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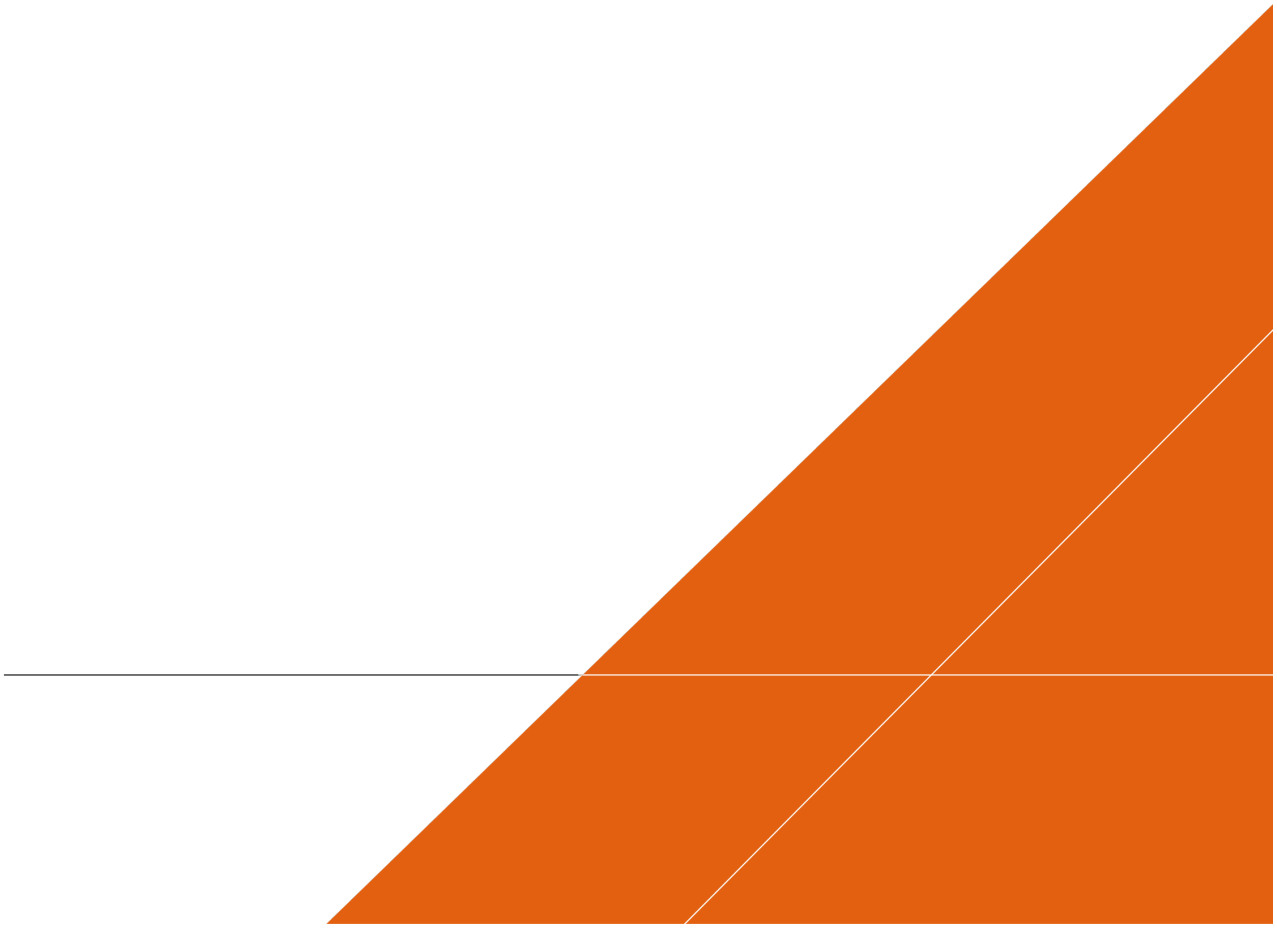
MAJOR ROAD PROJECTS VICTORIA

TECHNICAL REPORT K - CONTAMINATED LAND IMPACT ASSESSMENT

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

FINAL

15 JULY 2020



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

FINAL

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Report No	AA009647-N-CLM-R01-P32-YanYeanEES-Final
Date	15/07/2020
Revision Text	01

REVISIONS

Revision	Date	Description	Prepared by	Approved by
00	26.06.2020	Final	SS	DA
01	15.07.2020	Final – minor edits	SS	DA

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Glossary

Term	Description
Adit	An adit is a horizontal passage leading into a mine for the purposes of access, drainage or mineral prospecting.
Alluvium	General term for unconsolidated deposits of inorganic materials (clay, silt, sand, gravel, boulders) deposited by flowing water.
Aquifer	Rock or sediment in a formation, group of formations or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.
Aquitard	Saturated geological unit with a relatively low permeability that can store large volumes of water but does not readily transmit or yield significant quantities of water to bores or springs. An aquitard can sometimes, if impermeable, be called an aquiclude.
Australian Height Datum (AHD)	A level datum, uniform throughout Australia, that generally approximates mean sea level.
Bore	Artificially constructed or improved groundwater cavity used for the purpose of accessing or recharging water from an aquifer. Interchangeable with borehole, piezometer, monitoring well.
Borehole	Includes a well, excavation, or other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer. Interchangeable with bores, wells, piezometers.
Clay	Deposit of particles with a diameter less than 0.002 mm, typically contain variable amounts of water within the mineral structure and exhibit high plasticity.
Confined aquifer	An aquifer bounded above and below by impervious (confining) layers. In a confined aquifer, the water is under sufficient pressure so that when bores are drilled into the aquifer, measured water levels rise above the top of the aquifer.
Dissolved solids	Minerals and organic matter dissolved in water; a measure of salinity. Often referred to as Total Dissolved Solids with units of mg/L.
Ecosystem	An organic community of plants, animals and bacteria and the physical and chemical environment they inhabit.
Fault	Zone of displacement in rock formations resulting from forces of tension or compression in the earth's crust.
Formation	General term used to describe a sequence of rock layers.
Fracture	Break or defect in a rock including cracks, joints, and faults.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
Groundwater flow	The movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone.

Term	Description
Groundwater resource	Groundwater available for beneficial use, including human usage, aquatic ecosystems and the greater environment.
Hydrogeology	The study of the interrelationships of geological materials and processes with water, especially groundwater.
Impact	An event that disrupts ecosystem, community, or population structure and alters the physical environment, directly or indirectly.
Infiltration	The downward movement of water from the atmosphere into the ground; not to be confused with percolation.
Lithology	The physical character of rocks.
Monitoring bore	A bore used to monitor groundwater levels or quality.
Permeability	The ease with which a fluid can pass through a porous medium and is defined as the volume of fluid discharged from a unit area of an aquifer under unit hydraulic gradient in unit time (metres per day).
pH	Absolute value of the decimal logarithm of the hydrogen-ion concentration (activity). Used as an indicator of acidity (pH < 7) or alkalinity (pH > 7).
Salinity	The concentration of dissolved salts in water, usually expressed in electrical conductivity (EC) units (µS/cm) or total dissolved solids (TDS) units (mg/L TDS).
Sediment	Particles derived from rocks or biological materials that have been transported by air or water.
Shale	Finely laminated and fissile sedimentary rock composed primarily of consolidated mud and clay.
Siltstone	Consolidated silt; fine-grained sedimentary rock.
Well	A structure that is designed to bore through the earth's surface in order to extract resources.
Wetland	Victoria State Government describes wetlands in the Healthy Waterways Strategy 2018 (Government of Victoria, 2018) as "areas, whether natural, modified or artificial, subject to permanent or temporary inundation, that hold static or very slow-moving water and develop, or have the potential to develop, biota adapted to inundation and the aquatic environment. They may be fresh or saline. Examples of wetlands include swamps or billabongs."

Abbreviations

Acronym	Meaning
ACM	Asbestos Containing Material
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
ARMCANZ	Agriculture and Resources Management Council of Australia and New Zealand
AASS	Actual Acid Sulfate Soils
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CEMP	Construction Environmental Management Plan
CEC	Cation Exchange Capacity
CoEA	Certificate of Environmental Audit
COPC	Contaminants of potential concern
DELWP	Victorian Department of Environment, Land, Water & Planning
EAO	Environmental Audit Overlay
EC	Electrical conductivity
EE Act	*Environment Effects Act 1978* (Victoria) (amended 2005)
EES	Environmental Effects Statement
EIL	Ecological Investigation Levels
EMF	Environmental Management Framework
EP Act	*Environment Protection Act 1970* (Victoria)
EPA	Victorian Environment Protection Authority
EPR	Environmental Performance Requirements
ERA	Environmental Risk Assessment
ESL	Ecological Screening Levels
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
GQRUZ	Groundwater Quality Restricted Use Zone
HGU	Hydrogeological Unit
HIL	Health Investigation Level

Acronym	Meaning
HSL	Health Screening Level
IWRG	Industrial Waste Resource Guideline
km	kilometre
L/s	Litre per second
LFGRA	Landfill Gas Risk Assessment
m	metre
mAHD	metres Australian Height Datum
mbgl	metres below ground level
mg/L	milligrams per litre
MLs	Management Limits
MNES	Matters of National Environmental Significance
MRPV	Major Road Projects Victoria
NATA	National Association of Testing Authorities
NEPM	*National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013* (National Environment Protection Council)
NHMRC	National Health and Medical Research Council
OCP	Organochlorine pesticides
OPP	Organophosphorus pesticides
PAH	Polycyclic aromatic hydrocarbons
PAN	Pollution Abatement Notice
PASS	Potential Acid Sulfate Soils
PID	Photo ionisation detector
PSI	Preliminary Site Investigation
SCO	Specific Controls Overlay
SEPP	State Environment Protection Policy
SoEA	Statement of Environmental Audit
SRU	Suburban Roads Upgrade
SUP	Shared Use Path
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons

Acronym	Meaning
VOC	Volatile Organic Compounds
WMIS	Water Measurement Information System

EXECUTIVE SUMMARY

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.

This contaminated land impact assessment report has been prepared for the EES in accordance with the Scoping Requirements released by the Minister for Planning in June 2019.

Arcadis Australia Pacific Pty Ltd (Arcadis) has been engaged as the sub-consultant to WSP Australia Pty Ltd (WSP) in a joint engagement with MRPV. Acting as the Technical Advisor for the Project, Arcadis is responsible for undertaking a contaminated land assessment to characterise the existing contamination of the Project footprint and surrounding areas.

Existing Conditions

The following was conducted to complete an assessment of existing conditions:

- desktop review of historical land uses and environmental setting
- review of the likelihood of potential acid sulphate soils
- review of readily available data/reports from previous and current studies in the study area
- an intrusive soil assessment comprising 35 soil samples collected from 34 locations throughout the Project area and at targeted locations.

The Project area and the adjacent land within 500 metres (m) of the Project area boundary can be characterised by the following:

- the desktop findings indicate that Yan Yean Road has been used as a road since at least 1951. Land surrounding the Project area was historically used for farming and mining purposes and has been gradually redeveloped for residential and commercial purposes
- the local topography is between 165 to 200 m above Australian Height Datum
- the closest surface water receptors are noted to be several tributaries (drains) of the Plenty River
- the Project area is located in the East Port Phillip Bay Groundwater Catchment
- the Project area is underlain by Mesozoic/Palaeozoic age bedrock comprising sandstone, siltstone, mudstone and shale. Igneous (fractured rock) formations are also present in the region, including granites, granodiorites and igneous intrusions (dykes)
- no coastal acid sulfate soils were identified within 150 m of the Project area
- the intrusive investigation confirmed the presence of fill material, ranging from surface to 2.0 metres below ground level (mbgl). The fill material comprises of silty clay
- results of the soil assessment indicated:
  - petroleum hydrocarbon compound concentrations were below the adopted human health and management limits assessment criteria at all locations
  - concentrations of arsenic and nickel exceeded the adopted ecosystem assessment criteria for ‘urban residential and public open spaces’ land use at seven sampled locations
  - based on the available data, 21 out of 34 locations sampled are indicatively classified as Category C Contaminated Material. Arsenic, fluoride, hexavalent chromium and nickel concentrations exceeded the Fill Material threshold criteria.

Environmental Risk and Impact Assessment

The findings from desktop review and soil assessment was used to complete an environmental risk assessment (ERA), to identify environmental risks associated with construction and operation of the Project. Primary environmental risks were identified for contaminated land and initial risk ratings were assessed by considering likelihood and consequence categories. The following key environmental risks were identified:

- overall the potential risk to receptors from existing contamination was considered to be low, however former gold mining and current and former service stations were identified. These areas have been further investigated in conjunction with the geotechnical assessment to confirm absence of significant soil impact
- potential risk from spills or leaks during construction and operation were considered to be possible, but with an overall minor consequence following implementation of management measures, therefore the overall risk is considered to be low
- potential risk from unidentified contaminated soils during construction and operational maintenance works were also considered to be low
- potential risk from acid sulfate soils or coastal acid sulfate soils were considered to be low.

The findings from the ERA were then used as the basis for an impact assessment to be completed. The impact assessment focused on potential contamination and acid sulfate soil impacts on human health with respect to nearby residents, the general public and the environment. The potential impacts on human health and the environment from construction activities and management of spoil have been considered at a local context with regard to both contamination and acid sulfate soil with reference to the beneficial uses identified in the SEPP Prevention and Management of Contaminated Land.

Construction of the Project has the potential to cause the following impacts:

- disturbance, handling, storage or disposal of contaminated soil leading to health and environmental impacts
- disturbance, handling, storage or disposal of contaminated soil results in the generation of odorous material and loss of amenity
- unknown contamination and / or acid sulfate soils encountered resulting in health, environmental and amenity impacts
- fuel or chemical spill results in health, environmental or amenity impacts
- incorrect management of contaminated material resulting in environmental impacts.

The conclusions from the impact assessment indicate the following:

- potential impact from existing contaminated land to human health and the environment is considered to be low
- existing contamination in the area is considered to have a low impact on the design and Bridge Inn Road intersection design
- potential impacts from unidentified contaminated soils and from fuel or chemical spills during operational maintenance works are also considered to be low.

The implementation of environmental performance requirements for the Project are expected to mitigate the associated and potential unforeseen impacts from the construction of the Project and operational maintenance of road.

Environmental Performance Requirements

Environmental Performance Requirements (EPR) were developed to achieve acceptable environmental outcomes that are required for the Project. The EPRs are applicable to the final design, construction and operation approach and provide certainty regarding the environmental performance of the Project.

The EPRs are presented below:

Performance Objective	Applicable Legislation, Policy and Guideline	EPR Code	Risk No.	Environmental Performance Requirement	Project Phase
Effects on physical environment- Identify other potential adverse environmental effects of the project, such as on social and community amenity canvass an environmental management approach and performance measures to ensure any effects are identified and avoided, minimised or mitigated.					
Contaminated land To protect the beneficial uses of land and minimise risk to human health and ecosystems from exposure to contaminated soils	State Environment Protection Policy (SEPP) – Prevention and Management of Contamination of Land PFAS National Environmental Management Plan 1.0 2018 EPA Publication 480 (EPA Environmental Guidelines for Major Construction Sites) Environment Protection (Industrial Waste Resource) Regulations 2009 Industrial Waste Management Policy (Waste Acid Sulphate Soils) 1999 National Environment Protection (Assessment of Site Contamination) Measures 2013 WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos) AS 4482.1-2005 Guide to the investigation and sampling of sites with potentially contaminated soil AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil	CL1	5, 25, 45, 65	**Spoil management** The CEMP must include processes and measures to manage contaminated soil in accordance with the relevant objectives set out in State Environment Protection Policy (SEPP) – Prevention and Management of Contamination of Land and other relevant statutory requirements and guidelines. These include, but are not limited to: • Environment Protection (Industrial Waste Resource) Regulations 2009 • Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999 • National Environment Protection (Assessment of Site Contamination) Measures 1999, amended 2013 (ASC NEPM) • WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos) • PFAS National Environmental Management Plan 1.0 2018 • AS 4482.1-2005 Guide to the investigation and sampling of sites with potentially contaminated soil. The processes and measures must include: • Characterising soil prior to disposal or reuse • Identifying soil containing asbestos and if present, developing management strategies in accordance with the WorkSafe Regulations • Assessing geological formations with naturally enriched metals and applicable spoil management options and or off-site disposal to the satisfaction of EPA Victoria • Identifying suitably licensed facilities for the disposal or treatment of contaminated soil	Design and construction

Performance Objective	Applicable Legislation, Policy and Guideline	EPR Code	Risk No.	Environmental Performance Requirement	Project Phase
				• Management measures for storage, handling and transport of spoil for the protection of health, amenity and the environment • Management of wastewater • Management of dust, potential stormwater run-off and seepage from stockpiled materials • Undertaking a baseline site assessment of areas proposed for construction laydown prior to use • Protection of the beneficial uses of land associated with current and planned future use.	
Environmental Management Framework To provide a transparent framework with clear accountabilities for managing and monitoring the environmental effects associated with the Project	Legislation and policy as identified in all EPRs	EMF5	85, 105	Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's environmental management system and standards for managing declared roads in Victoria.	Operation and maintenance

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.

This contaminated land impact assessment report has been prepared for the EES in accordance with the 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 5.5 kilometre (km) 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 70 km/h, with the exception of north of Bridge Inn Road which is 80 km/h. The design for the Project has 3.5 metre (m) wide lanes with the majority of the Project using a 2.2 m wide central median. This 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 3 m wide shared user path on the western side and 1.2 m wide footpath on the eastern side of Yan Yean Road. The paths links 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 1.1.

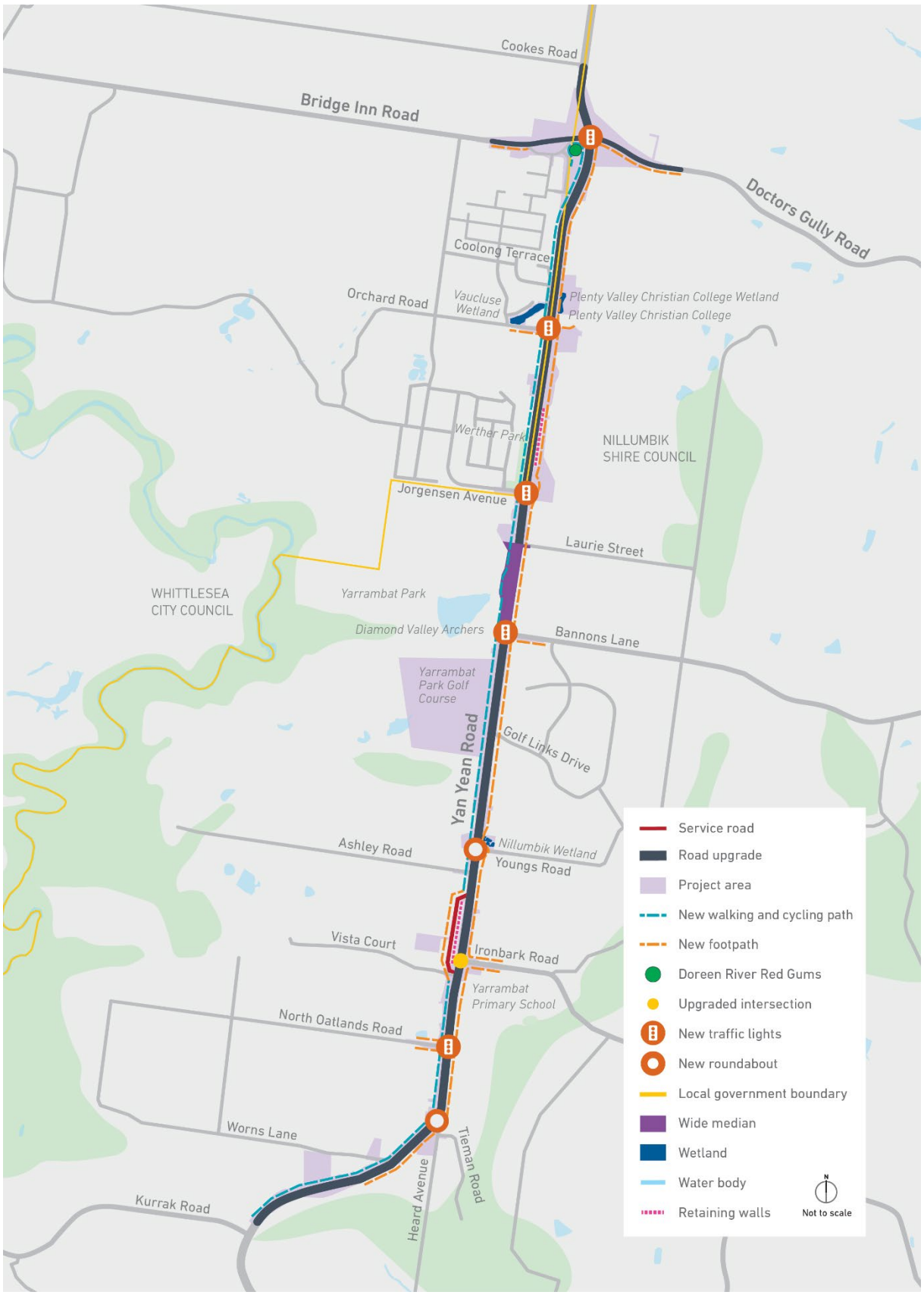

Figure 1.1: Project area

1.2.1 Yan Yean / Bridge Inn / Doctors Gully Road Intersection

The Bridge Inn Road / Yan Yean Road / 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 (see Figure 1.2). 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 1.2: 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 (EPR) for the Project. These construction activities would include:

- tree clearance and vegetation lopping 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 750 m of existing cut along the Project would be widened by approximately 20 m)
  - new cuttings (approximately 1300 m of new rock cut would be required to a width of approximately 5 m 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.
- 30-36 metre 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.

A detailed Project description of the Yan Yean Road Upgrade is provided in Appendix A.

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 limited soil assessment:

Draft evaluation objective

- *to avoid or, at least, minimise adverse effects on native vegetation (including remnant, planted, regenerated and large old trees), listed migratory and protected species/ecological communities and then to address offset requirements consistent with relevant state and commonwealth policies:*
  - *potential impacts to Matters of National Environmental Significance (MNES) through erosion, sedimentation and contamination of watercourses and groundwater near and downstream from the Project site resulting from the construction and operation of the Project.*

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:*
  - *surface runoff, flood potential and groundwater.*

The EMF will outline how potential adverse effects on receptors from existing contamination or spills and leaks during construction and operation will be avoided, minimised or mitigated.

3 METHODOLOGY

3.1 Study Area

The study area for the contaminated land investigation includes the length of Yan Yean Road between Kurrak Road in Yarrambat and Bridge Inn Road in Doreen and land immediately adjacent.

The study area for the desktop contamination assessment of current and historical activities that may impact upon the construction activities includes the Project area noted in Section 1.1 and the adjacent land within 150 m of the Project boundary. The Project area is presented in Figure 1, Appendix B.

3.2 Existing Conditions

The following methodology was adopted to assess the existing contaminated land conditions at Yan Yean Road and assess potential impacts to human health and the environment from the construction of the proposed Project:

- desktop review of historical land uses and environmental setting
- review of the likelihood of potential acid sulphate soils (PASS)
- review of readily available data/reports from previous and current studies in the study area
- an intrusive soil assessment comprising 35 soil samples collected from 34 locations throughout the Project area and at targeted locations.

3.2.1 Soil Assessment

Over several mobilisations between 20 June and 28 September 2017, the following intrusive scope of work was completed:

- prior to commencement of excavation and drilling works safety permits were completed i.e. Ground Penetration Permits
- underground service location search and site walkover
- excavation of 25 test pits, drilling of two soil boreholes, five pavement dips and two targeted test pits
- collection of one soil sample per location (except TP17-32-09 where 2 samples were collected)
- soil samples were screened in the field for volatile organic compounds (VOC) using a calibrated photo-ionisation detector (PID)
- soil profiles were logged in accordance with AS 1726:2017 Geotechnical Site Investigations by a WSP field engineer
- sample locations were located using a GPS unit
- soil samples were submitted for laboratory analysis at ALS (primary) and Eurofins (secondary) laboratories by National Association of Testing Authorities (NATA) accredited methods for a screen consistent with IWRG 621
- quality control and quality assurance (QA/QC) samples were collected as follows:
  - two sets of blind and split duplicate samples for the primary analytical suite (IWRG621)
  - ten rinsate blanks were analysed for metals analysis
  - six trip blank samples were submitted for total petroleum hydrocarbon (TPH) and benzene, toluene, ethylbenzene and xylene (BTEX) only.

3.3 Risk Assessment

An environmental risk assessment (ERA) has been completed to identify environmental impacts associated with construction and operation of the Project. The risk-based approach is shown in Figure 3.1 is integral to the EES as required by Sections 3.1 and 4 of the Scoping Requirements and the Ministerial guidelines for assessment of the environmental effects under the *Environment Effects Act 1978*. The contaminated land risk register is provided at Appendix C and the key impacts are presented in Section 7.

Primary environmental impact pathways were identified for contaminated land and initial risk ratings were assessed by considering likelihood and consequence categories (Table 3.2, Table 3.3 and Table 3.4) and applying the risk significance matrix (Table 3.1). The initial risk ratings were assessed assuming the implementation of standard controls. Standard controls include compliance with legislative requirements and best practice requirements typically incorporated into the construction contracts for the delivery of road projects. The standard controls do not include any Project-specific controls or requirements.

EPRs have been informed by the ERA, to set the minimum outcomes necessary to avoid, mitigate or manage environmental impacts and reduce environmental risks during delivery of the Project. The development of the proposed EPRs was an iterative process with input from the technical specialists and MRPV. Section 8 provides further detail of the specific EPRs developed for contaminated land.

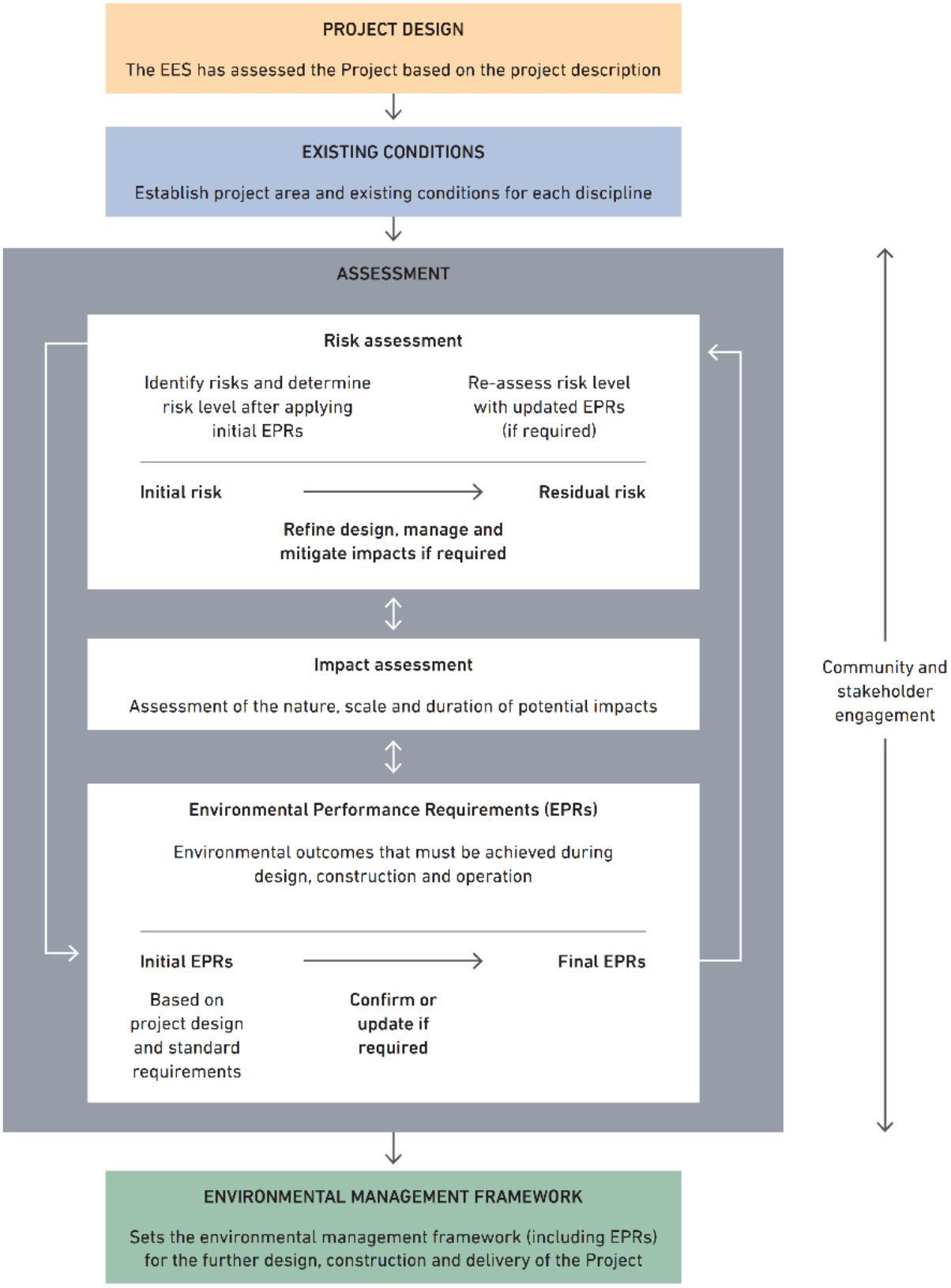

Figure 3.1: Environmental risk process

3.3.1 Risk Assessment Process

The ERA has guided the environmental studies for the Project. The objectives of the ERA are to:

- identify primary environmental risks that relate to the construction and operation of the Project
- guide the level and extent of investigation and data gathering necessary for accurately characterising the existing environment and assessing the Project's environmental effects
- help identify performance requirements to avoid, minimise and mitigate environmental risks
- inform assessment of likely residual effects that are expected to be experienced after standard controls and proposed EPRs have been implemented.

The risk assessment process for the EES incorporates risk management requirements as detailed in MRPV's Environmental Risk Management Guideline. The process includes:

- an approach to environmental management which is aligned with ISO 31000 Risk Management – Guidelines
- systems used to manage environmental risk and protect the environment, and how these are implemented at different stages of road construction, operation and maintenance
- tools and reporting requirements which provide guidance in managing environmental issues throughout the Project.

The ERA identifies impact events for each relevant element of the environment, details the primary risks and has informed the level and range of technical reporting required to address predicted impacts. The ERA utilises a risk matrix approach where likelihood and consequence of an event occurring are considered (Table 3.1, Table 3.2, Table 3.3 and Table 3.4).

Throughout the preparation of the EES, the likelihood and consequence categories were updated to ensure currency, as required.

Table 3.1: Risk significance matrix

Likelihood	**Consequence level**				
	Insignificant	Minor	Moderate	Major	Critical
Almost Certain	Medium	Significant	High	High	High
Likely	Medium	Medium	Significant	High	High
Possible	Low	Medium	Medium	Significant	High
Unlikely	Low	Low	Medium	Medium	Significant
Rare	Low	Low	Low	Medium	Medium

Likelihood and generic consequence criteria, informed by the MRPV corporate risk matrix, are shown in Table 3.2 and Table 3.3. Contaminated land specific consequence categories are provided in Table 3.4.

Risk ratings were then reassessed following risk evaluation and risk treatment to generate a 'residual' risk rating. Both initial and residual risk ratings are documented in the risk register attached in Appendix C.

Table 3.2: Likelihood criteria

Likelihood	Description
Almost certain	76-99% Has occurred before and is expected to occur again Is expected to occur each year or more frequently All of the controls associated with the risk are extremely weak/non-existent. Without control improvement there is almost no doubt that the risk will eventuate
Likely	51-75% Has occurred before with a chance of it occurring again Has occurred several times at the Department, Group, Division, Program or Project before The majority of the controls associated with the risk are weak. Without control improvement it is more likely than not that the risk will eventuate
Possible	26-50% Has occurred before with a chance of occurring again Has occurred at the Department, Group, Division, Program or Project once before There are some controls that need improvement, however unless there is improvement the risk may eventuate
Unlikely	6-25% Has occurred elsewhere before, therefore a small chance of occurring The majority of controls are strong with no control gaps. The strength of this control environment means that is likely that the risk eventuating would be caused by external factors not known to the organisation
Rare	0-5% Has never occurred but may occur Is expected to occur 1/100 or more years All controls are strong with no control gaps. The strength of this control environment means that if this risk eventuated, it is most likely as a result of external circumstances outside of the control of the organisation

Table 3.3: Generic consequence criteria

Consequence	Description
Critical	A critical degree of impact on an environmental asset, value or use of moderate or higher significance
Major	A high degree of impact on an environmental asset, value or use of moderate or higher significance
Moderate	A moderate degree of impact on an environmental asset, value or use of moderate or higher significance
Minor	A low degree of impact on an environmental asset, value or use
Insignificant	A very low degree of impact on an environmental asset, value or use

Table 3.4: Contaminated land consequence categories

Aspect	Insignificant	Minor	Moderate	Major	Critical
Contaminated Land	No disturbance of contaminated soils, acid sulfate soils / rocks.	Handling (including transportation, treatment and/or disposal) of contaminated soil and/or acid sulphate soils or rock with negligible risk to human health and/or the environment.	Handling (including transportation, treatment and/or disposal) of contaminated soil and/or acid sulphate soils or rock, with localised risk to human health and/or the environment.	Handling (including transportation, treatment and/or disposal) of contaminated soil and/or sulphate soils or rock with risk to human health and/or the environment in a number of localised areas.	Widespread irreversible risk to human health and/or the environment from handling (including transportation, treatment and/or disposal) of contaminated soil and/or acid sulphate soils or rock.

3.4 Impact Assessment

The potential impacts on human health and the environment from construction and operation activities and management of spoil have been considered at a local context with regard to both potential contamination and potential ASS with reference to the Beneficial Uses identified in the State Environment Protection Policy (SEPP) Prevention and Management of Contaminated Land (referred to as the Land SEPP).

The protected beneficial uses associated with the various land uses, defined in the Land SEPP are detailed in Table 3.5 below.

Table 3.5: SEPP prevention and management of contaminated land

Beneficial Use	Land Use						
	Parks & Reserves	Agricultural	Sensitive Use		Recreation / Open Space	Commercial	Industrial
			High density	Other			
Maintenance of Ecosystems							
Natural ecosystems	✓						
Modified Ecosystems	✓	✓		✓	✓		
Highly Modified Ecosystems		✓	✓	✓	✓	✓	✓
Human Health	✓	✓	✓	✓	✓	✓	✓
Buildings and Structures	✓	✓	✓	✓	✓	✓	✓
Aesthetics	✓		✓	✓	✓	✓	
Production of Food, Flora and Fibre	✓	✓		✓			

The method for assessing potential impacts on human health and the environment from construction activities and the management of spoil includes:

- desktop assessment of historical activities within the Project area that may have caused contamination to soil and are likely to be encountered during construction
- desktop assessment to identify contaminants of potential concern (CoPC) associated with historical activities within the Project area
- desktop assessment to identify potential acid sulfate soils within the Project area and that may be encountered during construction
- soil assessment comprising of 35 soil samples throughout the Project area and comparing the analytical results against applicable protected beneficial uses of land criteria
- assessing the potential impact that existing contamination may have on the current Project design and Bridge Inn Road intersection design
- assessment of the spoil management options to appropriately manage spoil produced during the construction and operation.

3.5 Environmental Performance Requirements

The environmental outcomes that must be achieved during design, construction and operation of the Projects are referred to throughout the EES as EPRs. EPRs must be achieved regardless of the construction methodology or design solutions adopted. Measures identified in this EES to avoid or reduce environmental impacts have formed part of the recommended EPRs for the Projects.

The development of the EPRs is in response to risks and impacts identified throughout this assessment, and in response to legislative requirements. The EPRs aim to promote measures to protect the beneficial uses of land and to minimise risk to human health and ecosystems from exposure to contaminated soils. Inputs from technical specialists and MRPV are utilised to consolidate a concise set of interrelated EPRs across the Project.

As outlined in Section 3.3 the risk assessment methodology has been designed to confirm if the developed EPRs are adequate or require further refinement.

The EPRs recommended for the contaminated land component of the Project are outlined in Section 8 and are included in the EES Environmental Management Framework.

The EPRs are applicable to the final design, construction approach and operation and provide certainty regarding the environmental performance of the Project.

3.6 Assumptions

The extent of the investigation completed is considered to satisfy the EES scoping requirements based on the findings of the ERA, the desktop review and the nature of the Project. Assessment of contaminants of potential concern was limited to those included within the Environment Protection Authority Industrial Waste Resource Guideline 621 (2009) Soil Hazard Categorisation and Management (IWRG621).

Groundwater has not been investigated as part of this assessment due to the absence of groundwater being identified during the intrusive investigation works. A groundwater impact assessment has been completed by Arcadis (2019) and the findings have been used to supplement the contaminated land assessment.

A landfill gas field investigation has not been completed to assess for the potential for landfill gas migration from the Plenty Landfill. However, historical documentation relating to the Plenty Landfill has been reviewed and the potential risk and likely impacts assessed as part of this report.

4 LEGISLATION, POLICIES AND GUIDELINES

This section assesses the Project against the Commonwealth and State legislation, policies and guidelines relevant to the contaminated land assessment.

4.1 Commonwealth Legislation

Commonwealth guidelines relevant to this assessment include:

- the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
  - the EPBC Act prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas and species, population and communities and heritage items.

The Project was referred to the Commonwealth Department of the Environment and Energy, who determined under Section 75 of the EPBC Act that the proposed action is a controlled action and, as such, it requires assessment and a decision about whether approval for it should be given under the EPBC Act.

4.2 State Legislation, Regulation and Policy

The State legislation, regulation and policies relevant to this assessment includes:

- the *Environment Protection Act 1970* (EP Act)
  - the framework for the management of contaminated land in Victoria is currently established through the EP Act. The EP Act aims to prevent pollution and environmental damage by setting environmental quality objectives and establishing programs to meet them. The Act establishes the powers, duties and functions of the Environment Protection Authority Victoria (EPA).
- the *Environment Protection Amendment Act 2018*
  - the *Environment Protection Amendment Act 2018* will take effect in 2021, or earlier by proclamation, and provides the foundation for the transformation of Victoria's environment protection laws and the EPA. This Act focuses on preventing waste and pollution impacts rather than managing those impacts after they have occurred. New guidelines are under development by EPA and will be released following implementation of the *Environment Protection Amendment Act 2018*. Central to the Environment Protection Amendment Act is the general environmental duty (GED). Under the GED businesses must understand the risk from their activities and how to address them. The extent of measures undertaken depends on how much risk the business' activities pose to human health and the environment.
- the National Environment Protection Council (1999) National Environment Protection (Assessment of Site Contamination) Measure, as varied in 2013 (NEPM 2013)
  - the NEPM 2013 provides a national framework for conducting contaminated land investigations in Australia and is implemented at the State level. The NEPM 2013 is primarily implemented through the State Environment Protection Policies (SEPP), particularly the SEPP (Prevention and Management of Contamination of Land) 2002.
- State Environment Protection Policy (SEPP) Prevention and Management of Contaminated Land (Land SEPP)
  - the SEPPs are subordinate Policies made under the provisions of the *Environment Protection Act 1970* to provide more detailed requirements and guidance for the application of the Act to Victoria. The Land SEPP establishes general uses of land in Victoria and provides a mechanism for determining whether these uses are being protected, such as indicators and objectives of use in assessing impacts.

Once construction of the Project commences, the most current version of the legislation will be used.

4.3 Guidelines

The following guidelines are considered relevant to assessment and management of contaminated land in Victoria:

- EPA VIC (June 2009) Industrial Waste Resource Guidelines Soil Hazard Categorisation and Management (IWRG 621)
- EPA VIC (June 2009) Industrial Waste Resource Guidelines Sampling and Analysis of Waters, Wastewaters, Soil and Wastes (IWRG 701)
- EPA VIC (June 2009) Industrial Waste Resource Guidelines Soil Sampling (IWRG 702)
  - the IWRG documents include waste categorisation and classification, waste transport, sampling and analysis and disposal guidance. Guidelines include information on most suitable patterns for sampling and the number of samples to be taken to ensure appropriate hazard categorisation is applied to soils being moved offsite for reuse, treatment and disposal.
- EPA VIC (July 2009) Publication 655.1 Acid Sulfate Soil and Rock
  - provides guidance to landowners, developers, consultants and other people involved in the disturbance of soil, sediment, rock and/or groundwater about identifying, classifying and managing acid sulfate soils and rock. Waste acid sulfate soils and rock must be managed in accordance with the requirements of the *Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999.*
- EPA VIC (August 2018) Publication 1669.2 Interim position statement on PFAS
- Heads of EPA (2018) PFAS National Environmental Management Plan (NEMP)
  - the interim position statement outlines EPA Victoria's current state of knowledge and position regarding PFAS and the NEMP is designed to achieve a clear and effective approach to the environmental regulation of PFAS. PFAS contaminated sites, PFAS contaminated materials and PFAS-containing materials.

Other relevant standards and guidelines relevant to contaminated land assessment include:

- EPA VIC (February 1996) Environmental Guidelines for Major Construction Sites (EPA Publication 480)
- Standards Australia (2005) Guide to the sampling and investigation of potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds, AS 4482.1-2005 (AS4482.1)
- Standards Australia (1999) Guide to the sampling and investigation of potentially contaminated soil, Part 2: Volatile substances, AS 4482.2-1999. (AS4482.2)
- CRC CARE Technical Report No. 10: Health screening Levels for Petroleum Hydrocarbons in Soil and Groundwater
- DSE (October 2010) Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils.

4.4 Site Assessment Criteria

4.4.1 Background

Given the proposed use of the site as a roadway, the most appropriate land use designation under the Land SEPP is 'Recreational/Open Space', consisting of general open spaces and public access areas.

The protected beneficial uses of land classified as 'Recreational/Open Space' include:

- human health
- maintenance of modified ecosystems and highly modified ecosystems
- buildings and structures
- aesthetics.

The soil assessment criteria are based on the *National Environment Protection (Assessment of Site Contamination) Amendment Measure* (NEPM 2013) for recreation/open space uses. Where no criteria are provided within the NEPM, relevant local and international criteria were adopted.

An assessment of impacts on buildings and structures has not been completed as part of this investigation. Soil aggressivity to building and structures has been considered in the geotechnical report (WSP, 2018) and have not been considered further in this report.

There are no published criteria specifically for the assessment of aesthetic impact. However, the Land SEPP states that 'contamination must not cause the land to be offensive to the senses of human beings. NEPM 2013 also states that site assessment requires balanced consideration of the quantity, type and distribution of foreign materials or odours in relation to the specific land use and its sensitivity.

4.4.2 Health Investigation Levels and Screening Levels

The quality objectives for human health, which reference the NEPM 2013 Health Investigation Levels (HIL) setting 'C' – Recreational/Open Space, have been adopted. Results were also screened against the NEPM 2013 Health Screening Levels for petroleum hydrocarbons in soil for recreational land use scenario (HSL C). The HSLs for vapour intrusion in sand (at depths relevant to the sample depth) were adopted as a conservative approach.

4.4.3 Maintenance Workers

To provide a qualitative assessment of the risk to maintenance/excavation workers from identified impacts in soil via inhalation and direct contact exposure pathways, concentrations of hydrocarbons have been compared to the risk-based HSLs detailed in CRC CARE Technical Report No. 10: *Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater* (Friebel and Nadebaum, 2011).

CRC CARE has undertaken the development of health-based screening levels (HSLs) for petroleum hydrocarbons to address an identified need for consistent human health risk assessment of petroleum hydrocarbon contamination in Australian conditions. The HSLs represent the best collective view of the available science and application of Australian approaches on selection of health criteria and exposure parameters (Friebel and Nadebaum, 2011).

HSLs for vapour exposure pathways have been developed for site-specific factors including soil types (sand, silt and clay) and depths below surface. The values for sand have been adopted as a conservative approach. Assumptions and limitations of application of the HSLs are detailed within CRC Technical Report 10 (Friebel and Nadebaum, 2011).

4.4.4 Ecological Screening and Investigation Levels

NEPM 2013 provides Ecological Investigation Levels (EIL) (derived for arsenic, copper, lead, naphthalene, nickel and zinc) for a range of different land uses. The EILs are generally applicable to the top 2 m of soil and have been selected based on average pH values and conservative cation exchange capacity (CEC) concentrations for Urban residential / Public open space.

Environmental Screening Levels (ESL) (derived for TPH fractions, BTEX and benzo(a)pyrene) have been selected based on coarse soil texture for Urban residential and Public open space.

4.4.5 Management Limits for Petroleum Hydrocarbons

The NEPM 2013 provides Management Limits (ML) for petroleum hydrocarbon compounds in soils. These limits are to assess for potential formation of light non-aqueous phase liquids (LNAPL), fire and explosion risk, and damage to buried infrastructure. For the Project area, MLs have been selected for Residential, Parkland and Public Open Space (coarse soil texture).

4.4.6 Waste Soil Classification

Waste soil classification was also completed and is documented in the appendices of this report and a summary of the results is provided in Section 5.9.

5 EXISTING CONDITIONS

5.1 Site Details

A summary of the Project area and surrounding areas is provided in Table 5.1 below. Further detailed information regarding the site setting is provided in Section 5.2 below. Lotsearch reports (Lotsearch, 2019) for the Project area are provided in Appendix D.

Table 5.1: Summary of Project area

Parameter	Site Details
Site address	Yan Yean Road, Kurrak Road to Bridge Inn Road, Yarrambat, Victoria
Current site use(s)	Road, residential, commercial, agricultural
Zoning	• Road Zone – Category 1 (RDZ1) • Road Zone – Category 2 (RDZ2) • Rural Conversation Zone – Schedule 3 (RCZ3) • Low Density Residential Zone (LDRZ) • Mixed Use Zone – Schedule 2 (MUZ2) • General Residential Zone – Schedule 1 (GRZ1) • Green Wedge Zone (GWZ) • Public Use Zone – Service and Utility (PUZ1) • Public Use Zone – Education (PUZ2) • Public Park and Recreation Zone (PPRZ) • Special Use Zone – Schedule 3 (SUZ3)
Overlays	• Environmental Audit Overlays (EAO) are located within the Project area and adjacent to the Project area at the following locations: – 573 Yan Yean Road - Yarra Valley Water Tower – 501 Yan Yean Road – 370-380 Yan Yean Road
Road alignment length	Approximately 5.5 km
Surrounding land uses	• **North**: Residential / Reserve / Undeveloped / Farmland • **East**: Residential / Undeveloped / Education / Farmland / Commercial • **South:** Residential / Commercial / Reserve / Undeveloped / Former Plenty Landfill • **West:** Residential / Undeveloped / Reserve / Commercial
Proposed site use	Arterial road

5.2 Local and Regional Setting

5.2.1 Surrounding land uses

The following land uses were identified surrounding the Project area:

- North: Residential / Reserve / Undeveloped / Farmland including:
  - reserve, automotive services, horse pedigree farm
- East: Residential / Undeveloped / Education / Farmland / Commercial including:
  - pet supplies, education facilities, egg suppliers, churches, drain, memorial park, general store
- South: Residential / Commercial / Reserve / Undeveloped including:
  - former Plenty Landfill, now a Recycling and recovery centre
- West: Residential / Undeveloped / Reserve / Commercial including:
  - veterinary hospital, childcare facilities, boarding kennels and cattery, church, golf course, archery range, horse racing track, public parks, tire supplies, service station, Plenty River and associated tributaries.

Several new residential subdivisions are occurring on land immediately to the west of the Project area, between Yan Yean Road and Plenty River.

5.3 Topography and Surface Water

The local topography within the Project area is between approximately 165 to 200 metres above Australian Height Datum (mAHD). The highest elevation is observed in the area of Doreen with the topography undulating across the Project area.

The closest surface water receptors are noted to be several tributaries (drains) of the Plenty River, which cross the central Project area. Doctors Gully Road Drain and Plenty River are located to the east and west of the road alignment respectively. The local surface drainage is likely to be collected at the drains either by infiltration through the soil profile or via overland flow during heavy rain events.

Several dams are present within individual residential properties along the Project area. The Yarrambat Park Lake is located to the north of the Yarrambat Golf Course and is considered to be a permanent freshwater lake.

5.4 Regional Geology

The Department of Economic Development, Jobs, Transport and Resources Geological Units 1:50,000 map indicates that the Yan Yean Road (Stage 2) Upgrade lies within geological deposits of the Murrindindi Supergroup (Melbourne Formation). The Melbourne Formation is made up of Mesozoic/Palaeozoic age bedrock comprising shale, mudstone, siltstone and sandstone with undisturbed Bouma sequences. Igneous (fractured rock) formations are also present in the general region, including granites, granodiorites and igneous intrusions (dykes). No superficial Quaternary deposits are reportedly present in the area. The Doreen Syncline and an unnamed anticline transects the Project area.

Review of the Geological Survey of Victoria, 1:63,360 Yan Yean map sheet, 1972 and the GeoVic database (GeoVic, 2015) indicate historical mining activities in the area of North Oatlands Road. Several historical gold mines are present in this area; however, no current operations are reported to be present.

Small scale gold mining activities were undertaken mainly from the 1920s to the 1950s in the area west of the current Yan Yean Road and north and south of Oatlands Road. In addition, three shafts were recorded in the area of the Plenty Landfill located to the south of Yan Yean Road. Gold bearing ore was extracted from narrow quartz veins, breccias and dykes that had intruded the basement siltstones.

The historical records, geological plans and cross sections indicate several mine shafts and adits associated with 5 mines were located west of Yan Yean Road, either side of North Oaklands Road (Kenny, 1940 and Whiting, 1955).

The superficial geology within the Project area and the location of the mine shafts are presented in Figure 2, Appendix B.

The interpreted locations relative to the current Yan Yean Road indicates the following:

- Golden Stairs – approximately 250 m west, several shafts are present to 60 m with associated adits at 30 m and 60 m depth below the surface
- Golden Crown – approximately 140 m west, several shafts are present to an approximate depth of 91 m below surface. Adits are present trending north between the shafts with adits extending west from the shafts
- Golden Gate – approximately 290 m west, shaft approximately 42 m deep with adit extending approximately 55 m west
- Golden King – approximately 125 m west, several shafts present to an approximate depth of 30 m. Several short adits 15 m to 22 m below surface extending east of the shaft
- Golden Step – approximately 250 m west
- three unnamed shafts – approximately 725 m south east of Yan Yean Road, east of Plenty Landfill.

Mining operations scaled down in the late 1970s. The Golden King mine closed in 1984 and the main shafts were filled in and capped in 1994.

It is considered that there is a low risk of historical mining activities impacting the Project as the proposed road alignment is greater than 100 m from the shafts and adits. However, limited information is available on the placement of overburden from the mines.

5.5 Regional and Site-specific Hydrogeology

The Project area is located in the East Port Phillip Bay Groundwater Catchment.

The general topography of the Project area indicates that groundwater flow is likely to be towards the west, towards the Plenty River which is considered to be the local groundwater receptor.

The bedrock aquifer (Mesozoic and Palaeozoic Bedrock, BSE) is regionally extensive, however it is not considered significant in terms of regional groundwater flow and is generally of low permeability and low quality (GHD, 2012). Groundwater in the area is classified as Segment B (Arcadis, 2019) under the State Environment Protection Policy (SEPP Waters) 2018.

Groundwater sampling and assessment was not completed as part of the contaminated land assessment scope of works, however geotechnical bores completed as part of this assessment indicated that groundwater was not intersected within 7.5 m of the ground surface.

A review of the Water Measurement Information System maintained by the Department of Environment, Land, Water and Planning (DELWP) revealed two registered groundwater bores within 500 m of the Project area one of which is registered for domestic uses and the other is registered for domestic and stock uses. Depth to groundwater in these bores is not reported (Arcadis, 2019).

A review of the Plenty Landfill Aftercare Management Plan (Golder, 2015) indicated that there are two additional groundwater monitoring bores located within 150 m of the Project area indicating groundwater is present at a depth of more than 60 mbgl.

Details of the groundwater bores are summarised in Table 5.2.

Table 5.2: Groundwater bore details for the Project area (within 500 m)

Well ID	Approximate Distance and Direction from Project Area (m)	Year Installed	Uses	Depth of Bore (mbgl*)	Information Provided
WRK051056 (BH7)	10 m South	2009	Monitoring (Plenty Landfill)	85.3	Coordinates, elevation, geology, well construction
WRK051507 (BH8)	10 m South	2009	Monitoring (Plenty Landfill)	72.0	Coordinates, elevation, geology, well construction
WRK990779	98 m North	2009	Domestic & stock	59.0	Coordinates, elevation, groundwater investigation use, lithology
WRK983650	325 m north of Yan Yean road / Worns Lane intersection	2008	Domestic	147.0	Coordinates, elevation, groundwater investigation use, lithology

* metres below ground level (mbgl)

5.6 Potential Acid Sulphate Soils

No coastal acid sulfate soils were identified within 150 m of the Project area. A low probability of occurrence of acid sulfate soils was reported in the Atlas of Australian Acid Sulfate Soils (Lotsearch, 2019).

5.7 Site History Desktop Review

5.7.1 Aerial Imagery Review (Historical and Current)

A review of the historical aerial photographs available between 1951 and 2017 (Google Earth imagery and Lotsearch) has been completed. The results of the review have been summarised in Table 5.3 below. The Lotsearch reports are provided in Appendix D.

Table 5.3: Summary of aerial photograph review

Date	Apparent Site Use	Surrounding Area – Features
1951	Roadway with tree lines on either side of the Project area	Vacant land and farmland with a few buildings (to the east and west). A few dams are present on land immediately west of the Project area. Some ground disturbance observed on land immediately north of North Oatlands Road, approximately 100-250 m west of Yan Yean Road. This is understood to be surface expression of previous gold mining activity. Aerial photographs do not indicate the presence of overburden deposits towards the east of the mines (i.e. towards Yan Yean Road).
1962/ 1963	Roadway	Surrounding land appeared largely unchanged. A large dam is present close to the corner of North Oatlands Road and Yan Yean Road (gold mining). A Harness Track is present to the south of North Oatlands Road in the 1962 photograph only.
1974	Roadway	Surrounding land appeared largely unchanged. Additional residential (to the north-east) and commercial (to the south-east) building developments were noted. A service station on the corner of Yan Yean Road and Worns Lane is present. Commencement of landfill activities approximately 300 m south of Yan Yean Road (Plenty Landfill).
1979	Roadway	Surrounding land appeared largely unchanged.
1982	Roadway	Surrounding land appeared largely unchanged. Additional buildings constructed around the Project area. Harness Track to the north of Yarrambat Golf Course.
1990/ 1991	Roadway	Surrounding land appeared largely unchanged. Several dams appeared to be infilled. Mine operations on the corner of North Oatlands Road and Yan Yean Road have ceased. Area converted to a residential property. Some mining dams are still present. One large dam appears to have been constructed on land immediately west of Yan Yean Road. Also referred to as Yarrambat Park Lake. Additional residential properties are under construction west of Yan Yean Road (Doreen Township). Large tank constructed north of Vista Court. Yarrambat Golf Course is under construction south of Doreen.
2005	Roadway A roundabout constructed at the intersection of Yan Yean Road and Kurrak Road.	Surrounding land appeared largely unchanged. Additional residential and commercial buildings have been constructed to the east and west of Yan Yean Road. The dams which formed part of the previous gold mine on the corner of North Oatlands Rd and Yan Yean Rd appears to have been in filled. A residential property has been developed to the south of North Oatlands Road, in the same location as a former dam. Doreen township is under construction. Yarrambat Golf Course is established. Service Station on the corner of Yan Yean Road and Worns Road has been demolished and cleared for residential development.

Date	Apparent Site Use	Surrounding Area – Features
2009	Roadway	Additional residential development within Doreen to the west of Yan Yean Road. Landfill activities 300m south of Yan Yean Road at Plenty Landfill have extended slightly to the north.
2017/ 18	Roadway	Some retail / commercial outlets and a service station have been constructed on the corner of Bridge Inn Road and Yan Yean Road. Heard Avenue Reserve appears to be present approximately 300 m south of Yan Yean Road (within the boundary of the former Plenty Landfill). Additional residential development has been completed to the west of Yan Yean Road (Doreen) and behind commercial properties on the corner of Bridge Road and Yan Yean Road. Further residential development under construction on the corner of Orchard and Yan Yean Road.

5.7.2 Previous Environmental Assessments

The Plenty Landfill, Aftercare Management Plan (Golder, 2015) was prepared for Nillumbik Shire Council following the issue of a Pollution Abatement Notice from the EPA (PAN9003408). The Aftercare Management Plan presents a risk assessment detailing the potential risks associated with the closed landfill, the proposed environmental monitoring requirements, contingency measures, reporting requirements and aftercare audit frequency.

The Department of Transport (DoT) contaminated land register was provided for review, however the document did not contain any information on the Project area.

5.7.3 EPA Register Review

A search of various EPA registers was undertaken in April 2020 to identify potentially contaminated sites. The results of the searches are presented in Table 5.4 below.

Table 5.4: Summary of search results - EPA registers

Register	Details
EPA Priority Sites	No current EPA priority sites identified within 150 m of the Project area
Former EPA Priority Sites and Other Pollution Notices	No former EPA priority sites identified within 150 m of the Project area
EPA Groundwater Quality Restricted Use Zones (GQRUZ)	No restrictions in groundwater use were identified within 150 m of the Project area
EPA Licensed Activities	No existing or former EPA licensed activities were identified within 150 m of the Project area
Waste Management Facilities (former and current)	No existing or former waste management facilities were identified within 150 m of the Project area. Plenty landfill was identified 300 m south of the Project area
Environmental Audit Report Search	Nine environmental audits were identified within 150 m of the Project area.

5.7.4 Environmental audit report summary

Nine environmental audits within 150 m of the Project area were identified within the Lotsearch report (Lotsearch, 2019) and have been confirmed on the EPA website (2019). The search results are provided in Appendix D. Information on the environmental audit sites are summarised in Table 5.5 to Table 5.13 below. The identified Audit sites are presented on Figure 3, Appendix B, with the exception of the Forest Management Areas (CARMS 68515-9) due to the extensive area.

Table 5.5: Nearby audit report search – CARMS 68515-9

Report	Information
VicForests from within the Central and Dandenong Forest Management Areas (FMAs), Victoria	
CARMs No.	68515-9
Site history	State forest
Audit background and outcome	Forest Audit Program (FAP) of timber harvesting and forest generation in State forest in Victoria under the Department of Environment and Primary Industries (DEPI). Thirty-four coupes of timber harvesting operations were assessed in the audit. Document review, site inspections and discussions were conducted during the audit. The audit findings were addressed by Modules 1 and 3 of the FAP: • module 1 (coupe planning, harvesting and closure) • module 3 (regeneration and finalisation). It was concluded that during the operations, fuel storage and waste disposal appeared to have been managed appropriately. No obvious environmental pollution, waste soil, empty drums or discarded machinery parts were observed. Phytoclean (which contained benzalkonium chloride) was used during the harvesting operations for one of the audited coupes.
Completion date	11 February 2015
Proximity to Yan Yean Road	Approximately 0 m south-west (refer to Lotsearch report Section 1, EPA Records – Audit Reports & Groundwater Quality Restricted Use Zone - GQRUZ).
Soil quality	Moderate to high subsoil erosion categories were recorded. Several additional erosion control measures were introduced to minimise risks of further erosion.
Groundwater quality	Groundwater monitoring was not conducted in this Audit.
Groundwater/soil remediation	Groundwater remediation was not conducted in this Audit.

Table 5.6: Nearby audit report search – CARMS 49436-1

Report	Information
Former Shell Service Station, Site 1, 450-456 Yan Yean Road, Yarrambat, Victoria	
CARMs No.	49436-1
Site history	Former Service Station
Audit background and outcome	Section 53X audit. This audit was conducted as part of due diligence prior to site sale. A statement of environmental audit was issued stating that the site was considered suitable for rural and residential use subject to the following conditions: • if fill material is an aesthetic concern it should be removed or covered with 0.5 m of clean fill • where sensitive plants or crops are to be planted then horticulture advice should be sought regarding the suitability of the metals detected at the site or plants should be propagated in 0.5 m of clean fill • soil and perched water in the area of the former tank pit should remain covered with 0.5 m clean fill or hardstand • if any unidentified petroleum storage infrastructure is encountered in the future, it should be removed, reported and approved by an Environmental Auditor appointed under the EP Act • if any future perched or regional groundwater abstraction is required than advice should sought from an Environmental Auditor appointed under the EP Act.
Completion date	13 May 2003
Proximity to Yan Yean Road	Approximately 0 m south-west (refer to Lotsearch report Section 1, EPA Records – Audit Reports & GQRUZ).
Soil quality	Soils at depth in the vicinity of former underground storage tanks were identified to have residual TPH concentrations. This was considered unlikely to be significant impact to sensitive receptors provided the material remains at depth. Soil impact was delineated to the north of the site adjacent to Yan Yean Road and no impact identified within 5 m of surface, in this area. Natural soil and fill materials on site were identified to have minor levels of metals (arsenic, nickel and zinc) which exceeded adopted ecological assessment criteria but below levels that would present a significant risk to human health.
Groundwater quality	Groundwater was not intersected at the site to a depth of 20 mbgl. Perched groundwater was encountered (at approximately 1.0 mbgl) but appeared limited to former tank pit areas. The perched water was identified to have residual TPH impacts. BTEX was not detected in perched groundwater. Risks to human and environmental receptors was considered to be limited unless the groundwater is abstracted.
Groundwater/soil remediation	Groundwater/soil remediation was not conducted in this Audit.

Table 5.7: Nearby audit report search – CARMS 42626-1

Report	Information
344-368 Yan Yean Road, Plenty, Victoria	
CARMs No.	42626-1
Site history	Previous mining activities and the property was likely to be contaminated by these activities
Audit background and outcome	This audit was conducted to provide the basis for a Planning Amendment to have the Environmental Audit Overlay (EAO) removed from the property. Followed by the remediation, the site was issued with a Statement of Environmental Audit (SoEA) with the following condition: • clean fill in the north-east corner shall be maintained to minimise exposure of underlying soil and rock • excavation workers must be informed of contamination and adopt good health and safety practices • contaminated soils and fill may need to be classified and managed in accordance with EPA Guidelines, if removed from site.
Completion date	24 October 2000
Proximity to Yan Yean Road	Approximately 44 m south-west (refer to Lotsearch report Section 1, EPA Records – Audit Reports & GQRUZ).
Soil quality	TPH and metals (arsenic, chromium, copper, lead and zinc) concentrations were detected. The contaminants were localised, and human health risk was considered to be negligible.
Groundwater quality	Groundwater monitoring was not conducted. However, the beneficial uses of groundwater were limited due to its high salinity. Contaminants in the surface soils were not anticipated to impact on the groundwater quality due to their low mobility.
Groundwater/soil remediation	Groundwater remediation was not conducted in this Audit. Soil remediation was conducted to the north-east corner of the property by covering the soils (elevated arsenic concentrations) with clean fill to a nominal depth of 0.5 m.

Table 5.8: Nearby audit report search – CARMS 31365-1

Report	Information
Lots 1 & 2, Kurrak Road, Yarrambat, Victoria	
CARMs No.	31365-1
Site history	Farmland
Audit background and outcome	This audit was conducted to request for a Certificate of Environmental Audit (CoEA). Residual asbestos contamination was found during the investigation work. Minor remediation of asbestos by removal was conducted, the site was then issued with a CoEA.
Completion date	23 June 1997
Proximity to Yan Yean Road	Approximately 103 m south-west (refer to Lotsearch report Section 1, EPA Records – Audit Reports & GQRUZ).

Report	Information
Soil quality	TPH and arsenic concentrations were reported. Minor occurrence of TPH did not yield any significant contamination. Arsenic concentrations in the soils do not present any significant risk to human health.
Groundwater quality	Groundwater monitoring was not conducted.
Groundwater/soil remediation	Groundwater remediation was not conducted in this Audit. Minor remediation of asbestos by removal was conducted.

Table 5.9: Nearby audit report search – CARMS 40576-1

Report	Information
541-533 Yan Yean Road, Yarrambat, Victoria	
CARMs No.	40576-1
Site history	Residential with previous mining activities and the property was likely to be contaminated by these activities.
Audit background and outcome	This audit was conducted to provide the basis for a Planning Amendment to have the EAO removed from the property. Investigation and remediation works were performed at the site. Elevated arsenic, mercury, chromium and nickel were detected in soil. Remediation was conducted and SoEA was issued as the site was suitable for residential use with adequate site management, and soils were contained and handle appropriately if excavated in future.
Completion date	17 February 2000
Proximity to Yan Yean Road	Approximately 0 m south-west (refer to Lotsearch report Section 2, EPA Records – Audit Reports & GQRUZ).
Soil quality	TPH and arsenic concentrations were reported. Minor occurrence of TPH did not yield any significant contamination. Arsenic concentrations in the soils do not present any significant risk to human health.
Groundwater quality	Groundwater monitoring was not conducted. However, groundwater was reported to be approximately 90 m below ground surface, therefore mining activities were unlikely to have impacted groundwater.
Groundwater/soil remediation	Groundwater remediation was not conducted in this Audit. Soil remediation was conducted on western and southern boundaries by capping with imported fill 0.5 to 1m. The remediated areas were covered with vegetation of trees and grass.

Table 5.10: Nearby audit report search – CARMS 41023-1

Report	Information
509 Yan Yean Road, Yarrambat, Victoria	
CARMs No.	41023-1
Site history	Residential with previous mining activities and the property was likely to be contaminated by these activities.
Audit background and outcome	This audit was conducted to provide the basis for a Planning Amendment to have the EAO removed from the property. Concentrations of arsenic and mercury were noted in soil in reviewed reports. SoEA was issued as the site was suitable for residential use with adequate site management, and soils were contained and handle appropriately if excavated in future.
Completion date	20 July 2000
Proximity to Yan Yean Road	Approximately 0 m south-west (refer to Lotsearch report Section 2, EPA Records – Audit Reports & GQRUZ).
Soil quality	Arsenic concentrations in the soils do not present any significant risk to human health but may be detrimental to some flora and fauna introduced to the site.
Groundwater quality	Groundwater monitoring was not conducted. However, groundwater was reported to be approximately 90 m below ground surface, therefore mining activities were unlikely to have impacted groundwater.
Groundwater/soil remediation	Groundwater/soil remediation was not conducted in this Audit.

Table 5.11: Nearby audit report search – CARMS 41057-1 and 41057-2

Report	Information
527-539 Yan Yean Road, Yarrambat, Victoria	
CARMs No.	41057-1 and 41057-2 (not available)
Site history	Residential with previous mining activities and the property was likely to be contaminated by these activities.
Audit background and outcome	This audit was conducted to provide the basis for a Planning Amendment to have the EAO removed from the property. Concentrations of arsenic and mercury were noted in soil. SoEA was issued as the site was suitable for residential use with adequate site management, and soils were contained and handle appropriately if excavated in future.
Completion date	30 May 2000
Proximity to Yan Yean Road	Approximately 0 m south-west (refer to Lotsearch report Section 2, EPA Records – Audit Reports & GQRUZ).
Soil quality	Arsenic concentrations in the soils do not present any significant risk to human health but may be detrimental to some flora and fauna introduced to the site.
Groundwater quality	Groundwater monitoring was not conducted. However, groundwater was reported to be approximately 90 m below ground surface, therefore mining activities were unlikely to have impacted groundwater.
Groundwater/soil remediation	Groundwater/soil remediation was not conducted in this Audit.

Table 5.12: Nearby audit report search – CARMS 70612-1

Report	Information
Lot 1, 515-525 Yan Yean Road, Yarrambat, Victoria	
CARMs No.	70612-1
Site history	Site was used for pastoral grazing, low-density residential and potentially horticulture and is located at the lower slope of the former Golden King Goldmine, located immediately north of North Oatlands Road. The dam located onsite was part of the settling ponds used to recycle process water from the mine and mine tailings were disposed on the western portion of the site.
Audit background and outcome	This audit was conducted to provide the basis for a Planning Amendment to have the EAO removed from the property. Concentrations of arsenic and mercury were noted in soil in reviewed reports. SoEA was issued as the site was suitable for sensitive use, recreation / open space, commercial and industrial.
Completion date	19 November 2012
Proximity to Yan Yean Road	Approximately 0 m south-west (refer to Lotsearch report Section 2, EPA Records – Audit Reports & GQRUZ).
Soil quality	Arsenic and mercury concentrations in the soils do not present any significant effect on the highly modified ecosystem at the site.
Groundwater quality	Groundwater monitoring was not conducted. However, the depth to groundwater, the salinity and the low yield of the aquifer indicated that beneficial uses other than maintenance of ecosystems was unlikely to be realised at or near the site.
Groundwater/soil remediation	Groundwater/soil remediation was not conducted in this Audit.

Table 5.13: Nearby audit report search – CARMS 28958-1

Report	Information
Lot 2 North Oatlands Road | 515-525 Yan Yean Road, Yarrambat, Victoria	
CARMs No.	28958-1
Site history	The site was occupied by some of surface operations of the Golden King goldmine.
Audit background and outcome	This audit was conducted to provide the basis for a Planning Amendment to have the EAO removed from the property. Concentrations of arsenic and mercury were noted in soil and surface water in reviewed reports. It was concluded that the site was not suitable for any beneficial use and was only suitable for residential use provided the integrity of the 0.5 m thickness of soil were maintained. Any soil to be disposed of off-site is to be in compliance with EPA, the site was kept well vegetated to prevent surface run-off particularly to the west of the site (crushing battery area).
Completion date	16 April 1997
Proximity to Yan Yean Road	Approximately 122 m south-west (refer to Lotsearch report Section 2, EPA Records – Audit Reports & GQRUZ).
Soil quality	Arsenic and mercury concentrations in the soils were present.

Report	Information
Groundwater quality	Groundwater monitoring was not conducted and was not considered to be an issue for this audit.
Groundwater/soil remediation	Groundwater/soil remediation was not conducted in this Audit. Soil remediation was conducted in the south-west corner of the site.

5.8 Conceptual Site Model

5.8.1 Background

This section provides a summary of the Contaminants of Potential Concern (COPC), relevant pathways and receptors associated with the Project area based on the review of desktop information.

5.8.2 Potential Sources of Contamination

A review of the available current and historical information identified multiple sources of potential contamination and associated COPC as summarised in Table 5.14 below.

Table 5.14: Potential sources of contamination

Activity	Property Use (Current/Historical)	Contaminants of Potential Concern
Within the Project area		
Yan Yean Road	Historical – Roadway (imported materials, vacant land, farmland, state forest) Current – Roadway	Heavy metals (arsenic and mercury), hydrocarbons, polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides (OCP), organophosphate pesticides (OPP).
Within 150 m of the Project area		
Farmland (pastoral and agricultural purposes)	Historical	Benzene, toluene, ethyl benzene and xylene (BTEX); total petroleum hydrocarbons (TPH), PAH, OCPs, OPPs, arsenic.
Butchers - Kurrak Road, Yarrambat - Yan Yean Road, Yarrambat	Historical	Sodium carbonates, surfactants / detergent (chlorine, silicate or phosphate), aldehydes, phenols / cresols, alcohols, peroxides, peracetic acid.
Former gold mining activities - North and south of North Oatlands Rd, located > 100m to the west of Yan Yean Rd, Yarrambat	Historical	TPH, BTEX, metals, acids, sulfates
Homestead Farm - 25 Doctors Gully Road, Doreen Yarrambat Saddlery - Bannons Lane, Yarrambat	Current	TPH, BTEX (heating oil), glutaraldehyde and formaldehyde, hydrogen peroxide, peracetic acid (sterilizing agents), fungicides, herbicides, insecticides (biocides), glycols, alcohols, aldehydes, oxidizing agents, phenolics, silver, copper (disinfectants).
Yarrambat Doreen Farm Fresh Eggs - 638 Yan Yean Road, Yarrambat	Current	Alkaline chlorinated compound (egg cleaning compound), sea acid (detergent), ethanol based cleaner.

Activity	Property Use (Current/Historical)	Contaminants of Potential Concern
Motor Garages and Service Stations - Corner of Yan Yean and Bridge Inn Road, Doreen (United Petroleum) - 450-456 Yan Yean Road (Shell Service Station) - 901 Bridge Inn Road, Doreen - 940 Bridge Inn Road, Doreen	Current Historical Current Current	TPH, BTEX, PAHs, metals.
Boarding Kennels & Cattery – 605 Yan Yean Road, Yarrambat	Current	Arsenic, lead, OCPs, OPPs, sodium tetraborate, carbamates, sulphur, synthetic pyrethroids.
Other Potential Sources		
Former Plenty Landfill / Nillumbik Recycling and Recovery Centre - 290 Yan Yean Road, Plenty	Historical / Current	TPH, BTEX, PAHs, metals, landfill gas and leachate.

Given that the Project area is a roadway and historical land uses include farmland and goldmine operations, it is possible that imported fill material underlying the site may be contaminated with TPH, BTEX, PAH, metals, OCP and OPP compounds.

The existing road is likely to have been developed using a cut and fill method and imported crushed rock is likely to have been used for the base course material. The potential for asbestos to be present below the existing road is therefore considered to be low.

Available information (Plenty Landfill Management Report (Golder, 2015), Audit Reports (various) and the Geotechnical Report, (WSP, 2018)) provide information on the depth to groundwater across the Project area. Groundwater is estimated to be more than 60 m below ground surface in the area of the cut and fill works within the Project area, which is supported by the review of Audit Reports in Section 5.7 above, therefore Project activities are considered unlikely to mobilise existing contamination which would then impact groundwater. A full assessment of potential impacts to groundwater is provided in the Groundwater Impact Assessment (Arcadis, 2020). No groundwater sampling was completed as part of this assessment.

Coastal acid sulfate soils were not identified within the Project area. A low probability of occurrence of acid sulfate soils was reported.

5.8.3 Potential Pathways and Receptors

For a source to pose a risk to a potential receptor, three components are required:

- Source: a potentially hazardous substance that has been released into the environment
- Pathway: the mechanism by which receptors may be exposed to the source or derivatives of the source
- Receptor: the human or ecological component potentially at risk of experiencing an adverse response from exposure to the source, or derivatives of the source.

The assessment of the overall risk associated with the potential sources and receptors identified within the Project area consider the environmental impacts during construction and operation works only.

A summary of the potential receptors and pathways is presented in Table 5.15.

Table 5.15: Summary of potential receptors and pathways

Receptors	Medium	Pathway
Project area construction and intrusive maintenance workers	Soil Soil vapour	Dermal contact Ingestion Vapour / dust inhalation
Adjacent commercial and intrusive maintenance workers		
Adjacent residents		
Adjacent ecosystem and terrestrial receptors	Soil	Direct contact
Adjacent surface water bodies (i.e. Doctors Gully Road Drain, Plenty River)	Soil	Direct contact and sediment run-off

A landfill gas risk assessment (LFGRA) was completed as part of the Plenty Landfill Aftercare Management Plan (Golder, 2015). In accordance with the management plan, landfill gas has been monitored in natural material located outside the landfill area. The risk assessment considered potential receptors to the north and west of the Yan Yean Road area and adjacent residential sites (located between 100 m and 200 m from the landfill). The report proposed that landfill gas was migrating at a low flux rate that allows the degradation of methane by microbial oxidation. The LFGRA indicated that lateral landfill gas migration was very unlikely, and the risks were considered acceptable with respect to impacts to receptors. Therefore, the risks to construction activities at the Project are considered to be low.

Migration of contaminated groundwater from adjacent, potentially contaminated sites is considered unlikely to impact the proposed construction works due to the depth to groundwater.

5.8.4 Conceptual Site Model Summary

Review of the current and historical activities within the Project area identified three areas where potentially contaminated soils may be present from current or former uses as follows:

- United Petroleum Service Station currently located on Bridge Inn Road
- Shell Service Station historically located at 450-456 Yan Yean Road
- Historical mining activities located in the area of Yarrambat, north and south of North Oatlands Drive.

The quantity and quality of imported fill material used within the road alignment is not documented and no information on the materials used to fill former dams along the alignment is available, therefore there is a potential for contaminated fill material to be present.

The findings of the desktop review were used to inform the ERA and the sites identified as potential sources are presented on Figure 3, Appendix B.

5.9 Soil Assessment Results

Based on the findings of the desktop assessment and the ERA, a field program of intrusive works was completed to address these data gaps. The following sections detail the result of the intrusive works. The field investigation sampling locations are presented in Figure 3, Appendix B.

5.9.1 Field Observations

A summary of soils encountered during sampling is presented in Table 5.16. Soil logs are presented in Appendix E. Olfactory observations were not recorded during the sampling event. PID readings ranged from 0.1 to 0.5 ppm between 0.3 and 0.9 mbgl.

Table 5.16: General soil descriptions

Depths (mbgl)	Soil Description
0.0 – 0.3	TOPSOIL: Clayey SILT; low plasticity, brown grey.
0.0 – 2.0	Fill: Silty CLAY; low plasticity, pale yellow brown, trace of fine to medium grained gravel, crushed rock.
0.2 – 2.0	Silty CLAY; low to high plasticity, orange brown.
4.8 – 5.29	SANDSTONE: fine grained, pale grey, pale purple.
1.0 – 7.50	SILTSTONE; highly weathered, pale brown, pale grey, orange red brown, very low to low strength.

Perched water or groundwater was not identified during drilling of bores installed as part of the geotechnical assessment (WSP, 2018) to a maximum depth of 7.5 mbgl.

5.9.2 Soil Analytical Results

Selected soil samples (34 in total) collected from various locations across the Project area were analysed for a broad contaminant suite (IWRG 621 screen). Soil samples were selected based on a combination of sample location (to provide site coverage) and field observations of soil impact. Initial locations were identified based on the results of the desktop and targeted areas of potential concern.

The following sections provide a summary of the results of the soil assessment completed to assess the existing conditions across the Project area. Laboratory certificates are provided in Appendix F and Table 1, Appendix G presents the analytical results compared against the adopted assessment criteria.

Human health and maintenance workers

All analytical results for soil samples analysed were below the adopted human health assessment criteria for an urban residential/open space scenario.

All analytical results for soil samples analysed were below the adopted assessment criteria for maintenance / excavation workers via inhalation and direct contact exposure pathways.

Maintenance of ecosystems

Table 5.17 below summarises soil concentrations which exceeded the adopted ecosystem assessment criteria for ‘urban residential and public open spaces’ land use.

Table 5.17: Summary of soil samples exceeding ecosystem criteria

Analyte	Sample Location / Depth (m)	Criteria Limit (mg/kg)	Reported Concentration (mg/kg)
Arsenic	TP17-32-25 at 0.6 m	100	118

Management limits

Concentrations of petroleum hydrocarbon compounds in soils did not exceed Management Limits in any of the samples analysed.

Indicative waste soil classification

Table 1, Appendix I presents the analytical results compared against the IWRG criteria. A summary of the results is provided in Table 5.18. Figure 4, Appendix B presents the indicative waste classification of the samples across the Project area.

Table 5.18: Summary of indicative waste classification

Analyte	Samples Exceeding EPA Vic Fill Upper Limit	Indicative Classification
Arsenic	TP17-32-18, TP17-32-19, TP17-32-20, TP17-32-23, TP17-32-24, TP17-32-25, TP17-32-29, TP17-32-30, TP17-32-31, TP17-32-36	Category C Contaminated Soil
Fluoride	PD17-32-02, PD17-32-47, TP17-32-01, TP17-32-03, TP17-32-09, TP17-32-10, TP17-32-13, TP17-32-16, TP17-32-19, TP17-32-20, TP17-32-24, TP17-32-29, TP17-32-30, TP17-32-31, TP17-32-33, TP17-32-35, TP17-32-36, TP17-32-43	Category C Contaminated Soil
Hexavalent Chromium	PD17-32-47	Category C Contaminated Soil
Nickel	PD17-32-43, Target 2	Category C Contaminated Soil

Low soil pH (between pH 4 and 5) were measured across the Project area. This is consistent with the average pH for the Shire of Nillumbik which is approximately pH 4.4 for depths less than 0.6 mbgl (Mikkonen et al, 2018). Therefore, the pH values identified during this assessment are considered to be naturally occurring.

Elevated natural background concentrations of arsenic and fluoride are present in the Nillumbik area (Mikkonen et all, 2018). If disposal of Category C soil be required, further assessment during construction may allow the reclassification of Category C soils as Fill Material.

If disposal of Category C soils is required during construction, leachate analysis will be required by the receiving landfill prior to disposal.

Following implementation of the *Environment Protection Amendment Act 2018* in July 2020, this soil classification may change based on the introduction of new waste regulations. The available data should be reassessed in the context of the new regulations at the appropriate time to confirm soil disposal classifications.

5.9.3 Quality Assurance and Quality Control

A summary of the quality assurance and quality control procedures and results obtained throughout this assessment are presented in Appendix H.

Differences in concentrations reported between the primary and split sample were identified and are considered likely to be due to the heterogeneity of the soil samples. Variations observed could also be attributed to differences in testing regime and laboratory conditions between the primary and secondary laboratories. Overall, these variations in concentrations are not considered to impact on the interpretation of the soil results or conclusions of this assessment.

As such, it is considered that the QA/QC procedures and results were adequate for the assessment works completed.

6 RISK ASSESSMENT

The residual environmental risks identified for contaminated land are provided in Table 6.1. The residual risk ratings consider the standard controls and proposed EPRs. The proposed EPRs are set out in Table 8.1 in Section 8.

An assessment of risks to Beneficial Uses of land (as specified in the Land SEPP) posed by the Project was undertaken in accordance with the methodology described in Section 3.3.

Potential risks were identified in the context of activities completed during construction and also during operational / maintenance phases of the Project.

Table 6.1: Summary of contaminated land and risk assessment

Risk No.	Aspect	Impact Pathway	Mitigation Measures to Inform Environmental Performance Requirement	EPR	Residual Risk Rating
Construction					
5, 25, 45, 65	Contaminated Land	Excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Prepare and implement a Construction Environmental Management Plan (CEMP) which includes processes and measures to manage contaminated soil that comply with relevant legislation and guidelines, including but not limited to: • Land and water objectives set out in the Environment Reference Standards (EP Amendment Act 2018) • EPA Publication 1827: Waste classification assessment protocol and EPA Publication 1828: Waste disposal categories - characteristics and thresholds • Environment Protection (Industrial Waste Resource) Regulations 2009 • Industrial Waste Management Policy (Waste Acid Sulphate Soils) 1999 • National Environment Protection (Assessment of Site Contamination) Measures 2013 • Environment Protection (Scheduled Premises and Exemptions) Regulations 2007 • WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos). This will include measures such as: • Characterising soil prior to disposal or reuse • Identifying soil containing asbestos and if present, developing management strategies in accordance with the WorkSafe Regulations • Assessing geological formations with naturally enriched metals and applicable spoil management options and or off-site disposal to the satisfaction of EPA Victoria • Identifying suitably licensed facilities for the disposal or treatment of contaminated soil • Management of wastewater • Management of dust, potential stormwater run-off and seepage from stockpiled materials • Undertaking a baseline site assessment of areas proposed for construction laydown prior to use	CL1	Low

Risk No.	Aspect	Impact Pathway	Mitigation Measures to Inform Environmental Performance Requirement	EPR	Residual Risk Rating
			• Protection of the beneficial uses of land associated with current and planned future use. Note that mitigations identified in relation to the current Environment Protection Act (1970) and relevant subordinate legislation should be revisited and reconsidered within the context of the upcoming *Environment Protection Amendment Act (2018)* when it comes into effect as of 1 July 2021.		
Operations					
85	Contaminated Land	Operational activities that require excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's standards for managing declared roads in Victoria.	EMF5	Low
Maintenance					
105	Contaminated Land	Maintenance activities that require excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's standards for managing declared roads in Victoria.	EMF5	Low

7 IMPACT ASSESSMENT

The potential impacts on human health and the environment from construction activities and management of spoil have been considered at a local context with regard to both contamination and acid sulfate soil with reference to the beneficial uses identified in the SEPP Prevention and Management of Contaminated Land. As outlined in Section 4.4.1, the most appropriate land use designation under the Land SEPP considered for the Project is 'Recreational/Open Space'.

Desktop and field investigations were conducted and the results of the investigations were used to carry out the impact assessment. The results from the investigations are presented in Section 5. The sections below summarise the identified potential construction and operational impacts based on those results.

7.1 Construction Impacts

Construction of the Project has the potential to cause the following impacts:

- disturbance, handling, storage or disposal of contaminated soil leading to health and environmental impacts
- disturbance, handling, storage or disposal of ASS / contaminated soil results in the generation of odorous material and loss of amenity
- unknown contamination and / or ASS encountered resulting in health, environmental and amenity impacts
- fuel or chemical spill results in health, environmental or amenity impacts
- incorrect management of contaminated material resulting in environmental impacts.

Based on the desktop and field investigations conducted, the results indicated no significant areas of soil contamination or ASS were identified. The results of the intrusive soil investigation are considered to be indicative of the contamination profile of the shallow soils. The findings from the soil assessment and risk assessment also indicate that the potential impacts from existing contaminated land to human health and the environment is considered to be low. The existing contamination in the area is considered to have a low impact on the design and Bridge Inn Road intersection design.

Known contaminated soil and unexpected contaminated material / ASS during construction of the Project is expected to be managed through developing and implementing a Construction Environmental Management Plan (CEMP).

The CEMP forms the basis of EPRs that are necessary to achieve acceptable environmental outcomes.

EPRs for management of soils and spoils, including ASS during construction are presented in Section 8.

Potential impacts from chemical leaks or spills during construction will be mitigated by implementation of standard controls which will be documented in the contaminated soil and spoil management plan.

7.2 Operational Impact

Similar to the construction impact, potential impacts from unidentified contaminated soils and from fuel or chemical spills during operational maintenance works are also considered to be low. Standard controls and management measures to minimise the impact of operational maintenance works would be similar to control and management measures specified for managing the construction impact of the Project.

The development and implementation of contaminated soil and spoil management plan for the Project are expected to mitigate the associated impacts from the construction of the Project and operational maintenance of road.

8 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

Table 8.1 lists the proposed EPRs relevant to the contaminated land assessment.

Table 8.1: Environmental Performance Requirements

Performance Objective	Applicable Legislation, Policy and Guideline	EPR Code	Risk No.	Environmental Performance Requirement	Project Phase
Effects on physical environment- Identify other potential adverse environmental effects of the project, such as on social and community amenity canvass an environmental management approach and performance measures to ensure any effects are identified and avoided, minimised or mitigated.					
Contaminated land To protect the beneficial uses of land and minimise risk to human health and ecosystems from exposure to contaminated soils	State Environment Protection Policy (SEPP) – Prevention and Management of Contamination of Land PFAS National Environmental Management Plan 1.0 2018 EPA Publication 480 (EPA Environmental Guidelines for Major Construction Sites) Environment Protection (Industrial Waste Resource) Regulations 2009 Industrial Waste Management Policy (Waste Acid Sulphate Soils) 1999 National Environment Protection (Assessment of Site Contamination) Measures 2013 WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos) AS 4482.1-2005 Guide to the investigation and sampling of sites with potentially contaminated soil AS 4482.2-1999 Guide to the sampling and investigation of potentially contaminated soil	CL1	5, 25, 45, 65	**Spoil management** The CEMP must include processes and measures to manage contaminated soil in accordance with the relevant objectives set out in State Environment Protection Policy (SEPP) – Prevention and Management of Contamination of Land and other relevant statutory requirements and guidelines. These include, but are not limited to: • Environment Protection (Industrial Waste Resource) Regulations 2009 • Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999 • National Environment Protection (Assessment of Site Contamination) Measures 1999, amended 2013 (ASC NEPM) • WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos) • PFAS National Environmental Management Plan 1.0 2018 • AS 4482.1-2005 Guide to the investigation and sampling of sites with potentially contaminated soil. The processes and measures must include: • Characterising soil prior to disposal or reuse • Identifying soil containing asbestos and if present, developing management strategies in accordance with the WorkSafe Regulations • Assessing geological formations with naturally enriched metals and applicable spoil management options and or off-site disposal to the satisfaction of EPA Victoria	Design and construction

Performance Objective	Applicable Legislation, Policy and Guideline	EPR Code	Risk No.	Environmental Performance Requirement	Project Phase
				• Identifying suitably licensed facilities for the disposal or treatment of contaminated soil • Management measures for storage, handling and transport of spoil for the protection of health, amenity and the environment • Management of wastewater • Management of dust, potential stormwater run-off and seepage from stockpiled materials • Undertaking a baseline site assessment of areas proposed for construction laydown prior to use • Protection of the beneficial uses of land associated with current and planned future use.	
Environmental Management Framework To provide a transparent framework with clear accountabilities for managing and monitoring the environmental effects associated with the Project	Legislation and policy as identified in all EPRs	EMF5	85, 105	Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's environmental management system and standards for managing declared roads in Victoria.	Operation and maintenance

9 CONCLUSION

A contaminated land assessment has been completed for the Yan Yean Road (Stage 2) Upgrade to assess potential impacts of soil contamination and acid sulfate soils as a result of the Project construction and operation works and to identify management options to reduce potential impacts.

9.1 Existing Conditions

The review of available information and data collected during the soil assessment indicates the following:

- the desktop findings indicate that Yan Yean Road has been used as a road since at least 1951. Land surrounding the Project area was historically used for farming and mining purposes and has been gradually redeveloped for residential and commercial purposes
- the local topography is between 165 to 200 mAHD
- the closest surface water receptors are noted to be several tributaries (drains) of the Plenty River
- the Project area is located in the East Port Phillip Bay Groundwater Catchment
- the Project area is underlain by Mesozoic/Palaeozoic age bedrock comprising sandstone, siltstone, mudstone and shale. Igneous (fractured rock) formations are also present in the region, including granites, granodiorites and igneous intrusions (dykes)
- no coastal acid sulfate soils were identified within 150 m of the Project area
- the intrusive investigation confirmed the presence of fill material, ranging from surface to 2.0 mbgl. The fill material comprises of silty clay.
- groundwater was not intersected within 7.5 m of the ground surface during installation of the geotechnical bores completed as part of the assessment
- results of the soil assessment indicated:
  - petroleum hydrocarbon compound concentrations were below the adopted human health and management limit assessment criteria at all locations
  - concentrations of arsenic and nickel exceeded the adopted ecosystem assessment criteria for ‘urban residential and public open spaces’ land use at seven sampled locations
  - based on the available data, 21 out of 34 locations sampled are indicatively classified as Category C Contaminated Material. Arsenic, fluoride, hexavalent chromium and nickel concentrations exceeded the Fill Material threshold criteria.

9.2 Environmental Risk and Impact Assessments

An ERA and impact assessment identified the following potential risks and impacts associated with construction of the Project and operational maintenance works:

- overall, the potential risk to receptors from existing contamination was considered to be low, however former gold mining and current and former service stations were identified. These areas have been further investigated in conjunction with the geotechnical assessment to assess absence of significant soil impact
- potential risk from spills or leaks during construction and operation were considered to be possible, but with an overall minor consequence following implementation of management measures, therefore the overall risk is considered to be low
- potential risk from unidentified contaminated soils during construction and operational maintenance works were also considered to be low
- potential risk from acid sulfate soils or coastal acid sulfate soils were considered to be low.

In conclusion:

- potential impact from existing contaminated land to human health and the environment is considered to be low

- existing contamination in the area is considered to have a low impact on the design Bridge Inn Road intersection design
- potential impacts from unidentified contaminated soils and from fuel or chemical spills during operational maintenance works are also considered to be low.

The implementation of EPRs for the Project are expected to mitigate the associated and potential unforeseen impacts from the construction of the Project and operational maintenance of road.

9.3 Environmental Performance Requirements

EPRs were developed to achieve acceptable environmental outcomes for the Project. The EPRs are applicable to the final design, construction and operation approach and provide certainty regarding the environmental performance of the Project.

Managing existing contamination or unexpected contamination and / or acid sulfate soils, and fuel or chemical spills during the construction and operation phases would be undertaken by developing and implementing a CEMP for the Project prior to construction or early works.

10 REFERENCES

Arcadis (2020), Yan Yean Road (Stage 2) Upgrade. Preliminary Groundwater Impact Assessment. Arcadis Australia Pty Ltd.

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11 LIMITATIONS

The findings of this report are based on the Scope of Work described in this report. Arcadis Australia Pacific Pty Limited (Arcadis) performed the services in a manner consistent with the level of care and expertise exercised by members of the environmental profession.

No warranties, express or implied, are made. Subject to the Scope of Work, Arcadis' assessment is limited strictly to identifying typical environmental conditions associated with the subject property.

While normal assessments of data reliability have been made, Arcadis assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of Arcadis, or developments resulting from situations outside the scope of this Project

Arcadis prepared this report for the sole and exclusive benefit and use of the client. Notwithstanding delivery of this report by Arcadis or the client to any third party, any copy of this report provided to a third party is provided for informational purposes only, without the right to rely.

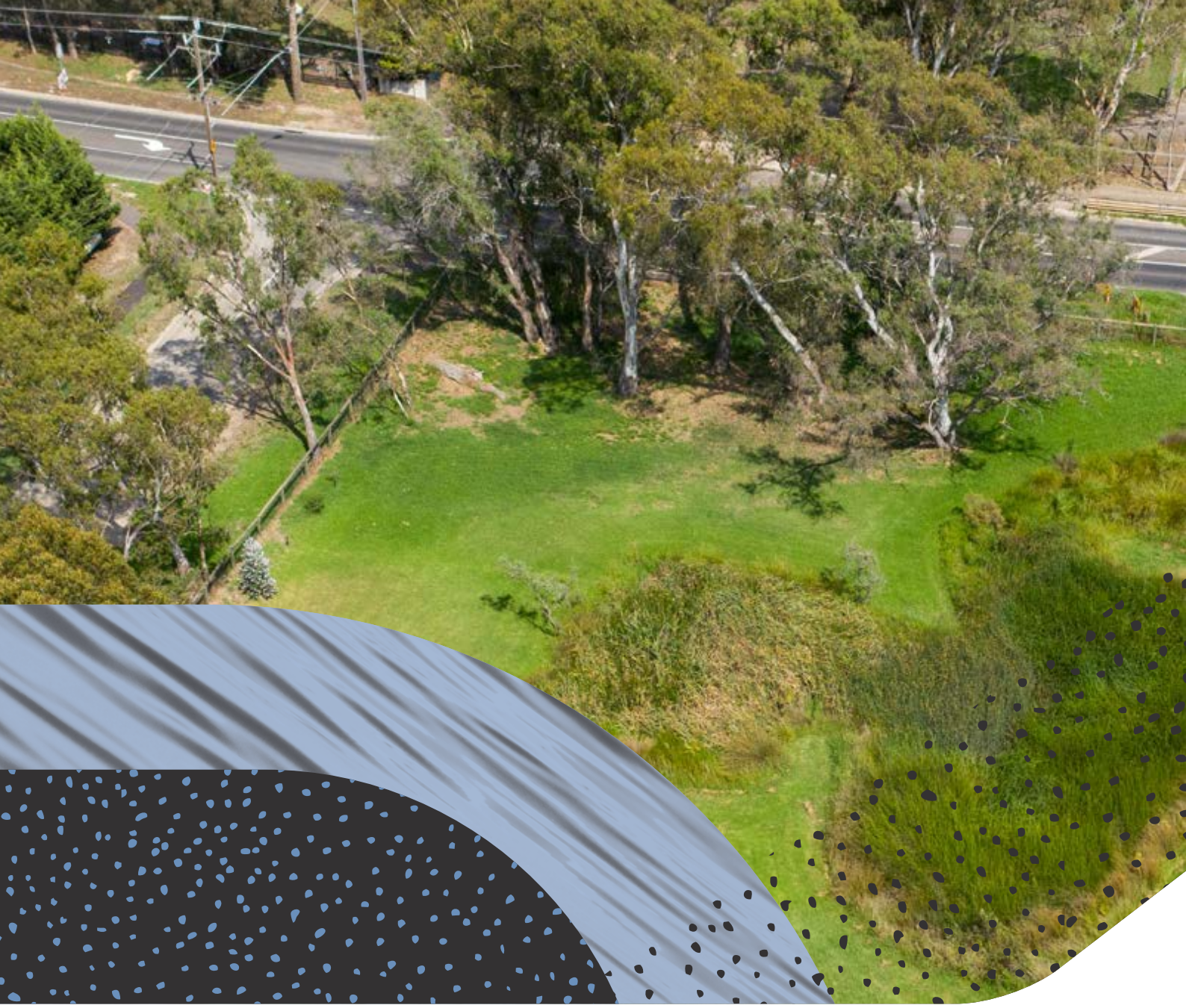
Information from samples collected by Arcadis personnel relating to soil, groundwater, waste, air or other matrix conditions in this document is considered to be accurate at the date of issue. Surface, subsurface and atmospheric conditions can vary across a particular site or region, which cannot be wholly defined by investigation. As a result, it is unlikely that the results and estimations presented in this report will represent the extremes of conditions within the site that may exist. Subsurface conditions including contaminant concentrations can change in a limited period of time and typically have a high level of spatial heterogeneity.

From a technical perspective, there is a high degree of uncertainty associated with the assessment of subsurface, aquatic and atmospheric environments. They are prone to be heterogeneous, complex environments, in which small subsurface features or changes in geologic conditions or other environmental anomalies can have substantial impact on water, air and chemical movement.

Arcadis' professional opinions are based upon its professional judgment, experience, and training. These opinions are also based upon data derived from the limited testing and analysis described in this report. It is possible that additional testing and analysis might produce different results and/or different opinions. Arcadis has limited its investigation(s) to the scope agreed upon with its client.

That standard of care may change and new methods and practices of exploration, testing and analysis.

APPENDIX A PROJECT DESCRIPTION: YAN YEAN ROAD UPGRADE – STAGE 2



PART 1 INTRODUCTORY CHAPTERS

5 Project Description

5.1 Introduction

This chapter describes the proposed design, construction and operation of the duplication of Yan Yean Road between Kurrak Road and Bridge Inn Road (the Project). The chapter should be read in conjunction with Attachment VI *Map Book*, which contains detailed plans and drawings of key elements of the Project.

This Project description has been developed to provide an understanding of all components, processes and development stages of the Project to enable assessment of the Project's potential environmental effects. The description includes specific design elements to address the potential for the Project to generate adverse environmental effects and impacts.

5.2 Project overview

Yan Yean Road is a significant north-south arterial road servicing the Shire of Nillumbik and the City of Whittlesea, providing connectivity for the City of Whittlesea's growing suburbs of Doreen and Mernda to the townships of Plenty and Yarrambat. Yan Yean Road connects with major east-west arterials such as Bridge Inn Road, Kurrak Road and Diamond Creek Road and also provides a connection to employment and services in established neighbouring suburbs such as Greensborough and Diamond Creek.

Stage 1 of the Yan Yean Road upgrade (Diamond Creek Road to Kurrak Road) was completed in 2019, and construction on Stage 2 (the subject of this EES) is scheduled for completion by 2025.

The Project seeks to upgrade an existing road in hilly terrain, largely within the existing road reserve. The surrounding environment is characterised by low density residential and rural living areas such as farmland and agricultural areas, with the suburb of Doreen experiencing rapid change from rural living to higher density residential developments. The Project alignment and immediate surrounds intersect a range of land uses including residential, open space, rural living, commercial and education.

Key land uses along the alignment include Yarrambat Park and the Yarrambat Park Golf Course, Plenty Valley Christian College, Yarrambat Primary School, St Macarius Coptic Orthodox Church and the Doreen business precinct.

Terms used in this project description

Carriageway: lanes where traffic would be travelling, plus shoulders and auxiliary lanes

Cross section: shows the width of the road with the position and number of traffic lanes, medians, walking and cycling paths and footpaths

Cutting: ground excavation that is required to create a smooth base for construction of a road

Land parcel: the smallest unit of land able to be transferred within Victoria's cadastral system

Median: the area between two opposing carriageways

Mid-block: a section of road between key intersections

Outer edge / shoulder: the area next to a roadway that provides clearance between the roadway and roadside

Road reserve: all the area of land that is within the boundaries of a road

Roadside: any land that is within the boundaries of a road (other than the shoulders of the road) which is not a roadway or pathway

Roadway: the area of the public road that is open to or used by members of the public and is developed by a road authority for the driving or riding of motor vehicles

Signalised intersections: intersections controlled by traffic lights

The Project would duplicate a 5.5 kilometre section 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 within the extent of the project area is 70 kilometres per hour, with the exception of north of Bridge Inn Road where the design speed is 80 kilometres per hour. This is consistent with existing speed limits. The design for the Project assessed in this EES has 3.5-metre-wide lanes, with the majority of the Project using a central 2.2 metre-wide median. This design was adopted due to various constraints: road safety issues, steep and rolling terrain, high cut and fill batters and subsequent retaining walls at certain locations.

The design also seeks to limit impacts to existing properties, local accesses and trees along Yan Yean Road. The existing road alignment has been retained due to constraints around the topography and land uses adjacent to the road corridor. The exception is at the Bridge Inn Road intersection, which would be shifted to the north east to retain two River Red Gums (referred to as the Doreen River Red Gums) and two businesses. The project area is shown in Figure 5.1 and key components of the Project are shown in Figure 5.2.

The Project includes:

- Two new roundabouts: one at Heard Avenue and one at Youngs Road
- Five new signalised intersections at Bannons Lane, Jorgensen Avenue, North Oatlands Road, Orchard Road and Bridge Inn Road
- Upgrades to one existing signalised intersection at Ironbark Road, including an additional right-hand turning lane, slip lane and traffic island
- New street lighting at all intersections, road signage and landscaping
- A new walking and cycling path on the western side and a footpath on the eastern side of Yan Yean Road, linking Diamond Creek to Doreen and improving safety and connectivity for pedestrians and cyclists
- Continuous safety barriers running along the Project's length, proposed in the median and behind outer kerbs along the mid-block sections of the carriageways
- A wide median between Bannons Lane and Jorgensen Avenue to provide for additional landscaping opportunities and potential avoidance of existing biodiversity values and large trees.

Figure 5.1 Project area

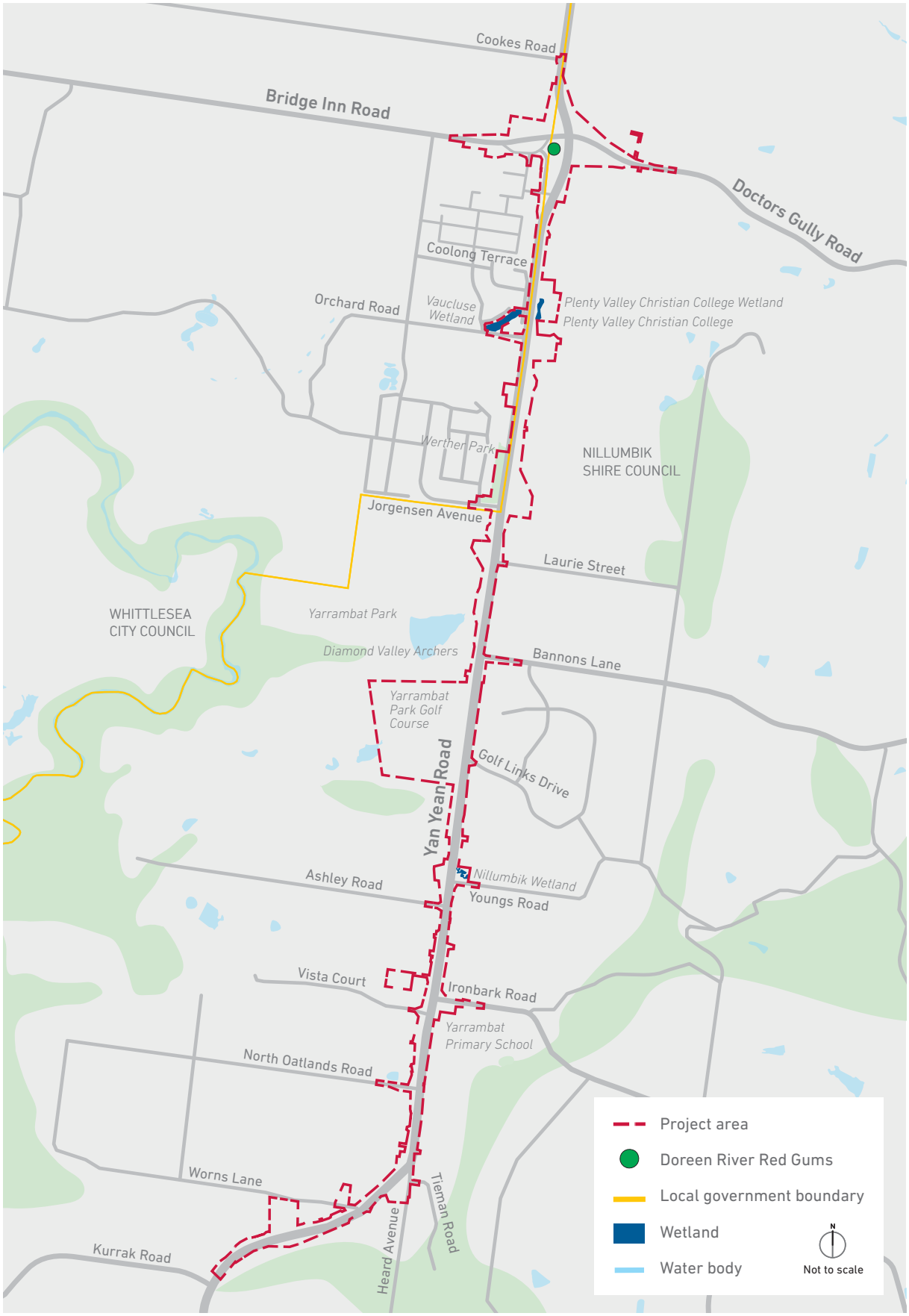
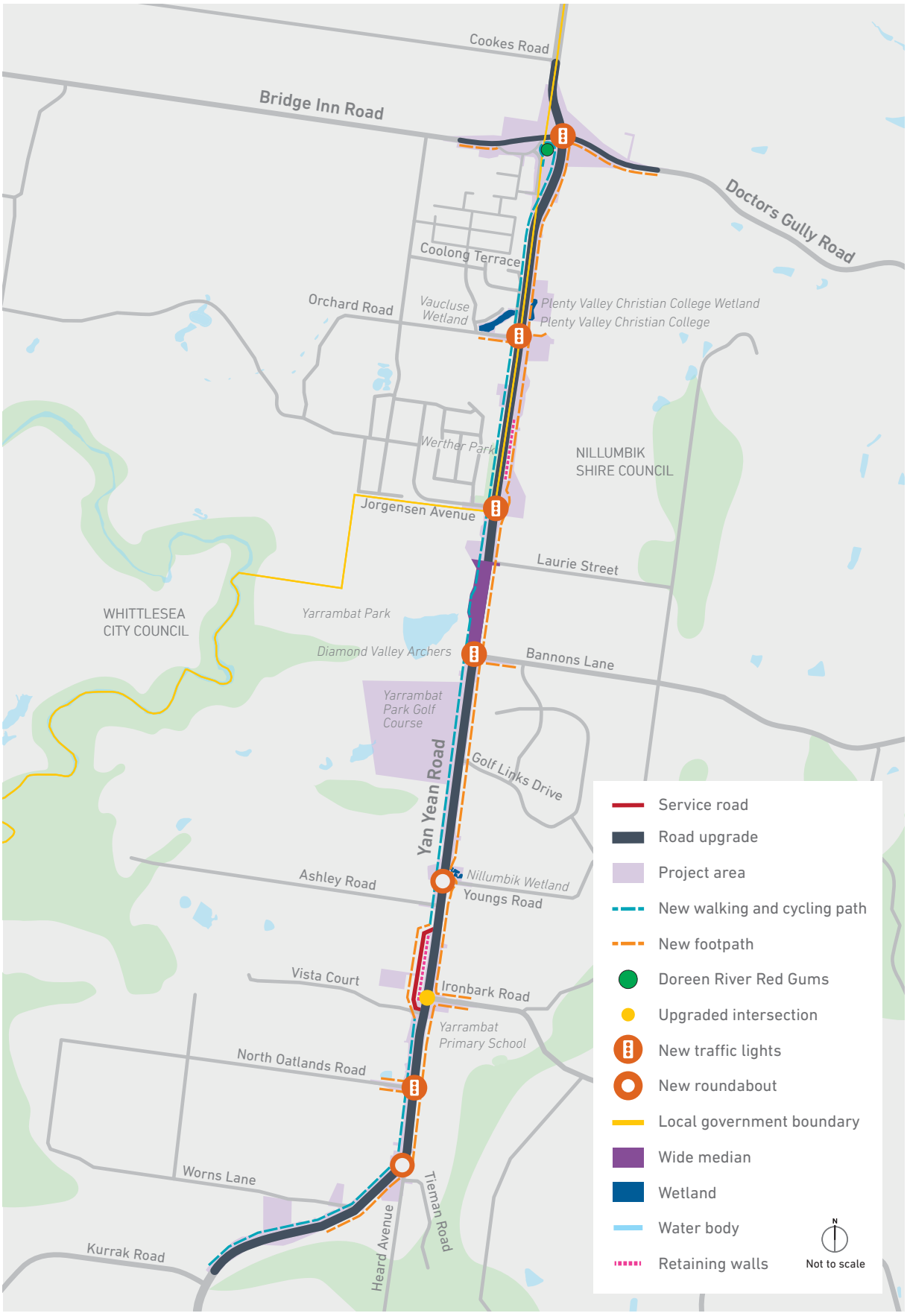


Figure 5.2 Key components of the Project



5.3 Project design

5.3.1 Road design

There are a number of elements to the road design of Yan Yean Road:

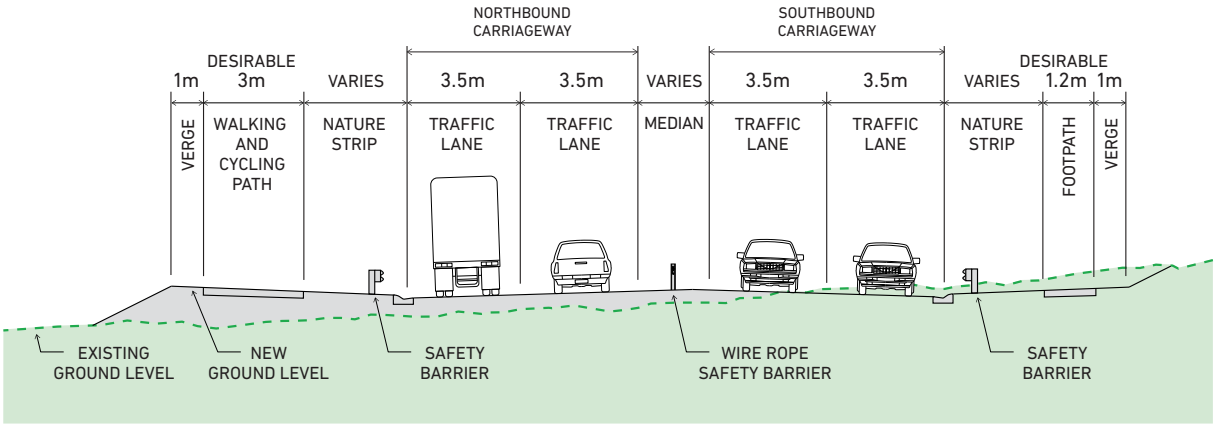
- Typical cross section
- Intersections
- Access
- Wide median
- Safety barriers
- Retaining walls
- Fencing
- Car parks
- Bus facilities.

Typical cross section

The following diagram indicates the typical cross section of the road design for the Project. At some locations along the alignment, such as intersections or roundabouts, this cross section would be slightly different and wider. Figure 5.3 shows the preferred mid-block cross section design, which allows for duplication with a 2.2 metre median with safety barriers.

The installation of safety barriers provides opportunities for tree planting in closer proximity to the road carriageway than would be otherwise permissible, in accordance with the Project's Landscape Strategy (Technical Report G). The total road reserve width along most of the proposed design is 24.2 metres increasing to 33 metres between Bannons Lane and Jorgensen Avenue to accommodate the widened median at this location. The current typical roadway width is eight metres.

Figure 5.3 Yan Yean Road preferred cross section design



For illustrative purposes only.

Intersection design

The scope of the Project includes modifications to a number of intersections. Signalised intersections are proposed to improve safety, provide U-turn opportunities and increase the capacity of existing intersections, and roundabouts are proposed to improve safety and provide larger U-turn opportunities. Intersection works include:

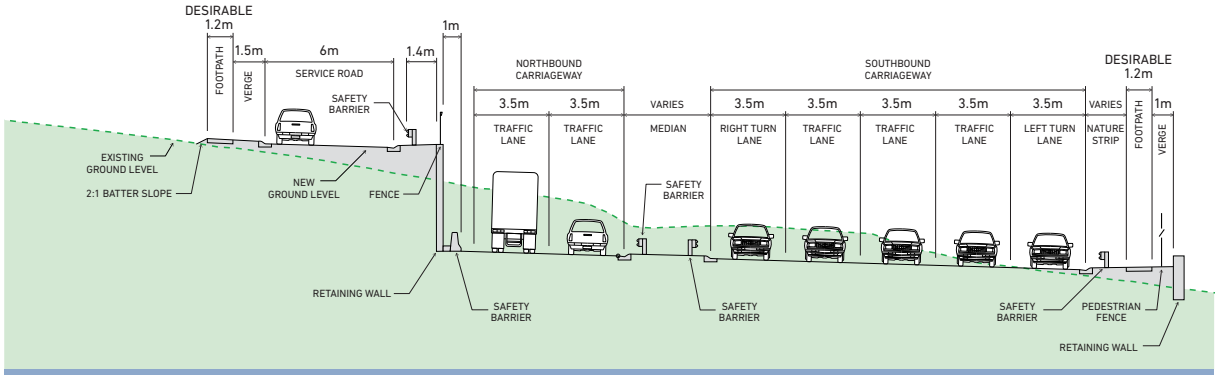
- Signalised intersections at North Oatlands Road, Ironbark Road (refer to Figure 5.4), Bannons Lane, Jorgensen Avenue, Orchard Road and Bridge Inn Road (refer to Figure 5.5)
- Roundabouts at Heard Avenue and Youngs Road
- Proposed left in / left out arrangements at all other intersections, including:
  - Yan Yean Road / Activity Way
  - Yan Yean Road / Laurie Street
  - Yan Yean Road / Golf Links Drive
  - Yan Yean Road / Ashley Road
  - Yan Yean Road / Service Road A exit (left out only)
  - Yan Yean Road / Vista Court
  - Yan Yean Road / Worns Lane
  - Yan Yean Road / 807 Yan Yean Road access
  - Yan Yean Road / Service Road B (between Kurrak Road and Worns Lane)
  - Residential properties and businesses along the alignment
- Auxiliary lanes provided for all left turns (and where applicable, right turns) from Yan Yean Road into key intersections to separate turning traffic from the main traffic flow to reduce collisions and improve the road capacity.

The project design at Bridge Inn Road would retain the two Doreen River Red Gums situated adjacent to the Bridge Inn Road and Yan Yean Road T-intersection and the General Store / former post office and Pet Supplies and Stockfeeds Store on the corner of Doctors Gully Road. It proposes shifting the whole intersection to the north-east corner of Yan Yean Road / Bridge Inn Road with two lanes in each direction.

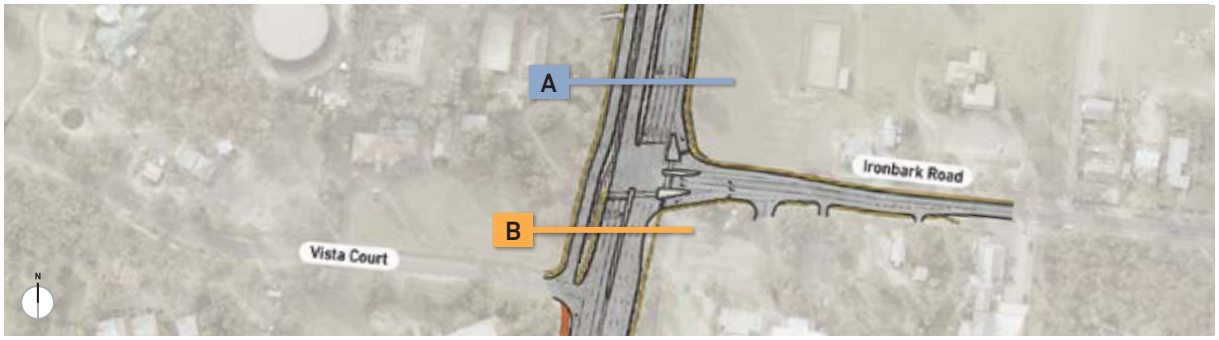
The design at Bridge Inn Road has been refined following community consultation and in response to additional arboriculture advice on the Doreen River Red Gums, which are situated south-west of the proposed intersection (refer to Figure 5.5).

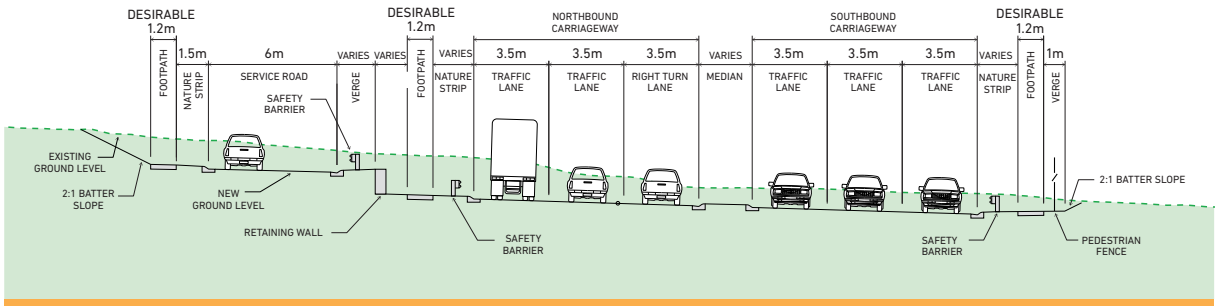
The project design at Bridge Inn Road would retain the two Doreen River Red Gums situated adjacent to the Bridge Inn Road – Yan Yean Road T-intersection and the General Store.

Figure 5.4 Typical signalised intersection cross section – Ironbark Road (northbound)



A: IRONBARK ROAD INTERSECTION DEPARTURE

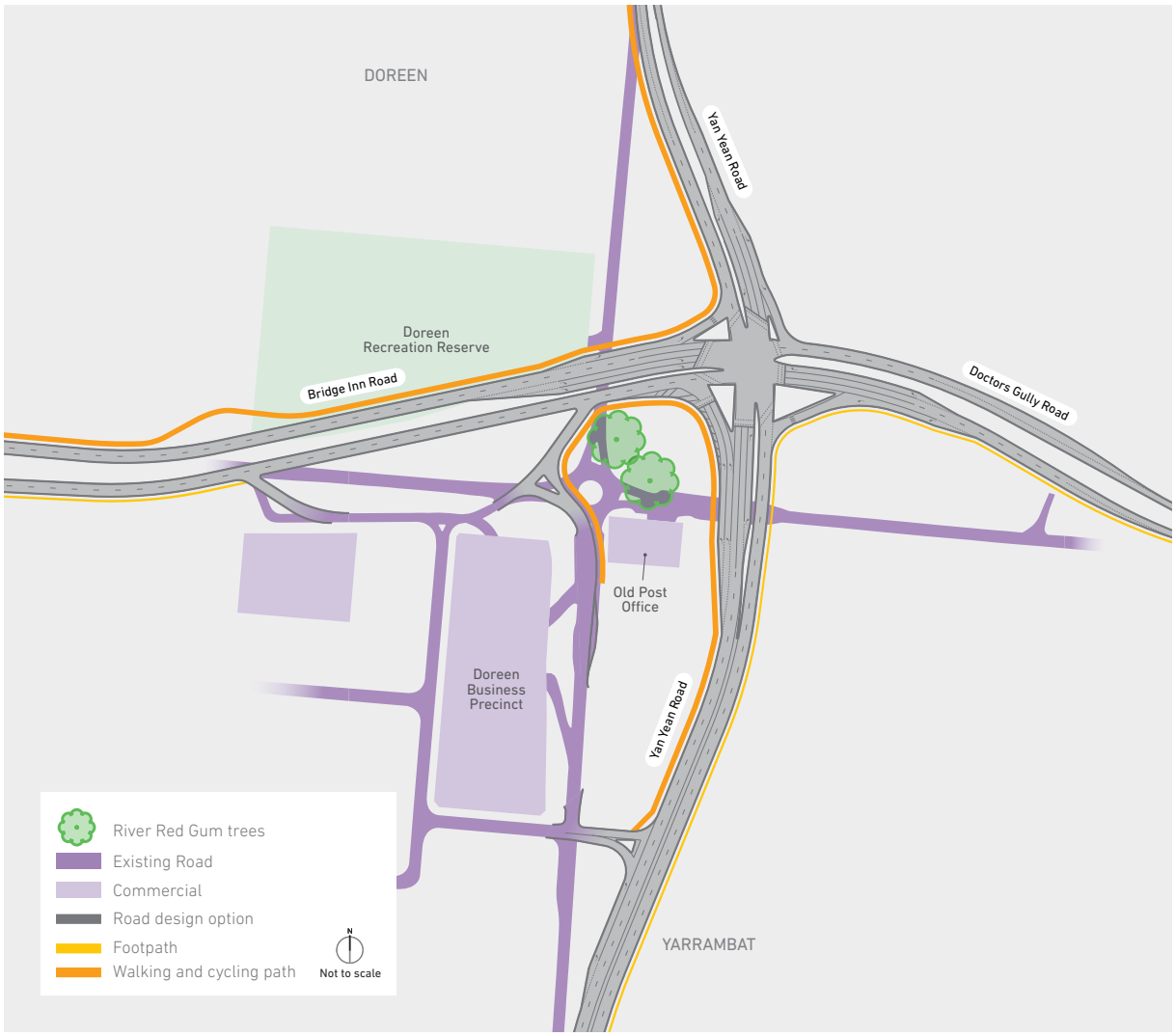




B: IRONBARK ROAD INTERSECTION APPROACH

For illustrative purposes only.

Figure 5.5 Bridge Inn Road intersection design



For illustrative purposes only.

Access design

All existing accesses would be changed to left in / left out arrangements to allow for the installation of a centre median and safety barriers. U-turn lanes would be provided at the following locations to allow for the safe turning of vehicles wishing to travel in the opposite direction:

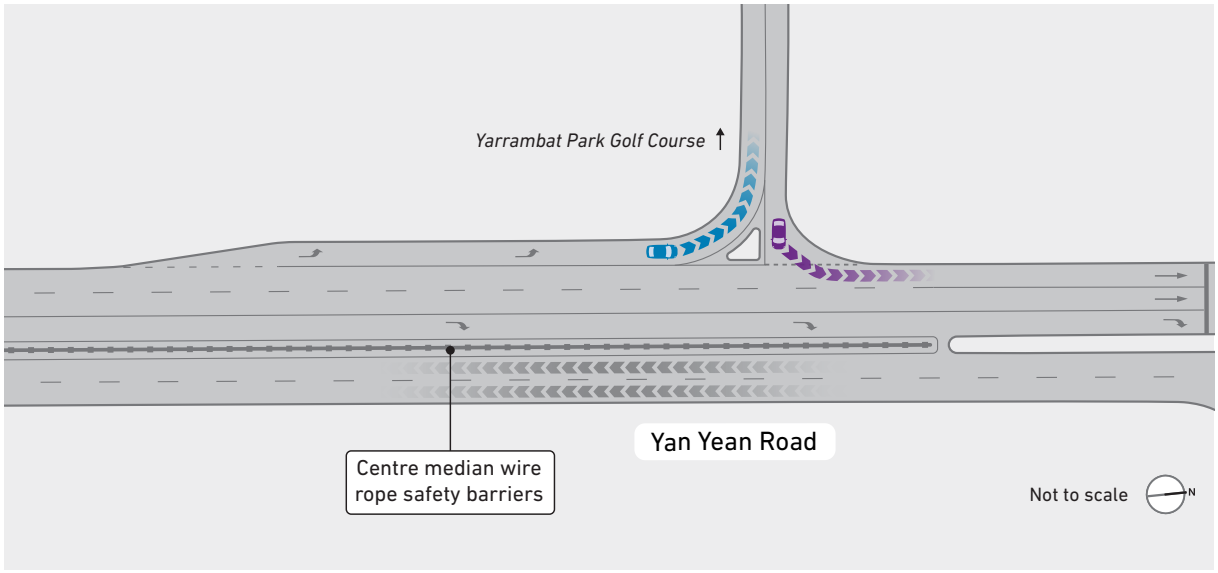
- Bridge Inn Road signalised intersection (cars only)
- Orchard Road signalised intersection (cars only)
- Jorgensen Avenue signalised intersection (cars only)
- Bannons Lane signalised intersection (cars only)
- Youngs Road roundabout (cars, cars with trailers / horse floats, semi-trailers and trucks)
- Ironbark Road signalised intersection (cars only)
- North Oatlands Road signalised intersection (cars only)
- Heard Avenue roundabout (cars, cars with trailers / horse floats, semi-trailers and trucks).

All existing Council approved property access and driveways are proposed to be maintained with minor tie-in works. Access for properties at the western side of Yan Yean Road from Vista Court to Ashley Road would be via a service road due to the steep grade and level differences between properties and Yan Yean Road (refer to Figure 5.4 and Attachment VI *Map Book*).

Access conditions at Yarrambat Primary School and Plenty Valley Christian College would be revised due to intersection upgrades impacting existing access and carpark arrangements.

The proposed design includes a left in / left out arrangement (refer to Figure 5.6) to the Yarrambat Park Golf Course.

Figure 5.6 Left in / left out arrangement – Access to Yarrambat Park Golf Course



For illustrative purposes only.

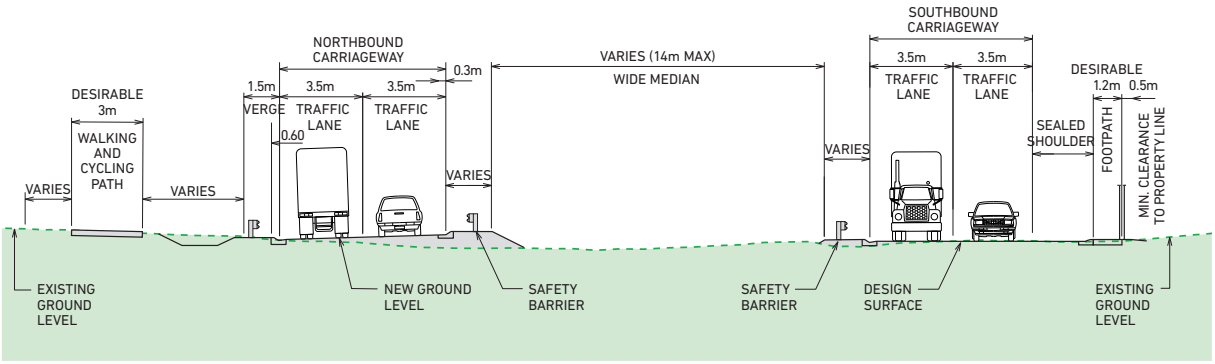
Wide median

A divided carriageway (boulevard design) increases the median width of Yan Yean Road from 2.2 metres to approximately 14 metres by realigning the northbound carriageway between Bannons Lane and Jorgensen Avenue (refer to Figure 5.7). The maximum road reserve width at this point would be approximately 33 metres, although the cross section would taper at either end to tie back into the standard cross section of 24.2 metres, as described above. A wider median at this location would provide for additional landscaping opportunities and potential avoidance of existing biodiversity values (including Matted Flax-lily) and large trees in accordance with the Project's Landscape Strategy (Technical Report G).

The southbound carriageway is aligned to follow the existing carriageway edge to retain the existing separation distance between driveways, residences and Yan Yean Road.

The wide median section of the road design tapers back to the standard cross section width at Bannons Lane. This allows the safe tapering of the road back to the standard road width while avoiding private land acquisition further south of the golf course.

Figure 5.7 Wide median cross section design



For illustrative purposes only.

Safety barrier design

Continuous safety barriers are proposed in the median and behind most outer kerbs (where there are not intersections). Safety barriers would be installed at various setbacks from the kerb ranging from 0.6 to 1 metre, depending on factors such as speed limit, topography and barrier type. Safety barriers require a cleared area behind them to maintain the integrity of their effectiveness. This includes clearance from walking and cycling paths, as well as footpaths. Proposed safety barriers include guardrail, wire rope and concrete barriers if deemed required.

Retaining walls design

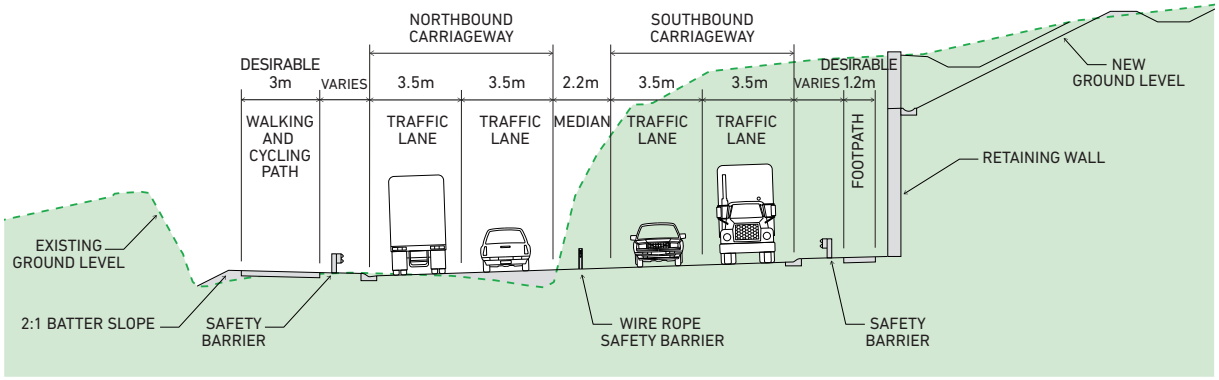
Retaining walls have been proposed at selected locations along Yan Yean Road to minimise the extent of land acquisition on adjacent properties, provide access to properties abutting Yan Yean Road, maximise the retention of existing trees and reduce the extent of cut earthworks. The design of retaining walls would be carried out in accordance with guidelines in the Project's Landscape Strategy (Technical Report G). Retaining walls are likely to be installed at the following locations (refer to Figure 5.8 and Figure 5.9):

- Between Service Road A and Yan Yean Road: a 270 metre long wall with an approximate maximum height of 3.6 metres. This retaining wall has been proposed to retain access to existing properties abutting Yan Yean Road and minimise impacts to existing trees
- At the north-east corner of Ironbark Road: a 230 metre long wall with an approximate maximum height of 2.4 metres. This retaining wall has been proposed to minimise the extent of land acquisition at the adjacent property
- North of North Oatlands Road along the western verge of Yan Yean Road: a 50 metre long wall with an approximate maximum height of 1.1 metres. This retaining wall has been proposed to minimise the extent of land acquisition at the adjacent property and minimise the impact to the existing driveway arrangement
- North of Jorgensen Avenue along the eastern verge of Yan Yean Road: a 220 metre long wall with an approximate maximum height of 8 metres. This retaining wall has been proposed to avoid impacting the existing telecommunication tower on the abutting property, maintain access to the adjacent property and telecommunication tower, maximise the retention of existing trees and reduce the extent of cut works.

Figure 5.8 Retaining wall locations

For illustrative purposes only.

Figure 5.9 Retaining wall cross section – north of Jorgensen Avenue intersection (northbound)



For illustrative purposes only.

Fencing design

The Project is required to ensure adequate safety measures are in place so that golf balls from Yarrambat Park Golf Course do not land on the walking and cycling path or road. This EES assumes that a 30-36 metre-high and 360 metre long fence along the edge of the golf course is included in the design to avoid golf ball collisions with pedestrians, cyclists or vehicles.

The proposed fence would incorporate elements to increase its visibility to Swift Parrot and other bird species. The alternative option to building a fence is to reconfigure golf course holes 1, 10 and 18 to increase their distance from the road and reduce the risk of golf balls landing on the new road and walking and cycling path to an acceptable level. This would not reduce the number of holes at the golf course.

A 1.8 metre timber paling fence has been designed to mitigate the risk of arrows from the Diamond Valley Archers facility affecting the road or walking and cycling path.

Plenty Valley Christian College and Yarrambat Primary School

Access to Plenty Valley Christian College and Yarrambat Primary School directly adjacent to the project area would be maintained during the Project's construction and operation. Some temporary arrangements may be required during construction to manage roadworks adjacent to the schools.

The Project would reconfigure and reinstate an existing car park at Plenty Valley Christian College. This includes a new access road to tie into the existing road. The dam at Plenty Valley Christian College would also require reconfiguration. This would be completed in collaboration with the school.

Land currently used by Yarrambat Primary School for informal car parking would require reconfiguration.

To facilitate these changes, partial land acquisition would be required along the frontage of both schools. This would be limited in extent and would not result in a long-term change to the existing land use; however, it would result in a permanent reduction in the land area on both school sites (refer to Attachment VI *Map Book*).

Bus facilities

Existing bus stops are proposed to be reinstated at the same location or within close proximity, in consultation with the Department of Transport and Public Transport Victoria. The project area allows for indentations around bus stops along the alignment if required.

5.3.2 Active transport design elements

Walking and cycling path and footpath

The design provides a walking and cycling path on the western side of Yan Yean Road in the following locations (refer to Figure 5.2):

- Adjacent to the northbound carriageway of Yan Yean Road from Kurrak Road to Bridge Inn Road, connecting to the existing walking and cycling path at both ends
- Adjacent to the eastbound carriageway of Bridge Inn Road, to be connected to existing walking and cycling paths.

Between Bannons Lane and Jorgensen Avenue, the walking and cycling path is realigned through Yarrambat Park and Shire of Nillumbik land to avoid the removal of more trees on the western side of Yan Yean Road. The walking and cycling path north of Jorgensen Avenue follows the existing footpath for the same purpose. The walking and cycling path would generally be three metres wide and would reduce slightly in width at various locations to allow the retention of trees.

In addition, a footpath, generally 1.2 metres wide, is proposed on the eastern side of Yan Yean Road in the following locations (refer to Figure 5.2):

- Adjacent to the southbound carriageway of Yan Yean Road from Bridge Inn Road to Kurrak Road to connect into the existing footpath
- Adjacent to the northbound carriageway of Yan Yean Road, along Service Road A from Vista Court to Ashley Road to connect to the proposed walking and cycling path extents
- Along Doctors Gully Road to Yan Yean Road to connect into the existing footpath.

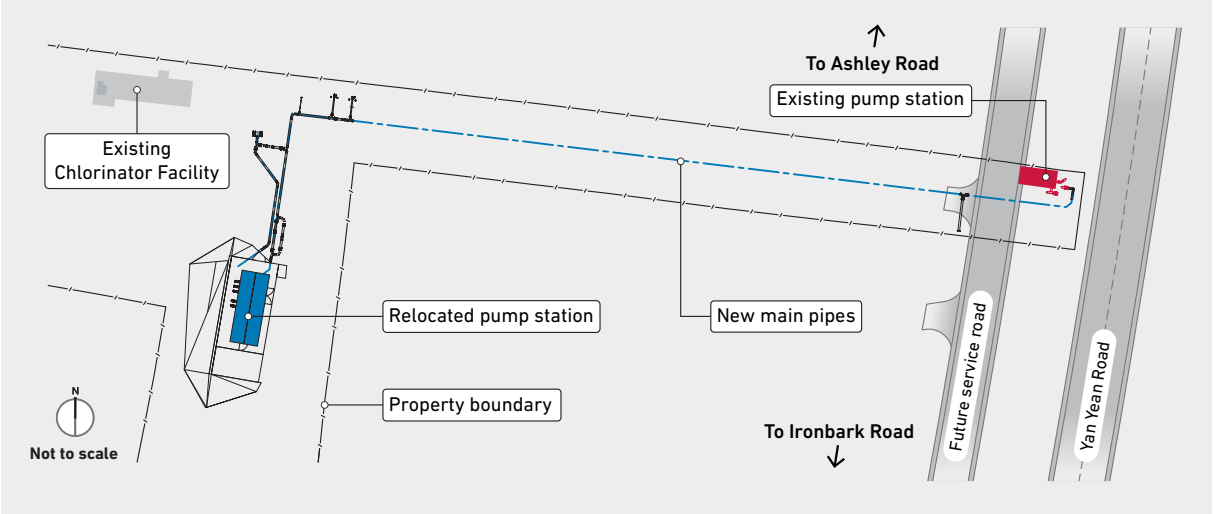
5.3.3 Utilities

New utility service upgrades, relocations and protection works may be required along the length of the Project. Where utility services cannot be avoided, protection / relocation / diversion works would occur adjacent to the proposed road pavement. Relocation of power lines along the alignment is anticipated to involve a combination of above ground and underground power. Works associated with existing water mains, sewer, gas and telecommunications assets may also require relocation and/or diversion adjacent to the road pavement. As such, a minimum allowance of five metres from the outermost construction extent (toe / top of batter, retaining wall, etc.) has been made to allow for potential utility upgrades and service relocations within the project area.

Relocation of Yarra Valley Water pump station

The project area includes a Yarra Valley Water pump station, near Ironbark Road on the western side of the existing Yan Yean Road, which the Project may be required to relocate. The tank may be re-located and new connecting infrastructure installed, all on existing Yarra Valley Water land. Refer to Figure 5.10 for the indicative relocation plan. MRPV continue to investigate design opportunities that could avoid the requirement to relocate the pump station.

Figure 5.10 Yarrambat pump station relocation indicative plan



For illustrative purposes only.

5.3.4 Drainage design

New drainage works, upgrades and relocations would occur along the length of the Project. Drainage along the alignment has been developed based on a flood model and expected outfall locations (which were determined by existing topography); however, the Project is also required to comply with water sensitive urban design (WSUD) requirements from Melbourne Water. This approach aims to make better use of stormwater in urban areas and reduce the harm it causes to the natural water cycle, rivers and creeks. Meeting Melbourne Water's requirements is likely to comprise grassed swale drains (where practicable), detention basins and water treatment basins.

The project area provides for a minimum 10 metres offset from the top of each drainage swale to allow for construction. In areas where drainage swales are not required, a minimum allowance of five metres from the outermost construction extent (toe / top of batter, retaining wall, etc.) has been provided in the project area to allow adequate construction space. The Project would coordinate closely with local schools to ensure the functionality of existing car parks and outdoor playing fields is maintained if these areas are impacted by drainage works.

Detention basin sites for surface water management have also been allowed for within the project area in proximity to Worns Lane, Heard Avenue, Youngs Road, Orchard Road (Melbourne Water wetland) and Bridge Inn Road.

5.3.5 Landscaping and urban design

A Landscape Strategy (Technical Report G) has been developed in consultation with Councils and other key stakeholders to ensure that the Project fits sensitively into the built, natural and cultural environment of Doreen and Yarrambat. The strategy would ensure that landscaping undertaken as part of the Project is well designed and contributes to the character and functioning of the Yan Yean Road corridor and the surrounding area, as well as to the accessibility and connectivity of people within the wider region and community. The Project would provide new and reinstated landscapes that are appropriate to the local conditions and consistent with the existing varied character of the area. Wherever possible, the Project would provide opportunities to increase canopy cover and improve amenity in the public realm.

The Landscape Strategy provides overarching principles to guide the Project landscape design, with a particular focus on minimising impacts on trees along the road corridor. Planting typologies have been considered to enhance the experience of drivers, pedestrians and cyclists, provide visual interest, screen infrastructure elements, improve habitat values and provide subtle wayfinding clues. Planting adjacent to the shared path would provide shelter and shade to improve user amenity. The activation of remnant open space would be explored to provide increased amenity to the local community where feasible.

5.3.6 Sustainability and climate change

MRPV is committed to delivering projects that optimise social, economic and environmental outcomes over the long term. To fulfil this commitment, MRPV would ensure:

- Sustainability risks and opportunities are identified and refined into project-appropriate performance objectives and requirements
- Delivery partners are monitored to ensure achievement of sustainability performance objectives and requirements
- Project sustainability performance is measured, verified and publicly reported on.

Key sustainability opportunities for the Project include:

- Ensuring the Project is resilient to the challenges of climate change by preparing and implementing a climate risk assessment and adaptation plan
- Optimising the use of recycled content in infrastructure materials
- Reducing greenhouse gas emissions, material lifecycle impacts and waste generation during the Project's construction and operation
- Protecting and enhancing the built, natural and cultural environment within and adjacent to the project area.

5.3.7 Land acquisition

The existing road corridor is not of sufficient width to accommodate the duplication and supporting infrastructure such as service roads, walking and cycling path and drainage. The Project would require the partial or full acquisition of 96 parcels of land. In most cases, partial acquisition of the land would be required along the frontages of landholdings.

This acquisition would be limited in extent and would not result in a long-term change in the existing land use, but it would result in a permanent reduction in the land area on those land parcels.

The land acquisition process would be undertaken in accordance with the *Land Acquisition and Compensation Act 1986* and would include consultation with affected landowners. Compensation would be provided for all land acquired for the Project. Refer to Attachment VI *Map Book* for the proposed Public Acquisition Overlay (PAO).

The landowner status of proposed land acquisition for the Project includes:

- Shire of Nillumbik: 24 land parcels
- City of Whittlesea: four land parcels
- Private: 60 land parcels
- Public Authorities / State: eight land parcels.

5.4 Project construction

5.4.1 Construction activities

Construction details would be subject to further refinement as the Project progresses; however, any changes to the activities and requirements outlined below would need to be in accordance with the Environmental Performance Requirements (EPRs) set out in Chapter 12 *Environmental Management Framework*.

Proposed construction activities would be standard road construction activities to be undertaken in accordance with the EPRs for the Project.

Site establishment would involve tree clearance and vegetation lopping and removal within the project area, establishment of construction site compounds, clearing and grubbing, temporary sediment and erosion control works, and establishment of environmental and traffic controls.

Earthworks would involve remediation of any existing contamination and removal of any hazardous material, as appropriate, protecting and relocating services, widening of existing rock cuttings (approximately 750 metres of existing cut along the Project would be widened by approximately 20 metres), new cuttings (approximately 1,300 metres of new rock cut would be required to a width of approximately five metres along the Project), and bulk earthworks and haulage. Some of the cutting locations would require retaining walls. Refer to Figure 5.8 for the location of proposed retaining walls in the Project and Figure 5.9 for a representative retaining wall cross section.

Civil and structure works would involve construction of infrastructure, including intersection upgrades, walking and cycling paths, retaining walls, drainage works and pavement works.

Reinstatement would involve implementing traffic management systems and landscaping in accordance with the Landscape Strategy (Technical Report G) for the Project.

5.4.2 Construction laydown areas

To minimise disruption at and around the Project site, one or more separate site compounds (or 'laydown areas') would be established for site offices, storage of materials and plant, amenities for workers, secure container storage, short-term storage for waste and potentially workforce parking. The laydown area(s) would be required to be in use for the full duration of Project construction.

Construction laydown areas have not yet been identified for the Project, other than those included in the project area. Following the engagement of a contractor, they would identify one or more sites that are suitable for this purpose on the basis of minimal environmental impact. Depending on the site(s) selected, a separate planning approval process may be required which would need to be informed by site investigation and consultation.

The project area has allowed for a site on the western side of Yan Yean Road in close proximity to the Yarrambat Horse and Pony Club, which is currently being used as laydown area by Yarra Valley Water. The Project may also utilise the existing Department of Transport owned land at 423-437 Yan Yean Road Yarrambat at the southern end of the project area. Vegetation removal would avoid the no-go zones identified in Attachment VI *Map Book*.

The laydown area(s) would be reinstated following works to their pre-Project condition, or as agreed with the landholder. The nature of reinstatement and any improvement works would be agreed with the landowner and any other relevant stakeholders, potentially Council and the Department of Transport.

5.4.3 Construction method

The construction methods adopted would seek to develop the Project in discrete stages to the extent practicable. This would assist with localising construction impacts for each stage of works. Maintaining traffic flow throughout the Project would be a key component of the construction methodology. Constructing new lanes 'offline' would be integral to maintaining traffic flow, including diverting traffic into new lanes as staged sections were completed. As traffic is diverted into newly constructed lanes, old lanes would be upgraded to assist in maintaining traffic flow.

Temporary road closures and diversions would be required for the construction of intersections. Road closures and diversions would be managed through community consultation and detailed traffic management plans.

Spoil is defined as waste soil or rock resulting from excavation activities. Spoil generated by construction activities would be managed in accordance with EPA requirements applicable at the time of construction.

The final spoil disposal strategy would be developed in accordance with EPA Victoria requirements, particularly in regard to managing any contamination entrained within the soil, and whether spoil would be stockpiled or taken immediately to landfill. Haulage routes would be constrained to arterial roads, including Yan Yean Road. Where roads other than Yan Yean Road or designated arterials are required to be used, this would be done in consultation with the Department of Transport and the relevant local authority, with appropriate notice given to any affected residents.

5.4.4 Working hours

Construction work for the Project would be undertaken in accordance with EPA requirements applicable at the time of construction. Standard construction work hours are:

- Monday to Friday, 7am to 6pm
- Saturday, 7am to 1pm.

Construction outside standard hours might occur at discrete stages to enable particular tasks to be undertaken more safely than could otherwise be achieved. Night works would also be required to minimise impacts on traffic or nearby stakeholders. Works proposed for outside standard hours would need to be approved in advance by MRPV, following consultation with all relevant stakeholders.

5.5 Project operation and maintenance

When complete, Yan Yean Road would be owned by the Department of Transport and operated in accordance with its environmental management approach. Ongoing monitoring and associated management and mitigation measures set out in the EPRs would be implemented during operation of the Project by the relevant organisation.

Maintenance of the infrastructure would be undertaken by Department of Transport, or local Councils for pathways and service roads, in accordance with the *Road Management Act 2004 – Code of Practice*.

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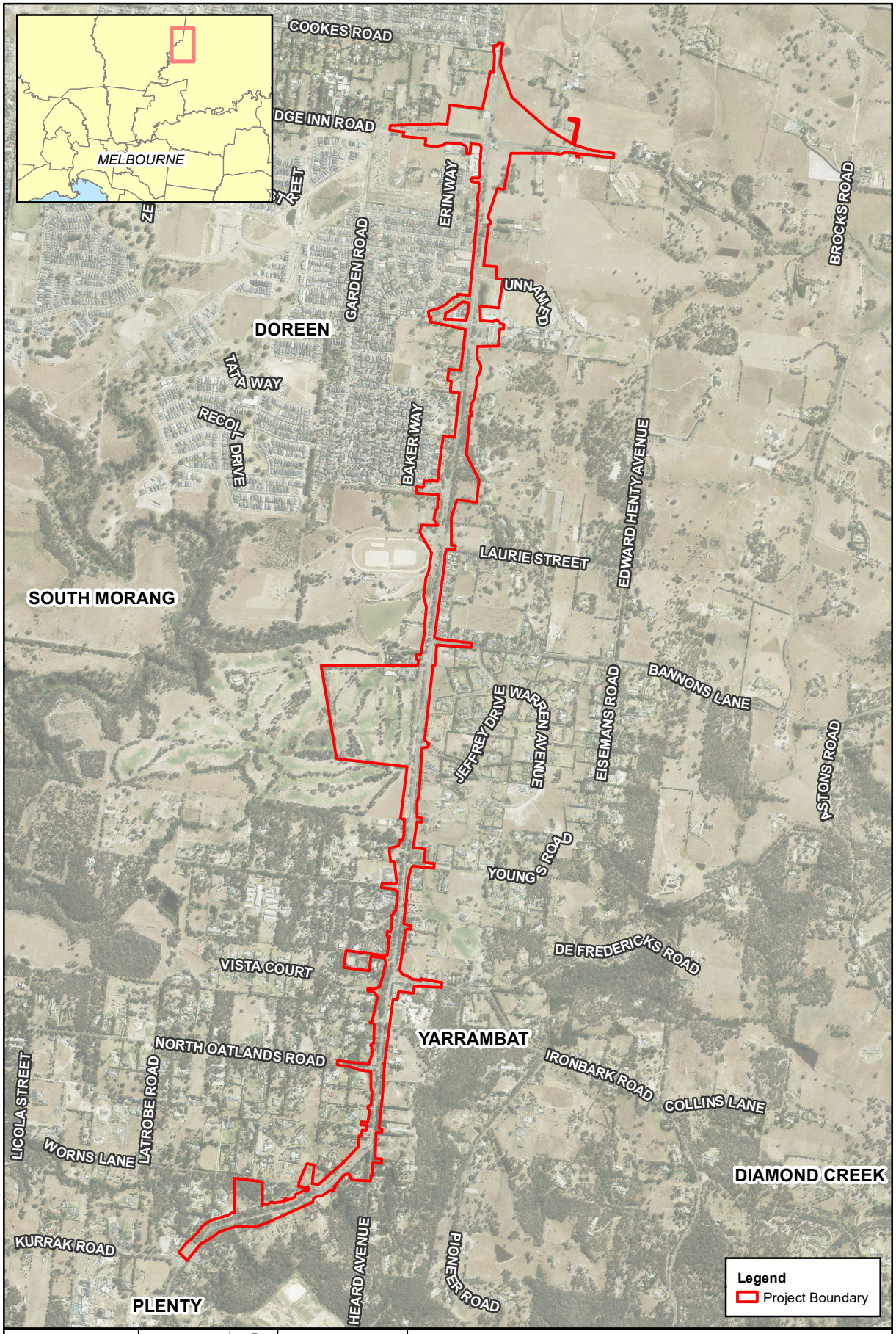
APPENDIX B FIGURES



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Data source: VicRoads. Copyright © The State of Victoria, Department of Environment, Land, Water & Planning 2018

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VICTORIA State Government

WSP

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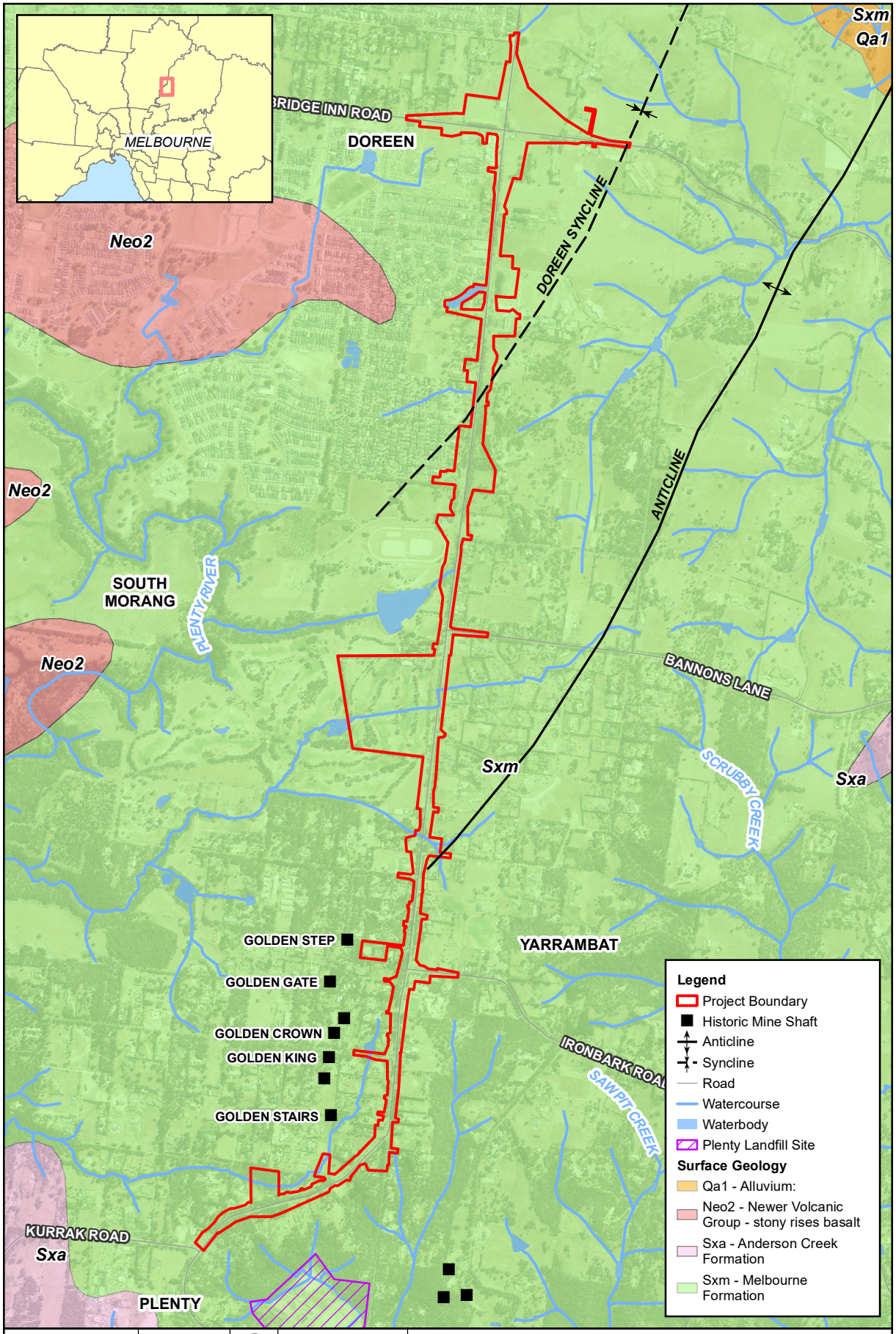
Engineering and Technical Services for Yan Yean Road Upgrade

Investigation Area

Figure 1



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Coordinate system: GDA 1994 MGA Zone 55

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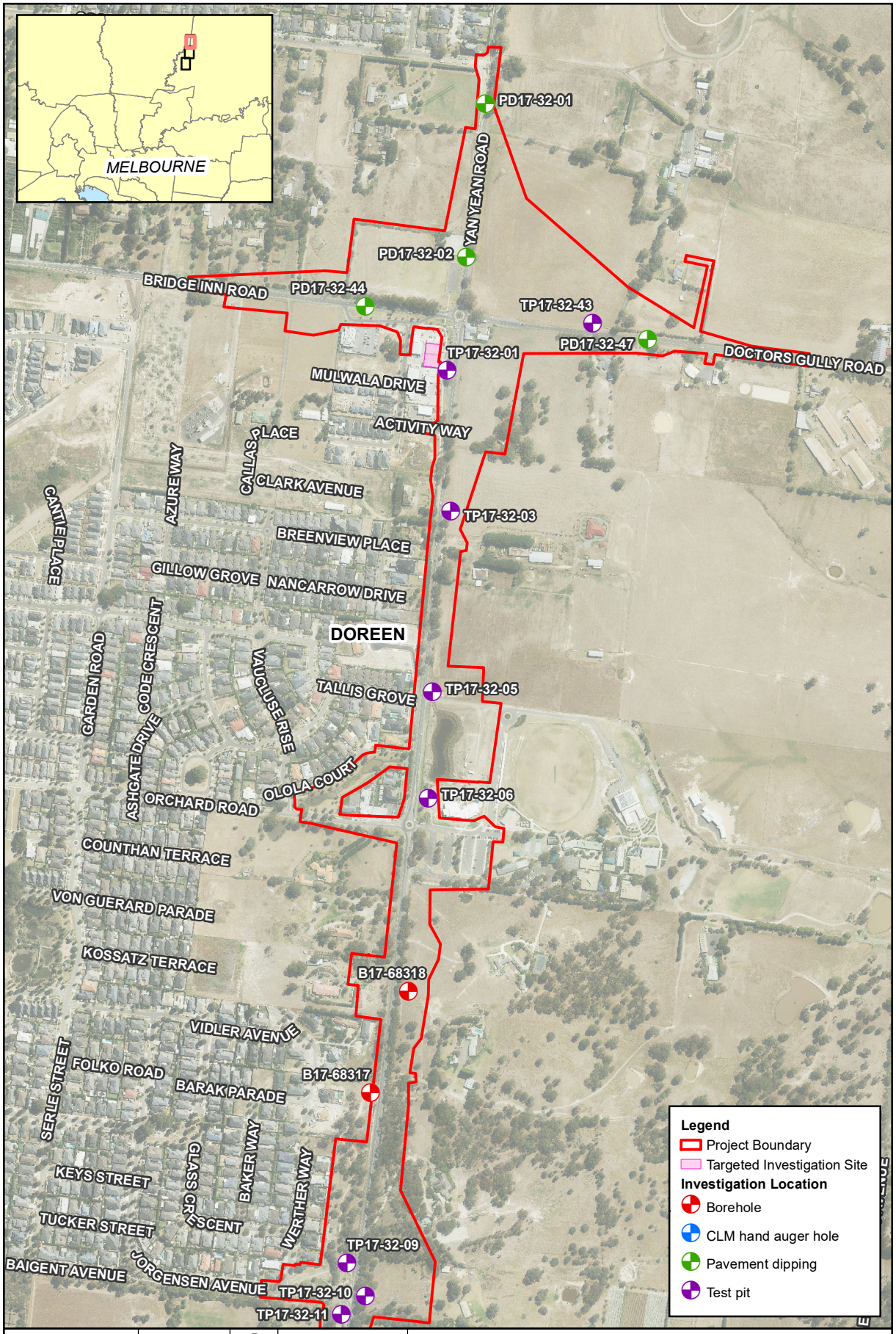
Engineering and Technical Services for Yan Yean Road Upgrade

Geology

Figure 2



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Data source: VicRoads. Copyright © The State of Victoria, Department of Environment, Land, Water & Planning 2018

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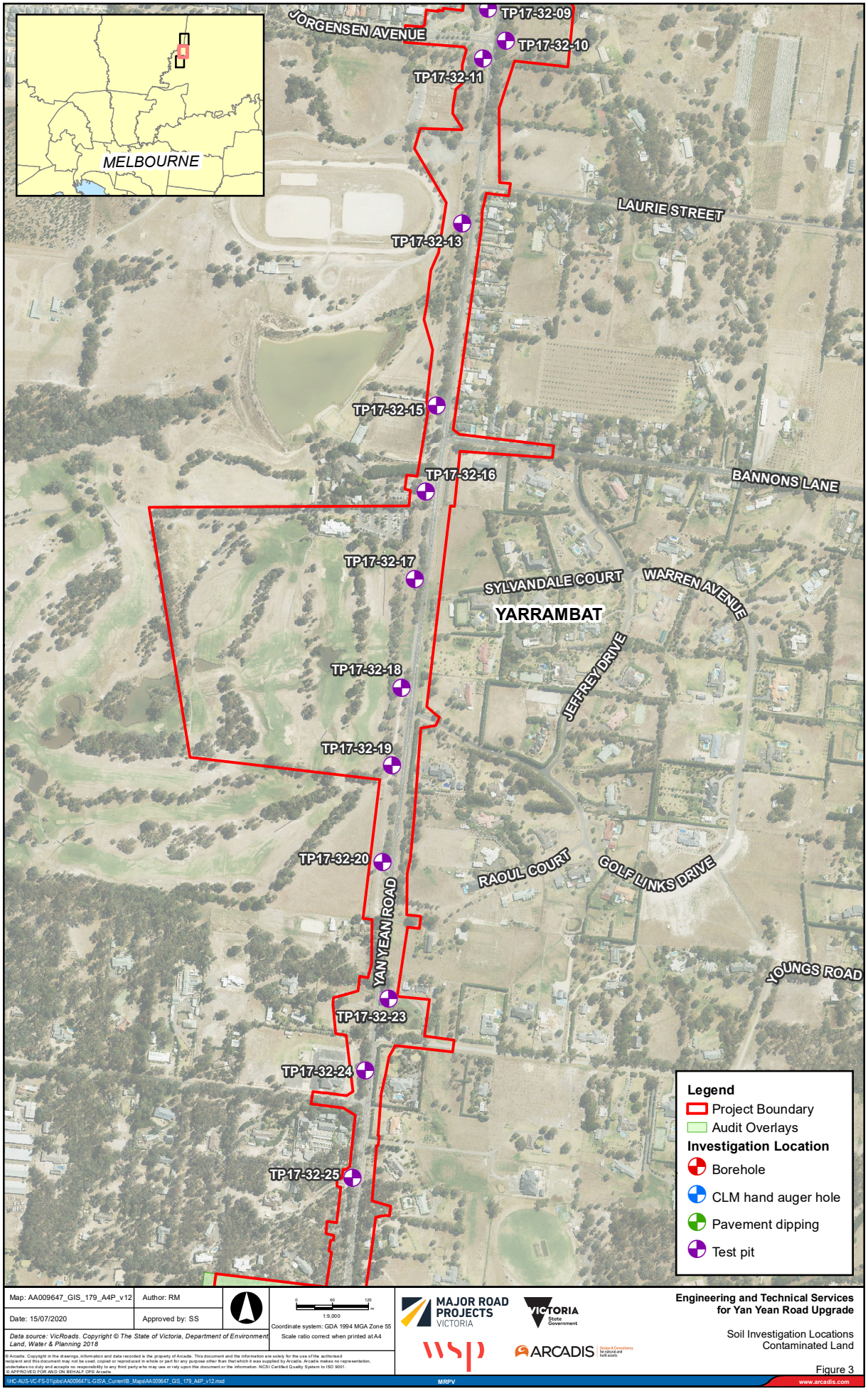
Engineering and Technical Services for Yan Yean Road Upgrade

Soil Investigation Locations
Contaminated Land

Figure 3



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Engineering and Technical Services for Yan Yean Road Upgrade

Soil Investigation Locations Contaminated Land

Figure 3

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MRPV

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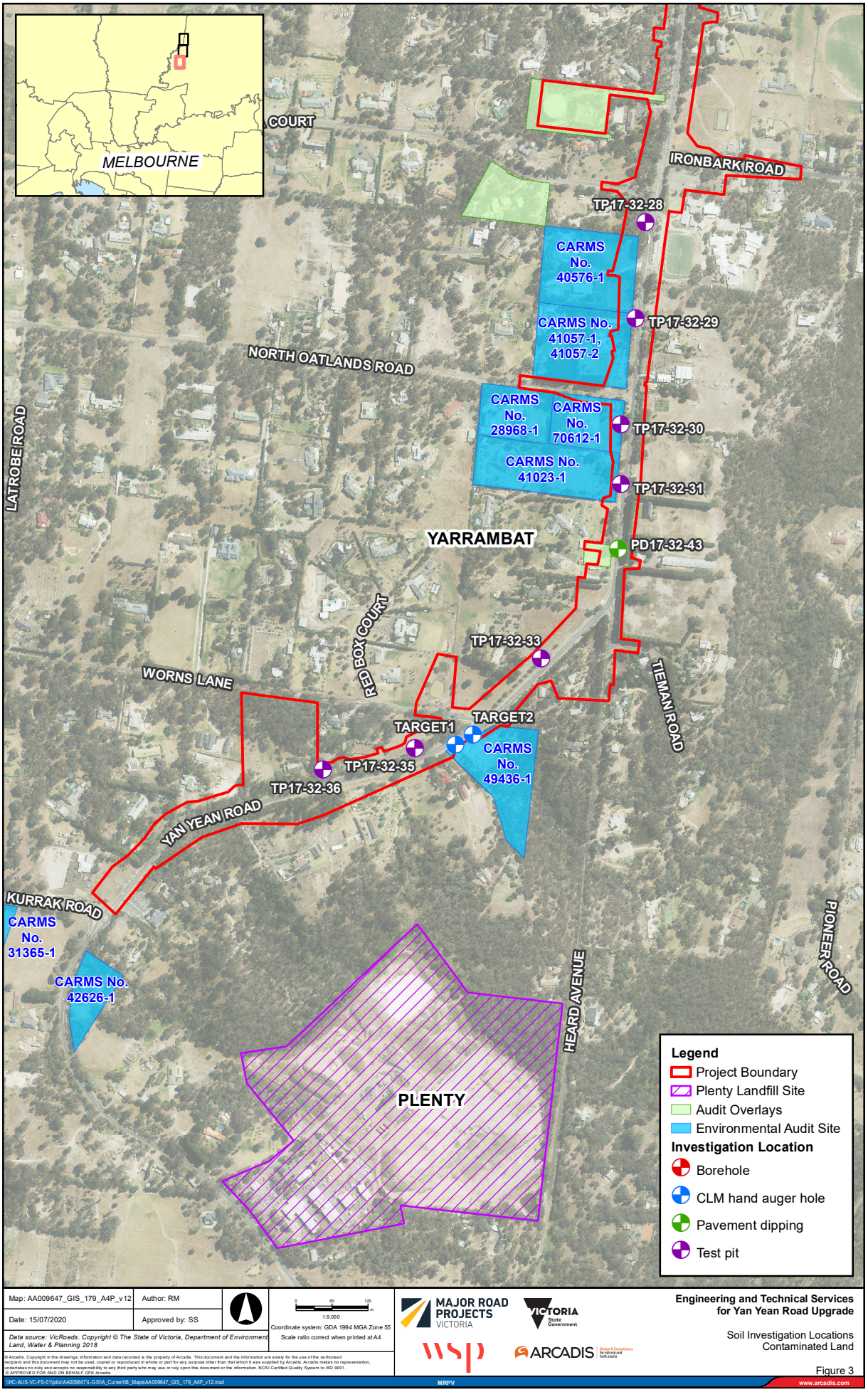

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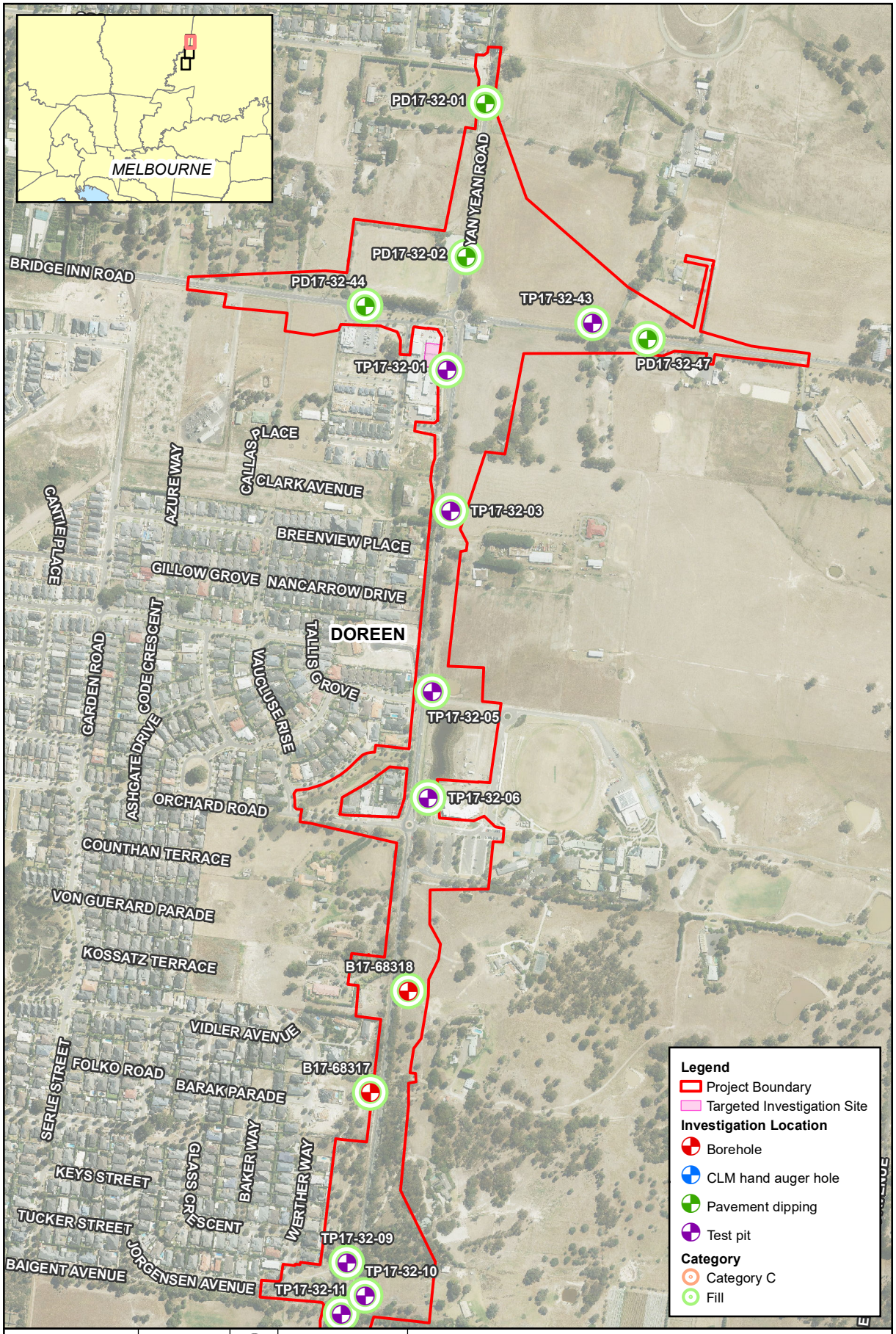
Engineering and Technical Services for Yan Yean Road Upgrade

Soil Investigation Locations Contaminated Land

Figure 3



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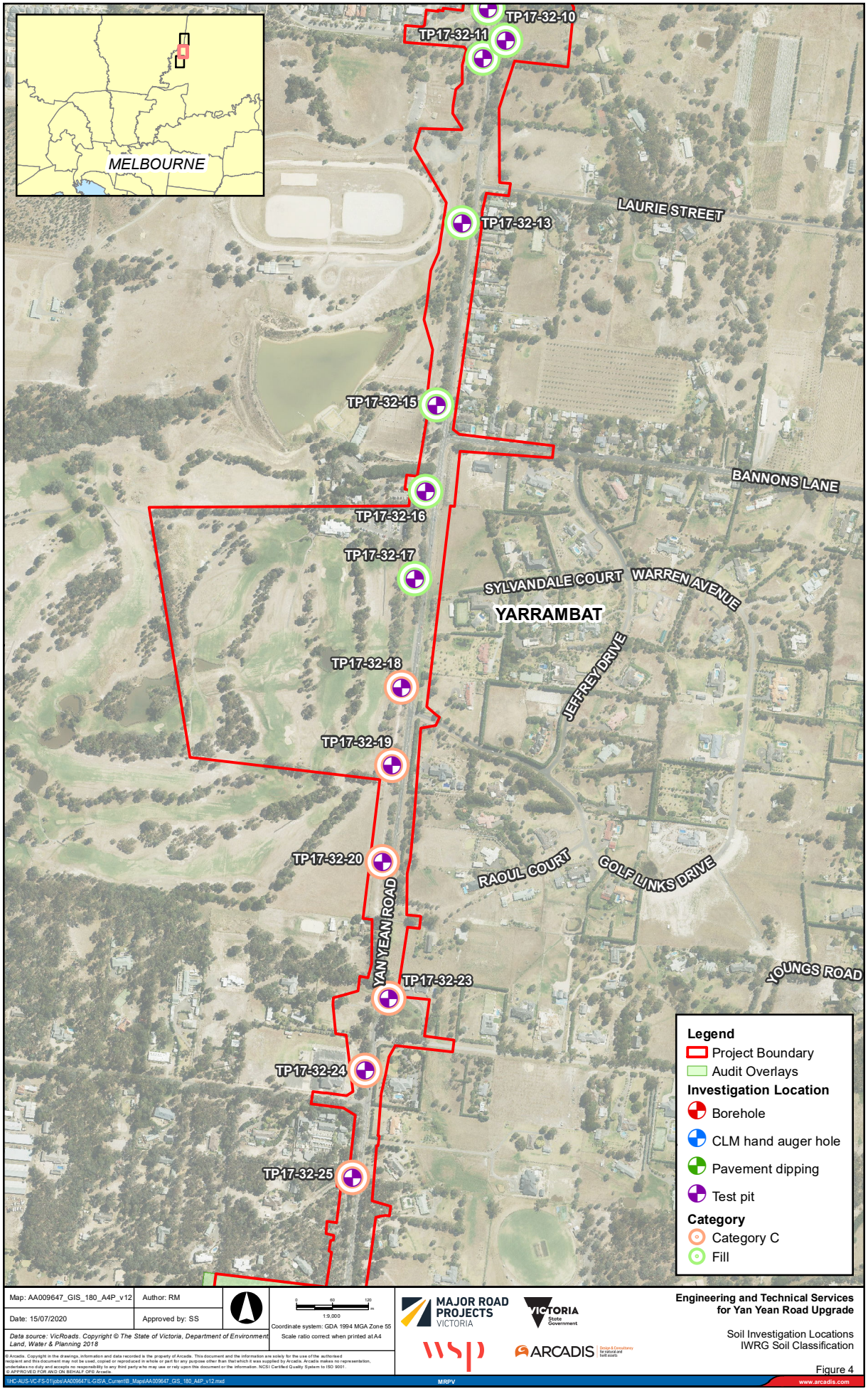
Soil Investigation Locations
IWRG Soil Classification

Figure 4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TP17-32-13
LAURIE STREET
TP17-32-15
BANNONS LANE
TP17-32-16
TP17-32-17
SYLVANDALE COURT
WARREN AVENUE
YARRAMBAT
TP17-32-18
JEFFREY DRIVE
TP17-32-19
TP17-32-20
RAOUL COURT
GOLF LINKS DRIVE
YAN YEAN ROAD
YOUNGS ROAD
TP17-32-23
TP17-32-24
TP17-32-25
Legend
Project Boundary
Audit Overlays
Investigation Location
Borehole
CLM hand auger hole
Pavement dipping
Test pit
Category
Category C
Fill
Map: AA009647_GIS_180_A4P_v12
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Date: 15/07/2020
Approved by: SS
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Coordinate system: GDA 1994 MGA Zone 55
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Soil Investigation Locations
IWRG Soil Classification
Figure 4
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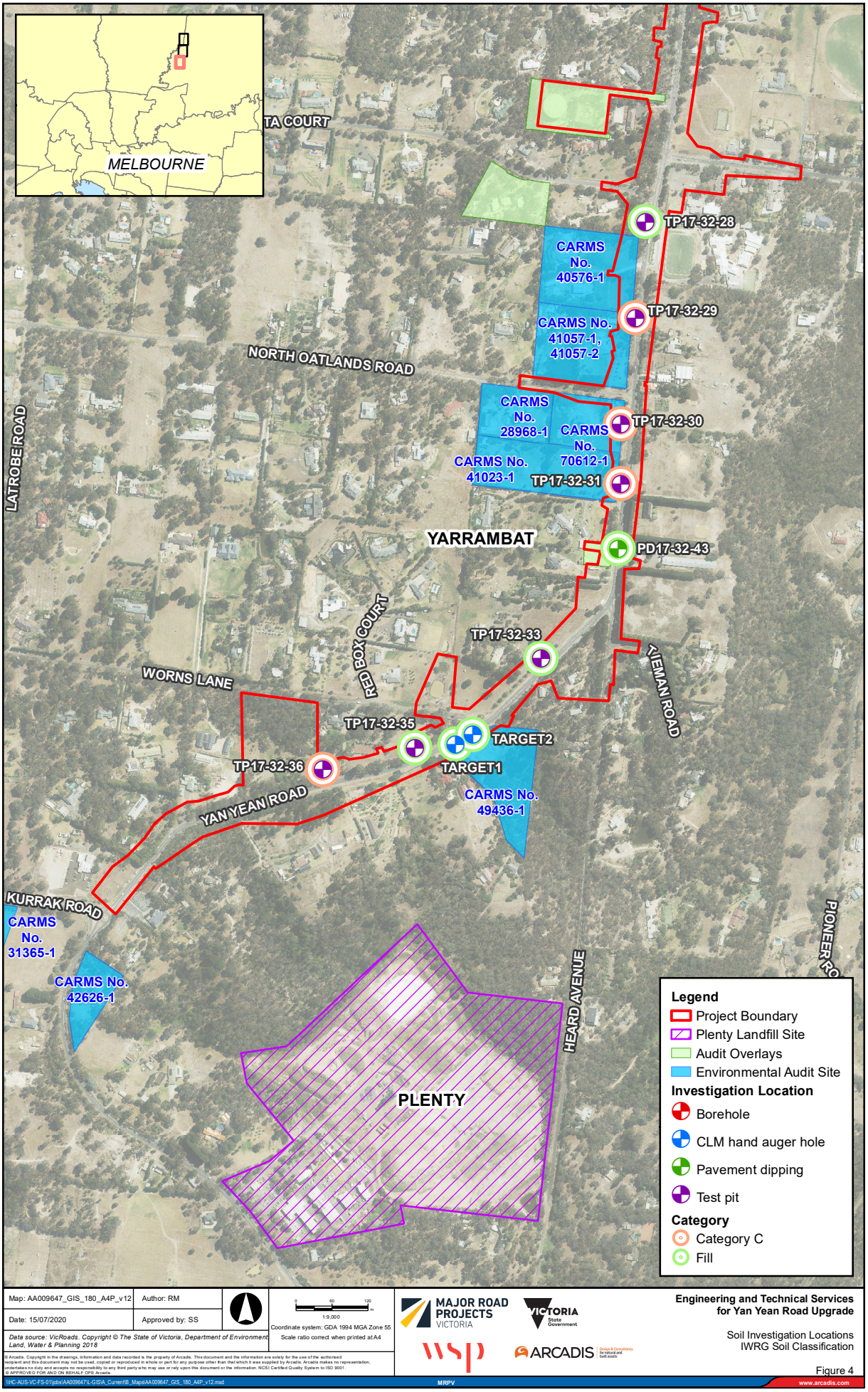

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Engineering and Technical Services for Yan Yean Road Upgrade

Soil Investigation Locations
IWRG Soil Classification

Figure 4

APPENDIX C CONTAMINATED LAND RISK REGISTER

Major Road Projects Victoria

Project name: Yan Yean Road Stage 2 EES Environmental Risk Register - Draft Post Environmental Risk Workshop & Specialist Input

Version: 5

Date: 26/06/2020

Author: Sabrina Chapman

Contributors: Matt Knight, Tori Harvey, Paige Krygger, Louie D'Amore, Will Parker, Clinton Kenna, Arvind Deivasigamani, Louise McGinley, Sarah Sawyer, Sam Vertucci, Cameron Ryder, Rachael Mino, Samantha Fidge, Ellen Buswell, George Bazeley, Marianne Stoettrup

Review: Mat Peel

				Initial Risk					Residual Risk				
No	Aspect	Impact Pathway	Activity	Likelihood	Consequence	Inherent Risk Rating	Mitigation measures to inform Environmental Performance Requirement	EPR	Likelihood	Consequence	Residual Risk Rating	Rationale	Relevant impact assessment
5	Contaminated land	Excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Site establishment	Possible	Minor	Medium	Prepare and implement a Construction Environmental Management Plan which includes processes and measures to manage contaminated soil that comply with relevant legislation and guidelines, including but not limited to: • Land and water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018* and other relevant statutory requirements • EPA Publication 1827: Waste classification assessment protocol and EPA Publication 1828: Waste disposal categories - characteristics and thresholds • Environment Protection (Industrial Waste Resource) Regulations 2009 • Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999 • National Environment Protection (Assessment of Site Contamination) Measures 1999, amended 2013 (ASC NEPM) • WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos). The Construction Environmental Management Plan will include measures such as: • Characterising soil prior to disposal or reuse • Identifying soil containing asbestos and if present, developing management strategies in accordance with the WorkSafe Regulations • Assessing geological formations with naturally enriched metals and applicable spoil management options and or off-site disposal to the satisfaction of EPA Victoria • Identifying suitably licensed facilities for the disposal or treatment of contaminated soil • Management of wastewater • Management of dust, potential stormwater run-off and seepage from stockpiled materials • Undertaking a baseline site assessment of areas proposed for construction laydown prior to use • Protection of the beneficial uses of land associated with current and planned future use.	EPR CL1	Unlikely	Minor	Low	The Limited Environmental Site Assessment (Arcadis 2019) found low pH soil and elevated natural background concentrations of arsenic and fluoride within the study area, however they are consistent with background levels found in the Shire of Nillumbik. If disposal is required, leachate analysis will be required by the receiving landfill prior to disposal. With standar d mitigation measures applied, the assessment identified impact from existing contaminated land to sensitive receptors to be low. The Assessment also included soil classification and disposal, with targeted sampling completed adjacent to areas which have been historically used for industrial or commercial purposes.	Technical Report K - *Contaminated land impact assessment*
25	Contaminated land	Excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Earthworks	Possible	Minor	Medium	Implement a Construction Environmental Management Plan which includes processes and measures to manage contaminated soil that comply with relevant legislation and guidelines, including but not limited to: • Land and water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018* and other relevant statutory requirements • EPA Publication 1827: Waste classification assessment protocol and EPA Publication 1828: Waste disposal categories - characteristics and thresholds • Environment Protection (Industrial Waste Resource) Regulations 2009 • Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999 • National Environment Protection (Assessment of Site Contamination) Measures 1999, amended 2013 (ASC NEPM) • WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos). The Construction Environmental Management Plan will include measures such as: • Characterising soil prior to disposal or reuse • Identifying soil containing asbestos and if present, developing management strategies in accordance with the WorkSafe Regulations • Assessing geological formations with naturally enriched metals and applicable spoil management options and or off-site disposal to the satisfaction of EPA Victoria • Identifying suitably licensed facilities for the disposal or treatment of contaminated soil • Management of wastewater • Management of dust, potential stormwater run-off and seepage from stockpiled materials • Undertaking a baseline site assessment of areas proposed for construction laydown prior to use • Protection of the beneficial uses of land associated with current and planned future use.	EPR CL1	Unlikely	Minor	Low	The Limited Environmental Site Assessment (Arcadis 2019) found low pH soil and elevated natural background concentrations of arsenic and fluoride within the study area, however they are consistent with background levels found in the Shire of Nillumbik. If disposal is required, leachate analysis will be required by the receiving landfill prior to disposal. With standar d mitigation measures applied, the assessment identified impact from existing contaminated land to sensitive receptors to be low. The Assessment also included soil classification and disposal, with targeted sampling completed adjacent to areas which have been historically used for industrial or commercial purposes.	Technical Report K - *Contaminated land impact assessment*
45	Contaminated land	Excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Civils and structures	Possible	Minor	Medium	Implement a Construction Environmental Management Plan which includes processes and measures to manage contaminated soil that comply with relevant legislation and guidelines, including but not limited to: • Land and water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018* and other relevant statutory requirements • EPA Publication 1827: Waste classification assessment protocol and EPA Publication 1828: Waste disposal categories - characteristics and thresholds • Environment Protection (Industrial Waste Resource) Regulations 2009 • Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999 • National Environment Protection (Assessment of Site Contamination) Measures 1999, amended 2013 (ASC NEPM) • WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos). The Construction Environmental Management Plan will include measures such as: • Characterising soil prior to disposal or reuse • Identifying soil containing asbestos and if present, developing management strategies in accordance with the WorkSafe Regulations • Assessing geological formations with naturally enriched metals and applicable spoil management options and or off-site disposal to the satisfaction of EPA Victoria • Identifying suitably licensed facilities for the disposal or treatment of contaminated soil • Management of wastewater • Management of dust, potential stormwater run-off and seepage from stockpiled materials • Undertaking a baseline site assessment of areas proposed for construction laydown prior to use • Protection of the beneficial uses of land associated with current and planned future use.	EPR CL1	Unlikely	Minor	Low	The Limited Environmental Site Assessment (Arcadis 2019) found low pH soil and elevated natural background concentrations of arsenic and fluoride within the study area, however they are consistent with background levels found in the Shire of Nillumbik. If disposal is required, leachate analysis will be required by the receiving landfill prior to disposal. With standar d mitigation measures applied, the assessment identified impact from existing contaminated land to sensitive receptors to be low. The Assessment also included soil classification and disposal, with targeted sampling completed adjacent to areas which have been historically used for industrial or commercial purposes.	Technical Report K - *Contaminated land impact assessment*
65	Contaminated land	Excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Reinstatement	Unlikely	Minor	Low	Implement a Construction Environmental Management Plan which includes processes and measures to manage contaminated soil that comply with relevant legislation and guidelines, including but not limited to: • Land and water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018* and other relevant statutory requirements • EPA Publication 1827: Waste classification assessment protocol and EPA Publication 1828: Waste disposal categories - characteristics and thresholds • Environment Protection (Industrial Waste Resource) Regulations 2009 • Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999 • National Environment Protection (Assessment of Site Contamination) Measures 1999, amended 2013 (ASC NEPM) • WorkSafe Occupational Health and Safety Regulations 2007 (Asbestos). The Construction Environmental Management Plan will include measures such as: • Characterising soil prior to disposal or reuse • Identifying soil containing asbestos and if present, developing management strategies in accordance with the WorkSafe Regulations • Assessing geological formations with naturally enriched metals and applicable spoil management options and or off-site disposal to the satisfaction of EPA Victoria • Identifying suitably licensed facilities for the disposal or treatment of contaminated soil • Management of wastewater • Management of dust, potential stormwater run-off and seepage from stockpiled materials • Undertaking a baseline site assessment of areas proposed for construction laydown prior to use • Protection of the beneficial uses of land associated with current and planned future use.	EPR CL1	Unlikely	Minor	Low	The Limited Environmental Site Assessment (Arcadis 2019) found low pH soil and elevated natural background concentrations of arsenic and fluoride within the study area, however they are consistent with background levels found in the Shire of Nillumbik. If disposal is required, leachate analysis will be required by the receiving landfill prior to disposal. With standar d mitigation measures applied, the assessment identified impact from existing contaminated land to sensitive receptors to be low. The Assessment also included soil classification and disposal, with targeted sampling completed adjacent to areas which have been historically used for industrial or commercial purposes.	Technical Report K - *Contaminated land impact assessment*

85	Contaminated land	Operational activities that require excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Operations	Rare	Insignificant	Low	Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's standards for managing declared roads in Victoria.	EPR EMF5	Rare	Insignificant	Low	The Limited Environmental Site Assessment (Arcadis 2019) found low pH soil and elevated natural background concentrations of arsenic and fluoride within the study area, however they are consistent with average levels found in the Shire of Nillumbik. If disposal is required, leachate analysis will be required by the receiving landfill prior to disposal. With standard mitigation measures applied, the assessment identified any impact from existing contaminated land to sensitive receptors to be considered low.	Technical Report K - *Contaminated land impact assessment*
105	Contaminated land	Maintenance activities that require excavation, stockpiling, transport and/or disposal of known or previously unrecorded contaminated material (including acid sulfate soils) leading to potential risks to human health and the environment	Maintenance	Unlikely	Minor	Low	Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's standards for managing declared roads in Victoria.	EPR EMF5	Unlikely	Minor	Low	The Limited Environmental Site Assessment (Arcadis 2019) found low pH soil and elevated natural background concentrations of arsenic and fluoride within the study area, however they are consistent with background levels found in the Shire of Nillumbik. If disposal is required, leachate analysis will be required by the receiving landfill prior to disposal. With standard mitigation measures applied, the assessment identified any impact from existing contaminated land to sensitive receptors to be considered low.	Technical Report K - *Contaminated land impact assessment*

APPENDIX D DESKTOP SEARCH INFORMATION

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*.

APPENDIX E SOIL LOGS

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*.

APPENDIX F LABORATORY CERTIFICATES

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*.

APPENDIX G TABLES

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*.

APPENDIX H QUALITY ASSURANCE AND QUALITY CONTROL

Appendix H - Quality Assurance and Quality Control

Analytical results and Relative Percentage Difference (RPD) calculations for the intra-laboratory and inter-laboratory field duplicates are provided in Table 2, Appendix F. The precision of the results for each analyte between the primary sample and the field duplicate was determined by calculating the RPD, as follows:

$$RPD = \frac{(Concentration\ 1 - Concentration\ 2)}{(Concentration\ 1 + Concentration\ 2)/2} \times 100$$

Based on Australian Standard AS 4482.1-2005, a field duplicate RPD within the range of 30% to 50% is considered acceptable. Based on NEPM 2013, a field duplicate and secondary duplicate RPD of greater than 30% indicates that a review should be conducted of the cause (e.g. instrument calibration, extraction efficiency, appropriateness of methods used, etc). Both guidelines recognise that higher variations can be expected for organic analysis and where low concentrations of analytes are recorded.

The results of internal laboratory quality control procedures are provided within the laboratory analysis reports (Appendix F). The acceptance criterion for internal laboratory replicates is generally set at an RPD of 20% to 50%. Laboratory recoveries should be in the range 75% to 125%.

Table H.1 and Table H.2 below summarise the results of field QA/QC and laboratory QA/QC procedures, respectively.

Table H.1: Field QA/QC Procedures

QA/QC Requirement	Completed	Comments
Appropriate sampling strategy used, and representative samples collected	Yes	A lineal sampling approach was adopted along the length of the road corridor.
Field instruments calibrated	Yes	See Appendix E for calibration certificates.
Appropriate and well documented sample collection, handling, logging, transportation and decontamination procedures	Yes	Refer to Section 3.2.1 for details.
Chain of custody documentation completed	Yes	All samples were transported under WSP's chain of custody procedures and signed chain of custody documents are included in Appendix F.
Required number of blind and split duplicates collected (1:20)	Yes	Two primary soil samples were analysed, and two sets of blind and split duplicates were collected and analysed.
Soil QA/QC samples reported RPDs within limits set by AS4482.1-2005	Partial	RPD values were generally within the acceptable range. Exceedances were noted for arsenic, copper, lead, nickel and zinc. Variations are attributed to the heterogeneous nature of the sample medium. Soil RPD results are presented in Table 2, Appendix F.
Required numbers of trip and rinsate blank samples collected (one trip blank per cooler, one rinsate blank per day)	Yes	10 rinsate blanks and three trip blanks were collected and analysed.
Acceptable trip and rinsate blank results	Yes	All trip and rinsate blank results were below the laboratory limit of reporting (LOR). Trip and rinsate blank results are included are attached as Table 3 in Appendix F.
Samples delivered to laboratory within sample holding times and with correct preservative	Yes	Samples were delivered to the laboratories within the sample holding times and in laboratory-supplied containers prepared with the appropriate preservative (where required).

Table H.2: Laboratory QA/QC Procedures

QA/QC Requirement	Completed	Comments
Samples extracted and analysed within relevant holding times	Yes	All analytes were extracted within holding times. Refer to ALS Interpretive Quality Control reports in Appendix F.
All analyses NATA accredited	Yes	Both ALS and Eurofins are NATA accredited for all the analyses performed.
Appropriate analytical methodologies used, in accordance with Schedule B(3) of the NEPM	Yes	Refer to the Interpretive Quality Control reports in Appendix F for methods used and relevance to Schedule B (3) of the NEPM.
Acceptable laboratory Limits of Reporting (LORs) adopted	Yes	All LORs are acceptable.
Acceptable laboratory QC results: Surrogates: 70% to 130% recovery. Matrix Spikes: 70% to 130% recovery Control Samples: 70% to 130% recovery for soil or 80% to 120% recovery for waters. Duplicate Samples: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%. Method Blanks: zero to <LOR.	Partial	The results of internal laboratory quality control procedures are provided within the laboratory analysis reports (Appendix F). All Laboratory RPD values were within the acceptable range. Laboratory matrix spike recoveries (for water) were within acceptable range, with the exception of mercury and zinc. Mercury recovery rates were less than data quality objectives. Zinc recovery rates were not determined. Laboratory control blank results were generally below the LORs. Laboratory control spike outliers (for soil) was noted for 2-cyclohexyl-4,6-dinitrophenol in one batch. As this analyte is not considered to be a COPC, this non-conformance is not considered to adversely affect the results and therefore is considered acceptable. Frequency of quality control samples for matrix spikes (mercury) and laboratory control samples (hexavalent chromium) were below acceptable limits. However, this is not anticipated to adversely affect the results as these analytes are not considered to be COPC. All method blank results were below the LORs.

The differences in RPD between the primary and split sample is likely to be due to the heterogeneity of the sample. Variations observed could also be attributed to differences in testing regime and laboratory conditions between the primary and secondary laboratories. Overall, this is not considered to impact on the interpretation of the soil results or conclusions. As such, it is considered that the QA/QC procedures and results were adequate for the assessment works completed.

APPENDIX I SOIL CLASSIFICATION LETTER

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*.

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