ARBORICULTURE & ENVIRONMENT

Yan Yean Road Upgrade – Stage 2:
Kurrak Road to Bridge Inn Road

Technical Report C
Arboriculture Assessment

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1. Introduction

Major Road Projects Victoria (MRPV) proposes to duplicate Yan Yean Road from Kurrak Road to Bridge Inn Road as part of the Yan Yean Road (Stage 2) Upgrade (the project).

On 14 October 2018, the Minister for Planning decided that an Environment Effects Statement (EES) is required under the *Environment Effects Act 1978* (EE Act) to assess the potential environmental effects of the project. The EES process provides for identification and analysis of the potential environment effects of the project and the means of avoiding, minimising and managing adverse effects. It includes public involvement and allows stakeholders to understand the likely environmental effects of the project and how they will be managed.

The Arboricultural assessment report has been prepared for the EES in accordance with the Environmental Performance Requirements (Code No. AR1, AR2, AR3 & AR4 and Risk No. 3, 23, 43 & 63) and Scoping Requirements released by the Minister for Planning in June 2019.

1.1 Background

Yan Yean Road is a primary north-south arterial road and connects the growth suburb of Doreen, with major east-west arterials such as Bridge Inn Road, Kurrak Road and Diamond Creek Road. The road runs through the townships of Yarrambat and Plenty and connects with established areas of Diamond Creek and Greensborough. There is a high demand for north-south travel from Doreen and surrounding towns to established northern suburbs for employment and services.

Stage 1 of the Yan Yean Road upgrade (Diamond Creek Road to Kurrak Road) was completed in 2019, and construction on Stage 2 (this project) is due to be completed by 2025.

1.2 Project Description

The project would duplicate a 5.5km portion of Yan Yean Road between Kurrak Road and Bridge Inn Road increasing the existing two lanes to four lanes (comprising two lanes in each direction). The design speed along Yan Yean Road is 70km/h, with the exception of north of Bridge Inn Road which is 80km/h. The design for the project has 3.5m wide lanes with the majority of the project using a 2.2m wide central median. The cross section was adopted in design due to various constraints ranging from road safety issues, steep and rolling terrain, high cut and fill batters and subsequent retaining walls at certain locations, as well as seeking to limit impacts to existing properties, local accesses and trees along Yan Yean Road.

The project will include:

- two new roundabouts (at Heard Avenue, and Youngs Road)
- five new signalised intersections (Bannons Lane, Jorgensen Avenue, North Oatlands, Orchard and Bridge Inn Roads)
- upgrades to one existing signalised intersection, including an additional right hand turning lane, slip lane, and traffic island (Ironbark Road)
- new street lighting at all intersections, road signage and landscaping.

The project will also include a new 3m wide shared user path on the western side and 1.2 m wide footpath on the eastern side of Yan Yean Road. The paths link Diamond Creek to Doreen and would improve safety and connectivity for pedestrians and cyclists.

Continuous safety barriers would run along the project's length and are proposed in the median and behind outer kerbs along the mid-block sections of the carriageways. The project area and key project components are shown in Figure 1.

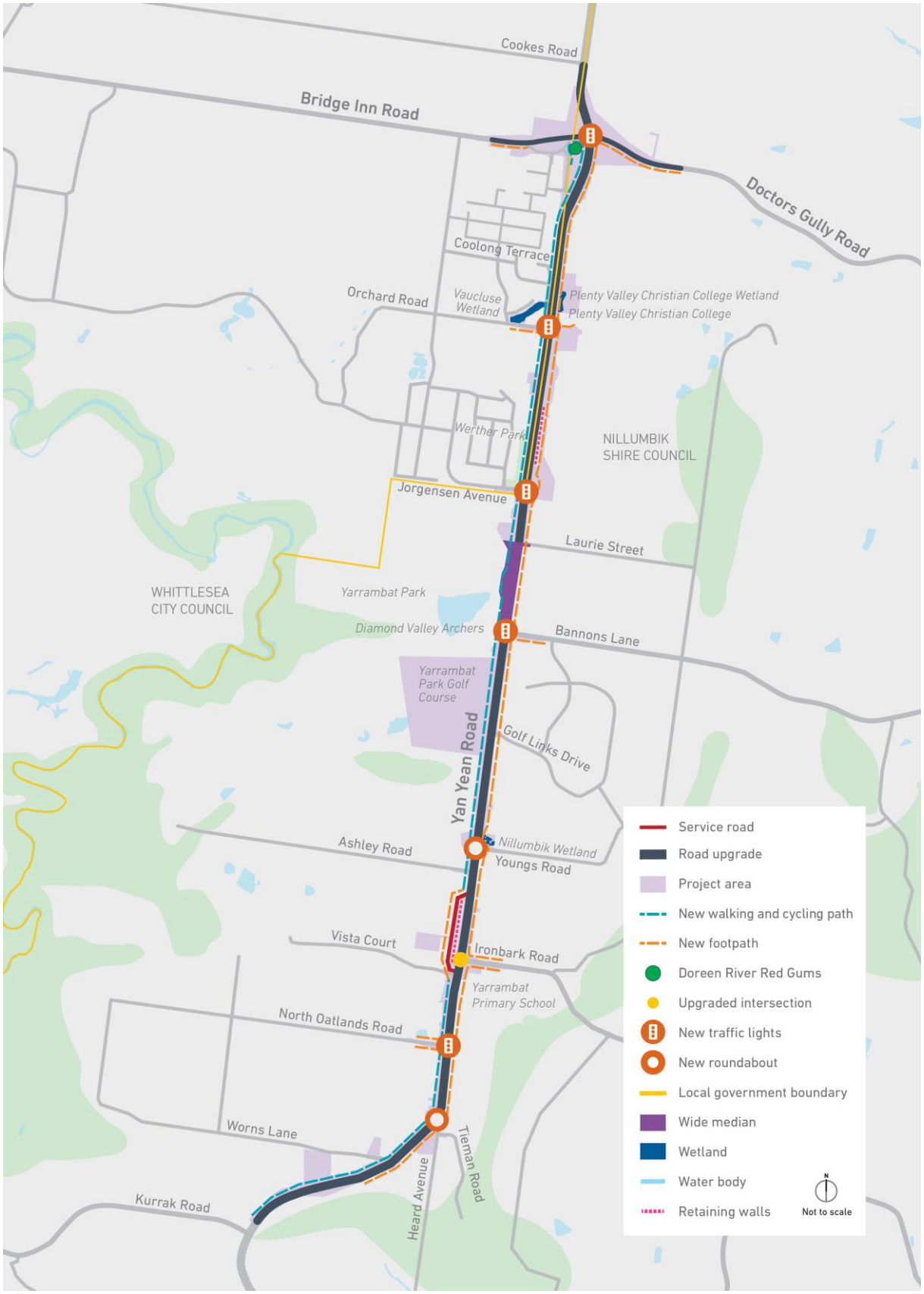
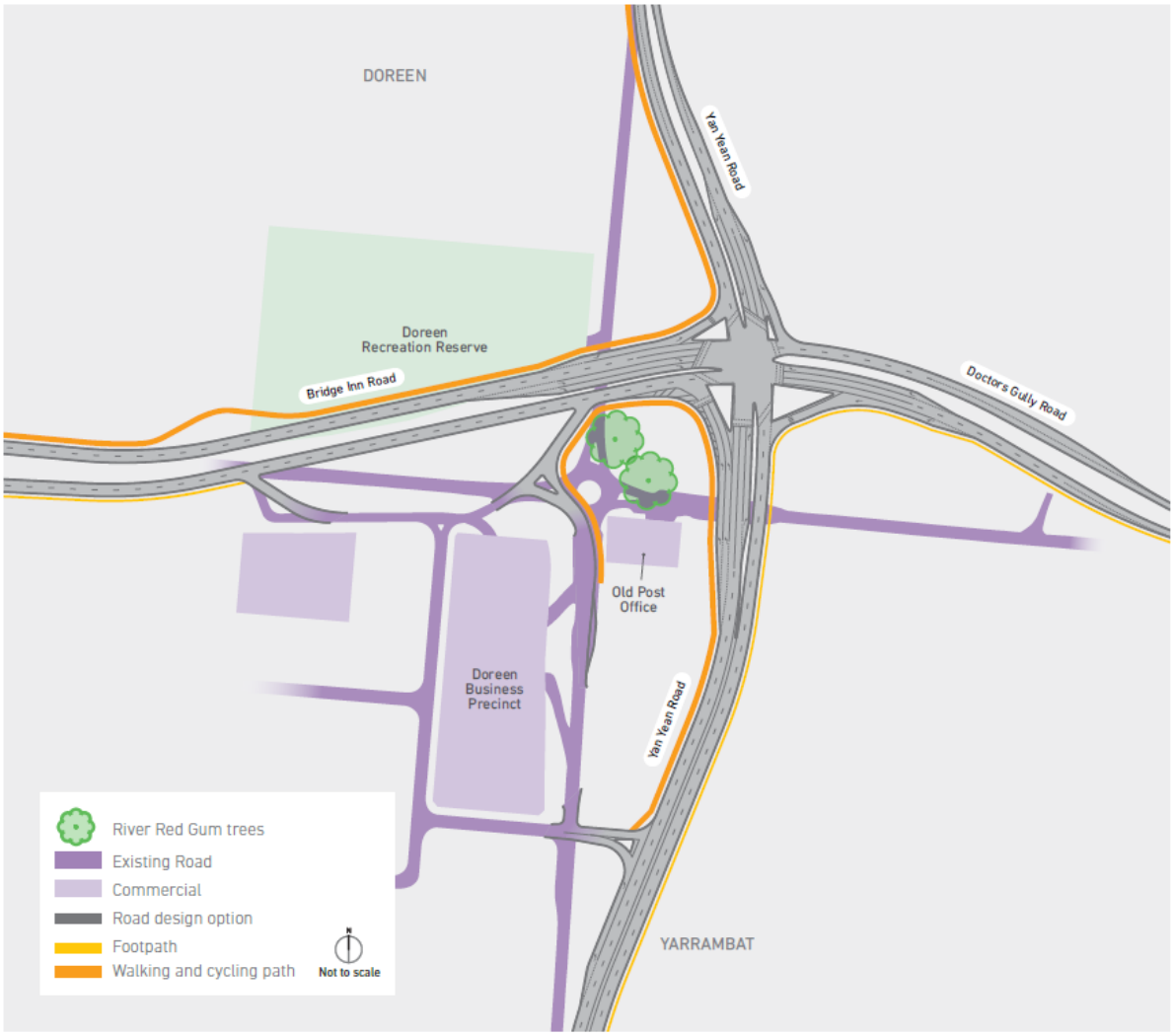


Figure 1: Project area.

1.2.1 Design Alternatives-Bridge Inn Road Intersection

The Yan Yean / Bridge Inn / Doctors Gully Road intersection has been designed to retain the two Doreen River Red Gums, General Store and Pet Supply/Stockfeed business situated adjacent to the current Doctors Gully and Yan Yean Road intersection by shifting the whole intersection to the north east (Figure 2). This intersection design has been developed following community consultation and in response to arboricultural advice on the Doreen River Red Gums.



For illustrative purposes only and subject to change

Figure 2: Bridge Inn Road intersection design.

1.2.2 Construction Activities

Proposed construction activities would likely be standard road construction activities to be undertaken in accordance with the Environmental Performance Requirements for the project. These construction activities would include:

- tree clearance, vegetation pruning and removal
- establishment of construction site compounds
- clearing and grubbing, temporary sediment and erosion control works
- establishment of environmental and traffic controls
- earthworks, including:

  - remediation of any existing contamination and removal of any hazardous material
  - protecting and relocating services
  - widening of existing rock cuttings (approximately 750m of existing cut along the project would be widened by approximately 20m)
  - new cuttings (approximately 1300m of new rock cut would be required to a width of approximately 5m along the project)
  - bulk earthworks and haulage.
- civil and structure works, including:
  - roundabouts and intersection upgrades
  - shared user path and pedestrian path construction and connections
  - retaining walls
  - drainage works
  - pavement works.
- 30-36m high fence along the edge of the Yarrambat Park Golf Course to avoid golf ball collisions with pedestrians, cyclists or vehicles
- traffic management systems and landscaping.

1.3 Project Objectives

The project aims to improve travel times and reliability to and from growing residential areas in Doreen and Mernda, enhance north-south travel in the area, and improve safety along the corridor. The objectives of the project are set out below:

To improve road safety: The project will achieve this by isolating road users from hazards and improving access control through signalised intersections. Congestion and the complex road environment (poor sight lines due to undulating linear / perpendicular grades and adjacent terrain) are presently contributing to the poor safety record on Yan Yean Road.

To improve the customer experience: The project will achieve this by improving access, improving network connectivity, opportunities for active transport, and providing more road capacity.

To improve network efficiency: The project will achieve improved traffic flow and a reduction in travel times by increasing road capacity and reducing congestion.

To maintain environmental and amenity values: The project will achieve this by managing environmental effects to acceptable levels and ensuring that impacts are avoided, minimised and mitigated to the extent practicable.

2. EES Scoping Requirements

The *Scoping Requirements for Yan Yean Road (Stage 2)* Upgrade Environment Effects Statement (June 2019) have been prepared by DELWP on behalf of the Minister for Planning. The Scoping Requirements set out the specific environmental matters to be investigated and documented in the EES, which informs the scope of the EES technical studies. The following matters of the Scoping Requirements are relevant to the arboricultural impact assessment:

Draft evaluation objective

To avoid or minimise the adverse effects on social and cultural values, including landscape values, Aboriginal and historical cultural heritage values, and remnant, planted and regenerated vegetation, and to maximise the enhancement of these values where opportunities exist.

Key issues

- *Potential for adverse impact on local amenity including visual impact, such as through reduction in canopy cover.*
- *Potential adverse effects on urban landscapes that provide a range of functions (e.g. visual amenity, cooling from vegetation and shade).*

Existing environment

- *Identify the cultural and social value of trees within the project area and determine the existing amenity, cultural and ecological services value of the trees that may be affected by the project.*
- *Identify key landscape features and visual amenity values, as provided by trees, including urban landscape character, canopy cover, form, appearance, aesthetics and function.*

Likely effects

- *Assess the potential direct and indirect effects of the project on arboriculture elements (including remnant, planted, regenerated and large old trees).*
- *Assess likely effects on visual amenity values, as provided by arboriculture, including through use of photo-montages, sections and analysis drawings or other suitable methods for depicting predicted landscape changes, particularly from key viewing points.*

Environmental management framework (EMF) *Management measures proposed in the EES to address specific issues, including commitments to mitigate adverse effects and enhance environmental outcomes should be clearly described in the EMF. The EMF should describe proposed objectives, indicators and monitoring requirements, including for (but not limited to) managing or addressing:*

- *tree retention*

Additional technical reports, including the Landscape Character and Visual Impact Assessment, Biodiversity Impact Assessment, Aboriginal Cultural and Historic Heritage Impact Assessment and Social and Cultural Value Impact Assessments will also address the scoping requirements in relation to cultural values. The EMF will outline how potential adverse effects on arboricultural values will be avoided, minimised or mitigated.

3. Method

Trees were visually assessed from all sides where practical. Initial assessment of trees within or near the project boundary were completed between 16 November and 21 December 2017. Data for the project is reflective of the time when it was collected and it is recognised that as time passes, the trees' health, structure, useful life expectancy (ULE) and dimensions will change due to environmental, abiotic and biotic factors. As the project scope changed, additional trees were assessed between 10 March and 4 April 2020.

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)
- Largest stem diameter
- Health
- Structure
- ULE
- Tree significance
- Retention value
- Presence of Hollows (5x15cm)
- Comments

For all tree assessment descriptors, see Appendix 1.

The assessed trees were located using differentially corrected Global Navigation Satellite System (GNSS). Where possible trees have been aligned to match the feature survey. The trees were 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.

Tree assessments between Worns Lane and Kurrak Road had already been completed by a third party and the supplied tree data has been incorporated into this report as requested. Third party trees were given with ID number between 4,501 and 5,049. The quality or accuracy of the additional data has not been tested or audited and C&R Ryder Consulting does not warrant its accuracy.

Definition of a Tree

The definition of a tree for assessment included:

- All trees planted in streets and reserves of an amenity nature. This included all street trees irrespective of size and all trees in parks that were not bushland. For the purpose of the report all trees in this category had the potential to exceed 3m in height at maturity.
- Semi-mature and mature trees in bushland, unmanaged areas, fence lines etc. In bushland areas, not all specimens that could exceed 3m were included as the number of very small saplings would have made the dataset exceptionally large. Where there were few, all were collected, where there were many a representative proportion was collected.
- In general, 1-2m tall saplings in bushland areas were not assessed as they would be dealt with as part of a patch of vegetation.

4. Site Map

The subject site is 5.5km length section of Yan Yean Road from Kurrak Road to Bridge Inn Road. The updated project boundary is shown in Figure 3.

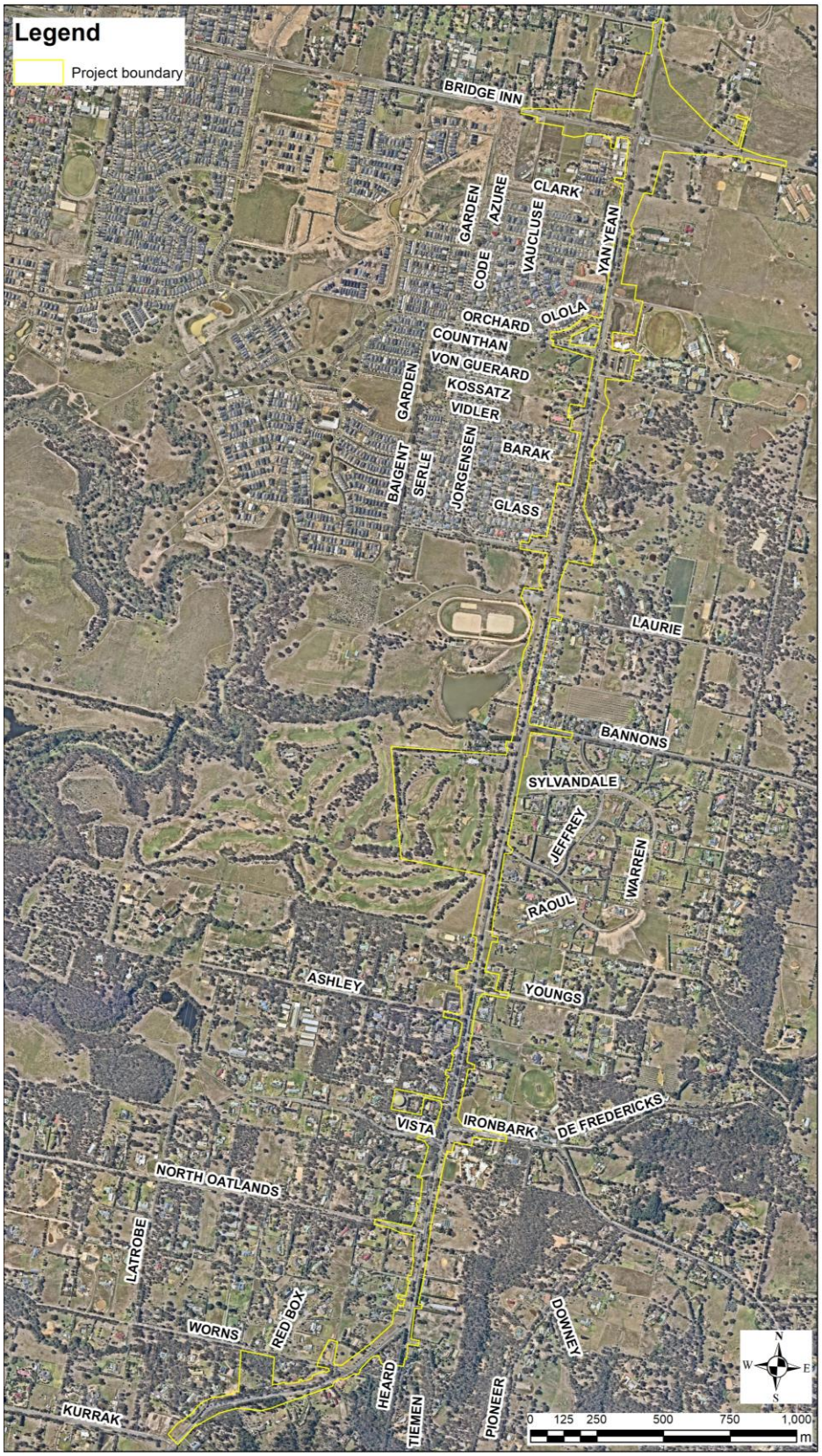


Figure 3: Project location overview.

5. Tree Details

6,735 trees were assessed along Yan Yean Road within the project boundary between Bridge Inn Road and Worns Lane. Data previously collected by a third party for 549 trees from Worns Lane to Kurrak Road were incorporated into the assessment report as requested by the client.

In total, 7,284 trees were assessed within and around the project boundary. Since the commencement of initial tree data collection, 253 trees (out of 7,284) are understood to have been removed through various development until now. The tree data have been revised to reflect the past clearance of the 253 assessed trees and the assessment summary for remaining 7,031 trees, is presented in this report. About 53% of the assessed tree population are indigenous species, 26% are Australian native and 21% are exotic trees. Photographic tree reports are provided in Appendix 4.

49% of the tree population comprised of only 6 tree species including Red Box *Eucalyptus polyanthemos*, Long-leaved Box *Eucalyptus goniocalyx,* Leyland Cypress *x Cuprocyparis leylandii,* Red Stringybark *Eucalyptus macrorhyncha,* Monterey Pine *Pinus radiata,* and Yellow Box *Eucalyptus melliodora* (Table 1).

Table 1: Top 18 tree species at the subject site

Botanical Name	Common Name	Origin	Count	% of population
Eucalyptus polyanthemos	Red Box	Indigenous	1,223	17%
Eucalyptus goniocalyx	Long-leaved Box	Indigenous	931	13%
× *Cuprocyparis leylandii*	Leyland Cypress	Exotic	481	7%
Eucalyptus macrorhyncha	Red Stringybark	Indigenous	277	4%
Pinus radiata	Monterey Pine	Exotic	263	4%
Eucalyptus melliodora	Yellow Box	Indigenous	247	4%
Eucalyptus camaldulensis	River Red Gum	Indigenous	239	3%
Acacia pycnantha	Golden Wattle	Indigenous	192	3%
Pittosporum undulatum	Sweet Pittosporum	Native	187	3%
Exocarpos cupressiformis	Cherry Ballart	Indigenous	185	3%
Eucalyptus leucoxylon	Yellow Gum	Native	156	2%
Corymbia maculata	Spotted Gum	Native	133	2%
Melaleuca armillaris	Giant Honey Myrtle	Native	123	2%
Acacia melanoxylon	Blackwood	Indigenous	119	2%
Acacia mearnsii	Black Wattle	Indigenous	118	2%
Acacia baileyana	Cootamundra Wattle	Native	112	2%
Cupressus macrocarpa	Monterey Cypress	Exotic	109	2%
Eucalyptus sideroxylon	Red Ironbark	Native	104	1%
	Other species		1,832	26%
	Total		7,031	

Approximately 30% of the population belongs to two indigenous eucalypt species, Red Box *Eucalyptus polyanthemos* and Long-leaved Box *Eucalyptus goniocalyx* (Figure 4).

- Red Box *Eucalyptus polyanthemos* is not usually a large tree, being generally less than 20m tall. This tree occurs throughout a large part of Victoria and extending into New South Wales. Red Box is essentially a woodland tree, but also occurs in dry forest country, particularly on stony slopes and on heavier soils (Kelly, Chippendale & Johnson 1969).

- Long-leaved Box *Eucalyptus goniocalyx* is a small to medium-sized, single or multi-stemmed tree indigenous to much of central Victoria. It has typical box bark that becomes shaggy with age and glossy green leaves in adult trees. Occasionally cultivated it is best suited to well drained soils of moderate rainfall (Brooker & Kleinig 1999, Nicolle 2006).

Figure 4: Predominant indigenous eucalypts Red Box (Tree 005) and Long-leaved Box (Tree 865) at the site

Three eucalypt species including Red Stringybark *Eucalyptus macrorhyncha,* Yellow Box *Eucalyptus melliodora and* River Red Gum *Eucalyptus camaldulensis* comprise approximately 11% of the trees.

- Red Stringybark *Eucalyptus macrorhyncha* is a small to medium-sized tree with rough, thick, fibrous and stringy, dark-brown to greyish-brown bark. The tree occurs on ranges and tablelands of New South Wales, Australian Capital Territory and Victoria, with a small, disjunct population south-west of Clare in South Australia. (Brooker and Kleinig 1999).
- Yellow Box *Eucalyptus melliodora*. is predominantly a single stemmed, medium-sized, woodland tree or occasionally tall forest tree, widely distributed throughout Victoria, eastern New South Wales and south-eastern Queensland (Brooker & Kleinig 1999). The species is common on the inland side of the Great Dividing Range associated with open forest or savannah woodland (Boland *et al*. 2015, Chippendale & Johnson 1969).

- River Red Gums are medium to tall woodland trees that can grow up to 45m in height. It is one of the few eucalypts that lack a lignotuber; an underground swelling which is an organ for food storage and regeneration (Penfold & Willis 1961). The most widely distributed species in Australia, River Red Gums are found throughout most of Victoria in every mainland state of Australia. They grow mostly along the floodplains of watercourses, in areas that receive periodic inundation or where subterranean moisture is available. They grow on variable soils ranging from sand to heavy clay (Kelly, Chippendale & Johnson 1969, Nicolle 2006).

Leyland Cypress *x Cuprocyparis leylandii and* Monterey Pine *Pinus radiata* ccontribute 11% of the tree population.

- Leyland Cypress is a fast-growing evergreen tree and widely used as hedge plant or windbreak plant. It's a hybrid between Nootka Cypress *Chamaecyparis nootkatensis* and Monterey Cypress *Cupressus macrocarpa* and grows up to 15-20m tall. Leaves are scale-like and very small with pointed tips. Bark is red-brown in colour with shallow ridges (Coombes 1992).
- Monterey Pine is an evergreen conifer, native to California and capable of growing to 25-50m tall (Spencer 1995). The bark is dark brown to grey-black and deeply furrowed, with the dark-green needles densely clustered and grouped in threes (Burnley plant directory 2002). Although it is a valuable forestry species, it is classed as a weed species in many areas including Victoria.

Golden Wattle *Acacia pycnantha,* Cherry Ballart *Exocarpos cupressiformis* and Sweet Pittosporum *Pittosporum undulatum* are the other major tree species at the subject site (each comprises 3% of tree population).

Monterey Pine and Sweet Pittosporum are declared as environmental weeds by Nillumbik Shire Council (Nillumbik Shire Council 2018).

Detailed tabular data for assessed tree parameters are provided in Appendix 2.

5.1 Health, Structure and ULE of Trees

The subject site has generally a healthy tree population as about 82% of the trees were assessed with fair to good health and 1% (82 trees) were assessed with very good health (Table 2). More than half of the trees (53%) are indigenous and well adapted to the site. Nearly 66% of the assessed trees are demonstrating fair to good structure.

Table 2: Summary of tree attributes

Health	Count	Health percent	Structure	Count	Structure percent	ULE	Count	ULE percent
Very good	82	1%	Good	1,019	14%	20+ years	1,595	23%
Good	2,486	35%	Fair	3,630	52%	10-20 years	1,538	22%
Fair	3,331	47%	Poor	2,232	32%	5-10 years	1,538	22%
Poor	753	11%	Very Poor	142	2%	Less than 5 years	2,212	31%
Very poor	88	1%	Hazardous	8	0.11%	0 years	148	2%
Dead	291	4%						
Total	7,031		Total	7,031		Total	7,031	

The presence of atypical canopies, codominant stems, included bark, borer attack, trunk decay and splits in the stems have potentially reduced the health and structure of trees. About 32% of the tree population was assessed with poor structure with one or more of these defects. A lack of proactive management has possibly lead to the development of structural defects.

Codominant stems containing included bark is a major defect noticed within assessed trees (Figure 5). With traditional branch attachment, the branch and trunk fibres overlap each other as they grow forming a strong, embedded attachment. With codominant stems, this is not the case as the fibres run roughly parallel and don't knit together. This form of attachment is regarded as weaker and more prone to failure (Kane, Farrell, Zedaker, Loferski & Smith 2008; Harris, Clark & Matheny 1999; Shigo 1991). When combined with included bark, it is often only a matter of time until the stems fail.

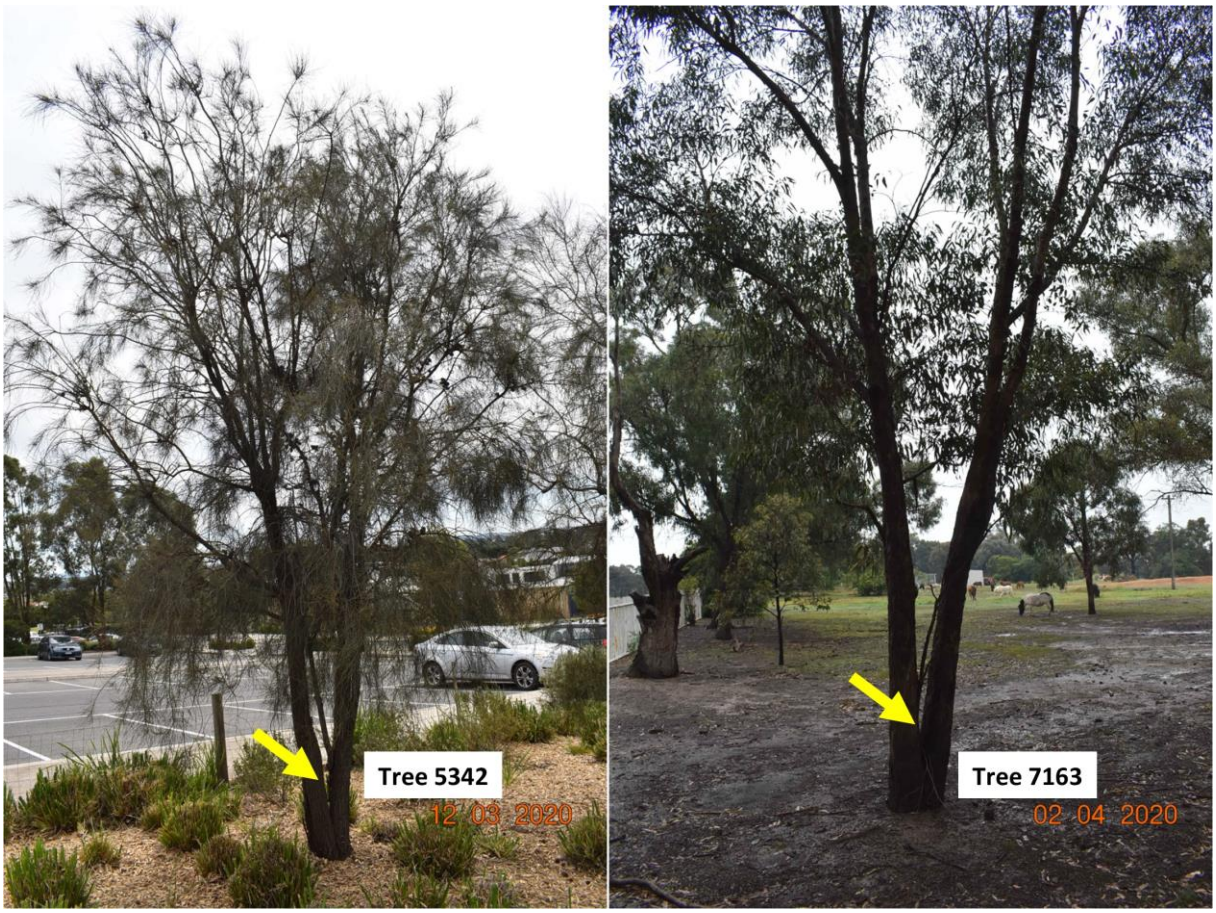


Figure 5: Trees 5342 and 7163 showing the presence of codominant stems

The presence of borers has resulted in many trees having low to no retention value. Borer attack can be severe on stressed trees whereas healthy trees have normally been able to tolerate the infestation. Red Stringybark, Long-leaved Box, Cherry Ballart and Golden wattle are the tree species mostly affected by borers. Jewel Beetle and Longicorn Beetle are key members of wood borers which attack trunks and roots of a wide variety of trees including eucalypts and wattles (Jones *et al*., 2015). Splits or cracks in the trunk is another defect to reduce the value of the tree that has been occasionally observed (Figure 6). Three dead trees (Tree 665, 813 and 836) were classified as hazardous. They are recommended for removal as soon as possible.

Useful life expectancy of a tree is not an estimate of tree longevity rather the estimated duration with which it will be useful in the landscape at an acceptable level of risk and management input. 1,595 healthy specimens in good condition were assessed with the ULE of 20+ years and 1,538 trees were assessed with 10-20 years. 1,538 specimens with poor to fair health and structure were assessed with 5-10 years of ULE and trees generally in decline and/or with poor structure were assessed with 1-5 years ULE.

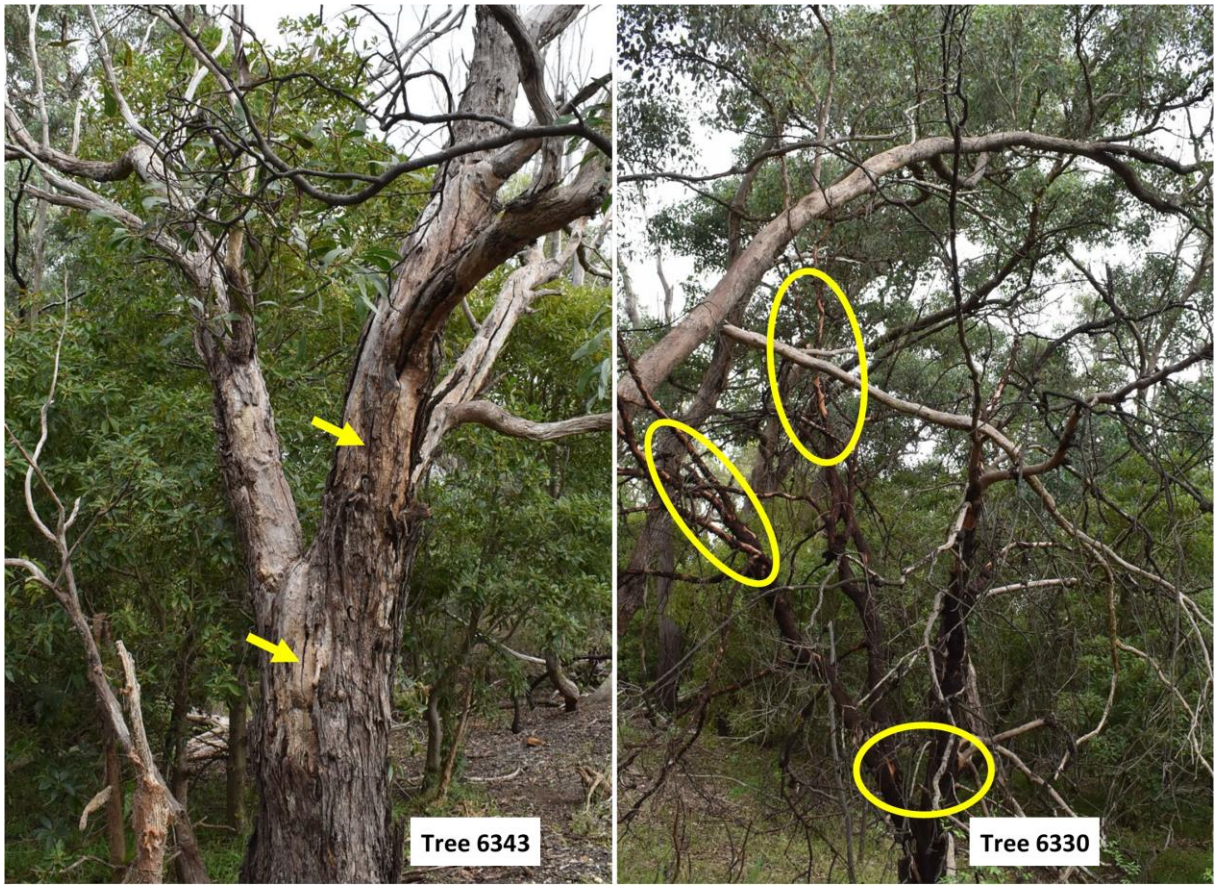


Figure 6: Presence of splits (in Tree 6343) and borers (in Tree 6330) in assessed trees

5.2 Tree Hollows

As part of the assessment, the presence of tree hollows was noted for the trees. The dimensions were approximately 5cm × 15cm. Data for any tree where hollows were observed was collected. The depth of the hollow could not be assessed due to the restrictions of the ground assessment.

A total of 109 trees were identified as containing hollows. Tree data that was collected as part of a previous survey by another consultant did not assess this attribute.

In general, the larger trees contained more hollows than the smaller trees.

Hollow trees include: 5, 11, 13, 179, 240, 241, 300, 307-309, 333, 356, 364, 420, 465, 705, 728, 747, 753, 766, 791, 793, 795, 796, 807, 814, 815, 818-820, 828, 832, 834, 837, 849, 854, 870, 947, 984, 992, 1003, 1102, 1132, 1258, 1264, 1267, 1276, 1293, 1297-1319, 1369, 1511, 1532, 1533, 1537, 1836, 1839, 1867, 1869, 1870, 1871, 2188, 2244, 2434, 2435, 2483, 2623, 2663, 2667, 2672, 2693, 2701, 2922, 2945, 2954, 3044, 3614, 3639, 4175, 4180, 4300, 5539, 5540, 5632, 5633, 6863, 7108 & 7171.

5.3 Tree Retention Value

5.3.1 Trees Assessed as Very High Retention Value

A total of 12 trees were assessed as very high retention value. They included Trees 230, 943, 947, 1265, 4915, 4945, 4954, 4968, 4995, 5002, 5632 and 6037.

Tree 230, the Studley Park Gum *Eucalyptus studleyensis*, is an uncommon hybrid between Swamp Gum *Eucalyptus ovata* and River Red Gum *Eucalyptus camaldulensis* and assessed with good health and good structure (Figure 7).

Figure 8 shows very high retention value trees across the subject site. All the trees assessed in this category are demonstrating fair to good health and structure and have 10-20 years or 20+ years of ULE. They should be retained and protected for their indigenous origin, habitat significance or large size.

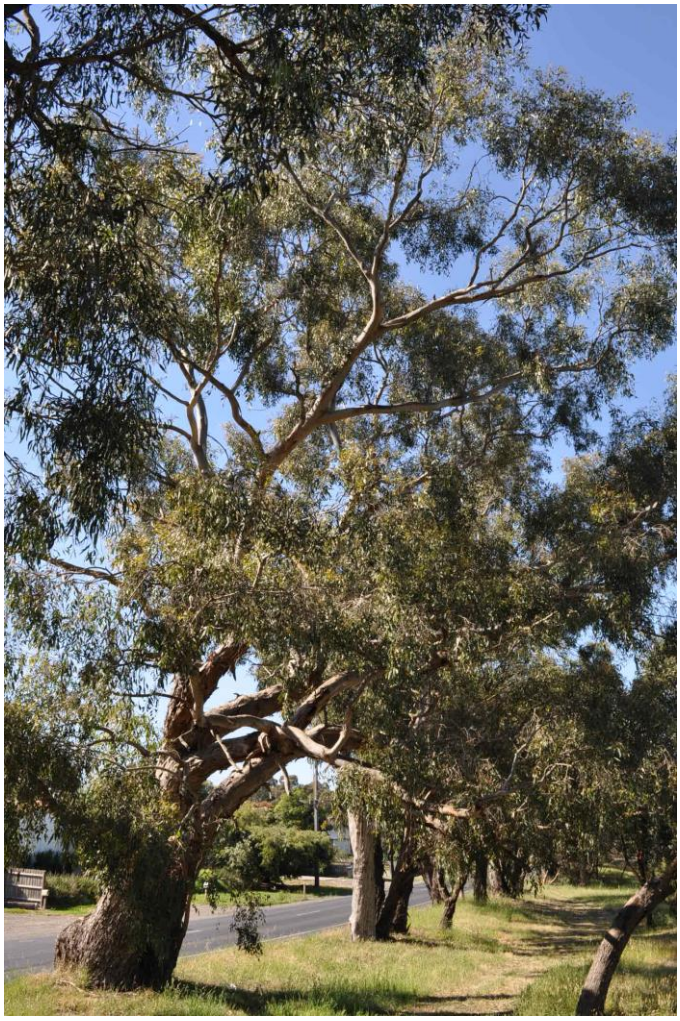


Figure 7: Tree 230, Studley Park Gum *Eucalyptus studleyensis* assessed as very high retention value

5.3.2 Trees Assessed as High Retention Value

A total of 346 trees were assessed as high retention value (Figure 8). Their retention is preferred, and the design should accommodate them wherever possible. Most of the specimens in this category are indigenous eucalypts.

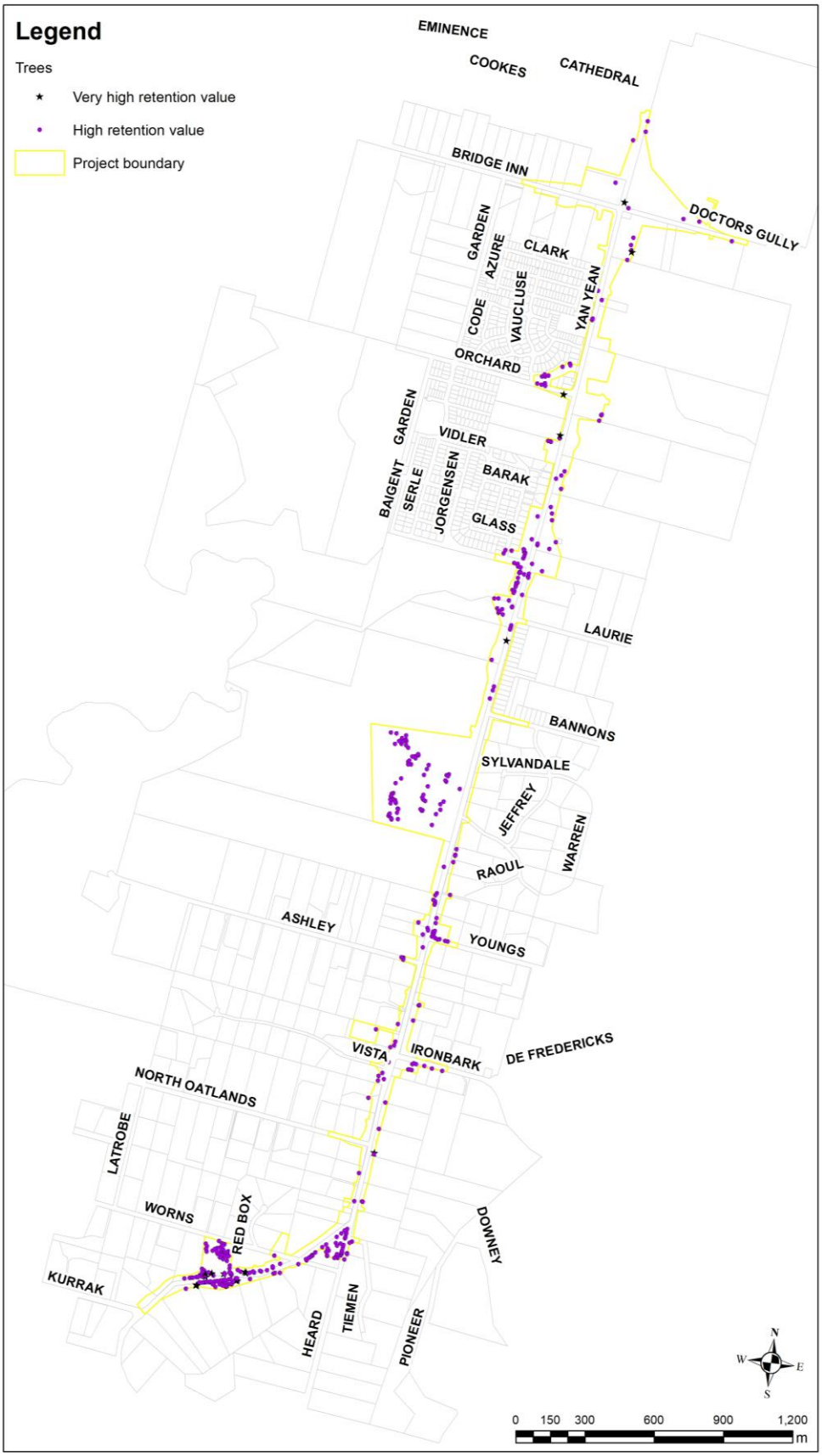


Figure 8: Trees assessed as very high retention value and high retention value at the project site

5.3.3 Trees Assessed as Moderate Retention Value

A total of 2,169 trees (approximately 31% of the tree population) were assessed as moderate retention value. Generally, they are semi mature to mature specimens with fair health and structure. Most are indigenous eucalypts and planted hedges. They are suitable for retention; however, are such that their individual loss would not have a significant impact on the landscape. Wherever possible, these trees are to be retained unless the design does not allow.

5.3.4 Trees Assessed as Low Retention Value

A total of 3,533 trees (approximately 50% of the tree population) were assessed as low retention value. The majority are either young or declining trees and could be retained. Design changes are not considered worthwhile to retain trees in this category.

A total of 1,532 trees assessed in this category are eucalypt tree species (Figure 9). Though grouped as low retention value, it is recommended to accommodate the retention of young eucalypts with good health and structure wherever possible.

Figure 9: Juvenile eucalypt trees assessed as low retention value

5.3.5 Trees Assessed with No Retention Value

A total of 189 trees were assessed with no retention value. They should be removed irrespective of the design as they are hazardous. 183 trees with no retention value are eucalypt species Figure 10).

Figure 10: Dead eucalypt trees assessed with no retention value

5.3.6 Trees Assessed as Third Party Ownership

A total of 782 trees are located outside of the current project boundary and were assessed as Third Party Ownership. These trees have been placed in this category irrespective of health and structure assessments. They will require protection as part of the design and construction process unless approval is sought and provided for their removal by the tree owner and/or the responsible authority.

5.3.7 Tree Retention Summary

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

- 12 trees have very high retention value
- 346 trees have high retention value
- 2,169 trees have moderate retention value
- 3,533 trees have low retention value
- 189 trees have no retention value
- 782 trees were assessed Third Party Ownership.

The tree retention values provide a guideline for retention or removal of trees at the subject site and to ensure the protection of retained trees in relation to construction activities.

6. Discussion

6.1 The Site

The subject site is approximately 5.5km in length, from Kurrak Road to Bridge Inn Road. Data from a previous arboricultural assessment for Yan Yean Road, between Kurrak Road and Worns Lane was supplied by a third party. C&R Ryder Consulting collected tree data from Worns Lane to Bridge Inn Road. The subject site predominantly lies within the Nillumbik Shire Council. A small section of the subject site west of Yan Yean Road between Bridge Inn Road and Jorgensen Avenue is within Whittlesea Council.

6.2 Design Proposal and Construction Impact

It is proposed to upgrade the section of Yan Yean Road between Bridge Inn Road in the north and Kurrak Road in the south. To inform the design, preliminary assessment of trees at the subject site has been completed.

The impact of the proposed design on the trees will be assessed in accordance with AS4970-2009 *Protection of trees on Development Sites*. Any existing feature within TPZs (e.g. road running lane) will be considered to determine if the tree can be retained or requires removal. Any tree to be retained within the boundary will require protection during construction. The easiest way of achieving this is the establishment of Tree Protection Zones (Section 6.3 Tree Protection). The construction impact will then be determined based on percentage encroachment into Tree Protection Zones (TPZ) and whether there is encroachment into the Structural Root Zone (SRZ).

6.3 Tree Protection

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 for long-term. Damage to the trees can come in one of two 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).

6.3.1 Tree Protection Zones

Trees can be easily protected from development by the installation of Tree Protection Zones (TPZs). 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 Appendix 2. In general, a tree protection fence should be designed to be robust and withstand easy movement or ingress (Figure 11).

Unless detailed within an approved Tree Management Plan, 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).

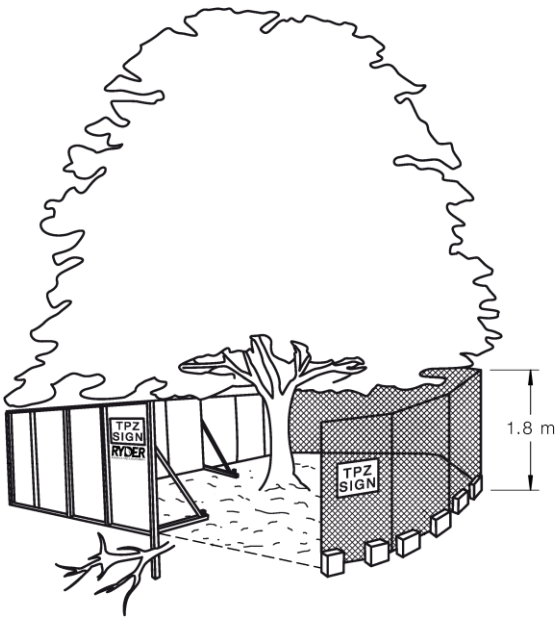


Figure 11: Indicative TPZ construction

Figure 12: Suitable TPZ signage to be displayed on TPZ fences

Include the following procedures in setting up and maintaining any TPZ (as per AS 4970-2009 & MRPV specifications):

- locate the TPZ fences at the boundary of radial Tree Protection Zone wherever possible.
- erect warning signs at intervals of no less than 20m along the length of any protective TPZ fencing stating 'No Go Zone – No Unauthorised Access' (Figure 12).
- construct TPZ fencing to prevent pedestrian access into the protected area.
- retain the TPZ fencing throughout the duration of construction activities
- mulch the TPZ area to a depth of 100mm with woodchips (if available, use woodchips generated from onsite tree clearing).
- irrigate TPZs periodically, as determined by the consulting arborist.

6.3.2 Structural Root Zones

The Structural Root Zone (SRZ) 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 Appendix 2.

6.3.3 Tree Protection Zone encroachment

Encroachment of less than 10% of the TPZ and outside the SRZ is deemed to be minor encroachment according to AS 4970-2009 (Figure 13). 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.

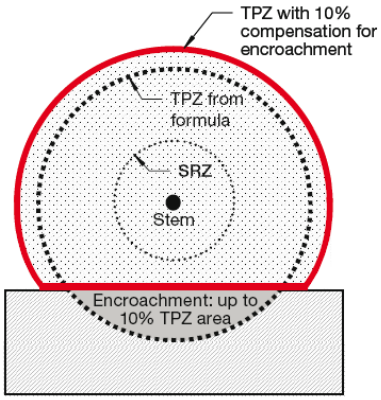


Figure 13: Example of TPZ encroachment and compensatory offset (Image from AS 4970-2009)

6.4 Considerations to mitigate impacts

The following should be considered to mitigate TPZ impacts to retained trees and to reduce the number that are required to be removed:

1. **Shared-use path and footpath**
    a. Relocate the paths where possible to avoid or minimise TPZ encroachments. This would include not only trees with a high retention value but also lower retention value trees that are acting as screens or forming part of an avenue or formal planting.
    b. Shared-use paths and footpaths should as a minimum be outside SRZs of the retained trees, where possible.
    c. Reduce the width of the paths where possible to minimise the level of TPZ encroachments.
    d. Minimise soil excavation required to mitigate tree root damage. If required, build them up and batter with additional topsoil.
    e. Construct the shared-use path and footpath with suitable techniques so that the paths retain porosity within TPZs. Use alternative materials to create accents and points of difference along the route.
2. **Safety Barriers**
    a. Keep the barriers as far away as possible from the trees.
    b. Optimise safety barrier design to minimise the requirement for tree removal
    c. The impact to the trees will be minimised if the safety barriers can be installed by post holes rather than trenching.

d. Provide details on soil excavation required for safety barrier installation so that TPZ encroachments by barriers can be assessed carefully and can potentially retain more trees.

3. **Levels and Grades**
   a. Since certain parts of the road within the project boundary are on moderate to steep slopes, provision of cut and fill details and grading requirements are to be supplied for a detailed assessment.
4. **Signals and Conduits**
   a. Location of signals, power and communications conduits need to be shown as part of the design. Soil excavation through trenching for their installation will potentially cause root damage to trees in close proximity.
   b. Any installation work of these assets within TPZs of retaining trees is to be conducted via directional drilling/boring or with the use of hydro-excavation.
5. **No Go Zones**
   a. Establishment of No Go Zones during construction is imperative to protect the trees that can be retained within the project boundary. In areas where no works are proposed, they are to be either fenced off and signed appropriately within the worksite or excised from the worksite with proper construction fencing to exclude the trees.

6.5 Construction Impact Assessment

This is a preliminary tree assessment report and the proposed construction design has to be reviewed to determine the possible impacts to all trees located within the project boundary in accordance with AS4970-200 *Protection of Trees on Development Sites.* The project boundary incorporates the area required to build the proposed additional lanes, footpaths, shared use paths and to implement any of the 5 options discussed in section 1.2.1.

The tree retention values, level of TPZ encroachments and nature of design components will be considered while deciding on retention or removal of trees within the project area. On completion of the design review process, a construction impact statement is to be prepared. The preliminary data provided here is to help guide the design with the express aim of retaining as many trees of the highest value as possible.

Following finalisation and approval of a design, a tree protection management plan is to be prepared and incorporated into the constructor's Environmental Management Procedures outlining how the retained trees will be protected throughout the construction process. The Environment/Vegetation Management Overlays and Environmental Weeds List of the respective Councils are also to be considered before planning any tree removal and mitigation measures developed.

6.6 Tree Protection Management Plan

Following completion of a design and determination of trees to be retained and removed, a Tree Protection Management Plan (TPMP) is to be developed in accordance with AS4970-2009 *Protection of Trees on Development Sites* and the Environmental Performance Requirements (EPR) of the project. See section 7. The TPMP contains:

- The engagement of a project arborist with a minimum qualification of Diploma in Arboriculture (AQF level 5 or equivalent)
- Trees to be removed and retained
- Conditions and/or significance of pruning and tree removal, if any
- Possibilities for relocation and reinstatement of trees. Trees are to be reinstated, if any, as per the Landscape Strategy of the project
- Procedures regarding how the trees will be retained:

  - During initial grading
  - Pre and post construction
  - For the duration of construction.
- A tree protection plan that explains:
  - all Tree Protection Zones and Structural Root Zones,
  - all tree protection fenced off areas and areas where ground protection systems will be applied
  - The construction techniques used within the TPZs
  - All services to be located within the tree protection zone and a notation to state that all services will either be located outside of TPZ or bored under TPZ
  - A notation to refer to the tree management plan for specific advice on what actions are required within the TPZs.
- Location of measures for trunk and branch protection and ground protection
- Certification, milestones, inspection times and hold points.

6.7 Pruning and Removal

Pruning and tree removal activities will be required throughout the construction to provide clearance and to accomplish the project objectives. All pruning and tree removal works should be completed by qualified arborists with a minimum of Certificate III in arboriculture (or equivalent). All pruning works are to be completed in accordance with AS4373-2007 *Pruning of Amenity Trees*.

6.8 New Trees

Planting of suitable new trees will likely to become part of the landscape plan to compensate the trees that are being lost. Planting of new trees is discussed in AR3 of the proposed EPRs of the project. All new trees should be sourced from reputable nurseries and inspected prior to delivery. Tree growth systems and the supplied stocks are to be in accordance with AS2303-2018 *Tree Stock for Landscape Use.*

7. Environmental Performance Requirements

Table 3 lists the proposed Environmental Performance Requirements (EPRs) relevant to the arboricultural assessment. The EPRs were prepared in consultation with MRPV and informed by the detailed Non-destructive Root Investigation (NDRI) completed within the TPZs of 2 River Red Gums (ID 1264 & 1265) located at the corner of Bridge Inn Road intersection (Appendix 5). Incorporation of the listed EPR's into the Environmental Management Framework will ensure the control measures and recommendations outlined in this report to are completed for the necessary project phases.

Table 3: Environmental Performance requirements associated with arboricultural assessment

Performance objective	Applicable legislation, policy and guideline	EPR Code	Risk no.	Environmental Performance Requirement	Project phase
Arboriculture To avoid where possible, and otherwise minimise adverse impacts on remnant, planted, regenerated, or large old trees	Australian Standard 4970-2009 *Protection of Trees on Development Sites*	AR1	3, 23, and 43	**Avoid and minimise tree removal** During detailed design and construction, review potential tree impacts (particularly large/higher value trees and high value vegetation as identified within the Landscape Strategy's 'Cultural Value of Vegetation Assessment'), and provide for maximum tree retention where possible. This may be achieved through: • Design permanent and temporary works to avoid where possible, and otherwise minimise, adverse effects on trees (see also EPRs E1, AR2 and AR3) • The location and width of walking and cycling paths and footpaths is to be varied further to minimise Tree Protection Zone encroachment where possible • Apply suitable construction techniques to minimise impact on Tree Protection Zones, including limiting excavation depth or building above grade. Include additional retaining walls in the design for high priority trees where appropriate • Optimise design of Safety Barriers to retain trees, such as avoiding trenching • Prepare a Tree Impact Assessment which includes consideration of necessary cut and fill and grading requirements (3D design) which can be undertaken in stages • Establishment of no-go zones identified in Attachment VI *Map Book* to exclude and protect the trees within the project area, with fencing to be as per the Australian Standard 4970-2009 *Protection of Trees on Development Sites*.	Design and construction
		AR2	3, 23, 43 and 63	**Tree Protection Management Plan** Prior to construction commencing, develop and implement a Tree Protection Management Plan (see also EPRs E3 and AR3) based on the recommendations of Australian Standard 4970-2009 *Protection of Trees on Development Sites*. This will be in consultation with the City of Whittlesea and Shire of Nillumbik and informed by a project arborist (with a minimum qualification of Diploma in Arboriculture (AQF level 5 or equivalent), which covers: • Trees to be removed or retained which will be informed by Tree Impact Assessment	Design and construction

Performance objective	Applicable legislation, policy and guideline	EPR Code	Risk no.	Environmental Performance Requirement	Project phase
				• Condition or significance of trees to be removed • Options for relocation and reinstatement of trees if feasible • All tree protection zones and structural root zones • All tree protection fenced off areas and areas where ground protection systems will be used • All services to be located within the tree protection zone. All services will either be located outside of the tree protection zone or bored under the tree protection zone • Location of tree protection measures and ground protection • To reduce tree removal and retain trees for as long as possible, tree removal will be undertaken as late as possible during construction works.	
		AR3	3, 23, 43 and 63	**Doreen River Red Gums** At the Bridge Inn Road intersection, the two Doreen River Red Gums will be retained. Prior to any works, a detailed Tree Protection Plan will be prepared by a suitably qualified arborist and must be signed off by MRPV. This will include tree protection measures relevant to proposed works such as a calculated no-go zone and Tree Protection Zones and specific controls for works (including excavation, utility installation, lighting) within the calculated Tree Protection Zones of the Doreen River Red Gums as follows: • Works must not occur within the no-go zone determined in the Tree Protection Plan • The maximum depth of excavation must not exceed 800 millimetres below the existing ground surface within the Tree Protection Zones identified in the Tree Protection Plan • There must be no damage to the tree canopy of the Doreen River Red Gums • Fence/crash barrier, signage footings and road furniture can be installed within the identified Tree Protection Zones identified in the Tree Protection Plan but are not to be more than one metre below the existing ground surface level and must not be strip footings or similar if they exceed 800 millimetres below the existing ground surface level	Design and construction

Performance objective	Applicable legislation, policy and guideline	EPR Code	Risk no.	Environmental Performance Requirement	Project phase
				• Any utilities or services such as conduits or pipes to be installed within the Tree Protection Zones identified in the Tree Protection Plan, but outside of the no-go zone identified in the Tree Protection Plan, are to be bored with a minimum of one metre cover to the existing ground surface and are to be no greater than 500 millimetres in diameter • Arrangements for appropriate long-term access to water are to be provided to the Doreen River Red Gums • The finished level of any surface adjacent to the no-go zone must be +/- 200 millimetres of the existing road and no additional fill can be placed within the undisturbed areas of the Tree Protection Zones identified in the Tree Protection Plan • Reinstatement - the area that is available, must be converted to mulched garden bed with complementary indigenous plantings such as acacias. Reinstatement of existing pavement areas within the Tree Protection Zones identified in the Tree Protection Plan shall be to a minimum depth of 500 millimetres. The indicative tree protection plan is provided in Appendix 6.	
		AR4	3	**Reinstatement** Reinstatement of soft and hard landscaping is to be in accordance with the Project's Landscape strategy (See also EPRs E6 and LV2) and include: • Protecting retained trees • Ensuring new tree planting does not adversely impact existing vegetation.	

8. Conclusion

C&R Ryder Consulting Pty Ltd was engaged to complete an assessment of 6,735 trees along a 4.8km stretch of Yan Yean Road from Worns Lane to Bridge Inn Road. Additional data was supplied by a third party from Kurrak Road to Worns Lane bringing the total number of trees to 7,284. A total of 253 trees (out of 7,284) have already been removed through various development.

Assessment results for 7,031 trees are presented in the preliminary tree assessment report. 53% of the trees at the project site are indigenous species and the remaining specimens are comprised of Australian native (26%) and exotic trees (21%). Generally, it's a healthy tree population with 82% of the trees demonstrating fair to good health. About 66% of the trees having fair to good structure and 32% of the trees were assessed with poor structure.

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

- 12 trees have very high retention value
- 346 trees have high retention value
- 2,169 trees have moderate retention value
- 3,533 trees have low retention value
- 189 trees have no retention value
- 782 trees were assessed Third Party Ownership.

This is a preliminary assessment report and a proposed design has not been reviewed. Retention and removal of assessed trees is yet to be determined. When designing the road upgrades, the following are to be considered to mitigate impact within TPZs of trees to be retained:

- The location and width of shared-use paths is to be varied if possible, to minimise TPZ encroachments. Apply suitable construction techniques so that the path will maintain porosity within the TPZs.
- While establishing Safety Barriers, optimise the design to maximise tree retention and use post holes rather than trenching.
- Necessary cut and fill and grading requirements are to be provided for a detailed assessment.
- Directional drilling/boring and/or Non-Destructive Digging is preferable within TPZs for the installation of signals, utilities and conduits.
- Establishment of No Go Zones to exclude and protect the trees within project boundary.

Following completion of a final design, a Tree Protection Management Plan should be prepared detailing how trees proposed for retention will be protected throughout construction.

9. References

AS 2303, 2018, *Australian Standard Tree Stock for Landscape Use,* Standards Australia.

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

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

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Harris, R.W., Clark, J.R. & Matheny, N.P., 1999, *Arboriculture; Integrated management of landscape trees, shrubs, and vines,* Prentice Hall, Upper Saddle River, New Jersey.

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Shigo, A.L., 1991 *Modern Arboriculture*, Shigo and Trees, Associates, Durham, New Hampshire.

Spencer R. 1995, *Horticultural flora of south eastern Australia*; Vol. 1, Ferns, Conifers and their Allies, University of New South Wales Press, Sydney, NSW.

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 of the tree as estimated by the arborist in whole metres.

The average canopy 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 1.3m 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 Tree Hollows

The presence of tree hollows was assessed for the trees. The dimensions were approximately 5cm×15cm. The assessment was completed from the ground as part of the broader visual tree assessment.

1.7 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 in its location with respect to its location and broader context. The canopy is full and complete and there are no signs of significant pests or disease, causing tree decline.
Fair	The tree may have shown a reduction in optimal growth and/or there may be some twiggy deadwood on the extremities of the canopy that is the result of decline. There may be the presence of some pests or diseases that are having an impact and causing some 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

1.8 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.
Hazard-ous	The tree has major defects and is likely to fail. It should be removed as soon as possible.

1.9 Useful Life Expectancy

Standing dead trees have been assessed with a ULE where appropriate to reflect the likely amount of time they will remain stable and of ecological value in the landscape.

20+	The tree is a healthy specimen with fair to good health and structure. It is expected to provide contribution to the landscape for at least another 20 years with an appropriate level of management.
10-20	The tree is a reasonably healthy specimen with good or fair health and/or structure. It is expected to provide contribution to the landscape for 10-20 years with an appropriate level of management.
5-10	The tree has fair health or structure or is 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	The tree is a poor specimen in structural decline and is likely to require removal within 1-5 years.
0	The tree has substantial defects requiring its removal in the short term.

1.10 Tree Significance

Highly Significant	The tree is a large, mature example of the species. 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 or may 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, 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.

1.11 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 with fair to good health/structure and a ULE of at least 10 years, is suitable to the site and should be retained in a new development. Large, dead, stable trees providing habitat value with a long ULE may also be assessed in this category
Moderate	The tree is a semi-mature or mature specimen, has fair to good health/structure that is suitable for retention; however, is located such that its loss would not have a significant impact on the landscape. Moderate-sized, dead, stable trees providing habitat value with a long ULE may also be assessed in this category
Low	The tree is likely to be juvenile, in decline, weed species or low value and could be retained; however design changes are not considered worthwhile to retain a tree in this category. Dead, unstable trees providing habitat value may also be assessed in this category.
None	The tree should be removed irrespective of a design as it is hazardous. Smaller dead trees may also be assessed in this category.
Third Party Tree	This tree is located outside the project area and is owned by a third party. The assessment of health and structure is considered irrelevant as the tree must be retained.

Appendix 2. Tabular Tree Data

See Appendix 2 attachment.

The entire EES document with the full appendices is available at *https://roadprojects.vic.gov.au/projects/yan-yean-road-upgrade*. Alternatively, if you would like a copy of the full EES including these appendices sent to you on USB, please email *contact@roadprojects.vic.gov.au*. and including page numbers.

Appendix 3. Enlarged Maps

See Appendix 3 attachment.

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Appendix 4. Photographic Tree Reports

See Appendix 4 attachment.

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Appendix 5. NDRI Report-Doreen River Red Gums

See Appendix 5 attachment.

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Appendix 6. Indicative Tree Protection Plan for Doreen Red Gums

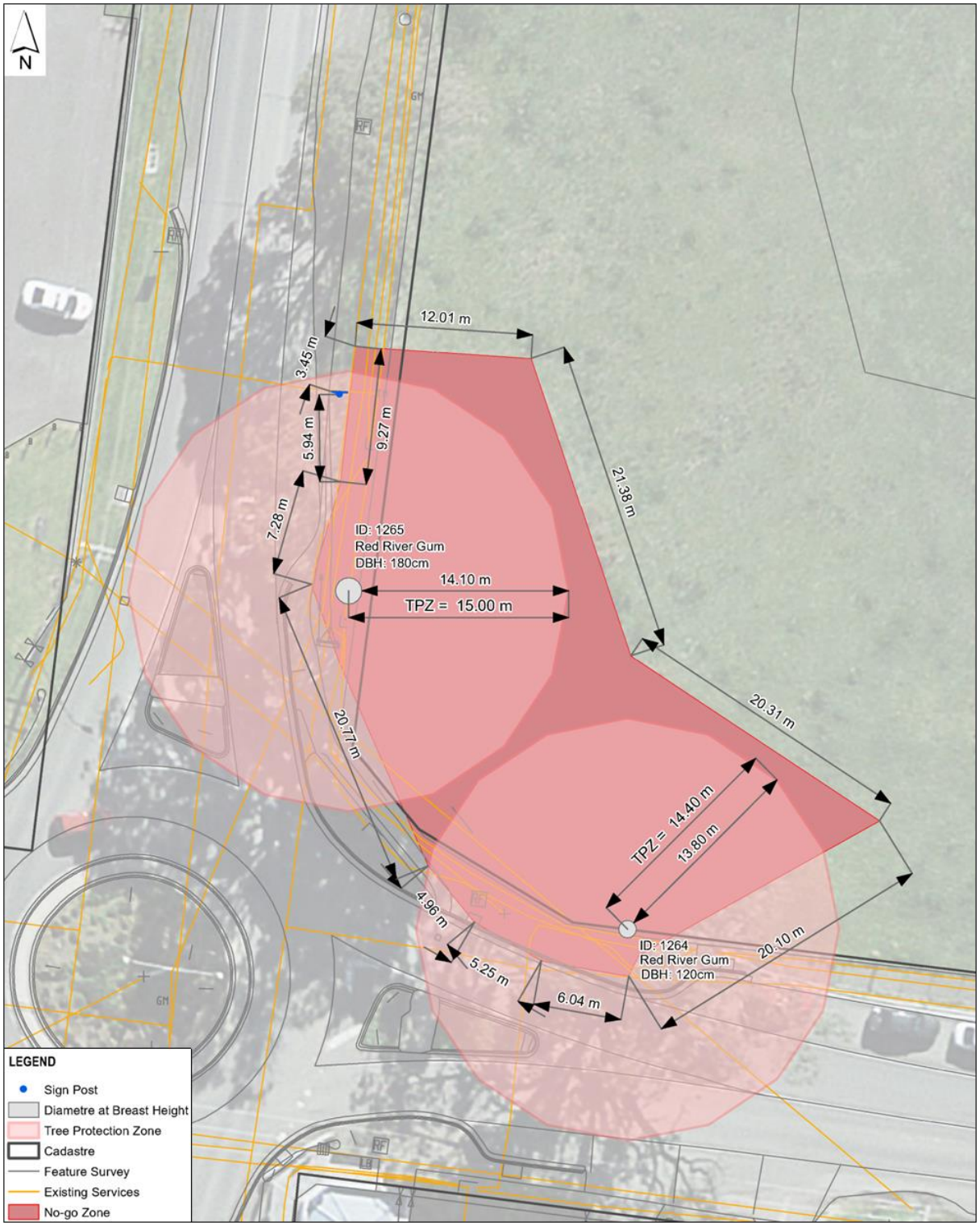

Figure 14: Indicative tree protection Plan for two River Red Gum trees at Bridge Inn Road intersection.

Appendix 7. Project Description-Yan Yean Road Upgrade

See Appendix 7 attachment.

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