ARBORICULTURAL INSPECTION REPORT

BALACLAVA RETAIL RENEWAL AREA

NOVEMBER 2018

Prepared by Stephen Fitzgerald
for:
City of Port Phillip

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Arboricultural Inspection Report
Balaclava Retail Renewal Area
(39-47 Camden Street , Balaclava)

Brief

Arboriculture Pty Ltd has been retained by the City of Port Phillip to inspect nominated trees within part of an area known as the Balaclava Retail Renewal Area (as indicated on drawings supplied).

The report is to detail an the findings of a tree inspection including tree species, condition, tree retention value and tree protection zones (TPZs).

Method

Trees within the project area were visually inspected[1] from ground level, their heights estimated and trunk diameters (DBH[2]) measured. No decay detection or intrusive investigation methods were carried out on the trees or their root systems.

Trees were plotted using a GNSS device[3] and feature survey plan provided by the City of Port Phillip. Where tree locations existed on the feature survey those tree positions were used. Where tree locations were not indicated on the feature survey the GNSS device was used to plot their approximate position.

Arboricultural maintenance requirements recommendations were made where appropriate to minimise risk and prolong the aesthetic and landscape life expectancy of the trees. Maintenance recommendations are prioritised as *low, medium, high* or *urgent* with perceived risk being the main determining factor. See Appendix 4 Definitions & Methods – Priority (action) for suggested minimum time schedules for each priority.

Photos were taken with an Olympus digital camera (see Appendix 1).

The tree inspection was carried out on 26/11/2018.

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[1]Visual inspection in the case of tree assessment implies certain limitations. See Appendix 4 *Definitions and Methods* for further explanation.

[2] Diameter at breast height – 1.4m above ground level

[3] Tree locations were plotted using a differential global navigation satellite system (DGNSS) device employing real-time corrections from VicPos GPSnet Continuously Operating Reference Stations service (http://gnss.vicpos.com.au/) with an expected sub-metre accuracy

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The Arborist's Role in the Development Site Planning Process

This report follows the requirements for a *preliminary arboricultural report* as indicated in the Australian Standard AS 4970-2009, *Protection of Trees on Development Sites*, Section 2: *Planning and the Tree Management Process*.

In preparation for this report, a *preliminary tree assessment* was carried out.

The purpose of the preliminary tree assessment is to provide quantitative and qualitative information on the trees. All trees included in the site survey are numbered and assessed as the basis for deciding which trees are suitable for retention.

The preliminary report is not intended to be a comprehensive tree protection report. The information in the preliminary report is to be used by planners, architects, designers and consultant arborists, in conjunction with any planning controls and other legislation, to develop the design layout in such a way that trees selected for retention are provided with enough space to remain viable.

The report is part of the *development design and review* process as outlined in AS 4970. The preliminary arboricultural report should guide the development layout. During the design and documentation stages, the project arborist should be involved in ongoing review of architectural, engineering (e.g. bulk earth works and construction drawings), services and landscape drawings. The purpose of this is to determine the potential impact on trees proposed to be retained.

Summary Tree Details

Fourteen (14) trees were located and inspected within the project area.

All the trees are species common in cultivation in South Eastern Australia.

Five (5) of the trees were considered *low* retention value due to defects or being weedy species. Eight (8) were considered *medium* retention value trees. These are trees that are not individually significant specimens in the landscape and may have defects or infrastructure interference issues. One (1) tree was considered *high* retention value by virtue of its size and apparent age (tree 14, a large mature Melaleuca).

Site and Tree Description

The trees are all within an a car park area or street trees within Carlisle Street (tree 1) or Camden Street (trees 2 to 6). Many of the trees are planted within small spaces that will limit their useful landscape life expectancy as well as cause damage to infrastructure such as kerb and paths.

Discussion & Conclusion

The amenity of *medium* and *low* retention value trees could easily be replaced by appropriate specimens given space within or nearby and proposed development.

The large Melaleuca (tree 14) would be worth retaining if space can be allowed for in designs for the area. The tree however is fairly central to the car park and its retention may preclude reasonable development of the space.

Note has been made regarding infrastructure interference developing from the structural roots (e.g. tree 1) of trees or trunk growth (e.g. tree 11).

General advice is given below for consideration when designing near trees that are to be retained.

Tree Protection - General

The depth at which tree roots occur in most urban soils has been traditionally misrepresented. It is now known that trees in urban areas tend to have generally extensive but shallow root systems. Because of common misconceptions trees often suffer root injury during construction of buildings and landscapes as well as from trenches dug for services, irrigation systems and the like. Tree decline often occurs over a number of years. Three to five years seems to be a common time period following significant root disturbances, unless massive root damage is suffered or tree is particularly sensitive, when sudden decline often occurs. Once symptoms of decline are noticed it is usually too late to prevent decline and eventual tree death.

To minimise impacts from root damage and other construction activities the Australian Standard AS 4970 – 2009, *Protection of trees on development sites,* specifies a tree protection zone (TPZ) based on a tree's trunk diameter. The TPZ is:

> "*A specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development*." (AS 4970 paragraph 1.4.7).

For all trees apart from tree ferns, palms and other monocotyledon trees, the TPZ is calculated as an area with a radius (measured from the tree trunk centre) equivalent to 12 times the tree's DBH (diameter at breast height or 1.4m above ground) with a minimum of 2m and a maximum of 15m.

Similar to the TPZ, an area known as the structural root zone (SRZ) is where roots important to a tree's structural stability theoretically exist. The SRZ is:

> "*The area around the base of a tree required for the tree's stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The SRZ is nominally circular with the trunk at its centre and is expressed by its radius in metres. This zone considers a tree's structural stability only, not the root zone required for a tree's vigour and long-term viability, which will usually be a much larger area* (AS 4970 paragraph 1.4.5).

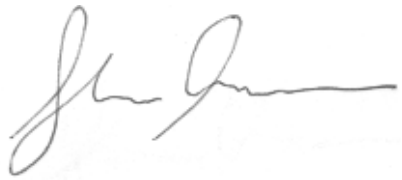
Construction damage often occurs when excavation occurs within the top 1m of soil and can cause significant injury to a tree, depending on tree species, soil type and distance from the tree, with excavation as shallow as 10-20cm. Significant impacts to long-term tree health also occur when soil compaction (usually from heavy machinery or vehicles), fill or sealed surfaces prevent free air and moisture movement between the soil and atmosphere.

Both the TPZ and SRZ areas are hypothetical and trees roots may exist within them to a greater or lesser extent depending on a number of factors including soil and moisture conditions, past disturbances and the existence of obstacles

below and above the soil including sealed surfaces. Where there is any question regarding the actual existence of tree roots, exploration trenches can be excavated using special low-impact techniques. High velocity air tools such as an 'Air Spade' – a tool that expels a stream of high pressure air that is able to loosen and shift soil without significant damage to roots can be used to uncover and 'map' the size and location of tree roots.

The Australian Standard (AS4970-2009, *Protection of trees on development sites*) allows for disturbance of the TPZ up to 10% of the calculated area provided the disturbance is outside the SRZ (structural root zone) and provided the lost area is compensated for elsewhere contiguous with the TPZ. Where more than 10% of the TPZ is proposed to be disturbed the encroachment is considered to be major and it must be demonstrated by the arborist that the tree(s) would remain viable.

Should any matters in this report require clarification please contact me,



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Appendix 1 Photos

Balaclava Retail Renewal Area

Photo 1 from south-east: Tree 1 bifurcation defect of stem

Photo 2 from south: Tree 1

Photo 3 from south: Tree 1 upheaval of hard surfaces around tree

Photo 4 from east: Tree 2

Photo 5 from north-east: Tree 2 narrow planting space

Photo 6 from north-east: Tree 2 vehicle impact damage to stem

Photo 7 from south: Tree 3

Photo 8 from south: Tree 4

Photo 9 from north: Tree 4 broken stems

Photo 10 from south: Tree 5

Photo 11 from south: Tree 6

Photo 12 from north: Tree 6 stem has filled out planting space

Photo 13 from south: Tree 7

Photo 14 from south: Tree 8

Photo 15 from southeast: Tree 9

Photo 16 from southeast: Tree 9 kerb has moved due to structural root growth

Photo 17 from east: Tree 10

Photo 18 from north-east: Tree 11

Photo 19 from north: Tree 11 stem has filled out planting space

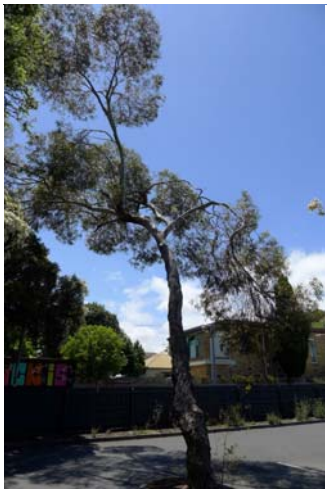

Photo 20 from south-west: Tree 12

Photo 21 from west: Tree 13

Photo 22 from north: Tree 14

Photo 23 from north: Tree 14

Appendix 2 - Tree Inspection Records - Balaclava Retail Renewal Area

Tree #	SPECIES / COMMON NAME	AGE	DBH [1]	HEIGHT x Width	HEALTH	STRUCTURE	DEFECTS [2]	WORKS / ACTIONS	PRIORITY [3]	TPZ [4]	RETENTION VALUE	ORIGIN	COMMENTS
1	***Robinia pseudoacacia*** Locust	Mature	36cm	7m x 6m	Good	Poor	Bifurcation defect of stem	Landscape treatment of planting area to reduce trip hazard	Medium	4.32m	Low	Exotic (weedy)	Structural roots heaving pavement and causing a moderate to high risk trip hazard See Appendix 1 Photos 1, 2 & 3
2	***Melaleuca armillaris*** Bracelet Honey-myrtle	Mature	35cm	9m x 9m	Good	Poor	Bifurcation defects of stem, Vehicle impact wounds @ 2m roadside	Weight reduce canopy	Low	4.2m	Medium	Vic Native	2.2m wide footpath - 1.1 passable-slight tripping hazard. Poor species selection for narrow planting space. Stems naturally recline into vehicle or pedestrian space causing a hazard and requiring constant maintenance See Appendix 1 Photos 4, 5 & 6 (Multi-DBH (cm): 29 19)
3	***Robinia pseudoacacia*** Locust	Semimature	7cm	3m x 3m	Good	Poor	Bifurcation defects of stem	Clearance prune - pedestrians	Low	2m	Medium	Exotic (weedy)	Poor stock, suckering at base See Appendix 1 Photo 7 (Multi-DBH (cm): 6,3)
4	***Callistemon salignus*** Willow Bottlebrush	Mature	19cm	4m x 3m	Fair	Poor	Broken stems/branches (possible vehicle impact or vandalism)	No works required	N/A	2.28m	Low	Aus Native	See Appendix 1 Photos 8 & 9
5	***Robinia pseudoacacia*** Locust	Young	4cm	3m x 1m	Good	Poor	Broken branches	Formative prune	Low	2m	Low	Exotic (weedy)	Poor stock. Thorns on stems - possibly rootstock has overgrown scion. Thorns become a hazard for pedestrians in future See Appendix 1 Photo 10
6	***Melaleuca linariifolia*** Snow-in-Summer	Mature	43cm	7m x 7m	Fair	Fair	Minor or none noticed	No works required	N/A	5.16m	Medium	Aus Native	Base of tree beginning to crack kerb. Stem has filled out planting space and will damage kerb in future See Appendix 1 Photos 11 & 12
7	***Acer pseudoplatanus*** Sycamore	Semimature	7cm	5m x 3m	Good	Good	Wounds in lower stem (stem failure wound)	No works required	N/A	2m	Low	Exotic (weedy)	Weedy species possibly self-sown See Appendix 1 Photo 13
8	***Acer pseudoplatanus*** Sycamore	Semimature	5cm	3m x 2m	Good	Good	Minor or none noticed	No works required	N/A	2m	Low	Exotic (weedy)	Weedy species possibly self-sown See Appendix 1 Photo 14
9	***Melaleuca linariifolia*** Snow-in-Summer	Mature	43cm	9m x 8m	Good	Poor	Bifurcation of stem	Prune for clearance to street light	Medium	5.16m	Medium	Aus Native	Approx. 1m wide planting strip, infrastructure damage occurring. See Appendix 1 Photos 15 & 16
10	***Melaleuca linariifolia*** Snow-in-Summer	Mature	66cm	9m x 9m	Good	Poor	Bifurcation defects of stem	No works required	N/A	7.92m	Medium	Aus Native	Approx. 0.7m wide planting strip, infrastructure damage occurring See Appendix 1 Photo 17
11	***Melaleuca styphelioides*** Prickly-leaved Paperbark	Mature	36cm	8m x 6m	Fair	Fair	Bifurcation defects of stem	Weight reduce stems with bifurcations	Medium	4.32m	Medium	Aus Native	Approx. 0.7m wide planting strip, infrastructure damage occurring. Stem has filled out planting space. See Appendix 1 Photos 18 & 19 (Multi-DBH (cm): 12,15,17,21,15)

1 DBH measured as per method outlined in AS4970. Where more than 1 stem is measured an equivalent single stem DBH is calculated based on the area of each stem as per AS4970. Where there is more than 1 stem the individual measurements are given in Comments field

2 Defects: Only defects deemed significant to the survival or safety of the tree are listed

3 Recommended Action Priority Schedules: Urgent - as soon as possible; High - within 6 months; Medium - within 12 months; Low - within 24 months

4 TPZ (tree protection zone) calculated according to Australian Standard 4970-2009. TPZ measurement is radius from centre of main stem(s). TPZs have been reduced for dead trees as only stability would be required if retained.

Tree #	SPECIES / COMMON NAME	AGE	DBH [1]	HEIGHT x Width	HEALTH	STRUCTURE	DEFECTS [2]	WORKS / ACTIONS	PRIORITY [3]	TPZ [4]	RETENTION VALUE	ORIGIN	COMMENTS
12	***Eucalyptus leucoxylon subsp. megalocarpa*** Large-fruited South Australian Blue Gum	Mature	44cm	10-14m x 7m	Fair	Poor	History of branch failure, general poor form causing tree to be prone to branch failure, crossing branches	No works required	N/A	5.28m	Medium	Aus Native	infrastructure damage occurring See Appendix 1 Photo 20
13	***Melaleuca linariifolia*** Snow-in-Summer	Mature	29cm	4m x 4m	Fair	Poor	Bifurcations of stem	No works required	N/A	3.48m	Medium	Aus Native	Multi-stemmed form not ideal for confined position See Appendix 1 Photo 21 (Multi-DBH (cm): 11,19,13,13)
14	***Melaleuca linariifolia*** Snow-in-Summer	Mature	65cm	10-14m x 13m	Good	Poor	Bifurcation defects of stem	Weight reduce stems with bifurcations	Medium	7.8m	High	Aus Native	Approx. 1m wide planting strip, infrastructure damage occurring. Stem has filled out planting space and will continue damaging kerb in future. Largest and most likely oldest tree in the car park. See Appendix 1 Photos 22 & 23

1 DBH measured as per method outlined in AS4970. Where more than 1 stem is measured an equivalent single stem DBH is calculated based on the area of each stem as per AS4970. Where there is more than 1 stem the individual measurements are given in Comments field

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Appendix 3 - Tree Location / TPZ Plan

Balaclava Retail Renewal Area Tree Survey 2018

39-47 Camden Street , Balaclava (incl. street trees nearby)

Notes:
- Drawn tree canopies are representative of size only, not shape or location
- Trees located using feature survey supplied and GNSS device where trees are not plotted on feature survey
- TPZ radii measurements are given in Appendix 2 Tree Inspection Records

Legend

Retention Value/Canopy
- High
- Medium
- Low

Tree Protection Zone to AS4970

N

1:300 @ A3

0 — 10 m

Arboriculture Pty Ltd November 2018

Appendix 4 Definitions and Methods

<table>
<tr><td>Tree Number</td><td>A number referencing a tree location record to the tree location plans.</td></tr>
<tr><td>Species</td><td>Botanical Name (field identified)</td></tr>
<tr><td>Common Name</td><td>Common name for species (Horticultural Flora of South-Eastern Australia (R. Spencer, volumes 1-5, 1995-2005) are referenced wherever possible)</td></tr>
<tr><td>Age (class)</td><td>This field describes the stage of maturity of the tree or dominant specimens in a tree group as indicated by its form.

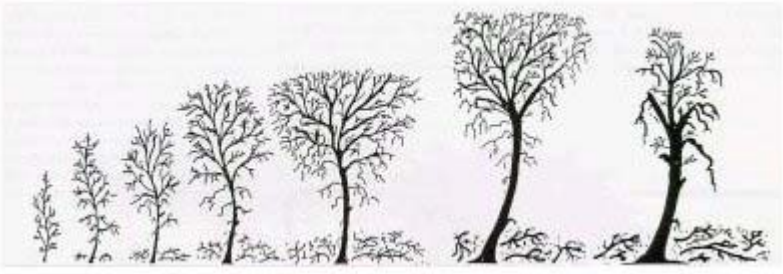
Young — Seedling or sapling stage

Semi-mature — Approaching its expected form and size

Mature — Expected ultimate form and size of tree before decline

Over-mature — Mature tree exhibiting signs of age related structural decline

Occasionally stunted or atypical specimens were found that, despite being old in years, appeared semi-mature.

 
<table><tr><td>Young</td><td>Semi-mature</td><td>Mature</td><td>Over-mature</td></tr></table></td></tr>
<tr><td>Health</td><td>Health of a tree as determined by factors such as leaf colour and size, shoot growth extension and percentage of living canopy:

Dead — < 10% of canopy living (shoots & stems dead)

Poor — Determined by any single or combination of factors above. Tree health is declining or has declined usually due to pest, disease, senescence, unsuitable site conditions or physiological damage such as root severance or root death due to soil cut, fill or compaction.

Fair — Tree is in ‘normal’ health. Some pests, diseases, deadwood, minor crown dieback may be present but not considered to be severely affecting the tree’s health.

Good — Tree is largely unaffected by pests, diseases and has no significant deadwood or crown dieback.</td></tr>
<tr><td>Landscape Life Expectancy</td><td>Landscape life expectancy is the estimated number of years (or range) a tree could be expected to live in a reasonably healthy and safe condition given moderate weather conditions and reasonable maintenance.</td></tr>
</table>

Structure	Determined by both the existence of defects in the tree's structure. Hazard — Tree structures that are highly likely to fail in the near future causing a hazard threat to people or property in its vicinity. Poor — Trees with structural defects such as bifurcated trunks, significant wounds or cavities, noticeable girdling roots. Poor tree structures are common and not necessarily a cause for concern. Remedy with pruning or cable bracing may be an option. Fair — Indicates trees with some minor structural defects. Good — Trees with few if any significant form or structural defects
DBH	Trunk diameter measured at breast height (1.4m above ground). If the trunk divides into branches or stems at or below 1.4 metres then an equivalent single stem diameter is calculated from the DBH measurements of the individual stems using the formula: $Total\ DBH = \sqrt{(DBH_1)^2 + (DBH_2)^2 + (DBH_3)^2}$ If a buttress or deformity exists at 1.4m then the DBH is measured immediately above this point. See Australian Standard AS 4970, *Protection of Trees on Development Sites*, Appendix A for details of procedure used. DBH measurement is useful for categorising the size of trees for analysis and is also used in calculations: e.g. calculating the nominal TPZ.
DAB	Diameter above buttress. The trunk diameter measured immediately above the root buttress. The DAB is used to calculate the SRZ.
Trunks	Where the trunk divides into branches or stems at ground level it is considered to have more than one trunk or stem. This number is recorded here
Actions	List of recommended works. Works are specified as required to mitigate hazard or improve the landscape life expectancy of the tree. Where possible, terms specified in Australian Standard AS 4373-2007 *Pruning of Amenity Trees* are used.
Priority (action)	**Action Priorities** are categorised as *Low, Medium, High* or *Urgent*. ***Low*** work priorities are those that are not concerned with conditions that affect the immediate health and safety of trees (or people and property) and/or trees that are not considered valuable enough to warrant immediate attention. These works are mostly removal of small branches lodged in the tree crown or removal of branch stubs. It is recommended that these works be carried out optionally and when convenient over the next **24 months**. Tree work priorities may be increased to Medium on subsequent inspections if required. ***Medium*** work priorities are specified if the work will improve the tree's health, safety and/or aesthetics or the safety of the area (people or property) if carried out in the short term. These works are often specified for trees with larger broken lodged branches and occupying a high profile position or frequently used area within the landscape. Tree removals in this category are those that do not pose high-risk danger to persons or property. It is recommended that these works be carried out within the next **6 to 12 months**. ***High*** work priorities are specified where a tree condition poses a potential safety hazard to people or property or the tree and works are

	considered significant enough to warrant immediate attention. Trees requiring high priority work will include those with large broken lodged branches, flawed or damaged structures (crown, trunk or roots) that are likely to lead to failure causing property damage, injury or death. Works in this classification should be carried out within **3 months** or sooner if budgets and convenience allow. ***Urgent*** work priorities are usually specified where a tree condition causes an imminent safety hazard to people or property. Works in this classification should be carried out **as soon as possible**.
Retention Value	All trees surveyed were assigned a 'retention value'. Retention value can aid in decision making regarding cost vs. benefit as well as prioritisation of resources and planning. Factors contributing to retention value include: • tree origin; • age; • significance; • habitat value (hollows being used by fauna, etc); • species suitability to the urban residential/naturalistic parkland situation, and • condition (health and structure). Self-sown, remnant indigenous and planted indigenous trees of known local seed source were generally rated higher than trees from non-indigenous or unknown seed sources. Trees considered as being in a potentially dangerous condition rated lowest regardless of their significance or origins. Other tree species that rated low were weedy species, tree species regarded as being inappropriate to the urban residential situation and specimens with low life expectancy. **No Retention Value** trees are those that would usually be best removed if landscape renovation or development were to take place in their vicinity. Trees should be removed if recommended specifically or if they are dead or have poor structure/health. **Low Retention** trees should have low priority compared to development considerations. Trees considered to have low retention value should be eventually removed or replaced whether or not development goes ahead. **Medium Retention** trees could be retained if desired but could be removed to allow for development at the discretion of the developer or planner. They are trees that are considered to be appropriate to their planting situation but not necessarily of high cultural, historical or landscape value. They range from young specimens with fair to good health with no significant structural defects, to mature trees in fair to good health with defects that may be managed by arboricultural or landscape planning techniques. Trees may contribute to the immediate landscape but would not contribute greatly to the wider landscape. **High Retention** trees are those assessed as being of significant environmental, cultural or other significance and in suitable condition to be safely retained (remedial arboricultural works or landscape planning may be required for their retention). These trees should be preserved wherever possible and may justify some alterations of design. **Very High Retention** trees are similar to High Retention trees but are considered to be remnant indigenous specimens or trees with other significance that may be of or eligible for State or National recognition.

	These trees should be preserved wherever possible and would usually justify alterations of development design to allow for their preservation.
Risk	Evaluation of risk using recognised published method. In this case the Bartlett Method' (Smiley, E. T., Fraedrich, B. R., Hendrickson, N. (2002) Tree Risk Management, Charlotte NC, Bartlett Tree Research Laboratories) Each tree receives a score out of 15 as the result of multiple site and tree factors assessed. **Risk Rating Method** The method is basic and capable of being used in large scale tree data capture situations. The arborist makes an estimate of tree failure potential and the consequences of failure including the frequency of occupation of a site based on their experience. Limitations are that the method is not based on quantitative data and is very simple – as such it should be used as a guide only. Total Risk Score is derived by the addition of 2 criteria: **Failure Potential/Defect Severity (F)** — **Score** Critical Risk – Failure imminent — 10 High Risk – Failure likely especially in storms — 7 Moderate Risk – Failure possible especially in severe storms — 4 Low Risk – Failure unlikely — 1 **Consequence of Failure (C)** Considers potential for injury/loss should a failure occur based on such factors as size of defective part, target value and frequency of use Severe Consequence — 5 Moderate Consequence — 3 Low Consequence — 1 **Total Risk Rating (= F + C)** 13-15 Critical Risk: Failure imminent; Personal Injury and/or property damage inevitable (lower end of scale indicates lower potential for injury) 10-12 High Risk: Failure likely especially during storms; Personal injury and/or property damage likely (lower end of scale indicates lower potential for injury/property damage) 7-9 Moderate Risk: Failure unlikely, and/or high risk of failure but low risk of property damage/personal injury <7 Low Risk: Failure unlikely and low risk of property damage
SRZ	The structural root zone (SRZ) is the area around the base of a tree required for its stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The SRZ is nominally circular with the trunk at its centre and is expressed by its radius in metres. This zone considers a tree's structural stability only, not the root zone required for a tree's vigour and long-term viability, which will usually be a much larger area (AS 4970, *Protection of trees on development sites*). An indicative SRZ radius can be determined from the trunk diameter measured immediately above the root buttress (DAB or diameter above buttress) according to AS 4970, *Protection of trees on development sites*.

TPZ	The tree protection zone (TPZ) is a specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development (AS 4970, *Protection of trees on development sites*). The nominal TPZ is calculated from the DBH according to AS 4970, *Protection of trees on development sites*.
Comments	General comments regarding individual trees or conditions.

Visual Inspection

Visual tree inspection is part of a process of assessing trees for conditions that may affect safety. An inspection is made of a tree for signs or symptoms of defects. Only when indications of defects are found which are considered serious enough, is further investigation recommended or undertaken. Further investigation may be a closer visual examination (such as accessing the tree canopy via climbing techniques or by way of an Elevated Platform Vehicle) or a rigorous, detailed technical examination using mechanical or electronic instruments (eg. sound or stress-wave timer device or devices that measure the force needed to drill test holes into the tree).

Visual Tree Assessment (VTA) is a method described by biomechanical engineer Dr Claus Mattheck in his book *The Body Language of Trees* (Mattheck & Breloer 1994). It involves visual inspection of the tree and provides guidelines for identifying symptoms of stress in trees caused by defects. It is based on the *Axiom of uniform stress* in which trees grow in such a way that all stresses on their surfaces are distributed evenly (Mattheck & Breloer 1994). Where this state is disturbed the tree repairs its structure by forming locally thicker annual rings. These reparative structures are recognised as symptoms of internal defects in the tree.

References

Mattheck, C., and Breloer, H. 1994, *The Body Language of Trees: A Handbook for Failure Analysis.*, HMSO Publications. London