



ARBORICULTURAL IMPACT ASSESSMENT

Upper Australia Exhibit-

Taronga Zoo

Prepared for: Taronga
Conservation Society

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Executive Summary

Site visits were conducted on 7th, 8th, 9th June 2020 for the original report and 25th March 2021 to assess the new amendment to the Southern Link connection.

A total of one hundred and ninety-eight (198) trees were assessed during our initial site visit, the full assessment details for each tree can be found in Appendix 2 of this report.

We cross-checked the suite of drawings that we had been provided in order to confirm the level of impact imposed by each of the proposed elements.

A total of thirty-nine (39) trees will require removal to facilitate this development, they are as follows:

Retention value	High Priority for retention	Medium Consider for retention	Low Consider for removal	Remove Priority for removal
Tree numbers	90	29-59-63- 101-103-118- 119-120-175	1-3-9-26-27- 30-64-78-78a- 78b-79-80- 89-91-99-100- 102-122-131- 154-155- 155a-166- 167-168-176- 196-197-198	N/A

Tree protection measures will be required to protect the remaining trees within and around the development area.

Generic tree protection measures have been provided in Appendix 3 and a generic Arboricultural work method statement can be found in Appendix 4.

Once a building contractor has been engaged, a detailed construction management plan must be provided by the contractor and the project Arborist is to prepare a site-specific tree protection plan detailing the following:

- Access and egress for personnel and machinery into the site including a pruning specification if required.
- Location of tree protection fencing.
- Any areas where ground protection will be required.
- Locations for site sheds, amenities, temporary electricity and water.
- Stockpile areas for soil and materials.
- Storage area for machinery, fuels and chemicals etc.
- Inspection regime and reporting protocols

All pruning must be conducted in accordance with AS4373-2007- The Pruning of Amenity Trees.

No underground services are to be located within the TPZ or SRZ of any tree to be retained.

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Introduction

Sydney Arbor Trees Pty Ltd have been engaged by Taronga Conservation Society to provide an Arboricultural Impact Assessment (AIA), in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs), and in support of the SSDA for the proposed development of the Upper Australia Exhibit within Taronga Zoo, Mosman.

The proposed development is to demolish the existing site features shown in red and orange in figure 1 below as part of the early works schedule.



Figure 1- Demolition plan showing the structures to be demolished for stage 1 works.

The demolition of existing structures and the potential impacts upon trees has been assessed separately as part of a local development application which is to be lodged with Mosman Council. There were no trees to be removed in relation to the Mosman Council DA and there were no significant impacts anticipated to be imposed by these works. To ensure that no significant impacts were imposed, tree protection controls were specified in relation to working around trees, similar controls will be specified in relation to this application. This Arboricultural Impact Assessment (AIA) is to form part of a State Significant Development Application (SSDA) and will assess the potential negative impacts upon the trees from the proposed development. Trees will be specified for removal or retention based upon current designs and where practical to do so, recommendations will be provided to mitigate the impacts upon trees to enable their successful retention.

The image shown in figure 2 (below) has been created with 3D modelling technology (Bimx) and has been provided to me by the client to assist in the visualisation of the overall project. The areas labelled below are the main features of this proposed development and each one will be discussed in relation to its potential impact upon trees.

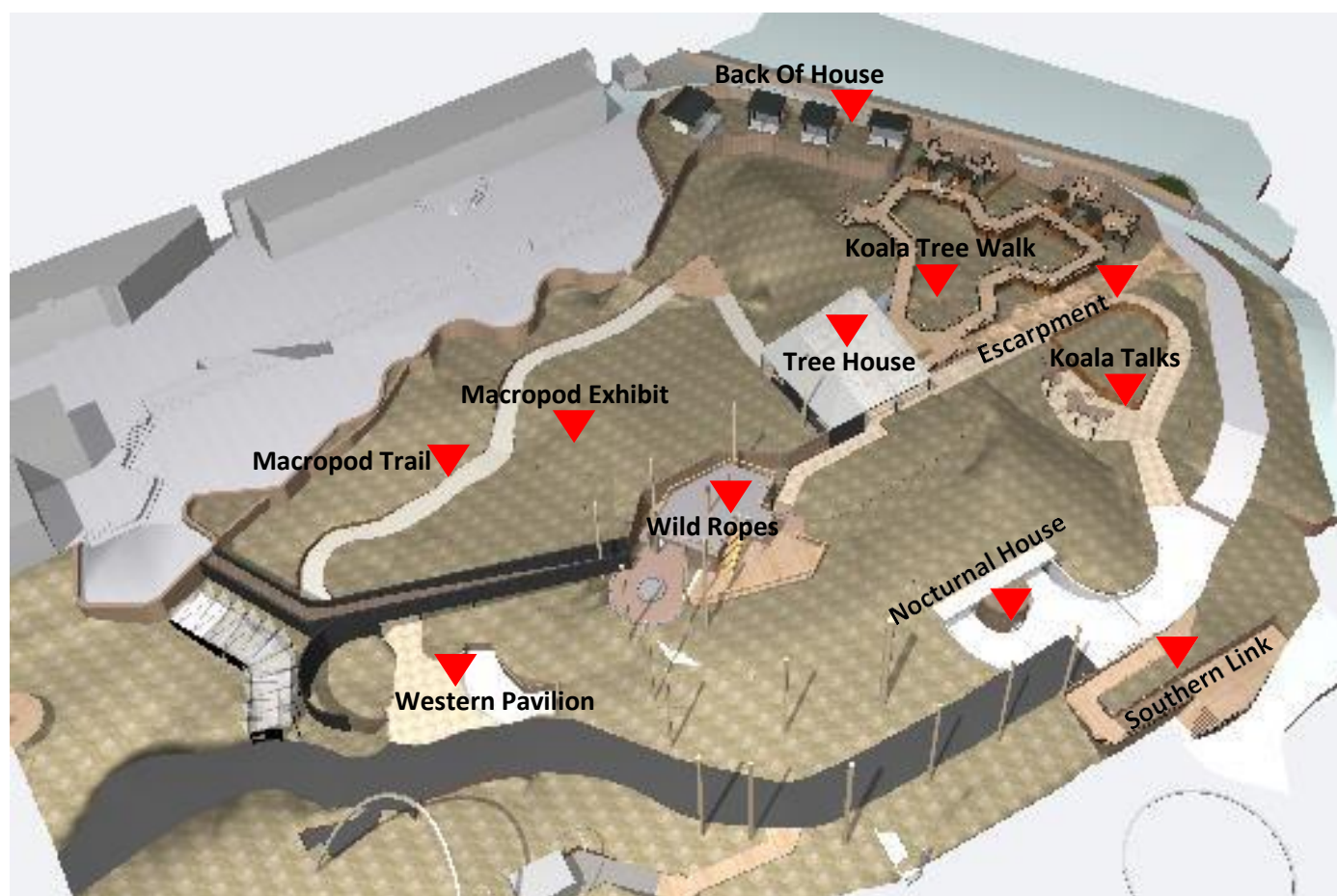


Figure 2- Bimx image showing the proposed development areas. Image provided by the client.

Methodology

Site visits were conducted on 7th, 8th & 9th June 2020.

Assessment of the trees was undertaken using the framework of the visual tree assessment procedure (VTA) as prescribed by Mattheck & Broeler 1994.¹



Tree Protection Zones and Structural Root Zones were calculated in accordance with AS4970-2009- The Protection of Trees on Development Sites ²(see Section 1.2). Tree Retention Values were determined using the IACA 'Significance of a Tree, Assessment Rating System' ³(STARS – see Section 1.3).

- No internal diagnostic testing of trees has been completed.
- All observations were made from the ground only.
- Tree heights and diameters have been estimated.
- Only trees greater than 5m in height have been assessed.
- Tree protection zones & structural root zones (TPZ & SRZ) have been calculated in accordance with AS4970-2009.
- Tree protection zones will be shown in Blue, structural root zones are shown in Pink.

¹ Mattheck & Broeler 1994- The Body Language of Trees.

² Standards Australia- AS4970-2009- The Protection of Trees on Development Sites

³ IACA- Significance of a Tree Assessment Rating System- STARS

Site Details

The site is at Taronga Zoo, Mosman.

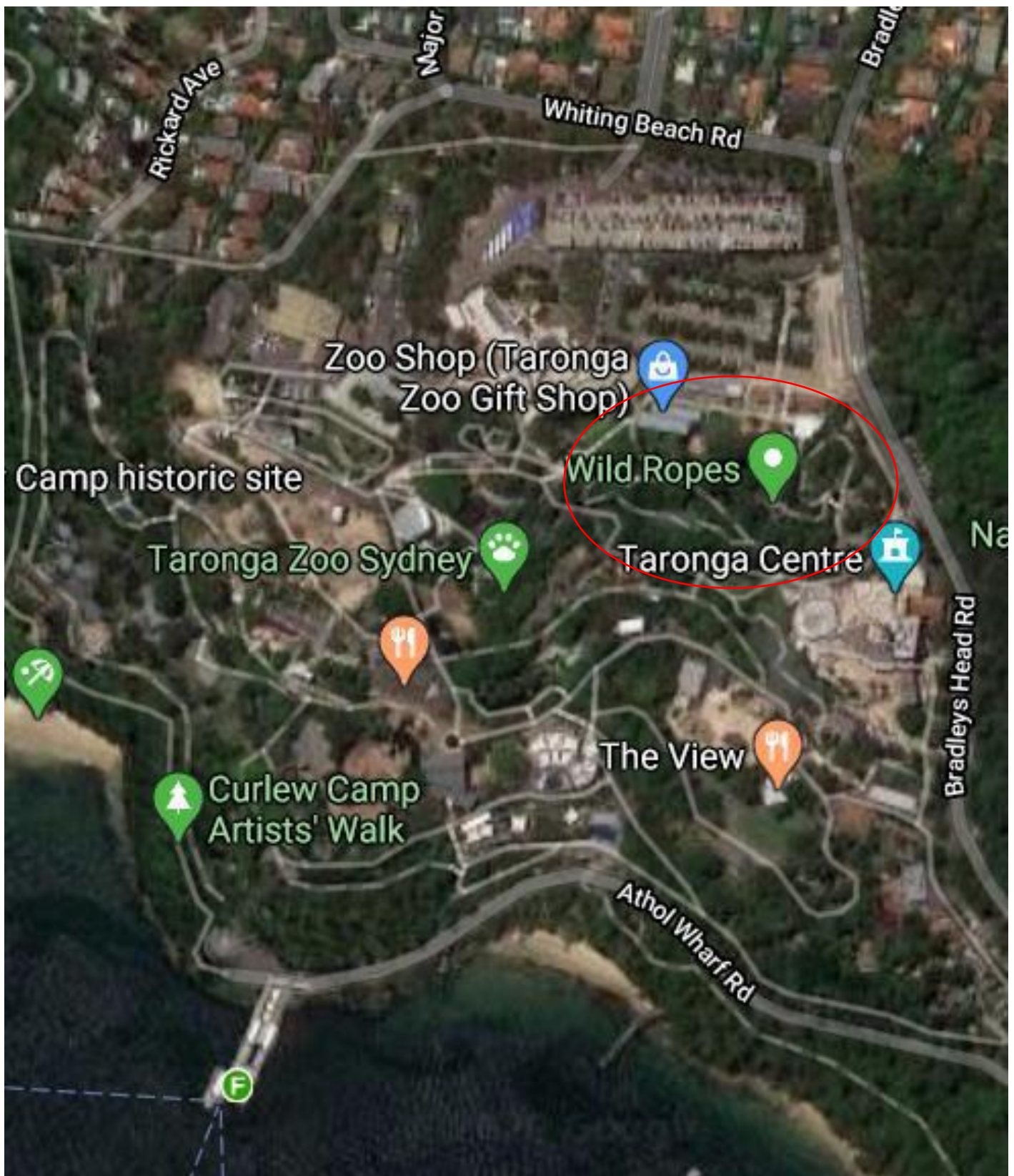


Figure 3- The location of the proposed development site. Image from Google Maps

Tree location plan

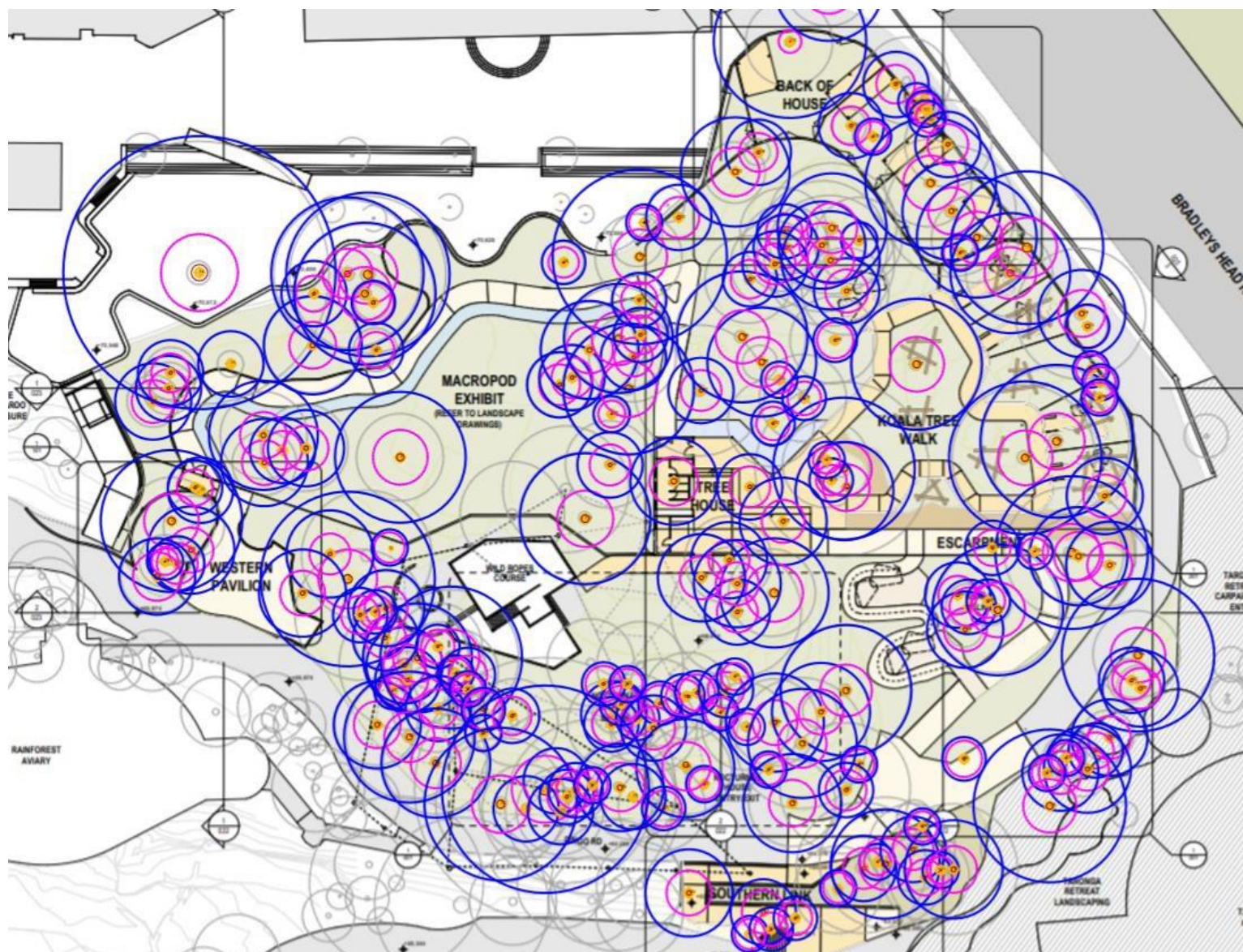


Figure 4- The surveyed trees overlaid on the proposed development drawing, blue = TPZ, Pink = SRZ

Western Pavilion

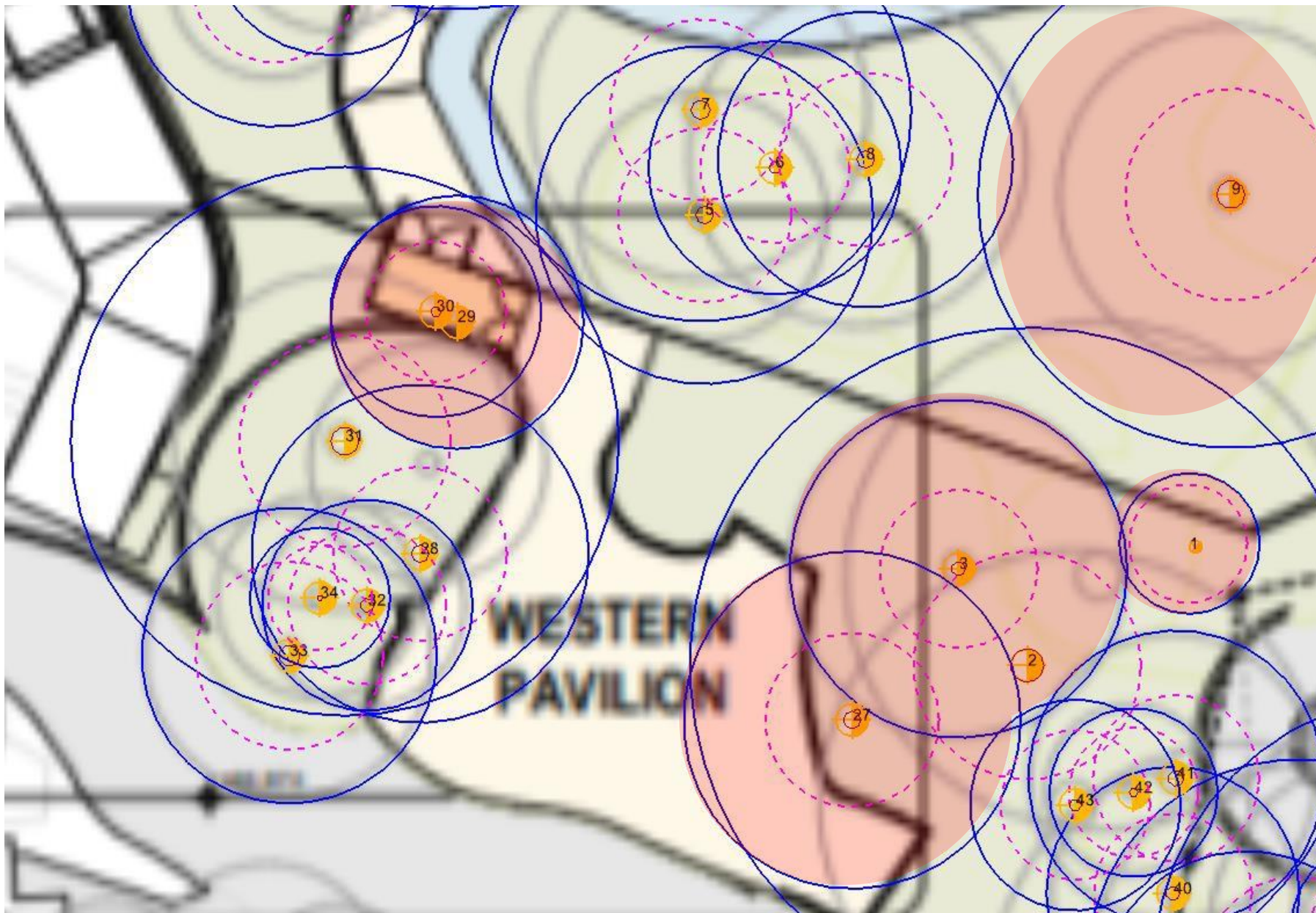


Figure 5- Trees affected by the proposed 'Western Pavilion'.

WESTERN PAVILION

Tree number	Impacts	Mitigation	Remove/retain
1	Conflicts with footprint of new bridge to wild ropes course	N/A	Proposed for removal
2	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
3	Conflicts with footprint of new bridge to wild ropes course	N/A	Proposed for removal
5	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
6	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
7	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
8	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
9	Drainage of existing ponds/ altered micro-climate	N/A	Proposed for removal
27	Drainage of existing ponds/ altered micro-climate	N/A	Proposed for removal
28	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
29	Conflicts with footprint of new bridge to wild ropes course	N/A	Proposed for removal
30	Conflicts with footprint of new bridge to wild ropes course	N/A	Proposed for removal
31	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
32	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
33	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
34	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect

Notes: Tree nine (9) is a large Casuarina adjacent to the existing ponds and boardwalk. The tree could be retained throughout this development; however, it has significant decay and structural defects. These defects were of less concern whilst the tree was within an exhibit, however the new development will bring far greater occupancy under the tree and will elevate the risk to an unacceptable level. This tree is proposed for removal on these grounds.

Macropod trail

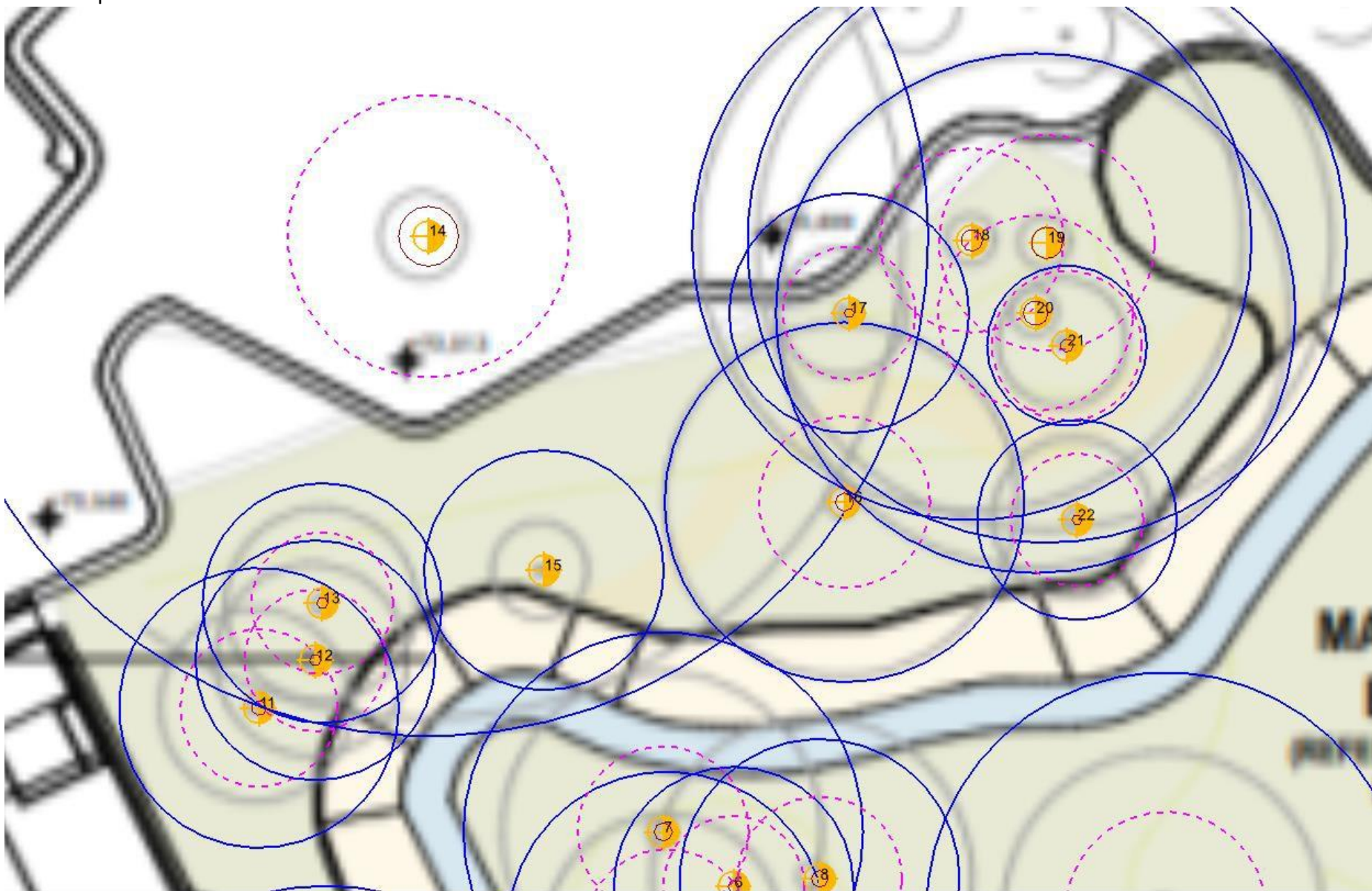


Figure 6- Trees impacted by the Macropod trail

Macropod trail/ Macropod exhibit

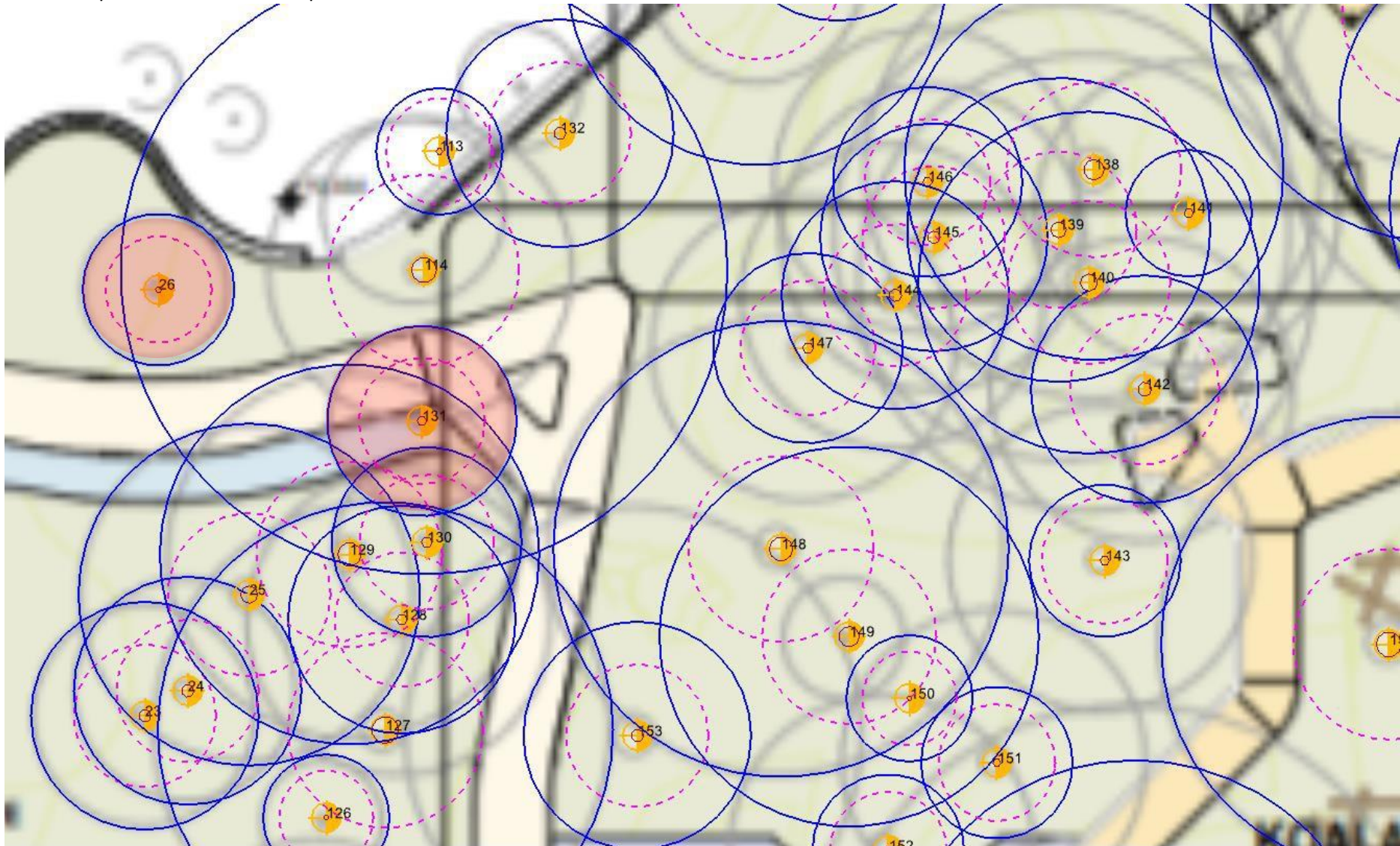


Figure 7- Macropod trail continued.

MACROPOD TRAIL/ MACROPOD EXHIBIT

Tree number	Impacts	Mitigation	Remove/retain
11	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
12	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
13	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
14	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
15	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
16	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
17	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
18	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
19	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
20	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
21	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
22	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
23	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
24	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
25	Drainage of existing ponds/ altered micro-climate	Install irrigation and misters to maintain moisture levels	Retain & protect
26	Dead tree	N/A	Proposed for removal
113	Unaffected by proposal	Tree protection fencing	Retain & protect
114	Heavily encroached upon by Macropod trail	Section of the trail within the TPZ must be built on or above grade using tree sensitive construction methods.	Retain & protect
126	Unaffected by proposal	Tree protection fencing	Retain & protect
127	Heavily encroached upon by Macropod trail	Section of the trail within the TPZ must be built on or above grade using tree sensitive construction methods.	Retain & protect
128	Minor encroachment from the Macropod trail	Tree protection fencing	Retain & protect
129	Minor encroachment from the Macropod trail	Tree protection fencing	Retain & protect
130	Minor encroachment from the Macropod trail	Tree protection fencing	Retain & protect
131	Heavily encroached upon by Macropod trail and water feature	N/A	Proposed for removal

132	Heavily encroached upon by new containment fence	Fencing must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
138	Unaffected by proposal	Tree protection fencing	Retain & protect
139	Unaffected by proposal	Tree protection fencing	Retain & protect
140	Unaffected by proposal	Tree protection fencing	Retain & protect
141	Unaffected by proposal	Tree protection fencing	Retain & protect
142	Encroached upon by viewing platform	Raised platform footings must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
143	Unaffected by proposal	Tree protection fencing	Retain & protect
144	Unaffected by proposal	Tree protection fencing	Retain & protect
145	Unaffected by proposal	Tree protection fencing	Retain & protect
146	Unaffected by proposal	Tree protection fencing	Retain & protect
147	Unaffected by proposal	Tree protection fencing	Retain & protect
148	Minor encroachment from the Macropod trail	Tree protection fencing	Retain & protect
149	Unaffected by proposal	Tree protection fencing	Retain & protect
150	Unaffected by proposal	Tree protection fencing	Retain & protect
151	Unaffected by proposal	Tree protection fencing	Retain & protect
152	Unaffected by proposal	Tree protection fencing	Retain & protect
153	Minor encroachment from the Macropod trail	Tree protection fencing	Retain & protect

Notes: Many of the trees are near the edge of the existing ponds. The removal of the ponds must consider sensitive construction methods such as hand demolition or retaining sections of the ponds in situ. The trail must be located within the footprint of the existing ponds. There is a small Melaleuca which does not meet the definition of a prescribed tree which will require removal to enable the pathway to be installed. Tree sixteen (16) is a large Tuckeroo which may require minor crown lifting for pedestrian access.

Trees #144, #127, #132, #142 are heavily encroached upon the proposed structures and tree sensitive construction methods must be employed.

Macropod back of house

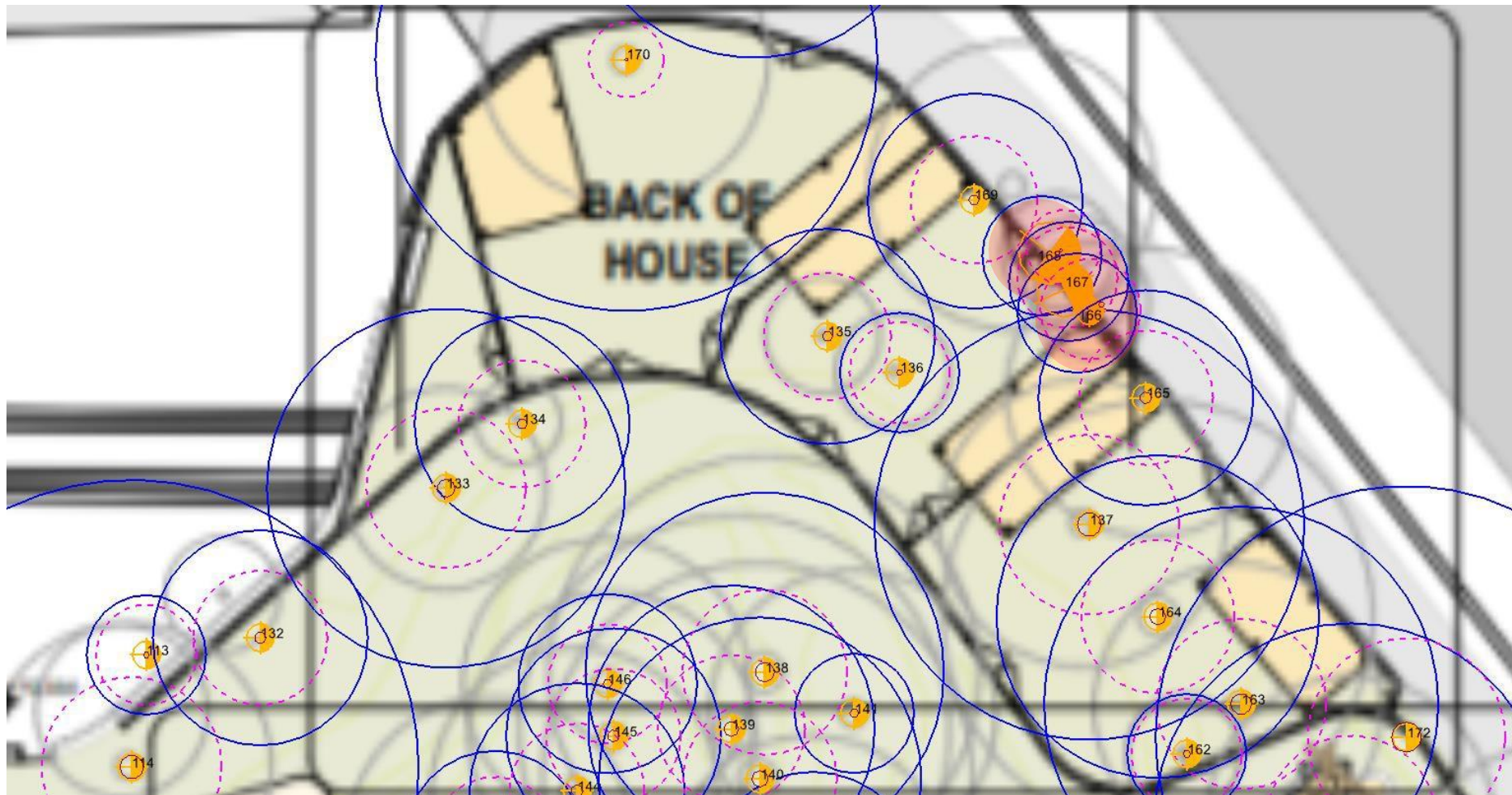


Figure 8- Trees impacted by the Macropod back of house

MACROPOD BACK OF HOUSE

Tree #	Impacts	Mitigation	Remove/retain
133	Heavily encroached upon by new containment fence	Fencing must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
134	Heavily encroached upon by new containment fence	Fencing must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
135	Heavily encroached upon by platform 3	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
136	Unaffected by proposal	Tree protection fencing	Retain & protect
137	Heavily encroached upon by platforms 4 & 5	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
162	Heavily encroached upon by new containment fence	Fencing must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
163	Heavily encroached upon by platform 6	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
164	Heavily encroached upon by platform 6	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
165	Heavily encroached upon by platform 5	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
166	Heavily encroached upon by platform 4 & new containment fence	N/A	Proposed for removal
167	Heavily encroached upon by platform 4 & new containment fence	N/A	Proposed for removal
168	Heavily encroached upon by new containment fence and gate	N/A	Proposed for removal
169	Heavily encroached upon by platform 2, 3 & new containment fence	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
170	Heavily encroached upon by platform 1	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
171	Unaffected by proposal	Tree protection fencing	Retain & protect
172	Heavily encroached upon by platform 6 & new containment fence	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect

Notes: Many of the trees are heavily encroached upon by the new containment fence and the platform structures. Tree sensitive methods such as hand digging must be used to install the footings which must be located outside of the structural root zone of the tree. Any concrete pads must be installed at or above grade with no excavation within the tree protection zones other than for footings. Works within tree protection zones will be under Arborist supervision. Trees #166, #167, #168 are all poor specimens of *Casuarina glauca*, these trees have been recommended for removal due to conflicts with the existing design and their inappropriate locations.

Tree House



Figure 9- Trees impacted by the tree house

TREE HOUSE

Tree #	Impacts	Mitigation	Remove/retain
116	Unaffected by development	N/A	Retain & protect
117	Minor encroachment from tree house structure	Tree protection fencing	Retain & protect
118	Within Tree House footprint	N/A	Proposed for removal
119	Major encroachment from tree house structure	N/A	Proposed for removal
120	Major encroachment from tree house structure	N/A	Proposed for removal
121	Minor encroachment from tree house structure	Tree protection fencing	Retain & protect
122	Within Tree House footprint	N/A	Proposed for removal
123	Minor encroachment from tree house structure	Tree protection fencing	Retain & protect
125	Unaffected by development	N/A	Retain & protect
152	Unaffected by development	N/A	Retain & protect
154	Within Tree House footprint	N/A	Proposed for removal
155	Major encroachment from tree house structure	N/A	Proposed for removal
155a	Major encroachment from tree house structure	N/A	Proposed for removal
156	Major encroachment from tree house structure	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
157	Major encroachment from tree house structure	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect

Notes: The tree house structure is primarily a raised structure and few impacts are anticipated other than what arises from direct conflicts with the building line itself. Trees #118, #122, #154 are all within the building footprint and will require removal. Trees #119 and #120 are too close to the proposed structure to be sustainable in the long-term and are proposed for removal. Trees #155 and #155a are small suppressed trees that are leaning towards the proposed structures, there will be ongoing canopy conflicts between the trees and the proposed structures so they have been recommended for removal.

Koala Tree Walk

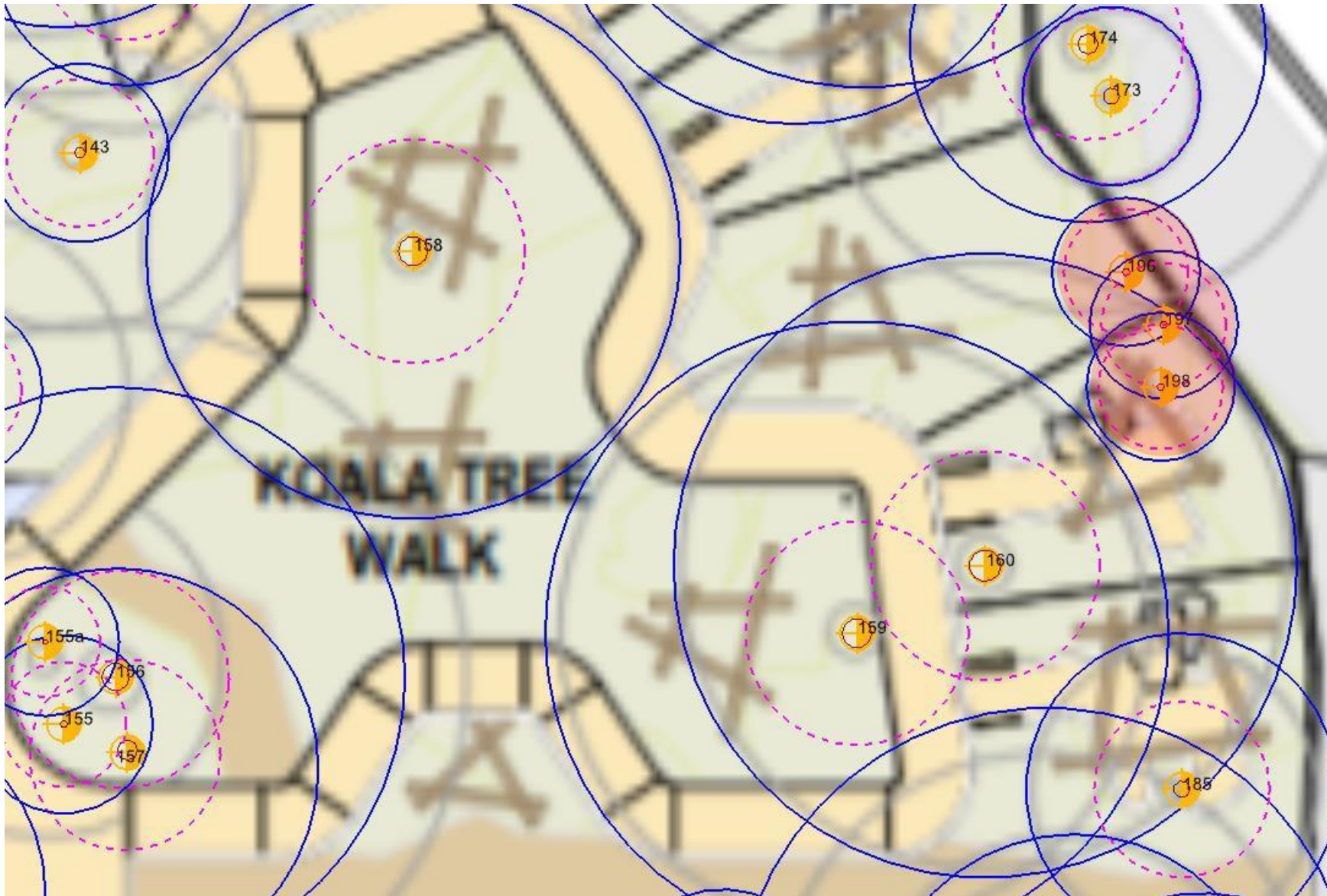


Figure 10- Trees impacted by the Koala tree walk

KOALA TREE WALK

Tree #	Impacts	Mitigation	Remove/retain
158	Proposed raised boardwalks around the tree	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ. This tree will require pruning (see notes).	Retain & protect
159	Proposed raised boardwalks around the tree	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
160	Proposed raised boardwalks around the tree	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
173	Heavily encroached upon by new containment fence	Fencing must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
174	Heavily encroached upon by new containment fence	Fencing must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
185	Proposed raised boardwalks around the tree, minor encroachment from containment fence	Structures must be installed using tree sensitive construction measures with piers located outside of SRZ.	Retain & protect
196	Heavily encroached upon by new containment fence	N/A	Proposed for removal
197	Heavily encroached upon by new containment fence	N/A	Proposed for removal
198	Heavily encroached upon by new containment fence	N/A	Proposed for removal
<p>Notes: The boardwalk structures will impose minimal impacts from root disturbance if sensitive construction methods are used. Tree #158 will require a significant amount of pruning to remove the lower branches and provide enough headroom. This would be the lowest branches on the Eastern and Northern sides of the tree. The pruning would require the removal of approximately 10% of the trees canopy and would result in no significant impacts upon tree health. Trees #159 and #160 have substantial amounts of large diameter deadwood within the canopy which will require removal before opening to the public.</p>			

Escarpment/ Koala Talks

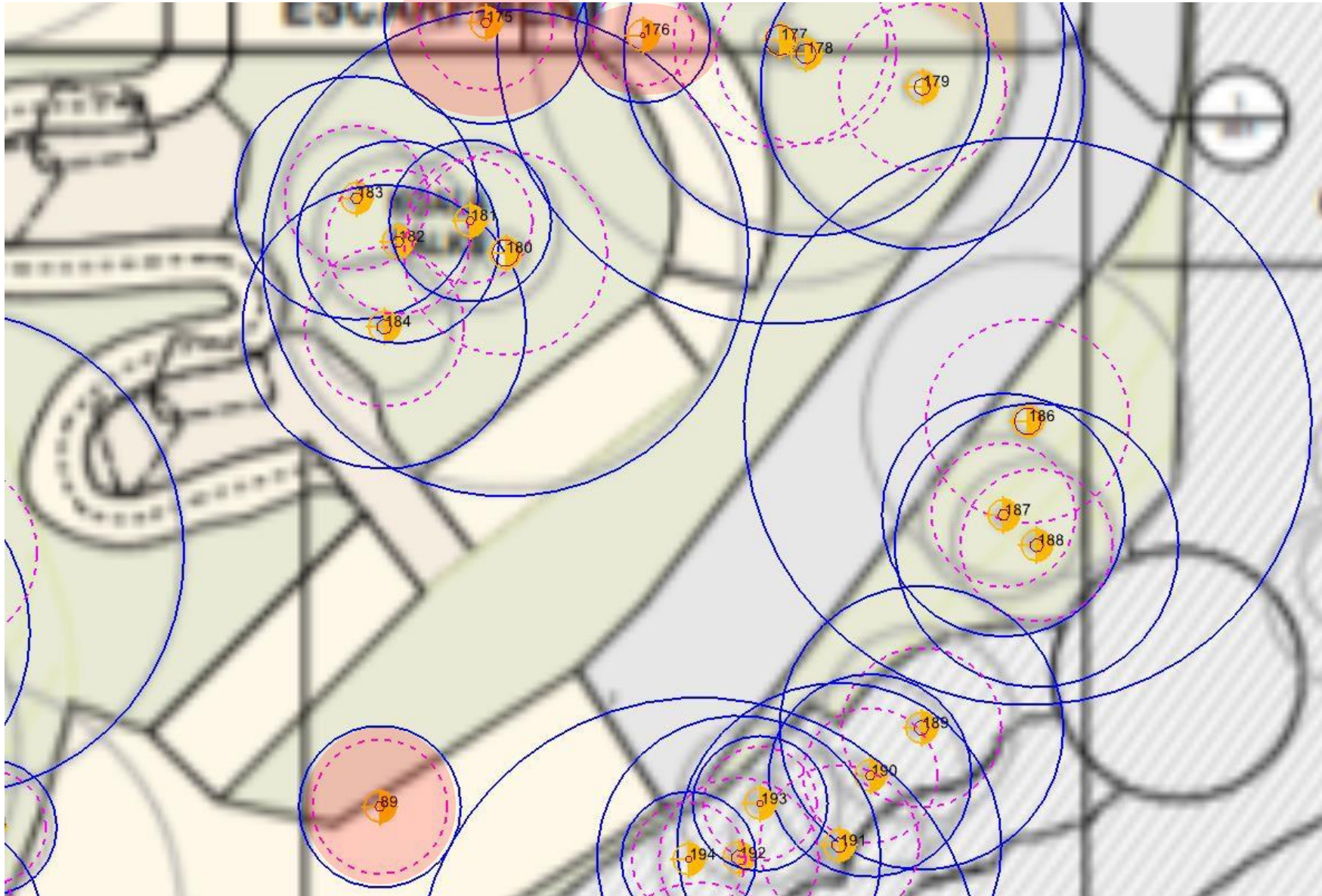


Figure 11-Trees impacted by the escarpment/Koala talks

ESCARPMENT/KOALA TALKS

Tree #	Impacts	Mitigation	Remove/retain
175	Within the escarpment footprint	N/A	Proposed for removal
176	Within the escarpment footprint	N/A	Proposed for removal
177	Major encroachment from escarpment	Tree protection fencing	Retain & protect
178	Major encroachment from escarpment	Tree protection fencing	Retain & protect
179	Minor encroachment from escarpment	Tree protection fencing	Retain & protect
180	Within raised garden bed-Unaffected by proposal	Tree protection fencing	Retain & protect
181	Within raised garden bed-Unaffected by proposal	Tree protection fencing	Retain & protect
182	Within raised garden bed-Unaffected by proposal	Tree protection fencing	Retain & protect
183	Within raised garden bed-Unaffected by proposal	Tree protection fencing	Retain & protect
184	Within raised garden bed-Unaffected by proposal	Tree protection fencing	Retain & protect
186	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
187	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
188	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
189	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
190	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
191	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
192	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
193	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
194	Behind demolished structure- Unaffected by proposal	Tree protection fencing	Retain & protect
89	Within roadway footprint	N/A	Proposed for removal

Notes: Trees #175, #176, #89 are within the footprints of proposed roadways and are recommended for removal. The remaining trees in this area are located surrounding the old Platypus house which is to be demolished. There are specific controls relating to the demolition of the Platypus house and the Wombat exhibit which were contained within the local DA report. The retaining walls holding these trees may be carefully reduced in height (without the use of machinery and under supervision of the project Arborist) to the level of the soil which is holding the trees, all below ground structures must remain in situ. It is unlikely that there will be any significant impact upon these trees from the proposed design.

Southern Link

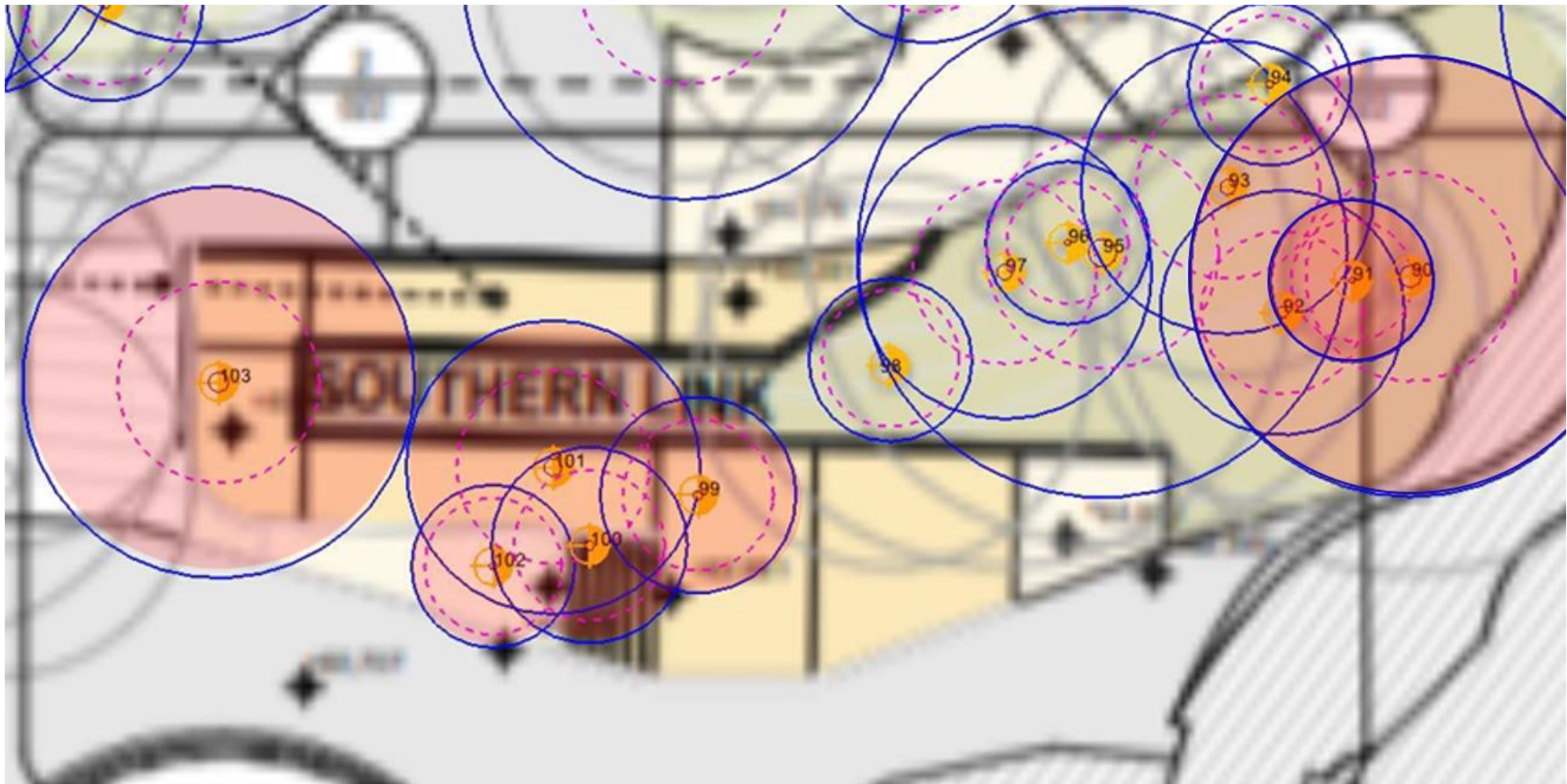


Figure 12- Trees impacted by the Southern link.

SOUTHERN LINK

Tree #	Impacts	Mitigation	Remove/retain
90	Within footprint of Southern Link	N/A	Proposed for removal
91	Within footprint of Southern Link	N/A	Proposed for removal
92	Unaffected by proposal	N/A	Retain & protect
93	Heavily encroached by roadway	Tree protection fencing	Retain & protect
94	Heavily encroached by roadway	Tree protection fencing	Retain & protect
95	Heavily encroached by roadway	Tree protection fencing	Retain & protect
96	Unaffected by proposal	N/A	Retain & protect
97	Heavily encroached by roadway	Tree protection fencing	Retain & protect
98	Unaffected by proposal	N/A	Retain & protect
99	Within footprint of Southern Link	N/A	Proposed for removal
100	Within footprint of Southern Link	N/A	Proposed for removal
101	Within footprint of Southern Link	N/A	Proposed for removal
102	Within footprint of Southern Link	N/A	Proposed for removal
103	Within footprint of Southern Link	N/A	Proposed for removal

Notes: Trees #90, #91, #99, #100, #101, #102, #103 are within the footprint of the proposed Southern link and are recommended for removal. The remaining trees in this area are located within a raised garden bed. Trees #93, #94, #95, #97 are encroached upon by the roadway but are unlikely to be affected. The retaining walls holding these trees may be carefully reduced in height (without the use of machinery and under supervision of the project Arborist) to the level of the soil which is holding the trees, all below ground structures must remain in situ. It is unlikely that there will be any significant impact upon these trees from the proposed design.

The trees highlighted in Red text are trees which have been impacted by a recent amendment to the Southern Link connection ramp. Please see Appendix 5 of this report for updated drawings.

Nocturnal House

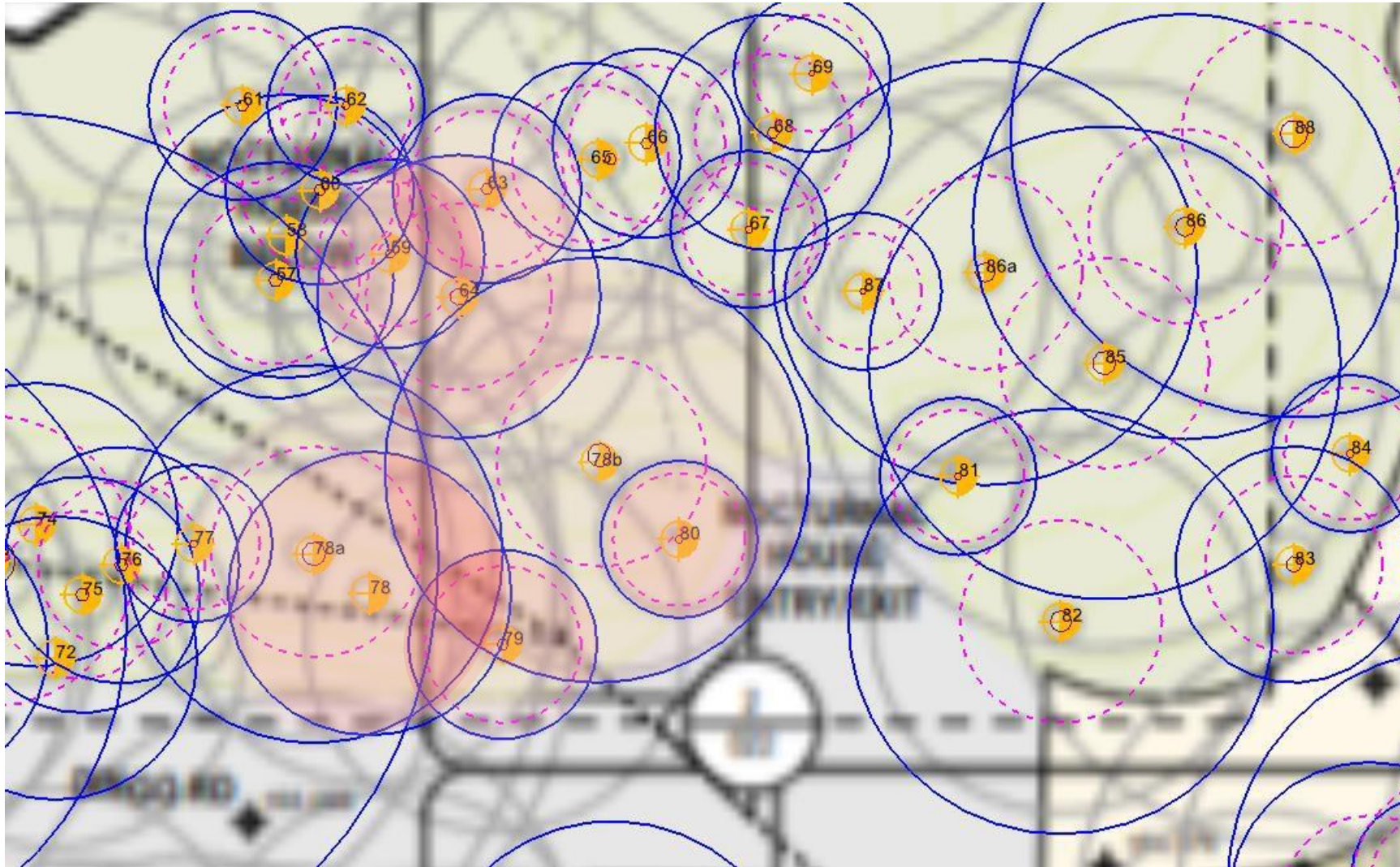


Figure 13- Trees impacted by the nocturnal house.

NOCTURNAL HOUSE

Tree #	Impacts	Mitigation	Remove/retain
57	Unaffected by proposal	Tree protection fencing	Retain & protect
58	Unaffected by proposal	Tree protection fencing	Retain & protect
59	Nocturnal house demolition	N/A	Proposed for removal
60	Unaffected by proposal	Tree protection fencing	Retain & protect
61	Unaffected by proposal	Tree protection fencing	Retain & protect
62	Unaffected by proposal	Tree protection fencing	Retain & protect
63	Nocturnal house demolition	N/A	Proposed for removal
64	Nocturnal house demolition	N/A	Proposed for removal
65	Unaffected by proposal	Tree protection fencing	Retain & protect
66	Unaffected by proposal	Tree protection fencing	Retain & protect
67	Unaffected by proposal	Tree protection fencing	Retain & protect
68	Unaffected by proposal	Tree protection fencing	Retain & protect
69	Unaffected by proposal	Tree protection fencing	Retain & protect
72	Unaffected by proposal	Tree protection fencing	Retain & protect
74	Unaffected by proposal	Tree protection fencing	Retain & protect
75	Nocturnal house demolition	N/A	Proposed for removal
76	Unaffected by proposal	Tree protection fencing	Retain & protect
77	Unaffected by proposal	Tree protection fencing	Retain & protect
78	Nocturnal house demolition	N/A	Proposed for removal
78a	Nocturnal house demolition	N/A	Proposed for removal
78b	Nocturnal house demolition	N/A	Proposed for removal
79	Nocturnal house demolition	N/A	Proposed for removal
80	Nocturnal house demolition	N/A	Proposed for removal
81	Unaffected by proposal	Tree protection fencing	Retain & protect
82	Unaffected by proposal	Tree protection fencing	Retain & protect
83	Unaffected by proposal	Tree protection fencing	Retain & protect
84	Unaffected by proposal	Tree protection fencing	Retain & protect
85	Unaffected by proposal	Tree protection fencing	Retain & protect
86	Unaffected by proposal	Tree protection fencing	Retain & protect

86a	Unaffected by proposal	Tree protection fencing	Retain & protect
87	Unaffected by proposal	Tree protection fencing	Retain & protect
88	Unaffected by proposal	Tree protection fencing	Retain & protect

Notes: Trees #59, #63, #64, #75, #78, #78a, #78b, #79, #80 are affected by the nocturnal house demolition and are recommended for removal. The remaining trees in this area are located within a raised garden bed. Trees #82, #83, #84 are encroached upon by the roadway but are unlikely to be affected. The retaining walls holding these trees may be carefully reduced in height (without the use of machinery and under supervision of the project Arborist) to the level of the soil which is holding the trees, all below ground structures must remain in situ. It is unlikely that there will be any significant impact upon these trees from the proposed design.

Trees proposed for removal

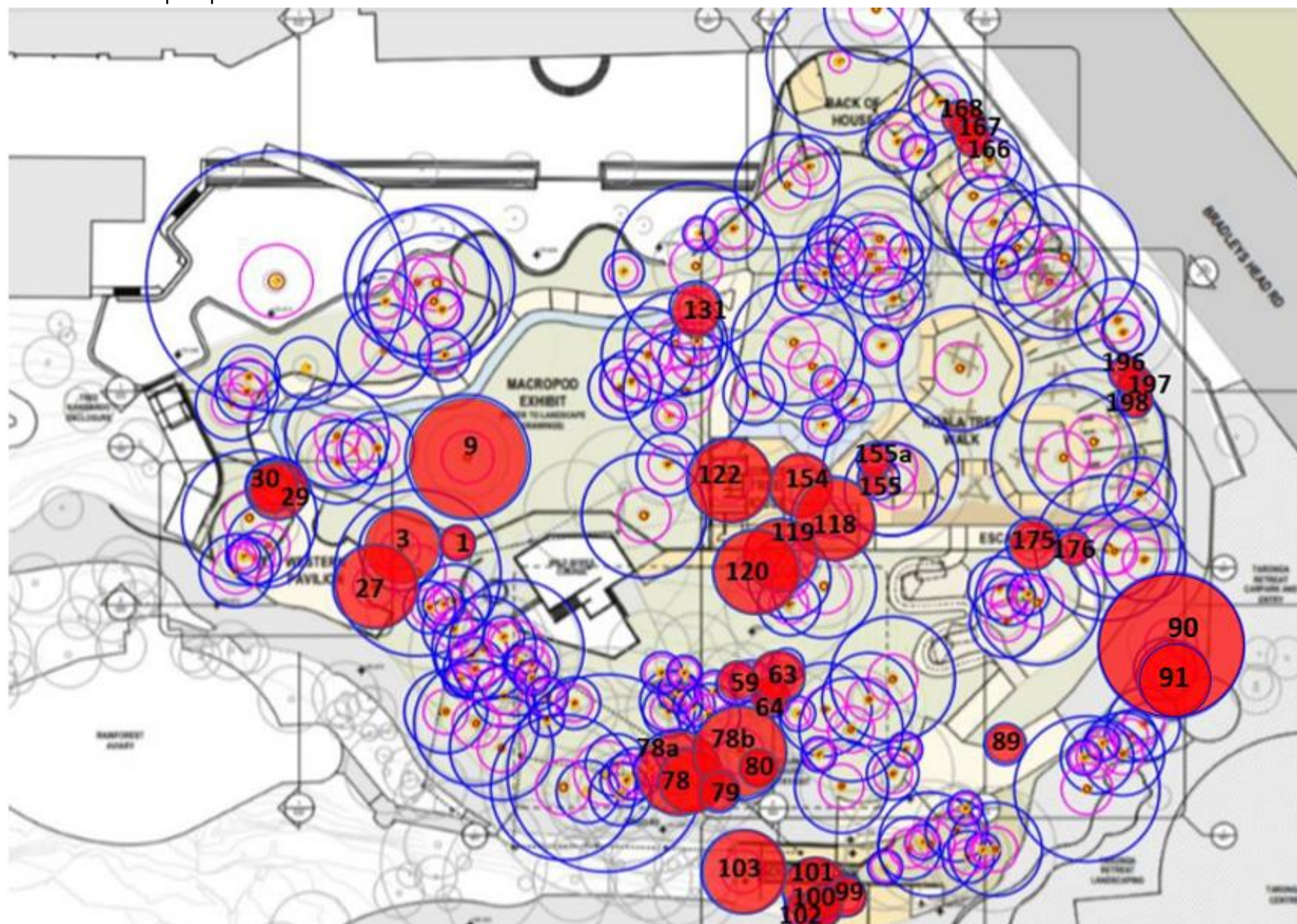


Figure 14- Trees proposed for removal marked in red, Blue represents the tree protection zone TPZ and Pink represents the structural root zones (SRZ).

Conclusions

Site visits were conducted on 7th, 8th, 9th June 2020.

A total of one hundred and ninety-eight (198) trees were assessed during our initial site visit, the full assessment details for each tree can be found in Appendix 2 of this report.

We cross-checked the suite of drawings that we had been provided in order to confirm the level of impact imposed by each of the proposed elements.

An amendment to the Southern link connection (March 2021) has resulted in the need to remove two (2) additional trees (90 & 91). These trees and the amended demolition plan are shown in Appendix 5).

An updated total of thirty-nine (39) trees will require removal to facilitate this development, they are as follows:

Retention value	High Priority for retention	Medium Consider for retention	Low Consider for removal	Remove Priority for removal
Tree numbers	90	29-59-63- 101-103-118- 119-120-175	1-3-9-26-27- 30-64-78-78a- 78b-79-80- 89-91-99-100- 102-122-131- 154-155- 155a-166- 167-168-176- 196-197-198	N/A

Tree protection measures will be required to protect the remaining trees within and around the development area.

Generic tree protection measures have been provided in Appendix 3 and a generic Arboricultural work method statement can be found in Appendix 4.

Once a building contractor has been engaged, a detailed construction management plan must be provided by the contractor and the project Arborist is to prepare a site-specific tree protection plan detailing the following:

- Access and egress for personnel and machinery into the site including a pruning specification if required.
- Location of tree protection fencing.
- Any areas where ground protection will be required.
- Locations for site sheds, amenities, temporary electricity and water.
- Stockpile areas for soil and materials.
- Storage area for machinery, fuels and chemicals etc.
- Inspection regime and reporting protocols

All pruning must be conducted in accordance with AS4373-2007- The Pruning of Amenity Trees.

No underground services are to be located within the TPZ or SRZ of any tree to be retained.

Recommendations

1. A site – specific tree protection plan will be required to identify specific controls in relation to the trees to be retained and will also need to respond to any conditions raised by the consent authority.
2. The tree protection plan must reference and consider the construction management plan and implement hold points for specific milestones, including but not limited to: Certification of tree protection measures, Certification of supervision for the erection of scaffolding, tree pruning, any excavation within the TPZ of any tree to be retained.
3. Monthly site inspections are to be conducted by the project Arborist, who will inspect the trees and ensure that all controls remain in place and are effective.
4. All tree protection measures must be completed in accordance with AS4970-2009 and appendix 3 & 4 of this report.

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Disclaimer:

The information contained within this report is to be used solely for the purposes that were specified at the time of engagement.

All attempts have been made to ensure the legitimacy of any information which has been gathered in the process of compiling this report, however Sydney Arbor Trees Pty. Ltd. cannot be held liable for inaccurate or misleading information which has been provided by others.

Any tree inspections or assessments which have been carried out for the purposes of this report are valid only at the time of inspection and are based on what could reasonably be seen or diagnosed from a visual inspection carried out from ground level.

All inspections, unless otherwise stated, are based upon Visual Tree Assessment (VTA) techniques, industry best practice and applied knowledge. No internal diagnostic testing or below ground investigation has been carried out, unless otherwise stated.

Trees are a dynamic living organism and as such they have a finite lifespan the end of which cannot always be predicted or understood, even apparently healthy trees can die suddenly or fall without warning. As such there is no warranty or guarantee provided, or implied, regarding the future risks associated with any tree.

Please feel free to contact me either via telephone or email if you have any questions regarding this report.

Kind regards

Tom Hare- AQF level 5 Consulting Arborist

Sydney Arbor Trees

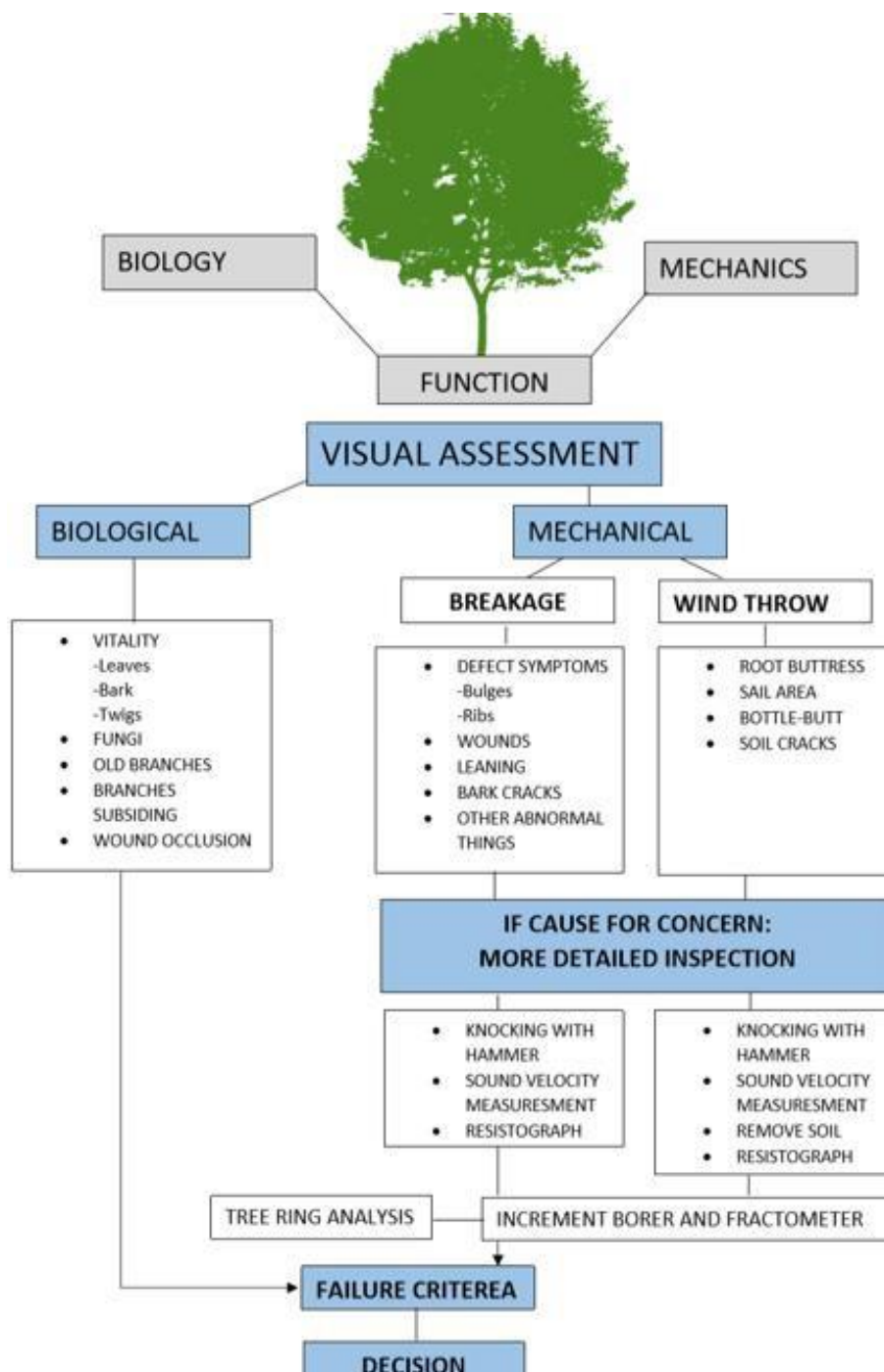
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Appendix 1: Tree assessment methodology

Visual Tree Assessment (VTA)

The VTA system is based on the theory of tree biology and physiology, as well as tree architecture and structure. This method is used by arborists to identify visible signs on trees that indicate good health, or potential problems. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole-tree, part-tree and/or branch failure. This system is based around methods discussed in *'The Body Language of Trees'*⁴.



For the purpose of this report, elements of the VTA system will be used, along with industry standard literature, and other relevant studies that provide an insight into potential hazards in trees. This assessment is a snapshot of what could be reasonably seen or determined from a basic visual inspection. The VTA system is generally used as a means to identify hazardous trees; however it is important to realize that for a tree to be hazardous there must be a target; a hazard poses no risk if there is no exposure to the hazard.

Health and Vigour Assessment

The health and vigour of a tree is assessed by looking at the tree canopy and how it is performing. Certain indicators provide information on which to base the assessment. Abnormally small leaves, chlorosis (yellowing), sparse crown, wilting, and die-back can be signs of ill-health or decline but may also be related to a temporary imbalance due to drought or pest infestations. Epicormic growth can be a sign of stress and low energy reserves but can also be related to increased light levels through the removal or pruning of adjacent trees. Extension growth can be a good indicator of vigour but this can vary greatly between species and under differing climatic conditions. For these reasons, each individual symptom or observation needs to be assessed with objectivity and consideration of all available information.

Structural Assessment

The structural assessment of trees is carried out using the basic framework of Visual Tree Assessment. Signs and symptoms of defects are assessed to gauge the likelihood of failure, because not every defect constitutes a hazard e.g. *"...co-dominant stems are a structural defect. The severity of the defect is increased by included bark, large crowns and strong wind."*⁵ If trees were removed purely on the basis that there were defects present without assessing the likelihood of failure or whether practical mitigation measures are available, the urban forest would cease to exist. A basic visual tree assessment is undertaken from ground level, if defects are suspected further investigation may be required and recommended. *"[When using] the Visual Tree Assessment (VTA) procedure for assessing trees, as the suspicion increases that defects are present, the examination becomes more thorough and searching."*¹

*"Some defects, especially some forms of decay, do not give rise to external signs and therefore tend to escape detection in a purely visual survey. If there is no reason for suspecting a hidden defect to occur within a particular part of the tree, there is no reasonable basis for carrying out a detailed internal assessment. Although in theory an unsuspected defect might be detectable by the use of specialized diagnostic devices, this would be impracticable in the absence of some external sign to indicate the place which should be probed. Also, internal examination without good reason is undesirable, as it usually causes injury to the tree and is unreasonably time consuming and costly."*⁶

⁴ Mattheck, C. & Broeler, H. 1994. *The Body Language of Trees*.

⁵ Matheny, N. & Clark, J. 1994. *A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas*.

⁶ Lonsdale. 1999. *Principles of Tree Hazard Assessment and Management*.

Tree Protection Zone (TPZ) & Structural Root Zone (SRZ) Calculations

In accordance with Australian Standard AS4970-2009 *Protection of trees on development sites*⁷, Tree Protection Zone (TPZ) radius is calculated using the following procedure. Diameter of the trunk is measured at approximately 1.4m above ground level; this measurement is referred to as DBH (Diameter at Breast Height). $R_{TPZ} = DBH \times 12$. For multi-stemmed trees the formula used is $R_{TPZ} = \sqrt{[(DBH1)^2 + (DBH2)^2 + (DBH3)^2]}$. The TPZ is measured radially from the centre of the stem and must be protected on all sides.

The Structural Root Zone (SRZ) radius is calculated by measuring the diameter of the stem close to ground level, just above the basal flare. This measurement is taken as D and then used in the following formula: $R_{SRZ} = (D \times 50)^{0.42} \times 0.64$ and becomes the Structural Root Zone, measured radially from the centre of the stem.

It is important to realize that these calculations provide a notional figure only and tree dynamics, form and site conditions will greatly affect these zones, and it is the job of the arborist to interpret the information correctly.

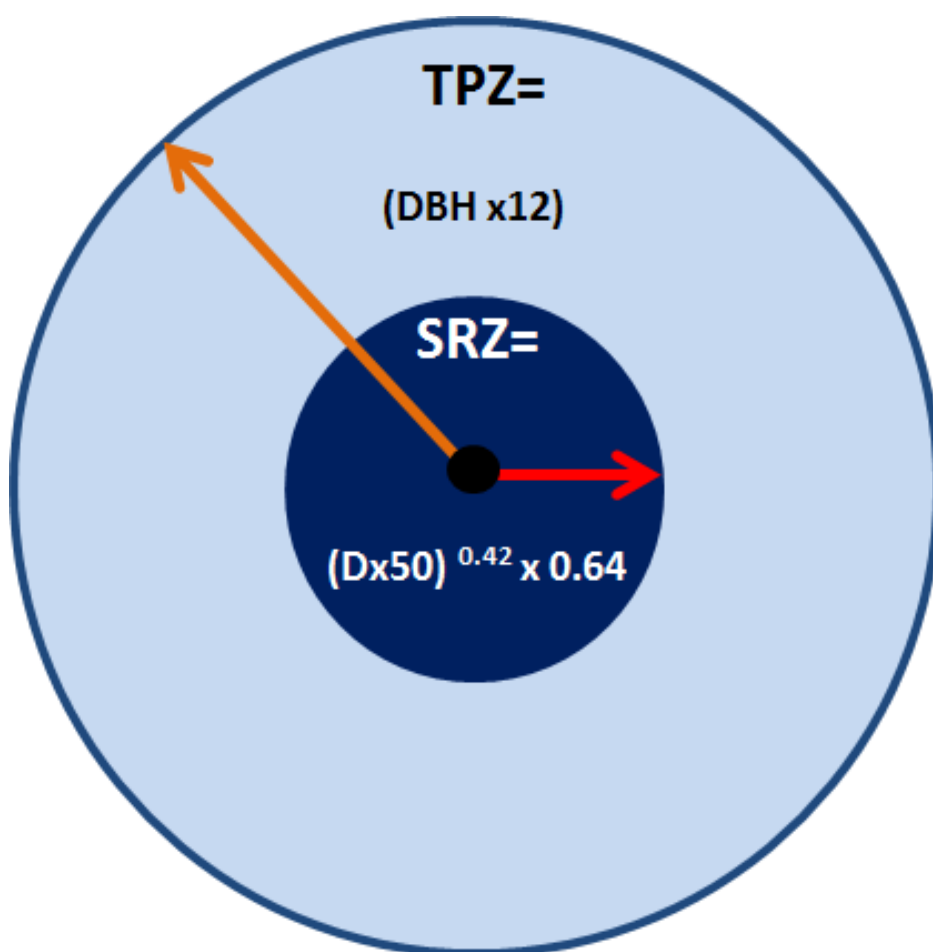


Figure 2 – A representation of TPZ & SRZ calculations.

For palms, cycads, tree ferns, and similar monocots, the TPZ is positioned at least 1m outside the crown projection. SRZs are not applicable to these plant types.

AS4970-2009³ states “a TPZ should not be less than 2m nor greater than 15m (except where crown protection is required)” and the minimum radius for an SRZ is 1.5m.

⁷ Standards Australia. 2009. AS4970-2009 *Protection of trees on development sites*.

Significance of a Tree, Assessment Rating System (STARS)

IACA Significance of a Tree, Assessment Rating System (STARS)© (IACA 2010)©

In the development of this document IACA acknowledges the contribution and original concept of the Footprint Green Tree Significance & Retention Value Matrix, developed by Footprint Green Pty Ltd in June 2001.

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. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria and Tree Retention Value - Priority Matrix*, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

This rating system will assist in the planning processes for proposed works, above and below ground where trees are to be retained on or adjacent a development site. The system uses a scale of *High, Medium and Low* significance in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined. An example of its use in an Arboricultural report is shown as Appendix A.

Tree Significance - Assessment Criteria



1. High Significance in landscape

- 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 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.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour;
- 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 moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa *in situ*.

3. Low Significance in landscape

- 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 surrounding properties as 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 dimension 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 potential to become structurally unsound.

Environmental Pest / Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties,
- The tree is a declared noxious weed by legislation.

Hazardous/Irreversible Decline

- The tree is structurally unsound and/or unstable and is considered potentially dangerous,
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.

Note: The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety e.g. hedge.

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

Table 1.0 Tree Retention Value - Priority Matrix.

		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					
Legend for Matrix Assessment						
		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 AS4970 <i>Protection of trees on development sites</i> . Tree sensitive construction measures must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.				
		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.				

USE OF THIS DOCUMENT AND REFERENCING

The IACA Significance of a Tree, Assessment Rating System (STARS) is free to use, but only in its entirety and must be cited as follows:

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

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

Appendix 2- Tree Schedule

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
1	<i>Hymenosporum flavum</i>	Native Frangipani	5-10	<5	150	200	2	1.68	Fair	Fair	Semi-mature	Medium	Low	Low	This tree is within the footprint of the proposed bridge and will require removal.
2	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	10-15	10-15	800	950	9.6	3.17	Good	Fair	Mature	Medium	Medium	Medium	
3	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	5-10	5-10	400	400	4.8	2.25	Good	Fair	Semi-mature	Medium	Low	Low	This tree is within the footprint of the proposed bridge and will require removal.
5	<i>Ficus coronata</i>	Sandpaper Fig	5-10	5-10	400	500	4.8	2.47	Good	Fair	Mature	Medium	Medium	Medium	
6	<i>Ficus coronata</i>	Sandpaper Fig	5-10	5-10	300	350	3.6	2.13	Good	Fair	Mature	Medium	Medium	Medium	
7	<i>Tristaniopsis laurina</i>	Kanooka	10-15	5-10	500	550	6	2.57	Good	Good	Mature	Medium	Medium	Medium	
8	<i>Tristaniopsis laurina</i>	Kanooka	5-10	5-10	350	500	4.2	2.47	Fair	Fair	Mature	Short	Low	Low	
9	<i>Casuarina cunninghamiana</i>	River She-oak	15-20	5-10	600	800	7.2	3.01	Good	Poor	Mature	Short	Low	Low	This tree has major structural defects and is unsuitable for retention due to increased occupancy and alteration of under tree usage.
11	<i>Tristaniopsis laurina</i>	Kanooka	10-15	5-10	350	450	4.2	2.37	Fair	Fair	Mature	Short	Low	Low	
12	<i>Tristaniopsis laurina</i>	Kanooka	5-10	5-10	300	350	3.6	2.13	Fair	Fair	Mature	Short	Low	Low	
13	<i>Tristaniopsis laurina</i>	Kanooka	5-10	5-10	300	350	3.6	2.13	Fair	Fair	Mature	Short	Low	Low	
14	<i>Ficus obliqua</i>	Small-leaved Fig	15-20	20-30	1500	1800	15	4.24	Poor	Fair	Mature	Medium	High	High	Heritage tree
15	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	10-15	<5	250	350	3	2	Good	Good	Mature	Medium	Medium	Medium	
16	<i>Cupaniopsis anacardioides</i>	Tuckeroo	10-15	10-15	450	550	5.4	2.57	Good	Fair	Mature	Medium	Medium	Medium	Tree may require minor crown lifting for pedestrian access
17	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	5-10	5-10	300	300	3.6	2	Good	Fair	Semi-mature	Short	Low	Low	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
18	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	15-20	10-15	700	650	8.4	2.76	Fair	Fair	Mature	Short	Medium	Low	
19	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	15-20	10-15	750	950	9	3.24	Fair	Fair	Mature	Medium	Medium	Medium	
20	<i>Eucalyptus robusta</i>	Swamp Mahogany	15-20	15-20	650	750	7.8	2.93	Good	Poor	Mature	Short	Medium	short	
21	<i>Tristania laurina</i>	Kanooka	5-10	5-10	200	400	2.4	2.25	Fair	Fair	Semi-mature	Medium	Low	Low	
22	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	5-10	5-10	250	300	3	2	Good	Fair	Semi-mature	Medium	Low	Low	
23	<i>Casuarina glauca</i>	Swamp she-oak	5-10	5-10	300	400	3.6	2.25	Good	Poor	Semi-mature	Short	Low	Low	
24	<i>Casuarina glauca</i>	Swamp she-oak	5-10	5-10	300	400	3.6	2.25	Good	Poor	Semi-mature	Short	Low	Low	
25	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	10-15	10-15	450	550	5.4	2.57	Good	Fair	Mature	Short	Low	Low	
26	Dead Tree	Dead tree	5-10	<5	200	200	2.4	1.68	Dead	Poor	Juvenile	Remove	Low	Low	Remove dead tree.
27	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	10-15	10-15	400	500	4.8	2.47	Poor	Poor	Senescent	Short	Low	Low	This tree is proposed for removal
28	<i>Glochidion ferdinandi</i>	Cheese Tree	10-15	10-15	400	500	4.8	2.47	Good	Poor	Mature	Short	Low	Low	
29	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	10-15	<5	300	350	3.6	2.13	Good	Good	Mature	Medium	Medium	Medium	This tree is within the footprint of the proposed bridge and will require removal.
30	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	5-10	5-10	250	300	3	2	Good	Fair	Semi-mature	Medium	Low	Low	This tree is within the footprint of the proposed bridge and will require removal.
31	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	15-20	10-15	650	800	7.8	3.01	Good	Fair	Mature	Medium	Medium	Medium	
32	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	10-15	5-10	250	400	3	2.25	Good	Fair	Semi-mature	Medium	Medium	Medium	
33	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	10-15	5-10	350	600	4.2	2.67	Good	Fair	Mature	Medium	Low	Low	
34	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	5-10	<5	100	150	2	1.5	Fair	Fair	Juvenile	Medium	Low	Low	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
35	<i>Castanospermum australe</i>	Black bean	10-15	5-10	400	550	4.8	2.57	Poor	Poor	Mature	Remove	Low	Low	ArborSafe #357
36	<i>Syzygium smithii</i>	Lilly Pilly	5-10	<5	150	150	2	1.5	Poor	Fair	Semi-mature	Short	Low	Low	
37	<i>Polyscias elegans</i>	Celerywood	10-15	5-10	300	400	3.6	2.25	Good	Fair	Mature	Medium	Medium	Medium	ArborSafe #358
38	<i>Polyscias elegans</i>	Celerywood	15-20	10-15	350	450	4.2	2.37	Good	Fair	Mature	Medium	Medium	Medium	ArborSafe #359
39	<i>Polyscias elegans</i>	Celerywood	15-20	10-15	500	600	6	2.67	Fair	Poor	Mature	Short	Low	Low	ArborSafe #363
40	<i>Syzygium smithii</i>	Lilly Pilly	5-10	10-15	300	400	3.6	2.25	Fair	Fair	Mature	Short	Low	Low	ArborSafe #360
41	<i>Syzygium smithii</i>	Lilly Pilly	10-15	10-15	350	450	4.2	2.37	Good	Fair	Mature	Short	Low	Low	ArborSafe #362
42	<i>Syzygium smithii</i>	Lilly Pilly	5-10	5-10	200	250	2.4	1.85	Good	Fair	Mature	Short	Low	Low	
43	<i>Syzygium smithii</i>	Lilly Pilly	5-10	10-15	250	350	3	2	Good	Fair	Mature	Medium	Low	Low	ArborSafe #361
44	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	5-10	5-10	200	250	2.4	1.85	Fair	Fair	Semi-mature	Short	Low	Low	
45	<i>Eucalyptus saligna</i>	Sydney Blue Gum	20-30	15-20	650	850	7.8	3.09	Fair	Fair	Mature	Short	Medium	Low	ArborSafe #366
46	<i>Hymenosporum flavum</i>	Native Frangipani	5-10	5-10	150	200	2	1.68	Poor	Poor	Senescent	Remove	Low	Low	
47	<i>Grevillea robusta</i>	Silky Oak	10-15	5-10	250	350	3	2	Good	Fair	Semi-mature	Short	Low	Low	ArborSafe #365
48	<i>Polyscias elegans</i>	Celerywood	10-15	10-15	300	350	3.6	2.13	Good	Fair	Mature	Medium	Medium	Medium	
49	<i>Castanospermum australe</i>	Black bean	15-20	15-20	600	650	7.2	2.76	Good	Good	Mature	Medium	Medium	Medium	
50	<i>Polyscias elegans</i>	Celerywood	15-20	10-15	500	650	6	2.76	Good	Fair	Mature	Medium	Medium	Medium	
51	<i>Hymenosporum flavum</i>	Native Frangipani	5-10	<5	150	200	2	1.68	Dead	Poor	Semi-mature	Short	Low	Low	
53	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	5-10	<5	200	350	2.4	2.13	Dead	Poor	Semi-mature	Remove	Low	Low	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
54	<i>Hymenosporum flavum</i>	Native Frangipani	5-10	<5	150	300	2	2	Dead	Poor	Semi-mature	Remove	Low	Low	
55	<i>Hymenosporum flavum</i>	Native Frangipani	10-15	5-10	250	350	3	2	Fair	Poor	Mature	Short	Low	Low	
57	<i>Podocarpus elatus</i>	Brown Pine	10-15	5-10	250	350	3	2	Good	Good	Mature	Medium	Medium	Medium	
58	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	5-10	<5	200	300	2.4	2	Good	Good	Mature	Medium	Medium	Medium	
59	<i>Brachychiton acerifolius</i>	Illawarra Flame Tree	10-15	5-10	200	250	2.4	1.85	Fair	Good	Semi-mature	Long	Low	Medium	Proposed for removal (nocturnal house)
60	<i>Laurus nobilis</i>	Bay Tree	10-15	5-10	200	300	2.4	2	Good	Good	Semi-mature	Long	Low	Medium	
61	<i>Banksia integrifolia</i>	Coast Banksia	5-10	5-10	200	300	2.4	2	Good	Good	Mature	Long	Low	Medium	
62	<i>Eucalyptus microcorys</i>	Tallowwood	5-10	5-10	150	200	2	1.68	Good	Fair	Juvenile	Long	Low	Medium	
63	<i>Toona ciliata</i>	Red Cedar	5-10	5-10	200	300	2.4	2	Good	Good	Semi-mature	Long	Low	Medium	Proposed for removal (nocturnal house)
64	<i>Pittosporum undulatum</i>	Sweet Pittosporum	5-10	5-10	300	450	3.6	2.37	Good	Fair	Mature	Medium	Low	Low	Proposed for removal (nocturnal house)
65	<i>Melaleuca styphelioides</i>	Prickly-leaved Paperbark	5-10	5-10	200	300	2.4	2	Good	Fair	Semi-mature	Medium	Low	Low	
66	<i>Melaleuca styphelioides</i>	Prickly-leaved Paperbark	5-10	5-10	200	300	2.4	2	Good	Fair	Semi-mature	Medium	Low	Medium	
67	<i>Banksia integrifolia</i>	Coast Banksia	5-10	<5	150	200	2	1.68	Good	Good	Mature	Medium	Low	Medium	
68	<i>Pittosporum rhombifolium</i>	Queensland Laurel	5-10	5-10	250	300	3	2	Good	Fair	Semi-mature	Medium	Low	Medium	
69	<i>Angophora costata</i>	Smooth-barked Apple Myrtle	5-10	<5	100	150	2	1.5	Dead	Poor	Juvenile	Remove	Low	Low	
70	<i>Ficus benjamina</i>	Weeping Fig	10-15	10-15	700	900	8.4	3.17	Good	Fair	Mature	Medium	Low	Low	
71	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	5-10	5-10	150	200	2	1.68	Good	Good	Mature	Medium	Low	Low	
72	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	5-10	5-10	150	200	2	1.68	Good	Good	Mature	Medium	Low	Low	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
73	<i>Toona australis</i>	Red Cedar	20-30	20-30	950	1300	11.4	3.69	Good	Good	Mature	Long	High	High	
74	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	5-10	5-10	150	200	2	1.68	Good	Good	Mature	Medium	Low	Low	
75	<i>Castanospermum australe</i>	Black bean	10-15	15-20	250	350	3	2	Good	Fair	Mature	Medium	Medium	Medium	
76	<i>Castanospermum australe</i>	Black bean	10-15	15-20	250	350	3	2	Good	Fair	Mature	Medium	Medium	Medium	
77	<i>Toona australis</i>	Red Cedar	5-10	5-10	150	200	2	1.68	Good	Good	Semi-mature	Medium	Low	Medium	
78	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm	5-10	5-10	300	350	3.6	2.13	Good	Good	Mature	Medium	Low	Low	Proposed for removal (nocturnal house)
78a	<i>Pittosporum undulatum</i>	Sweet Pittosporum	5-10	5-10	300	350	3.6	2.13	Good	Good	Mature	Medium	Low	Low	Proposed for removal (nocturnal house)
78b	<i>Glochidion ferdinandi</i>	Cheese Tree	10-15	10-15	450	550	5.4	2.57	Good	Good	Mature	Medium	Low	Low	Proposed for removal (nocturnal house)
79	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	5-10	5-10	200	300	2.4	2	Good	Good	Mature	Medium	Low	Low	Proposed for removal (nocturnal house)
80	<i>Acacia fimbriata</i>	Fringed Wattle	5-10	<5	150	200	2	1.68	Good	Good	Mature	Short	Low	Low	Proposed for removal (nocturnal house)
81	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	5-10	<5	150	200	2	1.68	Good	Good	Semi-mature	Medium	Low	Low	
82	<i>Eucalyptus maidenii</i>	Maiden's Gum	10-15	5-10	450	550	5.4	2.57	Fair	Fair	Mature	Short	Low	Low	
83	<i>Eucalyptus botryoides</i>	Southern Mahogany	10-15	10-15	250	400	3	2.25	Good	Fair	Mature	Medium	Medium	Medium	
84	<i>Hymenosporum flavum</i>	Native Frangipani	10-15	5-10	150	200	2	1.68	Good	Fair	Mature	Medium	Low	Low	
85	<i>Banksia integrifolia</i>	Coast Banksia	15-20	10-15	500	600	6	2.67	Good	Fair	Mature	Medium	Medium	Medium	
86	<i>Glochidion ferdinandi</i>	Cheese Tree	10-15	5-10	450	500	5.4	2.47	Fair	Fair	Mature	Medium	Medium	Medium	
86a	<i>Glochidion ferdinandi</i>	Cheese Tree	10-15	5-10	400	500	4.8	2.47	Fair	Fair	Mature	Medium	Medium	Medium	
87	<i>Hymenosporum flavum</i>	Native Frangipani	10-15	<5	100	150	2	1.5	Fair	Fair	Semi-mature	Medium	Low	Low	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
88	<i>Glochidion ferdinandi</i>	Cheese Tree	10-15	10-15	600	700	7.2	2.85	Fair	Fair	Mature	Medium	Medium	Medium	
89	<i>Hibiscus sp</i>	Hibiscus	5-10	5-10	200	300	2.4	2	Fair	Fair	Mature	Medium	Low	Low	Proposed for removal (roadway)
90	<i>Eucalyptus robusta</i>	Swamp Mahogany	15-20	10-15	450	550	5.4	2.57	Good	Fair	Mature	Long	Medium	High	Proposed for removal (Southern Link-see appendix 5)
91	<i>Eucalyptus robusta</i>	Swamp Mahogany	5-10	<5	100	150	2	1.5	Fair	Poor	Juvenile	Remove	Low	Low	Proposed for removal (Southern Link- see appendix 5)
92	<i>Eucalyptus robusta</i>	Swamp Mahogany	10-15	5-10	250	300	3	2	Poor	Poor	Mature	Short	Medium	Low	
93	<i>Lophostemon confertus</i>	Queensland Box	10-15	5-10	300	400	3.6	2.25	Good	Fair	Mature	Long	Low	Medium	
94	<i>Buckinghamia celsissima</i>	Ivory Curl Tree	5-10	<5	150	200	2	1.68	Good	Fair	Semi-mature	Medium	Low	Low	
95	<i>Eucalyptus botryoides</i>	Bangalay	15-20	10-15	500	700	6	2.85	Fair	Fair	Mature	Long	Medium	High	
96	<i>Hymenosporum flavum</i>	Native Frangipani	10-15	<5	100	150	2	1.5	Fair	Fair	Mature	Medium	Low	Low	
97	<i>Allocasuarina littoralis</i>	Black She-oak	10-15	10-15	300	400	3.6	2.25	Fair	Fair	Mature	Medium	Medium	Medium	
98	<i>Syncarpia glomulifera</i>	Turpentine	5-10	5-10	150	200	2	1.68	Fair	Fair	Semi-mature	Long	Low	Medium	
99	<i>Polyscias murrayi</i>	Pencil Cedar	5-10	5-10	200	250	2.4	1.85	Good	Fair	Semi-mature	Medium	Low	Low	Proposed for removal (Southern link)
100	<i>Eucalyptus punctata</i>	Grey Gum	10-15	5-10	200	250	2.4	1.85	Fair	Fair	Semi-mature	Medium	Low	Low	Proposed for removal (Southern link)
101	<i>Polyscias murrayi</i>	Pencil Cedar	10-15	10-15	300	450	3.6	2.37	Fair	Fair	Mature	Medium	Medium	Medium	Proposed for removal (Southern link)
102	<i>Acacia implexa</i>	Lightwood	10-15	5-10	150	200	2	1.68	Fair	Fair	Mature	Short	Low	Low	Proposed for removal (Southern link)
103	<i>Flindersia schottiana</i>	Bumpy Ash	10-15	5-10	400	500	4.8	2.47	Good	Good	Mature	Medium	Medium	Medium	Proposed for removal (Southern link)
113	<i>Angophora costata</i>	Smooth-barked Apple Myrtle	5-10	<5	150	200	2	1.68	Fair	Fair	Semi-mature	Short	Low	Low	
114	<i>Lophostemon confertus</i>	Queensland Box	10-15	5-10	800	800	9.6	3.01	Good	Fair	Mature	Long	Medium	High	Heavily encroached upon by Macropod trail

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
116	<i>Eucalyptus botryoides</i>	Southern Mahogany	5-10	10-15	300	400	3.6	2.25	Good	Fair	Mature	Medium	Low	Low	
117	<i>Eucalyptus botryoides</i>	Bangalay	10-15	5-10	500	900	6	3.17	Fair	Fair	Mature	Medium	Medium	Medium	
118	<i>Eucalyptus saligna</i>	Sydney Blue Gum	15-20	10-15	400	450	4.8	2.37	Good	Fair	Semi-mature	Medium	Medium	Medium	Proposed for removal (Tree House)
119	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	5-10	350	400	4.2	2.25	Good	Fair	Mature	Medium	Medium	Medium	Proposed for removal (Tree House)
120	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	5-10	400	450	4.8	2.37	Good	Fair	Mature	Medium	Medium	Medium	Proposed for removal (Tree House)
121	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	5-10	400	450	4.8	2.37	Good	Fair	Mature	Medium	Medium	Medium	
122	<i>Stenocarpus sinuatus</i>	Fire Wheel Tree	10-15	5-10	400	600	4.8	2.67	Good	Poor	Mature	Short	Low	Low	Proposed for removal (Tree House)
123	<i>Eucalyptus botryoides</i>	Southern Mahogany	20-30	10-15	600	800	7.2	3.01	Fair	Poor	Mature	Short	Medium	Low	
125	<i>Eucalyptus botryoides</i>	Bangalay	10-15	5-10	300	400	3.6	2.25	Fair	Fair	Mature	Medium	Medium	Medium	
126	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	5-10	<5	100	150	2	1.5	Fair	Good	Semi-mature	Medium	Low	Low	
127	<i>Eucalyptus botryoides</i>	Bangalay	15-20	10-15	600	850	7.2	3.09	Fair	Fair	Mature	Medium	High	High	Heavily encroached upon by Macropod trail
128	<i>Eucalyptus microcorys</i>	Tallowwood	10-15	5-10	300	350	3.6	2.13	Good	Good	Mature	Medium	Medium	Medium	
129	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	15-20	5-10	500	750	6	2.93	Fair	Fair	Mature	Medium	Medium	Medium	
130	<i>Casuarina cunninghamiana</i>	River She-oak	5-10	5-10	250	350	3	2	Fair	Fair	Semi-mature	Medium	Low	Low	
131	<i>Casuarina cunninghamiana</i>	River She-oak	5-10	5-10	250	300	3	2	Fair	Fair	Semi-mature	Medium	Low	Low	Proposed for removal (Macropod trail)
132	<i>Eucalyptus microcorys</i>	Tallowwood	5-10	5-10	300	400	3.6	2.25	Good	Fair	Mature	Long	Low	Medium	
133	<i>Corymbia maculata</i>	Spotted Gum	15-20	10-15	500	600	6	2.67	Good	Good	Mature	Long	Medium	Medium	
134	<i>Corymbia maculata</i>	Spotted Gum	10-15	5-10	300	350	3.6	2.13	Good	Good	Semi-mature	Medium	Medium	Medium	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
135	<i>Corymbia maculata</i>	Spotted Gum	5-10	5-10	300	350	3.6	2.13	Fair	Fair	Semi-mature	Medium	Low	Low	
136	<i>Corymbia maculata</i>	Spotted Gum	5-10	<5	150	200	2	1.68	Fair	Fair	Semi-mature	Medium	Low	Low	
137	<i>Casuarina glauca</i>	Swamp she-oak	15-20	10-15	600	800	7.2	3.01	Good	Fair	Mature	Medium	Medium	Medium	
138	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	10-15	500	650	6	2.76	Good	Fair	Mature	Long	Medium	High	
139	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	10-15	400	500	4.8	2.47	Fair	Fair	Mature	Short	Medium	Low	
140	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	10-15	450	550	5.4	2.57	Good	Fair	Mature	Short	Medium	Low	
141	<i>Eucalyptus microcorys</i>	Tallowwood	10-15	5-10	150	300	2	2	Fair	Fair	Semi-mature	Long	Low	Medium	
142	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	5-10	300	450	3.6	2.37	Good	Fair	Mature	Long	Low	Medium	
143	<i>Angophora costata</i>	Smooth-barked Apple Myrtle	10-15	5-10	200	300	2.4	2	Fair	Poor	Semi-mature	Remove	Medium	Low	
144	<i>Corymbia maculata</i>	Spotted Gum	15-20	5-10	300	400	3.6	2.25	Fair	Fair	Mature	Short	Medium	Low	
145	<i>Corymbia maculata</i>	Spotted Gum	10-15	5-10	300	400	3.6	2.25	Fair	Fair	Mature	Medium	Low	Low	
146	<i>Eucalyptus saligna</i>	Sydney Blue Gum	15-20	5-10	250	300	3	2	Fair	Fair	Semi-mature	Medium	Medium	Medium	
147	<i>Eucalyptus microcorys</i>	Tallowwood	5-10	5-10	250	350	3	2	Fair	Fair	Semi-mature	Long	Low	Medium	
148	<i>Eucalyptus microcorys</i>	Tallowwood	20-30	15-20	600	750	7.2	2.93	Fair	Fair	Mature	Medium	High	High	
149	<i>Eucalyptus microcorys</i>	Tallowwood	15-20	10-15	500	650	6	2.76	Fair	Fair	Mature	Medium	Medium	Medium	
150	<i>Ficus sp.</i>	Fig	5-10	<5	100	150	2	1.5	Good	Good	Semi-mature	Long	Low	Medium	
151	<i>Angophora costata</i>	Smooth-barked Apple Myrtle	5-10	5-10	200	250	2.4	1.85	Good	Fair	Semi-mature	Medium	Low	Low	
152	<i>Eucalyptus botryoides</i>	Southern Mahogany	5-10	5-10	200	250	2.4	1.85	Fair	Fair	Semi-mature	Short	Low	Low	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
153	<i>Corymbia maculata</i>	Spotted Gum	15-20	10-15	300	400	3.6	2.25	Good	Fair	Mature	Medium	Medium	Medium	
154	<i>Banksia integrifolia</i>	Coast Banksia	5-10	5-10	300	400	3.6	2.25	Good	Fair	Mature	Medium	Low	Low	Proposed for removal (Tree House)
155	<i>Buckinghamia celsissima</i>	Ivory Curl Tree	5-10	5-10	200	200	2.4	1.68	Good	Good	Semi-mature	Medium	Low	Low	Proposed for removal (Tree House)
155a	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	5-10	5-10	150	200	2	1.68	Good	Good	Mature	Medium	Low	Low	Proposed for removal (Tree House)
156	<i>Eucalyptus botryoides</i>	Southern Mahogany	20-30	15-20	650	750	7.8	2.93	Good	Fair	Mature	Long	High	High	
157	<i>Eucalyptus botryoides</i>	Southern Mahogany	15-20	10-15	450	550	5.4	2.57	Good	Poor	Mature	Short	Medium	Low	
158	<i>Lophostemon confertus</i>	Queensland Box	10-15	10-15	600	800	7.2	3.01	Good	Fair	Mature	Long	Medium	High	
159	<i>Lophostemon confertus</i>	Queensland Box	15-20	10-15	700	800	8.4	3.01	Poor	Fair	Senescent	Short	High	Low	
160	<i>Eucalyptus punctata</i>	Grey Gum	15-20	15-20	700	850	8.4	3.09	Fair	Fair	Mature	Medium	Medium	Medium	
161	<i>Casuarina glauca</i>	Swamp she-oak	15-20	10-15	550	700	6.6	2.85	Fair	Fair	Mature	Medium	Medium	Medium	
162	<i>Casuarina cunninghamiana</i>	River She-oak	5-10	<5	150	250	2	1.85	Fair	Fair	Semi-mature	Medium	Low	Low	
163	<i>Casuarina glauca</i>	Swamp she-oak	15-20	15-20	550	700	6.6	2.85	Good	Fair	Mature	Medium	Medium	Medium	
164	<i>Casuarina glauca</i>	Swamp she-oak	10-15	5-10	450	550	5.4	2.57	Good	Good	Mature	Long	Medium	Medium	
165	<i>Casuarina glauca</i>	Swamp she-oak	5-10	5-10	300	400	3.6	2.25	Fair	Fair	Mature	Medium	Low	Low	
166	<i>Casuarina glauca</i>	Swamp she-oak	5-10	<5	150	200	2	1.68	Good	Good	Semi-mature	Medium	Low	Low	Proposed for removal (Back of House)
167	<i>Casuarina glauca</i>	Swamp she-oak	5-10	<5	150	200	2	1.68	Good	Good	Semi-mature	Medium	Low	Low	Proposed for removal (Back of House)
168	<i>Casuarina glauca</i>	Swamp she-oak	5-10	<5	100	100	2	1.5	Good	Good	Semi-mature	Medium	Low	Low	Proposed for removal (Back of House)
169	<i>Casuarina glauca</i>	Swamp she-oak	10-15	5-10	300	350	3.6	2.13	Good	Good	Semi-mature	Medium	Low	Low	

Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
170	<i>Lophostemon confertus</i>	Queensland Box	10-15	10-15	700	1000	8.4	3.31	Fair	Fair	Mature	Medium	High	High	
171	<i>Glochidion ferdinandi</i>	Cheese Tree	10-15	10-15	500	800	6	3.01	Fair	Fair	Mature	Medium	Medium	Medium	
172	<i>Lophostemon confertus</i>	Queensland Box	10-15	10-15	700	1000	8.4	3.31	Fair	Fair	Mature	Medium	High	High	
173	<i>Glochidion ferdinandi</i>	Cheese Tree	5-10	5-10	200	450	2.4	2.37	Good	Fair	Semi-mature	Long	Low	Medium	
174	<i>Acacia melanoxylon</i>	Blackwood	10-15	5-10	400	550	5.4	2.57	Fair	Fair	Mature	Short	Low	Low	
175	<i>Lophostemon confertus</i>	Queensland Box	5-10	<5	250	300	3	2	Good	Good	Semi-mature	Long	Low	Medium	Proposed for removal (Escarment)
176	<i>Banksia integrifolia</i>	Coast Banksia	5-10	<5	100	150	2	1.5	Good	Good	Semi-mature	Medium	Low	Low	Proposed for removal (Escarment)
177	<i>Casuarina cunninghamiana</i>	River She-oak	15-20	10-15	700	900	8.4	3.17	Good	Fair	Mature	Long	Medium	High	
178	<i>Casuarina cunninghamiana</i>	River She-oak	15-20	10-15	450	600	5.4	2.67	Good	Fair	Mature	Long	Medium	High	
179	<i>Lophostemon confertus</i>	Queensland Box	10-15	5-10	400	500	4.8	2.47	Fair	Fair	Mature	Medium	Medium	Medium	
180	<i>Casuarina glauca</i>	Swamp she-oak	15-20	10-15	600	800	7.2	3.01	Fair	Fair	Mature	Medium	Medium	Medium	
181	<i>Casuarina cunninghamiana</i>	River She-oak	5-10	5-10	200	250	2.4	1.85	Fair	Fair	Semi-mature	Long	Low	Medium	
182	<i>Pittosporum rhombifolium</i>	Queensland Laurel	5-10	5-10	250	350	3	2	Good	Good	Mature	Medium	Low	Low	
183	<i>Glochidion ferdinandi</i>	Cheese Tree	5-10	<5	300	350	3.6	2.13	Fair	Fair	Semi-mature	Short	Low	Low	
184	<i>Glochidion ferdinandi</i>	Cheese Tree	10-15	5-10	350	450	4.2	2.37	Fair	Fair	Mature	Medium	Medium	Medium	
185	<i>Lophostemon confertus</i>	Queensland Box	15-20	5-10	300	350	3.6	2.13	Fair	Fair	Mature	Short	Low	Low	
186	<i>Eucalyptus robusta</i>	Swamp Mahogany	15-20	15-20	700	800	8.4	3.01	Fair	Fair	Mature	Medium	Medium	Medium	
187	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	10-15	10-15	300	350	3.6	2.13	Good	Fair	Mature	Long	Remove	Remove	Weed species

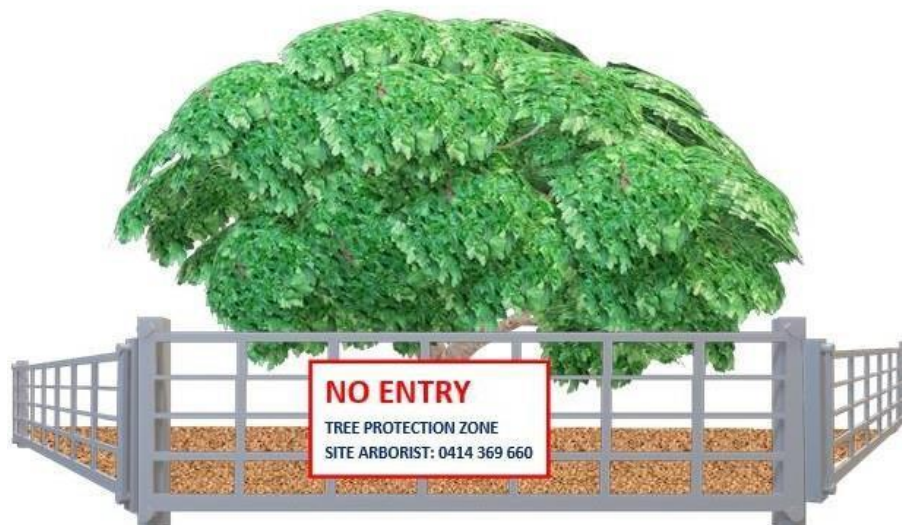
Tree No.	Scientific Name	Common Name	Height	Canopy Spread	DBH	DAB	TPZ	SRZ	Health	Structure	Age	E.L. E	Tree Significance	Retention value	Comments
188	Eucalyptus robusta	Swamp Mahogany	15-20	10-15	350	400	4.2	2.25	Good	Fair	Mature	Medium	Low	Low	
189	Lophostemon confertus	Queensland Box	15-20	10-15	350	450	4.2	2.37	Fair	Fair	Mature	Short	Low	Low	
190	Pittosporum undulatum	Sweet Pittosporum	5-10	5-10	250	300	3	2	Poor	Fair	Semi-mature	Remove	Low	Low	
191	Eucalyptus punctata	Grey Gum	15-20	15-20	400	450	4.8	2.37	Fair	Fair	Mature	Short	Low	Low	
192	Glochidion ferdinandi	Cheese Tree	10-15	10-15	350	450	4.2	2.37	Fair	Fair	Mature	Short	Low	Low	
193	Pittosporum undulatum	Sweet Pittosporum	5-10	5-10	200	350	2.4	2.13	Fair	Fair	Mature	Short	Low	Low	
194	Pittosporum undulatum	Sweet Pittosporum	5-10	5-10	200	150	2.4	1.5	Good	Fair	Mature	Long	Low	Low	
195	Eucalyptus punctata	Grey Gum	15-20	15-20	700	750	8.4	2.93	Fair	Fair	Mature	Short	Medium	Low	
196	Syzygium smithii	Lilly Pilly	5-10	<5	150	200	2	1.68	Good	Good	Juvenile	Medium	Low	Low	Proposed for removal (Koala Tree Walk)
197	Elaeocarpus reticulatus	Blueberry Ash	5-10	<5	150	200	2	1.68	Good	Good	Juvenile	Medium	Low	Low	Proposed for removal (Koala Tree Walk)
198	Elaeocarpus reticulatus	Blueberry Ash	5-10	<5	150	200	2	1.68	Good	Good	Juvenile	Medium	Low	Low	Proposed for removal (Koala Tree Walk)

Appendix 3- Tree protection

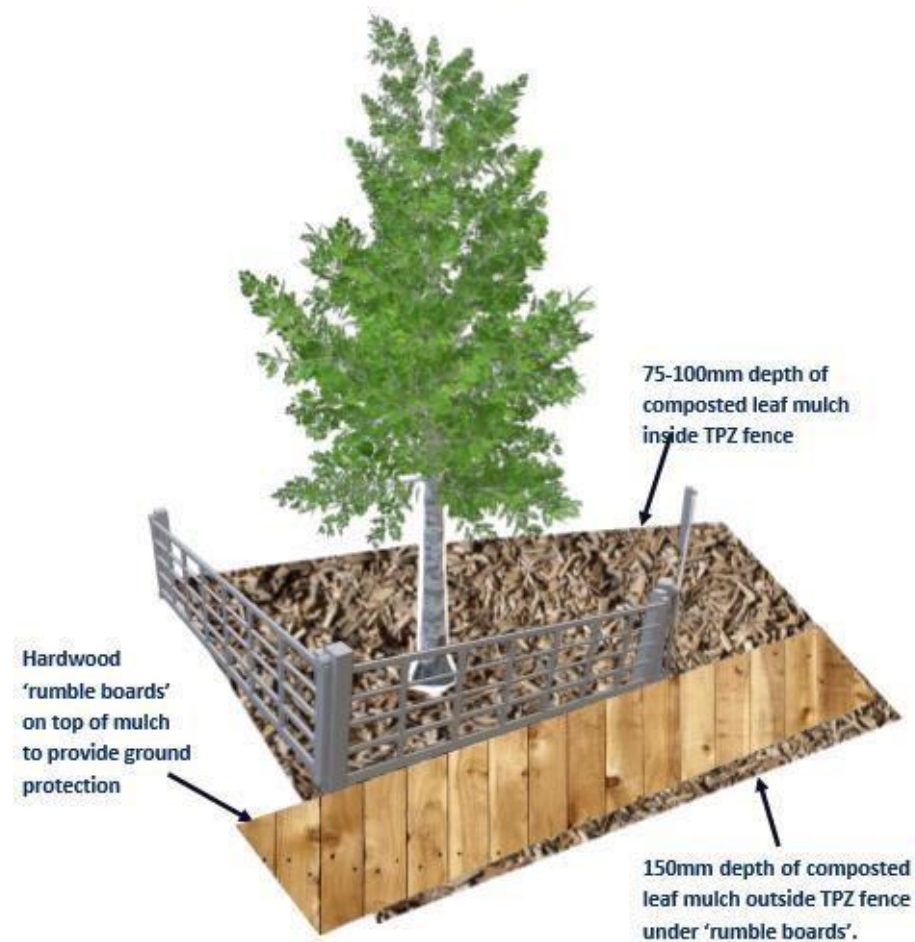
Tree protection measures are used to isolate the calculated tree protection zone from the impacts of construction activities. Tree protection measures come in many different forms and types depending on the type of protection required for the situation. The protection measures can be broadly considered as tree root protection, canopy protection or trunk and branch protection.

Tree root protection: TPZ Fencing- Figure 1

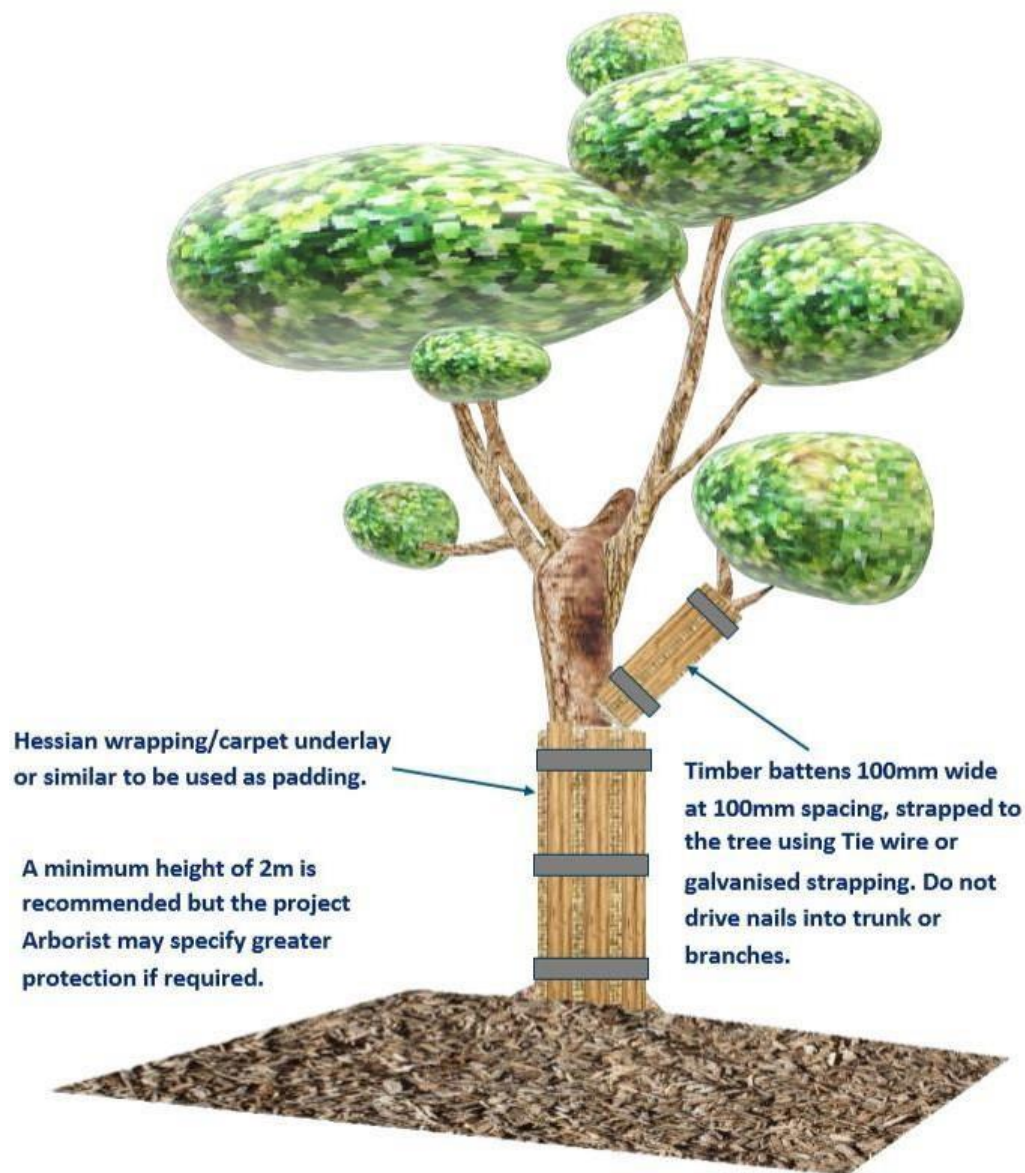
Tree root protection is generally achieved with the allocation and delineation of a tree protection zone (TPZ) in accordance with AS4970-2009- The Protection of Trees on Development Sites. Temporary fencing is used to isolate the area from construction activity and restrict unauthorized access. Where access into the TPZ is required and unavoidable, ground protection measures may be recommended to ensure that the tree roots which are to be protected remain undamaged during works within the TPZ. Any works within the allocated tree protection zones must be directly supervised by a project Arborist with a minimum AQF level 5 qualification. In situations where there are low lying tree branches to be protected, the TPZ may be extended beyond the calculated TPZ in order to incorporate canopy protection as shown below.



Ground protection: Access road within TPZ- Figure 2.



Trunk and branch protection- Figure 3.



Tree protection specifications:

In accordance with AS4970-2009- The Protection of Trees on Development Sites, activities restricted within the TPZ include but are not limited to:

- a) Machine excavation including trenching.
- b) Excavation for silt fencing.
- c) Cultivation.
- d) Storage of materials or machinery.
- e) Preparation of chemicals, including cement products.
- f) Parking of vehicles and plant.
- g) Refuelling of machinery.
- h) Dumping of waste.
- i) Wash down and cleaning of equipment.
- j) Placement of fill.
- k) Lighting fires.
- l) Soil level changes.
- m) Temporary or permanent installation of utilities and signs.
- n) Physical damage to the tree.

Tree protection fencing:

Tree protection fencing is to be installed prior to site establishment, demolition or commencement of any works on site.

All fencing must be chainmesh fencing 1.8m in height, secured with concrete 'feet' and in accordance with AS4678-Temporary Fencing and Hoardings. Depending on the type of development, shade cloth or similar may be recommended to reduce the spread of dust, particulate matter and liquids into the protected area. Silt fencing may also be required and may be incorporated into the TPZ fencing if required. Once the TPZ fencing has been installed the site Arborist must provide a letter of certification of tree protection measures to the client which may be forwarded on to the private certifier or council. Tree protection fencing is not to be moved, realigned, dismantled or tampered with in any way and shall only be relocated under instruction of the project Arborist. (See Figure 1) If the protective fencing requires temporary removal, trunk, branch and ground protection must be installed and must comply with AS 4970-2009 - Protection of trees on development sites. Existing fencing and site hoarding may be used as tree protection fencing, providing the TPZ remains isolated from construction activities. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Ground protection may include a permeable membrane such as geotextile fabric beneath a layer of mulch, crushed rock or rumble boards.

Any additional construction activities within the TPZ of the subject trees must be assessed and approved by the project arborist and must comply with AS 4970- 2009 - Protection of trees on development sites.

Tree protection signage:

Tree protection zone signage must be installed and clearly visible from all angles within the site stating, "NO ENTRY TREE PROTECTION ZONE" and phone numbers for the site Arborist and site supervisor/foreman must be provided. TPZ signage must be laminated or otherwise protected to ensure that it remains legible for the duration of the project. (See Figure 1)

Ground protection:

Where access into the TPZ of a tree is necessary and unavoidable, the project Arborist must specify the methods of additional protection required. This may be ground protection in the form of 150mm depth of composted mulch beneath hardwood 'rumble boards' alternatively track mats or road plates may be used (See figure 2). Tree roots are essential for the uptake/absorption of water, oxygen and mineral ions (solutes). It is essential to prevent the disturbance of the soil beneath the dripline and within the TPZ of trees that are to be retained. Soil compaction within the TPZ will adversely affect the ability of roots to function correctly.

Generally, soil level changes within the TPZ of a tree is not recommended and is contrary to AS4970-2009 The Protection of Trees on Development Sites. Certain circumstances can arise where this may be necessary, and the requirements must be carefully considered by the project Arborist. If the grade is to be raised within the TPZ, the material should be coarser or more porous than the underlying material and the suitability of this action must be assessed by the project Arborist.

Trunk and branch protection:

Where there is the risk of accidental mechanical damage due to narrow access paths or large machinery movements, trunk and branch protection may also be recommended (see figure 3). The removal of bark or branches allows the potential ingress of micro-organisms which may cause decay. Furthermore, the removal of bark restricts the trees' ability to distribute water, mineral ions (solutes), and glucose.

Trunk protection shall consist of a layer of either Hessian wrapping, carpet underlay, geotextile fabric or similar wrapped around the trunk, followed by softwood timbers approximately 100mm wide, aligned vertically and spaced evenly around the trunk (with an approx. 100 mm gap between the timbers).

The timbers must be secured using galvanized hoop strapping or tie wire. The timbers shall be wrapped around the trunk but not fixed to the tree with nails, screws or other means, as this will cause injury/damage to the tree.

Crown protection:

Tree crowns/canopy may be injured or damaged by machinery such as; excavators, drilling rigs, trucks, cranes, plant and vehicles. Where crown protection is required, it will usually be located at least one meter outside the perimeter of the crown.

Crown protection may include the installation of a physical barrier, pruning selected branches to establish clearance, or the tying/bracing of branches.

Supervision of works within the TPZ:

If incursion/excavation amounting to greater than 10% of the TPZ is unavoidable, exploratory excavation (under the supervision of the Project Arborist) using non-destructive methods may be considered to evaluate the extent of the root system affected and determine if the tree can remain viable.

If the project arborist identifies conflicting roots that require pruning, they must be pruned with a sharp implement such as; secateurs, pruners, handsaws or a chainsaw back to undamaged tissue. All works within the TPZ of any tree to be retained must be completed under the direct supervision of the project Arborist. This may include non-destructive excavation or hand digging to locate individual piers or fence posts.

The project Arborist is to recommend measures to protect and preserve any roots uncovered during these activities, this may include wrapping the tree roots in hessian or similar and keeping them moist to prevent desiccation.

Any tree roots which are damaged are to be assessed by the supervising Arborist who is to determine the best course of action. If root pruning is recommended, the project Arborist should sever the damaged roots cleanly back to undamaged tissue and cover the exposed portion of root to prevent desiccation.

Where significant roots have been pruned, the project Arborist should complete a letter of certification including a root mapping report explaining the number and diameter of roots which were severed, what impacts are likely and provide recommendations for mitigation of such impacts if required.

All supervision works must be completed by an Arborist with a minimum AQF level 5 in Arboriculture.

Hold points/ certification:

Arborist involvement will be required throughout the development process at key milestones, at a minimum these are:

1. Certification of tree protection installation prior to site establishment
2. Monthly inspection of trees to ensure tree protection measures are effective.
3. Supervision and certification of any works within tree protection zones.
4. Removal of tree protection measures and final certification.

The approved tree protection plan must be available onsite prior to the commencement of works, and throughout the entirety of the project. To ensure the tree protection plan is implemented, hold points have been specified in the schedule of works for Arborist involvement. It is the responsibility of the principal contractor to complete each of the tasks. Once each stage is reached, the work will be inspected and certified by the project arborist and the next stage may commence. Alterations to this schedule may be required due to necessity. However, this shall be through consultation with the project arborist only.

A recommended schedule of works for Arborist involvement is as follows:

Pre-construction: Prior to demolition and site establishment indicate clearly (with spray paint on trunks) trees marked for removal only.


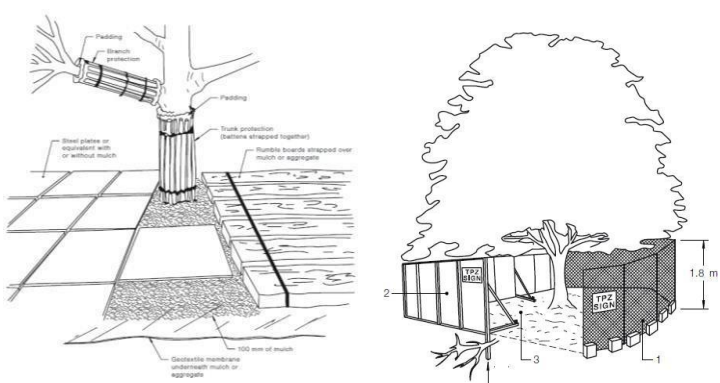
Tree protection (for trees that will be retained) shall be installed prior to demolition and site establishment, this will include mulching of areas within the TPZ.

Scheduled inspection of trees by the project arborist should be undertaken monthly during the construction period.

During Construction: Inspection of trees by project arborist after all major construction has ceased, following the removal of tree protection measures.

Post Construction: Final inspection of trees by project arborist to confirm tree condition and provide final letter of certification.

Appendix 4- Tree protection methodology statement/AWMS

Activity	Methodology	Controls
1. Install tree protection measures	<ol style="list-style-type: none"> The project Arborist is to supervise the installation of TPZ fencing and signage, ground protection measures and trunk and branch protection in accordance with <i>AS4970-2009-The Protection of Trees on Development Sites</i>. <ol style="list-style-type: none"> Concrete feet supporting the fence panels must be kept clear of significant tree roots. Fencing must not be attached or fixed in any way to the retained tree. Fencing panels must be firmly secured together with brackets to prevent unauthorised access to the TPZ and installed in accordance with Australian Standard- <i>AS4687-2007-Temporary Fencing and Hoardings</i>. TPZ signage must be laminated, hard wearing signs of minimum A4 dimensions, installed on panels on each side of the tree and must be visible from all angles. The signs must state-Tree Protection Zone -No entry or similar. The signs must have the name and contact details of the site supervisor/foreman and the project Arborist as a minimum. <div data-bbox="324 483 600 866">  </div> <div data-bbox="622 483 1339 866">  </div> <ol style="list-style-type: none"> Ground protection measures are to be installed wherever access within the TPZ is required. This is to be overseen by the project Arborist who will specify the exact type of control required dependent on site requirements, i.e. foot traffic or machinery access. In areas where machinery access is required the base layer should be a permeable Geotextile fabric with 100mm of woodchip and hardwood rumble boards on top. Rumble boards must be strapped together with steel strapping. Trunk and branch protection are to be installed if access to the TPZ is required. Trunk and branch protection to consist of padding (double wrapped hessian, carpet underlay or similar), timber batons to be a minimum of 90mm x 35mm at 100mm spacing around the circumference of the trunk/branch. Batons to be attached with steel strapping or similar. No nails or screws are to be used to attach anything to the tree in any way. 	<ol style="list-style-type: none"> This Arboricultural work method statement (AWMS) is to form part of the site documentation and must be part of the site-specific induction process. Any worker entering the site must be familiar with this document and the control measures in relation to the tree. Anyone entering the site must sign this document to confirm that they have been inducted into the specific requirements relating to the tree. The project Arborist must continue to monitor the site and specified controls and must update this AWMS accordingly if conditions change or controls are not being effective. Project Arborist is to monitor tree protection measures to ensure they remain in their specified location and remain effective. The project Arborist is to certify that the tree protection measures have been installed in accordance with AS4970-2009.
2. Site establishment	<ol style="list-style-type: none"> Install perimeter fencing to isolate the worksite from unauthorised persons. Install amenities, temporary electricity and other temporary services. Install silt fencing and sediment control. There is to be no excavation within TPZs of retained trees to install sediment fencing, alternative methods must be sought such as coir logs/hay bales etc. 	<ol style="list-style-type: none"> The project Arborist is to supervise any works which may impact upon the tree protection zone of retained trees.

<p>3.</p> <p>Root protection</p>	<ol style="list-style-type: none"> 1. Any tree roots greater than 30mm in diameter from trees to be retained are to be protected unless otherwise specified by the project Arborist. 2. Any tree roots which are pruned must be cut cleanly back to undamaged tissue. 3. Tree roots to be retained must be protected from drying out by wrapping in moist hessian or geotextile fabric to prevent desiccation. 	<ol style="list-style-type: none"> 1. The project Arborist is to conduct any minor tree root pruning which may be required. 2. The project Arborist must protect any tree roots which are uncovered during the excavation.
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Appendix 5- Amended Southern Link connection

