Arboricultural assessment report

13 Grosvenor & 1A-F Woodstock Streets, Balaclava

18 January 2024
Treelogic Ref. 013174

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Objectives

Treelogic was engaged by H2o Architects Pty Ltd to conduct a tree assessment and prepare an *arboricultural report* for trees that maybe impacted by future proposed development of the site. The address of the site is 13 Grosvenor & 1A-F Woodstock St, Balaclava.

Undertake site inspection and assess only specified trees, identifying the tree species, collecting information on tree dimensions, conditions, and growing environment.

Establish the arboricultural merit and retention value of the assessed trees.

Allocate **tree protection zones** (TPZ) and **structural root zones** (SRZ) as outlined in the Australian Standard for protection of trees on development sites (AS4970 – 2020).

This report is to determine tree impacts based on the supplied and current proposed building plan and provide recommendations on impact reduction measures for trees that are to be retained.

Site summary

The site was located within the City of Port Phillip and was not subject to any relevant planning overlays.

The street trees are considered Council assets, and their removal or where works intrude into their TPZ is subject to a permit. There are also limits as to the works related activities that can be undertaken within the TPZ of a Council tree and is described under the document “City of Port Phillip Tree Protection Fact Sheet” (updated February 2019) that is available on the City of Port Phillip website. These limitations are in line with AS4970 and are typical limitations when working near protected trees for those jurisdictions that use AS4970 as guidance.

There is also the requirement for the preparation of a **tree protection management plan** (TPMP) for retained trees as part of the permitted construction activity. Works to street trees must only be performed by those authorised by Council. Trees removed are also subject to a charge of the amenity valuation costs and removal and replacement costs.

The site is also subject to the local law regarding trees that are considered as “significant“, which is defined as the total circumference of the trunk as measured at 1.0 m from the ground of 150 cm or greater (48 cm diameter). The method for this calculation can be found on the City of Port Phillip website and is part of the Community Amenity Local Law 2023. Trees that are defined as “significant” require a permit to remove, destroy, damage, interfere with or kill, or direct or allow another person to do so. This extends to tree parts that overhang a property. This relates to **Trees 2, 5 and 6**.

The study area was at the time of the inspection occupied housing of various sizes and included car parking, a children’s play area, and vehicle access to parking to the rear (internal) of the site.

In total 41 individual trees and seven tree groups were assessed within, directly neighbouring and within the street.

The survey plans and drawings provided and used in this assessment included:

- "Feature & Level Survey", dated 21st of December 2023.
- Supplied as a multi-page document titled "2334 - HF- GROSVENOR ST- PDF-181223.pdf", dated 18th December 2023. This includes pages titled "Proposed Ground Floor Site Coverage", "Proposed Roof", and "Proposed Basement Carpark".
- "ZLA _ Grosvenor Street, Balaclava_ Draft Landscape Concept Package 20.12.2023.pdf", dated 20th December 2023.

Aerial imagery used was sourced from Nearmap.com (2023).

Method

The tree assessment was carried out on the 30th of November 2023 by Thiet Nguyen and Andrew Traczynski of Treelogic. The trees were inspected from the ground and observations were made of the growing environment and surrounding areas. The trees were not climbed, and no samples of the tree or site soil were taken.

Assessment details of individual trees are listed in the Tree Assessment Table in Appendix 1 A. Tree locations, along with tree protection zones can be seen in Appendix 2 A.

Observations were made of the trees and include:

- Identify the tree species,
- Tree heights measured with a Nikon Pro Forestry device or estimated in metres when canopy was obscured.
- **Diameter at breast height** (DBH) was measured at 1.4 m from ground level where possible with either a diameter tape or estimated where tree base was not accessible.
- Basal diameter just above root flare was measured where possible with either a diameter tape or estimated where tree base was not accessible.
- Canopy spread was paced and estimated in metres,
- Health and Structure,
- Make comments on any issues or any appropriate specific site characteristics.

Photographs of assessed trees and site conditions were taken for further reference and inclusion in the report. Photographs were taken on an iPhone 12 Pro with basic exposure and image sharpening made within Adobe Photoshop.

Each of the assessed trees were attributed an 'Arboricultural Rating'. The arboricultural rating correlates the combination of tree condition factors (health and structure) with tree amenity value. Definitions of arboricultural ratings can be seen in Appendix 3.

The assessed trees have been allocated TPZ and indicative SRZ as described in AS4970. This method provides a TPZ and an SRZ 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. SRZ distances are measured as a radius based on the measurement of the diameter just above root flare of the trunk. All TPZ and SRZ measurements for trees proposed for retention are provided in Appendix 1.

Observations

In total 41 individual trees and seven tree groups were assessed within, directly neighbouring and within the street.

The study area included the subject site and the trees located in the street directly surrounding the site. The site included various housing dwellings, brick walls, paved vehicle access points with car parking internal to the site, rear and front yards and a children's play area.

The tree population was of a mixed palette of species typically found planted across the metropolitan Melbourne area. Most common species included Ornamental Pear (*Pyrus calleryana* var.), Crepe Myrtle (*Lagerstroemia indica*), and Dessert Ash (*Fraxinus angustifolia*).

Provenance and species

None of the assessed trees were remnant or of indigenous origin. Nine trees were of Australian origin, while the remaining 31 trees were of exotic origin with another being an exotic palm. Of the tree groups three were of Australian origin, while the other four were of exotic origin.

Tree attributes

The arboricultural rating of the assessed trees found that none were of a **high** or **moderate A** rating, six were **moderate B**, 23 were **moderate C**, eleven were **low** and one was **very low**. Of the tree groups one was a moderate B, five were **moderate C** and one was **low**.

Definitions of arboricultural ratings can be seen in Appendix 3.

The **useful life expectancy** (ULE) nine of the assessed trees being greater than 21 years, while twenty were 11 to 20 years, eleven were 6 to 10 years, and one was 1 to 5 years. Of the tree groups, two had a relatively long ULE while the others had a significantly reduced ULE.

The tree population ages were dominated by mature street tree.

Tree condition (health and structure)

The health rating was assessed based on foliage colour, size, and density, shoot initiation and elongation as well as overall canopy density. Other factors such as decay and dead parts are also taken under consideration.

The health of the general population was fair. Issues noted included some decay, minor deadwood, and suppression by larger neighbouring trees.

The structure rating was assessed on tree form, unions and branch attachments, root anchorage, as well as other factors.

Main issues noted included co-dominant and acute unions, suckering/basal growth, twisted or crossing branches, tree guards being embedded into the trunks, active splitting unions, conflicts with the built environment and suppression. In some cases, vines were infesting trees.

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 TPZ and indicative SRZ for all retained trees.

The Australian Standard for protection of trees on development sites

The Australian Standard for protection of trees on development sites (AS4970) has been used as the method for calculating a TPZ and the indicative SRZ. The TPZ defines an area in which construction activity is either avoided, or at least controlled, to successfully sustain a tree. The indicative SRZ is an area that all activities must be excluded as this is the minimal area required for a tree to remain upright. Works are not permitted inside the SRZ without the consultation and guidance by the project arborist. These measurements are provided in the tree assessment data in Appendix 1. Tree locations with TPZ and indicative SRZ is included in Appendix 2.

A **minor encroachment** is where the proposed works occupy up to 10% of the TPZ. This is generally permissible provided encroachment is compensated for the recruitment and protection of an equivalent area of land contiguous with the TPZ.

A **major encroachment** is where the proposed works either occupy more than 10% of the TPZ and/or intrude into the SRZ of a retained tree. AS4970 requires the site arborist to show that where there is a major encroachment that the retained trees are not adversely affected by the proposal. This may require further investigation (i.e., root mapping), the use of construction methods and materials sympathetic to tree roots, or modifications to the design footprint.

Proposed works

The supplied proposed works show the redevelopment of the complete with a multi storey development with a basement carpark facility. There will also be open garden space and private courtyards with various sized trees. No trees internal to the site are proposed to be retained. Trees external of the site are to be retained, including **Trees 2, 3, 5, 6, 7, 12, 13, 18, 19, 20, 21, 23 and 24**.

Please see the mapping in “Appendix 2 B” for an indication of the tree locations and their respective protection projections over the current proposal footprint.

Impacts to trees

The following information is based on the current design plans provided.

Please refer to the table below for a breakdown of which trees are required to be removed and which trees can be retained. Please note that further detail drawings may change tree impacts. Some trees have the potential to be retained even if they have major encroachments and maybe considered lost.

Please see Table 1 below for a breakdown of which trees fall under each category.

Table 1: Impacts to trees

Impact type	Number of trees	Tree No.
Major – removal required	26 + 6 groups	**1, 4, 8, 9, 10, 11, 14, 15, 16, 17, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, and 41. Groups 1, 2, 3, 4, 5 and 6.**
Major – can be retained with mitigation measures	7 + 1 group	**2, 5, 6, 20, 21, 24, 25 and 40. Group 7**
Minor – can be retained with mitigation measures	3	**7, 19 and 23.**
No impacts – can be retained with appropriate tree protection	5	**3, 12, 13, and18.**

Please refer to Appendix 2 A and B for tree locations.

- Crossovers/vehicle entry points, and basement car parking

Tree 1 and Group 1 will require removal due to the location of the basement carpark entry location in the current design proposal. Their removal to facilitate the proposed development would be considered reasonable as relocating this access point would likely impact other trees.

Tree 40 and Group 7 will incur major encroachments based on the current design proposal. Given that there is a brick wall along the shared property boundary fence that would likely have limited root growth within the subject site, the impact to these trees is likely to be less severe.

- Works inside the subject site

It appears that all trees within the subject site are proposed to be removed. However, **Tree 25** could be retained if the landscaping could be designed to accommodate the tree and as much of its TPZ as possible. Trees requiring removal include **Trees 1, 4, 8, 9, 10, 11, 14, 15, 16, 17, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, and 41. Groups 1, 2, 3, 4, 5 and 6**.

- Street trees

Of note are the existing site conditions near **Trees 2, 5, 6 and 7** where there is evidence of recent trenching works for underground services within the pedestrian pavement. These works would have likely severed tree roots and limiting tree root activity within the subject site. On this basis it would be reasonable to assume that impacts to these trees are not as major as the TPZ projection would indicate and it would be reasonable to assume or treat these encroachments as minor.

Trees that receive no impacts are **Trees 3, 12, 13 and 18**.

Trees 19, 20, 21 and 23 are impacted by landscaping elements such as fencing and internal gardens. While it is likely that tree roots arising from these trees are located within the subject site, the trees are likely to remain viable post works provided tree protection measures are in place and respected throughout the entire building process. This includes pruning of tree roots only where required, if roots are encountered and can be retained that they are designed around, and tree protection fencing is in place. Tree branch pruning is likely required and is to be in accordance with AS4373 and be as minimal as possible, removing no greater than 20% of the canopy. If more than 20% of the canopy is required to be removed, then guidance from the project arborist is to be sought.

Tree 24 will incur a major encroachment by both landscaping elements and the construction of a part of the building that houses the substation. The substation impact is approximately 7% of the TPZ and defined under AS4970 as a minor encroachment. Required branches and root pruning works are to be pruned in accordance with AS34373. Landscaping works are to be as per **Trees 19, 20 21 and 23**.

Tree 25 is surrounded by landscaping gardening elements such as raised steel planting beds and granitic sand pavement. Provided the landscaping is caried out with respect to the tree roots, the tree is unlikely to be adversely impacted by the works.

Measures to reduce tree impacts

General measures include:

- Installation of physical protection (i.e., boundary fencing, tree padding).
- Powered equipment and machinery are to operate outside the TPZ unless appropriate ground protection is installed.
- Movement of machinery when near a retained tree must be guided by a spotter when required to enter the TPZ of a retained tree.
- Soil levels within or skirting the TPZ of retained trees are not to be overly modified or have soil heaped against the trunk,
- Tree roots must be pruned only where required, and cleanly in accordance with AS4373 and guidance from the project arborist.
- Smaller diameter tree roots that require pruning must be done also with clean sharp tools making the smallest possible cut by cutting perpendicular to the root direction. Roots are not to be torn or ripped by equipment.
- All vehicles and equipment are to remain outside the TPZ of a retained tree except when on hard paved surfaces. Where no hard-paved surfaces exist, and redirection of traffic is not feasible, then appropriate ground protection is to be installed.
- The use of machinery, equipment, or heavy traffic on unpaved sections inside the TPZ requires the installation of ground protection, such as *track-mats* to minimise compaction and root damage. Project arborist is to be consulted.
- Powered equipment is to be located outside the TPZ, with the bucket end of the excavator facing the tree trunk.

- Prior to the movement of powered equipment or vehicles, a path is to be scouted to ensure that collision damage to retained trees is avoided.
- Specific works are to have an arborist present to supervise works. These works are the excavation and operation of powered equipment within the TPZ of retained trees where the tree is both considered to be moderately to highly rated and that the works are considered a major encroachment under AS4970.
- Root investigations are to occur for several trees and is to be conducted by non-destructive methods, such as air-spade or hydro-excavation under the guidance and supervision of the project arborist.

Tree protection and work site culture

General tree protection requirements and measures are to be included in the 'site induction' process for all those working on the site.

All those working on the site should also be reminded of the tree protection requirements and measures through regular discussions being included in 'Toolbox Talks' where this information can be easily disseminated.

The information can be relatively simple and procedural and is to include remaining outside the TPZ fencing of a retained tree, looking out for collision with tree parts, the use of spotters, working under branches and correct pruning of tree roots.

The Site Supervisors should be made aware of all documents regarding tree protection and to remain vigilant in herding all personnel to adhere to the tree protection requirements.

Prohibited activities

The area of the **TPZ** is a **NO GO ZONE**, where ANY and ALL activities are prohibited unless agreed to by the project arborist or Council within the accepted works footprint. This includes but not limited to:

- the traffic of personnel, equipment, or vehicles without adequate ground protection within the TPZ.
- the storage or parking of equipment, vehicles, toilets, materials, fill, soil, chemicals, seating,
- the preparation of chemicals, including preparation of cement products,
- the cleaning of equipment, personnel, materials,
- existing soil grades must remain unaltered except for the construction footprint,
- trenching for services or the placement of soil fill greater than 100 mm in depth must not occur within the TPZ of retained trees except for the construction footprint,
- refuelling,
- dumping of waste,
- lighting of fires,
- attaching temporary or permanent utilities and signs to tree parts,

- physical damage to the tree.

Fencing

AS4970 requires that appropriate fencing be installed prior to commencement of any works on the site, including any site preparation and demolition works.

Tree protection fencing is to be erected to protect the trees that are not already protected by other protection measures, such as maintaining distance from the tree or its part.

Figure 1: Example of TPZ signage.

This fencing is to be signed that the area is a 'TREE PROTECTION ZONE" and that access is only allowed upon permission from the site arborist. The signage should comply with AS1319. Please see Figure 1.

All tree protection fencing is to be installed to incorporate as much of the TPZ of a retained tree as possible. The fencing is not to be installed over the road, vehicle crossovers, pedestrian pathways, or in a manner that impedes normal vehicle or pedestrian movements.

Examples of tree protection fencing can be seen in Figures 2 and 3.

Figure 2: Tree protection fencing across a long section

Figure 3: Tree protection fencing around a single tree in a nature strip setting.

The fencing should be modified to accommodate tree branches.

The fencing is to stay in place for the entirety of the works within that area.

For more tree protection information please refer to appendix 4 in this document.

Tree roots and root pruning

Where tree roots are encountered within the works footprint that require pruning, that these works be performed in accordance with AS4373 with clean sharp tools. Removal of the existing built form is to be by hand when inside the TPZ of a tree that is to be retained. The arborist is to

provide guidance for the pruning of significant roots or those roots greater than 50 mm in diameter.

Roots are not to be left exposed for a length of time greater than 1 hour on hot days, 2 hours on mild days. Roots are to be covered with moist material, such as hessian, to prevent roots drying out until such time that the soil surface is reinstated.

Changes in soil levels other than the removal of the existing concrete base and structure remains is to be avoided.

Specific works are to have an arborist present to supervise works. These works are the excavation and operation of powered equipment within the TPZ of retained trees where the tree is both considered to be moderately to highly rated and that the works are considered a major encroachment under AS4970.

Root investigations are to occur for several trees and is to be conducted by non-destructive methods, such as air-spade or hydro-excavation under the guidance and supervision of the project arborist.

For more tree protection information please refer to appendix 4 in this document.

Tree branches and tee roots

It is likely that some branches and tree roots will require removal to facilitate the proposed works. These works are recommended to be undertaken by a trained arborist in accordance with AS4373 with clean sharp tools. No tree branch is to be pruned by any tradespersons on the site unless the part is under a finger thickness in diameter and can be achieved using secateurs.

Recommendations and conclusions

1. Upon approval for any development on the site from the relevant authority, a **tree protection management plan** (TPMP) is to be prepared by a suitably qualified arborist (minimum of AQF level V or equivalent).

2. A permit from the relevant authority is required to perform works within the TPZ or to remove a tree designated as a Council asset. This is for all street trees.

3. Remove **Trees 1, 4, 8, 9, 10, 11, 14, 15, 16, 17, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, and 41. Groups 1, 2, 3, 4, 5 and 6** to facilitate the proposed development.

4. Careful implementation of landscaping elements around **Tree 25** to accommodate and disturb as little as possible the tree roots.

5. **Trees 2, 5 and 6** are considered as “significant“, and a permit is required to remove, destroy, damage, interfere with or kill, or direct or allow another person to do so. This extends to tree parts that overhang a property, as per the City of Port Phillip Community Amenity Local Law 2023. If these trees require pruning, then prior permission is to be sought from the relevant authority.

6. Trees removed are also subject to a charge of the amenity valuation costs and removal and replacement costs.

7. All trees that are to be retained are to be afforded appropriate tree protection that is to be respected throughout the entire process.

8. All trees are to be marked appropriately on the relevant drawings to include those that are to be removed and those that are to be retained along with their respective TPZ and SRZ projections.

9. Any required works to any trees retained is to be performed by appropriately trained personnel and be in accordance with the Australian Standard for the Pruning of amenity trees (AS4373). Works to street trees must only be performed by those authorised by Council.

I am available to answer any questions arising from this report.

No part of this report is to be reproduced unless in full.

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Clark, J.R. & Matheny, N.P. (1998), *Trees and Development: A technical guide to preservation of trees during land development*. I.S.A., Champaign, Illinois.

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City of Port Phillip (2023), *Significant tree permit*, City of Port Phillip, 99a Carlisle Street, St. Kilda, Victoria, Australia. Website accessed 8th December 2023. <https://www.portphillip.vic.gov.au/planning-and-building/construction-permits/significant-tree-permit>

City of Port Phillip (2019), *City of Port Phillip Tree Protection Fact Sheet*, City of Port Phillip, 99a Carlisle Street, St. Kilda, Victoria, Australia.

Images

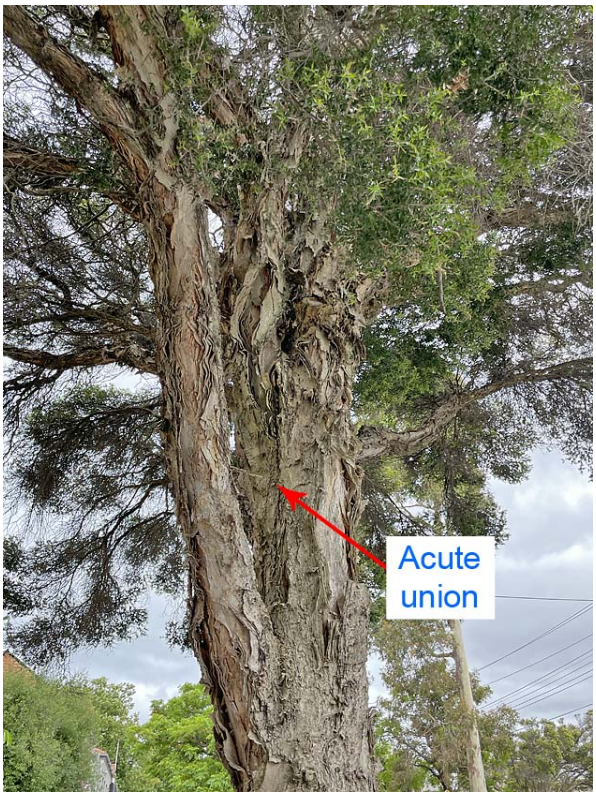


Image 1: Shows an acute co-dominant union of **Tree 2**.

Image 2: Shows **Tree 3**.

Image 3: Shows **Tree 5**.

Image 4: Shows **Tree 6**.

Image 5: Shows **Tree 7**.

Image 6: Shows **Tree 24**.

Image 7: Shows **Trees 8 through 12**.

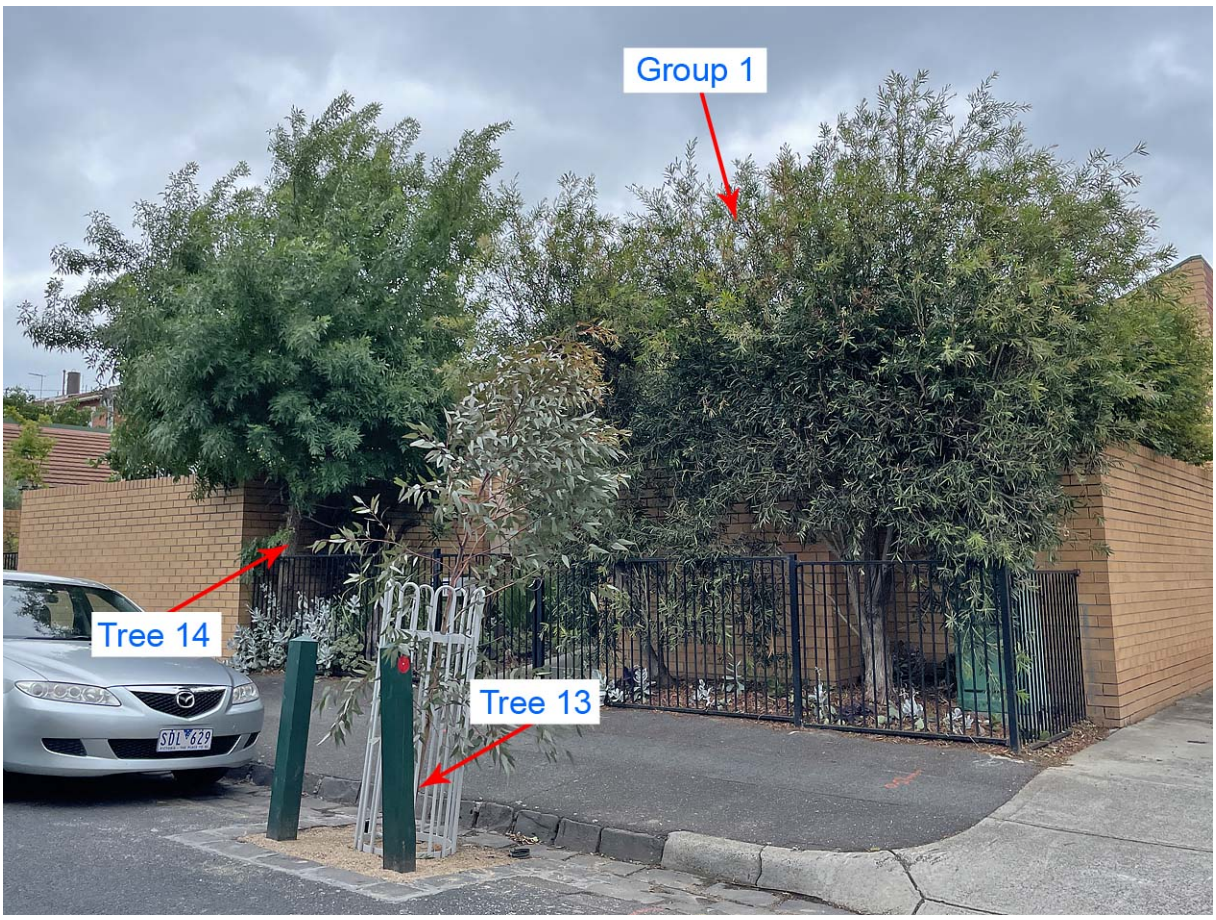


Image 8: Shows **Trees 13, 14** and **Group 1**.

Image 9: Shows **Trees 19** and **20**.

Image 10: Shows **Tree 21**.

Image 11: Shows **Tree 25**.

Image 12: Shows **Trees 26 and 27**.

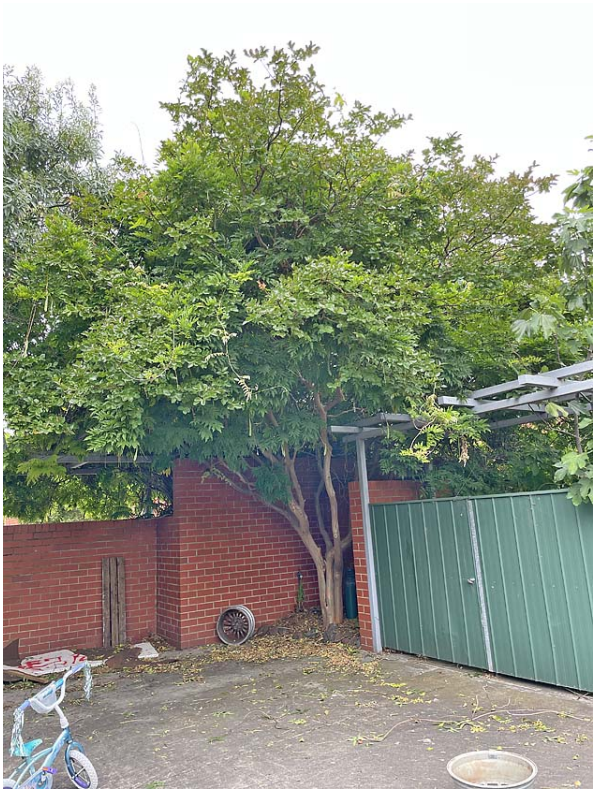


Image 13: Shows **Tree 31**.

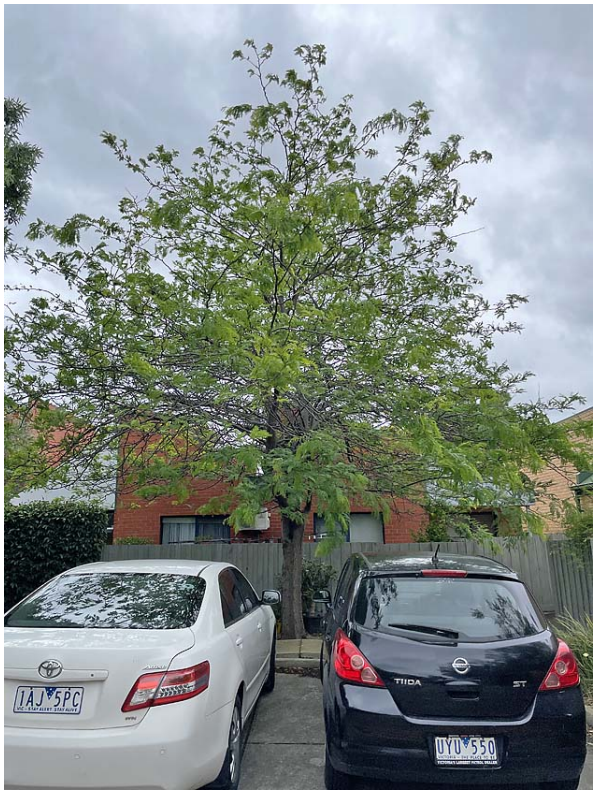


Image 14: Shows **Tree 38**.

Image 15: Shows the base of **Tree 37** with the uplift of concrete pavement and location of services.

Image 16: Shows **Tree 40**.

Image 17: Shows **Groups 4 and 5**.

Image 18: Shows **Trees 37, 39 and Group 6**.

Image 19: Shows **Group 7**.

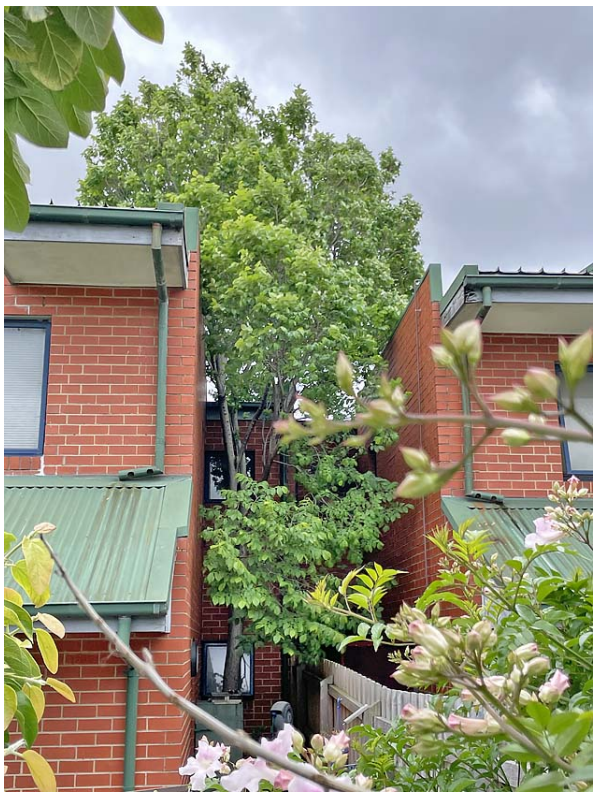


Image 20: Shows **Tree 41**.

Appendix 1: Tree assessment numbers and details

DBH = diameter at breast height (measured in centimetres at 1.4 m above ground unless otherwise stated). **TPZ** = tree protection zone (metre radius). **SRZ** = structural root zone. Radius distances measured in metres from the centre of trunk. **ULE** = useful life expectancy. For tree locations and numbering refer Appendix 2. See Appendix 3 for tree descriptors.

Please refer to the following pages for tree data.

Appendix 1: Tree data

treeid	species	comm_name	age_class	origin_typ	DBH (cm)	H x W (m)	health	structure	arb_rating	ule_yrs	Comments	tpz_rad_m	srz_rad_m
1	Ficus sp.	Fig	Young	Exotic evergreen	15	4 x 2	Fair	Fair	Mod.C	6 to 10		2	1.7
2	Melaleuca styphelioides	Prickly-leaved Paperbark	Maturing	Australian native	40,23	7 x 8	Fair	Fair to Poor	Mod.B	21 to 40	Acute forks, Exposed roots, Included bark, Past branch failure, root lifting, significant tree	5.5	2.5
3	Melia azedarach	White Cedar	Early-mature	Australian native	27	4 x 5	Fair	Fair to Poor	Mod.C	11 to 20	, root popping out near to kerb	3.2	2.2
4	Prunus armeniaca	Apricot	Early-mature	Exotic deciduous	17	5 x 5	Fair	Poor	Low	6 to 10	, against the fence, past pruning	2	1.7
5	Melaleuca styphelioides	Prickly-leaved Paperbark	Maturing	Australian native	50	7 x 8	Fair	Fair to Poor	Mod.B	21 to 40		6	2.6
6	Melaleuca styphelioides	Prickly-leaved Paperbark	Maturing	Australian native	41,33	7 x 9	Fair to Poor	Poor	Mod.C	11 to 20	Congested primary union, Trunk wounds, kerb moving, significant tree	6.3	2.6
7	Melia azedarach	White Cedar	Maturing	Australian native	36	6 x 7	Fair	Fair	Mod.B	21 to 40	, next to underground setvices: water,	4.3	2.4
8	Betula pendula	Silver Birch	Semi-mature	Exotic deciduous	15	9 x 4	Fair	Fair to Poor	Mod.C	6 to 10	, growing against the fence, underground services	2	1.7
9	Fraxinus angustifolia	Narrow-leaved Ash	Early-mature	Exotic deciduous	30	7 x 6	Fair	Fair to Poor	Mod.C	11 to 20	Co-dominant stems, past pruning	3.6	2.1
10	Phoenix canariensis	Canary Island Date Palm	Semi-mature	Exotic palm	20	5 x 6	Fair	Fair	Mod.C	11 to 20		2.4	2.7
11	Fraxinus angustifolia	Narrow-leaved Ash	Early-mature	Exotic deciduous	34	9 x 8	Fair	Fair	Mod.C	6 to 10	, against to the fence, parts touching the house, underground services, past parts removed.	4.1	2.5
12	Eucalyptus sp.	Gum Tree	Young	Australian native	3	4 x 1	Fair	Fair	Low	21 to 40		2	1.5
13	Eucalyptus sp.	Gum Tree	Young	Australian native	3	3 x 1	Fair	Fair	Low	21 to 40		2	1.5
14	Fraxinus angustifolia	Narrow-leaved Ash	Semi-mature	Exotic deciduous	15	7 x 5	Fair to Poor	Fair to Poor	Mod.C	6 to 10		2	1.7
15	Pyrus calleryana	Callery's Pear	Young	Exotic deciduous	10	5 x 1	Fair	Fair to Poor	Low	6 to 10	Suppressed,	2	1.5
16	Pyrus calleryana	Callery's Pear	Semi-mature	Exotic deciduous	15	6 x 2	Good	Fair to Poor	Mod.C	21 to 40		2	1.7
17	Brachychiton rupestris	Queensland Bottle Tree	Young	Australian native	15	6 x 2	Fair	Fair	Mod.C	11 to 20		2	1.7
18	Eucalyptus sideroxylon	Red Ironbark	Young	Australian native	2	2 x 1	Fair	Fair	Low	21 to 40		2	1.5
19	Pyrus calleryana	Callery's Pear	Semi-mature	Exotic deciduous	14	6 x 5	Good	Fair to Poor	Mod.C	11 to 20	Suckering,	2	1.6
20	Pyrus calleryana	Callery's Pear	Semi-mature	Exotic deciduous	21	7 x 6	Good	Poor	Mod.C	11 to 20	Acute forks, Included bark, basal growth	2.5	2
21	Pyrus calleryana	Callery's Pear	Early-mature	Exotic deciduous	32	7 x 11	Fair	Fair to Poor	Mod.B	21 to 40	Co-dominant stems, Epicormic shoots, Hangers,	3.8	2.1
22	Ligustrum lucidum	Shining Privet	Semi-mature	Exotic evergreen	Multiple Stems	6 x 6	Fair	Poor	Very Low	1 to 5	, adjacent to the wall	2.4	1.8
23	Pyrus calleryana	Callery's Pear	Semi-mature	Exotic deciduous	8,8,5	4 x 4	Fair	Poor	Mod.C	6 to 10	Suckering,	2	1.5
24	Pyrus calleryana	Callery's Pear	Early-mature	Exotic deciduous	28	5 x 7	Good	Fair to Poor	Mod.C	11 to 20	Over-extended limbs, Suckering, assymetric, bias north	3.4	2.1
25	Robinia pseudoacacia 'Frisia'	Black locust	Maturing	Exotic deciduous	38	9 x 9	Fair	Fair to Poor	Mod.B	11 to 20	Acute forks, Deadwood, Exposed roots, Suckering, tree gaurd embeded, trunk wound with bored, play area	4.6	2.4
26	Robinia pseudoacacia 'Frisia'	Black locust	Maturing	Exotic deciduous	38	9 x 9	Fair	Fair to Poor	Mod.C	11 to 20	Vine infested, play area,	4.6	2.4
27	Lagerstroemia indica	Crape Myrtle	Early-mature	Exotic deciduous	Multiple Stems	5 x 5	Fair	Fair to Poor	Mod.C	11 to 20	, bias east	2	2
28	Lagerstroemia indica	Crape Myrtle	Early-mature	Exotic deciduous	12,6	4 x 5	Fair	Fair	Mod.C	11 to 20	Co-dominant stems, grafted branch	2	1.6
29	Lagerstroemia indica	Crape Myrtle	Early-mature	Exotic deciduous	12, 17	5 x 6	Fair	Fair	Mod.C	21 to 40		2.5	1.7
30	Lagerstroemia indica	Crape Myrtle	Semi-mature	Exotic deciduous	6,5	3 x 2	Fair	Poor	Low	11 to 20	, twisting branches	2	1.5
31	Lagerstroemia indica	Crape Myrtle	Early-mature	Exotic deciduous	19,16,9,9	6 x 7	Fair	Poor	Low	6 to 10	Active split, covered with wisteria	3	1.8
32	Ficus carica	Common Fig	Young	Exotic deciduous	Multiple Stems	5 x 4	Fair to Poor	Fair to Poor	Low	6 to 10	, conflic with building structure	2	1.7
33	Ficus carica	Common Fig	Semi-mature	Exotic deciduous	10,10,6	4 x 4	Fair	Fair to Poor	Low	11 to 20		2	1.7
34	Prunus sp.	Almond, Cherry, Peach, Plum	Semi-mature	Exotic deciduous	15,10,10	6 x 6	Fair to Poor	Fair to Poor	Low	11 to 20	Co-dominant stems,	2.5	1.8
35	Olea europaea	Olive	Semi-mature	Exotic evergreen	15	5 x 4	Fair to Poor	Fair to Poor	Low	11 to 20	, near building	2	1.7
36	Ficus carica	Common Fig	Semi-mature	Exotic deciduous	15	6 x 4	Fair	Fair to Poor	Mod.C	11 to 20		2	1.7
37	Fraxinus angustifolia	Narrow-leaved Ash	Early-mature	Exotic deciduous	34	9 x 7	Fair	Fair	Mod.B	6 to 10	Damage to infrastructure, Vine infested, underground services. damaged to path. limited growing space	4.1	2.3
38	Gleditsia triacanthos	Honey Locust	Maturing	Exotic deciduous	32	7 x 9	Fair	Fair to Poor	Mod.C	11 to 20	Crossing branches, Exposed roots,	3.8	2.2
39	Wisteria sp.	Wisteria	Maturing	Exotic deciduous	15	5 x 10	Fair to Poor	Fair to Poor	Mod.C	6 to 10	, wisteria chineses, limited growing area,	2	2.5
40	Alnus incana	Grey Alder	Maturing	Exotic deciduous	20	6 x 4	Fair to Poor	Fair to Poor	Mod.C	11 to 20	, limited growing space	2.4	1.8
41	Ulmus sp.	Elm Tree	Early-mature	Exotic deciduous	20	9 x 5	Fair	Fair to Poor	Mod.C	11 to 20	, close to building	2.4	2

Appendix 1: Tree group data

treeid	species	comm_name	age_class	origin_typ	stems_no	height_m	width_m	health	structure	arb_rating	ule_yrs	comments	tpz_rad_m	srz_rad_m
G1	Pittosporum tenuifolium	Kohuhu	Semi-mature	Exotic evergreen	3	5	2	Fair	Fair to Poor	Mod.C	21-40 y		2.4	1.8
G2	Callistemon viminalis	Weeping Bottlebrush	Semi-mature	Australian native	2	4	3	Fair	Fair to Poor	Mod.C	11-20 y		2	1.5
G3	Pittosporum tennuifolium	Kohuhu	Semi-mature	Exotic evergreen	4	2	1	Good	Fair	Mod.B	21-40 y		2	1.5
G4	Leptospermum petersonii	Lemon-scented Tea-tree	Early-mature	Australian native	4	5	4	Fair	Fair	Mod.C	11-20 y		2	1.6
G5	Leptospermum petersonii	Lemon-scented Tea-tree	Semi-mature	Australian native	2	3	2	Fair	Fair	Mod.C	11-20 y		2	1.7
G6	Wisteria sp.	Wisteria	Semi-mature	Exotic deciduous	3	6	6	Fair	Poor	Low	6-10 y	services, crack wall, water,	2	2
G7	Alnus incana	Grey Alder	Early-mature	Exotic deciduous	4	7	4	Fair	Fair	Mod.C	11-20 y	limited growing space.	2.4	1.8

Appendix 2 A: Mapping – trees in current site context

LEGEND

Tree
- Moderate
- Mod-A
- Mod-B
- Mod-C
- Low
- Very Low
- No data

Group
- Mod-A
- Mod-B
- Mod-C
- Low
- Very Low

AS4970
- SRZ
- TPZ

APPENDIX 2 A
TREE LOCATIONS AND PROTECTION ZONES

PROJECT
13 Grosvenor & 1A-F
Woodstock Streets, Balaclava

TL REF.
013174

MAP NO.
1 / 1

CLIENT
H2O Architects Pty Ltd

DATE
2024-01-18

DATA SOURCES
Supplied drawings
NearMap imagery

TREE LOCATION DISCLAIMER
Tree locations are approximate

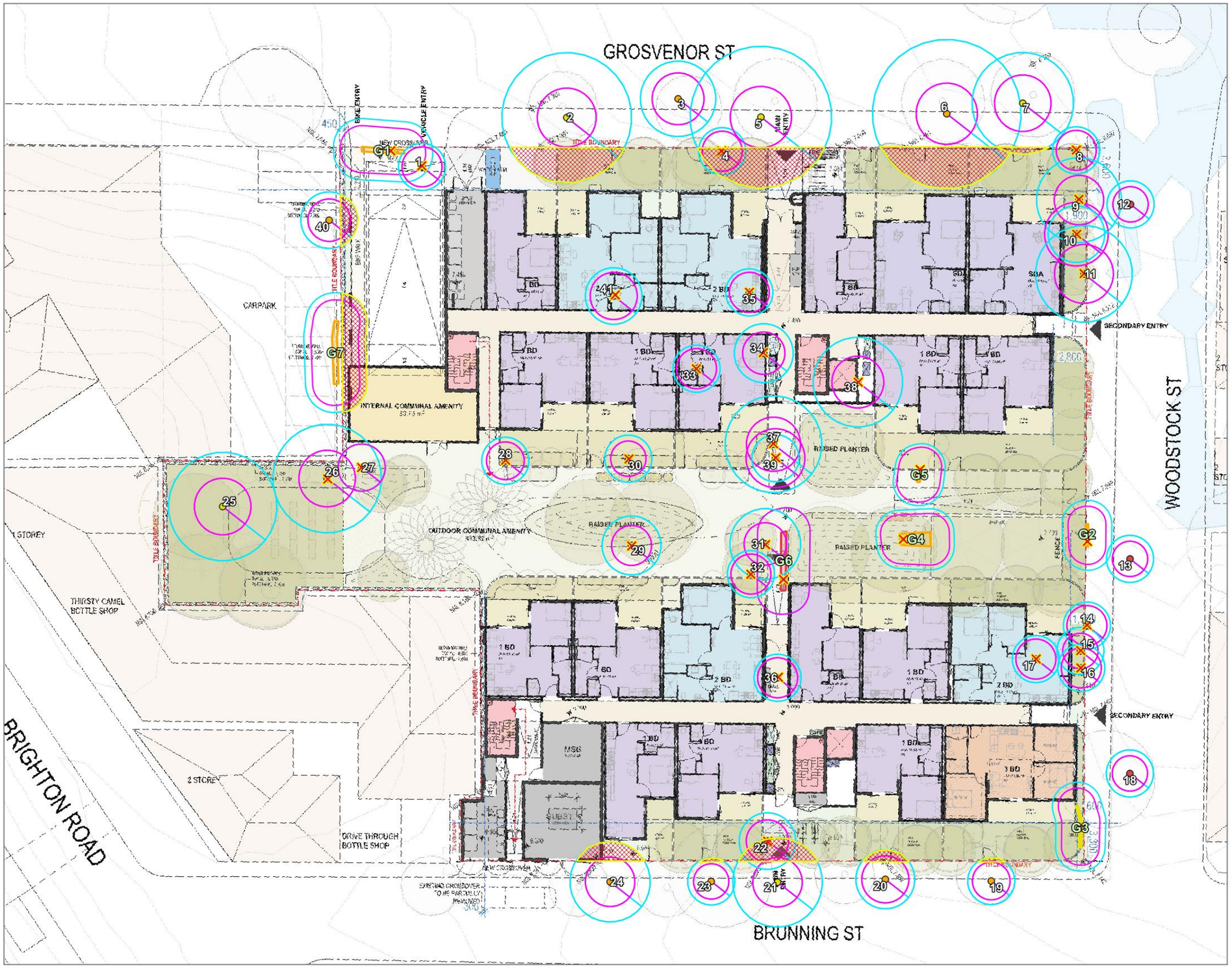
COORDINATE REFERENCE SYSTEM
GDA 2020 MGA Zone 55

0 4 8m

TREELOGIC PTY LTD
ABN: 95 080 021 610
TEL: 1300 656 926
4 / 21 Eugene Tce
Ringwood, VIC
Australia 3134

Treelogic
Plan, manage, protect

Appendix 2 B: Mapping – Trees with proposal



LEGEND

- Remove
- Impact

Tree

- Moderate
- Mod-A
- Mod-B
- Mod-C
- Low
- Very Low
- No data

Group

- Mod-A
- Mod-B
- Mod-C
- Low
- Very Low

AS4970

- SRZ
- TPZ

APPENDIX 2 B
TREES OVER PROPOSED GROUND FLOOR

PROJECT
13 Grosvenor & 1A-F
Woodstock Streets, Balaclava

TL REF.
013174

MAP NO.
1 / 1

CLIENT
H2O Architects Pty Ltd

DATE
2024-01-18

DATA SOURCES
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GDA 2020 MGA Zone 55

0 4 8m

TREELOGIC PTY LTD 4 / 21 Eugene Tce
ABN: 95 080 021 610 Ringwood, VIC
TEL: 1300 666 926 Australia 3134

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Appendix 3: Arboricultural Descriptors (January 2019)

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.

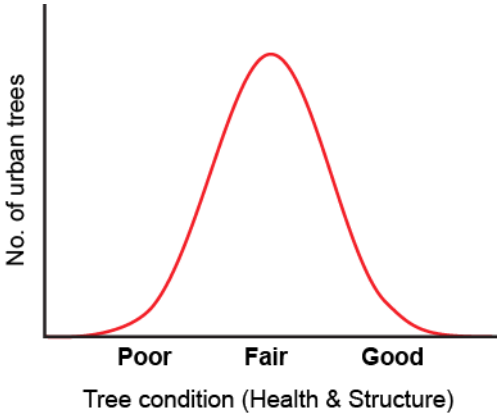


Diagram 1: Indicative normal distribution curve for tree condition

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 and 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 tree 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
Poor	Minimal - declining	Excessive, large and/or prominent amount & size of dead wood	Exhibiting severe deficiencies. Thinning foliage, generally smaller or deformed	Extreme and contributing to decline
Dead	N/A	N/A	N/A	N/A

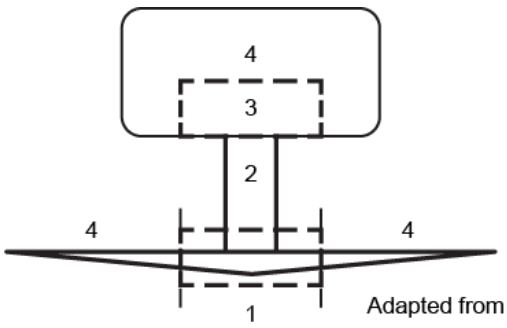
7. Structure

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 (ULE)	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 assigned tree condition factors, including health and structure (arboricultural merit) and ULE, and conveys an amenity value (An amenity tree can occupy a site that complements its surroundings in a useful manner which culminates in the aid, protection, comfort and emotional response of humans. Adapted from Coder, 2004). 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 considered.

The arboricultural rating can be used by applying only the main category high, moderate, low or very low without using the sub categories. The sub-categories can assist in differentiating a trees value and/or characteristic in more detail within the specific tree assessment context, such as a development site.

<table>
<tr><th>Category</th><th colspan="3">Description</th></tr>
<tr><td>High</td><td colspan="3">Exemplary specimen due to multiple factors which could include; good condition and vitality, large size/canopy and prominence in the landscape. Likely to be a very long-term component in the landscape with a long ULE.
Other factors that could contribute to a high rating:
• Particularly good example of the species; rare or uncommon.
• Tree has visual importance as a landscape feature; provides substantial contribution to landscape character.
• Tree may have significant ecological or conservation value.
• *Tree has historical, commemorative or other distinct social/cultural significance.
Trees in this category must be considered for retention and/or incorporated within design proposals.</td></tr>
<tr><th>Category</th><th>Description</th><th>Sub cat.</th><th>Description</th></tr>
<tr><td rowspan="3">Moderate</td><td rowspan="3">Tree of moderate quality, in fair or typical condition. Tree may have a condition, and or structural problem that will respond to arboricultural treatment.
These trees have the potential to be moderate- to long-term components of the landscape (moderate to long ULE) if managed appropriately.
The sub-categories relate predominately to age, size and amenity.
Trees in this category should be considered for retention and/or incorporated within design proposals.</td><td>A</td><td>Moderate to large, maturing tree. Suited to the site & contributes to the landscape character.
Tree may have conservation or other cultural/social value.</td></tr>
<tr><td>B</td><td>Moderate sized, established tree, > 50% of attainable age/size. Suited to the site & contributes to the landscape character (other attributes covered under ‘Moderate’ description)</td></tr>
<tr><td>C</td><td>• Young to semi-mature, generally a smaller tree, established, >15 cm DBH, >5 years in the location. Not a dominant canopy. No significant qualities currently but has the potential to become a higher value tree & long-term component of the landscape. Replacement of tree is likely to take up to 6 - 10 years to attain similar attributes.
• Semi- to mature tree with accumulating deficiencies and reducing ULE, trending towards Low arboricultural value.</td></tr>
<tr><td>Low</td><td colspan="3">Unremarkable tree of low quality or little amenity value. Tree in either poor health and/or with poor structure. Short to transitory useful life expectancy (<10 years).
• Tree is not prominent in the landscape due to 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 or capable of being transplanted.
• Tree (species) is functionally inappropriate to the specific location. Is causing excessive damage/nuisance to adjacent infrastructure or would be expected to be problematic if retained (i.e. palm tree under power lines).
• Unremarkable tree of no material landscape, conservation or other cultural value. Not visible from surrounding landscapes.
• Tree infected with pathogens that could lead to its decline.</td></tr>
</table>

Category	Description
	• Tree has potential to be an environmental woody weed (may be dependent on location of tree in an urban landscape). • Tree impacting or suppressing trees of better quality. Retention of such trees may be considered if not requiring a disproportionate expenditure of resources for a tree in its condition and location.
Very low	Trees of low quality with a brief to no remaining ULE (<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 or tree part would be expected in the short term. • Tree whose retention would not be viable after the removal of adjacent trees, such as trees that have developed in close spaced Tree Groups and would not be expected to adapt to severe and sudden alterations to environmental & site conditions, e.g. removal of adjacent shelter trees. • Small or young tree, <5m in height, <10cm DBH. Easily replaced in short-term or capable of being transplanted. • Acknowledged environmental woody weed species. Tree has a detrimental effect on the environment, for example, the tree has weed potential and is likely to spread into waterways or natural areas if nearby. • Tree infected with pathogens that will lead to decline and has potential to spread to adjacent trees. • Tree is dead (dead tree may offer habitat values) or is showing signs of significant, immediate, and irreversible overall decline. Tree cannot realistically be retained and should be considered for removal.

Other considerations - Even though a tree may be declining or dead, a tree could be retained for other purposes such as habitat or soil stabilisation. These trees would still need to be managed appropriately to reduce risk.

*A tree may have (attract) a high value by the community for historical, commemorative or other distinct social/cultural significance factors, albeit the tree may not be in good condition. In the context of an assessment, for multiple reasons, but more so for development, if it is a noted 'significant' tree it should receive higher consideration during the planning process.

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Appendix 4: Tree protection zones (2015)

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.

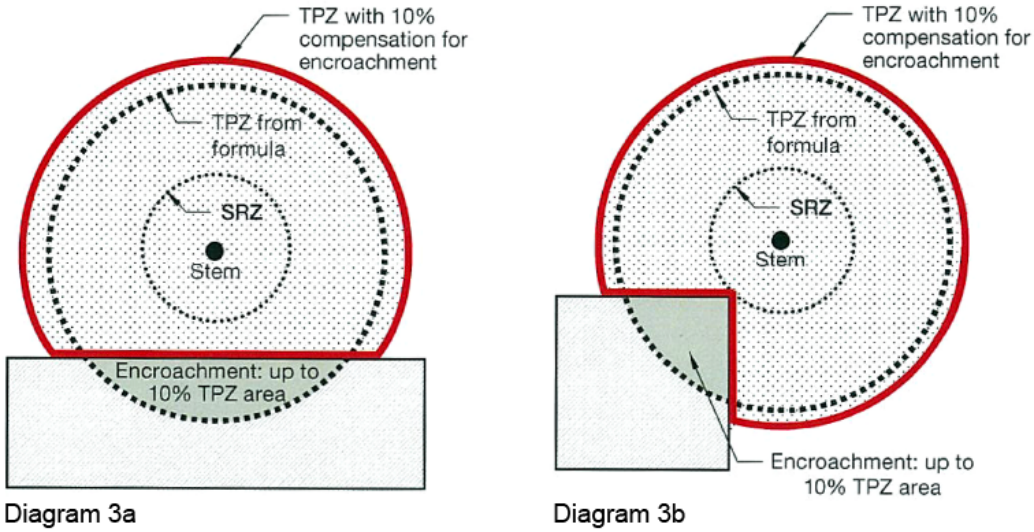


Diagram 3: Examples of Minor encroachment into TPZ, (Extract from : AS4970-2009, Appendix D, P30 of 32)

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.

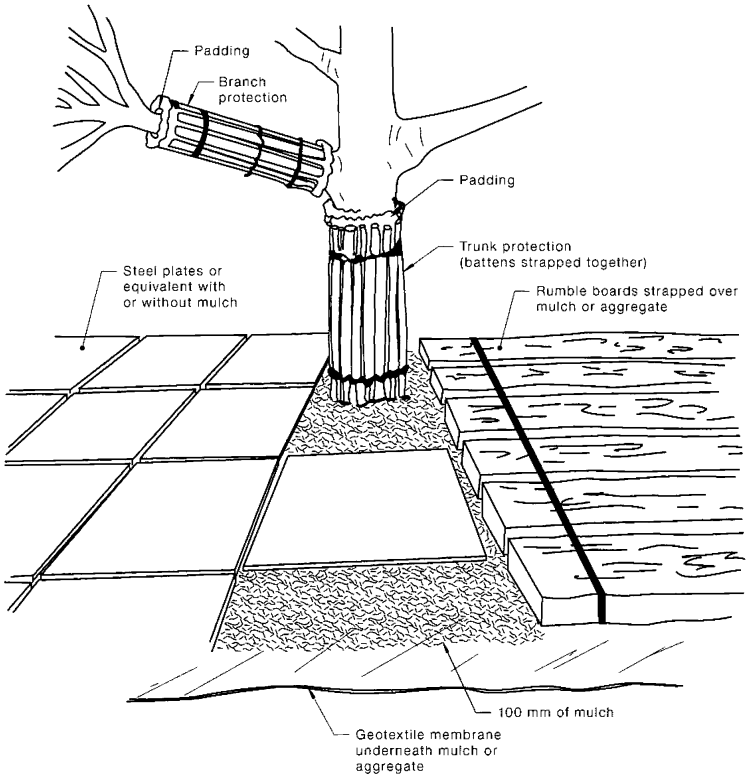
No root or soil disturbance is permitted within the SRZ.
In the area outside the SRZ the tree may tolerate the loss of one or a number of roots. The table below indicates the size of tree roots, outside the SRZ that would be deemed substantial for various tree heights. The assessment of combined root 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.



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.

***Diagram 4**: Examples of ground buffering and trunk and limb protection.*

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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Appendix 5:

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