



ARBORICULTURAL REPORT

TARNEIT PRECINCT STRUCTURE PLAN-91.



Report commissioned by:
Dane Logan for the
Growth Areas Authority.

July 2011

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1 Executive summary

Client Brief

The Growth Areas Authority (GAA) commissioned Tree Logic to undertake an arboricultural survey of tree features within the Tarneit area, defined as Precinct 91 to inform the future precinct design process.

The tree study area, Precinct Structure Plan 91 (PSP91), comprised approximately 1,444 hectares and is defined to the north by Leakes Road, to the east by Davis Road and Davis Creek, to the south by the Werribee River and an arbitrary diagonal alignment to the west. The study area is transected east to west by Sayers Road. Refer to image below.

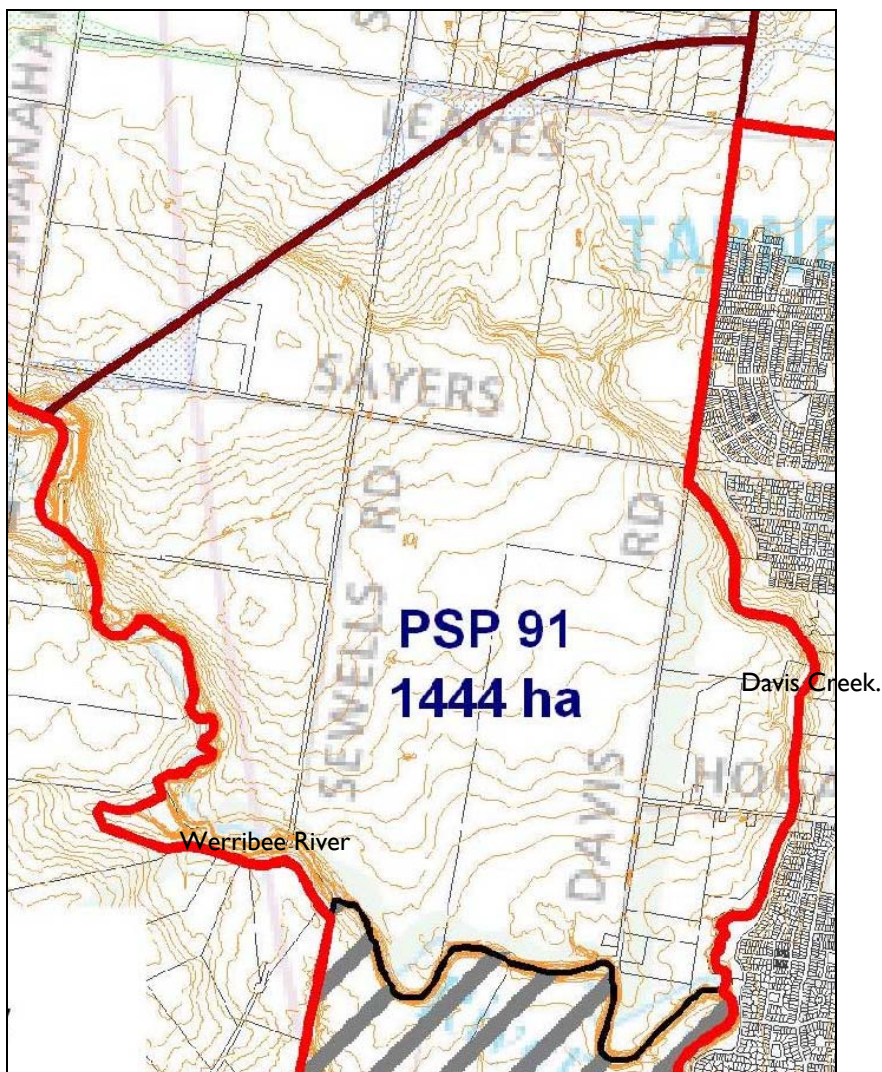


Figure 1: Tarneit PSP 91 Area and Context Map

The land is currently used for a variety of rural purposes including grazing, horse agistment, cropping and market gardens and rural residential. The precinct is zoned Urban Growth Zone and Rural Conservation Zone with a number of overlays affecting parcels within the site. It is divided into allotments of varying size from 1.6 to 160 hectares.

Key Objectives

The arboricultural assessment was required to include:

- Identification of all trees considered to have High or Very High retention value by the consultant arborist. Trees that are considered to have less than High retention value are not required to be surveyed.

- Survey trees with High or Very High retention value that are over 150mm calliper measured at breast height (1.4m above surrounding ground level)
- Survey data collected was to include:
 - Tree number, Number of trees (if assessed as a group)
 - Location (XY co-ordinates)
 - Species (botanical and common name)
 - Tree origin (exotic, native, indigenous)
 - Dimensions (DBH, Height, Width)
 - Age class
 - Health rating
 - Structural rating
 - Useful life expectancy
 - Arboricultural retention value (High or Very High)
 - Tree Protection Zone
 - Any relevant comments
- Provide an arboricultural report which tables the collected data, illustrating the retention value of all surveyed trees on a plan of the PSP area, and includes discussion and clear recommendations regarding suitability for retention in an urban environment, required protection zones (AS4970-2009) and strategies to maximise longer term viability, where relevant.
- Locate the trees in conjunction with cadastral layers provided by the GAA as site plans attached as Appendix 2.

Summary of Opinion

- 1.1 The tree population was sparse and unremarkable overall both across the site and within individual properties.
- 1.2 Only one trees attracted a Very High arboricultural rating, being Tree 1.
 - 1.2.1 Seventeen tree features attracted a High arboricultural rating, being Trees 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 24 and groups 1 (48 trees), 4 (≈150 trees), 7(≈850 trees), and 9 (≈55 trees),
 - 1.2.2 A further 21 features were inspected which attracted a Moderate or Low arboricultural rating comprising approximately 500 trees.
- 1.3 Five trees were considered to be remnant indigenous trees, being trees 1, 2, 3, 14 & 16, that appeared to be naturally occurring.
 - 1.3.1 The remaining indigenous specimens were planted as ornamentals or functional installations.
- 1.4 Not all 'Moderate or Low' rated tree features should be dismissed as candidates poorly suited for retention, though overall, the retention of such trees should not compromise design intent. In general Moderate rated trees were of semi-mature age and size and could be readily replaced during development of the site. In certain landscape settings, smaller specimens in otherwise reasonable condition have the potential to offer an established tree resource, even if only as an interim measure. Low rated trees with health or structural deficiencies are generally not desirable candidates for retention. Windrows with health and structural defects should generally be removed.

2 Method

2.1. Site inspection methodology;

- 2.1.1 A site inspection was undertaken by Tree Logic staff during the week ending July 15, 2011. The trees were inspected from the ground and observations made of the growing environment and surrounding area. The trees were not climbed, no samples of the trees or site soil were taken and no investigation of the root plate below ground was undertaken.
- 2.1.2 Trees less than 10m in height were included in the assessment where such tree(s) were felt to be noteworthy because of their potential for being a long-term landscape component or constituted a prominent landscape feature.
- 2.1.3 Trees on public land were recorded as “Public Trees” or “Public Groups”.
- 2.1.4 Individually assessed trees and tree group features were attributed with unique identifying numbers. Trees numbers used in this report and appearing in column 1 of the tree assessment table in Appendix 1 correspond with unique identifying labels provided in the GIS data sets and plans compiled for the site.
- 2.1.5 Observations were made of the trees to determine age and condition, with measurements taken to establish tree height (measured with a height meter), crown width (paced) and trunk diameter (measured at 1.4m above grade unless otherwise stated). Definitions of arboricultural descriptors can be seen in Appendix 3.
- 2.1.6 Photographs of trees and site conditions were taken for further reference and inclusion in the report.
- 2.1.7 Spatial data relating to tree locations was recorded measuring tool equipped ruggedised tablet computers using a combination of GIS surveying software (ArcPad), orthorectified site aerial imagery and property boundary cadastre data supplied by the GAA.
- 2.1.8 Where sufficient identifying characteristics were present trees were identified to species level. Trees were assessed to determine their age class, structure and condition. Tree height was measured using a height meter. Where groups of close spaced trees were assessed, sample heights within the stand were taken and the height of remaining trees estimated against the sample heights. Crown spread was estimated by pacing the crown widths on the widest axis.
- 2.1.9 Trunk diameter was measured using linear tape measures and diametric tape measures in 5cm increments. The default height for measurement was 1.4m above grade. Where short trunked trees forking at or below 1.3m above grade were assessed, trunk diameter was measured at the narrowest point of the single stem below the fork.

2.2. Field Survey Limitations

- 2.2.1. Assessment exclusion zones applied to the following:
 - Werribee River – 100m from the centre of the river.
 - Davis Creek – 50m from the centre of the creek.
- 2.2.2. Not all properties were accessible for the purpose of this survey. Where access restrictions occurred, limited assessments of trees in such properties were made from external vantage points.
- 2.2.3. Accurate assessment of dimensions, health and structure of these trees must be verified by closer arboricultural inspection prior to enacting any recommendations arising from this report.

2.3. Arboricultural assessment method;

- 2.3.1. The health and structural characteristics of each tree was assessed and each tree was attributed an ‘Arboricultural Rating’. The arboricultural rating correlates the combination of tree condition factors (health, structure & form) with tree amenity value. Amenity relates to the trees biological, functional and aesthetic characteristics

within a built environment. The arboricultural rating in combination with other factors can assist the project team and planners in nominating trees suitable for retention. The four arboricultural ratings used by Tree Logic include:

- **Very High:** Tree of very high quality in good condition. Generally a prominent arboricultural feature. Tree is capable of tolerating changes in its environment if managed appropriately.
- **High:** Tree of high quality with generally sound structural condition and good health. Generally is or has the potential to become a prominent landscape feature.

Trees that were considered to have less than High retention value were not required to be surveyed.

Trees that are generally desirable for retention typically display the following attributes:

- Are of a healthy condition that would allow it to tolerate development-associated modifications to its growing environment and,
- Have a structure that was not predisposed to potential failure that could cause damage or injury and,
- Are of an age and/ or size that provide an immediate and ongoing obvious contribution to the landscape.

Conversely trees in poor health, with suspect or deficient structure, or subject to pest or disease infestation that was having a discernable negative impact on tree condition are generally not considered suitable for retention in an urban environment. Trees recognised as environmental weeds and known to be potentially invasive in the locale of the subject site are generally not considered suitable for retention. Small specimens that provide negligible contribution to the landscape, irrespective of condition should not impede reasonable land use.

Full tree descriptors are attached as Appendix 3.

2.3 Establishing Tree Protection Zones (TPZ);

- 2.3.1 To successfully retain suitable trees within or around a development site, consideration must be given to protecting the trunk, crown and roots of each specimen. Tree protection zones (TPZ's) are used to provide adequate space for the preservation of sufficient roots to maintain tree health (particularly important for mature trees) whilst providing a buffer zone between construction activity and the tree trunk and crown.
- 2.3.2 The method for determining tree protection zones adopted in this report is the Australian Standard for protection of trees on development sites (AS4970-2009). It provides a method for establishing a TPZ area that is based on the trunk diameter measurement measured at 1.4m and multiplied by 12. The trunk of the tree is used as the centre point for the measurement.
- 2.3.3 TPZ measurements are included in the tree assessment data in Appendix 1.
- 2.3.4 The method employed in this document for assigning tree protection zones is a guide for planning purposes. Additional guidelines are outlined in Appendix 4 for establishment and maintenance of the tree protection

2.4 Documents reviewed include;

- Planning property reports and Wyndham City council planning overlays relevant to the sites including:
- Development Plan Overlays
- Heritage Overlay Schedules.
- Environmental Significance Overlay

- Urban Growth Zone, Business 1 Zone, Public Use Zone-Services and Utilities, Rural Living Zones.
- Clause 52.17 applies to sites greater than 4,000 m² in area.
Under the clause it is a requirement to '*demonstrate the steps taken to;*'
 - *Avoid the removal of vegetation native to Victoria.*
 - *Minimise the removal of native vegetation.*
 - *Appropriately offset the loss of native vegetation if required.'*

3 Observations

3.1 Site description.

The site is generally flat land on the volcanic plains west of Melbourne which is highly disturbed with a long history of previous land uses including farming for grazing and crop raising and agistment of horses.

The Davis Creek runs in a north south direction along the lower eastern boundary of the site and crosses Davis Road at the intersection of Sayers Road. Away from the creek lines the land was predominantly flat and featureless with a minor gradual fall towards the Werribee River in the south.

Within the tree study area there was very little remnant indigenous vegetation comprising 5 naturally occurring trees, being Trees 1, 2, 3, 14 & 16. There was no recruitment of naturally occurring indigenous species.

The existing tree cover was generally sparse with the greatest concentration of trees existing as ornamental plantings, screens and wind breaks surrounding house lots and sheds or as shelter belts and wood lots along internal and boundary fence lines. With the exception of the 5 remnant indigenous trees, all trees were planted specimens, predominantly installed for functional purposes. Relatively few trees were installed as ornamental specimens, and occurrences of such trees were typically restricted to areas surrounding property dwellings and entrance driveways. The tree stock predominantly comprised maturing to over-mature Sugar Gums (*Eucalyptus cladocalyx*) and Bushy Sugar Gum (*Eucalyptus cladocalyx* 'Nana') planted generally as groups along paddock boundaries, as close spaced woodlots or as individual specimens scattered at random across larger paddocks to shade grazing animals.

Suffice to say the overall impression of the site was that vegetation comprised planted trees of assorted species, age and quality but with very few mature to over-mature specimens of indigenous trees and few trees that were of high arboricultural value or were individual dominant landscape features.

Relatively new planting of mixed native species had been planted as a windbreak along the eastern road verge of Davis Road, south of Sayers Road and several of the farm houses. It is estimated that these were approximately 10 years of age. Despite their overall small stature, by virtue of the lack of trees across the study area, even small trees provided a positive visual impact to the landscape.

3.2 Tree population.

Approximately 1,630 trees were observed across the site comprising 29 individual trees of which 14 were attributed a High or Very High arboricultural rating.

11 groups comprising approximately 1,600 trees were inspected of which 4 were attributed a High arboricultural rating comprising approximately 1,100 trees.

3.3 The species and origin of each tree was identified to determine whether any trees were locally indigenous or native to Victoria and is recorded in the tree data as tree origin.

3.3.1 As already stated, apart from the 5 indigenous trees, all trees were planted specimens for either ornamental, amenity or functional purposes including 13 tree features comprising approximately 20 tree that were Victorian native.

3.3.2 A permit would be required to remove and appropriately offset the indigenous trees- 1, 2, 3, 14 & 16.

3.4 Tree health:

The health rating was assessed based on foliage colour, size and density as well as shoot initiation and elongation or presence of crown dieback.

A high proportion of the trees (<90%) displayed Fair or better health considered to be typical for the species growing in this environment under current conditions and at the end of more than a decade of drought.

Health deficiencies were typically associated with conditions including:

- Drought stress exhibited as crown dieback and desiccation of trees/branches exposed to hot winds,
- Age related decline,
- Overcrowding and suppressed conditions.

3.5 Tree structure:

The structure of the trees was assessed for structural defects and deficiencies, likelihood of failures and presence of targets.

In general the trees displayed Fair structural condition with 70% of the trees recorded displaying fair or better structural quality. Given that only trees of Very High or High arboricultural quality were required to be assessed the figures are considerably skewed to and a high proportion of deficient trees were not included in the tree assessment data.

Defects and deficiencies were generally observed as trees that had;

- been lopped or coppiced or were stump re-sprouts.
- been subject to major limb/stem failure,
- included bark forks and /or over-extended limbs,
- excessive dieback and deadwood,
- borer damage (especially Acacias and Sugar Gums) or
- asymmetric crowns and suppressed form.

3.6 Arboricultural rating.

Each of the assessed tree features was attributed an 'Arboricultural Rating'. Definitions of arboricultural ratings can be reviewed in Appendix 3.

Table 1 indicates the arboricultural ratings attributed to the trees inspected.

Table 1: Arboricultural rating	Total	Tree numbers
Very high	1	1
High	17	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 24, Grp 1 (48 trees), Grp4 (≈150 trees), Grp7(≈850 trees), Grp9 (≈55 trees), 14, 16, 17, 19, 20,
Additional trees of interest	9	Grp3 (6 trees), Grp5 (3 trees), Grp6 (≈110 trees), Grp8 (≈150 trees)
Total	27	

(Refer to Appendix 2 for tree location and numbering and Appendix 3 for tree descriptors).

3.7 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 (TPZs) for retained trees. Refer to appendix 4 for guidelines on establishing and managing tree protection zones in accordance with Australian Standard 4970-2009_Protection of trees on development sites.

4 Discussion

4.1 Many of the Sugar Gum trees displayed reduced foliage density or crown dieback as well as structural defects in the trunks, borer damage and evidence of limb failures. The characteristic habit of long ascending limbs with foliage held terminally limits effective arboricultural management of these trees especially in the urban context.

- 4.2 In arboricultural terms, maturing Sugar Gums are considered to be poorly suited to retention in the urban or residential context. Retention of High rated Sugar Gums should only be considered where they can be kept in large public open space with low target potential.
- 4.3 Due to the close grown nature of the Bushy Sugar Gum and Sugar Gum windrows the trees have developed in the shelter of the group and may become susceptible to tree or limb failure if the group is fragmented by failure of defective trees or removal of parts of the group during development. Fragmentation of such groups can expose trees with structural deficiencies to altered environmental conditions and wind loading resulting in increased failure rates among retained trees. Therefore, fragmentation should only occur where retained trees provide sufficient ongoing mutual protection to maintain stand integrity. If the group is overly fragmented it is unlikely the trees will acclimatise to the increased wind loading of previously protected limbs and limb failure and premature decline will result.
- 4.4 The Bushy Sugar Gum develops a lower branching habit and tends to be of smaller dimensions than the larger growing Sugar Gum it is related to. Given the reduced size potential it represents a better option for retention than the larger species though the tree has similar characteristics of developing over-extended end-weighted form that has the potential for branch failure. Despite their relatively small dimensions, the large number of trees in some of the Bushy Sugar Gum windrows and the overall distance the windrows cover makes them a feature of the southern extent of the study area worthy of consideration within the survey.
- 4.5 Longer-term preservation of windrows and mature specimens of native trees in urban landscapes is best achieved by ensuring the trees are retained in large areas of open space, preferably where the target potential is low and the trees can continue to grow in relatively undisturbed conditions.
- 4.6 Where trees have been coppiced, for the harvesting of timber for fencing and fuel, the trees are considered to have no arboricultural value because the regrowth that is produced in response to the coppicing is vigorous but comparatively poorly attached and the tree base is subject to decay and degradation. There were comparatively few lopped or coppiced Sugar Gums within the site.
- 4.7 Not all 'Moderate or Low' rated tree features should be dismissed as candidates poorly suited for retention, though overall, the retention of such trees should not compromise design intent. In certain landscape settings, smaller specimens in otherwise reasonable condition have the potential to offer an established tree resource, even if only as an interim measure. Low rated trees with health or structural deficiencies are generally not desirable candidates for retention. Windrows with health and structural defects should generally be removed.
- 4.7.1 Several group features of Moderate arboricultural quality have been included in the assessment because of the visual landscape contribution they contribute to the study area. They include Groups 3, 5, 6 and 8.
- 4.8 Trees attributed an arboricultural value of None were the least suited to retention on arboricultural grounds, having significant health and / or structural defects. Such trees are unlikely to provide a useful tree resource insofar as providing established canopy in future development even where risk levels associated with their retention can be managed to an acceptable level.
- 4.9 The assessment also included a useful life expectancy component. The useful life expectancy estimation provides an indicative range of potential functional longevity before anticipated health, structural or age related attrition renders such trees inappropriate in the context of an urban setting. Given the scale of the development and potential settings for trees, the useful life expectancy rating has obvious limitations. In a natural or semi-natural situation and in the absence of people or property, the useful life expectancy of a tree ends when it collapses and completely decomposes. In an urban setting the useful life expectancy of an individual tree or group of trees is measured by its ability to provide ongoing amenity and is therefore highly dependent on context. Another obvious challenge with assigning useful life expectancies is that it presumes some consistency of environmental conditions. Development can irrevocably alters site conditions that have a deleterious effect on tree condition and natural lifespan. Therefore attributing a meaningful useful life expectancy in the absence of design plans that contextualizes the trees setting

and environmental changes relies on many assumptions and may be misleading. The useful life expectancy attributed in this assessment, should not therefore be interpreted in isolation from other assessment criteria.

- 4.10 All trees nominated for retention will require periodic inspection and appropriate arboricultural maintenance and pruning. All pruning must be undertaken by suitably trained and experienced arborists and comply with Australian Standard 4373-2007 - Pruning of Amenity trees.
- 4.11 No form of excavation for footings or trenching for installation of underground services is permitted within the nominated Tree Protection Zone (TPZ) areas due the risk of severing roots vital to the stability and continued health of the trees. Smothering of tree roots by raising soil levels by more than 150mm within the TPZ area can also cause trees to decline.
- 4.12 In the absence of site design plans, it is not appropriate to speculate on which trees are most appropriate for retention, beyond the general guide provided by the arboricultural ratings attributed to each tree feature. Retention suitability correlates with the future landscape setting of retained trees, which will vary given the scale of the intended development. The following recommendations are provided for consideration in the design process.
 - 4.12.1 On the basis of tree quality and potential amenity, preference should be given to retaining trees of High or Very High arboricultural rating in built areas, or areas of increased target potential.
 - 4.12.2 Trees of Moderate or Low arboricultural value should not compromise reasonable design intent.
 - 4.12.3 Small trees of Low arboricultural value that are otherwise in reasonable condition may offer a potential established tree resource, even if only as an interim measure.
 - 4.12.4 Low rated trees with health or structural deficiencies should generally be considered for removal.
 - 4.12.5 Principles of risk management should be adopted to appropriately locate large maturing River Red Gum and Sugar Gum trees that are to be retained in any future development.
 - 4.12.6 Avoid fragmenting retained windrows. Fragmentation should only be considered when the fragments retain sufficient trees to largely negate the change in the trees' environment that may otherwise result in deterioration of retained specimens.
 - 4.12.7 Position retained windrows in large areas of open space, where the target potential is low and the trees can continue to grow in relatively undisturbed conditions.
 - 4.12.8 Windrows of Low arboricultural value with health and structural defects should be removed.
- 4.13 Under the Native Vegetation Framework act section 52.17 appropriate steps must be demonstrated to avoid, minimise or offset the removal of naturally occurring vegetation that is native to Victoria. This applies to the remnant indigenous trees identified in the study area including Trees 1, 2, 3, 14 & 16.
 - 4.13.1 Exemptions apply to trees planted for ornamental or windbreak purposes or as street trees.
- 4.14 No Tree Controls apply to any of the areas within the study area associated with Heritage Overlays (HO).
 - 4.14.1 It was observed that there were several prominent trees associated with an older homestead located at 85 to 87 Sewell Rd, Tarneit which is covered by Heritage Overlay Schedule 92 and 93. These trees have been included in the assessment although there are no specific tree controls that apply to the site under HO92 or HO93. The trees were observed from the property boundary as there were no contact details available to arrange access to observe these trees.
- 4.15 Environmental Significance Overlay-Schedules 1 and 2 apply to the Werribee River and Davis Creek. *'No permit is required to remove, destroy or lop any vegetation, including dead*

vegetation where the vegetation is non native'. No assessment of trees was required of trees within 100m of the Werribee River or 50m of Davis Creek.

5 Photographic catalogue



1



2



3

- 1 Shows the relative size, condition and location of High rated River Red Gum tree no. 2 in the horse agistment paddocks at 23 Davis Road. The tree was recovering from drought stress and mistletoe infestation.
- 2 Shows the relative size, condition and location of High rated Sugar Gum tree no. 3 in the horse agistment paddocks at 23 Davis Road. Despite basal decay the tree could be managed with arboricultural maintenance.
- 3 Shows the relative size, location and poor structural condition of Tree 14, the remnant Blue Box (*Eucalyptus bauerana*). The tree had lost the main leader and had extensive trunk decay. The tree should be retained within a reserve that excludes people from lingering beneath the tree and that permit natural regeneration of this species which is relatively uncommon in the region.



4



5



6

- 4 Shows the relative size and condition of the Bushy Sugar Gum in windrow Group 7. Looking to the southwest. Note the absence of trees between the group and the Werribee river in the background.
- 5 Shows the relative size and condition of the Bushy Sugar Gum in windrow Group 7. Looking to the north east.
- 6 Shows the relative size, location and poor structural condition of Tree 16, River Red Gum in the horse agistment paddocks at 23 Davis Road. The tree had lost the main leader and had extensive trunk decay. The tree should be retained within a reserve that excludes people from lingering beneath the tree and that permit natural regeneration of this species.

6 Conclusion and Recommendations

- 6.1 Tree Logic, acting on behalf of The Growth Areas Authority, surveyed and assessed trees within the Tarneit Precinct Zone 91. The survey was commissioned primarily for the purpose of providing information on the arboricultural merit of larger trees onsite to inform the design process.
- 6.2 The tree population was unremarkable overall both across the site and within individual properties. Only one tree attracted a Very High arboricultural rating and sixteen tree features attracted a High arboricultural rating. Refer to Table 1, Arboricultural ratings on Page 6.
- 6.2.1 Approximately 1,630 trees were observed across the site comprising 29 individual trees and 11 groups comprising approximately 1600 trees.
- 6.3 Trees 1, 2, 3, 14 and 16 were indigenous trees that appeared to be naturally occurring and remnants from before clearing of the surrounding land. The remaining native/indigenous specimens were planted as ornamentals or functional installations.
- 6.4 In the absence of site design plans, it is not appropriate to speculate on which trees are most appropriate for retention, beyond the general guide provided by the arboricultural ratings attributed to each feature. Retention suitability correlates with the future landscape setting around retained trees, which will vary given the scale of the intended development. Therefore, on the basis of tree quality and potential amenity, preference should be given to retaining trees of Very High or High arboricultural rating in built areas, or areas of increased target potential. Design modification should be altered where such trees have relatively long lifespan.
- 6.5 Conversely, areas of public open space are not only suited to the retention of quality stock, but may also provide opportunity to retain low quality trees either as interim canopy until such time as new landscapes establish or as longer term landscape elements in areas where risk associated with the retention of such trees is acceptable. Arboricultural ratings and useful life spans have been provided for all assessed trees/groups in the tree assessment table in Appendix 1 of this document.

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

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Appendix 1: Tree and group details: Tarneit PSP 91

High and Very High rated trees and groups.

Refer to following page.

DBH = Diameter at Breast Height (measured in centimetres at 1.3m above ground unless otherwise stated).

H x W = Height x Width of crown (measured in metres).

TPZ = Tree Protection Zone (metre radius). Radius distances measured in metres from the centre of the trunk.

For tree location and numbering refer to plans at Appendix 2. See Appendix 3 for tree descriptors.

ID No	Common name (Botanic name)	DBH (cm)	Height (m)	Width (m)	Age range	Health	Structure	Arb rating	Tree origin	TPZ (m radius)	COMMENTS	No of trees	ULE (Years)
1	River Red Gum (Eucalyptus camaldulensis)	90	17	25	Maturing	Good	Fair	Very high	Indigenous	10.8	Abutting boundary and roadside reserve	1	25-50
2	River Red Gum (Eucalyptus camaldulensis)	99	9	18	Over-mature	Fair	Fair	High	Indigenous	11.9	Mistletoe	1	25-50
3	River Red Gum (Eucalyptus camaldulensis)	100	13	17	Over-mature	Good	Fair to poor	High	Indigenous	12.0	Basal decay	1	25-50
4	River Red Gum (Eucalyptus camaldulensis)	55	15	13	Semi-mature	Fair	Fair	High	Victorian native	6.6	Planted	1	50 +
5	River Red Gum (Eucalyptus camaldulensis)	38	12	8	Semi-mature	Fair	Fair	High	Victorian native	4.6	Planted	1	50 +
6	River Red Gum (Eucalyptus camaldulensis)	43	12	11	Semi-mature	Fair	Fair	High	Victorian native	5.2	Planted	1	50 +
7	Yellow Gum (Eucalyptus leucoxylon)	54	12	14	Maturing	Good	Fair	High	Victorian native	6.5		1	15-25
8	Kurrajong (Brachychiton populneus)	54	6	8	Semi-mature	Good	Fair	High	Australian native	6.5		1	15-25
9	Spotted Gum (Corymbia maculata)	35	13	8	Semi-mature	Fair	Fair	High	Victorian native	4.2		1	50 +
10	Aleppo Pine (Pinus halepensis)	110	20	20	Maturing	Fair	Good	High	Exotic conifer	13.2	120 dbh	1	15-25
11	Chinese Pistachio (Pistacia chinensis)	85	16	17	Maturing	Good	Good	High	Exotic deciduous	10.2		1	15-25
12	Aleppo Pine (Pinus halepensis)	70	16	14	Maturing	Good	Good	High	Exotic conifer	8.4		1	15-25
13	Kurrajong (Brachychiton populneus)	90	9	9	Maturing	Good	Fair	High	Australian native	10.8	90@50	1	15-25
24	Spotted Gum (Corymbia maculata)	55	13	10	Semi-mature	Good	Good	High	Victorian native	6.6		1	50 +
Grp1	Bushy Sugar Gum (Eucalyptus cladocalyx 'Nana')	30	7	8	Semi-mature	Good	Fair	High	Australian native	3.6	Low branching.	48	15-25
Grp4	Mixed natives	50	14	14	Semi-mature	Good	Fair	High	Mixed natives	6.0	Boundary observations only. Inc; E spathulata, E platypus, E occidentalis,	150	15-25
Grp7	Bushy Sugar Gum (Eucalyptus cladocalyx 'Nana')	30	9	8	Semi-mature	Fair	Fair	High	Australian native	3.6	Low branching. <5% fair to poor structure.	850	15-25

ID No	Common name (Botanic name)	DBH (cm)	Height (m)	Width (m)	Age range	Health	Structure	Arb rating	Tree origin	TPZ (m radius)	COMMENTS	No of trees	ULE (Years)
Grp9	Bushy Sugar Gum (Eucalyptus cladocalyx 'Nana')	33	8	9	Semi- mature	Fair	Fair	High	Australian native	4.0	Trunk wounds.	55	15-25
14	Blue Box (Eucalyptus bauerana)	90	10	14	Over- mature	Fair	Poor	Low	Indigenous	10.8	Remnant tree. Previously lopped- Trunk decay Retain	1	< 15
16	River Red Gum (Eucalyptus camaldulensis)	102	6	9	Over- mature	Fair to poor	Poor	Low	Indigenous	12.2	Lost main leader-resprouting	1	< 15
17	Sugar Gum (Eucalyptus cladocalyx)	80	18	15	Maturing	Fair	Fair to poor	Moderate	Australian native	9.6	Boundary observations only. Trunk wounds. Located adjacent to heritage site- HO62	1	< 15
19	River Red Gum (Eucalyptus camaldulensis)	90	20	17	Maturing	Good	Fair to poor	Moderate	Victorian native	10.8	Boundary observations only. Located adjacent to heritage site- HO93	1	15-25
20	Aleppo Pine (Pinus halepensis)	80	15	14	Maturing	Good	Fair to poor	Moderate	Exotic conifer	9.6	Boundary observations only. Located adjacent to heritage site- HO93	1	15-25
Grp3	River Red Gum (Eucalyptus camaldulensis)	33	10	6	Semi- mature	Fair	Fair	Moderate	Victorian native	4.0	Planted. Close grown	6	25-50
Grp5	River Red Gum (Eucalyptus camaldulensis)	35	11	7	Semi- mature	Fair	Fair	Moderate	Victorian native	4.2		3	25-50
Grp6	Mixed natives	30	9	7	Semi- mature	Fair	Fair	Moderate	Mixed natives	3.6	Inc: E polyanthemom, E camaldulensis, E cladocalyx.	110	25-50
Grp8	Bushy Sugar Gum (Eucalyptus cladocalyx 'Nana')	40	9	9	Semi- mature	Fair	Fair to poor	Moderate	Australian native	4.8	Low branching. ~10% fair to poor structure.	150	25-50

Appendix 2: Tree and group numbers & locations: Tarneit PSP 91

High and Very High rated trees and groups.

Refer to following page.

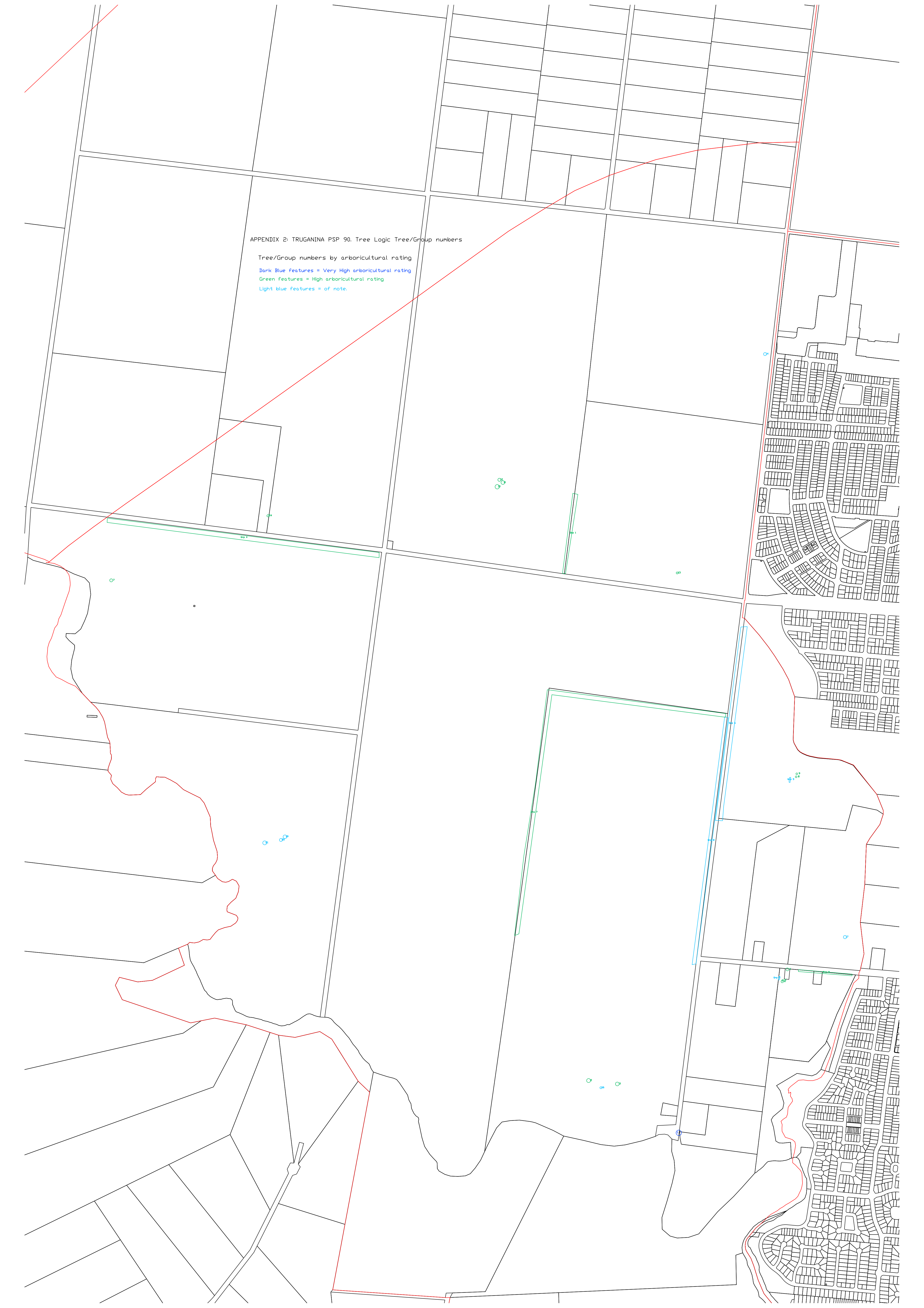
APPENDIX 2: TRUGANINA PSP 90. Tree Logic Tree/Group numbers

Tree/Group numbers by arboricultural rating

Dark Blue features = Very High arboricultural rating

Green features = High arboricultural rating

Light blue features = of note.



Appendix 3: Tree Descriptors, Version 3 (June 2006) Tree Logic Pty. Ltd.

Tree Condition: The assessment of tree condition evaluates factors of health, structure and form. 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. 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 author.

The normal distribution curve is a statistical model which shows that for a large number of observations of a particular population, the frequency of the observations creates a bell-shaped curve. This pattern is commonly found in the natural and behavioural sciences. Diagram 4, 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. Furthermore, that those individual trees with an assessed condition approaching the outer ends of the spectrum occur less often.

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

DBH: Indicates the trunk diameter (expressed in centimetres) of an individual tree measured at 1.3m above the existing ground level (Diagram 1) or where otherwise indicated (Diagram 2), multiple leaders are measured individually (Diagram 3). Plants with multiple leader habit, e.g. *Cotoneaster* sp., may be measured at the base. Measurements undertaken with foresters' tape or builders tape.

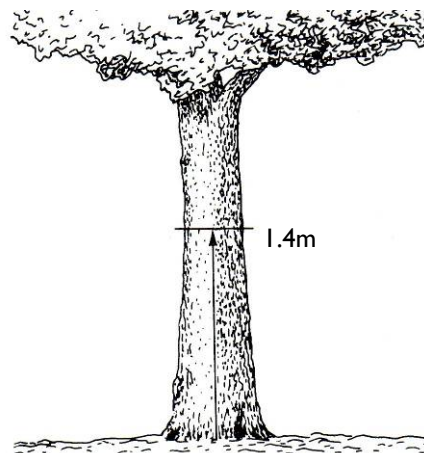


Diagram 1: Measurement of DBH on tree with single trunk

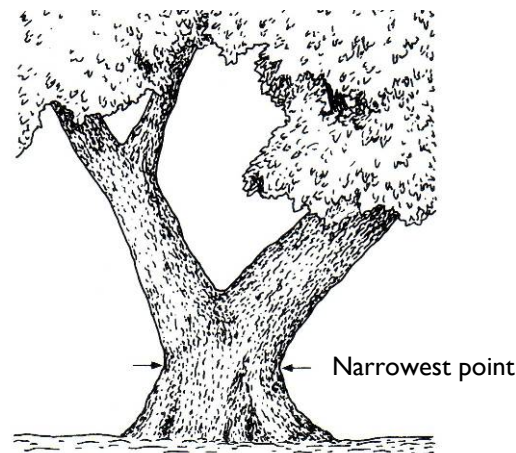


Diagram 2: Measurement of basal diameter at narrowest point above the basal flare

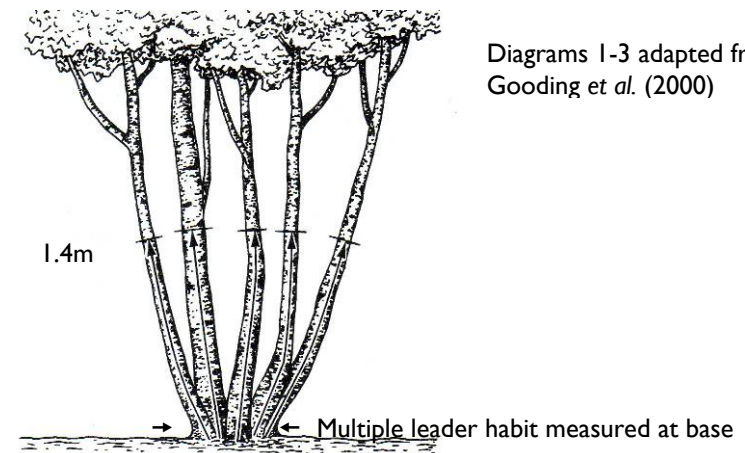


Diagram 3: Measurement of DBH on tree with multiple trunks, measured individually or at the base

Diagrams 1-3 adapted from Gooding et al. (2000)

H x W: Indicates height and width of the individual tree; dimensions are expressed in metres. Crown heights are measured with a clinometer 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 clinometer readings in conjunction with author's experience. Crown widths are generally paced (estimated) at the widest axis or can be measured on two axes and averaged.

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
Victorian native	Occurs naturally within some part of the State of Victoria (not exclusively) but is not indigenous
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
Palm	Woody monocotyledon
Other	Other descriptions as indicated

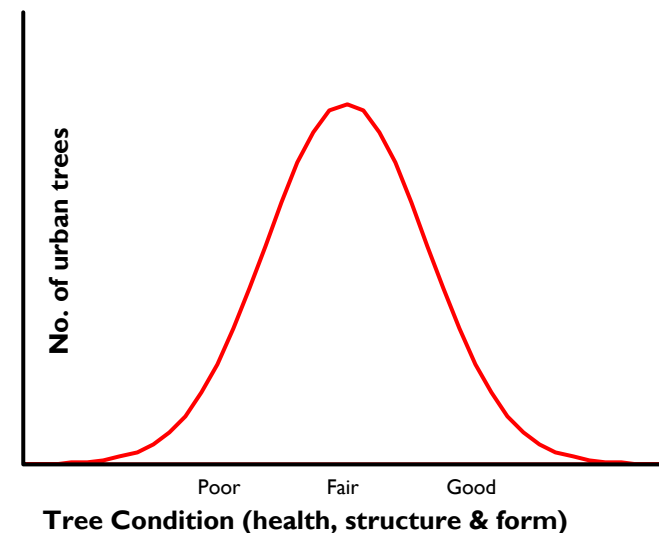


Diagram 4: Indicative normal distribution curve for tree condition

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

Category	Description
Young	Sapling tree and/or recently planted
Semi-mature	Tree rapidly increasing in size and yet to achieve expected size in situation
Maturing	Specimen approaching expected size in situation, with reduced incremental growth
Over-mature	Tree is senescent and in decline

Form: Describes the general shape of the tree.

Category	Description
Symmetric	Generally evenly balanced and full crown
Asymmetric	Crown generally biased in one direction; can be minor or major
Stump re-sprout	Adventitious shoots originating from stump or trunk (after severe dieback or lopping)
Suppressed	Tree form inhibited
Manipulated	Hedge, pollard, topiary, windrow; managed for specific landscape use or aesthetic

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

Category	Vigour/Extension growth	Decline symptoms/Deadwood	Foliage density, colour, size, intactness	Pests and or disease
Good	Above typical	None or minimal	Better than typical	None or minimal
Fair	Typical	Typical or expected	Typical	Typical, within damage thresholds
Fair to Poor	Below typical	More than typical	Exhibiting deficiencies	Exceeds damage thresholds
Poor	Minimal	Excessive and large amount/size	Exhibiting severe deficiencies	Extreme and contributing to decline
Dead	N/A	N/A	N/A	N/A

Structure: Assesses principal components of tree structure (Diagram 5).

	Zone 1	Zone 2	Zone 3	Zone 4		
Descriptor	Root plate & lower stem	Trunk	Primary branch support	Outer crown and roots	Lean from vertical	Risk potential if targets present
Good	No damage, disease or decay; obvious basal flare / stable in ground	No damage, disease or decay; well tapered	Well formed, attached, spaced and tapered	No damage, disease, decay or structural defect	Low or none	Low or none
Fair	Minor damage or decay	Minor damage or decay	Typically formed, attached, spaced and tapered	Minor damage, disease or decay; minor branch end-weight or over-extension	Minor / natural	Minor
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	Moderate	Moderate
Poor	Major damage, disease or decay; fungal fruiting bodies present	Major damage, disease or decay; exceeds recognised thresholds; fungal fruiting bodies present	Decayed, cavities or has acute branch attachments with included bark; excessive compression flaring; failure likely	Major damage, disease or decay; fungal fruiting bodies present; major branch end-weight or over-extension	Acute	High
Very Poor	Excessive damage, disease or decay; unstable / loose in ground; failure probable	Excessive damage, disease or decay; cavities	Decayed, cavities or branch attachments with active split; failure imminent	Excessive damage, disease or decay; excessive branch end-weight or over-extension	Excessive – root plate failure or stem failure probable	Severe/imminent

The lowest or worst descriptor assigned to the tree in any column could generally be the overall rating assigned to the tree.

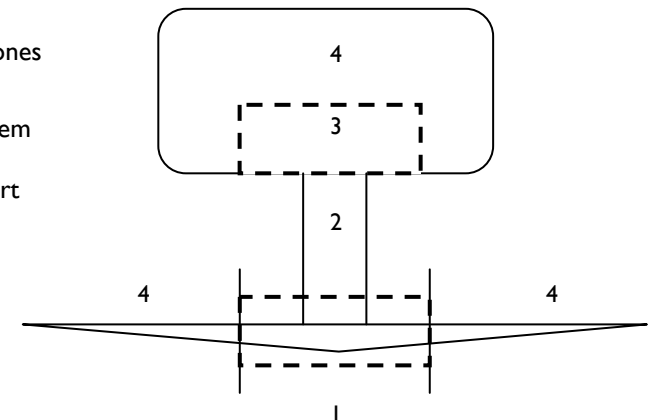
The assessment for structure is limited to observations of external and above ground tree parts. It does not include any exploratory assessment of underground or internal tree parts unless this is requested as part of the investigation.

Trees are assessed and the 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.

Diagram 5: Tree structure zones

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



Arboricultural Rating: Relates to the combination of previous tree condition factors, including health, structure and form (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.

Category	Description
Very High	Tree of very high quality in good condition. Generally a prominent arboricultural feature. Tree is capable of tolerating changes in its environment if managed appropriately. These trees have the potential to be a long-term component of the landscape if managed appropriately. Retention of these trees is highly desirable.
High	Tree of high quality with generally sound structural condition and good health. Generally is or has the potential to become a prominent landscape feature. Tree is capable of tolerating changes in its environment and has the potential to be a long-term component of the landscape if managed appropriately.
Moderate	Tree of moderate quality, in fair or better condition. Tree may have a condition, and or structural problem that will respond to arboricultural treatment. Tree is capable of tolerating changes in its environment if managed appropriately. These trees have the potential to be a medium- to long-term component of the landscape if managed appropriately. Retention of these trees is generally desirable.
Low	Tree of low quality and/or little amenity value. Tree in poor health and/or with poor structure. Tree unlikely to respond positively to changes in its environment and does not warrant design modification to preserve it. Tree is not significant for its size and/or young. These trees are easily replaceable. Tree (species) is functionally inappropriate to specific location and would be expected to be problematic if retained. Retention of such trees may be considered if not requiring a disproportionate expenditure of resources for a tree in its condition and location.
None	Tree has a severe structural defect and/or health problem that cannot be sustained with practical arboricultural techniques and the loss of tree would be expected in the short term. Tree whose retention would be unviable after the removal of adjacent trees (includes trees that have developed in close spaced groups and would not be expected to acclimatise to severe alterations to surrounding environment – removal of adjacent shelter trees) Tree has a detrimental effect on the environment, for example, the tree is a woody weed. These trees should be removed on the basis of sound arboricultural management.

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Appendix 4: Tree protection zones. Tree logic Pty. Ltd. © 2009

1.0 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.

2.0 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.

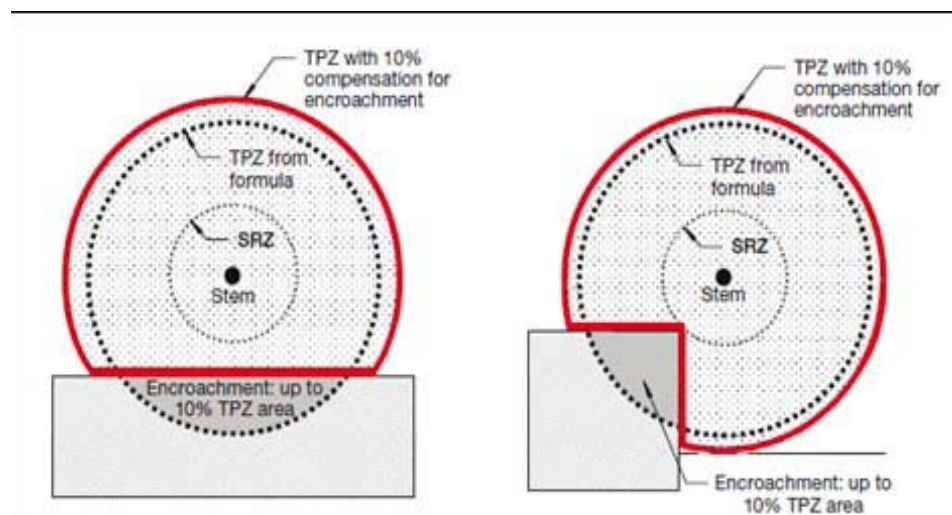


Diagram 1: Examples of minor encroachment into a TPZ. Extract from: AS4970-2009, Appendix D, p30 of 32

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 could be referred to as the Root Plate Radius (Mattheck & Breloer, 1994). Within the Root Plate Radius (RPR) distance, all roots and the soil surrounding the roots are deemed significant.

No root or soil disturbance is permitted within the RPR. In the area outside the RPR, the tree may tolerate the loss of one or a number of roots. The table below indicates the size of tree roots, outside the RPR 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 RPR

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

Construction Guidelines

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

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

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