Arboricultural Assessment and Report

Carlisle Street Carpark, Balaclava

3 May 2021
Treelogic Ref. 011551

Prepared for Alana Donoghue | City of Port Phillip
Prepared by Kelvin Lui – Consulting Arborist | Tree Logic Pty. Ltd.

1 Summary

Reason for assessment

Treelogic was engaged to undertake an arboricultural assessment and prepare a report for trees located within and adjacent the carparks to the north of Carlisle Street in Balaclava. The requirements of the arboricultural report include;

- To provide information on the species, origin, dimensions, health and structure of the trees and their appropriateness for retention
- Determine the Tree Protection Zones (TPZ) for trees compliant with AS4970 'Protection of trees on development sites'
- Provide a written report outlining the tree condition at the time of inspection, suitability for retention and any short-term arboricultural works required.

Overview

Thirty-nine (39) trees were assessed within two (2) tree study areas. Twenty-eight (28) Moderate rated trees represent the best options for retention, being larger established specimens, which contributed greatly to the landscape character. Prominent trees include most of the Gum specimens (*Eucalyptus* sp.) and Paperbark (*Melaleuca* sp.) which had well established within the site. Low rated trees were generally represented by small sized specimens (five tree features) or trees that exhibited poor health and / or structure (6 tree features).

The assessed trees were generally in fair condition and likely to have adapted to conditions with limited permeability. In any future design proposal, any tree nominated for retention should be afforded protection by limiting encroachment to 10% of the TPZ and/or replicating/improving the existing growing conditions of the trees.

2 Method

2.1 A site inspection was undertaken on the 26th of April 2021. The trees were inspected from the ground and observations were made of the growing environment and surrounding area. The trees were not climbed, and no samples of the tree or soil were taken.

2.2 Observations were made of the assessed trees to determine the species, age category, and condition with measurements taken to establish tree crown height (measured with a height meter) and crown width (paced) and trunk dimensions (measured 1.4 metres above ground level with a diameter tape unless otherwise stated). Descriptors used in the assessment can be seen in Appendix 3. Where trees were on neighbouring properties, estimations were made on some measurements.

2.3 Assessment details of individual trees are listed in Appendix 1 and a copy of the tree location plan can be seen in Appendix 2.

2.4 Some photographs of the trees and the environs were taken for further reference and inclusion in the report.

2.5 Only trees were assessed, and data collected. A tree is generally a plant with a height greater than 5 metres on a single trunk with a single trunk (stem) diameter (DBH) being greater than 150 mm at a height of 1.4 metres above ground level.

2.6 Each of the assessed trees was attributed an 'Arboricultural Rating'. The arboricultural rating correlates the combination of tree condition factors (health and structure) with tree amenity value. It should be noted that the arboricultural rating is different to the conservation/ecological values placed on trees by other professions. Definitions of arboricultural ratings can be seen in Appendix 3.

2.7 The assessed trees have been allocated tree protection zones (TPZ). The Australian Standard, AS 4970-2009, has been used as a guide in the allocation of TPZs for the assessed trees. This method provides a TPZ that addresses both the stability and growing requirements of a tree. TPZ distances are measured as a radius, from the centre of the trunk at (or near) ground level. All TPZ measurements for retained trees are provided in Appendix 1.

3 Observations

3.1 The tree study area was two (2) Commercial Zone (C1Z) located to the north of Carlisle Street, specifically an allotment bordered by Alfred and Nelson Streets (referred to as Study Area 'A') and an allotment to the west of Camden Street (referred to as Study Area 'B'). The tree study areas were used as a carpark space and pre-dominantly covered by non-permeable surfaces such as concrete and asphalt. Trees were generally aligned evenly spaced in rows, throughout and along the peripheries of the site. The tree study areas can be referred to below in Figure 1.

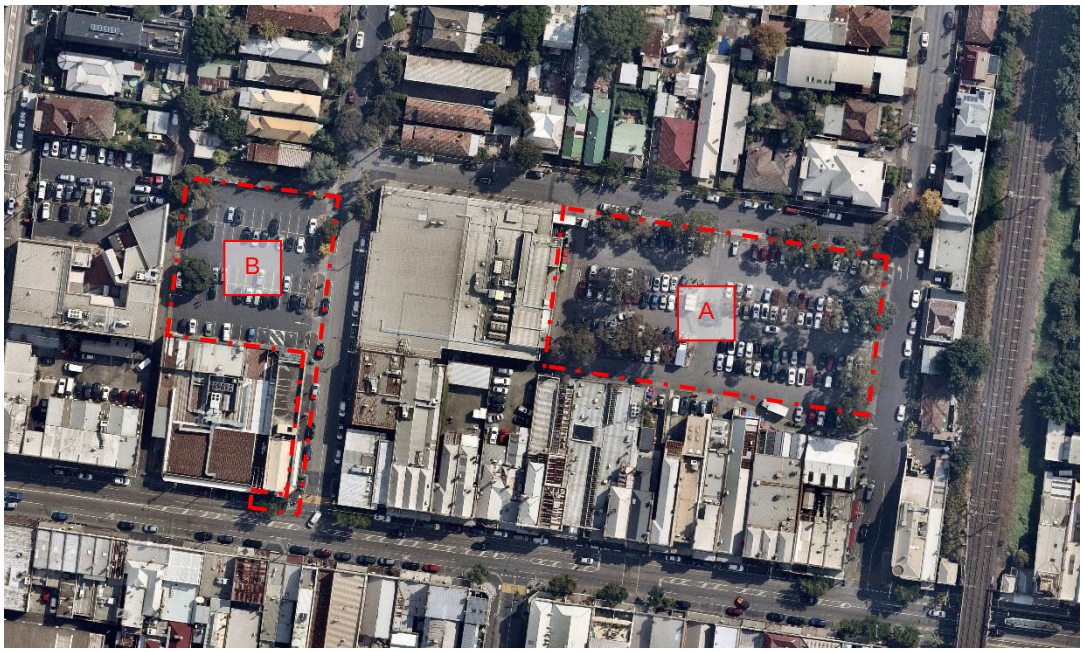

Figure 1. Tree study areas A and B outlined in red dotted line

4 Tree population

4.1 Thirty-nine (39) individual trees were assessed. Of the trees assessed, five (5) trees were located within the Camden Street footpath and one (1) tree was located within the Carlisle Street footpath. See the tree assessment table attached as Appendix 1 for details of each tree feature. See Appendix 2 for tree numbers and locations.

The species observed were mostly Victorian and Australian native specimens, with the Victorian Blue Gum (*Eucalyptus globulus* subsp. *bicostata*), Yellow Gum (*Eucalyptus leucoxylon*) and Brittle Gum (*Eucalyptus mannifera*) being most prevalent.

4.2 **Tree health**

Tree health was assessed based on foliage colour, size and density as well as shoot initiation and elongation. Overall, the tree population was in Good to Fair condition.

- Thirty-five (35) were in good to fair health, exhibiting characteristics considered to be typical or above typical of the species growing in this environment under current conditions.
- Four (4) trees were in Fair-poor health exhibiting reduced foliage density and reduced vigor in comparison in other trees within the vicinity.

4.3 **Tree structure**

Tree structure was assessed for structural defects and deficiencies, likelihood of failures and risk to potential targets.

- Thirty-five (35) trees displayed Fair structure in terms of primary branching arrangement and architecture. Trees of Fair structure were trees that grew without competition or impediment from structures and/or other trees.
- Four (4) trees displayed fair to poor structure, generally being trees that had been suppressed by nearby trees and will continue to grow with a biased canopy. Some of these trees exhibited branch failures and limb overextension due to growth suppression.

4.4 **Arboricultural rating**

The assessed trees were attributed with an arboricultural rating. This rating relates to the combination of tree condition factors, including health and structure (arboricultural merit), and also conveys an amenity value. Amenity relates to the trees biological, functional and aesthetic characteristics within an urban landscape context. A summary of the arboricultural ratings are listed below in Table 1.

Table 1. Arboricultural ratings

Arboricultural Rating		No. of trees	Tree numbers
Moderate	A	4	13, 17, 26, 31
	B	16	3, 4, 7, 8, 10, 11, 15, 16, 19, 22, 23, 24, 25, 27, 28, 34
	C	8	2, 5, 9, 20, 21, 29, 35, 39
Low		11	1, 6, 12, 14, 18, 30, 32, 33, 36, 37, 38
Total		39 trees	

4.5 **Moderate A:** Trees with a Moderate A arboricultural rating were generally moderate to large maturing trees and contributes to the landscape character.

4.6 **Moderate B:** Trees with a Moderate B arboricultural rating were generally trees >50% of attainable age/size and suitable for retention. The retention of these trees are generally desirable and retention should be considered during all phases of design and development.

4.7 **Moderate C**: Trees which are trending towards a Low arboricultural rating or are small/semi-mature trees that do not exhibit a dominant canopy. Trees that are large and maturing however exhibit an accumulation of deficiencies and/or structural defects. These trees however represent an established tree resource and may be considered for retention if not requiring a disproportionate expenditure of resources.

4.8 **Low:** Trees with a Low arboricultural rating generally had low retention values. They were either fair specimens of relatively small size, inappropriate species, or displayed general health or structural deficiencies and were not worthy of being a constraint on reasonable design intent. Retention of Low rated trees may be considered in some instances if not requiring a disproportionate expenditure of resources to successfully incorporate into the design or manage ongoing condition.

5 Tree permit requirements

5.1 The tree study area falls within the City of Port Phillip. No specific controls apply to the study area under the City of Port Phillip Planning Scheme.

5.2 City of Port Phillip Local Law No. 1 (Community Amenity) applies and Part 3 Division 2 (44) covers 'significant trees' and states that a permit is required to: Destroy, damage, remove, cut, trim, lop or prune or allow these actions to occur.

A Significant Tree means a tree or palm on private land with a trunk circumference of 150 centimetres or greater measured 1 metre from the base; multi-stemmed tree where the circumference of its exterior stems equals or is greater than 1.5 metres when measured 1 metre from its base; or if the tree has been removed, a trunk circumference of 150 centimetres or greater measured at its base.

6 Tree protection zones

6.1 The Tree protection zones (TPZs) provided for each tree in the Tree Assessment Table in Appendix 2 and referred to in this statement, are calculated using the formula provided in the Australian Standard AS4970 where the Radial TPZ = Trunk diameter (DBH) measured at 1.4m above grade and multiplied by 12. TPZ distances are measured as a radius from the centre of the trunk at (or near) ground level. A TPZ should not be less than 2m nor greater than 15m.

6.2 The TPZ forms an area around a tree or group of trees that addresses both the stability and growing requirements of a tree. Construction and worksite activities within the TPZ need to be determined to assess their impacts in order to preserve tree condition.

6.3 Minor encroachment, up to 10% of the TPZ area, is generally permissible provided encroachment is compensated for by recruitment of an equal area contiguous with the TPZ. Encroachment greater than 10% is considered major encroachment under AS4970 and is only permissible if it can be demonstrated that after such encroachment the tree would remain viable. Refer to Figure 1 below.

6.4 The structural root zone (SRZ) provided for each tree has been calculated using the method provided in AS4970. The SRZ is the area in which the larger woody roots required for tree stability are found close to the trunk and which then generally taper rapidly. This is the minimum area recommended to maintain tree stability but does not reflect the area required to sustain tree health.

6.5 No works are permitted within the SRZ radius as tree stability could be compromised.

7 Images

Image 1: Viewing west of Tree 1 with Tree 2 in the background (leaning to the north) within Study Area A.

Image 2: Viewing west of Tree 3, a Victorian Blue Gum located within Study Area A.

Image 3: Viewing of Tree 4, a Bald Island Marlock (*Eucalyptus conferruminate*) located within Study Area A with Tree 5, a Brittle Gum located in front.

Image 4: Viewing east of Tree 6, a young Yellow Box (*Eucalyptus melliodora*) located within Study Area A.

Image 5: Viewing west of Tree 7, a Moderate rated Victorian Blue Gum within Study Area A.

Image 6: Viewing south-east of Trees 8 – 11 (left to right) located within Study Area A.

Image 7: Viewing south of Tree 13, a Moderate rated Brittle Gum located within Study Area A.

Image 8: Viewing south-east of Trees 14 to 17 (right to left) located within Study Area A.

Image 9: Viewing west of Tree 17, a Moderate rated Victorian Blue Gum located within Study Area A.

Image 10: Viewing south-west of Trees 18 and 19, with Tree 18 being suppressed by Tree 19. Trees located within Study Area A.

Image 11: Viewing south-west of Tree 25, a Moderate rated Brittle Gum located within Study Area A.

Image 12: Viewing north of Trees 21 – 23 (right to left) located within Study Area A.

Image 13: Viewing south-east of Tree 24, a Moderate rated Brittle Gum located within Study Area A.

Image 14: Viewing north-west of Trees 26 and 27, Snow-in-Summers (*Melaleuca linariifolia*) located within Study Area B.

Image 15: Viewing north of Tree 30, a Low rated Yellow Gum located within Study Area B.

Image 16: Viewing south-west of Tree 29, a Moderate rated Snow-in-Summer located within Study Area B.

Image 17: Viewing south of Tree 31, a Moderate rated Snow-in-Summer located within Study Area B.

Image 18: Viewing south of Tree 34, a Snow-in-Summer located within the Camden Street footpath.

Image 19: Viewing south of Tree 36, a young Locust (*Robinia pseudoacacia*) located within the Camden Street footpath.

Image 20: Viewing east of Tree 39, a Locust located within the Carlisle Street footpath.

8 Discussion

8.1 The pre-development arboricultural inspection provides planners and designers with information on the suitability of tree retention on the site.

8.2 In the absence of specific site design plans, it is not appropriate to speculate on which trees are most appropriate for retention, beyond the general guide provided by the arboricultural ratings attributed to each tree or based on the existing site conditions. Retention suitability will be dependent on the proposed landscape setting in which trees are intended to be retained.

8.3 The arboricultural ratings assigned to the trees should be a guide to tree retention priority:

- **Moderate A and B** rated trees are generally most suitable for retention. Sufficient space should be allocated within future designs to adequately protect the calculated TPZs of the trees.
    - Twenty (20) trees were attributed a Moderate A or B rating and were mostly represented by the Gum (*Eucalyptus* sp.) located within Study Area A and the Paperbark (*Melaleuca* sp.) located within Study Area B.
    - The Gum specimens were of early-mature to maturing specimens. Considering the size and maturity of these trees, pro-active tree management (risk management, crown maintenance) will be key to ensuring the trees remain as safe and prominent features of the landscape if nominated for retention.
    - The Paperbarks all exhibited Good to Fair health and are suitable specimens for the urban environment.
- **Moderate C** rated trees were generally semi-mature to early-maturing trees which were of smaller dimension still contribute to landscape amenity. Eight (8) trees were attributed a Moderate C rated. Most trees were specimens in Fair condition. Trees in this category are expected to become more prominent specimens in the future.
- **Low** rated trees are specimens which are either young and newly planted trees or were trees that exhibited poor health, poor structure or a combination of both.

- Trees 6, 12, 36, 37 and 38 were Low rated due to size and were in Fair condition. These trees could become larger specimens in the future if provided appropriate care.
- Trees 1, 14, 18 and 30 were semi-mature to early-mature specimens of which exhibited reduced health symptoms or had a compromised structure and canopy bias due to past branch failures and / or suppression from other trees.
- Trees 32 and 33, Sycamore (*Acer pseudoplatanus*) located within Tree Study Area B, exhibited fair-poor health and structure. The trees are considered to be self-seeded and could easily be replaced.

8.4 During the design process, the Tree Protection Zones of the trees should be considered as per the following:

- The majority of the trees were generally surrounded by surfaces with a range of permeability and compaction, pre-dominantly concrete and asphalt surfaces with strips of permeable open space. The majority of assessed trees were established specimens and exhibited typical vigor, therefore it is expected that the trees had well adapted to the growing environment.
- It is recommended that any future design should consider adding or replacing surfaces on a like-for-like basis to replicate the existing ground growing conditions.
- When proposing structures within the TPZs of trees, consideration must be given to root sensitive methods of construction such as isolated footing systems (piling, piers, stumps) or cantilevering.

8.5 The most important consideration for the successful retention of trees is to allow appropriate and adequate above and below space for the trees to continue to grow. This requires the allocation of tree protection zones (TPZ) for all retained trees.

- All TPZ measurements are provided in the tree assessment data in Appendix 1.

8.6 To successfully retain those trees deemed to be most suitable for retention in conjunction with any redevelopment, tree protection zones must be incorporated into the design and appropriate construction controls, fencing and management practices must be implemented prior to commencing any construction related activity, including demolition and bulk earthworks. Where TPZ fencing is impractical, ground protection measures will be required.

- Refer to Appendix 4 for TPZ establishment and management guidelines.

9 Conclusion

Thirty-nine (39) trees were of assessed and the species palette was represented by early-mature to maturing Victorian and Australian native specimens. The tree population was generally in Fair health, exhibiting growth characteristics typical for the growing environment.

In the absence of design plans, retention suitability is generally based on the arboricultural ratings attributed to the trees:

- **Moderate rated trees:** Twenty (20) Moderate A or B rated trees represent the best trees for retention. Eight (8) Moderate C rated trees were of smaller size and could also be considered for retention.
- **Low rated trees:** Eleven (11) trees were generally unremarkable trees of low quality, small size or little amenity value.

The implementation of tree protection zones and tree management outlined Sections 3, 4 and Appendix 4 will aid design to reduce impacts to any tree nominated for retention.

If trees are retained, additional tree impacts assessments may be required during the design phase of the development.

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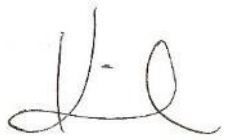

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(Grad Cert Arb, ML'scapeArch)

Tree No.	Botanical name	Common name	Age class	Origin	DBH (cm)	Basal (cm)	TPZ (m radius)	SRZ (m radius)	Height x Width (m)	Health	Structure	Arb. Rating	Comments	ULE (years)
1	*Eucalyptus globulus* subsp. *bicostata*	Victorian Blue Gum	Early-mature	Victorian native	65	74	7.8	2.9	15 x 10	Fair to Poor	Fair to Poor	Low	Top crown dieback with main leader in decline. Tree has developed a northerly canopy bias as a result. Roots at base has been ground to accommodate kerb replacement.	11-20 y
2	*Eucalyptus leucoxylon*	Yellow Gum	Semi-mature	Victorian native	26	29	3.1	2.0	9 x 5	Fair	Fair	Mod.C	Northerly lean over roadway. Tree base appears to be structurally sound.	21-40 y
3	*Eucalyptus globulus* subsp. *bicostata*	Victorian Blue Gum	Maturing	Victorian native	63	82	7.6	3.0	12 x 10	Fair	Fair	Mod.B	Minor deadwood.	>40 y
4	*Eucalyptus conferruminata*	Bald Island Marlock	Maturing	Australian native	39,33	66	6.1	2.8	11 x 10	Good	Fair	Mod.B		>40 y
5	*Eucalyptus mannifera*	Brittle Gum	Semi-mature	Australian native	26	33	3.1	2.1	14 x 6	Fair	Fair	Mod.C		>40 y
6	*Eucalyptus melliodora*	Yellow Box	Young	Victorian native	3	4	2.0	1.5	2 x 1	Fair	Fair	Low (size)		>40 y
7	*Eucalyptus globulus* subsp. *bicostata*	Victorian Blue Gum	Maturing	Victorian native	68	79	8.2	3.0	14 x 9	Fair	Fair	Mod.B		>40 y
8	*Eucalyptus globulus* subsp. *bicostata*	Victorian Blue Gum	Early-mature	Victorian native	44	54	5.3	2.6	11 x 7	Fair	Fair	Mod.B		>40 y
9	*Eucalyptus mannifera*	Brittle Gum	Semi-mature	Australian native	19	20	2.3	1.7	10 x 4	Fair	Fair	Mod.C	Southerly lean.	>40 y
10	*Eucalyptus globulus* subsp. *bicostata*	Victorian Blue Gum	Early-mature	Victorian native	45	56	5.4	2.6	11 x 8	Fair	Fair	Mod.B	Partly suppressed canopy bias	>40 y
11	*Eucalyptus globulus* subsp. *bicostata*	Victorian Blue Gum	Early-mature	Victorian native	45	65	5.4	2.8	10 x 8	Fair	Fair	Mod.B		>40 y
12	*Eucalyptus leucoxylon*	Yellow Gum	Early-mature	Victorian native	15,11	21	2.2	1.7	4 x 6	Fair	Fair	Low (size)	Stunted specimen but in good condition.	21-40 y
13	*Eucalyptus mannifera*	Brittle Gum	Early-mature	Australian native	53	67	6.4	2.8	20 x 13	Fair	Fair	Mod.A		>40 y
14	*Eucalyptus leucoxylon*	Yellow Gum	Early-mature	Victorian native	32	34	3.8	2.1	9 x 7	Fair to Poor	Fair	Low	Reduced foliage density.	>40 y
15	*Eucalyptus mannifera*	Brittle Gum	Early-mature	Australian native	41	47	4.9	2.4	14 x 9	Fair	Fair	Mod.B		>40 y
16	*Eucalyptus mannifera*	Brittle Gum	Early-mature	Australian native	35	43	4.2	2.3	18 x 9	Fair	Fair	Mod.B	Past branch failure	>40 y
17	*Eucalyptus globulus* subsp. *bicostata*	Victorian Blue Gum	Maturing	Victorian native	94	116	11.3	3.5	19 x 15	Good	Fair	Mod.A	Lower eastern perpendicular branch should be considered for removal as load-end will continue to increase.	>40 y
18	*Eucalyptus mannifera*	Brittle Gum	Semi-mature	Australian native	34	43	4.1	2.3	6 x 6	Fair to Poor	Fair	Low	Tree is suppressed, resulting in a partly suppressed crown bias	11-20 y
19	*Eucalyptus mannifera*	Brittle Gum	Early-mature	Australian native	45	49	5.4	2.5	16 x 11	Fair	Fair	Mod.B		>40 y
20	*Eucalyptus mannifera*	Brittle Gum	Semi-mature	Australian native	22	24	2.6	1.8	8 x 11	Fair	Fair	Mod.C		>40 y
21	*Eucalyptus mannifera*	Brittle Gum	Early-mature	Australian native	35	43	4.2	2.3	14 x 8	Fair	Fair	Mod.C	Co-dominant stems	>40 y
22	*Eucalyptus mannifera*	Brittle Gum	Maturing	Australian native	48	52	5.8	2.5	13 x 9	Fair	Fair	Mod.B		>40 y
23	*Eucalyptus mannifera*	Brittle Gum	Maturing	Australian native	38	49	4.6	2.5	16 x 9	Fair	Fair	Mod.B		>40 y
24	*Eucalyptus mannifera*	Brittle Gum	Maturing	Australian native	51	65	6.1	2.8	17 x 10	Fair	Fair	Mod.B	Root base damage due to vehicular impact. Minor deadwood throughout canopy.	>40 y
25	*Eucalyptus mannifera*	Brittle Gum	Maturing	Australian native	78	84	9.4	3.1	18 x 10	Fair	Fair	Mod.B	Pruned for power cable clearance and roots had been shaved to minimise conflict with infrastructure.	>40 y
26	*Melaleuca linariifolia*	Snow in Summer	Early-mature	Australian native	42	45	5.0	2.4	7 x 6	Fair	Fair	Mod.A		>40 y
27	*Melaleuca linariifolia*	Snow in Summer	Maturing	Australian native	74	74	8.9	2.9	8 x 6	Fair	Fair	Mod.B		>40 y
28	*Melaleuca styphelioides*	Prickly-leafed Paperbark	Maturing	Australian native	25,19,18,17,13	54	5.0	2.6	8 x 6	Fair	Fair	Mod.B		>40 y
29	*Melaleuca linariifolia*	Snow in Summer	Maturing	Australian native	18,15,14,12	48	3.6	2.4	5 x 5	Fair	Fair	Mod.C		>40 y
30	*Eucalyptus leucoxylon*	Yellow Gum	Early-mature	Victorian native	42	48	5.0	2.4	12 x 8	Fair	Fair to Poor	Low	Excessive trunk lean and biased canopy. History of past branch failures.	21-40 y
31	*Melaleuca linariifolia*	Snow in Summer	Maturing	Australian native	82	86	9.8	3.1	9 x 9	Good	Fair	Mod.A		21-40 y
32	*Acer pseudoplatanus*	Sycamore	Semi-mature	Exotic deciduous	9	13	2.0	1.5	5 x 2	Fair	Fair to Poor	Low	Canker wounds	11-20 y
33	*Acer pseudoplatanus*	Sycamore	Semi-mature	Exotic deciduous	6	9	2.0	1.5	4 x 1	Fair to Poor	Fair to Poor	Low	Crown dieback and canker wounds.	6-10 y

Tree No.	Botanical name	Common name	Age class	Origin	DBH (cm)	Basal (cm)	TPZ (m radius)	SRZ (m radius)	Height x Width (m)	Health	Structure	Arb. Rating	Comments	ULE (years)
34	*Melaleuca linariifolia*	Snow in Summer	Maturing	Australian native	48	61	5.8	2.7	7 x 6	Fair	Fair	Mod.B		>40 y
35	*Gleditsia triacanthos*	Honey Locust	Semi-mature	Exotic deciduous	12	16	2.0	1.5	7 x 4	Fair	Fair	Mod.C		>40 y
36	*Robinia pseudoacacia*	Locust	Young	Exotic deciduous	2	3	2.0	1.5	2 x 1	Fair	Fair	Low (size)		21-40 y
37	*Robinia pseudoacacia*	Locust	Young	Exotic deciduous	2	3	2.0	1.5	1 x 1	Fair	Fair	Low (size)		21-40 y
38	*Robinia pseudoacacia*	Locust	Young	Exotic deciduous	2	3	2.0	1.5	1 x 1	Fair	Fair	Low (size)		21-40 y
39	*Robinia pseudoacacia*	Locust	Early-mature	Exotic deciduous	39	41	4.7	2.3	9 x 6	Fair	Fair	Mod.C	Crown pruned for power cable clearance. Roots lifting asphalt at tree pit.	21-40 y

LEGEND

Arb. rating

- Mod-A
- Mod-B
- Mod-C
- Low
- TPZ
- SRZ

NOTES

Insert comment here

APPENDIX 2

TREE LOCATIONS AND PROTECTION ZONES

PROJECT

Carlisle Street carpark

TL REF.
011551

MAP NO.
1 / 1

CLIENT
City of Port Phillip

DATE
2021-05-03

DATA SOURCES

Image acquired from Nearmap Imagery

TREE LOCATION DISCLAIMER

Tree locations are approximate

COORDINATE REFERENCE SYSTEM

EPSG: 28355 | GDA 94 MGA Zone 55

0 9 18 m

TREELOGIC PTY LTD
ABN: 95 080 021 610
TEL: 1300 656 926

4 / 21 Eugene Tce
Ringwood, VIC
Australia 3134

Treelogic

Plan, manage, protect

Arboricultural Descriptors

Note that not all of the described tree descriptors may be used in a tree assessment and report. The assessment is undertaken with regard to contemporary arboricultural practices and consists of a visual inspection of external and above-ground tree parts.

1. Tree Condition

The assessment of tree condition evaluates factors of health and structure. The descriptors of health and structure attributed to a tree evaluate the individual specimen to what could be considered typical for that species growing in its location under current climatic conditions. For example, some species can display inherently poor branching architecture, such as multiple acute branch attachments with included bark. Whilst these structural defects may technically be considered arboriculturally poor, they are typical for the species and may not constitute an increased risk of failure. These trees may be assigned a structural rating of fair-poor (rather than poor) at the discretion of the assessor.

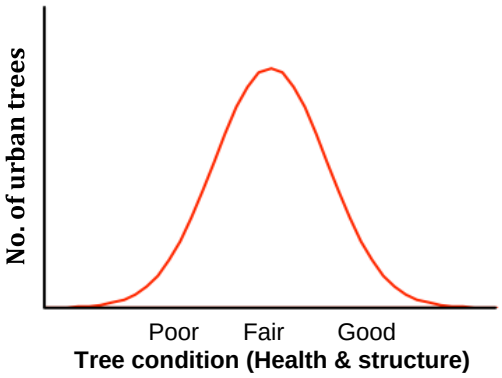


Diagram 1: Indicative normal distribution curve for tree condition

Diagram 1, provides an indicative distribution curve for tree condition to illustrate that within a normal tree population the majority of specimens are centrally located within the condition range (normal distribution curve). Furthermore, that those individual trees with an assessed condition approaching the outer ends of the spectrum occur less often.

2. Tree Name

Provides botanical name, (genus, species, variety and cultivar) according to accepted international code of taxonomic classification, and common name.

3. Tree Type

Describes the general geographic origin of the species and its type e.g. deciduous or evergreen.

Category	Description
Indigenous	Occurs naturally in the area or region of the subject site. Remnant.
Victorian native	Occurs naturally within some part of the State of Victoria (not exclusively) but is not indigenous (component of EVC benchmark). Could be planted indigenous trees.
Australian native	Occurs naturally within Australia but is not a Victorian native or indigenous
Exotic deciduous	Occurs outside of Australia and typically sheds its leaves during winter
Exotic evergreen	Occurs outside of Australia and typically holds its leaves all year round
Exotic conifer	Occurs outside of Australia and is classified as a gymnosperm
Native conifer	Occurs naturally within Australia and is classified as a gymnosperm
Native Palm	Occurs naturally within Australia. Woody monocotyledon
Exotic Palm	Occurs outside of Australia. Woody monocotyledon

4. Height and Width

Indicates height and width of the individual tree; dimensions are expressed in metres. Crown heights are measured with a height meter where possible. Due to the topography of some sites and/or the density of vegetation it may not be possible to do this for every tree. Tree heights may be estimated in line with previous height meter readings in conjunction with assessor's experience. Crown widths are generally paced (estimated) at the widest axis or can be measured on two axes and averaged. In some instances the crown width can be measured on the four cardinal direction points (North, South, East and West).

Crown height, crown spread are generally recorded to the nearest half metre (crown spread would be rounded up) for dimensions up to 10 m and the nearest whole metre for dimensions over 10 m. Estimated dimensions (e.g. for off-site or otherwise inaccessible trees where accurate data cannot be recovered) shall be clearly identified in the assessment data.

5. Trunk diameters

The position where trunk diameters are captured may vary dependent on the requirements of the specific assessment and an individual trees specific characteristics. DBH is the typical trunk diameter captured as it relates to the allocation of tree protection distances. The basal trunk diameter assists in the allocation of a structural root zone. Some municipalities require trunk diameters be captured at different heights, with 1.0 m above grade being a common requirement. The specific planning schemes will be checked to ascertain requirements.

Stem diameters shall be recorded in centimetres, rounded to the nearest 1 cm (0.01 m).

Diameter at Breast Height (DBH)

Indicates the trunk diameter (expressed in centimetres) of an individual tree measured at 1.4m above the existing ground level or where otherwise indicated, multiple leaders are measured individually. Plants with multiple leader habit may be measured at the base. The range of methods to suit particular trunk shapes, configurations and site conditions can be seen in Appendix A of Australian Standard *AS 4970-2009 Protection of trees on development site*s. Measurements undertaken using foresters tape or builders tape.

Basal trunk diameter

The basal dimension is the trunk diameter measured at the base of the trunk or main stem(s) immediately above the root buttress. Used to ascertain the Structural Root Zone (SRZ) as outlined in AS4970.

6. Health

Assesses various attributes to describe the overall health and vigour of the tree.

Category	Vigour, Extension growth	Decline symptoms, Deadwood, Dieback	Foliage density, colour, size, intactness	Pests and or disease
Good	Above typical. Excellent. Full canopy density	Negligible	Better than typical	Negligible
Fair	Typical vigour. >80% canopy density	Minor or expected. Little or no dead wood	Typical. Minor deficiencies or defects could be present.	Minor, within damage thresholds
Fair to Poor	Below typical - low vigour	More than typical. Small sub-branch dieback	Exhibiting deficiencies. Could be thinning, or smaller	Exceeds damage thresholds

Category	Vigour, Extension growth	Decline symptoms, Deadwood, Dieback	Foliage density, colour, size, intactness	Pests and or disease
Poor	Minimal - declining	Excessive, large and/or prominent amount & size of dead wood. Significant dieback	Exhibiting severe deficiencies. Thinning foliage, generally smaller or deformed	Extreme and contributing to decline
Dead	N/A	N/A	N/A	N/A

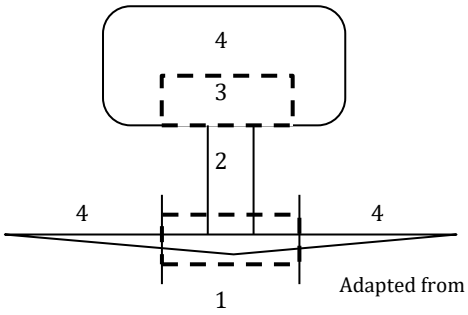
7. Structure

Assesses principal components of tree structure (Diagram 2).

Descriptor	Zone 1 - Root plate & lower stem	Zone 2 - Trunk	Zone 3 - Primary branch support	Zone 4 - Outer crown and roots
Good	No obvious damage, disease or decay; obvious basal flare / stable in ground	No obvious damage, disease or decay; well tapered	Well formed, attached, spaced and tapered. No history of failure.	No obvious damage, disease, decay or structural defect. No history of failure.
Fair	Minor damage or decay. Basal flare present.	Minor damage or decay	Generally well attached, spaced and tapered branches. Minor structural deficiencies may be present or developing. No history of branch failure.	Minor damage, disease or decay; minor branch end-weight or over-extension. No history of branch failure.
Fair to Poor	Moderate damage or decay; minimal basal flare.	Moderate damage or decay; approaching recognised thresholds	Weak, decayed or with acute branch attachments; previous branch failure evidence.	Moderate damage, disease or decay; moderate branch end-weight or over-extension. Minor branch failure evident.
Poor	Major damage, disease or decay; fungal fruiting bodies present. Excessive lean placing pressure on root plate	Major damage, disease or decay; exceeds recognised thresholds; fungal fruiting bodies present. Acute lean. Stump re-sprout	Decayed, cavities or has acute branch attachments with included bark; excessive compression flaring; failure likely. Evidence of major branch failure.	Major damage, disease or decay; fungal fruiting bodies present; major branch end-weight or over-extension. Branch failure evident.
Very Poor	Excessive damage, disease or decay; unstable / loose in ground; altered exposure; failure probable	Excessive damage, disease or decay; cavities. Excessive lean. Stump re-sprout	Decayed, cavities or branch attachments with active split; failure imminent. History of major branch failure.	Excessive damage, disease or decay; excessive branch end-weight or over-extension. History of branch failure.

Diagram 2: Tree structure zones

1. Root plate & lower stem
2. Trunk
3. Primary branch support
4. Outer crown & roots



Adapted from Coder (1996)

Structure ratings will also take into account general branching architecture, stem taper, live crown ratio, crown symmetry (bias or lean) and crown position such as tree being suppressed amongst more dominant trees.

The lowest or worst descriptor assigned to the tree in any column could generally be the overall rating assigned to the tree. The assessment for structure is limited to observations of external and above ground tree parts. It does not include any exploratory assessment of underground or internal tree parts unless this is requested as part of the investigation. Trees are assessed and then given a rating for a point in time. Generally, trees with a poor or very poor structure are beyond the benefit of practical arboricultural treatments.

The management of trees in the urban environment requires appropriate arboricultural input and consideration of risk. Risk potential will take into account the combination of likelihood of failure and impact, including the perceived importance of the target(s).

8. Age class

Relates to the physiological stage of the tree's life cycle.

Category	Description
Young	Sapling tree and/or recently planted. Approximately 5 or less years in location.
Semi-mature	Tree increasing in size and yet to achieve expected size in situation. Primary developmental stage.
Early-mature	Tree established, generally growing vigorously. > 50% of attainable age/size.
Mature	Specimen approaching expected size in situation, with reduced incremental growth.
Over-mature	Mature full-size with a retrenching crown. Tree is senescent and in decline. Significant decay generally present.

9. Useful life expectancy

Assessment of useful life expectancy provides an indication of health and tree appropriateness and involves an estimate of how long a tree is likely to remain in the landscape based on species, stage of life (cycle), health, amenity, environmental services contribution, conflicts with adjacent infrastructure and risk to the community. It would enable tree managers to develop long-term plans for the eventual removal and replacement of existing trees in the public realm. It is not a measure of the biological life of the tree within the natural range of the species. It is more a measure of the health status and the trees positive contribution to the urban landscape.

Within an urban landscape context, particularly in relation to street trees, it could be considered a point where the costs to maintain the asset (tree) outweigh the benefits the tree is returning.

The assessment is based on the site conditions not being significantly altered and that any prescribed maintenance works are carried out (site conditions are presumed to remain relatively constant and the tree would be maintained under scheduled maintenance programs).

Useful Life Expectancy	**Typical characteristics**
<1 year (No remaining ULE)	Tree may be dead or mostly dead. Tree may exhibit major structural faults. Tree may be an imminent failure hazard. Excessive infrastructure damage with high risk potential that cannot be remedied.
1-5 years (Transitory, Brief)	Tree is exhibiting severe chronic decline. Crown is likely to be less than 50% typical density. Crown may be mostly epicormic growth. Dieback of large limbs is common (large deadwood may have been pruned out). Tree may be over-mature and senescing. Infrastructure conflicts with heightened risk potential. Tree has outgrown site constraints.
6-10 years (Short)	Tree is exhibiting chronic decline. Crown density will be less than typical and epicormic growth is likely to present. The crown may still be mostly entire, but some dieback is likely to be evident. Dieback may include large limbs. Over-mature and senescing or early decline symptoms in short-lived species. Early infrastructure conflicts with potential to increase regardless of management inputs.
11-20 years (Moderate)	Tree not showing symptoms of chronic decline, but growth characteristics are likely to be reduced (bud development, extension growth etc.). Tree may be over-mature and beginning to senesce. Potential for infrastructure conflicts regardless of management inputs.
21-40 years (Moderately long)	Trees displaying normal growth characteristics but vigour is likely to be reduced (bud development, extension growth etc.). Tree may be growing in restricted environment (e.g. streetscapes) or may be in late maturity. Semi-mature and mature trees exhibiting normal growth characteristics. Juvenile trees in streetscapes.
>40 years (Long)	Generally juvenile and semi-mature trees exhibiting normal growth characteristics within adequate spaces to sustain growth, such as in parks or open space. Could also pertain to maturing, long-lived trees. Tree well suited to the site with negligible potential for infrastructure conflicts.

Note that ULE may change for a tree dependent on the prevailing climatic conditions, sudden changes to a tree's growing environment creating an acute stress or impact by pathogens.

The ULE may not be applicable for trees that are manipulated, such as topiary, or grown for specific horticultural purposes, such as fruit trees.

There may be instances where remedial tree maintenance could extend a tree's ULE.

10. Arboricultural Rating

Relates to the combination of tree condition factors, including health and structure (arboricultural merit), and also conveys an amenity value. Amenity relates to the trees biological, functional and aesthetic characteristics (Hitchmough 1994) within an urban landscape context. The presence of any serious disease or tree-related hazards that would impact risk potential are taken into account.

Category	Description
High	Tree of high quality in good to fair condition; good vigour. Generally a prominent arboricultural/landscape feature. Particularly good example of the species; rare or uncommon. Tree may have significant conservation or other cultural value. These trees have the potential to be a medium- to long-term components of the landscape (moderately long to long ULE) if managed appropriately. Retention of these trees is highly desirable.
Moderate	General - Tree of moderate quality, in fair or better condition. Tree may have a condition, and or structural problem that will respond to arboricultural treatment. These trees have the potential to be a moderate- to long-term component of the landscape (moderate to long ULE) if managed appropriately. Retention of these trees is generally desirable. The following sub-categories relate predominately to age and size and amenity.
	A. Moderate to large, maturing tree. Contributes to the landscape character. Tree may have conservation or other cultural value.
	B. Moderate sized, established tree, > 50% of attainable age/size. Contributes to the landscape character. Maturing tree with amenity value but with identified deficiencies.
	C. Small and/or semi-mature tree, established, >5 years in the location. May not be a dominant canopy. No special qualities. Maturing tree with accumulating deficiencies, trending towards becoming of Low arboricultural value.
Low	Unremarkable tree of low quality or little amenity value. Tree in either poor health or with poor structure or a combination. Short to transitory useful life expectancy. Tree is not significant because of either its size or age, such as young trees with a stem diameter below 15 cm. Tree < 5 years in location. These trees are easily replaceable. Trees regularly pruned to restrict size. Tree (species) is functionally inappropriate to specific location and would be expected to be problematic if retained. Retention of such trees may be considered if not requiring a disproportionate expenditure of resources for a tree in its condition and location.

Category	Description
None	Trees of low quality with an estimated remaining ULE of < 5 years. Tree has either a severe structural defect or health problem or combination that cannot be sustained with practical arboricultural techniques and the loss of the tree would be expected in the short term. Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline. Tree infected with pathogens of significance to either the health or safety of the tree or other adjacent trees. Tree whose retention would not be viable after the removal of adjacent trees (includes trees that have developed in close spaced groups and would not be expected to acclimatise to severe alterations to surrounding environment – removal of adjacent shelter trees). Tree has a detrimental effect on the environment, for example, the tree is a recognised environmental woody weed with potential to spread into waterways or natural areas. Unremarkable tree of no material landscape, conservation or other cultural value.

Trees have many values, not all of which are considered when an arboricultural assessment is undertaken. However, individual trees or tree group features may be considered important community resources because of unique or noteworthy characteristics or values other than their age, dimensions, health or structural condition. Recognition of one or more of the following criteria is designed to highlight other considerations that may influence the future management of such trees.

Significance	Description
Horticultural Value/ Rarity	Outstanding horticultural or genetic value; could be an important source of propagating stock, including specimens that are particularly resistant to disease or exposure. Any tree of a species or variety that is rare.
Historic, Aboriginal Cultural or Heritage Value	Tree could have value as a remnant of a particular important historical period or a remnant of a site or activity no longer in action. Tree has a recognised association with historic aboriginal activities, including scar trees. Tree commemorates a particular occasion, including plantings by notable people, or having associations with an important event in local history.
Ecological Value	Tree could have value as habitat for indigenous wildlife, including providing breeding, foraging or roosting habitat, or is a component of a wildlife reserve. Remnant Indigenous vegetation that contribute to biological diversity

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Appendix 4: Tree protection zones.

Introduction

In order to sustain trees on a development site consideration must be given to the establishment of tree protection zones.

The physical dimensions of tree protection zones can sometimes be difficult to define. The projection of a tree's crown can provide a guide but is by no means the definitive measure. The unpredictable nature of roots and their growth, differences between species and their tolerances, and observable and hidden changes to the trees growing environment, as a result of development, are variables that must be considered.

Most vigorous, broad canopied trees survive well if the area within the drip-line of the canopy is protected. Fine root density is usually greater beneath the canopy than beyond (Gilman, 1997). If few to no roots over 3cm in diameter are encountered and severed during excavation the tree will probably tolerate the impact and root loss. A healthy tree can sustain a loss of between 30% and 50% of absorbing roots (Harris, Clark, Matheny, 1999), however encroachment into the structural root system of a tree may be problematic.

The structural root system of a tree is responsible for ensuring the stability of the entire tree structure in the ground. A tree could not sustain loss of structural root system and be expected to survive let alone stand up to average annual wind loads upon the crown.

Allocation of tree protection zone (TPZ)

The method of allocating a TPZ to a particular tree will be influenced by site factors, the tree species, its age and developed form.

Once it has been established, through an arboricultural assessment, which trees and tree groups are to be retained, the next step will require careful management through the development process to minimise any impacts on the designated trees. The successful retention of trees on any particular site will require the commitment and understanding of all parties involved in the development process. The most important activity, after determining the trees that will be retained is the implementation of a TPZ.

The intention of tree protection zones is to:

- mitigate tree hazards;
- provide adequate root space to sustain the health and aesthetics of the tree into the future;
- minimise changes to the trees growing environment, which is particularly important for mature specimens;
- minimise physical damage to the root system, canopy and trunk; and
- define the physical alignment of the tree protection fencing

Tree protection

The most important consideration for the successful retention of trees is to allow appropriate above and below ground space for the trees to continue to grow. This requires the allocation of tree protection zones for retained trees.

The Australian Standard AS 4970-2009 Protection of trees on development sites has been used as a guide in the allocation of TPZs for the assessed trees.

The TPZ for individual trees is calculated based on trunk (stem) diameter (DBH), measured at 1.4 metres up from ground level. The radius of the TPZ is calculated by multiplying the trees DBH by 12. The method provides a TPZ that addresses both the stability and growing requirements of a tree. TPZ distances are measured as a radius from the centre of the trunk at (or near) ground level. The minimum TPZ should be no less than 2m and the maximum no more than 15m radius. The TPZ of palms should be not less than 1.0m outside the crown projection.

Encroachment into the TPZ is permissible under certain circumstances though is dependent on both site conditions and tree characteristics. Minor encroachment, up to 10% of the TPZ, is generally permissible provided encroachment is compensated for by recruitment of an equal area contiguous with the TPZ. Examples are provided in Diagram 1. Encroachment greater than 10% is considered major encroachment under AS4970-2009 and is only permissible if it can be demonstrated that after such encroachment the tree would remain viable.

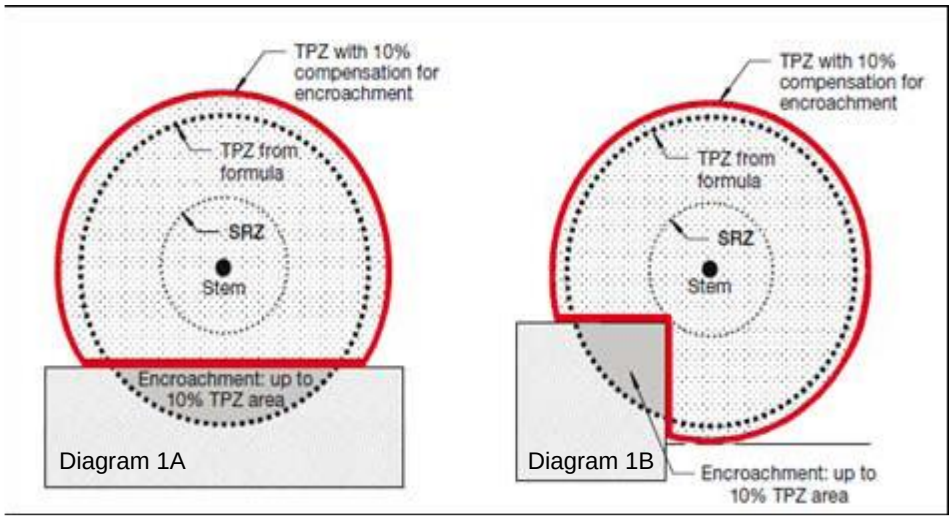


Diagram 1: Examples of minor encroachment into a TPZ.
(Extract from: AS4970-2009, Appendix D, p30 of 32)

The 10% encroachment on one side equates to approximately ⅓ radial distance. Tree root growth is opportunistic and occurs where the essentials to life (primarily air and water) are present. Heterogeneous soil conditions, existing barriers, hard surfaces and buildings may have inhibited the development of a symmetrically radiating root system.

Existing infrastructure around some trees may be within the TPZ or root plate radius. The roots of some trees may have grown in response to the site conditions and therefore if existing hard surfaces and building alignments are utilised in new designs the impacts on the trees should be minimal. The most reliable way to estimate root disturbance is to find out where the roots are in relation to the demolition, excavation or construction works that will take place (Matheny & Clark, 1998). Exploratory excavation prior to commencement of construction can help establish the extent of the root system and where it may be appropriate to excavate or build.

The TPZ should also give consideration to the canopy and overall form of the tree. If the canopy requires severe pruning in order to accommodate a building and in the process the form of the tree is diminished it may be worthwhile considering altering the design or removing the tree.

General tree protection guidelines

The most important factors are:

- Prior to construction works the trees nominated for tree works should be pruned to remove larger dead wood. Pruning works may also identify other tree hazards that require remedial works.
- Installation of tree protection fencing. Once the tree protection zones have been determined the next step is to mulch the zone with woodchip and erect tree protection fencing. This must be completed prior to any materials being brought on-site, erection of temporary site facilities or demolition/earth works. The protection fencing must be sturdy and withstand winds and construction impacts. The protection fence should only be moved with approval of the site supervisor. Other root zone protection methods can be incorporated if the TPZ area needs to be traversed.
- Appropriate signage is to be fixed to the fencing to alert people as to importance of the tree protection zone.
- The importance of tree preservation must be communicated to all relevant parties involved with the site.
- Inspection of trees during excavation works.

Exploratory excavation

The most reliable way to estimate root disturbance is to find out where the roots are in relation to the demolition, excavation or construction works that will take place (Matheny & Clark, 1998).

Exploratory excavation prior to commencement of construction can help establish the extent of the root system and where it may be appropriate to excavate or build. This also allows management decisions to be made and allows time for redesign works if required.

Any exploratory excavation within the allocated TPZ is to be undertaken with due care of the roots. Minor exploration is possible with hand tools. More extensive exploration may require the use of high pressure water or air excavation techniques. Either hydraulic or pneumatic excavation techniques will safely expose tree roots; both have specific benefits dependent on the situation and soil type. An arborist is to be consulted on which system is best suited for the site conditions.

Substantial roots are to be exposed and left intact.

Once roots are exposed decisions can be made regarding the management of the tree. Decisions will be dependent on the tree species, its condition, its age, its relative tolerance to root loss, and the amount of root system exposed and requiring pruning.

Other alternative measures to encroaching the TPZ may include boring or tunnelling.

How to determine the diameter of a substantial root

The size of a substantial root will vary according to the distance of the exposed root to the trunk of the tree. The further away from the trunk of a tree that a root is, the less significant the root is likely to be to the tree's health and stability.

The determination of what is a substantial root is often difficult because the form, depth and spread of roots will vary between species and sites. However, because smaller roots are connected to larger roots in a framework, there can be no doubt that if larger roots are severed, the smaller roots attached to them will die. Therefore, the larger the root, the more significant it may be.

Gilman (1997) suggests that trees may contain 4-11 major lateral roots and that the five largest lateral roots account (act as a conduit) for 75% of the total root system.

These large lateral roots quickly taper within a distance to the tree, this distance is identified as the Structural Root Zone (SRZ). Within the SRZ distance, all roots and the soil surrounding the roots are deemed significant.

No root or soil disturbance is permitted within the SRZ.
In the area outside the SRZ the tree may tolerate the loss of one or a number of roots. The table below indicates the size of tree roots, outside the SRZ that would be deemed substantial for various tree heights. The assessment of combined root loss within the TPZ would need to be undertaken by an arborist on an individual basis because the location of the tree, its condition and environment would need to be assessed.

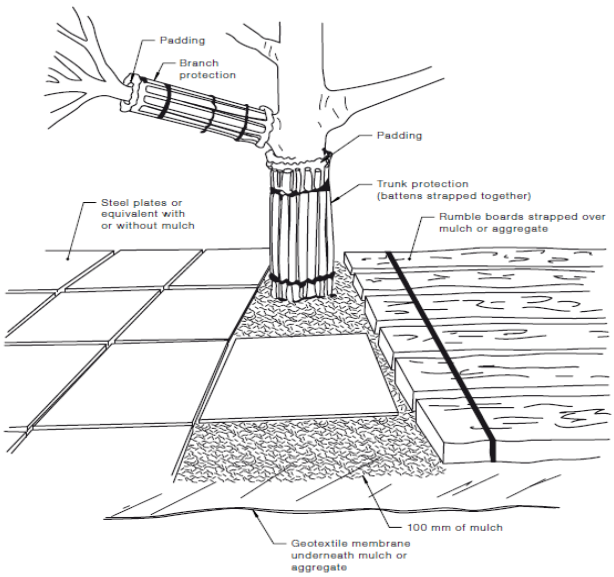
Table 1: Estimated significant root sizes outside SRZ

Height of tree	Diameter of root
Less than 5m	≥ 30mm
Between 5m - 15m	≥ 50mm
More than 15m	≥ 70mm

Ground buffering

Where works are required to be undertaken within the Tree root zone without penetration of the surface, ground buffering and trunk and limb protection must be provided to minimise the potential for soil to become compacted and avoid potential for impact wounds to occur to surface roots, trunk or limbs. Refer below.

Diagram 2: Examples of ground buffering and trunk and limb protection.



NOTES:

1 For trunk and branch protection use boards and padding that will prevent damage to bark. Boards are to be strapped to trees, not nailed or screwed.

2 Rumble boards should be of a suitable thickness to prevent soil compaction and root damage.

FIGURE 4 EXAMPLES OF TRUNK, BRANCH AND GROUND PROTECTION

(Extract from: AS4970-2009, Appendix D, pg17)

Construction Guidelines

The following are guidelines that must be implemented to minimise the impact of the proposed construction works on the retained trees.

- The Tree Protection Zone (TPZ) is fenced and clearly marked at all times. The actual fence specifications should be a minimum of 1.2 - 1.5 metres of chain mesh or like fence with 1.8 meter posts (e.g. treated pine or star pickets) or like support every 3-4 metres and a top line of high visibility plastic hazard tape. The posts should be strong enough to sustain knocks from on site excavation equipment. This fence will deter the placement of building materials, entry of heavy equipment and vehicles and also the entry of workers and/or the public into the TPZ. Note: There are many different variations on the construction type and material used for TPZ fences, suffice to say that the fence should satisfy the responsible authority.
- Contractors and site workers should receive written and verbal instruction as to the importance of tree protection and preservation within the site. Successful tree preservation occurs when there is a commitment from all relevant parties involved in designing, constructing and managing a development project. Members of the project team need to interact with each other to minimise the impacts to the trees, either through design decisions or construction practices. The importance of tree preservation must be communicated to all relevant parties involved with the site.
- The consultant arborist is on-site to supervise excavation works around the existing trees where the TPZ will be encroached.
- A layer of organic mulch (woodchips) to a depth of no more than 100mm should be placed over the root systems within the TPZ of trees, which are to be retained so as to assist with moisture retention and to reduce the impact of compaction.
- No persons, vehicles or machinery to enter the TPZ without the consent of the consulting arborist or site manager.
- Where machinery is required to operate inside the TPZ it must be a small skid drive machine (i.e Dingo or similar) operating only forwards and backwards in a radial direction facing the tree trunk and not altering direction whilst inside the TPZ to avoid damaging, compacting or scuffing the roots.
- Any underground service installations within the allocated TPZ should be bored and utility authorities should common trench where possible.
- No fuel, oil dumps or chemicals shall be allowed in or stored on the TPZ and the servicing and re-fuelling of equipment and vehicles should be carried out away from the root zones.
- No storage of material, equipment or temporary building should take place over the root zone of any tree.
- Nothing whatsoever should be attached to any tree including temporary services wires, nails, screws or any other fixing device.
- Supplementary watering should be provided to all trees through any dry periods during and after the construction process. Proper watering is the most important maintenance task in terms of successfully retaining the designated trees. The areas under the canopy drip lines should be mulched with woodchip to a depth of no more than 100mm. The mulch will help maintain soil moisture levels. Testing with a soil probe in a number of locations around the tree will help ascertain soil moisture levels and requirements to irrigate. Water needs to be applied slowly to avoid runoff. A daily watering with 5 litres of water for every 30 mm of trunk calliper may provide the most even soil moisture level for roots (Watson & Himelick, 1997), however light frequent irrigations should be avoided. Irrigation

should wet the entire root zone and be allowed to dry out prior to another application. Watering should continue from October until April.

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