

Arboricultural Assessment and Report

87-103 Manningham Street, Parkville

14 August 2017
Tree Logic Ref. 008301

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Executive Summary

The subject site comprised an area of 1.1 hectares and was located directly across from Royal Park on the western side of Manningham Street. The site contained two storey dwellings and several multi-unit developments, with a tennis court and swimming pool located in the middle of the site. To the north was the eight storey Evo apartment complex and to the west was City Link Freeway.

Thirty-seven percent of the tree population (22 trees) were attributed an arboricultural rating of Moderate. Retaining Moderate rated trees is desirable from an arboricultural perspective. With appropriate consideration and management such trees have the potential to be medium- to long-term components of the landscape.

Collectively, thirty-seven (37) trees or sixty-three percent of the population were rated Low or None and comprised predominantly specimens of a small size, identified environmental woody species, or were dead/dying. These Low and None rated trees should not constrain a proposed development of the site.

Of the assessed trees, there were several specimens of a higher arboricultural significance which may warrant protection during any proposed site redevelopment. These trees were outliers in the population given the lower overall quality of trees within the site.

1 Objectives

- 1.1 Tree Logic was engaged by the Department of Treasury and Finance to undertake an arboricultural assessment and prepare a report to ascertain the current status, condition and arboricultural value of the trees located within and adjacent to the subject site, 87-103 Manningham Street, Parkville. The requirements of the arboricultural report include;
- To undertake a site inspection and assess trees within the study area including street trees, identifying species, collecting information on tree dimensions, condition, growing environment and useful life expectancy.
 - Establish the arboricultural merit and retention value of the assessed trees.
 - Determine the Tree Protection Zones (TPZ) for trees compliant with AS4970 'Protection of trees on development sites' and trees subject to permit requirement.
 - To provide appropriate tree management recommendations.

2 Method

- 2.1 A site inspection was carried out on Thursday 10 August, 2017. The trees were inspected from the ground and observations were made of the growing environment and surrounding area. The trees were not climbed and no samples of the tree or soil were taken.
- 2.2 Observations were made of the assessed trees to determine the species, age category, and condition with measurements taken to establish tree crown height (measured with a height meter) and crown width (paced) and trunk dimensions (measured 1.4 metres above ground level with a diameter tape unless otherwise stated). Descriptors used in the assessment can be seen in Appendix 3.
- 2.3 Assessment details of individual trees are listed in Appendix 1 and a copy of the tree location plan can be seen in Appendix 2.
- 2.4 Some photographs of the trees and the environs were taken for further reference and inclusion in the report.
- 2.5 Only trees were assessed and data collected. A tree is generally a plant with a height greater than 5 metres on a single trunk with a single trunk (stem) diameter (DBH) being greater than 150 mm at a height of 1.4 metres above ground level.
- 2.6 Each of the assessed trees was attributed an 'Arboricultural Rating'. The arboricultural rating correlates the combination of tree condition factors (health and structure) with tree amenity value. It should be noted that the arboricultural rating is different to the conservation/ecological values placed on trees by other professions. Definitions of arboricultural ratings can be seen in Appendix 3.

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

Documents viewed;

- Planning Property Reports, 87-103 Manningham Street, Parkville – Department of Environment, Land, Water and Planning
- East West Link (Eastern Section) Project – Western, Surplus Land and Social Housing, Department of Economic Development, Jobs, Transport and Resources, dated 14/04/2016

3 Observations

- 3.1 The subject site comprised an area of 1.1 hectares and was located directly across from Royal Park on the western side of Manningham Street. The site contained two storey dwellings and several multi-unit developments, with a tennis court and swimming pool located in the middle of the site. To the north was the eight storey Evo apartment complex and to the west was City Link Freeway.

3.2 Tree population

- Fifty-nine (59) individual trees and two (2) tree group features were assessed in total.
 - Forty-nine (49) individual trees were located within the subject site.
 - Two (2) tree groups were collected where trees of the same species were closely grown with reasonably consistent attributes.
 - Ten (10) individual trees were located within the Manningham Street reserve.

See the tree assessment table attached as Appendix 1 for details of each tree feature. See Appendix 2 for tree numbers and locations.

- 3.3 The assessed trees were generally a mix of Australian native, exotic deciduous, palm and conifer species. Based on the spatial arrangement of the trees it was concluded that all trees on site were specimens planted for screening, garden and amenity purposes. There were no indigenous trees identified in the inspection.

- 3.4 The tree population comprised a palette of thirty-five (35) different species.

Refer to Table 2 for the ten (10) most commonly occurring species.

Table 2: Species occurrence and origin type.

Botanic name Common Name	Origin	No. of trees
<i>Prunus serrulata</i> Japanese Cherry	Exotic deciduous	6
<i>Betula pendula</i> Silver Birch	Exotic deciduous	4
<i>Hesperocyparis macrocarpa</i> Monterey Cypress	Exotic conifer	4
<i>Tristanopsis laurina</i> Kanooka	Australian native	4
<i>Alnus acuminata subsp. glabrata</i> Evergreen Alder	Exotic evergreen	3
<i>Phoenix canariensis</i> Canary Island Date Palm	Exotic palm	3
<i>Pittosporum tenuifolium</i> Kohuhu	Exotic evergreen	3
<i>Agonis flexuosa</i> Willow Myrtle	Australian native	2
<i>Corymbia ficifolia</i> Red-flowering Gum	Australian native	2
<i>Jacaranda mimosifolia</i> Jacaranda	Exotic deciduous	2

3.5 **Tree health** was assessed based on foliage colour, size and density as well as shoot initiation and elongation.

- The majority of assessed trees (41 trees) were displaying characteristics considered to be typical or better of the species growing in this environment under current conditions.
- Eleven (11) trees displayed Fair to poor health with deficiencies such as reduced foliage density and tip dieback.
- Three (3) trees were in Poor health, showing symptoms of immediate and irreversible decline.
- Four (4) trees were dead.

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

- Twenty-nine (29) trees displayed Fair structure considered to be typical and acceptable for the species.
- Fifteen (15) trees had Fair to poor structure with minor defects, including previous branch failures, codominant stems or being lopped in the past. These trees are expected to be manageable with appropriate arboricultural treatment.

- Fifteen (15) trees displayed Poor structure, with major defects such as trunk wounds, cracks/splits and basal decay.

3.7 Arboricultural Rating

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

It should be noted that the arboricultural rating is different to the conservation/ecological values placed on trees by other professions. Definitions of arboricultural ratings can be seen in Appendix 3.

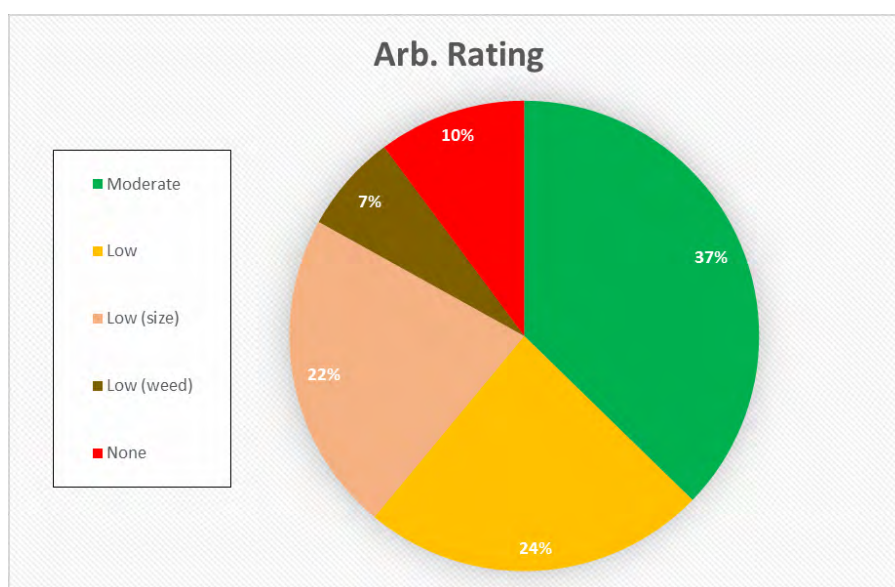


Figure 1: Breakdown of tree population by arboricultural rating.

Thirty-seven percent of the tree population (22 trees) were attributed an arboricultural rating of Moderate. Retaining Moderate rated trees is desirable from an arboricultural perspective. With appropriate consideration and management such trees have the potential to be medium to long-term components of the landscape.

Collectively, thirty-seven (37) trees or sixty-three percent of the population were rated Low or None and comprised predominantly specimens of a small size, identified environmental woody species, or were dead/dying. These Low and None rated trees should not constrain a proposed development of the site.

Small trees rated Low (size) that are otherwise in reasonable condition may offer a potential established tree resource, even if only as an interim measure.

- 3.8 Of the assessed trees, there were several specimens of a higher arboricultural significance which may warrant protection during any proposed site redevelopment. These trees were outliers in the population given the lower overall quality of trees within the site.

Refer to Table 1 for a list of prominent trees

Table 1: Prominent trees within the subject site.

Tree No.	Botanic name Common Name	DBH (cm)	Height x Width (m)
13	<i>Phoenix canariensis</i> Canary Island Date Palm	61	12 x 8
15	<i>Hesperocyparis macrocarpa</i> 'Horizontalis Aurea' Golden Cypress	71@1.0m	13 x 14
17	<i>Phoenix canariensis</i> Canary Island Palm	65	12 x 9
28	<i>Eucalyptus camaldulensis</i> River Red Gum	63	24 x 14
34	<i>Jacaranda mimosifolia</i> Jacaranda	37	13 x 9
35	<i>Brachychiton acerifolius</i> Illawarra Flame Tree	38	15 x 8
44	<i>Cedrus deodar</i> Deodar	59	16 x 14

- 3.9 Three (3) Canary Island Date Palms (*Phoenix canariensis*) were assessed within the subject site. All were attributed an arboricultural rating of Moderate, with Tree 13 in particular being of excellent condition and a significant landscape feature. The root morphology of palms, with a large, fibrous and compact rootball, allows for the removal and relocation of palms to be a viable option. The palms on site may be good candidates for transplanting, however the associated costs would need to be considered in the context of any redevelopment.

- 3.10 Tree 28, a *Eucalyptus camaldulensis* (River Red Gum) specimen, was located along the northern boundary and growing in close proximity to the eight storey Evo apartment complex. Some lower branches have been pruned to accommodate the new building and a large portion of exposure to northern sunlight has been lost. The tree was showing signs of response to these factors with a pronounced upright form and poor branching taper. While in fair health, the loss of lower canopy has reduced the ability of the tree to dampen the effects of prevailing winds.



Figure 2: A view looking west showing the proximity of Tree 28 to the neighbouring apartment complex.

Multi-storey development to the south may create a 'wind tunnel' effect and expose the tree to artificial wind patterns. Should the tree be retained in conjunction with any redevelopment of the site, adequate above and below-ground space should be provided to preserve existing growing conditions (exposure to sun, wind) as much as possible.

The tree has been allocated a TPZ of 7.6 metres, which has been encroached significantly from the apartment complex on the northern side (see Figures 3 and 4 below). Given existing conditions, the tree would not be expected to tolerate any further encroachment to the south. For the tree to be retained, the area within the TPZ would need to be maintained as a permeable and porous surface. Further information on Tree Protection Zones is provided in Section 6 and Appendix 4.

Specific design plans would be required before any potential impacts to the tree could be accurately identified.



Figure 3: A view looking north-west showing the existing permeable surface within the TPZ.



Figure 4: An aerial view showing the extent of the TPZ of Tree 28.

- 3.11 Trees 29 to 33 were a row of *Hesperocyparis macrocarpa* (Monterey Cypress) trees observed to be growing as a group with touching canopies. The growth of each tree has either influenced or been influenced by the growth habit of its neighbouring trees. Management of close grown trees requires that consideration be given to management of the group rather than individual trees because any tree removal has the potential to expose the remaining trees to subsequent failure due to increased exposure to new wind forces, increased evapo-transpiration rates and loss of amenity. Tree 35, a *Brachychiton acerifolius* (Illawarra Flame Tree) specimen, was also growing as a part of this group. For these trees to remain viable, retention of the entire group is necessary to avoid the above mentioned impacts to remaining trees.

- 3.12 Ten (10) council managed street trees were also assessed within the Manningham Street reserve. Overall, the street trees were in reasonable condition, displaying typically healthy characteristics for the species and growing conditions. The most prominent was Tree 56, a *Corymbia ficifolia* (Red-flowering Gum), which was in Fair health despite significant powerline clearance pruning (see Figure 3 below).



Figure 5: A view looking south showing the relative size, condition and location of Tree 56.

4 Photos



Image 1. South elevation showing the relative size, condition and location of Tree 13, a Moderate rated Canary Island Date Palm.



Image 2. North elevation showing the relative size, condition and location of Tree 28, a Moderate rated River Red Gum.



Image 3. South elevation showing the relative size, condition and location of Tree 15, a Moderate rated Golden Cypress



Image 4. West elevation showing the relative size, condition and location of Tree 34, a Moderate rated Jacaranda.



Image 5. West elevation showing the relative size, condition and location of Tree 16, a Moderate rated Lemon-scented Gum..



Image 6. South elevation showing the relative size, condition and location of Tree 38, a Low rated Prickly-leaved Paperbark..

5 Tree Permit Requirements

- 5.1 The subject site falls within the City of Melbourne and is covered by Schedule 1 to the General Residential Zone (GRZ1). The site is not covered by any specific tree regulations under the Melbourne Planning Scheme.
- 5.2 All council managed trees, regardless of arboricultural rating, must be afforded appropriate protection to sustain the trees within any proposed redevelopment of the site, unless otherwise negotiated with council.

6 Tree Protection Zones

- 6.1 The arboricultural assessment report provides planners and designers with information on the measures required to protect trees suitable for retention. 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 (TPZ) for all retained trees.
- 6.2 The Australian Standard for Protection of Trees on Development Sites (AS4970 – 2009) has been used as the method for calculating a TPZ. The TPZ defines an area in which construction activity is either avoided, or at least controlled, in order to successfully sustain a tree. The TPZ measurements are provided in the tree assessment data in Appendix 1.
- 6.3 Minor encroachment, up to 10% of the TPZ, is generally permissible provided encroachment is compensated for the recruitment and protection of an equivalent area contiguous with the TPZ. No construction should be proposed in the Reduced TPZ unless based the results of non-destructive root investigation, utilising root sensitive design & construction methods.
- 6.4 The Structural Root Zone (SRZ) represents the minimum area required to maintain tree stability without consideration to the ongoing health of the tree. No works are recommended within the SRZ.
- 6.5 Appendix 4 provides tree protection guidelines that should be incorporated into the design and management plans for retained trees.

Refer to Figure 6 for examples of minor encroachment.

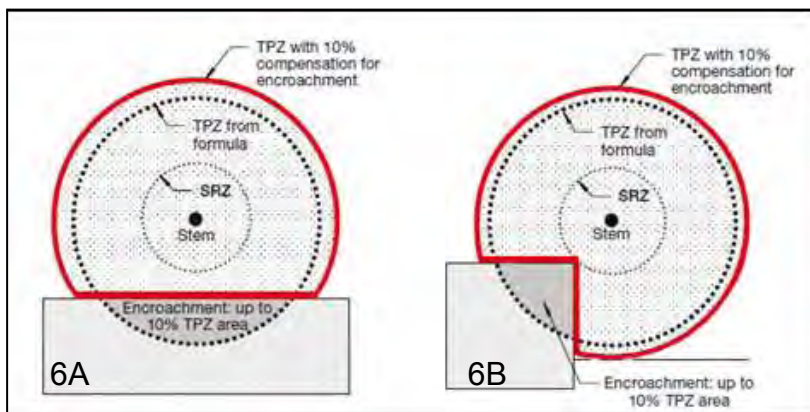


Figure 6: 6A & 6B - Examples of minor encroachment into a TPZ.

Extract from: AS4970-2009, Appendix D, pg. 30 of 32

7 Conclusion

- 7.1 The subject site comprised an area of 1.1 hectares and was located directly across from Royal Park on the western side of Manningham Street. The site contained two storey dwellings and several multi-unit developments, with a tennis court and swimming pool located in the middle of the site. To the north was the eight storey Evo apartment complex and to the west was City Link Freeway.
- 7.2 The subject site falls within the City of Melbourne and is covered by Schedule 1 to the General Residential Zone (GRZ1). The site is not covered by any specific tree regulations under the Melbourne Planning Scheme.
- 7.3 Fifty-nine (59) individual tree features and two (2) tree group features were inspected and assessed within the subject site, including street trees. Individual tree numbers are provided in the tree assessment data in Appendix 1. Tree numbers and locations can be found on the tree location plan in Appendix 2.
- 7.4 The tree population comprised a palette of thirty-five (35) different species comprising a mixture of exotic planted and Australian native specimens. All trees were attributed an arboricultural rating which reflects the retention value of each tree.

- Twenty-two (22) trees were attributed an arboricultural rating of Moderate.
- Thirty-seven (37) trees were attributed an arboricultural rating of Low.

Of these Low rated trees:

- Fourteen (14) displayed significant health and/or structural deficiencies.
- Thirteen (13) were of insignificant size/age and easily replaceable in the landscape.
- Four (4) were identified environmental woody weed species.
- Six (6) trees, which were dead/dying, were attributed an arboricultural rating of None.

As a general guide trees should be considered for retention based on their arboricultural value.

- Moderate rated trees represent the best opportunity to retain established trees of fair or better quality and would be suitable to consider for retention within the proposed development of the site.
- Trees attributed a Low arboricultural rating displayed general health and/or structural deficiencies and are generally not considered worthy of being a constraint on reasonable design intent and outcomes.
- Trees attributed a rating of None were generally defective, dead or dying and not suitable to retain in conjunction with any site redevelopment.

- 7.5 Of the assessed trees, there were several specimens of a higher arboricultural significance which may warrant protection during any proposed site redevelopment. This included Trees 13, 15, 17, 28, 34, 35 and 44. These trees were outliers in the population given the lower overall quality of trees within the site.
- 7.6 All council managed trees, regardless of Arboricultural Rating, must be afforded appropriate protection to sustain the tree within any proposed redevelopment of the site, unless otherwise negotiated with council.
- 7.7 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 (TPZ) for all retained trees.
- 7.8 All TPZ measurements are provided in the tree assessment data in Appendix 1.
- 7.9 To successfully retain those trees deemed to be most suitable for retention in conjunction with any redevelopment, tree protection zones must be incorporated into the design and appropriate construction controls, fencing and management practices must be implemented prior to commencing any construction related activity, including demolition and bulk earthworks. Where TPZ fencing is impractical, ground protection measures will be required.
- Refer to Appendix 4 for TPZ establishment and management guidelines.

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

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Signed

Timothy Burgess

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Appendix 1: Tree Assessment Data: 87-103 Manningham Street, Parkville

Key: DBH = Diameter at breast height, 1.4m up trunk, unless otherwise indicated. Basal dimensions is trunk diameter at base immediately above root buttress. ARB rating = arboricultural rating. TPZ = Tree protection zone in radial metres. SRZ = Structural root zone in radial metres. Definition of the descriptor categories used in the assessment can be seen in Appendix 3.

Refer to following two (2) pages.

Tree No.	Species	Origin	Age	H x W (m)	DBH (cm)	Basal (cm)	Health	Structure	ULE (yrs)	Arb. Rating	Comments	TPZ (m radius)	SRZ (m radius)
1	<i>Ficus sp.</i> (Fig)	Exotic deciduous	Early-mature	7 x 8	27,15,15,10,10	50	Fair	Poor	6-10 yrs	Low	Lopped at base, vine infested	4.5	2.5
2	<i>Platanus Xacerifolia</i> (London Plane)	Exotic deciduous	Semi-mature	8 x 8	30@0.5m	40	Fair	Poor	11-20 yrs	Low	Acute forks, lopped	3.6	2.3
3	<i>Banksia grandis</i> (Bull Banksia)	Australian native	Semi-mature	7 x 5	14	18	Fair to poor	Fair to poor	6-10 yrs	Low	Reduced foliage density, suppressed, tip dieback	2.0	1.6
4	<i>Hakea salicifolia</i> (Willow-leaved Hakea)	Australian native	Over-mature	6 x 7	23,14,8	46	Fair to poor	Poor	6-10 yrs	Low	Basal wounds, past stem failure	3.4	2.4
5	<i>Agonis flexuosa</i> (Willow Myrtle)	Australian native	Early-mature	9 x 6	14,9,5	28	Poor	Poor	1-5 yrs	Low	Chlorotic foliage, declining, multi-stemmed	2.1	1.9
6	<i>Alnus acuminata</i> subsp. <i>glabrata</i> (Evergreen Alder)	Exotic deciduous	Over-mature	11 x 9	44	51	Fair to poor	Fair to poor	6-10 yrs	Low	Past branch failure	5.3	2.5
7	<i>Betula pendula</i> (Silver Birch)	Exotic deciduous	Early-mature	10 x 7	23	31	Poor	Fair	1-5 yrs	None	Declining, tip dieback	2.8	2.0
8	<i>Betula pendula</i> (Silver Birch)	Exotic deciduous	Semi-mature	9 x 5	18	24	Dead	Fair to poor	<1	None		2.2	1.8
9	<i>Betula pendula</i> (Silver Birch)	Exotic deciduous	Semi-mature	8 x 7	25	32	Fair	Fair	11-20 yrs	Low (size)		3.0	2.1
10	<i>Betula pendula</i> (Silver Birch)	Exotic deciduous	Semi-mature	5 x 5	10	16	Fair to poor	Poor	6-10 yrs	Low	Suppressed	2.0	1.5
11	<i>Gleditsia triacanthos f. inermis</i> (Honey Locust)	Exotic deciduous	Early-mature	9 x 11	21	24	Fair	Fair to poor	11-20 yrs	Moderate	Acute forks	2.5	1.8
12	<i>Melaleuca bracteata</i> (Black Tea-tree)	Australian native	Over-mature	9 x 9	26,22,20,18,16	79	Fair	Poor	1-5 yrs	Low	Splitting at base	5.6	3.0
13	<i>Phoenix canariensis</i> (Canary Island Date Palm)	Exotic palm	Early-mature	12 x 8	61	75	Fair	Good	>40	Moderate		7.3	2.9
14	<i>Pittosporum eugenioides 'Variegatum'</i> (Variegated Tarata)	Australian native	Early-mature	7 x 7	12,12	25	Fair	Fair	11-20 yrs	Low (size)		2.0	1.8
15	<i>Hesperocyparis macrocarpa 'Horizontalis Aurea'</i> (Golden Cypress)	Exotic conifer	Early-mature	13 x 14	71@1.0m	80	Fair	Fair	21-40	Moderate	Lower canopy height 2.0m	8.5	3.0
16	<i>Corymbia citriodora</i> (Lemon-scented Gum)	Australian native	Early-mature	15 x 12	38	46	Fair to poor	Fair	11-20 yrs	Moderate	Reduced foliage density	4.6	2.4
17	<i>Phoenix canariensis</i> (Canary Island Date Palm)	Exotic palm	Early-mature	12 x 9	65	84	Fair	Fair	21-40	Moderate		7.8	3.1
18	<i>Pittosporum tenuifolium</i> (Kohuhu)	Exotic evergreen	Maturing	9 x 5	15	20	Fair	Fair	11-20 yrs	Low (size)		2.0	1.7
19	<i>Pittosporum tenuifolium</i> (Kohuhu)	Exotic evergreen	Maturing	9 x 5	15	20	Fair	Fair	11-20 yrs	Low (size)		2.0	1.7
20	<i>Pittosporum eugenioides 'Variegatum'</i> (Lemonwood)	Australian native	Over-mature	7 x 6	17,15	31	Fair to poor	Poor	6-10 yrs	Low	Remove southern stem, cracks/splits, decay	2.7	2.0
21	<i>Ligustrum sp.</i> (Privet)	Exotic evergreen	Early-mature	7 x 5	14	17	Fair	Fair	6-10 yrs	Low (weed)	Self-sown	2.0	1.6
22	<i>Jacaranda mimosifolia</i> (Jacaranda)	Exotic deciduous	Early-mature	12 x 8	33	40	Fair	Fair	11-20 yrs	Moderate	Possum grazing	4.0	2.3
23	<i>Livistona australis</i> (Cabbage Palm)	Australian palm	Maturing	10 x 5	30	37	Fair	Fair	11-20 yrs	Moderate		3.6	2.2
24	<i>Alnus acuminata</i> subsp. <i>glabrata</i> (Evergreen Alder)	Exotic evergreen	Early-mature	7 x 6	25	32	Poor	Poor	<1	None	Declining	3.0	2.1
25	<i>Alnus acuminata</i> subsp. <i>glabrata</i> (Evergreen Alder)	Exotic evergreen	Early-mature	6 x 3	20	25	Dead	Poor	<1	None		2.4	1.8
26	<i>Syagrus romanzoffiana</i> (Queen Palm)	Exotic palm	Early-mature	11 x 7	32	40	Fair	Fair	21-40	Moderate		3.8	2.3
27	<i>Phoenix canariensis</i> (Canary Island Date Palm)	Exotic palm	Semi-mature	6 x 9	90@base	90	Fair	Fair	21-40	Moderate		10.8	3.2
28	<i>Eucalyptus camaldulensis</i> (River Red Gum)	Victorian native	Early-mature	24 x 14	63	75	Fair	Fair	21-40	Moderate	Suppressed by eight storey apartment building to north resulting in poor taper and upright form	7.6	2.9
29	<i>Hesperocyparis macrocarpa</i> (Monterey Cypress)	Exotic conifer	Early-mature	12 x 8	47	48	Dead	Fair to poor	<1	None		5.6	2.4
30	<i>Hesperocyparis macrocarpa</i> (Monterey Cypress)	Exotic conifer	Maturing	22 x 16	111	114	Fair	Fair to poor	11-20 yrs	Moderate	Codominant stems, excess end weight	13.3	3.5
31	<i>Hesperocyparis macrocarpa</i> (Monterey Cypress)	Exotic conifer	Early-mature	21 x 12	57	62	Fair	Fair	11-20 yrs	Moderate	Partially suppressed to north east	6.8	2.7

Tree No.	Species	Origin	Age	H x W (m)	DBH (cm)	Basal (cm)	Health	Structure	ULE (yrs)	Arb. Rating	Comments	TPZ (m radius)	SRZ (m radius)
32	<i>Hesperocyparis macrocarpa</i> (Monterey Cypress)	Exotic conifer	Maturing	19 x 13	70	89	Fair to poor	Fair	11-20 yrs	Moderate	Growing within group of Cypress, acute forks	8.4	3.2
33	<i>Pittosporum undulatum</i> (Sweet Pittosporum)	Victorian native	Early-mature	7 x 7	19	25	Fair	Fair to poor	6-10 yrs	Low (weed)		2.3	1.8
34	<i>Jacaranda mimosifolia</i> (Jacaranda)	Exotic deciduous	Early-mature	13 x 9	37	46	Fair	Fair	11-20 yrs	Moderate	Remove epicormic branch	4.4	2.4
35	<i>Brachychiton acerifolius</i> (Illawarra Flame Tree)	Australian native	Early-mature	15 x 8	38	45	Good	Fair	21-40	Moderate	Suppressed, growing within group	4.6	2.4
36	<i>Schefflera actinophylla</i> (Umbrella Tree)	Exotic evergreen	Early-mature	6 x 7	22,15,8@0.5m	41	Fair	Fair to poor	11-20 yrs	Low (size)		3.3	2.3
37	<i>Prunus serrulata</i> (Japanese Cherry)	Exotic deciduous	Over-mature	7 x 7	45,34	80	Good	Poor	6-10 yrs	Low	Good reactive growth, two self-sown ligustrum at base, basal decay, trunk wounds	6.8	3.0
38	<i>Melaleuca styphelioides</i> (Prickly-leaved Paperbark)	Australian native	Over-mature	13 x 13	97@0.90	90	Fair to poor	Fair to poor	6-10 yrs	Low	Past powerline clearance, previous failures	11.6	3.2
39	<i>Arbutus unedo</i> (Strawberry Tree)	Exotic evergreen	Early-mature	6 x 4	18,6,6,6	38	Fair	Poor	6-10 yrs	Low	Lopped	2.5	2.2
40	<i>Corymbia ficifolia</i> (Red-flowering Gum)	Australian native	Early-mature	11 x 10	51@1.0m	55	Fair	Fair to poor	11-20 yrs	Moderate	Lopped	6.1	2.6
41	<i>Ligustrum lucidum</i> (Shining Privet)	Exotic evergreen	Early-mature	9 x 7	23,15	31	Fair	Poor	1-5 yrs	Low (weed)	Crossing branches, multi-stemmed	3.3	2.0
42	<i>Prunus serrulata</i> (Japanese Cherry)	Exotic deciduous	Over-mature	10 x 5	40	40	Dead	Poor	<1	None		4.8	2.3
43	<i>Ligustrum lucidum</i> (Shining Privet)	Exotic evergreen	Early-mature	7 x 5	19,19	29	Fair to poor	Poor	1-5 yrs	Low (weed)		3.2	2.0
44	<i>Cedrus deodara</i> (Deodar)	Exotic conifer	Early-mature	16 x 14	59	63	Fair	Fair	11-20 yrs	Moderate	Hangers, past powerline clearance, previous failures	7.1	2.7
45	<i>Agonis flexuosa</i> (Willow Myrtle)	Australian native	Early-mature	9 x 9	28,20	45	Fair	Fair	11-20 yrs	Moderate		4.1	2.4
46	<i>Melaleuca linariifolia</i> (Snow in Summer)	Australian native	Early-mature	7 x 7	25,18	44	Fair	Fair to poor	11-20 yrs	Moderate	Codominant stems, vine infested	3.7	2.3
47	<i>Prunus serrulata</i> (Japanese Cherry)	Exotic deciduous	Semi-mature	4 x 4	15@1.0m	19	Fair	Fair to poor	11-20 yrs	Low (size)	Street tree	2.0	1.6
48	<i>Prunus serrulata</i> (Japanese Cherry)	Exotic deciduous	Semi-mature	4 x 5	13,11,8,6	24	Fair	Fair	11-20 yrs	Low (size)	Street tree	2.4	1.8
49	<i>Prunus serrulata</i> (Japanese Cherry)	Exotic deciduous	Semi-mature	4 x 8	15,14,13,13	26	Fair	Fair	11-20 yrs	Low (size)	Street tree	3.3	1.9
50	<i>Tristaniaopsis laurina</i> (Kanooka)	Exotic deciduous	Semi-mature	4 x 3	9	12	Fair	Fair	21-40	Low (size)	Street tree	2.0	1.5
51	<i>Callistemon viminalis</i> (Weeping Bottlebrush)	Australian native	Early-mature	5 x 5	28,22	48	Fair to poor	Fair to poor	6-10 yrs	Low	Fungal fruiting bodies, reduced foliage density, street tree	4.3	2.4
52	<i>Tristaniaopsis laurina</i> (Kanooka)	Australian native	Young	2 x 2	8	9	Fair	Fair	21-40	Low (size)	Street tree	2.0	1.5
53	<i>Tristaniaopsis laurina</i> (Kanooka)	Australian native	Semi-mature	2 x 2	8	9	Good	Fair	21-40	Low (size)	Street tree	2.0	1.5
54	<i>Schinus areira</i> (Peppercorn Tree)	Exotic evergreen	Semi-mature	8 x 11	35,23	43	Fair	Fair to poor	11-20 yrs	Moderate	Past powerline clearance	5.0	2.3
55	<i>Tristaniaopsis laurina</i> (Kanooka)	Australian native	Young	2 x 2	8	9	Fair	Fair	21-40	Low (size)	Street tree	2.0	1.5
56	<i>Corymbia ficifolia</i> (Red-flowering Gum)	Australian native	Maturing	10 x 13	51,38,38,32	98	Fair	Fair to poor	11-20 yrs	Moderate	Multi-stemmed, past powerline clearance, street tree	9.7	3.3
57	<i>Radermachera sinica</i> (China Doll)	Australian native	Early-mature	9 x 8	30	39	Fair to poor	Fair	11-20 yrs	Moderate	Reduced foliage density, tip dieback	3.6	2.2
58	<i>Pittosporum tenuifolium</i> (Kohuhu)	Exotic evergreen	Maturing	9 x 6	10,10,8,8est	20	Fair	Fair	11-20 yrs	Low (size)	Inaccessible, measurements estimated	2.2	1.7
59	<i>Prunus serrulata</i> (Japanese Cherry)	Exotic deciduous	Early-mature	3 x 3	12,11	33	Fair	Poor	6-10 yrs	Low	Street tree	2.0	2.1
Group No.	Species	Origin	Age	H x W (avg. m)	DBH (avg. cm)	No. stems	Health	Structure	ULE	Arb. Rating	Comments	TPZ (m radius)	SRZ (m radius)
Grp 1	<i>Syzygium smithii</i> (Lilly Pilly)	Australian native	Early-mature	8 x 3	20	~30	Fair to poor	Poor	6-10 yrs	Low	Condition of trees deteriorates towards the south. All previously lopped	2.4	1.5
Grp 2	<i>Pittosporum tenuifolium</i> (Kohuhu)	Exotic evergreen	Early-mature	5 x 3	10	10	Fair	Fair	11-20 yrs	Low (size)	Row of screening trees	2.0	1.5

Appendix 2: Tree Location Plan: 87-103 Manningham Street, Parkville

Refer to following four (4) pages.



Appendix 2 - Tree Location Plan 87-103 Manningham Street, Parkville

Co-ordinate System: GDA 1994
MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994



Legend

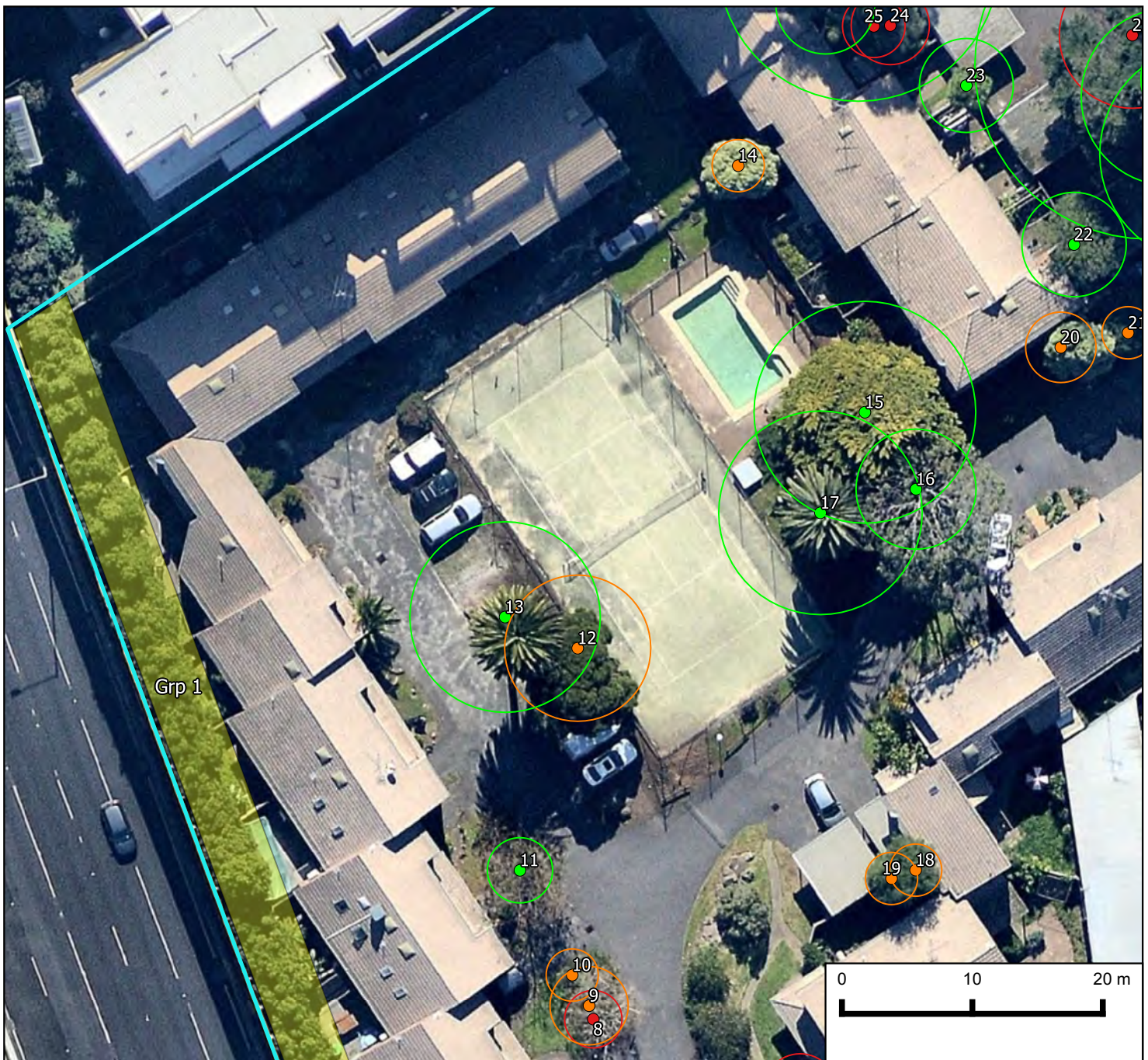
Arb. Rating	TPZs	Tree Group
● Moderate	 Moderate	 Study Area
● Low	 Low	
● None	 None	





Appendix 2 - Tree Location Plan 87-103 Manningham Street, Parkville

Co-ordinate System: GDA 1994
MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994



Legend

Arb. Rating	TPZs	
● Moderate	 Moderate	 Tree Group
● Low	 Low	 Study Area
● None	 None	



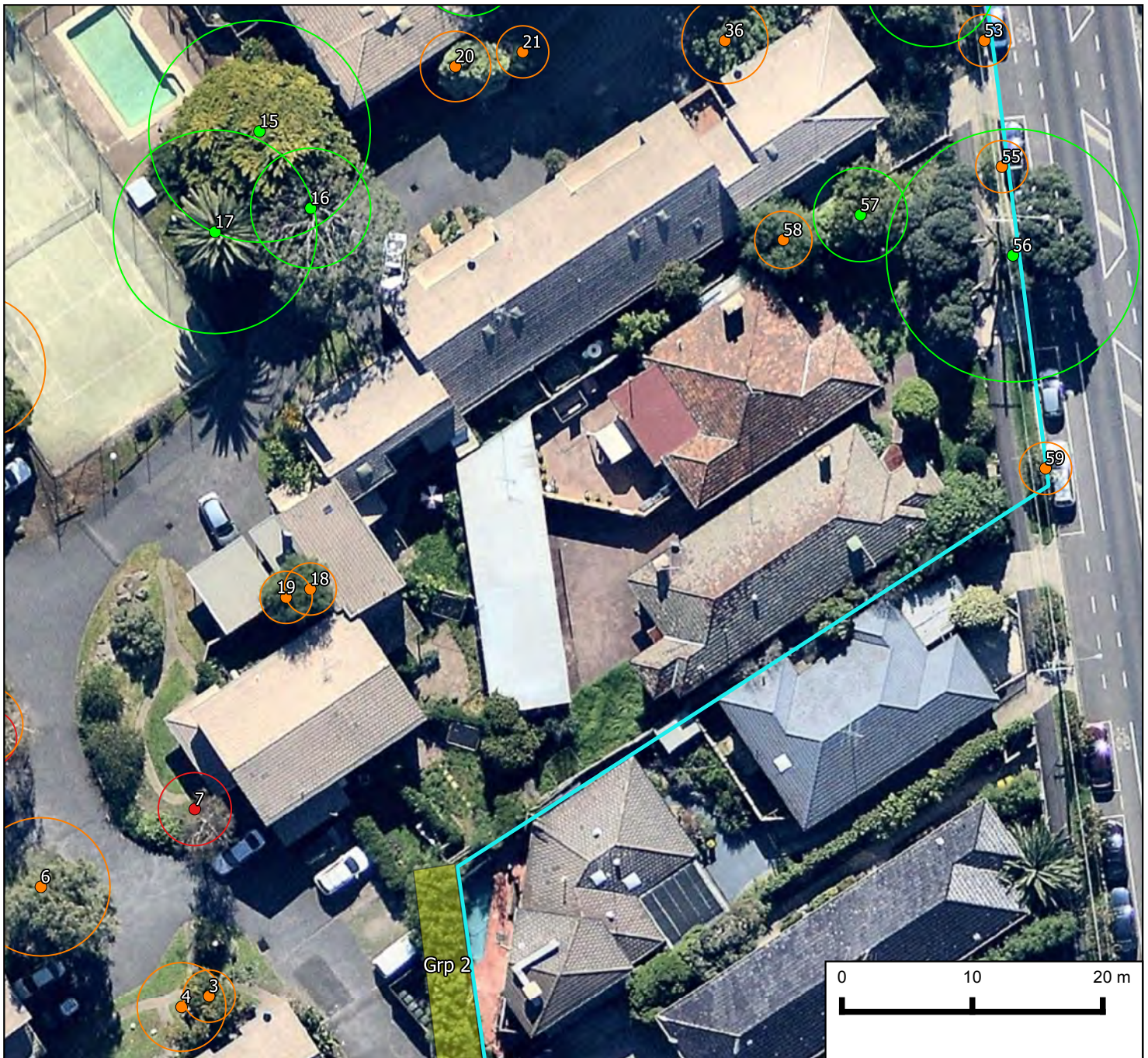
Client: Department of Treasury and Finance
Map Source: Nearmap
Author: Tree Logic
Date: 14/08/2017

Map 2



Appendix 2 - Tree Location Plan 87-103 Manningham Street, Parkville

Co-ordinate System: GDA 1994
MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994



Legend

Arb. Rating

- Moderate
- Low
- None

TPZs

- Moderate
- Low
- None

Tree Group

Study Area



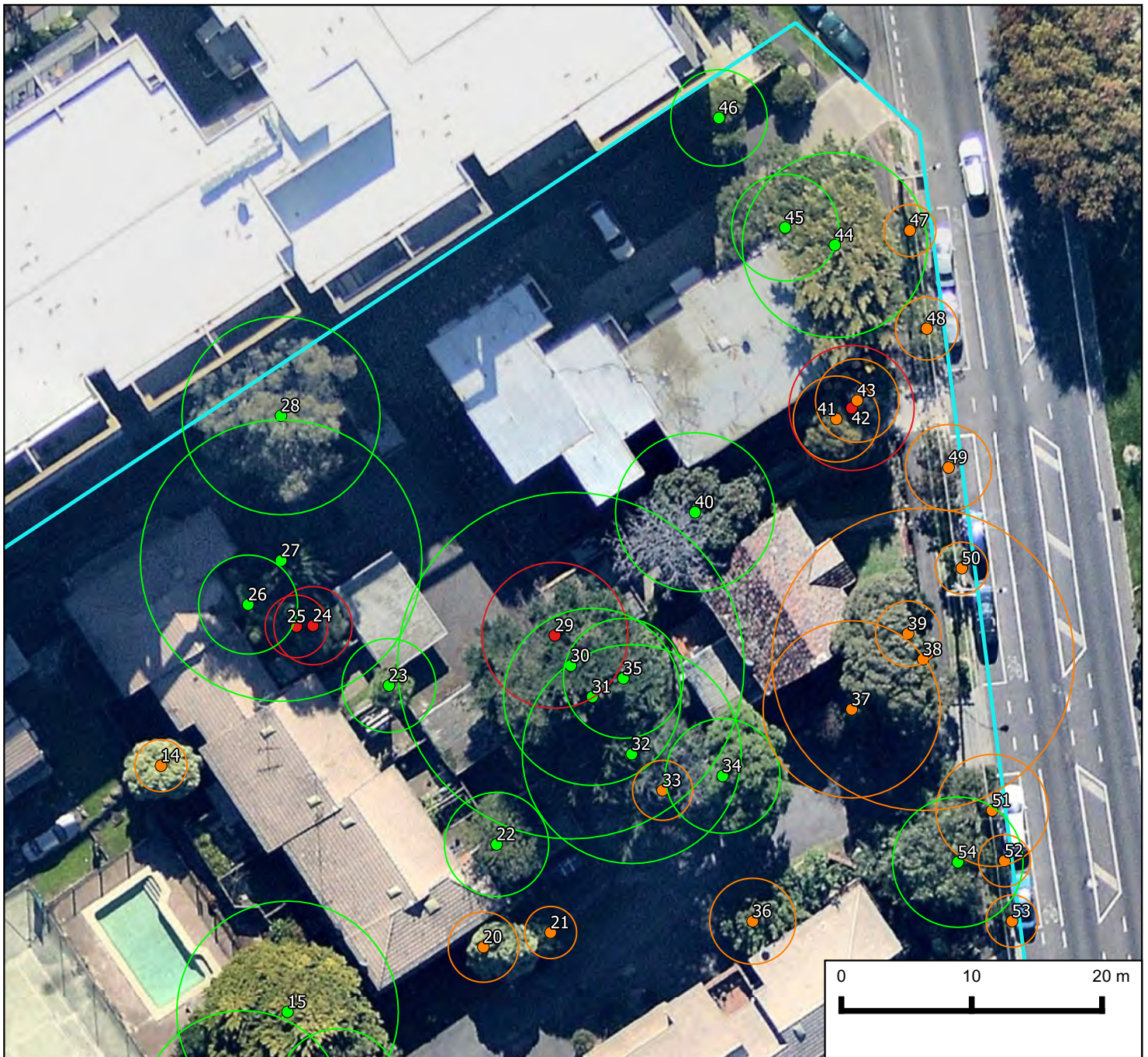
Client: Department of Treasury and Finance
Map Source: Nearmap
Author: Tree Logic
Date: 14/08/2017

Map 3



Appendix 2 - Tree Location Plan 87-103 Manningham Street, Parkville

Co-ordinate System: GDA 1994
MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994



Legend

Arb. Rating	TPZs	Tree Group
● Moderate	 Moderate	 Tree Group
● Low	 Low	 Study Area
● None	 None	



Client: Department of Treasury and Finance
Map Source: Nearmap
Author: Tree Logic
Date: 14/08/2017

Map 4

Appendix 3 - Arboricultural Descriptors (June 2017)

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

1. Tree Condition

The assessment of tree condition evaluates factors of health and structure.

The descriptors of health and structure attributed to a tree evaluate the individual specimen to what could be considered typical for that species growing in its location under current climatic conditions. For example, some species can display inherently poor branching architecture, such as multiple acute branch attachments with included bark. Whilst these structural defects may technically be considered arboriculturally poor, they are typical for the species and may not constitute an increased risk of failure.

These trees may be assigned a structural rating of fair-poor (rather than poor) at the discretion of the assessor.

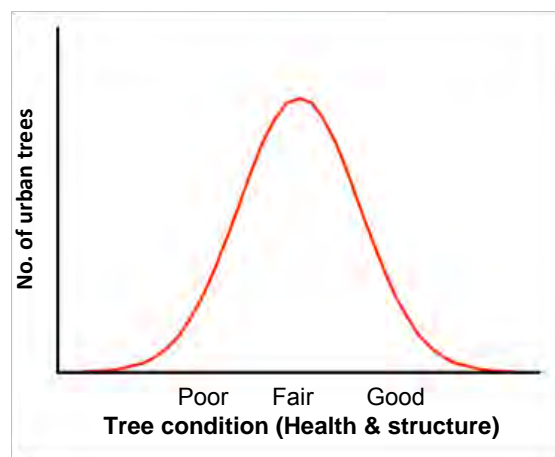


Diagram 1: Indicative normal distribution curve for tree condition

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

2. Tree Name

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

3. Tree Type

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

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

4. Height and Width

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

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

5. Trunk diameters

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

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

Diameter at Breast Height (DBH)

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

7. Health

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

Health 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

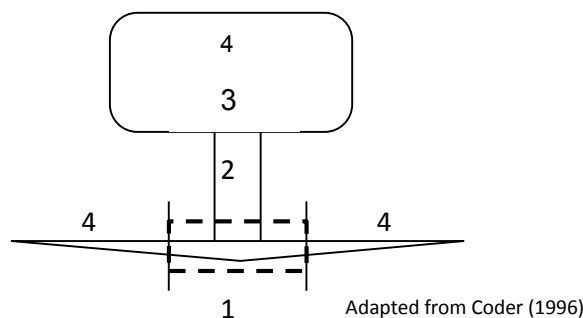
8. Structure

Assesses principal components of tree structure (Diagram 2).

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.

Diagram 2: Tree structure zones

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



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). See table over page.

Structure Category	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.

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). See table over page.

Useful Life Expectancy category	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, which can either increase or decrease, or sudden changes to a tree's growing environment creating an acute stress.

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 be extend a tree's ULE.

9. Arboricultural Rating

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

Arboricultural rating Category	Description
High	<p>Tree of high quality in good to fair condition; good vigour. Generally a prominent arboricultural/landscape feature. Particularly good example of the species; rare or uncommon. Tree may have significant conservation or other cultural value.</p> <p>These trees have the potential to be a medium- to long-term components of the landscape (moderately long to long ULE) if managed appropriately.</p> <p>Retention of these trees is highly desirable.</p>
Moderate	<p><i>General -</i></p> <p>Tree of moderate quality, in fair or better condition. Tree may have a condition, and or structural problem that will respond to arboricultural treatment.</p> <p>These trees have the potential to be a moderate- to long-term component of the landscape (moderate to long ULE) if managed appropriately. Retention of these trees is generally desirable.</p> <p>The following sub-categories relate predominately to age and size and amenity.</p>
	<p>A. Moderate to large, maturing tree. Contributes to the landscape character. Tree may have conservation or other cultural value.</p>
	<p>B. Moderate sized, established tree, > 50% of attainable age/size. Contributes to the landscape character.</p>
	<p>C. Small and/or semi-mature tree, established, >5 years in the location. May not be a dominant canopy. No special qualities.</p>
Low	<p>Unremarkable tree of low quality or little amenity value. Tree in either poor health or with poor structure or a combination. Short to transitory useful life expectancy.</p> <p>Tree is not significant because of either its size or age, such as young trees with a stem diameter below 15 cm. Trees regularly pruned to restrict size. These trees are easily replaceable.</p> <p>Tree (species) is functionally inappropriate to specific location and would be expected to be problematic if retained.</p> <p>Retention of such trees may be considered if not requiring a disproportionate expenditure of resources for a tree in its condition and location.</p>
None	<p>Trees of low quality with an estimated remaining life expectancy of less than 5 years. Tree has either a severe structural defect or health problem or combination that cannot be sustained with practical arboricultural techniques and the loss of the tree would be expected in the short term.</p> <p>Trees that are dead or are showing signs of significant, immediate, and irreversible overall decline. Tree infected with pathogens of significance to either the health or safety of the tree or other adjacent trees.</p> <p>Tree whose retention would not be viable after the removal of adjacent trees (includes trees that have developed in close spaced groups and would not be expected to acclimatise to severe alterations to surrounding environment – removal of adjacent shelter trees).</p> <p>Tree has a detrimental effect on the environment, for example, the tree is a recognised environmental woody weed with potential to spread into waterways or natural areas.</p> <p>Unremarkable tree of no material landscape, conservation or other cultural value.</p>

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

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

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Appendix 4: Tree Protection Zones

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Introduction

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

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

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

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

Allocation of tree protection zone (TPZ)

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

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

The intention of tree protection zones is to:

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

Tree protection

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

The Australian Standard AS 4970-2009 Protection of trees on development sites has been used as a guide in the allocation of TPZs for the assessed trees. The TPZ for individual trees is calculated based on trunk (stem) diameter (DBH), measured at 1.4 metres up from ground level. The radius of the TPZ is calculated by multiplying the trees DBH by 12. The method provides a TPZ that addresses both the stability and growing requirements of a tree. TPZ distances are measured as a radius from the centre of the trunk at (or near) ground level. The minimum TPZ should be no less than 2m and the maximum no more than 15m radius. The TPZ of palms should be not less than 1.0m outside the crown projection.

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

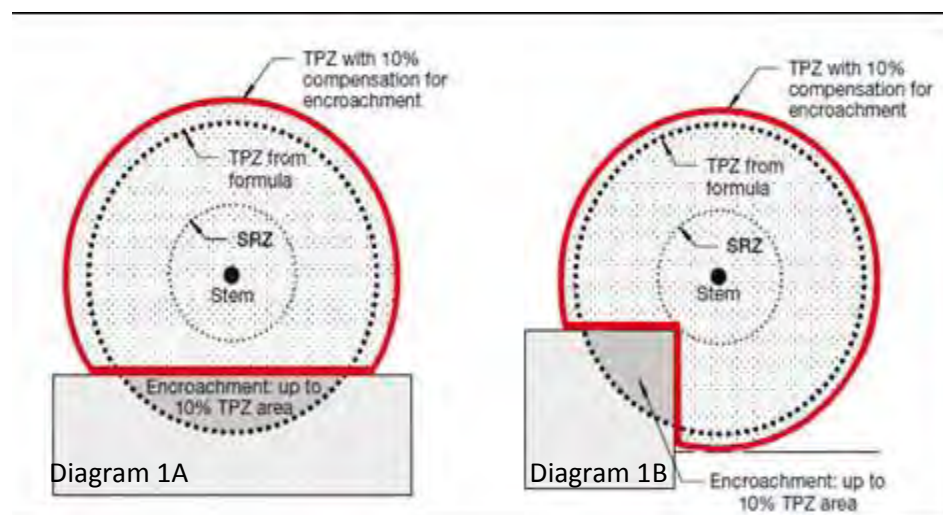


Diagram 1: Examples of minor encroachment into a TPZ.
(Extract from: AS4970-2009, Appendix D, p30 of 32)

The 10% encroachment on one side equates to approximately $\frac{1}{3}$ radial distance. Tree root growth is opportunistic and occurs where the essentials to life (primarily air and water) are present. Heterogeneous soil conditions, existing barriers, hard surfaces and buildings may have inhibited the development of a symmetrically radiating root system.

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

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

General tree protection guidelines

The most important factors are:

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

Exploratory excavation

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

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

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

Substantial roots are to be exposed and left intact.

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

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

How to determine the diameter of a substantial root

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

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

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

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

No root or soil disturbance is permitted within the SRZ.

In the area outside the SRZ the tree may tolerate the loss of one or a number of roots. The table below indicates the size of tree roots, outside the SRZ that would be deemed substantial for various tree heights. The assessment of combined root loss within the TPZ would need to be undertaken by an arborist on an individual basis because the location of the tree, its condition and environment would need to be assessed.

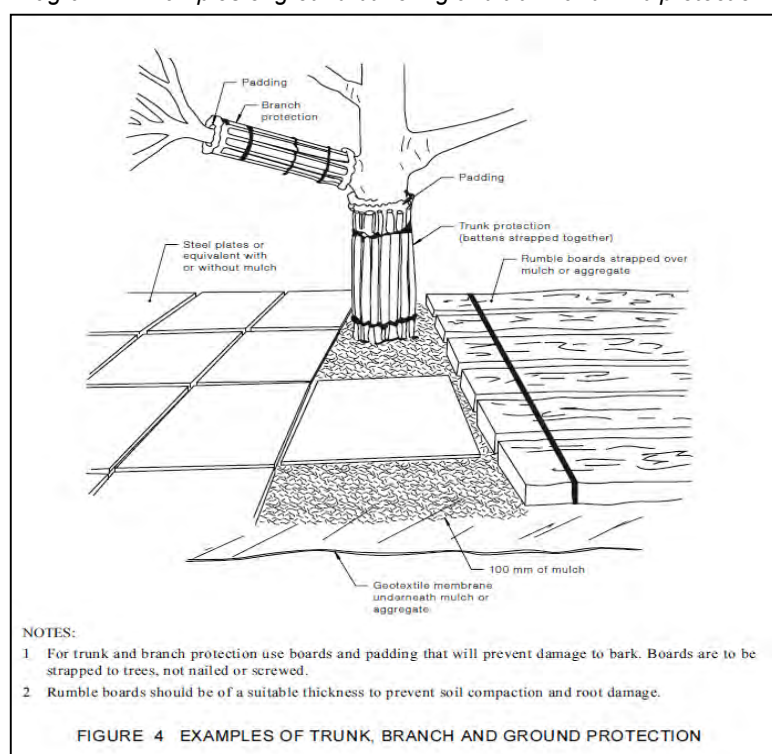
Table 1: Estimated significant root sizes outside SRZ

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

Ground buffering

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

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



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

Construction Guidelines

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

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

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