APPENDIX I

Geotechnical Investigation:
Northcote Golf Course
143 Normanby Avenue, THORNBURY

Geotechnical Investigation:
Northcote Golf Course
143 Normanby Avenue
THORNBURY

Report Prepared for:

MICHAEL SMITH & ASSOCIATES

Report Prepared by A.S. James Pty Ltd

14 April 2023

Report No: 122226

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1. INTRODUCTION

1.01 **Investigation Requested by:** The geotechnical investigation was commissioned by Michael Smith of Michael Smith & Associates via a signed authorization of engagement dated 7 March 2023.

1.02 **Purpose of Investigation:** It is proposed to build a pedestrian path and related amenities at Northcote Golf Course, 143 Normanby Avenue, Thornbury. Herein, it was required to forecast foundation conditions and recommend design parameters for the proposed works.

The goals of the geotechnical investigation are outlined as follows:

- Establish the subsurface profile including ground water conditions of the boreholes.
- Provide recommendations for appropriate footing arrangements for the proposed redevelopment including a hazard factor for earthquake loading in accordance with Australian Standard 1170.4, 2007.
- Provide minimum founding depths and allowable bearing pressures for the recommended footing arrangements.
- Provide subgrade preparation and design parameters for pavements.

At the time of preparing this report, the specific details of the proposed structures were not known. It has therefore been assumed, for the purpose of this report that no unusual loads or performance specifications apply.

1.03 **Geology:** The Geological Survey of Victoria, 1:63 360 Series Melbourne sheet, indicates the subject site to be underlain by Quaternary Olivine Basalts, which are generally referred to as "Newer Volcanics". Weathering of the basalt has typically resulted in shallow, surface residual silts underlain by firm to very stiff residual clays, which grade to variably weathered basalt at depth. The residual clays are generally highly reactive and the depth to rock is often highly variable over short distances.

1.04 **Field Methods:** As part of the geotechnical investigation the following field methods were incorporated:

i) Auger Drilling: All boreholes were drilled using a Dingo K9-4 rotary drilling rig equipped with continuous flight 110 millimetre diameter augers fitted with a tungsten carbide drill bit.

ii) In-situ Vane Shear Strength Testing: In-situ vane shear strength testing was carried out within the cohesive soils at shallow depths using a Pilcon hand vane tester. The tests were conducted in accordance with the test procedure outlined in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes". Test Method 6.2.1.

iii) Dynamic Cone Penetrometer Testing: Dynamic cone penetrometer testing was conducted adjacent to borehole locations in accordance with the test procedure outlined in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes," Test Method 6.3.2.

iv) Logging of Soil Profiles: The soil profile encountered in the borehole was logged in accordance with Australian Standard AS 1726 - 2017, "Geotechnical Site Investigations."

2. RESULTS

2.01 **Site Description:** At the time of the site investigation the following site features were noted:

- The site is essentially flat with some slight slopes along the proposed path and moderate slopes close to the locations BH2, BH4 and BH5.
- There are no boulders of rocks visible over the ground surface, however some floaters are likely below the ground surface level.
- The site surface drainage conditions are considered to be moderate.
- The site generally has a good cover of grass where some parts are well worn except for the existing footpaths which has crushed rock surfacing.
- There are numerous trees of varying sizes throughout the subject site.
- The proposed path alignment runs adjacent to Merri Creek towards the southern end and adjacent to a tributary creek off Merri Creek towards the northern end.
- No significant signs of slope instability were observed in the vicinity of the proposed path alignment.

2.02 **Borehole Drilling:** Five (5) boreholes were drilled at the approximate locations indicated in Appendix 1 Figure 1. The logs of the boreholes, together with the results of the in-situ vane shear strength tests carried out in the boreholes, are given in Appendix 1 Figures 2 – 6.

2.03 **Dynamic Cone Penetrometer Tests:** Dynamic cone penetrometer testing was carried out adjacent to boreholes. The results of the tests are given in Appendix 1 Figures 7 - 11.

2.04 **Sub Surface Soil Profile:** Target depth was 2.0 metres, however BH1, BH2 and BH3 are deepened up to 3.0 metres and still no natural soil was encountered. The investigation indicated that the site is underlain by fill up to 3.0 metres. In borehole 1, 0.2 metres of silty clay fill was encountered from surface. The fill was underlain by silt fill to 1.1 metres deep then which turned to clay fill up to depth of 3.0 metres. In borehole 2, silt fill with some clay, gravels, brick and glass fragments were encountered from surface which persisted to the termination depth of 3.0 metres. In borehole 3, silt fill encountered from surface to 0.2 metres deep underlain by sand fill to 0.5 metres deep. Sand fill is underlain by silty clay fill to 1.1 metres deep where the borehole terminated on extremely weathered basalt.

In boreholes 4 and 5 silt fill was encountered from the surface to 0.8 and 0.3 metres deep respectively. In borehole 4, the silt fill is underlain by clay fill up to 2.0 metres deep and underlain by natural dark grey silty clay which has stiff consistency until the termination depth of 2.2 metres on extremely weathered basalt. In borehole 5, the silt fill is underlain by clay fill which persisted to the termination depth of 1.8 metres on extremely weathered basalt.

A summary of the sub-soil/rock profile is shown in the table below:

BH	Fill (Silty Clay)	Fill (Silt)	Fill (Sand)	Fill (Silty Clay)	CLAY (CH)
1	0.0 – 0.2 m	0.2 – 1.1 m	-	1.1 – 3.0 m	-
2	-	0.0 – 3.0 m	-	-	-
3	-	0.0 – 0.2 m	0.2 – 0.5 m	0.5 – 1.1 m (R)	-
4	-	0.0 – 0.8 m	-	0.8 – 2.0 m	2.0 – 2.2 m (R)
5	-	0.0 – 0.3 m	-	0.3 – 1.8 m (AR)	-

Table 1. Summary of Sub-surface Soil Profile

(R): Refusal on Extremely Weathered Basalt

(AR): Power Auger Refusal

In considering the logs of the boreholes the following should be noted:

- Significant variations in both the level and quality of the basalt rock can occur over very short lateral distances. In all probability the drilling program completed is not likely to have determined either the maximum or minimum depths to the basalt rock underlying the subject site.

- The drilling program almost certainly have not encountered the maximum depth of fill on the site.

- Basalt boulders, possibly quite large in size, can occur in a highly random manner within the residual basaltic clays underlying the subject site.

2.05 **Ground Water:** No free ground water was encountered at the time of the site investigation, and none would normally be expected within the depths investigated. It should be appreciated, however, that following prolonged periods of rainfall surface soils are susceptible to moisture ingress, thereby significantly reducing the workability and strengths of both the surface soils and the underlying clays at shallow depths.

3. RECOMMENDATIONS

3.1 FOUNDATIONS

The following recommendations are only for the amenities proposed for the pedestrian path upgrade such as drinking fountain, bins or seats which considered not sensitive to movement. This movement is typically considered acceptable for the footings founded on uncontrolled fill material and accommodated through ongoing maintenance. No rigid structures, structures with settlement performance requirements or structures containing brickwork can be founded on uncontrolled fill.

Timber and steel structures should be preferred over masonry and where possible, structures should be placed on long bolted base plates which can be adjusted to accommodate the expected movement.

3.1.1 **Pad and Strip Footings:** The use of pad and strip footings may be considered for the proposed structures. Normal pad and strip footings could be founded on fill at the base of any fill/ silt or clay which has been softened by moisture ingress, subject to a minimum depth of 0.8 metres

below finished ground surface. Such footings may be designed on the following maximum allowable pressures.

Isolated Pads	-	50 kPa
Continuous Strips	-	40 kPa

Note: Where trees are within close proximity to the proposed structures recommendations given in section 4.02 should be adopted.

3.1.2 **Minimum Dimensions and Reinforcement for Strip Footings:** Any proposed strip footings should have minimum basic dimensions and reinforcement corresponding to details given for the Class "M" strip footing arrangement, as outlined in Australian Standard AS 2870, 2011 "Residential Slabs and Footings - Construction". It is emphasised, however, that this is intended as a guide and not as a classification and that design should be based on engineering principles. It is also emphasised that the proposed structure should be of a flexible nature and/or well-articulated.

3.1.3 **Earthquake Loading:** In accordance with Australian Standard 1170.4-2007, Part 4, "Earthquake Actions in Australia", site sub-soil class of Ce – Shallow soil site and Hazard Factor (Z) of 0.09 should be adopted for the design of the proposed structures at the subject site.

3.2 PAVEMENT CONSTRUCTION AND SITE EARTHWORKS

3.2.1 **Flexible/Rigid Pavements Constructed on Clay Fill Subgrades:** From an overall assessment of the field it is recommended that all pavements be constructed on an adequately prepared or clay fill subgrade which has been moisture conditioned to within 85 – 115% of the Standard optimum moisture content and compacted to a minimum 95% of the maximum dry density value determined by the Standard compaction test in accordance with current Australian Standard 1289, 5.1.1. Accordingly, pavements may be designed using a CBR value of 1.5% on clay fill subgrade. Rigid pavements could be designed using a Modulus of Subgrade Reaction of 15 kPa/mm for adequately prepared clay fill.

Should an increased subgrade strength be required for the proposed pavements in any areas, or additional fill proposed to be imported, a design parameter for the improved subgrade could be calculated using the formula proposed by the Japan Road Association and outlined as follows:

$$CBR_M = [\Sigma(h_n \times CBR_n^{0.33})]^3$$

Where n = layer number and Σh_n must be one metre
h_n = height or thickness of layer n
CBR_M = composite CBR of the multi-layered system, and
CBR_n = CBR of layer n

It should be pointed out, however, that the pavement design parameters recommended above are given subject to the subgrade preparation outlined in Clauses 3.2.2 and 3.2.3 being carried out, in addition to adequate subgrade drainage control, as outlined in Clause 3.2.4.

Note: Where trees are within close proximity to the proposed pavements it is likely to observe high level of ground movements due to moisture changes in subgrade.

3.2.2 **Subgrade Preparation:** Preparation of pavement subgrades should consist of stripping to grade and compacting the clay with appropriate compactive equipment to a dry density not less than 95% of the maximum density ratio determined by the Standard compaction test in accordance with current Australian Standard 1289, 5.1.1. Any localised areas which comprise predominantly silt should be excavated and replaced with clean compactable fill.

The moisture content of the subgrade should be within 85-115% of the Standard optimum moisture content at the time of compaction.

Upon completion of compaction the subgrade should be thoroughly proof rolled with an appropriate roller, ensuring that any localised soft or spongy areas are removed and made good with clean granular filling, which should be compacted to a minimum dry density ratio of 95% Standard. Additional filling should then be placed.

If work is carried out following prolonged rain periods it is quite possible that the subgrade may exist in a condition wet of optimum moisture content. Under such conditions it is not possible to proof roll the subgrade and it will be necessary to review the situation at the time of construction. The effects of movements on any proposed rigid pavements can be minimised by incorporation of positive load transfer devices such as dowels.

3.2.3 **Subgrade Moisture Control During Construction:** It should be appreciated that the long term performance of the proposed pavements and slabs constructed on a clay subgrade significantly depends on the subgrade moisture conditions at the time of construction. If the subgrade is significantly wet of the standard optimum moisture content at the time of construction, then there is the risk of some subsequent shrinkage occurring as the clay dries out.

On the other extreme, if the subgrade is significantly dry of the Standard optimum moisture content at the time of construction, there could be a risk of some resulting heave as the clays wet up. The moisture content of the subgrade should therefore be adjusted to within 85-115% of the Standard optimum moisture content.

3.2.4 **Long Term Subgrade Moisture Control:** It is considered essential for the long term performance of the proposed pavements at the subject site that both an effective surface and lateral cut-off drainage system be provided and maintained to minimise the risk of moisture migration into both the pavement sub-base and subgrade layers. Under no circumstances should the pavement and subgrade layers be permitted to remain in a saturated condition.

An edge turn down or edge protection could be provided to all pavements to a minimum depth of 0.6m to mitigate against the moisture content change.

3.2.5 **Earthworks:** It is pointed out that clays are difficult to work as fill and if not compacted at or very close to the optimum moisture content, can exhibit measurable volume change with time.

Any imported structural fill proposed on the site should preferably be of a granular nature. All fill material should have a nominal particle size of 40 millimetres or less and if required a guide for selecting an appropriate material would be as follows:

- Plasticity Index. X Percentage Passing 0.425 millimetre (AS Sieve) less than or equal to 600.

Structural fill should be compacted in layers not greater than 200 millimetres when loose and should be compacted to a dry density not less than 95% of the maximum density ratio determined by the Standard Compaction Test in accordance with current Australian Standard AS 1289, 5.1.1 using an appropriate medium to heavyweight vibrating roller.

During compaction, the fill material should have a moisture content within the range 85% to 115% of the optimum moisture content as determined by the Standard Compaction Test in accordance with current Australian Standard AS 1289.

3.2.6 **Pavement Performance:** The performance of pavement subgrades is highly variable. Notable risks include the following:

- Seasonal movements as a result of soil swelling / shrinkage from trees influence in highly reactive clays
- Seasonal movements as a result of soil swelling / shrinkage from surface drainage in highly reactive clays
- Settlement of uncontrolled fills

This movement is typically considered acceptable for these pavements and accommodated through ongoing maintenance. If higher performance is required, options in this report are provided to reduce the impact of these risks including moisture barriers for trees or edge turns downs. Stiffening of the pavements through structural design can also improve these conditions.

3.2.7 **Long Term Batters:** Long term batters with a maximum height of 2.0 metres should not exceed the following batter angles unless a retaining structure is incorporated.

Fill	-	20º
Stiff Clay	-	25º
Weathered Basalt	-	35º

It is highlighted that without protection the fill material encountered on site will be prone to deterioration without protection. Hence a cover of vegetation or geotextile should be adopted.

3.2.8 **Pavement Design:** Footpath design should be in accordance with the Darebin Council Standard Drawings. In particular DWG No. DS7. The 50mm thick bedding should consist of a size 20mm crushed rock and assuming this, its thickness would be a minimum 75mm. Reuse of site won crushed rock may be done with careful sorting. Where pavements require capacity for significant vehicular traffic, specific pavement design would be required.

4. CONSTRUCTION AND MAINTENANCE OF FOOTING SYSTEMS

4.01 **General Site Drainage:** It is essential that no water be allowed to pond against footings once they have been constructed. The ground adjacent to the footings should be graded as soon as footing construction has been completed so as to provide a grade of at least 1 in 20 over the first 2.0 metres. Alternatively, all water run-off should be collected and permanently channelled away from the proposed structures.

Water should not be permitted to pond in footing excavations for any length of time during construction.

Service trench excavations located adjacent to footings should be avoided. However, where this cannot be avoided the service trench excavations should be backfilled in such a manner so as to prevent water from seeping beneath the footings.

All service pipes, drains, sewers, downpipes and guttering should be installed and maintained in such a manner that no leakages occur.

4.02 **Planting of Trees and Shrubs:** Unless specific design of the proposed footing and pavements is carried out to allow for drying effects of any trees and shrubs, these should not be planted or permitted to remain closer than 1.0 times their mature height to any footings or pavements. The following alternatives are available:

- Deepen all footings located within 1.0 times the mature height of any tree to a minimum founding depth of 2.5 metres below the existing ground surface level or to basalt rock. The use of bored piers may prove to be the most economical for such an arrangement.

- Construct a suitable moisture barrier between the proposed footings and the offending tree. The moisture barrier should extend to a depth of at least 2.5 metres or to basalt rock. In addition the moisture barrier should extend a distance equivalent to the mature height of the tree in either direction.

  Alternatively, the potential for movement in the paths and footings can be accepted and accommodated through maintenance.

4.03 **Inspection of Footing Excavations:** All footing excavations must be carefully examined to ensure that the required founding soil has been exposed throughout. Any unusual features must be reported to this office immediately in order to ensure that the recommendations outlined in this report remain relevant.

For any footings where failure poses a significant risk such as light poles, the footings should be inspected by this office with DCP testing to confirm the fill is of reasonable strength and does not contain any voids.

4.04 **Excavation Conditions:** Excavation within the fill and the underlying clays should be straightforward, with moderate to high capacity plant, assuming that the excavation is adequately dewatered at all times during construction.

Highly variable excavation conditions may be encountered at the subject site due to the presence of random basalt boulders within the residual clays, possibly quite large in size. As such, an allowance should be made for over-excavation in both the proposed footing excavations and pavement subgrade preparations.

It would also be sensible to assume that difficult excavation conditions will prevail within excavations extending below the depths where practical power auger refusal was encountered, requiring the use of a high capacity plant equipped with a hydraulic rock breaker or equivalent

4.05 **Excavation Support for Footings and Trenches:** Where trenches/footings extend to a depth greater than 1.0 metre and temporary benches and/or batters are not possible, and/or if open cut methods are adopted, a shoring system such as an internal propped steel shoring box will be required. For the excavated trench/footing, the soil profile is not anticipated to self-support under vertical excavation for any length of time.

Additional information is given in the WorkSafe Compliance Code – Excavation Edition 2, Dec 2019.

4.06 **General:** The above recommendations are based on the bore and test results, together with experience of similar conditions and are expected to be typical of the area or areas being considered. Nevertheless, all excavations should be examined carefully and any unusual feature reported to us in order to determine whether any changes might be advisable.

Conditions may change with the seasons. In particular, the surface fill and near surface clays underlying the site at shallow depths may become saturated and unworkable following prolonged periods of rainfall.

The Modulus of Subgrade reactions specified throughout the report are referred to as the K (0.3) value in most literature on the subject. As such, they are directly relevant where point loads are critical, but otherwise will require amendment depending on the value of the loading and geometry of the structural element involved.

Under no circumstance should this report be reproduced unless in full.

If any point remains in doubt, please do not hesitate to contact this office.

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APPENDIX 1

Investigation Results

A.S. JAMES PTY LTD **Geotechnical Engineers**	**LEGEND** Denotes approximate borehole location	**BOREPLAN**
JOB: Northcote Golf Course 143 Normanby Avenue THORNBURY		**Checked:** P. Beasley **Drawn:** F. Istanbulluoglu
Job No: 122226 **Date:** Apr 23		Figure 1

A.S.JAMES PTY. LTD.
Geotechnical Engineers

Location: 143 Normanby Avenue THORNBURY **Borehole** 1
Job No. 122226 **Date:** Apr 2023
Ground Water: NIL

Soil Type	Description	Depth	Tests	Results
FILL	Clay Silt	**0.00**		
	Dark Grey, Gravels and Brick			
	Dry-Moist, Firm-Stiff	**0.20**		
FILL	Silt			
	Pale Brown, Trace Gravels and Clay			
	Dry-Moist, Medium Dense			
		1.10		
			S	80 kPa
FILL	Clay			
	Dark Brown Grey			
	Silt Gravels and Trace Bricks			
	Moist, Firm-Stiff			
	END OF BOREHOLE	**3.00**		Reached Target Depth

+ Standard Penetration Test - N blows/150mm. incr.	c Apparent Cohesion	L.L. Liquid Limit	**Figure 2**
I Undisturbed Sample - Diameter Stated	Ø Friction Angle	P.L. Plastic Limit	
s Vane Shear Strength	P Wet Density	P.I. Plasticity Index	
p Pocket Penetrometer Resistance	w Moisture Content	L.S. Linear Shrinkage	

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Location: 143 Normanby Avenue THORNBURY **Borehole** 2
Job No. 122226 **Date:** Apr 2023
Ground Water: NIL

Soil Type	Description	Depth	Tests	Results
		0.00		
FILL	Silt Dark Brown Gravels, Clay and Glass Fragments Dry-Moist, Medium Dense			
		0.80		
			S	68 kPa
FILL	Silt Dark Brown Sand, Gravels, Glass Fragments and Trace Clay Moist, Medium Dense			
	END OF BOREHOLE	3.00		Reached Target Depth

+ Standard Penetration Test - N blows/150mm. incr.	c Apparent Cohesion	L.L. Liquid Limit	**Figure 3**
I Undisturbed Sample - Diameter Stated	Ø Friction Angle	P.L. Plastic Limit	
s Vane Shear Strength	P Wet Density	P.I. Plasticity Index	
p Pocket Penetrometer Resistance	w Moisture Content	L.S. Linear Shrinkage	

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Location: 143 Normanby Avenue THORNBURY **Borehole** 3
Job No. 122226 **Date:** Apr 2023
Ground Water: NIL

Soil Type	Description	Depth	Tests	Results
FILL	Silt	**0.00**		
	Dark Grey, Trace Gravels and Clay			
	Dry-Moist, Medium Dense	**0.20**		
FILL	Sand			
	Grey, Trace Gravels and Silt			
	Dry, Medium Dense	**0.50**		
FILL	Silt Clay			
	Dark Grey			
	Brick Fragments			
	Moist, Stiff		**S**	138 kPa
	BOREHOLE TERMINATED	**1.10**		Power Auger Refusal

+ Standard Penetration Test - N blows/150mm. incr.
l Undisturbed Sample - Diameter Stated
s Vane Shear Strength
p Pocket Penetrometer Resistance

c Apparent Cohesion
Ø Friction Angle
P Wet Density
w Moisture Content

L.L. Liquid Limit
P.L. Plastic Limit
P.I. Plasticity Index
L.S. Linear Shrinkage

Figure 4

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Geotechnical Engineers

Location: 143 Normanby Avenue THORNBURY **Borehole** 4
Job No. 122226 **Date:** Apr 2023
Ground Water: NIL

Soil Type	Description	Depth	Tests	Results
		0.00		
FILL	Silt			
	Pale Brown			
	Gravels and Clay			
	Dry, Medium Dense			
		0.80		
FILL	Silt Clay			
	Dark Brown			
	Gravels			
	Dry-Moist, Firm-Stiff		S	68 kPa
CLAY (CH)	Dark Grey	2.00		
	Silty, Moist, Stiff			
	BOREHOLE TERMINATED	2.20		Power Auger Refusal

+ Standard Penetration Test - N blows/150mm. incr.	c Apparent Cohesion	L.L. Liquid Limit	**Figure 5**
I Undisturbed Sample - Diameter Stated	Ø Friction Angle	P.L. Plastic Limit	
s Vane Shear Strength	P Wet Density	P.I. Plasticity Index	
p Pocket Penetrometer Resistance	w Moisture Content	L.S. Linear Shrinkage	

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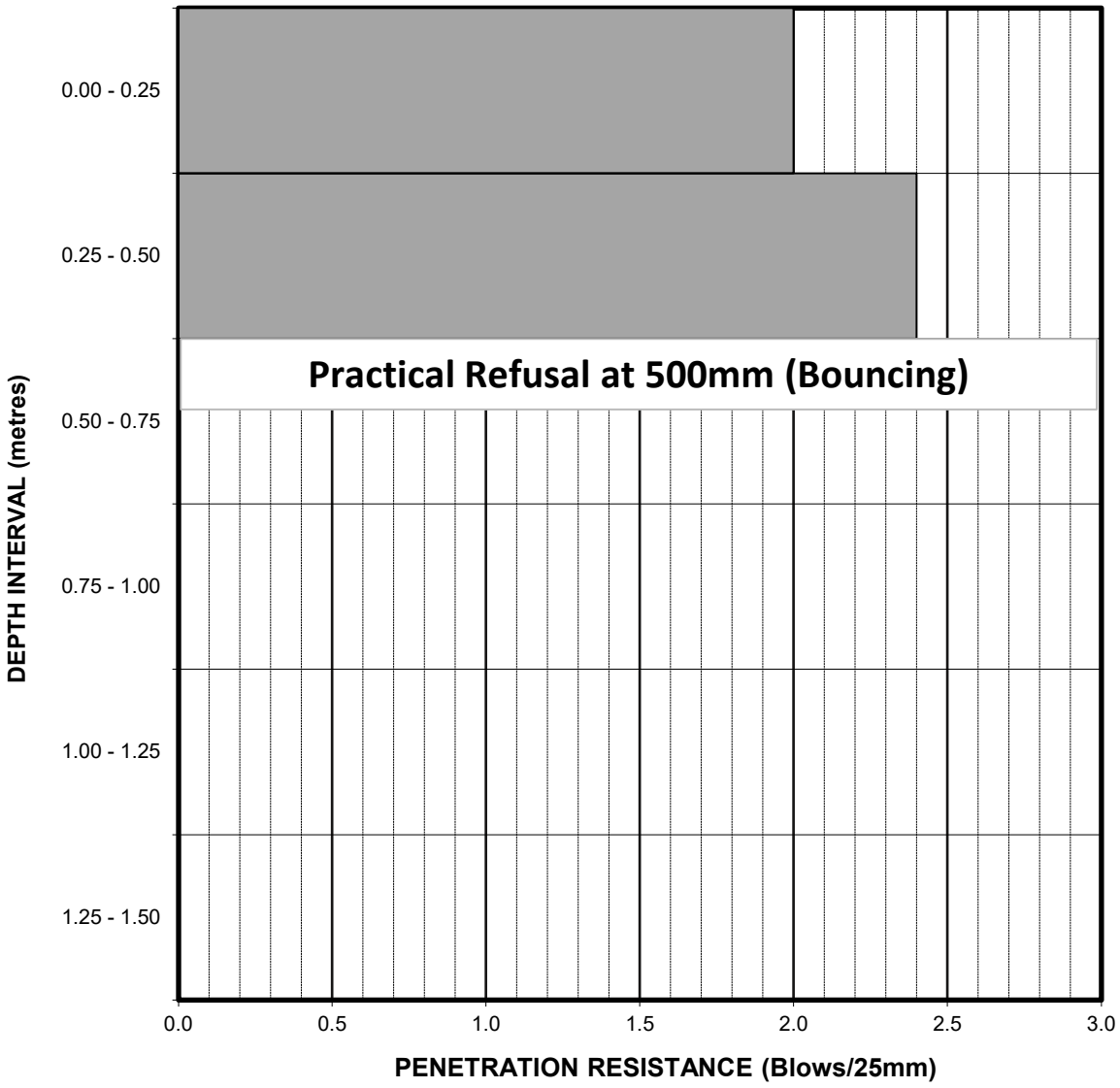
Location: 143 Normanby Avenue THORNBURY **Borehole** 5
Job No. 122226 **Date:** Apr 2023
Ground Water: NIL

Soil Type	Description	Depth	Tests	Results
FILL	Silt	**0.00**		
	Dark Brown			
	Gravels and Clay			
	Dry-Moist, Medium Dense	**0.30**		
FILL	Clay			
	Dark Brown			
	Gravels and Silt			
	Moist, Firm-Stiff			
		1.20		
FILL	Clay			
	Red Brown			
	Gravels and Silt		**S**	Practical Refusal
	Moist, Firm-Stiff			
	BOREHOLE TERMINATED	**1.80**		Power Auger Refusal

+ Standard Penetration Test - N blows/150mm. incr.	c Apparent Cohesion	L.L. Liquid Limit	**Figure 6**
I Undisturbed Sample - Diameter Stated	Ø Friction Angle	P.L. Plastic Limit	
s Vane Shear Strength	P Wet Density	P.I. Plasticity Index	
p Pocket Penetrometer Resistance	w Moisture Content	L.S. Linear Shrinkage	

A.S. JAMES PTY LTD Geotechnical Engineers	JOB: Northcote Golf Course 143 Normanby Av. THORNBURY	JOB No. 122226
		DATE: Apr 23

Depth below ground surface at the commencement of penetration: 0.0 metres



TEST LOCATION:

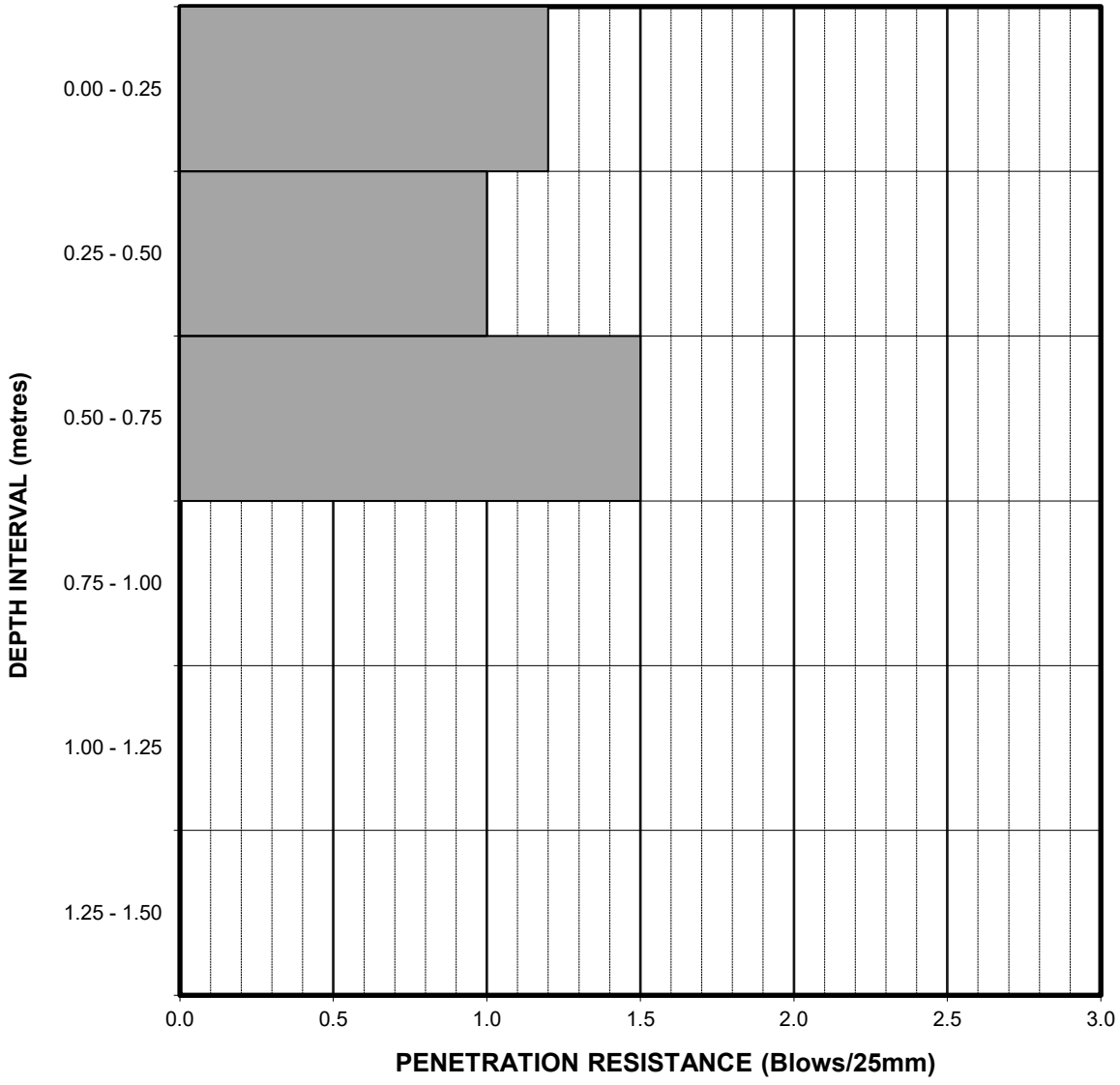
BOREHOLE 1

(REFER TO FIGURE 1)

DYNAMIC CONE PENETROMETER TEST (AS1289, 6.3.2, 1997) 325 sq.mm Cone - 9 kg Weight Falling 510 mm	Drawn / Tested: F. Istanbulluoglu Checked: P. Beasley	Figure 7

A.S. JAMES PTY LTD Geotechnical Engineers	JOB: Northcote Golf Course 143 Normanby Av. THORNBURY	JOB No. 122226 DATE: Apr 23

Depth below ground surface at the commencement of penetration: 0.0 metres



TEST LOCATION:

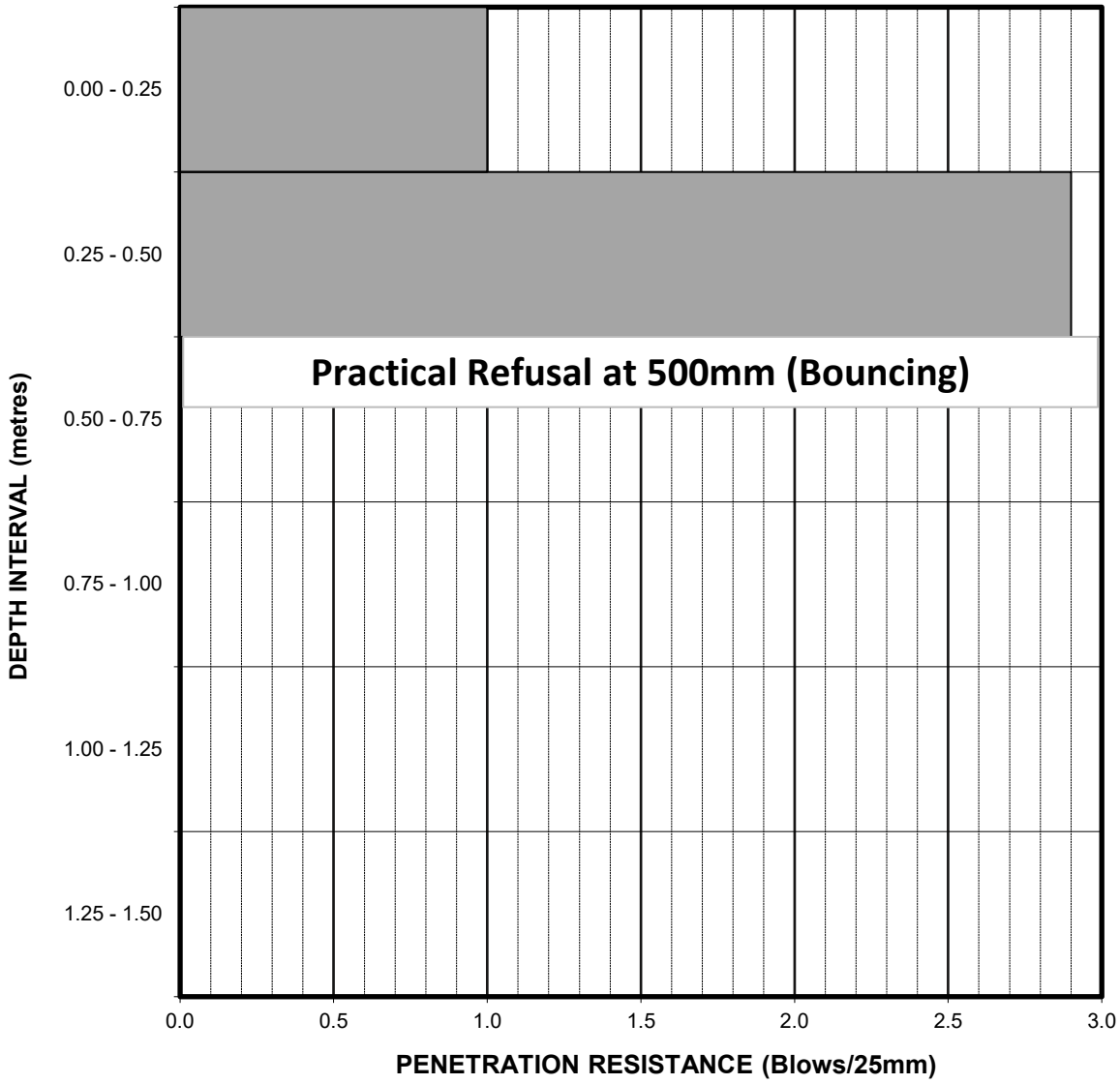
BOREHOLE 2

(REFER TO FIGURE 1)

DYNAMIC CONE PENETROMETER TEST (AS1289, 6.3.2, 1997) 325 sq.mm Cone - 9 kg Weight Falling 510 mm	Drawn / Tested: F. Istanbulluoglu Checked: P. Beasley	Figure 8

A.S. JAMES PTY LTD Geotechnical Engineers	JOB: Northcote Golf Course 143 Normanby Av. THORNBURY	JOB No. 122226 DATE: Apr 23

Depth below ground surface at the commencement of penetration: 0.0 metres



TEST LOCATION:

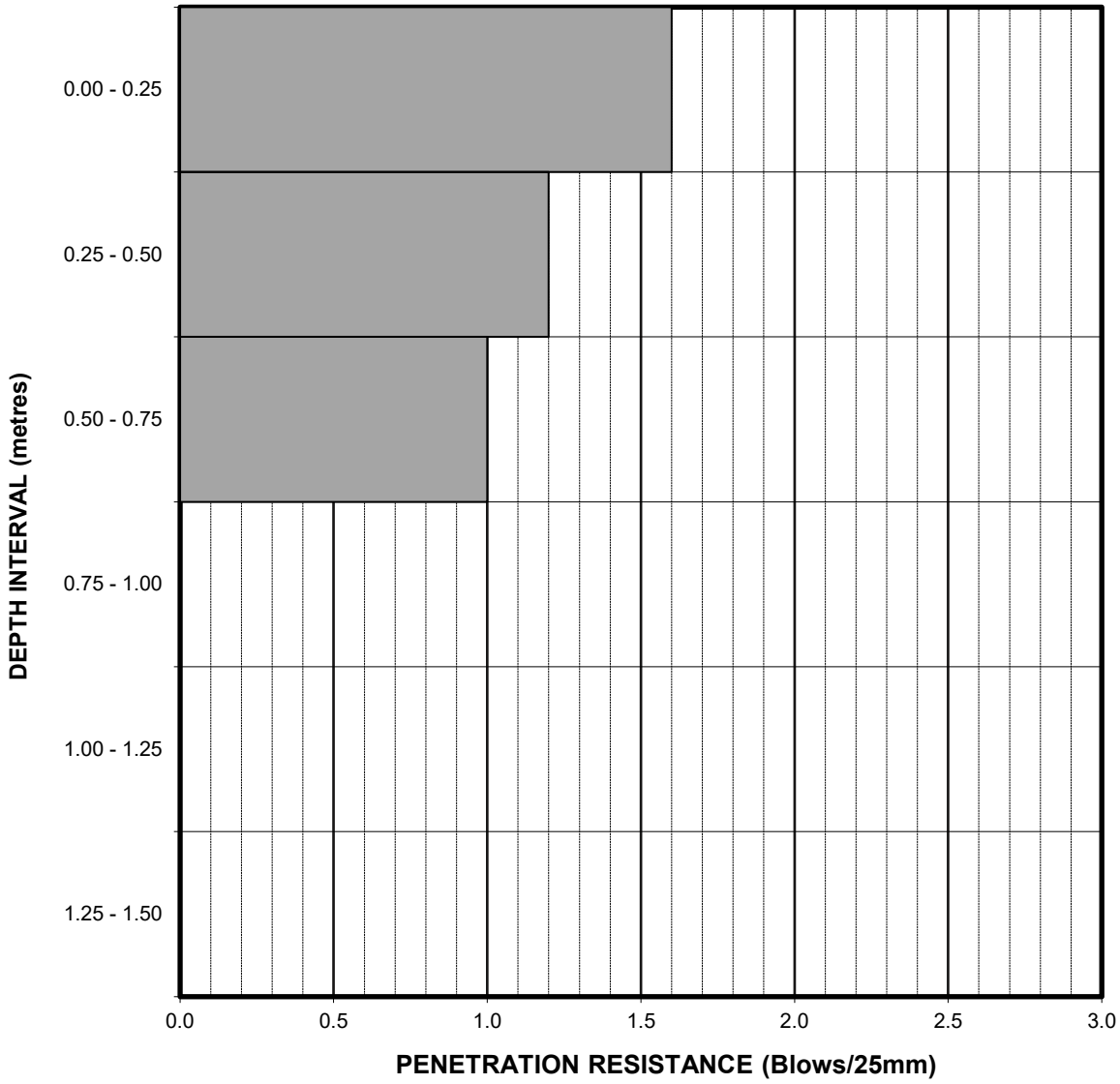
BOREHOLE 3

(REFER TO FIGURE 1)

DYNAMIC CONE PENETROMETER TEST (AS1289, 6.3.2, 1997) 325 sq.mm Cone - 9 kg Weight Falling 510 mm	Drawn / Tested: F. Istanbulluoglu Checked: P. Beasley	Figure 9

A.S. JAMES PTY LTD Geotechnical Engineers	JOB: Northcote Golf Course 143 Normanby Av. THORNBURY	JOB No. 122226 DATE: Apr 23

Depth below ground surface at the commencement of penetration: 0.0 metres



TEST LOCATION:

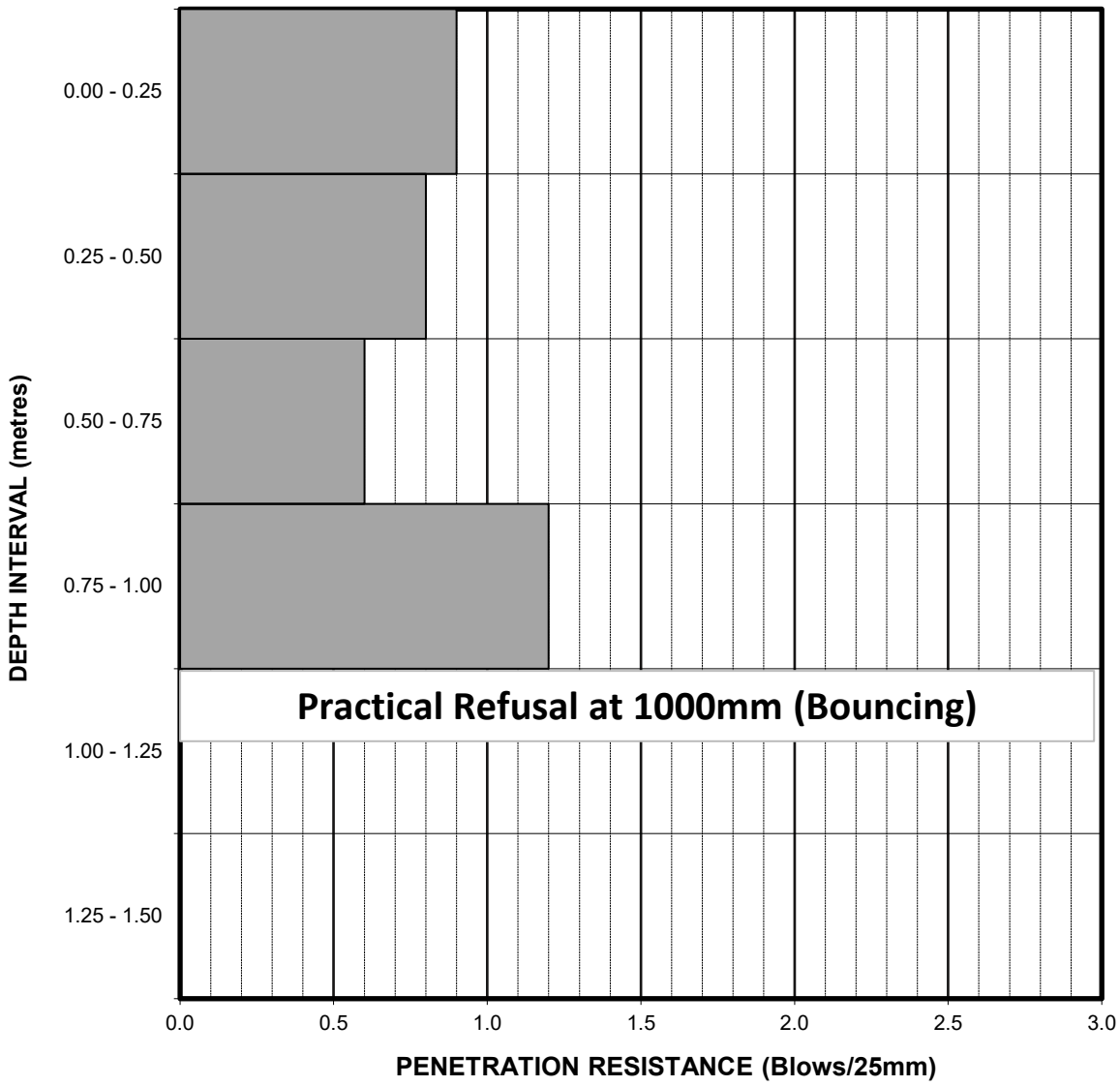
BOREHOLE 4

(REFER TO FIGURE 1)

DYNAMIC CONE PENETROMETER TEST (AS1289, 6.3.2, 1997) 325 sq.mm Cone - 9 kg Weight Falling 510 mm	Drawn / Tested: P. Beasley Checked: T. Holt	Figure 10

A.S. JAMES PTY LTD Geotechnical Engineers	JOB: Northcote Golf Course 143 Normanby Av. THORNBURY	JOB No. 122226 DATE: Apr 23

Depth below ground surface at the commencement of penetration: 0.0 metres



TEST LOCATION:

BOREHOLE 5

(REFER TO FIGURE 1)

DYNAMIC CONE PENETROMETER TEST (AS1289, 6.3.2, 1997) 325 sq.mm Cone - 9 kg Weight Falling 510 mm	Drawn / Tested: P. Beasley Checked: T. Holt	Figure 11

APPENDIX J

ARBORICULTURE & ENVIRONMENT

Assessment of Trees at Northcote Golf Course

Arboricultural Impact Assessment

Prepared For: Michael Smith and Associates
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29 May 2023

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Table of Contents

1. Introduction

It is proposed to install a shared use path within the Northcote Golf Course land. The path will be situated in the eastern section of the golf course, extending from the footbridge near Beavers Road at the south, to Woolton Road at the north.

C&R Ryder Consulting has been engaged to assess the trees likely to be affected by the proposed works and provide an arboricultural impact assessment. This report will provide:

- the findings of the assessment
- the preliminary impact of the proposed works to the trees
- construction methods to minimise impacts to trees
- protection measures for trees to ensure their longevity.

2. Tree Assessment Method

Liam Ainsworth inspected the subject site on Monday, 17 April 2023. The following data were collected for the trees:

- Unique ID
- Image of tree
- Botanic and common name
- Tree dimensions (Height x Width)
- Diameter at breast height (DBH)
- Diameter at base (DAB)
- Health
- Structure
- Useful life expectancy (ULE)
- Retention value
- Comments

Assessment boundaries were specified by Michael Smith Landscape Architects and only those trees were assessed. Trees have been aligned to match the supplied feature survey.

The trees were visually assessed from ground level, heights and widths were estimated and trunks measured with a diameter tape. No invasive tests were conducted or samples taken and any assessments of decay are qualitative only.

For all tree assessment descriptors, see Appendix 1.

Tree protection detail has been prepared and mapped in accordance with AS4970-2009 *Protection of Trees on Development Sites.*

3. Site Map

Figure 1: Aerial image of all trees (Nearmap image dated 01/01/2023).

3.1 The Site

Northcote Golf Club, located at 143 Normanby Avenue Thornbury, is a large open space comprising a 9 hole public golf course, walking tracks, and various facilities. The site is bordered by Merri Creek to the west and south, residential properties to the east (Figure 2) and an oval to the north.

Figure 2: The eastern border of the Golf Club is lined by residential properties.

This site is undulating with various slopes and basins throughout. Vegetation is generally restricted to the edges of fairways and usually in clusters.

3.2 Planning Controls and Overlays

Environmental Significance Overlay Schedule 1 (ESO1)

ESO1 applies to the site, a permit is required to remove, destroy or lop any vegetation, including dead vegetation. The requirement for a permit to remove, destroy or lop any vegetation does not apply to:

- A tree in a residential zone with a trunk circumference of less than 0.35 metre at 1 metre above the ground and which is less than 6 metres high or has an overall branch spread of less than 4 metres.
- A non-indigenous tree that has the capacity to adversely affect stream flow.
- The control or removal of non-indigenous plants in preparation for revegetation works.
- Pruning of plants to maintain access or to maintain a plant's horticultural health.

Clause 52.17 Native Vegetation

A permit is required to remove, destroy or lop native vegetation, including dead native vegetation. This does not apply:

- If the table to Clause 52.17-7 specifically states that a permit is not required.
- If a native vegetation precinct plan corresponding to the land is incorporated into this scheme and listed in the schedule to Clause 52.16.
- To the removal, destruction or lopping of native vegetation specified in the schedule to this clause.

3.3 The Trees

76 trees were assessed within the collection area specified. The trees were predominantly indigenous (84%), with 11 Australian native (14%) and 1 exotic specimen. A total of 10 individual species were recorded and are detailed in (Table 1).

Table 1: Tree species summary.

Botanical Name	Common Name	Origin	Count
Eucalyptus camaldulensis	River Red Gum	Indigenous	45
Eucalyptus melliodora	Yellow Box	Indigenous	8
Casuarina cunninghamiana	River She-oak	Australian Native	8
Allocasuarina littoralis	Black She-oak	Indigenous	5
Eucalyptus leucoxylon	Yellow Gum	Indigenous	3
Acacia implexa	Lightwood	Indigenous	3
Pittosporum undulatum	Sweet Pittosporum	Australian Native	1
Fraxinus angustifolia	Narrow Leaf Ash	Exotic	1
Eucalyptus mannifera	Brittle Gum	Australian Native	1
Eucalyptus bicostata	Eurabbie	Australian Native	1
		Total	76

Full tree details with images are provided in Appendix 5 Photographic Tree Reports.

In general, the assessed trees have fair to good health and structure and 71 of the trees have a useful life expectancy (ULE) of 20+ years.

Health

The health of trees was typical of a largely unmanaged population growing within a relatively natural setting. Minor issues amongst the population included Psyllid damage, pest grazing and minor dieback. Given many of the trees are located within a basin and are often waterlogged, some trees displayed reductions in optimal foliage density and vigour; however, is consistent with a naturalised, predominantly River Red Gum population.

- 6 trees (1, 2, 3, 51, 52 & 73) were assessed with good health. The trees had full, vigorous canopies with no indications of pests or disease.
- 67 trees (ID 4-16, 18-21, 23-28, 30-50, 53-72, 74, 75,& 76) were assessed with fair health. In general, the trees had slightly reduced canopy density, minor deadwood, minor pests and disease like Psyllid and bird/possum grazing.
- 3 trees (ID 17, 22 & 29) were assessed with poor health. The trees were generally declining in health with dieback and minor deadwood. All of the trees are semi-mature to mature River Red Gums located within a basin and are often inundated with water during rain periods.

Structure

In general, tree structure was consistent with a naturalised, predominantly unmanaged population, with 60 of the 76 trees (78%) assessed with fair structure. the most common structural defects amongst the population were co-dominant trunks and canopies, trunk leans, previous limb failures and deadwood.

10 of the 76 trees (ID 9, 10, 15, 17, 31, 33, 36, 38, 40 & 69) had poor structure, with Tree 4 having very poor structure. Defects were mainly heavy leans of trunks, kinked trunks or regrowth from stumps.

Useful Life Expectancy (ULE)

71 trees (ID 1-3, 5-8, 10-16, 18-21, 23-68 & 70-76) (93%) were assessed as having a ULE of greater than 10 years. In general, these are long-lived trees or are still semi-mature to mature. They are expected to provide a contribution to the landscape for at least another 10-20 years with an appropriate level of management.

5 trees (ID 4, 9, 17, 22 & 69) were assessed as having a ULE of less than 5 years. In general, these trees are in decline, have structural faults such as codominant stems, dead stems and multiple canopy failures, or have already died. These trees do not provide any substantial amenity value and have a low or no retention value.

3.4 Tree Retention

3.4.1 Trees Assessed as High Retention Value

13 trees (ID 1, 7, 48, 51, 52, 53, 60, 64-67, 71 & 72) were assessed as High retention value. Generally, the trees have fair to good health and structure and ULEs of greater than 20 years. The trees are generally free from significant defects or health issues.

3.4.2 Trees Assessed as Moderate Retention Value

32 trees (ID 1, 2, 5, 11, 12, 14, 16, 18, 19, 20, 21, 24, 26, 28, 30, 32, 35, 37, 39, 41, 42, 46, 47, 49, 50, 55, 58, 62, 63, 74, 75 & 76) were assessed as Moderate retention value. The trees are semi-mature to mature specimens, generally in fair condition. They are suitable for retention; however, are such that their individual loss would not have a significant impact on the landscape.

3.4.3 Trees Assessed as Low Retention Value

28 trees (ID 6, 8, 10, 13, 15, 17, 22, 23, 25, 27, 29, 31, 33, 36, 38, 40, 43, 44, 45, 54, 56, 57, 59, 61, 68, 69, 70 & 73) were assessed as Low retention value. Whilst these could be retained, they are not considered worthy of design alterations and could be compensated with post construction landscape plantings.

3.4.4 Trees Assessed as No Retention Value

Trees 4 & 9 were assessed as having no retention value. Tree 4 has fair health and very poor structure due to ringbarking with a large saw cut in its trunk. Tree 9 has very poor health and poor structure. The tree grows on a significant lean with a kinked trunk.

3.4.5 Tree Retention Summary

The trees were assessed for their health, structure and ULE and placed in a retention category:

- 13 trees have a High retention value
- 32 trees have a Moderate retention value
- 28 trees have a Low retention value
- 2 trees have no retention value and should be removed.

The retention value should be used as a guide to aid in decision-making regarding tree retention and removal at a site.

Any trees to be retained throughout the construction of the path will require protection during construction. The easiest way of achieving this is with the installation of Tree Protection Zones (See Appendix 2).

3.5 Design Proposal

No formal designs have been provided; however, it is proposed to install a concrete footpath at the eastern section of the golf course, extending from the footbridge near Beavers Road at the south, to Woolton Road at the north (Figure 3).

There are two possible locations for the path within the basin section, highlighted in yellow in Figure 3 & Figure 4, however it has not yet been advised which alignment the path will take in this area.

Figure 3: Proposed path location (Blue line). Two possible alignments exist within the yellow box.

Figure 4: Two approximate alignments for the path.

The path is proposed to be 1.8m wide along the length of the path and have a profile depth of 200mm. The total length of the path will be ~710 metres. The path has been drawn to scale in its approximate location in Appendix 4.

3.6 Preliminary Arboricultural Impact

The preliminary impact of the proposal on the trees' TPZs and SRZs have been assessed (Appendix 3 & Appendix 5).

The percentage encroachments were calculated and the levels of impact were determined in accordance with AS 4970-2009, *Protection of Trees on Development Sites* as follows:

- **Major -** Encroachment >10% and/or SRZ intrusion
- **Minor** - Encroachment <10% and no SRZ intrusion
- **None** - No TPZ encroachment.

3.6.1 TPZ Impact Summary

The proposal will have an impact on the assessed trees as detailed in Table 2 below.

Table 2: Summary of construction impact

Retention Value	Within design, remove	>10% remove	>10% retain	<10% retain	No impact, retain	Total
High	0	0	10	2	1	**13**
Moderate	0	1	13	8	11	**33**
Low	1	1	14	7	5	**28**
None	2	0	0	0	0	**2**
Total	**3**	**2**	**37**	**17**	**17**	**76**

- 3 trees (ID 4, 9 & 54) are located within the proposed footpath design and would require removal under the proposed design. Tree 4 has a low retention value and Trees 9 & 54 have no retention rating.
- 6 trees (ID 10, 36, 55, 56, 59 & 66) have major TPZ encroachment of 43%, 49%, 43%, 41%, 45% and 41% respectively. The encroachment is such that the trees are unlikely to remain viable under the proposed design and are considered lost.
- 31 trees (ID 1, 5, 7, 8, 12, 13, 17, 19, 21, 27, 28, 29, 31, 35, 37, 38, 42, 44, 47, 49, 50, 52, 53, 58, 60, 64, 65, 69, 71, 72 & 73) have major TPZ encroachments of between 12-37%. 22 of the 31 trees (ID 1, 7, 8, 12, 13, 17, 19, 21, 27, 29, 31, 35, 37, 38, 42, 44, 47, 49, 50, 65, 69 & 71) also have intrusion into SRZs. All of the trees are expected to remain viable throughout and following the proposed construction, provided specified construction methods are adhered to.
- 17 trees (ID 2, 3, 14, 18, 20, 22, 30, 33, 40, 41, 43, 51, 57, 61, 68, 75 & 76) have minor TPZ encroachment (<10%) and are expected to remain viable throughout and following the proposed construction with standard tree protection measures.
- 17 trees (ID 6, 11, 15, 16, 23-26, 32, 34, 39, 46, 48, 62, 63, 70 & 74) do not have any TPZ encroachment and are expected to remain viable throughout the proposed construction with standard tree protection measures.

3.7 Impact Mitigation

The proposal is to construct the path at grade with a 200mm excavation required for base preparations. The path will be 1800mm wide for its entirety. In general, the path will be constructed along existing, informal tracks utilised by pedestrians.

There are two possible routes for the path to be located between Trees 8-52 (Figure 5). Following review of tree locations, TPZs and potential TPZ impacts, the proposed alignment at the western side of the basin has the least impact on the trees.

This alignment impacts on less trees and under the proposed design, no trees require removal in this section to facilitate the installation. Should the lower alignment be favoured, there is potential that trees will require removal in this section to facilitate the design.

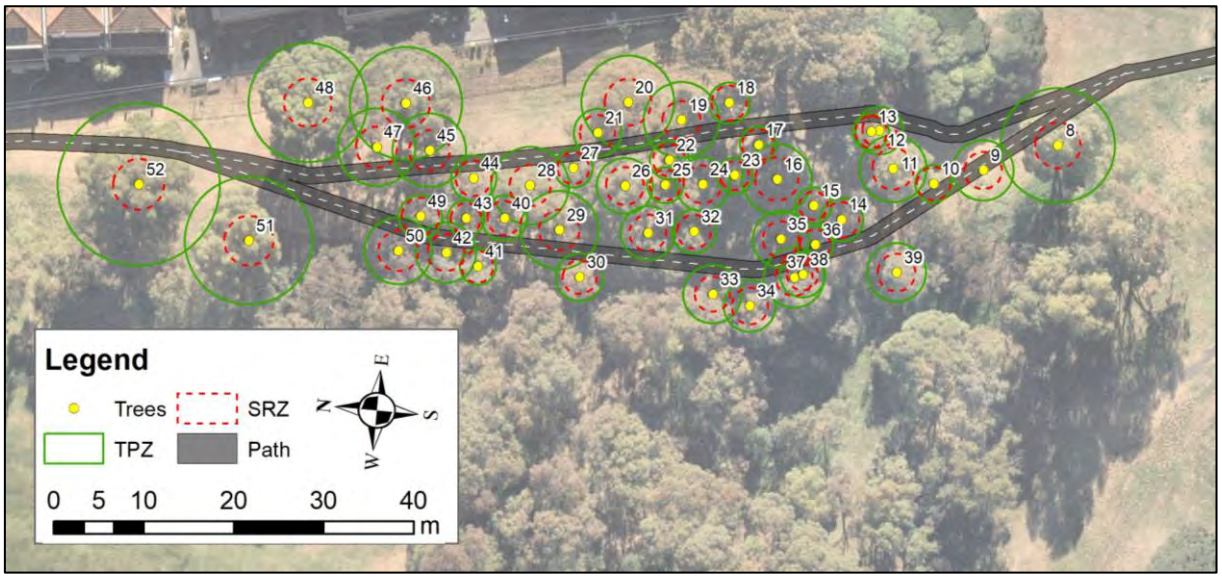

Figure 5: 2 potential alignments are located between Tree 8 and Tree 52.

Much of the proposed alignment is currently utilised by pedestrians and there is some level of compaction to soil as a result. Erosion of the grass surface and some soil was consistent along the entirety of the unformed track from foot traffic, exposing surface roots (Figure 6).

Figure 6: Surface root adjacent Tree 65

Given the proximity of the proposed path to existing trees which generally have significant structural roots and expansive root networks, sensitive construction methods will be required to minimise and avoid root damage to the trees.

In areas where the path is close to trees, consideration will need to be given to constructing the path on top of the existing soil level and battering off the sides. Trees 64-68 are located in an area where alignment of the path is inflexible due to boundary fencing and large trees (Figure 7) and the path will likely require installation above grade in this area.

Figure 7: Path alignment near trees 64-68 is inflexible due to boundary fencing and trees.

Recommended Path Construction Methodology

To minimise impacts to trees and roots, it is recommended that:

1. Where possible, the path alignment should maximise the offset to tree trunks and curve around trees to minimise potential damage to tree roots.
2. Trees 55 & 59 have non-destructive digging (NDD) along the footprint of the proposed path to determine if any roots are located within the design and whether the trees can remain viable within the landscape.
3. Trees 64-68 have NDD along the footprint of the proposed path alignment to determine whether any roots are located within the alignment and whether installation of the path at grade is appropriate in this location.
4. Prior to works beginning, all grass areas within TPZs are to be cordoned off with parawebbing or similar. Works are to be limited to within the project footprint.
5. All excavation and sub-base preparation is performed under the supervision of the project arborist where within TPZs.
6. Excavation is limited to 100mm for the proposed path or constructed above grade where significant tree roots are evident.
7. Excavation within the TPZs of Trees 1, 5, 7, 8, 10, 12, 13, 17, 19, 21, 27, 28, 29, 31, 35-38, 42, 44, 45, 47, 49, 50, 52, 53, 55, 56, 58, 59, 60, 64-67, 69 & 71- 73 to be supervised by the project arborist.
8. Any roots <50mm should be cleanly pruned by the project arborist in accordance with AS4373-2007 *Pruning Amenity Trees*.
9. Any roots >50mm should ideally be retained and incorporated into the design. An assessment of the root(s) will be made by the project arborist who will determine if the root can be removed or must remain.
10. Topsoil should be used to batter off the edge of the footpath where it must sit above natural ground level.

4. Conclusion

It is proposed to install a new footpath within Northcote Golf Club, where existing unformed tracks are being utilised by pedestrians. C&R Ryder Consulting was engaged to assess trees which may be impacted by these works and provide an arboricultural impact assessment.

Tree Summary

76 trees were assessed in proximity to the works area and as specified by the client. In general, they have fair health with minor issues observed such as Psyllid, pest grazing and deadwood. The majority of trees have fair structure due to individual issues such as codominant trunks and canopies, trunk leans and previous failures.

The trees were assessed for their health, structure and ULE and placed in a retention category:

- 13 trees (ID 1, 7, 48, 51, 52, 53, 60, 64-67, 71 & 72) were assessed as High retention value.
- 32 trees (ID 1, 2, 5, 11, 12, 14, 16, 18, 19, 20, 21, 24, 26, 28, 30, 32, 35, 37, 39, 41, 42, 46, 47, 49, 50, 55, 58, 62, 63, 74, 75 & 76) were assessed as Moderate retention value
- 28 trees (ID 6, 8, 10, 13, 15, 17, 22, 23, 25, 27, 29, 31, 33, 36, 38, 40, 43, 44, 45, 54, 56, 57, 59, 61, 68, 69, 70 & 73) were assessed as Low retention value.
- 2 trees (ID 4 & 9) were assessed as having no retention value.

Project Proposal

The proposal will involve the installation of a new concrete footpath, 1800mm wide with a proposed excavation of 200mm to prepare a base for the path.

Arboricultural Impact

- 3 trees (ID 4, 9 & 54) are located within the proposed footpath design and would require removal under the proposed design.
- 6 trees (ID 10, 36, 55, 56, 59 & 66) have major TPZ encroachment of 43%, 49%, 43%, 41%, 45% and 41% respectively and are considered lost under the proposed design.
- 31 trees (ID 1, 5, 7, 8, 12, 13, 17, 19, 21, 27, 28, 29, 31, 35, 37, 38, 42, 44, 47, 49, 50, 52, 53, 58, 60, 64, 65, 69, 71, 72 & 73) have major TPZ encroachments of between 12-37%. All of the trees are expected to remain viable throughout and following the proposed construction, provided specified construction methods are adhered to.
- 17 trees (ID 2, 3, 14, 18, 20, 22, 30, 33, 40, 41, 43, 51, 57, 61, 68, 75 & 76) have minor TPZ encroachment (<10%) and are expected to remain viable throughout and following the proposed construction with standard tree protection measures.
- 17 trees (ID 6, 11, 15, 16, 23-26, 32, 34, 39, 46, 48, 62, 63, 70 & 74) do not have any TPZs.

Following completion of a final, detailed design, it is recommended that the arboricultural impact assessment is reassessed to determine any changes to tree retention and removal.

5. References

AS 4373, 2007, *Australian Standard, Pruning of Amenity Trees*, 2nd Edition Standards Australia.

AS 4970, 2009, *Australian Standard, Protection of Trees on Development Sites*, Standards Australia.

Boland D.J., Brooker M.I.H., Chippendale G.M, Hall. N, Hyland B.P.M, Johnston R.D, Kleinig D.A., McDonald, M. W. and Turner J.D., 2015, *Forest Trees of Australia*. Fifth edition, CSIRO Publishing.

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Coder, K. D., 1995, 'Tree quality BMPs for developing wooded areas and protecting residual trees', in *Trees and Building Sites, Proceedings of an International Workshop on Trees and Buildings,* Edited by G. W. Watson and D. Neely, International Society of Arboriculture, Champaign, Illinois.

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Kelly, S., Chippendale, G. M. & Johnson, R. D. 1969, *Eucalypts*, Thomas Nelson Limited, Melbourne.

Nicolle, D., 2006, *Eucalypts of Victoria and Tasmania*, Bloomings Books, Melbourne.

Penfold, A. R. & Willis, J. L., 1961, *The Eucalypts, Botany, Cultivation, Chemistry and Utilization*, World Crops Books, Leonard Hill Limited, London.

Appendix 1. Tree Assessment Descriptors

1.1 Image of tree

Digital image captured on the day of assessments.

1.2 Botanic Name/Common Name

The tree identified to genus and species level as well as the generally accepted common name for the tree.

1.3 Tree Dimensions

The height and width of the tree as estimated by the arborist in whole metres.

1.4 Diameter at Breast Height

The trunk diameter of the tree measured with a diameter tape at 1.4m above ground level.

1.5 Diameter at Base

The trunk diameter of the tree measured with a diameter tape above the root flare.

1.6 Health

Very Good	The tree is demonstrating exceptional growth for the species, has a full, dense canopy and there is no sign of any pest or disease**.**
Good	The tree is demonstrating good growth for the species with respect to its location and broader context. The canopy is full and complete and there are no signs of pest of disease.
Fair	The tree may have shown a reduction in optimal growth and/or there may be some twiggy deadwood within the canopy. There may be the presence of some pests or diseases that are not causing a significant decline in the tree
Poor	The tree is in decline with little growth. There may be sections of the canopy missing and pests or diseases may be prevalent
Very Poor	The tree is in significant decline, with large sections of the canopy dead. This tree is very unlikely to recover.
Dead	The tree is dead

1.7 Structure

Good	The tree's structure is typical of the species with no significant hazards such as included bark, trunk decay, splits or tears. In general there will be a single trunk with scaffold and/or subordinate branches that display good attachments
Fair	There may be minor defects in the canopy, but the overall tree is still relatively free of significant issues. The tree may need minor pruning to fix minor defects. The canopy will by mostly symmetrical and typical of the species.
Poor	The tree will have 1 or more significant defect that may be able to be remedied with pruning. This tree is likely to have an atypical canopy and may contain defects such as included bark or codominant stems.
Very Poor	The tree has substantial defects associated with its primary trunk and scaffold structure that cannot be remedied with pruning or other measures. It is likely that this tree will require removal in the short term.
Hazardous	The tree has major defects and is likely to fail. It should be removed as soon as possible.

1.8 Useful Life Expectancy

20+	The tree is a healthy specimen in good condition. It is expected to provide a contribution to the landscape for at least another 20 years with an appropriate level of management.
10-20 years	The tree is a reasonably healthy specimen in good or fair condition. It is expected to provide a contribution to the landscape for 10-20 years with an appropriate level of management.
5-10 years	The tree is in fair condition or a short lived species. It is likely to provide contribution to the landscape for 5-10 years with an appropriate level of management at which point removal may need to be considered.
1-5 years	The tree is a poor specimen in decline and is likely to require removal within 1-5 years.
0 years	The tree is either dead or has substantial defects requiring its removal in the short term.

1.9 Tree Significance

Highly Significant	The tree is a large, mature example of the species, generally in fair to good condition. It may be a remnant specimen or have substantial habitat value. The tree may have specific landscape context or be very prominent in the broader environment. This tree may be suitable for inclusion on a significant tree register at local or state government level. Significant efforts should be made to retain this tree.
Significant	The tree is a mature example of the species in good condition and/or have particular prominence in the landscape. There may be evidence of the tree being used as a habitat tree by local fauna and/or it may be a remnant specimen. It has a long ULE and should be considered for retention. The loss of the tree may have a significant impact on the surrounding landscape.
Moderately Significant	The tree is a semi mature to mature example of the species in good condition, may be well sited in the landscape and/or may have habitat value. The removal of this tree would be noticed in the landscape.
Low	The tree is generally a smaller specimen or may be in decline. It is not located in a prominent position and its removal would have little impact on the broader landscape.
None	The tree is considered insignificant and its loss would go unnoticed.

1.10 Tree Retention

Very High	The tree is an outstanding example of the species and it should be retained at all costs.
High	The tree is a mature specimen in fair to good condition with a ULE of at least 10 years, is suitable to the site and should be retained in a new development.
Moderate	The tree is a semi-mature or mature specimen, in fair to good condition that is suitable for retention; however, is located such that its loss would not have a significant impact on the landscape.
Low	The tree is likely to be juvenile or in decline and could be retained; however design changes are not considered worthwhile to retain a tree in this category.
None	The tree should be removed irrespective of a design as it is in severe decline, hazardous or dead.
Third Party Tree	This tree is located off the subject property and is owned by a third party. The assessment of health and structure is considered irrelevant as the tree must be retained.

Appendix 2. Tree Protection

2.1 Tree Protection Zones

It is important when considering development or construction that assets to be retained are properly protected. In this case the trees are the assets and require protection if they are to be retained in the landscape long-term. Damage to the trees can come in 1 of 2 ways. The first is immediate damage directly to the tree in the form of root severance, breaking of branches and wounding of the trunk. The second is more insidious and can take some time to manifest. This is a more indirect form of damage and usually relates to modification of soil structure or grade, drainage patterns or hydrology (Coder 1995).

Trees can be easily protected from development by the installation of Tree Protection Zones (TPZ). TPZs have been calculated according to AS4970-2009 *Protection of Trees on Development Sites* for all trees to be retained. This calculates the TPZ radius by multiplying the trunk DBH by 12 to a maximum of 15m radius. These figures have been supplied in section Appendix 3 & Appendix 5.

A tree protection fence should be designed to be robust and withstand easy movement or ingress. Chain mesh fencing, temporary fencing panels or solid hoarding are all good examples (Figure 8).

Figure 8: Indicative TPZ construction

Figure 9: Suitable TPZ signage to be displayed on TPZ fences

The following should be prohibited within a TPZ (adapted from AS 4970-2009):

- built structures or hard landscape features (i.e. paving, retaining walls)
- materials storage (i.e. equipment, fuel, building waste or rubble)
- soil disturbance (i.e. stripping or grade changes)
- excavation works including soil cultivation(specifically surface-dug trenches for underground utilities)
- placement of fill
- lighting of fires
- preparation of chemicals, including preparation of cement products

- pedestrian or vehicular access (i.e. pathways).

Include the following procedures in setting up and maintaining any TPZ (adapted from AS 4970-2009):

- erect warning signs at regular intervals along the entire length of any protective TPZ fencing (Figure 9)
- construct TPZ fencing to prevent pedestrian access into the protected area.
- mulch the TPZ area to a depth of 100mm with woodchips (if available, use woodchips generated from on site tree clearing).
- irrigate TPZs periodically, as determined by the consulting arborist.

2.2 Structural Root Zones (SRZs)

The structural root zone is a formula to define the theoretical volume of soil and tree roots required to keep a tree stable in the ground. It is in no way related to tree health and significant excavation at or near the SRZ for many trees will cause severe decline and/or death.

Excavation within SRZs can lead to whole tree failure often with devastating results. SRZs have been calculated in accordance with AS 4970-2009 *Protection of Trees on Development Sites* using the equation:

$$R_{srz} = (D \times 50)^{0.42} \times 0.64$$

Where D=trunk diameter at base in metres.

These figures have been supplied in section Appendix 3 & Appendix 5.

2.3 Encroachment

Encroachment of less than 10% of the TPZ and outside the SRZ is deemed to be minor encroachment according to AS 4970-2009. See Figure 10. Variations must be made by the project arborist considering other relevant factors including tree health, vigour, stability, species sensitivity and soil characteristics.

Encroachment of more than 10% of the TPZ or into the SRZ is major encroachment. The project arborist must demonstrate that the tree(s) would remain viable. This may require root investigation by non-destructive methods and consideration of relevant factors tree health, vigour, stability, species sensitivity and soil characteristics.

In any case, the lost TPZ should be compensated and be contiguous with the existing TPZ.

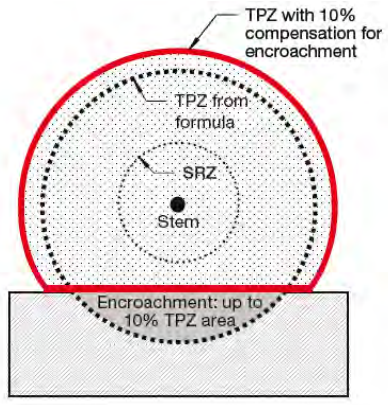

Figure 10: Example of TPZ encroachment and compensatory offset (image from AS 4970-2009)

Appendix 3. Tabular Tree Data

Tabular Tree Data

ID	Botanical Name	Common Name	Origin	Height	Width	DBH	DAB	Health	Structure	ULE (Years)	Retention Value	TPZr (m)	SRZr (m)
1	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	9	5	24	32	Good	Good	20+	Moderate	2.88	2.05
2	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	15	9	58	65	Good	Fair	20+	Moderate	6.96	2.76
3	*Casuarina cunninghamiana*	River She-oak	Australian Native	21	14	77	83	Good	Fair	20+	High	9.24	3.06
4	*Eucalyptus mannifera*	Brittle Gum	Australian Native	9	5	48	60	Fair	Very Poor	0	None	5.76	2.67
5	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	13	16	65	84	Fair	Fair	20+	Moderate	7.8	3.08
6	*Casuarina cunninghamiana*	River She-oak	Australian Native	12	4	25	30	Fair	Fair	11-20	Low	3	2.00
7	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	16	12	68	88	Fair	Fair	20+	High	8.16	3.14
8	*Eucalyptus melliodora*	Yellow Box	Indigenous	12	10	53	53	Fair	Fair	20+	Low	6.36	2.53
9	*Eucalyptus melliodora*	Yellow Box	Indigenous	6	4	28	33	Very poor	Poor	0	None	3.36	2.08
10	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	6	7	17	25	Fair	Poor	11-20	Low	2.04	1.85
11	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	14	6	31	42	Fair	Fair	20+	Moderate	3.72	2.30
12	*Eucalyptus melliodora*	Yellow Box	Indigenous	9	5	22	26	Fair	Fair	20+	Moderate	2.64	1.88
13	*Acacia implexa*	Lightwood	Indigenous	6	5	14	22	Fair	Fair	11-20	Low	2	1.75
14	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	4	20	29	Fair	Fair	20+	Moderate	2.4	1.97
15	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	6	3	10	17	Fair	Poor	20+	Low	2	1.57
16	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	16	14	32	46	Fair	Fair	20+	Moderate	3.84	2.39
17	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	6	3	16	22	Poor	Poor	1-5	Low	2	1.75
18	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	4	19	28	Fair	Fair	20+	Moderate	2.28	1.94
19	*Eucalyptus melliodora*	Yellow Box	Indigenous	9	7	29 20	34	Fair	Fair	20+	Moderate	4.2	2.10
20	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	13	11	43	56	Fair	Good	20+	Moderate	5.16	2.59
21	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	8	6	22	28	Fair	Fair	20+	Moderate	2.64	1.94
22	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	4	14 11	23	Poor	Fair	1-5	Low	2.16	1.79
23	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	5	3	5 4 3	18	Fair	Fair	11-20	Low	2	1.61
24	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	9	6	25	34	Fair	Fair	20+	Moderate	3	2.10
25	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	5	15	21	Fair	Fair	11-20	Low	2	1.72

Tabular Tree Data

ID	Botanical Name	Common Name	Origin	Height	Width	DBH	DAB	Health	Structure	ULE (Years)	Retention Value	TPZr (m)	SRZr (m)
26	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	11	5	26	34	Fair	Good	20+	Moderate	3.12	2.10
27	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	5	18	22	Fair	Fair	11-20	Low	2.16	1.75
28	*Eucalyptus melliodora*	Yellow Box	Indigenous	13	9	27 24	41	Fair	Fair	20+	Moderate	4.32	2.28
29	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	2	16 16 14	40	Poor	Fair	11-20	Low	4.32	2.25
30	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	8	3	22	26	Fair	Fair	20+	Moderate	2.64	1.88
31	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	7	25	30	Fair	Poor	11-20	Low	3	2.00
32	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	8	5	20	25	Fair	Fair	20+	Moderate	2.4	1.85
33	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	5	14 14 14	28	Fair	Poor	11-20	Low	3.24	1.94
34	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	9	5	24	30	Fair	Fair	20+	Moderate	2.88	2.00
35	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	8	7	26	30	Fair	Fair	20+	Moderate	3.12	2.00
36	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	8	7	16	20	Fair	Poor	11-20	Low	2	1.68
37	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	9	6	28	32	Fair	Fair	20+	Moderate	3.36	2.05
38	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	6	5	15 15	21	Fair	Poor	11-20	Low	2.52	1.72
39	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	8	4	27	33	Fair	Fair	20+	Moderate	3.24	2.08
40	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	5	6	21	26	Fair	Poor	11-20	Low	2.52	1.88
41	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	5	16	22	Fair	Fair	20+	Moderate	2	1.75
42	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	6	10	28	32	Fair	Fair	20+	Moderate	3.36	2.05
43	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	6	3	17	20	Fair	Fair	11-20	Low	2.04	1.68
44	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	9	7	21	29	Fair	Fair	20+	Low	2.52	1.97
45	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	8	26 22	40	Fair	Fair	20+	Low	4.08	2.25
46	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	17	12	52	60	Fair	Good	20+	Moderate	6.24	2.67
47	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	17	13	36	42	Fair	Fair	11-20	Moderate	4.32	2.30
48	*Eucalyptus melliodora*	Yellow Box	Indigenous	13	13	44 33	60	Fair	Fair	20+	High	6.6	2.67
49	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	10	5	20	34	Fair	Fair	20+	Moderate	2.4	2.10
50	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	7	8	23 21	40	Fair	Fair	20+	Moderate	3.72	2.25
51	*Eucalyptus melliodora*	Yellow Box	Indigenous	18	8	59	64	Good	Fair	20+	High	7.08	2.74
52	*Eucalyptus melliodora*	Yellow Box	Indigenous	14	13	53 38 37	67	Good	Fair	20+	High	9	2.80

Tabular Tree Data

ID	Botanical Name	Common Name	Origin	Height	Width	DBH	DAB	Health	Structure	ULE (Years)	Retention Value	TPZr (m)	SRZr (m)
53	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	17	13	47	53	Fair	Fair	20+	High	5.64	2.53
54	*Allocasuarina littoralis*	Black She-oak	Indigenous	7	6	20 20	26	Fair	Fair	11-20	Low	3.36	1.88
55	*Eucalyptus leucoxylon*	Yellow Gum	Indigenous	16	12	35 25	57	Fair	Fair	20+	Moderate	5.16	2.61
56	*Eucalyptus leucoxylon*	Yellow Gum	Indigenous	15	12	34 23	55	Fair	Fair	20+	Low	4.92	2.57
57	*Allocasuarina littoralis*	Black She-oak	Indigenous	8	5	13 13 13 10 10	36	Fair	Fair	11-20	Low	3.24	2.15
58	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	15	13	45	51	Fair	Fair	20+	Moderate	5.4	2.49
59	*Allocasuarina littoralis*	Black She-oak	Indigenous	9	5	22 17	32	Fair	Fair	11-20	Low	3.36	2.05
60	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	15	9	47	65	Fair	Fair	20+	High	5.64	2.76
61	*Allocasuarina littoralis*	Black She-oak	Indigenous	6	4	18	23	Fair	Fair	11-20	Low	2.16	1.79
62	*Allocasuarina littoralis*	Black She-oak	Indigenous	10	6	36	42	Fair	Fair	20+	Moderate	4.32	2.30
63	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	12	8	36	45	Fair	Fair	20+	Moderate	4.32	2.37
64	*Casuarina cunninghamiana*	River She-oak	Australian Native	18	13	81	86	Fair	Fair	20+	High	9.72	3.11
65	*Eucalyptus leucoxylon*	Yellow Gum	Indigenous	14	12	48	50	Fair	Fair	20+	High	5.76	2.47
66	*Eucalyptus camaldulensis*	River Red Gum	Indigenous	16	14	56	77	Fair	Fair	20+	High	6.72	2.97
67	*Casuarina cunninghamiana*	River She-oak	Australian Native	18	14	72 49 49	118	Fair	Fair	20+	High	12	3.55
68	*Casuarina cunninghamiana*	River She-oak	Australian Native	7	5	20 18 17	35	Fair	Fair	11-20	Low	3.84	2.13
69	*Casuarina cunninghamiana*	River She-oak	Australian Native	5	2	7 5 5 5	30	Fair	Poor	1-5	Low	2	2.00
70	*Casuarina cunninghamiana*	River She-oak	Australian Native	8	6	18	24	Fair	Good	20+	Low	2.16	1.82
71	*Eucalyptus bicostata*	Eurabbie	Australian Native	16	14	123	147	Fair	Fair	20+	High	14.76	3.89
72	*Casuarina cunninghamiana*	River She-oak	Australian Native	18	7	56	79	Fair	Fair	20+	High	6.72	3.00

Tabular Tree Data

ID	Botanical Name	Common Name	Origin	Height	Width	DBH	DAB	Health	Structure	ULE (Years)	Retention Value	TPZr (m)	SRZr (m)
73	*Pittosporum undulatum*	Sweet Pittosporum	Australian Native	8	5	27 25	48	Good	Fair	11-20	Low	4.44	2.43
74	*Acacia implexa*	Lightwood	Indigenous	9	5	27	34	Fair	Fair	11-20	Moderate	3.24	2.10
75	*Acacia implexa*	Lightwood	Indigenous	11	5	25	31	Fair	Fair	11-20	Moderate	3	2.02
76	*Fraxinus angustifolia*	Narrow Leaf Ash	Exotic	10	8	46	57	Fair	Fair	11-20	Moderate	5.52	2.61

Appendix 4. Enlarged TPZ Map

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Trees, TPZs, SRZs and Proposed Map

CLIENT
MICHAEL SMITH & ASSOCIATES
1ST FLOOR/407 WHITEHORSE ROAD
BALWYN VICTORIA 3103

LEGEND

- Trees
- Encroachment
- SRZ
- Path
- TPZ

Base information supplied by Nearmap.
Nearmap Image dated: 01/01/2023

Overview Map

SCALE BAR
0 12.5 25 50 75 m
SCALE 1:1,400 SHEET SIZE A3

AUTHOR	L. Ainsworth
DATE	29/05/2023
MAP DATUM	GDA 2020 MGA Zone 55

NORTH ARROW

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LEGEND

- Trees
- Encroachment
- SRZ
- Path
- TPZ

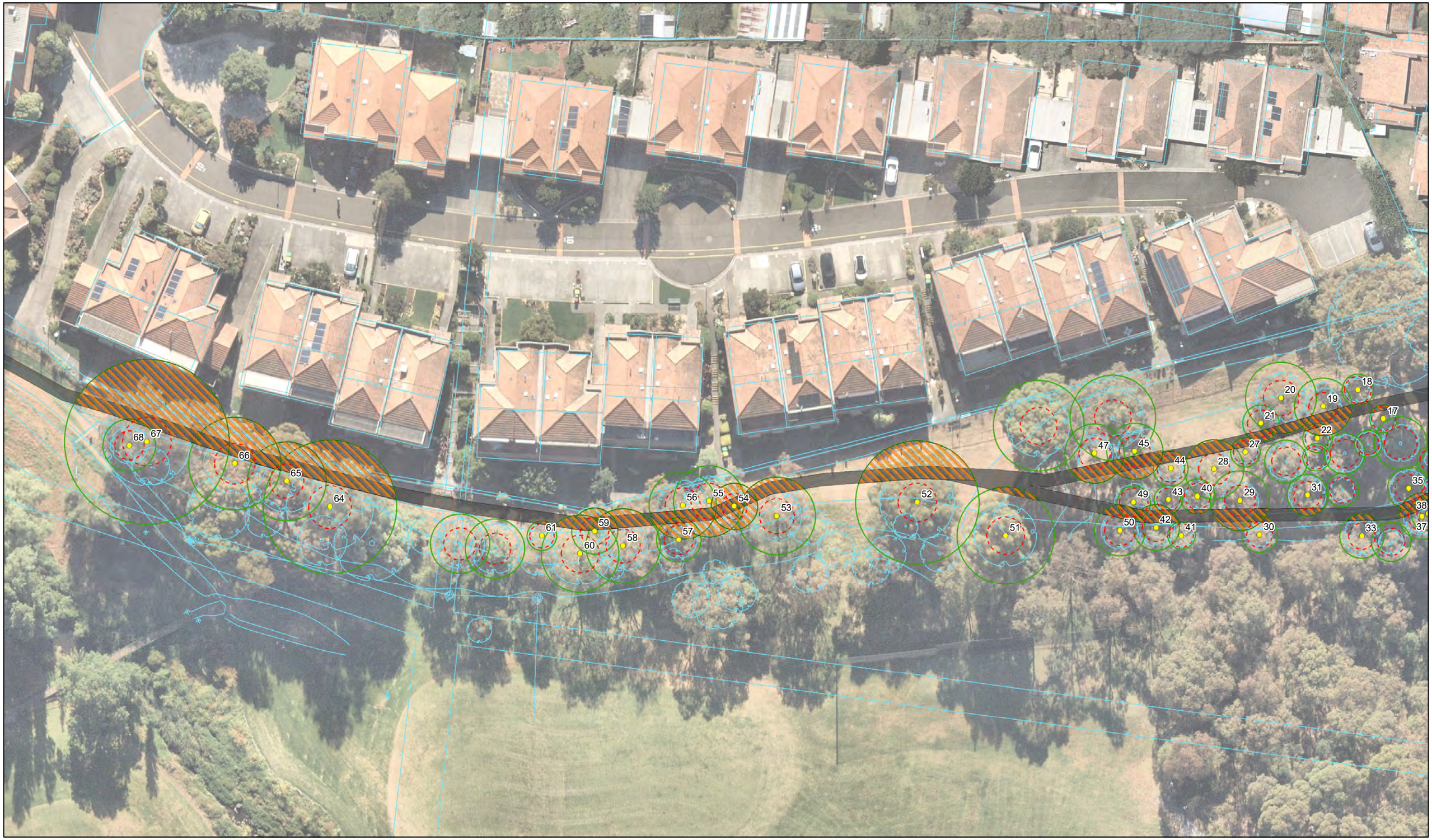
Base information supplied by Nearmap.
Nearmap Image dated: 01/01/2023

Map 1 of 3

SCALE BAR
0 5 10 20 30 m
SCALE 1:500 SHEET SIZE A3

AUTHOR	L. Ainsworth
DATE	29/05/2023
MAP DATUM	GDA 2020 MGA Zone 55

NORTH ARROW



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LEGEND

- Trees
- SRZ
- TPZ
- Encroachment
- Path

Base information supplied by Nearmap.
Nearmap Image dated: 01/01/2023

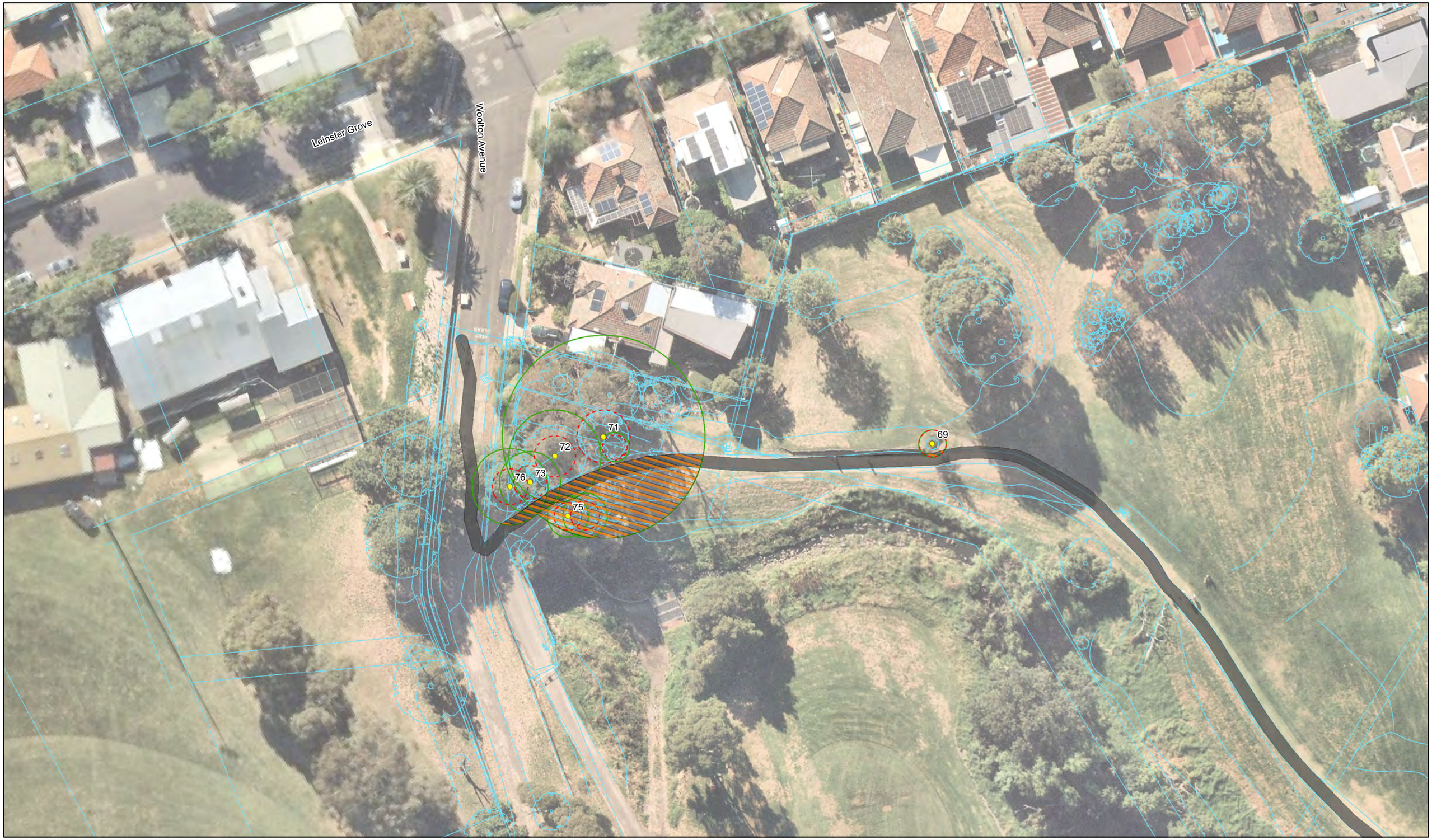
Map 2 of 3

SCALE BAR
0 5 10 20 30 m

SCALE 1:500 SHEET SIZE A3

AUTHOR	L. Ainsworth
DATE	29/05/2023
MAP DATUM	GDA 2020 MGA Zone 55

NORTH ARROW



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Trees, TPZs, SRZs and Proposed Map

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BALWYN VICTORIA 3103

LEGEND

- Trees
- SRZ
- TPZ
- Encroachment
- Path

Base information supplied by Nearmap.
Nearmap Image dated: 01/01/2023

Map 3 of 3

SCALE BAR
0 5 10 20 30 m

SCALE 1:500 SHEET SIZE A3

AUTHOR	L. Ainsworth
DATE	29/05/2023
MAP DATUM	GDA 2020 MGA Zone 55

NORTH ARROW

Appendix 5. Photographic Tree Reports

Tree ID 1

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 9 **Health:** Good
Width (m): 5 **Structure:** Good
DBH (cm): 24 **ULE:** 20+
Dia. @ base (cm): 32

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 2.88 **TPZ encroachment %:** 16
SRZ Radius (m): 2.1 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: ~70cm from edge of existing gravel path

Tree ID 2

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 15 **Health:** Good
Width (m): 9 **Structure:** Fair
DBH (cm): 58 **ULE:** 20+
Dia. @ base (cm): 65

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 6.96 **TPZ encroachment %:** 7
SRZ Radius (m): 2.8 **SRZ intrusion:** No

Encroachment Level: Minor **Outcome:** Retained

Comments:

Tree ID 3

Botanical Name: *Casuarina cunninghamiana*

Common Name River She-oak **Origin:** Australian Native

Height (m): 21 **Health:** Good
Width (m): 14 **Structure:** Fair
DBH (cm): 77 **ULE:** 20+
Dia. @ base (cm): 83

Tree Significance: Significant

Retention Value: High

TPZ Radius (m): 9.24 **TPZ encroachment %:** 2
SRZ Radius (m): 3.1 **SRZ intrusion:** No

Encroachment Level: Minor **Outcome:** Retained

Comments:

Tree ID 4

Botanical Name: *Eucalyptus mannifera*

Common Name Brittle Gum **Origin:** Australian Native

Height (m):	9	**Health:**	Fair
Width (m):	5	**Structure:**	Very Poor
DBH (cm):	48	**ULE:**	0
Dia. @ base (cm):	60		

Tree Significance: None

Retention Value: None

TPZ Radius (m):	5.76	**TPZ encroachment %:**	100
SRZ Radius (m):	2.7	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Lost

Comments: Tree has been ring barked with large saw cut in trunk

Tree ID 5

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	13	**Health:**	Fair
Width (m):	16	**Structure:**	Fair
DBH (cm):	65	**ULE:**	20+
Dia. @ base (cm):	84		

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m):	7.8	**TPZ encroachment %:**	15
SRZ Radius (m):	3.1	**SRZ intrusion:**	No
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Extended low limbs over exitisting foot pad. Casuarina growing from base on southern side

Tree ID 6

Botanical Name: *Casuarina cunninghamiana*

Common Name River She-oak **Origin:** Australian Native

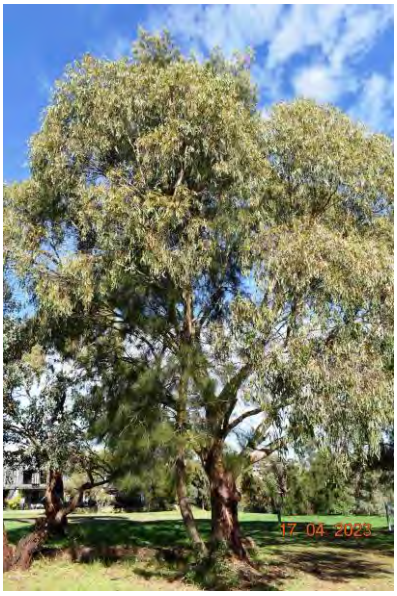
Height (m):	12	**Health:**	Fair
Width (m):	4	**Structure:**	Fair
DBH (cm):	25	**ULE:**	11-20
Dia. @ base (cm):	30		

Tree Significance: Low

Retention Value: Low

TPZ Radius (m):	3	**TPZ encroachment %:**	0
SRZ Radius (m):	2.0	**SRZ intrusion:**	No
Encroachment Level:	None	**Outcome:**	Retained

Comments: Growing from base of adjacent tree



Tree ID 7

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 16 **Health:** Fair
Width (m): 12 **Structure:** Fair
DBH (cm): 68 **ULE:** 20+
Dia. @ base (cm): 88

Tree Significance: Significant

Retention Value: High

TPZ Radius (m): 8.16 **TPZ encroachment %:** 31
SRZ Radius (m): 3.1 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Tree is on lean over path

Tree ID 8

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m): 12 **Health:** Fair
Width (m): 10 **Structure:** Fair
DBH (cm): 53 **ULE:** 20+
Dia. @ base (cm): 53

Tree Significance: Significant

Retention Value: Low

TPZ Radius (m): 6.36 **TPZ encroachment %:** 33
SRZ Radius (m): 2.5 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Located inbetween 2 foot pads. Tree rapidly dying

Tree ID 9

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m): 6 **Health:** Very poor
Width (m): 4 **Structure:** Poor
DBH (cm): 28 **ULE:** 0
Dia. @ base (cm): 33

Tree Significance: None

Retention Value: None

TPZ Radius (m): 3.36 **TPZ encroachment %:** 100
SRZ Radius (m): 2.1 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Lost

Comments: Located inbetween 2 foot pads

Tree ID 10

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	6	**Health:**	Fair
Width (m):	7	**Structure:**	Poor
DBH (cm):	17	**ULE:**	11-20
Dia. @ base (cm):	25		
Tree Significance:	Low		
Retention Value:	Low		
TPZ Radius (m):	2.04	**TPZ encroachment %:**	43
SRZ Radius (m):	1.9	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Trunk on significant lean, poor canopy structure, low branches over western path

Tree ID 11

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	14	**Health:**	Fair
Width (m):	6	**Structure:**	Fair
DBH (cm):	31	**ULE:**	20+
Dia. @ base (cm):	42		
Tree Significance:	Moderately Significant		
Retention Value:	Moderate		
TPZ Radius (m):	3.72	**TPZ encroachment %:**	0
SRZ Radius (m):	2.3	**SRZ intrusion:**	No
Encroachment Level:	None	**Outcome:**	Retained

Comments: Reduction in health. Located 1m from southern path

Tree ID 12

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m):	9	**Health:**	Fair
Width (m):	5	**Structure:**	Fair
DBH (cm):	22	**ULE:**	20+
Dia. @ base (cm):	26		
Tree Significance:	Moderately Significant		
Retention Value:	Moderate		
TPZ Radius (m):	2.64	**TPZ encroachment %:**	33
SRZ Radius (m):	1.9	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Reduction in health. Located 1m from southern path

Tree ID 13

Botanical Name: *Acacia implexa*

Common Name Lightwood **Origin:** Indigenous

Height (m):	6	**Health:**	Fair
Width (m):	5	**Structure:**	Fair
DBH (cm):	14	**ULE:**	11-20
Dia. @ base (cm):	22		
Tree Significance:	Low		
Retention Value:	Low		
TPZ Radius (m):	2	**TPZ encroachment %:**	19
SRZ Radius (m):	1.8	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Growing on lean due to adjacent tree canopy

Tree ID 14

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	7	**Health:**	Fair
Width (m):	4	**Structure:**	Fair
DBH (cm):	20	**ULE:**	20+
Dia. @ base (cm):	29		
Tree Significance:	Moderately Significant		
Retention Value:	Moderate		
TPZ Radius (m):	2.4	**TPZ encroachment %:**	6
SRZ Radius (m):	2.0	**SRZ intrusion:**	Yes
Encroachment Level:	Minor	**Outcome:**	Retained

Comments: Slightly reduced health

Tree ID 15

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	6	**Health:**	Fair
Width (m):	3	**Structure:**	Poor
DBH (cm):	10	**ULE:**	20+
Dia. @ base (cm):	17		
Tree Significance:	Low		
Retention Value:	Low		
TPZ Radius (m):	2	**TPZ encroachment %:**	0
SRZ Radius (m):	1.6	**SRZ intrusion:**	No
Encroachment Level:	None	**Outcome:**	Retained

Comments: Juvenile specimen with kinked trunk

Tree ID 16

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 16 **Health:** Fair
Width (m): 14 **Structure:** Fair
DBH (cm): 32 **ULE:** 20+
Dia. @ base (cm): 46

Tree Significance: Significant

Retention Value: Moderate

TPZ Radius (m): 3.84 **TPZ encroachment %:** 0
SRZ Radius (m): 2.4 **SRZ intrusion:** No

Encroachment Level: None **Outcome:** Retained

Comments:

Tree ID 17

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 6 **Health:** Poor
Width (m): 3 **Structure:** Poor
DBH (cm): 16 **ULE:** 1-5
Dia. @ base (cm): 22

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 2 **TPZ encroachment %:** 15
SRZ Radius (m): 1.8 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Trunk lean with several kinks

Tree ID 18

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Fair
Width (m): 4 **Structure:** Fair
DBH (cm): 19 **ULE:** 20+
Dia. @ base (cm): 28

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 2.28 **TPZ encroachment %:** 3
SRZ Radius (m): 1.9 **SRZ intrusion:** Yes

Encroachment Level: Minor **Outcome:** Retained

Comments: Trunk has minor lean

Tree ID 19

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m):	9	**Health:**	Fair
Width (m):	7	**Structure:**	Fair
DBH (cm):	29 20	**ULE:**	20+
Dia. @ base (cm):	34		

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m):	4.2	**TPZ encroachment %:**	37
SRZ Radius (m):	2.1	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Co-dominant near base and canopy

Tree ID 20

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	13	**Health:**	Fair
Width (m):	11	**Structure:**	Good
DBH (cm):	43	**ULE:**	20+
Dia. @ base (cm):	56		

Tree Significance: Significant

Retention Value: Moderate

TPZ Radius (m):	5.16	**TPZ encroachment %:**	8
SRZ Radius (m):	2.6	**SRZ intrusion:**	No
Encroachment Level:	Minor	**Outcome:**	Retained

Comments:

Tree ID 21

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	8	**Health:**	Fair
Width (m):	6	**Structure:**	Fair
DBH (cm):	22	**ULE:**	20+
Dia. @ base (cm):	28		

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m):	2.64	**TPZ encroachment %:**	27
SRZ Radius (m):	1.9	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Minor decline in health. directly next to foot pad. Visible surface root adjacent in middle of path

Tree ID 22

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Poor
Width (m): 4 **Structure:** Fair
DBH (cm): 14 11 **ULE:** 1-5
Dia. @ base (cm): 23
Tree Significance: Low
Retention Value: Low
TPZ Radius (m): 2.16 **TPZ encroachment %:** 10
SRZ Radius (m): 1.8 **SRZ intrusion:** Yes
Encroachment Level: Minor **Outcome:** Retained

Comments: Declining health. Located 1m from existing foot pad

Tree ID 23

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 5 **Health:** Fair
Width (m): 3 **Structure:** Fair
DBH (cm): 5 4 3 **ULE:** 11-20
Dia. @ base (cm): 18
Tree Significance: Low
Retention Value: Low
TPZ Radius (m): 2 **TPZ encroachment %:** 0
SRZ Radius (m): 1.6 **SRZ intrusion:** No
Encroachment Level: None **Outcome:** Retained

Comments: Minor health decline. Located 50cm from existing foot pad

Tree ID 24

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 9 **Health:** Fair
Width (m): 6 **Structure:** Fair
DBH (cm): 25 **ULE:** 20+
Dia. @ base (cm): 34
Tree Significance: Moderately Significant
Retention Value: Moderate
TPZ Radius (m): 3 **TPZ encroachment %:** 0
SRZ Radius (m): 2.1 **SRZ intrusion:** No
Encroachment Level: None **Outcome:** Retained

Comments: Minor health decline. Located 70cm from existing foot pad

Tree ID 25

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 15 **ULE:** 11-20
Dia. @ base (cm): 21
Tree Significance: Low
Retention Value: Low
TPZ Radius (m): 2 **TPZ encroachment %:** 0
SRZ Radius (m): 1.7 **SRZ intrusion:** No
Encroachment Level: None **Outcome:** Retained

Comments: Minor health decline. Located 50cm from existing foot pad

Tree ID 26

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 11 **Health:** Fair
Width (m): 5 **Structure:** Good
DBH (cm): 26 **ULE:** 20+
Dia. @ base (cm): 34
Tree Significance: Significant
Retention Value: Moderate
TPZ Radius (m): 3.12 **TPZ encroachment %:** 0
SRZ Radius (m): 2.1 **SRZ intrusion:** No
Encroachment Level: None **Outcome:** Retained

Comments: Minor health decline

Tree ID 27

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 18 **ULE:** 11-20
Dia. @ base (cm): 22
Tree Significance: Low
Retention Value: Low
TPZ Radius (m): 2.16 **TPZ encroachment %:** 26
SRZ Radius (m): 1.8 **SRZ intrusion:** Yes
Encroachment Level: Major **Outcome:** Retained

Comments: Minor health decline

Tree ID 28

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m):	13	**Health:**	Fair
Width (m):	9	**Structure:**	Fair
DBH (cm):	27 24	**ULE:**	20+
Dia. @ base (cm):	41		
Tree Significance:	Significant		
Retention Value:	Moderate		
TPZ Radius (m):	4.32	**TPZ encroachment %:**	17
SRZ Radius (m):	2.3	**SRZ intrusion:**	No
Encroachment Level:	Major	**Outcome:**	Retained

Comments:

Tree ID 29

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	7	**Health:**	Poor
Width (m):	2	**Structure:**	Fair
DBH (cm):	16 16	**ULE:**	11-20
Dia. @ base (cm):	40		
Tree Significance:	Low		
Retention Value:	Low		
TPZ Radius (m):	4.32	**TPZ encroachment %:**	33
SRZ Radius (m):	2.3	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Declining health and average structure

Tree ID 30

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	8	**Health:**	Fair
Width (m):	3	**Structure:**	Fair
DBH (cm):	22	**ULE:**	20+
Dia. @ base (cm):	26		
Tree Significance:	Moderately Significant		
Retention Value:	Moderate		
TPZ Radius (m):	2.64	**TPZ encroachment %:**	8
SRZ Radius (m):	1.9	**SRZ intrusion:**	No
Encroachment Level:	Minor	**Outcome:**	Retained

Comments: Edge of unkempt area

Tree ID 31

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Fair
Width (m): 7 **Structure:** Poor
DBH (cm): 25 **ULE:** 11-20
Dia. @ base (cm): 30

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 3 **TPZ encroachment %:** 13
SRZ Radius (m): 2.0 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Trunk on heavy lean over foot pad

Tree ID 32

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 8 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 20 **ULE:** 20+
Dia. @ base (cm): 25

Tree Significance: Low

Retention Value: Moderate

TPZ Radius (m): 2.4 **TPZ encroachment %:** 0
SRZ Radius (m): 1.9 **SRZ intrusion:** No

Encroachment Level: None **Outcome:** Retained

Comments: Co-dominant trunk at 1.6m

Tree ID 33

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Fair
Width (m): 5 **Structure:** Poor
DBH (cm): 14 14 **ULE:** 11-20
Dia. @ base (cm): 28

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 3.24 **TPZ encroachment %:** 9
SRZ Radius (m): 1.9 **SRZ intrusion:** No

Encroachment Level: Minor **Outcome:** Retained

Comments: Heavy lean from base towards path, multi-stemmed

Tree ID 34

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 9 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 24 **ULE:** 20+
Dia. @ base (cm): 30

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 2.88 **TPZ encroachment %:** 0
SRZ Radius (m): 2.0 **SRZ intrusion:** No

Encroachment Level: None **Outcome:** Retained

Comments: Within unkempt area

Tree ID 35

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 8 **Health:** Fair
Width (m): 7 **Structure:** Fair
DBH (cm): 26 **ULE:** 20+
Dia. @ base (cm): 30

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 3.12 **TPZ encroachment %:** 18
SRZ Radius (m): 2.0 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Moderate trunk lean over path

Tree ID 36

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 8 **Health:** Fair
Width (m): 7 **Structure:** Poor
DBH (cm): 16 **ULE:** 11-20
Dia. @ base (cm): 20

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 2 **TPZ encroachment %:** 49
SRZ Radius (m): 1.7 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Moderate trunk lean over path. Wound at base on eastern side

Tree ID 37

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 9 **Health:** Fair
Width (m): 6 **Structure:** Fair
DBH (cm): 28 **ULE:** 20+
Dia. @ base (cm): 32

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 3.36 **TPZ encroachment %:** 32
SRZ Radius (m): 2.1 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Located 40cm from path

Tree ID 38

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 6 **Health:** Fair
Width (m): 5 **Structure:** Poor
DBH (cm): 15 15 **ULE:** 11-20
Dia. @ base (cm): 21

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 2.52 **TPZ encroachment %:** 27
SRZ Radius (m): 1.7 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Co-dominant near base and on lean

Tree ID 39

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 8 **Health:** Fair
Width (m): 4 **Structure:** Fair
DBH (cm): 27 **ULE:** 20+
Dia. @ base (cm): 33

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 3.24 **TPZ encroachment %:** 0
SRZ Radius (m): 2.1 **SRZ intrusion:** No

Encroachment Level: None **Outcome:** Retained

Comments: Within unkempt area

Tree ID 40

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 5 **Health:** Fair
Width (m): 6 **Structure:** Poor
DBH (cm): 21 **ULE:** 11-20
Dia. @ base (cm): 26

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 2.52 **TPZ encroachment %:** 7
SRZ Radius (m): 1.9 **SRZ intrusion:** Yes

Encroachment Level: Minor **Outcome:** Retained

Comments: Stunted growth and poor form

Tree ID 41

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 16 **ULE:** 20+
Dia. @ base (cm): 22

Tree Significance: Low

Retention Value: Moderate

TPZ Radius (m): 2 **TPZ encroachment %:** 1
SRZ Radius (m): 1.8 **SRZ intrusion:** No

Encroachment Level: Minor **Outcome:** Retained

Comments:

Tree ID 42

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 6 **Health:** Fair
Width (m): 10 **Structure:** Fair
DBH (cm): 28 **ULE:** 20+
Dia. @ base (cm): 32

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 3.36 **TPZ encroachment %:** 36
SRZ Radius (m): 2.1 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Edge of unkempt area

Tree ID 43

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 6 **Health:** Fair
Width (m): 3 **Structure:** Fair
DBH (cm): 17 **ULE:** 11-20
Dia. @ base (cm): 20

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 2.04 **TPZ encroachment %:** 10
SRZ Radius (m): 1.7 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments:

Tree ID 44

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 9 **Health:** Fair
Width (m): 7 **Structure:** Fair
DBH (cm): 21 **ULE:** 20+
Dia. @ base (cm): 29

Tree Significance: Moderately Significant

Retention Value: Low

TPZ Radius (m): 2.52 **TPZ encroachment %:** 25
SRZ Radius (m): 2.0 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments:

Tree ID 45

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 7 **Health:** Fair
Width (m): 8 **Structure:** Fair
DBH (cm): 26 22 **ULE:** 20+
Dia. @ base (cm): 40

Tree Significance: Moderately Significant

Retention Value: Low

TPZ Radius (m): 4.08 **TPZ encroachment %:** 39
SRZ Radius (m): 2.3 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: ~30cm from foot pad

Tree ID 46

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 17 **Health:** Fair
Width (m): 12 **Structure:** Good
DBH (cm): 52 **ULE:** 20+
Dia. @ base (cm): 60

Tree Significance: Significant

Retention Value: Moderate

TPZ Radius (m): 6.24 **TPZ encroachment %:** 0
SRZ Radius (m): 2.7 **SRZ intrusion:** No

Encroachment Level: None **Outcome:** Retained

Comments: Declining health

Tree ID 47

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 17 **Health:** Fair
Width (m): 13 **Structure:** Fair
DBH (cm): 36 **ULE:** 11-20
Dia. @ base (cm): 42

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m): 4.32 **TPZ encroachment %:** 28
SRZ Radius (m): 2.3 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Co-dominant at 2m with extended limbs

Tree ID 48

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m): 13 **Health:** Fair
Width (m): 13 **Structure:** Fair
DBH (cm): 44 33 **ULE:** 20+
Dia. @ base (cm): 60

Tree Significance: Significant

Retention Value: High

TPZ Radius (m): 6.6 **TPZ encroachment %:** 0
SRZ Radius (m): 2.7 **SRZ intrusion:** No

Encroachment Level: None **Outcome:** Retained

Comments:

Tree ID 49

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	10	**Health:**	Fair
Width (m):	5	**Structure:**	Fair
DBH (cm):	20	**ULE:**	20+
Dia. @ base (cm):	34		

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m):	2.4	**TPZ encroachment %:**	29
SRZ Radius (m):	2.1	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments:

Tree ID 50

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	7	**Health:**	Fair
Width (m):	8	**Structure:**	Fair
DBH (cm):	23 21	**ULE:**	20+
Dia. @ base (cm):	40		

Tree Significance: Moderately Significant

Retention Value: Moderate

TPZ Radius (m):	3.72	**TPZ encroachment %:**	21
SRZ Radius (m):	2.3	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Edge of unkempt area

Tree ID 51

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m):	18	**Health:**	Good
Width (m):	8	**Structure:**	Fair
DBH (cm):	59	**ULE:**	20+
Dia. @ base (cm):	64		

Tree Significance: Significant

Retention Value: High

TPZ Radius (m):	7.08	**TPZ encroachment %:**	3
SRZ Radius (m):	2.7	**SRZ intrusion:**	No
Encroachment Level:	Minor	**Outcome:**	Retained

Comments: Within unkempt area

Tree ID 52

Botanical Name: *Eucalyptus melliodora*

Common Name Yellow Box **Origin:** Indigenous

Height (m):	14	**Health:**	Good
Width (m):	13	**Structure:**	Fair
DBH (cm):	53 38	**ULE:**	20+
Dia. @ base (cm):	67		
Tree Significance:	Significant		
Retention Value:	High		
TPZ Radius (m):	9	**TPZ encroachment %:**	28
SRZ Radius (m):	2.8	**SRZ intrusion:**	No
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Edge of unkempt area

Tree ID 53

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	17	**Health:**	Fair
Width (m):	13	**Structure:**	Fair
DBH (cm):	47	**ULE:**	20+
Dia. @ base (cm):	53		
Tree Significance:	Significant		
Retention Value:	High		
TPZ Radius (m):	5.64	**TPZ encroachment %:**	19
SRZ Radius (m):	2.5	**SRZ intrusion:**	No
Encroachment Level:	Major	**Outcome:**	Retained

Comments: Edge of unkempt area

Tree ID 54

Botanical Name: *Allocasuarina littoralis*

Common Name Black She-oak **Origin:** Indigenous

Height (m):	7	**Health:**	Fair
Width (m):	6	**Structure:**	Fair
DBH (cm):	20 20	**ULE:**	11-20
Dia. @ base (cm):	26		
Tree Significance:	Low		
Retention Value:	Low		
TPZ Radius (m):	3.36	**TPZ encroachment %:**	100
SRZ Radius (m):	1.9	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Lost

Comments: Trunk co-dominant

Tree ID 55

Botanical Name: *Eucalyptus leucoxylon*

Common Name Yellow Gum **Origin:** Indigenous

Height (m): 16 **Health:** Fair
Width (m): 12 **Structure:** Fair
DBH (cm): 35 25 **ULE:** 20+
Dia. @ base (cm): 57

Tree Significance: Significant

Retention Value: Moderate

TPZ Radius (m): 5.16 **TPZ encroachment %:** 43
SRZ Radius (m): 2.6 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Lost

Comments:

Tree ID 56

Botanical Name: *Eucalyptus leucoxylon*

Common Name Yellow Gum **Origin:** Indigenous

Height (m): 15 **Health:** Fair
Width (m): 12 **Structure:** Fair
DBH (cm): 34 23 **ULE:** 20+
Dia. @ base (cm): 55

Tree Significance: Moderately Significant

Retention Value: Low

TPZ Radius (m): 4.92 **TPZ encroachment %:** 41
SRZ Radius (m): 2.6 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Co-dominant near base

Tree ID 57

Botanical Name: *Allocasuarina littoralis*

Common Name Black She-oak **Origin:** Indigenous

Height (m): 8 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 13 13 **ULE:** 11-20
Dia. @ base (cm): 36

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 3.24 **TPZ encroachment %:** 8
SRZ Radius (m): 2.2 **SRZ intrusion:** No

Encroachment Level: Minor **Outcome:** Retained

Comments:

Tree ID 58

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 15 **Health:** Fair
Width (m): 13 **Structure:** Fair
DBH (cm): 45 **ULE:** 20+
Dia. @ base (cm): 51

Tree Significance: Significant

Retention Value: Moderate

TPZ Radius (m): 5.4 **TPZ encroachment %:** 20
SRZ Radius (m): 2.5 **SRZ intrusion:** No

Encroachment Level: Major **Outcome:** Retained

Comments:

Tree ID 59

Botanical Name: *Allocasuarina littoralis*

Common Name Black She-oak **Origin:** Indigenous

Height (m): 9 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 22 17 **ULE:** 11-20
Dia. @ base (cm): 32

Tree Significance: Moderately Significant

Retention Value: Low

TPZ Radius (m): 3.36 **TPZ encroachment %:** 45
SRZ Radius (m): 2.1 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Lost

Comments: Edge of path

Tree ID 60

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m): 15 **Health:** Fair
Width (m): 9 **Structure:** Fair
DBH (cm): 47 **ULE:** 20+
Dia. @ base (cm): 65

Tree Significance: Significant

Retention Value: High

TPZ Radius (m): 5.64 **TPZ encroachment %:** 12
SRZ Radius (m): 2.8 **SRZ intrusion:** No

Encroachment Level: Major **Outcome:** Retained

Comments:

Tree ID 61

Botanical Name: *Allocasuarina littoralis*

Common Name Black She-oak **Origin:** Indigenous

Height (m):	6	**Health:**	Fair
Width (m):	4	**Structure:**	Fair
DBH (cm):	18	**ULE:**	11-20
Dia. @ base (cm):	23		
Tree Significance:	Low		
Retention Value:	Low		
TPZ Radius (m):	2.16	**TPZ encroachment %:**	6
SRZ Radius (m):	1.8	**SRZ intrusion:**	Yes
Encroachment Level:	Minor	**Outcome:**	Retained

Comments:

Tree ID 62

Botanical Name: *Allocasuarina littoralis*

Common Name Black She-oak **Origin:** Indigenous

Height (m):	10	**Health:**	Fair
Width (m):	6	**Structure:**	Fair
DBH (cm):	36	**ULE:**	20+
Dia. @ base (cm):	42		
Tree Significance:	Significant		
Retention Value:	Moderate		
TPZ Radius (m):	4.32	**TPZ encroachment %:**	0
SRZ Radius (m):	2.3	**SRZ intrusion:**	No
Encroachment Level:	None	**Outcome:**	Retained

Comments:

Tree ID 63

Botanical Name: *Eucalyptus camaldulensis*

Common Name River Red Gum **Origin:** Indigenous

Height (m):	12	**Health:**	Fair
Width (m):	8	**Structure:**	Fair
DBH (cm):	36	**ULE:**	20+
Dia. @ base (cm):	45		
Tree Significance:	Significant		
Retention Value:	Moderate		
TPZ Radius (m):	4.32	**TPZ encroachment %:**	0
SRZ Radius (m):	2.4	**SRZ intrusion:**	No
Encroachment Level:	None	**Outcome:**	Retained

Comments:

Tree ID 64

Botanical Name: *Casuarina cunninghamiana*

Common Name	River She-oak	**Origin:**	Australian Native
Height (m):	18	**Health:**	Fair
Width (m):	13	**Structure:**	Fair
DBH (cm):	81	**ULE:**	20+
Dia. @ base (cm):	86		
Tree Significance:	Significant		
Retention Value:	High		
TPZ Radius (m):	9.72	**TPZ encroachment %:**	28
SRZ Radius (m):	3.1	**SRZ intrusion:**	No
Encroachment Level:	Major	**Outcome:**	Retained

Comments:

Tree ID 65

Botanical Name: *Eucalyptus leucoxylon*

Common Name	Yellow Gum	**Origin:**	Indigenous
Height (m):	14	**Health:**	Fair
Width (m):	12	**Structure:**	Fair
DBH (cm):	48	**ULE:**	20+
Dia. @ base (cm):	50		
Tree Significance:	Significant		
Retention Value:	High		
TPZ Radius (m):	5.76	**TPZ encroachment %:**	36
SRZ Radius (m):	2.5	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments:

Tree ID 66

Botanical Name: *Eucalyptus camaldulensis*

Common Name	River Red Gum	**Origin:**	Indigenous
Height (m):	16	**Health:**	Fair
Width (m):	14	**Structure:**	Fair
DBH (cm):	56	**ULE:**	20+
Dia. @ base (cm):	77		
Tree Significance:	Significant		
Retention Value:	High		
TPZ Radius (m):	6.72	**TPZ encroachment %:**	41
SRZ Radius (m):	3.0	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments:

Tree ID 67

Botanical Name: *Casuarina cunninghamiana*

Common Name River She-oak **Origin:** Australian Native

Height (m): 18 **Health:** Fair
Width (m): 14 **Structure:** Fair
DBH (cm): 72 49 **ULE:** 20+
Dia. @ base (cm): 118

Tree Significance: Significant

Retention Value: High

TPZ Radius (m): 12 **TPZ encroachment %:** 39
SRZ Radius (m): 3.6 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments:

Tree ID 68

Botanical Name: *Casuarina cunninghamiana*

Common Name River She-oak **Origin:** Australian Native

Height (m): 7 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 20 18 **ULE:** 11-20
Dia. @ base (cm): 35

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 3.84 **TPZ encroachment %:** 2
SRZ Radius (m): 2.1 **SRZ intrusion:** No

Encroachment Level: Minor **Outcome:** Retained

Comments:

Tree ID 69

Botanical Name: *Casuarina cunninghamiana*

Common Name River She-oak **Origin:** Australian Native

Height (m): 5 **Health:** Fair
Width (m): 2 **Structure:** Poor
DBH (cm): 7 5 5 **ULE:** 1-5
Dia. @ base (cm): 30

Tree Significance: Low

Retention Value: Low

TPZ Radius (m): 2 **TPZ encroachment %:** 12
SRZ Radius (m): 2.0 **SRZ intrusion:** Yes

Encroachment Level: Major **Outcome:** Retained

Comments: Regrowth from stump

Tree ID 70

Botanical Name: *Casuarina cunninghamiana*

Common Name River She-oak **Origin:** Australian Native

Height (m):	8	**Health:**	Fair
Width (m):	6	**Structure:**	Good
DBH (cm):	18	**ULE:**	20+
Dia. @ base (cm):	24		
Tree Significance:	Low		
Retention Value:	Low		
TPZ Radius (m):	2.16	**TPZ encroachment %:**	0
SRZ Radius (m):	1.8	**SRZ intrusion:**	No
Encroachment Level:	None	**Outcome:**	Retained

Comments:

Tree ID 71

Botanical Name: *Eucalyptus bicostata*

Common Name Eurabbie **Origin:** Australian Native

Height (m):	16	**Health:**	Fair
Width (m):	14	**Structure:**	Fair
DBH (cm):	123	**ULE:**	20+
Dia. @ base (cm):	147		
Tree Significance:	Significant		
Retention Value:	High		
TPZ Radius (m):	14.76	**TPZ encroachment %:**	28
SRZ Radius (m):	3.9	**SRZ intrusion:**	Yes
Encroachment Level:	Major	**Outcome:**	Retained

Comments:

Tree ID 72

Botanical Name: *Casuarina cunninghamiana*

Common Name River She-oak **Origin:** Australian Native

Height (m):	18	**Health:**	Fair
Width (m):	7	**Structure:**	Fair
DBH (cm):	56	**ULE:**	20+
Dia. @ base (cm):	79		
Tree Significance:	Significant		
Retention Value:	High		
TPZ Radius (m):	6.72	**TPZ encroachment %:**	12
SRZ Radius (m):	3.0	**SRZ intrusion:**	No
Encroachment Level:	Major	**Outcome:**	Retained

Comments:

Tree ID 73

Botanical Name: *Pittosporum undulatum*

Common Name Sweet Pittosporum **Origin:** Australian Native

Height (m): 8 **Health:** Good
Width (m): 5 **Structure:** Fair
DBH (cm): 27 25 **ULE:** 11-20
Dia. @ base (cm): 48
Tree Significance: Low
Retention Value: Low
TPZ Radius (m): 4.44 **TPZ encroachment %:** 13
SRZ Radius (m): 2.4 **SRZ intrusion:** No
Encroachment Level: Major **Outcome:** Retained
Comments:

Tree ID 74

Botanical Name: *Acacia implexa*

Common Name Lightwood **Origin:** Indigenous

Height (m): 9 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 27 **ULE:** 11-20
Dia. @ base (cm): 34
Tree Significance: Moderately Significant
Retention Value: Moderate
TPZ Radius (m): 3.24 **TPZ encroachment %:** 0
SRZ Radius (m): 2.1 **SRZ intrusion:** No
Encroachment Level: None **Outcome:** Retained
Comments:

Tree ID 75

Botanical Name: *Acacia implexa*

Common Name Lightwood **Origin:** Indigenous

Height (m): 11 **Health:** Fair
Width (m): 5 **Structure:** Fair
DBH (cm): 25 **ULE:** 11-20
Dia. @ base (cm): 31
Tree Significance: Moderately Significant
Retention Value: Moderate
TPZ Radius (m): 3 **TPZ encroachment %:** 3
SRZ Radius (m): 2.0 **SRZ intrusion:** No
Encroachment Level: Minor **Outcome:** Retained
Comments:

Tree ID 76

Botanical Name: *Fraxinus angustifolia*

Common Name	Narrow Leaf Ash	**Origin:**	Exotic
Height (m):	10	**Health:**	Fair
Width (m):	8	**Structure:**	Fair
DBH (cm):	46	**ULE:**	11-20
Dia. @ base (cm):	57		
Tree Significance:	Moderately Significant		
Retention Value:	Moderate		
TPZ Radius (m):	5.52	**TPZ encroachment %:**	10
SRZ Radius (m):	2.6	**SRZ intrusion:**	No
Encroachment Level:	Minor	**Outcome:**	Retained

Comments:

INTEROFFICE MEMORANDUM

DATE: 31/10/2023

TO: Ben Smith

FROM: Jessica Blade

RE: Northcote Golf Course – Connecting Pathway Development

I have reviewed the supplied arborist report prepared by Ryder Arboriculture and Environment dated 29/05/2023.

The tree protection zone and the method of tree protection must be clearly noted on all plans.

The subject site contains significant vegetation, with no trees located in neighbouring private properties that will be affected by the proposal. The site is used as a 9-hole public golf course and has recently undergone some works to rezone parts of the golf course to a shared park use, this is the reason for the upgrade to the connecting walking tracks so as the public are not walking through the golf course to navigate to the recreation areas of the park. The site is within ESO1 and boarders Merri Creek.

The proposal for the walking paths will look to retain the exsisting trees first and foremost, by avoiding impcact and where that is not possible minimising impcat to the trees. Where a tree must be removed replacment of the tree must be on a 1:2 basis or more and must see the replacment planting use endemic species to Merri Creek as the site is covered by ESO1.

The arborist report has detailed the impcats of the propsed walking track to the trees, however without a set of more detailed construction plans we can only provide general advise that should be taken into account when these plans are being developed. A tree protection management plan (TPMP) will also be required for these works.

Recommendations/Conditions:

- Where the walking track/path is within the TPZ of trees by more than 10% encroachment, the path must be constructed at or above the existing soil level, with permeable materials, and with no trenching or major excavation inside the TPZ of these trees. These works will be closely supervised by the project arborist, to ensure there is no inadvertent impact to the roots of this tree.

- Where the walking track/path is encroaching within the SRZ of any trees at all, the path must be constructed at or above the existing soil level, with permeable materials, and with no trenching or major excavation inside the TPZ of these trees. These works will be closely supervised by the project arborist, to ensure there is no inadvertent impact to the roots of this tree.

- All excavations for the construction of the proposed walking track/path are to be supervised by a suitably qualified and experienced arborist with all root pruning undertaken in accordance with section 9 of AS4373-2007 Pruning of Amenity Trees.

- No tree protection is required for neighbouring trees.

- Tree protection is required for the site trees as indicated in picture above. TPZ fencing to be installed before any works occur on site, including demolition works.

- A qualified arborist must oversee all works in and around Tree Protection Zones (TPZ) for trees 1 to 76.

- All services must be routed outside 'Tree Protection Zones'. If there is no alternative to passing through the protection zone, the local authority and the consulting arborist must be advised in writing on the need for directional boring beneath root zone; this must be maintained at a minimum depth of 45cm in soil depth when inside the TPZ of a retained tree.

- All tree protection zones must be observed according to Australian Standard AS4970-2009 **Protection of trees on development sites**. Tree protection zones are to be shown all plans and must be put in place before any works occur on site.

- All pruning recommended is to be carried out to Australian Standards, AS4373-2007 **Pruning of Amenity Trees**. This work should be supervised or carried out by a qualified arborist.

- Prior to the endorsement of plans, including any related demolition, Tree Protection Management Plan (TPMP) prepared by a suitably qualified arborist, to the satisfaction of the Responsible Authority, must be submitted to and be endorsed by the Darebin City Council. This report must be made available to all relevant parties involved with the site.

- The TPMP must include:

    - a) Details of Tree Protection Zones, as per AS4970-2009, for all trees to be retained on the site and for all trees on neighbouring properties (including public open space trees) where any part of the Tree Protection Zone falls within the subject site;

    - b) Protection measures to be utilised and at what stage of the development they will be implemented;

    - c) Appointment of a project arborist detailing their role and responsibilities;

    - d) Stages of development at which the project arborist will inspect tree protection measures and;

    - e) Monitoring and certification by the project arborist of implemented protection measures.

- Before any works associated with the approved development, a project arborist must be appointed and the name and contact details of the project arborist responsible for implementing the endorsed TPMP must be submitted to the Responsible Authority.

- Any modification to the TPMP must be approved by the project arborist. Such approval must be noted and provided to the Responsible Authority within seven days.

- The TPMP must include a Tree Protection Plan (TPP) in accordance with AS4970-2009 Protection of Tees on Development Sites.

- The TPP must:

    - f) Be legible, accurate and drawn to scale;

    - g) Indicate the location of all tree protection measures to be utilised and;

    - h) Include the development stage (demolition, construction, landscaping) of all tree protection measures to be utilised and;

    - i) Include a key describing all tree protection measures to be utilised.

- All protection measures identified in the Tree Management and Protection Plans must be implemented, and development works undertaken on the land must be undertaken in accordance with the Tree Management and Protection Plans, to the satisfaction of the Responsible Authority.

- Any pruning that is required to be done to the canopy of any tree to be retained is to be done by a qualified Arborist to Australian Standard – Pruning of Amenity Trees AS4373-1996. Any pruning of the root system of any tree to be retained is to be done by hand by a qualified Arborist.

Canopy tree planting

- Where any tree is removed, it must be replaced with two trees of endemic species to Merri Creek. The replacement trees must have a minimum mature height of 8m. At the time of planting these trees are to be from 50L size pots and at least 2m in height.
- A two-year maintenance period must be provided for the replacement tree by the planting contractor, and must include formative pruning, watering, mulching, fertilizing and weed management. Any replacement tree that dies within the two-year maintenance period must be replaced by the contractor and the two-year maintenance period is start a fresh from the planting of the new tree.

Regards
Jessica Blade
Planning Arborist

REPORT ON SAFETY ISSUES

Report Date: 9th December 2022

STRI Australia

APPENDIX K

Northcote Golf Club

Report on Safety Issues on the Golf Course

Version 2 – 21st December 2022

Consultant: Stephen Ridgway

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Date of visit: 6th December 2022 – undertaken by Sam Myott

Visit objective: To review current safety issues to external boundaries from the golf course in its current form

Executive Summary

- STRI has been engaged by Darebin City Council to assess the potential safety implications from existing and proposed golf holes located along the boundaries of Northcote Park golf course.
- The most appropriate guidance has been applied to the golf holes in question to highlight areas at greatest risk from wayward golf shots.
- Existing holes 6 and 7 have been assessed for the potential risks to adjacent residential properties and the new public recreation area.
- The proposed 5th hole has also been assessed to highlight possible safety constraints that should be considered during its design and what knock-on effects to be aware of.
- Mitigation measures have been suggested where necessary to reduce risks as far as is practical to golf course and park users

Introduction

This report has been compiled by Stephen Ridgway (Author) of STRI Ltd for Darebin City Council (Client).

Stephen Ridgway is a Golf Course Architect and Senior Design Consultant for STRI Ltd. He has a MSc in Golf Course Architecture from Heriot-Watt University, Edinburgh and is a member of the European Institute of Golf Course Architects (EIGCA). Stephen has been designing golf courses and practice facilities for over 18 years and during this time has conducted several safety audits and reports for golf clubs.

A number of layout/design changes are proposed at Northcote Park golf course, which is owned and operated by the client, due to the release of the southern section of the course for public recreation. This report was requested by the client to better understand the safety issues posed to adjacent residential properties, to members of the public and to golfers by the existing and remodelled 5th, 6th and 7th holes.

Current Design Safety Guidance

Golf course architects and their organisations have not adopted any specific design and safety standards for a golf course layout. Documents typically provide general recommendations and strongly emphasise the importance of site-specific design criteria and the use of an experienced and reputable golf course architect. However, there have been a few guidelines produced which will be referenced in the following pages.

In 2002, the EIGCA produced a report[1] for exclusive use by its members to aid them when laying out a golf course. This report suggested a basic framework for laying out of a golf course by providing some basic principles for good design practice. Because each golf hole as well as each golfer is different, these principles were not 'hard and fast' rules but rather guidelines which relied upon the experience of the golf course architect to layout the golf holes as safely as reasonably practical.

The following diagrams are of greatest relevance to the situations at Northcote Park GC.

Basic framework for a golf hole parallel to a boundary (measurement in mtrs.)

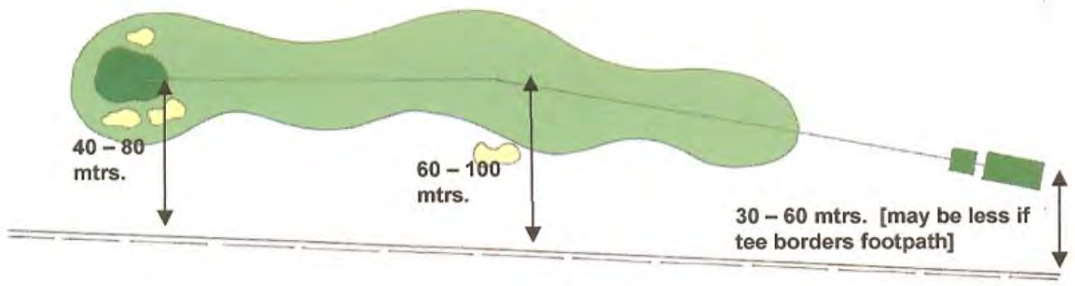

Fig. 1

Note: A hole played parallel to a boundary should wherever possible be played with the danger on the left side of the hole i.e. on the hook side for the right-hander. [During a survey on site it was noted that the percentages of left-handers on a given day seemed to vary from 7% to 9%, a comparatively low percentage compared to that of right-handers. It was also interesting to observe that many of the left-handers surveyed tended to pull the ball to the right of the target.]

Note: If a hole is laid out parallel to an unprotected boundary then generally the tee should be moved away from the boundary as suggested above.

Figure 1 – extract from EIGCA basic design principles report referencing golf holes played parallel with a boundary

The diagram (Fig. 1) illustrates that a boundary should be a minimum of 60-100 metres from the centre line of the hole. The variation depends upon the boundary; for instance, a highway is considered a much more sensitive boundary than an open field and should be afforded a greater safety margin.

With regards left and right-handed players; as in life, the predominance is for golfers to be right-handed and many left-handers also learn to play right-handed. There is also a predominance for right-handed golfers to slice the golf ball (i.e. left to right) and for left-handers to hook the ball (i.e. left to right). This implies that the right-hand side of a golf hole is the side that will see the most 'action'.

Another study into safety was carried out by the Canadian golf course architect, Dr Michael Hurdzan in the 1990's[2]. The diagram below (Fig. 2) illustrates some of the safety elements he uses when laying out a golf course.

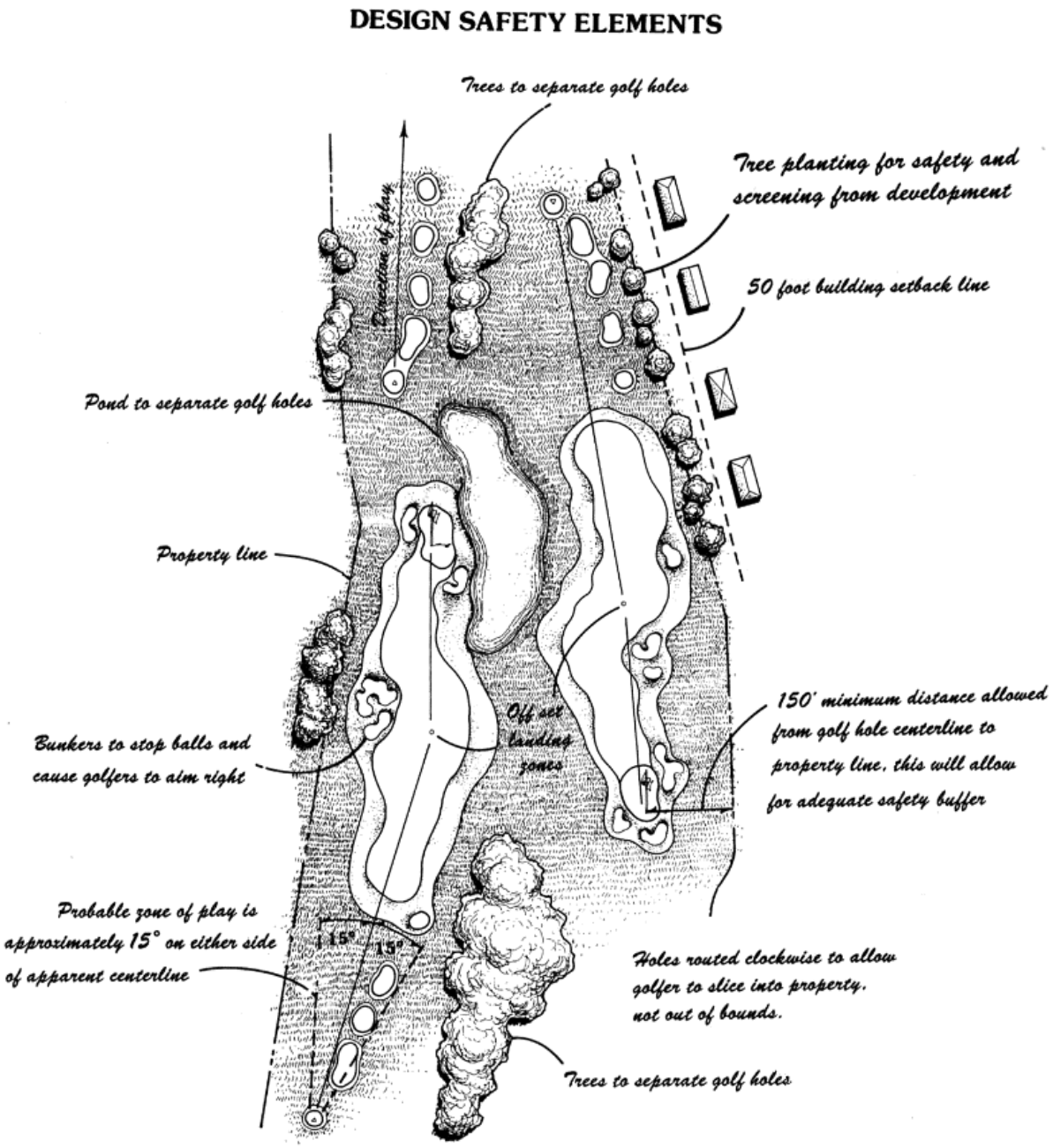

Figure 2 – extract from Dr. Michael Hurdzan's basic design principles taken from his book Golf Course Architecture.

Of most relevance to this report is to the bottom left of the figure showing a 15 degree *'probable zone of play'* from the centre line of the hole.

Both sets of guidance are broadly the same and are helpful for judging relative safety parameters but there are other variables such as prevailing wind, trees, location of hazards which must also be taken into account when assessing the safety of a golf hole and this is where the architect's knowledge and experience must be taken into account.

The Hurdzan guidance and another publication produced by PGA Design Consulting Ltd[3] found that 92% of golf balls finish within the *'zone of play'* (i.e. 15 degrees either side of the ideal line of play). Depending upon the sensitivity of the boundary and the frequency of use (i.e. number of balls hit), this figure may be unacceptably low.

In terms of netting, the EIGCA guidance states the following –

'If golf holes are laid out correctly then the need for fencing is greatly minimised and should not generally be required. However, there may be instances where additional fencing is seen as further security against a particularly sensitive boundary or indeed demanded by planning authorities, at least until a thick screen of planting is established. Where concern is expressed regarding shots from tee to fairway then protective fencing should be located by the tee, and as close to the tee as possible.

If fencing by a tee is to be installed then its height should not be less than 7-8 metres above that of the level of the tee, and then taken some distance beyond the edge of the particular tee. Fencing will not catch the very poor skied or high sliced shot – what it will do is catch the pulled, topped shot.'

Where fencing near the tee is not possible but locating it along the problem boundary is,

'the height of the fencing needs to be related to the possible height of the golf ball in flight, possibly in excess of 25m. This would be enormously costly and unsightly and thus all attempts should be made to find an alternative solution'.

In relation to guidance for laying out adjacent golf holes and features, the following figures (3 and 4) are of the most relevance.

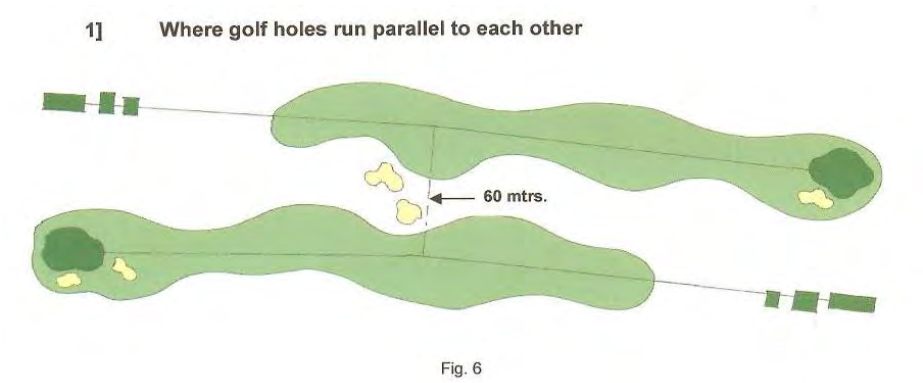

Fig. 3 – Parallel holes (Extract from EIGCA guidelines)

Fig. 4 – Adjacent greens and tees (Extract from EIGCA guidelines)

Fig. 5 – Existing 7th Hole – Safety

Northcote Park – 7th Hole

A short par 4 which can be played like a par 3 for most longer hitters. Bracken Creek traverses the hole about half-way down the fairway and the green is protected by bunkers short and left. Trees flank both sides of the hole.

There is some existing netting to the right of the tees. This extends for 40m and is 10m high. The netting is positioned very close to the right side of the tee and appears to be in good condition.

As can be seen from the illustration to the right (Fig. 5), the eastern boundary line and residential properties sit outside the 15 degree 'zone of play' and could be regarded as being 'as safe as reasonably practical'. The addition of the netting supplements this and affords an extra 'layer' of protection. The probability of a golf ball impacting on a neighbouring property is felt to be negligible.

The approximate boundary line of the new public park area does appear to encroach slightly into the 'zone of play' of the 7th hole although the line of the proposed footpath remains outside of it. The existing netting should still provide good protection but some additional tree and shrub planting from the end of the netting to the bridge over the creek would offer increasing protection as it matures. However, the probability of someone being struck by a golf ball is marginally higher than for the adjacent properties and the severity much greater.

There is also a slight internal safety issue to the left of the hole with the tees on the 4th hole falling inside the 'zone of play', particularly for golfers trying to drive the green. Whilst offering a degree of protection, the intervening trees prevent intervisibility between the two holes, reducing awareness of other golfers playing on the course.

Figure 6 (below) – 7th tee with 'ball-stop' netting to right

Figure 7 (below) – looking back towards 7th tee illustrating height of 'ball-stop' netting

Northcote Park – 6th Hole

Figure 8 (above) – aerial view of 6th hole showing 'zone of play' and possible boundary with new public area

This short downhill par 3 again is flanked with trees with a bunker short right of the green. The hole currently runs parallel to the existing 5th hole to the left (south) but this hole is due to be decommissioned to make way for a public park.

The approximate line of the new park boundary is illustrated by the red dashed line on the image to the left (Fig. 8) but it is expected to be a 'soft' boundary consisting of new tree and shrub planting. The boundary and new footpath also run across the rear of the 6th tees so it will need to be reduced in size to accommodate this.

The image also shows where the 15 degree 'zone of play' lies for the 6th hole. However, the tee is also raised quite a way above the green and surrounds (see Figs. 9 and 10) which will cause a golf ball to travel slightly further than for a level hole, and potentially further in the wrong direction.

The additional planting along the proposed boundary to the left of the hole will bolster what is currently there and provide a stronger buffer between the two although it's efficacy is questionable given the elevation change.

A short section of netting could be erected to the left of the tee but the elevation change means that any netting too far beyond the front of the tee will need to be very substantial to be effective. If possible, locations where members of the public are likely to spend extended periods of time, i.e. footpaths, benches etc, should be sited as far away from the 6th hole as possible to minimise the risk to park users.

The bunker short right of the green likely encourages golfers to aim further left to avoid it. It is also situated across the natural walk-off area to the next hole. By relocating this bunker to the opposite side of the green

it will shift the focus of more golf shots to the right and away from the boundary and also reduce the amount of wear experienced to the right side of the green.

By altering the bunkering, strengthening the planting along the line of the proposed boundary to the left, and avoiding infrastructure being placed close to the boundary it is considered the probability of a member of the public being struck by a wayward golf ball is low.

Figure 9 is a view from the 6th tee down towards the green and highlights the elevation change. The bunker short right of the green focusses tee shots further left.

Figure 10 is a view back towards the 6th tees from the fairway and again, highlights the change in elevation down the line of the hole. The proposed footpath will run in front of the housing across the back of the tee.

5th Hole

Figure 11 – aerial view of proposed 5th hole. Indicative layout shows 'zone of play', possible boundary with new public area (red dashed line) and existing overhead powerlines (yellow zig-zag lines)

The current 5th hole is to be decommissioned to allow the creation of the new public park area to the south of the golf course. So a replacement 5th hole is proposed between an avenue of trees between the current 4th and 6th holes (see Fig. 11 left). This avenue once formed the line of a much longer 7th hole but this was shortened a number of years ago for safety reasons. The new 5th hole will be a par 3 hole but its design has not yet been finalised so the figure to the left is merely indicative.

The designer should be conscious of the distance beyond the proposed green to the 7th tees to avoid creating a safety issue, particularly as most golfers are likely to wait to the left side of the tee. The EIGCA guidance (Fig. 4) suggests a 30-40m buffer between a green and the following tee, although this should be increased slightly when the holes are not in sequence. Care should also be taken when positioning hazards so that they do not pose a safety hazard to the tee, footpath users or properties beyond.

In this position too, the new 5th green is in close proximity to the landing area for the 4th hole (see Fig. 3) although, with the hole being a left to right dog-leg, most errant drives are likely to end up on the other side of the fairway. Whilst the intervening trees do provide a degree of protection, they also obscure the green from the tee so golfers will be unaware of the danger of a stray shot, struck in this direction.

The site for the proposed 5th tees is also in quite close proximity to the 4th

green/approach. This situation is worsened by the trees along the right side of the 4th fairway which forces golfers to aim further left to avoid them, bringing them closer to the proposed 5th tees.

A potential design solution exists whereby the 4th hole could be realigned more to the west. This would resolve the safety issues to both the proposed 5th green and 5th tees and make the creek more of a feature of this hole. It would however require the removal of some trees to make way for the realigned fairway but additional tree planting to offset the loss could be carried out on the outside of the new dog-leg which would also serve to better protect the new 5th green.

Consideration should also be given to the access route from the 6th green to the 7th tees to avoid the potential for golfers to stray too close to the 5th hole. Repositioning the bunker on the 6th as outlined earlier, will assist with this, allowing golfers to exit the 6th green further away from the line of the 5th hole. A suitable route for new paths between the 6th green and 7th tees and between the 5th green and 6th tees should be decided upon on site.

Depending upon the height of the overhead powerlines, the new 5th tees should not be directly underneath them as this could be hazardous during construction. Based upon the approximate boundary line as shown on the plan, the angle from the 5th tee to the public park is sufficient to ensure a properly struck but wayward shot will not be a danger. However, a mis-struck shot off the 'toe' of the club could result in a golf ball shooting low and fast almost at right angles to the line of play so installing lower fencing or netting to prevent this would be advisable.

Figure 12– View of proposed 5th hole from potential tee location

Figure 13 – View of potential 5th green location with existing 7th tees beyond

This report should be issued to the chosen designer for them to fully understand the current safety issues on the golf course, newly arising impacts based on the changes being proposed to make way for the new public park and the potential impacts of their design both internally to other golfers and greens staff and externally to park users and the surrounding residential property. The recommendations made in this report to mitigate the risks are intended to be fairly simple and practical to implement but there may be other options available that may be equally or more effective but come with much greater cost and /or more disruption. All adopted mitigation measures should be in place prior to opening up the park to the public.

Bibliography

1) *Indicative Working Design Considerations For The Laying Out Of Golf Courses, European Institute of Golf Course Architects (EIGCA) – Feb 2002*

2) *Golf Course Architecture, Dr. Michael J Hurdzan – 1996 – Sleeping Bear Press*

3) *Golf Course Design Safety Guidelines, PGA Design Consulting Ltd – July 2008*