.
4. If expansion joints are required, the use of a material designed for reducing trip hazards and maintenance, for example, 'Tripstop'¹⁰ should be implemented.
5. The extension of the footpath into the existing roadway would require backfilling to retain an even surface. A fill material providing a high air-filled porosity is required, being no less than a 'sandy loam' or an aggregate, for example, 'structural soil', design for roots.
6. Roots that less than 30 millimetres in diameter can be severed. However, the accumulative number of severed roots should be limited to no more than five.
7. Any root pruning that is required in excess of that provided in Condition 6 would require further assessment from the project arborist to determine the opportunity/mitigation.
8. All root pruning requires the following procedures
 - 8a. the cut provides the smallest surface area available; that is right angles to the side of the root.
 - 8b. the cut face has a fungicide (e.g., sulphur) applied to the wound face immediately.
 - 8c. the cutting equipment is sterilised between cuts, use of a solution of 70 per cent methylated spirits and 30 per cent water, in a spray bottle.
9. The finished surface must be no closer than 100 millimetres from the girth of the tree.

7.2.2 Kerb, Inground uplights, garden edging

The close vicinity of the works required for the strip-type excavation installation for each of these services can compromise the tree stability pending potential root severance. Based on this premise, either, alternative design or work methodology is required for these structures that can avoid strip type excavation greater than 100 millimetres, or preliminary investigation via root mapping would be required by the

⁹ Smiley, E.T. 2008. Comparison methods to reduce sidewalk damage from tree roots. *Arboriculture and Urban Forestry* 34:123-128

¹⁰ http://www.tripstop.net/en/index.php?option=com_content&task=view&id=72&Itemid=470

project arborist. The later method would determine the proportion of significant roots and allow a tangible means for design and installation.

7.2.3 Other infrastructure, seating, bike hoops, etc.

Based on the limited size of these items, the location is considered reasonable flexible and could allow for relocating up to 1000 millimetres either way to reduce the impact on apparent roots. To reduce the impact on the trees and mitigation of proposed structures, the following conditions are nominated for the construction methodology. Alternate methodologies can be adopted subject to agreement with TfNSW and/or the asset owners.

- 10.** Proposed structures are recommended to be placed outside of the SRZ, and consideration should be given to those structures that reside close to or on a tangent of a SRZ. This is based on the growing SRZ.
- 11.** Other than items that require a post hole (bike hoops, etc.), excavation should be maintained to a minimum depth of 100 millimetres.
- 12.** Where fill material is required it is recommended to be a coarse aggregate to alleviate root travel and areas where substantial roots are retained and exposed, these are required to have a cover of extruded polystyrene foam (>10 millimetres thick) placed over the surface of the root to separate the concrete from the root.
- 13.** No footing should be any closer than 100 millimetres from a root.
- 14.** No severance for roots greater than 30 millimetres in diameter should occur for these structures.

7.3 Sub-surface utilities

No drawings have been provided for the proposed route of sub-surface utilities. Any trenching, other than what has been allowed for shall be avoided within the area of the TPZ. Any proposed route shall be re-routed outside of the TPZ. Under boring may be required if a limitation for the route of a service is restricted to an area that falls within the TPZ. Any excavation in the area of a TPZ must be authorised and conditioned by the project arborist.

7.4 Protection measures

The following protection measures are required to be implemented for the following trees before initiation of site works (including demolition/excavation) and retained until the landscaping works are required unless otherwise specified.

7.4.1 Stem Protection: Tree No. 4 and 5

Stem Protection is required to be installed to protect the stem from all site-related work and is recommended to be located in accordance with the requirements of the AS 4970, listed in Appendix B. This must be

installed prior to the commencement of any demolition, excavation or construction works and shall be maintained throughout the entire construction phase of the development, and until landscaping works and installation of the drive/cross-overs is required.

7.4.2 Conditions of demolition

The following conditions are required during the demolition stages for the zones of protection.

1. The demolition process must remove all other site structures before removal of the sealed surfaces surrounding these trees (including the portion of the kerb, gutter, and pavers) that are within the TPZ.
2. Machinery can be used for part of this removal, however, must always be retained to a hard surface (retained footpath or road). No machine should on any occasion work on a soil-based surface within the area of the TPZ.
3. That part of the sealed surfaces that falls within the area of 3 metres radius from the girth of each tree must be removed via hand tools, e.g., Jackhammers, etc. removal of the remaining surfaces must disturb as little area as possible. That is, the removal of this area should not carry any soil with it.
4. If machinery is required to enter the TPZ where no hard surface exists, then ground protection methods are required to be employed. Any machinery used within this process must provide for a minimum height of 2500 millimetres, and that sufficient clearance is offered beneath the branch structure and machine to avoid injury. No pruning can occur for access to machinery.

7.4.3 Conditions for compliance

The following conditions are required before any works proceed on site.

Site induction; All workers related to the construction process and before entering the site must be briefed about the requirements/conditions outlined in this report relative to the zone of protection, measures, and specifications before the initiation of work. This is required as part of the site induction process.

Project Arborist; A project arborist who conforms to the requirements of the AS 4970 is required to be nominated immediately after a *Notice of Determination* is issued, and they are to be provided with all related site documents.

7.5 Compliance Documentation

The following stages would require assessment and documentation (report, letter, certification) by the project arborist or person responsible for the specific

work type, and the related documentation is to be issued to the principal certifying agent.

7.5.1 Table 2; Assessment/Certification hold points

Hold points	Work type	Document required
Pre-demolition	Installation of the protection measures, Section 7.4	Certificate*
During construction	Severance to any root greater than 30 millimetres.	-
During construction	Any <u>further works</u> required within the area of the TPZ, or decline related to the trees that have not been covered by this report.	Report Brief
During construction	Any crown modification including pruning or root disturbance.	Report Brief

Construction refers to the time between the initiation of demolition and till completion.

*Mandatory

8.0 Protection Specification

The retention and protection of trees provide for the requirement of the Tree Protection Zone (TPZ) to conform to the conditions outlined below. These conditions provide the limitations of work permitted within the area of the Tree Protection Zone (TPZ) and must be adhered to unless otherwise stated.

1. Foundation/footing types should not be strip type, but utilise footing types that are sympathetic towards retaining root system that is, screw, pier, etc. Slab on the ground can be accommodated in some circumstances and will be nominated by the project arborist. The extent of encroachment will be dependent upon the tree species, soil type (texture and profile) and gradients.
2. Subsurface utilities can extend through the TPZ and Structural Root Zone (SRZ), however, are limited to the method of installation. That is under boring is permitted, however trenching is limited and depends on the proposed route within the TPZ. No trenching is permitted within the area of the TPZ unless stipulated by the project arborist.
3. Crown pruning can be accommodated, however, must conform to the AS 4373; *Pruning of Amenity Trees*, and not misshape the crown nor remove in excess of 10-15 per cent of the existing crown, pending on the species, and vitality. The opportunity for, type and proportion of pruning will be required to be nominated by the project arborist.

4. Soil levels within the TPZ must remain the same. Any excavation within the TPZ must have been previously specified and allowed for by the project arborist:
 - a) So it does not alter the drainage to the tree.
 - b) Under specified circumstances,
 - Added fill soil does not exceed 100 millimetres in depth over the natural grade. Construction methodologies exist that can allow grade increases in excess of 100 millimetres, via the use of an impervious cover, an approved permeable material or permanent aeration system or other approved methods.
 - Excavation cannot exceed a depth of more than 50 millimetres within the area of the TPZ, not including the SRZ. The grade within the SRZ cannot be reduced without the consent from a project arborist.
5. No form of material or structure, solid or liquid, is to be stored or disposed of within the TPZ.
6. No lighting of fires is permitted within the TPZ.
7. All drainage runoff, sediment, concrete, mortar slurry, paints, washings, toilet effluent, petroleum products, and any other toxic wastes must be prevented from entering the TPZ.
8. No activity that will cause excessive soil compaction is permitted within the TPZ. That is, machinery, excavators, etc. must refrain from entering the area of the TPZ unless measures have been taken, and with consultation with the project, arborist to protect the root zone.
9. No site sheds, amenities or similar site structures are permitted to be located or extend into the area of the TPZ unless the project arborist provides prior consent.
10. No form of construction work or related activity such as the mixing of concrete, cutting, grinding, generator storage or cleaning of tools is permitted within the TPZ.
11. No part of any tree may be used as an anchorage point, nor should any noticeboard, telephone cable, rope, guy, framework, etc. be attached to any part of a tree.
12. (a) All excavation work within the TPZ will utilise methods to preserve root systems intact and undamaged. Examples of methods

permitted are by hand tools, hydraulic, or pneumatic air excavation technology.

- (b) Any root unearthed which is less than 50 millimetres in diameter must be cleanly cut and dusted with a fungicide, and not allowed to dry out, with minimum exposure to the air as possible.
- (c) Any root unearthed which is greater than 50 millimetres in diameter must be located regarding their directional spread and potential impact. A project arborist will be required to assess the situation and determine future action regarding retaining the tree in a healthy state.

Project Arborist: person nominated as responsible for the provision of the tree assessment, arborist report, consultation with stakeholders, and certification for the development project. This person will be adequately experienced and qualified with a minimum of a level 5 (AQF); Diploma in Horticulture (Arboriculture)¹¹.

¹¹ Based upon the definition of a 'consulting arborist' from the AS 4970; Protection of trees on development sites; 2009, section 1.4.4, p 6.

9.0 Summary of tree impact

Based on the design supplied, the following summary provides the impacts imposed on the trees included in this report.

9.1 Trees No. 1, 2, 4, 6 and 7

These trees are not adversely impacted by the design, that is, they conform to a minor encroachment or less and the nominated zones of protection (TPZ, SRZ) based on the requirements of the Protection Specification, Section 8.0. The proposed design does not adversely affect these trees.

9.2 Tree No. 3

This tree provides a limited useful life expectancy and would require removal irrespective of the proposed works. This tree is recommended for removal.

9.3 Tree labelled B

This tree is recommended to be transplanted further towards the east.

9.4 Tree No. 5

This tree is subject to a major encroachment, although could be retained pending the conditions outlined in Section 7.2 are viable and consistent with the intended design.

9.5 Sub-surface utilities

No drawings have been provided for the proposed route of sub-surface utilities. Any trenching, other than what has been allowed for should be avoided within the area of the TPZ's for any tree nominated for retention. Any proposed route shall be re-routed outside of the TPZ. Under boring may be required if a limitation for the route of service is restricted to an area that falls within the TPZ from any tree. Any excavation in the area of a TPZ must be authorised and conditioned by the project arborist.

9.6 Protection measures

Protection measures (outlined in Section 7.4 and 7.5) are required to be implemented for the trees nominated for retention (referenced in Section 9.1) and installed before initiation of site works (including demolition/excavation) and retained until the landscaping works are required unless otherwise specified.

All workers related to the construction process and before entering the site must be briefed about the requirements/conditions outlined in this report relative to the zone of protection, measures, and specifications before the initiation of work.

A project arborist is required to be nominated, and the stages and related certification or similar documentation is to be issued to the principal certifying agent.

10.0 Appendix A- Terminology Defined

Height

Is a measure of the vertical distance from the average ground level around the root crown to the top surface of the crown, and on palms - to the apical growth point.

DBH

Diameter at Breast Height – being the stem diameter in meters, measured at 1.4m from ground level, including the thickness of the bark.; Mult. refers to multiple stems, that is in excess of 4 stems.

Crown Spread

A two-dimension linear measurement (in metres) of the crown plan. The first figure is the north-south span, the second being the east-west measurement.

Age

Is the estimate of the specimen's age based upon the expected lifespan of the species. This is divided into three stages.

Young (Y)	Trees less than 20% of life expectancy.
Mature (M)	Trees aged between 20% to 80% life expectancy.
Over-mature (O)	Trees aged over 80% of life expectancy with probable symptoms of senescence.

Crown Aspect

In relation to the root crown, this refers to the aspect the majority of the crown resides in. This will be either termed Symmetrical (Sym.) where the centre of the crown resides over the root crown or the cardinal direction the centre of the crown is biased towards, being either North (N), South (S), East (E) or West (W).

Vitality Rating

Is a rating of the health of the tree, irrespective and independent of the structural integrity, and defined by the 'ability for a tree to sustain its life processes' ((Draper, Richards, 2009). This is divided between three variables, and based on the assessment of symptoms including, but not limited to; leaf size, colour, crown density, woundwood development, adaptive growth formation, and epicormic growth.

A: Normal vitality, typical for the species

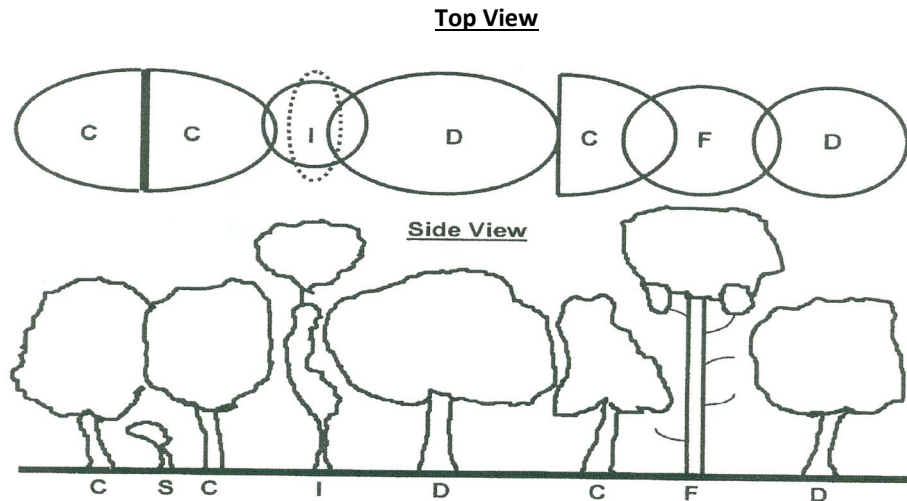
B: Below average vitality, possibly temporary loss of health, partial symptoms.

C: Poor vitality; obvious decline, potentially irreversible

Crown Class

Is the differing crown habits as influenced by the external variables within the surrounding environment. They are:

D – <i>Dominant</i>	Crown is receiving uninterrupted light from above and sides, also known as emergent.
C – <i>Codominant</i>	Crown is receiving light from above and one side of the crown.
I – <i>Intermediate</i>	Crown is receiving light from above but not the sides of the crown.
S – <i>Suppressed</i>	Crown has been shadowed by the surrounding elements and receives no light from above or sides.
F – <i>Forest</i>	Characterised by an erect, straight stem (usually excurrent) with little stem taper and virtually no branching over the majority of the stem except for the top of the tree which has a small concentrated branch structure making up the crown.



D C, I & S, and side view, after (Matheny, N. & Clark, J. R. 1998, Trees Development, Published by International Society of Arboriculture, P.O. Box 3129, Champaign IL 61826-3129 USA, p.20, adapted from the Hazard Tree Assessment Program, Recreation and Park Department, City of San Francisco, California).

Levels of assessment

Level 1: Limited visual: a visual tree assessment to manage large populations of trees within a limited period and in order to identify obvious faults which would be considered imminent.

Level 2: Basic assessment: a standard performed assessment providing for a detailed visual assessment including all parts of the tree and surrounding environment and via the use of simple tools.

Level 3: Advanced assessment: specific type assessments conducted by either arborist who specialise with specific areas of assessment or via the use of specialised equipment. For example, aerial assessment by use of an EWP or rope/harness, or decay detection equipment.

TPZ; Tree Protection Zone

Is an area of protection required for maintaining the trees vitality and long-term viability. Measured in meters as a radius from the trees centre. The requirements of this zone are outlined within the Protection Specification, Section 8.0, and are to be adhered to unless otherwise stated.

The size of the Tree Protection Zone (TPZ) has been calculated from the *Australian Standard, 4970; 2009* – Protection of Trees on Development Sites

The TPZ does not provide the limit of root extension, however, offers an area of the root zone that requires predominate protection from development works. The allocated TPZ can be modified by some circumstances; however will require compensation equivalent to the area loss, elsewhere and adjacent to the TPZ.

SRZ; Structural Root Zone

Is the area around the tree containing the woody roots necessary for stability. Measured in meters as a radius from the trees centre. The requirements of this zone are outlined within the Protection Specification, Section 8.0, and are to be adhered to unless otherwise stated.

Protection Measures

These are required for the protection of trees during demolition/construction activities.

Protective barriers are required to be installed before the initiation of demolition and/or construction and are to be maintained up to the time of landscaping. Samples of the recommended protection measures are illustrated in Appendix B.

All other definitions are referenced from;

Draper D.B., Richards P.A., 2009, Dictionary for Managing Trees in Urban Environments CSIRO Pub., Australia

Significance Rating, Significance of a Tree Assessment Rating System (S.T.A.R.S), IACA, 2010¹²

Tree Significance – Assessment Criteria

1. High Significance in landscape

- The tree is in good condition and good vitality;
- 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 vitality;
- 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 vitality;
- 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,

¹² IACA, 2010, IACA Significance of a Tree, Assessment Rating System (STARS), Institute of Australian Consulting Arboriculturists, Australia, www.iaca.org.au

unlikely to reach dimensions typical for the taxa in situ – tree is inappropriate to the site conditions,

- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms,
 - The tree has a wound or defect that has potential to become structurally unsound.
- Environmental Pest / Noxious Weed Species
- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties,
 - The tree is a declared noxious weed by legislation.

Hazardous/Irreversible Decline

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


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

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





Table 3; 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					

Legend for Matrix Assessment



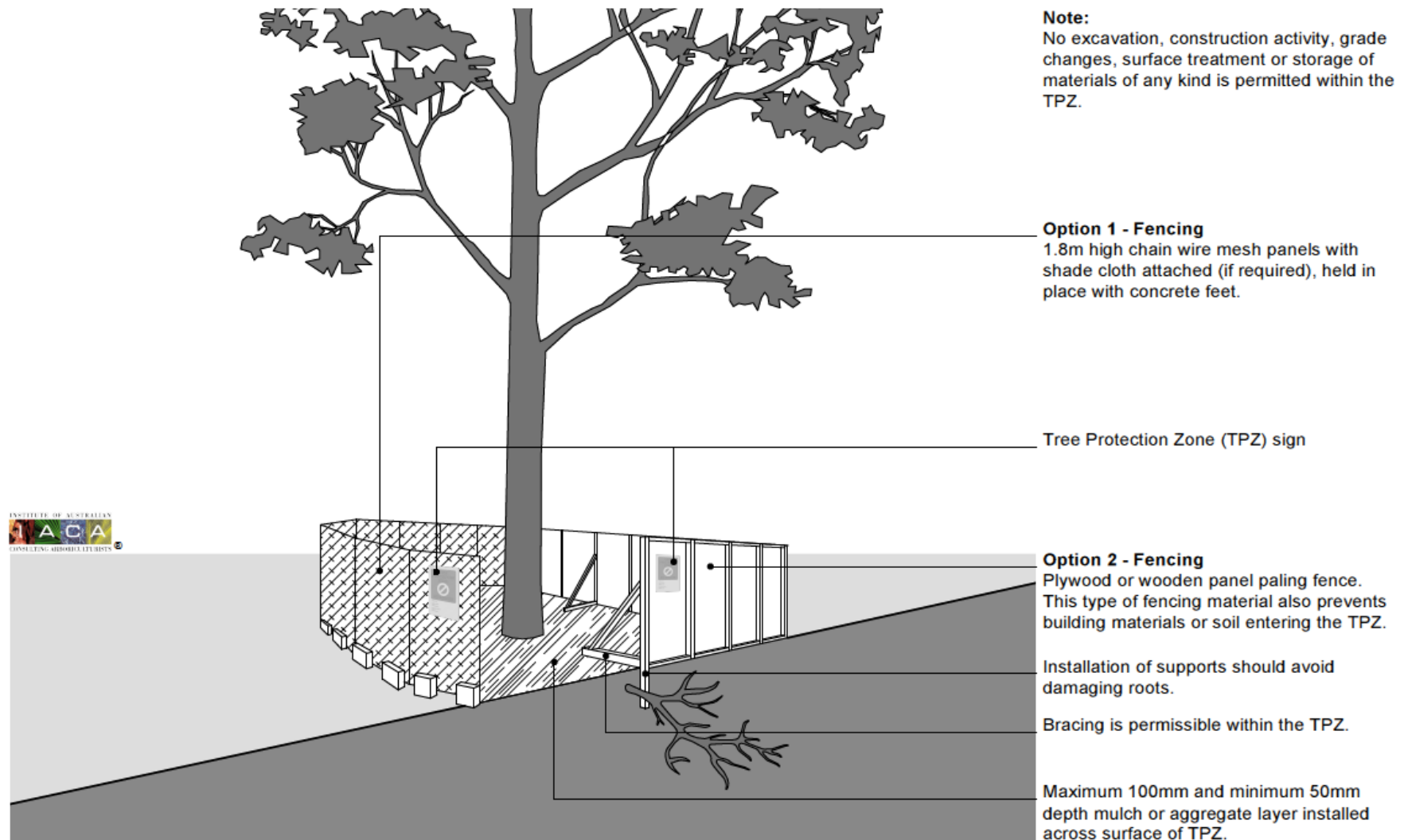
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	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian 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.

Safe Useful Life Expectancy – S.U.L.E (Barell 1995)

	1. Long	2. Medium	3. Short	4. Removal	5. Moved or Replaced
	Trees that appeared to be retainable at the time of assessment for more than 40 years with an acceptable level of risk.	Trees that appeared to be retainable at the time of assessment for 15 – 40 years with an acceptable level of risk.	Trees that appeared to be retainable at the time of assessment for 5 – 15 years with an acceptable level of risk.	Trees that should be removed within the next 5 years.	Trees which can be reliably moved or replaced.
A	Structurally sound trees located in positions that can accommodate future growth.	Trees that may only live between 15 and 40 years.	Trees that may only live between 5 and 15 more years.	Dead, dying, suppressed or declining trees through disease or inhospitable conditions.	Small trees less than 5m in height.
B	Trees that could be made suitable for retention in the long term by remedial tree care.	Trees that may live for more than 40 years but would be removed for safety or nuisance reasons.	Trees that may live for more than 15 years but would be removed for safety or nuisance reasons.	Dangerous trees through instability on recent loss of adjacent trees.	Young trees less than 15 years old but over 5m in heights
C	Trees of special significance for historical, commorative or rarity reasons that would warrant extraordinary efforts to secure their long term retention.	Trees that may live for more than 40 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting.	Trees that may live for more than 15 years but should be removed to prevent interference with more suitable individuals or to provide space for new planting.	Damaged trees through structural defects including cavities, decay, included bark, wounds or poor form.	Trees that have been pruned to artificially control growth.
D		Trees that could be made suitable for retention in the medium term by remedial tree care.	Trees that require substantial remedial tree care and are only suitable for retention in the short term.	Damaged trees that are clearly not safe to retain.	
E				Trees that may live for more than 5 years but should be removed to prevent interference with more suitable individuals or to provide space for new plantings.	
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 reasons given in (A) to (F).	

Appendix B- Protection measures; Protective fence



Stem and Ground protection

