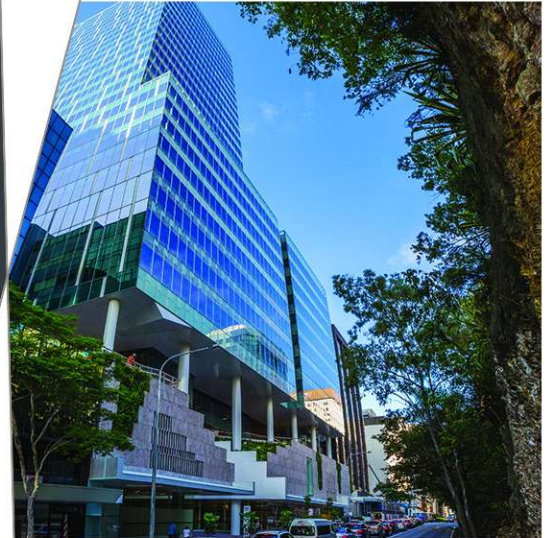


Review of Environmental Factors

Dunheved Road Upgrade

80021086



Prepared for
Penrith City Council

24 August 2022

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Executive Summary

Penrith City Council (Council) are proposing to upgrade Dunheved Road between Richmond Road and the Christie Street/Werrington Road roundabout. Dunheved Road is currently a two-way two-lane carriageway. The upgrade will include a new medium separated four lane carriageway and shared user path along the extent of the 4.2km stretch of road. The proposal includes upgrades to the drainage network at Orleton Place and Rugby Street to the south of Dunheved Road and the addition of three new roundabouts at the following locations:

- > Tasman Street and Eton Road intersection
- > Henry Lawson Avenue and Madigan Drive intersection
- > John Batman Avenue and Ovens Drive intersection

A number of intersections will also be improved for turning and upgraded signalisation and egress and ingress points to busy commercial areas will be improved to assist with traffic flow.

The intent of the project is to help reduce traffic impacts occurring along Dunheved Road, especially during peak times of use and to improve traffic flows and safety in and out of intersections that connect into Dunheved Road. Future projections for the area show that population increase, and job growth would increase the number of road users along Dunheved Road and therefore if the road is not upgraded the congestion along this stretch of Dunheved Road is predicted to get worse.

The REF would be assessed under Division 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and in accordance with Clause 170 and 171 of the Environmental Planning & Assessment Regulations 2021 (EP&A Regulation) to ensure that all relevant environmental factors have been assessed and incorporated in the preparation of this document.

The purpose of the REF is to describe the proposed works, to document the likely environmental impacts of the works and to detail mitigation measures to be implemented to mitigate any impacts. In doing so the REF helps fulfil the requirements of Section 5.5 of the EP&A Act that Council examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

To support the REF, a number of specialist field studies were undertaken including traffic modelling, noise modelling, an ecological survey, a cultural heritage due diligence assessment, a geotechnical investigation and contaminated land assessment. These studies were carried out to guide and determine the proposed impacts to sensitive environments within the Study Area and its surrounds.

Overall, the strategic need for the Dunheved Road upgrades is well established in regional, district and local policies and plans, in terms of catering for projected population increases and economic growth. It is also important to note that if left unchanged the traffic network along Dunheved Road is likely to fail by 2036. This is indicated by the traffic modelling presented by two traffic assessments produced by SMEC in 2021 and 2022. While a number of short-term negative impacts during the construction phase are noted, such as dust, traffic delays and aesthetics, many of these can be managed and minimised through the implementation of effective mitigation measures via a Construction environmental Management Plan (CEMP) and good design.

The key environmental impacts of the project are as follows:

It is proposed that up to 5.15 ha of native vegetation be removed including 1.34 ha of Cumberland Plain Woodland (CPW) and up to 0.22 ha of River-flat Eucalypt Forest (RFEF) Threatened Ecological Communities (TECs). These are important vegetation communities and representing habitat for the threatened Cumberland Plain Land Snail (CPLS). The loss of CPW due to the project will further contribute to loss of extent of this critically endangered listed TEC and this loss is likely to have a significant impact on the long-term presence of the CPW and the associated CPLS. As such, it is recommended that a referral be considered to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) regarding the potential impacts of the project on the CPW listed threatened community.

Acoustic barriers are recommended to be erected along sections of Dunheved Road to minimise noise impacts from increased traffic flow, however it should be noted that many of these properties were predicted to exceed noise criteria even if the project did not proceed. Further property treatments will also be required at some properties along the road alignment in addition to the noise barrier. The noise barriers will minimise the impacts

of noise for those affected properties however visual and aesthetic impacts may represent an issue to individual landowners and members of the public using the road on a regular basis. Careful consideration will be given to material, colour and design. Landscape plantings will also help to blend and disguise barriers in the long term.

A number of mature trees will be lost due to the upgrade, however landscaping will be undertaken to replace and enhance areas where trees are removed. The design has been altered and undergone many iterations to retain as many trees as possible.

Other environmental impacts include:

- > Socio-economic short term negative impacts are expected with regards to amenity and access and businesses will be negatively impacted if access is restricted to their shopping precincts. This is particularly the case for Stage One, where the construction will be located in front of the Werrington Village Shopping Centre. However, in the long-term increased traffic flow will likely bring improved economic conditions and throughput.
- > There would be temporary major impacts to access of private and commercial properties along Dunheved Road during the construction phase. The proposed works have been broken up into four stages to reduce these impacts to minimise these issues and a Traffic Management Plan (TMP) with active controls will be implemented for the duration of works. Following the upgrade, it is expected that the works will have a long-term positive impact on traffic and access by reducing congestion and improving overall traffic flows and safety.
- > Impacts to traffic during construction will be minimised through maintaining the existing traffic lanes to allow continued use during all construction phases, partial closures and delays will be managed through a TMP.
- > The potential risk for contamination within the development footprint is considered low. However, as exceedances of ecological criteria were observed in some samples at deeper ground level, further testing of soils will be required at construction stage before a waste classification certificate can be issued.
- > Impacts from dust, noise, amenity, contaminated runoff/sedimentation and construction traffic will be managed in a project CEMP to ensure these impacts are minimised during each of the construction stages.
- > No non-Aboriginal heritage places occur within the Study Area. The closest heritage site is Werrington House which is located approximately 280m south from the Study Area. Impacts from noise and vibration during construction are unlikely to impact the heritage place due to its set back from the road.
- > No Aboriginal heritage items were found within the Study Area and it was concluded that the archaeological potential of the Study Area is low. However, there is still potential for unexpected items to be encountered during earthworks and bridge works near Werrington Creek.
- > Construction impacts relating to air quality and waste management impacts would be temporary and mitigated through the application of conventional management methods implemented by the appointed contractor through the CEMP.
- > Hydrology and flooding road/bridges designed to allow for flood event of 1% AEP with no discernible difference in flood risk to the area post construction of the Upgraded Dunheved Road and new bridges.

The proposed development is subject to assessment under Division 5.1 of the EP&A Act. This REF has assessed and considered to the fullest extent possible all matters impacting or likely to impact the environment by reason of the proposed development.

A number of potential environmental impacts from the proposed development have been avoided or reduced during the design phases and options assessment. The proposed development as described in the REF best meets the project objectives, though would still result in some environmental impacts. Safeguards and management measures as detailed in this REF would be implemented and minimise most of these expected impacts.

The proposed development is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required. However, as a Biodiversity Development Assessment Report (BDAR) is currently being undertaken to further assess impacts to biodiversity values, in particular impacts to the CPW and the CPLS under the NSW *Biodiversity Conservation Act 2016*. Results from the BDAR are expected in early 2023.

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Glossary and Abbreviations

Term/Acronym	Description
ABS	Australian Bureau of Statistics
AEP	Annual Exceedance Probability
AHIMS	Aboriginal Heritage Information Management System
ARNTG	At-Receiver Noise Treatment Guideline
AS	Australian Standards
ASC	Australian Soil Classification
ASS	Acid Sulfate Soils
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
B&C SEPP	Biodiversity and Conservation SEPP
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BH	Bore hole
BOS	Biodiversity Offset Scheme
BTEX	Benzene, toluene, ethylbenzene and xylene
Cardno	Cardno now Stantec
CEC	Cation Exchange Capacity
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CLM Act	NSW <i>Contaminated Land Management Act 1997</i>
CNVG	Construction Noise and Vibration Guideline (RMS 2016)
CPLS	Cumberland Plain Land Snail
CPW	Cumberland Plain Woodland
Council	Penrith City Council
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
dB	Decibels
dBA	A-weighted decibels
DECC	NSW Department of Environment and Climate Change
DECCW	NSW Department of Environment, Climate Change and Water
DIPNR	Department of Infrastructure, Planning and Natural Resources
DLWC	Department of Land, Water and Conservation
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPI	NSW Department of Primary Industry
DPI Fisheries	NSW Department of Primary Industry (Fisheries)
DPIE	NSW Department of Planning, Industry and Environment (now DPE)
EDS	Economic Development Strategy
EEC	Endangered Ecological Community
EIL	Ecological Investigation Levels
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth <i>Environmental Protection and Biodiversity Conservation Act 1999</i>

Term/Acronym	Description
EPI	Environmental Planning Instrument
EPL	Environmental Protection Licence
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	NSW <i>Environmental Planning and Assessment Regulation 2021</i>
ESCP	Erosion Sediment Control Plan
ESL	Ecological screening levels
FM Act	NSW <i>Fisheries Management Act 1994</i>
GDE	Groundwater Dependent Ecosystem
GRDC	Grains Research and Development Corporation
Heritage Act	NSW <i>Heritage Act 1977</i>
HIL	Health Investigate Level
HSL	Health Screening Level
ICNG	Interim Construction Noise Guidelines (DECC 2009)
ISEPP	NSW <i>State Environmental Planning Policy (Infrastructure) 2007</i>
KFH	Key Fish Habitat
L _{AMAX}	the A-weighted maximum noise level measured during the measurement period.
L _{A1}	the A-weighted noise level exceeded for 1% of the measurement period.
L _{A10}	the noise A-weighted level exceeded for 10% of the measurement period, generally referred to as the average maximum sound pressure level
L _{A90}	the A-weighted noise level exceeded for 90% of the measurement period, generally referred to as the average minimum sound pressure level or background noise level (refer AS 1055:2018, <i>Acoustics – Description and Measurement of Environmental Noise</i>).
L _{Aeq}	the equivalent continuous noise level over the measurement period, generally referred to as the energy averaged sound pressure level over the measurement period.
LALC	Land and Aboriginal Council
LEP	Local Environmental Plan
LGA	Local Government Area
LOR	Level of Reporting
LoS	Level of Service
LSPS	Local Strategic Planning Statement
MNES	Matters of National Environmental Significance
NCG	Noise Criteria Guideline
NMG	Noise Mitigation Guideline
NML	Noise Management Level
NEPM	National Environmental Protection Measures
NMVG	Noise Model Validation Guideline
NPW Act	NSW <i>National Parks and Wildlife Act 1974</i>
NSW	New South Wales
NSW SES	NSW State Emergency Services
NVMP	Noise and Vibration Management Plan
OCP	Organichlorine Pesticide
OOHW	Outside of Hours Work

Term/Acronym	Description
OPP	Organophosphorous Pesticides
PAH	Polycyclic aromatic hydrocarbons
PC	Pavement Core
PCB	Polychlorinated Biphenyls
Penrith LEP	Penrith Local Environmental Plan 2010
PID	Photoionisation Detector
PM	Particulate Matter
PMF	Probable Maximum Flood
PMST	Protected Matters Search Tool
POEO Act	NSW <i>Protection of the Environment Operations Act 1997</i>
REF	Review of Environmental Factors
RMS	NSW Roads and Maritime Services
RMT	Random meander transect
RNP	Road Noise Policy
Roads Act	NSW <i>Roads Act 1993</i>
SIDRA	Signalised and unsignalized Intersection Design and Research Aid (traffic engineering software)
SEPP	State Environmental Planning Policy
SHR	State Heritage Register
SREP	Sydney Regional Environmental Plan
SSO	Strahler Stream Order
TEC	Threatened Ecological Community
TfNSW	Transport for NSW
TMP	Traffic Management Plan
T&I SEPP	Transport and Infrastructure State Environmental Planning Policy
TRH	Total Recoverable Hydrocarbons
UFP	Unexpected Finds Protocol
VOC	Volatile Organic Compounds

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1 Introduction

1.1 Project background

Penrith City Council (Council) is proposing to upgrade Dunheved Road between Richmond Road and the Christie Street/Werrington Road roundabout. The Dunheved Road Upgrade will improve an integral part of Penrith's local road network and is being fully funded by the Australian Government's Urban Congestion Fund.

The upgrade will include a new medium separated four lane carriageway and shared user path along sections of the 4.2km stretch of road. The proposal includes upgrades to the drainage network at Orleton Place and Rugby Street to the south of Dunheved Road and the addition of three new roundabouts at the following locations:

- > Tasman Street and Eton Road intersection
- > Henry Lawson Avenue and Madigan Drive intersection
- > John Batman Avenue and Ovens Drive intersection

Along with the widening of the carriageway, a number of intersections will have improvements for turning, upgraded signalisation and egress/ingress points to busy commercial areas will be improved to assist with traffic flow and to compliment the development and future traffic projections.

1.2 Project Site Description

The project site is located in the Penrith Local Government Area (LGA) and spans across the suburbs of Cambridge Park, Cambridge Gardens, Werrington, Werrington Downs and Werrington County. Dunheved Road is a regional road that travels through residential areas and the Werrington County town centre. The subject land on which the works would be undertaken is primarily within road reserve owned and managed by Council and Transport for NSW (TfNSW). Twelve parcels of land will need to be acquired along Dunheved Road, two of which will be freehold land parcel (see Section 3.3.7 for a discussion on this).

The project site runs through a highly modified urban environment, with existing road infrastructure, commercial areas and roadside parkland with scattered vegetation patches and street trees. The eastern extent of the project site crosses Werrington Creek and the green corridor that extends north to south. The land uses surrounding the road reserve where the upgrades are proposed consists of low and medium density residential, retail and commercial areas, public recreation, cultural use and areas set aside for environmental conservation. The broad locality of the project is shown in Figure 1-1.

There are patches of remnant vegetation adjacent the existing road and within the road reserve that are consistent with CPW, a critically endangered ecological community. Dunheved Road is located within Cumberland Interim Biogeographic Regionalisation for Australia (IBRA) subregion, however the Cumberland Plain Recovery Plan 2011 and the associated Cumberland subregion Biodiversity Investment Opportunities Map for the Penrith LGA does not show Dunheved Road as being within core areas, however Werrington Creek at the eastern end of Dunheved Road is mapped as being part of a Regional Corridor for investment and recovery of the Cumberland Community (for further discussion on this matter see Section 6.8).

1.3 Purpose of the Report

This Review of Environmental Factors (REF) has been prepared by Cardno (NSW/ACT) Pty Ltd (Cardno) on behalf of Council. For the purpose of this project Council is both the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of this REF is to describe the project and document any likely environmental impacts that the project would have and provide mitigation and management measures that will be implemented to minimise or avoid the potential impacts identified. In doing so, the REF helps to fulfil the requirements of Section 5.5 of the EP&A Act that Council examine and consider to the fullest extent possible all matters affecting, or likely to affect, the environment by reason of the activity. The findings of the REF would be considered when assessing:

- > Whether the proposal would be likely to have a significant on the environment, and therefore whether it is necessary to prepare an environmental impact statement and seek approval for the works from the Minister for Planning under Part 5.1 of the EP&A Act; and/or
- > The potential for significant impacts on Matters of National Environmental Significance (or Commonwealth land) subject to the Commonwealth EPBC Act, and the need to make a referral to the Commonwealth DCCEW or whether assessment and approval is required under the EP&A Act.

A REF should include an assessment of the significance of any impact on any threatened species, ecological communities or endangered populations listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and/or *NSW Fisheries Management Act 1994* (FM Act), and therefore whether a Species Impact Statement or a BDAR is required.

In the case of this project, biodiversity investigations have determined there is potential for a significant impact of the critically endangered ecological community, the CPW. Council have decided to opt into the Biodiversity Offset Scheme (BOS) and complete a full BDAR together with comprehensive ecological surveys. The BDAR is currently being undertaken and will inform the final REF.

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Figure 1-1 Locality plan

2 Need and Options Considered

2.1 Strategic Need for the Project

The Penrith City local government area (LGA) serves as a home to an approximate population of 216,000 people (estimated from Australian Bureau of Statistics, 2020). Population projections indicate that this number will increase to a total of 370,000 people by 2041. Penrith is a growing city, critical for jobs, services and housing, and will be the closest city centre to the future Western Sydney Airport and surrounding aerotropolis.

Given the proximity to the planned airport and national and international freight opportunities, new infrastructure is needed to deliver a better-connected region. The strategic importance of Penrith is recognised in various state plans, with the LGA needing to provide more housing and deliver more jobs.

As such, the primary objectives for the Dunheved Road project are to:

- > Facilitate responsible growth for the future of Penrith
- > Cater for future traffic demand, improve capacity and reduce congestion on the wider arterial road network
- > Improve the safety of the road through intelligent design
- > Improve access and safety for pedestrians and cyclists
- > Building the specific capability of service providers for Council in support of expected growth in Western Sydney
- > Consider whole of life costs and to ensure the project outcomes achieve value for money.

See Section 3 for a discussion around the project and the consistency of the projects objectives with the strategic planning documents at a regional, district and local level. While the strategic need for the Dunheved Road upgrades is well established as summarised above, it is important to note that if left unchanged the traffic network along Dunheved Road is likely to fail by 2036. This is indicated by the traffic modelling presented by two traffic assessments produced by SMEC in 2021 and 2022. For further discussion on the need for the project in relation to the transport network and projected future base case performance see Section 6.1 Traffic and Transport.

2.2 Options Considered and Design refinements

The project design has been through a number of iterations and refinements with community, stakeholder and technical input. The key refinements throughout the design phases are summarised in Table 2-1 below.

If the 'do nothing' option was selected, and the road upgrade didn't go ahead this would be incongruous with many of the guiding transport and economic strategies and long term planning requirements for the wider locality, district and region. Doing nothing would mean the current congestion and queuing issues along Dunheved Road would not be resolved and projected population growth for Penrith and wider Western Sydney would exacerbate existing traffic flow issues causing intersections and the road network to eventually fail by 2036.

A technical traffic report was produced by SMEC in 2021 and updated 2022 which modelled the future predicted network base case (using SIDRA traffic network modelling) and the improved performance results based on three potential options for the Dunheved Road upgrades.

The base case modelling results show several capacity issues on the Dunheved Road corridor in the year 2036, due to the one lane configuration (each way). Side roads also experience long queues and delays, as vehicles back up from the Dunheved Road main line. Suggested potential mitigation measures for the network from the SMEC 2021 report are as follows:

- > Duplicate the Dunheved Road to have a 4-lane cross-section (2 through lanes on each side)
- > Seagull intersections to be upgraded to traffic signals
- > Convert Dunheved Rd/ Christie St/ Werrington Ave roundabout to a signalised intersection
- > Ban right turns on any priority-controlled intersections (or signalise such intersections if needed), such as at the Werrington County Shopping Village accesses.

The three potential options modelled outcomes by testing variations of the base case mitigations measures mentioned above. For more information on the base case modelling and the options considered refer to Appendix D for the Traffic Assessment reports.

After a number of workshops with Council and refinements to design, further sensitivity testing was undertaken by SMEC in 2022 to assist with identifying the optimum design option. Refinements are still being made to the design, intersections and signalisations options.

In parallel to this, environmental studies have been undertaken and technical experts have been consulted throughout concept, 50%,80% and up to 100% design phases to ensure impacts to biodiversity, heritage, and local amenity were minimised. Where impacts could not be avoided suitable mitigation measures have been proposed. In the case of biodiversity matters, studies/surveys are still being undertaken to better understand impacts as part of the BDAR process (See Section 6.8 for more details on biodiversity matters).

Table 2-1 Design Refinement Summary (Source: Cardno Design Report 2022)

Design Phase	Approximate Location	Design Change	Reason for Design Change
Concept Design Phase	Trinity Drive intersection	Deceleration lane provided for left-in	Allow vehicles to safely decelerate to perform left-turn into Trinity drive and reduce risk of rear-end collision.
	Tasman Street intersection	Ban right-out movement out of Tasman Street	To reduce risk of collision between vehicles turning right-out of Tasman Street.
	Francis Street intersection	Provide dual right turns on Francis Street	To improve level of service, in accordance with traffic modelling.
	Francis Street intersection	Provide left-in slip lane from Dunheved Road into Francis Street	To improve level of service, in accordance with traffic modelling.
	Lavin Crescent intersection	Replace unsignalised seagull intersection with signalised intersection	To improve level of service, in accordance with traffic modelling, and improve safety.
	Entry to Red Rooster	Remove left-out of private carpark	To improve safety, and reduce risk of collision, due to its proximity to proposed signalised intersection.
	John Batman Avenue intersection	Replace unsignalised seagull intersection with signalised intersection	To improve level of service, in accordance to traffic modelling, and improve safety.
80% Design Phase	Tasman Street / Eton Road intersection	Proposed mountable roundabout	To facilitate vehicle movements that can no longer perform the right-out movement from Trinity Drive.
	Henry Lawson Avenue / Madigan Drive intersection	Proposed mountable roundabout	To facilitate vehicle movements that can no longer perform the right-in movement into Lockyer Avenue.
	John Batman Avenue / Ovens Drive intersection	Proposed mountable roundabout	To facilitate vehicle movements that can no longer perform the right-in movement into Lockyer Avenue.
	Tasman Street intersection	Additional left-turn slip lane into Tasman St	To improve level of service, in accordance with traffic modelling, and improve safety.

Design Phase	Approximate Location	Design Change	Reason for Design Change
	Between Greenbank Drive (West) and Greenbank Drive (East) intersections	Road alignment shifted south	To allow space for potential noise walls and increase separation from properties on northern side.
	Werrington Road roundabout	Continuation of Shared Path and adjust island treatment	To improve pedestrian connectivity to footpath on the bridge on Christie Street
	On Dunheved Road, where posted speed limit is 70 km/h	Increase kerbside lane from 3.5m to 3.95m (measured to kerb face)	Council preference for wider lanes for improved driver comfort
	Tasman Street intersection	Signalisation of intersection	To provide pedestrian connectivity between the northern and southern sides of Dunheved Road.
	Trinity Drive intersection	Provide right-in movement	Community consultation noted that access to shops at Boomerang Place is preferred.
	Werrington Road roundabout	Provision of dual through movements for the eastbound lanes from Christie Street into Dunheved Road	To improve level of service, in accordance with traffic modelling.
100% Design Phase	Southern side of Dunheved Road (approx. MC10 CH90)	Retaining wall and safety barrier included.	Avoid impact to existing electrical pole, and safety barrier introduced to reduce risk of collision with retaining wall.
	"Little" Dunheved Road	Pedestrian crossing has been shifted to the north of "Little Dunheved Road".	Reduce impacts to significant trees along northern edge of Dunheved Road.
	Dunheved Road / Tasman Street Intersection	Slight adjustment of Dunheved Road median geometry	Reduce chance of unauthorised right turn out of Tasman Street.
	'Red Rooster' driveway on Dunheved Road (approx. MC10 CH2250)	Kerbs within the 'Red Rooster' carpark has been adjusted to accommodate wider driveway.	Lengthen traffic island prevents a 'left turn out' onto Dunheved Road. This was requested from TfNSW as the driveway was too close to the proposed signals
	'Red Rooster' driveway on Lavin Cres	Kerbs within the 'Red Rooster' carpark has been adjusted to accommodate wider driveway.	As vehicles cannot exit 'Red Rooster' at Dunheved Road, the widened driveway onto Lavin Crescent has been provided to accommodate delivery vehicles.
	Dunheved Road eastbound turn lane into 'Red Rooster'	Dedicated left turn lane into 'Red Rooster' has been removed.	TfNSW raised concerns that having two left turn lanes in short succession would be confusing for drivers, and hence requested for the left turn lane into 'Red Rooster' to be removed.
	John Oxley Avenue	John Oxley Avenue is no longer signalised and replaced with an unsignalised left-	TfNSW raised concerns of the signalised intersections at John Oxley and John Batman Avenues being too close together, and the risk of see-through effects and potential for

Design Phase	Approximate Location	Design Change	Reason for Design Change
		in/left-out and right-in treatment.	rear-end accidents. Hence, John Oxley Avenue signals were removed.
	Dunheved Road (MC10 CH3200 to CH3500)	Shared Path Meander and Additional Landscaping	Council's request to include additional landscaping for aesthetic purposes.
	Dunheved Road (approx. MC10 CH3150 and CH3500) Tasman Street (approx. MC50 CH40)	Addition of driveway laybacks for maintenance access.	Access for maintenance vehicles provided as requested by Council.
	Dunheved Road (Approx. MC10 CH3900)	Barrier design at existing bridge	Barrier design has been amended on either sides of existing bridge, as Council requested not to modify any existing barriers or the structure.
Environmental design refinements in relation to sensitive Environmental Factors	<ul style="list-style-type: none"> > Refinements to ensure there are suitable acoustic treatments for residential areas (Discussed in Section 6.2) > Refinements to ensure suitable buffers/mitigation for sensitive ecological areas and threatened species (Discussed in Section 6.8) > Refinements to ensure suitable amenity considerations are included in landscape design (Discussed in Section 1.1.1) > Refinements to ensure, where practical, the retention and replacement of trees and green areas through landscape design (Discussed in Section 1.1.1) 		

3 Description of the Proposal

This chapter describes the proposal, including the design parameters, design features, and the construction methodology proposed for the project.

3.1 The Proposal

Council proposal for the development of a concept and detailed design for the proposed upgrade of Dunheved Road from Richmond Road to Christie Street and just east of the intersection with Werrington Road. The length of the proposed upgrade is approximately 4.2 km. The upgrade will also include ancillary works to the drainage network at Orleton Place and Rugby Street situated behind Lavin Crescent and the upgrade of three roundabouts on adjacent side streets.

Currently, Dunheved Road is a two-lane two-way road for the majority of the project area with eleven existing intersections identified. Of these existing intersections, there is one roundabout, four signalised intersections, and six unsignalised intersections. An existing bridge structure is located over Werrington Creek, approximately 200 metres west of the Christie Street/Werrington Road roundabout.

The proposed road upgrade will involve widening the Dunheved Road corridor to provide two additional through lanes across the entire alignment. The proposed upgrade will also include turn lane, bus lane, roundabout, bridges and intersection treatments. Summary plans of the design showing the wider study area, construction footprint and 80% design footprint are included in Appendix A. The 80% design drawings, due to their size are provided separately. For an overall summary of the footprint please refer to the locality plan Figure 1-1.

The 80% detailed design includes:

- > Dunheved Road will be upgraded to a dual-carriageway with 7-metre wide carriageways in eastbound and westbound directions.

- > A 'future-proofed' intersection that will tie-in to Richmond Road and consider the integration with TfNSW bus lane proposal.
- > A 3.0m wide shared path is proposed along the southern edge of Dunheved Road, from Richmond Road to Werrington Road. A 1.5m footpath is also provided along the northern edge of Dunheved Road for most of the length of the project. The alignment and length of these paths will be altered in future design iterations depending on the environmental values along the extent.
- > Improvement of the existing intersections at:
 - Dunheved Road / Richmond Road
 - Dunheved Road / Trinity Drive
 - Dunheved Road / Tasman Street
 - Dunheved Road / Greenbank Drive
 - Dunheved Road / Francis Street
 - Dunheved Road / Lavin Crescent
 - Dunheved Road / Shopping Centre Access
 - Dunheved Road / Henry Lawson Avenue
 - Dunheved Road / John Oxley Drive
 - Dunheved Road / John Batman Avenue
 - Dunheved Road / Werrington Road
- > Two new bridges:
 - A new road bridge over Werrington Creek
 - A new shared path bridge over Werrington Creek.
- > Three new concrete mountable roundabouts at:
 - Tasman Street / Eton Road
 - Henry Lawson Avenue/ Madigan Drive
 - John Batman Avenue/ Ovens Drive.
- > An upgrade of the Orleton Place and Rugby Street drainage network (behind Lavin Crescent).

The existing bridge will be retained and be used during construction to maintain traffic flow and then will be used for one way traffic once the other bridges are completed. Both bridges are proposed to be single span super-T structures.

Where required, safety barriers have been provided, including beside steep batters, retaining walls and culvert headwalls, and on the bridge approaches, additional bus stops and lighting will also be considered as part of the later design phase.

3.2 Design Criteria

The design criteria which formed the basis of the 80% detailed design is outlined in the Design Report and key elements have been summarised in Table 3-1 below. Dunheved Road is an Unclassified Regional Road (no 7288).

Table 3-1 Design Criteria (Source: Detailed Design Report, Cardno 2022)

Aspect	Design Criteria
Design/Check Vehicle	
Dunheved through movements, Richmond Road turn movements, Christie Street and Werrington Road roundabout movement	B double 25/26m
Other roads turned movements Dunheved Road into/out of side roads	12.5m truck/bus and 19m semi-trailer
Design Speed/Posted Speed Limit	
Posted Speed (Outside Town Centre)	70km/h

Aspect	Design Criteria
Design Speed (Outside Town Centre)	80km/h
Posted Speed (Within Town Centre)	50km/h
Design Speed (Within Town Centre)	60km/h
Road Grade	
Minimum Road Grade	0.5% min
Maximum Road Grade	4-6% flat area (80km/hr) 6-8% flat area (60km/hr)
Cross Section/Required widths	
Carriageway Width	7.0m
Traffic Lane Width	3.5m
Left/right turn Auxiliary Width	3.5m
Median Width	1.8m at signalised intersections; otherwise, 1.2m (min)
Footway/utility Corridor	5.5m/varies
Shared Path Width	3.0m (desirable) 2.5m (min)
Shoulder Width	N/A
Batter slopes (cut/fill)	4H:1V (Fill) 2H:1V (Cut)
Drainage	
Minor Storm	Local/Collector: ARI 10 years Sub-Arterial: ARI 20 Years
Major Storm	ARI 100 years

3.3 Construction Methodology

The preferred construction contractor will confirm the final construction activities, staging and methodology with Council upon award. Therefore, this section provides a broad outline of likely methodology to identify potential environmental constraints and subsequent design refinements and to assist with community consultation particularly around the construction phase of the project. A general work method has been developed in this section. The construction footprint and proposed locations of compounds/material stockpiles is shown in plans in Appendix A.

3.3.1 Construction Staging

The project has been separated into four stages to minimise disruptions to the transport network, access, and movement for residential and commercial areas along Dunheved Road and adjacent suburbs. The four stages are shown in Figure 3-1 below. The stage numbers, locations and chainages are as follows:

- > Stage 1 – Werrington Shopping Centre Frontage (CH 2120m – 2640m) – will include the Orleton Place and Rugby Street Drainage Upgrades and the three roundabout upgrades on adjacent side streets.
- > Stage 2 – Greenbank Drive Intersections (CH 700m – 2120m).

Three new roundabouts have been proposed to be installed at the following locations:

- Tasman Street and Eton Road intersection

- Henry Lawson Avenue and Madigan Drive intersection
 - John Batman Avenue and Ovens Drive intersection
- > Stage 3 – Richmond Road to Greenbank Drive (CH 0m – 700m) will include works adjacent to and intersecting with Richmond Road, a Transport for NSW managed road.
- > Stage 4 – Eastern End to Christie Street (CH 2640m – 4200m)- will include the bridge replacement works over Werrington Creek.

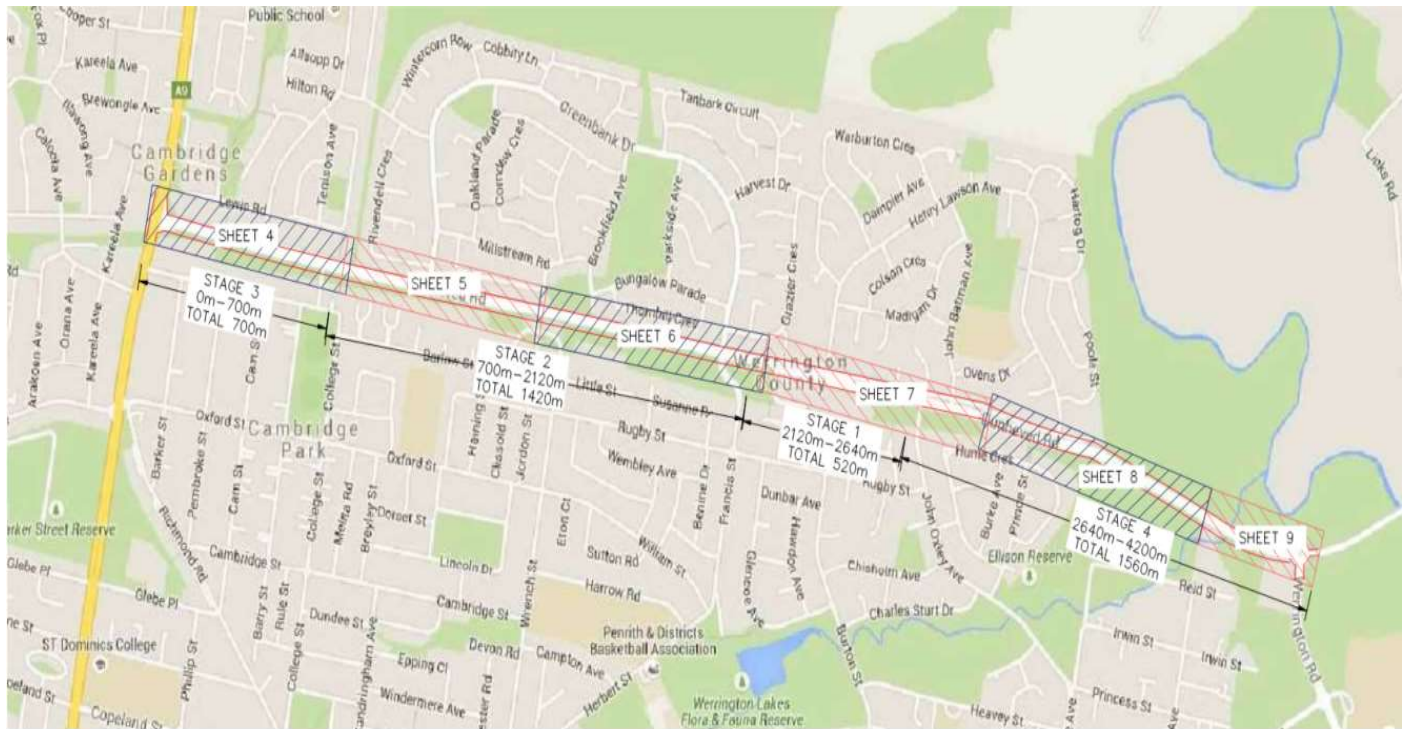


Figure 3-1 Proposed Project Construction Staging (Source: PCC/Cardno Design Report 2022)

3.3.2 Proposed Work Methodology

The construction works will be managed under the preferred contractor's project specific CEMP and will incorporate any mitigation measures proposed in the REF and any licencing requirements, for example if the project triggers an Environmental Protection Licence for road works. However, road construction works generally follow practical steps of preparation through to final landscaping/street furniture installation post road surface construction. It is assumed that these work steps will be worked through to completion for each of the four construction phases.

3.3.2.1 Site Preparation

For each stage 1-4 site preparation works will be required, as follows:

- > Notifications to all properties and stakeholders of the commencement of works,
- > Ensure all licences and permit are in place
- > Carry out all pre-clearance surveys, and any other pre works investigations
- > Establish no go zones for construction, particularly Tree Protection Zones and sensitive ecological areas
- > Demarcate site compounds, set equipment storage and fencing, establish access requirements
- > Vegetation clearing, tree trimming, grubbing of scrub
- > Establish ESC and drainage devices for stormwater management

3.3.2.2 Earthworks

For each stage 1-4 earthworks will be required, as follows:

- > Ensure all existing utility locations are known prior to breaking ground
- > Relocation any infrastructure/utilities as required
- > Implement traffic management controls
- > Strip topsoil and subsoils and Implement stockpile management/dust suppression
- > Ensure any material to be disposed of offsite is sampled and tested for waste classification purposes
- > Grading and compaction, importing and managing any fill
- > Installation of drainage devices, pipes, and culverts as per the design
- > Install any WSUD features – swales, detention basins

3.3.2.3 Stage 1-4 Dunheved Road Upgrades, drainage works and roundabouts

For each stage 1-4 the road pavement, intersections, drainage upgrades, roundabouts and footpaths and cycleway will be constructed, and the following works will be required:

- > Implement traffic management controls
- > Manage ESC devices
- > Install any retaining walls
- > Cut and fill related activities
- > Preparation and levelling of subgrade materials
- > Laying of pavement material and compaction
- > Installation of footpaths and adjacent surfaces
- > Install new kerbs and any stormwater/drainage devices
- > Install supporting Infrastructure – Traffic signals, signage, lighting and conduits
- > Street line markings

3.3.2.4 Stage 4 – Werrington Creek Bridges Construction

The bridges will be installed during Stage 4 of the construction works. The new road bridge, proposed for the eastbound carriageway, spans approx. 28 metres, and the new shared path bridge spans approx. 27.6 metres. They both will be constructed in parallel while the existing bridge remains in use. Construction works will consist of the following:

- > Install Erosion Sediment Control devices as required within and adjacent to Werrington Creek
- > Consider any requirements for any permits and implement any required mitigation
- > Install abutment foundations
- > Construct abutments and any retaining walls/batters
- > Install load bearing structure, and pavement and any drainage features

3.3.2.5 Acoustic mitigation, Landscaping and Amenity facilities

For each stage 1-4 acoustic mitigation, landscaping and amenity works will be required, as follows:

- > Final grading of adjacent areas
- > Importation/stockpiling of landscaping materials
- > Planting and mulching
- > Installation of acoustic barriers, safety barriers, street furniture and bus shelters
- > Temporary fencing for sensitive areas and signage

3.3.3 Hours of Construction

It is expected that the proposed works would commence in Mid-2023 and the duration of the project would be approximately 30 months.

In accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC 2009) construction hours would be, where possible, limited to:

- > Monday-Friday 7am-6pm
- > Saturday 8am-1pm
- > Sundays and Public Holidays – no work.

Any work carried out outside of standard working hours would be in accordance with the ICNG (DECC 2009) and *Construction Noise and Vibration Guideline* (CNVG) (RMS 2016a).

3.3.4 Plant and Equipment

Based on a review of the Roads and Maritime Services noise estimator tool, plant and equipment likely to be used on the proposal has been listed in Table 3-2.

Table 3-2 Proposed Plant and Equipment

Activity	Plant and Equipment
Site establishment / vegetation removal (if required) / operation of site compound	<ul style="list-style-type: none"> ▪ Truck (medium rigid) ▪ Light vehicles ▪ Road truck ▪ Scissor lift ▪ Franna crane ▪ Power generator ▪ Chainsaw 4-5 hp ▪ Tub grinder / mulcher 40-50 hp
Utility relocations / protection	<ul style="list-style-type: none"> ▪ Vacuum truck ▪ Backhoe ▪ Power generator ▪ Concrete saw ▪ Pneumatic hammer ▪ Franna crane 20 t ▪ Excavator (tracked) 35 t
Bridge Construction	<ul style="list-style-type: none"> ▪ Franna crane 20t ▪ Piling rig - driven ▪ Piling rig - bored ▪ Power generator ▪ Concrete pump ▪ Concrete truck ▪ Compressor ▪ Pneumatic hammer ▪ Welding equipment ▪ Utility vehicle
Road works	<ul style="list-style-type: none"> ▪ Pavement profiler ▪ Front end loader ▪ Concrete saw ▪ Pavement laying machine ▪ Dump truck ▪ Road truck ▪ Asphalt truck and sprayer ▪ Concrete truck ▪ Smooth drum roller ▪ Water cart ▪ Bulldozer D9 ▪ Backhoe ▪ Excavator (tracked) 35 t ▪ Front end loader ▪ Scraper 651 ▪ Franna crane 20 t
Road furniture installation / line marking	<ul style="list-style-type: none"> ▪ Road truck ▪ Scissor lift

Activity	Plant and Equipment
	<ul style="list-style-type: none"> ▪ Franna crane 20 t ▪ Line marking truck

3.3.5 Traffic Management and Access

During the daily pre-work briefings, construction workers would be encouraged to travel to the compound and project site via public transport, and (where possible) not park in surrounding roads.

Construction traffic and access would be managed in accordance with a traffic and access management sub-plan, to be prepared by the construction contractor as part of the CEMP for the proposal.

Dunheved Road will remain operational throughout the proposed construction works, with the construction zone occurring in parallel to the existing road for each of the first three phases. However, delays will be experienced during certain phases when traffic signals are upgraded, and traffic management is required creating a backup of traffic and delays for turning vehicles. Access may become restricted for certain properties for short periods of time. Access issues will be managed through a detailed traffic management plan prepared and implemented by the preferred contractor and individual property agreements. The public will be made aware of any traffic disruptions through signage and local notifications.

During the 4th construction stage the existing bridge will remain open while the two new bridges are being constructed with the new road bridge located north of the existing road bridge, and the new shared path bridge located south of the existing road bridge. There may be traffic disruptions caused by construction deliveries for larger components of the bridge structure.

3.3.6 Utilities

Throughout the design process consultation has been carried out with the following Utility Stakeholders as they have infrastructure within the study area:

- > Jemena
- > Endeavour Energy
- > NBN Co
- > Optus
- > Telstra
- > Sydney Water

The design will continue to be sensitive to requirements of these utilities and all investigations and earthworks will be undertaken with DBYD plans with utility locators providing locations onsite. Of particular note is the existing Endeavour Energy transmission tower (132kV) is located on Dunheved Road between John Batman Street and Henry Lawson Avenue. The base of the tower lies approximately 4.2 metres away from the edge of the existing westbound lane. It is separated by an existing crash barrier and is located on the verge. The design team are continuing to work with Endeavour Energy to determine separation requirements from the tower.

3.3.7 Property Acquisitions

Council may need to acquire two parcels of private land for the proposed upgrade of Dunheved Road. The existing road corridor in some areas is not wide enough to accommodate the proposed road corridor. In some locations, the proposed route alignment deviates from the existing road alignment which will result in property outside of the existing road corridor being impacted. The required property acquisitions, which also include some Council owned lots, is shown in Table 3-3.

Table 3-3 Proposed Property Acquisitions at 80%

Lot & DP	Approx. Area of Acquisition (m ²)	Council Owned (Y/N)
DP1075359 Lot 20	960	Y
DP607665 Lot 38	2890	Y

DP259016 Lot 1149	550	Y
DP259920 Lot 3095	1840	Y
DP260454 Lot 5071	540	Y
DP259920 Lot 3093	990	Y
DP2460 Lot 7A	110	Y
DP2460 Lot 7B	455	Y
DP576288 Lot 32	70	Y
DP1194378 Lot 2	240	N - Freehold
DP719910 Lot 3	890	Y
DP719910 Lot 2	50	N- Freehold

DRAFT

4 Statutory and Planning Framework

This chapter provides the statutory and planning framework for the proposal and considers the provisions of the relevant state environmental planning policies, local environmental plan and other legislation.

4.1 NSW Environmental Planning and Assessment Act 1979

In NSW, the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulations) regulate development, planning and environmental impact assessment requirements. Division 5.1 of the EP&A Act regulates 'activities' which are unlikely to have a significant environmental impact and require an REF to be supplied for approval by the determining authority (Council).

Under Section 5.5 of the EP&A Act, Council is required to examine and consider, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of its activities.

This REF has been developed in accordance with Section 170 and 171 of the *Environmental Planning & Assessment Regulations 2021* to ensure that all relevant environmental factors have been assessed and incorporated in the preparation of this document.

4.2 State Environmental Planning Policies (SEPPs)

On 1st of March 2022, the NSW government consolidated the 45 existing State Environmental Planning Policies (SEPPs) into 11 Policies. This has been undertaken as an administrative exercise to reduce complexity in the planning system. New policies, relevant to this project are summarised in Table 4-1 below. These consolidated SEPPs have now been released in full by the Department of Planning & Environment (formerly Department of Planning, Industry and Environment). These changes will have no effect or create any change to the use or implementation of the provisions of previous SEPPs and will carry over (in accordance with the *Interpretation Act 1987*). This is relevant to this project as much of the assessment work and consultation has been carried out under the older provisions.

Table 4-1 Consolidated SEPPs – Relevant to this Project

Focus Area	Consolidated SEPPs	New Consolidated SEPP
Transport & Infrastructure	<ol style="list-style-type: none"> 1. SEPP (Infrastructure) 2007 (Infrastructure SEPP) 2. SEPP (Educational Establishments and Childcare Facilities) 2017 (Education and Childcare SEPP) 3. SEPP (Major Infrastructure Corridors) 2020 (Corridor SEPP) 4. SEPP (Three Ports) 2013 (Three Ports SEPP). 	Transport & Infrastructure SEPP
Biodiversity & Conservation	<ol style="list-style-type: none"> 1. SEPP (Vegetation in Non-Rural Areas) 2017 (Vegetation SEPP) 2. SEPP (Koala Habitat Protection) 2020 (Koala SEPP 2020) 3. SEPP (Koala Habitat Protection) 2021 (Koala SEPP 2021) 4. Murray Regional Environmental Plan No 2—Riverine Land (Murray REP) 5. SEPP No 19—Bushland in Urban Areas (SEPP 19) 6. SEPP No 50—Canal Estate Development (SEPP 50) 7. SEPP (Sydney Drinking Water Catchment) 2011 (Sydney Drinking Water SEPP) 8. Sydney Regional Environmental Plan No 20 – Hawkesbury – Nepean River (No 2 – 1997) (Hawkesbury–Nepean River SREP) 9. Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (Sydney Harbour Catchment SREP) 10. Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment (Georges River REP) 11. Willandra Lakes Regional Environmental Plan No 1 – World Heritage Property (Willandra Lakes REP). 	Biodiversity & Conservation SEPP

4.2.2 Transport & Infrastructure SEPP

The Transport & Infrastructure SEPP (T&I SEPP) represents the administrative consolidation of 4 SEPPs, including the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP). Chapter 2 of the T&I SEPP contains the planning rules and controls from the ISEPP for Infrastructure in NSW and aims to facilitate the effective delivery of infrastructure across the state. Chapter 2, Part 2.3, Div 17 Roads and Traffic are the relevant provisions for this project.

Dunheved Road is a regional public road within an existing road corridor managed by Council, a public authority for the purposes of the T&I SEPP and *Roads Act 1993*. Section 2.109 of the T&I SEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent (Part 4 Development Consent). Development under these provisions include alterations or additions to an existing road (such as widening, duplication or reconstruction of lanes, changing the alignment or strengthening of the road). The widening of Dunheved Road with the addition of lanes, altering intersections, expanded bridges (to cater for additional lanes across Werrington Creek) and additions of roundabouts on feeder roads are covered by these provisions.

As the proposed modifications is for a road and is to be carried out by a public authority, and it can be assessed under Division 5.1 of the EP&A Act, Development Consent from Council is not required. Section 2.111 of the T&I SEPP contains provisions for public authorities to consult with the local council prior to the commencement of certain types of development. In this case the consultation was carried out under the former ISEPP and this is discussed in Section 5 of this REF.

The drainage work (on Rugby Street and Orleton Court) has been determined to be 'exempt development' under Section 2.113 and 2.20 of the T&I SEPP and therefore can proceed without Development Consent (Part 4) or the need for a Part 5 assessment (involving no more than minimal impact on the environment or amenity of the surrounding area). Regardless of this, the works have been assessed for environmental impacts as part of this REF, so appropriate mitigation measures can be implemented.

4.2.3 Biodiversity & Conservation SEPP

The Biodiversity and Conservation SEPP (B&C SEPP) represents the administrative consolidation of 11 SEPPs, including Sydney Regional Environmental Plan (No 20) – Hawkesbury- Nepean River (No 2- 1997). This former SREP has been transferred into Chapter 9 of the new B&C SEPP and still contains the same provisions from the Hawkesbury–Nepean River SREP which relates to the protection of the environment of this river system. It should be noted that as the former SREP provisions have not materially changed, the repealed EPIs are still applicable and as stated above these changes are understood to have no effect or create any change to the use or implementation of the provisions during this transitional period.

Werrington Creek is part of the Scenic Protection Corridor designated in the former SREP, passing north/south under Dunheved Road and the existing bridge, it falls within part of the project footprint. The existing bridge will be upgraded, and two new bridges will be constructed one for vehicles and the other will cater for pedestrians/cyclists. Construction works and landscape planting are proposed for this part of the project footprint which will enhance existing vegetation. Any works will need to be managed in order to minimise impacts to the catchment and the corridor.

Part 4 Miscellaneous of the former SREP sets out the relationship of this EPI to other SEPPs/EPIs and states that this EPI applies in addition to other EPI's. It also states that if there is an inconsistency between this EPI and another EPI made before this plan, this plan prevails to the extent of the inconsistency.

As the former ISEPP commenced after this former SREP the provisions of the ISEPP prevails, however it is noted that the mitigation measures proposed in this REF help to achieve the applicable policies outcomes of this former SREP.

A number of specific planning policies within the SREP are relevant to this project and are summarised below in the 0.

Table 4-2 Biodiversity & Conservation SEPP- relevant provisions

Biodiversity & Conservation SEPP (former Sydney Regional Environmental Plan (No 20) – Hawkesbury- Nepean River (No 2- 1997)	Project's Consistency with the SEPP (former SREP)
<p>Total catchment management</p> <p>Policy: Total catchment management is to be integrated with environmental planning for the catchment.</p>	<p>Adopted strategies for the project:</p> <ul style="list-style-type: none"> Consider the impact of the development concerned on the catchment. Consider the cumulative environmental impact of development proposals on the catchment. <p>As part of the REF, impacts to the Werrington Creek, a tributary to South Creek and the Nepean River, are being considered and mitigation measures are proposed to minimise these impacts</p>
<p>Environmentally sensitive areas</p> <p>Policy: The environmental quality of environmentally sensitive areas must be protected and enhanced through careful control of future land use changes and through management and (where necessary) remediation of existing uses.</p> <p>Note: Environmentally sensitive areas in the Hawkesbury-Nepean catchment include: the river, riparian land, escarpments and other scenic areas, conservation area sub catchments, national parks and nature reserves, wetlands, other significant floral and faunal habitats and corridors, and known and potential acid sulphate soils.</p>	<p>Adopted strategies for the project:</p> <ul style="list-style-type: none"> Minimise adverse impacts on water quality, aquatic habitats, riverine vegetation and bank stability. Consideration should be given to the impact of the development concerned on the water table and the formation of acid sulphate soils. <p>As part of the REF, impacts to the Werrington Creek waterbody are being considered and mitigation measures are proposed to minimise these impacts. There are no national parks or reserves in proximity of the project. However, some plant communities near the Werrington Creek riparian corridor are significant on a state level and efforts will be made to protect, where practical, and enhance the vegetation communities within the corridor. Testing has been conducted in soils adjacent the creek and acid sulphate soils have a low probability of occurring but if encountered management measures will be implemented to prevent harm to environment and adjacent waterbodies.</p>
<p>Water quality</p> <p>Policy: Future development must not prejudice the achievement of the goals of use of the river for primary contact recreation (being recreational activities involving direct water contact, such as swimming) and aquatic ecosystem protection in the river system. If the quality of the receiving waters does not currently allow these uses, the current water quality must be maintained, or improved, so as not to jeopardise the achievement of the goals in the future.</p>	<p>Adopted strategies for the project:</p> <ul style="list-style-type: none"> Assess the likely impact of, any predicted increase in pollutant loads on receiving waters. Consider the need for an Erosion and Sediment Control Plan (to be in place at the commencement of development) where the development concerned involves the disturbance of soil. Minimise or eliminate point source and diffuse source pollution by the use of best management practices. Site and orientate development appropriately to ensure bank stability. Plant appropriate native vegetation along banks of the river and tributaries of the river, but not so as to prevent or inhibit the growth of aquatic plants in the river and consider the need for a buffer of native vegetation. Protect the habitat of native aquatic plants. <p>As part of the REF, impacts to the Werrington Creek waterbody are being considered and mitigation measures are proposed to minimise these impacts. The existing environment surrounding Werrington Creek has been assessed as part of a Biodiversity Assessment and consultation has been undertaken with the Department of Fisheries to better understand concerns in relation to the key fish habitat status of the creek. Vegetation will be retained where practical and landscape enhancement will be undertaken as part of the project. Best practice surface water management will be implemented during the construction phase of the project with an ESCP recommended for implementation as part of the broader environmental management of the construction site.</p>

	<p>Adopted strategies for the project:</p> <ul style="list-style-type: none"> • Conserve and, where appropriate, enhance flora and fauna communities, particularly threatened species, populations and ecological communities, aquatic habitats, wetland flora, rare flora and fauna, riverine flora, flora with heritage value, habitats for indigenous and migratory species of fauna, and existing or potential fauna corridors. • Locate structures where possible in areas which are already cleared or disturbed instead of clearing or disturbing further land. • Minimise adverse environmental impacts, protect existing habitat and, where appropriate, restore habitat values by the use of management practices. • Consider the range of flora and fauna inhabiting the site of the development concerned and the surrounding land, including threatened species and migratory species, and the impact of the proposal on the survival of threatened species, populations and ecological communities, both in the short and longer terms. • Consider the need to maintain corridors for fish passage and protect spawning grounds and gravel beds. <p>As part of the REF, impacts to flora and fauna are being considered and mitigation measures are proposed to minimise these impacts. The existing environment surrounding Dunheved Road has been assessed as part of a Biodiversity Assessment and any potential significant impacts will be further investigated as part of the Biodiversity Offsets Scheme and the BDAR. Werrington Creek is a key fish habitat and advice has been provided by the Department of Fisheries on best practice mitigation. The new bridges will be single span and therefore impediments to flow and fish passage will be minimal.</p>
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4.3 Other Environmental Planning Instruments (EPIs)

4.3.1 Greater Sydney Region Plan (A Metropolis of Three Cities)

The Greater Sydney Region Plan (A Metropolis of Three Cities) 2018 sets the strategic framework for the region, aiming to protect and enhance the region's assets and plan for a sustainable future. It is a 40-year strategic plan having regard to economic, social and environmental matters prepared in accordance with section 3.3 of the *Environmental Planning and Assessment Act 1979* and applies to the five districts that make up the region, including Central City, Eastern City, North, South, and Western City (includes Penrith LGA).

The Plan sets out 40 individual objectives aimed at driving growth and change within the region. These objectives and the broader plan have been developed in collaboration with Local and State Government agencies.

It is noted that this is the first regional plan to be prepared concurrently with Future Transport 2056 and the State Infrastructure Strategy, aligning land use, transport and infrastructure planning to reshape Greater Sydney as three unique but connected cities.

The study area of this REF falls within the footprint of the Greater Sydney Region Plan (Penrith City LGA/Western Parkland City District) and aligns with the relevant objectives identified in the Plan. The objectives most relevant to the project are summarised in Table 4-3.

Table 4-3 Greater Sydney Region Planning Priorities

Greater Sydney Region Planning Priorities – Western Parkland City Vision	Project's Consistency with the Plan
Infrastructure and collaboration The Western Sydney City Deal will optimise infrastructure and business investment, employment and liveability outcomes. Collaboration Areas at Liverpool, Greater	Werrington and St Mary's are identified as a key/strategic centres within the greater Penrith to Eastern Creek Growth Area. Dunheved Road, sitting just north of the Great

Penrith and Campbelltown-Macarthur will address complexities and coordinate planning, governance and implementation to support growth.	Western Highway and St Mary's provides an alternative movement corridor in this growth area.
Liveability The city will emerge with the development of new neighbourhoods and centres, and with urban renewal close to existing centres. Place-making will help to design neighbourhoods with fine grain fabric and human scale. This will support healthy lifestyles and connected communities.	The Greater Sydney Green Grid will be a core element of the amenity of the Western Parkland City. As part of the Dunheved Road upgrade, replacement bridges are planned over Werrington Creek, a tributary to South Creek which is part of the Green Grid Corridor. The improvements will have a positive impact on public amenity and accessibility to this green corridor by improving linkages with dual purpose cycle and pedestrian bridges planned.
Productivity The designation of the metropolitan cluster recognises the opportunity to build on the strengths of the three established centres and deliver a 30-minute city. The city will include expansive industrial and urban services lands to the north and east of the Western Sydney Airport. Supported by a freight link, these lands will provide for Greater Sydney's long-term freight and logistics and industrial needs.	The key objectives of the proposed upgrades to Dunheved Road are: <ul style="list-style-type: none"> > Facilitate responsible growth for the future of Penrith > Cater for future traffic demand, improve capacity and reduce congestion on the wider arterial road network > Improve the safety of the road through intelligent design > Improve access and safety for pedestrians and cyclists > Building the specific capability of service providers for Council in support of expected growth in Western Sydney > Consider whole of life costs and to ensure the project outcomes achieve value for money.
Sustainability Development along the spine of South Creek and its tributaries will re-imagine liveability and sustainability, providing new cool and green neighbourhoods and centres with generous open space in a parkland setting. Increased tree canopy cover will provide shade and shelter for walkable neighbourhoods within easy reach of shops and services. The parkland character will be enhanced by the national parks and rural areas framing the city.	

4.3.2 Western City District Plan

This Western City District Plan is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision for Greater Sydney. One of the purposes of the District Plan is to inform local strategic planning statements and local environmental plans, the assessment of planning proposals as well as community strategic plans and policies. The plan has the same key principles/focus areas as the Greater Sydney Region Plan (Infrastructure, Liveability, Productivity and Sustainability), and also 22 Planning Priorities, all of which are applicable in the consideration of an infrastructure project in this district. The most applicable planning priorities in the district plan to this project are included in Table 4-4.

Table 4-4 Western City District Relevant Planning Priorities

Western City District Planning Priority	Project's Consistency with the Plan
Planning Priority W1 A city supported by infrastructure	Planning for a city supported by infrastructure. This District Plan responds to major transport, health and education investments either committed or planned across the Western District, including the Western Sydney Airport and aligns with Future Transport 2056. The Western Sydney Deal will drive innovative planning for future infrastructure needs. This project aligns with this planning priority and specifically Objectives 2 and 3 which relate to infrastructure alignment with forecast growth and infrastructure adapting to meet future needs. Werrington/St Mary's is identified as a key/strategic centre within the greater Penrith to Eastern Creek Growth Area. Dunheved Road, sitting just north of the Great Western Highway provides expanded options for a movement corridor in this growth area.
Planning Priority W7 A well connected city	Establishing the land use and transport structure to deliver a liveable, productive and sustainable Western Parkland City.

	<p>Integrated transport and land use planning will be key in planning for the Western Parkland City and the Western Economic Corridor. Critical transport planning elements will enhance the efficiency and competitiveness of the freight sector and enhance inter-regional transport connections and their integration with land use planning.</p> <p>Werrington/St Mary's is identified as a key/strategic centre within the greater Penrith to Eastern Creek Growth Area. Dunheved Road sitting just north of the Great Western Highway provides expanded options for a movement corridor in this growth area.</p>
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4.3.3 Penrith Local Strategic Planning Statement

Council (Council) has prepared a Local Strategic Planning Statement (LSPS) to provide a 20-year land use planning vision for the City. It has been developed to be consistent with existing local and regional strategies and has identified the basis for strategic planning in the Penrith LGA, having regard to economic, social and environmental matters. The current LSPS has been developed, exhibited and adopted by Council in March 2020.

The Local Strategic Plan addresses the following themes which sit above the planning priorities which address challenges within the Penrith LGA:

- Infrastructure
- Partnerships
- Homes
- Communities
- Localities/Place
- Connectivity
- Economy
- Environment
- Sustainability
- Resilience
-

The Study Area of this REF falls within the footprint of the Penrith Local Strategic Planning Statement (within Werrington County and adjacent St Mary's Strategic Growth Area) and aligns with the relevant objectives identified in the Plan. The relevant planning priorities are summarised in the Table 4-5. This project has been identified as a key initiative under the Penrith LSPS as illustrated in Figure 4-1.

Table 4-5 Penrith Local Strategic Planning Statement relevant Planning Priorities

Penrith Local Strategic Planning Statement Relevant Planning Priorities	Consistency with the Plan
Infrastructure – align development growth and infrastructure	Penrith has experienced rapid growth over the past decade and some of this infrastructure has not caught up with the increased demand. The upgrade of Dunheved Road will facilitate for responsible growth for the future of Penrith and cater for future traffic demand, improve capacity and reduce congestion on the wider arterial road network.
Connectivity – provide a safe connected and efficient local network supported by public transport	<p>Recreational access will be improved within the corridor with the construction of separate cycle/pedestrian bridge and improved pathway along Dunheved Road. The upgrade of Dunheved Road will provide for a growing population in the western district. It will improve the safety of the road through intelligent design.</p> <p>This project has specifically been listed under this planning priority due to Dunheved Road being a vital connection between two major state arterial roads and it is servicing the growing population to the north of our City.</p> <p>Provision for better public transport connections have been made in the design with the addition of a bus lane at the Richmond Road end of the corridor and the installation of new bus shelters/stops along Dunheved Road.</p>
Economy – Enhance and grow Penrith's economic triangle	Dunheved Road sits within the economic triangle which extends from the Western Sydney airport and includes the Penrith

	Metropolitan area and the strategic/key centres of St Mary's and Werrington. As a key link within this triangle, the upgrade will only enhance economic opportunities and efficiencies.
Environment – Connect our green and blue grid	Green areas adjacent Dunheved Road will be retained where possible and enhanced in areas. The design will include areas of landscape plantings with native species being used where practical and existing trees will be retained as part of the road upgrade where possible. Riparian vegetation along Werrington Creek will be retained or enhanced where practical maintaining the green grid/corridor along the waterbody for fauna movement. Recreational access will also be improved within the corridor with the construction of separate cycle/pedestrian bridge and an improved pathway along Dunheved Road.
Resilience – manage flood risk and cool our city	<p>Flood modelling has been undertaken for the project with Werrington Creek and the likelihood of a severe event occurring being considered during design process. Water sensitive urban design has been considered as part of the project. The Nepean River is central to Penrith City development but also provides inherent risks of flood and hazards. The upgrade of Dunheved Road will also provide more efficient flood evacuation movement away from flood prone areas.</p> <p>The urban heat island effect in a warming climate will become more exaggerated as areas become more urbanised and development increases. The upgrade of Dunheved Road will mean more sealed surfaces in this area of Penrith. To counter this the design will include areas of landscape plantings with native species being used where practical and existing trees and permeable grass surfaces will be retained as part of the road upgrade wherever possible.</p>

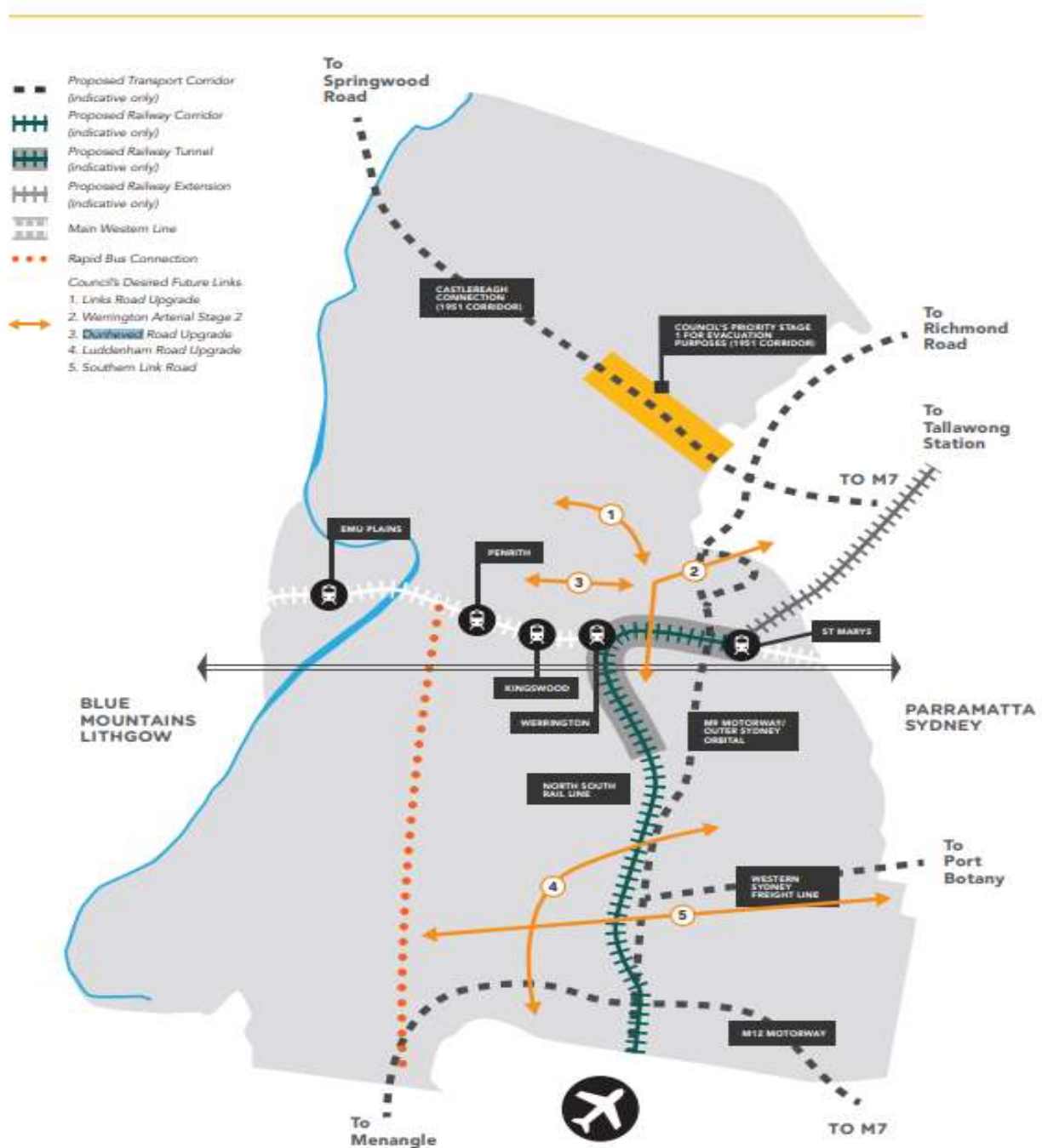


Figure 4-1 Dunheved Road Upgrade (Desired Link Number 3) is identified in the Penrith LSPS as a Key Initiative (Source: Penrith LSPS 2020)

4.3.4 Penrith Local Environmental Plan

Local Environmental Plans (LEPs) are statutory documents that guide planning decisions on development and land use for local governments. Land zoning and development controls help councils determine how land is utilised in LGAs.

The proposal would occur on land use zoned under the Penrith Local Environmental Plan 2010 (Penrith LEP) as:

- > R2 Low Density Residential
- > R3 Medium Density Residential
- > RE1 Public Recreation

- > B2 Local Centre
- > E2 Environmental Conservation
- > SP2 Infrastructure.

There are a number of statutory controls that apply to the site under the LEP, consistent with the objectives for each land use zone. However, the ISEPP overrides the provisions of the LEP and development consent under Division 4.1 of the EP&A Act is not required.

4.4 Other Relevant NSW Legislation

There is a range of other relevant legislation State legislation that have been considered in Table 4-6. The need for any additional permits, licences or approvals for the works have been identified in the table.

Table 4-6 Other relevant legislation

Legislation	Approval Authority	Relevance to the Proposal	Required Permits and Approvals
NSW Contaminated Land Management Act 1997 (CLM Act)	Environment Protection Authority (EPA)	Relates to areas where contamination presents a significant risk of harm to human health or some other aspect of the environment. Must report to the EPA if contaminated land is encountered during the works that meets the duty to report contamination requirements under Section 60 of this Act. A waste classification certificate will need to be applied for if any soils are removed from site with a requirement for the soil to be characterised for contamination and disposed of offsite at a registered facility	A waste classification certificate will need to be applied for if any soils are removed from site with a requirement for the soil to be characterised for contamination and disposed of offsite at a registered facility – this will need to be obtained once construction/earthworks commences.
NSW Heritage Act 1977	Heritage NSW, Department of Premier and Cabinet	The Heritage Act protects and preserves items of non-aboriginal heritage significance. It provides for the protection of items of local, regional and state heritage significance. Approval must be sought under Section 60 of this Act if the proposed works are likely to have an impact on an item of significance that is listed in the State Heritage Register.	None - Unless an object or site of cultural heritage is encountered during construction (refer to Section 6.6).
NSW National Parks and Wildlife Act 1974 (NPW Act)	Department of Planning, Industry and Environment (DPIE)	Relates to the disturbance or destruction of any Aboriginal objects or places and removal of identified native species, populations and ecological communities. The works do not fall within a designated National Park and would not affect any National Parks.	None - Unless an object or site of Aboriginal cultural heritage is encountered during construction (refer to Section 6.7).
NSW Protection of the Environment Operations Act 1997 (POEO Act)	Environment Protection Authority (EPA)	Regulates noise, air and water pollution and waste management activities that could cause water pollution. 'Scheduled activities' as listed under Schedule 1 of the Act require an Environment Protection Licence (EPL) from the EPA, unless clauses in Schedule 1 specify otherwise. Clause 35 of Schedule 1 relates to Road Construction and	The following Schedule 1 triggers may apply: Clause 35 (3) a (ii) the extraction or processing (over the life of the road construction) of more than 150,000 tonnes of material – this threshold will need to be checked once the design is finalised and cut and fill requirements are confirmed. or

Legislation	Approval Authority	Relevance to the Proposal	Required Permits and Approvals
		specifies thresholds that trigger the need for an EPL.	<p>Clause 35 (3) b(ii) the existence of 4 or more traffic lanes (other than bicycle lanes or lanes used for entry or exit) for a continuous length of at least 3 kilometres—where the road is in a metropolitan area and is classified, or proposed to be classified, as a main road (but not a freeway or tollway) under the <i>Roads Act 1993</i></p> <p>While Dunheved Road is not currently classified as a 'main road' under the <i>Roads Act 1993</i>. Any future classification once the road is upgraded is not yet known.</p> <p>Dunheved Road is currently listed as an unclassified regional road</p> <p>An EPL may be required for the construction phase of the project due to the potential for one of both of these clauses being applicable.</p>
NSW Waste Avoidance and Resource Recovery Act 2001	Environment Protection Authority (EPA)	The works would use resources and generate waste, and as such needs to consider the Resource Management Hierarchy (Avoidance, Recovery and Disposal) in the Act.	None - However, as the works would generate waste it is required to consider the waste management hierarchy referred to in this Act.
NSW Roads Act 1993 (Roads Act)	Transport for NSW (TfNSW)/Council	Section 138 of the Roads Act requires that consent from the appropriate road authority must be received in the event that there is a need to close, or conduct works on or over a public road.	A road occupancy license must be sought from the appropriate road authority prior to the road closure/works commencing on Dunheved Road.
NSW Biodiversity Conservation Act 2016 (BC Act)	DPIE/EES	The BC Act protects threatened species, populations and ecological communities and their habitat in NSW. If any threatened species, ecological communities or habitat could be impacted by the proposal then an assessment of significance needs to be carried out to determine the significance of the impact in accordance with section 7 of the Act.	<p>There is potential for there to be significant impact on the critically endangered Cumberland Plain Woodland and Cumberland Plain Land Snail (<i>Meridolum corneovirens</i>) an endangered species at a state level.</p> <p>A BDAR is currently being prepared with surveys being undertaken throughout the second half of this year.</p> <p>Further information about the impacts on biodiversity is provided in Section 6.8.</p>
NSW Biosecurity Act 2015	Department of Agriculture, Water and Environment (DAWE)	Under the Biosecurity Act everyone has a general biosecurity duty to prevent, eliminate or minimise any biosecurity risks they encounter. Biosecurity includes weeds and pest animals.	None - If weeds are encountered then proponent would be obligated to remove and dispose of the weeds in an appropriate manner (refer Section 6.8).
NSW Fisheries Management Act 1994 (FM Act) and Fisheries Management (General) Regulation 2002 (FM Regulation)	DPI (Fisheries)	<p>Certain marine and estuarine species are listed as vulnerable under the Act and protected under the Regulation.</p> <p>Permits are required under the following sections of the FM Act to undertake the activities specified:</p>	<p>No dredging works to be carried out so council does not require a permit under Section 200</p> <p>There will be no harm to Marine vegetation as no tidal influence along Werrington Creek.</p> <p>The road design includes the replacement of the existing bridge with two bridges for vehicles and pedestrian/cyclists however the</p>

Legislation	Approval Authority	Relevance to the Proposal	Required Permits and Approvals
		<p>Section 200: Carrying out of dredging and reclamation works;</p> <p>Section 205: Works that harm marine vegetation (i.e. seagrass); and</p> <p>Section 219: Obstruct fish passage permit is not required due to s.219(5b).</p>	<p>design will be single span and therefore will not impact on flow or impede fish passage. DPI have been consulted as part of the REF process and their response is summarised in Section 5 and further information in relation to design can be found in Section 3. The impacts on aquatic ecosystems as well as fish, invertebrates can be found in the biodiversity chapter (Section 6.8).</p> <p>A permit allowing for the obstruction of fish passage will not be required.</p> <p>The works will require a Section 200 permit for dredging and reclamation. Permits outline control measures to minimise the impacts from construction and operation of the asset.</p>

4.5 Commonwealth Legislation

4.5.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act a referral to the Australian Government is required for proposed actions that have the potential to significantly impact on Matters of National Environmental Significance (MNES) or the environment of Commonwealth land.

A search of the EPBC Protected Matters Search Tool (PMST) was conducted on 23 March 2022. The nine MNES protected under the EPBC Act are shown in Table 4-7 which identifies the potential for occurrence within a 5 km radius of the proposal. A copy of the results from the PMST search are in Appendix B. Potential impacts to these biodiversity matters are considered in Section 6.6 of this REF.

Table 4-7 Potential impacts on MNES

Matters of National Environment Significance	Potentially occurring
World Heritage Properties	None
National Heritage places	None
Wetlands of international importance (listed under the Ramsar Convention)	None
Great Barrier Marine Park	None
Commonwealth marine areas	None
Threatened ecological communities	8
Threatened species	44
Migratory species (protected under international agreements such as JAMBA, CAMBA and ROKAMBA)	16

Other Commonwealth matters identified through the PMST are identified in Table 4-8.

Table 4-8 Other Commonwealth matters

Other Commonwealth matters	Number
Commonwealth Land	122
Commonwealth Heritage Places	2
Listed Marine Species	22

It is worth noting, due to the high number of Commonwealth land results, that the impacted area will be contained primarily within the existing road reserve and no commonwealth lands will be encroached upon.

One of the Threatened Ecological Communities (TECs), CPW, is present within the study area and will be impacted by the proposed upgrades. Up to 0.62 ha of CPW is proposed to be removed as part of the Dunheved Road Upgrade project and over 1.77 ha of CPW located immediately adjacent to the Study Area will remain. The portion of CPW to be cleared is part of the patch of vegetation closer to the existing Dunheved Road and was mapped as being in low condition due to the presence of weeds and level of disturbance. Therefore, it is considered that the extent of CPW to be cleared is small compared to area of the TEC to be retained. However, regardless of its extent, the loss of 0.62 ha of CPW would potentially reduce the extent of the community and would contribute to cumulative impacts to this commonwealth listed TEC. This loss could be considered a significant impact on relevant MNES and therefore, the proposed road activities warrant a referral to DCCEE.

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5 Consultation

5.1 Agency and Stakeholder Consultation

As mentioned above, on March 1, 2022 the NSW government consolidated the 45 existing SEPPs into 11 policies. This has been undertaken as an administrative exercise to reduce complexity in the planning system. These changes have no effect on the use or implementation of the provisions of previous SEPPs and provisions largely carry over. This chapter will reference the former ISEPP as consultation was carried out under this EPI.

Part 2 of the former ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Clauses 13 to 16 of the former ISEPP require public authorities to consult with local council where the development has impacts on council related infrastructure or services, impacts on local heritage or impacts on flood liable land. As Council is the proponent for the proposed works, Clauses 13 to 15 are to be addressed via internal consultation with respect to the development.

In addition, Clause 15AA required consultation with NSW State Emergency Service (NSW SES) for development on flood liable land that may be carried out without development consent under a relevant provision. A review of the Council flood mapping data determined that the proposed works corridor overlaps with the probable maximum flood (PMF) extent. The NSW SES was contacted and asked to provide comments which are shown in Table 5-2.

Clause 16 of the former ISEPP states that a consent authority must not carry out any of the following development without giving written notice to the specified authority and taken their responses into consideration. This is outlined in Table 5-1 below.

Table 5-1 ISEPP consultation requirements

Consultation trigger	Application to project
Clause 15AA Consultation with NSW State Emergency Service – development on flood prone land	The proposed works are located on flood liable land. Consultation was undertaken with the NSW SES, who advised that the proposed works are likely to have minimal risk to the NSW SES response operations. They did raise concern regarding impacts to emergency vehicle routes from disruptions to the operation of Dunheved Road during the construction and asked to be notified if significant disruption to the roads was expected. A copy of the correspondence is provided in Appendix C .
Clause 16(2)(a) Development adjacent to land reserved under the <i>National Parks and Wildlife Act 1974</i> or to land acquired under Part 11 of that act.	Not applicable -The project is not adjacent to a National Park.
Clause 16(2)(b) Development on land in Zone E1 National Parks and Nature Reserves or in a land use zone that is equivalent to that zone.	Not applicable -The project is not in land zoned E1 or equivalent.
Clause 16(2)(c) Development adjacent to an aquatic reserve or a marine park declared under the <i>Marine Estate Management Act 2014</i> .	Not applicable - The project is not located adjacent to a marine park.
Clause 16(2)(d) Development in the foreshore area within the meaning of the <i>Sydney Harbour Foreshore Authority Act 1998</i> .	Not applicable - The project is not located within the foreshore area within the meaning of the <i>Sydney Harbour Foreshore Authority Act 1998</i> .
Clause 16(2)(e) Development comprising a fixed or floating structure in or over navigable waters.	Not applicable - The project would not involve development over navigable waters.
Clause 16(2)(f)	Not applicable - whilst a portion of the road extends into a bushfire prone area the project is not development for the

Consultation trigger	Application to project
Development for the purposes of a health services facility, correctional centre or group home, or for residential purposes, in an area that is bush fire prone land (as defined by the Act).	purposes of an educational establishment, health care facilities, correctional centre or group home, or for residential purposes and therefore no consultation with the NSW RFS is required.
Clause 16(2)(g) Development that may increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map.	Not applicable - is the project is not within the dark sky region.
Clause 16 (2)(h) Development on defence communications facility buffer land within the meaning of Clause 5.15 of the Standard Instrument.	Not applicable -The project is not within defence communications facility buffer land
Clause 16 (2)(i) Development on land in a mine subsidence district within the meaning of the <i>Mine Subsidence Compensation Act 1961</i> .	Not applicable – The project is not within a mine subsidence district.

Division 17 of the former ISEPP details specifications for works involving development in or adjacent to road corridors and road reservations. Dunheved Road is a regional road under the control of Council however it intersects on the western end with Richmond Road which is a State-owned road. Therefore, the proposed works fall within the corridor of a state classified road and TfNSW is to be consulted.

No crown land reserves are located within or adjacent to the Study Area and therefore Crown Lands do not need to be consulted prior to the commencement of the works.

The road upgrade extends over Werrington Creek which is classified as Key Fish Habitat and therefore the works may possibly trigger the need for a Part 7 Permit under the FM Act 1994. DPI Fisheries was consulted and asked to provide comments on the proposed works. The response is shown in Table 5-2.

The following government agencies and stakeholders were consulted on 30 July 2021 regarding the proposal:

- > DPI Fisheries
- > TfNSW
- > SES Emergency

Issues that have been raised as a result of consultation with these agencies and stakeholders are outlined in Table 5-2.

Table 5-2 Issues raised through government agency consultation

Agency	Issue raised	Response/where addressed in REF
DPI Fisheries	<p>A response from DPI Fisheries was received on 22 November 2021. DPI Fisheries made no objections to the proposed works however provided the following comments:</p> <ol style="list-style-type: none"> 1. The works will require a Section 200 permit for dredging and reclamation. Permits outline control measures to minimise the impacts from construction and operation of the asset. Permit application forms are available from the DPI Fisheries website at: http://www.dpi.nsw.gov.au/fisheries/habitat/help/permit 2. As no marine vegetation is to be harmed in this proposal a section 205 permit under Part 7 of the FM Act is not required. 3. Under s.219(5)(a) any work that is permitted under the FM Act turns off the requirement for a section 219 permit to block fish passage. So, a section 219 permit is not required for this project. 4. When preparing design detail of any over-water structures, please refer to DPI Fisheries <i>Policy and Guidelines for Fish Habitat Conservation and Management (2013)</i>. 5. Erosion and sediment mitigation devices are to be erected in a manner consistent with currently accepted Best Management 	Ecological matters including aquatic ecology impacts have been addressed in Section 1.1.1.

	<p>Practice (i.e. Managing Urban Stormwater: Soils and Construction 4th Edition Landcom, 2004) to prevent the entry of sediment into the waterway prior to any earthworks being undertaken. These are to be maintained in good working order for the duration of the works and subsequently until the site has been stabilised and the risk of erosion and sediment movement from the site is minimal.</p> <ol style="list-style-type: none"> Environmental safeguards are to be used during the works to ensure that there is no escape of turbid plumes into the adjacent aquatic environment. Any material removed from the waterway that is to be temporarily deposited or stockpiles on land is to be located well away from the waterway and to be contained by appropriate sediment control devices. DPI Fisheries (1800 043 536) and the Environment Protection Authority (131 555) is to be notified immediately if any fish kills occur in the vicinity of the works. In such cases, all works other than emergency response procedures are to cease until the issue is rectified and approval is given by DPI Fisheries and/or the Environment Protection authority for the works to proceed. 	
Transport for NSW	<p>An initial consultation package was sent to TfNSW on 30 July 2021 however no response was received within the required statutory 21 days under the former ISEPP. A second consultation email with accompanying information was sent to TfNSW on 3 November 2021 and no response was received.</p> <p>However, the design team/Council and the Traffic modellers have worked with TfNSW on the signalisation of intersections along Dunheved Road and have included specific design considerations in this regard. Council met TfNSW Planning and Programs' representatives on 15 February 2022 and 16 June 2022 to discuss several design matters. TfNSW provided feedback to Council by email on 15 February 2022 and 16 June 2022. Council addressed each set of TfNSW comments. On 10 August 2022 TfNSW provided further information and comments, which were taking into consideration in the project design. See Appendix C for a full reference to the TfNSW's feedback received about the project design.</p>	<p>No response was received. Assumed no comment.</p> <p>Traffic issues are addressed in Section 6.1</p>
SES Emergency	<p>Response was received from NSW SES on 5 August 2021. NSW SES reviewed the proposed works and concluded there is minimal risk to NSW SES response operations. They noted that if the construction phase of the upgrades causes any disruption to the operation of the roads that this may impact the ability for emergency vehicles to use this route. Therefore, the NSW SES request that notification be provided where there are likely to be significant delays in the operations of the roads affected by the upgrades.</p>	<p>Flooding issues have been addressed in Section 6.4.</p>

5.2 Local Aboriginal Land Council

During the archaeological survey undertaken as part of this REF, a site visit was undertaken on 10 June 2021 with the CEO of the Deerubbin Land and Aboriginals Council (LALC) to understand if the LALC had any issues or concerns with the proposed road upgrade.

A letter was provided by the LALC in March 2022 proving their feedback on the aboriginal heritage assessment and providing their final sign off on the project. This is included in Appendix H as part of the Cultural Heritage Assessment.

5.3 Community Consultation

Council has engaged with the community regarding the proposed project during the Concept phase of the project. Consultation was open for four weeks between Monday 18 October and Friday 12 November 2021. The central focus of this process was a 'Your Say Penrith' page where people could review the concept plans and associated details to provide feedback via a dedicated project email or in writing to Council. An online survey was available on the page which was also promoted through Council's social media channels.

The purpose of the community consultation was to:

- > inform community members and stakeholders about the proposed concept designs for the Dunheved Road upgrade
- > provide information and visual resources about the concept designs, including an FAQs document, 3D fly through, specific intersection upgrade maps and proposed traffic detour information
- > encourage people to provide feedback and comments about the proposed upgrade works, and
- > inform the next stage of design work for the proposed road upgrades.

Council conducted an extensive consultation process on the concept designs for the Dunheved Road upgrade. This included promotional activities to build awareness of the project, as well as feedback opportunities for people to have their say.

Most of the consultation was carried out online (due to limitations under the COVID-19 Public Health Orders) although some in-person business meetings were also held.

Promotional activities included:

- > Two media releases.
- > Information on the Your Say Penrith pages, including general project information, an FAQs document, a concept design map, 14 intersection maps, seven detour maps, a 3D fly-through and an online survey.
- > Two-page flyers distributed to local residents and businesses around Dunheved Road.
- > Addressed letters to local businesses and business landlords.
- > Addressed letters to local schools and childcare centres.
- > Information in the Mayoral Column and corporate news brief in the Western Weekender newspaper.
- > Information in Council's community EDM and the Penrith New West EDM newsletters.
- > Advertising on Vintage FM radio.
- > Organic and boosted posts on Council's Facebook, Instagram and LinkedIn pages.

Community members were invited to have their say and provide feedback on the concept designs using the online survey or by contacting Council via:

- > email: DunhevedRoadUpgrade@penrith.city
- > phone: (02) 4732 7777
- > email: Penrith City Council, PO Box 60, Penrith, NSW 2751

A community consultation report was developed as a result of the community consultation effort above. This report summarises the key issues raised about aspects of the road upgrade and the response from the design team and Council to help work towards resolving these issues. This report has been included as Appendix C.

Main issues that were raised as a result of consultation with the community are outlined in Table 5-3 below. See Section 3.4 of Appendix C of the BAR attached in Appendix I for a full reference to the feedback received during the consultation period.

Table 5-3 Issues raised through community consultation

Key topics	Issue raised	Council Response
General feedback		
<ul style="list-style-type: none"> • 36 comments 	<p><i>The designs will see wider roads which will handle more traffic and will also provide safer intersections.</i></p> <p><i>Dunheved Road desperately needs to be widened.</i></p> <p><i>This is a difficult process and not everyone will be happy with the outcome.</i></p> <p>What's the expected increase to traffic flow after the upgrade is complete and will this enable faster journeys?</p> <p>The designs will result in quicker traffic along Dunheved Rd but the side streets will be more congested and used as a rat run.</p> <p>The designs will create frustrations with drivers taking more risks.</p> <p>Will the upgrade bring Dunheved closer to houses and will those back fences need to be replaced?</p> <p>Why will the work take 5 years?</p>	<p>The upgrade is designed to better manage the increasing traffic volumes along the route as the area continues to grow. It seeks to improve both traffic flow and safety.</p> <p>Extensive surveys, studies and modelling have been conducted as per standards while developing the upgrade design. Current and planned developments in and around the proposed development which will contribute significantly to the traffic volumes have also been factored in the design.</p> <p>In line with current practice, Council will continue to monitor traffic flow on Dunheved Road and side streets. Council will continue to address traffic issues on side streets as required.</p> <p>The new road will be widened on the northern side near Lavin Crescent and the southern side all along Dunheved Road with a median separation. The road maybe closer to houses due to the median separation requirement and shared path lane.</p> <p>Dunheved Road is a critical arterial road. Council will manage construction activities while maintaining the traffic flow.</p> <p>Construction work will be done in sections and this requires the defined timeline.</p>
Comments relating to specific road intersections		
<p>Richmond Road – upgraded signalised intersection with Dunheved Road</p> <ul style="list-style-type: none"> • 189 concerns • 15 comments 	<p>The dedicated left turn lane is too short.</p> <p>The left turn lane onto Richmond Road is obstructed by vehicles waiting to turn right.</p>	<p>The proposed upgrade is designed to improve the current left turn issues. It includes dedicated lanes to turn left as well as separate lanes to turn right.</p>
<p>Trinity Drive – upgraded intersection with Dunheved Rd</p> <ul style="list-style-type: none"> • 376 concerns • 284 comments 	<p>Preventing the right turns in and out of Trinity Drive will cause major problems for the back streets around Cambridge Gardens, especially during peak hour.</p> <p>Residents will not have a direct route to the local supermarket and other services. Local businesses will suffer.</p> <p>The design will create increased traffic and congestion around Boomerang Place, Greenbank Drive, Pasturegate Avenue, Lewis Road and other streets.</p>	<p>Council has listened to community views and concerns about this intersection and will review the proposed options.</p> <p>Feedback has been provided to the design team for investigation. Design changes will be considered where possible within technical constraints.</p> <p>The final design of Dunheved Road upgrade will be released in mid-2022. The design is intended to improve safety and connectivity between communities across Dunheved Road.</p> <p>A roundabout is not an appropriate traffic management device for the traffic volume on Dunheved Road to be safely operated.</p>

	<p>The design will cause delays for parents dropping their children at Cambridge Gardens Public School. Increased traffic will also increase safety risks for young children.</p> <p>A better option would be to install a roundabout or traffic lights at this intersection.</p> <p>The Trinity Drive exit onto Richmond Road will need to be upgraded to make it safer.</p>	<p>A revised proposal for this intersection will be included in the detailed designs which will be released mid-2022. These will seek to find a better balance between convenience, safety and traffic flow.</p>
<p>Tasman Street – upgraded intersection with Dunheved Rd</p> <ul style="list-style-type: none"> • 209 concerns • 112 comments 	<p><i>Removing the right turn from Tasman Street into Dunheved Road will be good to reduce congestion and accidents. A barrier would help to prevent people still trying to turn right.</i></p> <p>Removing the right turn will create congestion along Rugby Street, Barlow Street and Eton Road.</p> <p>The right turn out of Tasman Street is needed to access Cambridge Park shops, the sporting area and the school. If this right turn is removed, then Wrench Street and Brookfield Avenue could be opened up to Dunheved Road to help with access.</p> <p>The intersection should have a roundabout or traffic lights installed.</p> <p>The Tasman Street exit needs to be wider to eliminate the back up of drivers turning right.</p> <p>Widening this road will make it more difficult to cross for pedestrians and cyclists.</p>	<p>The design seeks to balance pedestrian and driver safety with better traffic flow.</p> <p>A roundabout at this intersection would require more space than is currently available. Traffic lights are therefore the only other option to manage traffic.</p> <p>A roundabout is not an appropriate traffic management device for the level of traffic volume on Dunheved Road to be safely operated.</p>
<p>Francis Street – upgraded signalised intersection with Greenbank Drive (eastern end)</p> <ul style="list-style-type: none"> • 177 concerns • 53 comments 	<p><i>There are regular accidents at the Greenbank Drive / Frances Street intersection and the upgrade will be good to slow speeding traffic around the area.</i></p> <p>Install speed cameras and/or red-light cameras around Francis Street to help with road safety and general safety.</p> <p>Francis Street should be wider with a left turn only lane, a straight-ahead lane, and a right turn lane so that left turning traffic isn't blocked by those turning right.</p> <p>The turning lane into Francis Street should be longer.</p> <p>Join Francis Street with Lavin Crescent to reduce a set of lights on Dunheved Road and build a U-turn bay on Francis Street.</p>	<p>The installation of speed cameras and red-light cameras are determined by TfNSW.</p> <p>The new design proposes two right-turn lanes and one left / straight-ahead lane out of Francis Street which should alleviate the current traffic problems. The new turning lanes provide more lead time than the current layout.</p> <p>It is not possible to join Francis Street with Lavin Crescent due to existing services. Lights at Lavin Crescent provide pedestrian connectivity.</p>
<p>Henry Lawson Avenue (western end) – upgraded</p>	<p><i>Proposed changes here will make a positive difference.</i></p>	<p>A roundabout is not an appropriate traffic management device for the level of traffic volume on Dunheved Road to be safely operated.</p>

<p>signalised intersection with Dunheved Rd</p> <ul style="list-style-type: none"> • 140 concerns • 39 comments 	<p>Proposed changes will see more traffic along Henry Lawson Avenue which is already over-used and will therefore be more dangerous for pedestrians and cars.</p> <p>A roundabout is needed here instead of traffic lights.</p> <p>The right-hand turn from Dunheved Road into Henry Lawson Avenue should be closed.</p>	<p>The right-turn from Dunheved Road into Henry Lawson Avenue is needed for access to the local community.</p>
<p>Werrington County Shopping Village – upgraded driveway entrance</p> <ul style="list-style-type: none"> • 293 concerns • 12 comments 	<p>The design provides too many entrances into the shops. Instead there should be one main entrance and a roundabout off Dunheved Road in conjunction with Henry Lawson Avenue to help control traffic in and out.</p> <p>The shopping centre needs entry and exit points off John Oxley Avenue and Francis Street rather than Dunheved Road.</p> <p>Stopping the right-hand turn lane near KFC will create more traffic through the main car park which could cause more accidents.</p> <p>Getting to local shops will be harder for local residents.</p> <p>More pedestrian lights may be needed near the shops as people often cross where there are no lights.</p>	<p>The entrances off Dunheved Road will access individual properties.</p> <p>It is not feasible to create access from John Oxley Avenue and Francis Street.</p> <p>Elimination of the right turn near KFC ensures safer alternate exit on Dunheved Road.</p> <p>The design includes a pedestrian crossing at Lavin Crescent traffic lights and at John Oxley Avenue to prevent pedestrians from crossing the road at unsafe areas.</p>
<p>John Oxley Avenue – new signalised intersection with Dunheved Road</p> <ul style="list-style-type: none"> • 158 concerns • 36 comments 	<p><i>Traffic lights here will be good to help children from Werrington County Public School stay safe.</i></p> <p>This should be a left in and left out intersection instead of traffic lights, or a roundabout here.</p> <p>The traffic lights at John Oxley Avenue and John Bateman Avenue are too close together. It would be good to make a cross section at these two streets and install just one set of lights.</p> <p>Will the upgrade improve right turns onto Dunheved Road?</p>	<p>This intersection needs to maintain the right turns to accommodate bus services that travel this route.</p> <p>A roundabout is not an appropriate traffic management device for the level of traffic volume on Dunheved Road to be safely operated.</p> <p>Re-aligning this intersection with John Bateman Avenue would require access through multiple private properties and would therefore not be practical.</p> <p>The new design proposes a dedicated right lane onto Dunheved Road which will improve right turns.</p>
<p>John Bateman Avenue – new signalised intersection with Dunheved Road</p> <ul style="list-style-type: none"> • 104 concerns • 6 comments 	<p><i>Traffic lights here will help to make the area safer, especially in peak hour, and will also help local school children crossing the road.</i></p> <p>This intersection needs a roundabout instead of traffic lights. Traffic already banks up when cars turn into Dunheved Road and traffic lights will make this worse, adding more time to the morning commute.</p> <p>The intersection should be left in and left out, instead of lights. The traffic lights at John Bateman Avenue and John Oxley Avenue are too close together. It would be good to make a</p>	<p>A roundabout is not an appropriate traffic management device for the level of traffic volume on Dunheved Road to be safely operated.</p> <p>The right turns are needed at this intersection because of the designated bus routes in the area.</p> <p>Re-aligning this intersection with John Oxley Avenue would require access through multiple private properties and would therefore not be practical.</p>

	cross section at these two streets and install one set of traffic lights.	
Werrington Road / Christie Street – new integration into the roundabout with Dunheved Road <ul style="list-style-type: none"> 216 concerns 83 comments 	<p>The Dunheved Road upgrade will cause a bottleneck as it joins the roundabout, as Werrington Road and Christie Street also need to be upgraded to cope with increased traffic.</p> <p>Traffic lights should be installed at the corner of Dunheved Road and Werrington Road.</p> <p>A left-turn slip lane could be installed from Werrington Road into Dunheved Road.</p> <p>A safer passage for school children and other pedestrians is needed around the Christie Street area.</p>	<p>A major upgrade to Christie Street and Werrington Road is outside Dunheved Road Upgrade project scope.</p> <p>Council is advocating for funding to upgrade Christie Street – see https://www.penrithcity.nsw.gov.au/resourcesdocuments/advocacy/advocacy-priorities.</p> <p>The new integration with the roundabout will see two lanes in and two lanes out of Dunheved Road which will help to improve traffic flow coming on and off the roundabout.</p> <p>A pedestrian crossing near Christie Street will be part of the major upgrade.</p>
Comments relating to other general topics		
More congestion on local roads <ul style="list-style-type: none"> 156 comments 	<p>The design only caters for through traffic and does not consider local residents and road users, especially those in Cambridge Park, Cambridge Gardens and Werrington Downs.</p> <p>The design pushes traffic onto suburban back roads which creates more localised congestion and rat runs.</p> <p>The design will result in increased safety concerns for residents and school children as the back streets will be busier.</p>	<p>The new proposal is designed to improve traffic flow along Dunheved Road while balancing the safety of drivers and pedestrians in surrounding streets</p> <p>In line with current practice, Council will continue to monitor traffic flow on Dunheved Road and side streets. Council will continue to address traffic issues on side streets as required.</p>
Pedestrian access and safety <ul style="list-style-type: none"> 77 comments 	<p>The designs need to consider more pedestrian accessibility.</p> <p>Will there be a continuous footpath along the route, and will there be a barrier to separate pedestrians from traffic?</p> <p>Can there be a safe pedestrian crossing near Trinity Drive and Tasman Street?</p> <p>Will there be refuge islands on Dunheved Road to help people cross, and how wide is the median strip?</p> <p>Ensure the footpath remains beside the shopping area with dedicated crossings.</p> <p>Consider building a pedestrian bridge across Dunheved Road near the shopping centre to link the community on both sides</p>	<p>The design has considered pedestrian accessibility.</p> <p>A continuous shared path has been designed on the southern side of Dunheved Road, from Richmond Road to the Christie Street roundabout.</p> <p>To increase safety, a sufficient buffer has been provided in line with relevant standards. Safety barriers will be installed as required as part of a safety audit.</p> <p>Refuge islands are not the safest means of crossing a road. Sufficient pedestrian crossings have been considered in the design to cross Dunheved Road.</p> <p>Feedback is being considered in the detail design.</p>
Walking and cycle paths <ul style="list-style-type: none"> 65 comments 	<p>It is good to have a footpath and shared path, however it is not wide enough to accommodate both cyclists and pedestrians together.</p> <p>The shared pathway will not be practical for road bike riders who travel at 25-60 km/h.</p>	<p>The shared path has been designed to TfNSW guidelines.</p> <p>The design features a footpath on the northern side of Dunheved Road.</p> <p>The new path will be for all pedestrians, including older people, families with young children and prams, and people with limited mobility. The pathway will still provide an opportunity for people jogging and for children or adults riding</p>

	The design should include safer walking and cycling paths with a dedicated cycle lane on both sides of the road.	bikes for leisure (at slow speeds). More confident bike riders should use the roadway in keeping with the NSW road rules. Feedback is being considered in the detail design.
Traffic lights – general <ul style="list-style-type: none"> 64 comments 	<p><i>Traffic lights will be good to help slow and control traffic.</i></p> <p>Traffic lights should be replaced with roundabouts to keep traffic flowing and ensure drivers don't have to backtrack into other streets.</p> <p>There are too many sets of traffic lights too close together which will slow traffic and create congestion.</p> <p>Traffic cameras and lights should be installed.</p> <p>Traffic lights should be synched to manage peak flows more efficiently.</p> <p>Move the lights at John Bateman Avenue to the eastern end of Henry Lawson Avenue to space them out more and increase traffic flow.</p>	<p>A roundabout is not an appropriate traffic management device for the level of traffic volume on Dunheved Road to be safely operated.</p> <p>The installation of speed cameras and red-light cameras are determined by TfNSW.</p> <p>The traffic lights will be synched with all the other lights along Dunheved Road to ensure traffic runs smoothly.</p> <p>Moving the lights from John Bateman Avenue to the eastern end of Henry Lawson Avenue has been investigated but was found to be not feasible as they would interfere with the current bus route.</p>
Dust, noise and pollution <ul style="list-style-type: none"> 48 comments 	<p>Concerns the upgrade will see an increase in traffic volume which will increase traffic noise, including noise from trucks.</p> <p>Are we providing noise abatement measures for local homes, such as noise walls or dense trees along all or part of Dunheved Road and Lockyer Avenue?</p> <p>Concerns the extra traffic will create extra dirt, dust and fumes.</p>	<p>Council is undertaking noise assessments along the length of Dunheved Road to assess current projected noise levels.</p> <p>A Review of Environmental Factors (REF) will be carried out for this project over the coming months and made available for public comment in mid-2022. This will assess any need for noise abatement measures, as well as impacts from dust, dirt and traffic fumes.</p>
<p><i>Notes: For specific road intersection upgrades, the number of 'Concerns' reflects the number of respondents who indicated in the survey that these intersections were a concern to them; the number of 'Comments' reflects the number of written comments made in the survey about that intersection.</i></p>		

Once the REF has been completed, a copy will be placed on public exhibition. Council proposes for this to occur in August 2022. Community consultation activities for the proposed works will be undertaken during the exhibition period which will last four weeks.

The REF will be put on exhibition on Council's and during the period that the report is being exhibited, the community is invited to provide any feedback regarding the proposed works. Feedback can be submitted via email at DunhevedRoadUpgrade@penrith.city.

Community feedback will be revised and if necessary, any changes to the REF will be made accordingly. The final version will form the basis for which council determines whether the proposed works will proceed

6 Environmental Assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposed works.

6.1 Traffic and Transport

The road corridor, Dunheved Road provides access to Richmond Road at the western end and Christie Street which links to Forrester Road at the eastern end. These roads are experiencing increases in traffic volume numbers that are adding pressure to the current road infrastructure (SMEC 2021). A traffic and transport report was prepared by SMEC (2021) for Council to undertake traffic analyses and modelling to inform strategic options for the Dunheved Road corridor. SMEC also undertook further traffic analysis based on a number of upgrade design variations (SMEC 2022). A copy of both reports are included in Appendix D.

The main purpose of the studies was to develop models to inform decision-making in the design process by identifying issues on the road network.

6.1.1 Methodology

SMEC used Signalised and unsignalized Intersection Design and Research Aid (SIDRA) intersection modelling software for the traffic model development and the analysis was also developed under the *Roads and Maritime Services (now TfNSW) Traffic Modelling Guideline, Version 1.0 February 2013*. The model was coded and calibrated to the year 2020 and a growth rate was obtained from Sydney Strategic Traffic Forecasting Model for forecasted road demands for the years 2026 and 2036 (SMEC 2021). The performance of each intersection was measured by the average delay per vehicle which corresponds to a Level of Service (LOS) for the intersections.

A site visit was also conducted on 3 September 2020 between 7-9am and 3-5pm to collect traffic count data and make any observations regarding the intersections along Dunheved Road. The Dunheved Study area for the traffic assessments is shown in Figure 6-1.

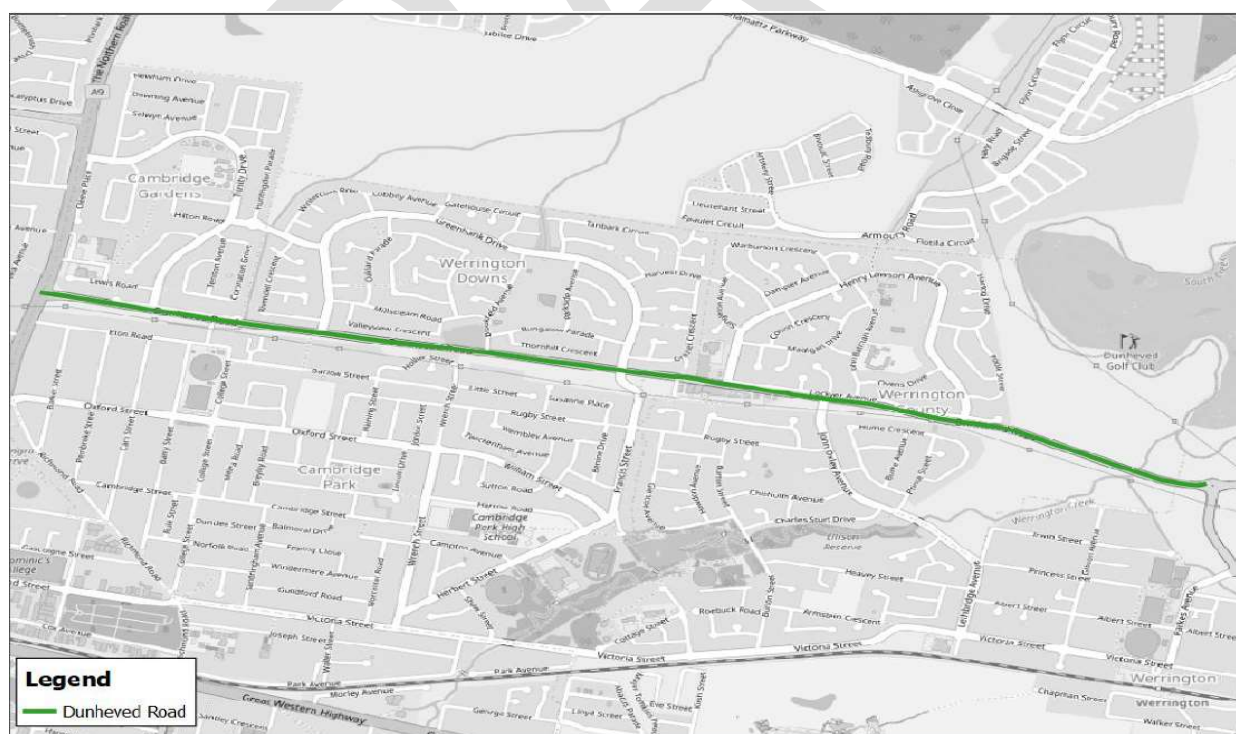


Figure 6-1 Traffic Assessment Study Area (Source SMEC 2021 and 2022)

The standard RMS (now TfNSW) LOS criteria for intersections is listed in Table 6-1.

Table 6-1 Modelling guidelines Level of Services for intersections (SMEC 2021)

Level of Service (LoS)	Average Delay per Vehicle (sec/vehicle)	Traffic Signal and Roundabout	Give Way and Stop Sign
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays. Roundabout require other control mode	At capacity, requires other control mode
F	>70	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing

In their 2022 report, SMEC conducted a series of sensitivity tests which were undertaken to identify the optimum design option as well as address community and Transport for NSW concerns regarding potential traffic issues. Eight sensitivity tests were conducted based on the completed Proposed Design submitted on 8 January 2021.

6.1.2 Existing Environment

6.1.2.1 Road network

Dunheved Road is categorised as an unclassified regional road under TfNSW schedule for Classified Roads and Unclassified Regional Roads. Regional Roads perform an intermediate function between the main arterial network of State Roads and council controlled Local Roads. The Regional Road category comprises two sub-categories: those Regional Roads that are classified pursuant to the *Roads Act 1993*, and those Regional Roads that are unclassified.

Based on 2011 census data, the preferred mode of travel within the traffic study area surrounding Dunheved Road is a private car with 69% residing within the study area and making outbound trips and 57% working within the study area making inbound trips to the study area (SMEC 2021).

The Dunheved Road corridor is a B-Double route restricted to 19m B-Double and Richmond Road is a B-double route with allowance for 26m B-Double vehicles. The majority of Dunheved Road is a posted 70km per hour road except through Werrington town centre where it drops to 50 km per hour. Dunheved road is a two lane, two-way road for majority of the Study Area. There are twelve intersections identified within the Study Area including one roundabout, five signalised intersections and six unsignalized intersections (see Table 6-2) (Cardno, 2021a). An existing bridge structure is located over Werrington Creek approximately 200 m west of the Dunheved Road, Werrington Road and Christie Street roundabout (Cardno, 2021a).

Table 6-2 Intersections within the study area and their corresponding control (Cardno 2022).

Intersection Name	Control Type
Richmond Road/Dunheved Road	Signalised intersection
Dunheved Road/Trinity Drive	Unsignalised intersection
Dunheved Road/ Tasman Street	Signalised intersection
Dunheved Road/ Greenbank Drive	Signalised intersection
Dunheved Road/ Greenbank Drive/ Francis Street	Signalised 4-way intersection
Dunheved Road/ Lavin Crescent	Unsignalised intersection
Dunheved Road/ Henry Lawson Avenue	Signalised intersection
Dunheved Road/ Shopping Centre Access	Unsignalised intersection
Dunheved Road/ John Oxley Drive	Unsignalised intersection

Dunheved Road/ John Batman Avenue	Unsignalised intersection
John Batman Avenue/Ovens Drive	Unsignalised intersection
Dunheved Road/ Werrington Road/ Christie Street	Roundabout

6.1.2.2 Public transport

The closest railway stations to the western end of the Study Area are Penrith Station and Kingswood Station and to the eastern end is Werrington Station. All three of these stations are located on the T1 North Shore and Western line.

No bus services transit along the western end of Dunheved Road between the Richmond Road/Dunheved Road intersection and the Dunheved Road/ Greenbank Drive/ Francis Street intersection. Two bus routes (780 and 782) travel along the eastern end of Dunheved Road. The 780 bus route travels between Penrith Station and Mount Druitt Station via Ropes Crossing, and this bus route runs multiple services daily and stops along Dunheved Road at the Werrington County Shopping Village. The 782 bus route travels between St Marys and Penrith via Werrington. Services between St Mary's Interchange and Penrith Station run six times a day (each way) on Monday to Friday between 8:30am-3pm and runs multiple times daily between Penrith Station and Werrington Station. The bus route has a stop along Dunheved Road at the Werrington County Shopping Village and another stop on John Batman Avenue after Lockyer Avenue. Three bus routes, the 677, 678 and 782 transit along Richmond Road past the intersection of Richmond Road and Dunheved Road.

6.1.2.3 Current road network performance

Traffic surveys and traffic modelling were carried out by SMEC and a site survey was conducted at the end of 2020. As part of the study, they surveyed fourteen intersections along Dunheved Road and nearby streets. The site survey showed high queue lengths which were observed at most of the signalised intersections in both the AM and PM peak hours (which were identified as 8am-9am for the AM peak and 4:45pm-5:45pm for the PM peak). See Figure 6-2 for an example of peak hour traffic and indicative queuing at an intersection along Dunheved Road. The Dunheved Road/ Greenbank Drive/ Francis Street intersection experienced the longest queues out the eleven intersections analysed, with long westbound rolling queues observed, that spilled back between John Batman Avenue and the Christie Street roundabout (SMEC 2021).

Currently, Dunheved Road is operating close to its capacity at Level of Service (LoS) D and three out of the fourteen intersections that were surveyed were identified as failing. The Dunheved Road/Lavin Crescent intersection is LoS F for both AM and PM peak and the Dunheved Road/ Greenbank Drive/ Francis Street and the Dunheved Road/Shopping Centre Access intersection are LoS F for PM peak (SMEC 2021).



Figure 6-2 An example of current queue length at signalised intersection on Dunheved Road- AM peak period (Source SMEC 2021)

6.1.2.4 Modelled future network performance without the Dunheved Road upgrade

Currently the future base case suggests that if no mitigation measures are implemented and Dunheved Road is not upgraded and left in its existing state as a single lane corridor, there will be a significant drop in the average speed by 15 km/hr and a total travel time of up to three times what is currently being spent on the road due to increased traffic congestion and queuing within 15 years. This is supported by the traffic modelling undertaken by SMEC (2021 and 2022 studies) and is based on surrounding travel zones and the population and employment growth projected for these zones in this same time period. It is predicted that by 2026 Dunheved Road would be operating at LoS D for AM peak and LoS E for PM peak and that by 2036 Dunheved Road will be operating at LoS F for both AM and PM peak. Due to the one lane configuration each way queue lengths currently bank back during peak times and from the modelling future estimated increases to queue lengths.

By 2036 it is estimated that during the PM peak hour period queue lengths could reach up to 2km, all the way to the roundabout at Christie Street and Werrington Road. Modelling at the intersections along Dunheved Road also indicated that by 2036, the majority of the intersections will be operating at unsatisfactory levels with major delays. Increases in traffic demands along Dunheved Road would result in limited gaps for side roads at intersections along Dunheved Road, especially on priority-controlled intersections.

Further modelling was conducted by SMEC in July 2022 to update the SIDRA modelling based on the completed 80% design to further refine the design for optimal traffic network performance.

6.1.3 Potential Impacts

6.1.3.1 Construction Phase

Construction of the proposal would generate both light and heavy vehicle movements. The works would result in temporary traffic and transport related impacts during construction. Some of the impacts that are anticipated during the construction works include:

- Increase in traffic from construction vehicle movements
- Temporary changes to the existing road network including closure of roads and diversion of traffic
 - Traffic delays from roadworks
 - Disruptions to property access to private and commercial areas
 - Disruptions to pedestrian and cyclists

There are several proposed compounds and stockpile areas along Dunheved Road and heavy vehicles would need to access these compounds from Dunheved Road directly (See Appendix A for proposed locations). These compounds would be gated, and typically construction vehicles would need to enter and exit these gates under supervised active traffic control to minimise impacts on the local road network and the local community. Construction vehicles using compound access gates may also pose a safety risk to pedestrians and cyclists. This risk would be highest when these are located closer to residential areas and where there is higher potential pedestrian/cyclist activity. The locations of these construction sites will be refined prior to construction commencing in consideration of appropriate vehicular access as well as safe arrangements for the local community.

Mitigation measures such as the use of appropriate signage to businesses, local roads and residences to maintain access and minimise confusion for motorists. Risks to road safety would be minimised through a reduced speed limits near construction activities and the requirement for all work to be undertaken in accordance with relevant industry standards and Work Health and Safety regulations.

The construction of the upgrade works would be in four stages to reduce impacts to residents and road users. During early works, and subsequent phases it is expected all the activities would be completed behind barriers and no change to the traffic network capacity is expected. Stage 4 would allow for roads users to continue to access the existing bridge while the other two bridges are constructed. Details of Construction works and phasing are set out in Section 3 of this report.

The construction staging strategy allows the continued use of one lane of traffic in each direction along Dunheved Road, as per the existing scenario, with only minor disruptions to traffic performance. Stage 1 will include upgrades around the commercial area of Werrington Village which is predicted to cause major disruptions due to current access ways being routed directly from Dunheved Road, this stage will be strictly managed under a Traffic Management Plan (TMP) with active controls.

Access to private properties would be maintained, and in instances where access is not feasible, an agreement will be reached prior to any works commencing. Where changed traffic conditions restrict some existing turning movements in and out of property accesses, alternative options may be provided.

There would be minor disruptions to the bus services along Dunheved Road with delays and adjusted timetables.

Further traffic assessment may be required prior to the commencement of works to confirm the potential for traffic impacts for all four stages of construction and identify whether any additional mitigation measures or traffic control measures would be required as part of a TMP, including road closures and partial road closures.

6.1.3.2 Operational Phase

With an upgraded Dunheved Road, bridges and associated intersections and roundabouts, the traffic volumes and traffic times for future modelled scenarios are expected to decrease along Dunheved Road and within residential streets adjacent to Dunheved Road.

The preferred mitigation measures proposed will improve traffic network performance and therefore have a positive impact on Dunheved Road users and residents who live within the locality.

They include:

- > The addition of additional lanes along the road corridor, converting Dunheved to a four-lane road with a medium strip
- > Improvements to turning and queuing at the existing 11 intersections;
- > New Werrington Creek crossing will consist of two separate bridges – one for vehicles and a new pedestrian bridge; improving safety and efficiency;

- > Improvement of performance issues at Dunheved Road and Tasman Road intersection as well as improving short lane capacity so that queue lengths do not exceed short lane lengths
- > The potential inclusion of a bus lane to improve public transport options in the locality
- > The construction of three new roundabouts at three intersections off Dunheved Road would improve traffic flows on associated side streets; and
- > Improved drainage design, including in adjacent Orleton Place and Rugby Street

However, as currently proposed, mitigation measures will not address all issues and short lane capacity issues would still remain an issue at the following intersections: Dunheved/John Batman Avenue, Dunheved Road/Richmond Road and Dunheved Road/Werrington Road/Christie Street.

Pedestrian and cyclist facilities

The new shared path adjacent to the new bridge structure over Werrington Creek will improve access and safety for cyclists utilising Dunheved Road and the upgraded pathway along the length of Dunheved Road will also provide improved access.

Upgrades to traffic signalling at three intersections Dunheved Road/Greenbank Drive, Dunheved Road/Francis Street and Dunheved Road/Henry Lawson Avenue would have pedestrian only phases allowing diagonal movements and improving safety and access for pedestrians crossing over Dunheved Road. The staged pedestrian crossing proposed at Dunheved Road and Tasman Street on the western approach and full pedestrian crossing on the southern approach on Tasman Street would also provide safe crossing for pedestrians using this intersection.

The inclusion of these facilities would enhance the existing pedestrian network along Dunheved Road and provide greater accessibility and a safe environment for pedestrian and cyclists.

6.1.4 Mitigation Measures

Mitigation measures to manage the impacts of the proposed works to traffic and transport are presented in Table 6-3.

Table 6-3 Mitigation measures for traffic and transport

ID	Impacts	Safeguards	Responsibility	Timing
TT1	Traffic and Transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will seek to minimise the disruption to traffic and ensure the safety of road users and the construction workforce. The following measures to mitigate impacts to traffic and access will be included in the TMP:</p> <ul style="list-style-type: none"> • Confirmation of proposed haulage routes and the location of site compounds and stockpiles; • Measures to maintain access to local roads, shops and properties; • Site specific traffic control measures (including signage) to manage and regulate traffic; • Measures to maintain pedestrian and cyclist access; • Provision of off road parking for construction vehicles • The proposed community consultation methods to inform the community of impacts to the local road network and access issues; 	Contractor	Pre-construction/ Construction

ID	Impacts	Safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> Location of access to the construction sites to prevent construction vehicles queueing on public roads; A response plan for any construction traffic incident; Consideration of other cumulative traffic impacts arising from other developments that may be under construction simultaneously; A program of monitoring, review and updates. <p>The TMP sub plan and CEMP will be implemented during the construction phase.</p>		
TT2	Traffic control	<ul style="list-style-type: none"> Traffic control devices such as concrete barriers will separate works from traffic and provide protection for construction personnel. Work site speed limits will be enforced for the duration of construction. Traffic control signage will be installed in line with Australian Standard AS1742.3 and will provide warnings to drivers of changes to traffic conditions. Active traffic management controls may be required during some phase of works. 	Construction contractor	Construction
TT3	Road closures	<p>Council will consult with NSW SES and TfNSW to ensure planned road lane closures do not impact their activities.</p> <p>Appropriate road occupancy licences will be in place prior to construction works commencing, where road closures are likely</p> <p>Further traffic modelling may be required prior to the commencement of works to confirm the potential for construction traffic impacts for all stages of works (1-4) and identify whether any additional mitigation measures or traffic control measures would be required including road closures or partial road closures.</p>	Council	Construction
TT4	Damage to existing road features	All roads, kerbs, gutters and footpaths that are damaged during construction will be restored to their pre-construction condition.	Construction contractor	Post-construction
TT5	Impacts to community	<ul style="list-style-type: none"> Community consultation will be undertaken with residences and businesses in the area to discuss the impacts of the project. The CEMP will provide mechanisms for receiving and responding to complaints and these will be implemented during construction. Road users, local communities and the freight industry will be provided with 	Council	Pre-construction/ construction

ID	Impacts	Safeguards	Responsibility	Timing
		timely, accurate, relevant and accessible information about changed traffic arrangements and delays as a result of construction activities.		
TT7	Impact to access	Where pedestrian or cyclist access is disrupted by the works, alternative safe access would be provided. Access to properties and commercial areas will be considered on a case by case basis and alternative options may be provided where appropriate. Access issues in relation to the Werrington Village will be carefully planned as part of the TMP	Contractor	Construction

6.2 Noise and Vibration

6.2.1 Existing Environment - Noise

The existing acoustic environment generally consists of road traffic noise from Dunheved Road. Residents located to the south of Dunheved Road currently have a larger separation distance than residents to the north, due to a vacant land corridor, partially allocated to the proposed road upgrade. Residential dwellings on the northern side of Dunheved Road generally back directly onto the road corridor or are separated by a local access road. Residents closer to the western end of the project may also experience road traffic noise impacts from Richmond Road.

Noise modelling has been carried out to determine whether the proposed upgrade works for the Dunheved Road Upgrade project are likely to result in appropriate noise criteria adopted in accordance with the NSW Road Noise Policy (DECCW July 2011) (RNP). This assessment considers potential impacts from road traffic noise as a result of the upgrade in accordance with the following policies and guidelines:

- > NSW Road Noise Policy (DECCW July 2011) (RNP)
- > RMS Noise Criteria Guideline (Roads and Maritime 2015) (NCG)
- > RMS Noise Mitigation Guideline (Roads and Maritime 2015) (NMG)
- > RMS Noise Model Validation Guideline (Roads and Maritime 2016) (NMVG)

The prediction of future road traffic noise levels has been based on projected future traffic volumes. Modelling assumptions have been outlined in Appendix E Traffic Noise Assessment Report.

6.2.2 Noise Assessment Methodology

Unattended noise monitors were installed at four locations within the study area for a period of 7 days to measure road traffic noise and ambient (i.e., background) noise levels. The noise monitors were configured to measure 15-minute statistics, between the 28 October and 4 November 2021. The unattended noise monitors were configured to measure noise levels as follows:

- > 'A' weighting
- > 'Fast' response
- > 15-minute statistical intervals
- > Measurement descriptors LAMax, LAeq, LA1, LA10, LA90 (defined in the glossary)

All monitoring was conducted in accordance with Australian Standard AS 2702 – 1984, Acoustics-Methods for the Measurement of Road Traffic Noise.

Calibration of the measuring equipment was carried out before and after the measurements, and it was noted that the maximum variation was less than +/- 0.3 dBA during the course of the monitoring for all equipment used.

A summary of the environmental conditions noted during the measurement period were as follows (weather data obtained from the Bureau of Meteorology weather station in Penrith, approximately 4km northwest of the site):

- > **Conditions:** Generally fine with light winds. Wind speeds reached above 5 m/s during the daytime period on the 29th of October 2021, with some light rainfall on 4th November 2021.
- > **Wind:** 0 – 44 km/h from various direction
- > **Humidity:** 21 - 98%
- > **Temperature:** 9 – 33°C

Detailed weather information recorded at the site during the monitoring period is provided on the noise charts presented in Traffic Noise Assessment (Appendix E). Daytime noise data from 29th October 2021 was excluded in the analysis due to wind. Noise records during rainy periods were excluded in the analysis of the recorded noise data. Excluded periods of data are shown in the Traffic Noise Assessment (Appendix E).

6.2.3 Criteria for the Operational Traffic Assessment

NSW Road Noise Policy 2011 (RNP)

The RNP provides definitions of the functional class of the road under consideration. Table 6-4 outlines the roads under assessment and their functional class. For the purposes of adoption of assessment criteria from the RNP, the Noise Criteria Guideline (RMS 2015) (NCG) states that collector roads are classed as sub-arterial roads.

Table 6-4 Assessed Roads – Functional Class

Road	Road Section	Functional Class
Dunheved Road	Northern Road to Christie Street Roundabout	Sub Arterial

TfNSW Noise Criteria Guideline (NCG)

Noise criteria are assigned to sensitive receivers using the NCG. The NCG provides guidance on how to apply the NSW RNP. As defined in the NCG, the study area extends to where noise levels are dominated by other roads that are not being assessed as part of the proposal. This is up to a maximum distance of 600 metres from the project works for urban areas. For this project, the study area has been refined based on the methodology defined in the NCG.

Residential Receivers Target Criteria

Residences may be assigned new, redeveloped, transition zone or relative increase criteria depending on how the project will influence noise levels. For each facade of a sensitive receiver, the most stringent applicable criteria will be used in the assessment.

The redeveloped road criteria is 5 dB(A) higher than the new road criteria, however, a receiver location with relatively equal exposure to both new and redeveloped roads will have target noise level between the higher and lower of the two noise limits.

The applicable RNP target criteria for residential receivers located near to sub-arterial and collector roads are shown in Table 6-5.

Table 6-5 RNP Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project / Land Use	Assessment Criteria, dB(A)	
		Day 07:00-22:00	Night 22:00-07:00
Freeway/arterial/sub-arterial/collector roads	1. Existing residences* affected by noise from new freeway/ arterial/sub-arterial road corridors	L _{Aeq} (15hour) 55 (external)	L _{Aeq} (9hour) 50 (external)

Local roads	2. Existing residences* affected by noise from redevelopment of existing freeway/arterial/ sub-arterial roads	L _{Aeq} (15hour) 60 (external)	L _{Aeq} (9hour) 55 (external)
	3. Existing residences affected by noise from a transition zone between new and redeveloped roads	L _{Aeq} (15hour) 55-60 (external)	L _{Aeq} (9hour) 50-55 (external)
	4. Existing residences affected by noise from new local road corridors	L _{Aeq} (1hour) 55 (external)	L _{Aeq} (1hour) 50 (external)
Local roads	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		

Relative Increase Criteria

In addition to the assessment criteria outlined in Table 6-5, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development is required to be considered.

The NCG states that residences experiencing increases in total traffic noise level above the relative increase criteria shown below in Table 6-6 should also be considered for mitigation.

For other existing sensitive land uses as outlined in Table 6-7, the relative increase criteria should be applied to the respective L_{Aeq}(period) for that land use type, except for open space. For road projects where the main subject road is a local road, the relative increase criterion does not apply.

Table 6-6 Relative Increase Criteria for Residential Land Uses

Road Category	Type of project / land use	Total Traffic Noise Level Increase, dB(A)	
		L _{Aeq} , 15 hour 07:00-22:00	L _{Aeq} , 9 hour 22:00-07:00
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing + 12 dB(A) (external)	Existing + 12 dB(A) (external)

Non-Residential Receivers

The applicable NCG target criteria for non-residential sensitive receivers relevant to this project are outlined in Table 6-7:

Table 6-7 NCG Road Traffic Noise Assessment Criteria for Other Sensitive Land Uses

Existing Sensitive Land Use	Location	Assessment Criterial, dB(A)	
		L _{Aeq} , 1 hour 07:00-22:00	L _{Aeq} , 1 hour 22:00-07:00
School Classrooms	Internal (when in use)	40	-
Open Space (Active Use)	External (when in use)	60	-
Open Space (Passive Use)	External (when in use)	55	-

It is generally accepted that most residential buildings provide a noise reduction of at least 10 dB(A) when windows are left 20% open. Therefore, where the noise goals are internal, a 10 dB(A) reduction from external to internal noise levels has been adopted to allow an external assessment.

For non-residential receivers, external to internal noise level reductions have been estimated based on a conservative 10 dB(A) reduction from external to internal noise levels has been adopted to allow an external assessment of road traffic noise impact.

Minor Works

The NCG states the following with regard to minor works:

- > Some works may be primarily to improve safety. This may include minor straightening of curves, installing traffic control devices, intersection widening and turning bay extensions or making minor road realignments.
- > These works are not considered redeveloped or new as they are not intended to increase the traffic carrying capacity of the overall road or accommodate a significant increase in heavy vehicle traffic.
- > Roads and Maritime applies existing road criteria where the minor works increase noise levels by more than 2.0 dB(A) relative to the existing noise levels at the worst affected receiver.
- > The noise catchment area should include all receivers where noise levels increase. A 600-metre noise catchment may not be required.
- > Transition zones (where new roads meet existing, and where redeveloped meet new roads) are not applicable to minor works.

Review of the above indicates that the Minor Works classification does not apply to this project, and all receivers where noise levels are expected to increase by more than 2 dB(A) as a result of traffic on the project roads have been considered within the relevant project area.

TfNSW Noise Mitigation Guideline

The TfNSW Noise Mitigation Guideline (NMG) provides guidance in managing and controlling road traffic generated noise and describes the principles to be applied when reviewing noise mitigation. The NMG recognises that the criteria recommended by the NCG are not always practicable and that it is not always feasible or reasonable to expect that they should be achieved.

The NMG outlines the applicable methodology for the determination of mitigation in accordance with the project specific noise limits set by the NCG. Noise mitigation options that should be considered are listed in order of preference below:

- > Quieter pavement surfaces
- > Noise mounds
- > Noise walls
- > At property treatments

The NMG provides three triggers where a receiver may qualify for consideration of noise mitigation (beyond the adoption of road design and traffic management measures), as follows:

- > Trigger 1: The predicted Build noise level exceeds the NCG controlling criterion and the noise level increase due to the project (i.e., the noise predictions for the Build minus the No Build) is greater than 2 dB(A).
- > Trigger 2: The predicted Build noise level is 5dB (A) or more above the criteria (exceeds the cumulative limit) and the receiver is significantly influenced by project road noise (more than 2 dB(A)), regardless of the incremental impact of the project.
- > Trigger 3: The noise level contribution from the road project is acute (daytime LAeq,15hr 65 dB or higher, or night-time LAeq,9hr 60 dB or higher) then it qualifies for consideration of noise mitigation even if noise levels are dominated by another road.

The eligibility of receivers for consideration of additional noise mitigation is determined before the benefit of additional noise mitigation (quieter pavement and noise barriers) is included. The requirement for the project is to provide reasonable and feasible additional mitigation for these eligible receivers to meet the NCG controlling criterion. If the NCG criterion cannot be satisfied with quieter pavement and noise barriers, then the receiver is eligible for consideration of at-property treatment.

Australian Standards.

The following Australian Standards provide criteria and methodologies that have been adopted in this assessment.

- > Australian Standard AS1055-2018 Acoustics – Description and measurement of environmental noise.
- > Australian Standard AS 2702-1984, Methods for the Measurement of Road Traffic Noise.

Based on a review of the statutory noise criteria listed in Section 6.2.3, a summary of the operational road traffic noise design benchmarks applicable to this project are provided in Table 6-8 below.

Table 6-8 Summary of Road Traffic Criteria

Applicable Assessment Criteria	Assessment Criteria — dB(A)	
	Day (7 AM–10 PM)	Night (10 PM–7 AM)
Residential Receivers		
Target Noise Criteria – Redeveloped and Existing Roads	L _{Aeq} , (15 hour) 60 (external)	L _{Aeq} , (9 hour) 55 (external)
Relative Increase Criteria	⁽¹⁾ Design year “no build” (road traffic) noise level + 12.0 dB(A), as determined on a receiver point by receiver point basis.	
NCG Criteria	The more stringent of the Target Noise Criteria or Relative Increase Criteria will be the NCG criteria, as determined on a receiver point by receiver point basis.	
Cumulative Criteria	NCG Criteria +5dBA	
⁽²⁾ Acute Criteria	L _{Aeq} , (15 hour) 65 (external)	L _{Aeq} , (9 hour) 60 (external)
Non-Residential Receivers		
Schools (Classrooms)	L _{Aeq,1hr} 40 (internal) ⁽³⁾ L _{Aeq,1hr} 50 (external)	Not applicable
Schools (Outdoor Play Areas)	L _{Aeq,1hr} 55 (external active)	Not applicable

Notes:

- (1) A single storey dwelling may have up to 4 receiver points, whilst a two-storey dwelling may have up to 8 receiver points within the 3D noise model. This may include assessment points on north, south, east and west facing facades on each floor level. The relative increase criteria noise limits can be different for each individual assessment point on the one building.
- (2) This applies to predicted impacts from project roads only for the year after year of opening.
- (3) This assumes and outside to inside noise reduction of 10 dB(A).

6.2.4 Potential Impacts

6.2.4.1 Construction Phase

The noise modelling undertaken for the project was to understand Operational Road Traffic Noise impacts, which is discussed below.

Noise and vibration impacts from the project can be categorised into impacts during the construction phase relating to the breaking of ground, earthworks, road material being poured and compacted and associated machinery and traffic. As these impacts are short term, temporary works this REF has relied on Construction Noise guidelines issued by the EPA.

The Interim Construction Noise Guideline (INCG) (DECC, 2009) provides guidance on assessing potential impacts and managing construction works to minimise noise, with an emphasis on communication and cooperation with all involved in, or affected by, construction noise. The ICNG sets out standard construction hours as:

- > Monday-Friday: 7:00am to 6.00pm;
- > Saturday: 8.00am to 1.00pm; and
- > No work on Sunday and Public Holidays.

The ICNG (DECC, 2009) stipulates a noise guideline of 75 dB(A) (sound pressure) which equates to the 'highly noise affected' management level for construction noise received at residential properties.

The ICNG identifies the relevant noise criteria for the types of receivers near the Study Area are summarised in Table 6-9. Taking into consideration the type of development surrounding the works site, the representative noise environment has been classified as R2 noise area category based on the Roads and Maritimes Services Construction Noise Estimator Tools (version 21/03/2017). Within this R2 noise category the noise management level for residential receivers has been assumed to be 55 dB(A) for standard working hours.

Table 6-9 Noise criteria for sensitive receivers (DECC, 2009)

Receiver Type	Noise management level (L
Dunheved Road	Noise affected – rating background level + 10 dB(A) for standard working hours High noise affected – 75 dB(A)
Classrooms in schools or other educational facilities	Internal noise level – 45 dB(A)
Active recreation areas (characterized by sporting facilities which generate their own noise)	External noise level – 65 dB(A)
Passive recreation areas (characterised by sporting facilities which generate little noise)	External noise level – 60 dB(A)
Places of worship	Internal noise level – 45 dB(A)

A number of sensitive receptors have been identified along or adjacent to Dunheved Road including educational premises, passive recreation areas and residential premises.

There will be a temporary increase in noise in the area due to the presence of construction related vehicle movements and construction equipment. The types of construction equipment likely to be used for the proposed works are identified in Section 3.3.4.

It is reasonable to assume based on the known machinery sound power levels that the works would result in some increase in noise levels above the noise management level RBL +10dB to nearby residents for short periods during construction.

Construction is expected to be undertaken over a 30-month period. It should be noted that construction will be phased and will take place in four stages with all works being completed before construction works commence in any of the subsequent stages. This will minimise the duration of potential construction noise in any one area.

Construction works will create temporary additional noise and vibration through operation of site machinery for the duration of works. The phasing of the works will ensure no individual sensitive receiver will be affected for an extended period of time. Proposed safeguards and mitigation measures will minimise the effects of noise and vibration on sensitive receivers as outlined in Section 6.2.5.

6.2.4.2 Operational Phase

For a full outline of the Noise modelling assumptions and inputs refer to Appendix E Traffic Noise Assessment.

The traffic noise model was used to predict post-development road traffic noise impacts in the year 2026 and 2036, as a result of the project. The predicted noise levels were compared to the relevant noise criteria and exceedances determined.

Recommendations relating to feasible and reasonable mitigation measures were then developed.

The Australia (NSW) CoRTN assessment methodology was adopted for the calculation of road traffic. SoundPLAN was used for modelling and calculation. Northbound and southbound lanes were amalgamated into one road.

Existing (2021) traffic volumes within the project area were obtained from traffic surveys conducted during the noise monitoring period of 28 October to 4 November 2021.

Traffic volume predictions were obtained from traffic model results prepared by Cardno for the proposal. The predicted traffic volumes were provided for the year 2026 and 2036. Traffic model results were provided as hourly volumes. These volumes were analysed to determine 15-hour and 9-hour traffic volumes to correlate with calculating LAeq 15hr and LAeq 9hr noise levels.

6.2.5 Predicted Operational Traffic Noise Levels

Residential Receivers

A summary of the findings is presented in Table 6-10. Noise predictions in the form of noise contour maps are presented in Appendix E Traffic Noise Assessment.

Table 6-10 Predicted Road Traffic Noise Levels Summary

Summary items	Time Period	Noise Model Scenarios	
		No mitigation	2.0m barriers
Total number of residential receivers	All	829	829
Number of dwellings whereby criteria is exceeded	Day	230	221
	Night	213	205
Range of exceedances	Day	1 - 11 dBA	1 - 10 dBA
	Night	1 - 11 dBA	1 - 9 dBA
Number of receivers where noise level will increase by more than 2 dBA	Day	0	0
	Night	0	0
Number of addresses qualifying for the consideration of mitigation due to exceedance of the cumulative noise limit.	Day	132	77
	Night	124	72

The results presented in Table 6-10 can be summarised as follows:

- > Without mitigation, there are up to 230 locations that exceed the NCG target criteria, and of these up to 132 would qualify for the consideration of mitigation (i.e., qualify for the consideration of at-property treatments to each dwelling) based on the triggers presented in TfNSW Noise Mitigation Guideline
- > With incorporation of a 2.0 metre barrier the number of receivers qualifying for consideration of mitigation would reduce from 132 to 77, an overall reduction of 55 receivers.

Refer to Section 6.2.6 for recommendations regarding the construction of acoustic barriers.

- > For the receiver locations where exceedances of the criteria were predicted, it was found that the predicted increase in noise levels due to construction of the project did not exceed 2 dBA. Therefore, traffic noise impacts at most receiver locations would exceed the criteria even if the project were not to go ahead. Exceedances of the cumulative criteria is the trigger (TfNSW Noise Mitigation Guideline Trigger 2) qualifying residents for the consideration of mitigation.

Refer to Appendix E for recommendations in relation to the prescription of at-property treatments to dwellings that qualify for its consideration.

Predicted Noise impacts at Cambridge Park School demonstrate compliance with required criteria and therefore no acoustic treatment is required at this sensitive receptor.

6.2.6 Noise Mitigation

The NMG provides a consistent approach to implementing feasible and reasonable noise mitigation measures for road projects within NSW. In cases where affected receivers qualify for consideration of noise mitigation, the order of preference for treatments under the NSW RNP is as follows:

1. Quieter pavement surfaces
2. Noise mounds
3. Noise walls
4. At-property treatments.

In accordance with the NMG, quieter pavement surfaces, noise mounds and noise walls are typically only considered in cases where 4 or more closely located receivers are eligible for the consideration of acoustic treatment.

Modelling showed Acoustic Walls at 2.0 m were most effective in reducing the impact. The assessed barrier location is shown in Figure 6-3.

The increase in traffic noise levels due to the implementation of the project are predicted to exceed the NCG and Cumulative criteria at a number of residential receivers.

In accordance with the NSW RNP, the extent of mitigation should be selected on the basis of feasible measures, which are considered reasonable on the basis of social, economic, and environmental effects, including the cost of the abatement measures at Council's discretion. A total of 77 properties qualifies for further mitigation if the acoustic barriers are constructed.

In accordance with the At-Receiver Noise Treatment Guideline (Draft) (TfNSW, 2017) (ARNTG), dwellings where traffic noise levels exceed the criteria by 1 dBA or more may be eligible for the acoustic treatment packages. Details of these acoustic packages can be found in Appendix E Traffic Noise Assessment.

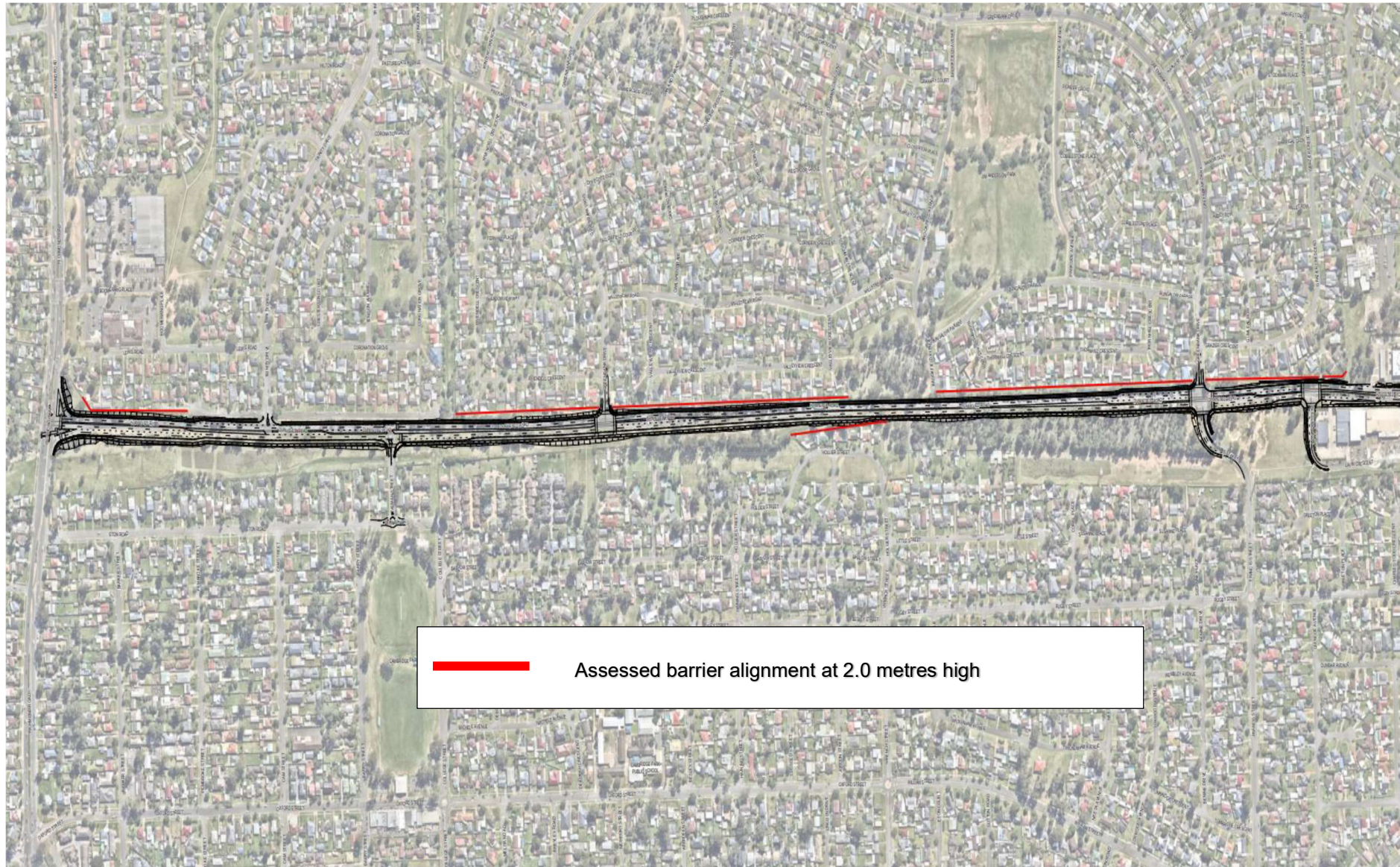


Figure 6-3 Assessed Acoustic Barrier Alignment Locations

6.2.7 Recommendations for Operational Impacts

The assessment of road traffic noise from the Dunheved Road Upgrade Project was conducted in accordance with the NSW RNP, NCG and NMG. The assessment of current and future traffic conditions has resulted in the following conclusions:

- > Without barriers there are up to 230 locations that exceed the NCG target criteria, and of these up to 132 would qualify for the consideration of mitigation (i.e., qualify for the consideration of at-property treatments to each dwelling) based on the triggers presented in Section 3.4.
- > With incorporation of a 2.0 metre barrier the number of receivers qualifying for consideration of mitigation would reduce from 132 to 77, an overall reduction of 55 receivers. Refer to Section 6.1.2 for recommendations regarding the construction of acoustic barriers.
- > For the receiver locations where exceedances of the criteria were predicted without barriers, it was found that the predicted increase in noise levels due to operation of the project did not exceed 2 dBA. Therefore, traffic noise impacts at most receiver locations where exceedance were noted would exceed the criteria even if the project were not to go ahead.
- > Noise impacts to the Cambridge Park Public School were predicted to comply with the relevant assessment criteria.

6.2.8 Mitigation Measures

Mitigation measures to manage the impacts of the proposed works to noise and vibration are presented in Table 6-11.

Table 6-11 Mitigation Measures for Noise and Vibration Impacts

ID	Impact	Safeguards	Responsibility	Timing
NV1	Noise and Vibration - Construction	<ul style="list-style-type: none"> > A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the Interim Construction Noise Guideline (ICNG) (DECC, 2009) and identify: <ul style="list-style-type: none"> > All potential significant noise and vibration generating activities associated with the activity > Feasible and reasonable mitigation measures to be implemented, taking into account Beyond the Pavement: urban design policy, process and principles (Roads and Maritime, 2014). > A monitoring program to assess performance against relevant noise and vibration criteria > Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures > Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. <p>In addition to the above, the NVMP will also consider:</p> <ul style="list-style-type: none"> • Place as much distance as possible between the plant or equipment and residences and other sensitive land uses, particularly at site compounds. • Use of temporary site buildings and materials stockpiles as noise barriers where possible (e.g., on site compounds). 	Contractor	Preconstruction/construction

ID	Impact	Safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> Scheduling construction of any permanent walls so that they can be used as early as possible as noise barriers where possible. Where practical, scheduling the use of vibration intensive equipment for less sensitive times of the day. Avoid multiple vibration intensive activities occurring at the same time where possible. Selection of ancillary sites location shall consider the proximity of the sites to sensitive receivers. Where compounds are close to residences, additional care shall be taken in layout and utilising structures and stockpiles as noise screens. Where possible, work outside of standard construction hours will be planned so that noisier work is carried out in the earlier part of the evening or nighttime. Examining different types of machines that perform the same function and compare the noise level data to select the least noisy machine. For example, rubber wheeled tractors can be less noisy than steel tracked tractors. Selecting appropriately sized equipment for the task rather than using large equipment when not necessary. Reducing throttle setting and turn off equipment when not being used. Regularly inspecting and maintaining equipment to ensure it is in good working order. Also check the condition of mufflers. Where acceptable from a work health and safety perspective, quieter alternatives to reversing alarms (such as spotters, closed circuit television monitors and 'smart' reversing alarms) will be used particularly during out of hours activities. Noise monitoring will be undertaken to assess compliance with noise management levels (NMLs) and assess the effectiveness of noise mitigation. All noise complaints will be investigated, and appropriate mitigation measures implemented where practicable to minimise further impacts. 		
NV2	Noise and Vibration - Construction	<p>> All local residents would be informed about the commencement of construction via direct mail-out and/or letterbox drop, articles in the local newspaper or Council website.</p> <ul style="list-style-type: none"> Additional notification to be provided to potential noise affected residences near the work sites detailing the likely timing of noisy activities. A contact should be provided to the affected parties for further enquiries. Signage is to be erected at the construction site with relevant contact details for persons responsible for complaints and enquires. 	Contractor	Pre-construction / construction

ID	Impact	Safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> > A complaints register will be established for the duration of the works to record any community noise complaints. Any complaints will be responded to promptly and appropriately by the contractor. > Should noise complaints be received the need for additional mitigation measures such as respite offers would be investigated and implemented as required. 		
NV3	Noise and Vibration - Construction	<p>All sensitive receivers (e.g., schools, local residents) likely to be affected will be notified at least five days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:</p> <ul style="list-style-type: none"> • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting and how to obtain further information. 	Designer/ Contractor	Pre-construction/ Construction
NV4	Noise and Vibration - Construction	<p>Hours of work will be limited to standard hours (Monday-Friday, 7am-6pm; Saturday, 8am-1pm; no works Sundays or public holidays)</p> <p>Where work is required outside standard construction hours, an out of hours work procedure will be developed in accordance with the Construction Noise and Vibration Guideline as an appendix to the NVMP.</p> <p>Construction programming will be developed in consultation with Council to minimise noise impacts – this may include agreement on completing construction in as short a time as possible or implementing time and duration restrictions and respite periods subject to community consultation.</p>	Contractor	Pre-construction/ Construction
NV5	Noise and Vibration- Operation	Reasonable and feasible operational noise mitigation in the form of noise barriers and at-property treatments have been assessed and determined. At-property treatments will be determined and implemented in consultation with impacted property owners.	Council/Contractor/Designer	Design/Pre-construction

6.3 Contamination, Soils and Geology

6.3.1 Existing Environment – Topography, Soils and Geology

Topography

The local topography of the site varies across the proposed alignment along Dunheved Road. At the western end of the site the ground topography rises from the Richmond Road intersection to the Greenbank Drive intersection and slopes down from the Greenbank Drive intersection towards the eastern project boundary.

The existing road starting from approximately 500m east from the intersection of John Oxley Avenue and Dunheved Road up to the bridge over Werrington Creek appears to be built on a raised embankment (Cardno 2022a). Surface elevations within the existing road corridor vary between 54m to 22m (RL mAHD) in a west to easterly direction. In general, the Study Area is comprised of asphaltic road wearing surface crowned at the centre and graded towards grassed verges (Cardno 2022a).

Geology and Soils

The Penrith 1:100,00 Geological Series Sheet 9030 indicates the site is predominantly underlain by Bringelly Shale of Wianamatta Group (Rwb) which is characterised by shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff. There was some minor intrusion of alluvial

soil (Qal) on the eastern end of the Study Area which is characterised by fine grained sand, silt and clay (Cardno, 2022a). Figure 6-4 shows the geology of the site.



Figure 6-4 The geology of the site (Source: Cardno 2022b)

The soil landscapes within the Study Area are Luddneham (lu) and South Creek (sc) soils with the majority of the site overlying the Luddenham erosional soil landscape (DPIE 2022). Soils within this landscape consisted shallow dark podzolic soils or massive earthy clays on crests, moderately deep red podzolic soils on upper slopes, and moderately deep yellow podzolic soils and prairies soils on lower slopes and drainage lines (Cardno 2022b). The eastern most part of the site (east of Lockyer Avenue) overlies the South Creek alluvial soil landscape. The South Creek landscape consisted of often very deep layered sediments over bedrock or relict soils. Structured plastic clays or structured loams in and/or immediately adjacent to drainage lines are present. Red and yellow podzolic soils are most common terraces with small areas of structured grey clays, leached clays and yellow solodic soils (Cardno 2022b).

The following studies were carried out as part of the design investigations:

- Geotechnical Investigation Report by Cardno (2022a);
- Desktop Contamination Assessment with Limited Sampling by Cardno (2022b)

These full reports are included as Appendix F and G of this report respectively. The results of these investigations and key recommendations are included below. Information from these studies can be used to consider how erosive and dispersive the soils would be during construction, and how any potential contaminants may travel (migrate) through the soils and geology, potentially impacting on surface and groundwaters.

6.3.2 Geotechnical Investigation Methodology

The investigation was undertaken to assess conditions for the management of geotechnical works and risks that may affect the proposed road upgrade, to assist design, in particular to aid footing designs for minor structures & earthworks specification for cut and fill transitions during construction.

Fieldwork for the geotechnical investigations was carried out in October 2021 and included the following:

- > The drilling of forty-two (42) shallow pavement core / auger holes using a ute-mounted drill rig equipped with a solid flight auger with TC- bit.
- > Drilling of four (4) deep boreholes adjacent Werrington Creek for the bridge construction using a track mounted drill rig with solid flight auger and TC bit. The rock coring was carried out using NMLC rock coring techniques;
- > Dynamic Cone Penetration (DCP) tests were undertaken at each pavement core down to 1.5m or refusal, if encountered prior;
- > Standard Penetration Test (SPT) tests were carried out at 1.5m intervals at each deep borehole until refusal was achieved;
- > Collection of disturbed soil samples for laboratory testing; and
- > Survey of all boreholes using a Global Navigation Satellite System (GNSS) receiver.

Borehole locations are contained within the site plan found in Appendix A of the Geotechnical Investigation.

6.3.3 Geotechnical Investigation Results

Majority of the boreholes were terminated at 1.5m depth or prior refusal with an exception of PC39 which was terminated at 3.00 m below surface level (bsl). The four deep boreholes all hit bedrock at around 8m and reached their target depth ranging from 13-15m bsl.

The subsoil profiles encountered across the subject site on the pavement boreholes comprised generally of the following:

- > Asphaltic Concrete Pavement (overlying)
- > Fill comprising of gravel, sand and clay (overlying)
- > Residual clay and siltstone bedrock

The subsoil profiles encountered across the proposed bridge over Werrington Creek comprised generally of the following:

- > Topsoil (overlying)
- > Imported Fill comprising of clay (overlying)
- > Alluvial soil comprising of clay, gravel, sand and siltstone bedrock

Overall, the subsurface conditions encountered across the site were relatively uniform and consistent with the regional geology of the area. The ground profile is generally comprised of fill layer overlying residual or alluvial and/or bedrock.

Generally, testing found the shallow soils in the boreholes were non dispersive indicating these soils would be less susceptible to breakdown and erode in wet conditions.

Results for the deeper boreholes suggest that some soils at depth showed mild to aggressive chemical characteristics to steel and concrete which will need to be considered in the bridge design for any piles and abutments.

Other recommendations and the corresponding laboratory results for pavement design, site preparation and also recommendations for bridge abutments and box culverts are included in the Geotechnical Investigation report in Appendix F.

6.3.4 Existing environment- Contaminated Land

6.3.4.1 Historical Land Use – aerial photography

Soil contaminants can either comprise long-lasting and persistent substances or substances that can degrade quickly. As such, it is important to understand legacy and current land uses in the area, both of which may have affected soil and water quality. Therefore, as part of the contaminated land desktop assessment a search of available historical aerial photographs pertaining the site and the surrounding land was completed by Cardno 2022b.

Details of this review dating from 1947 until 2021 are summarised in Table 6-12. Overall, the study area was historically undeveloped and used for agricultural purposes prior to 1947 to sometime before 1961, from at least 1961 to 1994 the study area showed evidence of development with roads and associated infrastructure. From 1982 onwards, the surrounding land appeared to be cleared and developed as residential subdivisions. Finally, from 1996 to present day the study area and surrounding land use has remained unchanged from its land use as a road servicing a residential area and associated activities (Cardno 2022b).

6.3.4.2 Acid Sulfate Soils

Acid sulphate soil (ASS) are soils containing iron sulphides which when exposed to the air, generate sulphuric acid that can cause environmental and human health impacts. They typically occur in low-lying coastal floodplains, rivers and creeks

Government databases indicate that the site does not lie on an area with an acid sulfate soils (ASS) risk (DPIE 2022 and Cardno 2022b). Additionally, a review of the Penrith LEP indicated that there were no ASS risk maps for the Penrith LGA.

Therefore, there is a low risk and low likelihood of ASS within the Study Area, and it is not expected that ASS would be encountered onsite and this assertion was supported by the limited sampling undertaken by Cardno (2022b) and the subsequent laboratory analysis of soil samples and results.

Table 6-12 Summary of Key Historical Aerial Photographs

Dates	Site Use Observations	Surrounding Land Use Observations
1947	The site appeared to be vacant grassed land with sporadic trees across. A creek was evident in the easternmost part of the site, adjacent the creek the land appeared to be used for agricultural purposes with presumed crops and small farmhouses evident.	<p>The surrounding land north of the site appeared to be consistent with the majority of the site, being occupied by vacant grassed land with sporadic tree coverage.</p> <p>The surrounding land east of the site appeared to be occupied agricultural land.</p> <p>The surrounding land south of the site appeared to be occupied by dirt roads and tracks, dense to sporadic tree coverage and residential dwellings.</p> <p>The surrounding land west of the site appeared to be occupied by a road, followed by grassed land and sporadic tree coverage. Further south-west of the site the surrounding land appeared to be occupied by multiple industrial warehouses, factories and roads, and industrial goods.</p>
1961	The central-western part of the site appeared to be occupied by a dirt road. The remainder of the site appeared predominantly unchanged from 1955/1956.	<p>The surrounding land north, east and west of the site appeared predominantly unchanged from 1955/1956.</p> <p>The land immediately south of the western part of the site had been further developed with residential dwellings and associated structures. Further south of the site the land has been further developed with additional residential dwellings, roads and a rail corridor.</p>
1970	The site appeared predominantly unchanged from 1961, however multiple dirt roads and paths were evident in the westernmost part of the site.	<p>The surrounding land north of the western half of the site appeared predominantly unchanged from 1965. The surrounding land north of the eastern half of the site had been developed as a golf course. Further north of the site some land clearing and two industrial warehouses were evident.</p> <p>South and west of the site the surrounding land appeared to have been further developed residentially, with land clearing, additional roads and dwellings evident.</p> <p>The surrounding land immediately east of the site appeared unchanged from 1965.</p>
1975	The site appeared predominantly unchanged from 1970. However, north of the western and central parts of the site land clearing and the establishment of roads were evident, presumably for residential subdivisions.	<p>The land immediately north of the western and central parts of the site appeared to have been subject to land clearing, with roads and exposed soils evident as part of presumed residential subdivisions. The surrounding land north of the eastern part of the site appeared unchanged from 1970.</p> <p>The surrounding land south and west of the site (full site extents) had now been further developed residentially, with additional dwellings and roads evident.</p> <p>The land immediately east of the site appeared unchanged from 1970. However, the land further east to north-east of the site appeared to have been developed industrially with multiple (varying types) warehouses evident.</p>
1982	<p>The western part of the site appeared to have been subject to some land clearing with some dirt roads evident. Within this part of the site, two asphalt roads were present, associated with the adjoining subdivisions.</p> <p>The central part of the site seemed to be occupied appeared to be occupied by multiple asphalt/gravel roads. Whilst the easternmost part of the site was occupied by grassed land and dirt roads/tracks.</p>	<p>The surrounding land north of the majority of the site extent, now appeared to have been densely occupied by residential dwellings. Former vegetation (dense trees) evident in 1978 had been predominantly cleared as part of this development.</p> <p>The surrounding land north of the easternmost part of the site was covered with grass, multiple dirt roads and tracks and sporadic trees.</p> <p>The surrounding land east, south and west of the site appeared predominantly unchanged from 1978.</p>

Dates	Site Use Observations	Surrounding Land Use Observations
1986	The site now appeared to be occupied by an asphalt dual lane road spanning the length of the site, with adjoining cross streets along the road corridor. The road corridor was completed with grass, vegetation and/or dirt. A concrete bridge was evident along the easternmost part of the road (site), above the creek bed.	The surrounding lands north, south, east and west of the site appeared predominantly unchanged in use from 1982. However, at least six commercial-like buildings (presumed shopping centre) and associated open-air carpark was evident immediately south of the sites centre.
1991	The site appeared predominantly unchanged from 1986. However, the road corridor immediately north of the eastern site extent appeared to subject to earthworks, given exposed soils and machinery were evident.	<p>The majority of the surrounding lands north, south, east and west of the site appeared predominantly unchanged from 1986. However, the following minor changes in land use were noted from 1986:</p> <ul style="list-style-type: none"> ▪ Immediately adjacent the western end of the site and additional road lane had been constructed for the adjacent road that runs perpendicular to the site; ▪ Immediately north of the western end, land had been partially cleared, with three concrete driveways/footpaths and a fence evident; ▪ Immediately south of the centre of the site an additional commercial building was evident immediately east of the buildings evident in 1986; and <p>North to north-east of the easternmost site extent, the land appeared to have been subject to land clearing with exposed soils and machinery evident.</p>
1994	The site appeared predominantly unchanged from 1991. However, an asphalt and concrete roundabout was now evident at the easternmost extent of the site.	<p>The majority of the surrounding lands north, south, east and west of the site appeared predominantly unchanged in use from 1991. However, the following minor changes in land use were noted from 1991:</p> <ul style="list-style-type: none"> ▪ Two additional turn lanes were evident at the westernmost end of the site, adjoining the road perpendicular to the site; ▪ The land immediately north of the site had been developed residentially with multiple dwellings evident; ▪ Further north of this part of the site had been developed with two commercial-like buildings and associated asphalt carparks; ▪ Immediately north of the centre of the site a commercial-like building was evident; ▪ Immediately south of the centre of the site, an additional two commercial buildings and asphalt carpark were evident; ▪ Immediately south-east of the easternmost part of the site a golf course was evident; and <p>Immediately north and east of the easternmost site extent, exposed soils were evident adjacent the road.</p>
2000	The site appeared predominantly unchanged from 1994.	<p>The majority of the surrounding lands north, south, east and west of the site appeared predominantly unchanged in use from 1998.</p> <p>Large electrical poles and lines appeared to have been constructed north of the easternmost part of the site.</p>
2007	The site appeared predominantly unchanged from 2000.	The surrounding land north, south, east and west of the site appeared predominantly unchanged in use from 2005.

Dates	Site Use Observations	Surrounding Land Use Observations
		<p>Immediately south of the central part of the site two additional commercial buildings were evident, with an associate concrete hardstand carpark.</p> <p>West of these commercial buildings (centre of the site) and immediately south and adjoining the road (the site), an adjoining street appeared to have been altered and traffic lights had been installed with an intersection evident.</p> <p>The land immediately south of the westernmost part of the site appeared to be and construction site/ yard, with multiple stockpiles of soil, trucks, sheds and machinery evident.</p>
2021	The site appeared predominantly unchanged from 2020.	<p>The surrounding land north, south, east and west of the site appeared predominantly unchanged in use from 2020.</p> <p>The land immediately south of the westernmost part of the site had been covered in grass with small stockpiles of soil evident.</p>

6.3.4.3 Salinity

Saline soils are associated with certain soil types, including Bringelly Shales. They can wash out into the soil and surface water increasing their salinity. In turn, this can affect soil quality and structure, and impact flora and fauna and waterways.

Based on a review of the Department of Infrastructure, Planning and Natural Resources (DIPNR) (now DPE) *Salinity Potential in Western Sydney 2002* map the majority of the site lies within an area mapped as moderate salinity potential which can be described as areas on Wianamatta Group Shales and Tertiary Alluvial Terraces where evidence of scattered scaling or vegetation indicators may be observed (Cardno 2022b).

The easternmost part of the site adjacent Werrington Creek is mapped as high salinity potential. High salinity potential can be described as areas where soil, geology, topography and groundwater conditions predispose a site to salinity and are likely to occur in areas of lower slopes and drainage systems where water accumulation is high (Cardno 2022b).

6.3.4.4 Contamination

A review of the NSW Contaminated Lands Register returned results for 8 sites within the Penrith LGA, however none of these sites were located within the Study Area. Four sites were listed under the EPA List of Contaminated Sites Notified to the EPA. Two of these sites were within the Study Area and the other two are located within the surrounding area. Details of these sites are outlined in Table 6-13 and shown in Figure 6-5. It is noted that these databases do not contain an exhaustive list of contaminated sites and there remains potential to encounter previously unidentified contaminated land.

Table 6-13 Sites within the Study Area and surrounds that are listed under the EPA List of Contaminated Sites Notified to the EPA

Label	Site Name	Address	Activity	EPA Management Class	Distance and Direction
A	Caltex Cambridge Park	1 Boomerang Place, Cambridge Gardens	Service Station	Regulation under CLM Act not required	~200m north of intersection of Richmond Road and Dunheved Road
B	Caltex Service Station	Cnr Dunheved Road and Henry Lawson Drive, Werrington County	Service Station	Regulation under CLM Act not required	Within study area, but outside impact area
C	7-Eleven Werrington	Lot 122 Dunheved Road, Werrington County	Service Station	Regulation under CLM Act not required	Within study area but outside impact area
D	Claremont Meadows Former landfill	Gipps Street, Werrington County	Landfill	Regulation under CLM Act not required	~1.5km South Dunheved Road and Werrington Road intersection

6.3.5 Limited Contaminated Land Investigation Methodology

A desktop assessment of publicly available data sets and historical imagery of the area were undertaken to describe the site setting and previous land uses of the area.

The publicly available data sets that were assessed included the following:

- > NSW DPIE eSPADE 2.1 website
- > Penrith 1:100,000 Geological Series Sheet 9030
- > WaterNSW *Real Time Water Data Portal*
- > Department of Infrastructure, Planning and Natural Resources *Salinity Potential in Western Sydney 2002* map
- > Historical aerial imagery was supplied in Lotsearch documents and the following aerial photographs were reviewed:
- > Lotsearch: 1949, 1955/1956, 1961, 1965, 1970, 1982, 1986, 1991, 1994, 2000, 2005, 2009, 2018 and 2021.

- > The following online websites and additional aerial photographs were also reviewed:
- > NSW Government, *Historical Imagery Viewer* for imagery from 1947, 1975, 1998 and 2004
- > MetroMap for imager from 2007, 2018, 1998 and 2020.

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Figure 6-5 Map of sites listed under the EPA list of NSW contaminated sites notified to EPA

A site inspection was undertaken by an experienced Environmental Scientist from Cardno on 7 October 2021 and observations about the site were made and limited sampling was undertaken in parallel with the geotechnical investigation. Samples were analysed and assessed against national and state guidelines, including, the National Environmental Protection Measure for Contaminated Land (2013). All samples were analysed at a NATA accredited laboratory.

6.3.5.2 Human Health Criteria

National and State Guidelines that set out criteria for human health exposure settings for the site has been provided below in Table 6-14, along with the rationale behind the application of these criterion.

Table 6-14 Adopted Human Health Criteria

Guidelines	Specific Criteria	Justification
NEPM (2013)	HIL-D	Health Investigation Level (HIL) D thresholds have been adopted to assess the risk to site users for industrial and commercial settings. This land setting is consistent with the proposed future land use as a road corridor.
	HSL-D	Health Screening Level (HSL) D thresholds for soil vapour have been adopted to assess the potential for a vapour intrusion risk present from site soils. These criteria were applicable for commercial and industrial settings, which is consistent with the future use as a road corridor.
	For asbestos	<ul style="list-style-type: none"> No visible asbestos for surface soils. HSL-D: 0.05% for bonded ACM. 0.001% w/w for friable asbestos in soil.

Results from the limited sampling indicated that all concentrations of metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylene (BTEX), Polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticide (OCP)/organophosphorus pesticides (OPPs) and Polychlorinated biphenyls (PCBs) in the collected samples of both fill and natural soils were all either below the applicable laboratory Level of Reporting (LOR) or below the adopted NEPM 2013 Tier 1 human health screening criteria.

Therefore, from a human health perspective, the soils assessed at these discrete locations were considered suitable to remain onsite under the proposed land use.

6.3.5.3 Ecological Criteria

Ecological Investigation Levels (EIL) and Ecological Screening Levels (ESL) have been adopted from NEPM (2013) Guidelines to assess the risk to future ecological receptors (i.e., flora and fauna in potential landscaped areas and nearby waterbodies) under a commercial and industrial land use scenario, as well as general leachability to groundwater.

The application of the commercial and industrial EIL and ESL are considered appropriate to capture risk to unidentified ecological receptors.

A summary of the EIL criteria for applicable contaminants are provided below in Table 6-15 along with the pH, Cation Exchange Capacity (CEC) and clay content that were utilised in deriving EIL.

Table 6-15 EIL Criteria

Analytes	EIL (mg/kg)	Inputs
Metals	Arsenic	160
	Copper	320
	Chromium III	680
	Lead	1,800
	Nickel	370
	Zinc	940
PAHs	Naphthalene	370

Analytes		EIL (mg/kg)	Inputs
OCPs	DDT	640	

Results from the limited sampling indicated that all concentrations of metals, TRH, BTEX, PAHs, OCP/OPPs and PCBs in the collected samples were below the adopted ecological criteria, with the exceptions of two sample locations within the central part of the site which exceeded the ESL criteria for Benzo(a)pyrene a chemical associated with roading material such as asphalt. Based on the limited data gathered during this assessment, the material within these discrete locations may not be suitable to remain onsite unless placed under a structure or roadway (hardstand) and isolated from potential interaction with ecological receptors. If the material cannot be placed under a structure or roadway further assessment may be necessary to determine the suitability for onsite re-use or to classify for off-site disposal purposes (should that be required).

6.3.6 Other Soil Criteria

6.3.6.1 Waste Classification Criteria

In-situ soils were assessed preliminarily for Waste Classification purposes. The criteria used for assessment was from the NSW EPA Waste Classification Guideline (2014), variously determining if material could be preliminarily classified as either General Solid Waste, Virgin Excavated Natural Material, Restricted or Hazardous Waste and the appropriate method of disposal or treatment.

Results of the limited sampling indicated the following:

- No asbestos was observed during sampling nor identified within laboratory analytical reports.
- Coal tar was not identified to be present within the sampled asphalt.
- Loose road base and asphalt materials were encountered within the fill material across most borehole locations.
- Generally, no additional anthropogenic inclusions were observed in the fill material

Based on these results, fill soils encountered were preliminarily classified as Restricted Solid Waste, however could potentially be reclassified to General Solid Waste subject to additional laboratory testing such as leachability. Residual and alluvial soils may be suitable for classification as either Excavated Natural Material or Virgin Excavated Natural Material, however this would need to be confirmed through further assessment that satisfies applicable NSW EPA guidelines.

Further sampling for waste classification purposes will need to be conducted prior to construction commencing.

6.3.6.2 Salinity Criteria

Based on the preliminary review of the DIPNR (2002) *Salinity Potential in Western Sydney Map*, it was determined that natural soils would undergo a preliminary salinity assessment. Soils were assessed for salinity based on the electrical conductivity (ECe) value in comparison to the criteria outlined in the Department of Land, Water and Conservation (DLWC) (2002) *Site Investigations for Urban Salinity* Guidelines. This assessment would determine if soils are classed from either non-saline to highly saline.

Laboratory analysis indicated that the deeper (>0.8 m) residual soils along the assessment area were found to be non-saline to slightly saline within the western and central parts of the site, and sodic to highly sodic in nature.

6.3.7 Summary of the Limited Contaminated Land Investigation Results

Based on the review of the historical and surrounding land uses and the site walkover inspection and limited sampling a conceptual site model was produced. Overall, results indicate there is generally a low risk of contamination where sampling took place. The conceptual model developed for the site has identified that the following sources of contamination may be encountered within the site (Cardno, 2022b):

- > Imported fill material or road base used beneath the existing road surface and on the road embankments
- > Potential fly tipping along the road corridor
- > Potential use of pesticides and herbicides along the road corridor

- > Potential contamination associated with offsite neighbouring sources such as fuel leakages associated with underground storage tanks, fuel pumps, bowzers and breather pipes from former service stations
- > Potential contamination associated with former site structures or uses including:
 - Demolition waste from residential dwellings potentially containing hazardous materials (e.g., lead based paints, asbestos etc.)
 - Application of herbicides (former EPA licensed activities, previous agricultural land use etc.)
 - Industrial businesses, including anti-corrosive paint, aluminium and joinery manufacturers and builder suppliers

Whilst not considered a contaminant source, the potential presence of saline soils at the site is also considered a notable constraint.

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6.3.8 Potential Impacts

6.3.8.1 Construction Phase

During site preparation in the early stages of each construction phase vegetation will be removed, scrub, trees and grassed areas, which would expose soils. Topsoil stripping, general excavation, earthworks and ground profiling would also expose subsoils. This would see the temporary stockpiling of top soil and sub soil at its point of excavation and its longer term storage at one of the site compounds and stockpile areas.

The Geotechnical assessment concluded that the near surface material at the site should be easily excavatability. Most soils encountered on site should be within the excavation limits of a small dozer in bulk excavations or medium size backhoe in trench excavations. It is proposed that most excavation works will not exceed 1m bsl, and therefore hard ground-breaking equipment would unlikely be required for much of the site preparation.

Generally, testing showed the shallow soils in the boreholes were nondispersive therefore these soils would be less susceptible to breakdown and erosion in wet conditions. This also indicates that the generation of dust would be less of an issue. However, management measures would still be required to be implemented to prevent air quality issues and the contamination of runoff.

Both cut and fill would be required as part of the ground preparation. Existing fill will require further testing to confirm its waste classification category and disposal requirements, if any, in particular those areas that have been shown to have exceedances in ecological criteria or where fill cannot be placed in accordance with recognised standards and as such is deemed 'uncontrolled'. In these instances, mitigation measures should be implemented to allow for management of uncontrolled fill in accordance with relevant standards.

While no groundwater was encountered for much of the Dunheved Road geotechnical testing, it was encountered in each of the deeper bores adjacent Werrington Creek. Deeper excavations that encounter groundwater run the risk of contaminating the groundwater source, and mitigation measures should be implemented to minimise this risk.

There is a risk of contamination on the site in the areas adjacent service stations, however the risk to the project is considered low due to the proposed shallow earthworks. If the design is modified and deeper excavations are needed the contaminant risk and construction constraints may need to be reconsidered.

Highly sodic soils were identified at depths >0.8 metres, however the shallow earthwork depths are unlikely to encounter these soils. For there to be an impact there would either need to be a notable change in groundwater chemistry, flows or conditions, or the creation of a migration pathway. Accordingly, the depth, scale and location of proposed ground excavation would be likely insufficient to cause such a change meaning there would only be a remote risk of any associated impacts.

Generally, the proposed works would cause the following impacts:

- > Washout, erosion and sediment discharge of exposed soils
- > Erosion, leaching and dust generation from stockpiled materials
- > Loss of soil quality and condition from material stockpiling
- > Associated soil quality impacts through accidental spills caused by:
 - Use of chemicals outside of the contained areas
 - Traffic accidents, including loading and unloading risks
 - Leaks and drips from poorly maintained vehicles, machinery and equipment
 - The temporary storage and management of spoil and waste (leading to leaching).

Overall, due to the shallow excavations proposed, there is a low risk of encountering contamination, particularly at the locations where samples were collected. However large portions of the site remain unassessed and therefore there is still a risk that contaminated soils may be encountered during earthworks. Further testing will be undertaken prior to construction commencing.

6.3.8.2 Operational Phase

Once the project is operational there would be potential for indirect impacts to soils as a result of run-off and drainage. There will be a period post construction while new landscape plantings and turf establishes that runoff and loose soils may continue to cause sedimentation issues and carry contaminated runoff to surrounding waterways, properties and stormwater drains. Devices can remain in place during this period to minimise issues in the short term while the soils and landscape areas stabilise over time.

An increase in vehicles may increase the risk of hydrocarbon spills and leaks, and road pollutant runoff. More specifically, the road runoff pollutant impacts may include:

- > Sediment washout from pavement wear and natural atmospheric deposition
- > Heavy metal discharge washout from exhaust emissions flushing from the pavement
- > Oil, grease and hydrocarbons flushing from the pavement
- > Tyre rubber and break pad dust
- > Nutrient from the use of vegetation maintenance herbicides.

The impacts would be most notable during a storm event following a prolonged dry period where the stormwater drains, and supplementary water quality basins were not properly maintained. However, having appropriate devices installed near drains and waterways can minimise these impacts.

6.3.9 Mitigation Measures

Mitigation measures to manage the impacts of construction on soils are presented in Table 6-16.

Table 6-16 Mitigation measures for impacts on soils and contamination

ID	Impact	Safeguards	Responsibility	Timing
SC1	Excavation of soil	<p>The CEMP will be prepared prior to undertaking any future works. The CEMP will be prepared in accordance with appropriate guidelines and regulatory attributes and will include details regarding waste classification, stockpile and waste and management procedures for any soils being excavated and requiring offsite disposal.</p> <p>A CEMP should identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.</p> <p>The Plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.</p> <p>All site preparation work should be carried out in accordance with AS3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments'.</p>	Contractor	Pre-construction / construction
SC2	Removal of waste soil from site	During construction all material proposed for removal from site will require sampling and analysis for Waste Classification purposes, which must be outlined in the CEMP. Waste classification sampling and certificates will be completed in accordance with the NSW EPA (2014) Waste Classification Guidelines	Contractor	Construction
SC3	Relocation of structural fill	<ul style="list-style-type: none"> It is recommended that the placement of all structural fill be inspected, tested and certified by Cardno to Level 1 requirements, during the earthworks operations to ensure that all fill is placed in a 'controlled manner', in accordance 	Contractor/ Cardno	Construction

ID	Impact	Safeguards	Responsibility	Timing
		<p>with AS3798-2007 'Guidelines on Earthworks for Commercial and Residential developments'.</p> <ul style="list-style-type: none"> Prior to placement of any structural fill, the site should be proof rolled using a minimum 10 tonne vibrating pad foot roller. Should isolated soft/loose areas be encountered during this process, this material should be removed and replaced with select fill. 		
SC4	Unexpected find of contaminated materials	<ul style="list-style-type: none"> Preparation of an unexpected finds protocol (UFP) which outlines the procedures to be followed should contamination be identified during future works. Capture and management of any surface runoff contaminated by exposure to the contaminated land Further investigations required to Classify Waste for disposal offsite if required. This would determine the extent, concentration and type of contamination, as identified in the Desktop Contaminated Land with Limited sampling Report Measures to ensure the safety of site personnel and local communities during construction. 	Contractor	Construction
SC5	General soil and water impacts	<ul style="list-style-type: none"> A mixture of work management controls, catch drains, temporary stabilisation, temporary surface treatment, sediment barriers, vegetation buffer strips and the stabilisation of drainage lines will be adopted Temporary sediment basins and sediment sumps will be installed where practical 	Designer/ Contractor	Pre-construction/ Construction
SC6	WSUD	<ul style="list-style-type: none"> Incorporate WSUD into road design and associated stormwater features 	Designer	Pre- Construction
SC7	Bridge construction	For bridge construction in the fourth phase, any piles driven within a high groundwater level area should have temporary casings to protect against contamination of water source.	Contractor	Construction

6.4 Hydrology and Flooding

6.4.1 Existing Environment

6.4.1.1 Surface Water

Surface water sources within the Study Area includes Werrington Creek at the eastern end of the Study Area (See watercourses defined in 0) and a drainage line running on the northern and southern side of Dunheved Road. Werrington Creek crosses Dunheved Road at two section just west of the roundabout at the intersection of Dunheved Road, Werrington Road and Christie Street. Both creek lines are Strahler Stream order (SSO) 3 and drain in a north easterly direction before draining into South Creek (SSO 6) downstream of Dunheved Road. The main creek line which runs under the bridge on Dunheved Road sits in a gully at a lower elevation from the road verge. The area surrounding both creek lines is highly vegetated with a mix of native and invasive plant species. Dunheved Road travels through two different catchment areas, the College, Orth and Werrington Creek catchment and the South Creek Catchment.

One large stormwater channel is present on the western end of the Study Area near Tasman Street. This stormwater channel feeds into South Creek approximately 500 metres north to north-east of the site. Another modified waterway is present just east of the intersection of Dunheved Road and Tasman Street. This waterway runs from the north of Dunheved Road to the South via an existing culvert that traverses underneath Dunheved Road.

6.4.1.2 Groundwater

A desktop review of the BoM Atlas of Groundwater Dependent Ecosystems (GDE) and the WaterNSW Groundwater Bores and Wells database was undertaken on 24 March 2022. Two areas along the Study Area were identified on the terrestrial GDE map. One area on the southern side of Dunheved Road, between Greenbank Drive and Holllier Street was mapped as having a high potential terrestrial GDE and another area at the eastern end of Dunheved Road between the eastern end of Lockyer Avenue and the roundabout at Dunheved Road, Werrington Road and Christie Street was mapped as having a high to moderate potential terrestrial GDE. The WaterNSW groundwater bores and wells map did not identify any bores or wells within the Study Area.

As part of the geotechnical investigations carried out by Cardno (Cardno 2022a), four bore holes were drilled near Werrington Creek (two on either side of the bridge crossing over Werrington Creek). These bore holes were observed for soil composition and also groundwater levels. At the time of investigation groundwater was encountered within these boreholes at 4.2-6.5 m bsl.

6.4.1.3 Flooding

A draft flood impact assessment report was prepared for Council by Cardno on 30 July 2021 (Cardno, 2021b). Two flood studies were provided by Council to use for the study including the College, Orth and Werrington Creek Flood Study by Catchment Simulation Solutions undertaken in 2017 and the South Creek Flood Study by WorsleyParsons undertaken in 2015 (Cardno 2021b).

College, Orth and Werrington Creek Catchment

The College, Orth and Werrington Creek Catchment is located in Penrith LGA and the catchment covers the suburbs of Werrington, Werrington County, Cambridge Park, Kingwood, Caddens and part of Orchard Hills. A 2D flood model of the catchment area was developed using TUFLOW software which uses a grid to define the spatial variation in topography, hydrolic (known as direct rainfall) and hydraulic properties (e.g., mannings 'n' roughness, rainfall losses) across the model area (Cardno 2021b).

South Creek Catchment

The South Creek catchment extends from Bringelly Road in the south to Blacktown Road-Richmond Road Bridge crossing in the north. The total study is captured in the South Creek Flood Study Report is 240km and lies within the Hawkesbury, Penrith, Blacktown, Fairfield and Liverpool LGA's. Werrington Creek is a minor tributary of South Creek and as such the Werrington Creek catchment is included within the extents of the flood study area (Cardno 2021b).

The South Creek flood study (WorsleyParsons 2015) aimed to update the previously existing hydrologic and hydraulic models that were developed as part of the 1990 DWR Flood Study Report, South Creek. A 2D hydraulic model of South Creek system was developed to replace the previous hydraulic models from the 1990 Flood Study.

Results

The Cardno (2021b) study found flood levels in Werrington Creek are controlled by the flood level in South Creek. Flood modelling for 1% annual exceedance probability (AEP) event and probable maximum flood (PMF) event in the existing state around Werrington Creek shows deeper inundation occurring around the watercourse and riparian vegetation located downstream from Werrington Creek Bridge.

The peak pre-development flood depth upstream of the existing bridge structure over Werrington Creek is 5.4 metres. The existing flood velocities for the 1% AEP event are less than 1.5 m/s for flows upstream from Werrington Creek bridge.

For the PMF event existing flood velocities increase up to 3 m/s around Werrington Creek bridge with velocities increasing between 1-3m/s for flows in both directions from the bridge. Existing flood extents and velocities for 1% AEP and PMF are shown in Figure 6-6, Figure 6-7, Figure 6-8 and Figure 6-9.

Results of the flood modelling post construction of the upgraded Dunheved Road is discussed below.

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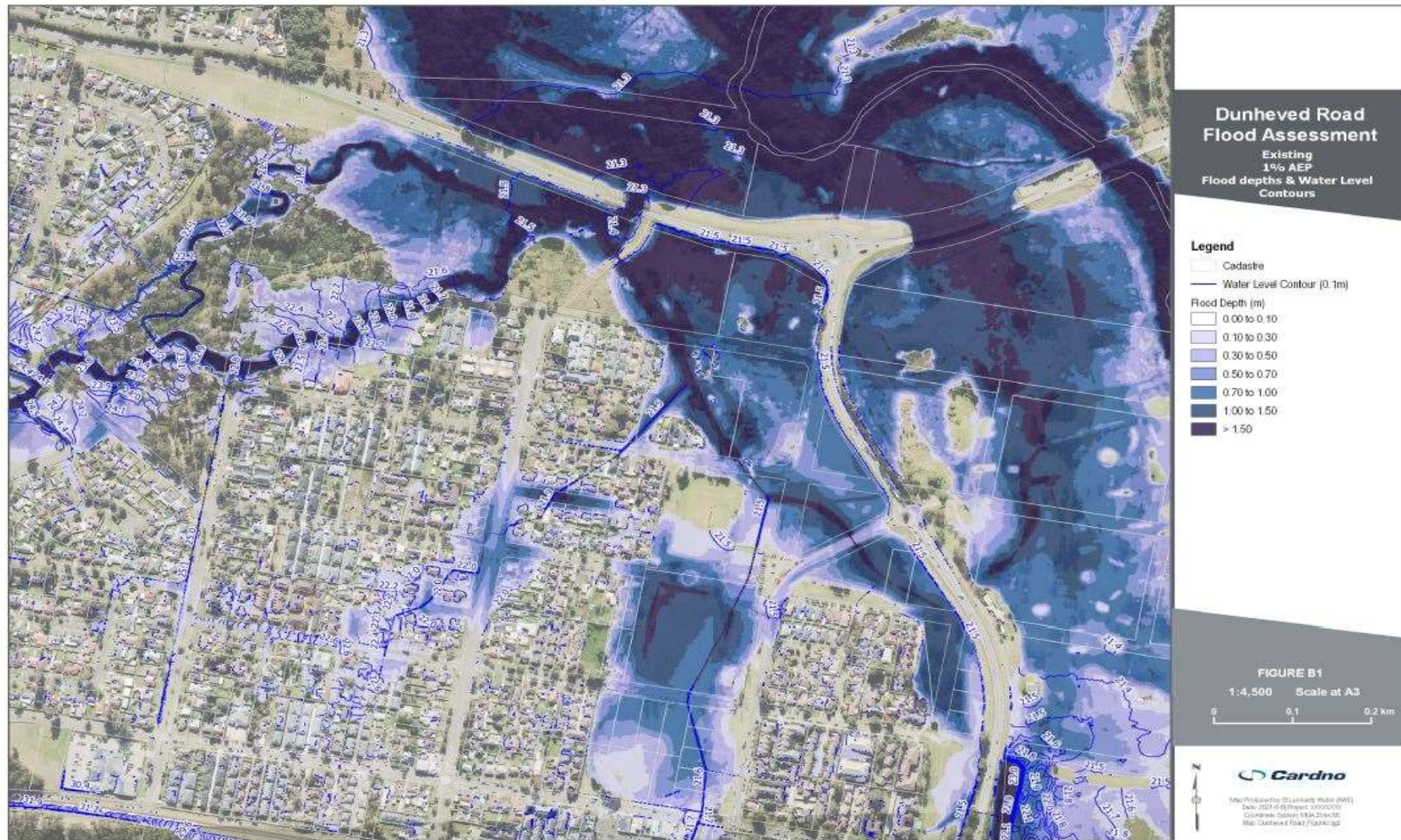


Figure 6-6 Existing 1% AEP flood depth modelled for Werrington Creek (Source: Cardno 2021b)



Figure 6-7 Existing 1% AEP flood velocity modelled for Werrington Creek (Source: Cardno 2021b)

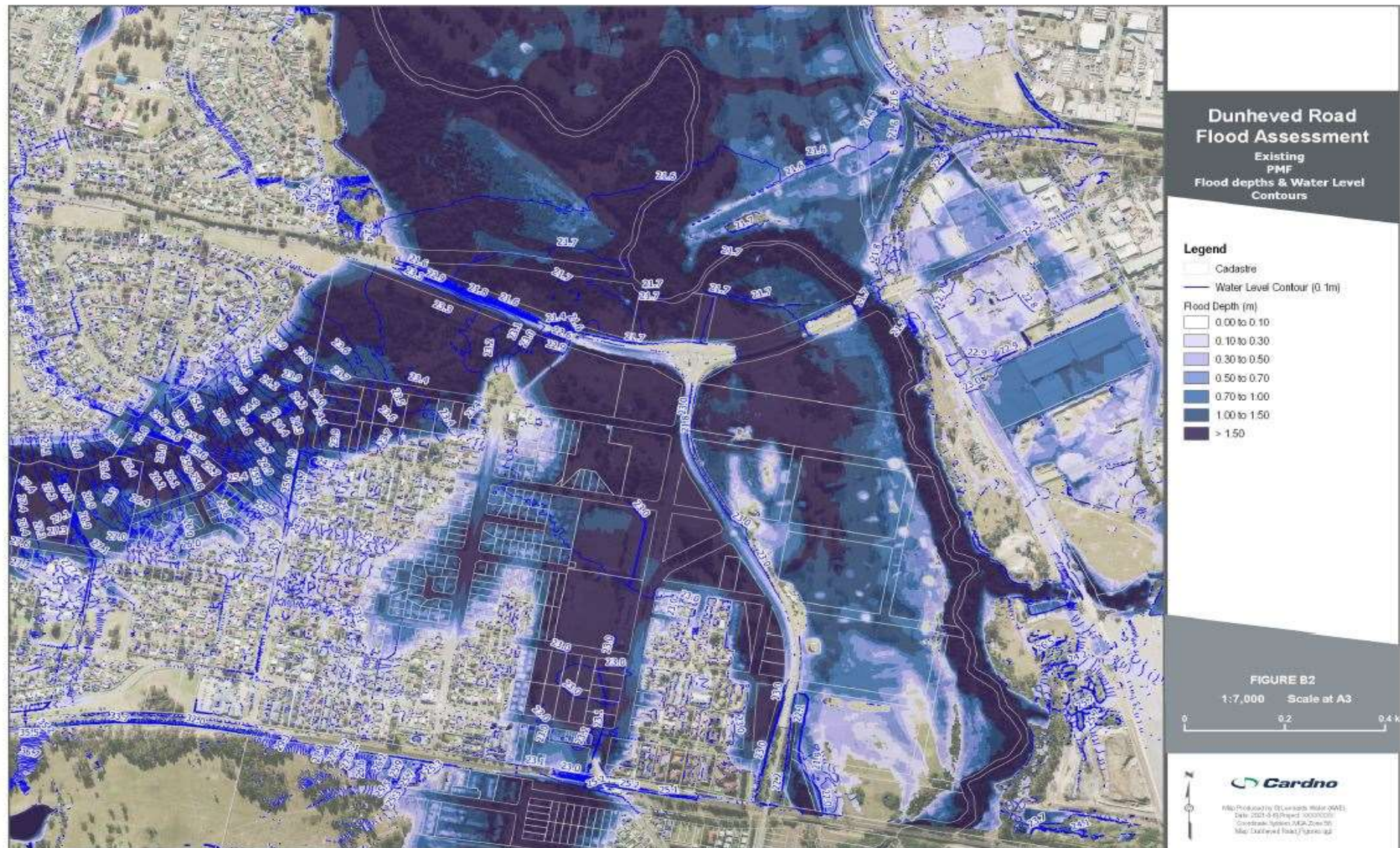


Figure 6-8 Existing PMF flood depth modelled for Werrington Creek (Source: Cardno 2021b)

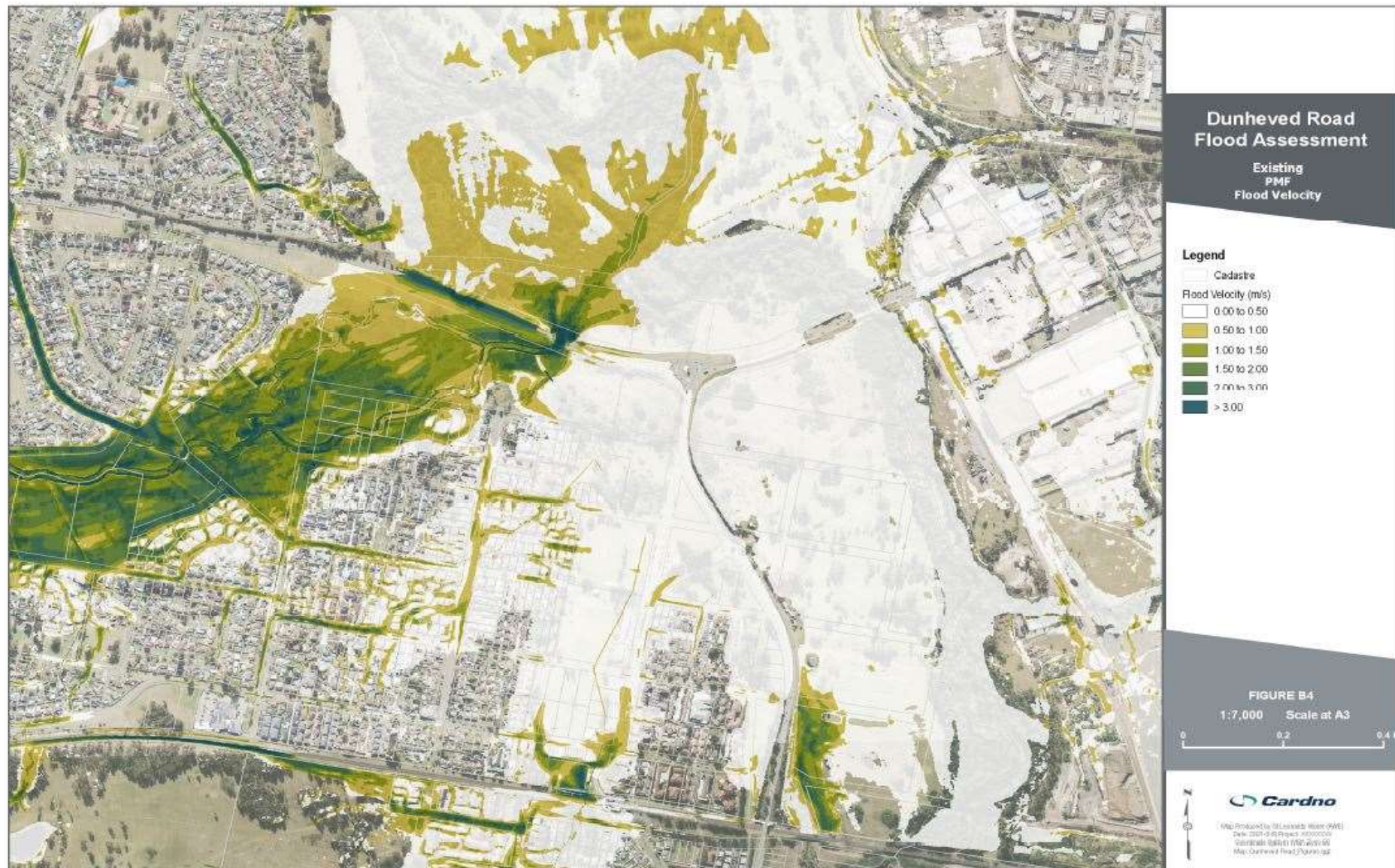


Figure 6-9 Existing PMF flood velocity modelled for Werrington Creek (Source: Cardno 2021b)

6.4.2 Potential Impacts

6.4.2.1 Construction Phase

Construction activities that have the potential to impact on water quality include:

- > Stripping vegetation and topsoil including the removal of riparian vegetation
- > Stockpiling topsoil, excavated material and vegetation waste and other construction materials
- > Earthworks movements, haul roads and lay down yard boundaries including vehicle and plant movements on exposed surfaces
- > Upgrade works on culverts and draining systems along the road verge
- > Removal of pavement
- > Oils, fuels and other chemical spills and leaks from vehicles, plant and equipment, incorrect storage or incorrect usage
- > Leaching of metals into water systems from the reuse of soils from stockpiles

The potential impacts to water quality arising from these construction activities would include:

- > Erosion and sedimentation that may results in sediment laden runoff flows into Werrington Creek and South Creek catchments.
- > Pollution of water from construction activities, construction materials and spills of liquids such as diesel, machinery oils and unleaded petrol
- > Increased levels of turbidity, nutrients, metals and other pollutants transported via sediment reducing overall water quality at receiving environments

Earthworks can also impact on groundwater stores however due to the shallow depth of excavation that is expected from the works it is not anticipated that groundwater will be encountered or impacted by the works.

The flood modelling undertaken for the proposed Dunheved Road upgrade in the vicinity of Werrington Creek shows a small increase in flood levels in Werrington Creek upstream of Dunheved Road (25mm for the 1% AEP and 45mm for the PMF event) compared to the existing flood conditions. The change in the velocity downstream of the bridge is also small.

The Werrington Creek model shows that properties south east of the bridge are already at risk of flooding in the 1% AEP event and the impact of the bridge construction does not appear to result in any new flood impacts to properties that are not currently impacted.

Overall the results show that there is a negligible change in the flood extents when comparing existing flood modelling conditions with those modelled for the proposed works.

Differences in water level and velocities between the existing and proposed conditions for 1% AEP and PMF are shown in Figure 6-10, Figure 6-11, Figure 6-12 and Figure 6-13.

6.4.2.2 Operational Phase

During the operation of the proposal the potential impacts to water quality could include:

- > Pollutants such as heavy metals, hydrocarbons, gross pollutants and nutrients accumulation on the new road surface from passing traffic, atmospheric deposition and wind deposition. These pollutants may get washed off by stormwater runoff and transported into the nearby creek system.
- > Large spills of hazardous substances from traffic incidents involving vehicles carrying hazardous substances. The spilt substances can enter the drainage system or the creek lines and find their way into the bay.
- > Upgrades to the existing drainage system on Orleton Street will have improvements on surface water runoff within the area.
- > Steep incline along the ridge at the eastern end of the Study Area and down into Werrington Creek may exacerbate the risk of accelerating flows and causing erosion along the creek line



Figure 6-10 Difference in water level for 1% AEP when comparing proposed flood conditions with existing flood conditions for the area of Werrington Creek that crosses the eastern end of the Study Area (Source: Cardno 2021b)



Figure 6-11 Difference in velocity for 1% AEP when comparing proposed flood conditions with existing flood conditions for the area of Werrington Creek that crosses the eastern end of the Study Area (Source: Cardno 2021b)

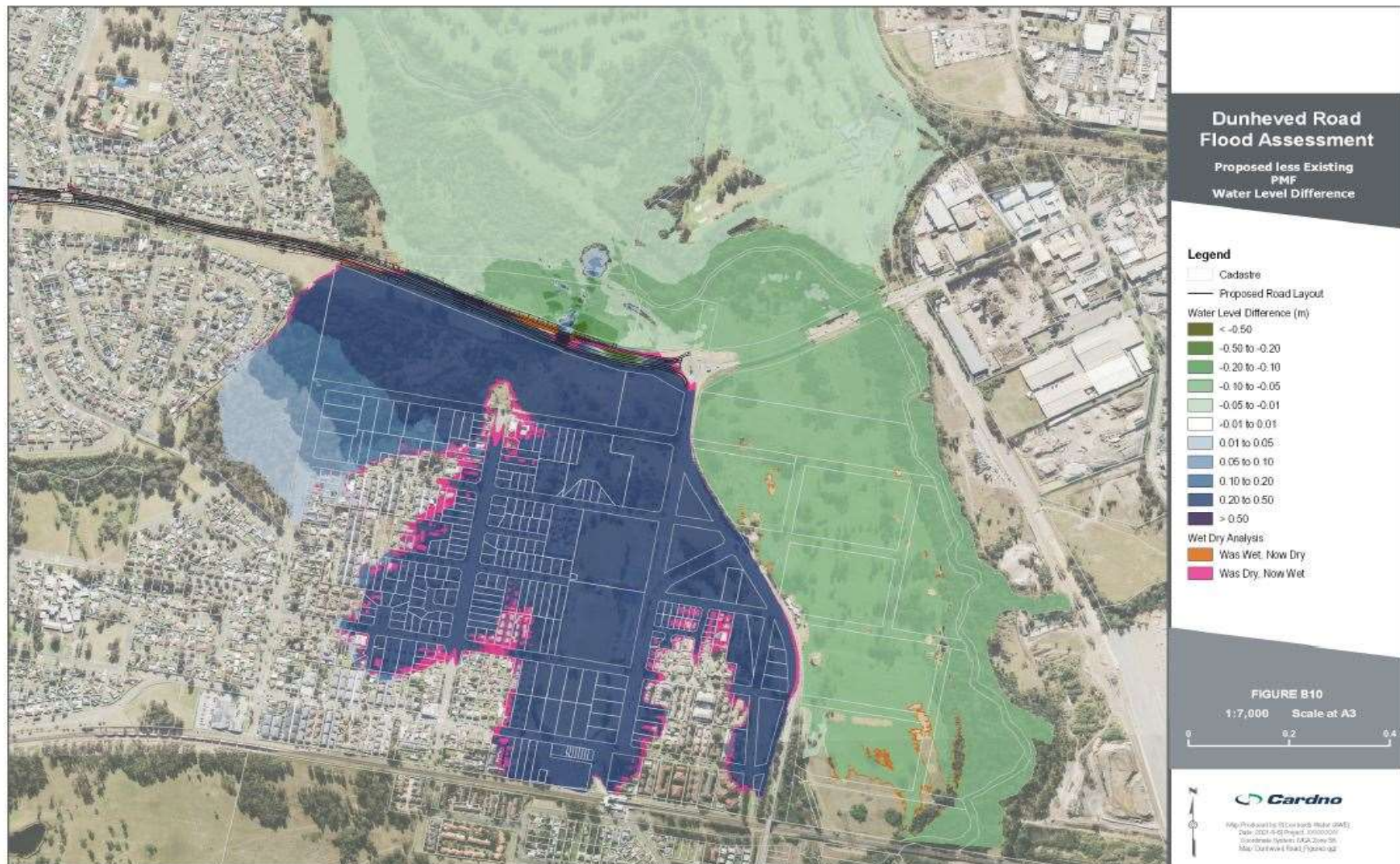


Figure 6-12 Difference in water level for PMF when comparing proposed flood conditions with existing flood conditions for the area of Werrington Creek that crosses the eastern end of the Study Area (Source: Cardno 2021b)

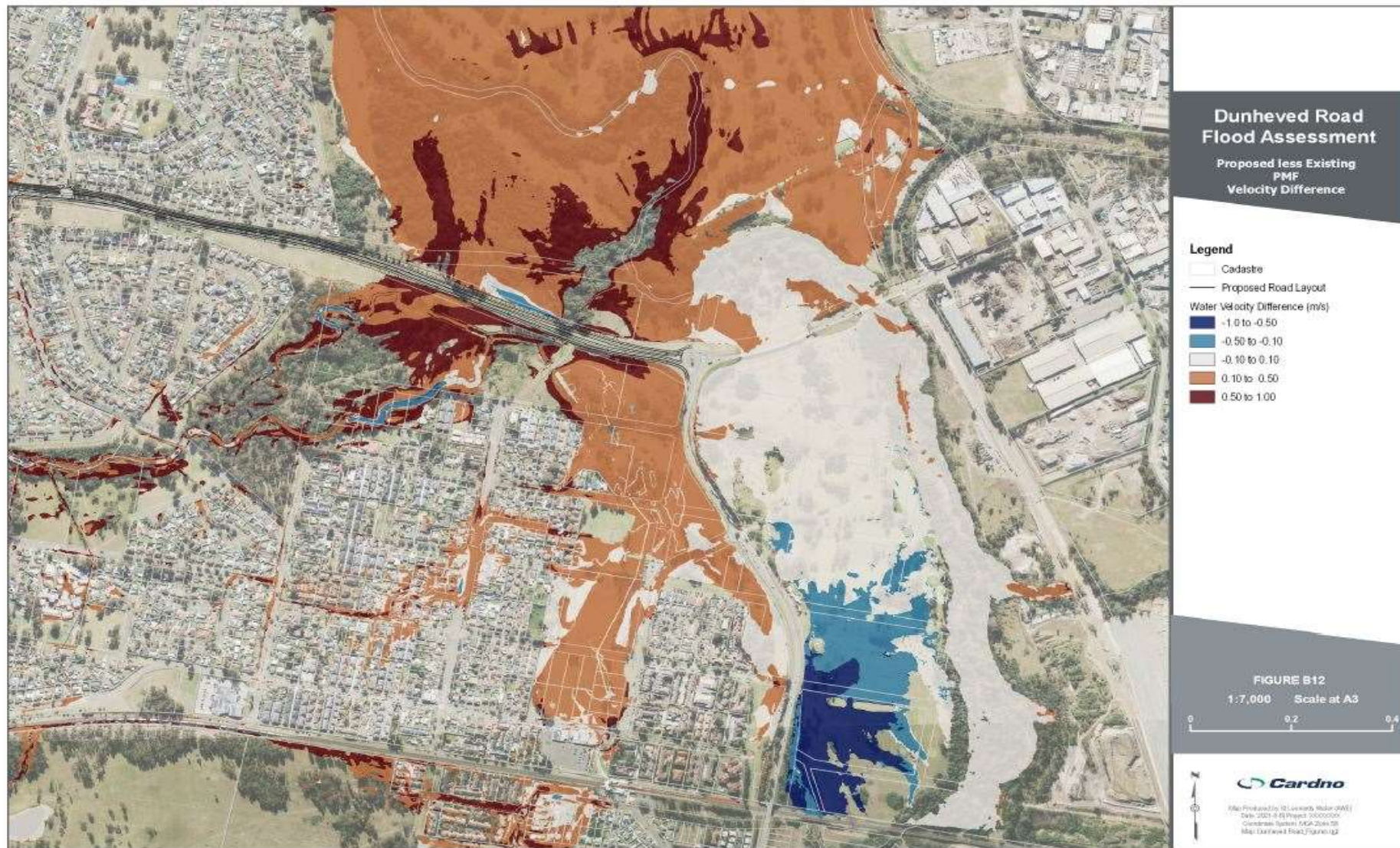


Figure 6-13 Difference in velocity for PMF when comparing proposed flood conditions with existing flood conditions for the area of Werrington Creek that crosses the eastern end of the Study Area (Source: Cardno 2021b)

6.4.3 Mitigation Measures

Mitigation measures to manage the impacts of construction on hydrology and flooding are presented in Table 6-17.

Table 6-17 Mitigation measures for hydrology and flooding

ID	Impacts	Safeguards	Responsibility	Timing
HF1	Water quality	<ul style="list-style-type: none"> A site-specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of Soil and Water Management in the CEMP. The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather To prevent surface water contamination during the construction of Werrington Creek Bridges suitable ESC devices should be deployed to prevent contamination of the waterway, Once the bridges are operational filters and oil traps should be incorporated into the design to intercept hydrocarbons from entering Werrington Creek. Do not store equipment and materials within proximity to the watercourse A spill response plan would be developed and incorporated in the CEMP. This plan would detail measures for the prevention, containment and clean-up of accidental spills of fuels and chemicals Any spills with the potential for material harm to the community or environment will be notified to the EPA 	Contractor	Pre-construction/ construction
HF2	Groundwater	The contractor is to develop a groundwater management procedure as part of the CEMP detailing methodologies and management measures in case of groundwater interception during construction works.	Contractor	Pre-construction/ construction
HF3	Flooding	<ul style="list-style-type: none"> Detail design to ensure no change to the wider stormwater system in the locality and no changes to flooding Adequate drainage systems to be developed and implemented to alleviate runoff capabilities especially for the new bridge structures 	Designer	Pre-construction

6.5 Air Quality and Climate

6.5.1 Existing Environment

The project is being undertaken in an urban residential area within an existing road network. Sources of air pollution in the Study Area are likely to include emissions from vehicles using local and arterial roads, emissions from petrol stations located within the Study Area and surrounds and emissions from residential land use and airborne dust. The existing ambient air quality of the study area is heavily influenced by road traffic emissions, typically comprising oxides of nitrogen (NO_x), oxides of sulphur (SO_x) and particulate matter (PM).

Climate data for the project area was obtained from Penrith Lakes AWS (station number 067113) which is located approximately 5km north west of the Study Area. Climate statistics from the BoM website show that average daily maximum temperatures in this location range from 18°C in July to 31.2°C in January, whilst average daily minimum temperatures range from 5.3°C in July and 18.7°C in January (BoM, 2021). The wettest period for the area is between January and March, with the highest average monthly rainfall recorded in February (122.1mm). The driest period of the year on average is between July and September, with the lowest average monthly rainfall recorded in July (29.8mm) (BoM, 2021).

The average annual wind speed for Penrith Lakes in the morning (9am) is 8.8 km/h and for the afternoon (3pm) is 15.2 km/h. The average monthly wind speeds for the morning and afternoon conditions are the greatest between September and November. During the mornings it is calm 14% of the time with wind direction predominately coming from a north or south direction (Figure 6-14). During the afternoons, winds are stronger with calm conditions only 1% of the time. The strongest winds come in from a west to north west direction (Figure 6-15).

9 am
9196 Total Observations

Calm 14%

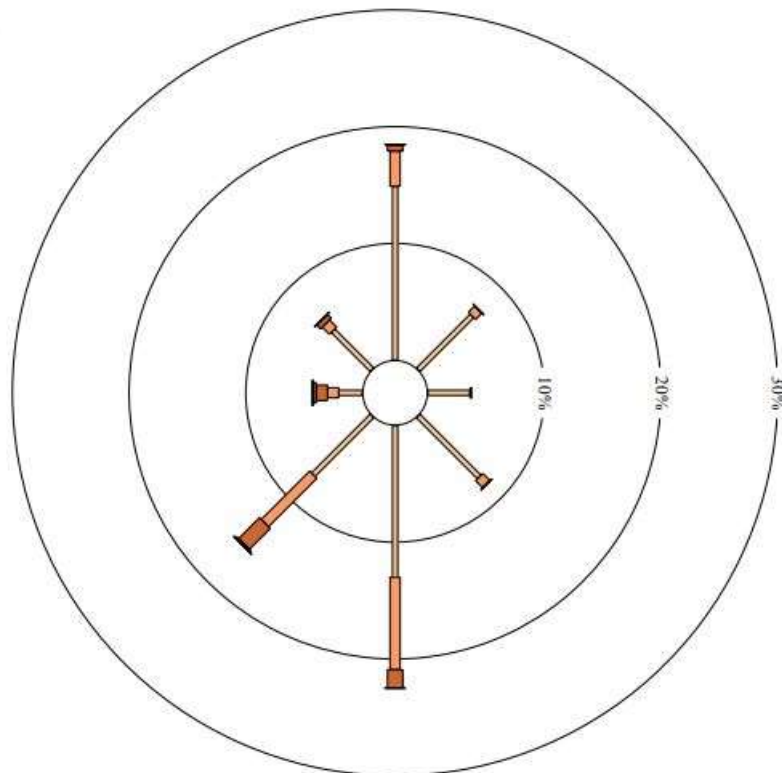


Figure 6-14 Wind rose from Penrith Lakes station (AM)

3 pm
9185 Total Observations

Calm 1%

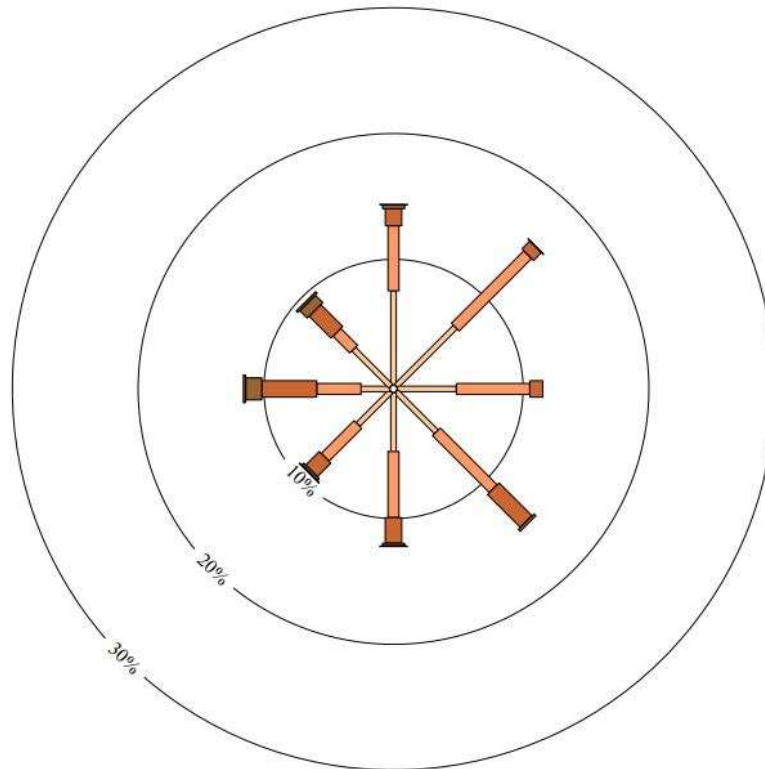


Figure 6-15 Wind rose from Penrith Lakes (PM)

There are various air quality monitoring stations operated by the NSW EPA around the northwest of Sydney. Parramatta North, Penrith, Prospect, Richmond, Rouse Hill, St Marys and Vineyard. The closest monitoring station to the site is the Penrith air quality monitoring station which is located on the corner of Laycock Street and Shelbourne Place in Cranebrook, approximately 2km north west from the eastern end of the Study Area.

Air quality data for the monitoring station in Penrith indicates that daily results (between January 2021 and June 2021) for particulate matter less than 10 µm in diameter (PM10), nitrogen dioxide (NO2) and sulphur dioxide (SO2) were identified as being 'good' (DPIE, 2021). No measurements during this time period were recorded over the maximum concentration standards for each of the pollutants as described in the National Environment Protection (Ambient Air Quality) Measure (NEPM) (NEPM 2003) and shown in Table 6-18.

Table 6-18 NEPM maximum concentration standards for pollutants.

Pollutant	Averaging period	Maximum concentration
Nitrogen dioxide	1 hour	0.12 ppm
	1 year	0.03 ppm
Photochemical oxidants (as ozone)	1 hour	0.10 ppm
	4 hours	0.08 ppm
Sulfur dioxide	1 hour	0.20 ppm
	1 day	0.08 ppm
	1 year	0.02 ppm
Particles as PM10	1 day	50 µg/m3

Air quality (including dust) can lead to a range of health and nuisance-related issues. This can include mild to severe respiratory illnesses (i.e., allergies, asthma and bronchitis), through to nuisance issues such as dust-deposition on washing, window and cars. As such, it is reasonable to consider properties in the vicinity of the works as sensitive receivers. These are taken to be the same receivers as those discussed in the Noise Chapter in Section 6.2.

6.5.2 Potential Impacts

6.5.2.1 Construction Phase

Potential impacts from construction are most likely present as increased dust emission and vehicle emissions. Air quality impacts as a result of increased dust emissions are expected to be minor as they would be temporary for the duration of the construction phase which will be staged to minimise overall impacts of the project. Activities that are likely to cause increased dust emissions include:

- clearing vegetation
- earthworks
- vehicle movement over unsealed paths/roads
- striping, stockpiling and managing topsoil
- Transportation and handling of soils and materials loading and movement of spoil materials.

The total amount of dust would depend on the silt and moisture content in the soils, prevailing weather conditions and the types of activities that are being carried out. The geotechnical investigation did find that the characteristics in soils sampled in shallow boreholes were nondispersive (Cardno 2021a).

Increase in vehicle emissions would be a result of exhaust fumes from construction vehicles, motor vehicles and from plant equipment being used on site.

Depending on wind speed and direction, short-term impacts could be experienced at all nearby sensitive receivers. Nuisance dust can be expected to impact on residential and commercial areas. The generation of dust associated with the works is expected to be below nuisance levels through the implementation of appropriate mitigation measures.

During the application of asphalt and line marking, odours may be generated that impact adjacent residential areas or users open space areas. These impacts would be limited to the duration of certain activities during construction and no long-term odour impacts would result from the proposal.

6.5.2.2 Operational Phase

Potential impacts to air quality during the operational phase would be associated with exhaust emissions of vehicles using Dunheved Road and associated intersections.

The project has been implemented to deal with traffic along Dunheved Road, especially during peak hours and to prepare the road for increased usage in the future. The proposal would contribute to reduced congestion along Dunheved Road, in turn contributing to less traffic congestion and lower numbers of idling cars along the road which can be a source of increased emissions. This will have immediate short-term positive impacts on air quality.

However, long term, based on traffic counts and modelling carried out by SMEC (2022) it is anticipated that the numbers of vehicles on Dunheved Road will increase substantially in the future, however this would likely increase regardless of the proposed works due to population and growth projections. Therefore, increased emissions cannot be linked directly to the proposed upgrades of Dunheved Road and rather to growth and development in surrounding areas.

6.5.2.3 Mitigation Measures

Mitigation measures to manage the impacts of construction on air quality and climate are presented in Table 6-19.

Table 6-19 Mitigation measure for air quality impacts

ID	Impact	Safeguards	Responsibility	Timing
AQ1	Air Quality	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include measures to address potential risks to air quality arising from the works and will include, but not be limited to the following:</p> <ul style="list-style-type: none"> • Air quality management objectives to be consistent with relevant EPA guidelines 	Contractor	Pre-construction / construction

ID	Impact	Safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> Measures to minimise dust on site such as covering or watering exposed areas to suppress airborne particles Not carrying out dust generating activities during strong winds or other adverse weather conditions; Vehicles transporting waste, fill or other materials to be covered during transportation; and Management of stockpiled materials. 		
AQ2	Vehicle emissions	<ul style="list-style-type: none"> Construction plant and equipment will be maintained in good working condition to limit impacts on air quality Where practicable vehicles will be fitted with pollution reduction devices and will be switched off when not in use. 	Contractor	Construction

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6.6 Non-Aboriginal Heritage

Historical archaeological potential is defined as the potential of a study area/proposal site to contain historical archaeological relics, as classified under the *Heritage Act 1977*.

The significance of an item or potential archaeological site can be assessed as being of local or State significance in relation to a place, building, work, relic, moveable object or precinct, means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item.

6.6.1 Existing Environment

Historically, Werrington County/Downs and the adjacent St Mary's were industrial areas including tanneries and munitions factories with surrounding open agricultural areas. The unoccupied Australian Defence Industries munitions site is to the north of Werrington County and is noted as being a largely undeveloped area which retains remnants of infrastructure such as bunkers and buildings of the World War II factory (PC History 2022).

Werrington House, originally owned by the daughter of the Governor King (in office 1800 -1806) located to the south of Dunheved Road was the original house on the expansive Werrington estate (PC History 2022). Cambridge Gardens/Park are residential areas adjacent to Dunheved Road that were originally subdivided from a much larger estate in the 1880s (PC History 2022).

Desktop searches were undertaken of historic registers to understand if any places/sites of historical significance occur within or near the study area. The Australian Heritage Database was searched on 8 June 2021 to identify any items of Commonwealth heritage significance that may occur in or near the project area.

The Australian Heritage Database contains listings for the World Heritage List, Commonwealth Heritage List and the Register of the National Estate (non-statutory archive). One item listed on the Register of the National Estate (non-statutory archive) was found within 500 metres of the Study Area. This item is shown in Table 6-20.

The results from the EPBC PMST search (see Table 4-8) show two Commonwealth heritage sites within a 5 km radius of the Study Area however these would not be impacted by the works.

The State Heritage Inventory was searched on 8 June 2021 to identify any items of state heritage significance that may occur in or near the project area. The State Heritage Inventory contains listings for the State Heritage Register and the Section 170 NSW State Agency Heritage Register. There are no items listed on the State Heritage Register or Section 170 NSW State Agency Heritage Register located near the Study Area.

Local heritage items are listed under Schedule 5 of the *Penrith City Council Local Environmental Plan* (Penrith LEP) 2010. Only one heritage item was found within 500 metres of the Study Area. This item is shown in Table 6-20.

Table 6-20 Heritage Sites listed within the vicinity of the Study Area

Item Name	Address	Lot Number	Significance	Listing	Proximity to Study Area
Werrington House ¹ , dwelling, driveway and garden	108 Rugby Street, Werrington County	Lot 101, DP 605907	National and Local	Register of the National Estate (non-statutory archive) Penrith LEP (Item no. 248)	Approximately 270m south of the shopping village on Dunheved Road

6.6.2 Potential Impacts

6.6.2.1 Construction Phase

As the number of heritage listings within the vicinity of the study are limited to one site that is located outside of the both the study area and the construction boundary, no short term or long-term impacts to items of heritage significance or sites of heritage potential are likely to occur.

The local and national significant heritage listed site, Werrington House, is located at the end of a long driveway on Rugby Street. The curtilage of the heritage site includes the dwelling, the driveway and gardens is shown in Figure 6-18. The Dunheved Road upgrades are approximately 270 m north from the boundary of the heritage site, and the Rugby Street drainage works are 200 m from the outer boundary of the heritage site. Due to this distance, and temporary nature of the works, it is not anticipated that the heritage place will be impacted by noise and vibration from construction work or visually impacted by the proposed upgrades and drainage works.

There is the potential for minor noise and vibration impacts from the movement of construction traffic along Rugby Street during the construction phase however these will be temporary in nature and unlikely to have material impact on the heritage dwelling and surrounds, considering the set back of the house in relation to the road.

Accidental discovery protocols will be implemented in the event that any unexpected heritage items, archaeological remains or potential relics are encountered.

Overall, construction impacts to non-Aboriginal heritage are expected to be neutral/minor and any minor impact to the heritage site of Werrington House associated with construction works/traffic on Rugby Street, would be offset by the long-term benefits by improving road safety conditions and increasing capacity for the future growth of the area.

6.6.2.2 Operational Phase

The operation of the proposal would not impact non-Aboriginal or archaeological heritage.

6.6.3 Mitigation Measures

Mitigation measures to manage the impacts of the proposal on non-Aboriginal heritage are presented in Table 6-21.

Table 6-21 Mitigation measures for impacts on non-Aboriginal heritage

ID	Impact	Safeguards	Responsibility	Timing
H1	Previously unidentified heritage sites or places discovered	An unexpected finds protocol will be developed and implemented under the CEMP to manage the risk of unexpected archaeological finds. If the works uncover any items of suspected heritage significance, all activity in the immediate area must cease and Council	Contractor	Pre-construction / construction

ID	Impact	Safeguards	Responsibility	Timing
		<p>A qualified archaeologist is to be contacted to assess the situation and consult with Heritage NSW and/or DPE regarding the most appropriate course of action.</p> <p>Where the find comprises human remains, NSW Police must be contacted in the first instance.</p>		

6.7 Aboriginal Heritage

An Aboriginal Due Diligence Assessment was prepared by Austral Archaeology (Austral 2021). The findings of the assessment are summarised in this chapter. A copy of the report is provided in Appendix H.

6.7.1 Methodology

Under Section 87 of the *National Parks and Wildlife Act 1974* (NPW Act) it states that it is a liability offence to knowingly or unknowingly harm Aboriginal objects or declared Aboriginal places without an Aboriginal Heritage Impact Permit (AHIP). The NPW Act allows for a person or organisation to exercise due diligence to determine if an action will or is likely to have an impact on any Aboriginal objects or places. In the case that an activity is likely to cause harm consent in the form of an AHIP is required. The Aboriginal Cultural Heritage Due Diligence Advice was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (the Code) (DECCW, 2010a) which was adopted under the *National Parks and Wildlife Regulation 2009* (NPW Regulation). The Code sets out the reasonable and practicable steps which individuals and organisations need to take in order to:

- > Identify whether Aboriginal objects are, or are likely to be, present within the study area.
- > If Aboriginal objects are, or are likely to be present, determine whether their activities are likely to cause harm.
- > Determine whether further assessment or an AHIP application is required for the activity to proceed.

A desktop study and archaeological survey were conducted by Austral to identify if any Aboriginal objects or places are present or likely to be present within the Study Area. Listed Aboriginal sites within and in the vicinity of the Study Area were identified through an extensive search of the Aboriginal Heritage information Management System (AHIMS) database.

A visual inspection of the Study Area was undertaken on 10 June 2021 by an Austral Archaeologist and the CEO of the Deerubbin Land and Aboriginals Council (LALC). A further site inception was conducted on 21 October 2021 to survey the 3 locations for the new roundabouts. The visual inspection was conducted via foot and consisted of a systematic survey of the Study area to identify and record any Aboriginal archaeological sites visible on the surface or areas of Aboriginal archaeological potential and cultural sensitivity (Austral 2021).

6.7.2 Aboriginal History

Aboriginal occupations of the Cumberland Plain and Nepean River valley extends back to the Pleistocene, around 10,000 years before present. Currently the oldest accepted date for an archaeological site in the Sydney region is about 14,700 years before present which was obtained from Shaws Creek rock shelter K2 located north of Penrith, not far from the Study Area (Austral, 2021).

The Study Area lies on the boundary of two Aboriginal groups, the Mulgoa and the Boorooberongal, who both belong to the wider Dharug language group. The pre-contact population numbers for the Study Area are unknown but were estimated to be between 500-1000 people.

Following European settlement in the years between 1794-1816 tensions between Aboriginals and Europeans in the area rose due to increased farming along the Hawkesbury River which replaced areas of natural resources for the Dharug people. Aboriginal populations slowly started to decimate through disease and encounters with Europeans and by 1828 the census recorded only 150 natives living in the Penrith Area. Those who survived were pushed out to the fringes of white settlements who occupied the fertile and productive areas (Austral, 2021).

6.7.3 Existing Environment

The results of the extensive AHIMS search conducted on 13 June 2021 identified that there are 118 Aboriginal archaeological sites within an 8 km of the Study Area which are summarised in Table 6-22.

Table 6-22 AHIMS sites within 8km of the Study Area (Austral 2021)

Site Type	Occurrence	% of total
Artefact	64	54.2
Artefact + Potential Archaeological Deposit (PAD)	12	10.2
Isolated find	12	10.2
Open Camp Site	29	24.6
PAD	1	0.8
Grand Total	118	100

Based on the results of the AHIMS search (shown in Figure 6-16), none of the identified sites were located within the Study Area. The closest site (WD-72, AHIMS #45-5-0711) was located 470m north from the central part of the Study area and contained seven stone artefacts. Majority of sites identified in the AHIMS search were located to the north of the Study area around Wainamatta Regional Park. The most likely type of site to occur within the Study Area are artefacts, followed by open camp sites or artefacts with potential archaeological deposits (PADs) (Austral 2021). The archaeological potential of the site was determined to be low.

Historical aerial imagery shows evidence of land disturbance in the Study Area and the cultural history provided during the site inspection by the Deerubbin LALC indicated that the Study Area has been significantly modified. The Deerubbin LALC has reviewed the final assessment report and have provided a letter (March 2022) confirming the conclusions are consistent with their understanding of the project and impacts to Aboriginal cultural heritage (also provided in as part of the assessment in Appendix H).

6.7.4 Potential Impacts

6.7.4.1 Construction Phase

Earthworks and site preparation during the construction phase will have impacts on landscape features which may potentially contain Aboriginal objects. While large portions of the Study Area have already been highly disturbed there are less disturbed areas that are unable to be avoided during the development of the road.

Austral developed a series of predictive statements to indicate the type and character of Aboriginal cultural heritage sites likely to exist in the Study Area and where they are most likely to be located. These statements indicated that:

- > Isolated artefacts and artefact scatter sites are the most common archaeological site type to be found.
- > Most sites are located within 100 metre of water sources.
- > Level, raised areas, safe from flooding nearby waterways are likely to be locations of repeated occupation.
- > Burial areas are unlikely to occur due to their general rarity in the area.
- > Scarred trees are unlikely to be present due to the study area having been fully cleared in the period of European occupation.
- > Grinding grooves and engraving sites are unlikely to be present due to lack of suitable requirements (i.e. fine grained, level sandstone platforms).
- > Ceremonial grounds are exceedingly rare in this part of NSW, but in the unlikely event the Study Area was used as a ceremonial ground, this is unlikely to be identified archaeologically due to the Study Area being cultivated.
- > Quarries occur near outcrops on or near ridgelines, spurs and sometimes near creeks or waterways. No ridgelines or spurs are present within the Study Area, and no stone outcrops were found during the survey near the creek. As such, quarries are unlikely to be present within the Study Area.
- > Midden sites are unlikely to be present as the creek does not contain species known to be exploited as a food source at this location.

Overall, the assessment conducted by Austral concluded that further assessment is not warranted and that the project may proceed with caution as long as the recommendations by Austral are adhered to.

6.7.4.2 *Operational Phase*

No impacts to Aboriginal heritage are expected during the operational phase.

DRAFT

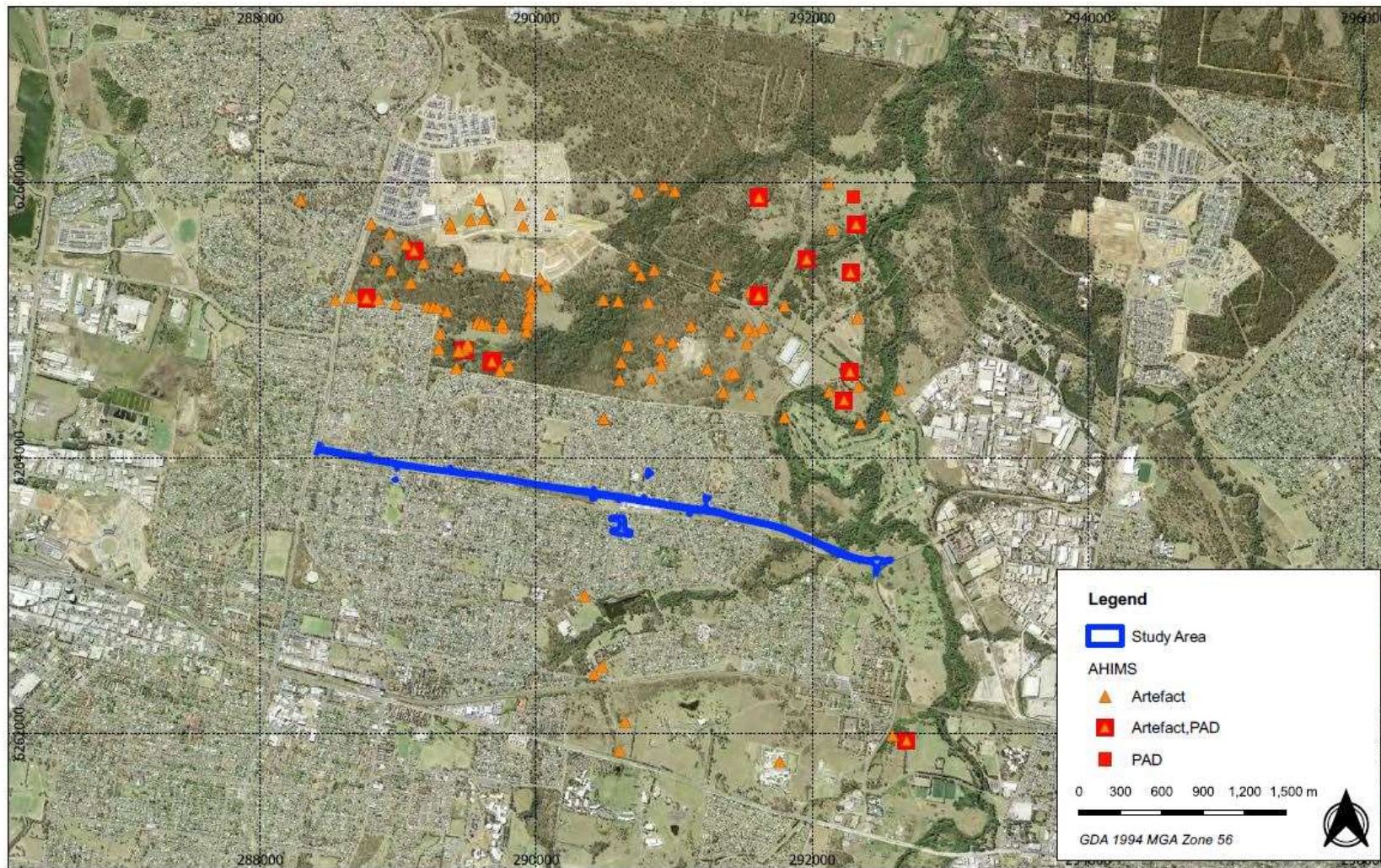


Figure 3 - AHIMS in relation to the study area

21063 - Dunheved Road - ACHDDA

Source: NSW LPI Aerial

Drawn by: ARH Date: 2021-11-08



Figure 6-16 AHIMS search results (Source: Austral 2021)

6.7.5 Mitigation Measures

Mitigation measures to manage the impacts of the proposal on Aboriginal heritage are presented in Table 6-23.

Table 6-23 Mitigation measure for impacts on Aboriginal heritage

ID	Impact	Safeguards	Responsibility	Timing
AH1	Aboriginal Heritage	<p>Personnel, contractors and subcontractors should be made aware of all statutory obligations for Aboriginal cultural heritage under the National Parks and Wildlife Act 1974 and the Heritage Act 1977.</p> <p>Aboriginal heritage awareness training must be provided for all contractors and personnel prior to commencement of construction to outline the identification of potential heritage items and associated procedures to be implemented in the event of the discovery of Aboriginal heritage materials, features or deposits (that is, unexpected finds), or the discovery of human remains</p>	Contractor	Pre-construction/construction
AH2	Unexpected finds of Aboriginal objects or places	<p>Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying Heritage NSW and Aboriginal stakeholders.</p>	Contractor	Construction
AH3	Unexpected finds of Aboriginal ancestral remains	<p>Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity, you must:</p> <ul style="list-style-type: none"> immediately cease all work at that location and not further move or disturb the remains notify the NSW Police and Heritage NSW's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location not recommence work at that location unless authorised in writing by Heritage NSW. 	Contractor	Construction

6.8 Biodiversity

A Biodiversity Assessment Report (BAR) was prepared by Cardno now Stantec (Cardno, 2022c). The findings of the assessment are summarised in this chapter. A copy of the report is provided in Appendix I. This report considered:

- The significance of any impact on any threatened species, ecological communities or endangered populations listed under the BC Act and/or FM Act, and therefore whether a Species Impact Statement or a Biodiversity Development Assessment Report is required; and/or
- The potential for significant impacts on Matters of National Environmental Significance (or Commonwealth land) subject to the Commonwealth EPBC Act, and the need to make a referral to the Commonwealth DCCEEW or whether assessment and approval is required under the EP&A Act.

6.8.1 Assessment Methodology

6.8.1.1 Desktop Review

The following databases and maps were reviewed for biodiversity attributes within the Study Locality (i.e a 5 km radius around the Study Area):

- > NSW BioNet (NSW OEH, 2021a);
- > Threatened Biodiversity Data Collection (NSW DPIE, 2021);
- > Fish communities and threatened species distribution of NSW (NSW DPI, 2016);
- > Threatened species lists (NSW DPI, 2021a);
- > Listed Protected Fish Species (NSW DPI, 2021a);
- > The Native Vegetation of the Sydney Metropolitan Area – Version 3.1 VIS_ID 4207 (NSW DPIE, 2013, Tozer 2010);
- > Mapping the habitats of NSW estuaries (Creese, Glasby, West, & Callen, 2009);
- > Protected Matters Search Tool (PMST) (DoEE, 2021);
- > Atlas of Living Australia (Atlas of Living Australia, 2021);
- > NSW WeedWise (NSW DPI, 2021);
- > NSW Aquatic Pest and Disease Distribution (NSW DPI, 2019c); and
- > Map of marine pests in Australia (Australian Government, 2019).

A minimum search area of 5 km was undertaken for the majority of the database and map searches.

The desktop review also identified any sensitive ecological sites (e.g. Commonwealth Marine Parks, NSW, Marine Parks, NSW Aquatic Reserves, wetlands) and other areas protected by Commonwealth, State and local environmental planning instruments (EPIs) due to their ecological significance. Sources included:

- > Areas of Outstanding Biodiversity Value (AOBV) listed under the BC Act;
- > Critical habitat listed under the FM Act;
- > Critical habitat listed under the EPBC Act;
- > Key Fish Habitat (KFH) maps (NSW DPI, 2019e);
- > Australian Marine Parks map (Parks Australia, 2019);
- > NSW National Parks map (NSW National Parks and Wildlife Service, 2019);
- > Australian Ramsar Wetlands map (DoEE, 2019b);

6.8.1.2 Site Inspection

Four site inspections were undertaken as follows:

- > Site inspection 1 (23 - 24 September 2021). Details include:
 - > The biodiversity Study Area was 18.26 ha and included a 20 m buffer around the project footprint.

- > Vegetation mapping as per existing government databases were used as base to ground-truth vegetation within the Study Area. The existing vegetation map included the Vegetation Map – Cumberland Plain West (VIS 4207) map. Prior to site inspection, the existing vegetation map and Study Area boundary were created in ArcMap 10.7 and in the ESRI app Collector into a hand-held tablet.
- > A random meander transect (RMT) across the Study Area to verify:
 - Presence of native vegetation as Plant Community Types (PCTs). Current extent of PCTs were mapped in Collector using a hand-held tablet;
 - Identifying fauna habitat features and collecting opportunistic sightings of flora and fauna. Where suitable habitat occurred, searches for threatened flora and the CPLS were undertaken;
 - Assessing presence and condition of aquatic habitat features. A qualitative habitat assessment was undertaken where Dunheved Road crosses Werrington Creek.
- > Site Inspection 2 (12 January 2022). Undertook two detailed vegetation plots (BAM plots) in Cumberland Plain Woodland within the Study Area. Vegetation plot datasheets are provided in Appendix C of the BAR report attached in Appendix I.
- > Site Inspection 3 (23 February 2022). Undertook targeted surveys for CPLS in selected areas.
- > Site Inspection 4 (18 March 2022). Ground-truthed additional area for Construction Boundary.
- > Initial Surveys (26, 27 and 30 May 2022). BAM plots and bird surveys.

6.8.2 Existing Environment

6.8.2.1 Terrestrial Environment

The Study Area consisted predominantly of cleared land, roads and road reserves with exotics. Native vegetation included planted natives (e.g., in road reserves), remnant native vegetation and paddock trees. Native vegetation recorded consisted of two PCTs, PCT 849 and PCT 835 in differing conditions (see Table 6-24). Ground-truthed vegetation is shown in Figure 6-17 to Figure 6-21.

Table 6-24 Vegetation Communities within the Study Area

PCT ID	PCT Name	Condition	Description	Construction Boundary Area (ha)
Native Vegetation				
849	Cumberland Shale Plains Woodland	Moderate	Open woodland with canopy and ground layer, sparse shrubs. Species present included <i>Eucalyptus molucana</i> , <i>Eucalyptus</i> sp. (regrowth stems <10 cm DBH ¹), <i>Eragrostis</i> sp., <i>Bursaria spinosa</i> , <i>Exocarpos curpressiformis</i> , <i>Dodonaea viscosa</i> , <i>Dillwynia sieberi</i> , <i>Themeda triandra</i> , <i>Diannella caerulea</i> , <i>Lomandra multiflora</i> and <i>Dichondra repens</i> . Exotic species present included <i>Araujia cericifera</i> , <i>Asparagus aetiopicus</i> , <i>Plantago lanceolata</i> , <i>Sida rhombifolia</i> , <i>Bidens pilosa</i> , <i>Senna pendula</i> , <i>Bryophyllum delagoense</i> , <i>Asparagus asparagoides</i> and <i>Verbena bonariensis</i> .	0.01
849	Cumberland Shale Plains Woodland	Low - Moderate	Open woodland with canopy and ground cover composition similar to above, however, the shrub component was dense and mainly consisting of <i>Bursaria</i> .	0.14
849	Cumberland Shale Plains Woodland	Low	Open woodland with remnant canopy and dominance of exotic species in the ground cover. African Lovegrass (<i>Eragrostis curvula</i>) dominates the ground cover.	0.47

¹ DBH = Diameter at Breast Height (cm) measured at 1.3m above ground level.

PCT ID	PCT Name	Condition	Description	Construction Boundary Area (ha)
849	Remnant Trees - Cumberland Shale Plains Woodland	Remnant Trees	Patch of remnant trees were areas located in cleared land with no native shrub and ground layer, but with native trees whose canopies were touching or were within 50m of each other. Native trees which are part of the Cumberland Shale Plains Woodland included <i>Eucalyptus molucana</i> , <i>Eucalyptus tereticornis</i> and <i>Angophora floribunda</i> .	0.72
835	Cumberland Riverflat Forest	Low - Moderate	Open forest with <i>Angophora floribunda</i> as the main canopy component, incidences of <i>Eucalyptus molucana</i> and <i>Eucalyptus tereticornis</i> . Native shrub layer included <i>Bursaria spinosa</i> , the native ground layer was sparse including <i>Dichondra repens</i> . Exotics were dominant in the shrub and ground layer, species included <i>Ligustrum sinense</i> , <i>Tradescantia fluminensis</i> , <i>Sida rhombifolia</i> , <i>Asparagus asparagoides</i> , <i>Eragrostis</i> sp and <i>Senna pendula</i> .	0.01
835	Cumberland Riverflat Forest	Very Low	The vegetation zone had a sparse native canopy and shrub layer, including <i>Angophora floribunda</i> , <i>E. tereticornis</i> and <i>Acacia parramattensis</i> . The native groundcover consisted of occasional occurrence of <i>Dichondra repens</i> . Exotic species included <i>Ligustrum lucidum</i> (shrub/canopy), <i>Verbena bonariensis</i> , <i>Asparagus asparagoides</i> , <i>Plantago lanceolata</i> and <i>Ehrharta erecta</i> . A highly degraded area along the riparian corridor of Werrington Creek has some elements of PCT 835, including <i>Cassuarinas</i> , with dominance of exotic species.	0.21
-	Native regrowth with exotics	NA	A small patch of exotic dominated vegetation with native shrub with <i>Eucalypt</i> sp. regrowth (small trees with DBH <10cm diameter). The native component included <i>Melaleuca decora</i> and <i>Pandorea pandorana</i> . Exotic species included <i>Eragrostis curvula</i> , <i>Ehrharta erecta</i> , <i>Tradescantia fluminensis</i> , <i>Jasmin</i> sp., <i>Arujia cericifera</i> , <i>Plantago lanceolata</i> and <i>Taraxacum officinale</i> .	0.05
-	Patch of remnant trees	NA	Patch of remnant trees were areas located in cleared land with no native shrub and ground layer, but with native trees whose canopies were touching or were within 50m of each other. Native trees included <i>Angophora floribunda</i> .	0.47
-	Paddock Trees	NA	Paddock trees were native gum trees located in otherwise cleared land (i.e. exotic lawn) which were isolated. This category also included road site trees. Species included <i>A. floribunda</i> and <i>Eucalyptus</i> sp.	
-	Planted natives	NA	Planted natives were observed on road reserves, road mid-lanes and landscaped areas within the Study Area. The most widely planted species were <i>Melaleuca</i> spp., <i>Callistemon citrinus</i> , and <i>Eucalyptus</i> spp. Other species included <i>Acacia</i> spp., <i>Bursaria spinosa</i> , <i>Jacaranda mimosifolia</i> , <i>Lomandra multiflora</i> , <i>Dianella caerulea</i> and <i>Cassuarina glauca</i> . These areas have some level of exotic invasion from low to high weediness. Exotic species included <i>Bidens pilosa</i> , <i>Conyza boniariensis</i> , <i>Asparagus</i>	3.07

PCT ID	PCT Name	Condition	Description	Construction Boundary Area (ha)
			<i>aethiopicus</i> , <i>Plantago lanceolata</i> , <i>Taraxacum officinale</i> , <i>Eragrostis curvula</i> , <i>Ehrharta erecta</i> , <i>Bromus catharticus</i> and <i>Chloris</i> sp.	
Miscellaneous vegetation / areas				
	Cleared Land / Exotics	NA	Consisted mainly of maintained lawns with exotic herbs. This category also includes drain lines as these areas predominantly consisted of exotic species.	12.97
	Blackberry Patch	NA	A patch of Blackberry (<i>Rubus fruticosus</i> sp. aggr.)	X
	Built	NA	Roads, culverts, commercial/residential structures	A
Notes: NA = Not applicable; X = within 10m outside of the Study Area; A – included in Cleared Land / Exotics				

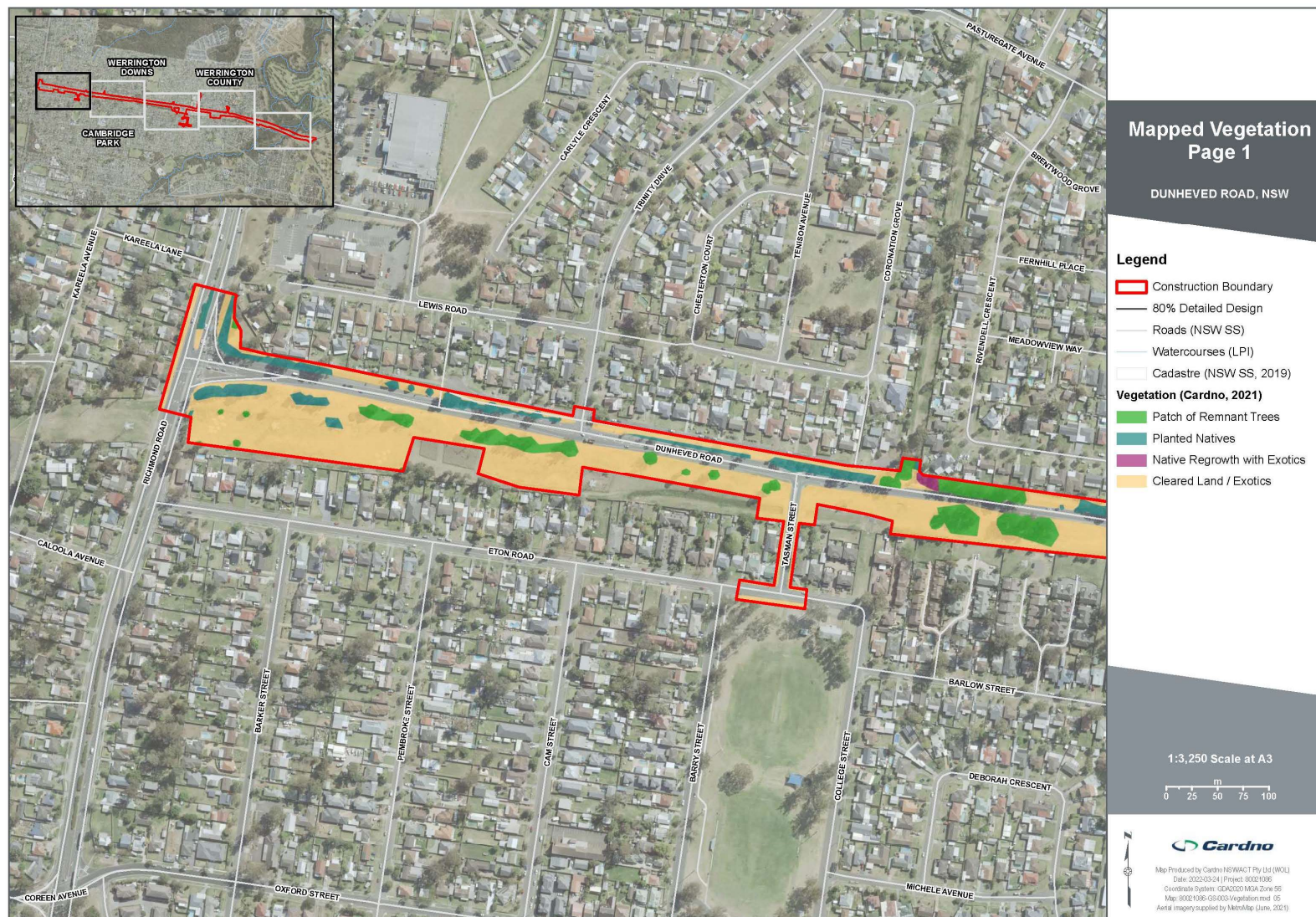


Figure 6-17 Ground Truthed Vegetation – Study Area section 1 (Cardno, 2022)

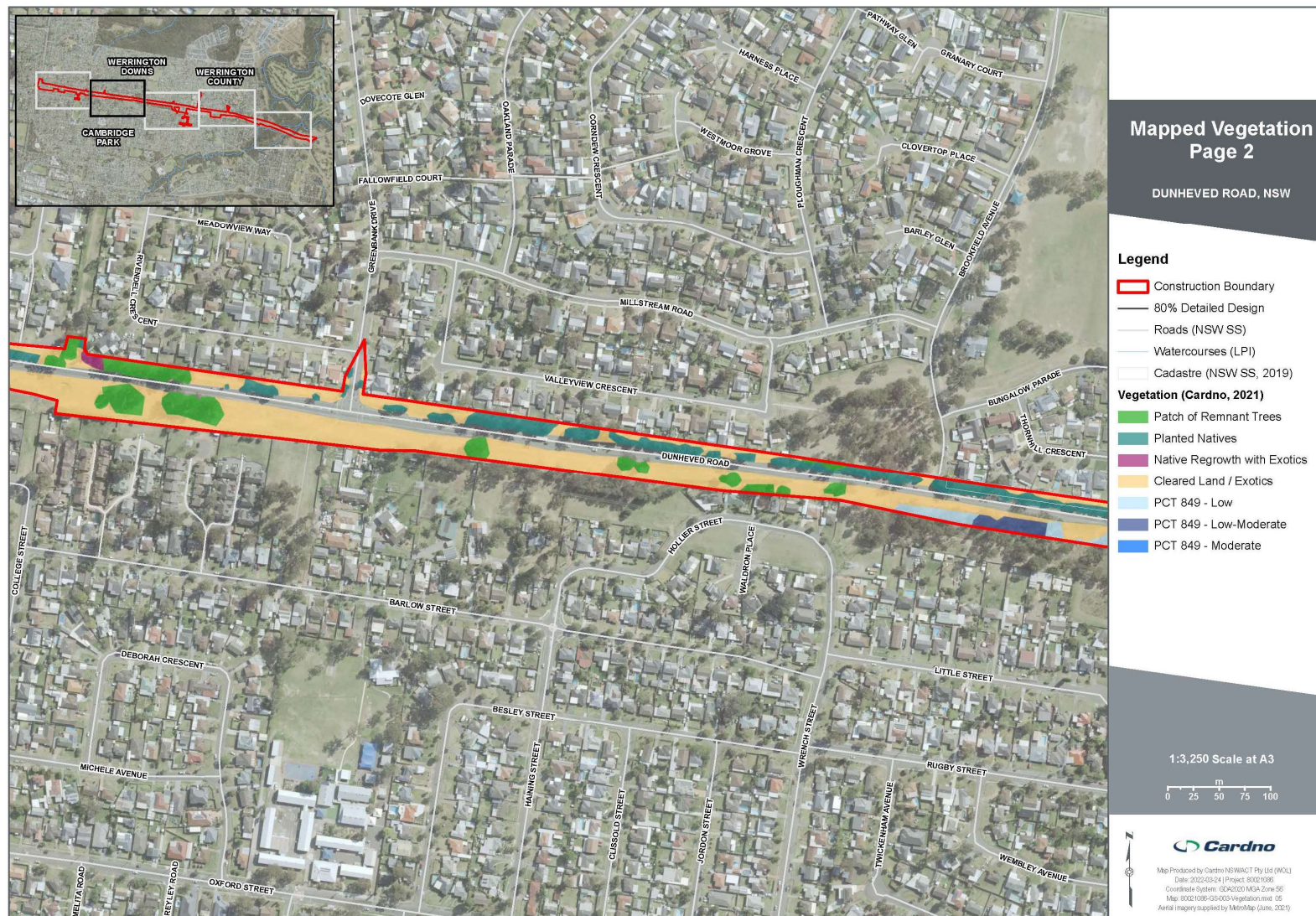


Figure 6-18 Ground Truthed Vegetation – Study Area section 2 (Cardno, 2022)

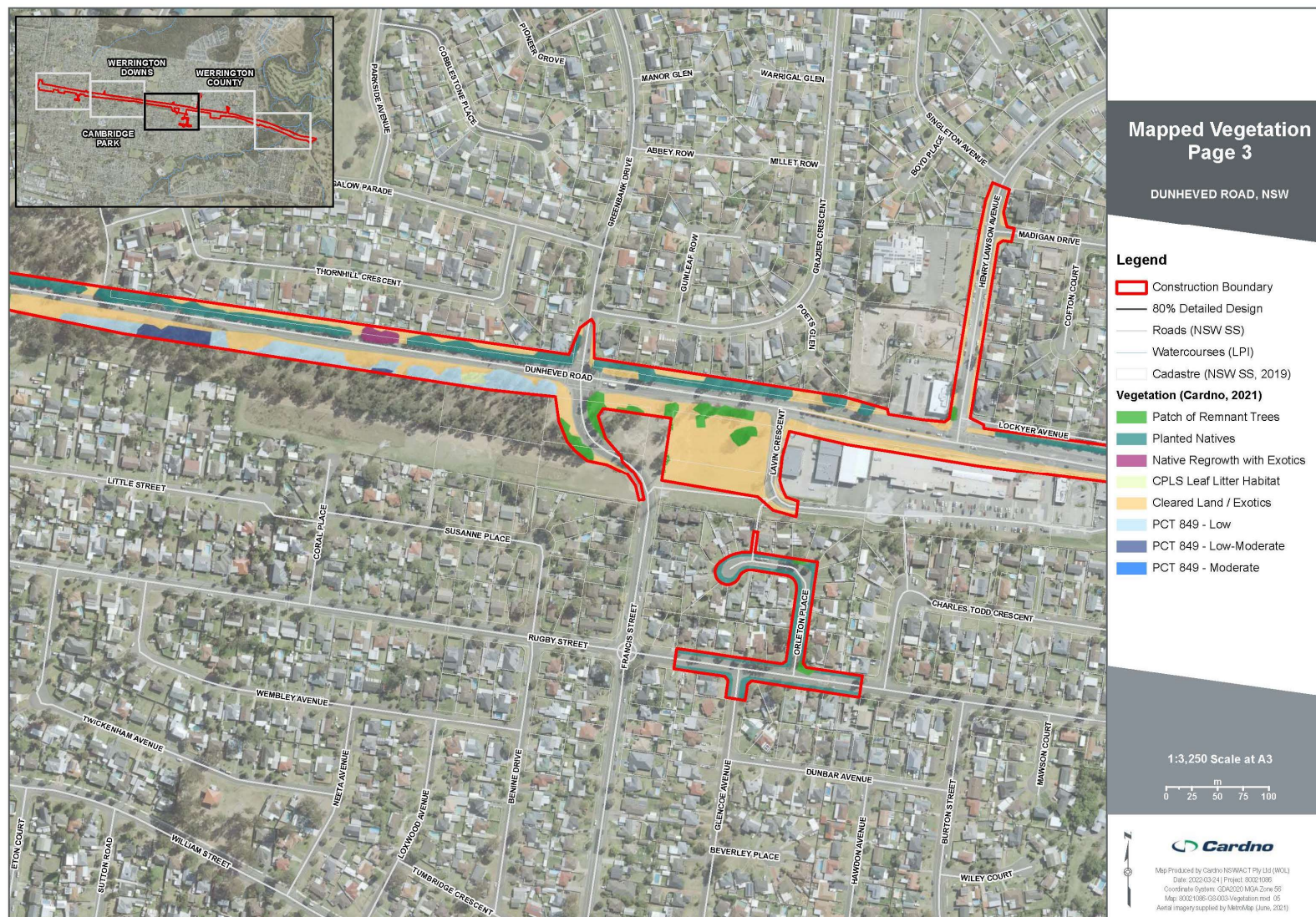


Figure 6-19 Ground Truthed Vegetation – Study Area section 3 (Cardno, 2022)

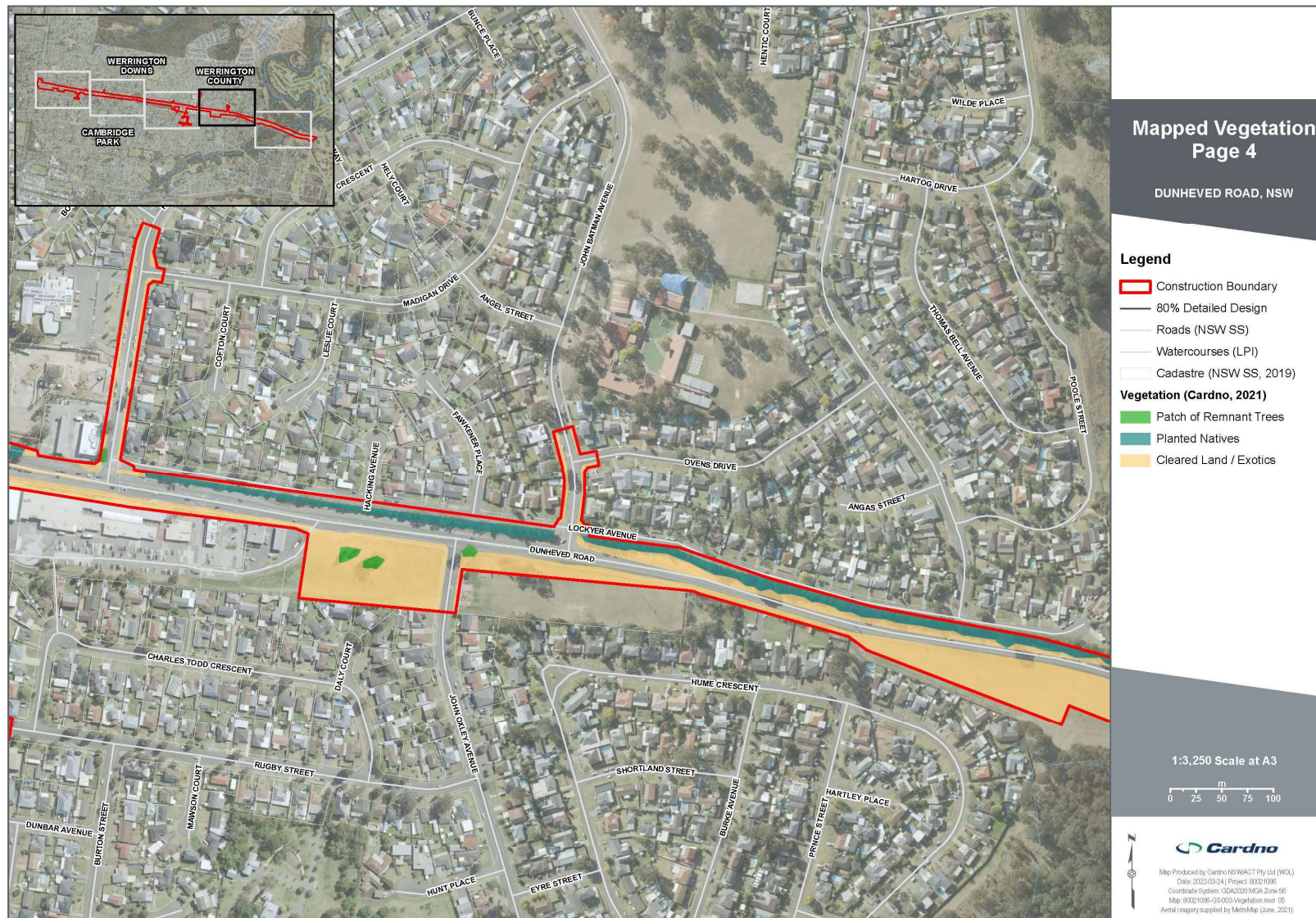


Figure 6-20 Ground Truthed Vegetation – Study Area section 4 (Cardno, 2022)



Figure 6-21 Ground Truthed Vegetation – Study Area section 5 (Cardno, 2022)

Fauna Species

Table 3-2 of the BAR attached in Appendix I provides list of fauna species recorded within the Study Area. One threatened fauna species was recorded, Cumberland Plain Land Snail (*Meridolum cornovirens*), a shell and the fragment of a shell were found during targeted surveys in February 2022.

Terrestrial fauna habitats

Habitats including but not limited to native vegetation and canopy, hollow bearing trees, stags, leaf litter and aquatic habitat were found within the Study Area. A summary of these habitat features can be found in Table 3-3 of the BAR attached in Appendix I.

Threatened ecological communities

The desktop review revealed seven TECs listed under the BC Act and/or EPBC Act with potential to occur within the Study Area. These PCTs are:

- > Castlereagh Scribbly Gum and Agnes Banks Woodland of the Sydney Basin Bioregion, listed as Critically Endangered Ecological Community (CEEC) under the BC Act and as an Endangered Ecological Community (EEC) under the EPBC Act.
- > Coastal Swamp Oak (*Casuarina glauca*) forest of New South Wales and South East Queensland ecological community, listed as an EEC under the BC Act and the EPBC Act;
- > Cooks River/ Castlereagh Ironbark Forest of the Sydney Basin Bioregion, listed as an EEC under the BC Act and as a CEEC under the EPBC Act;
- > Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, listed as an CEEC under the BC Act and EPBC Act;
- > River-flat Eucalypt Forest on coastal floodplains of southern New South Wales and eastern Victoria, listed as an EEC under the BC Act and as a CEEC under the EPBC Act;
- > Shale Sandstone Transition Forest of the Sydney Basin Bioregion, listed as a CEEC under the BC Act and the EPBC Act;
- > Western Sydney Dry Rainforest and Moist Woodland on Shale, listed as an EEC under the BC Act and as a CEEC under the EPBC Act.

As shown in Table 6-25, two of the PCTs recorded within the Study Area are associated with TECs and these were confirmed to occur within the Study Area.

Table 6-25 Threatened Ecological Communities

PCT ID	PCT Name	Act	TEC Name	TEC Status	Is PCT commensurate with TEC?
849	Cumberland Shale Plains Woodland	BC Act	Cumberland Plain Woodland in the Sydney Basin Bioregion	CEEC	<p>Yes, patches of the vegetation with canopy, shrub and ground cover meets the typical community structure as an "open canopy, a near continuous groundcover dominated by grasses and herbs, sometimes with layers for shrubs and/or small trees" and the composition of species being characteristic of the TEC (NSW TSSC 2010).</p> <p>The final determination is unclear as to whether or not paddock trees and patches of remnant trees with exotic groundcover, and where no other native strata is present, would constitute part of the TEC. Clarification has been sought from the NSW Threatened Species Scientific Committee. At the time the BAR was prepared, a response from the NSW TSSC indicated that remnant and</p>

PCT ID	PCT Name	Act	TEC Name	TEC Status	Is PCT commensurate with TEC?
					paddock trees are considered part of the TEC (see Appendix B).
		EPBC Act	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CEEC	Yes, the vegetation is commensurate with the EPBC Act listed TEC (DEWHA 2009, TSSC 2009). Overall, the patches of PCT 849 meet the patch size and native cover criteria for Category A patches of the TEC.
					Remnant trees and paddock trees do not confirm to the EPBC Act listed TEC.
835	Cumberland Riverflat Forest	BC Act	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC	Yes, patches of PCT 835 within the Study Area are considered commensurate with the BC Act listed TEC due to the vegetation structure, location in floodplain and to the native component being consistent with characteristic species of the TEC.
		EPBC Act	River-flat Eucalypt Forest on coastal floodplains of southern New South Wales and eastern Victoria	CEEC	Partially, only patches of PCT 835 low-moderate condition are commensurate with the EPBC Act listed TEC due to the dominance of canopy species (DAWE 2020).

Act: BC Act = NSW Biodiversity Conservation Act 2016; EPBC Act = Commonwealth Environment Protection and Biodiversity Conservation Act 1999

TEC Status: EEC = Endangered Ecological Community; CEEC = Critically Endangered Ecological Community

Threatened migratory and protected species

A total of 43 threatened species and 15 migratory species were predicted to occur within the Study Area based on BioNet Atlas and PMST report. A likelihood of occurrence assessment was undertaken to assess the likelihood of the predicted threatened biodiversity occurring in the Study Area. The likelihood of occurrence with the assessment for all predicted species is provided in Appendix A of the BAR attached in Appendix I and a category of likelihood is provided based on availability of habitat in the Study Area. The likelihood of occurrence table with assessment for all predicted species is provided in Table A-2 of the BAR attached in Appendix I.

Although foraging habitat in the Study Area occurs for these threatened, migratory and protected fauna, the habitats are considered suboptimal due to the level of disturbance, their fragmented condition and their location on a highly developed urban landscape with limited connectivity. For mobile species, such as birds and microbats, more suitable habitat is likely available in larger remnant patches of woodland in the broader locality. Therefore, it is unlikely that any of these species that occasionally occurred in the Study Area would depend on habitats in the Study Area and the resources they may provide.

Notwithstanding this, eleven species were considered to have moderate likelihood of occurrence in the Study Area (See Table A-2 in Appendix A of the BAR attached in Appendix I), including one species of flora, three microbat, six birds and one land snail.

The Juniper-leaved Grevillea (*Grevillea juniperina subsp. juniperina*) was not recorded during surveys in the Study Area.

None of the threatened fauna were seen during site inspections but one shell of the Cumberland Plain Land Snail (CPLS) (*Meridolum corneovirens*) which had been searched for in leaf litter at the base of paddock trees and during site inspections, was found. The presence of CPLS shells suggest that the species is and/or was present in the location within the last two years. The species has very cryptic lifestyle and local populations have small habitat range (up to 300m). Suitable habitat for the species includes native vegetation such as PCTs 949 and 835 present in the Study Area.

6.8.2.2 Aquatic Environment

Two aquatic habitats were recorded in the Study Area (see Figure 3-5 of the BAR attached in Appendix I), as follows:

> Werrington Creek, a third order stream, and tributary of South Creek, which flows under a bridge over Dunheved Rd. The creek is highly disturbed with eroded banks, and no aquatic vegetation (emergent and submerged) present. The stretch of Werrington Creek within the Study Area is mapped as key fish habitat (NSW DPI, 2019e), but is considered to be Type 3 – Minimally sensitive key fish habitat (DPI 2013) due to the absence of native aquatic plants, unstable and eroded banks. The classification of Werrington Creek in relation to classification of waterways for fish passage (DPI 2013) corresponds to Class 3 – Minimal key fish habitat as it is an intermittent stream with a clearly defined bed and bank without freshwater aquatic vegetation present.

> A small drain line connected to a culvert which flows under Dunheved Rd and eventually into South Creek. The drain line was primarily composed of exotic weeds, shallow and have no suitable habitat for protected or threatened aquatic species and would only flow after rain.

Threatened ecological communities

The desktop review did not identify any listed aquatic TEC with potential to occur within the Study Area.

No aquatic TEC was observed in the Study Area during the site inspection. Hence, aquatic TECs would not be considered any further in this assessment.

Threatened migratory and protected species

The desktop review revealed four threatened species/endangered populations and eight migratory wetland species listed under the FM Act and/or EPBC Act with potential to occur within the Study Area. The predicted threatened species included three vulnerable species (one fish species and two amphibians), one endangered fish species and eight migratory bird species.

An assessment on the likelihood of occurrence of the predicted threatened species was undertaken (see Appendix A of the BAR attached in Appendix I). Based on the assessment, it was concluded that all predicted threatened species had low likelihood of occurrence within the Study Area. These species will no longer be considered in further assessment.

Aquatic pests and diseases

Werrington Creek, which crosses the Study Area, is part of the Hawkesbury River system. The following freshwater pest species and diseases are known to occur in the Hawkesbury:

- > Redfin Perch (*Perca fluviatilis*);
- > Pacific oyster (*Crassostrea gigas*);
- > Carp (*Cyprinus carpio*);
- > Eastern gambusia (*Gambusia holbrooki*);
- > Goldfish (*Carassius auratus*);
- > Oriental weatherloach (*Misgurnus anguillicaudatus*);
- > Caulerpa (*Caulerpa taxifolia*)
- > Pacific oyster mortality syndrome (POMS);
- > Queensland unknown (QX);
- > Epizootic ulcerative syndrome (EUS) also known as red spot disease.

No aquatic vegetation, including exotic species, were recorded in the stretch of Werrington Creek within the Study Area.

6.8.3 Potential Impacts

6.8.3.1 Construction Phase

Terrestrial Biodiversity

Direct Impacts: Native Vegetation

Clearing of native vegetation, removal of trees and cleared of planted natives would result in a loss of habitat (see Table 6-26). Up to 5.15 ha of native vegetation will be cleared during the construction phase including:

- > 0.22 ha of PCT 835;
- > 1.34 ha of PCT 849
- > 0.05ha of native regrowth with exotics;
- > 0.47ha of remnant and paddock trees;
- > 3.07ha of planted natives.

Table 6-26 Direct impact due to clearing

Vegetation Zone	TEC Associated	TEC Status BC Act EPBC Act	Clearing extent (ha)
PCT 835_Low-moderate	RFEF	EEC CEEC	0.01
PCT 835_Very Low			0.21
PCT 849_Moderate	CPW	CEEC CEEC	0.01
PCT 849_Low-moderate			0.14
PCT 849_Low			0.47
PCT 849_Remnant trees		CEEC NA	0.72
Patch of remnant trees	-	-	0.47
Planted natives	-	-	3.07
Native regrowth with exotics	-	-	0.05
Total clearing (ha)			5.15

TECs (name BC Act | name EPBC Act): RFEF = River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions | River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria; CPW = Cumberland Plain Woodland | Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest

Status: EEC = Endangered Ecological Community; CEEC = Critically Endangered Ecological Community

NA – Not applicable as the vegetation zone is not commensurate with the TEC.

Five of the vegetation zones identified correspond to BC Act listed TECs and four vegetation zones correspond to EPBC Act listed TECs. Up to 1.34 ha (see Section 6.8.2.1) of CPW and up to 0.22 ha of River-flat Eucalypt Forest TECs will require removal. Of this 0.62 ha of the total CPW to be removed meets the criteria for the EPBC Act listed TEC.

Proposed mitigation measures (see Section 6.8.5) include managing edge effects and offsetting according to the BOS of the BC Act.

The BC Act Test of Significance and EPBC Act Assessment of Significance for this TEC (see Appendix C of the BAR attached in Appendix I), precautionarily concluded that, although remaining patches of the TEC in and adjacent to the Study Area would be viable, the removal of patches of the TEC would potentially contribute to cumulative impacts (i.e., in conjunction with historical clearing from other projects) to CPW at a broader level. Given cumulative impacts erode the long-term viability of the TEC within the broader locality, even small clearances of CPW that cannot be mitigated to the level of 'no net loss', could be considered a significant impact.

To address this, Council, the Proponent, has opted into the BOS and preparation of a BDAR has commenced (see Section 6.8.4). Because of the potential impact of the project to the EPBC Act listed CEEC the BAR recommended consideration be given to prepare a referral to the Commonwealth.

Given only a small amount of 0.22 ha of BC Act listed RFEF is proposed to be removed (and that most of this, 0.21 ha in is the very-low condition), and that larger patches in better condition remain in the locality, the clearance required for the project would not affect the viability of RFEF within and adjoining the Study Area. Only 0.01 ha of low-moderate condition RFEF to be cleared meets the EPBC Act listing threshold. This is not considered a significant impact under either the BC Act or the EPBC Act.

Direct Impacts: Cumberland Plain Land Snail

PCT 849 and PCT 835 are known habitat for the Cumberland Plain Land Snail (CPLS) and hence the loss of the extent of these PCTs also represents a direct loss of habitat for the CPLS. An assessment of significance was undertaken for the CPLS (see Table C-3 in Appendix C of the BAR attached Appendix I) and it is concluded that provided adequate protocol for pre-clearing and clearing is prepared and implemented prior to commencement of construction phase of the project, it is unlikely that significant impacts on a local population of the CPLS would occur. As indicated above, given CPLS's habitat would not be significantly affected by the project (i.e., these PCTs would remain viable within and adjoining the Study Area), it is not expected that there would be impacts to the CPLS. Further, a Plan of Management proposed for the CPLS will ensure long-term viability of snails in translocated areas.

Uncertain Direct Impacts: Southern Myotis

The Study Area provides foraging habitat for insectivorous microbat species. Also, roosting habitat for the Southern Myotis within the Study Area includes the underbridge at Werrington Creek, a tributary of South Creek. Foraging habitat for Southern Myotis, which forages over streams and pools catching insects and small fish across the water surface, occurs at South Creek and Werrington Creek. It is considered that foraging habitat under and adjacent to the bridge is limited and seasonal as observations therein suggest that water levels are variable, with inundated channel present only after heavy rain events. The scope of works for the present assessment was limited to fauna habitat assessment within the Study Area and opportunistic observations for flora and fauna. An assessment of significance was undertaken for three microbat species, the Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Southern Myotis (*Myotis macropus*) (see Table B-1 in Appendix B of the BAR attached in Appendix I) and it was concluded that based on the information available to date, it is considered unlikely the proposed road upgrade would result in adverse effect on the life cycle of the Eastern Coastal Free-tailed Bat and the Greater Broad-nosed Bat, nor would a local population of these species be placed at risk of extinction. It was also concluded, that in the case of the Southern Myotis, it is uncertain if this fishing bat roosts and/or breeds under the road bridge, therefore, the possibility that the proposed road upgrade would have an adverse effect on the life cycle of Southern Myotis cannot be precluded. Additional assessment of the underbridge as habitat for Southern Myotis and assessment of the use of the underbridge as a roosting and/or breeding habitat warrants further survey and will be undertaken as part of BDAR assessment (see Section 6.8.4).

Indirect Impacts

The following indirect impacts are likely to arise from the works related to the project:

- > Weed invasion due to creation of edges in patches of native vegetation and due to cross-contamination of vegetated areas with tissue of exotic species transported in machinery, tools, PPE or imported soils (if required).
- > Infection of aquatic fauna (e.g. frogs) and native species (e.g. plants of the family Myrtaceae) due to introduction of pathogens in soils on machinery, tools or PPE.
- > Change of hydrological patterns due to surface run-off.
- > Accidental death of protected fauna during vegetation clearing and removal of trees.
- > Temporary disturbances to native fauna occupying the road bridge (e.g. potential roost habitat for Southern Myotis).

Aquatic Biodiversity

Direct Impacts

The proposed project would require widening of the overbridge at Werrington Creek. It is understood that the bridge extension will be located outside the creek channel and that footings would be outside the riparian corridor.

Some construction activities have the potential to directly impact the creek, for example by contaminating the creek with building materials (e.g., concrete sludge) and/or accidentally dropping construction materials into the creek channel and care will be required to avoid these impacts.

With mitigation in place as per Section 6.8.5 and given the extensions to the bridge will not require structures within the creek bed or riparian corridor, there would be no direct impacts on the creek or its aquatic habitat (e.g., aquatic vegetation, boulders).

Indirect Impacts

Impacts on water quality of Werrington Creek have the potential of indirectly impacting aquatic fauna.

It is noted that no native aquatic vegetation will be impacted at the site as none is present in the creek and that given the highly disturbed condition of the creek, it is not considered to be suitable habitat for freshwater threatened species at the site or in nearby downstream areas. However, the possibility of the creek being inhabited or occasionally (seasonally or during movements up/down stream) being used by native protected aquatic fauna (e.g., turtles, eels and macroinvertebrates) cannot be precluded.

Migration of sediment into the creek from the works area could result in indirect impacts on aquatic native fauna by indirectly impacting the water quality of the creek or the depth of the creek. Reduction in water quality of creeks could result in reduction of biodiversity of invertebrates, which in turn could affect feeding resources for other organisms at upper levels in the food chain (e.g., frogs, birds, reptiles, microbats) at the site and in downstream habitats. Notwithstanding this, these potential impacts will be avoided if standard controls for protecting the creek, and drainage lines, from runoff from the works are implemented (refer to Section 6.8.5).

6.8.3.2 Operational Phase

No impacts to terrestrial or aquatic biodiversity are expected to occur as result of the proposed road upgrade and during the operational phase.

6.8.4 BC Act and the Biodiversity Offsets Triggers

As previously mentioned, the BC Act is the current legislative instrument that sets the rules for assessment of impacts of development on biodiversity (e.g., flora and fauna) in NSW. In general, a BDAR is now required for all development applications within NSW which require clearing of native vegetation. A BDAR will be required to accompany a development application when native vegetation is proposed to be cleared and the Biodiversity Offsets Scheme (BOS) is triggered. The BDAR details the impacts that the development may have on threatened biodiversity and provides recommendations to help ameliorate the impacts. It also outlines the development restrictions within a site, based on the site's ecological values, and provides options and conditions on which the development can proceed.

Based on impact assessment undertaken as part of this BAR, it is considered that the proposed project is likely to result in significant impacts on threatened biodiversity (i.e., TECs, threatened species or their habitat). Additional surveys as per the Biodiversity Assessment Method (BAM) and avoidance of net-loss are proposed to further assess identified impacts and avoid net-loss of biodiversity via offsetting residual impacts as per the BOS.

Please refer to Table 4-2 of the BAR attached in Appendix I, which provides the BOS triggers and their applicability to the proposed project.

The following is understood about the proposed road upgrade project and with regards to applicability of the BOS:

> It is understood that the proposed Dunheved Road Upgrade project is a Part 5 Development as per the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) and will be assessed under the State Environmental Planning Policy (infrastructure) 2007 (Infrastructure SEPP). Division 4 of the ISEPP states that

exempt development may be carried out without the need for development consent under Part 5 of the EP&A Act where it is stated that exempt development:

- (a) must be of minimal environmental impact; and
- (b) cannot be carried out in critical habitat of an endangered species, population or ecological community (identified under the Threatened Species Conservation Act 1995 [replaced by the BC Act] or the Fisheries Management Act 1994), and
- (c) cannot be carried out in a wilderness area (identified under the Wilderness Act 1987).

> Division 17, Clause 94 (1) of the Infrastructure SEPP states that development permitted without consent – general is “Development for the purpose of a road or road infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land [part]”.

> Based on the NSW Biodiversity Offsets Scheme and Land Management Framework Biodiversity Assessment and Approval Pathways for local government, the proposed Dunheved Road Upgrade project requires Council approval. Due to the identified likelihood of significant impacts on threatened biodiversity arising by the proposed project, Council, as the consent authority, has the following options:

- Prepare a Species Impact Statement (SIS); or
- Opt into the BOS which requires preparation of a BDAR by an accredited assessor.

Provided concerns raised about the potential impacts of the project on Southern Myotis (*Myotis macropus*), Cumberland Plain Woodland (listed as a CEEC under the BC Act and EPBC Act) and Cumberland Plain Land Snail (*Meridolum corneovirens*), Council has opted into the BOS and preparation of a BDAR is underway, to understand impacts to these threatened communities and species. The BDAR is being prepared as per the following phases:

> Phase 1: Desktop review and initial surveys. Initial surveys were undertaken in May 2020 and included detailed BAM plots and bird surveys. BAM plot data was included in the BAM calculator (BAM-C) to identify candidate ecosystem credit species (ECS) and species credit species (SCS). The BAM-C predicted a total of 36 ECS and 46 SCS associated with vegetation zones in the Study Area. Following habitat assessment, suitable habitat for 17 SCS was considered present in the Study Area.

> Phase 2: Phase 1 results has informed the additional targeted Surveys that will be undertaken for the 17 SCS identified in the Study Area over three survey campaigns, i.e., Initial *Pimelea spicata* Survey, Spring and Summer Campaigns, as presented in Appendix I below.

> Phase 3: Reporting.

Due to survey times for species credit species, it has been estimated that the BDAR will be ready at end January 2023 and will inform the final REF.

The Department of Planning and Infrastructure (DPE) via their Environment and Heritage Group (EHG) has confirmed that DPE concurrence on the BDAR for the proposed project is not required. DPE's EHG indicated that the consent authority (i.e., Council) is responsibly to ensure adequacy of the BDAR for inclusion in the REF.

Table 6-27 Candidate (SCS) Identified for Targeted Surveys

Scientific Name	Common Name	PCT 849 -	PCT 849 - Low-	PCT 835 -	"849" Patch of Remnant Trees	"849" NatRegrowt	"849" Planted	Summer	Autumn			Winter			Spring			
								Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
<i>Acacia pubescens</i>	Downy Wattle	Y	Y		Y													
<i>Callistemon linearifolius</i>	Netted Bottle Brush	Y	Y	Y	Y													
<i>Dillwynia tenuifolia</i>	Dillwynia tenuifolia	Y	Y	Y														
<i>Grevillea juniperina</i> subsp. <i>Juniperina</i>	Juniper-leaved Grevillea	Y	Y	Y	Y													
<i>Litoria aurea</i>	Green and Golden Bell Frog			Y														
<i>Lophoictinia isura</i>	Square-tailed Kite			Y														
<i>Marsdenia viridiflora</i> subsp. <i>Viridiflora</i>	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Y	Y	Y	Y													
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	Y	Y	Y	Y							***						
<i>Miniopterus australis</i>	Little Bent-winged Bat			Y														
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat			Y														
<i>Myotis macropus</i>	Southern Myotis			Y														
<i>Persicaria elatior</i>	Tall Knotweed			Y														

<i>Pilularia novae-hollandiae</i>	Austral Pillwort			Y														
<i>Pimelea curviflora</i> var. <i>curviflora</i>	<i>Pimelea curviflora</i> var. <i>curviflora</i>	Y	Y	Y	Y													
<i>Pimelea spicata</i>	Spiked Rice-flower	Y	Y	Y	Y								**				**	**
<i>Pomaderris brunnea</i>	Brown Pomaderris			Y														
<i>Thesium australe</i>	Austral Toadflax	Y	Y	Y	Y													

**4wks after a 30mm rainfall event. Survey at least three times, each at least one month apart unless detected

*** After rainfall event

Months of Survey

Months of Survey SCS

N/A Months of Survey

6.8.5 Mitigation Measures

Mitigation measures to manage the impacts of the proposal on biodiversity are presented in Appendix I.

Table 6-28 Mitigation Measures

Potential Impact	Mitigation Measures
Habitat loss due to clearing of native vegetation, trees and/or planted native vegetation	<ul style="list-style-type: none"> Compensatory replanting of trees at a rate 1:1. Plantings to be placed on road reserve. Offsets to be met in accordance with the BOS for loss of 0.62 ha of Cumberland Plain Woodland and loss of 0.22 ha of River-flat Eucalypt Forest. Both PCTs are habitat for the Cumberland Plain Land Snail (CPLS). The CPLS was recorded in a patch of PCT 849. Avoid and minimise loss of CPLS by: <ul style="list-style-type: none"> Preparing and implementing a pre-clearance and clearance protocol prior to commencement of construction phase. This protocol will avoid and minimise (as far as practicable) loss of individuals of the CPLS from the Study Area. The protocol must include methodology to search for and identify individuals of the species and have identified a suitable location within the Study Area to translocate individuals to (e.g., part of patch of PCT849 to be retained) or a known site inhabited by the species. Preparation and implementation of a CPLS Plan of Management to prevent degradation or loss of the translocation location/site. This will support viability of the site for the long-term survival of the CPLS population receiving the translocated individuals.
Weed invasion or dispersion	Strict weed management, monitoring and control practices should be implemented as part of the Construction Environmental Management Plan (CEMP) to minimise the spread of exotic species into natural areas within and outside of the Study Area. In particular, priority weed and high threat exotic species should be targeted in accordance with the NSW DPI WeedWise recommended control measures (DPI 2022).
Introduction of diseased to flora and fauna	<ul style="list-style-type: none"> Riparian corridors beyond footprint extent to be fenced off and labelled as No-Go areas to prevent accidental impacts and introduction of pathogens, such as <i>Batrachochytrium dendrobatidis</i>, a pathogen that caused chytridiomycosis, an infection disease on amphibians. All machinery should be cleaned of foreign soil and vegetative matter to avoid the spread of <i>Phytophthora cinnamomi</i>, Exotic Rust Fungi of the order Pucciniales pathogenic (Myrtle Rust) and dispersal of seeds of non-native plants.
Incidental death of protected fauna during vegetation clearing and tree removal	Wildlife protection during construction by implementing the following: <ul style="list-style-type: none"> Stop-work procedure on the chance encounter of any dispersing wildlife during works should be implemented to avoid death or injury; Ensure that a suitable qualified ecologist is present during the removal of all trees to act as a spotter / catcher that can relocate any captured wildlife; Ensure that all captured animals are relocated into the nearest suitable native vegetation; and Ensure that all injured animals are taken to a local wildlife carer for treatment.
Contamination of, or mobilisation of sediment or turbid runoff into, Werrington Creek due to changes in hydrological patterns of surface run-off	<ul style="list-style-type: none"> Strict erosion and sediment control measures should be implemented as part of the CEMP, monitored and maintained to prevent impacts on areas adjacent to the works areas, particularly drainage lines and Werrington Creek, and following erosion and sediment mobilisation from rain events. Stockpiling of materials should occur within previously disturbed areas and not within driplines, retained vegetation or within 20 m of Werrington Creek.

6.9 Socio-economic and Visual Amenity

6.9.1 Existing Environment

Penrith is geographically positioned to service the North-West and South-West Growth Centres of Western Sydney and it is expected that the population and availability of jobs will increase over the next 20 years. As a growing city, Penrith is critical for jobs, services and housing, and will be the closest city centre to the Western Sydney Airport and surrounding aerotropolis. Given the proximity to the airport and national and international freight opportunities, new infrastructure is needed to deliver a better-connected region.

The strategic importance of Penrith is recognised in various state plans, with the LGA needing to provide more housing and deliver more jobs. The Economic Development Strategy (EDS) (PCC, 2017) provides Council with target sectors for jobs growth and focus area to stimulate economic development within the LGA. Significant investment in rail and road infrastructure is planned to support the forecasted increase in growth within the area. Over the next 20 years Penrith's population is expected to increase by 60,000 and Penrith's economic catchment is forecast to grow from 500,000 to over a million (PCC, 2017). As part of the Local Strategic Planning Statement (LSPS) (PCC, 2020) connectivity is one of the focus areas and improving traffic congestion within the community is a key priority for Council. The Dunheved Road upgrade will provide vital connection between two major state arterial roads and service the growing population in Penrith City. It is considered a key connection upgrade that is required to support growth of the City (Penrith City Council, 2020).

The study area crosses through four suburbs within the Penrith LGA including Cambridge Park, Cambridge Gardens, Werrington and Werrington Country. In 2016 Penrith LGA had a population of 196,066 people, with a median age of 34 and a median weekly household income of \$1,658 (ABS 2020). Population projections indicate that this number will increase to a total of 370,000 people by 2041.

In the 2016 census the most common occupations in Penrith included Clerical and Administrative Workers (17.8%), Professionals (14.8%), Technicians and Trades Workers (14.8%), Machinery Operators and Drivers (10.8%) and Community and Personal Service Workers (10.5%). The most common method for people to get to work in the area is by car with 75.1% of people travelling to work either as a driver or a passenger and 11.4% of employed people who used some form of public transport (ABS 2020).

The local landscape is dominated by manmade development in an urban landscape surrounded by residential areas. There are number of green areas - recreational reserves and parklands located in the suburbs surrounding Dunheved Road, of particular note are Wianamatta Regional Park to the north, Dunheved Golf Course near Werrington Creek and smaller local parks such as Jim Anderson Park and Cambridge Park. Dunheved Road has a large number of planted mature trees and green areas along both sides of existing road extent.

Dunheved Road runs through the Werrington town centre and there are a number of businesses and services located within the vicinity of the works. These include:

- Retail, food outlets and supermarkets
- Medical facilities
- Educational institutes including Werrington County Public School and Cambridge Park Public School
- Fitness centre and swim school

Figure 6-20 shows the key local socio-economic features along and adjacent to Dunheved Road.

Currently, Dunheved Road experiences major congestion issues especially during peak hours of travel. This has had negative impacts on the amenity and accessibility of Werrington town centre thus impacts local businesses in the area.

The existing noise levels experienced by some residential houses along Dunheved Road currently exceed noise management levels which would impact negatively on local residents' health and amenity.



Figure 6-22 Local socioeconomic features – open spaces (green), schools (red) and commercial activity (yellow) (Base map Source: Draft 50% Landscape Analysis, Cardno)

6.9.2 Potential Impacts

6.9.2.1 Construction Phase

The construction phase of the works would result in temporary socio-economic impacts from disruptions/changes to access and traffic flow, increased congestion and reduced visual amenity in the locality due to the presence of construction equipment and vehicles within the area for the duration of the works. These impacts would be minimised by managing the construction works in four stages in order to minimise sections of Dunheved Road and adjacent properties that will be impacted at any one time.

Landscape and Visual Amenity

During construction, potential impacts on community values in regard to landscape and visual amenity would generally be associated with:

- > Heavy vehicles on the road, sediment tracking on existing sealed surfaces from vehicle tyres/movement
- > Temporary compound fencing, and signage would impact visual amenity
- > Removal of established trees within construction areas impacting on visual amenity and the nature of the local landscape
- > Tree planting and roadside median planting to offset the removal of vegetation during construction

There will be temporary impacts to visual amenity from construction infrastructure, however the phasing of construction works will help to minimise this impact. Dust and sediment on existing road surfaces can be managed through implementing vehicle hygiene measures such as wheels washes at compounds, suppressing dust and limiting earthworks after heavy rain events.

There will be a large number of mature trees removed as a result of the Dunheved Road upgrade which will impact the amenity and landscape of the locality. Landscape design will include considerable planting requirements along roadside areas to enhance and screen, however these will take some time to establish

and grow. The proposed landscape plan is included as Appendix J and includes representation of the trees that will be removed and trees that will be planted to enhance or replace green areas and strips as part of the upgrade and development.

Traffic and Transport

During the construction phase there would be an increase in both light and heavy vehicles throughout the construction stages. This may result in changes to the road network including the potential for detours, modified property access, and alternate public transport access. Construction may also result in delays and disruptions for some motorists and other road users, and impact on perceptions of road safety for some road users.

Community access and connectivity during construction stages will be impacted by:

- > Light and heavy vehicle movements to and from the area due to construction activities
- > Short term access changes to property and commercial areas
- > traffic delays and disruptions for motorists, including from temporary closure of some traffic lanes, road diversions, and increases in construction vehicles using local road network
- > Potential disruptions or changes to public transport services
- > Potential changes to pedestrian access to public transport and local businesses and services
- > Changes to road conditions, potentially impacting on road safety

Notification of construction works and the potential for delays should be provided to the public and variable messaging signs may be used to inform road users of construction works and any restricted speed limits along Dunheved Road and associated local side streets.

Access to private properties near to construction work would be maintained during construction. Where temporary changes are required, suitable access arrangements would be implemented in consultation with affected property and business owners.

Noise and Vibration

A number of sensitive receptors have been identified along or adjacent to Dunheved Road including educational premises, passive recreation areas and residential premises. There will be a temporary increase in noise in the area due to the presence of construction related vehicle movements and construction equipment and activities.

It is reasonable to assume based on the known machinery sound power levels that the works would result in some increase in noise above the noise management levels. However, the phasing of the works will ensure no individual sensitive receiver will be affected for an extended period of time and with the implementation of proposed safeguards and mitigation measures, this will minimise the effects of noise and vibration during construction.

Air Quality

The high number of residential areas along Dunheved Road suggests means that a number of receivers may be sensitive to changes in air quality as a result of construction activities. Construction activities can generate nuisance dust which may impact the amenity of the community, in particular residents living adjacent Dunheved Road, local businesses and users of local parkland. While construction activities would result in the deterioration in local air quality, the emissions would occur intermittently over the length of construction, however the proposed staged construction will minimise these impacts to smaller section of the road.

Local Economy

While there may be negative amenity impacts on nearby businesses including impacts to traffic and transport, access, noise and vibration impacts and air quality as a result of construction activities, local businesses would likely benefit positively during the construction phase of the works by creating a demand for local contractors (e.g. truck and dog operators, waste removal companies) and goods and services. Local retailers within the area would also be positively impacted by the increase in customers from workers in the area who are likely to make purchases from retailers during construction works.

Many residential properties (both north and south of Dunheved Road) use Dunheved Road to access town centres, schools, shops, etc. The town centre located in the middle of Dunheved Road can only be accessed via Dunheved Road and will be heavily impacted by any upgrade to the road.

Property Acquisitions

Two private properties will be acquired as part of the proposed upgrades. The impacts in relation to these acquisitions will be dealt with separately as landowners are provided with their own compensation agreements. Other land parcels that will be encroached upon are Council owned land parcels, the location of the site compounds and construction works will likely cause disruptions to roadside parklands, however these impacts are temporary in nature with the roadside parklands being enhanced with additional plantings, upgraded footpaths/cycleway and street furniture in the long term, post construction.

6.9.2.2 Operational Phase

Traffic and Transport

The major impact of the proposed works would be improvements to the traffic flow and efficiency which will reduce wait times and traffic for residents and road users along Dunheved Road and its intersections. Also upgrades to intersections and traffic signalling would improve flow and vehicle movements in and out of Dunheved Road. With future growth in population and jobs anticipated for the Penrith LGA improvements to the road network would positively impact road users and ensure the road network remains efficient even with increased vehicle numbers.

Once works are complete it is anticipated the following positive impacts will be realised:

- > improved formal bus stops and improved infrastructure to assist commuters
- > there will be an improvement in traffic flow and a reduction in queuing time
- > Improved access and connectivity through the surrounding area and improved safety and amenities outcomes for the community
- > Improvement to existing footpaths and cycle ways and connectivity to green areas/parkland.

The works would improve safety for pedestrians and cyclists due to the addition of a shared user bridge and improvements to traffic signalisation and pedestrian walkways at a number of intersections along Dunheved Road. Improved turning lanes and signals would also impact safety by reducing the likelihood of accidents.

Landscape and visual amenity

Once Dunheved upgrade is operational, the development will incorporate new urban design and landscaping features such as plantings along the verges and median of Dunheved Road. Plantings have been chosen to complement the surrounding land uses, providing suitable frontages and improved screening for residential areas to the north and south of the expanded road footprint.

There will be a short to medium term impact while the new landscape areas and plantings establish themselves and mature. There will be a number of street trees removed to make way for the additional lanes, however these will be retained wherever practical and incorporated into the landscape design.

Acoustic barriers have been recommended as part of the noise mitigation measures for operational traffic noise. These barriers will be located mostly on the northern side of Dunheved Road and will be located at the boundary fences of residential properties identified as needing the additional mitigation. A visual representation of these barrier locations is shown in Figure 6-3.

These barriers will be a minimum of 2.0m high and will be made of suitable material to dampen noise generated by traffic flow. They will appear as high boundary fences and will be made from unobtrusive material and colour/texture and patterns, so they blend into their environment. Landscape plantings will also assist with blending these barriers into the environment.

The TfNSW Noise Wall Design Guideline (2008) provides good guiding principles for the design of a noise mitigation wall and will be utilised by Council when considering the final design and material of the wall.

Noise and Vibration

Operational traffic noise generated by the completed Dunheved Road Upgrade will be unlikely to exceed 2 dBA, however as sensitive receivers along Dunheved Road would exceed acceptable noise management levels even if the upgrade would not proceed, the Traffic Noise assessment recommended that mitigation be considered under the cumulative criteria trigger of the *TfNSW Noise Mitigation Guideline* (Trigger 2). Appropriate mitigation has been recommended to future impacts to local residents including acoustic barriers and at-property treatments.

Local Economy

Once operational, the proposal would have long-term beneficial impacts on businesses and industry through improved access and connectivity, including for freight transport. An enhanced roadway would support economic growth and help reduce congestion and safety issues. Improved public transport options would also bring additional people to local shops and the area.

Overall, the project would have a strong socio-economic benefit associated with reduced traffic within the Werrington town centre and flow on effects to the arterial roads at either end of Dunheved Road. Reductions in traffic would lessen congestion and improve safety and amenity as well as access to surrounding residences and businesses which would benefit the local community and visitors. Therefore, the upgrades are expected to have a positive impact on the future wellbeing of the community.

6.9.3 Mitigation Measures

Mitigation measures to manage the impacts of the proposal on socioeconomics are presented in Table 6-29.

Table 6-29 Mitigation measure for impacts on socioeconomics

ID	Impact	Safeguards	Responsibility	Timing
SE1	Impacts to residents, businesses and road users	<p>A Communication Plan will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The Plan will include (as a minimum):</p> <ul style="list-style-type: none"> Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions Contact name and number for complaints. 	Contractor	Pre-construction / construction
	Ongoing Community Communication	<ul style="list-style-type: none"> A free-call number will be established for enquiries regarding the proposal and will remain active for the duration of construction. Contact details will be clearly displayed at the entrance to the site. All enquiries and complaints will be tracked through a tracking system and acknowledged within 24 hours of being received. 	Contractor	Pre-construction / construction
	Amenity	Ensure the CEMP has appropriate mitigation measures to control dust and the spread of sediment on road surfaces such as vehicle hygiene washes, spraying water in areas	Contractor	Pre-construction/construction

ID	Impact	Safeguards	Responsibility	Timing
		<p>requiring dust suppression, covering stockpiles, installing dust screens etc</p> <p>Impacts from unsightly compound fencing and signage will be minimised through construction staging</p> <p>Acoustic Barriers will change the amenity of adjacent residential areas but will be enhanced with careful choice of material/colours and landscape plantings</p>		
SE2	Traffic - Road closures and reduced access	<ul style="list-style-type: none"> Access to private properties will be maintained during construction. An appropriate TMP will be established as part of the CEMP. Heavy vehicle access will be limited near schools and childcare centres during drop-off and pick-up times. 	Contractor	Construction
SE3	Local economy	Investigate opportunities to encourage the use of local contractors and to encourage the purchase of goods and services locally.	Council	Pre-construction / construction
SE4	Landscape and Visual Impact	<p>An Urban Design Plan will be prepared and be implemented as part of the CEMP.</p> <p>The UDP will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment.</p> <p>The UDP will incorporate the Landscape Design prepared and attached as Appendix J.</p> <p>The Plan will include design treatments for:</p> <ul style="list-style-type: none"> •Location and identification of existing vegetation and proposed landscaped areas, including species to be used •Built elements including retaining walls, bridges and noise walls •Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings •Fixtures such as seating, lighting, fencing and signs •Details of the staging of landscape work taking account of related environmental controls such as erosion and sedimentation controls and drainage •Procedures for monitoring and maintaining landscaped or rehabilitated areas. <p>The UDP will be prepared in accordance with relevant guidelines, including:</p>	Council/Contractor	Design/pre-construction

ID	Impact	Safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> •Beyond the Pavement urban design policy, process and principles (Roads and Maritime, 2014) •Landscape Guideline (RTA, 2008) •Bridge Aesthetics (Roads and Maritime 2012) Noise Wall Design Guidelines (TfNSW 2008).		
SE5	Landscape and Visual Impact	The Acoustic Noise barriers should be designed in accordance with best practice urban design principles and guidelines, including the TfNSW Guideline.	Council/Contractor	Design/Pre-construction
SE6	Landscape and Visual Impact	<ul style="list-style-type: none"> •All reasonable measures shall be taken to minimise the loss of vegetation at and surrounding the interchange, including rationalisation of the requirements for maintenance access •Management of the natural environment will include rehabilitation of any affected areas of important native habitat and creek embankments; use of endemic vegetation in these and other areas where habitat values are important; during the detailed design phase identify and retain as many mature trees as possible; rehabilitate and replace any lost public uses. <p>Mature trees potentially affected by the proposed modification will be retained in residential streets (where possible) to maintain the visual character of the area.</p> <p>All trees to be retained should be protected prior to the commencement of construction in accordance with AS4970 the Australian Standard for Protection of Trees on Development Sites and Adjoining Properties.</p> <p>An arborist should be consulted prior to construction commencing to ensure all trees marked for retention are adequately protected in accordance with the Tree Protection Plan.</p>		
SE7	Landscape and Visual Impact	Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including appropriate fencing or screening (eg use of shade cloth), storage of equipment, parking, stockpile screening and arrangements for the	Contractor	Construction

ID	Impact	Safeguards	Responsibility	Timing
		storage and removal of rubbish and waste materials. Compound and ancillary facilities will be decommissioned, and the sites rehabilitated to their existing condition or as otherwise agreed with the landowner on completion of work.		
SE8	Land acquisition	Design to minimise land acquisition where possible	Designer/Council	Pre-construction

6.10 Waste Management

6.10.1 Statutory Framework

Section 143 of the *Protection of the Environment Operations Act 1997* requires waste to be transported to a place that can lawfully accept it and that the owner of the waste and the transporter are responsible for ensuring that waste is transported to a suitable waste facility.

Principles of waste management and the Resource Management Hierarchy (e.g., avoid, reduce, reuse, dispose) are embodied in the *Waste Avoidance and Resource Recovery Act 2001* and through the *NSW Waste Avoidance and Resource Recovery Strategy 2007* (EPA, 2014a).

The Waste Regulation sets out the provisions related to the following:

- > Storage and transportation of waste;
- > Reporting and record-keeping requirements for waste facilities;
- > Special requirements for the management of certain special wastes including asbestos;
- > Payment of waste contributions (referred to as a waste levy) by the occupiers of licensed waste facilities; and
- > Exemption of certain occupiers or types of waste from paying waste contributions and from requiring an Environment Protection Licence (Part 9 of the Regulation).

The Waste Regulation provides for exemptions from some of the requirements under the *Protection of the Environment Operations Act 1997* (POEO Act) and Regulation for certain wastes and resource recovery activities where it can be demonstrated that waste reuse would not cause harm to human or environmental health. Under these provisions, the EPA requires two separate applications, either or both of which may be applicable to a project, namely:

- > A Resource Recovery Order made under clause 93 of the Regulation, which covers the requirements for the generation and / or processing of material for reuse
- > A Resource Recovery Exemption made under clauses 91 and 92 of the Regulation, which relates to the consumption of any material for reuse.

There are a number of Resource Recovery Orders and Exemptions that are relevant to similar types of construction projects, including:

- > Recovered aggregate;
- > Excavated public road material; and
- > Reclaimed asphalt pavement.

6.10.2 Potential Impacts

6.10.2.1 Construction Phase

The following waste streams are expected to be produced during the construction phase of the proposed works:

- > Green waste generated from vegetation removal

- > Waste road material from the road upgrade works
- > Spoil
- > Construction and demolition waste
- > General garbage and refuse
- > Waste from temporary erosion and sediment controls; and
- > Waste oils, greases and lubricants from any site maintenance undertaken on construction plant and equipment.

For efficient use of resources and to manage waste generated during construction activities the waste hierarchy which underpins the *Waste Avoidance and Resource Recovery Act 2001* should be implemented.

The hierarchy is as follows:



Fill materials considered unsuitable to remain on site would be classified in accordance with the NSW EPA Waste Classification Guidelines (2014) and disposed of at an appropriately licensed facility.

Waste classification would be carried out by a suitably qualified and experienced environmental professional and could be done while the materials are in-situ or ex-situ. It should be noted that a preliminary waste classification has been carried out as part of the desktop and limited sampling Investigation included as Appendix G, however a full waste classification sampling and testing regime will be required once soils have been stockpiled to determine appropriate reuse or disposal.

Surplus material may also be suitable for reuse onsite subject to satisfaction of an NSW Resource Recovery Exemption/Order and appropriate classification.

Stockpiled materials must be kept separated where possible to maximise the potential for reuse and any potentially contaminated materials must be managed in accordance with the CEMP to ensure they are not mixed in with other materials.

Short term impacts may include a slight increase in the general domestic waste as a result of escape from construction bins or littering.

Materials that require import to site during construction must be suitable and have been classified in accordance with and to the satisfaction of an NSW EPA Resource Recovery Exemption/Order. These imported materials would require appropriate supporting documentation such as evidence of classification, appropriate tracking and material validation at receipt of the site to satisfy quality control.

6.10.2.2 Operational Phase

Operational waste generated in the operational phase would generally be similar to the existing situation. Fly tipping and litter would likely continue to be an issue and Council should investigate solutions to these issues through additional monitoring and resources dedicated to cleaning up the wider LGA.

There would some small amounts of green waste associated with maintenance of landscaping works.

6.10.3 Mitigation Measures

Mitigation measures to manage waste generated by the proposal are presented in Table 6-30.

Table 6-30 Mitigation measure for waste

ID	Impact	Safeguards	Responsibility	Timing
WM1	Waste materials generated	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The plan will be prepared in accordance with the	Contractor	Pre-construction / construction

ID	Impact	Safeguards	Responsibility	Timing
	during construction	<p>NSW EPA Waste Classification Guidelines (2014) and will include:</p> <ul style="list-style-type: none"> • Classification of wastes and management options (re-use, recycle, stockpile, disposal) to ensure compliance with the resource management hierarchy principles. • Measures and controls to avoid and minimise waste generation. • Statutory approvals required for managing both on and off-site waste. • Procedures for storage, transport and disposal of waste • Unsuitable fill material and all other waste streams must be classified in accordance with the guidelines and disposed of at an appropriately licensed facility. • Monitoring, record keeping and reporting 		
WM2	General waste generated during construction	<ul style="list-style-type: none"> • Appropriate waste receptacles, including general waste and recycling bins, will be provided on-site. Bins are to be located in the works compound or in an area to be used by the construction contractor. • Works areas will be maintained free of rubbish and cleaned up at the end of each work day. 	Contractor	Construction
WM3	Waste oils	<ul style="list-style-type: none"> • Any uncontrolled spills of waste oils, fuels and other materials will be contained using a spill kit and managed by an environmental professional. All waste generated as a result of uncontrolled spills and maintenance will be managed in accordance with the protocol in Safeguard WM1. 	Contractor	Construction

6.11 Cumulative Impacts

6.11.1 Existing Environment

There is a requirement under Clause 171 of the EP&A Regulation to take into account any cumulative environmental impacts of the works with other existing or planned future activities. Cumulative impacts have the potential to arise from the interaction of individual components within the site and the effects of the proposal with other projects in the local area.

A search of DPIE's major projects portal was conducted on 22 March 2022 to determine if any other projects are being done nearby to the works and see if it is likely that there might be cumulative impacts from other nearby projects. A search was conducted within the Penrith LGA and returned results for 45 projects however none of these projects were within close proximity to the Study Area.

The closest significant projects to the Study Area are the North Penrith Defence Redevelopment and Subdivision project, located near The Crescent in Penrith, approximately 1.6 kilometres north west from the western end of the Study Area (measured from the intersection of Richmond Road and Dunheved Road). There are also various projects as part of the Penrith Lakes Scheme including the Employment Lands Rehabilitation Works and the Nepean River Pump and Pipeline projects. These projects are located near the Nepean River, approximately 3 kilometres west north west from the western end of the Study Area.

6.11.2 Potential Impacts

6.11.2.1 Construction Phase

Due to the location of the proposed works compared to other ongoing/proposed significant projects within the Penrith LGA, it is unlikely that there will be any cumulative impacts in terms of overlapping noise and amenity issues.

However, there is a risk that due to the Dunheved Road Upgrade being carried out in stages there may be localised cumulative impacts from each of the individual stages. To minimise this, it is proposed that all major construction works will be completed for each stage before moving to the next stage to reduce the likelihood of overlap of works which will expose sensitive receptors unnecessarily to ongoing nuisance and amenity issues. An estimated total of 442.5 ha (4.0%) of CPW was lost in the Cumberland Plain between 2002 and 2010. The development of Western Sydney (DPIE 2020b) would add at least 1,014.6 ha of CPW loss. It is predicted however, that the loss of native vegetation across the Cumberland Plain and Penrith LGA would have been much larger over the last 20 years, including the real cumulative loss of CPW. Therefore, it is considered that any net-loss on the extent of CPW is most likely significant as the long-term presence of the TEC is further placed at risk of extinction due to clearing and development. Note that the Department of Planning and Environment has released a draft Cumberland Plain Conservation Plan which aims to provide a coordinated plan for protecting biodiversity across Western Sydney including the area covered by this project.

Proposed mitigation measures include managing edge effects and offsetting according to the BOS part of the BC Act. the BC Act Test of Significance and EPBC Act Assessment of Significance for these TECs (see Appendix C of the BAR attached in Appendix I) precautionarily concluded that, although remaining patches of the TECs in and adjacent to the Study Area would be viable, the reduction of patches of the TECs would potentially contribute to cumulative impacts (i.e., in conjunction with historical clearing from other projects) to CPW at a broader level. Provided that cumulative impacts erode the long-term viability of the TECs within the broader locality, even small clearances of CPW that cannot be mitigated to the level of 'no net loss' could be considered a significant impact. As such, the BAR recommended preparation of a BDAR and consideration of preparing a referral to the Commonwealth Government under the EPBC Act in regard to potential impacts of the project to CPW.

6.11.2.2 *Subject to outcomes of the BDAR and provision of appropriate offsets, then there would likely be no net loss to BC Act or EPBC Act listed CPW. Operational Phase*

The project will impact on aspects of the environment such as biodiversity, cause increased noise and local impacts to air quality which can contribute to regional cumulative issues relating to biodiversity loss and emissions, however the projects impacts have been minimised where possible.

The proximity of residences to the new road alignment and the predicted traffic increases along Dunheved Road would have cumulative impacts in relation to noise, visual and socio-economic impacts which have been explored throughout this environmental assessment.

These cumulative impacts are balanced with the benefits of the project in terms of managing traffic flow along Dunheved Road and providing a more efficient road network for future generations. The Dunheved Road upgrade project would assist in meeting the increased demand of road users which is forecast to keep growing in the next 20-30 years as future development and land use changes in the Penrith area occur. The project would also reduce potential congestion on the surrounding road networks and at intersections along Dunheved Road and improve safety for motorists, pedestrians and cyclists.

6.11.2.3 Mitigation Measures

Mitigation measures to manage potential cumulative impacts are presented in Table 6-31.

Table 6-31 Mitigation measures for cumulative impacts

ID	Impact	Safeguards	Responsibility	Timing
CM1	Cumulative impacts from surrounding projects	<ul style="list-style-type: none"> Prior to construction works, Council should confirm that other local development in the vicinity of the 	Council	Pre-construction

ID	Impact	Safeguards	Responsibility	Timing
		<p>works would not coincide with the proposed development.</p> <ul style="list-style-type: none"> The TMP and Construction Noise and Vibration Management Plan should consider surrounding projects during the development. 		

DRAFT

7 Summary of Consideration of Environmental Factors

The factors listed in the EPBC Act and under clause 171 of the EP&A Regulation have been addressed in Table 7-1 and Table 7-2 in accordance with requirements that the likely impacts of the proposed works on the natural and built environment are fully considered.

Factors listed under the EPBC Act

Under the environmental assessment provisions of the EPBC Act, the following MNES and impacts on Commonwealth land are to be considered to assist in determining whether the proposal should be referred to the DCCEE. A referral may be required for proposed actions that may affect nationally listed threatened species, TECs and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and considering relevant guidelines and policies.

Table 7-1 Summary of consideration of Environmental Factors under Commonwealth EPBC Act

Factor	Impact
Any impact on a World Heritage property?	No impact
Any impact on a National Heritage place?	No impact
Any impact on a wetland of international importance?	No impact
Any impact on a listed threatened species or communities?	The BAR (Appendix C of the BAR attached in Appendix I) has assessed the impact the project will have on MNES threatened ecological communities, CPW and River-flat Eucalypt Forest, were recorded within the Study Area. It was assessed that a referral to the Commonwealth Government should be considered for CPW but not for River-flat Eucalypt Forest.
Any impacts on listed migratory species?	No impact
Any impact on a Commonwealth marine area?	No impact
Does the proposal involve a nuclear action (including uranium mining)?	No impact
Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	No impact

Factors listed under the EP&A Regulation

Under clause 171 of the EP&A Regulation a number of factors are to be considered to assess the likely impact of the proposal on the environment. These Environmental Factors are addressed in this REF document and are summarised in Table 7-2.

Table 7-2 Summary of consideration of Environmental Factors under clause 171 of the NSW EP&A Regulation

Factor	Comment	Impact
a) Any environmental impact on a community?	<p>During construction of the proposal, the community would be temporarily impacted by disruptions to traffic and access changes, air quality and socio-economic factors. There would also be impacts to noise and biodiversity that potentially need further mitigation measures or assessment. Most environmental impacts would be minimised through the implementation of mitigation measures identified in Section 6.</p> <p>There will be short to medium term impacts to community amenity with the removal of a large number of trees along Dunheved, while these will be replaced, and compensatory plantings are proposed these will take some time to establish. However, the upgrades have provided an opportunity to develop an overall Landscape plan for all of the Dunheved that integrates a shared use pathway and additional landscaping, therefore the overall impact to the community in the long-term will be positive.</p>	<p>Short-medium -term negative</p> <p>Long-term positive</p>

Factor	Comment	Impact
	<p>The installation of an Acoustic barrier will change the aesthetics of the area for the community; however, this mitigation will be carefully designed to blend into the existing environment through appropriate landscaping and colour and material.</p> <p>Overall, the proposed development would have a long-term positive impact as the Upgrade will improve traffic flow and road safety for all road users.</p>	
b) Any transformation of a locality?	<p>The project involves expanding the carriageway from two lanes to four, two new bridges, upgrading intersections including changes to signalisations and construction of three additional roundabouts.</p> <p>As a result, there would be impacts on the local environment during construction along Dunheved Road including an increase in noise and heavy traffic and visual impacts including the removal of trees and addition of noise barriers which will change the appearance of the road and surrounds. These impacts are discussed in Section 6.</p> <p>Implementation of the mitigation measures contained within this REF (Section 6) will ensure impacts are reduced or ameliorated so that the environment is maintained for future generations.</p> <p>Long term the expansion of Dunheved Road will transform the area with higher traffic flows, however Penrith as a wider locality is projected to grow whether the upgrade proceeds or not. Ultimately, the project has been justified as it will benefit future generation by reducing congestion and improving traffic flow and safety.</p>	<p>Short- medium term negative</p> <p>Long-term positive</p>
c) Any environmental impact on the ecosystems of the locality?	<p>Section 6.8 outlines the proposal's impact on biodiversity within the Study Area. Majority of the construction footprint falls within highly disturbed localities however there is a section of existing Cumberland Plain Woodland that is present within the Study Area and ecological surveying concluded that the endangered Cumberland Plain Land Snail was present within the Study Area and further assessment through a BDAR is required. Therefore, Council opted into the BOS and preparation of a BDAR has commenced, to further assess these impacts and offsets will likely be required. Due to survey times for species credit species, it has been estimated that the BDAR will be ready in January 2023.</p>	Potential long-term negative
d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	<p>There would be temporary aesthetic impacts during construction of the proposal due to construction equipment and activities.</p> <p>Short to Medium term impacts due to tree removal and the time it will take for replacement planting to establish</p> <p>However, in the longer-term landscaping works would restore the areas with landscape character.</p> <p>The installation of an Acoustic barrier will change the aesthetics of the locality, however this mitigation will be carefully designed to blend into the existing environment through appropriate landscaping and colour and material.</p> <p>Any loss of CPW will further place this TEC at risk of extinction. Impacts on RFEF are limited to areas with weed dominated areas in very low condition of the TEC and offset obligations are met, the proposed project will not result in significant impacts on RFEF. Further, CPW and RFEF represent primary habitat for the CPLS. Any impacts to the threatened CPLS would have negative impacts on the scientific and environmental quality of the locality. A</p>	Potential long-term negative

Factor	Comment	Impact
	BDAR has commenced to further assess these impacts and offsets will likely be required.	
e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?	<p>Section 0 and Section 6.7 outline the proposal's impact on Non-Aboriginal and Aboriginal heritage within the Study Area.</p> <p>No non-Aboriginal heritage items were found within the Study Area however one heritage place is located within 280 metres of the proposed works site; however, this is well set back from the road and is unlikely to have an impact on the heritage values of Werrington House.</p> <p>An Aboriginal Due Diligence Assessment was conducted for the project. No aboriginal sites or places were found within the Study Area and the archaeological potential was found to be low.</p>	Minor, or neutral impacts
f) Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)?	Section 6.8 outlines the proposal's effects on biodiversity within the Study Area. The ecological assessment determined that there is habitat within the Study Area that is suitable for threatened species. Therefore, the proposal has the potential to have a negative impact on the habitat of protected fauna, CPLS and Southern Myotis. Therefore, Council opted into the BOS and preparation of a BDAR.	Potential long-term negative
g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?	As referred under (c), (d) and (e), the need of a BDAR was determined for the project, due to the potential impacts of the project on CLW, CPLS and Southern Myotis. The BDAR will detail the impacts that the development may have on the identified threatened biodiversity and will provide recommendations to help ameliorate the impacts. The BDAR is expected to be completed in early 2023.	Potential long-term negative
h) Any long-term effects on the environment?	Subject to the implementation of mitigation measures outlined in Section 6 the project would not result in any long-term effects on the environment.	No impact
i) Any degradation of the quality of the environment?	<p>The construction phase would have temporary impacts on nearby residences and business through increases in noise and vibration, changes to traffic conditions, changes to the visual amenity of the area, and possible increases in dust and air emissions. There is also the risk of erosion and sedimentation, and chemical spills and pollution, to the environment from construction activities.</p> <p>These impacts would be minimised through the implementation of mitigation measures which are outlined in Section 6 to reduce the impact to any environmental degradation as a result of the project.</p>	Minor, short-term negative
j) Any risk to the safety of the environment?	<p>Construction related activities pose potential risks to the safety of the environment through spills/leaks of fuel, oil or other chemicals.</p> <p>The movement of construction traffic near residential area and the closure of footpaths and cycle ways could increase the risk of safety to individuals however this would be managed through a TMP.</p> <p>Impacts would be minor-medium with the implementation of the mitigation measures identified in Section 6.</p>	Minor-medium, short-term negative
k) Any reduction in the range of beneficial uses of the environment?	The Dunheved Road upgrade will overall benefit residents and road users by improving traffic flows and reducing congestion along Dunheved Road and reducing traffic queues at associated intersections.	Long-term positive

Factor	Comment	Impact
l) Any pollution of the environment?	<p>Construction related activities may result in pollution of the environment through spills/leaks of fuel, oil or other chemicals. Other potential impacts include erosion and sedimentation, additional exhaust emissions associated with construction vehicles, plant and equipment, and the generation of waste.</p> <p>Low risk of contamination based on limited testing. However, if deeper excavations are required in the vicinity of Petrol Stations further investigations will be required.</p> <p>Waste from excavated material must also be managed correctly so soils are disposed of correctly and to ensure soils being reused for fill are not contaminated.</p> <p>Impacts would be minor with implementation of the mitigation measures as identified in Sections 6.3.9, 6.4.3 and 6.10.3.</p>	Minor, short-term negative
m) Any environmental problems associated with the disposal of waste?	<p>Section 6.10 outlines the existing waste sources and identifies mitigation measures to ensure all wastes generated on site are disposed of appropriately and do not cause any adverse environmental impacts.</p> <p>Section 6.3 outlines potential waste and contamination impacts from excavated soils and protocols for the reuse of soils on site or the disposal of soils to an offsite facility.</p>	Minor, short-term negative
n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?	Where possible, throughout the design of the proposal, management and conservation of natural resources has been incorporated. This has included minimising vegetation removal to reduce the potential impact to the environment	No impact
o) Any cumulative environmental effect with other existing or likely future activities?	<p>Section 6.11 discusses cumulative impacts of the project. There is potential for cumulative impacts on traffic and in relation to noise if there are concurrent construction at the time of construction. These impacts would be managed in accordance with the mitigation measures in 6.11.2.3.</p> <p>Cumulative noise impacts and suitable mitigation are also discussed in Section 6.2.</p>	Minor, short-term negative
p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?	The proposal is not located in the coastal zone	No impact
q) Any applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1?	The Penrith LGA is expected to have a surge in growth relating to population and economically through jobs. The Penrith Local Strategic Planning Statement highlights how this growth would be managed into the future. The Dunheved Road upgrade would contribute to the objectives of this plan by reducing current congestion and improving traffic flows for future generations.	Long-term positive
r) Any other relevant environmental factors?	No additional environmental factors are anticipated to be impacted by the proposed works.	None

8 Justification and Conclusion

The REF has assessed the potential environmental impacts that may arise from the proposed works. The factors listed in the EPBC Act and under Clause 171 of the EP&A Regulation have been addressed in Section 7 to demonstrate that the likely impacts of the proposal on the natural and built environment have been fully considered.

8.1 Justification

The proposal is justified to meet Council's objectives to improve reduce traffic along Dunheved Road and improve traffic flow and safety at twelve intersections within the Study Area. Dunheved Road is currently a two-lane two-way road for majority of the Study Area and provides access between Richmond Road, a main arterial road at the western end and Werrington Road and Christie Street, two regional roads at the eastern end.

The traffic modelling conducted and reported in this REF identified that the section of Dunheved Road in the Study Area and majority of the associated intersections are likely to fail by 2036 if nothing is done to the existing road. The do-nothing option would result in continues delays and declines in traffic flow along Dunheved Road and the roads that it intersects. These traffic flows are expected to worsen as traffic flows increase with future predicted population increases and growth in jobs within the area. Council has considered the need for the project and taken into consideration the benefits and impacts from the project and it has been determined that the beneficial outcome of the road upgrade outweighs the negative impacts provided that the mitigation measures presented in this REF are implemented and adhere to the objects of the EP&A Act.

The objects of the EP&A Act are considered in Table 8-1.

Table 8-1 Assessment against the objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	<p>As outlined in this REF document, the proposed development will cause short term disruptions to the commercial area of Werrington Village for businesses and locals that use the shops. However, this will be managed closely through a TMP and worked will be staged to minimise these disruptions as much as possible.</p> <p>Acoustic Noise barriers are recommended to ameliorate impacts from cumulative noise impacts.</p> <p>There will be medium term impacts to amenity from tree removal and the period required for replacement plantings to establish.</p> <p>In the long term the proposal would result in community benefits by improving road safety, decreasing travel times and increasing the capacity of the road network to support future growth in the area.</p> <p>Mitigation measures and offsets had been proposed to manage residual environmental impacts which could not be avoided after project design improvements. Further, the BDAR will detail the impacts that the development may have on the identified threatened biodiversity and will provide recommendations to help ameliorate the impacts.</p>
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental, and social considerations in decision-making about environmental planning and assessment.	<p>The preparation of this REF in line with legislative requirements will facilitate sound environmental planning and assessment. This document considers ecologically sustainable development by integrating economic, environmental, and social considerations to assist with decision making.</p>
1.3(c) To promote the orderly and economic use and development of land.	<p>The proposal is an upgrade to the road network over four suburbs within the Penrith LGA and overall would improve traffic flow, reduce travel times, and improve safety within the area. The development would primarily be located within the existing road corridor however some land acquisitions will be required; however, these will be minimized through the design process wherever possible</p>

Object	Comment
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The BAR has assessed threatened communities and species within the Study Area. Mitigation measures and offsets had been proposed to manage residual environmental impacts which could not be avoided. The BDAR will detail the impacts that the development may have on the identified threatened biodiversity and will provide recommendations to help ameliorate those impacts.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The works are not expected to impact on any non-Aboriginal or Aboriginal cultural heritage. The impacts of the project on heritage are not considered significant (refer Section 0 and Section 6.7 ; Austral 2021).
1.3(g) To promote good design and amenity of the built environment.	The proposed development has been carefully designed and modifications made in consultation with technical experts, the community, and stakeholders. Where applicable best practice design principles have been applied. Environmental advice has been sought throughout the design process and efforts have been made to ensure minimal impacts to amenity including visual impacts.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	The proposal is being undertaken by the local council (Council). The project is being funded by the Australian Government who has committed \$127 million for this project through the Urban Congestion Fund to ease congestion and address safety issues that have been raised by residents within the area.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Community engagement undertaken for the project is outlined in Section 5.3 . Further consultation may be undertaken with owners of land that is being acquired for the works. The REF will be put on public exhibition on 15 August 2022.

8.2 Ecologically sustainable development

8.2.1 The precautionary principle

This principle states ‘if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation’. Evaluation and assessment of alternatives for the proposed development have aimed to reduce the risk of serious and irreversible impacts on the environment. Specialist studies were carried out for key issues to provide accurate and impartial information to assist in the development process.

The BAR results conclude that the project will require clearing of up to 5.15 ha of native vegetation. Up to 1.34 ha of CPW and up to 0.22 ha of RFEF will require removal, which are important vegetation and represent primary habitat for the CPLS. The loss of CPW due to the project will further contribute to loss of extent of this critically endangered community and this loss is most likely a significant impact on its long-term presence. As such, under a precautionary approach, the BAR recommended to consider a referral under the EPBC Act to the Commonwealth Government regarding the potential impacts of the project to this community.

Further, Council has opted into the BOS and preparation of a BDAR has commenced, to further assess the impacts mainly on CPW and CPLS, and offsets will likely be required. Results from the BDAR surveys are expected in early 2023.

The proposed development has sought to minimise impacts where possible. A number of safeguards have been proposed to minimise potential impacts as were described in this REF document. These safeguards would be implemented during construction and operation of the project.

A CEMP would be prepared before construction starts. This requirement would ensure the project achieves a high-level of environmental performance. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

8.2.2 Intergenerational equity

This principle states, 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.'

The proposed development would result in some short to medium term impacts to local amenity however would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations. Additionally, the overall project will have a long-term positive impact for the local community and will reduce the potential future issues for the local community by providing a safer and more efficient transportation system.

The proposed development would benefit future generations by improving efficiency and functionality of the road network, and would assist in meeting the increased demand of road users as population numbers grow and future development and land use changes within the Penrith LGA occur. The project would also reduce potential congestion within the surrounding road network and improve safety for motorists, pedestrians and cyclists. Should the revised proposal including the proposed modification not proceed, the principle of intergenerational equity may be compromised, as public safety may be affected by future traffic incidents that may occur.

8.2.3 Conservation of biological diversity and ecological integrity

This principle states the 'diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.

As previously mentioned, the proposed development would reflect the findings and recommendations of the BDAR currently being developed. Results from the BDAR surveys are expected in early 2023.

8.2.4 Improved valuation, pricing and incentive mechanisms

This principle requires that 'costs to the environment should be factored into the economic costs of a project'. This REF has examined the environmental impacts and benefits of the project and identified safeguards and management measures to mitigate the potential for adverse impacts. The requirement to implement these safeguards and management measures would result in an economic cost to Council. The implementation of safeguards and management measures would increase both the capital and operating costs of the project. This signifies that those environmental resources have been given appropriate valuation.

8.3 Conclusion

The proposed works along Dunheved Road and surrounding streets are subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and considered to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity based on the information available.

This has included consideration where relevant, conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposed development have been avoided or reduced during the design development and options assessment. The proposed development as described in the REF best meets the project objectives, though would still result in some impacts. Safeguards and management measures as detailed in this REF would minimise these expected impacts. Section 6 of this REF provides assessment of the impacts of the project in accordance with Clause 171 of the EP&A Regulation. The factors for consideration under Clause 171 have been addressed in Section 7.

While the project will have short term disruptions to community and business during the construction phase, the long-term outcomes of the projects have strong socio-economic benefits associated with improvements to the road network from reduced traffic and improvements to traffic flows and road safety. These impacts would benefit the local community and visitors using the road infrastructure. It is therefore expected that the Dunheved Road upgrade would have positive implication for the future health and wellbeing within the community.

The assessment shows the majority of negative impacts would be temporary/short term during construction phase of the project for traffic and transport, access, construction noise and vibration, hydrology, air quality, non-Aboriginal heritage and socio-economic values.

There will be medium term negative impacts in relation to the removal of trees and the period during which landscaping and enhancements would require to establish. The REF details mitigation measures that will ameliorate or minimise these expected impacts.

The Traffic Noise Assessment demonstrated that affected properties would exceed noise management levels regardless of the project proceeding. However, suitable noise mitigation has been recommended in line with noise guidelines, including the installation of acoustic noise barriers which will assist with the minimisation of noise impacts from the proposed development.

Up to 5.15 ha of native vegetation would be removed including 1.34 ha of CPW and up to 0.22 ha of RFEF TECs. These are important vegetation communities representing primary habitat for the threatened CPLS. The loss of CPW due to the project will further contribute to loss of extent of this critically endangered listed TEC and this loss is likely to have a significant impact on the long-term presence of the CPW and the associated CPLS. As such, it is recommended that a referral be considered to DCCEEW under the Commonwealth EPBC Act regarding the potential impacts of the project on the CPW listed threatened community.

The 0.22 ha of RFEF proposed to be removed are part of larger patches in the locality and the removal would not affect its viability within and adjoining the Study Area.

Additionally, the proposed road upgrade could potentially have an adverse effect on the life cycle of the microbat species Southern Myotis. Additional assessment of its habitat will be undertaken in the BDAR.

Council has opted into the BOS and preparation of a BDAR has commenced to further assess the predicted impacts and offsets will likely be required. Results from the BDAR surveys are expected in early 2023. The Department of Planning and Infrastructure (DPE) via their Environment and Heritage Group (EHG) has confirmed that DPE concurrence on the BDAR for the proposed project is not required. DPE's EHG indicated that the consent authority (i.e., Council) is responsibly to ensure adequacy of the BDAR for inclusion in the REF.

Overall, the proposal would provide improved travel times, improved traffic and improved road user safety. The Dunheved Road upgrade works would contribute to an improving efficiency and functionality of the road network and would assist in meeting the increased demand of road users as population numbers grow and future development and land use changes within the Penrith LGA occur. The project would also reduce potential congestion within the surrounding road network and improve safety for motorists, pedestrians and cyclists.

On balance the proposed modification is considered justified, and the following conclusions are made:

Significance of impact under NSW legislation

The proposed development would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister under Division 5.2 of the EP&A Act.

A Biodiversity Development Assessment Report is currently being undertaken because of the potential for significant impacts on listed TEC under the BC Act

The proposed development is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposed development may cause a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act, because of the clearing of 0.62 ha of CPW patches corresponding to the listed TEC under the EPBC Act. A referral to the Australian Government DECCW is recommended for consideration.

It is recommended that a Consistency Report is prepared to assess any subsequent design changes to confirm the outcomes of this REF with the Final Detailed Design.

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9 References

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APPENDIX

A

DESIGN DRAWINGS 80%

APPENDIX

B

PMST RESULTS

APPENDIX

C

CONSULTATION RESPONSES

APPENDIX

D

TRAFFIC AND TRANSPORT REPORT

APPENDIX

E

NOISE AND VIBRATION
ASSESSMENT



now



APPENDIX

F

GEOTECHNICAL INVESTIGATION

APPENDIX

G

DESKTOP CONTAMINATION
ASSESSMENT

APPENDIX

H

HERITAGE



now



APPENDIX

I

BIODIVERSITY ASSESSMENT REPORT



now



APPENDIX

J

LANDSCAPE ASSESSMENT
80% SHOWING TREES TO BE
REMOVED



now

