ARBORICULTURAL IMPACT ASSESSMENT REPORT

Prepared for

BIOSIS PTY LTD

Site Address

MOUNT PENANG GARDENS, KARIONG, NSW 2250

Project

Mount Penang Essential Infrastructure Works Review of Environmental Factors

Prepared by

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Graduate Certificate of Arboriculture (AQF Level 8), LLB.

Preface

Trees are now regarded as critical infrastructure and community assets with their benefits spanning environmental, economic, cultural and political domains alike.

Trees grow in a delicate balance with their environment and any changes to that balance must be minimized if the tree is to remain healthy and fulfil its potential. It is rarely possible to repair stressed and injured trees, so damage needs to be avoided during all stages of development construction.

A tree's roots are critical supply lines for water and minerals and are essential for both carbohydrate storage and hormonal signalling, congruent with physically anchoring the tree to the ground.

The aim of this Arboricultural Impact Assessment is to guide earthworks around retained trees located on the proposed development site through the formulation and implementation of best management practice tree protection methodologies. Thereby ensuring the trees long-term, integrity, vitality, and viability.

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Mount Penang Gardens, Kariong NSW

1 Executive Summary

Active Green Services Pty Ltd (AGS) has been engaged by Biosis Pty Ltd (Biosis) to prepare an Arboricultural Impact Assessment (AIA) with regards to trees and proposed infrastructure works within a specified survey area of Mount Penang Gardens, Kariong NSW. Hence, from the 14th - 18th of March 2022, two hundred and forty-one (241) individual Visual Tree Assessments (VTA) pursuant to *Standards Australia AS 4970-2009 Protection of trees on development sites* were carried out on the subject tree population by a suitably qualified (AQF Level 5) AGS arborist.

The abovementioned site-specific tree assessment data includes tree maturity, dimensions, estimated life expectancy, vitality, ecophysiology, biomechanics, pedology, root morphology, landscape significance, and retention value *in situ*. This tree data provides the necessary arboricultural fundamentals required for calculating foreseeable arboricultural impact, its pragmatic mitigation and tree viability pre and post development. For ease of identification all of the assessed trees have been GPS located, aerial mapped, photographed and individually numbered with a physical tree tag.

Of the tree assessment data collected (241 trees), one hundred and fifty (150) trees were further assessed with regards to foreseeable development encroachment and impact per the supplied Northrop Design Plans. On review of this tree data, it was calculated that the proposed infrastructural works will encroach on the Tree Protection Zones[1] (TPZ) of one hundred and fifteen (115) trees. Nineteen (19) of these TPZ encroachments are calculated as *'Minor'*[2]; and ninety-six (96) TPZ encroachments being calculated as *'Major'*[3]. Of arboricultural concern is that seventy-five (75) of the *'Major'* encroachments are calculated to be within the Structural Root Zone[4] (SRZ).

With regards to the abovementioned *'Major'* encroachments and the current design plans provided, on the balance of probabilities it is of a reasonable arboricultural belief that a high percentage of the subject trees will not remain viable and therefore will need to be pragmatically removed concurrent with recommended Compensatory Replanting to offset canopy loss. However, if initial Non-Destructive Root Exploration (Root Mapping) is utilised in combination with pragmatic Tree Sensitive Design modifications the impact level on a number of trees can be foreseeably reduced and therefore tree retention numbers will be increased.

The detail supporting this summary follows.

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[1] *AS 4970-2009 – Protection of trees on development sites s1.4.7*, Tree Protection Zone (TPZ): A specified area above and below ground and at a given distance from the trunk set aside for the protection of a tree's roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development.

[2] *AS 4970-2009: Minor encroachment (<10%): If the proposed encroachment is less than 10% (total area) of the TPZ, and outside of the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ.*

[3] *AS 4970-2009: Major- Viable encroachment (>10%):* If the proposed encroachment is greater than 10% (total area) of the TPZ, the project arborist must demonstrate that the tree(s) remain viable. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ. Tree sensitive construction techniques may be used for minor works within this area providing no structural roots are likely to be impacted, and the project arborist can demonstrate that the tree(s) remain viable. Root investigation by non-destructive methods may be required for proposed works within this area. All work within the TPZ must be carried out under the supervision of the project arborist.

[4] *AS 4970-2009*: The SRZ is the area of the root system used for stability, mechanical support, and anchorage of the tree. Severance of structural roots (>50 mm in diameter) within the SRZ is not recommended as it may lead to the destabilisation and/or serious decline of the tree.

2 Introduction

i. AGS has been commissioned by Biosis to prepare an AIA with regards to trees and the proposed infrastructure works at Mount Penang Gardens, Kariong. This AIA will:

- Identify trees within the development site that are likely to be impacted upon by any of the proposed works per the supplied Design Plans.
- Assess the vitality and retention value of these foreseeably impacted trees *in situ*.
- Assess, calculate and discuss the impacts with regards to tree retention and foreseeable viability.
- Put forward best practice management recommendations as to effective tree protection and development impact pursuant *to Standards Australia AS 4970-2009 Protection of trees on development sites.*

2.1 Objective

i. The purpose of this AIA is to provide all parties with standing an objective and unbiased arboricultural assessment of the tree population within the designated survey area with regards to tree viability and the ensuing impacts of the proposed infrastructural works per the supplied Design Plans.

2.2 Limitations

i. All arboricultural reasonings that have been discussed and provided are based on extensive empirical arboricultural knowledge, the internationally recognised Visual Tree Assessment (VTA) methodology (Mattheck and Breloer, 1994), (Matheny and Clark, 1998), the recognised Institute of Australian Consulting Arboriculturists (IACA) Significance of a Tree, Assessment Rating System (STARS), and Australian Standards *AS 4970-2009 Protection of trees on development sites*.

ii. Whilst this arboricultural assessment is thorough it should be noted that trees are dynamic living organisms exposed to both unforeseeable biotic and abiotic variables which on occasion can be harsh and severe. Therefore, this arboricultural assessment will consider on the balance of probabilities the most likely outcome(s) as opposed to those which could, may or fancifully occur.

2.3 Report References

i. As a progressive arboricultural company AGS keeps abreast of research data relating to all aspects of arboriculture and urban forestry. Hence the following arboricultural observations, reasonings, conclusions and recommendations are founded on industry standards and extensive empirical arboricultural knowledge. The science-based arboricultural survey methodologies and references used can be found in the Appendix.

ii. Please note that additional educational material has been appended to promote the urban forest through understanding and knowledge.

2.4 Scope of Works

i. Infrastructural works are proposed for Mount Penang Gardens, Kariong. These works are to include: HV power, water, sewage, a shared footpath and roading.

ii. A full set of Design Concept Plans are available upon request from Biosis and/or Northrop.

2.5 Location and Study Area

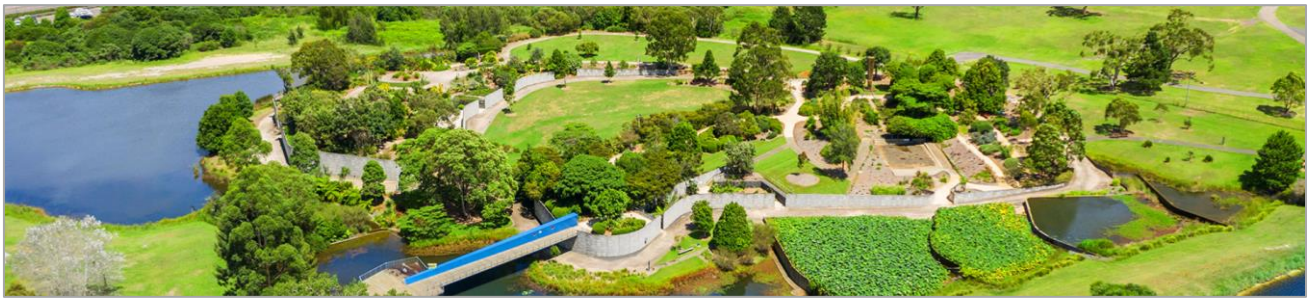


Image 1: Mt Penang Gardens (courtesay of Hunter & Central Coast Development Corporation)

Image 2: Site location and Survey Area (courtesy of Biosis)

2.6 Mapping Methodology

i. With regards to assessing and calculating arboricultural impact the subject tree population within the abovementioned survey area has been mapped, divided into twelve (12) sub-map areas and numbered as per the satellite Master-map provided below.

ii. All trees within the twelve (12) sub-maps which were identified as being of particular interest and/or relevance regarding the development works were GPS located using the Collector Esri Application and given a unique physical tree tag number.

iii. A CSV File and/or Shape File can be provided with the following tree data upon request.

2.7 Tree Locations

i. Please find below a Master-map and Sub-maps with the indicative locations of the assessed trees.

ii. For convenience the calculated Retention Values of the subject trees are colour-coded per the (*STARS) Tree Retention Value - Priority Matrix* which can be found in the Appendix.

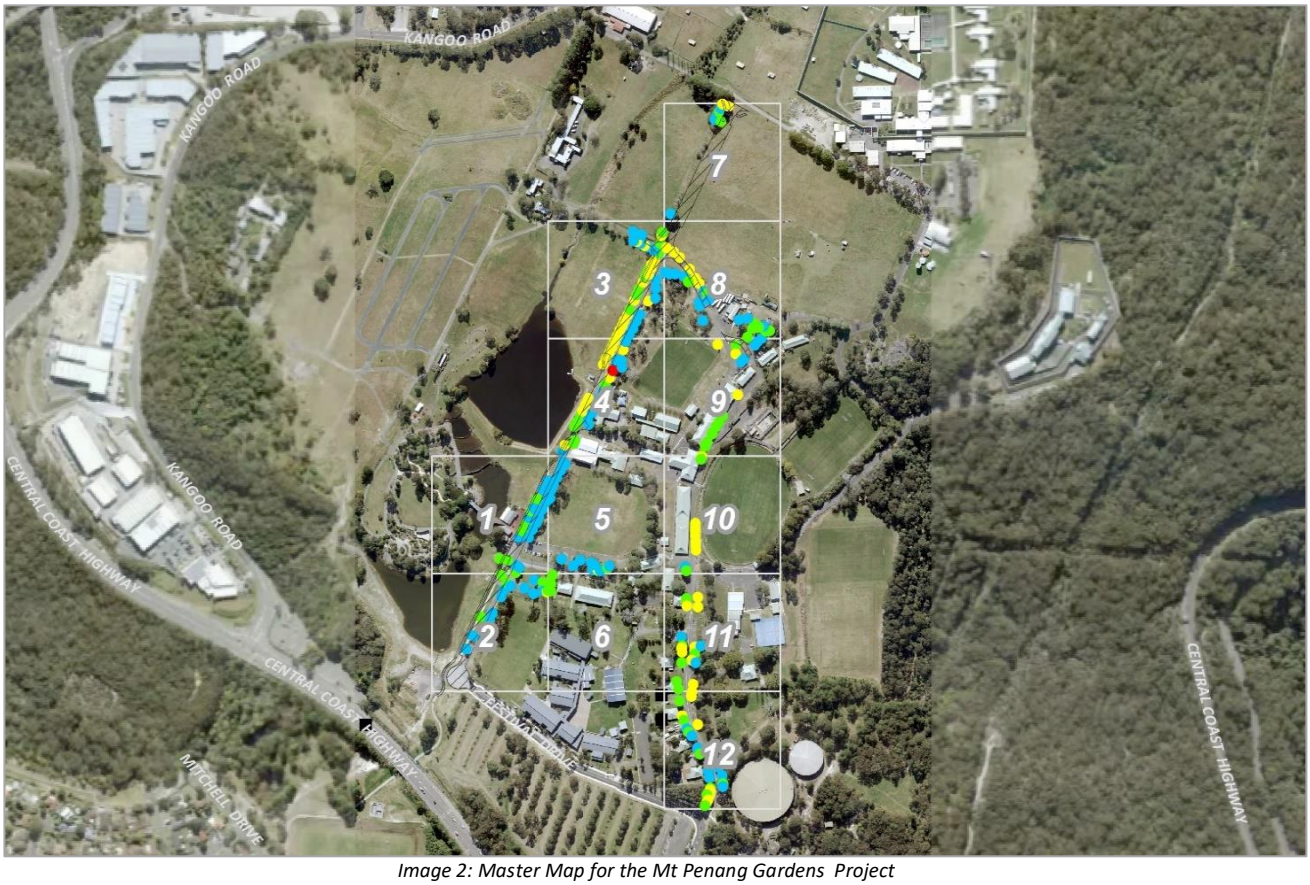
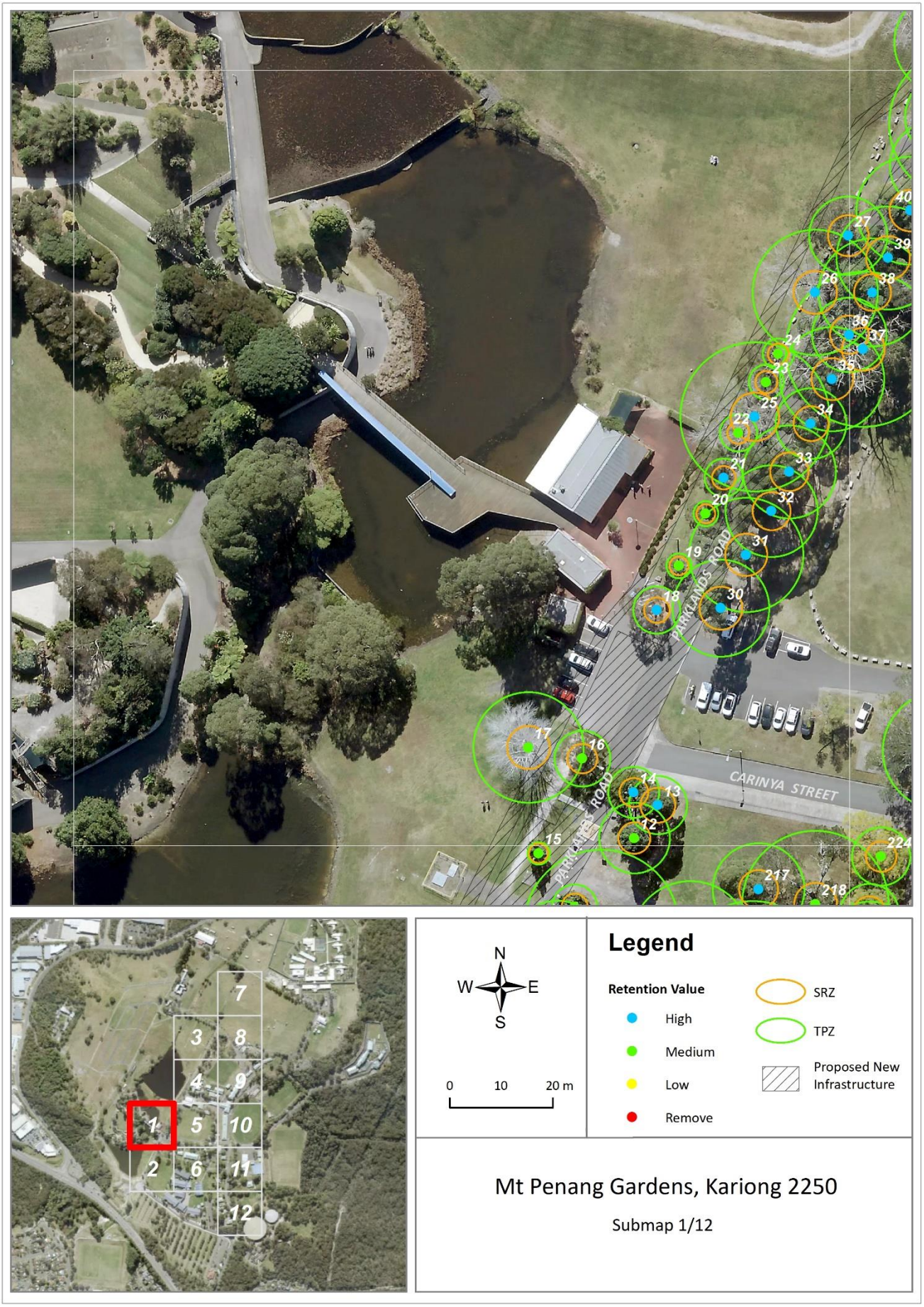


Image 2: Master Map for the Mt Penang Gardens Project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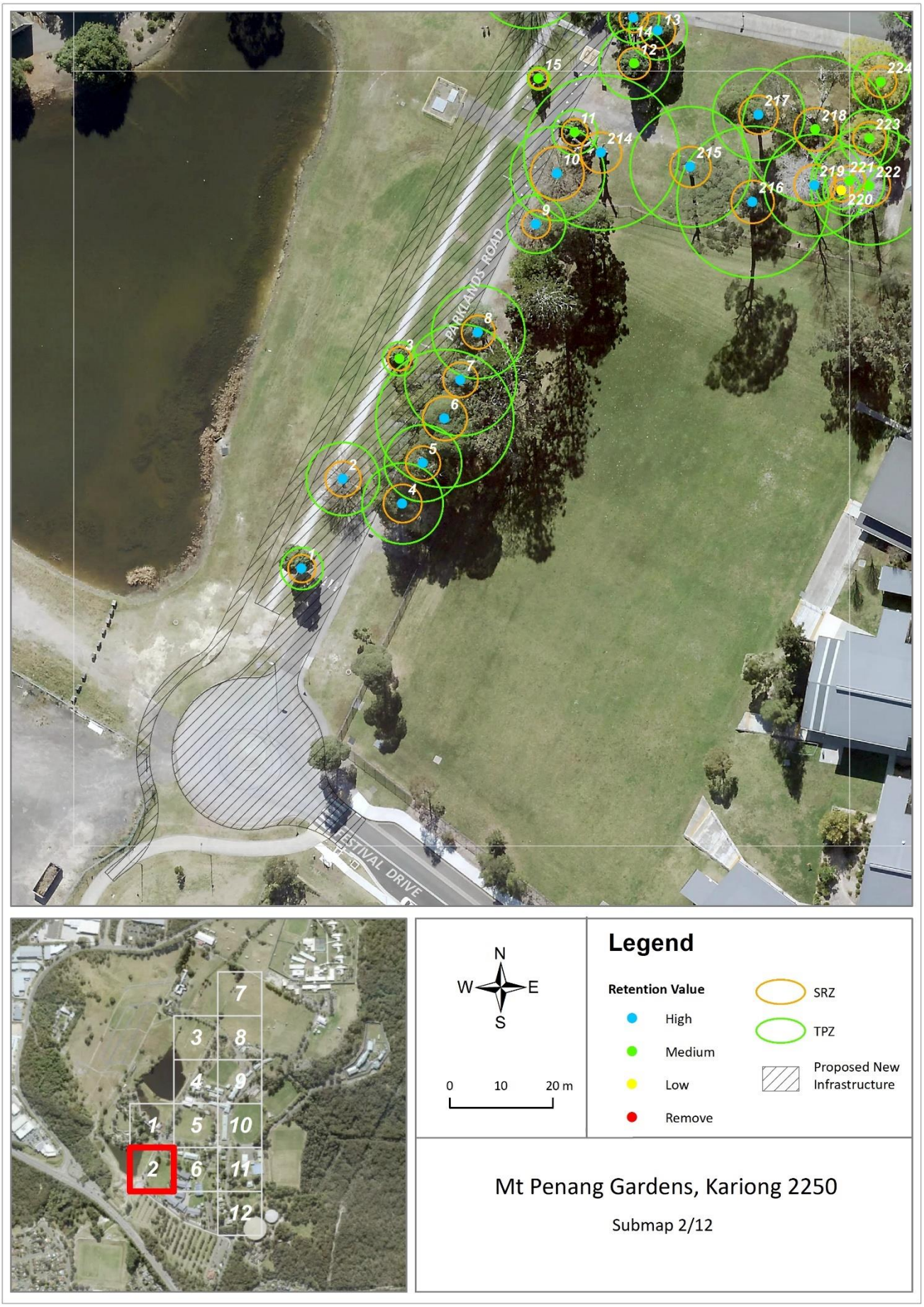
Submap 1/12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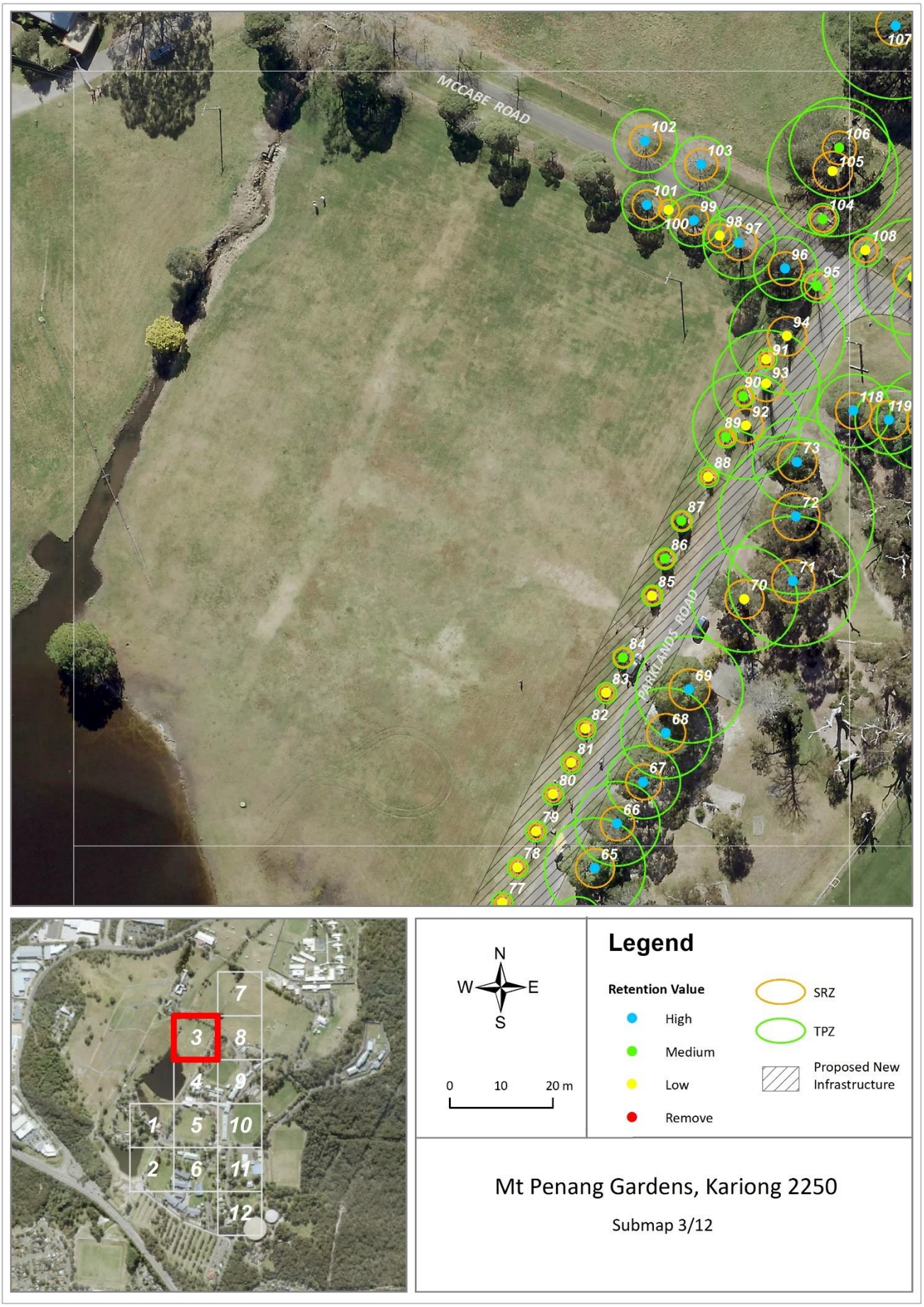
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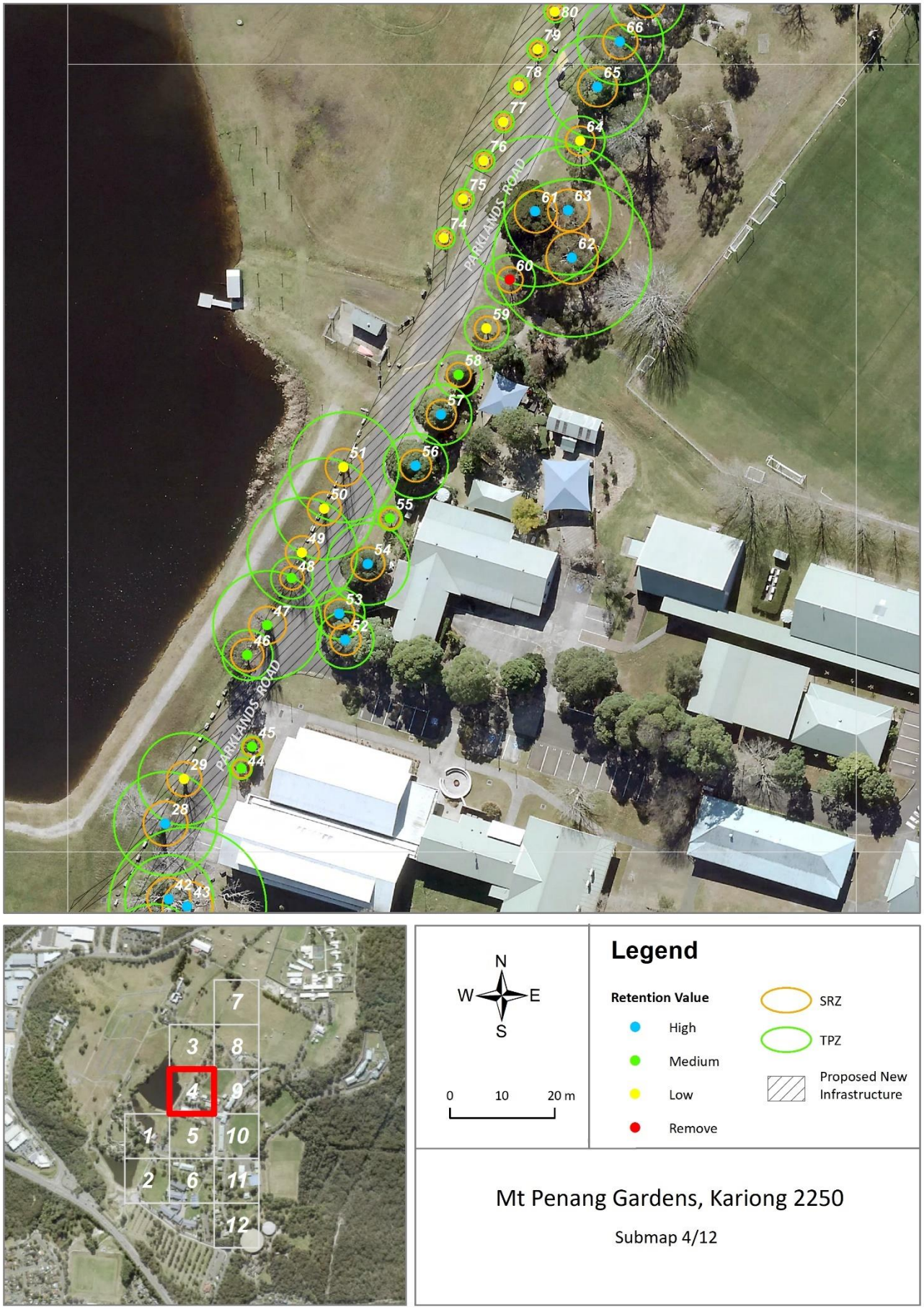
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Mt Penang Gardens, Kariong 2250

Submap 5/12

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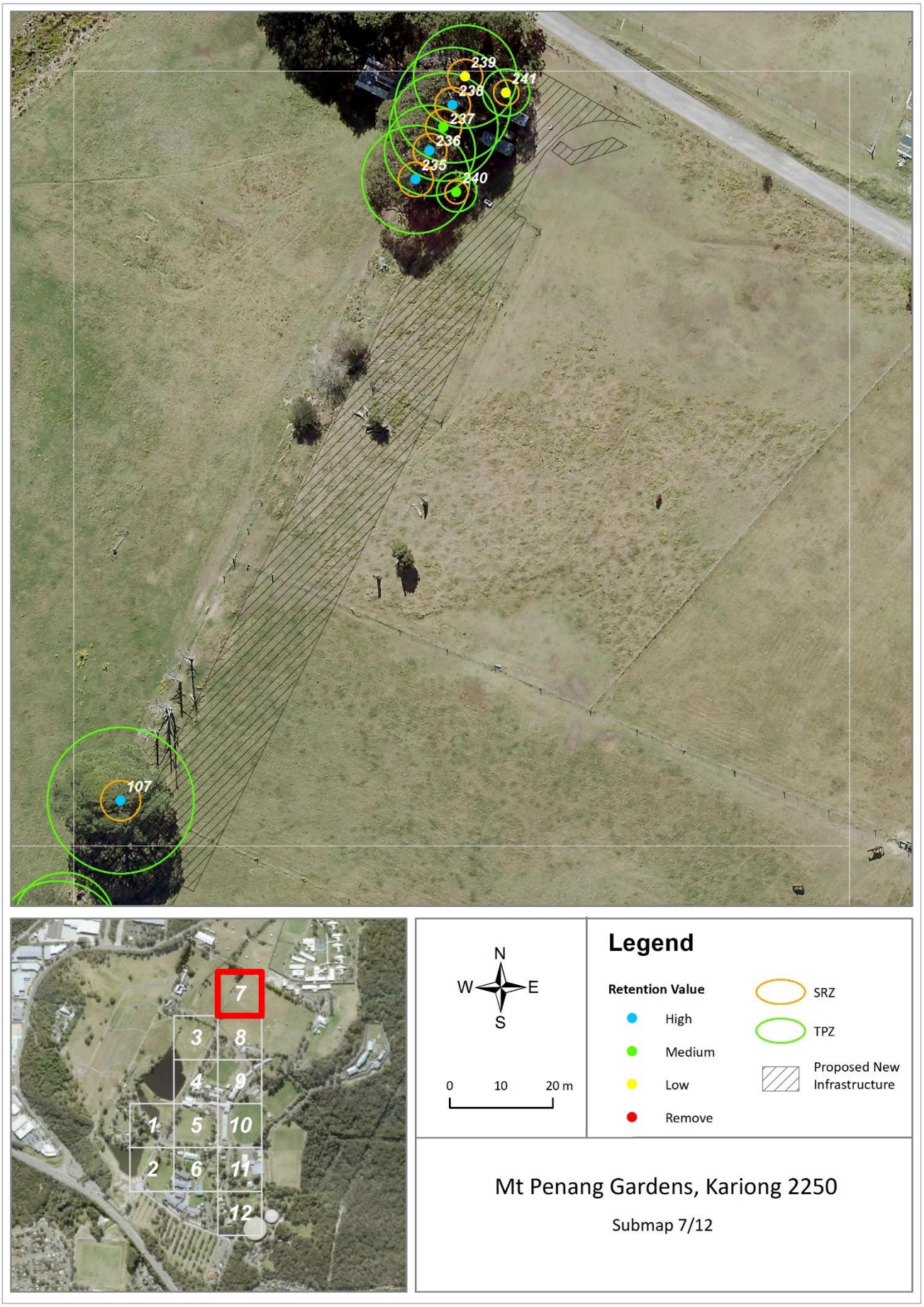
Mt Penang Gardens, Kariong 2250

Submap 6/12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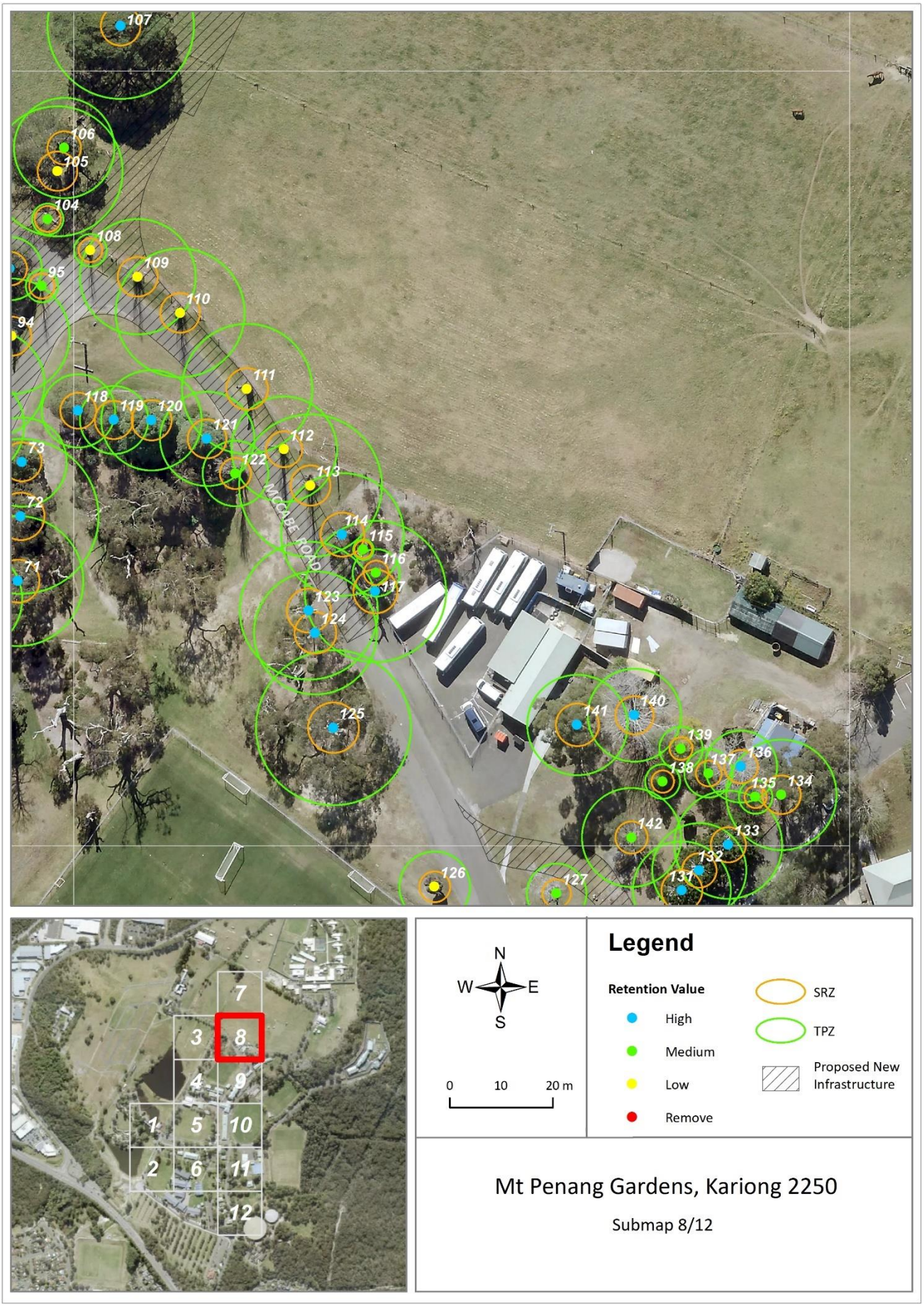
Submap 7/12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Submap 8/12

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Retention Value

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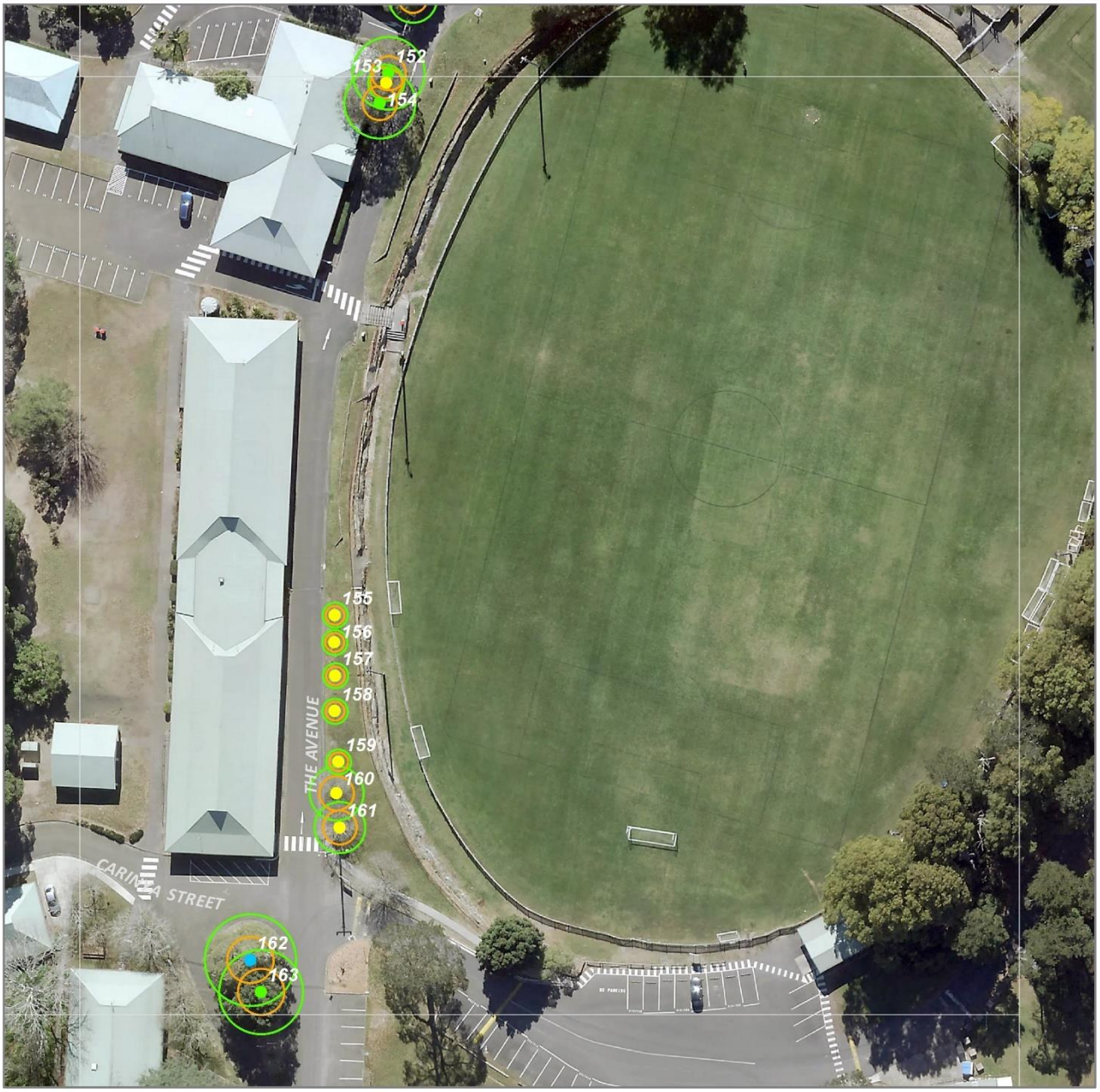
Mt Penang Gardens, Kariong 2250

Submap 9/12



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Retention Value

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- Proposed New Infrastructure

Mt Penang Gardens, Kariong 2250

Submap 10/12


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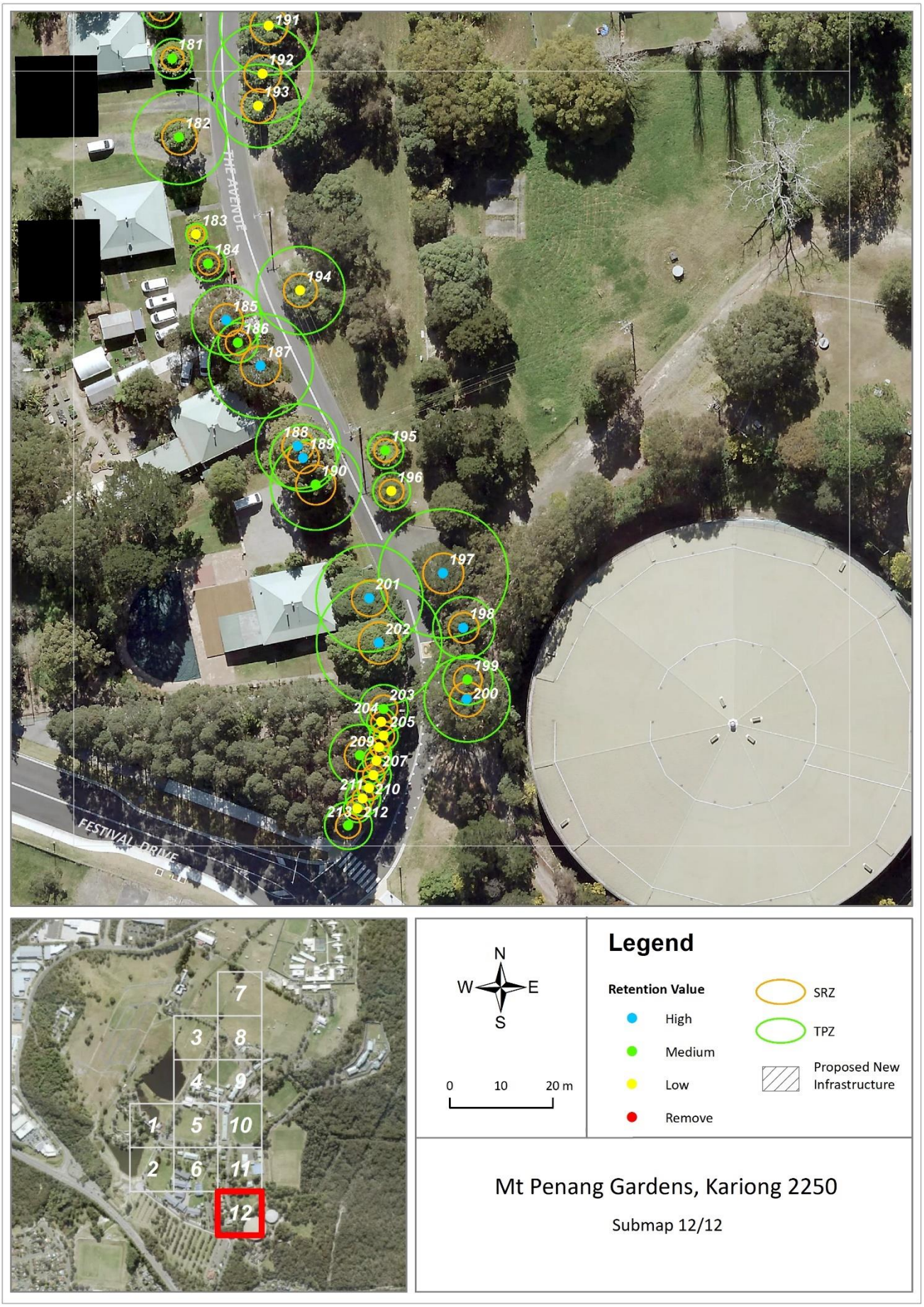
Submap 11/12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Submap 12/12

3 Arboricultural Methodology

3.1 Visual Tree Assessment

i. A Visual Tree Assessment (VTA) consistent with modern arboricultural practices (Mattheck and Breloer, 1994) was conducted by a suitably qualified and experienced (AQF Level 8) AGS arborist on the subject tree on the 11th of January 2022. This assessment was carried out at ground level and therefore classified as *Level 2: Basic Assessment* (Dunster et al., 2013). The VTA method is an internationally used and acknowledged method for tree inspection. Hazard symptoms are construed, defects are confirmed, measured and criteria of failure are assessed. A VTA provides science-based information about the body language and the biomechanics of a tree and if deemed necessary can recommend further dendrological diagnostic testing.

ii. The tools used onsite to gather the necessary VTA data were a nylon percussion hammer, mobile phone, and an I-pad. The total tree height(s) and canopy spread(s) were recorded using a digital laser range finder (Nikon Forestry Pro). The trunk diameter and DBH height measurements were made by using a forestry DBH measuring tape.

iii. For ease of identification all of the subject trees that will be foreseeably impacted upon have been mapped, photographed and individually tree tagged. No soil analysis, tissue sampling and/or geological investigations were carried out at that time.

3.2 Visual Tree Assessment Parameters

i. The following information outlines the basic parameters used to assess the subject trees. These parameters relate to the Tree Assessment data in *Table 1* below. Comprehensive definitions of the following descriptors are in the Appendix.

Tree Vitality is categorised through a visual determination using:

- leaf, twig or needle size, shape, and colour
- seasonal growth rates
- reaction wood development
- foliage density
- foliage coverage throughout the crown
- branch-tip dieback
- typical branch senescence.

For example, a tree assessed to have an average or fair vitality rating would generally have irregular [minor] leaf or needle shape and/or colour and/or size; and/or irregular [minor] foliage density, distribution and/or average growth indicators and/or some tip dieback.

Tree Form is an indication of crown shape. Crown shapes are influenced by their surroundings, light availability and branch loss, which can have varying impacts on their symmetry. The trees have generally been assessed on their individual crown shape, however, as the tree may be growing within a group environment, this could lead to the individual shape being assessed further down the scale. Although a poor rating may be attributed to the tree, the tree's contribution to the setting may be high

through association within the group canopy. This can be generally recognised through the Crown Class rating.

Crown Class rating provides an indication on the tree's relationship with the surrounding tree environment. The categories used include Dominant, Codominant, Intermediate, Suppressed and Open grown, as shown in the below diagram.

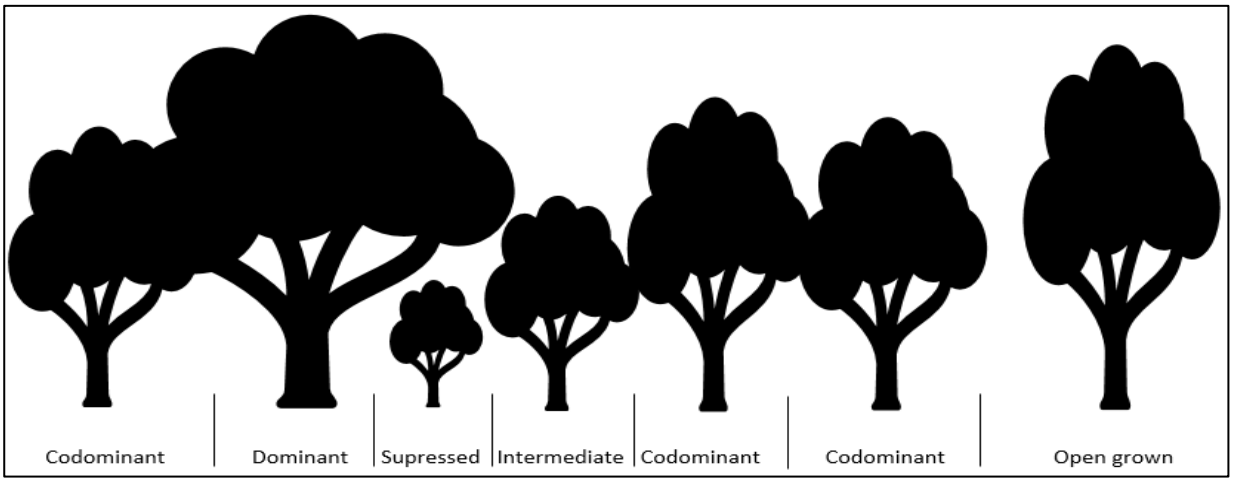

Image 2: Indicative Crown Class

Limb Structure: is a general evaluation on the branch union formation, weight balance, growth formation and foliage loss (that may affect branch weight and/or mass damping). This assessment is derived on typical structure of the species and its typical branch formation.

Trunk Form: assesses the flare at the base, taper, decay and cavities, formation of multi-stems that develop near or at ground level, girdling roots and growing angles.

Rootzone: visually assesses the general soil health, soil compaction and growth impediments. For example, growing environments with a high percentage of impervious seal or compaction are likely to be categorised as poor, notwithstanding the health of the tree.

Amenity Value: considers the appropriateness and value of the tree in the setting, any cultural and/or heritage significance and general ornamental value. In a group setting, it assesses the tree's value to the group and the adverse effects to the amenity of the group if the tree were to be removed. For example, the removal of a small, suppressed tree from a group setting may have a negligible adverse effect on the group's amenity value, therefore it is likely to be assessed as 'Little value' (*Very Poor*).

Function: of the tree assesses the usefulness of the tree in its setting. For example, does the tree contribute to soil retention on the side of a bank? The provision of stormwater attenuation? The amenity of the site, the provisions of microclimates/cooling during summer months and contribution to wildlife (roosting, perching and habitat). This is weighed up against any negative issues the trees may be causing, for example: conflict and damage to structures, the value of the structure is considered, the tree's growing location – is it the correct tree for the setting's use, etc.

Impediments: (rootzone and canopy) are structures that impede or supress normal tree development and/or function. This can include hard impervious surfaces within the rootzone or powerlines and other structures within or adjacent to the canopy.

Estimated Life Expectancy: An Estimated Life Expectancy (ELE) rating was determined by using the adapted Safe Useful Life Expectancy (SULE) and Tree AZ methodologies (Barrell. 1996, 2000). The aim of these two systems is to convert what amounts to a relatively complex Arboricultural assessment into a few broad categories that are more logically understood. An ELE rating provides an estimate of a tree's expected remaining lifespan after considering the current condition, vigour, and vitality of the subject tree(s) *in situ*. Ultimately the main aim is the establishment of a tree Retention Value. The objective of a ELE assessment is to contribute to the relative value of individual trees for the purpose of informing future management options. This calculated ELE rating will be inserted into the above-mentioned STARS Matrix (please refer to the Appendix section for further information).

Retention Value: Significance of a Tree, Assessment Rating System (STARS) provides the Retention Value of a tree and/or group of trees by balancing a combination of environmental, cultural, physical, amenity and social values. The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the Retention Value for a tree. A tree retention assessment has been undertaken in accordance with the *Institute of Australian Consulting Aboriculturalists (IACA) Significance of a Tree, Assessment Rating System (STARS)*. The system uses a scale of High, Medium, and Low significance in the landscape. Once the landscape significance of a tree has been defined, the Retention Value can be determined congruent with the trees' abovementioned Estimated Life Expectancy (ELE). Further details and the assessment criteria are in the Appendix.

- **Low:** These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
- **Medium:** These trees are moderately important for retention. Their removal should only be considered if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
- **High:** These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed per *Standards Australia AS 4970 Protection of trees on development sites*.

3.3 Root Zone Encroachment

i. Root depth and extension can be severely limited and highly irregular in urban settings. When root restrictions are minimal, root spread shows a strong relationship with trunk diameter, which is a more reliable predictor than canopy diameter ('drip-line') or tree height (Day et al., 2010). Therefore, all arboricultural recommendations and conclusions contained in this AIA with regards to tree root protection/retention were based upon and determined in accordance with the Australian Standards *AS 4970-2009 Protection of Trees on Development Sites.*

ii. A diagram indicative of a calculated TPZ and SRZ with regards to encroachment is included below to aid in the visualisation of the 'No-Dig' zones and where initial Non-Destructive Root Exploration must be carried out under the direct supervision of a Project Arborist. This diagram can be used to indicatively

portray a SRZ and TPZ of any tree within close proximity to works and thus the necessary 'stair-step' tree protection methodology can be adopted per the Construction Encroachment Descriptors & Categories Table below.

Diagram 1: McCabe Road (Tree 125) Eucalyptus haemastoma – Diagrammatical calculated zones

Please note that whilst working within the Tree Protection Zone (TPZ) of any tree all 'Major' encroachments must be undertaken by initial Non-Destructive Root Exploration through the use of Hand-digging and/or Air -Spade under the guidance of the onsite Project Arborist.

Construction Encroachment Descriptors & Categories Table: A Stair-step Approach

LEVEL	IMPACT CATEGORY	DESCRIPTION
1	*Removal*	The design and tree encroach each other to a point either the design must be modified, or the tree removed.
2	*Major: Non- Viable*	The construction proposal design has an encroachment of greater than 10% of Tree Protection Zone or impacts the Structural Root Zone. The tree does require immediate removal, though under the current design proposal, the works are expected to impact the tree significantly enough that it is expected to die or fail in the future due to resultant works. In order to retain the tree, designs modifications are required to reduce construction footprint on tree to an acceptable level. Unless non-destructive root exploration can identify minimal root distribution in area.
3	*Major: Viable under design constraints*	The construction proposal designs have an encroachment of greater of 10% of Tree Protection Zone or impacts the Structural Root Zone. These trees can remain viable if the following is applied: • Tree sensitive construction methods are utilised. • Any works in SRZ are undertaken after non-invasive root exploration. • Exploratory root excavation findings are documented and made available to necessary parties for review. • Pre / during/ post inspections are carried out by Project Arborist, on all trees onsite and adjoining properties. • All underground services are diverted around TPZ, with the exception of underground boring.
4	*Major: Viable*	The construction proposal designs have an encroachment of greater than 10% of Tree Protection Zone and outside the Structural Root Zone. These trees can remain viable if the following applies: • Alternative tree sensitive design methods are implored. • Site conditions have limited root growth in specific area. • The species is tolerant to development impacts. • Non-destructive root exploration is undertaken and demonstrates minimal root area in TPZ. The tree requires a TPZ erected prior to construction or demolition phase of works. Compensation for lost TPZ area should be added.
5	*Minor*	The construction proposal designs have an encroachment of less than 10% of Tree Protection Zone. The tree is expected to remain viable. A TPZ is be erected prior to construction or demolition phase.

4 Visual Tree Assessment Data

Table 1: Visual Tree Assessment Data (14-18/03/2022). Full details of the abovementioned descriptors and arboricultural methodologies used can be found in the Appendix section of this document.

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
1	*Lophostemon confertus* Queensland Box	Mature	9	EW:6 NS:6	0.34	0.59	4.08	2.65	Good	Good	Long	High	Yes	Yes	100%	MAJOR
2	*Ficus superba* Cedar Fig	Mature	7	EW:9 NS:11	0.59	1.09	7.08	3.43	Fair	Good	Long	High	Yes	Yes	92%	MAJOR
3	*Syzygium smithii* Lilly Pilly	Semi Mature	5	EW:4 NS:4	0.27	0.41	3.24	2.28	Fair	Good	Medium	Medium	Yes	Yes	100%	MAJOR
4	*Lophostemon confertus* Queensland Box	Mature	15	EW:8 NS:8	0.65	1.29	7.80	3.68	Good	Good	Long	High	Yes	Yes	21%	MAJOR
5	*Lophostemon confertus* Queensland Box	Mature	19	EW:9 NS:8	0.62	1.01	7.44	3.32	Good	Fair	Long	High	No	Yes	19%	MAJOR
6	*Cinnamomum camphora* Camphor Laurel	Mature	16	EW:10 NS:11	1.11	1.84	13.32	4.28	Good	Good	Long	High	Yes	Yes	32%	MAJOR
7	*Cinnamomum camphora* Camphor Laurel	Mature	16	EW:10 NS:8	0.90	1.05	10.80	3.38	Fair	Fair	Long	High	Yes	Yes	31%	MAJOR
8	*Lophostemon confertus* Queensland Box	Mature	17	EW:8 NS:9	0.75	0.93	9.00	3.21	Good	Good	Long	High	Yes	Yes	33%	MAJOR
9	*Ficus superba* Cedar Fig	Mature	7	EW:9 NS:10	0.47	0.61	5.64	2.69	Fair	Good	Long	High	No	Yes	14%	MAJOR
10	*Ficus superba* Cedar Fig	Mature	8	EW:10 NS:11	0.76	2.90	9.12	5.18	Fair	Good	Long	High	Yes	Yes	31%	MAJOR
11	*Syzigium leuhmannii* Small-leaved Lilly Pilly	Semi Mature	6	EW:5 NS:5	0.36	0.53	4.32	2.53	Fair	Good	Medium	Medium	Yes	Yes	19%	MAJOR
12	*Lophostemon confertus* Queensland Box	Mature	7	EW:7 NS:7	0.57	0.83	6.84	3.06	Poor	Good	Medium	Medium	No	Yes	3%	MINOR

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
13	*Lophostemon confertus* Queensland Box	Mature	9	EW:6 NS:7	0.47	1.05	5.64	3.38	Good	Good	Long	High	No	No	0%	N/A
14	*Castanospermum australe* Black Bean	Mature	10	EW:8 NS:9	0.41	0.66	4.92	2.78	Fair	Good	Long	High	Yes	Yes	24%	MAJOR
15	*Syzygium smithii* Lilly Pilly	Mature	5	EW:4 NS:4	0.18	0.26	2.16	1.88	Fair	Good	Medium	Medium	Yes	Yes	100%	MAJOR
16	*Eucalyptus haemastoma* Scribbly Gum	Mature	8	EW:7 NS:7	0.45	0.71	5.40	2.87	Fair	Good	Long	Medium	Yes	Yes	38%	MAJOR
17	*Populus alba* White Poplar	Mature	15	EW:16 NS:14	0.89	1.70	10.68	4.14	Poor	Good	Medium	Medium	Yes	Yes	15%	MAJOR
18	*Eucalyptus haemastoma* Scribbly Gum	Mature	8	EW:7 NS:7	0.38	0.49	4.56	2.45	Fair	Good	Long	High	No	Yes	3%	MINOR
19	*Corymbia ficifolia* Red Flowering Gum	Mature	4	EW:5 NS:5	0.20	0.24	2.40	1.82	Fair	Fair	Medium	Medium	No	No	0%	N/A
20	*Corymbia ficifolia* Red Flowering Gum	Mature	4	EW:5 NS:5	0.20	0.24	2.40	1.82	Fair	Fair	Medium	Medium	No	No	0%	N/A
21	*Eucalyptus haemastoma* Scribbly Gum	Mature	8	EW:7 NS:7	0.31	0.40	3.72	2.25	Good	Good	Long	High	No	Yes	2%	MINOR
22	*Eucalyptus haemastoma* Scribbly Gum	Mature	8	EW:7 NS:6	0.30	0.35	3.60	2.13	Fair	Good	Long	Medium	No	Yes	1%	MINOR
23	*Eucalyptus haemastoma* Scribbly Gum	Mature	6	EW:7 NS:7	0.28	0.35	3.36	2.13	Fair	Good	Long	Medium	No	No	0%	N/A
24	*Eucalyptus haemastoma* Scribbly Gum	Mature	8	EW:7 NS:6	0.25	0.31	3.00	2.02	Fair	Good	Long	Medium	No	No	0%	N/A
25	*Populus deltoides* Cottonwood	Mature	28	EW:17 NS:20	1.20	2.26	14.40	4.66	Good	Fair	Long	High	Yes	Yes	30%	MAJOR
26	*Populus deltoides* Cottonwood	Mature	28	EW:18 NS:15	1.01	1.73	12.12	4.17	Good	Fair	Long	High	Yes	Yes	34%	MAJOR

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
27	*Eucalyptus robusta* Swamp Mahogany	Mature	23	EW:9 NS:10	0.63	1.52	7.56	3.95	Fair	Good	Long	High	Yes	Yes	36%	MAJOR
28	*Populus deltoides* Cottonwood	Mature	26	EW:10 NS:9	0.82	1.78	9.84	4.22	Fair	Fair	Long	High	Yes	Yes	44%	MAJOR
29	*Platanus x acerifolia* London Plane	Mature	10	EW:8 NS:8	0.73	0.98	8.76	3.28	Poor	Fair	Medium	Low	Yes	Yes	46%	MAJOR
30	*Lophostemon confertus* Queensland Box	Mature	14	EW:8 NS:9	0.78	1.70	9.36	4.14	Fair	Fair	Long	High	Yes	Yes	29%	MAJOR
31	*Lophostemon confertus* Queensland Box	Mature	18	EW:9 NS:12	0.92	1.65	11.04	4.08	Good	Good	Long	High	Yes	Yes	26%	MAJOR
32	*Lophostemon confertus* Queensland Box	Mature	13	EW:7 NS:6	0.74	1.29	8.88	3.68	Good	Good	Long	High	Yes	Yes	28%	MAJOR
33	*Lophostemon confertus* Queensland Box	Mature	15	EW:8 NS:8	0.75	1.32	9.00	3.72	Good	Good	Long	High	Yes	Yes	28%	MAJOR
34	*Lophostemon confertus* Queensland Box	Mature	18	EW:9 NS:8	0.57	1.04	6.84	3.36	Fair	Fair	Long	High	Yes	Yes	29%	MAJOR
35	*Lophostemon confertus* Queensland Box	Mature	13	EW:10 NS:9	0.84	1.60	10.08	4.03	Good	Good	Long	High	Yes	Yes	27%	MAJOR
36	*Lophostemon confertus* Queensland Box	Mature	15	EW:8 NS:8	0.60	1.30	7.20	3.69	Good	Good	Long	High	Yes	Yes	35%	MAJOR
37	*Populus deltoides* Cottonwood	Mature	23	EW:21 NS:19	1.27	1.70	15.00	4.14	Fair	Good	Long	High	No	Yes	18%	MAJOR
38	*Lophostemon confertus* Queensland Box	Mature	15	EW:9 NS:8	0.87	1.20	10.44	3.57	Fair	Good	Long	High	Yes	Yes	27%	MAJOR
39	*Lophostemon confertus* Queensland Box	Mature	12	EW:8 NS:8	0.83	1.78	9.96	4.22	Good	Good	Long	High	Yes	Yes	28%	MAJOR
40	*Lophostemon confertus* Queensland Box	Mature	13	EW:8 NS:8	0.87	1.60	10.44	4.03	Fair	Good	Long	High	Yes	Yes	27%	MAJOR

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
41	*Lophostemon confertus* Queensland Box	Mature	10	EW:8 NS:8	0.71	1.70	8.52	4.14	Fair	Fair	Long	High	Yes	Yes	30%	MAJOR
42	*Lophostemon confertus* Queensland Box	Mature	17	EW:8 NS:10	0.70	1.68	8.40	4.12	Fair	Fair	Long	High	Yes	Yes	34%	MAJOR
43	*Populus deltoides* Cottonwood	Mature	26	EW:30 NS:27	1.35	2.40	15.00	4.78	Fair	Fair	Long	High	Yes	Yes	21%	MAJOR
44	*Lophostemon confertus* Queensland Box	Semi Mature	5	EW:3 NS:3	0.09	0.21	2.00	1.72	Fair	Fair	Long	Medium	No	Yes	1%	MINOR
45	*Lophostemon confertus* Queensland Box	Semi Mature	5	EW:4 NS:4	0.14	0.23	2.00	1.79	Fair	Fair	Long	Medium	No	Yes	1%	MINOR
46	*Eucalyptus robusta* Swamp Mahogany	Mature	9	EW:7 NS:8	0.40	0.86	4.80	3.11	Fair	Fair	Medium	Medium	Yes	Yes	51%	MAJOR
47	*Populus nigra* Lombardy Poplar	Mature	11	EW:5 NS:5	0.86	1.18	10.32	3.55	Fair	Fair	Medium	Medium	Yes	Yes	55%	MAJOR
48	*Ulmus parvifolia* Chinese Elm	Mature	5	EW:7 NS:7	0.33	0.38	3.96	2.20	Fair	Good	Medium	Medium	Yes	Yes	63%	MAJOR
49	*Populus nigra* Lombardy Poplar	Mature	10	EW:5 NS:5	0.87	0.91	10.44	3.18	Poor	Fair	Short	Low	Yes	Yes	44%	MAJOR
50	*Populus nigra* Lombardy Poplar	Mature	8	EW:5 NS:5	0.80	0.90	9.60	3.17	Poor	Fair	Short	Low	Yes	Yes	46%	MAJOR
51	*Populus nigra* Lombardy Poplar	Mature	10	EW:5 NS:5	0.87	1.16	10.44	3.52	Poor	Fair	Short	Low	Yes	Yes	43%	MAJOR
52	*Lophostemon confertus* Queensland Box	Mature	9	EW:7 NS:7	0.45	0.72	5.40	2.88	Fair	Fair	Long	High	Yes	Yes	24%	MAJOR
53	*Lophostemon confertus* Queensland Box	Mature	9	EW:7 NS:7	0.40	0.69	4.80	2.83	Fair	Fair	Long	High	No	Yes	16%	MAJOR
54	*Lophostemon confertus* Queensland Box	Mature	10	EW:8 NS:8	0.65	0.90	7.80	3.17	Good	Good	Long	High	No	Yes	14%	MAJOR

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
55	*Lophostemon confertus* Queensland Box	Mature	5	EW:4 NS:4	0.19	0.28	2.28	1.94	Fair	Poor	Medium	Medium	No	No	0%	N/A
56	*Lophostemon confertus* Queensland Box	Mature	9	EW:8 NS:8	0.51	0.78	6.12	2.98	Good	Good	Long	High	No	Yes	7%	MINOR
57	*Lophostemon confertus* Queensland Box	Mature	9	EW:8 NS:8	0.48	0.69	5.76	2.83	Fair	Good	Long	High	No	Yes	5%	MINOR
58	*Lophostemon confertus* Queensland Box	Mature	7	EW:7 NS:6	0.36	0.42	4.32	2.30	Fair	Fair	Medium	Medium	No	Yes	0%	MINOR
59	*Lophostemon confertus* Queensland Box	Mature	6	EW:7 NS:6	0.35	0.43	4.20	2.32	Fair	Poor	Short	Low	No	No	0%	N/A
60	*Lophostemon confertus* Queensland Box	Mature	9	EW:7 NS:7	0.40	0.48	4.80	2.43	Fair	Dead	Dead	Remove	No	No	0%	N/A
61	*Pinus radiata* Monterey Pine	Mature	16	EW:11 NS:13	1.19	1.60	14.28	4.03	Fair	Good	Long	High	No	Yes	25%	MAJOR
62	*Eucalyptus haemastoma* Scribbly Gum	Mature	10	EW:18 NS:20	1.80	2.60	15.00	4.94	Fair	Fair	Long	High	No	Yes	0%	MINOR
63	*Eucalyptus haemastoma* Scribbly Gum	Mature	10	EW:10 NS:9	1.02	1.52	12.24	3.95	Poor	Fair	Long	High	No	Yes	5%	MINOR
64	*Lophostemon confertus* Queensland Box	Mature	7	EW:7 NS:6	0.39	0.66	4.68	2.78	Fair	Poor	Short	Low	No	No	0%	N/A
65	*Lophostemon confertus* Queensland Box	Mature	16	EW:9 NS:9	0.81	1.32	9.72	3.72	Good	Fair	Long	High	No	Yes	22%	MAJOR
66	*Lophostemon confertus* Queensland Box	Mature	14	EW:12 NS:8	0.68	0.97	8.16	3.27	Good	Poor	Medium	High	No	Yes	17%	MAJOR
67	*Lophostemon confertus* Queensland Box	Mature	16	EW:9 NS:9	0.59	1.08	7.08	3.42	Fair	Fair	Long	High	No	Yes	7%	MINOR
68	*Lophostemon confertus* Queensland Box	Mature	14	EW:10 NS:9	0.73	1.32	8.76	3.72	Fair	Poor	Long	High	No	Yes	16%	MAJOR

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
69	*Lophostemon confertus* Queensland Box	Mature	17	EW:10 NS:10	0.86	1.50	10.32	3.92	Fair	Fair	Medium	High	No	Yes	19%	MAJOR
70	*Pinus radiata* Monterey Pine	Mature	18	EW:9 NS:8	0.85	1.33	10.20	3.73	Fair	Very Poor	Short	Low	No	Yes	10%	MINOR
71	*Eucalyptus haemastoma* Scribbly Gum	Mature	14	EW:21 NS:18	1.05	1.70	12.60	4.14	Poor	Fair	Long	High	No	No	0%	N/A
72	*Eucalyptus haemastoma* Scribbly Gum	Mature	17	EW:18 NS:15	1.63	2.15	15.00	4.56	Poor	Fair	Long	High	No	Yes	15%	MAJOR
73	*Lophostemon confertus* Queensland Box	Mature	16	EW:9 NS:10	0.72	1.35	8.64	3.75	Good	Good	Long	High	No	Yes	19%	MAJOR
74	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.07	2.00	1.50	Good	Good	Long	Low	Yes	Yes	72%	MAJOR
75	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.07	2.00	1.50	Good	Good	Long	Low	No	No	0%	N/A
76	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.07	2.00	1.50	Fair	Good	Long	Low	Yes	Yes	100%	MAJOR
77	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.07	2.00	1.50	Fair	Good	Long	Low	Yes	Yes	100%	MAJOR
78	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.06	2.00	1.50	Good	Good	Long	Low	Yes	Yes	100%	MAJOR
79	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.07	2.00	1.50	Good	Good	Long	Low	Yes	Yes	100%	MAJOR
80	*Lophostemon confertus* Queensland Box	Immature	2	EW:2 NS:2	0.11	0.12	2.00	1.50	Good	Good	Long	Low	Yes	Yes	100%	MAJOR
81	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.07	2.00	1.50	Fair	Good	Long	Low	Yes	Yes	100%	MAJOR
82	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.08	0.10	2.00	1.50	Good	Good	Long	Low	Yes	Yes	100%	MAJOR

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83	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.05	0.07	2.00	1.50	Good	Very Poor	Long	Low	Yes	Yes	100%	MAJOR
84	*Lophostemon confertus* Queensland Box	Semi Mature	4	EW:1 NS:1	0.13	0.23	2.00	1.79	Good	Good	Long	Medium	Yes	Yes	100%	MAJOR
85	*Lophostemon confertus* Queensland Box	Semi Mature	4	EW:1 NS:1	0.13	0.19	2.00	1.65	Good	Good	Long	Low	Yes	Yes	100%	MAJOR
86	*Lophostemon confertus* Queensland Box	Semi Mature	5	EW:3 NS:3	0.15	0.21	2.00	1.72	Good	Good	Long	Medium	Yes	Yes	100%	MAJOR
87	*Lophostemon confertus* Queensland Box	Semi Mature	5	EW:3 NS:3	0.14	0.22	2.00	1.75	Good	Good	Long	Medium	Yes	Yes	100%	MAJOR
88	*Lophostemon confertus* Queensland Box	Immature	2	EW:2 NS:2	0.07	0.12	2.00	1.50	Good	Good	Long	Low	Yes	Yes	74%	MAJOR
89	*Lophostemon confertus* Queensland Box	Semi Mature	4	EW:2 NS:2	0.10	0.18	2.00	1.61	Good	Good	Long	Medium	Yes	Yes	11%	MAJOR
90	*Lophostemon confertus* Queensland Box	Semi Mature	4	EW:2 NS:2	0.10	0.20	2.00	1.68	Good	Good	Long	Medium	Yes	Yes	24%	MAJOR
91	*Lophostemon confertus* Queensland Box	Immature	2	EW:1 NS:1	0.07	0.11	2.00	1.50	Fair	Good	Long	Low	No	Yes	5%	MINOR
92	*Populus nigra* Lombardy Poplar	Mature	8	EW:5 NS:5	0.86	0.98	10.32	3.28	Very Poor	Poor	Short	Low	Yes	Yes	46%	MAJOR
93	*Populus nigra* Lombardy Poplar	Mature	10	EW:5 NS:5	0.86	1.07	10.32	3.40	Very Poor	Poor	Short	Low	Yes	Yes	45%	MAJOR
94	*Populus nigra* Lombardy Poplar	Mature	6	EW:5 NS:5	0.93	1.36	11.16	3.77	Very Poor	Poor	Short	Low	Yes	Yes	45%	MAJOR
95	*Populus nigra* Lombardy Poplar	Mature	10	EW:2 NS:2	0.26	0.48	3.12	2.43	Very Poor	Poor	Medium	Medium	Yes	Yes	93%	MAJOR
96	*Lophostemon confertus* Queensland Box	Mature	10	EW:10 NS:9	0.51	0.96	6.12	3.25	Good	Good	Long	High	Yes	Yes	61%	MAJOR

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97	*Lophostemon confertus* Queensland Box	Mature	13	EW:8 NS:8	0.58	1.06	6.96	3.39	Fair	Fair	Long	High	Yes	Yes	29%	MAJOR
98	*Platanus x acerifolia* London Plane	Mature	2	EW:2 NS:2	0.27	0.38	3.24	2.20	Very Poor	Poor	Short	Low	No	No	0%	N/A
99	*Lophostemon confertus* Queensland Box	Mature	7	EW:7 NS:7	0.42	0.67	5.04	2.80	Fair	Fair	Long	High	No	Yes	0%	MINOR
100	*Platanus x acerifolia* London Plane	Mature	4	EW:2 NS:2	0.13	0.29	2.00	1.97	Fair	Fair	Medium	Low	No	No	0%	N/A
101	*Lophostemon confertus* Queensland Box	Mature	7	EW:7 NS:7	0.40	0.70	4.80	2.85	Good	Fair	Long	High	No	No	0%	N/A
102	*Platanus x acerifolia* London Plane	Mature	7	EW:7 NS:7	0.51	0.80	6.12	3.01	Fair	Good	Long	High	No	No	0%	N/A
103	*Platanus x acerifolia* London Plane	Mature	10	EW:9 NS:7	0.45	0.87	5.40	3.12	Fair	Good	Long	High	No	No	0%	N/A
104	*Acer negundo* Box Elder Maple	Mature	5	EW:7 NS:7	0.25	0.53	3.00	2.53	Fair	Fair	Medium	Medium	Yes	Yes	81%	MAJOR
105	*Pinus radiata* Monterey Pine	Mature	17	EW:13 NS:8	1.05	1.40	12.60	3.81	Poor	Poor	Short	Low	Yes	Yes	37%	MAJOR
106	*Pinus radiata* Monterey Pine	Mature	15	EW:14 NS:7	0.81	0.94	9.72	3.22	Fair	Poor	Medium	Medium	Yes	Yes	18%	MAJOR
107	*Pinus radiata* Monterey Pine	Mature	16	EW:20 NS:20	1.18	1.42	14.16	3.83	Good	Good	Long	High	No	Yes	29%	MAJOR
108	*Populus nigra* Lombardy Poplar	Semi Mature	8	EW:2 NS:2	0.26	0.41	3.12	2.28	Fair	Fair	Medium	Low	Yes	Yes	100%	MAJOR
109	*Populus nigra* Lombardy Poplar	Mature	8	EW:3 NS:3	0.93	1.42	11.16	3.83	Very Poor	Poor	Short	Low	Yes	Yes	67%	MAJOR
110	*Populus nigra* Lombardy Poplar	Mature	8	EW:4 NS:4	1.04	1.40	12.48	3.81	Very Poor	Poor	Short	Low	Yes	Yes	42%	MAJOR

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111	*Populus nigra* Lombardy Poplar	Mature	6	EW:4 NS:4	1.05	1.60	12.60	4.03	Very Poor	Poor	Short	Low	Yes	Yes	37%	MAJOR
112	*Populus nigra* Lombardy Poplar	Mature	14	EW:4 NS:4	0.85	1.12	10.20	3.47	Very Poor	Poor	Short	Low	Yes	Yes	46%	MAJOR
113	*Populus nigra* Lombardy Poplar	Mature	16	EW:5 NS:5	1.15	1.45	13.80	3.87	Very Poor	Poor	Short	Low	Yes	Yes	34%	MAJOR
114	*Eucalyptus haemastoma* Scribbly Gum	Mature	15	EW:9 NS:10	0.99	1.80	11.88	4.24	Poor	Fair	Long	High	Yes	Yes	37%	MAJOR
115	*Eucalyptus haemastoma* Scribbly Gum	Semi Mature	6	EW:4 NS:4	0.13	0.21	2.00	1.72	Fair	Fair	Medium	Medium	No	No	0%	N/A
116	*Eucalyptus haemastoma* Scribbly Gum	Mature	8	EW:6 NS:6	0.38	0.45	4.56	2.37	Fair	Good	Medium	Medium	No	Yes	7%	MINOR
117	*Eucalyptus haemastoma* Scribbly Gum	Overmature	9	EW:7 NS:7	1.14	1.80	13.68	4.24	Poor	Dead	Dead	High	Yes	Yes	25%	MAJOR
118	*Lophostemon confertus* Queensland Box	Mature	17	EW:9 NS:9	0.59	1.12	7.08	3.47	Good	Fair	Long	High	No	No	0%	N/A
119	*Lophostemon confertus* Queensland Box	Mature	17	EW:8 NS:9	0.55	1.30	6.60	3.69	Good	Fair	Long	High	No	No	0%	N/A
120	*Lophostemon confertus* Queensland Box	Mature	18	EW:11 NS:10	0.81	1.46	9.72	3.88	Fair	Good	Long	High	No	No	0%	N/A
121	*Lophostemon confertus* Queensland Box	Mature	17	EW:9 NS:9	0.76	1.34	9.12	3.74	Good	Fair	Long	High	No	Yes	19%	MAJOR
122	*Populus nigra* Lombardy Poplar	Mature	15	EW:5 NS:5	0.53	0.80	6.36	3.01	Fair	Fair	Medium	Medium	No	Yes	19%	MAJOR
123	*Eucalyptus haemastoma* Scribbly Gum	Overmature	6	EW:7 NS:7	1.11	1.82	13.32	4.26	Poor	Dead	Dead	High	Yes	Yes	28%	MAJOR
124	*Eucalyptus haemastoma* Scribbly Gum	Mature	16	EW:12 NS:10	0.99	1.58	11.88	4.01	Fair	Good	Long	High	No	Yes	21%	MAJOR

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
125	*Eucalyptus haemastoma* Scribbly Gum	Mature	17	EW:23 NS:26	1.68	2.53	15.00	4.89	Fair	Fair	Long	High	No	No	0%	N/A
126	*Cupressus sp.* Cypress	Mature	8	EW:5 NS:5	0.57	0.78	6.84	2.98	Fair	Poor	Medium	Low	No	No	0%	N/A
127	*Liquidamber styraciflua* Sweet Gum	Mature	8	EW:7 NS:8	0.48	0.64	5.76	2.74	Fair	Good	Medium	Medium	No	Yes	23%	MAJOR
128	*Grevillea robusta* Silky Oak	Mature	7	EW:7 NS:7	0.50	0.77	6.00	2.97	Poor	Poor	Short	Low	No	No	0%	N/A
129	*Liquidamber styraciflua* Sweet Gum	Mature	17	EW:15 NS:12	0.81	1.48	9.72	3.90	Fair	Fair	Long	High	No	No	0%	N/A
130	*Araucaria cunninghamii* Hoop Pine	Mature	23	EW:6 NS:8	0.66	0.89	7.92	3.15	Good	Fair	Long	High	No	Yes	6%	MINOR
131	*Araucaria cunninghamii* Hoop Pine	Mature	25	EW:8 NS:8	0.79	1.52	9.48	3.95	Good	Fair	Long	High	No	No	0%	N/A
132	*Araucaria cunninghamii* Hoop Pine	Mature	22	EW:8 NS:8	0.76	1.02	9.12	3.34	Good	Fair	Long	High	No	No	0%	N/A
133	*Araucaria cunninghamii* Hoop Pine	Mature	23	EW:9 NS:9	0.87	1.07	10.44	3.40	Good	Fair	Long	High	No	No	0%	N/A
134	*Populus nigra* Lombardy Poplar	Mature	17	EW:7 NS:7	0.89	1.34	10.68	3.74	Poor	Fair	Medium	Medium	No	No	0%	N/A
135	*Cedrus atlantica* Atlas Cedar	Mature	12	EW:7 NS:6	0.27	0.35	3.24	2.13	Good	Fair	Medium	Medium	No	No	0%	N/A
136	*Liquidamber styraciflua* Sweet Gum	Mature	15	EW:10 NS:10	0.58	0.94	6.96	3.22	Fair	Good	Long	High	No	No	0%	N/A
137	*Cedrus atlantica* Atlas Cedar	Mature	11	EW:8 NS:8	0.39	0.51	4.68	2.49	Fair	Fair	Medium	Medium	No	No	0%	N/A
138	*Cupressus sp.* Cypress	Mature	7	EW:6 NS:6	0.28	0.36	3.36	2.15	Fair	Fair	Medium	Medium	No	No	0%	N/A

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
139	*Cedrus atlantica* Atlas Cedar	Mature	9	EW:7 NS:6	0.35	0.38	4.20	2.20	Fair	Fair	Medium	Medium	No	No	0%	N/A
140	*Liquidamber styraciflua* Sweet Gum	Mature	17	EW:12 NS:15	0.75	1.30	9.00	3.69	Fair	Good	Long	High	No	No	0%	N/A
141	*Eucalyptus botryoides* Southern Mahogany	Mature	24	EW:12 NS:13	0.81	1.70	9.72	4.14	Good	Fair	Long	High	No	No	0%	N/A
142	*Melaleuca linariifolia* Snow in Summer	Mature	7	EW:8 NS:8	0.80	0.86	9.60	3.11	Fair	Fair	Medium	Medium	No	Yes	7%	MINOR
143	*Acer negundo* Box Elder Maple	Semi Mature	4	EW:3 NS:2	0.12	0.23	2.00	1.79	Poor	Fair	Short	Low	TBA	TBA	TBA	TBA
144	*Archontophoenix alexandrae* Alexandra Palm	Mature	7	EW:4 NS:4	0.38	0.59	4.56	2.65	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
145	*Melaleuca styphelioides* Prickly-leaved Paperbark	Mature	6	EW:7 NS:7	0.40	0.52	4.80	2.51	Fair	Fair	Medium	Medium	TBA	TBA	TBA	TBA
146	*Callistemon viminalis* Weeping Bottlebrush	Mature	7	EW:7 NS:7	0.44	0.51	5.28	2.49	Fair	Fair	Medium	Medium	TBA	TBA	TBA	TBA
147	*Melaleuca quinquenervia* Broad-leaved Paperbark	Mature	8	EW:7 NS:7	0.50	0.92	6.00	3.20	Fair	Fair	Medium	Medium	TBA	TBA	TBA	TBA
148	*Melaleuca styphelioides* Prickly-leaved Paperbark	Mature	7	EW:4 NS:4	0.22	0.40	2.64	2.25	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
149	*Melaleuca styphelioides* Prickly-leaved Paperbark	Mature	7	EW:4 NS:4	0.36	0.47	4.32	2.41	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
150	*Melaleuca styphelioides* Prickly-leaved Paperbark	Mature	7	EW:4 NS:4	0.22	0.24	2.64	1.82	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
151	*Melaleuca styphelioides* Prickly-leaved Paperbark	Mature	7	EW:4 NS:4	0.32	0.40	3.84	2.25	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
152	*Corymbia eximia* Yellow Bloodwood	Mature	8	EW:8 NS:7	0.48	0.63	5.76	2.73	Good	Good	Long	Medium	TBA	TBA	TBA	TBA

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
153	*Corymbia eximia* Yellow Bloodwood	Mature	7	EW:6 NS:2	0.24	0.52	2.88	2.51	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
154	*Corymbia eximia* Yellow Bloodwood	Mature	9	EW:8 NS:7	0.47	0.62	5.64	2.71	Good	Good	Long	Medium	TBA	TBA	TBA	TBA
155	*Lagerstroemia indica* Crepe Myrtle	Semi Mature	2	EW:3 NS:3	0.06	0.08	2.00	1.50	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
156	*Lagerstroemia indica* Crepe Myrtle	Semi Mature	2	EW:3 NS:3	0.06	0.08	2.00	1.50	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
157	*Lagerstroemia indica* Crepe Myrtle	Semi Mature	2	EW:2 NS:2	0.06	0.08	2.00	1.50	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
158	*Lagerstroemia indica* Crepe Myrtle	Semi Mature	2	EW:2 NS:2	0.06	0.08	2.00	1.50	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
159	*Lagerstroemia indica* Crepe Myrtle	Semi Mature	2	EW:2 NS:2	0.04	0.06	2.00	1.50	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
160	*Lagerstroemia indica* Crepe Myrtle	Mature	5	EW:6 NS:5	0.36	0.65	4.32	2.76	Poor	Fair	Medium	Low	TBA	TBA	TBA	TBA
161	*Lagerstroemia indica* Crepe Myrtle	Mature	5	EW:6 NS:5	0.34	0.62	4.08	2.71	Poor	Fair	Medium	Low	TBA	TBA	TBA	TBA
162	*Acacia melanoxylon* Blackwood	Mature	10	EW:10 NS:8	0.61	1.30	7.32	3.69	Fair	Good	Long	High	TBA	TBA	TBA	TBA
163	*Syzygium smithii* Lilly Pilly	Mature	10	EW:9 NS:9	0.56	1.30	6.72	3.69	Fair	Good	Long	Medium	TBA	TBA	TBA	TBA
164	*Lagerstroemia indica* Crepe Myrtle	Mature	5	EW:6 NS:5	0.34	0.62	4.08	2.71	Poor	Fair	Medium	Low	TBA	TBA	TBA	TBA
165	*Bauhinia variegata* Orchid Tree	Mature	5	EW:7 NS:7	0.38	0.43	4.56	2.32	Poor	Fair	Medium	Low	TBA	TBA	TBA	TBA
166	*Acer negundo* Box Elder Maple	Mature	7	EW:7 NS:7	0.32	0.39	3.84	2.23	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
167	*Acer negundo* Box Elder Maple	Mature	7	EW:7 NS:7	0.32	0.39	3.84	2.23	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
168	*Grevillea sp.* Grevillea	Semi Mature	3	EW:3 NS:3	0.12	0.16	2.00	1.53	Fair	Fair	Medium	Low	TBA	TBA	TBA	TBA
169	*Pinus radiata* Monterey Pine	Mature	21	EW:13 NS:13	1.16	1.40	13.92	3.81	Fair	Fair	Long	High	TBA	TBA	TBA	TBA
170	*Cedrus atlantica* Atlas Cedar	Mature	12	EW:7 NS:7	0.36	0.42	4.32	2.30	Good	Fair	Medium	Medium	TBA	TBA	TBA	TBA
171	*Syzigium sp.* Lilly Pilly	Semi Mature	5	EW:6 NS:6	0.12	0.32	2.00	2.05	Poor	Fair	Medium	Low	TBA	TBA	TBA	TBA
172	*Syzigium sp.* Lilly Pilly	Semi Mature	5	EW:7 NS:7	0.27	0.56	3.24	2.59	Poor	Fair	Medium	Low	TBA	TBA	TBA	TBA
173	*Pinus radiata* Monterey Pine	Mature	8	EW:4 NS:5	0.39	0.50	4.68	2.47	Poor	Poor	Short	Low	TBA	TBA	TBA	TBA
174	*Pinus radiata* Monterey Pine	Mature	18	EW:7 NS:5	0.49	0.57	5.88	2.61	Poor	Poor	Short	Low	TBA	TBA	TBA	TBA
175	*Pinus radiata* Monterey Pine	Mature	18	EW:7 NS:5	0.63	0.84	7.56	3.08	Fair	Poor	Medium	Medium	TBA	TBA	TBA	TBA
176	*Pinus radiata* Monterey Pine	Mature	21	EW:8 NS:8	0.78	1.10	9.36	3.44	Fair	Fair	Medium	High	TBA	TBA	TBA	TBA
177	*Acacia decurrens* Green Wattle	Mature	4	EW:4 NS:4	0.23	0.32	2.76	2.05	Poor	Fair	Medium	Low	TBA	TBA	TBA	TBA
178	*Lophostemon confertus* Queensland Box	Mature	18	EW:10 NS:9	0.84	1.60	10.08	4.03	Fair	Good	Long	High	TBA	TBA	TBA	TBA
179	*Cupressus sp.* Cypress	Mature	10	EW:5 NS:5	0.52	0.63	6.24	2.73	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
180	*Callistemon viminalis* Weeping Bottlebrush	Mature	7	EW:8 NS:8	0.32	0.49	3.84	2.45	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
181	*Syzigium leuhmannii* Small-leaved Lilly Pilly	Mature	5	EW:8 NS:8	0.32	0.36	3.84	2.15	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
182	*Lophostemon confertus* Queensland Box	Mature	11	EW:8 NS:8	0.76	1.04	9.12	3.36	Poor	Good	Medium	Medium	TBA	TBA	TBA	TBA
183	*Syzigium leuhmannii* Small-leaved Lilly Pilly	Semi Mature	3	EW:4 NS:4	0.12	0.18	2.00	1.61	Fair	Fair	Medium	Low	TBA	TBA	TBA	TBA
184	*Corymbia ficifolia* Red Flowering Gum	Mature	4	EW:7 NS:7	0.28	0.33	3.36	2.08	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
185	*Eucalyptus sideroxylon* Red Ironbark	Mature	23	EW:13 NS:12	0.56	0.87	6.72	3.12	Fair	Good	Long	High	TBA	TBA	TBA	TBA
186	*Betula sp.* Birch	Mature	7	EW:8 NS:8	0.32	0.45	3.84	2.37	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
187	*Pinus radiata* Monterey Pine	Mature	17	EW:12 NS:15	0.84	1.40	10.08	3.81	Fair	Fair	Long	High	TBA	TBA	TBA	TBA
188	*Eucalyptus microcorys* Tallowwood	Mature	21	EW:12 NS:9	0.68	0.83	8.16	3.06	Fair	Good	Long	High	TBA	TBA	TBA	TBA
189	*Eucalyptus microcorys* Tallowwood	Mature	21	EW:10 NS:9	0.54	0.78	6.48	2.98	Fair	Good	Long	High	TBA	TBA	TBA	TBA
190	*Leptospermum petersonii* Lemon-scented Tea Tree	Mature	7	EW:8 NS:9	0.73	1.40	8.76	3.81	Poor	Good	Medium	Medium	TBA	TBA	TBA	TBA
191	*Lophostemon confertus* Queensland Box	Mature	7	EW:8 NS:8	0.79	1.20	9.48	3.57	Poor	Good	Medium	Low	TBA	TBA	TBA	TBA
192	*Lophostemon confertus* Queensland Box	Mature	7	EW:8 NS:8	0.80	1.20	9.60	3.57	Poor	Good	Medium	Low	TBA	TBA	TBA	TBA
193	*Lophostemon confertus* Queensland Box	Mature	7	EW:7 NS:7	0.67	0.97	8.04	3.27	Poor	Good	Medium	Low	TBA	TBA	TBA	TBA
194	*Lophostemon confertus* Queensland Box	Mature	7	EW:8 NS:8	0.71	0.93	8.52	3.21	Poor	Good	Medium	Low	TBA	TBA	TBA	TBA

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
195	*Betula sp.* Birch	Mature	7	EW:6 NS:6	0.29	0.38	3.48	2.20	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
196	*Leptospermum petersonii* Lemon-scented Tea Tree	Mature	5	EW:7 NS:7	0.30	0.43	3.60	2.32	Poor	Good	Medium	Low	TBA	TBA	TBA	TBA
197	*Pinus radiata* Monterey Pine	Mature	17	EW:10 NS:11	1.04	1.49	12.48	3.91	Fair	Fair	Medium	High	TBA	TBA	TBA	TBA
198	*Angophora costata* Smooth-barked Apple Myrtle	Mature	11	EW:8 NS:7	0.50	0.73	6.00	2.90	Fair	Good	Long	High	TBA	TBA	TBA	TBA
199	*Eucalyptus botryoides* Southern Mahogany	Mature	14	EW:7 NS:10	0.40	0.62	4.80	2.71	Fair	Good	Long	Medium	TBA	TBA	TBA	TBA
200	*Eucalyptus botryoides* Southern Mahogany	Mature	16	EW:15 NS:15	0.69	1.03	8.28	3.35	Good	Good	Long	High	TBA	TBA	TBA	TBA
201	*Lophostemon confertus* Queensland Box	Mature	10	EW:9 NS:9	0.86	1.12	10.32	3.47	Good	Good	Long	High	TBA	TBA	TBA	TBA
202	*Lophostemon confertus* Queensland Box	Mature	17	EW:16 NS:14	1.01	1.60	12.12	4.03	Fair	Good	Long	High	TBA	TBA	TBA	TBA
203	*Corymbia maculata* Spotted Gum	Mature	17	EW:7 NS:7	0.39	0.59	4.68	2.65	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
204	*Corymbia maculata* Spotted Gum	Mature	10	EW:4 NS:4	0.23	0.30	2.76	2.00	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
205	*Corymbia maculata* Spotted Gum	Mature	14	EW:5 NS:3	0.23	0.30	2.76	2.00	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
206	*Corymbia maculata* Spotted Gum	Mature	14	EW:4 NS:2	0.16	0.23	2.00	1.79	Poor	Good	Medium	Low	TBA	TBA	TBA	TBA
207	*Corymbia maculata* Spotted Gum	Mature	14	EW:5 NS:3	0.23	0.37	2.76	2.18	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
208	*Corymbia maculata* Spotted Gum	Mature	14	EW:6 NS:4	0.28	0.33	3.36	2.08	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
209	*Lophostemon confertus* Queensland Box	Mature	16	EW:8 NS:8	0.50	0.83	6.00	3.06	Good	Good	Long	Medium	TBA	TBA	TBA	TBA
210	*Corymbia maculata* Spotted Gum	Mature	11	EW:5 NS:4	0.20	0.33	2.40	2.08	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
211	*Corymbia maculata* Spotted Gum	Mature	14	EW:6 NS:4	0.28	0.33	3.36	2.08	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
212	*Corymbia maculata* Spotted Gum	Mature	14	EW:6 NS:4	0.22	0.30	2.64	2.00	Fair	Good	Medium	Low	TBA	TBA	TBA	TBA
213	*Corymbia maculata* Spotted Gum	Mature	15	EW:6 NS:4	0.38	0.46	4.56	2.39	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
214	*Lophostemon confertus* Queensland Box	Mature	14	EW:7 NS:7	1.29	1.50	15.00	3.92	Fair	Dead	Dead	High	No	Yes	16%	MAJOR
215	*Lophostemon confertus* Queensland Box	Mature	11	EW:2 NS:2	0.97	1.50	11.64	3.92	Fair	Dead	Dead	High	TBA	TBA	TBA	TBA
216	*Eucalyptus robusta* Swamp Mahogany	Mature	30	EW:17 NS:20	1.22	1.70	14.64	4.14	Fair	Good	Long	High	TBA	TBA	TBA	TBA
217	*Lophostemon confertus* Queensland Box	Mature	24	EW:7 NS:8	0.74	1.34	8.88	3.74	Fair	Good	Long	High	TBA	TBA	TBA	TBA
218	*Pinus radiata* Monterey Pine	Mature	9	EW:13 NS:14	1.18	1.69	14.16	4.13	Poor	Fair	Medium	Medium	TBA	TBA	TBA	TBA
219	*Populus alba* White Poplar	Mature	23	EW:9 NS:9	0.82	1.52	9.84	3.95	Good	Good	Long	High	TBA	TBA	TBA	TBA
220	*Populus alba* White Poplar	Mature	10	EW:7 NS:6	0.30	0.36	3.60	2.15	Fair	Fair	Medium	Low	TBA	TBA	TBA	TBA
221	*Jacaranda mimosifolia* Jacaranda	Mature	8	EW:5 NS:10	0.56	0.72	6.72	2.88	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
222	*Populus alba* White Poplar	Mature	24	EW:10 NS:11	0.95	1.53	11.40	3.96	Poor	Good	Long	Medium	TBA	TBA	TBA	TBA

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
223	*Jacaranda mimosifolia* Jacaranda	Mature	7	EW:8 NS:10	0.47	0.92	5.64	3.20	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
224	*Jacaranda mimosifolia* Jacaranda	Mature	8	EW:9 NS:9	0.47	0.77	5.64	2.97	Fair	Good	Medium	Medium	TBA	TBA	TBA	TBA
225	*Cinnamomum camphora* Camphor Laurel	Overmature	16	EW:9 NS:9	0.96	1.70	11.52	4.14	Fair	Fair	Long	High	TBA	TBA	TBA	TBA
226	*Pinus radiata* Monterey Pine	Mature	11	EW:8 NS:8	0.60	0.74	7.20	2.92	Fair	Fair	Long	High	TBA	TBA	TBA	TBA
227	*Cinnamomum camphora* Camphor Laurel	Mature	17	EW:10 NS:15	1.38	2.15	15.00	4.56	Poor	Good	Long	High	TBA	TBA	TBA	TBA
228	*Cinnamomum camphora* Camphor Laurel	Mature	15	EW:18 NS:16	0.99	1.98	11.88	4.41	Fair	Good	Long	High	TBA	TBA	TBA	TBA
229	*Pinus radiata* Monterey Pine	Mature	15	EW:7 NS:9	0.75	0.99	9.00	3.30	Fair	Fair	Long	High	TBA	TBA	TBA	TBA
230	*Pinus radiata* Monterey Pine	Mature	8	EW:4 NS:5	0.38	0.40	4.56	2.25	Fair	Fair	Medium	Low	TBA	TBA	TBA	TBA
231	*Pinus radiata* Monterey Pine	Mature	16	EW:7 NS:7	0.64	0.93	7.68	3.21	Good	Fair	Long	High	TBA	TBA	TBA	TBA
232	*Pinus radiata* Monterey Pine	Mature	15	EW:13 NS:14	0.95	1.17	11.40	3.53	Good	Fair	Medium	High	TBA	TBA	TBA	TBA
233	*Pinus radiata* Monterey Pine	Mature	16	EW:7 NS:7	0.55	0.73	6.60	2.90	Fair	Poor	Medium	Medium	TBA	TBA	TBA	TBA
234	*Cinnamomum camphora* Camphor Laurel	Mature	14	EW:19 NS:10	1.02	2.20	12.24	4.61	Good	Good	Long	High	TBA	TBA	TBA	TBA
235	*Pinus elliottii* Slash Pine	Mature	14	EW:18 NS:8	0.87	1.03	10.44	3.35	Poor	Good	Long	High	No	Yes	12%	MAJOR
236	*Pinus elliottii* Slash Pine	Mature	14	EW:9 NS:8	0.73	0.96	8.76	3.25	Fair	Good	Long	High	No	Yes	7%	MINOR

Tree Tag	Botanical & Common Name	Age Class	Height (m)	Canopy Spread (m)	DBH (m)	DRC (m)	TPZ (m)	SRZ (m)	Structure	Vitality	ELE	Retention Value	SRZ Enc	TPZ Enc	Enc%	Impact Level
237	*Pinus elliottii* Slash Pine	Mature	14	EW:11 NS:8	0.87	1.13	10.44	3.48	Fair	Good	Long	Medium	No	Yes	15%	MAJOR
238	*Pinus elliottii* Slash Pine	Mature	14	EW:18 NS:7	0.93	1.09	11.16	3.43	Fair	Good	Long	High	No	Yes	16%	MAJOR
239	*Pinus elliottii* Slash Pine	Mature	14	EW:16 NS:5	0.83	1.03	9.96	3.35	Poor	Poor	Short	Low	Yes	Yes	16%	MAJOR
240	*Pinus elliottii* Slash Pine	Semi Mature	7	EW:7 NS:7	0.32	0.39	3.84	2.23	Good	Good	Long	Medium	Yes	Yes	65%	MAJOR
241	*Cinnamomum camphora* Camphor Laurel	Semi Mature	6	EW:7 NS:7	0.38	0.48	4.56	2.43	Fair	Good	Medium	Low	Yes	Yes	37%	MAJOR

KEY

- **DBH (Diameter at Breast Height) & DRC (Diameter above Root Collar), TPZ, SRZ & Encroachment %** calculated per *Qld Arboricultural Association & ProofSafe Calculators.*
- **Impact Level:** per *Standards Australia AS4970-2009 Protection of trees on development sites*
- **Structure & Vitality** per *International Society of Arboriculture (ISA)Tree Condition Rating System (2015) descriptors & (Coder, 2021)*
- **Canopy Spread**: estimation of canopy spread to the four (4) cardinal points. (North-South) & (East-West).
- **Estimated Life Expectancy (ELE):** adapted per *(Barrell, 1996) & (Barrell, 2000).*
- **Retention Value:** *Significance of a Tree, Assessment Rating System (STARS), Institute of Australian Consulting Arboriculturists, Australia (2010).*
  - **Low:** These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
  - **Medium:** These trees are moderately important for retention. Their removal should only be considered if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
  - **High:** These trees are considered important for retention and should be retained and protected. Initial Non-Destructive Root Exploration (Root Mapping) should be implemented. Tree Sensitive Design modification and/or re-location of building/s should be considered to accommodate the setbacks as prescribed per *Standards Australia AS 4970 Protection of trees on development sites*.

5 Arboricultural Discussion

5.1 Arboricultural Impact

i. With regards to the calculated arboricultural impact, it was calculated that:

- Nineteen (19) trees have encroachments less than 10% *(Minor)* - Pursuant to *AS 4970-2009 Minor encroachments* - If the proposed encroachment is less than 10% (total area) of the TPZ, and outside of the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere and be contiguous with the TPZ).
- Ninety-six (96) trees have encroachments greater than 10% *(Major).* These trees do not require immediate removal. However, as per *AS 4970-2009 Major encroachments* - it must be demonstrated that the trees will remain viable. Therefore, initial Non-Destructive Root Exploration[5] (hand-digging and/or Air-Vac) will need to be carried out under the supervision of an appointed Project Arborist.

5.2 Tree Retention Value

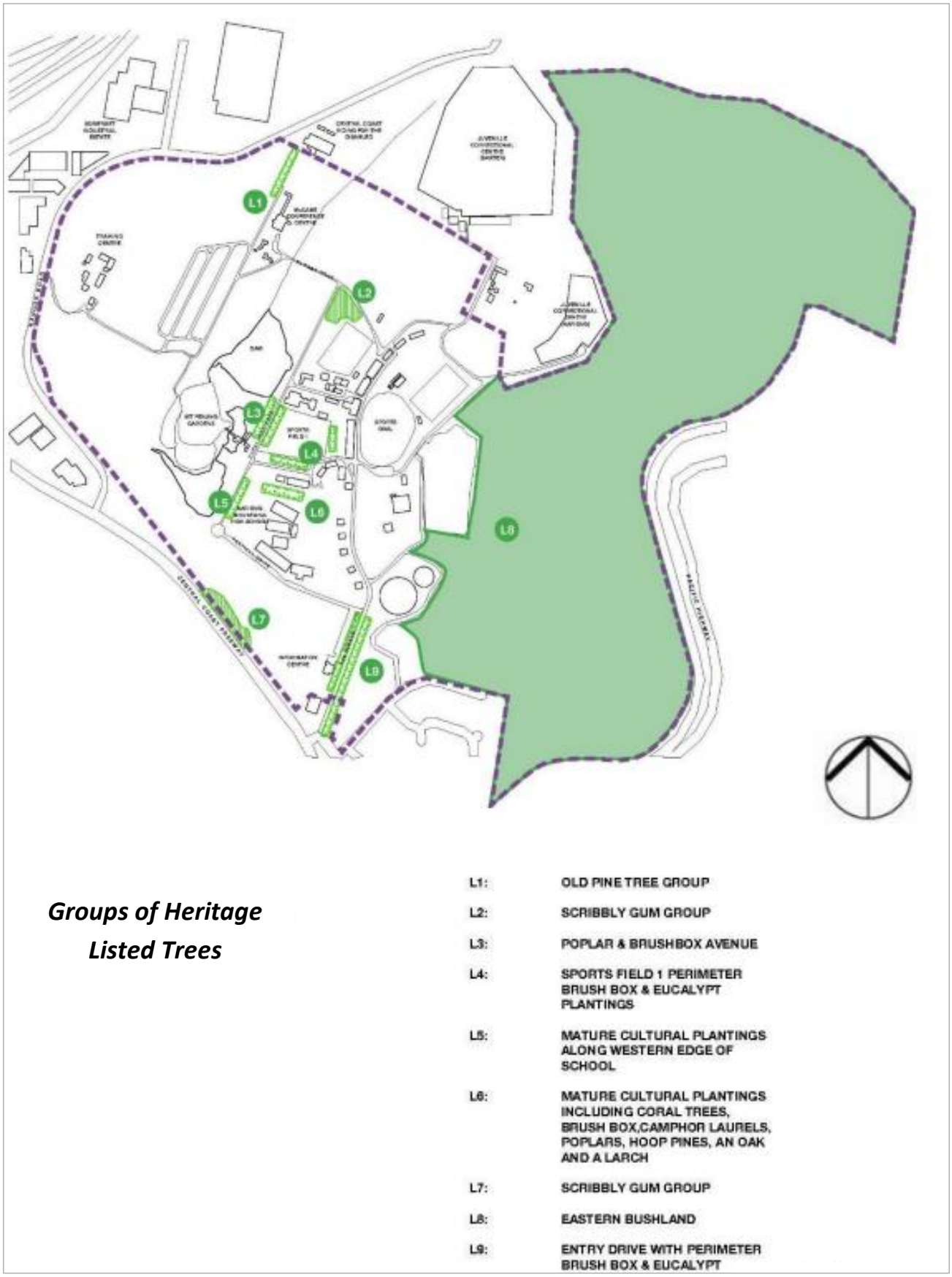
i. A tree with a calculated *'High'* Retention Value per the above-mentioned *STARS* criteria is desirable for retention. This even more as a number of the assessed subject trees have *'Heritage Status'* availed and the increased Urban Heat Island[6] footprint associated with this Project.

ii. As aforementioned initial Non-Destructive Root Exploration (Root Mapping) is the most reliable way to locate tree roots pre-development and therefore should be implemented where a tree is to be retained. Therefore, all excavations that are calculated as a *'Major'* Encroachment within the TPZ of a *High Retention* tree should initially be undertaken by Non-Destructive Root Exploration through the use of Hand-digging and/or Air -Spade under the guidance of the Project Arborist.

iii. Root Mappings will provide an accurate root location and cogent morphological data, which in turn will provide the opportunity to explore and/or implement tree sensitive modifications with regards to Plant Health Care (PHC), tree viability and pragmatic tree retention.

[5] Initial Non-Destructive Root Exploration (NDRE) is the most reliable way to locate tree roots post development (Matheny and Clark, 1998). To err on the side of caution, all excavations that are calculated as a 'Major' Encroachment within the TPZ must initially be undertaken by Hand-digging, Hydro-Vac, and/or Air -Spade under the guidance of the Project Arborist concurrent with strict adherence to a site-specific Tree Protection Plan. Further machine excavations should only be permitted within the TPZ if and when the Project Arborist is satisfied that the excavation envelope is free of any significant root biomass.

[6] *Urban Heat islands are urbanized areas that experience higher temperatures than outlying areas. As opposed to natural landscapes such as forests and water bodies, hard surfaces in the urban environment such as concrete, brick, glass, asphalt and roofing, have a high thermal mass, collecting the sun's heat during the day and re-radiating it slowly back into the atmosphere. This contributes to a rise in ambient temperature in cities, creating large, stable masses of hot air (urban heat islands), especially during periods of calm, still weather. This increase in heat particularly if combined with low soil moisture contributes to the decline of certain tree species and trees already 'stressed' (McPherson et. al. 2006).*



Groups of Heritage Listed Trees (courtesy of Taylor Brammer)

Summary Data Table: Tree Retention Value (18/03/2022)

Retention Value	Trees	Description
High	*100*	These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard *AS 4970 Protection of trees on development sites*. Tree sensitive construction measures must be implemented (i.e., pier and beam cantilever, porous paving, Directional drilling, Structural Confinement Cells) if works are to proceed within the TPZ and the tree is to remain viable.
Medium	*71*	These trees may be retained and protected. These are considered less critical; however, their retention should remain a priority, with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
Low	*69*	These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
Remove	*1*	These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.
Total	***241***	

5.3 Tree Sensitive Design Options

i. As is the scenario here, tree rooting depths in urban situations are frequently restricted by impenetrable surfaces, inhospitable soil layers and/or underground infrastructure. Lateral root extent is likewise subject to these restrictions congruent with low soil porosity under hardscapes and/or by the absence of 'free-water' and oxygen (Day and Bassuk 1994). Thereby roading, concrete slabs and footpaths have shown to provide adverse conditions for root growth and development (Day and Bassuk 1994) (Watson et al 2014), and a tree's root system spread may be halted within approximately 10cm after penetrating beneath such mediums (Gerhold and Johnson. 2003). Therefore, in keeping with this rationale it is recommended that the location of the new utilities (water, electricity and sewage) be amended to 'as far as reasonably practicable' from the base of the trees and under the existing roading where a lesser root biomass is anticipated. Another 'tree sensitive design' option for the installation of these utilities is the use of Directional Drilling or Boring. Please refer to the Appendix for further information regarding this option.

ii. With regards to the roading upgrades and the shared footpath, Tree Sensitive Design options such as tree transplanting, Screw Piling, Cantilevers, Structural Confinement Cells, raised paths (build-overs) and

Porous Paving may be incorporated with regards to reducing arboricultural impact. Please refer to the Appendix for further information.

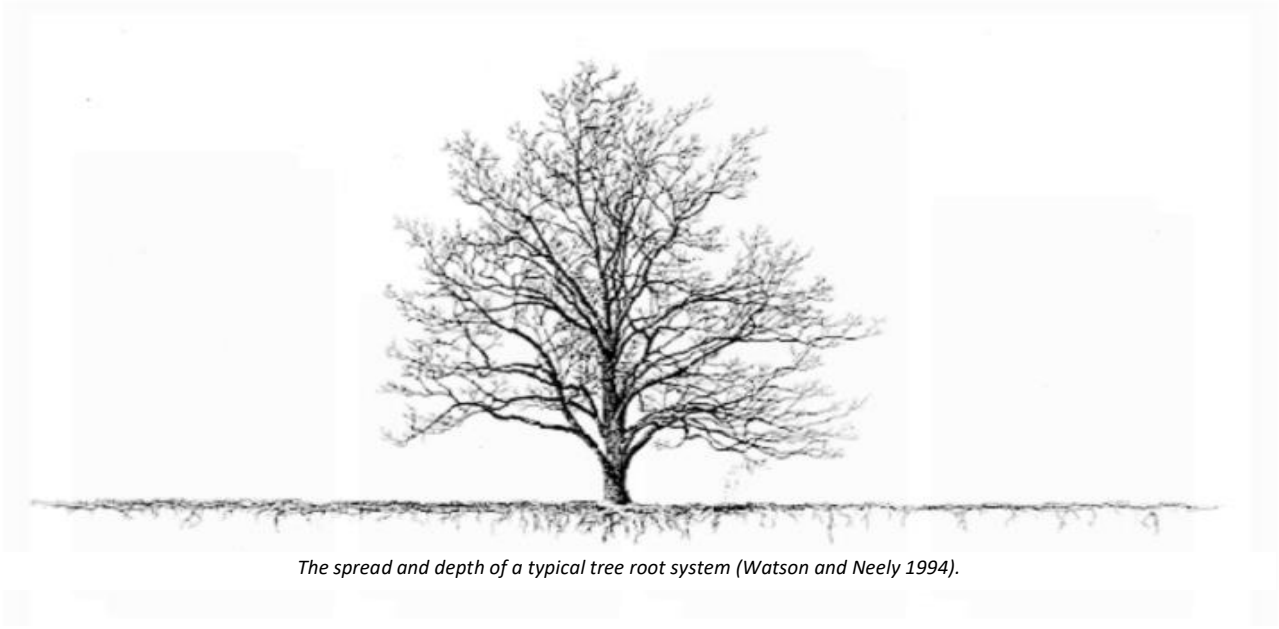
iii. Please note that the abovementioned Root Mapping findings will ultimately determine foreseeable tree viability and whether tree sensitive design modifications and/or tree removal will need to be undertaken on this Project. All findings will be documented by the appointed Project Arborist and made available to all parties with *locus standii* upon request.

5.4 Future Development

i. Trees grow in a delicate balance with their environment and any changes to that balance must be minimized if the tree is to remain healthy and fulfil its potential. It is rarely possible to repair stressed and injured trees, so damage needs to be avoided during all stages of development and construction.

ii. Recent research both clinical and empirical has shown that healthy trees such as these usually remain in good health when best management practice guidelines and arboricultural standards are adhered to on development sites per *AS4970-2009 Protection of trees on development sites* whilst under the guidance of a suitably qualified arborist. Thus, for trees to be retained and their requirements met, procedures must be in place to protect trees at every stage of the development process. This should be considered at the earliest planning stage of any outdoor event and/or design of a development project where trees are involved.

iii. Therefore, it is recommended that a Tree Protection Plan pursuant to *AS4970-2009 Protection of trees on development sites* is formulated and adopted pre-development for this Project moving forward. This will guide earthworks around retained trees located within the proposed work zone through the formulation and implementation of best management practice tree protection methodologies.



The spread and depth of a typical tree root system (Watson and Neely 1994).

"A tree without roots is just a piece of wood."
- *Marco Pierre White*

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7 Glossary

The following definitions are stated in the Glossary of Arboricultural Terms, International Society of Arboriculture 2011, unless otherwise stated.

Abiotic: plant ailment caused by non-living, environmental, or man-made agents

Adaptive Growth: or Response Growth is new wood produced in response to damage or loads, which compensates for higher strain (deformation) in marginal fibres; it includes reaction wood (compression & tension) and wound wood.

Age class: Described as Young, Semi-Mature, Mature, Over Mature or Veteran. All these dimensions should be determined by species and site factors.

Barrier Zone: chemically defended tissue formed by the still living cambium, after a tree is wounded or invaded by pathogens to inhibit the spread of decay into new annual growth rings. Wall 4 in CODIT model. Contrast with reaction zone

Bifurcation: Natural division of a branch or stem into two or more stems or parts

Biotic: pertaining to non-human living organism/ biotic agent: a living organism capable of causing disease/ biotic disorder: disorder caused by a living organism.

Bracket: British English term for fruiting body of a decay fungus. See *Conk*.

Codominant Structure: Stems or trunks of about the same size originating from the same position from the main stem52. When the stem bark ridge turns upward the union is strong; when the ridge turns inward the union is weak, a likely point of failure in storm or windy weather conditions or where increasing weight causes undue stress on the defective union.

CODIT: acronym for Compartmentalisation of Decay/Disease In Trees (refer Compartmentalisation).

Compartmentalisation: Dynamic tree defence process involving protection features that resist the spread of pathogens and decay causing organisms. Natural defence process in trees by which chemical and physical boundaries are created that act to limit the spread of disease and decay organisms.

Compaction: Results from loads or stress forces applied to the soil as well as shear forces. Both foot traffic and vehicle traffic exert both forces on soils. Vehicle traffic may cause significant compaction at depths of 150–200 mm (the area in which most absorbing roots are located). The degree of compaction will depend on weight of vehicles, number of movements, soil moisture levels and clay content. Soil handling, stockpiling, and transporting also tend to lead to the breakdown of soil structure and thus to compaction. Vibration as a result of frequent traffic or adjacent construction activities will also compact soils.

Compression wood: (1) in mechanics, the action of forces to squeeze, crush or push together any material (s) or substance(s): contrast with tension. (2) the ability of an internal combustion engine to contain or pressurized a combustible fuel - air mixture.

Conk: Fruiting body or non-fruiting body (sterile conk) of a fungus. Often associated with decay.

Crown: Portion of the tree consisting of branches and leaves and any part of the trunk from which branches arise.

Crown/Canopy: The main foliage bearing section of the tree, these terms are interchangeable.

Crown damage: The canopy of trees can be directly or indirectly damaged. Incorrect techniques of pruning such as lopping or flush cutting may produce wounds that are susceptible to infection by wood decay organisms. Similarly, mechanical damage to branches by machinery, etc. will also create wounds. Trees automatically respond to wounding and in doing so use stored sugars. Any wound places an additional load on trees that will inevitably be stressed during construction.

Damping: Damping occurs where energy is dissipated. In trees, damping occurs naturally in three main ways with aerodynamic damping of the leaves, internal damping in the wood and root zones, and with mass damping of the branches.

Deadwood: Dead branches within the canopy of tree. Deadwood is a naturally occurring feature of most tree species and comprises dead or decaying branches within the canopy of a tree. Deadwood may have habitat value and require removal only according to the considered risk of its location, i.e. high use pedestrian area or damage to adjacent infrastructure.

Removal of deadwood is generally recommended only where it represents an unacceptable level of hazard. Consideration of the need for deadwood removal should take into account the occupancy of the target zone, i.e. high use pedestrian area or

presence of infrastructure, possible damage to the tree during its removal as well as its conservation for habitat value. In some instances, retention of a reduced tree structure for habitat purposes maybe considered appropriate, especially when hollows are present.

Further reference: *Principles of Tree Hazard Assessment. Lonsdale, David. TSO, (2009).*

Dead wooding: **(Crown cleaning)**: The removal of dead branches60. Recommendation to remove deadwood is for removal of all dead branches within tree canopy > 30mm diameter in trees which overhang pedestrian or vehicular areas and removal of all dead branches within tree canopy > 50mm diameter if trees are located in a Parkland or similar area.

Decay: The process of degradation of woody tissues by micro-organisms.

Desiccation: Severe drying out. Dehydration.

Drip Line: Is the imaginary perimeter line at soil surface level which is directly below the outermost edge of the tree's foliage or canopy.

Estimated Life Expectancy (ELE): Assessed on trees of particular species in the urban environment, including health and structural conditions which may exist.

Epicormic bud: Latent or adventitious bud located at the cambium and concealed by the bark.

Epicormic shoots: Shoots produced from epicormic buds at the cambium of trunks or branches.

Field Capacity: Maximum soil moisture content following the drainage of water due to the force of gravity.

Hollow: is a semi-enclosed cavity which has naturally formed in the trunk or branch of a tree.

Included bark: Inwardly formed bark within the junction of branches or codominant stems.

Kino: Dark red to brown resin-like substance produced by trees in the genera Eucalyptus, Pterocarpus and Butea and related genera. Kino forms in the barrier zones. Large kino veins form in some tree in response to injury and infection.

Leaves: The main function of leaves is photosynthesis, that is, the production of sugars and oxygen. The sugars produced by the leaves (and any other green tissue) are the source of chemical energy for all living cells in the entire plant and as such are essential for the normal functioning and survival of the tree. Anything that directly or indirectly damages the leaves will interfere with photosynthesis.

Non-woody part of tree: 'organs that increase the surface area of vascular plants, thereby capturing more solar energy for photosynthesis'. … maybe classified as microphylls (usually spine-shaped leaves with a single vein) or megaphylls (leaves with a highly branched vascular system). Needles and leaves are major energy trapping organs of a tree. Flowers are modified leaves …. as they fit the definition of an organ (*Shigo.2003).*

Macropore: Relatively larger space between soil particles that is usually air-filled and allows for water movement and root penetration. Contrast with micropore.

Mature: Trees are close to their full height and crown size.

Micropore: Space between soil particles that is relatively small and likely to be water filled.

Mortality Spiral: Sequence of stressful events or conditions causing the decline and eventual death of a tree. Once in a mortality spiral trees are more likely to succumb to any further or additional stress factors such as drought, pest infestation or disease. (See definition Stress)

Necrosis: Localised death of tissue in a living organism.

Occlusion (See wound): Shut in or out. Occlusion is the process of trees forming callus and clear wood over wounds.

Over Mature: Associated with crown retrenchment.

Pathogen: A disease-causing organism.

Pipe: Mud filled channel extending upwards from root/ stem zone of tree.

Phototropism: Influence of light on the direction of plant growth. Tendency of plants to grow towards light.

Phloem: Plant vascular tissue that transports photosynthates and growth regulators. Situated on the inside of the bark, just

outside the cambium. Is bidirectional (transports up and down). Contrast with xylem.

Photosynthesis: Process in green plants (and in algae and some bacteria) by which light energy is used to form glucose (chemical energy) from water and carbon dioxide.

Reaction wood: Wood forming in leaning or crooked stems or on lower or upper sides of branches as a means of counteracting the effects of gravity. See compression wood and tension wood.

Semi-mature: Trees are between 1/3 and 2/3 of expected mature height.

Shrub: A woody plant similar to a tree except it is usually several-stemmed and smaller than a tree.

Significance: The quality of being worthy of attention; importance.

Stem / Trunk: Organ which supports branches, leaves, flowers and fruit; may also be referred to as 'the trunk'.

Stress: In Plant Health Care, (1) a factor that negatively affects the health of a plant; a factor that stimulates a response. (2) mechanics, a force per unit area.

Stress – acute: Disorder or disease that occurs suddenly and over a short period of time.

Stress – chronic: Disorder or disease occurring over a longer time.

Tree: Long lived woody perennial plant greater than (or usually greater than) 3 m in height with one or relatively few main stems or trunks. A tree has 3 major organs – roots, stem and leaves.

Vigour: Ability of a tree to sustain its life processes. The term 'vigour' in this document is synonymous with commonly used terms such as 'health' and 'vitality'. Inherent genetic capacity of a plant to deal with stress. Physical strength and health. A tree with good vigour has the ability to sustain life processes and synonymous with good health.

Visual Tree Inspection (VTA): Is a detailed visual inspection of a tree and surrounding site.

Vitality: Ability of plant to deal effectively with stress.

Watersprouts/ Epicormic growth (Usually multiple shoots): Shoots produced from epicormic buds at the cambium of trunks or branches. Grows 'from the stub ends and only grows from the outermost living tissue layer of that year's growth. They are weakly attached and prone to falling out or being blown off with the risk increasing markedly as they increase in size. When epicormic shoots arise from stub ends that are decaying, the chances of them falling out are significantly greater'.

Wound: An opening that is created when the bark is cut, removed, or injured.

NOTE: Pruning a live branch always creates a wound, even when the cut is properly made.

Xylem: Main water and mineral-conducting (unidirectional, up only) tissue in trees and other plants. Provides structural support. Arises (inward) from the cambium and becomes wood after lignifying. Contrasted with phloem.

Young: Trees have not yet reached 1/3 of their expected mature height. They are generally growing vigorously and have high apical dominance.

Zone of *Rapid Taper*: The area within 1–2m of the trunk on larger trees is frequently referred to as the *'Zone of Rapid Taper'* because structural roots found there often exhibit considerable secondary thickening- not present on roots farther from the trunk (*Wilson 1964*). *Wilson (1964)* additionally reviews the development of this zone and its relation to mechanical stability.

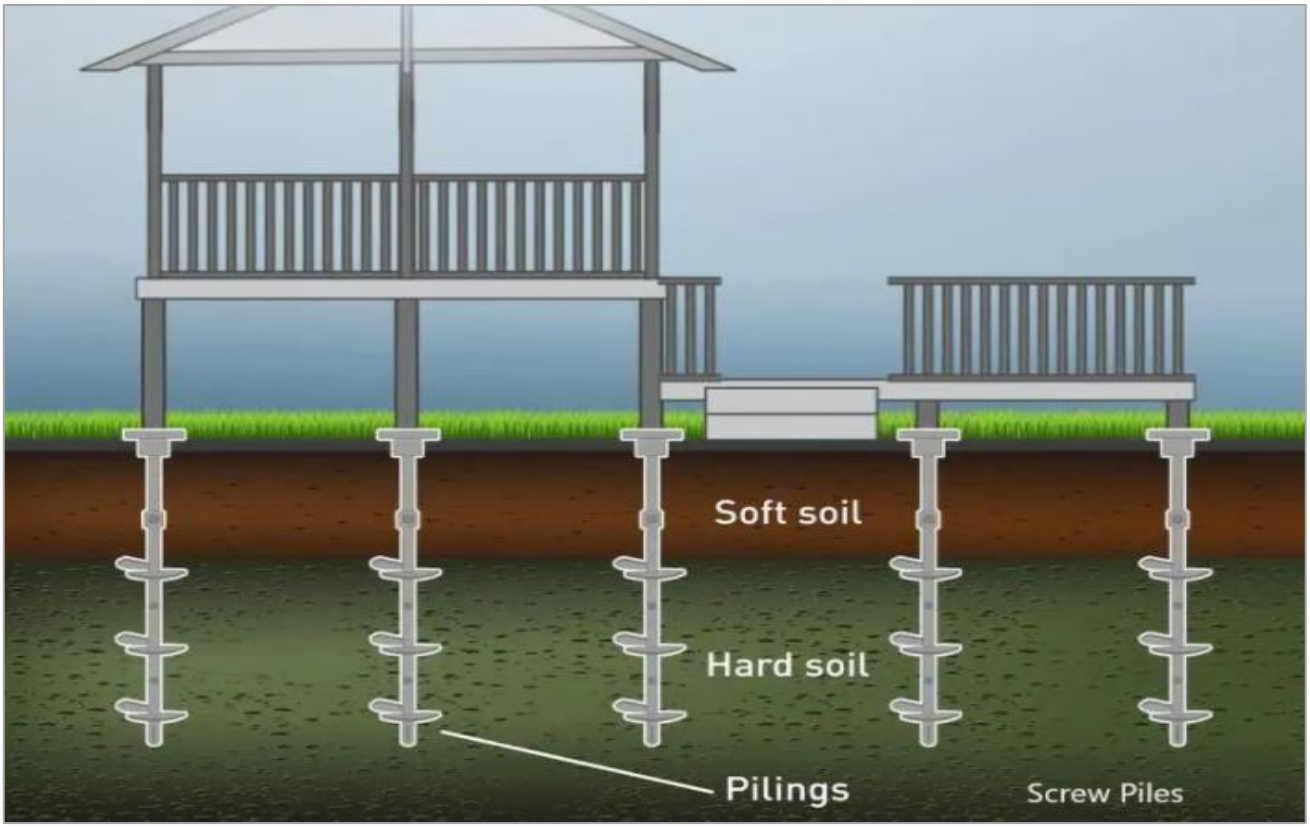
8 Appendix

8.1 Tree Sensitive Design

i. Unlike a dug-out or excavated continuous cement foundation, a pier foundation through the use of Screw Piles has proven to be the least damaging to soil and tree root biomass during and after the installation process (Whitcomb, 1991; Harris, Clark and Matheny, 2004).

ii. This Screw Pile construction methodology could be utilised in this project. The combination of initial Non-Destructive Root Exploration (Root Mapping) and Screw Piling make it possible to construct new buildings near trees, without adversely affecting their health, when all due care is taken in the design and installation. After initial Root Mapping, Screw Piles can either be drilled or banged into the soil with very little disturbance to the existing roots and root biomass. The Screw Piles then support the base of the building just above ground level with a framework of narrow diameter piles. Hence why Screw Piling is a preferred tree sensitive method as the buildings base is then constructed above ground level. This avails air and water to the roots which in turn promotes tree vitality and tree viability.

iii. Other benefits of Screw Piling include the prevention of macropore collapse and the proliferation of micropores in the soil profile due to compaction. Compaction of soil containing tree roots by traditional foundations has been shown to have a detrimental effect on the continued health of the tree. Compaction of soil reduces the passage of oxygen to roots during wet weather and can cause the soil to become so dense that roots are no longer able to penetrate through it (Craul, 1999). Screw piles overcome this by supporting load directly on their constituent helices. These are placed well below the tree roots to ensure the root ball does not experience any loading influence or disturbance.



Structural Confinement Cells

i. Where designs proposals encroach on the TPZ and/or the SRZ of trees, tree sensitive methods must be considered and utilised. Driveways and roadways should consist of permeable layers which allow water to penetrate freely. These designs should consist of:

- Sub-base (existing sub grade)
- An optional layer of geotextile material to stop the movement of the sub-base.
- A drainage system to provide sub surface irrigation.
- Porous concrete
- Permeable paving
- Geo-cells / Structural Confinement Cell installation (please refer to; The Use of Cellular Confinement Systems Near Trees: A Guide to Good Practice 2020).

ii. Where tree roots exist, roadways should be built with a granitic sand base to fill in and around root systems. Geogrid reinforcing is installed over the root systems which allows root development concurrent with the permeable system abovementioned.

iii. Weight distributing porous membranes are utilised for footpath designs. These layers can include large aggregate materials which allows water to pass through or a permeable paving system.

Types of Structural Confinement Cell alternatives include:

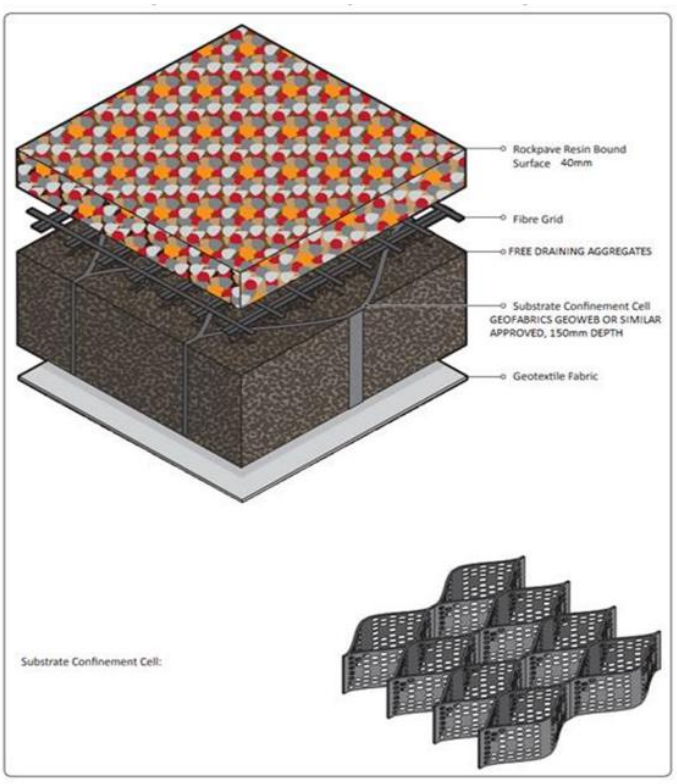


Figure 1: indicative Substrate Confinement Cell (Geo-cell).

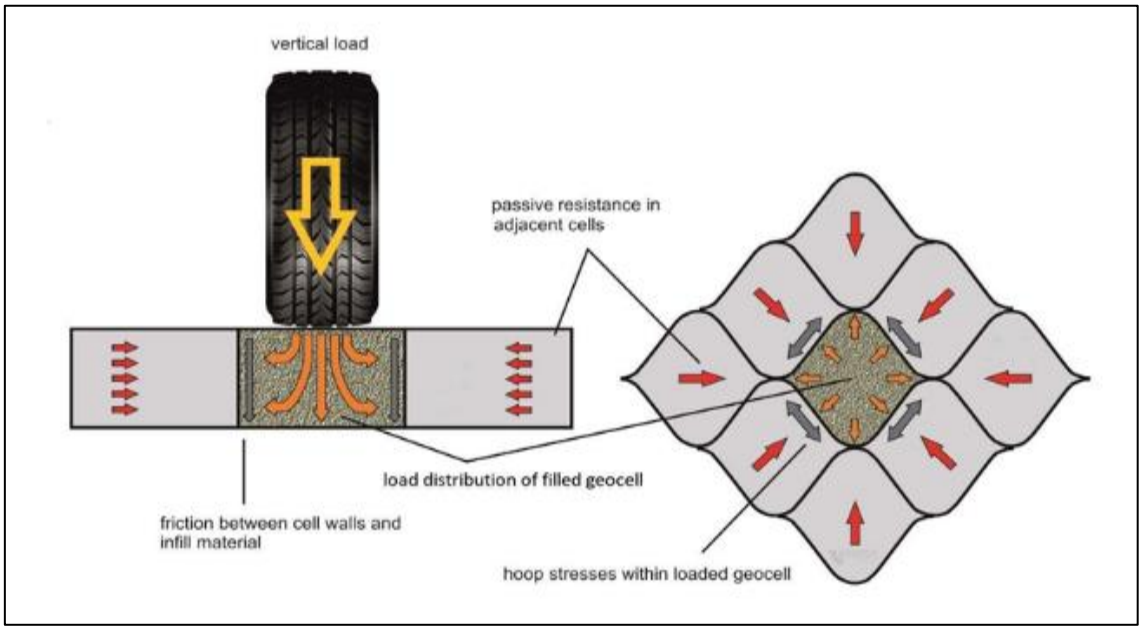


Figure2: This diagram illustrates how loads are spread when a vertical load is applied to a cellular confinement system.

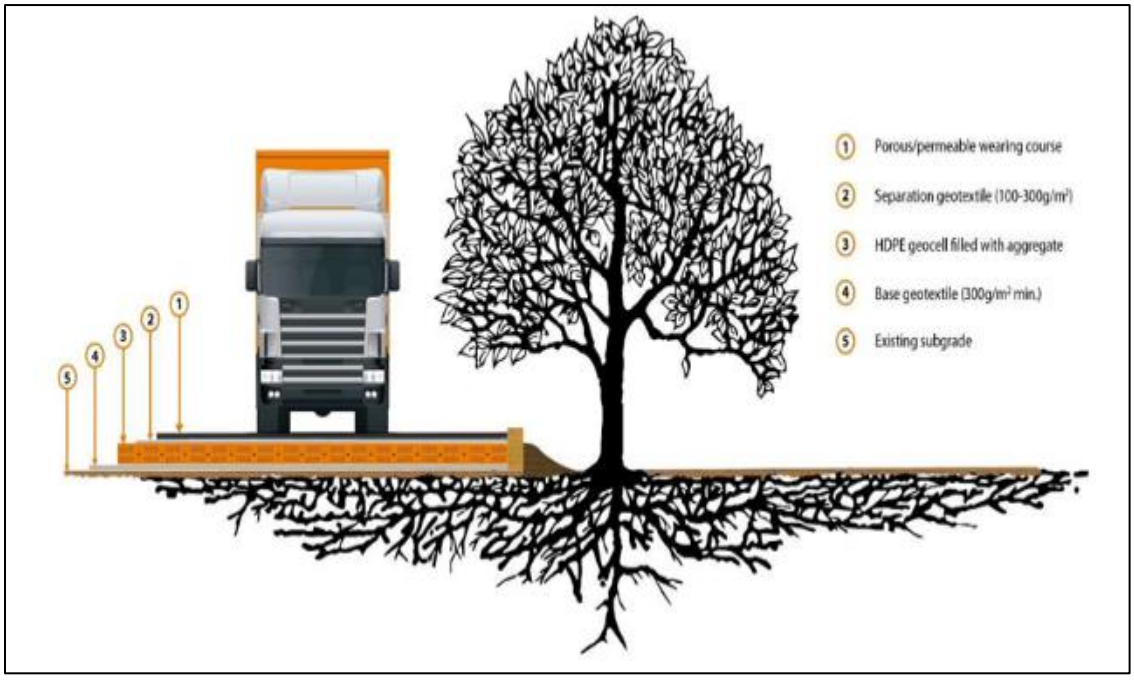


Figure 3: indicative representation of the use of a cellular confinement system over tree root zones.

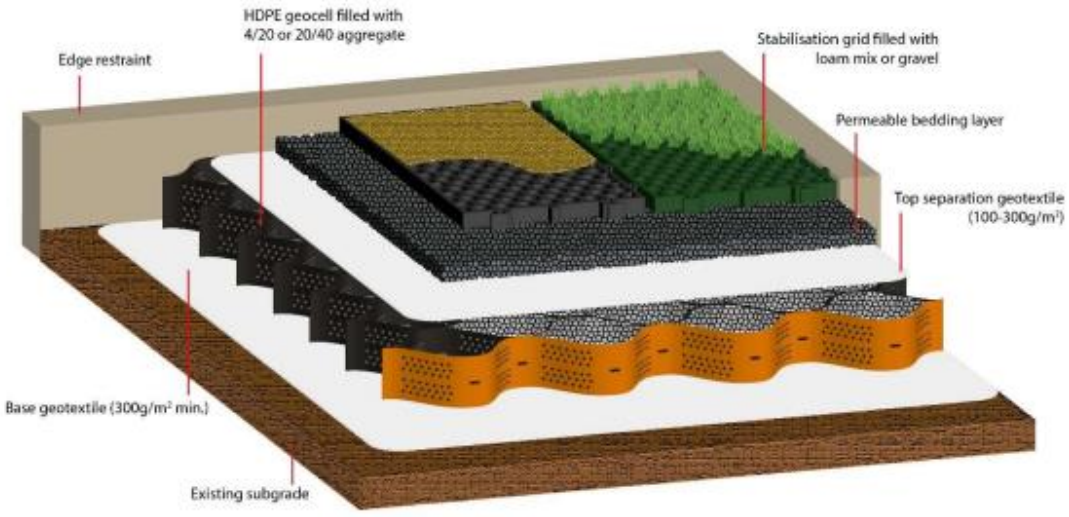


Figure 4 The sub-base configuration required for gravel or grass surfacing *[image courtesy of Core LP].*

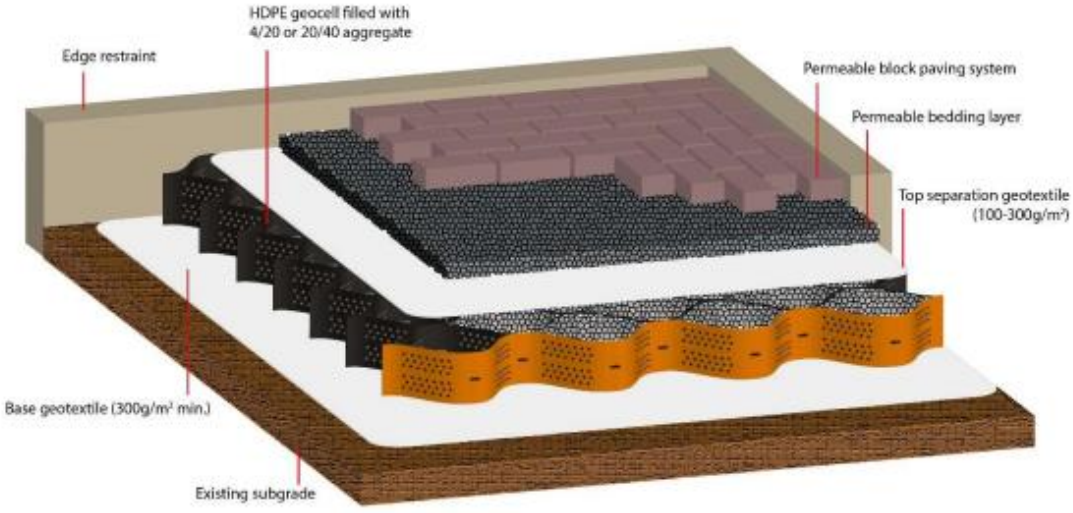
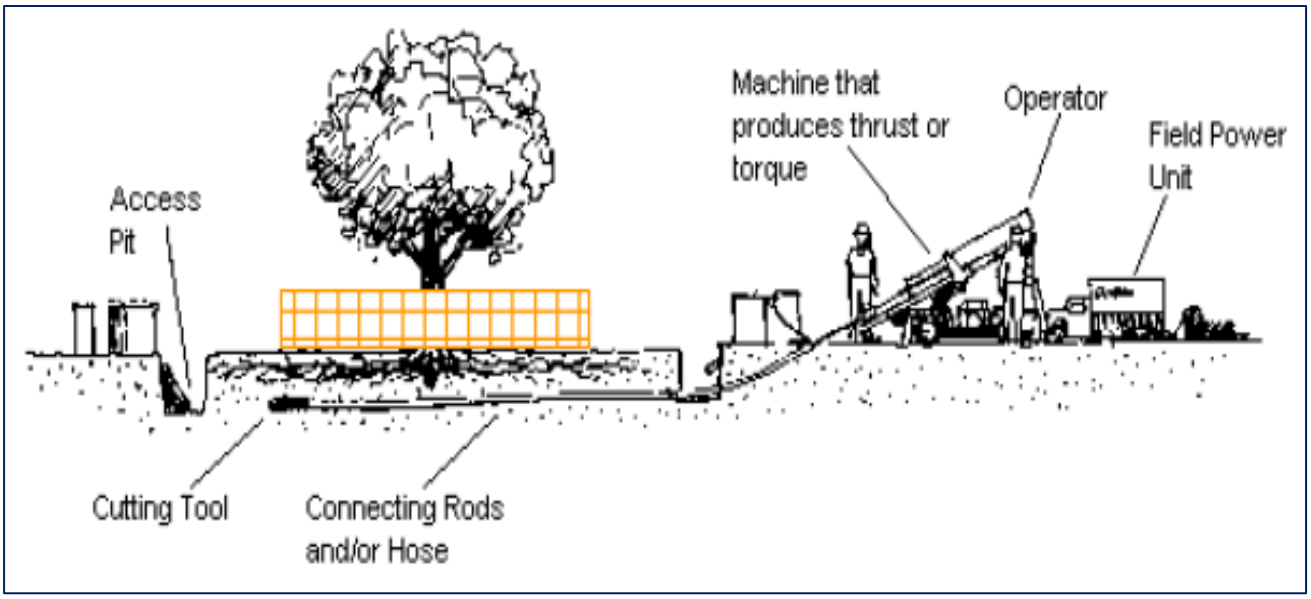


Figure 5 The recommended specification when installing permeable block paving above a cellular confinement system *[image courtesy of Core LP].*

Directional Drilling or Boring

i. The benefits provided by trees to open space and their contribution to micro-climates are immeasurable, so extreme care must be taken not to harm their root systems. Thus, horizontal Directional drilling has become an essential method for installing utilities and infrastructure near trees.

ii. *Directional drilling / Boring*; Traditional methods of service establishment (open cut trenching) can cause unnecessary root damage and/or soil disturbance. The action of 'thrusting' or 'directional drilling' is the most preferred method of service establishment within the Tree Protection Zone of trees. When Directional Drilling or the 'boring' method is used, the 'change of environment' around the tree is minimised. All machinery and starting pits associated with the action of thrusting or directional drilling must remain outside the TPZ of any trees. This is to minimise any root loss or ground compaction that may arise from the works. If the thrusting rod or directional drill-head becomes stuck underneath the dripline of a tree, then the arborist responsible for the trees on the site should be contacted prior to the retrieval process. Any retrieval of a thrusting rod or directional drill-head under the dripline of a tree should be undertaken with hand tools unless otherwise stated by the arborist responsible for the trees on the site.



Indicative Directional Drilling diagram.

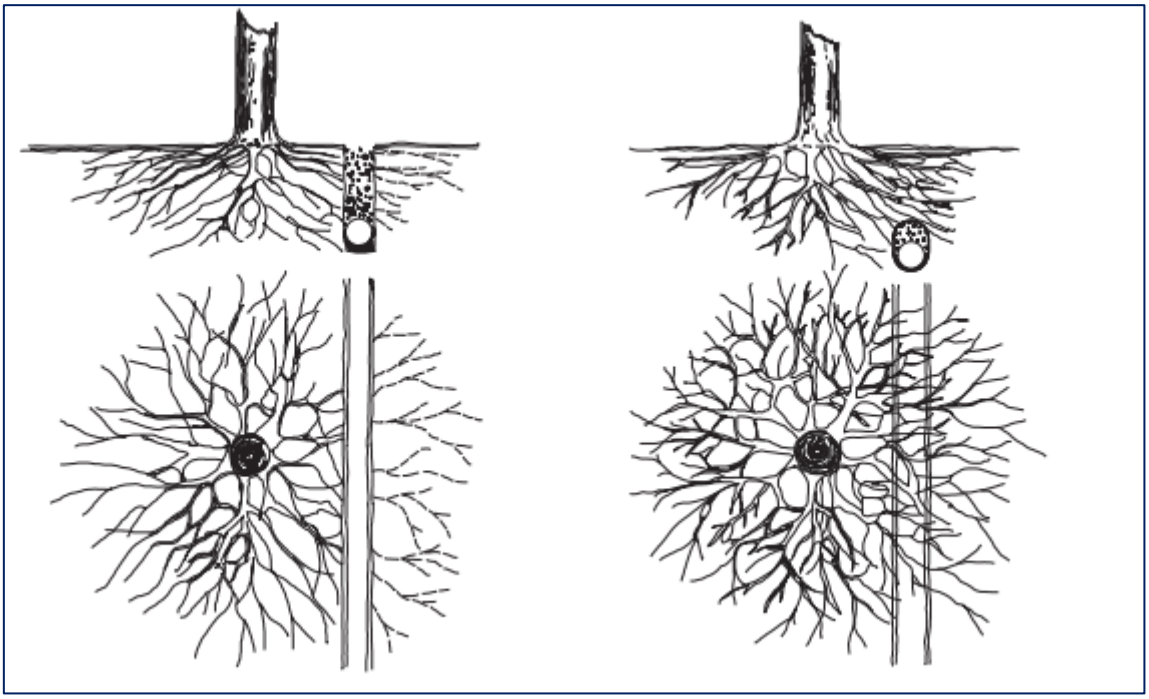
Key Points for Directional Drilling:

- Entry and exit pits will be positioned outside the designated/calculated TPZ of any tree under the guidance/supervision of the appointed onsite Supervising Arborist. This requirement will apply unless root sympathetic exploratory investigations (root mapping) have been undertaken and it has been determined by the Supervising Arborist that access within the TPZ will not significantly affect the tree per *AS 4970-2009* Construction Encroachment Descriptors & Categories.

- The extent or length of boring in the vicinity of trees will be determined by the TPZ.

- Pursuant to *AS 4970-2009* the depth of the boring/directional drilling must be at least 600mm deep. The Supervising Arborist will assess the likely impacts of boring and bore pits on the retained trees.

- Where boring is unavailable, excavation shall be by hand and/or Air-Spade/Air-Vac.



(Left) Trenching causes major damage, whilst (Right) Thrusting minimizes damage.

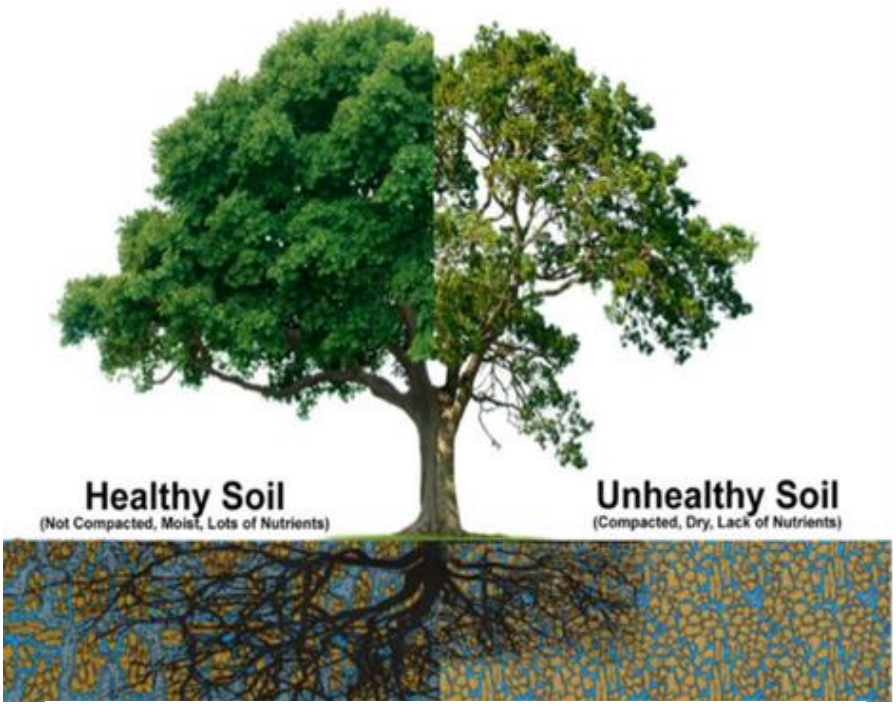
Permeable Porous Paving

i. Permeable Porous Paving (P3) is a paving product that allows water to filter through into the surrounding ground surfaces providing water to feeder tree roots. Within an urban environment tree pit, this allows effective capture and use of natural water which has many benefits.

ii. P3 helps maximises tree establishment and health, reduces environmental washout of loose material from tree pits, adds to the aesthetics of the surrounding streetscape and reduces trip hazards.

- *Improves tree health* - Increased rainfall penetrating to tree roots
- *Reduces impact of the Urban Heat Island effect* - Environmentally conscious product
- *Reduces water run-off and loss* – reduces the volume of storm water
- *High penetrability* – Maximises permeability
- *Reduces infrastructure costs* - Utilising natural water run-off
- *Environmentally friendly use of recyclable materials* - Reducing waste
- *Non-slip* - Improves pedestrian safety
- *Flexible and durable* - Reduces trip hazards while allowing for healthy root growth
- *Fast setting time* – Reduces installation time and costs
- *Hard wearing and low maintenance* - Designed for large volume traffic movement
- *Dual layer combination of permeable paving* - Allows for optimal performance

Surface Openings Around Trees



Indicative tree root growth

Surface opening treatment options			
	Suitable context	**Maintenance**	**Cost**
Organic mulch	Where space is available for open planters. Where footfall is very low, in wide footways and hard surfaced areas. Underneath other systems (eg tree grates).	Mulch will need to be replenished from time to time. Unsuitable for mechanical sweeping.	Very low
Loose aggregate	Wide footways and hard surfaced areas, where the tree surface opening will only be expected to accommodate low/occasional footfall.	Aggregate will need refilling from time to time. A ring of mulch should be included (and regularly refilled) immediately around the tree trunk. Unsuitable for mechanical sweeping.	Low
Porous paving self-binding aggregate	Wide footways and hard surfaced areas, where the tree surface opening will only be expected to accommodate low to medium footfall.	Aggregate will need refilling and loosening from time to time. A ring of mulch should be included (and regularly refilled) immediately around the tree trunk. Unsuitable for mechanical sweeping.	Low
Flexible permeable rubber surfacing	Footways and hard surfaced areas where the tree surface opening will be expected to accommodate medium to high footfall.	A ring of mulch should be included (and regularly refilled) immediately around the tree trunk.	Medium
Porous paving resin-bound aggregate	Footways and hard surfaced areas where the tree surface opening will be expected to accommodate medium to high footfall.	Subject to cracking under the pressure of buttress roots. Subject to clogging – particularly if subject to mechanical sweeping. A ring of mulch should be included (and regularly refilled) immediately around the tree trunk.	High

8.2 Root Morphology Considerations

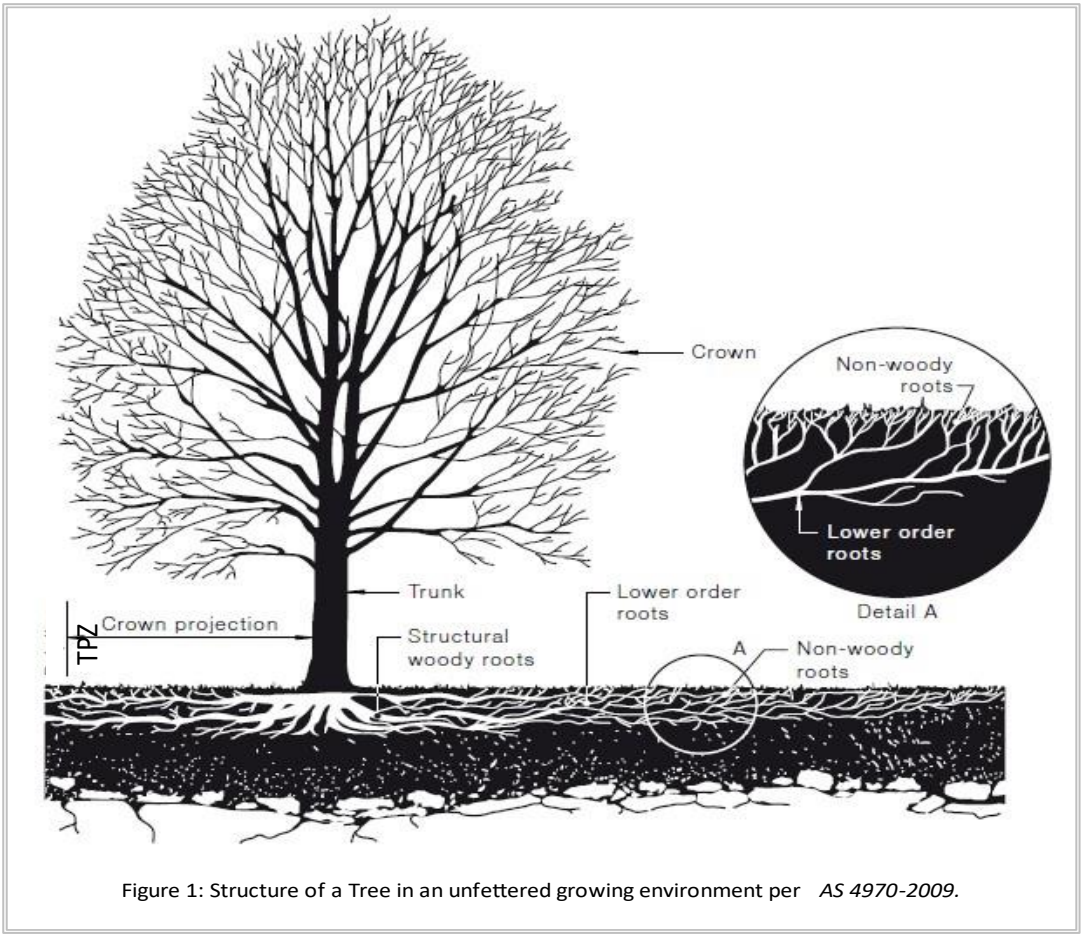


Figure 1: Structure of a Tree in an unfettered growing environment per *AS 4970-2009.*

Drawing 1: Indicative Root System and Rhizosphere of a Healthy Tree.

i. The main functions of roots include the uptake of water and nutrients, anchorage, storage of sugar reserves and the production of some plant hormones required by the shoots. For roots to function, they must be supplied with oxygen from the soil. The root system of trees consists of several 'types' of roots found in different parts of the soil and is generally much more extensive than commonly thought. The importance of roots is easily overlooked because they are not visible, that is 'out of sight, out of mind'. Damage to the root system is a common cause of tree decline and death and is the most common form of damage associated with development sites (Matheny et. al, 1998).

ii. Root systems consist of three main parts: (Sutton and Tinus, 1983).

- The structural woody roots (anchorage, storage and transport);
- Lower order roots (anchorage, storage and transport); and
- Non-woody roots (absorption of water and nutrients, extension, synthesis of amino acids and growth regulators) (please refer to Drawing 1 above).

iii. In addition to lateral root spread being underestimated, root depth in trees has also been grossly exaggerated. Deep root systems or taproots are the exception rather than the rule (Perry, 1982)

(Watson and Neely, 1994).

iv. Most roots of most trees are found in the very top of the soil. The vast majority of these roots are small non-woody absorbing roots which grow upward into the very surface layers of the soil and leaf litter. This delicate, non-woody system, because of its proximity to the surface, is very vulnerable to injury (Watson et. al, 2014).

8.3 Encroachment Descriptors

Tree Protection Zone (TPZ):

The TPZ is the optimal combination of crown and root area (as defined by *AS 4970-2009*) that requires protection during the construction process so that the tree can remain viable. The TPZ is an area that is isolated from the work zone to ensure no disturbance or encroachment occurs into this zone. Tree sensitive construction measures must be implemented if work is to proceed within the Tree Protection Zone.

Diameter at Breast Height (DBH) measured at 1.4m above ground level. DBH is the circumference divided by π.* Measurement taken by Standard issue DBH Tape.

Tree Protection Zone (TPZ) = DBH x 12 (The radius of the TPZ is calculated for each tree by multiplying its DBH × 12) Note: TPZ - minimum area is 2.0m / maximum area is 15m.

Please Note: The TPZ figure is expressed as a radius measurement which is to be taken from the centre of the stem at ground level and applied in an outwards direction towards the extremities of the branches for the entire circumference of the tree/s.

Structural Root Zone (SRZ):

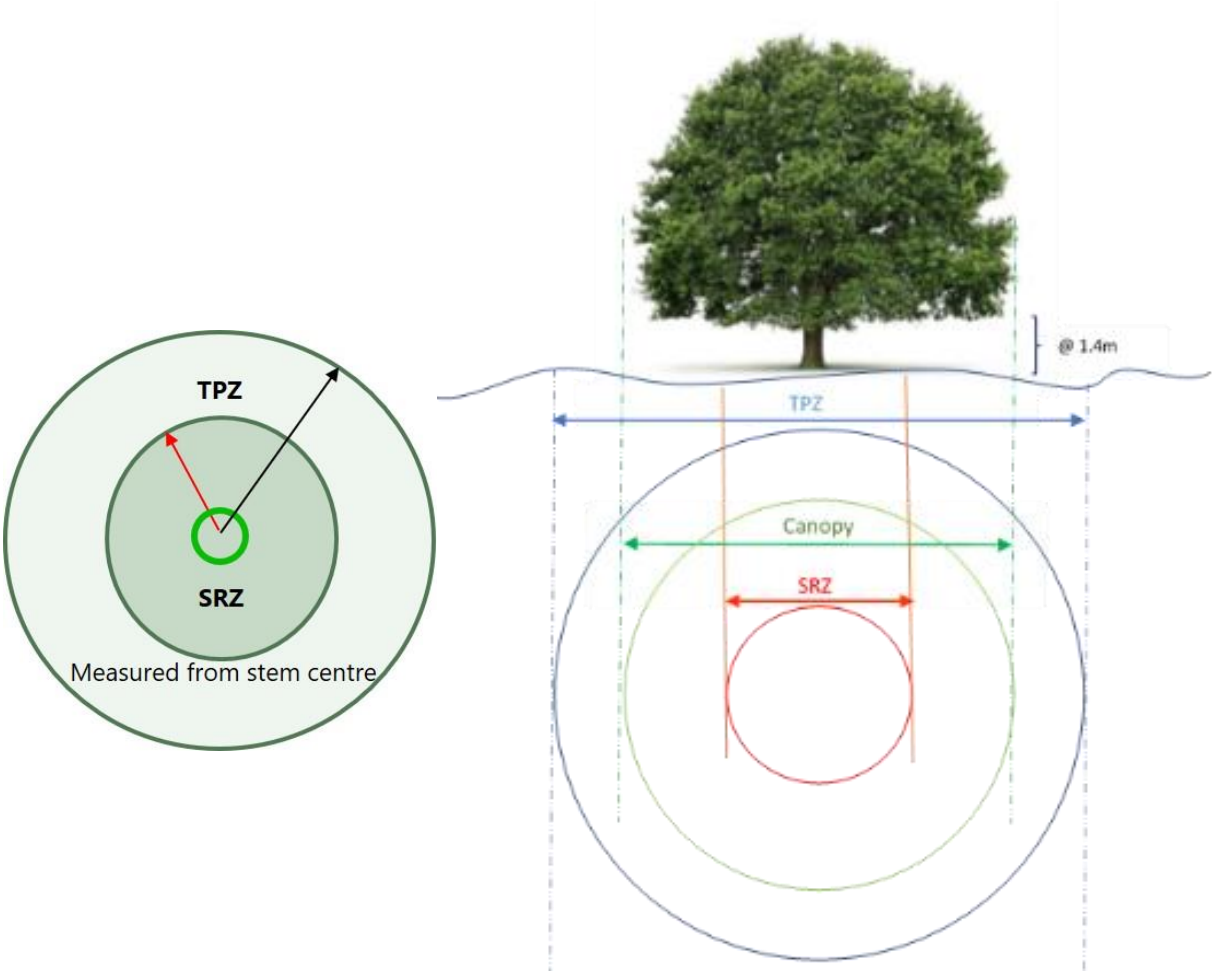
The SRZ is the area of the root system (as defined by *AS 4970-2009*) used for stability, mechanical support and anchorage of the tree. Severance of structural roots (>50 mm in diameter) within the SRZ is not recommended as it may lead to the destabilisation and/or serious decline of the tree.

Root Investigation:

When assessing the potential impacts of encroachment within the TPZ, consideration will need to be given to the location and distribution of the roots, including above or below ground restrictions affecting root growth. Location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as air spade and manual excavation. Root investigation is used to determine the extent and location of roots within the zone of conflict. Root investigation does not guarantee the retention of the tree.

8.4 Tree Protection Zone (TPZ) & Structural Root Zone (SRZ).

The Australian Standard *AS 4970-2009 - Protection of trees on development sites* is used for the allocation of tree protection zones. This method provides a TPZ that addresses both tree stability and growth requirements. TPZ distances are measured as a radius from the centre of the trunk at ground level.

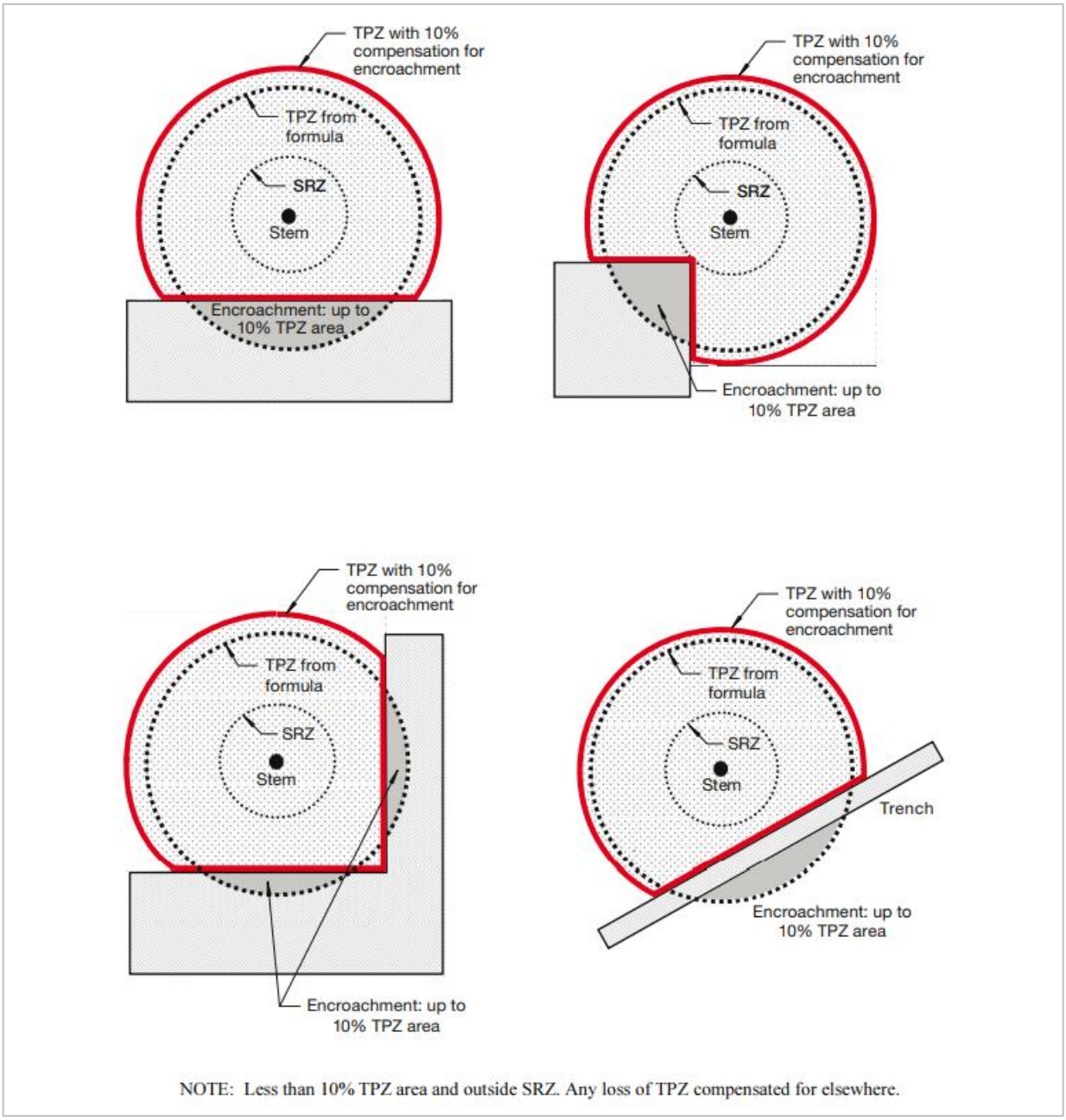


- AS4970-2009, s3: The radius of the TPZ is calculated for each tree by multiplying its Diameter @ Breast Height measured @ 1.4m from ground level (DBH × 12 = TPZ). (DBH = Trunk Girth @ 1.4m ÷ π).
- To calculate the SRZ: Radius SRZ = **D**iameter **A**bove **R**oot **C**rown (**DRC** x 50) ^ 0.42 x 0.64. If the DRC is less than 0.15m the SRZ will be 1.5m.
- Note: A TPZ should not be less than 2m or more than 15m from the tree stem.

You do not need to calculate the TPZ of palms, cycads and tree ferns. For these plants, the TPZ should not be less than 1m outside the crown.

8.5 Compensation for Tree Protection Zone Encroachment

Encroachment into the Tree Protection Zone (TPZ) is sometimes unavoidable. The images above are analogous to the abovementioned works scenario and indicate how encroachment within the tree protection zone can be compensated for elsewhere per *AS 4970-2009 Protection of Trees on Development Sites.*



NOTE: Less than 10% TPZ area and outside SRZ. Any loss of TPZ compensated for elsewhere.

8.6 Descriptors: Age, Vitality & Structure

(Per International Society of Arboriculture guidelines)

TREE AGE CLASS

Young Juvenile or recently planted approximately 1-7 years.
Semi-mature Tree actively growing in size and yet to achieve the expected size *in situ.*
Maturing Tree is approaching the expected size or has reached the expected size *in situ.*
Senescent Tree is over mature and has started to decline.

TREE VITALITY

Excellent: The tree is demonstrating excellent or exceptional growth. The tree should exhibit a full canopy of foliage and be free of pest and disease problems.
Good: Foliage of tree is entire, with good colour, very little sign of pathogens and of good density. Growth indicators are good i.e. Extension growth of twigs and wound wood development. Minimal or no canopy dieback (deadwood).
Fair: Tree is showing one or more of the following symptoms: <25% dead wood, minor canopy dieback, foliage generally with good colour though some imperfections may be present. Minor pathogen damage present, with growth indicators such as leaf size, canopy density and twig extension growth typical for the species in this location.
Poor: Tree is showing one or more of the following symptoms of decline; >25% deadwood, canopy dieback is observable, discoloured or distorted leaves. Pathogens present, stress symptoms are observable as reduced leaf size, extension growth and canopy density.
Very Poor: The tree appears to be in a state of decline. The tree is not growing to its full capacity. The canopy may be very thin and sparse. A significant volume of deadwood may be present in the canopy and/or pest and disease problems may be causing a severe decline in tree vitality.
Dead or dying: Tree is in severe decline; >55% deadwood, very little foliage, possibly Epicormic shoots and minimal extension growth.
Dead: The tree is completely dead and exhibits no new growth or live tissue.

***Please note that tree vitality cannot be measured directly, hence growth and physiological parameters that indicate tree vitality are used. Health or Vitality of a tree is evidenced by the general appearance of crown density, leaf colour, presence of epicormic shoots, ability to withstand disease invasion including pathogens and presence of dieback in crown at the time of inspection. Vigour may vary according to seasonal weather patterns and rainfall received (Dobbertin, 2005).*

***Tree Condition: The assessment of a tree(s) condition evaluates factors of tree vitality, form and structure. These descriptors of vitality, form and structure attributed to a tree evaluate the individual specimen to what could be reasonably considered by the arborist as typical for that species growing in situ. It is well documented that specific tree species can display inherently poor biomechanics, such as acute branch attachments with included bark, co-dominant leaders and other poor branch and root architecture. Whilst these 'structural defects' may be deemed arboriculturally flawed, they are typical for the species and my not constitute a foreseeable increased risk. These trees may be assigned a 'structural rating' of 'fair-poor' (as opposed to poor) at the arborist's discretion.*

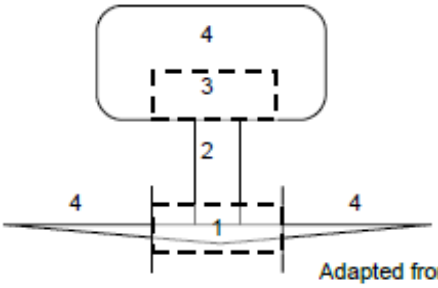
TREE STRUCTURE

Good: Trunk and scaffold branches show good taper and attachment with minor or no structural defects. Tree is a good example of species with well-developed form showing no obvious root problems or pests and diseases.
Fair/Fair-Poor: Tree shows minor structural defects or minor damage to trunk e.g. bark missing, there could be cavities present. Minimal damage to structural roots. Tree could be seen as typical for this species.
Poor/Very Poor: There are major structural defects, damage to trunk or bark missing. Co-dominant stems could be present with likely points of failure. Girdling or damaged roots obvious. Tree is structurally problematic.
Hazardous: Tree is immediate hazard with potential to fail, this should be rectified as soon as possible.

Tree Structure Matrix

Descriptor	Zone 1 - Root plate & lower stem	Zone 2 - Trunk	Zone 3 - Primary branch support	Zone 4 - Outer crown and roots
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
Fair	Minor damage or decay. Basal flare present.	Minor damage or decay	Typically formed, attached, spaced and tapered	Minor damage, disease or decay; minor branch end-weight or over-extension
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
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 resprout	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
Very Poor	Excessive damage, disease or decay; unstable / loose in ground; altered exposure; failure probable	Excessive damage, disease or decay; cavities. Excessive lean. Stump resprout	Decayed, cavities or branch attachments with active split; failure imminent	Excessive damage, disease or decay; excessive branch end-weight or over-extension

Diagram 2: Tree structure zones
1. Root plate & lower stem
2. Trunk
3. Primary branch support
4. Outer crown & roots



Adapted from Coder (1996)

Structure ratings will also take into account general tree architecture which considers aspects of stem taper, live crown ratio, branch distribution or crown bias and position such as a tree being suppressed amongst more dominant trees.

8.7 Descriptors: Estimated Life Expectancy (ELE)

The ELE is adapted from (*Barrell, 2001)*. The objective of a ELE assessment is to determine the relative value of individual trees for the purpose of informing future management options.

Estimated Life Expectancy – Assessment Criteria			
Dead	**Short**	**Medium**	**Long**
Trees with a high level of risk that would need removing within the next 5 years. Dead trees. Trees that should be removed within the next 5 years. Dying or suppressed or declining trees through disease or inhospitable conditions. Dangerous trees through instability or recent loss of adjacent trees. Dangerous trees through structural defects including cavities, decay, included bark, wounds or poor form. Damaged trees that considered unsafe to retain. Trees that could live for more than 5 years but may be removed to prevent interference with more suitable individuals or to provide space for new planting. Trees that will become dangerous after removal of other trees for the reasons.	Trees that appear to be retainable with an acceptable level of risk for 5-15 years. Trees that may only live between 5 and 15 more years. Trees that may live for more than 15 years but would be removed to allow the safe development of more suitable individuals. Trees that may live for more than 15 years but would be removed during the course of normal management for safety or nuisance reasons. Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.	Trees that appear to be retainable with an acceptable level of risk for 15-40 years. Trees that may only live between 15 and 40 more years. Trees that may live for more than 40 years but would be removed to allow the safe development of more suitable individuals. Trees that may live for more than 40 years but would be removed during the course of normal management for safety or nuisance reasons. Storm damaged or defective trees that require substantial remedial work to make safe and are only suitable for retention in the short term.	Trees that appear to be retainable with an acceptable level of risk for more than 40 years. Structurally sound trees located in positions that can accommodate future growth. Storm damaged or defective trees that could be made suitable for retention in the long term by remedial tree surgery. Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long-term retention

8.8 IACA Significance of Tree, Assessment Rating System (STARS)

Institute of Australian Consulting Arboriculturists (IACA) Significance of a Tree, Assessment Rating System (STARS) ***The tree is to have a minimum of 3 criteria in a category to be classified in that group***		
Low	**Medium**	**High**
The tree is in fair-poor condition and good or low vigour. The tree has form atypical of the species. The tree is not visible or is partly visible from the surrounding properties or obstructed by other vegetation or buildings. The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area. The tree is a young specimen which may or may not have reached dimensions to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen. The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa in situ – tree is inappropriate to the site conditions. The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms. The tree has a wound or defect that has the potential to become structurally unsound. **ENVIRONMENTAL PEST/NOXIOUS WEED** The tree is an environmental pest species due to its invasiveness and/or poisonous/allergenic, properties/ declared noxious weed. **HAZRADOUS / IRREVERSIBLE DECLINE** The tree is structurally unsound unstable and considered potentially dangerous. The tree is dead or in irreversible decline with the potential to fail/collapse.	The tree is in fair to good condition. The tree has form typical or atypical of the species. The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area. The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street. The tree provides a fair contribution to the visual character and amenity of the local area. The tree's growth is Mediumly restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa in situ.	The tree is in good condition and good vigour. The tree has a form typical for the species. The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age. The tree is listed as a heritage item, threatened species or part of an endangered ecological community or listed on councils' significant/notable tree register. The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity. The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values. The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa in situ – tree is appropriate to the site conditions.

(STARS) Tree Retention Value - Priority Matrix

IACA, 2010, IACA Significance of a Tree, Assessment Rating System (STARS), Institute of Australian Consulting Arboriculturists, Australia, (www.iaca.org.au).

		Significance				
		1.High	**2.Medium**	**3.Low**		
		Significance in Landscape	Significance in Landscape	Significance in Landscape	Environmental Pest/Noxious Weed Species	Hazardous / Irreversible Decline
Estimated Life Expectancy	1.Long **>40 Years**					
	2.Medium **15-40 Years**					
	3.Short **<1-15 Years**					
	Dead					

	Priority for Retention (High) - These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard *AS 4970 Protection of trees on development sites.* Tree sensitive construction measures must be implemented (pier and beam cantilever, Structural Confinement Cells etc if works are to proceed within the TPZ).
	Consider for Retention (Medium) - These trees may be retained and protected. These are considered less critical; however, their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	Consider for Removal (Low) - These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
	Priority for Removal - These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

8.9 Assumptions and Limiting Conditions

1) Active Green Services Pty Ltd (herein after referred to as AGS) contracts with you on the basis that you promise that all legal information which you provide, including land title and ownership of other property, are correct. AGS is not responsible for verifying or ascertaining any of these issues.
2) AGS contracts with you on the basis that your promise that all affected property complies with all applicable statutes and subordinate legislation.
3) AGS will take all reasonable care to obtain necessary information from reliable sources and to verify data. However, AGS neither guarantees nor is responsible for the accuracy of information provided by others.
4) If, after delivery of this report, you later require a representative of AGS to attend court to give evidence or to assist in the preparation for a hearing because of this report, you must pay an additional hourly fee at our then current rate for expert evidence.
5) Alteration of this report invalidates the entire report.
6) AGS retains the copyright in this report. Possession of the original or a copy of this report does not give you or anyone else any right of reproduction, publication or use without the written permission of AGS.
7) The contents of this report represent the professional opinion of the consultant. AGS consultancy fee for the preparation of this report is in no way contingent upon the consultant reporting a particular conclusion of fact, nor upon the occurrence of a subsequent event.
8) Sketches, diagrams, graphs and photographs in this report are intended as visual aids, are not to scale unless stated to be so, and must not be construed as engineering or architectural reports or as surveys.
9) Unless expressly stated otherwise:
    a. The information in this report covers only those items which were examined and reflects the condition of those items at the time of the inspection.
    b. Our inspection is limited to visual examination of accessible components without dissection, excavation or probing. There is no warranty or guarantee, express or implied, that even if they were not present during our inspection, problems or defects in plants or property examined may not arise in the future.
10) This Report supersedes all prior discussions and representations between AGS and the client on the subject.

8.10 AGS Quality Control

Document control

File reference	File type	Modifications	Date
JN 83857	AR	Original document	25/03/2022

Documents reviewed

Date	Title	Author	Company
N/A	N/A	N/A	N/A

Communication register

Date	Type	From	To	Description
N/A	N/A	N/A	N/A	N/A

Review register

Date	File reference	Reviewer	Qualification	Company
28/03/2022	JN 83857 Arboricultural Impact Assessment Report	I. Dunsmuir	Arborist (AQF 5)	Active Green Services