

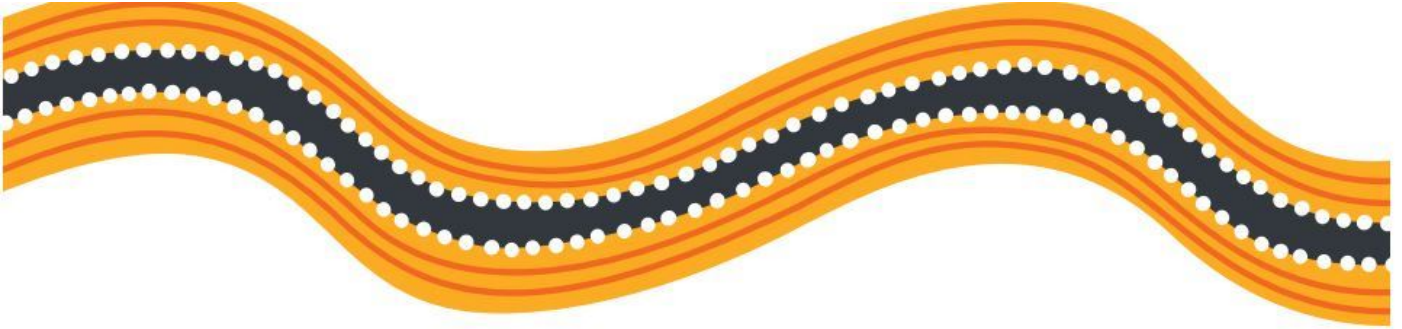


Mamre Road upgrade

Review of Environmental Factors

Dharug Country

Transport for NSW | August 2021



Acknowledgement of Country

Transport for NSW acknowledges the Dharug, the traditional custodians of the land on which the Mamre Road upgrade is proposed. We pay our respects to their Elders, past and present and celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Mamre Road upgrade Stage 1

Review of Environmental Factors

Transport for NSW | August 2021

Prepared by Aurecon Australasia Pty Ltd and Transport for NSW
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Executive summary

The proposal

Transport for NSW (TfNSW) proposes to upgrade about 3.8 kilometres of Mamre Road between the M4 Motorway, St Clair and Erskine Park Road, Erskine Park to a four-lane divided road (the proposal). The proposal forms Stage 1 of the larger Mamre Road upgrade project, which is proposed to be delivered by TfNSW in two stages.

Key features of the proposal include (refer to Figure 3-1):

- an upgrade of Mamre Road to a four-lane divided road with a wide central median that would allow for widening to six lanes in the future, if required
- changes to intersections with Mamre Road including:
 - an upgrade to the existing signalised intersection at Banks Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Solander Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Luddenham Road with new turning lanes
 - an upgrade to the existing signalised intersection at Erskine Park Road with new turning lanes
 - modified intersection arrangements (left in, left out only) at McIntyre Avenue and Mandalong Close
- a new shared path along the eastern side of Mamre Road and provision for a future shared path on the western side
- reinstatement of bus stops near Banks Drive with provision for additional bus infrastructure in the future
- changes to property access to Mamre House, Erskine Park Rural Fire Service and other private properties
- drainage and flooding infrastructure upgrades including culvert crossings, water quality basins, grass swales and channel tail-out work
- new traffic control facilities including new traffic signals and relocation of existing electronic variable message signage
- roadside furniture and street lighting
- noise walls along the eastern side of Mamre Road at St Clair
- utility relocations
- establishment of temporary ancillary facilities to support construction including compound sites, stockpile and laydown locations, temporary access tracks, temporary waterway crossings and concrete batching plants

Subject to approval, construction is expected to commence in 2022 and be completed in late 2025.

Construction of the proposal is planned to be carried out in two stages: early work and main construction work. Early work would involve utility relocations, site establishment activities, property adjustments and other low impact work required to facilitate construction. The main construction work for the proposal would mostly involve road widening, intersection upgrades, drainage upgrades, shared path and noise wall construction. Traffic staging would be used during main construction work to allow Mamre Road to remain operational during construction and minimise traffic impacts.

Need for the proposal

Mamre Road is a State arterial road that services north-south journeys for freight, general traffic and public transport in Western Sydney and provides connections to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis. The NSW Government has identified the need to progressively upgrade arterial roads in Western Sydney to support predicted future economic and residential growth in the area. An upgrade of Mamre Road would provide an improved link between the M4 Motorway in the north and Elizabeth Drive in the south. Elizabeth Drive would connect to the future M12 Motorway, which is expected to open in 2026 and would provide the main road access to the Western Sydney Airport.

Mamre Road currently experiences congestion during peak traffic periods. Traffic modelling shows that the average speed along Mamre Road was 34 kilometres per hour in the afternoon peak period in 2020, which was substantially lower than the 80 kilometres per hour speed limit. The average speed is predicted to decline to about 12 kilometres per hour in the afternoon peak period by 2036 due to increased traffic volumes along Mamre Road. The proposal would provide increased road capacity along Mamre Road, with an additional lane in each direction, to cater for the projected increase in traffic. The proposal would also preserve a wider road corridor to allow for further upgrades to a six-lane road along Mamre Road, if required in the future.

The Mamre Road upgrade project was initially developed as a longer length project that extended from the M4 Motorway, St Clair to Kerrs Road, Mount Vernon. Since then, community concern regarding the safety of Mamre Road for residents within St Clair and Erskine Park has led to the prioritising of the section of Mamre Road between the M4 Motorway and Erskine Park Road for upgrade. Road safety would continue to deteriorate along Mamre Road as traffic levels and congestion increases from planned growth in the area. As a result, the Mamre Road upgrade project has been split into two stages for delivery with Stage 1 (the subject of this proposal) being delivered first due to funding availability and the immediate priority to improve road safety.

Proposal objectives

The objectives of the proposal are to:

- improve road safety in line with the *NSW Road Safety Strategy 2012-2021* Safe System Directions and Safer Roads Key Focus
- improve movement and travel times between the M4 Motorway and Erskine Park Road for general traffic, freight and bus services operating along the corridor
- support economic growth and productivity by providing increased road capacity for the projected traffic volumes on Mamre Road
- improve quality of service, sustainability and liveability by providing facilities for walking, cycling and future public transport needs and improving the urban design of the road corridor
- maintain a safe and efficient environment for all road users

Options considered

Four strategic options were identified for the proposal: a 'do nothing' option, widening along the western side, widening along the eastern side and a new alignment option. These options were investigated and assessed with respect to development criteria which included consideration of existing and planned development, road safety and suitability for users, traffic and access impacts, environmental impacts, property acquisition and amenity and value for money. Widening Mamre Road along the western side was determined as the preferred option due to its ability to achieve the proposal objectives and optimise the use and suitability of Mamre Road with relatively less property acquisition and amenity impacts compared to widening along the eastern side or a new alignment. However, the preferred option would result in greater impacts on biodiversity and heritage compared to the 'do nothing' option or widening along the eastern side. As a result, the design refinement for the preferred option focused on avoiding or minimising these impacts, wherever possible.

A key design refinement was associated with identification of a 'vegetation clearance boundary' within the proposal area (refer to Figure 6-1), beyond which no vegetation clearance would be permitted. The process of developing this boundary involved optioneering to refine the footprint of permanent aspects of the design with an aim to reduce biodiversity impacts. The area between the vegetation clearance boundary and the proposal area is considered a 'no-go' zone for construction activities. The design was also specifically refined to avoid or minimise heritage impacts near the Mamre House State heritage curtilage and Aboriginal heritage sites.

Statutory and planning framework

The proposal is for the purpose of a road and is to be carried out by TfNSW, which is a public authority. In accordance with Clause 94 of State Environmental Planning Policy (Infrastructure) 2007 (ISEPP), the proposal can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from council is not required. This REF fulfils Transport for NSW's obligation under Section 5.5 of the EP&A Act including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

An assessment of the proposal concluded that it would be likely to significantly impact Cumberland Plain Woodland, which is listed as a critically endangered ecological community (CEEC) under both the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A referral is not required for proposed road activities that may affect nationally listed threatened species, endangered ecological communities and migratory species as the requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted by the Australian Government in September 2015. This REF has been prepared to meet the requirements of the EPBC Act strategic assessment approval for TfNSW Division 5.1 road activities.

The proposal is not likely to have a significant impact on other matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

Community and stakeholder consultation

TfNSW carried out a targeted community consultation campaign between November and December 2017 during the display of the strategic design of the Mamre Road upgrade project. This provided an opportunity for early community and stakeholder feedback on the proposal. The campaign included a media release, newspaper advertisements and distribution of a community update newsletter via a letterbox drop to local properties.

Since then, TfNSW has progressed planning the Mamre Road upgrade Stage 1 between Erskine Park Road to M4 Motorway, St Clair, which has been informed by the feedback received from the community. Community involvement during concept design development and preparation of the REF for the proposal has included one-on-one meetings with stakeholders and community updates regarding the progress of the proposal. The project community website, phone line and email address have been available since 2017.

Various government agencies and key stakeholders have been directly consulted about the proposal, including consultation with (but not limited to):

- Penrith City Council and State Emergency Services in accordance with the ISEPP due to potential impacts on local roads and proposed work within flood liable land that may change flood patterns
- DPI Fisheries in accordance with the FM Act due to potential impacts on key fish habitat
- Heritage NSW due to potential impacts on Mamre House, which is listed on the State Heritage Register
- Aboriginal stakeholders in accordance with the requirements of TfNSW's *Procedure for Cultural Heritage Consultation and Investigation* (Roads and Maritime Services, 2011) and the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010a)
- Other stakeholders that may be directly impacted by the proposal including Catholic Care (Mamre House), Office of Strategic Lands, NSW Rural Fire Service and utility providers.

The issues raised by the community, government agencies and key stakeholders were considered in the proposal design, options assessment and/or addressed in the REF (refer to Chapter 5). TfNSW will continue to seek feedback as the proposal progresses, including during detailed design and construction.

Environmental impacts

Biodiversity

The design for the proposal has been specifically refined to minimise removal of native vegetation, where possible. However, there is limited cleared space for widening of Mamre Road, which means that direct impacts on endangered ecological communities (EECs) could not be completely avoided. The proposal would involve removal of up to 9.38 hectares of native vegetation, including:

- 3.63 hectares of moderate condition PCT 849 Cumberland shale plains woodland (CEEC under the BC Act and EPBC Act)
- 0.92 hectares of low condition PCT 849 Cumberland shale plains woodland (CEEC under the BC Act)
- 2.84 hectares of moderate condition PCT 835 Cumberland riverflat forest (EEC under the BC Act and CEEC under the EPBC Act)
- 1.52 hectares of low condition PCT 835 Cumberland riverflat forest (EEC under the BC Act)
- 0.47 hectares of PCT 1800 Cumberland Swamp Oak riparian forest (EEC under the BC Act).

The biodiversity development assessment report (BDAR) prepared for the proposal concluded that the proposal may have a significant impact on Cumberland Plain Woodland. This vegetation removal may also lead to a reduction of fauna habitat for threatened species within the proposal area, including Cumberland Plain Land Snail and Southern Myotis microbats. There may also be a risk of fauna injury and mortality from construction vehicle and equipment movements. Safeguards and mitigation measures have been proposed to manage and minimise these impacts where possible (refer to Section 6.1.4). Biodiversity offsets required for the proposal in accordance with the Biodiversity Assessment Methodology (BAM) have also been identified (refer to Section 6.1.5).

Aboriginal cultural heritage

While impacts on Aboriginal cultural heritage have been avoided where possible, there are some residual impacts. This is due to the presence of Aboriginal sites close to the existing road corridor along the western side of Mamre Road, where there has been limited previous development or ground disturbing activities. The Aboriginal cultural heritage assessment report (CHAR) concluded that the proposal is likely to directly impact eight Aboriginal archaeological sites, of which four sites would have a total loss of value and four sites would be at least partially impacted.

TfNSW would apply for an Aboriginal heritage impact permit (AHIP) prior to any impact or harm to any sites. The proposal area also overlaps an area that is already covered under an existing AHIP. The design and construction methodology for the proposal will continue to be refined to further minimise impacts to Aboriginal cultural heritage. For example, since the preparation of the CHAR, several 'no-go zones' within the proposal area have been defined as a result of refinement of the vegetation clearance boundary and property acquisition areas. This would reduce the potential direct impact area on Aboriginal heritage compared to what has been conservatively assessed in this REF.

Non-Aboriginal heritage

The proposal would result in direct and indirect impacts on the Mamre House heritage property, which is a Georgian style homestead that is listed on the State Heritage Register, *Penrith Local Environmental Plan 2010* and a Section 170 register. These impacts would occur during construction and operation due to a new driveway, relocated utilities, roadside signage and the embankments of the widened road being located within and near the heritage curtilage. The existing driveway access to Mamre House would be closed, with access to the site to be provided via a new driveway connected to the Banks Drive western sub and U-turn facility. The proposal would not directly impact the Mamre House homestead buildings.

The proposal would also result in minor impacts on two locally listed non-Aboriginal heritage items during construction and operation: Marsden Memorial Cairn and Luddenham Road Alignment.

The design for the proposal has minimised impacts on non-Aboriginal heritage through sympathetic urban and landscaping designs and identification of heritage interpretation opportunities based on specialist heritage advice. TfNSW would apply for a s60 permit under the *Heritage Act 1977* prior to work within the Mamre House SHR curtilage as well as any other permits, as required.

Traffic and transport

During operation, the proposal would result in benefits to traffic, transport and access including:

- faster travel speeds and major travel time savings along Mamre Road during both morning and afternoon peak periods
- improved road safety by:
 - reducing congestion at key intersections along Mamre Road, which would reduce rear-end crashes
 - providing a new shared path for pedestrians and cyclists along the eastern side of Mamre Road, which would avoid the need for cycling or walking on-road next to heavy traffic
 - reducing risk of head-on crashes due to the central median and dual lanes separating vehicles
 - introducing traffic signals at key intersections, which would reduce the potential for people to attempt unsafe turns to or from side roads
- improved pedestrian and cyclist infrastructure through the provision of a new shared path along the eastern side of Mamre Road that would provide connectivity to existing local and regional routes.

However, there would be inconvenience and increased travel time for regular users of the Mandalong Close and McIntyre Avenue intersections due to the proposed change to these intersections to be left-in, left-out only. This change is due to the new central median along Mamre Road, which would restrict right-turn movements from these intersections. Other properties including Mamre House and the Erskine Park Rural Fire Service station, would also be provided revised access, as existing property accesses would be directly impacted by the proposal. The U-turn facilities on the western side of the Banks Drive and Solander Drive intersections would assist with vehicles turning around on Mamre Road, to minimise inconvenience due to the changed property access arrangements.

The construction of the proposal would be staged to generally provide one lane of traffic in each direction and allow Mamre Road to remain operational throughout construction. In most cases, construction work would be completed behind barriers during standard construction working hours. However, where this is not practical, construction work would be carried out during night-time and weekend lane closures with traffic control to divert or detour vehicles for short periods, which may result in traffic delays. Construction may also increase travel time along Mamre Road due to a reduced posted speed limit and the temporary signalisation of the Solander Drive and Luddenham Road intersections.

Access for pedestrians and properties would be maintained for the duration of construction, where possible. However, short detours and alternative temporary paths around construction areas may be required to maintain safe access. An alternate route would be proposed for cyclists until the new shared use path is constructed. Construction would also require the temporary relocation or closure of existing bus stops within the proposal area on Banks Drive, Mamre Road near Mamre House and Erskine Park Road and minor temporary changes to bus routes 776 and 779.

Noise and vibration

During construction, 'Highly Intrusive' daytime noise impacts are predicted at the nearest residential receivers to the east and isolated nearby residential receivers to the west of Mamre Road. The highest night-time noise levels are predicted to be around 85 dB at the nearest receivers to the east, which has potential to result in sleep disturbance. The highest noise levels would be experienced during the 'utilities, early works and earthworks - peak' and 'road, pathway and intersection upgrades - peak' construction scenarios when noise intensive equipment, such as a concrete saw, is used close to residential receivers. However, the highest noise levels are only likely to occur for relatively short periods. The main potential source of vibration during construction would be vibratory rollers, which would be required during the 'road,

pathway and intersection upgrades – peak’ construction scenario. The assessment found that some receivers would be within the minimum working distance for cosmetic damage and/or the human comfort minimum working distance during the worst-case vibration scenario. Noise and vibration impacts during construction would be minimised and managed as far as feasible and reasonable in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016a).

During operation, noise levels are predicted to increase the most for sensitive receivers directly to the west of Mamre Road (between 0.5 and 1.5 dB) due to the increased expected traffic volumes along Mamre Road and the proposed widening of Mamre Road generally being to the west.

The operational noise modelling results show that 170 residential receivers and four non-residential receivers would experience an exceedance of the adopted operational noise criteria during operation of the proposal. This is expected to apply to all first-row residential receivers immediately to the east of the proposal and isolated receivers to the west. However, most residential properties to the east of Mamre Road also have existing private fencing along the boundary with the road corridor, which would likely provide some degree of noise shielding. Therefore, the assessment results are considered conservative and the noise levels experienced at residential receivers are likely to be lower than predicted. To minimise operational noise impacts, the design has proposed the installation of noise walls along the eastern side of Mamre Road near the residential area of St Clair, which are likely to be up to 4.5 metres high. At-property treatment would also be considered for properties that would still experience noise levels exceeding the adopted criteria, following installation of any noise walls.

Soil and water quality

The proposal may result in water quality impacts during construction that may affect aquatic habitat and ecosystems within South Creek, which is classified as Key Fish Habitat. The highest risk of water quality impacts is from construction activities near the Luddenham Road intersection, where the proposal is closest to South Creek. This would include minor direct disturbance to South Creek during the construction of the drainage outlets at South Creek. Several safeguards and management measures have been proposed to minimise these impacts, including the establishment of three temporary sediment basins to capture and treat runoff and implementation of erosion and sediment control measures.

During operation, water quality basins, swales and scour protection has been included in the proposal design to minimise any adverse impacts on water quality during operation.

Other impacts

Other notable impacts associated with the proposal include:

- property impacts from acquisition of up to 11.1 hectares of land, including partial and full acquisitions of government owned land, private property, Crown land and Penrith City Council classified ‘community land’
- flooding risks during construction due to location of compound sites within flood prone land
- landscape character and visual changes associated with the widened road and vegetation removal
- potential cumulative traffic impacts from simultaneous construction of the proposal and other major projects in Western Sydney
- minor localised dust, vehicle and equipment emissions during construction, including from concrete batching plant operation
- generation of waste volumes, including asbestos containing material, and the need for importation of large volumes of clean fill material during construction.

Justification and conclusion

The proposal would involve an upgrade to about 3.8 kilometres of Mamre Road to improve road safety and movement between the M4 Motorway and Erskine Park Road and support future economic and residential growth in the surrounding area.

The need for the proposal has been driven by existing community concern for road safety and existing congestion along Mamre Road which is predicted to worsen with large increases of traffic volumes expected in the future. The proposal is also aligned with several strategic policies and government strategies, such as *Future Transport Strategy 2056* (TfNSW, 2018b) and *Road Safety Plan 2021 – Towards Zero* (NSW Government, 2018c).

Several potential environmental impacts from the proposal have been avoided or reduced during design refinement. However, the proposal would still result in some long-term impacts on biodiversity, Aboriginal and non-Aboriginal heritage and traffic noise as well as some temporary traffic, water quality and noise and vibration impacts during construction. Environmental safeguards and management measures as detailed in this REF would minimise these expected impacts.

Overall, the proposal is justified on the basis that it results in long-term benefits on road safety and movement along Mamre Road that would address community concern and support planned development in the surrounding area, which is considered to outweigh the potential adverse impacts.

Display of the review of environmental factors

This REF is on display for comment between Wednesday 25 August and Sunday 26 September 2021. You can access the documents as pdf files on the TfNSW website at <https://roads-waterways.transport.nsw.gov.au/projects/mamre-road-upgrade/index.html>.

A digital REF has been produced for the proposal to display the REF in a more interactive and engaging way for the community which is available at <https://tfnsw.ee.alytics.com/mamre-road-upgrade-stage-1/home>.

It is noted that the COVID-19 Legislation Amendment (Emergency Measures) Bill 2020 has removed the requirement for physical displays of this REF. The public display of the proposal is also not planned to involve face-to-face consultation activities due to COVID-19 social distancing requirements.

How can I make a submission?

To make a submission about this proposal, please send your written comments to:

Mail: Mamre Road upgrade
Transport for NSW
PO Box 973
Parramatta
NSW 2124

Email: mamreroadupgrade@transport.nsw.gov.au

Submissions must be received by Sunday 26 September 2021.

Submissions will be managed in accordance with the TfNSW Privacy Statement which can be found here: <https://roads-waterways.transport.nsw.gov.au/about/access-to-information/my-privacy.html>.

What happens next?

TfNSW will collate and consider the submissions received during public display of the REF.

After this consideration, TfNSW will determine whether or not the proposal should proceed as proposed and will inform the community and stakeholders of this decision. If the proposal is determined to proceed, TfNSW will continue to consult with the community and stakeholders prior to and during construction.

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Appendix J	Noise and Vibration Assessment
Appendix K	Urban Design and Landscape Character and Visual Impact Assessment
Appendix L	Air Quality Impact Assessment
Appendix M	Socio-economic Impact Assessment

1 Introduction

1.1 Proposal identification

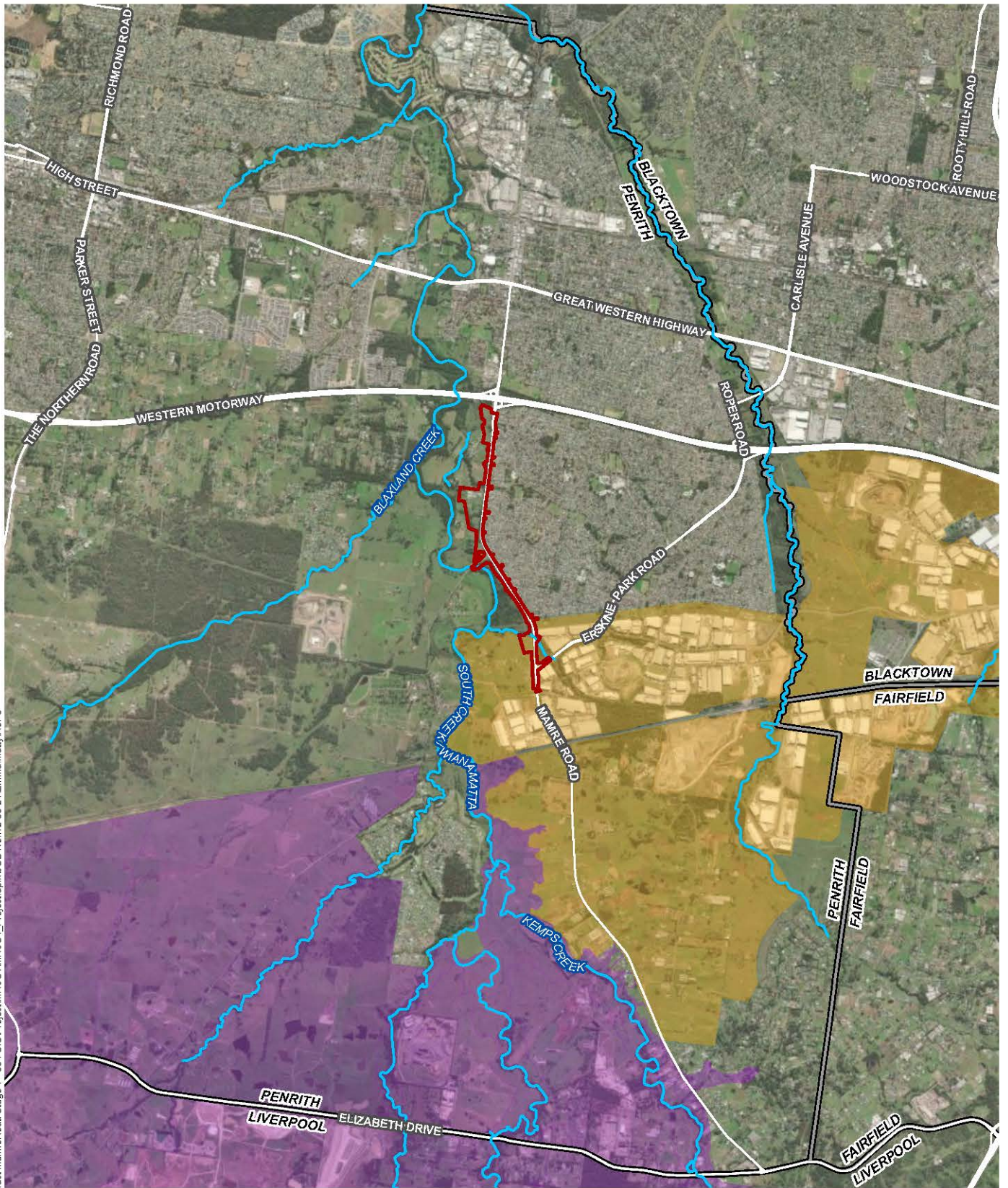
Transport for NSW (TfNSW) proposes to upgrade about 3.8 kilometres of Mamre Road between the M4 Motorway, St Clair and Erskine Park Road, Erskine Park to a four-lane divided road (the proposal). The proposal is located within the City of Penrith local government area (LGA) in Sydney, New South Wales (NSW). The proposal forms Stage 1 of the larger Mamre Road Upgrade Project, which is proposed to be delivered by TfNSW in two stages. Overall, the Mamre Road upgrade project would involve upgrades to a 10 kilometre long section of Mamre Road between the M4 Motorway, St Clair and Kerrs Road, Kemps Creek.

Mamre Road is a key transport corridor, which provides connections to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis. A key aim of the proposal is to improve road safety and movement between the M4 Motorway and Erskine Park Road through increasing the capacity of Mamre Road, which would support future economic and residential growth in the surrounding area.

Key features of the proposal would include:

- an upgrade of Mamre Road to a four-lane divided road with a wide central median that would allow for widening to six lanes in the future, if required
- changes to intersections with Mamre Road including:
 - an upgrade to the existing signalised intersection at Banks Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Solander Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Luddenham Road with new turning lanes
 - an upgrade to the existing signalised intersection at Erskine Park Road with new turning lanes
 - modified intersection arrangements (left in, left out only) at McIntyre Avenue and Mandalong Close
- a new shared path along the eastern side of Mamre Road and provision for a future shared path on the western side
- reinstatement of bus stops near Banks Drive with provision for additional bus infrastructure in the future
- changes to property access to Mamre House, Erskine Park Rural Fire Service and other private properties
- drainage and flooding infrastructure upgrades including culvert crossings, water quality basins, grass swales and channel tail-out work
- new traffic control facilities including new traffic signals and relocation of existing electronic variable message signage
- roadside furniture and street lighting
- noise walls along the eastern side of Mamre Road at St Clair
- utility relocations
- establishment of temporary ancillary facilities to support construction including compound sites, stockpile and laydown locations, temporary access tracks, temporary waterway crossings and concrete batching plants.

The location of the proposal is shown in Figure 1-1 and an overview of the proposal is provided in Figure 1-2. Chapter 3 describes the proposal in more detail.

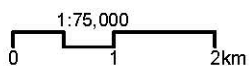


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- Watercourse
- REF proposal area
- Local government area
- Western Sydney Aerotropolis
- Western Sydney Employment Area



Source: Aurecon, Spatial Services, Nearmap, Esri

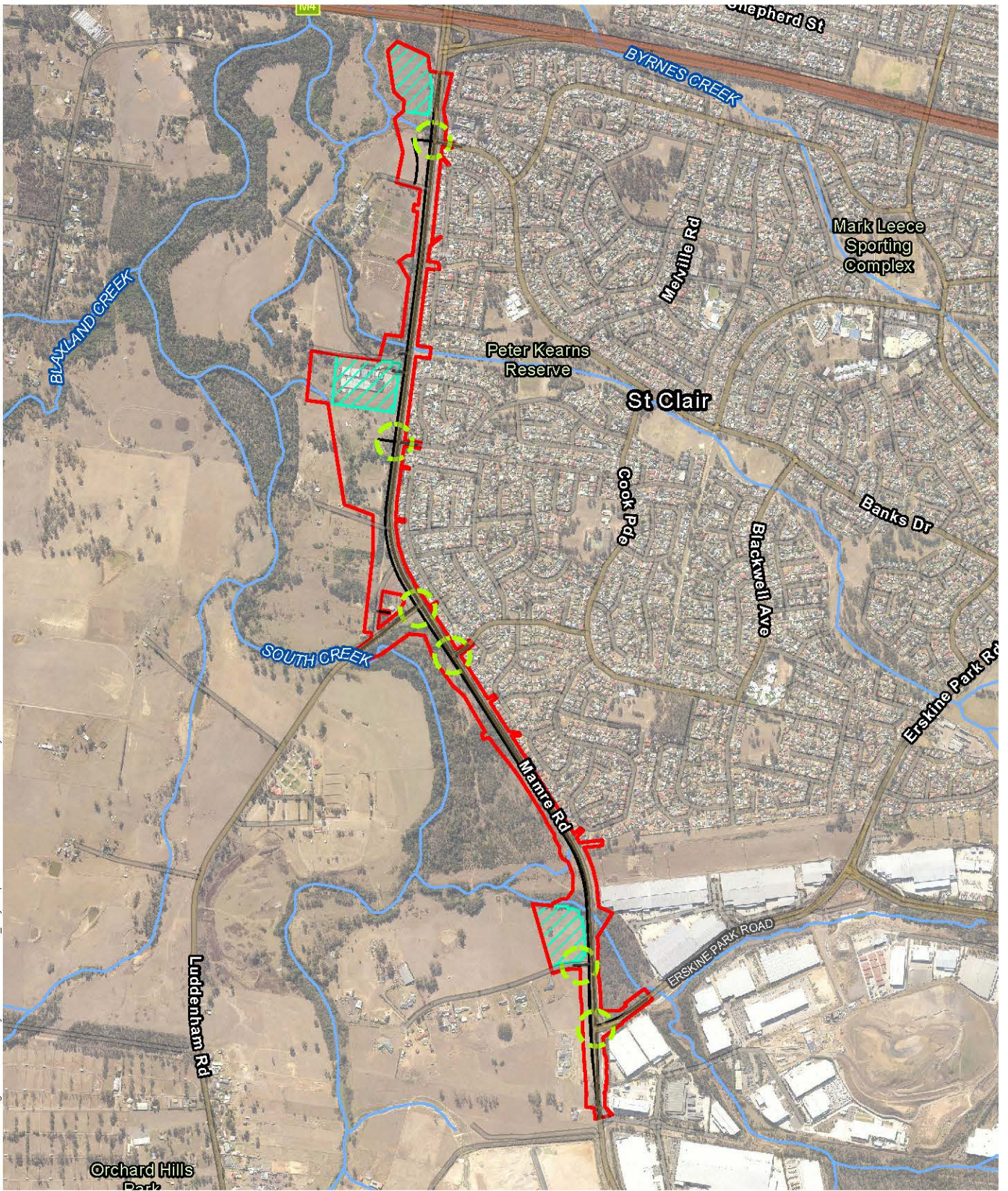


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Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 1-1: Location of the proposal

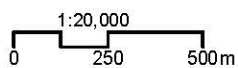


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- Waterways
- Proposed design's centerline
- - - Proposed changes to existing intersections
- Compound Sites
- REF proposal area



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 31/05/2021 Version: 2

Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 1-2: The proposal

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Aurecon Australasia Pty Ltd (Aurecon) on behalf of TfNSW (Western Parkland City – Sydney Infrastructure Development – Infrastructure and Place directorate). For the purposes of these works, TfNSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts has been undertaken in the context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), *Roads and Related Facilities EIS Guideline (DUAP 1996)*, the *Biodiversity Conservation Act 2016 (BC Act)*, the *Fisheries Management Act 1994 (FM Act)*, and the *Australian Government's Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

In doing so, the REF helps to fulfil the requirements of:

- Section 5.5 of the EP&A Act including that TfNSW examine and take into account 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 is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act
- the significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- the significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured
- the potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

2.1 Strategic need for the proposal

2.1.1 Need for the proposal

Overview

Mamre Road is a State arterial road that services north-south journeys for freight, general traffic and public transport in Western Sydney and provides connections to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis (refer to Figure 1-1).

The NSW Government has identified the need to progressively upgrade arterial roads in Western Sydney to deliver a more efficient, reliable network. This has been driven by the need for sufficient road infrastructure to support predicted future economic and residential growth in the area. This growth is mostly associated with development within the Western Sydney Employment Area, the Western Sydney Aerotropolis and the Western Sydney International (Nancy-Bird Walton) Airport (referred to as the Western Sydney Airport). An upgrade of Mamre Road between the M4 Motorway, St Clair and Kerrs Road, Mount Vernon (referred to as the Mamre Road upgrade project) was identified to be required to support economic and residential growth in the surrounding area. This upgrade would provide an improved link between the M4 Motorway in the north and Elizabeth Drive in the south. Elizabeth Drive would connect to the future M12 Motorway, which is expected to open in 2026 and would provide the main road access to the Western Sydney Airport. The M12 Motorway also includes provision for a future interchange and link between Devonshire Road and Mamre Road, however this is dependent on additional funding being available (TfNSW, 2020f).

A 40 metre wide road corridor was dedicated for the future upgrade of Mamre Road as a State Arterial Road in the 1950s. However, with the proposed M12 Motorway, which would run parallel with Elizabeth Drive and provide direct access to the Western Sydney Airport, Mamre Road is proposed to be designated as a Primary Arterial Road. As a Primary Arterial Road, Mamre Road would require a wider road corridor than the existing road corridor.

The NSW Government began planning for the Mamre Road upgrade project in 2016. The Mamre Road upgrade project was initially developed as a longer length project that extended from the M4 Motorway, St Clair to Kerrs Road, Mount Vernon. The strategic design for the Mamre Road upgrade project was exhibited for consultation between November and December 2017.

Since then, community concern regarding the safety of Mamre Road for residents within St Clair and Erskine Park has led to the prioritising of the 3.8 kilometre long section of Mamre Road between the M4 Motorway and Erskine Park Road for upgrade. In February 2019, the NSW Premier committed \$220 million to upgrade Mamre Road between the M4

Motorway and Erskine Park Road. The NSW Premier Gladys Berejiklian stated “this will transform the existing two-lane undivided road into a four-lane divided road, providing a safer, higher-capacity link. The Mamre Road upgrade will also be future proofed, allowing another two lanes to be added down the track” (NSW Government, 2019).

As a result, the Mamre Road upgrade project has been split into two stages for delivery with Stage 1 (the subject of this proposal) being delivered first due to funding availability and the immediate priority to improve road safety.

Immediate need to improve road safety and address community concern

In 2018, the State Member for Mulgoa Tanya Davies “called on the Federal Government to recognise Mamre Road as part of their strategic plans for the Western Sydney Airport and to provide urgent funding. Over 2000 residents signed the petition to see Mamre Road urgently upgraded” (NSW Government, 2019). She also stated that “every day residents of St Clair and Erskine Park must contend with the increasingly unsafe Mamre Road, battling semi-trailers, congestion and risky decisions of impatient motorists” (Tanya Davies, 2018).

The current and increasing risk of road incidents is supported by the crash history statistics from the section of Mamre Road from Banks Drive to Erskine Park Road (which includes crashes on adjoining roads close to intersections with Mamre Road). The crash history statistics from a five-year period between October 2014 and September 2019 show:

- there were 45 crashes within the proposal area, of which over half involved a serious or moderate injury (refer to Figure 2-1)
- the most common time for crashes to occur was during the morning and afternoon peak periods when traffic volumes are highest
- vehicles travelling in the same direction (mostly rear-end crashes) accounted for 56 per cent of the total crashes, which suggests that congestion may create a safety issue
- 30 per cent of crashes were at intersections along Mamre Road
- the proposal area has a crash severity index of 1.71, which is notably higher than the Sydney Metropolitan Area (1.22) and NSW (1.24).

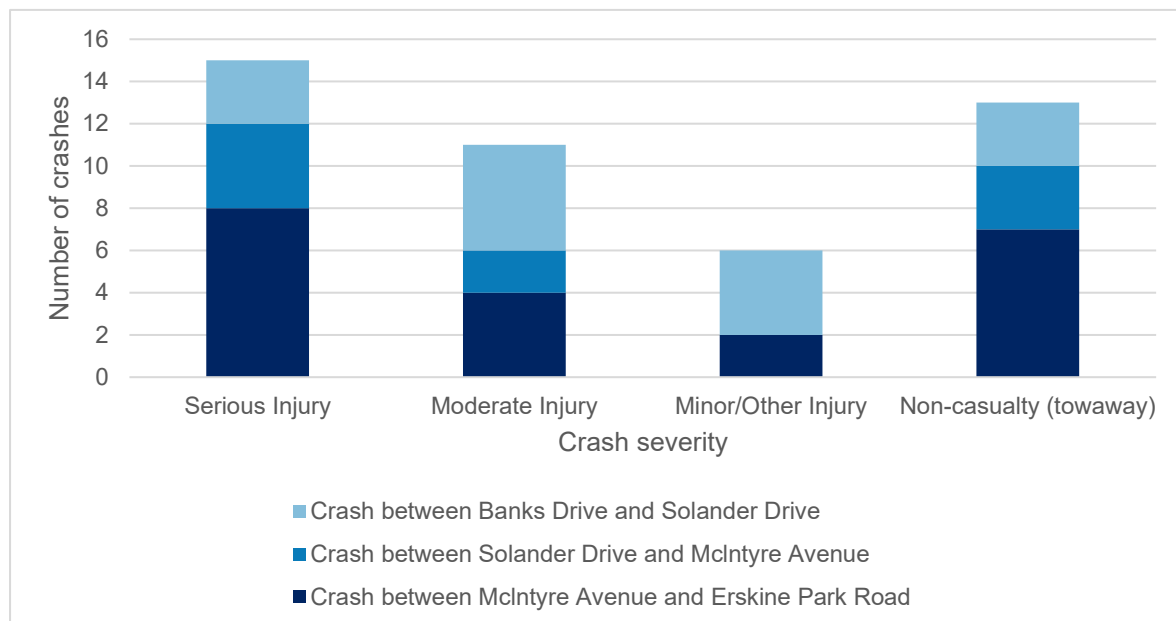


Figure 2-1: Summary of the number and severity of crashes within the proposal area between 2014 and 2019

These statistics also indicate that it is likely that road safety would continue to deteriorate along Mamre Road as traffic levels and congestion increases from planned growth in the area. This supports the need for an upgrade of Mamre Road between the M4 Motorway and Erskine Park Road in the short-term.

Long-term need to support planned developments and growth in the area

Mamre Road is located within Western Sydney, which is considered Australia's third largest economy. The population of Western Sydney is expected to grow from two million to three million people over the next 20 years. The NSW Government is planning for this growth by reserving residential and employment land for future developments.

There are several current and proposed developments served by Mamre Road that will increase population, employment and traffic congestion in the area. The area surrounding Mamre Road is particularly expected to see growth due to the nearby Western Sydney Employment Area, Western Sydney Airport and proposed Western Sydney Aerotropolis (refer to Figure 1-1).

The southern portion of the proposal area is located within the Western Sydney Employment Area. The Western Sydney Employment Area was established to supply employment land close to major road transport and provide jobs for Western Sydney.

The Western Sydney Airport, which is currently under construction and expected to open in 2026, is located about 10 kilometres south-west of the proposal area. The airport is expected to support almost 28,000 direct and indirect jobs by 2031 about five years after the airport opens. The Western Sydney Aerotropolis is a planned precinct near the Western Sydney Airport, which would provide 200,000 new jobs within aerospace and defence, manufacturing, healthcare, freight and logistics, agribusiness, education and research industries.

TfNSW has carried out traffic modelling, which indicates that at least one additional lane in each direction along Mamre Road would be required to adequately cater for current and projected traffic needs in the short to medium term. As such, there is a need to upgrade Mamre Road to a four-lane road so that it can sufficiently cater for the increased traffic volumes predicted from future developments and support the economic and residential growth in Western Sydney. The proposal would also preserve a wider road corridor to allow for further upgrades to a six-lane road or provision of additional public and active transport (walking and cycling) facilities, if required in the long-term future.

Future parkland is also expected to be established to the west of Mamre Road near the Banks Drive and Solander Drive intersection, which would require safe road access. Therefore, there is a need to consider the access needs of this surrounding future parkland in the design of any upgrade of Mamre Road.

The proposal would also complement other recent or planned road upgrades in the area including:

- Stage 2 of the Mamre Road upgrade, which would upgrade the section of Mamre Road directly south of the current proposal, between Erskine Park Drive and Kerrs Road, to a four-lane divided road.
- The M4 Smart Motorway project, which has recently been completed and included modification of the entry ramps at the M4 Motorway / Mamre Road interchange and installation of intelligent traffic system infrastructure. The M4 Smart Motorway project was aimed at improving safety, journey times and reliability along the M4 Motorway between Penrith and Parramatta.
- The proposed M12 Motorway, which is planned to open in 2026 and would provide direct access to the Western Sydney Airport. The M12 Motorway is currently proposed to be accessed from Mamre Road via Elizabeth Drive, however there is provision for a future interchange and link between the M12 Motorway, Devonshire Road and Mamre Road.
- Erskine Park Road Upgrade project, which has recently been completed by Penrith City Council. This project involved widening Erskine Park Road to a four-lane road between Bennett Road and Explorers Way and intersection upgrades to improve road safety and traffic flow efficiency.

Together these projects would improve the performance of Mamre Road in its entirety as well as the broader road network within Western Sydney to meet the future needs of the community and the economy.

2.1.2 NSW policy context

Future Transport Strategy 2056

The *Future Transport Strategy 2056* is NSW Government's vision for the next 40 years of transport in NSW (TfNSW, 2018b). The vision is based on the following six outcomes:

1. customer focused
2. successful places
3. a strong economy
4. safety and performance
5. accessible services
6. sustainability

The purpose of the Strategy is to guide integrated transport and land use planning across regional NSW and Greater Sydney. The Strategy is supported by a suite of issue-specific and place-based plans that focus on the role transport plays in the land use, tourism and economic development of towns and cities. Plans under the Strategy include the *Greater Sydney Services and Infrastructure Plan*, *Regional NSW Services and Infrastructure Plan* and *Road Safety Plan*. These plans build upon the preceding 2012 *Long Term Transport Master Plan*.

The proposal would be aligned with several outcomes of the strategy, including:

- Outcome 2 – successful places, which includes an aim to encourage active travel (walking and cycling) and using public transport. The proposal is aligned with this outcome as it would provide a new shared path along the eastern side of Mamre Road, provision for bus services as well as urban design measures to improve the sense of place.
- Outcome 3 – a strong economy, as the proposal would increase the capacity of Mamre Road to support the traffic volumes that would be generated from the planned economic growth within Western Sydney and improve freight travel times.
- Outcome 4 – safety and performance, as the proposal would improve road safety along Mamre Road for all road users.
- Outcome 5 – accessible services, as the proposal would provide provision for future bus stops along Mamre Road that are compliant with accessibility requirements.
- Outcome 6 – sustainability, as the proposal encourages walking and cycling and is expected to reduce congestion along Mamre Road.

These outcomes are also identified in *Connecting to the future – our 10 Year Blueprint* (TfNSW, 2018a), which outlines TfNSW's priorities and outcomes for the next 10 years of transport in NSW.

Road Safety Plan 2021 – Towards Zero

The *Road Safety Plan 2021 – Towards Zero* (NSW Government, 2018) is a supporting plan of the *Future Transport Strategy 2056*. The Plan sets out a framework with six priority targets to achieve the NSW Government's State Priority Target/s to reduce fatalities by 30 percent by 2021 and to achieve zero harm by 2056.

The six priority areas are:

- saving lives on country roads
- liveable and safe urban communities
- using the roads safely
- building a safer community culture
- new and proven vehicle technology
- building a safe future.

The Plan establishes the need for a 'safe system approach' to achieve the ultimate goal of zero deaths and serious injuries on NSW roads, which has four key components: safe roads, safe people, safe speeds and safe vehicles. The 'safe roads' component states that if a driver or rider makes a mistake, upgrades to road infrastructure and design can significantly reduce the chance that it will result in a fatality or serious injury. The proposal would form part of the 'safe roads' component and be aligned with the aims of this plan. It would involve road upgrades to improve the safety of Mamre Road for road users and ultimately reduce the risk of serious road incidents.

The priority areas of 'liveable and safe urban communities' and 'building a safe future' would also be addressed by the proposal. This would be achieved through consideration of Penrith City Council's Crime Prevention Through Environmental Design principles in the urban design for the proposal, as well as providing safer infrastructure for vehicles, pedestrians and cyclists along Mamre Road.

Greater Sydney Services and Infrastructure Plan

The *Greater Sydney Services and Infrastructure Plan* (TfNSW, 2018c) is a supporting plan of the *Future Transport Strategy 2056* (TfNSW, 2018b), which establishes a 40-year plan for transport in Sydney with a key focus on enabling people and goods to move safely, efficiently and reliably around Greater Sydney.

The Plan establishes several specific outcomes that transport customers in Greater Sydney can expect over the life of the Plan including:

- Customer Outcome 3: “walking or cycling is the most convenient option for short trips around centres and local areas, supported by a safe road environment and suitable pathways”. The proposal would help realise this outcome by providing a new shared path along the eastern side of Mamre Road for walking or cycling.
- Customer Outcome 9: “a safe transport system for every customer with the aim for zero deaths or serious injuries on the network by 2056”. The proposal would help realise this outcome by improving the safety of Mamre Road, which would reduce the risk of serious injuries along this road corridor.
- Customer Outcome 10: “fully accessible transport for all customers”. The proposal would provide provision for future bus stops along Mamre Road that are compliant with accessibility requirements as well as a new shared path for pedestrians and cyclists.
- Customer Outcome 12: “A resilient transport system that contributes to the NSW Government’s objective of net-zero emissions by 2050”. The proposal would help realise this outcome by providing facilities for lower emission transport (walking, cycling and future public transport needs), reducing congestion along Mamre Road and landscaping the road corridor.

NSW Freight and Ports Plan 2018-2023

The *NSW Freight and Ports Plan 2018-2023* (NSW Government, 2018b) is a supporting plan for *Future Transport Strategy 2056*. It sets the State government’s objectives on the long-term investment in the freight and logistics network, with the aim to provide assurance to the industry that these investments will not only benefit the industry but support the state economy. The primary intent of the *NSW Freight and Ports Plan 2018-2021* is to provide a transport network that allows the efficient flow of goods to their market. It aims to provide a network that minimises or eliminates congestion, supports economic growth and productivity and encourages regional development. It also aims to deliver a freight network that efficiently supports the projected growth of the NSW economy and provides a balance of freight needs with those of the broader community and environment.

The Plan details 70 initiatives to be delivered by 2023, with a focus on achieving five key objectives. These are:

- economic growth
- efficiency, connectivity and access
- capacity
- safety
- sustainability.

The Plan states that most freight movement across NSW is by road, with 80 per cent of the Greater Sydney freight task being carried out by road. The Greater Sydney freight network not only supports the demands of a growing population but also plays a role in connecting

the State and Australia to global markets. It is projected that there would be a 50 per cent increase in freight within the Greater Sydney area by 2036 (TfNSW, 2018b).

Mamre Road is an existing route approved for B-Double use and used for transportation of freight from industrial areas located on / near Mamre Road to broader Sydney through its connection with the M4 Motorway. The proposal would improve the capacity, reliability and safety of Mamre Road for freight vehicles. This would also improve the road network connection to the Western Sydney Employment Area and the Western Sydney Aerotropolis. These areas are proposed to be developed into a key location for freight and logistics, particularly for air freight travelling via the Western Sydney Airport (once operational). The Western Sydney Employment Area is also planned to include an intermodal terminal within the Mamre Road precinct (located south of the proposal area), which would be serviced by the planned Western Sydney Freight Line (DPIE, 2020c).

Greater Sydney Region Plan: A Metropolis of Three Cities

The *Greater Sydney Region Plan: A Metropolis of Three Cities* (Greater Sydney Commission, 2018a) is a 20-year plan that has been prepared along with *Future Transport 2056* and the *State Infrastructure Strategy 2018-2038* (NSW Government, 2018c), to align land use, transport and infrastructure outcomes for Greater Sydney region. The Plan has developed 10 directions (made up of 40 objectives) to manage social, economic and environmental changes. To address these changes, the objectives encourage the transformation of the Greater Sydney region into three self-sustaining, connected cities:

- the Eastern Harbour City
- the Central River City
- the Western Parkland City.

The proposal is located within the Western Parkland City, which would be established on the strength of the Western Sydney Airport and Aerotropolis. The population of the Western Parkland City is projected to grow from 740,000 in 2016 to 1.1 million by 2036.

The proposal aligns with several directions and associated objectives of the Greater Sydney Region Plan. This includes directions to achieve:

- 'A city supported by infrastructure', which includes:
 - Objective 2 – 'infrastructure aligns with forecast growth – growth infrastructure compact'. The proposal would support this objective by providing increased road capacity for the projected volumes on Mamre Road based on forecast growth within the Western Parkland City.
 - Objective 3 – 'infrastructure adapts to meet future needs'. The proposal would support this objective by providing for future road upgrades (including an additional lane in each direction), future bus stops and catering for planned development in the surrounding area.
 - Objective 4 – 'infrastructure use is optimised'. The proposal would support this objective by upgrading existing road infrastructure (Mamre Road) so that its use is optimised.
- 'A city for people', which includes objective 6 – 'services and infrastructure meet communities' changing needs'. The proposal would support the growth of and provide better connection to the communities surrounding Mamre Road. It would also improve liveability by providing facilities for walking and cycling and improving the urban design of the road corridor.

- ‘A well connected city’, which includes objective 18 – ‘freight and logistics network is competitive and efficient’. The proposal would support this objective by improving the efficiency of Mamre Road and its key intersections within the proposal area for freight and logistics.
- ‘A city in its landscape’, which includes:
 - Objective 26 – ‘a cool and green parkland city in the South Creek corridor’. The proposal would support this objective by providing landscaping within the South Creek corridor.
 - Objective 32 – ‘the Green Grid links parks, open spaces, bushland and walking and cycling paths’. The proposal would support this objective by providing increased green cover (i.e. plants) and shade along the new shared path for pedestrians and cyclists. The proposal also includes pedestrian crossing points at key intersections along Mamre Road to provide connection to the future parkland to the west.

NSW State Infrastructure Strategy 2018-2038

The *State Infrastructure Strategy 2018 – 2038 – Building Momentum* (Infrastructure NSW, 2018) is a 20-year strategy that makes recommendations on policies and projects for NSW’s key infrastructure sectors to provide a positive impact on the future of the State.

The proposal is aligned with recommendations for the Western Parkland City in the plan, which are to:

- prioritise intercity road connections to support access and provide a north-south mass transit connection, as Mamre Road would provide an improved road link:
 - to the M4 Motorway to the north and Elizabeth Drive in the south, by increasing the capacity of Mamre Road between these two roads
 - to the planned Luddenham station proposed as part of the Sydney Metro – Western Sydney Airport development by upgrading the Luddenham Road intersection that provides access to this station
- provide a freight network to support a growing city, as the proposal would increase the capacity of Mamre Road, which is an approved B-Double route used by freight.

Smart Cities Plan

The *Smart Cities Plan* (Commonwealth of Australia, 2016a) is a long-term strategy that aims to support the growth of Australian cities as further economic opportunities and challenges are presented. It includes three pillars – *Smart Investment*, *Smart Policy* and *Smart Technology* – to help ease pressures on housing affordability, access to jobs, the natural environment and traffic.

The proposal objectives align with those in the *Smart Cities Plan* through:

- assisting the realisation of '30 minute cities' by reducing the travel time for residents accessing employment, essential services, schools and recreational facilities to within 30 minutes from home
- investment in connecting outer suburbs to major cities, through improved connection to the M4 Motorway and wider Sydney, and reducing urban congestion along Mamre Road, therefore improving opportunities for isolated communities
- allowing for an integrated active transport route (through provisions for cycling and walking along Mamre Road) to promote more environmentally friendly modes of transporting large numbers of people within and between cities.

Western City District Plan

The *Western City District Plan* (Greater Sydney Commission, 2018b) sets out planning priorities and actions for improving the quality of life for residents as the Western City District grows and changes.

The proposal aligns with the following planning priorities outlined in the *Western City District Plan*:

- Planning priority W1 – planning for a city supported by infrastructure. The proposal would help realise this outcome by providing upgraded road infrastructure to support the future economic and residential growth in the surrounding area.
- Planning priority W3 – providing services and social infrastructure to meet people's changing needs. The proposal would help realise this outcome by providing an upgraded road corridor with potential for an additional lane in each direction, a new shared path along the western side and additional bus stops in the future, as the requirements of the Mamre Road corridor change.
- Planning priority W7 – establishing the land use and transport structure to deliver a liveable, productive and sustainable Western Parkland City. The proposal would increase the capacity of Mamre Road to support the traffic volumes that would be generated from the planned economic growth within Western Sydney. It would also incorporate urban design and landscaping measures as well as a new shared path to improve the liveability of the area surrounding Mamre Road.

2.1.3 Local policy context

Penrith City Council Community Plan

The *Penrith City Council Community Plan* (Penrith City Council, 2017) identifies long term community outcomes for the City, which was informed by community engagement, and strategies to achieve the outcomes.

The proposal is aligned with Outcome 2: We Plan for our future growth, as the proposal would:

- upgrade Mamre Road to a four-lane road to cater for the predicted traffic growth in the medium term
- future proof the road corridor through provision of a wide central median that would allow for a further upgrade to a six-lane road along both Mamre Road and Luddenham Road, if required in the long-term
- provide a new western stub for access to future parkland west of Mamre Road at the Banks Drive and Solander Drive intersections

The proposal is also aligned with Outcome 3: We can get around our city, as the proposal would contribute to achieving a safe and efficient road and shared pathway network within Penrith LGA.

Penrith Local Strategic Planning Statement

The *Penrith Local Strategic Planning Statement* (LSPS) was released by the Penrith City Council in March 2020. The purpose of the LSPS is to outline the Penrith LGA's economic, social and environmental land use needs over the next 20 years. The LSPS also outlines several planning priorities for the LGA.

The proposal is particularly aligned with Planning Priority 10: “provide a safe, connected and efficient local network supported by frequent public transport options”. The proposal would improve the safety and efficiency of Mamre Road, which provides a key route for road and public transport within the local road network.

2.2 Limitations of existing infrastructure

The 3.8 kilometre long section of Mamre Road proposed to be upgraded is currently a two-lane, single carriageway road with a posted speed limit of 80 kilometres per hour (except for a short section of Mamre Road near Banks Drive, which has a speed limit of 60 kilometres per hour). This section of Mamre Road currently experiences congestion during peak traffic periods. Traffic modelling shows that the average speed along Mamre Road in 2020 was 39 kilometres per hour in the morning peak period and 34 kilometres per hour in the afternoon peak period, which is substantially lower than the posted speed limit. In addition, the Banks Drive intersection with Mamre Road is currently operating at Level of Service (LOS) F in both morning and afternoon peak periods, which suggests major congestion (refer to Section 6.4.2). LOS is measured on a scale from A to F and refers to the nature of the traffic flow and how this impacts the comfort and convenience for road users.

Mamre Road is located within the Western Sydney Employment Area, near land reserved by the NSW Government for future parkland and would provide a key road link to the proposed Western Sydney Aerotropolis. Future development within the Western Sydney Employment Area and Western Sydney Aerotropolis is expected to notably increase traffic volumes and congestion in the area, including along Mamre Road. Modelling of future traffic volumes indicates that all intersections modelled within the proposal area would operate at LOS F in 2026 and 2036. In addition, the average speed along Mamre Road in 2036 is modelled to be 13 kilometres per hour in the morning peak period and 12 kilometres per hour in the afternoon peak period (refer to Section 6.4.2). This major congestion and lack of road capacity would increase travel time and make it harder for drivers to change lanes and manoeuvre around traffic.

Figure 2-2 shows a photo of the existing intersection of Mamre Road and Banks Drive, showing its use by both light and heavy vehicles (note this intersection has existing turning lanes for vehicles).



Figure 2-2: Photo of existing intersection of Mamre Road and Banks Drive looking south

Safety is a further issue that underpins the need for the proposal. Between July 2009 and June 2019 there were a total of 219 crashes on Mamre Road between the M4 Motorway and Kerrs Road, Kemps Creek, with at least one fatal crash (TfNSW 2017b, 2018d). Although accounting for only 38 per cent of this total road distance, 60 per cent or 129 of these total crashes occurred within the section between the M4 Motorway and Erskine Park Road. The casualty crash rate in this section of Mamre Road between 2014 and 2019 was 2.1 crashes per year per kilometre. This casualty crash rate for Mamre Road is higher than the NSW average of 1.8 crashes per year per kilometre for the same road type.

Some of the key intersections along the section of Mamre Road within the proposal area are currently unsignalised, including the Solander Drive and Luddenham Road intersections (refer to Figure 2-3 and Figure 2-4). This can make it difficult for vehicles to turn in and out of the intersections safely during periods of high traffic volumes along Mamre Road.

Without intervention, the forecasted increase in traffic volumes and congestion would see the deterioration of safety along Mamre Road for all road users in the future.



Figure 2-3: Photo of existing intersection of Mamre Road and Solander Drive



Figure 2-4: Photo of existing intersection of Mamre Road and Luddenham Road

The section of Mamre Road within the proposal area has a lack of continuous pathways for pedestrians and cyclists. There are relatively short sections of concrete pedestrian pathways located at the Banks Drive and Erskine Park Road intersections, however these pathways taper off on either side. There are also short sections of bicycle lanes on Mamre Road with road markings and signage indicating the lanes in some locations. However, the TfNSW Cycleway Finder (2020c) classifies Mamre Road as 'Hard Difficulty' for cycling. As shown in Figure 2-5, it is likely that this difficulty is due to the narrow width of the lanes, the closeness of fast-moving vehicles and the discontinuity of the pathway and markings.

This lack of active transport infrastructure reduces the ability for pedestrians and cyclists to safely travel along Mamre Road. There are also limited connections to existing access pathways that join Mamre Road to local residential streets in St Clair (refer to Figure 2-6).



Figure 2-5: Cyclist lane along a section of Mamre Road north of Erskine Park Road, looking north



Figure 2-6: Example of access pathway to residential streets in St Clair (looking east)

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal are to:

- improve road safety in line with the *NSW Road Safety Strategy 2012-2021 Safe System Directions and Safer Roads Key Focus*
- improve movement and travel times between the M4 Motorway and Erskine Park Road for general traffic, freight and bus services operating along the corridor
- support economic growth and productivity by providing increased road capacity for the projected traffic volumes on Mamre Road
- improve quality of service, sustainability and liveability by providing facilities for walking, cycling and future public transport needs and improving the urban design of the road corridor
- maintain a safe and efficient environment for all road users.

2.3.2 Development criteria

The development criteria for the proposal include:

- design all connections and upgrades to link to existing infrastructure while also allowing for future road upgrades and planned development in the surrounding area
- maximise the safety and suitability of Mamre Road for vehicles, pedestrians, cyclists and public transport users, including through urban design and landscaping
- optimise the design to improve constructability so it can be built with minimal traffic and access impacts for road users, utility providers and surrounding residences and businesses
- minimise adverse impacts on the environment during construction and operation of the proposal, including on native vegetation and species, water quality and heritage
- minimise private property acquisition and amenity impacts on surrounding properties, including potential noise and visual impacts
- achieve value for money.

2.3.3 Urban design objectives

Table 2-1 summarises the urban design objectives and principles that have been developed for the proposal.

Table 2-1: Summary of urban design objectives and principles for the proposal

Objective	Principle
<p>Objective 1 — Sense of place</p> <p>Recognise and enhance local places and landscape character through an appropriate landscape approach</p>	<ul style="list-style-type: none"> • reflect the distinctive landscape character along the road corridor in the design of noise wall elements and other structures and planting including Mamre House curtilage and South Creek • ensure an integrated engineering and urban design approach that incorporates place-making and community-centred design initiatives that reflect social and cultural themes of the area taking into account the broad actions set out in the TfNSW Reconciliation Action Plan • emphasise existing views to the Blue Mountains escarpment and other significant landmarks to enhance how people experience the surrounding landscape • reflect the traditional neighbourhood patterns of St Clair, east of the proposal, while enhancing the informal, scenic rural quality west of the proposal • respect and enhance significant cultural heritage values identified throughout the proposal area
<p>Objective 2 — Natural environment</p> <p>Reinforce the diversity of natural settings across the study area including waterways, bushland and remnant planting</p>	<ul style="list-style-type: none"> • emphasise connections to the wider Hawkesbury-Nepean environment and seek opportunities to celebrate local tributaries and watercourses within the road corridor • protect and reinforce sensitive environments adjacent to the road corridor including endangered ecological communities and riverine ecology • select plant species for the upgrade in accordance with Bush Fire Protection principles set out by NSW RFS and the Penrith City Council <i>Cooling the City Strategy</i>

Objective	Principle
<p>Objective 3 — Connectivity and way-finding</p> <p>Create an outcome which provides sense of place through reflecting positive aspects of the study area’s physical and community cultural setting</p>	<ul style="list-style-type: none"> • reduce the opportunity for crime, maximise passive surveillance and support safe, comfortable and enjoyable places that meet Penrith City Council Crime Prevention Through Environmental Design (CPTED) principles • design for universal access that will accommodate an increasing level of use by the general population and encourages physical activity which is vital to community health and well-being • ensure new shared user paths are integrated with existing and planned path networks set out in the <i>Penrith City Council Penrith Accessible Trails Hierarchy Strategy</i>, in particular potential upgrades of Priority Pathways • create shared user path environments that address community needs and aspirational strategies set out in the Penrith City Council Recreational and Cultural Strategy, in particular creating pleasant footpath and cycleway infrastructure to improve passive recreation activity • use architectural features including noise walls and lighting to accent pedestrian portals and road connections to help define the journey for pedestrians, cyclists, motorists and public transport users who travel at varying speeds • ensure an integrated engineering and urban design approach that reduces reliance on separate signage structures and minimises visual clutter and obstructions
<p>Objective 4 — Sustainability</p> <p>Strive for a sustainable design that considers connections to the wider environmental systems and ‘whole of life’ costs</p>	<ul style="list-style-type: none"> • investigate and mitigate the impacts caused by noise walls for residents of St Clair such as shadowing and access • incorporate water sensitive design elements to enhance waterways, in accordance with principles set out in the Penrith City Council Biodiversity Strategy and TfNSW Water Sensitive Urban Design guidelines • reinforce vegetation patterns and endangered vegetation communities to ensure continuity and connectivity of natural green corridors • select vegetation to screen and soften hard elements within the corridor, minimise visual bulk and provide a human-scale • ensure the design considers ongoing operations and maintenance and includes sustainably sourced and robust materials

2.4 Alternatives and options considered

2.4.1 Strategic corridor options

Methodology for selection of the preferred strategic corridor option

The strategic options phase for the proposal was considered as part of the broader Mamre Road upgrade project, which extended between the M4 Motorway and Kerrs Road.

The strategic corridor widening options for the Mamre Road upgrade were developed by considering different ways to achieve the desired upgraded road cross section and meet the proposal objectives. A 'do nothing' option was also identified, which allowed consideration of the consequences of not proceeding.

The desired cross section for Mamre Road once upgraded was set at about 50 metres wide, which would be able to accommodate four lanes (two lanes in each direction) with a widened median that could be removed to allow for six lanes, if required in the future. This cross section was expected to be sufficient to meet the future requirements of Mamre Road, which is planned to be designated as a Principal Arterial Road in the future due to development in the surrounding area including the Western Sydney Employment Area and Western Sydney Aerotropolis. It is noted that since these strategic corridor options were developed, the required corridor width has been refined and is wider than 50 metres in areas (refer to Section 2.5). Sections of the strategic corridor options relevant to Mamre Road upgrade Stage 1 were qualitatively assessed against the development criteria outlined in Section 2.3.2. This assessment was used to determine the preferred strategic corridor option to proceed with for Mamre Road upgrade Stage 1.

The strategic options for the future Mamre Road upgrade Stage 2 project are not discussed in this REF.

Identified strategic corridor options

The strategic corridor options identified for Mamre Road upgrade Stage 1 included:

- 'do nothing', which would involve not proceeding with upgrading Mamre Road to the desired cross section
- upgrading Mamre Road as desired by widening mostly along the western side of the existing road
- upgrading Mamre Road as desired by widening mostly along the eastern side of the existing road
- building a new road alignment separate to the existing Mamre Road corridor.

Analysis of strategic corridor options

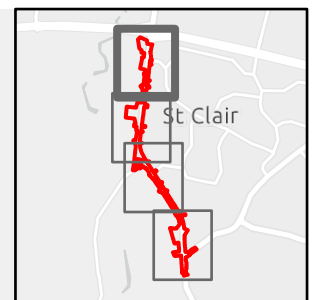
Table 2-2 presents a qualitative analysis of the strategic corridor options identified for the section of the Mamre Road upgrade project relevant to the proposal (i.e. Stage 1) compared to the development criteria outlined in Section 2.3.2.

Figure 2-7 provides a comparison of the strategic options to widen Mamre Road along the western side and eastern side. A new road alignment is not shown in this figure because this strategic option was not considered further following the assessment against the development criteria (refer to Table 2-2).

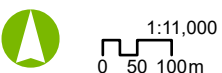


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- | | | | |
|--|--------------------|--|-----------------------------------|
| | Existing road | | Non-Aboriginal heritage |
| | Widening corridor | | Archaeological item |
| | Existing utilities | | Local heritage item |
| | Key fish habitat | | State heritage item |
| | | | Threatened ecological communities |



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 3/08/2021 Version: 2

Projection: GDA2020 MGA Zone 56

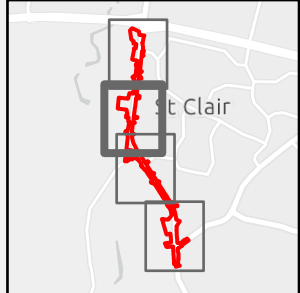
Mamre Road Upgrade Stage 1

Figure 2-7a: Strategic corridor options identified for the proposal

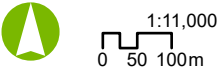


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| | Existing road | | Non-Aboriginal heritage |
| | Widening corridor | | Archaeological item |
| | Existing utilities | | Local heritage item |
| | Key fish habitat | | State heritage item |
| | Threatened ecological communities | | |



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 3/08/2021 Version: 2
 Projection: GDA2020 MGA Zone 56

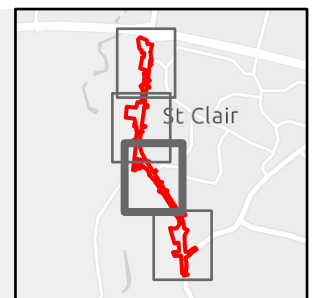
Mamre Road Upgrade Stage 1

Figure 2-7b: Strategic corridor options identified for the proposal

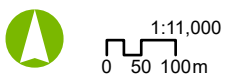


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- | | | | |
|--|--------------------|--|-----------------------------------|
| | Existing road | | Non-Aboriginal heritage |
| | Widening corridor | | Archaeological item |
| | Existing utilities | | Local heritage item |
| | Key fish habitat | | State heritage item |
| | | | Threatened ecological communities |



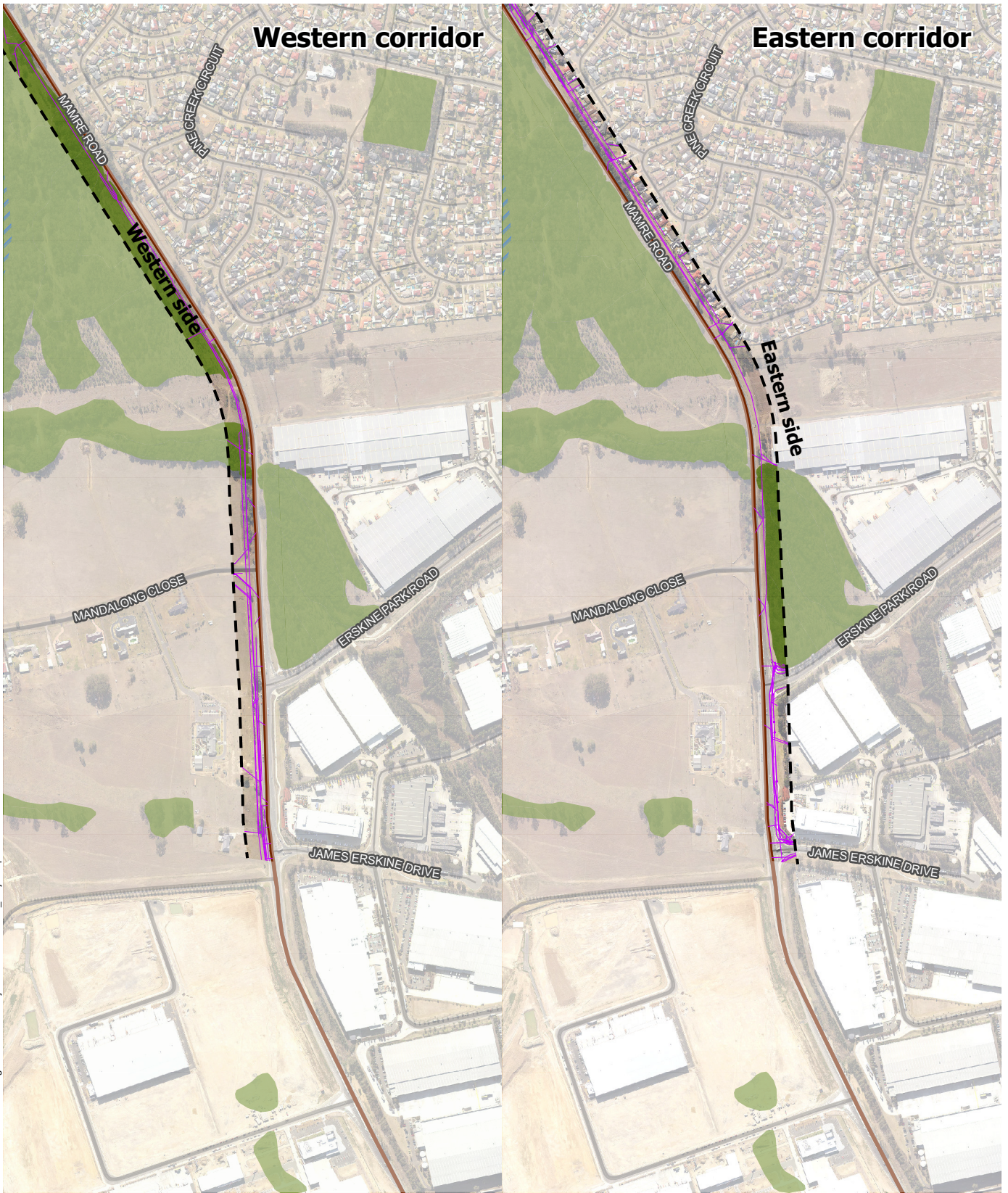
Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 3/08/2021 Version: 2
 Projection: GDA2020 MGA Zone 56

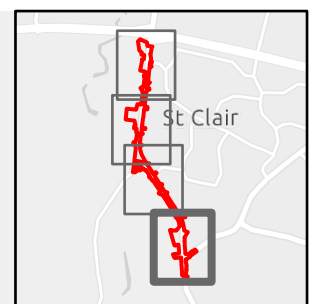
Mamre Road Upgrade Stage 1

Figure 2-7c: Strategic corridor options identified for the proposal

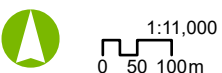


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|--|--------------------|--|-----------------------------------|
| | Existing road | | Non-Aboriginal heritage |
| | Widening corridor | | Archaeological item |
| | Existing utilities | | Local heritage item |
| | Key fish habitat | | State heritage item |
| | | | Threatened ecological communities |



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 3/08/2021 Version: 2
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 2-7d: Strategic corridor options identified for the proposal

Table 2-2: Analysis of strategic corridor options

Criteria	Do nothing	Upgrade by widening along western side	Upgrade by widening along eastern side	New road alignment
Link to existing infrastructure while also allowing for future road upgrades and access to planned development	Mamre Road currently experiences congestion during peak traffic periods (refer to Section 2.2), therefore it would not have sufficient capacity to support planned development without being upgraded.	This option provides an opportunity to improve access to future recreational parkland planned along the western side of Mamre Road within land owned by Office of Strategic Lands.	This option provides limited opportunity for new connections as it is heavily constrained by existing developments.	This option may not be able to provide improved access to planned development west of Mamre Road and the Western Sydney Employment Area to the east. It would also likely require new access roads to be built.
Maximise the safety and suitability of Mamre Road	Mamre Road has been associated with community concern regarding road safety, which would not be alleviated without a road upgrade.	Providing additional lanes and intersection upgrades could improve road safety and the road user experience along Mamre Road.	Providing additional lanes and intersection upgrades could improve road safety and the road user experience along Mamre Road.	Building a new road alignment would not alleviate the existing safety concerns associated with Mamre Road in its existing form.

Criteria	Do nothing	Upgrade by widening along western side	Upgrade by widening along eastern side	New road alignment
Minimise traffic and access impacts	The 'do nothing' option would avoid traffic and access impacts.	This option could be staged to minimise disruptions to traffic flow and access along Mamre Road.	This option could be staged to minimise disruptions to traffic flow and access.	This option may minimise disruption to the existing road network compared to the upgrade options as it could mostly be built without need for road or lane closures along Mamre Road, but would still result in traffic impacts during construction of tie-ins.
Minimise adverse environmental impacts	The 'do nothing' option would avoid environmental impacts.	This option would result in environmental impacts on areas of native vegetation that have been identified for conservation as well as non-Aboriginal and Aboriginal heritage items. The widened 50 metre road corridor would impact about eight hectares of threatened ecological communities (TECs) (there may be further impacts due to supporting infrastructure required beyond this widened road corridor such as water quality basins/swales).	This option would result in less environmental impacts than widening along the western side, however would result in greater property and amenity impacts. The widened 50 metre road corridor would impact about 1.6 hectares of TECs (there may be further impacts due to supporting infrastructure required beyond this widened road corridor such as water quality basins/swales).	This option would likely be built on undeveloped greenfield land and involve a larger footprint than an upgrade of an existing road, which would result in substantial environmental impacts.

Criteria	Do nothing	Upgrade by widening along western side	Upgrade by widening along eastern side	New road alignment
Minimise private property acquisition and amenity impacts	The 'do nothing' option would avoid property acquisition and amenity impacts.	This option could take advantage of the existing 50 metre wide road corridor reserved between the M4 Motorway and Luddenham Road. The widened road corridor would require about 9.7 hectares of additional land to be acquired (beyond the existing road corridor). The land to the west of Mamre Road includes a large amount of land owned by the Office of Strategic Lands, which would minimise the need for private property acquisition. Widening along the western side is also away from existing residential receivers to the east so would minimise amenity impacts.	The widened road corridor would require about 11.6 hectares of additional land to be acquired (beyond this existing road corridor). This option would result in substantial private property acquisition due to the close existing residential developments along the eastern side of Mamre Road. This option would also impact a much larger number of lots (178 lots) compared to option to widen along the western side (18 lots). It would also result in major amenity impacts and would not take full advantage of the existing road corridor .	This option would not be able to take advantage of existing road corridor so would likely result in major private property acquisition for the new road corridor.
Achieve value for money	The 'do nothing' option would result in no improvements to road safety, movement, travel times or quality of service compared to the existing scenario despite having no cost.	This option would minimise private property acquisition costs and maximise use of existing road infrastructure, so is considered able to achieve value for money. The potential road improvements would be similar to the option with widening along the eastern side.	This option would result in major property acquisition costs, which may not be justified. The potential road improvements would be similar to the option with widening along the western side.	This option would result in much greater property acquisition and construction costs compared to an upgrade. Although it would provide a new road, it would not maximise use of existing road infrastructure.

Preferred strategic corridor option

For Mamre Road upgrade Stage 1, the preferred option was to upgrade Mamre Road by widening the existing road to the west.

This was due to:

- the existing 50 metre wide road corridor reservation that extends along the western side of Mamre Road between the M4 Motorway and Luddenham Road, which would reduce the amount of private property that would require acquisition compared to widening to the east or a new alignment
- the established development on the eastern side of Mamre Road, which would result in more amenity impacts (e.g. noise and visual impacts) and constrain the design if widening to the east was preferred
- the ability for a widening to the west to provide improved access to the land owned on the western side of Mamre Road that has been identified for future parkland
- the potential of a new alignment to result in greater environmental impacts than road widening, as widening would follow existing areas of disturbance
- the inability for the 'do nothing' option to provide sufficient capacity to support future economic growth or development in the surrounding area
- the inability of the 'do nothing' option and 'new alignment' option to improve the road safety or experience along the existing Mamre Road corridor or the access.

However, the preferred option would result in greater impacts on biodiversity and heritage compared to the 'do nothing' option or widening along the eastern side. As a result, the design refinement for the preferred option focused on avoiding or minimising these impacts, wherever possible (refer to Section 2.5).

2.4.2 Intersection design sub-options

Methodology of intersection design sub-options

Following identification of the preferred strategic option, location-specific sub-options were developed for certain intersection layouts and access arrangements. The sub-options were assessed by TfNSW in relation to various criteria including road functionality, safety and environmental impacts.

Only the intersection design sub-options relevant to this proposal have been discussed in this REF.

Identified options

The safe access to and from the adjoining area through existing intersections was considered during the development of the design of the new dual carriageway for Mamre Road. Intersection sub-options were investigated further for locations where the required design was identified early, including options for the:

- intersection layout at Mandalong Close
- intersection layout at McIntyre Avenue.

The options for each of the intersections were also compared against a 'do nothing' option, where no upgrades to intersections or changes to the current Mamre Road configuration are proposed.

Mandalong Close

The intersection between Mandalong Close and Mamre Road is currently a T-junction with turn bays allowing all turning movements. It currently provides access to twelve houses and a childcare centre. As part of the State Significant Development for Mamre West precinct (SSD 7173) announced in 2016, an internal road network is planned to connect Mandalong Close to the main signalised access to the precinct at James Erskine Drive. This was taken into consideration during the design development of this intersection upgrade. As such, two intersection options were compared for the best interim measure pending the full development of the Mamre West precinct:

- Option 1 – Convert the Mandalong Close intersection into left in, left out only
- Option 2 – Add a new fourth leg at the intersection with Erskine Park Road and provide a connection to Mandalong Close via an existing lane for the childcare centre

McIntyre Avenue

McIntyre Avenue provides one of the three main access points to the residential area of St Clair and is located just south of the Luddenham Road intersection. As Luddenham Road is proposed to be signalised, the addition of traffic lights at McIntyre Avenue would cause clashes and conflict in the turning lane layout of these intersections.

To minimise these issues, the following options were considered:

- Option 1 – Convert the intersection with McIntyre Avenue to left in, left out only (refer to Figure 2-7).
- Option 2 – Realign Luddenham Road to connect with McIntyre Avenue by building a long bridge across the South Creek floodplain (refer to Figure 2-8). This would achieve one signalised intersection for both roads.
- Option 3 – Shifting the alignment of Mamre Road to the west to fit a north-south link road within the eastern side of the road corridor connecting McIntyre Avenue to the Luddenham Road intersection (refer to Figure 2-9). This intersection would be signalised and have a new fourth leg.



Figure 2-8: McIntyre Avenue intersection Option 1 (source: Mamre Road upgrade Options Report)

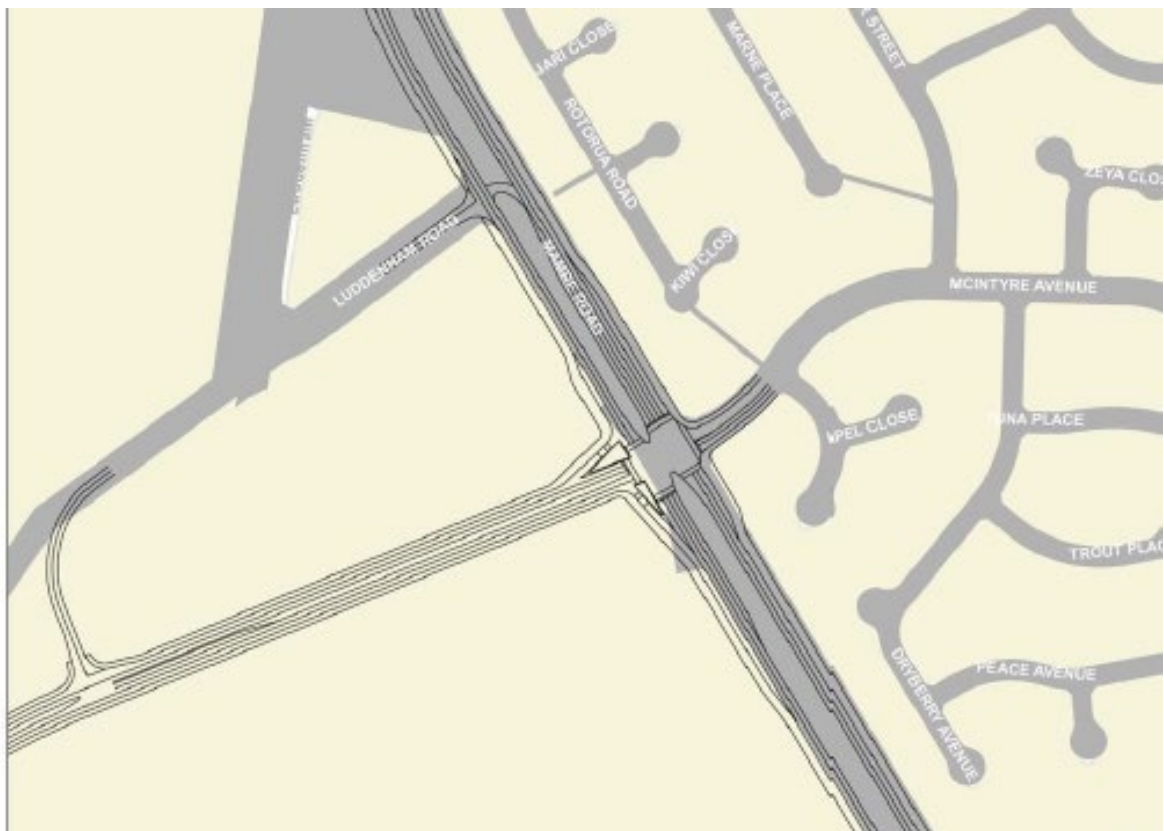


Figure 2-9: McIntyre Avenue intersection Option 2 (source: Mamre Road upgrade Options Report)



Figure 2-10: McIntyre Avenue intersection Option 3 (source: Mamre Road upgrade Options Report)

Analysis of options

The sub-options of each intersection identified for upgrade were evaluated separately under the relevant intersection option, as summarised in Table 2-3 and Table 2-4.

Table 2-3: Analysis of strategic intersection options for Mandalong Close

Option	Analysis
Do nothing	This option would involve no change to the current intersection configuration at Mandalong Close. The current network inefficiency would continue to progress and worsen in the future under the predicted increase in traffic volumes.
Option 1	<p>This option would provide access to Mandalong Close, with minimal changes to the intersection area and would not require a large amount of property acquisition.</p> <p>As this option only allows for a left turn into Mandalong Close, drivers travelling south who need to access this road could turn left into James Erskine Drive about 580 metres south, use the existing roundabout to turn around and then turn right onto Mamre Road to travel north. Drivers exiting Mandalong Close and needing to travel south could use the U-turn facility at Solander Drive about two kilometres north.</p>

Option	Analysis
Option 2	This option considers adding a new fourth leg at the Erskine Park Road intersection and connecting this leg to Mandalong Close via an existing lane for the childcare centre. Although this option would provide signalised turning, it would also involve a high amount of property acquisition and construction costs.

Table 2-4: Analysis of strategic intersection options for McIntyre Avenue

Option	Analysis
Do nothing	This option would involve no change to the current intersection configuration at McIntyre Avenue. The current network inefficiency would continue to progress and worsen in the future under the predicted increase in traffic volumes.
Option 1	<p>This option only allows for drivers to turn left out of McIntyre Road. Those needing to travel right out of McIntyre Road could use the existing local road network to then turn right out of Solander Drive or at Banks Drive, both which would be signalised.</p> <p>As this option also only allows for a left turn into McIntyre Avenue, drivers travelling north who need to access this road could turn left into the U-turn facility at Solander Drive (about 850 metres north of McIntyre Avenue) then turn right to travel south along Mamre Road and turn left into McIntyre Avenue. This U-turn facility would give drivers the flexibility of multiple route options for more efficient travel and to maintain a consistent traffic flow.</p>
Option 2	The construction of a new bridge across the South Creek floodplain would impact on sensitive environmental areas including land reserved for environmental offsets (biobanking area) and key fish habitat. This option would also involve extensive property acquisition and has been estimated to have a very high overall cost.
Option 3	The shifting of the Mamre Road alignment further to the west would impact on additional sensitive environmental areas, including a biobanking area. The link road from McIntyre Avenue to Luddenham Road would have an undesirable tight bend close to the Luddenham Road intersection as well as a tight bend around a corner property from McIntyre Avenue to the link road. These bends would adversely impact manoeuvrability and reduce the sight distance for drivers on the road, which is an added safety risk. There could be potential confusion from headlight glare to drivers travelling in opposing directions where the link road runs parallel to Mamre Road.

Preferred intersection design sub-options

Mandalong Close

Option 2 was rejected as it would involve a large amount of property acquisition and high construction costs, which were not considered justified for the relatively small volume of traffic that would use Mandalong Close.

The 'do nothing' option was rejected because the safety and performance of the Mandalong Close intersection would decline with the increased traffic volumes along Mamre Road that are predicted in the future.

Therefore, Option 1 to convert Mandalong Close to a left in, left out arrangement was preferred as it avoided property acquisition and high construction costs while still maintaining safe access to Mandalong Close.

McIntyre Avenue

The preferred option for this intersection was converting it to a left out only T-Junction (Option 1). The selection of this option was supported by the availability of alternative turning options for drivers who need to turn right in and out of McIntyre Avenue (as detailed in Table 2-4). This would allow for a consistent traffic flow and route flexibility.

Option 2 was rejected because it would have major environmental impacts, including impacts to threatened ecological communities, a biobanking area and key fish habitat.

Option 3 was rejected as it would have a greater impact on the land to the west, which comprises threatened ecological communities and a biobanking area. The design of the link road may also comprise tight bends and result in limited sight distance and headlight glare, which may result in safety issues.

2.5 Design refinements

During concept design development for the preferred option, several design refinements were identified for the proposal to minimise environmental impacts, better allow for future planned development or optimise the design for road users. The key design refinements for the proposal are summarised in Table 2-5 below.

Table 2-5: Summary of key design refinements

Refinement	Reason
Removal of the new left in, left out intersection north of Luddenham Road (as originally proposed in Option 1 for McIntyre Avenue – refer to Figure 2-7)	<p>There were concerns that vehicles may choose to use the new left in, left out unsignalised intersection in preference to the signalised intersection at Luddenham Road to save time, which may have been less safe for vehicles turning onto Mamre Road.</p> <p>This new intersection has been replaced with provision of a U-Turn facility within the Banks Drive and Solander Drive western stubs to provide access and route flexibility for local vehicles.</p>

Refinement	Reason
<p>Identification of a 'vegetation clearance boundary' and design refinement to reduce biodiversity impacts</p>	<p>The proposal area includes several areas of native vegetation that comprise threatened and endangered ecological communities (refer to Section 6.1). In addition, some of this vegetation has been specifically identified for conservation, including vegetation within the biobank site south of Luddenham Road, areas zoned for environmental conservation on the <i>Penrith Local Environmental Plan 2010</i> (refer to Figure 4-2) and a potential future biobank site proposed near Mamre House.</p> <p>The design for the proposal has been specifically refined in these areas to minimise removal of vegetation, where possible. This particularly focused on refinement and optioneering of the tail-out channel work and proposed locations of water quality basins and swales. These were aspects of the design that most influenced the vegetation clearing requirements beyond the proposed widened road footprint.</p> <p>Once the footprint of design was refined as much as possible (where feasible and reasonable), a vegetation clearance boundary was developed within the larger proposal area (refer to Figure 6-1), beyond which no vegetation clearance would be permitted. The area between the vegetation clearance boundary and the proposal area is considered a 'no-go' zone for construction activities.</p>
<p>Refinement of the design near the Mamre House State heritage curtilage</p>	<p>The design near the Mamre House State heritage curtilage has been refined from the strategic design to minimise heritage impacts, where possible. This has involved:</p> <ul style="list-style-type: none"> • removal of the swale proposed along the western side of the widened road to avoid encroachment into the curtilage • shortening of the left turn lane from Mamre Road to Banks Drive to narrow the section of the road next to the curtilage • minimising the extent of proposed utilities and signage near Mamre House • identification of suitable accesses to Mamre House including provision of a new main driveway off Banks Drive and maintaining the existing secondary access from Mamre Road • consideration of the visual setting and provision of heritage interpretation opportunities near Mamre House during development of the urban design and landscaping strategy

Refinement	Reason
Increase in footprint for Luddenham Road intersection including provision of dual right turn lanes out of Luddenham Road onto Mamre Road	It is expected that Luddenham Road may need to be upgraded in the future to three lanes in each direction due to increased traffic volumes from surrounding development such as the future Luddenham Metro Station. Therefore, the design of the Luddenham Road intersection has been developed to provide the required footprint for an additional lane in each direction in the future to minimise the need for future rework.
Identification of new access to Erskine Park Rural Fire Service	The design has identified the need for a new driveway to Erskine Park Rural Fire Service from Old Luddenham Road to maintain safe and efficient access to this facility.
Refinement of the active transport alignment	<p>The provision for pedestrians and cyclists has been refined to include:</p> <ul style="list-style-type: none"> • a shared path along the western side of Mamre Road between the Erskine Park Road intersection and the Mandalong Close intersection for pedestrian connectivity • 1.5 metre wide footpaths between intersection pram ramps on the western side of Mamre Road for pedestrian safety
Road corridor width	The strategic corridor options identified that a road corridor width of 50 metres along Mamre Road would be required for the proposal (refer to Section 2.4.1). However, during concept design development, a road width of greater than 50 metres has been identified in some areas. This wider road corridor would be generally required where there are additional turning lanes, large batters due to topography or utility corridors that require extra space.
Avoidance of Aboriginal heritage impacts	<p>Early identification of Aboriginal heritage sites allowed refinement of the proposal to avoid or reduce impacts to Aboriginal archaeological sites located within the Aboriginal heritage study area including:</p> <ul style="list-style-type: none"> • avoidance of impacts to MWP-AD7, MWP-AD8 and MWP-IF1 • minimisation of impact to Mamre Road AFT 3, Mamre Road AFT 4 and Mamre Road AFT 5 <p>The design and construction methodology will continue to be refined in detailed design to further minimise impacts to Aboriginal heritage. For example, since the preparation of the Aboriginal CHAR, several 'no-go zones' within the proposal area have been defined as a result of refinement of the vegetation clearance boundary and property acquisition areas. This would reduce the potential direct impact area on Aboriginal heritage compared to what has been conservatively assessed in Section 6.2.</p>

3 Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

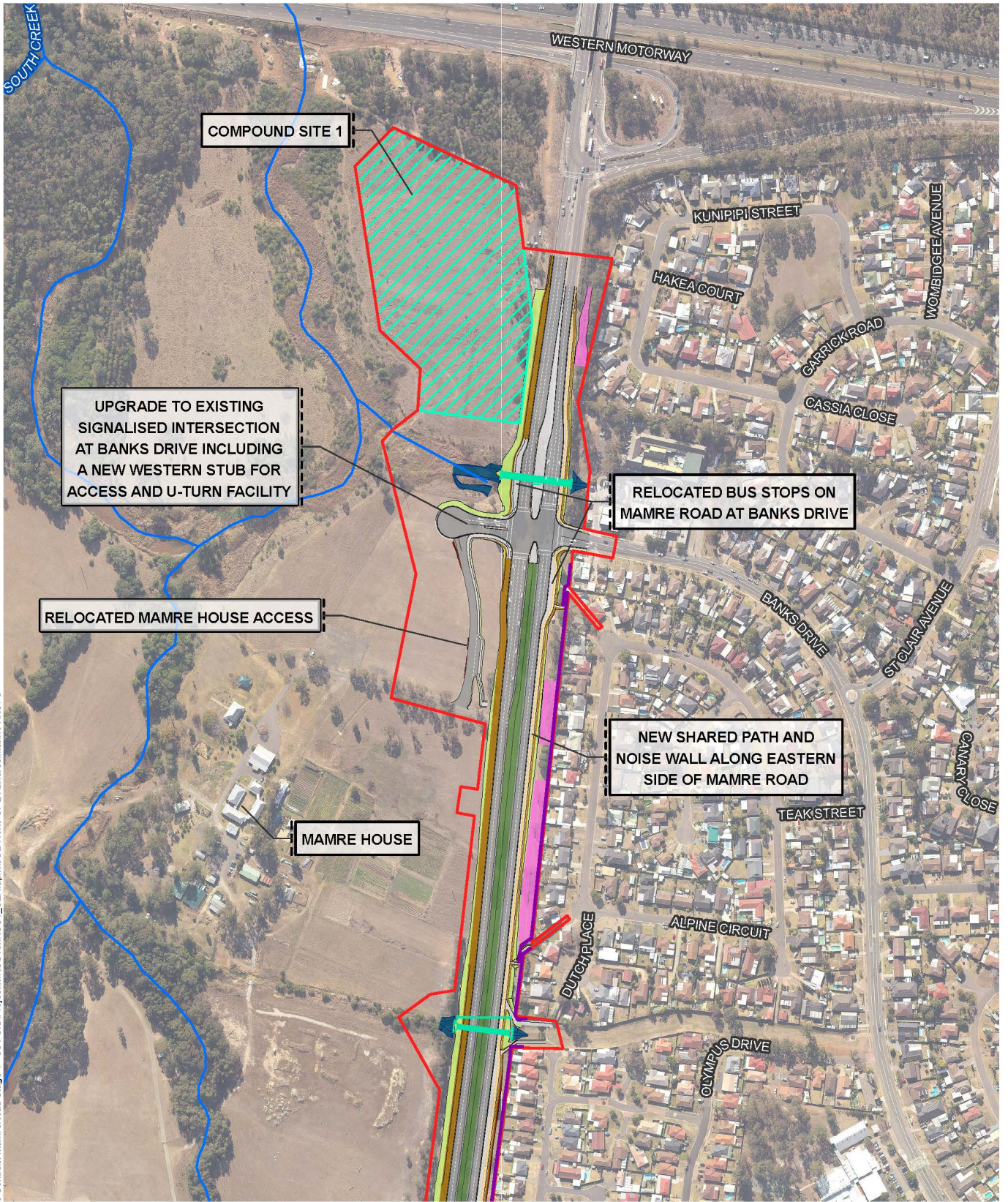
3.1 The proposal

TfNSW propose to upgrade about 3.8 kilometres of Mamre Road between the M4 Motorway, St Clair and Erskine Park Road, Erskine Park (the proposal). The proposal would support the expected economic and residential growth associated with the Western Sydney Employment Area and proposed Western Sydney Aerotropolis.

The proposal would involve widening Mamre Road from one lane either direction to two lanes in each direction. The proposal includes changes and upgrades to existing intersections and new facilities for public transport, walking and cycling along Mamre Road. Sufficient space within the road corridor would also be provided for an additional lane in each direction if required in the future.

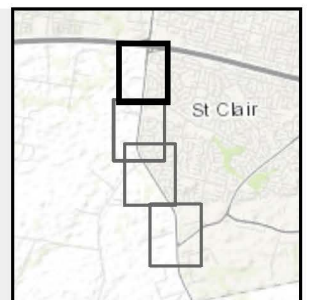
Key features of the proposal would include (shown on Figure 3-1):

- an upgrade of Mamre Road to a four-lane divided road with a wide central median that would allow for widening to six lanes in the future, if required
- changes to intersections with Mamre Road including:
 - an upgrade to the existing signalised intersection at Banks Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Solander Drive including a new western stub for access and a U-turn facility
 - a new signalised intersection at Luddenham Road with new turning lanes
 - an upgrade to the existing signalised intersection at Erskine Park Road with new turning lanes
 - modified intersection arrangements (left in, left out only) at McIntyre Avenue and Mandalong Close
- a new shared path along the eastern side of Mamre Road and provision for a future shared path on the western side
- reinstatement of bus stops near Banks Drive with provision for additional bus infrastructure in the future
- changes to property access to Mamre House, Erskine Park Rural Fire Service and other private properties
- drainage and flooding infrastructure upgrades including culvert crossings, water quality basins, grass swales and channel tail-out work
- new traffic control facilities including new traffic signals and relocation of existing electronic variable message signage
- roadside furniture and street lighting
- noise walls along the eastern side of Mamre Road at St Clair
- utility relocations
- establishment of temporary ancillary facilities to support construction including compound sites, stockpile and laydown locations, access tracks, waterway crossings and concrete batching plants.

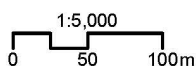


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|-----------------------|------------------|--------|
| Waterways | Basin | Median |
| Indicative noise wall | Shared user path | Road |
| Culverts | Channel work | Swale |
| REF proposal area | Concrete | Cut |
| Compound site options | Fill | Verge |



Source: Aurecon, Spatial Services, Nearmap, Esri

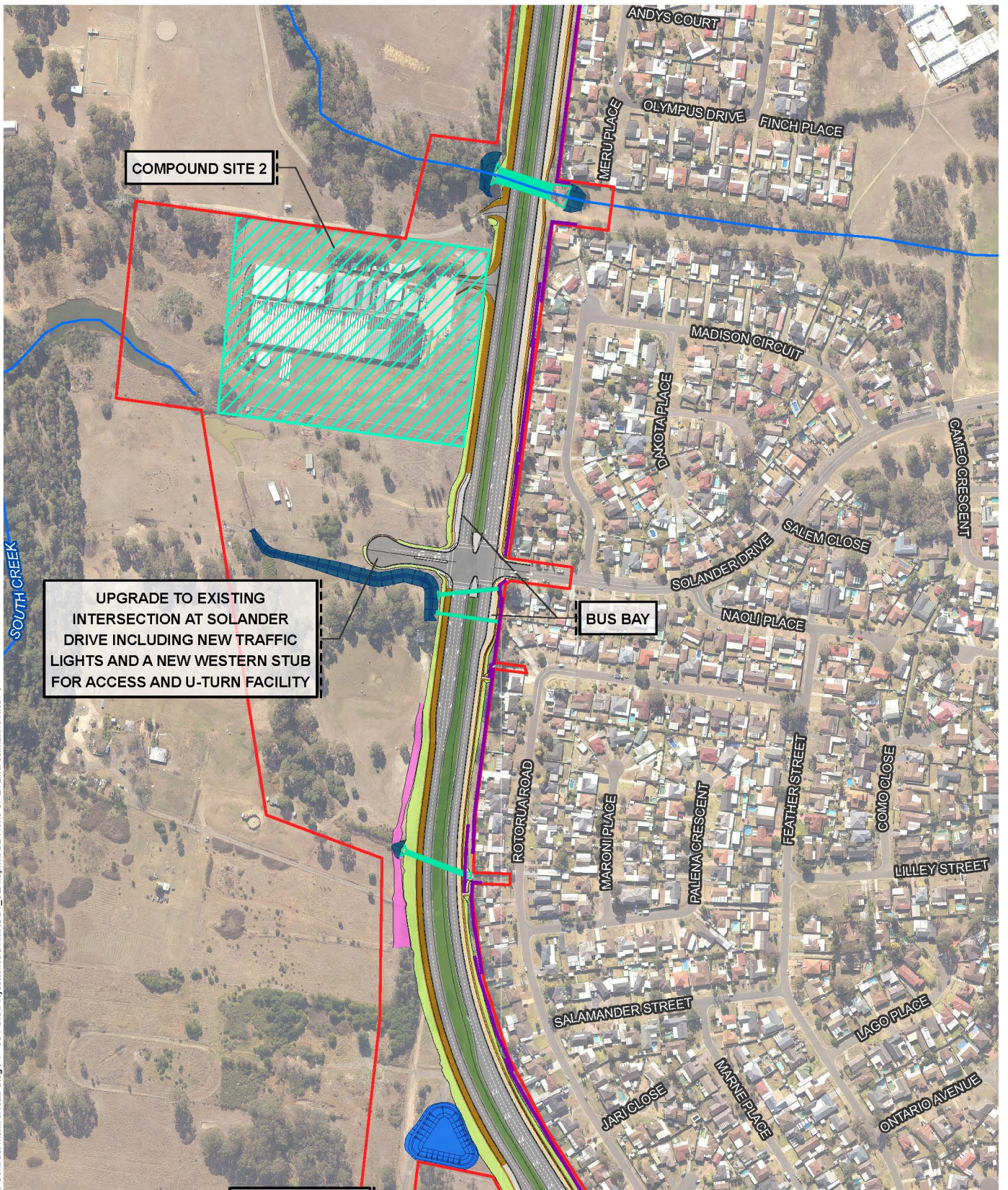


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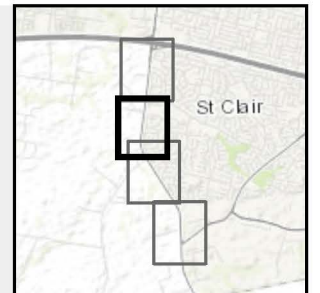
Mamre Road Upgrade Stage 1

Figure 3-1a: Key features of the proposal

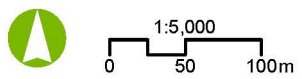


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| Waterways | Basin | Median |
| Indicative noise wall | Shared user path | Road |
| Culverts | Channel work | Swale |
| REF proposal area | Concrete | Cut |
| Compound site options | Fill | Verge |



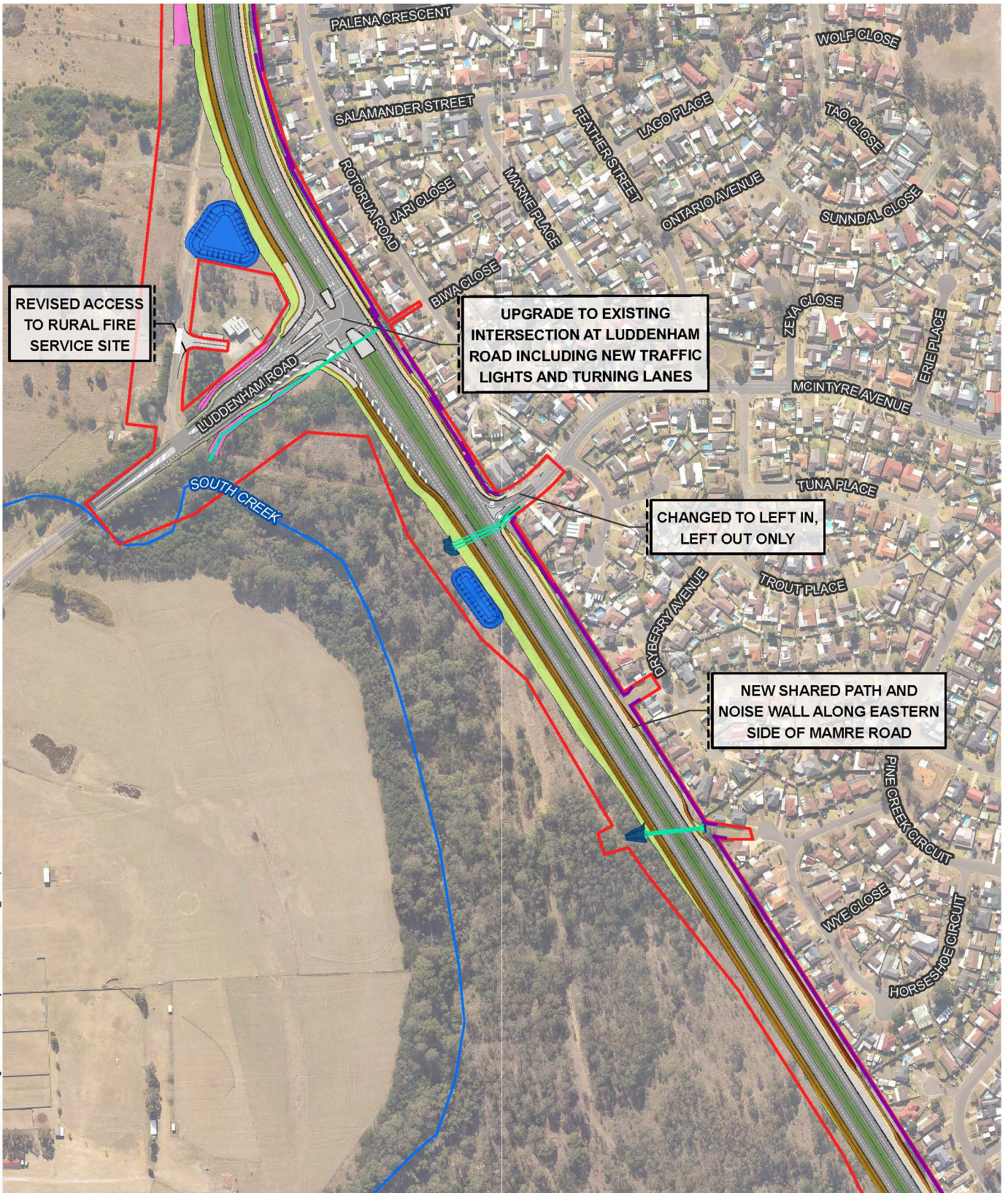
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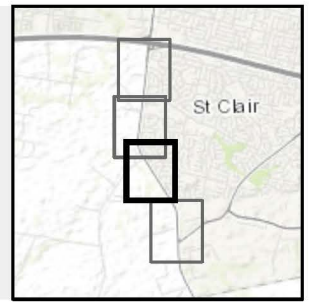
Mamre Road Upgrade Stage 1

Figure 3-1b: Key features of the proposal

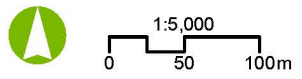


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Waterways	Basin	Median
Indicative noise wall	Shared user path	Road
Culverts	Channel work	Swale
REF proposal area	Concrete	Cut
Compound site options	Fill	Verge

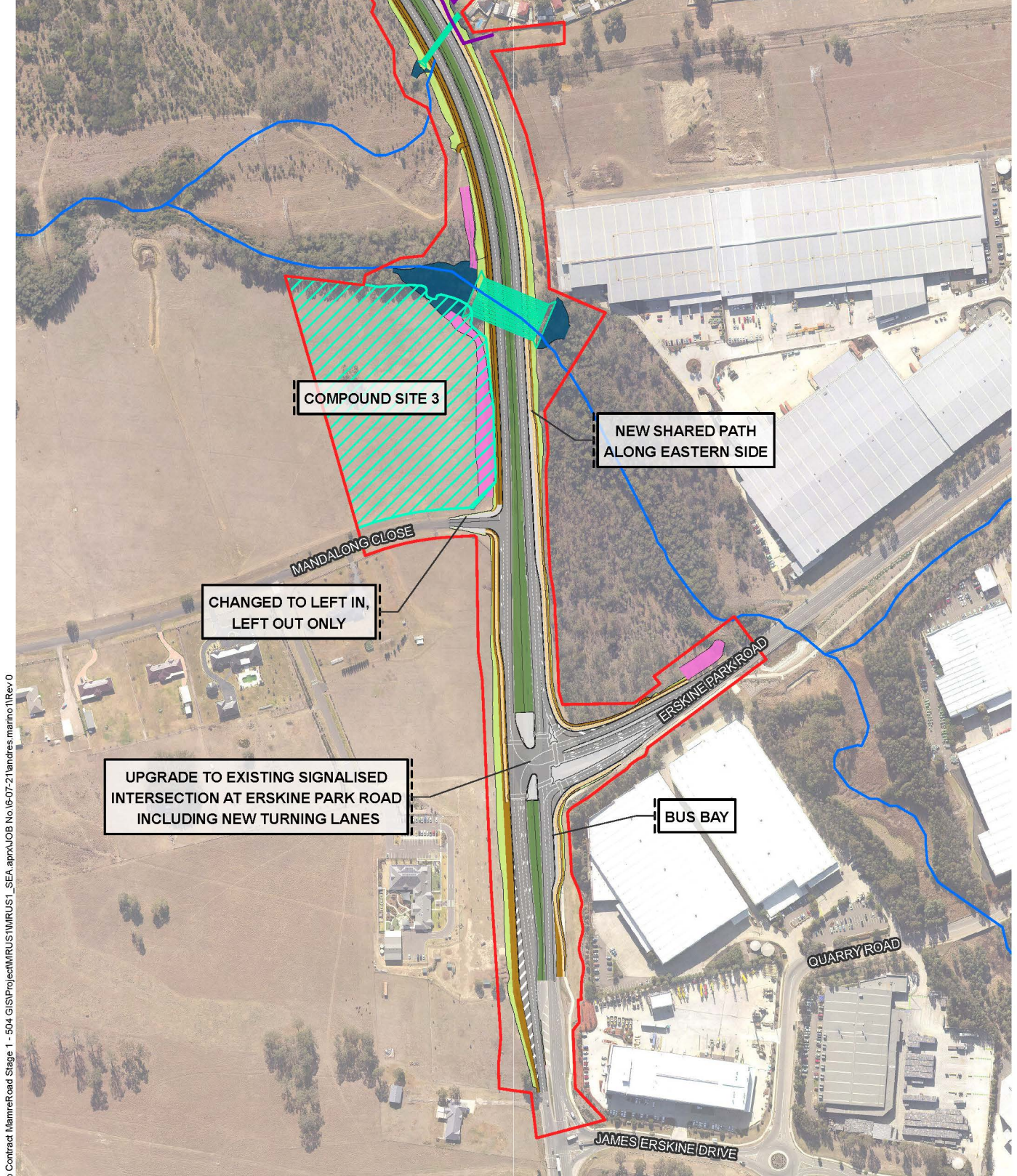


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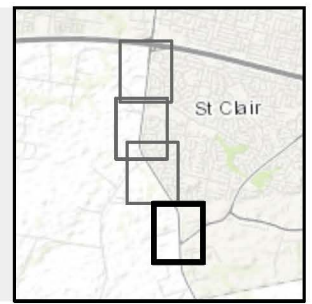
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Mamre Road Upgrade Stage 1
 Figure 3-1c: Key features of the proposal

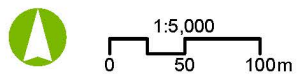


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	Waterways		Basin		Median
	Indicative noise wall		Shared user path		Road
	Culverts		Channel work		Swale
	REF proposal area		Concrete		Cut
	Compound site options		Fill		Verge



Source: Aurecon, Spatial Services, Nearmap, Esri



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 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1
 Figure 3-1d: Key features of the proposal

3.2 Design

The concept design for the proposal is described below and would be further refined during detailed design due to ongoing design investigation and consideration of the environmental safeguards discussed in Chapter 6 (Environmental assessment).

3.2.1 Design criteria

The proposal has been designed to NSW and Australian engineering, road safety, environmental and transport planning standards developed by TfNSW, Austroads and Standards Australia. These standards describe the criteria that should be adopted for specific road classifications and conditions. The criteria have been developed to ensure all roads are designed to be safe, effective, well-planned and easily maintained.

Table 3-1 shows the design criteria that has been adopted for the proposal. Figure 3-2 shows typical cross sections of the widened Mamre Road main carriageway.

Table 3-1: Summary of design criteria for the proposal

Aspect	Design criteria
Speed limit	<p>Mamre Road (main carriageway) and Luddenham Road:</p> <ul style="list-style-type: none"> 80 kilometres per hour posted speed 90 kilometres per hour design speed <p>Erskine Park Road:</p> <ul style="list-style-type: none"> 70 kilometres per hour posted speed 80 kilometres per hour design speed <p>Banks Drive, Solander Drive, Mandalong Close and McIntyre Avenue:</p> <ul style="list-style-type: none"> 50 kilometres per hour posted speed 60 kilometres per hour design speed
Cross section (refer to Figure 3-2 and Figure 3-3)	<p>Mamre Road (main carriageway) – minimum design criteria:</p> <ul style="list-style-type: none"> two northbound and two southbound through lanes general lane width: 4.0 metres kerb side, 3.5 metres otherwise median width at least 10 metres left turn lane width: 4.0 metres right turn lane width: 3.3 metres <p>Side roads – minimum design criteria:</p> <ul style="list-style-type: none"> general lane width and left turn lane width: 3.5 metres median width: 1.5 metres (where applicable) right turn lane width: 3.3 metres <p>Minimum shared path width: 3.0 metres</p> <p>Minimum bus bay width: 4.0 metres and bus shelter width: 3.2 metres</p>

Aspect	Design criteria
Design vehicles	<ul style="list-style-type: none"> • Mamre Road and Erskine Park Road: PBS Level 3A vehicles up to 36.5 metres in length • Mandalong Close, McIntyre Avenue, Solander Drive and Banks Drive: 12.5 metre long single unit truck, • Solander Drive and Banks Drive western leg U-turn facility: 19 metre long semi-trailer • Luddenham Road: 19 metre long semi-trailer
Grade	<p>Maximum grades of:</p> <ul style="list-style-type: none"> • 4 per cent for design speeds of 80 to 90 kilometres per hour • 3 per cent for design speeds of 60 kilometres per hour
Batter slope	Maximum 2H:1V cut and fill batters
Road surface	<p>The northbound carriageway would require the construction of new pavement and would consist of thick asphalt over lean mix concrete subbase.</p> <p>The southbound carriageway is partially located on the existing pavement. Where this occurs, the existing pavement would either be milled and re-sheeted or fully reconstructed as full depth pavement. Where new sections of the carriageway are constructed, full depth pavement would be required and would consist of thick asphalt over lean mix concrete subbase.</p> <p>The road surface and pavement design would be confirmed during detailed design.</p>
Flood immunity	1 per cent AEP flood event for Mamre Road

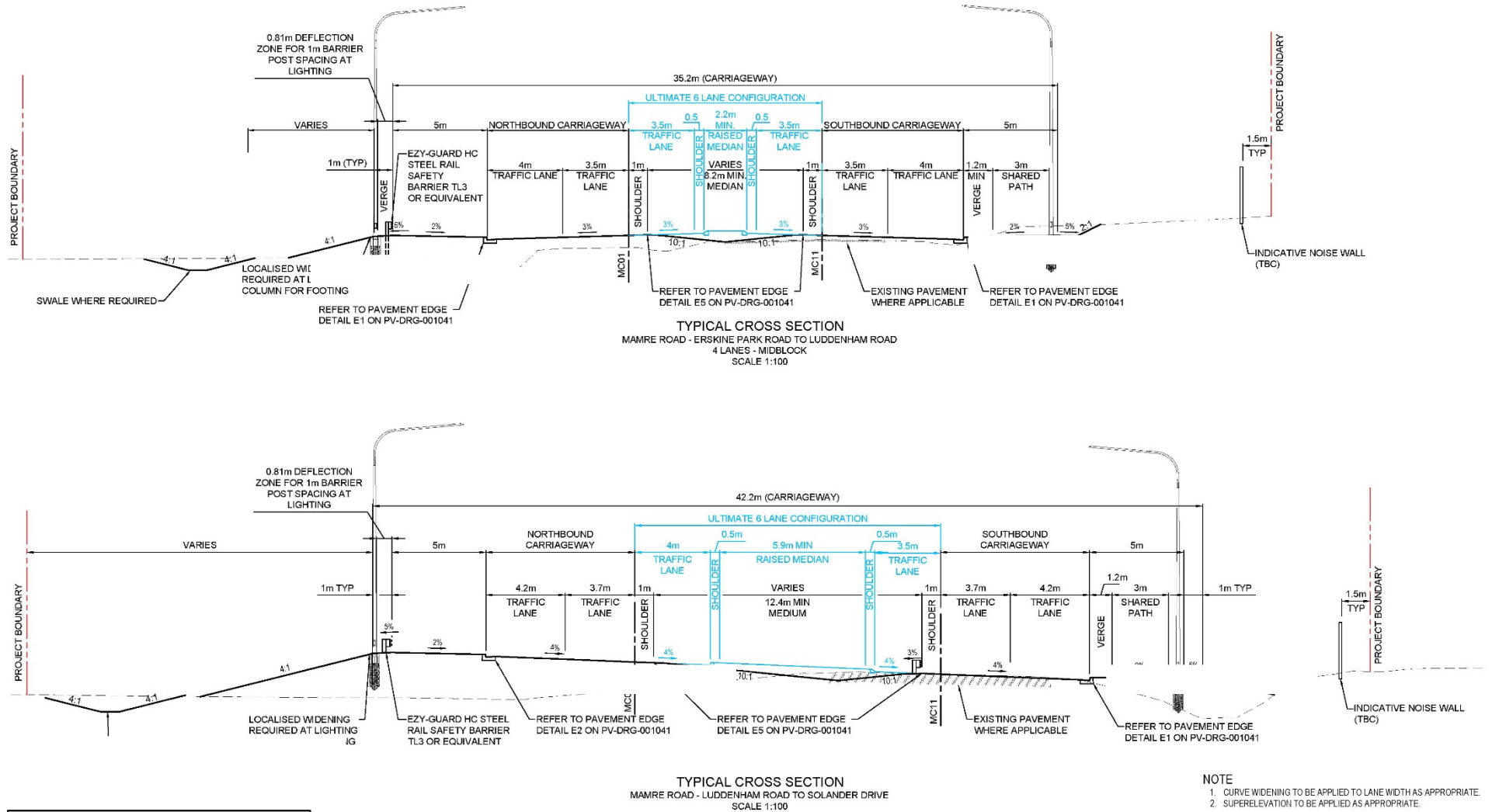


Figure 3-2: Typical cross sections of Mamre Road between Erskine Park Road and Solander Drive (between intersections) after being upgraded by the proposal

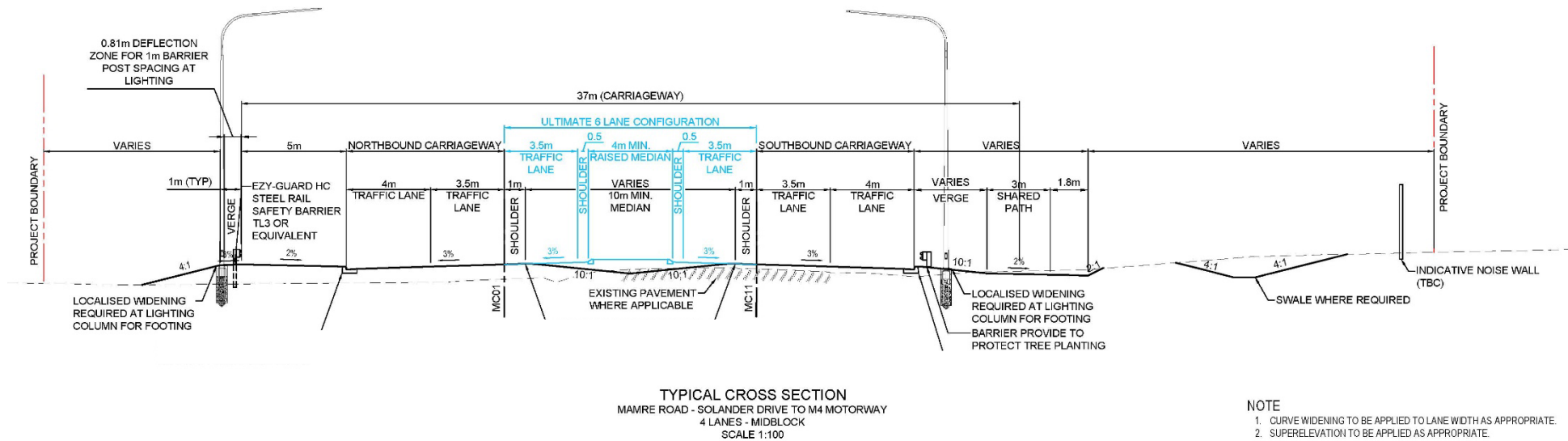


Figure 3-3: Typical cross section of Mamre Road between Solander Drive and the M4 Motorway (between intersections) after being upgraded by the proposal

3.2.2 Engineering constraints

Table 3-2 lists the main engineering constraints and how they have been addressed in the proposal design.

Table 3-2: Engineering constraints for the proposal

Constraint	How it has been addressed in the proposal design
Limited space for widening due to existing adjoining roads and surrounding properties	The proposal follows the existing Mamre Road alignment and maximises the use of the existing road corridor.
Existing and future land use changes and development west of Mamre Road that would require road access	<p>A new fourth intersection leg with a U-Turn facility has been provided at the Banks Drive and Solander Drive intersections to allow vehicles to turn around, if required. In the future, this western leg would provide access for future parkland west of Mamre Road.</p> <p>A new driveway for Mamre House has also been included to provide direct access from the Banks Drive intersection, rather than Mamre Road.</p> <p>A new driveway for Erskine Park Rural Fire Service has also been proposed off Old Luddenham Road to replace the existing Luddenham Road access that would be impacted by the proposal.</p>
Close residential properties on the eastern side of Mamre Road	A noise wall has been included in the design along the eastern side of Mamre Road to minimise operational noise impacts. Additional noise mitigation treatments (at-property treatment) may be considered for individual properties, where identified to be required in accordance with the noise modelling results.
Mamre Road passes through part of the South Creek floodplain	<p>Sections of Mamre Road have been raised to satisfy flooding and drainage requirements and improve the flood immunity of the road to a one per cent AEP event.</p> <p>Specific safeguards and management measures that could be implemented during construction to minimise construction flood risks would be considered further during detailed design. This would include planning compound site layouts to avoid or minimise loose material storage in flood prone areas and implementation of a flood action plan (refer to Section 6.5).</p>
Several existing utilities in the road corridor	Utility adjustment and/or protection would be carried out in consultation with the relevant utility provider (refer to Section 3.5).
Upgrading an existing operational road with minimal disturbance to traffic	Construction of the proposal would be staged with traffic switches to maintain use of Mamre Road.

3.2.3 Major design features

Mamre Road main carriageway widening

Mamre Road would be widened between Banks Drive and Erskine Park Road to be about 40 metres wide between intersections and 50 metres wide at intersections (excluding batters). The widening would mostly be undertaken on the western side of the road corridor and would generally follow the existing Mamre Road alignment. This widened road would provide enough space for both the current proposed road arrangement of two lanes in each direction and a future road arrangement with three lanes in each direction. The proposal would feature a wide central median along the length of the road to separate the northbound and southbound traffic lanes and to allow for upgrading the road to three lanes in each direction in the future. This median would be raised at intersections to provide pedestrian refuge at crossing locations.

Mamre Road would be raised at various locations along the alignment to provide improved drainage and flood immunity. As such, sections of the proposal would need to be built on imported 'fill' material or embankments to allow for the proposed increased road height compared to the existing road and natural ground level. Where the proposed road would need to be built below the natural ground level, material would need to be removed from the ground surface ('cut'). Estimated cut and fill volumes are provided in Section 3.3.5.

Intersection changes

The proposal involves changes to existing intersections with Mamre Road at Banks Drive, Solander Drive, Luddenham Road, Erskine Park Road, McIntyre Avenue and Mandalong Close. The following sections describe the changes in detail.

Banks Drive intersection upgrade

The proposal would upgrade the existing signalised three-way intersection at Banks Drive to a four-way signalised intersection (refer to Figure 3-4). The upgraded intersection would feature:

- two southbound and northbound through lanes on Mamre Road and left and right turning lanes for vehicles turning from Mamre Road to Banks Drive
- two lanes on Banks Drive in each direction
- a new western approach with dual lanes, which would provide access to Mamre House and a U-turn facility
- provision for a future bus priority lane on Mamre Road in the left turn lanes
- reinstated bus stops on the departure side.

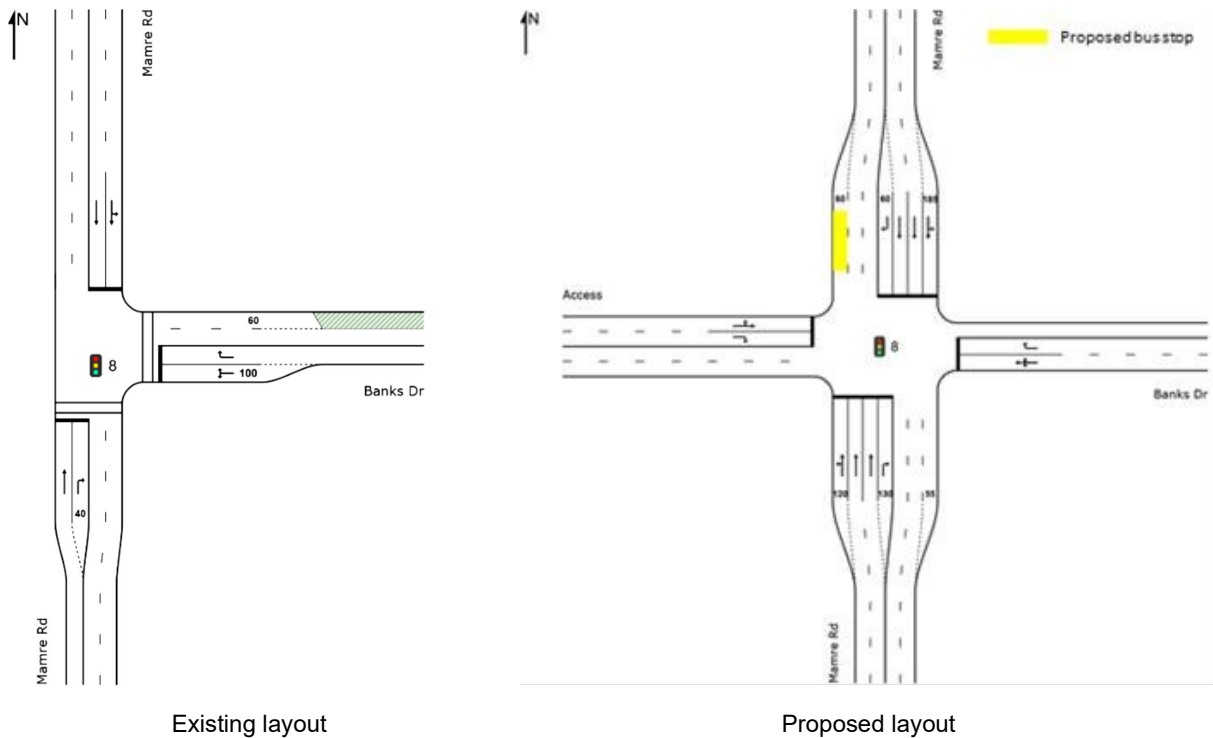


Figure 3-4: Existing and indicative intersection layout at Banks Drive

Solander Drive intersection upgrade

The proposal would upgrade the existing priority controlled three-way intersection at Solander Drive to a new signalised four-way intersection (refer to Figure 3-5). The upgraded intersection would feature:

- replacement of the stop sign on Solander Drive with new traffic lights
- two southbound and northbound through lanes on Mamre Road with new left and right turning lanes for vehicles turning from Mamre Road to Solander Drive
- a new western access approach including a U-turn facility
- provision for future bus priority within the left turn lanes on the approach side as well as future bus priority/bus stops on the departure side.

This intersection upgrade would require the removal of about six parking spaces along Solander Drive to provide space for the additional through lane.

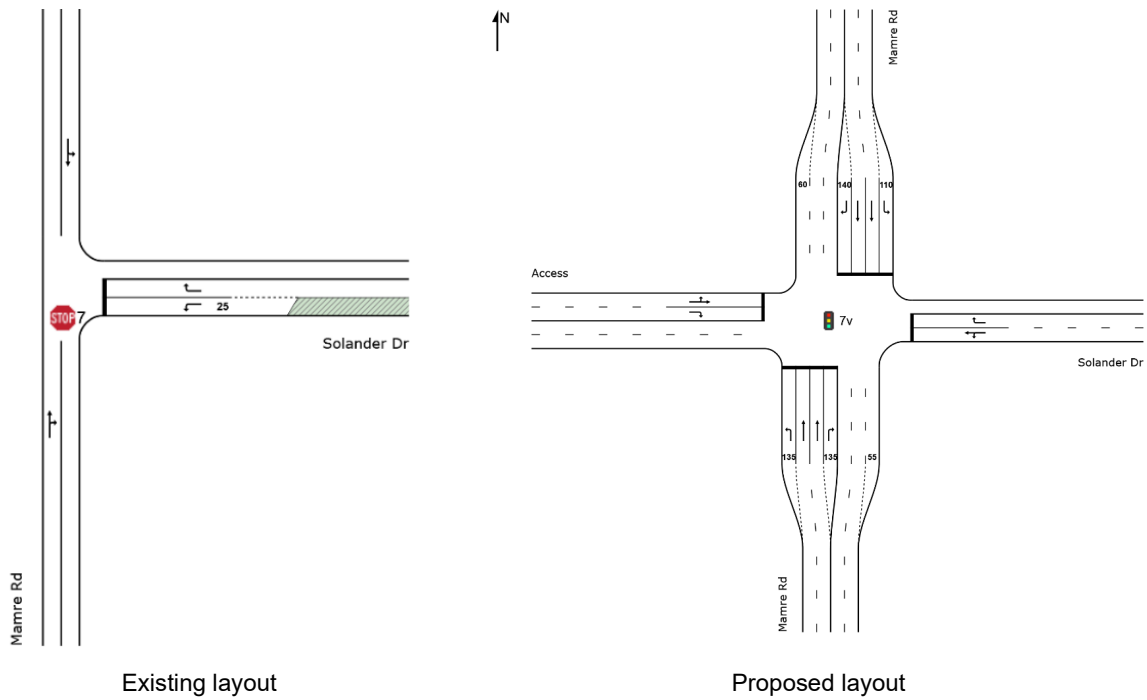


Figure 3-5: Existing and indicative intersection layout at Solander Drive

Luddenham Road intersection upgrade

The proposal would involve upgrading the existing priority controlled seagull intersection at Luddenham Road to a new signalised intersection (refer to Figure 3-6). The upgraded intersection would feature:

- replacement of the give way sign on Luddenham Road with new traffic lights
- two southbound and northbound through lanes on Mamre Road with additional turning lanes for vehicles turning from Mamre Road onto Luddenham Road
- dual left turn lanes and dual right turn lanes on Luddenham Road onto Mamre Road.

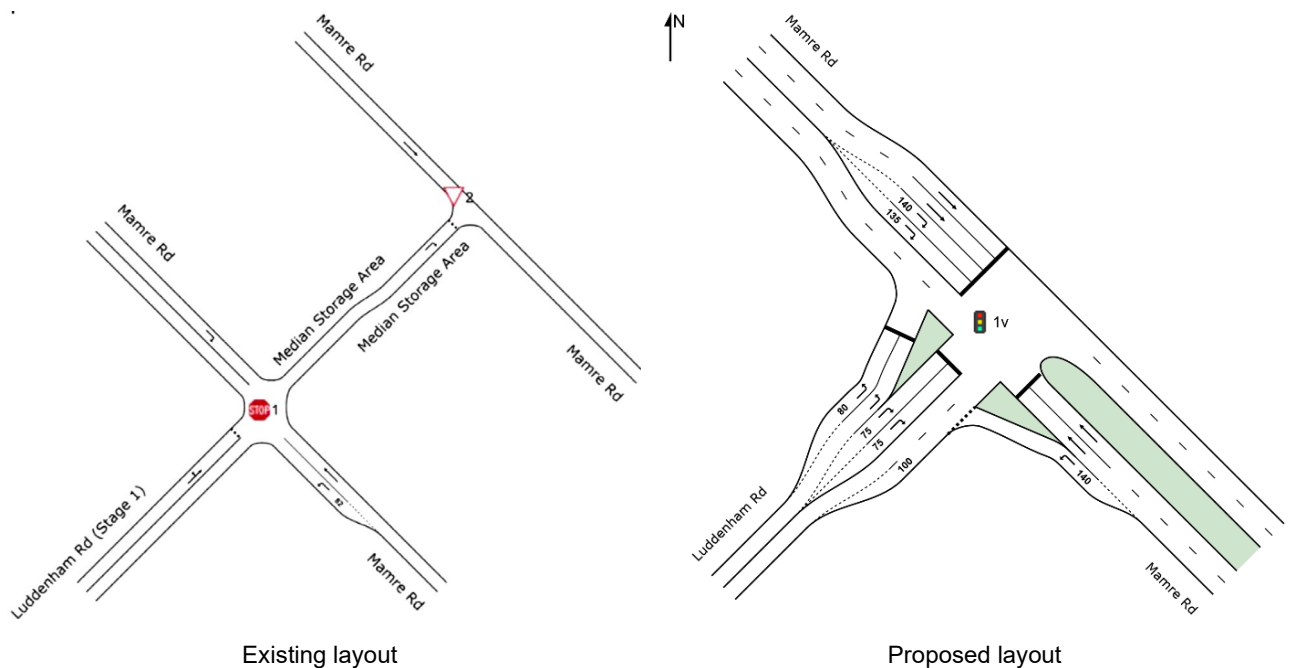


Figure 3-6: Existing and indicative intersection layout at Luddenham Road

Erskine Park Road intersection upgrade

The proposal would involve upgrading the existing signalised intersection at Erskine Park Road. The upgraded intersection would feature (refer to Figure 3-7):

- two southbound and northbound through lanes on Mamre Road and turning lanes for vehicles travelling onto Erskine Park Road
- dual left and right turning lanes for vehicles travelling from Erskine Park Road onto Mamre Road
- provision for a future a bus priority lane and a bus stop in the southbound direction.

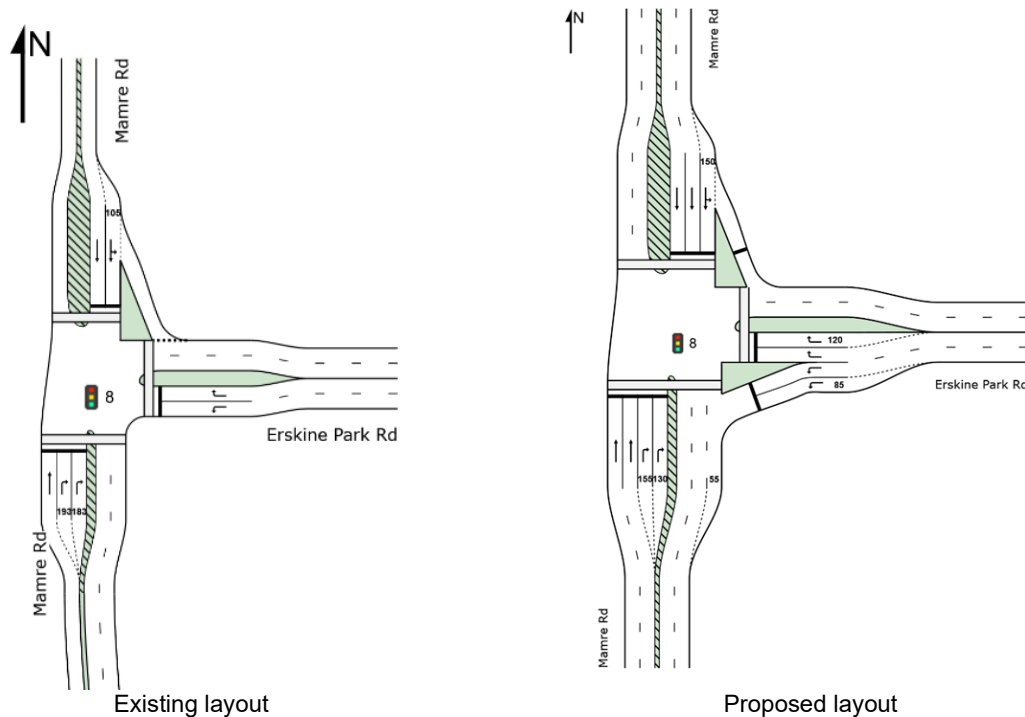
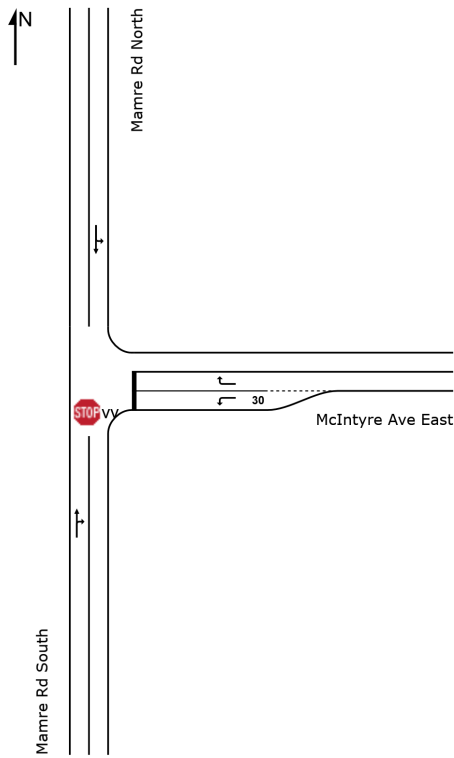


Figure 3-7: Existing and indicative intersection layout at Erskine Park Road

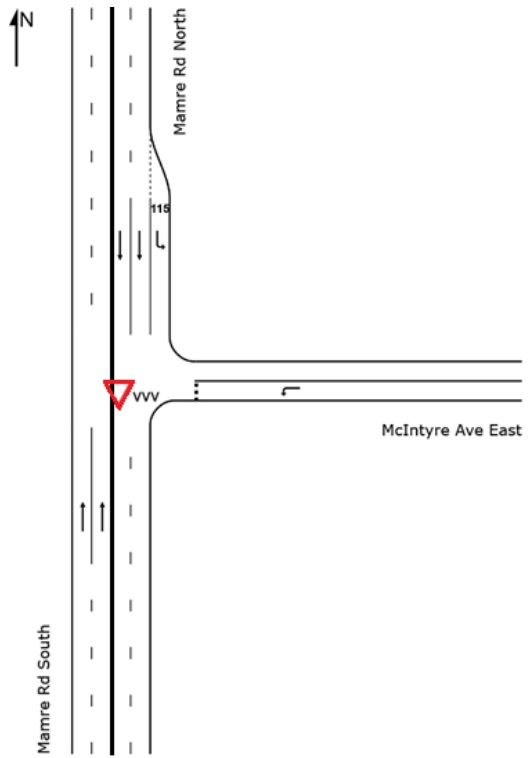
McIntyre Avenue and Mandalong Close intersection changes

The proposal would involve changes to the existing priority controlled intersections at McIntyre Avenue and Mandalong Close to be left in, left out only and have 'give-way' signage (refer to Figure 3-8 and Figure 3-9).

About two existing parking spaces on the eastbound side of McIntyre Avenue would be removed to provide space for the eastbound traffic through lane and accommodate the intersection work.

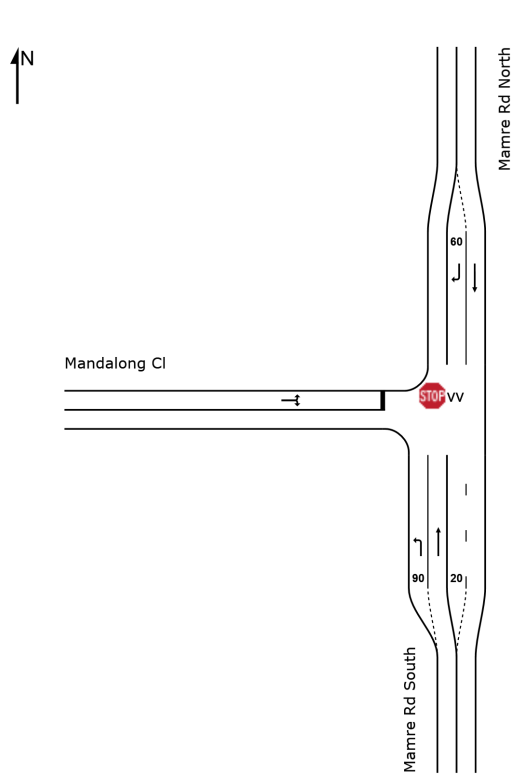


Existing layout

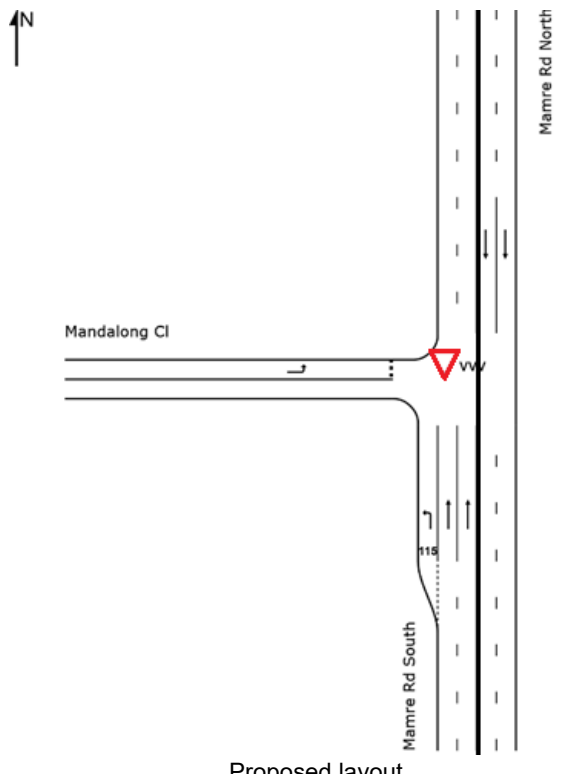


Proposed layout

Figure 3-8: Existing and proposed McIntyre Avenue intersection layouts



Existing layout



Proposed layout

Figure 3-9: Proposed McIntyre Avenue and Mandalong Close intersection layouts

Changes to property access

The proposal would require changes to property access including:

- removal of existing Mamre Road access to some properties owned by the Office of Strategic Lands west of Mamre Road (including Mamre House)
- provision of a new driveway access off the Banks Drive intersection for Mamre House and adjoining properties
- reinstatement of the existing secondary access to Mamre House off Mamre Road, which is also used to access the St Marys Air Quality Monitoring Station
- revised access to the Erskine Park Rural Fire Service site via a new driveway onto Old Luddenham Road
- revised access to an existing TransGrid tower about 330 metres north of Mandalong Close
- closure of several unregulated private property accesses for pedestrians or vehicles in St Clair that currently provide access from the rear of the property directly onto the Mamre Road corridor
- adjustment of the kerb to the driveway of the property on the north-east corner of the Solander Drive intersection to provide sufficient space for the upgraded intersection.

The changed property access arrangements would be confirmed during detailed design in consultation with the relevant landholders.

Bus facilities

The proposal would involve replacement of the existing northbound and southbound bus stops on Mamre Road near Mamre House with two new departure side bus stops at the Banks Drive intersection. The two existing westbound and eastbound bus stops on Erskine Park Road east of the intersection with Mamre Road and the westbound bus stop on Banks Drive would also be relocated further away from the intersection due to the proposal.

The indented bus bays would be about 65.5 metres long, which would provide enough space for two standard size buses. Additional bus bays have been located where future bus stops may be located.

The proposal would also provide sufficient reserved space for:

- future bus priority lanes within the left turn lanes at the Banks Drive and Solander Drive intersections and on the approach side of the Erskine Park Road intersection
- future bus stops on the departure side of the Solander Drive and Erskine Park Drive intersections, including future bus stop signs, seating, shelters and tactile markers.

Pedestrian and cyclist infrastructure

The proposed shared path for pedestrians and cyclists along the eastern side of Mamre Road would be about three metres wide, with slightly more room at the potential future bus stop locations. The shared paths would connect to local roads and informal pedestrian pathways in St Clair to the east of Mamre Road.

The shared path would be designed to enhance pedestrian and cyclist connectivity in the local region and to create a comfortable journey. To achieve this, the shared path has been separated from the road in three key locations, which would allow for additional tree and planting between the road and shared path and increase shading (refer to the urban design and landscaping plans provided in Appendix K).

The proposed signalised intersections would provide safe crossing facilities for both pedestrian and cyclists. In addition, 1.5 metre wide footpaths between intersection pram ramps have been provided on the western side of Mamre Road for pedestrian connectivity and safety.

The proposal also includes space allocation for a future shared path along the western side of Mamre Road, if required.

Urban design and landscaping

Several urban design and landscaping measures would be included in the design to improve the amenity of the road corridor for pedestrians and cyclists. These features would be confirmed during detailed design but are likely to include consideration of increased green cover (i.e. plants) and shade to protect pedestrian areas from heat, lighting, street art, creation of 'pedestrian portals' (refer to Figure 3-10), provision of break out spaces and stopping points along shared paths. Landscaping would be provided in the road verges and medians to assist in 'greening' the road corridor and provide screening in accordance with the urban and landscape design.

Further information on the urban design and landscaping concept for the proposal is provided in Appendix K.



Figure 3-10: Concept sketch of pedestrian portal (subject to detailed design)

Road drainage infrastructure

The proposal would include the following road drainage infrastructure:

- Longitudinal drains, which would run along length of the road and are designed to remove water from the road surface as quickly as possible. This would include a system of pits and pipes within the median and kerb of the road.
- Transverse drains, which transfer water under the road and are generally installed along natural low points on a road to allow natural stormwater runoff from the surrounding land to drain across a road to minimise disturbance to the existing flow patterns. This would include:
 - replacement of thirteen existing culvert structures with new upgraded reinforced concrete box culvert structures to achieve improved flood immunity
 - longitudinal drainage pipes.
- Water quality management and stormwater treatment measures that could include:
 - water quality basins
 - grass swales
 - replacement of the existing gross pollutant trap near the Banks Drive intersection
 - scour protection at transverse culverts, longitudinal pipes and channels to prevent erosion and scour from the flow of water.

Figure 3-1 shows the locations of the proposed culvert structures, water quality basins and swales.

The road drainage infrastructure and road alignment would be designed to achieve flood immunity for a one per cent AEP flood event along the section of Mamre Road. This flood immunity would generally be better than the existing case along Mamre Road and its intersections (refer to Section 6.4).

Noise walls

The proposal would include provision of noise walls that would be about 4.5 metres high along the eastern side of Mamre Road to minimise potential road traffic noise impacts during operation of the proposal. An indicative alignment of the noise wall is shown on Figure 3-1.

However, the design of the noise walls would be confirmed during detailed design including consideration of different noise wall alignment options. The alignment options would be developed considering the need to balance traffic noise reduction, flood risk, visual impacts and other design constraints such as underground utilities.

The noise wall design development would also consider opportunities to incorporate heritage interpretation (particularly near Mamre House) and urban design features such as clear panels, colour, art and graphics to help with navigation and improve aesthetics.

Supporting infrastructure

The proposal would feature supporting road infrastructure, lighting, signage and street furniture, which would be confirmed during detailed design and likely include provision of:

- safety barriers in some sections along Mamre Road to protect vehicles, pedestrians and cyclists from hazards such as steep batters or crossings of large culverts
- traffic control signals at signalised intersections
- traffic control facilities including traffic monitoring units, CCTV cameras, relocated variable message signage and associated utilities
- guide, regulatory and warning signs for road users
- line marking along the road corridor and retroreflective raised pavement markers (RRPMs) on all lane, edge and barrier lines
- roadside furniture to support public and active transport
- street lighting and fencing along the road corridor.

3.3 Construction activities

This section summarises the likely method, staging, work hours, plant and equipment and associated activities for construction of the proposal. The proposal would be built under TfNSW construction specifications under an approved construction environmental management plan (CEMP).

However, the actual work method may vary from the description provided in this section due to the identification of additional engineering constraints, ongoing design refinements, feedback from community and stakeholder consultation and contractor requirements and limitations. As such, the final construction activities and their sequencing would be confirmed during detailed design and outlined in the CEMP.

3.3.1 Work methodology

The construction strategy for the proposal has been designed in several stages to allow Mamre Road to remain operational during construction and minimise traffic impacts:

- Early work – during this stage, most utility relocations, preparation and site establishment activities that are required to be completed prior to the start of the main construction activities would be carried out
- Main construction work, which comprises:
 - Stage 1 – during this stage, Mamre Road would remain in its existing arrangement and the proposed northbound carriageway would be constructed offline behind safety barriers
 - Stage 2 – during this stage, Mamre Road would operate in a temporary contraflow arrangement using the new northbound carriageway (constructed in Stage 1), and the new proposed southbound carriageway would be constructed
 - Stage 3 – during this stage, Mamre Road would be configured to one lane in each direction using the new northbound and southbound carriageways to allow incomplete sections of the proposal to be finished.

Table 3-3 summarises the likely construction activities that would be carried out during the early work stage. Table 3-4 summarises the likely construction activities that would be carried out during the main construction stage (including Stages 1 to 3).

Table 3-3: Indicative construction activities for the proposal – early work

Activity	Associated work
Site establishment and environmental protection	<ul style="list-style-type: none"> • complete property acquisition and property leases • obtain permits and licences, as required • notify the community and stakeholders of upcoming work • conduct pre-construction dilapidation and building condition surveys • install temporary erosion and sediment (ERSED) controls • conduct pre-clearing surveys, as required • install temporary fencing around site boundaries and mark any environmentally sensitive areas to be avoided (no-go areas) • clear and grub vegetation for utilities, fencing and access tracks and site compounds • install traffic management controls including any temporary road barriers, closures and diversions • establish site compounds and stockpile areas • install noise mitigation measures and safeguards • establish waste management areas including for disposal and stockpiling of potentially contaminated materials
Early utility adjustments (including water, electricity, optical fibre and gas main infrastructure)	<ul style="list-style-type: none"> • protect remaining utilities • adjust and relocate existing utilities through a combination of trench excavation, underboring, pipeline and conduit installation. Service testing and commissioning • tie-in new utilities to existing utilities • install and test new utilities • backfill and restore ground surface, as required
Other early work	<ul style="list-style-type: none"> • establish temporary pavement and access tracks, including minor creek crossings containing temporary pipes to maintain water flow • complete minor property adjustment work including boundary fencing adjustments, driveway realignments and signage relocation
Demobilisation	<ul style="list-style-type: none"> • partially demobilise and remove temporary construction facilities • remove environmental, safety and traffic controls • clean up the site and dispose of waste materials

Table 3-4: Indicative construction activities for the proposal - main construction work

Activity	Associated work
Site establishment and environmental protection	<ul style="list-style-type: none"> • obtain permits and licences, as required • notify the community and stakeholders of upcoming construction work • install temporary erosion and sediment (ERSED) controls • install temporary fencing around site boundaries and mark any no-go areas • install traffic management controls including any road closures and diversions • establish site compounds and stockpile areas • install temporary water quality control
Compound operation	<ul style="list-style-type: none"> • load materials into concrete batching plant • produce concrete and load into trucks for use on site • stockpile materials and equipment
Remaining utility adjustments	<ul style="list-style-type: none"> • protect remaining utilities • adjust and relocate existing utilities through a combination of trench excavation, underboring, pipeline and conduit installation • tie-in new utilities to existing utilities • install and test new utilities • backfill and restore ground surface, as required
Earthworks	<ul style="list-style-type: none"> • clear and grub vegetation • strip and stockpile topsoil in stages • excavate cuttings • place material to create fill embankments • grade and compact areas • prepare geotechnical foundations • prepare batter treatments • dispose of unsuitable and/or surplus excavated material
Drainage and water quality upgrades	<ul style="list-style-type: none"> • install temporary drainage diversions • install/extend culverts and longitudinal drains • install scour protection • install permanent water quality measures
Road, pathway and intersection upgrades	<ul style="list-style-type: none"> • mill off top layer of asphaltic concrete in sections of existing road • prepare pavement base and sub-base • lay and compact new pavement layers • apply asphalt concrete road surface seal

Activity	Associated work
Supporting infrastructure and finishing work	<ul style="list-style-type: none"> • construct noise wall • install safety barriers • install kerbs, gutters and final median adjustments • install urban design features and landscaping • install line marking and signs • install street lighting • install traffic signals
Demobilisation	<ul style="list-style-type: none"> • rehabilitate disturbed areas • remobilise and remove temporary construction facilities • remove temporary environmental, safety and traffic controls • clean up the site and dispose of waste materials

3.3.2 Construction workforce

Construction of the proposal is likely to require up to 250 construction workers. However, the number of construction workers at any one time would vary depending on the stage of construction and the final methodology that would be identified during detailed design and within the CEMP.

3.3.3 Construction hours and duration

It is anticipated that construction of the proposal would start in 2022 and be completed in late 2025, subject to approvals, funding and weather. The early work stage of construction is estimated to take about 11 months to complete. The main construction stage would take about 16 months to complete overall, which comprises about six months for Stage 1, six months for Stage 2 and four months for Stage 3. However, these durations are indicative and would be confirmed by the construction contractor.

Construction would largely be carried out in accordance with the standard construction working hours defined by the *Interim Construction Noise Guideline* (ICNG; DECC, 2009):

- Monday to Friday: 7.00 am to 6.00 pm
- Saturday: 8.00 am to 1.00 pm
- Sunday and public holidays: no work.

However, it is noted that at the time of writing this REF, the Environmental Planning and Assessment (COVID-19 Development – Infrastructure Construction Work Days No. 2) Order 2020 is in place under section 10.17 of the EP&A Act to facilitate social distancing by spreading infrastructure construction work over more days in a week.

This Ministerial Order came into effect in December 2020 and allows development for public infrastructure projects to be carried out on Saturdays, Sundays and public holidays, providing the proposed work:

- is limited to the standard working hours for weekdays (i.e. 7.00 am to 6.00 pm)
- does not involve high noise generating work such as rock breaking, rock hammering, sheet piling, pile driving or similar activities
- takes all feasible and reasonable measures to minimise noise.

Construction activities that may result in traffic restrictions are likely to be carried out outside of standard construction working hours during night time periods to minimise disruption to traffic and provide a safer working environment for construction workers. The following work is likely to be carried out as night work, some with short term lane closures:

- installation of temporary concrete traffic safety barriers to provide separation between road users and the construction sites
- new pavement construction (temporary and permanent) at Banks Drive, Mandalong Close, Luddenham Road, Solander Drive, McIntyre Avenue and Erskine Park Road intersections as well as both the northern and southern tie-ins
- removal of the existing medians and traffic islands and construction of the new intersection at the Erskine Park Road during Stage 1
- removal of the existing median north of the Banks Drive intersection, placing temporary pavement and mill and re-sheeting the existing pavement
- deliveries of oversized materials or equipment
- use of construction compounds and other ancillary facilities.

All construction work, including work outside of standard working hours, would be carried out in accordance with:

- the provisions of the Environmental Planning and Assessment (COVID-19 Development – Infrastructure Construction Work Days No. 2) Order 2020, if still in force during construction, or another order amending these measures
- the allowable hours defined in the environmental protection licence (EPL) issued by the NSW Environmental Protection Authority (EPA) for the proposal (refer to Section 4.2)
- road occupancy licence (ROL) conditions from the relevant roads authority, if required due to work planned on a public road (refer to Section 4.2)
- the ICNG (DECC, 2009) and *Construction Noise and Vibration Guideline* (CNVG; Roads and Maritime Services, 2016a) to minimise potential noise impacts, including community notification prior to work outside standard construction working hours.

3.3.4 Plant and equipment

The plant and equipment needed to build the proposal would be typical of any road construction project and would vary depending on the construction activity being carried out.

Table 3-5 indicates the plant and equipment that is likely to be used during construction of the proposal, however the exact requirements would be finalised by the construction contractor.

Table 3-5: Indicative plant and equipment required for the construction of the proposal

Activity	Plant and equipment
Site establishment and environmental protection	<ul style="list-style-type: none"> • Site office, site shed and amenities • Light and heavy vehicles • Generator • Hand tools
Compound operation	<ul style="list-style-type: none"> • Concrete batching plant • Generator • Hand tools • Light and heavy vehicles
Utility adjustments, other early work, earthworks and drainage upgrades	<ul style="list-style-type: none"> • Light and heavy vehicles • Excavator • Concrete truck • Concrete saw • Piling rig • Generator • Hand tools • Trench compaction equipment • Crane
Road, pathway and intersection upgrades	<ul style="list-style-type: none"> • Asphalt profiling machine • Asphalt paver • Vibratory roller • Concrete truck • Excavator • Grader • Light and heavy vehicles • Generators
Supporting infrastructure and finishing work	<ul style="list-style-type: none"> • Line marking truck • Hand tools • Light vehicles
Demobilisation	<ul style="list-style-type: none"> • Light and heavy vehicles • Crane • Hand tools

3.3.5 Earthworks

Earthworks generally involve the creation of elevated areas from placement of fill material or lower areas from removal of material (cuts). The proposal would require major earthworks along some sections of Mamre Road to widen the road and intersections and adjust the vertical elevation of the road to improve drainage and flood immunity. Earthworks would also be required to construct the drainage infrastructure and relocate the existing utilities.

It is estimated that to build the proposal about:

- 58,000 cubic metres of subsurface material would be excavated (cut)
- 124,100 cubic metres of engineered fill material would be needed

Excavated materials would be managed and stored (stockpiled) in accordance with the mitigation measures outlined in this report (refer to Section 7.2). Movement of materials between work sites may be required from cutting to fill locations and embankment areas. As there is expected to be an excess of fill material needed during construction of the proposal (about 66,100 cubic metres), additional suitable material would need to be imported to site from beyond the proposal area. The final earthwork volumes and locations would be confirmed during detailed design.

The ability to reuse excavated material for fill material would depend on its physical and chemical properties. Some of the excavated material is proposed to be reused on-site for the new road sections, where suitable. Uncontaminated material that is not suitable for use as structural fill material could be used to line the utility trenches or in areas of landscaping. In the event that soil impacted with asbestos is encountered, the contaminated material may be remediated through on-site capping and/or containment in accordance with relevant guidelines and legislation (refer to Section 6.6.4). Material unsuitable for construction use and requiring disposal would need to be transported offsite by a licensed contractor for disposal at a licensed waste management facility, subject to testing and classification in accordance with the *Waste Classification Guidelines* (DECCW, 2014).

Stockpile sites would be used to temporarily store raw materials, excess spoil and waste before their use, reuse on-site or disposal off-site. Separate stockpile sites would be established to segregate material of different waste classifications and prevent cross-contamination. In particular, soil containing suspected asbestos containing material would be stockpiled separately to 'clean' soil. Stockpile sites would be established and managed in accordance with QA Specification R44 - Earthworks and the *Stockpile Site Management Guideline* (RMS, 2015d). Further information on the location and management of stockpile sites is provided in Section 3.4.

3.3.6 Source and quantity of materials

Various standard construction materials that are readily available within NSW would be needed to build the proposal. The indicative resources and materials needed to build the proposal (in addition to the imported fill) would include:

- pavement materials including:
 - about 5080 cubic metres of road base
 - about 15,560 cubic metres of asphalt
 - about 23,500 cubic metres of cast in-situ concrete for lean-mix concrete subbase, concrete paving, kerbs, backfill
- manufactured items including:
 - about 9750 tonnes of pre-cast concrete for the noise wall panels
 - about 12,250 metres of reinforced concrete pipes and box culverts
 - other steel and precast components for supporting road infrastructure, lighting, signage and street furniture
- natural resources such as aggregates and sand for use in concrete batching and landscaping
- water for dust suppression, concrete and watering plantings
- relatively small quantities of additional materials such as paint, oils and fuels.

Where possible, the re-use of suitable excavated material and production of materials on-site would be prioritised to minimise the required quantity and transportation of imported materials. Where material is required to be imported, materials would be sourced from commercial suppliers in nearby areas, a suitably licensed nearby quarry or other viable sources such as nearby infrastructure projects with excess clean excavated material.

3.3.7 Traffic management and access

Temporary traffic arrangements and controls

As discussed in Section 3.3.1, the construction of the proposal would be staged through establishment of alternate traffic arrangements that would generally facilitate one lane of traffic in each direction to allow Mamre Road to remain operational throughout construction. The construction staging strategy would consider minimising impacts to road users as well as local residents and businesses near construction.

In most cases, the construction staging would create work zones behind safety barriers where construction work can be completed safely and during standard construction working hours, to avoid the need for lane closures. Temporary concrete traffic safety barriers would be used along the edge of the existing carriageway to provide separation between road users and the construction sites. The installation of the temporary barriers for the early works would be completed under traffic control.

However, where this is not practical, construction work would be undertaken out of peak traffic periods using temporary traffic management arrangements, such as night time and weekend lane closures, and traffic controls to divert or detour vehicles onto the surrounding road network around the worksite for short periods. Section 3.3.3 outlines the construction work activities that would likely be undertaken as night or weekend work with short term

partial or full road closures. After each night or weekend shift, traffic conditions would return to normal to minimise the impact to road users.

Bus routes 776 and 779 may also be amended to avoid travelling via the section of Mamre Road within the proposal area during construction and instead use the local road network within St Clair. Any proposed alterations to bus routes would be carried out in consultation with the relevant bus service provider.

Access

Private property access would be maintained during construction (unless otherwise agreed with the property owner) through management of existing accesses or provision of a temporary alternate access route. Changed traffic conditions may restrict some existing turning movements in and out of property accesses and alternative detours may be provided. This would be carried out in consultation with the relevant property owner. The construction contractor would manage existing and temporary property accesses through traffic management in accordance with construction staging plans.

Access for emergency services along Mamre Road, including vehicles to and from Erskine Park Rural Fire Service, would be retained throughout construction. The construction contractor would consult with emergency services prior to construction.

Vehicular access to Mamre House would be maintained during Stage 1 before the new access at the fourth leg into Banks Drive has been constructed. This includes maintaining access for pedestrians that need to make their way to and from the pedestrian crossing at Banks Drive.

Access for pedestrians is expected to be maintained for the duration of construction. In some work areas, detours and alternative temporary pathways around construction areas may be required to safely maintain access for pedestrians. This would include new temporary paths that would allow pedestrians to walk behind safety barriers within the proposal area.

Construction of the proposal would also require the temporary relocation or closure of existing bus stops during construction stages that prevent safe access. This would include the existing bus stops:

- at the Erskine Park Road intersection heading eastbound, which would be temporarily relocated outside the proposal area during Stage 1
- on Banks Drive, which would be temporarily relocated outside the proposal area during Stage 2
- on Mamre Road northbound near Mamre House, which would be temporarily closed during Stage 1
- on Mamre Road southbound near Mamre House, which would be temporarily closed during Stage 2.

During the temporary closure of the bus stops on Mamre Road near Mamre House, commuters would be encouraged to use the nearby bus stop on Banks Drive.

There is little existing provision for cyclist movement along Mamre Road, which makes it difficult for cyclists to safely use Mamre Road as an access route (refer to Section 2.2). An alternate route through the local road network would be proposed for cyclists to discourage cyclists to use Mamre Road during construction, until the new shared use path is constructed.

Construction traffic

The proposal would generate light and heavy vehicle movements associated with delivery or removal of construction materials and equipment and construction worker movements to and from the proposal area. Table 3-6 summarises the expected construction traffic volumes associated with building the proposal.

Table 3-6: Indicative construction traffic volumes

Vehicle type	Average number of vehicles per day	Maximum number of vehicles per day	Typical movement pattern
Heavy vehicles	75	100	Spaced throughout the day
Light vehicles	75	100	Spaced throughout the day, with a peak at the beginning and end of construction shifts associated with construction worker movements
Oversized vehicles	2	5	Irregular movements as required

Haulage routes

Haulage routes describe the roads that the construction traffic and delivery vehicles would use to enter and leave the proposal area. Most transportation of material and equipment to and from the proposal area is expected to be via the M4 Motorway, which is located north of the proposal area. Construction vehicles are also likely to use Mamre Road, Erskine Park Road and Elizabeth Drive, which are existing routes approved for heavy vehicles including B-doubles. Construction vehicles that are not able to turn right out of the compound sites onto Mamre Road in Stage 1 of construction may also use the Kent Road interchange with the M4 Motorway. Use of local roads would be avoided, where possible, to minimise impacts to the local community. Most haulage vehicle movements are expected to occur within standard construction hours.

Parking

The construction contractor would provide off-road parking within the ancillary facilities and proposal area to prevent construction workers parking on surrounding local roads, where possible.

Construction of the proposal would require removal of about six parking spaces near the Solander Drive intersection and two parking spaces near the McIntyre Avenue intersection to provide space for construction activities and intersection operation.

3.4 Ancillary facilities

Several compound sites would be needed for offices and amenities and to store equipment, machinery and vehicles to build the proposal. Three potential compound sites have been identified for the proposal (refer to Figure 3-1):

- Site 1, which is located at the northern end of the proposal area near the intersection of the M4 Motorway and Mamre Road on Lot 1 DP849524, Lot 1 DP530579 and Lot 1 DP849524. This site would be accessed directly off Mamre Road and would be used as a northern site compound for workers, car parking and material storage.
- Site 2, which is located about 100 metres north of the Solander Drive on Lot 1 DP580390. This site would be accessed directly off Mamre Road and would be used as the main site compound for workers, concrete batching, car parking and bulk material storage.
- Site 3, which is located on cleared grassland north of Mandalong Close on Lot 201 DP1013539. This site would be accessed from Mandalong Close and would be used as a site compound, car parking for workers and stockpile areas.

The location of potential compound sites for the proposal has been selected with consideration of the following criteria, where feasible and reasonable:

- at least 40 metres away from the nearest waterway
- of low ecological and heritage conservation significance
- at least 100 metres away from residential dwellings and other land uses that may be sensitive to noise
- of relatively level ground
- outside the 20 year ARI floodplain.

Compound site facilities may include portable buildings with amenities such as lunch facilities and toilets, secure and bunded storage areas for site materials, including fuel and chemicals, office space, and associated parking.

Compound Site 2 would also include a concrete batching plant for the on-site production of concrete. On-site production of concrete would allow for project control over the quality, quantity and timing of concrete material for construction activities. It would also reduce the time required to transport concrete from its production to its use, which may result in a higher quality product and reduce the number of heavy vehicles required on the wider road network.

The specific requirements for each compound site would depend on the stage of construction, the construction activities the site is required to support and any site-specific mitigation measures that would be implemented. Each compound site would be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions. Upon completion of construction, the temporary compound sites, work areas, stockpiles, rubbish and materials would be removed from the proposal area. The compound sites would then be rehabilitated in consultation with the relevant property owner.

Stockpile sites would be located within the compound sites or proposal area on land that is outside the 20 year ARI floodplain and away from South Creek, where possible (refer to Section 6.5). Separate stockpile sites with appropriate fencing and warning signs would be established to segregate any potentially contaminated material and minimise risk of accidental disturbance or cross-contamination. Stockpiles would be managed in accordance with TfNSW's *QA Specification R44 – Earthworks* and the *Stockpile Site Management Guideline* (RMS, 2015d). Erosion and sediment control measures would also be

implemented, including requirements to cover and stabilise any long-term stockpiles, to minimise risk of mobilisation of materials off-site during high wind or storm events.

Three temporary sediment basins are required during construction of the proposal in accordance with the 'Blue Book' (Landcom, 2004). Two of these basins are proposed either side of the proposed culvert located about 260 metres south of Solander Drive and the third basin is proposed along the western side of Mamre Road near McIntyre Avenue. These temporary sediment basins would minimise water quality impacts by capturing and treating sediment laden runoff from the proposal area prior to discharging the water to existing stormwater drains. The discharge from these basins would occur in accordance with TfNSW's *QA Specification G38 Soil and Water Management* and any Environmental Protection Licence requirements.

The construction contractor would finalise the layout and requirements of the compound sites as well as any other stockpile sites, laydown locations or ancillary facilities identified to be required during detailed design. Any additional or revised ancillary facilities proposed by the contractor would be discussed with TfNSW's Environment Manager to determine if any additional environmental assessment is required.

3.5 Public utility adjustment

Several major utilities have been identified within the proposal area that would require adjustment and/or relocation during construction of the proposal, as described in the sections below. The relevant utility providers have been and will continue to be consulted with during detailed design and construction regarding the proposed relocation and/or protection of utilities within the proposal area. This would also include further consideration of any planned future utilities within the proposal area to avoid potential design conflicts and allow for growth in the area, where possible.

3.5.1 Electricity supply and street lighting

The proposal would require relocation of an existing 11 kilovolt overhead powerline owned by Endeavour Energy underground along Mamre Road during Stage 1 of construction. This would also involve replacing three existing pole mounted substations with pad-mounted substations. The proposal would also require installation of new street lighting on the southbound and northbound carriageway of Mamre Road and an associated electricity distribution network.

3.5.2 Gas

The proposal would require the relocation of an existing 110mm PE 210 kPa (medium pressure) gas main, which is located between Erskine Park Road and James Erskine Drive and owned by Jemena. The gas main is proposed to be extended during Stage 1 of construction about 300 metres to James Erskine Drive, which would involve a new crossing of Mamre Road. There are other smaller gas mains that terminate at Banks Drive, Solander Drive and McIntyre Road, which are unlikely to be impacted by the proposal. This would be further investigated during detailed design.

3.5.3 Telecommunications

The proposal would require relocation existing Telstra conduits on the western side of Mamre Road, which also carry optic fibre cables owned by other telecommunication providers including NBN and Optus. The strategy for relocation of the Telstra conduits and associated optic fibre cables would be confirmed during detailed design through further consultation and coordination with the utility providers. Optic fibre conduits owned by AARNet may also require extension and/or relocation near the road crossing at Mamre Road.

The reconnection of the optic fibre cables would likely require new cables to be pulled underground through existing conduits to nodes that can be accessed via existing pits. Some of these pits may be located outside the proposal area. However, this work is expected to be consistent in nature with existing maintenance activities for the utilities, accessed via existing formed roads or paths and would not involve any new ground disturbance. .

During detailed design, if any additional ground disturbance or traffic management (such as lane closures) is identified to be required, further assessment will be carried out as required prior to the start of the work.

3.5.4 Water and sewer

The proposal would require the relocation of existing DN100 and DN150 water mains owned by Sydney Water at two locations on the western side of Mamre Road to allow for construction of the northbound carriageway. These two locations are roughly between the northern extent of the proposal area (near the M4 Motorway) and Luddenham Road, and from Mandalong Close to Pine Creek Circuit. It is proposed that the new trunk main would be relocated as part of the Early Works stage of construction to bottom of the road batter.

A small section of an existing DN100 water main would be impacted by the proposed swales near the Luddenham Road intersection and would require relocation.

No relocation of sewer mains is proposed. However, there is an existing manhole and vent shaft on the northbound verge that would require adjustment, subject to detailed design.

Ongoing maintenance requirements for water and sewer assets will be considered during detailed design in consultation with Sydney Water. Sydney Water may need to remove and reinstate the noise wall panels to access the existing sewer main located behind the proposed noise wall, in front of the residential properties, east of Mamre Road. However, the noise wall alignment and access arrangements will be further refined during detailed design.

3.6 Property acquisition

TfNSW would need to acquire, lease and/or otherwise negotiate access to land prior to and during construction of the proposal. Table 3-7 and Figure 3-11 outline the lots that would be subject to property acquisition and/or leasing for the proposal. This includes about 11.10 hectares of land to be permanently acquired and 29.25 hectares of land to be leased.

Property acquisition would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, *Crown Land Management Act 2016* and/or *Local Government Act 1993*, as required (refer to Section 4.2).

In some locations, both leasing and permanent land acquisition would be required, due to the timing of these different agreements. For example, land acquisition processes may not be finalised before early works are required to commence, therefore a temporary lease would be agreed with these landholders.

Since development of the proposal area for this REF, several areas of land within the proposal area have been identified as not required for the proposal. These areas have been shown as 'no-go zones' on Figure 3-11 and would be avoided during construction of the proposal.

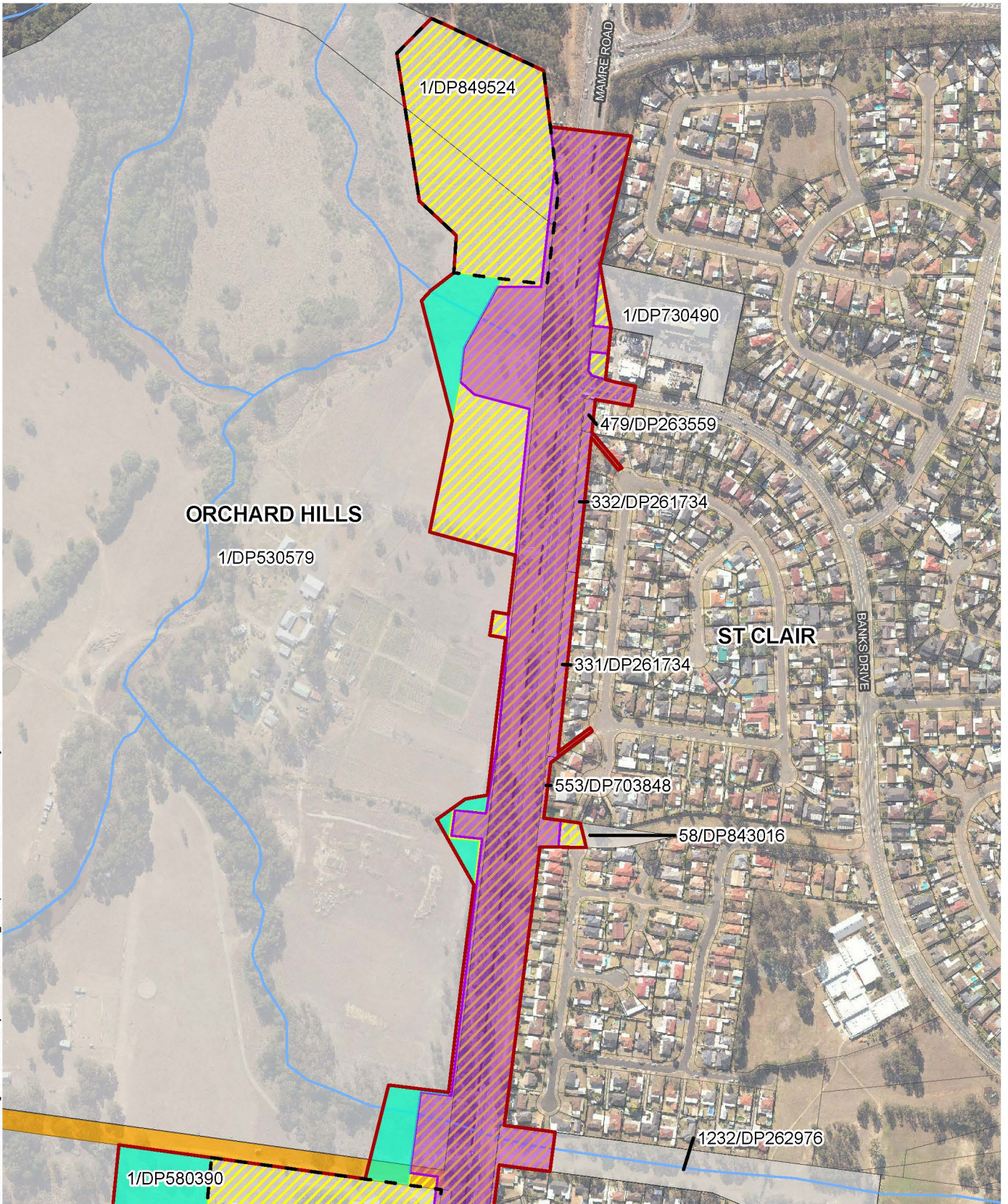
Table 3-7: Proposed property acquisition and leases

Lot and DP	Acquisition area (ha)	Lease area (ha)	Proposed acquisition type	Current owner	Land use zone (LEP) ¹
Lot 216 DP1013539	0.82	0.82	Lease and partial acquisition	Private	RU2 & SP2
Lot 215 DP1013539	0.57	0.57	Lease and partial acquisition	Private	RU2 & SP2
Lot 201 DP1013539	0.78	3.58	Lease and partial acquisition	Private	RU2 & E2 & SP2
Lot 23 DP1114968	0.26	0.45	Lease and partial acquisition	DPIE	RE1
Lot 24 DP1114968	0.53	0.53	Lease and partial acquisition	DPIE	E2
Lot 1 DP1128233	-	0.30	Lease	Private	IN1
Lot 2 DP1128233	0.32	0.58	Lease and partial acquisition	Minister administering the EP&A Act	E2
Lot 44 DP1151817	0.02	0.02	Lease and partial acquisition	Private	E2
Lot A DP162743	0.62	1.66	Lease and partial acquisition	DPIE	RE1
Lot 1 DP217319	0.44	0.44	Lease and partial acquisition	DPIE	E2
Lot 11 DP238969	1.58	1.92	Lease and partial acquisition	Minister administering the EP&A Act	E2
Lot 331 DP261734	0.19	0.19	Lease and full acquisition	Penrith City Council	R2
Lot 332 DP261734	0.14	0.14	Lease and full acquisition	Penrith City Council	R2
Lot 1232 DP262976	0.34	0.34	Lease and partial acquisition	Penrith City Council	R2 & RE1
Lot 412 DP263033	-	0.04	Lease	Penrith City Council	R2
Lot 465 DP263033	0.09	0.09	Lease and full acquisition	Penrith City Council	R2

Lot and DP	Acquisition area (ha)	Lease area (ha)	Proposed acquisition type	Current owner	Land use zone (LEP) ¹
Lot 501 DP263033	0.04	0.04	Lease and full acquisition	Penrith City Council	R2
Lot 502 DP263033	0.01	0.01	Lease and full acquisition	Penrith City Council	R2
Lot 2302 DP263116	0.16	0.16	Lease and full acquisition	Penrith City Council	R2
Lot 2134 DP263119	0.15	0.15	Lease and full acquisition	Penrith City Council	R2
Lot 479 DP263559	0.03	0.03	Lease and full acquisition	Penrith City Council	R2
Lot 2 DP529668	0.22	0.24	Lease and partial acquisition	DPIE	RE1
Lot 1 DP529668	0.63	2.11	Lease and partial acquisition	DPIE	RE1
Lot 1 DP530579	1.37	4.00	Lease and partial acquisition	DPIE (Mamre House)	RE1
Lot 1 DP580390	0.28	4.35	Lease and partial acquisition	Minister administering the EP&A Act	RE1
Lot 1 DP656828	0.53	2.38	Lease and partial acquisition	Minister administering the EP&A Act	RE1
Lot 3118 DP701131	0.09	0.09	Lease and full acquisition	Penrith City Council	SP2
Lot 3105 DP701131	-	0.05	Lease	Penrith City Council	R2
Lot 3117 DP701131	0.08	0.08	Lease and full acquisition	Penrith City Council	R2
Lot 3062 DP701131	-	0.04	Lease	Penrith City Council	R2
Lot 3116 DP701131	0.11	0.11	Lease and full acquisition	Penrith City Council	R2
Lot 553 DP703848	0.03	0.03	Lease and full acquisition	Penrith City Council	R2
Lot 1 DP730490	0.05	0.15	Lease and partial acquisition	Private	B6
Lot 1 DP744728	0.28	1.44	Lease and partial acquisition	DPIE	RE1
Lot 58 DP843016	0.06	0.12	Lease and partial acquisition	Penrith City Council	RE1

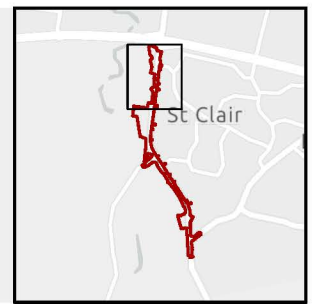
Lot and DP	Acquisition area (ha)	Lease area (ha)	Proposed acquisition type	Current owner	Land use zone (LEP) ¹
Lot 1 DP849524	0.03	1.84	Lease and partial acquisition	Minister administering the EP&A Act	RE1
No lot (Crown road)	0.20	0.21	Lease and partial acquisition	The Crown (Crown land)	E2 & SP2
No lot (Crown road)	0.03	0.07	Lease and partial acquisition	The Crown (Crown land)	RE1
No lot (Crown waterways)	0.07	0.07	Lease and partial acquisition	The Crown (Crown land)	E2 & SP2
No lot	-	0.10	Lease	Penrith City Council	R2

1) Refer to LEP land zonings outlined in Section 4.1.2



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- REF Proposal Area
- Compound Sites
- Acquisition Boundary
- Lease Boundary
- Crown Land
- No - Go Zones
- Intersected Lots
- Suburb
- ~ Waterways



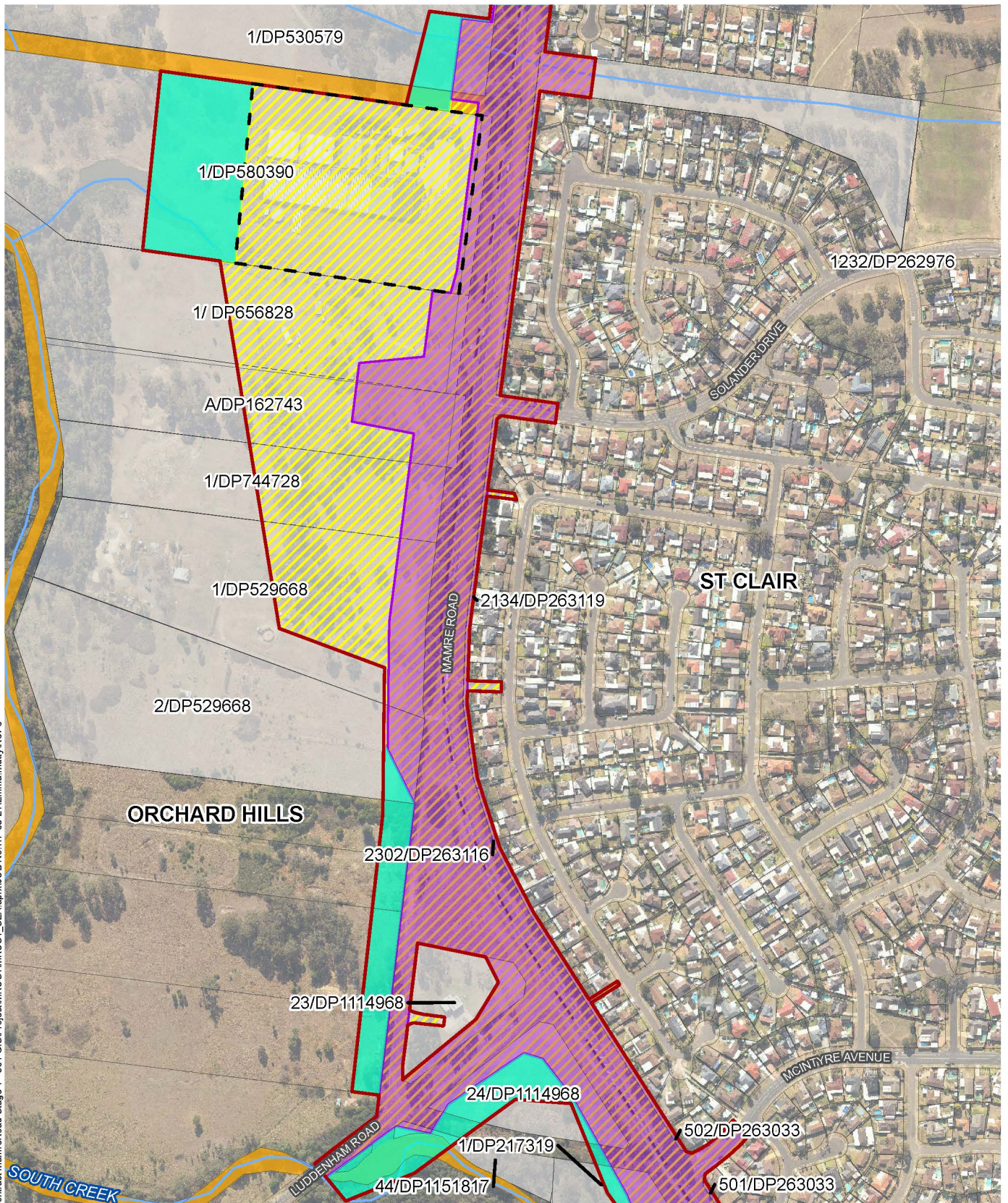
Source: Aurecon, Spatial Services, Nearmap, Esri



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Mamre Road Upgrade Stage 1

Figure 3.11a: Proposed property acquisition



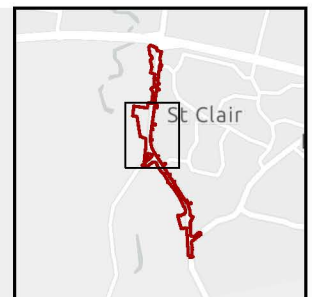
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- REF Proposal Area
- Compound Sites
- Acquisition Boundary
- Lease Boundary
- Crown Land
- No - Go Zones
- Intersected Lots
- Suburb
- ~ Waterways

Source: Aurecon, Spatial Services, Nearmap, Esri

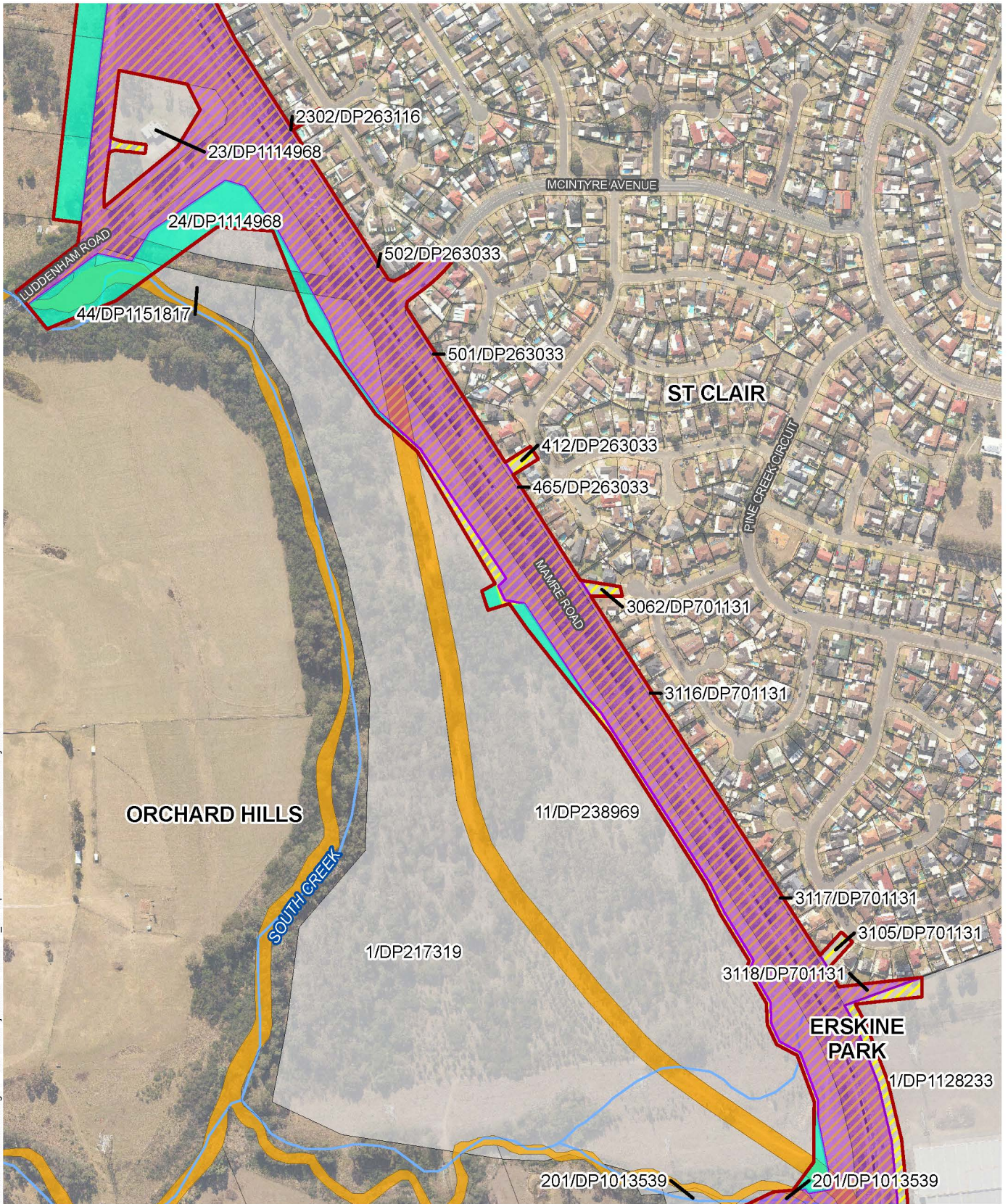


Date: 18/08/2021 Version: 3
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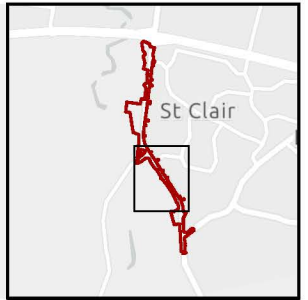
Mamre Road Upgrade Stage 1

Figure 3.11b: Proposed property acquisition



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- REF Proposal Area
- No - Go Zones
- Compound Sites
- Intersected Lots
- Acquisition Boundary
- Suburb
- Lease Boundary
- Crown Land
- ~ Waterways



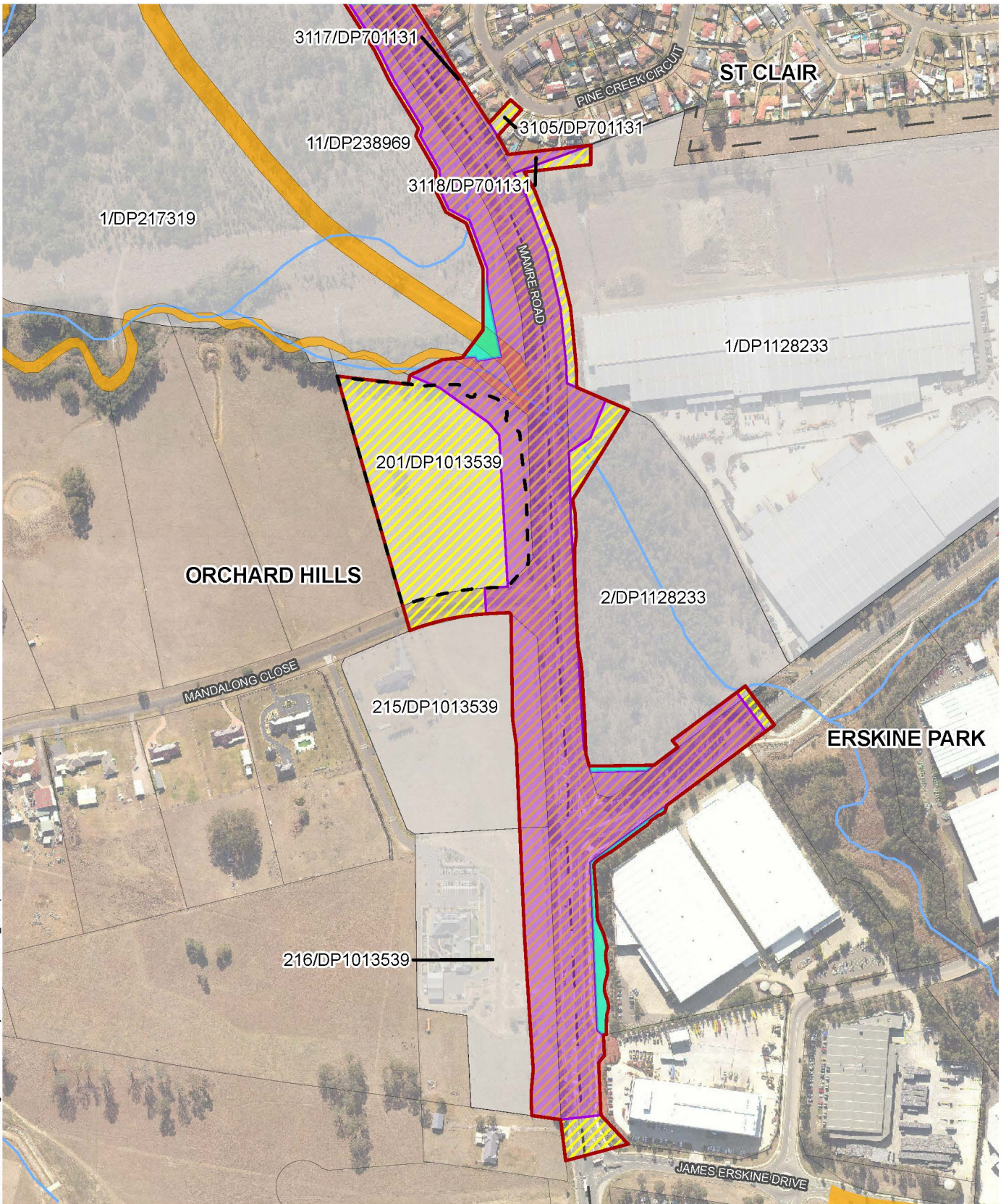
Source: Aurecon, Spatial Services, Nearmap, Esri



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 Projection: GDA2020 MGA Zone 56

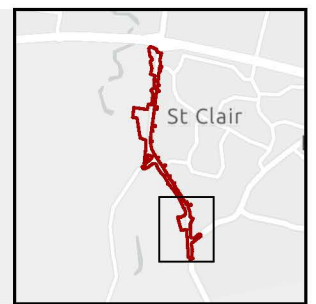
Mamre Road Upgrade Stage 1

Figure 3.11c: Proposed property acquisition



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- | | |
|----------------------|------------------|
| REF Proposal Area | No - Go Zones |
| Compound Sites | Intersected Lots |
| Acquisition Boundary | Suburb |
| Lease Boundary | Waterways |
| Crown Land | |



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 18/08/2021 Version: 3
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 3.11d: Proposed property acquisition

4 Statutory and planning framework

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

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of ISEPP 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.

As the proposal is for a road and is to be carried out by TfNSW, it can be assessed under Division 5.1 of the EP&A Act. Development consent from council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not require development consent or approval under State Environmental Planning Policy (Coastal Management) 2018, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (State Significant Precincts) 2005.

Part 2 of ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in Chapter 5 of this REF.

State Environmental Planning Policy (Western Sydney Employment Area) 2009

The State Environmental Planning Policy (Western Sydney Employment Area) 2009 (WSEA SEPP) aims to protect and enhance the land within the Western Sydney Employment Area for employment purposes. This SEPP establishes planning and development standards for the Western Sydney Employment Area, which would be controlled in accordance with a master plan and development control plans for the area.

Clause 33(1) of the WSEA SEPP states that “this Policy does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out without consent, or that is exempt development, under the *State Environmental Planning Policy (Infrastructure) 2007*”.

As such, the WSEA SEPP does not apply where it imposes controls that are inconsistent with the ISEPP. However, the WSEA SEPP is still relevant in identifying land use objectives, potential land use impacts and planning policy conflicts and as such, has still been considered for the area of the proposal that falls within the SEPP.

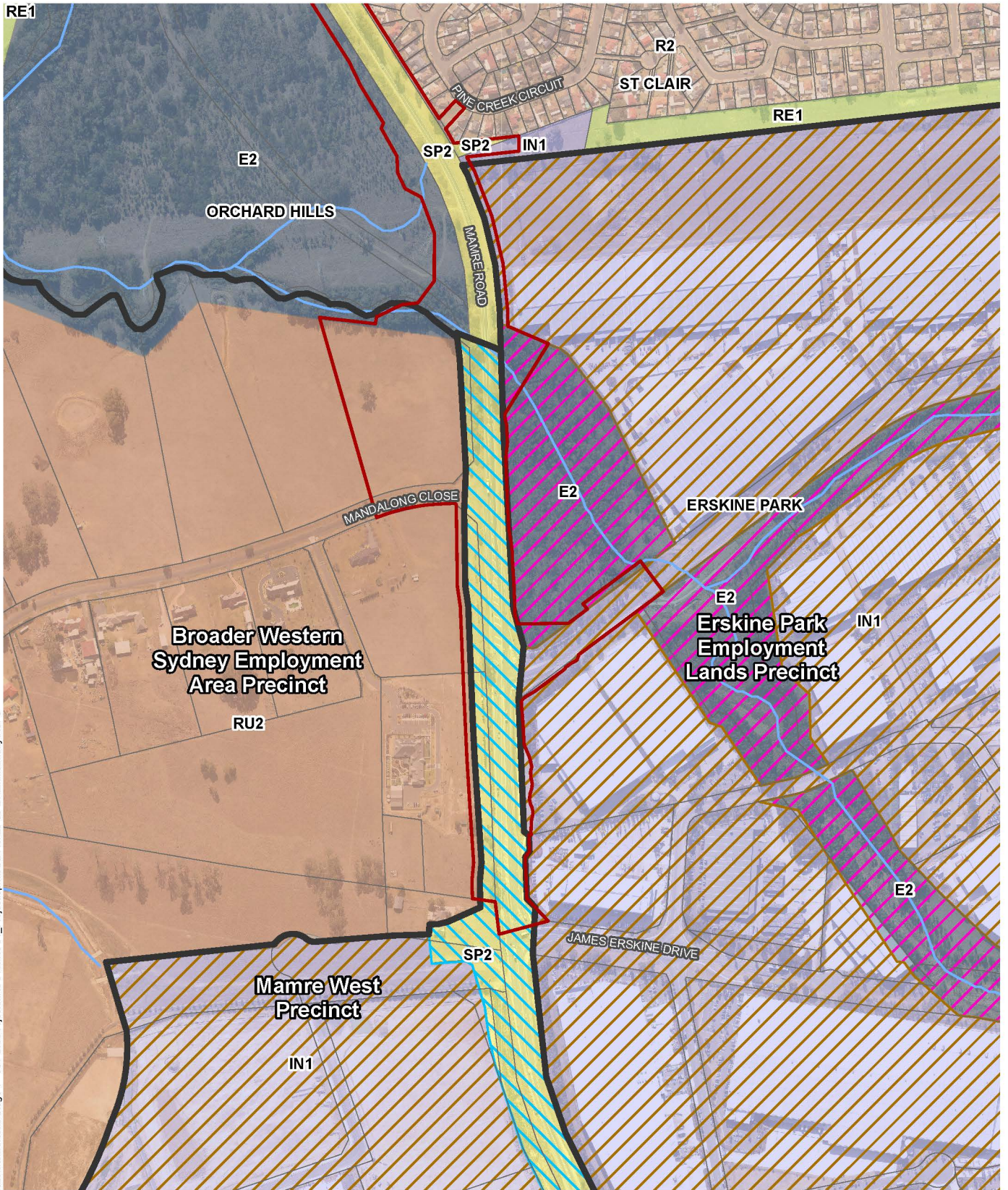
The southern portion of the proposal area near the Erskine Park Road intersection is located within the WSEA SEPP, in the following precincts (shown on Figure 4-1):

- Erskine Park Employment Lands precinct
- Mamre West precinct
- Broader Western Sydney Employment Area precinct.

The WSEA SEPP also includes a 'Mamre Road' precinct that considers opportunities for development of a warehousing industrial hub and intermodal terminal within this precinct as well as future transport corridors being developed by TfNSW. However, the Mamre Road precinct is located about one kilometre south of the proposal area and would be more relevant for Mamre Road upgrade Stage 2.

The WSEA SEPP establishes that a development control plan (DCP) would be developed for each precinct to guide how development would achieve outcomes such as employment and growth in each precinct. However, no DCPs have been established yet under the WSEA SEPP for the Erskine Park Employments Lands, Mamre West or Broader Western Sydney Employment Area precincts.

The portion of the proposal area within the WSEA SEPP is mainly zoned as SP2 Infrastructure, with small areas zoned as E2 Environmental Conservation or IN1 General Industrial (refer to Figure 4-1). Table 4-1 outlines the objectives of these zones, and how the proposal is aligned with these objectives.

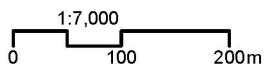


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- | | | |
|-----------------------|-------------------------------|----------------------------|
| REF Proposal Area | Land Zoning (WSEA SEPP) | IN1 General industries |
| WSEA SEPP - Precincts | E2 Environmental Conservation | R2 Low Density Residential |
| Road | IN1 General industries | RE1 Public Recreation |
| Suburb | SP2 Infrastructure | RU2 Rural Landscape |
| Waterways | Land Zoning (LEP) | SP2 Infrastructure |
| Cadastre | E2 Environmental Conservation | |



Source: Aurecon, Spatial Services, Nearmap, Esri



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 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 4-1: WSEA SEPP land zoning and precincts within the proposal area

Table 4-1: Consistency of proposal with WSEA SEPP land zones

Zone	Objectives of zone	Consistency of proposal with objectives
SP2 Infrastructure	<ul style="list-style-type: none"> • To provide for infrastructure and related uses • To prevent development that is not compatible with or that may detract from the provision of infrastructure 	<p>The proposal is consistent with the zone objectives as it would involve an upgrade to road infrastructure within this zone.</p>
E2 Environmental Conservation	<ul style="list-style-type: none"> • To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values • To prevent development that could destroy, damage or otherwise have an adverse effect on those values 	<p>The design of the proposal has been specifically refined in this zone to minimise impacts on ecological values, which is consistent with the objective of this zone.</p> <p>The new culvert and channel work proposed in the northern most section of this zone cannot be avoided, as it is required to minimise water quality and flooding impacts.</p> <p>A vegetation clearance boundary has been established to avoid vegetation clearance beyond that required to build the new infrastructure.</p>
IN1 General Industrial	<ul style="list-style-type: none"> • To facilitate a wide range of employment-generating development including industrial, manufacturing, warehousing, storage and research uses and ancillary office space • To encourage employment opportunities along motorway corridors, including the M7 and M4 • To minimise any adverse effect of industry on other land uses • To facilitate road network links to the M7 and M4 Motorways • To encourage a high standard of development that does not prejudice the sustainability of other enterprises or the environment • To provide for small-scale local services such as commercial, retail and community facilities (including child care facilities) that service or support the needs of employment-generating uses in the zone 	<p>The proposal is consistent with these objectives as the upgrade to Mamre Road (including the Erskine Park Road intersection) within this zone would improve access to employment generating development within the Western Sydney Employment area as well as the M4 Motorway to the north of the proposal area.</p>

Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2 – 1997)

Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No 2 – 1997) (SREP 20) is deemed a State Environmental Planning Policy. The proposal is located on land to which the SREP 20 applies in accordance with the SREP 20 land application map.

SREP 20 aims to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context. It adopts a twofold approach to achieving that aim: (1) the setting of the general planning considerations, specific planning policies and recommended strategies; and (2) the imposition of specific development controls.

Part 2, Clauses 5 and 6 of SREP 20 set out general planning considerations and specific planning policies and recommended strategies respectively. Clause 4 requires that those considerations, policies and recommended strategies be taken into consideration by public authorities proposing to undertake development that does not require consent. Appendix C provides a summary of how these have been considered in development of the proposal.

Part 3 of SREP 20 provides development controls for various types of development that would require development consent. However, these development controls do not apply to the proposal as the proposal does not require development consent.

State Environmental Planning Policy (Western Sydney Aerotropolis) 2020

State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 commenced on 1 October 2020 and provides development controls for the Western Sydney Aerotropolis. The land application map for this SEPP shows that it does not cover the proposal area and as such, the development controls outlined in this SEPP are not applicable to the proposal.

However, application of this SEPP would contribute to future economic growth and development near the proposal, as it would apply to land about one kilometre south-west of the proposal area. This has been considered during the development of the proposal, as development within the Western Sydney Aerotropolis would contribute to future growth in traffic volumes along Mamre Road and support the need for the proposal (refer to Chapter 2).

State Environmental Planning Policy No 55 – Remediation of Land

The State Environmental Planning Policy No 55 – Remediation of Land (SEPP 55) aims to promote the remediation of contaminated land or the purpose of reducing the risk of harm to human health or any other aspect of the environment. SEPP 55 establishes two categories of remediation work: Category 1 remediation work and Category 2 remediation work. In accordance with Clause 16, “a person who proposes to carry out a category 2 remediation work on any land must give notice of the proposed work to the council for the local government area in which the land is situated” at least 30 days before the work.

The contamination investigation identified eleven areas within the proposal area where existing asbestos containing material was identified either on the ground surface or within soil (refer to Section 6.6). A Remediation Action Plan would be prepared to evaluate potential remedial options and recommend a preferred option to manage any asbestos encountered during construction of the proposal. Any remediation work for the proposal would be carried out in accordance with SEPP 55, including prior notification to Penrith City Council if Category 2 remediation work is proposed.

4.1.2 Local Environmental Plans

The proposal area is within City of Penrith LGA. Local development control and land use zoning within the City of Penrith LGA, excluding those areas zoned under the WSEA SEPP, is managed under the *Penrith Local Environmental Plan 2010* (Penrith LEP). Similar to the WSEA SEPP, as the proposal is to be assessed under Division 5.1 of the EP&A Act, the development controls outlined within the Penrith LEP do not apply, however the LEP has still been considered. Table 4-2 outlines the objectives of these zones, and how the proposal is aligned with these objectives.

The proposal is located within the land zones under the Penrith LEP identified in Table 4-2 and mapped in Figure 4-2. Roads are permitted in all these land zones.

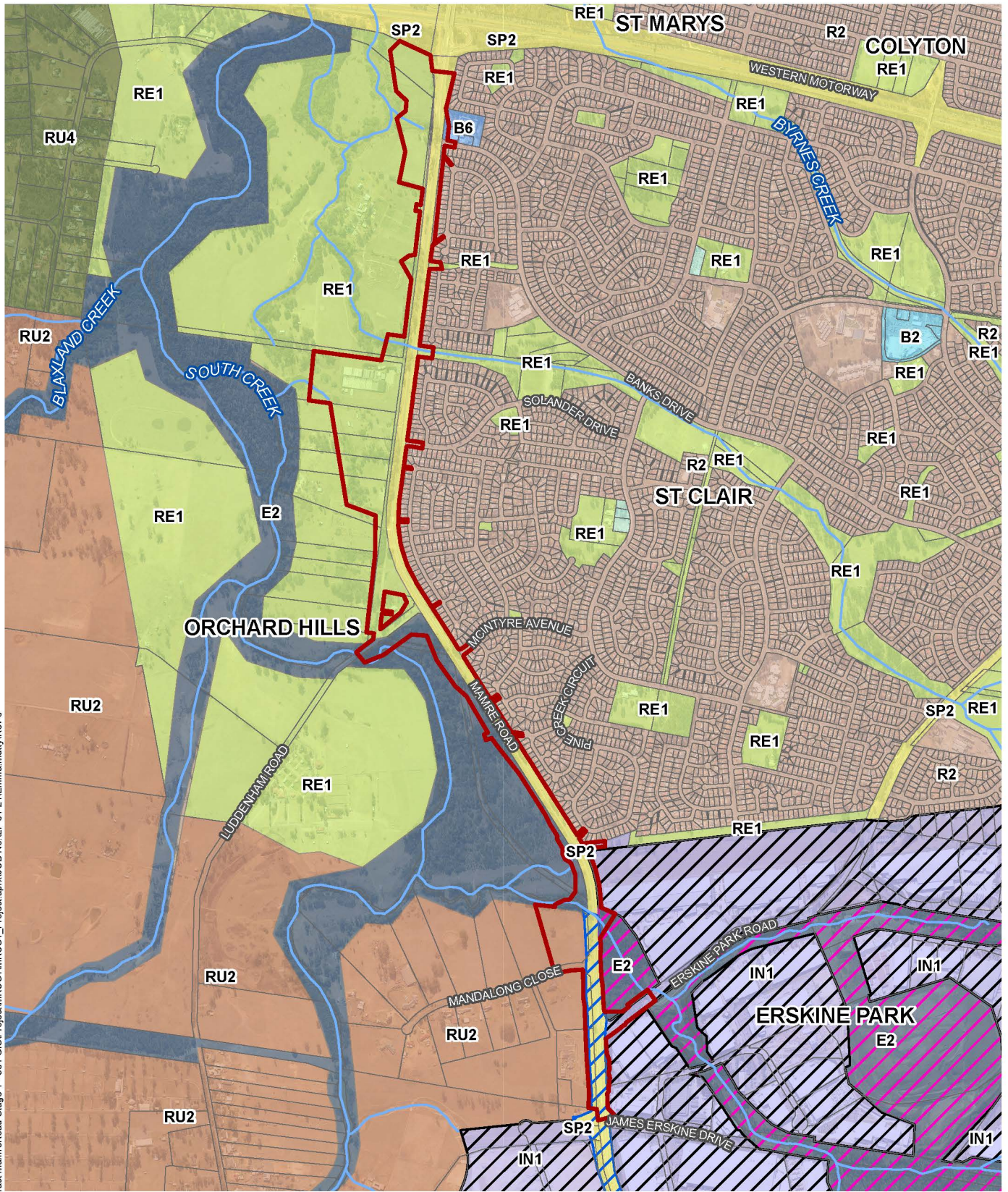
Table 4-2: Consistency of proposal with Penrith LEP land zones

Zone	Objectives of zone	Consistency of proposal with objectives
SP2: Infrastructure	<ul style="list-style-type: none"> To provide for infrastructure and related uses To prevent development that is not compatible with or that may detract from the provision of infrastructure 	<p>This zone covers the existing footprint of Mamre Road. The proposal is consistent with the zone objectives as it would involve an upgrade to road infrastructure within this zone.</p>
RE1: Public Recreation	<ul style="list-style-type: none"> To enable land to be used for public open space or recreational purposes To provide a range of recreational settings and activities and compatible land uses To protect and enhance the natural environment for recreational purposes To ensure that development is secondary and complementary to the use of land as public open space, and enhances public use, and access to, the open space To provide land for the development of services and facilities by public authorities for the benefit of the community 	<p>This zone mainly covers the lots along the western side of Mamre Road north of the Luddenham Road intersection. There are also two grassed areas with drainage culverts within this zone.</p> <p>The proposal would maintain access to current and future public recreation sites located within this zone, including through the new western leg at the Banks Drive and Solander Drive intersection. The proposal would maintain access from the shared path to the large grassed areas on the eastern side of Mamre Road.</p>

Zone	Objectives of zone	Consistency of proposal with objectives
E2: Environmental Conservation	<ul style="list-style-type: none"> • To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values • To prevent development that could destroy, damage or otherwise have an adverse effect on those values • To protect, manage, restore and enhance the ecology, hydrology and scenic values of riparian corridors and waterways, wetlands, groundwater resources, biodiversity corridors, areas of remnant indigenous vegetation and dependent ecosystems • To allow for low impact passive recreational and ancillary land uses that are consistent with the retention of the natural ecological significance 	<p>This zone covers the vegetated area south of the Luddenham Road intersection near South Creek on the western side of Mamre Road. The design of the proposal has been specifically refined in this zone to minimise impacts on ecological values, which is consistent with the objective of this zone.</p> <p>The new culvert and channel work proposed in the northern most section of this zone cannot be avoided, as it is required to minimise water quality and flooding impacts.</p> <p>A vegetation clearance boundary has been established to avoid vegetation clearance beyond that required to build the new infrastructure.</p>
RU2: Rural Landscape	<ul style="list-style-type: none"> • To encourage sustainable primary industry production by maintaining and enhancing the natural resource base • To maintain the rural landscape character of the land • To provide for a range of compatible land uses, including extensive agriculture • To minimise conflict between land uses within the zone and land uses within adjoining zones • To preserve and improve natural resources through appropriate land management practices • To ensure development is compatible with the environmental capabilities of the land and does not unreasonably increase the demand for public services or public facilities 	<p>This zone covers the lots near Mandalong Close on the western side of Mamre Road. The design of the proposal has been refined in this zone to minimise impacts on the existing agricultural activities and maintain the rural landscape character of the land, where possible.</p>

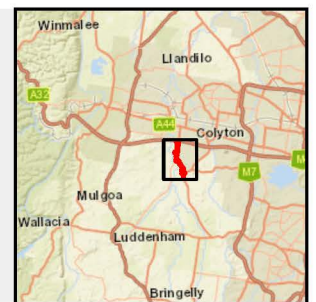
Zone	Objectives of zone	Consistency of proposal with objectives
IN1: General Industrial	<ul style="list-style-type: none"> • To provide a wide range of industrial and warehouse land uses • To encourage employment opportunities • To minimise any adverse effect of industry on other land uses • To support and protect industrial land for industrial uses • To promote development that makes efficient use of industrial land • To permit facilities that serve the daily recreation and convenience needs of the people who work in the surrounding industrial area 	<p>The proposal is marginally located within this zone on the eastern side of Mamre Road.</p> <p>The proposal is consistent with these objectives as the upgrade to Mamre Road would improve access to industrial development and provide road capacity to support growth of industrial businesses within this zone.</p>
R2: Low Density Residential	<ul style="list-style-type: none"> • To provide for the housing needs of the community within a low-density residential environment • To enable other land uses that provide facilities or services to meet the day to day needs of residents • To promote the desired future character by ensuring that development reflects features or qualities of traditional detached dwelling houses that are surrounded by private gardens • To enhance the essential character and identity of established residential areas • To ensure a high level of residential amenity is achieved and maintained 	<p>The proposal is marginally located within this zone on the eastern side of Mamre Road.</p> <p>The proposal is consistent with these objectives as the upgrade to Mamre Road within this zone would improve active transport infrastructure, safety, amenity and liveability along Mamre Road near St Clair. It would also allow residents to access services more efficiently in surrounding suburbs. The proposal would not involve acquisition of any dwellings.</p>
B6: Enterprise Corridor	<ul style="list-style-type: none"> • To promote businesses along main roads and to encourage a mix of compatible uses • To provide a range of employment uses (including business, office, retail and light industrial uses) • To maintain the economic strength of centres by limiting retailing activity 	<p>The proposal is marginally located within this zone on the eastern side of Mamre Road.</p> <p>The proposal is consistent with these objectives as the upgrade to Mamre Road within this zone would provide improved road capacity and access to support businesses within this zone.</p>

An assessment of potential impacts to heritage items listed in Schedule 5 of the Penrith LEP within and surrounding the proposal area is provided in Section 6.3.

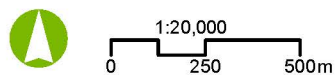


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- | | | |
|-------------------|-------------------------------|-----------------------------------|
| REF Proposal Area | Land Zoning (WSEA SEPP) | E2 Environmental Conservation |
| Road | E2 Environmental Conservation | IN1 General industries |
| Suburb | IN1 General industries | R2 Low Density Residential |
| Waterways | SP2 Infrastructure | RE1 Public Recreation |
| Cadastre | Land Zoning (LEP) | RU2 Rural Landscape |
| | B1 Neighbourhood Centre | RU4 Primary Production Small Lots |
| | B2 Local Centre | SP2 Infrastructure |
| | B6 Enterprise Corridor | |



Source: Aurecon, Spatial Services, Nearmap, Esri



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Mamre Road Upgrade Stage 1

Figure 4-2: Land zoning

4.2 Other relevant NSW legislation

4.2.1 Roads Act 1993

The *Roads Act 1993* (Roads Act) provides guidance on the use and access of public roads, including procedures regarding the opening and closure of public roads. The Roads Act also classifies roads and identifies the functions of road authorities.

The Roads Act states that a road authority may carry out road work on any public road for which it is the relevant road authority and on any other land under its control (Division 1, Clause 71). If the road is not under the control of the authority undertaking the works, then consent is required. Section 138 of the Roads Act requires consent to be obtained from the appropriate road authority for the following works to:

- erect a structure or carry out a work in, on or over a public road
- dig up or disturb the surface of a public road
- remove or interfere with a structure, work or tree on a public road
- pump water into a public road from any land adjoining the road
- connect a road (whether public or private) to a classified road.

The proposal is located on both classified roads that are managed by TfNSW and local roads that are managed by Penrith City Council. A Road Occupancy Licence would be required from the relevant roads authority by the contractor prior to work on public roads and any temporary road closures during construction of the proposal.

4.2.2 Crown Land Management Act 2016 and Crown Land Legislation Amendment Act 2017

The *Crown Land Management Act 2016* and *Crown Land Legislation Amendment Act 2017* set out the requirements for ownership, use and management of Crown Land. They describe the permissions and authorisation needed when planning the development of activities on Crown Land. They also include provisions relating to specific controls and restrictions on the development of Crown Land for Division 5.1 activities. The *Crown Land Management Act 2016* also describes the process for the acquisition of Crown Land.

The proposal area includes small sections of land mapped as (refer to Figure 3-9):

- a Crown Waterway, which follows the alignment of South Creek
- a Crown Road, which are located:
 - next to the northern boundary of Compound Site 2, south of Mamre House
 - on the western side of Mamre Road between the Luddenham Road and Mandalong Close intersections.

TfNSW would need to secure the required lease and/or land acquisition in accordance with these Acts before starting work on a Crown Road or Crown Waterway and for ongoing ownership of the road corridor during operation.

4.2.3 Protection of the Environment Operations Act 1997

The NSW *Protection of the Environment Operations Act 1997* (POEO Act) aims to reduce pollution and manage the storage, treatment and disposal of waste within NSW. The POEO Act also introduces the requirement for environmental protection licences (EPLs) to be obtained for scheduled activities that are of a nature and scale that have a potential to cause environmental pollution.

Road construction is declared to be a scheduled activity in accordance with Clause 35, Schedule 1 of the Act if it results in one or more of the following:

- a) the extraction or processing (over the life of the construction) of more than—
 - i. 50,000 tonnes of materials in the case of premises in the regulated area or in the local government areas of Bega Valley, Eurobodalla, Goulburn Mulwaree, Queanbeyan-Palerang Regional or Snowy Monaro Regional, or
 - ii. 150,000 tonnes of material in any other case,
- b) 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—
 - i. 1 kilometre—where the road is in a metropolitan area and is classified, or proposed to be classified, as a freeway or tollway under the Roads Act 1993, or
 - ii. 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 Roads Act 1993, or
 - iii. 5 kilometres—where the road is not in a metropolitan area and is classified, or proposed to be classified, as a main road, freeway or tollway under the Roads Act 1993.

As the proposal would involve an upgrade of Mamre Road, which is a classified main road under the Roads Act, over a continuous length of about 3.8 kilometres within a metropolitan area and would result in the existence of four or more traffic lanes, the proposal is considered a scheduled activity. As such, construction of the proposal would require an EPL to be obtained under the POEO Act.

4.2.4 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) is designed to protect both known heritage items (such as standing structures) and items that may not be immediately obvious (such as potential archaeological remains or 'relics'). This includes protection for items listed on the State Heritage Register (SHR), the heritage schedules of local council Local Environmental Plans (LEPs), NSW Government agency heritage and conservation registers established under section 170 of the Act as well as items subject to an Interim Heritage Order.

Section 57(1) of the Heritage Act lists the types of activities/works that require approval from Heritage NSW (a branch of the NSW Department of Premier and Cabinet) under Section 60 of the Heritage Act, when working on/in an item/place listed on the SHR. An application for an exemption can also be made under some circumstances.

The proposal area crosses into the curtilage of a historic homestead and the associated property, known as "Mamre" which is listed on the NSW State Heritage Register (SHR Item 00264). The Statement of Heritage Impact (SOHI) prepared for this proposal identified that a

Section 60 application to Heritage NSW under the *Heritage Act 1977* would be required for the proposed work within the curtilage of SHR listed Mamre House (refer to Section 6.3).

Section 139 of the Heritage Act protects archaeological 'relics' from being 'exposed, moved, damaged or destroyed' by the disturbance or excavation of land. The Heritage Act defines a 'relic' as any deposit, object or material evidence:

- a) *that relates to the settlement of the area that comprises NSW, not being aboriginal settlement; and*
- b) *is of State or Local heritage significance.*

This protection extends to the situation where a person has 'reasonable cause to suspect' that archaeological remains may be affected by the disturbance or excavation of the land. Excavation permits are issued by the Heritage Council of NSW in accordance with sections 60 or 140 of the Heritage Act. Excavation permits are usually subject to approval conditions. Alternatively, a Section 139(4) permit is an exception from the requirement to obtain a Section 140 permit and reflects the nature of the impact and the significance of the relics or potential relics being impacted upon.

The SOHI found that a Section 140 excavation permit may be required for the proposed excavation work within the State listed Mamre House grounds. It also found that a Section 139(4) exception notification may be required prior to work within the locally listed Luddenham Road alignment.

4.2.5 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the control and management of all national parks, historic sites, nature reserves, wetlands and other state reserves. The proposal is not located within land reserved under the NPW Act.

The NPW Act also provides for the protection of 'Aboriginal objects' and 'Aboriginal places' and makes it an offence to harm Aboriginal objects, places or sites without permission.

An Aboriginal cultural heritage assessment report (CHAR) has been prepared for the proposal in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime Services, 2011). The CHAR identified that the proposal would result in direct impacts to eight Aboriginal archaeological sites. TfNSW would apply for an Aboriginal heritage impact permit (AHIP) under section 90A of the NPW Act prior to any impact or harm to these sites (refer to Section 6.2).

Safeguards and mitigation measures would also be implemented to make sure that any site not covered within the AHIP would be avoided during construction and operation of the proposal. This would include an unexpected finds procedure, which would be implemented if an unexpected find occurs to prevent any accidental damage to any Aboriginal objects, places or sites due to the proposal (refer to Section 6.2).

4.2.6 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is directed at conserving threatened species, populations and ecological communities of animals and plants. The BC Act outlines the framework for addressing impacts on biodiversity from development and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme.

A biodiversity development assessment report (BDAR) has been prepared for the proposal in accordance with the requirements of the Biodiversity Assessment Methodology (BAM) under the BC Act (provided in Appendix D and summarised in Section 6.1). The BDAR concludes that the unavoidable impacts of the proposal on ecological values includes the clearing of 9.38 hectares of native vegetation and associated fauna habitat. It also outlines the biodiversity offset credit liability for the proposal that has been calculated in accordance with the BAM to offset the unavoidable impacts of the proposal.

In accordance with Section 7.15 of the BC Act, TfNSW would be required to retire biodiversity credits to offset the residual impact on biodiversity values prior to any activity being carried out that would impact on biodiversity values.

The proposal would directly impact on a small area of an existing biodiversity stewardship site (referred to as a biobanking site) owned by Office of Strategic Lands, south of the Luddenham Road intersection. This site has an existing biodiversity stewardship agreement established under the BC Act. TfNSW proposes to acquire the impacted section of this land in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.

Section 5.16, Clause 1 of the BC Act outlines that:

“(1) A public authority must not carry out development on a biodiversity stewardship site unless—

(a) it has given written notice of the proposed development to the Minister and the owner of the biodiversity stewardship site, and

(b) it has received written notice from the Minister consenting to the development.”

Section 5.16, Clause 3 of the BC Act states that *“The Minister may as a condition of granting consent direct TfNSW to retire biodiversity credits of a number and class (if any) specified by the Minister.”*

TfNSW will provide written notice of the proposal to seek consent from the Minister to carry out development on the Luddenham biobanking site, and would abide by any conditions of consent, as required.

4.2.7 Water Management Act 2000 and Water Act 1912

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of water resources. Aquifer interference approval requirements under the WM Act have not yet commenced, and regulation is managed under Part 5 of the *Water Act 1912*. The WM Act includes requirements for:

- a water access licence (Clauses 56 and 60A) to take water from a river, lake, dam or groundwater for irrigation, industrial or commercial purposes
- a water use approval (Clauses 89 and 91A) to use water for a specific purpose at a particular location
- a water supply work approval (Clauses 90(2) and 91B) to construct and use a water supply work, such as a pump, dam, channel or bore
- a drainage work approval (Clauses 90(3) and 91C) to construct and use a specified drainage work
- a flood work approval (Clauses 90(4) and 91D) for works on floodplains that divert floodwaters
- a controlled activity approval (Clauses 91(2) and 91E) to carry out work in a watercourse or within 40 metres of the bank of a river, lake or estuary, such as extracting material from a river bed, constructing a creek crossing or residential developments

The proposal would involve work within 40 metres of South Creek, which is considered a controlled activity. However, TfNSW is exempt from controlled activity approvals under Subdivision 4, Clause 41 of the *Water Management (General) Regulation 2018* as they are a public authority. The proposal does not involve any water take, use or supply from natural sources or flood diversion work.

The proposal would not be likely to intercept groundwater aquifers during most construction activities due to the shallow nature of the earthworks required for road construction. Slightly deeper excavations may be required for work associated with installation of utilities, drainage infrastructure and the noise walls, which has potential to intercept groundwater. Any requirement for dewatering would be minor, given the small excavation scale and low permeability of the local clay soils (refer to Section 6.6.4). However, a water access licence is not required for any minor dewatering. This is because it would be subject to an exemption under the *Water Management (General) Regulation 2018* as the water taken would likely be less than 3 megalitres in volume, would not be taken for consumption or supply and would be for a project to which Division 5.1 of the EP&A Act applies. Section 6.6.5 outlines the safeguards and management measures proposed to minimise impacts to water quality, including erosion and sediment controls.

Therefore, no approvals or licences are required for the proposal under the WM Act or *Water Act 1912*.

4.2.8 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) provides for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. One of the key objectives of the FM Act is to conserve fish stocks and key fish habitats.

Part 7 of the FM Act establishes that a permit is generally required to dredge, reclaim, obstruct fish passage, harm marine vegetation, use explosives or electrical devices in a waterway that is classified as key fish habitat. Some requirements are also captured by the TfNSW Code of Practice with Fisheries. It is noted that any dredging work or any

reclamation work carried out by a public authority is exempt from Division 3 of Part 7 of the Act if the work is carried out in accordance with the *Code of Practice for Minor Works in NSW Waterways* under the *Fisheries Management (General) Regulation 2019*.

South Creek is mapped as key fish habitat, which is located within the proposal area at its nearest point near Luddenham Road.

The proposal would involve construction of headwalls for drainage pipes that are required to outlet at South Creek, which may involve minor modification of South Creek at the outlet. This work may meet the definition of 'dredging and/or reclamation work' under FM Act.

NSW Department of Primary Industries – Fisheries (DPI Fisheries) have confirmed that no application for a permit under the FM Act is likely to be required for the proposal, subject to detailed design. However, TfNSW are required to provide written notice to the Minister for Agriculture and Western NSW and DPI Fisheries in accordance with section 199 of the FM Act at least 21 days prior to starting dredging or reclamation work.

The proposal's potential impact on aquatic habitat and water quality is discussed in Sections 6.1.3 and 6.6.4, respectively.

4.2.9 Biosecurity Act 2015

The *Biosecurity Act 2015* requires TfNSW to control, remove and eradicate weeds on land that they own to avoid further growth and spreading. Several weed species were observed within proposal area during field survey. The weed species commonly found were Cobblers Pegs (*Bidens pilosa*), Dandelion (*Taraxacum officinale*), Common Sowthistle (*Sonchus oleraceus*), Scarlet Pimpernel (*Lysimachia arvensis*), African Lovegrass (*Eragrostis curvula*), Green Cestrum (*Cestrum parqui*) and Fireweed (*Senecio madagascariensis*). Section 6.1.2 outlines the Priority and High Threat Exotic weeds that were recorded during field survey for the proposal and their associated duties under the *Biosecurity Act 2015*. Section 6.1.4 includes safeguards and management measures to manage these weeds in accordance with the *Biosecurity Act 2015* during construction and operation of the proposal.

4.2.10 Waste Avoidance and Resource Recovery Act 2001

The NSW *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) promotes the waste hierarchy to avoid resource consumption and implement resource recovery in the form of material reuse and recycling in preference to waste disposal. The Act acknowledges that certain materials present either human or environmental risk, requiring classification, treatment and disposal in accordance with specific waste management provisions. Waste generated during construction and operation of the proposal would be managed in accordance with the waste hierarchy and where required, disposed of in accordance with its waste classification and relevant legislation and guidelines.

4.2.11 Land Acquisition (Just Terms Compensation) Act 1991

The *Land Acquisition (Just Terms Compensation) Act 1991* was developed to ensure just terms for owners of land that is acquired by an authority of the State when land is not available for public sale. The Act promotes the requirement for compensation to be no less than the market value of the land at the date of acquisition.

Some property acquisition from government agencies, the Crown and private landholders would be required for the proposal. This would be required to accommodate the permanent

aspects of the proposal including the new road and associated infrastructure. All land acquisitions would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. Property acquisition requirements for the proposal are discussed in Section 3.6.

4.2.12 Local Government Act 1993

The *Local Government Act 1993* outlines the legal framework, responsibilities and powers of local government within NSW. The proposal is located within the Penrith City LGA.

The *Local Government Act 1993* establishes two classifications for council owned and managed land: operational land and community land. The proposal area includes areas classified as community land along the eastern side of Mamre Road, which would be impacted by the proposed noise wall, batters, culverts and swales. Division 2 of the Act outlines several procedures and restrictions regarding the use and management of community land. TfNSW will continue to consult with Penrith City Council regarding council owned land and assets. The design for the proposal will also be refined during detailed design to minimise impacts on community land, where possible.

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix A and Chapter 6 of the REF.

A referral is not required for proposed road activities that may affect nationally listed threatened species, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Potential impacts to these biodiversity matters are also considered as part of Chapter 6 of the REF and Appendix A.

Findings – matters of national environmental significance (other than biodiversity matters)

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of Agriculture, Water and the Environment under the EPBC Act.

Findings – nationally listed biodiversity matters (where the strategic assessment applies)

The assessment of the proposal's impact on nationally listed threatened species, endangered ecological communities and migratory species found that there is likely to be a

significant impact on relevant matters of national environmental significance (Cumberland Plain Woodland). Chapter 6 of the REF describes the safeguards and management measures to be applied to minimise or mitigate impacts. Chapter 6 also details the Biodiversity Offset Strategy to be implemented to address residual significant impacts on nationally listed biodiversity matters.

4.3.2 Native Title Act 1993

The *Native Title Act 1993* recognises and protects native title. The Act covers actions affecting native title and the processes for determining whether native title exists and compensation for actions affecting native title. It establishes the Native Title Registrar, the National Native Title Tribunal, the Register of Native Title Claims and the Register of Indigenous Land Use Agreements, and the National Native Title Register. Under the Act, a future act includes proposed public infrastructure on land or waters that affects native title rights or interest.

A search of the Native Title Tribunal Native Title Vision website was carried out on 18 August 2021, with no Native Title holders/claimants identified.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under clause 94 of ISEPP, the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

TfNSW is the determining authority for the proposal. This REF fulfils TfNSW's obligation under section 5.5 of the EP&A Act including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity. TfNSW has also:

- taken into account the relevant considerations, policies and recommended strategies outlined in the SREP 20 to minimise any impacts on the environment of the Hawkesbury-Nepean River system
- carried out consultation with Penrith City Council in accordance with the ISEPP due to potential impacts on local roads and proposed work within flood liable land that may change flood patterns
- carried out consultation with the State Emergency Services in accordance with the ISEPP due to proposed work on flood liable land
- carried out consultation with DPI Fisheries in accordance with the FM Act due to works meeting the definition of 'dredging and reclamation' and potential impact on key fish habitat
- carried out consultation with Heritage NSW due to potential impacts on Mamre House, which is listed on the SHR
- identified the requirement to obtain various licences and approvals in accordance with NSW legislation prior to construction as summarised in Section 7.3.

5 Consultation

This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

5.1 Consultation strategy

TfNSW has prepared a Community and Stakeholder Engagement Plan (CSEP) for the proposal to guide the communication and consultation activities for the proposal. The CSEP is designed to provide an agreed approach to communication and engagement, employing open communication channels and clear protocols. The consultation approach for the proposal aims to:

- keep the local community and other key stakeholders regularly informed of progress of the proposal
- provide the community and stakeholders with regular and targeted information to build awareness about the proposal
- provide clear information about what we are seeking feedback on, when and why
- ensure community and stakeholder feedback is continuously fed into communication and engagement practices and demonstrate how feedback is incorporated into project planning
- encourage participation from communities and other stakeholders and maintain a two-way dialogue
- engage in a manner that is collaborative, innovative, adaptive and sustainable
- ensure that community and stakeholder enquiries about the proposal are managed and resolved effectively.

The CSEP outlines the relevant stakeholder groups that have been identified for the proposal, as they may have interest in or be affected by the proposal. These groups include, but are not limited to:

- Federal, State and local government agencies and elected government representatives
- emergency services
- utility providers
- local residents, businesses and developers and other people from the local community
- special interest groups such as transport providers and heritage groups
- road users
- wider community.

These stakeholder groups have been and will continue to be consulted on relevant aspects of the proposal using a variety of consultation methods and engagement activities.

A summary of the consultation activities carried out to date and the planned ongoing or future consultation activities is provided in the sections below.

5.2 Community involvement

The NSW Government began planning for the Mamre Road upgrade project from Kerrs Road to the M4 Motorway, St Clair in 2016. The strategic design for the Mamre Road upgrade project was exhibited for consultation between 13 November and 15 December 2017.

Since then, TfNSW has progressed planning the Mamre Road upgrade Stage 1 between Erskine Park Road to M4 Motorway, St Clair, which has been informed by the feedback received from the community. Community involvement during concept design development and preparation of the REF for the proposal has included one-on-one meetings with stakeholders and community updates regarding the progress of the proposal. The project community website, phone line and email address have been available since 2017.

5.2.1 Overview of community engagement activities

Table 5-1 summarises the community engagement activities carried out for the proposal from 2017 to date.

Table 5-1: Community engagement activities carried out for the proposal

Activity/ consultation method	Summary
Project website	The proposal Mamre Road upgrade website (https://roads-waterways.transport.nsw.gov.au/projects/mamre-road-upgrade/index.html) provides the latest proposal information, and received 208 unique page visitors during the consultation period in 2017.
Community updates	Three community updates have been released via the project website: <ul style="list-style-type: none"> • May 2017 update (broader Mamre Road upgrade project), which notified the community of the ongoing planning, field investigations and strategic design development • November 2017 update (broader Mamre Road upgrade project), which was prepared for the display of the strategic design and preferred option for community comment • March 2020 update (proposal), which notified the community of the ongoing investigations (including geotechnical investigations, utility surveys and ground surveys) for Mamre Road upgrade Stage 1 concept design development.
Media release	A media release about the proposal was distributed to Penrith publications on 15 November 2017.
Newspaper advertisements	Four newspaper advertisements were published in local newspapers between 15 and 22 November 2017 to raise awareness of the community consultation process.
Community update newsletter	A community update newsletter was distributed via a letterbox drop to 6000 local properties in 2017.

Activity/ consultation method	Summary
Door knock	33 properties were door knocked in November 2017 to advise residents of the preferred option. 'Sorry we missed you' flyers were left at the properties that were door knocked and the property owner/occupant was not at home.
Letter to property owners	25 letters were sent to property owners to advise them about the proposal.
One on one meetings with property owners	One on one meetings have been held with property owners that may be directly affected by the proposal at their request between 2017 and 2021.
Toll free community enquiry number	A dedicated toll-free 1800 telephone number (1800 696 564) has been created to receive and respond to enquiries from the community and interested stakeholders on the proposal.
Project email address	<p>A dedicated email address (mamreroadupgrade@transport.nsw.gov.au) has been created to receive and respond to enquiries from the community and interested stakeholders.</p> <p>Roads and Maritime (now TfNSW) sent direct emails to 57 total stakeholders to raise awareness of the consultation and information sessions in 2017.</p>
Community information sessions	Two community information sessions were held during the consultation period. The first was held on 25 November 2017 at Banks Public School and the second was held on 29 November 2017 at Twin Creeks Golf and Country Club. A total of 89 people attended these sessions, however not all attendees signed in individually.

5.2.2 Issues raised by the community

Issues raised by the community are addressed in the following sections for the 2017 consultation period and for stakeholder meetings post 2017.

2017 consultation period

During the 2017 strategic design and preferred option report public display, a total of 35 submissions were received, including one submission each from Penrith City Council, WaterNSW and the (then) NSW Office of Environment and Heritage (OEH).

Table 5-2 summarises the key issues raised by the community during the 2017 consultation period and provides responses or a reference to where that issue is addressed in the REF. It is noted that this consultation related to the strategic design for the broader Mamre Road upgrade project, however only issues that were relevant to Stage 1 of the Mamre Road upgrade have been summarised and responded to in this section.

Issues raised by government agencies from the 2017 consultation period are addressed in Section 5.5.

More information is provided in the *Mamre Road upgrade Community Consultation Report* (Roads and Maritime Services, 2019).

Table 5-2: Summary of issues raised by the community

Issue/s raised	Response / where addressed in REF
Concern that noise from construction work during the night-time near residences would cause sleep disturbance	<p>A sleep disturbance screening assessment has been prepared for the proposal (refer to Appendix C of the noise and vibration assessment provided in Appendix J). The assessment found that the proposal has the potential to result in sleep disturbance impacts at the residential receivers that back onto Mamre Road in NCA03, NCA05 and NCA06 when noise intensive work is being carried out nearby. However, this assessment is based on conservative assumptions and the highest noise levels would only likely be noticeable for relatively short periods.</p> <p>Mitigation measures would be implemented to avoid or minimise the potential for sleep disturbance, where feasible and reasonable, in accordance with the CNVG (refer to Section 6.7.5).</p>
Road widening would lead to increased traffic and noise during operation that would result in the need to install noise walls.	The proposal includes installation of noise walls along the eastern side of Mamre Road to minimise road noise impacts during operation of the proposal. The recommended height and location of the noise walls has been informed by the noise and vibration assessment carried out for the proposal (see Section 6.7).
Concern about loss of trees and other vegetation	<p>The design for the proposal has been specifically refined to minimise removal of vegetation, where possible. This has also led to development of a vegetation clearance boundary within the larger proposal area, beyond which no vegetation clearance would be permitted (refer to Section 6.1.1).</p> <p>A Biodiversity Development Assessment Report has been prepared for the proposal to assess the potential unavoidable impacts on biodiversity and recommend appropriate mitigation measures and offset strategies (see Section 6.1 and Appendix D).</p>
Increased flooding risk with building of more 'hard surfaces'	The proposal has sought to minimise any potential changes to flood behaviour from the proposal. Flood modelling was conducted as part of the REF to assess the proposal's impact on flood risk and inform design and mitigation measure recommendations. The results of the flood modelling are summarised in Section 6.5 and provided in Appendix H.

Issue/s raised	Response / where addressed in REF
<p>Issues related to property impacts including:</p> <ul style="list-style-type: none"> • concern about reduction in property access due to grade change of driveway • request to minimise future property acquisition by taking from eastern and western sides of Mamre Road • concerns with possible devaluing of properties left behind after acquisition due to proximity to six-lane highway 	<p>TfNSW has actively sought to avoid or minimise potential impacts to private property. Property adjustment plans would be prepared for impacted properties as part of the detailed design to ensure appropriate, safe access.</p> <p>The options and design refinement process for the proposal included consideration of minimising private property acquisition. Further detail of the evaluation of different alignment options is provided in Section 2.4.</p> <p>Any private property subject to acquisition would be acquired in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i>.</p> <p>Potential property impacts as a result of the proposal are discussed further in Section 3.6.</p>
<p>Issues related to changes to intersections from the proposal including:</p> <ul style="list-style-type: none"> • concern that making McIntyre Avenue left-in, left-out would worsen existing traffic congestion at the intersection • concern that making Mandalong Close left-in, left-out would make it hard to exit the cul-de-sac and decrease the future development potential of the area • suggestion to combine the McIntyre Avenue / Luddenham Road intersection by realigning the roads and providing one set of traffic signals there • suggestion for a roundabout at Mandalong Close • concern that adding traffic lights at Solander Drive is 	<p>Various intersection sub-options were investigated for Mandalong Close and McIntyre Avenue, including an option that would connect Luddenham Road and McIntyre Avenue as suggested. Section 2.4 provides an assessment of the intersection options and explains why the left-in, left-out arrangements at McIntyre Avenue and Mandalong Close were preferred. The option of aligning Luddenham Road to meet McIntyre Avenue was discounted due to its substantially larger environmental impact (further detailed in Section 2.5).</p> <p>A roundabout option at the Mandalong Close intersection was discounted as it would impede traffic flow along Mamre Road and may result in increased traffic incidents, which does not align with the proposal objectives.</p> <p>A traffic and transport assessment has been prepared to model and assess the traffic impacts of the intersection changes as a result of the proposal (provided in Appendix G).</p> <p>The current intersection at Solander Drive is not efficient due to the volume of traffic on Mamre Road, resulting in delays to local traffic. The proposed traffic lights would allow local traffic to egress onto Mamre Road.</p> <p>The proposal includes dual left turning lanes for vehicles travelling from Erskine Park Road onto Mamre Road to maintain traffic flow.</p>

Issue/s raised	Response / where addressed in REF
<p>unnecessary and would add more traffic to local streets such as Cook Parade and Feather Street</p> <ul style="list-style-type: none"> suggestion for a free left-turning lane onto Mamre Road from Erskine Park Road to maintain traffic flow 	
<p>Supportive of shared paths for cyclists and pedestrians</p>	<p>TfNSW acknowledges the support for shared paths along Mamre Road. The proposal includes a new shared path for pedestrians and cyclists along the eastern side of Mamre Road and provides for a future shared path along the western side.</p>
<p>Suggestion to provide a heavy vehicle rest area</p>	<p>TfNSW has not identified the need for a heavy vehicle rest area within the proposal area. There is also insufficient space to make provision for a future heavy vehicle rest area as Mamre Road is highly constrained by existing development along the eastern side and environmentally sensitive land along the western side.</p>
<p>Need for a safe bay to conduct police operations</p>	<p>The location of a safe bay for police operations would be considered during detailed design in consultation with emergency services.</p>
<p>Need to seal driveways leading onto Mamre Road to prevent transportation of gravel onto road and increase safety for cyclists and motorcycles</p>	<p>The roads and driveways upgraded as part of the proposal would have a sealed road surface and would be subject to a road safety audit to make sure the design is safe for all road users.</p> <p>The proposal would also involve removal of several existing accesses to land owned by the Office of Strategic Lands west of Mamre Road. These access changes have been discussed and agreed with Office of Strategy Lands. The proposal may also result in closure of several unregulated rear private property accesses along the eastern side of Mamre Road. This reduction in the number of direct accesses to Mamre Road would improve safety for road users.</p>
<p>Raised safety concerns for school children crossing at Banks Public School with more traffic expected on Banks Drive</p>	<p>A pedestrian crossing at Banks Public School on Banks Drive is outside the scope of the proposal, however it is also noted that traffic movements on Banks Drive would not be expected to substantially increase due to the proposal.</p>

Issue/s raised	Response / where addressed in REF
Suggested introduction of measures to stop trucks speeding and tailgating	The issue of trucks speeding and tailgating is a compliance issue and outside the scope of this proposal.
<p>Concerns about lack of information provided in a coordinated manner including:</p> <ul style="list-style-type: none"> • information on noise, dust and other environmental impact • due to lack of attendance of Penrith City Council staff and project teams for other nearby road projects at community information sessions 	<p>A detailed assessment of environmental impacts (including noise and dust) and recommended mitigation measures have been provided in Chapter 6 and 7, respectively, of this REF.</p> <p>TfNSW has provided information on other nearby road projects within the community updates for the proposal, to assist the community in understanding the context of the proposal. TfNSW will work closely with Penrith City Council staff to ensure future engagement activities provide information on other nearby road projects, where possible.</p>
<p>Issues raised relating to the timing of the project included that:</p> <ul style="list-style-type: none"> • Mamre Road needs to be upgraded quickly given the existing congestion along Mamre Road and number of surrounding developments being built • the timing and funding of the project was unknown • three lanes in each direction should be provided now instead of in the future 	<p>TfNSW acknowledges the need to upgrade Mamre Road quickly to support future development and increased traffic volumes in the area.</p> <p>In September 2020, the proposal was fast-tracked as a part of the Jobs and Infrastructure Acceleration Fund.</p> <p>The NSW Government has committed \$220 million to the upgrade of Mamre Road between the M4 Motorway and Erskine Park Road (Mamre Road upgrade Stage 1). An additional \$28.2 million in funding for the proposal has been committed to the proposal as part of the Jobs and Infrastructure Acceleration Fund.</p> <p>Construction of the proposal is expected to start in 2022 and be completed by late 2025.</p> <p>Traffic modelling conducted for the proposal has indicated that two lanes in each direction would be adequate for current and projected traffic needs in the medium term. Despite this, the proposal has incorporated a wide central median that would allow the road to be further upgraded to three lanes in each direction in the future.</p> <p>Mamre Road upgrade Stage 2 (i.e. an upgrade of the section of Mamre Road south of Erskine Park Road) would be subject to separate funding, assessment and approval.</p>

Issue/s raised	Response / where addressed in REF
Concern that traffic on Luddenham Road would increase with new developments	It is expected that Luddenham Road may be required to be upgraded in the future to three lanes in each direction due to increased traffic volumes from surrounding development such as the future Luddenham Metro Station and the Western Sydney Aerotropolis. Therefore, the design of the Luddenham Road intersection with Mamre Road has been developed with the required footprint for this potential additional road upgrade to minimise the need for future rework.

Post 2017 stakeholder meetings

Following the 2017 consultation period, TfNSW has undertaken further community stakeholder engagement with residents and businesses. The issues raised by the community since 2017 and responses / where addressed in the REF are summarised in Table 5-3.

Table 5-3: Summary of issues raised by the community and stakeholders since the 2017 consultation period

Stakeholder	Issue/s raised	Response / where addressed in REF
Old MacDonald's Farm Child Care	Concern about safety of left-in, left-out turn at the Mandalong Close intersection.	The proposal has been designed to improve safety for road users along Mamre Road. The proposed arrangement for the Mandalong Close intersection has been developed in accordance with TfNSW and Austroads design standards and would be subject to a road safety audit during detailed design to make sure the design is safe for all road users.
	Concern that Mamre Road will become more congested over the next several years if the proposal goes ahead.	Congestion along Mamre Road is anticipated to worsen in the future due to surrounding development within the Western Sydney Aerotropolis and Western Sydney Employment Area, regardless of the proposal. The potential traffic impacts during construction and operation of the proposal have been assessed in a traffic and transport assessment (refer to Section 6.3).
	Request for four-way intersection at Mamre Road and Erskine Park Road instead of the three-way intersection currently proposed.	An east-west connection between Mamre Road and Luddenham Road was considered at Erskine Park Road. However, the extension of Southern Link Road was considered to be a more viable option. Therefore, Erskine Park Road would remain as a T-intersection with Mamre Road.

Stakeholder	Issue/s raised	Response / where addressed in REF
	Request for direct access from Mamre Road to property for emergency use.	The number of direct access points along Mamre Road have been minimised to improve safety considering the high speed and traffic volumes along the road. The proposal includes an upgrade of key intersections to allow motorists to safely enter and exit Mamre Road.
	Request for consideration of impacts of proposal on existing trees on property.	<p>The proposal has been developed with an aim to avoid removal of trees, where possible, to minimise visual and biodiversity impacts.</p> <p>An urban design and landscaping concept has been developed for the proposal (provided in Appendix K), which identifies opportunities to plant additional trees.</p>
	Concern about noise and flooding impacts of the proposal on the childcare business.	<p>A noise assessment has been carried out as part of the REF (see Section 6.7).</p> <p>A hydrology assessment has been carried out as part of the REF, which included flood modelling (see Section 6.4).</p>
	Request for details on area of the property to be acquired.	TfNSW have provided the area of land proposed to be acquired to the stakeholder.
Blue Cattle Dog Hotel	Discussed impacts of the proposal on the Blue Cattle Dog Hotel including any property acquisition impacts.	The potential impacts on the Blue Cattle Dog Hotel have been discussed in Section 6.10.4. TfNSW will continue consultation with this stakeholder to minimise impacts on this business, where relevant.
Residents	Queries regarding the property acquisition and access process.	TfNSW has and will continue to consult with landowners regarding the property acquisition process and any required additional access for the proposal. All property acquisition would be carried out in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .
	Discussed the design and proposed changes to the landscape.	<p>An urban design and landscaping concept has been developed for the proposal (provided in Appendix K), which will be refined in detailed design.</p> <p>The potential visual and landscape changes as a result of the proposal are discussed in Section 6.8.3.</p>

Stakeholder	Issue/s raised	Response / where addressed in REF
	Concern about increased numbers of trucks using Mamre Road and James Erskine Drive.	The proposed upgrade to Mamre Road has been designed to be suitable for heavy vehicles (refer to Section 3.2.1). The potential traffic impacts during construction and operation of the proposal are discussed in Section 6.3.
	Support the need for a future upgrade to Mamre Road.	TfNSW acknowledges the support for an upgrade of Mamre Road.

5.3 Aboriginal community involvement

The potential Aboriginal heritage impacts of the proposal have been considered in accordance with the requirements of TfNSW's *Procedure for Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime Services, 2011). Table 5-4 summarises the stages outlined in the PACHCI.

Table 5-4: Summary of TfNSW's Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial TfNSW assessment
Stage 2	Site survey and further assessment
Stage 3	Formal consultation and preparation of a cultural heritage assessment report
Stage 4	Implement environmental impact assessment recommendations

Stages 1, 2 and 3 of PACHCI have been completed for the proposal.

Initial field surveys of the proposal area were carried out for the Stage 2 PACHCI with representatives from the Deerubbin Local Aboriginal Land Council in attendance. The purpose of these field surveys was to assess the proposal's potential to harm Aboriginal cultural heritage, and to determine whether formal Aboriginal community consultation and a cultural heritage assessment report (CHAR) is needed for the proposal. The Stage 2 PACHCI assessment concluded that further investigation, including a test excavation program, formal consultation process and preparation of a CHAR would be required for the proposal.

The formal consultation process started by advertising for Registered Aboriginal Parties (RAPs) that would be interested in being consulted with about the proposal. A total of 26 RAPs were identified and have been consulted with as part of this proposal.

An Aboriginal Focus Group (AFG) meeting was held on 6 November 2020 to discuss the findings of the Stage 2 PACHCI and develop the proposed test excavation and Stage 3 PACHCI assessment methodologies.

An archaeological test excavation was carried out for the proposal between 28 January and 5 February 2021 in accordance with the *Code of Practice for Archaeological Investigation of*

Aboriginal Objects in New South Wales (DECCW 2010). This test excavation program was attended by archaeologists from Kelleher Nightingale Consulting and field representatives of RAPs.

The Aboriginal archaeological assessment identified eight Aboriginal archaeological sites (comprising nine AHIMS registrations) that would be at least partially impacted by the proposal (refer to Section 6.2.3). These results were summarised in a draft CHAR. The draft CHAR was provided to the RAPs on 7 May 2021 for a 28-day review and comment period.

A second AFG meeting was held on 24 May 2021 to discuss the results of the Stage 3 PACHCI.

The issues raised by the registered Aboriginal parties during the consultation period and responses in the REF are summarised in Table 5-5. Any issues raised by the RAPs have also been addressed in the final CHAR for the proposal that is provided in Appendix E.

Table 5-5: Issues raised through Aboriginal community consultation

Group	Issue	Response / where addressed in REF
Gunjeewong	<ul style="list-style-type: none"> Agreed with the draft CHAR 	TfNSW acknowledges the support for the CHAR prepared for the proposal (provided in Appendix E).
Corroboree	<ul style="list-style-type: none"> Agreed with the draft CHAR 	
Muragadi Heritage Indigenous Corporation	<ul style="list-style-type: none"> Agreed with the draft CHAR recommendations 	
Waawaar Awaa	<ul style="list-style-type: none"> Supported draft CHAR Archaeological Salvage Methodology (Appendix D to the CHAR) and mitigation measures Particularly noted support for several recommendations outlined in the draft CHAR including: <ul style="list-style-type: none"> an application for an AHIP that includes provision for impact mitigation through archaeological salvage excavation at sites Mamre Road AFT 1, Mamre Road AFT 2, Mamre Road AFT 3, Mamre Road AFT 4, Mamre Road community collection at sites Mamre Road 1 and Mamre Road IF 1 the recommendation that the edge of the AHIP area adjacent to the non-impacted portion of sites should be demarcated with protective fencing and listed in the CEMP. These areas should be identified as “no-go zones” on the 	TfNSW acknowledges the support for the archaeological salvage methodology, mitigation measures and recommendations outlined in the CHAR prepared for the proposal (provided in Appendix E). Section 6.2.4 outlines the safeguards and mitigation measures which would be applied as part of the proposal as per the recommendations outlined in the CHAR.

Group	Issue	Response / where addressed in REF
	CEMP maps and workers inducted as to appropriate protection measures and requirements to comply with conditions in the adjacent AHIP – the CEMP to include an Unexpected Finds Procedure	
Kamilaroi-Yankuntjatjara Working Group	<ul style="list-style-type: none"> • Noted that the site has significance to Aboriginal people • Noted that Aboriginal people would camp, hunt and gather resources for everyday living near the waterways close to the study area. As such, there is always potential to find burial sites • Agreed with the recommendations made • Supported the draft CHAR • Noted that the group looks forward to further consultation about the proposed project 	The CHAR (included in Appendix E to the REF) acknowledges the significance of the proposal area to Aboriginal people and the potential to find burial sites. The Unexpected Finds Procedure outlined in Section 6.2.4 outlines the processes to be followed if burial sites are unexpectedly discovered during construction of the proposal. TfNSW acknowledges the support for the recommendations outlined in the CHAR prepared for the proposal and any further consultation regarding the proposal.

5.4 ISEPP consultation

Clause 94 of the ISEPP provides that “development on behalf of a public authority for the purpose of a road or road infrastructure facilities may be carried out without consent” providing that certain key parties are consulted and/or notified about the work.

Penrith City Council has been consulted about the proposal under Clauses 13(1)(f) and 15 due to potential impacts on Council owned roads and flood liable land. The NSW State Emergency Service (SES) has been consulted about the proposal under Clause 15AA of the ISEPP due to proposed works being located on flood liable land.

Appendix B contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered.

Issues that have been raised as a result of this consultation are outlined below in Table 5-6.

Table 5-6: Issues raised through ISEPP consultation

Agency	Issue raised	Response / where addressed in REF
<p>Penrith City Council</p>	<p>Traffic models applied in the proposal should include projected growth from the Western Sydney Aerotropolis and future Sydney Metro Western Sydney Airport.</p>	<p>The traffic models for the proposal adopted the Travel Zone Projections 2019 (TZP19), which included consideration of future development within Western Parkland City and Western Sydney Aerotropolis as well as associated with the Western Sydney Airport and Sydney Metro.</p>
	<p>Request clarification on the lack of connection between Banks Drive and the M4 Motorway.</p>	<p>The proposal would tie-in to the existing section of Mamre Road about 100 metres south of the M4 Motorway and does not include an upgrade of the M4 Motorway westbound intersection.</p>
	<p>Call for Austroads best practice road design and long-term planning in line with Aerotropolis planning traffic modelling and Council objectives, particularly in relation to Luddenham Road.</p> <p>A new signalised intersection at Luddenham Road is supported, however the proposed new left in, left out intersection north of Luddenham Road is subject to reconstruction of a laneway at the rear of a government owned property.</p>	<p>The proposal has followed Austroads best practice road design guidelines, where feasible, and has been developed in consideration of planning for the Western Sydney Aerotropolis and Council objectives.</p> <p>TfNSW has and will continue consultation with Penrith City Council to seek agreement on the road geometry and layout where the proposal interfaces with local roads, including Luddenham Road. The Mamre Road / Luddenham Road intersection has been designed to cater for a future 6 lane configuration of Luddenham Road.</p> <p>A new left in, left out intersection north of Luddenham Road was proposed in an earlier version of the design for the proposal. However, this intersection has since been removed from the design due to concerns that vehicles may use this new intersection to bypass the proposed signalised intersection at Luddenham Road (refer to Sections 2.4 and 2.5).</p>

Agency	Issue raised	Response / where addressed in REF
	<p>Request for provision of bus priority at Luddenham Road and Erskine Park Road intersections to cater for future rapid bus routes between Blacktown and the Western Sydney Airport.</p> <p>The shared path should connect to the back of bus priority stops with enough space provided for compliant boarding points and shelters.</p>	<p>Traffic modelling for the proposal has indicated that bus priority is not required at present to manage public transport travel times. Despite this, the design for the proposal has made provision for future bus priority lanes at the Banks Drive, Solander Drive and Erskine Park Road intersections that can be implemented if required in the future.</p> <p>The design has provided for future bus stops on the departure side of the Banks Drive, Solander Drive and Erskine Park Drive intersections, including enough space for future bus stop signs, seating, shelters and tactile markers. The shared path would connect to the back of these bus stops as suggested.</p>
	<p>Support new shared path development and requests that the path width is at least five metres.</p>	<p>A shared path width of three metres has been provided on the eastern side of Mamre Road. A three metre path width has also been allowed for the future shared path on the western side. This width is considered appropriate in accordance with TfNSW and Austroads design guidelines.</p>
	<p>Need for pedestrian and cyclist access to Mamre House, including a suggestion for a pedestrian crossing at the Banks Drive intersection and short shared path section on the western side of Mamre Road.</p>	<p>The entrance to Mamre House would be relocated to the Banks Drive intersection and the access on Mamre Road would be closed. There would be a footpath on the western side of the Banks Drive intersection connecting to the pedestrian access gate.</p>

Agency	Issue raised	Response / where addressed in REF
	<p>Suggest additional mid-block pedestrian crossing points for local residents in St Clair. These would allow residents to cross Mamre Road, access public transport and access future development on the western side of Mamre Road.</p>	<p>Mamre Road does not include existing or proposed mid-block crossing facilities. This is because there is currently little pedestrian demand for mid-block crossings identified and mid-block crossings may impact on the traffic performance or safety of Mamre Road.</p> <p>Further consideration may be given to the need for mid-block crossings for development on the western side of Mamre Road in the future. However, this would not form part of the current proposal.</p>
	<p>Request pedestrian areas to be well lit and safe, including for use at night, and for energy efficient LEDs to be used in new streetlights.</p>	<p>The shared path would be lit by the road lighting that would be provided along Mamre Road. A mitigation measure has been incorporated to recommend consideration of energy efficient LEDs in new streetlights during detailed design (refer to Section 6.11.2).</p>
	<p>Request more detailed plans to identify whether Council land is affected by the proposal for proposed acquisition or construction compound sites. Any proposed acquisition of Council land would require the standard Just Terms acquisition process.</p>	<p>Land owned by Council that may be directly affected by the proposal has been identified in Section 3.6. TfNSW has and will continue to provide further information on Council land affected by the proposal. All land acquisition would be carried out in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i>.</p>

Agency	Issue raised	Response / where addressed in REF
	<p>Request assessment of all biodiversity impacts from the proposal during construction and operation, and that impacts are minimised on land mapped on the Biodiversity Values Map. Emphasised the need to detail how impacts will be minimised or include an offset proposal.</p>	<p>A Biodiversity Development Assessment Report has been prepared for the proposal to assess potential biodiversity impacts during construction and operation of the proposal in accordance with the BC Act and EPBC Act. It considered all aspects of the proposal including, but not limited to, aspects stated by Council (refer to Section 6.1 and Appendix D).</p> <p>The design for the proposal has been developed considering the need to minimise impacts on areas of ecological value. Safeguards and mitigation measures have been proposed where impacts could not be avoided, including biodiversity offsets in accordance with the Biodiversity Offsets Scheme established under the BC Act (refer to Section 6.1).</p>
	<p>Call for the Cooling the City Principles and the NSW Premier's Priorities related to heat and canopy cover to be met, particularly for the shared path and bus stops.</p>	<p>An urban design and landscaping concept plan has been developed for the proposal that considers maximising opportunities for tree planting close to the shared path (refer to Appendix K). The design of the landscape surrounding bus stops would be confirmed during detailed design and would seek to implement Cooling the City Strategies, where possible, to provide shade and protection from heat.</p>

Agency	Issue raised	Response / where addressed in REF
	<p>Note the requirement that, for any trees removed, equivalent and/or additional replacement trees be planted for shading and biodiversity and maintained for a minimum of one year to ensure establishment.</p>	<p>Opportunities to plant new trees within the proposal area would be investigated and confirmed within a Landscape Plan that would be prepared during detailed design. This would include consideration of planting trees for both shading and biodiversity purposes.</p> <p>The biodiversity assessment has considered the potential impacts from the removal of mature trees and recommended appropriate mitigation measures which would be implemented, including biodiversity offsets (refer to Section 6.1).</p> <p>Landscaping would be maintained for one year following construction.</p>
	<p>A Stage 1 Preliminary Site Investigation is to be prepared by a suitably qualified consultant addressing all areas that will be impacted by works. Where recommended, a Stage 2 Detailed Site Investigation is to be prepared to address any areas of environmental concern. Should remediation works be found to be required, a Remedial Action Plan will also be required. It is also considered appropriate that an Unexpected Finds Protocol be developed to support the development.</p>	<p>A combined Stage 1 Preliminary Site Investigation and Stage 2 Detailed Site Investigation has been prepared for the proposal by a suitably qualified environmental specialist. The potential risk associated with contamination has been discussed in Section 6.6.4. Safeguards and management measures, including the requirements for a Remediation Action Plan and Unexpected Finds Protocol, have been proposed in Section 6.6.5 of the REF.</p>

Agency	Issue raised	Response / where addressed in REF
	<p>An Acoustic Assessment is to be prepared by a suitably qualified acoustic consultant that addresses noise and vibration impacts during construction and operation. Consideration is to be given to the proposed hours of work, and potential sleep disturbance impacts. Recommendations are to be made regarding how noise impacts will be managed, particularly in relation to sensitive land uses.</p>	<p>A noise and vibration assessment has been prepared for the construction and operation of the proposal by a suitably qualified acoustic consultant (provided in Appendix J and summarised in Section 6.7). This has included consideration of the construction working hours, potential for sleep disturbance and recommendation of measures to manage noise impacts, where required.</p>
	<p>An Air Quality Assessment is to be prepared by a suitably qualified environmental consultant that addresses impacts to local air quality during construction and operational. Mitigation measures are to be put forward that suitably address any identified impacts.</p>	<p>An air quality assessment has been prepared for construction and operation of the proposal (provided in Appendix L). Safeguards and mitigation measures to manage potential air quality impacts have been proposed in Section 6.9.</p>
	<p>The proposal crosses a number of waterbodies, and these may be impacted by the development should appropriate management measures not be put in place. A Soil and Water Management Plan is to be prepared, incorporating site specific Erosion and Sediment Control Plans.</p> <p>Request preparation of an accompanying MUSIC model and information on what specific measures are proposed to protect the receiving waterways from increased pollutant loads.</p>	<p>A water quality and soil impact assessment has been prepared for the proposal that included development of a MUSIC model (provided in Appendix I).</p> <p>Potential impacts of the proposal on surface water quality and the required safeguards and management measures have been discussed in Section 6.6.5. This includes the requirement for a Soil and Water Management Plan and Erosion and Sediment Control Plans to be prepared prior to construction to manage and minimise potential soil and water quality impacts.</p>
	<p>A comprehensive Waste Management Plan is to be prepared to ensure that all waste arising from the construction is collected, transported and disposed of lawfully at a licenced waste management facility.</p>	<p>A Waste Management Plan would be prepared prior to construction to manage waste generated in accordance with relevant guidelines and legislation (refer to Section 6.11).</p>

Agency	Issue raised	Response / where addressed in REF
	Council's Water Sensitive Urban Design (WSUD) policy provides guidance and minimum treatment levels. WSUD options should be incorporated for drainage works and flooding minimisation, and considered for passive irrigation of trees	The drainage design for the proposal has considered Council's WSUD policy and incorporated several WSUD elements including water quality basins and grass swales (refer to Section 6.6).
	Welcome widening of Mamre Road as a critical component to the delivery of the Mamre Road Precinct and Western Sydney Aerotropolis.	TfNSW has noted the support for the proposal and its need to support future development in the area.
	Request planning consideration to be given to Luddenham Road widening.	The Mamre Road / Luddenham Road intersection has been designed to cater for a future six lane configuration of Luddenham Road, however, the widening of Luddenham Road is outside the scope of the proposal.
	Request consideration to be given to the future development of the area immediately south of Mandalong Close and how this area would be serviced by the proposal if it were to be developed for urban purposes	The traffic model prepared for the proposal includes the future traffic volume forecast as provided by the developer for the area south of Mandalong Close. The intersection layouts have also been developed to include the future traffic volume forecast from the Mamre West Precinct.
	Request planning consideration to be given to widening of Mamre Road between James Erskine Drive and Distribution Drive.	The upgrade of Mamre Road from James Erskine Drive to Distribution Drive is outside of the scope of Mamre Road upgrade Stage 1 and would be considered as part of Mamre Road upgrade Stage 2.
	Request planning consideration to be given to the likely inclusion of bus services along Luddenham Road and Erskine Park Road as the region develops, such as for the future Sydney Metro Western Sydney Airport.	The inclusion of bus services along Luddenham Road and Erskine Park Road is not within the scope of the proposal, but the proposal would not preclude this from happening in the future.

Agency	Issue raised	Response / where addressed in REF
	Request planning consideration to be given to the recreational role of South Creek, as outlined in the Western City District Plan. This includes the need for connections to the future potential parkland for pedestrians and cyclists.	There is provision for a future shared path on the western side of Mamre Road that would provide connections to the future parkland for pedestrians and cyclists. The inclusion in the design of a fourth leg at the Banks Drive and Solander Drive intersection allows for future connections to the future recreational parkland.
	Request consideration of the Mamre Road Precinct Development Control Plans and the Draft Precinct Plans for the Initial Precincts in the Western Sydney Aerotropolis, once they have been exhibited.	TfNSW will consider the Mamre Road Precinct Development Control Plans and the Draft Precinct Plans for the Western Sydney Aerotropolis, where relevant. However, the Mamre Road Precinct as established by the WSEA SEPP is located about one kilometre south of the proposal area and would be more relevant for Mamre Road upgrade Stage 2. Similarly the Western Sydney Aerotropolis is located about one kilometre south-west of the proposal area, as established by the <i>Sydney Environmental Planning Policy (Western Sydney Aerotropolis) 2020</i> (refer to Section 4.1.1).
	The proposal was not referred to Council for the reasons outlined in Clause 14 of the ISEPP, which requires consultation with Council where development may impact on local heritage. Council requests a review of the Heritage Impact Statement. As part of the REF process.	The consultation requirement under Clause 14 of the ISEPP was not triggered as the proposal would not result in more than minor impacts on local heritage items. Regardless of this, Council has been provided the Statement of Heritage Impact report that has been prepared for the proposal (as provided in Appendix F).

Agency	Issue raised	Response / where addressed in REF
	<p>Request a traffic management plan, identifying proposed detour routes and restrictions on heavy vehicle movements at the 20% design stage. Council are also concerned about the potential impact of detouring traffic onto local roads.</p>	<p>The potential traffic impacts during construction of the proposal have been assessed in Section 6.3, which includes consideration of construction traffic movements and potential detour routes. A traffic management plan would be prepared prior to construction, which would outline any proposed detour routes and other safeguards to minimise traffic impacts.</p>
	<p>The proposal provides an opportunity to improve existing drainage, including stormwater culverts that cross Mamre Road and drain from east to west into a floodplain. Any pipelines impacted by the proposal, which are currently under capacity, should be upgraded.</p> <p>Catchment plans for each stormwater pipeline within the proposal area, and hydraulic calculations demonstrating the adequacy of the pipeline are requested.</p> <p>Stormwater pits and access points should be located off the road.</p>	<p>There is a floodplain within the proposal area close to South Creek. All transverse culverts for the proposal have been sized to provide flood immunity for a one per cent AEP flood event. Existing drainage pipelines are proposed to be upgraded, where required.</p> <p>Catchment plans and hydraulic calculations have been prepared and are summarised in the hydrology report provided in Appendix H.</p> <p>Potential impacts of flooding have been assessed in the hydrology and flooding assessment. This assessment also recommended safeguards and mitigation measures which would be considered in detailed design. Existing drainage pipelines would be upgraded to meet project requirements where required.</p> <p>Stormwater pits would be located on the edge of kerb within the roadway, which is standard approach. Inspection pits and manholes would not be provided within the roadway, where possible and practical.</p>

Agency	Issue raised	Response / where addressed in REF
	Request planting of non-friable canopy trees along both sides of the road and the central median to form an avenue and maintain the rural setting. The median should be constructed in such a way that future development does not impact the newly planted trees.	<p>The design of the shared path and the noise wall alignment has taken into consideration the need to minimise impacts on existing trees, where possible.</p> <p>The landscaping plan has considered the need to maintain the rural setting, where possible. During detailed design, opportunities to plant non-frangible trees along the road would be reviewed. However, no large non-frangible trees would be proposed within the central median as the future 6 lane design would require the reconfiguration of this median with a narrower concrete median.</p>
	Note that Council does not wish to take over ongoing maintenance and renewal responsibility for noise walls.	The noise wall would be maintained by TfNSW.
	Suggestion to allow for digital enabling technology.	The proposal would include new traffic control facilities including new traffic signals and relocation of existing electronic variable message signage.
	Wayfinding should be considered at key pedestrian nodes and pedestrian portals. Heritage studies should help inform treatments and direction..	Wayfinding signage would be included at key pedestrian portals as suggested, which would be developed in detailed design in consultation with heritage specialists.
	Suggest keeping views open near Mamre House with low-lying native grasses and replacing fences like-for-like with a low, open wire fence	The landscaping plan for the proposal would incorporate low lying native grasses in front of the Mamre House heritage curtilage to keep views open as suggested. The proposal would also replace sections of impacted fencing with similar fencing types to what is existing (generally low open wire fence), where possible, to minimise visual impacts.

Agency	Issue raised	Response / where addressed in REF
	<p>Suggest the eastern side of the road opposite Mamre House could have some sort of European feature treatment inspired by Mamre House on the proposed noise wall. Any heritage treatment will need to be confirmed by Council's Heritage Advisor before proceeding.</p>	<p>The urban design for the proposal has considered opportunities to incorporate heritage interpretation and feature treatments in relation to Mamre House in consultation with heritage specialists (refer to Appendix K). The design of heritage treatments would be provided to Council for review during detailed design.</p>
	<p>Appreciate willingness for TfNSW to collaborate with Council during development of the proposal and requested timeline for the proposal development.</p>	<p>TfNSW would continue to consult Council on the proposal as it progresses and involve Penrith City Council in workshops and design review as the design develops.</p>
<p>NSW State Emergency Service</p>	<p>Note that proposed works appear to have minimal risk to NSW SES response operations.</p> <p>Request notification be provided where the construction phase of the proposal causes disruption to the operation of the road and impacts the ability for emergency vehicles to use this route.</p>	<p>Access for emergency services would be retained throughout construction. The construction contractor would consult with emergency services prior to construction.</p> <p>A traffic management plan would be prepared prior to construction, which would outline any proposed detour routes and other safeguards to minimise disruption to operation of the road (refer to Section 6.3).</p>

5.5 Government agency and stakeholder involvement

Various government agencies and stakeholders have been consulted about the proposal, including:

- Catholic Care (Mamre House)
- NSW Office of Environment and Heritage (OEH) (now Heritage NSW and DPIE)
- Office of Strategic Lands (OSL)
- Penrith City Council
- NSW Rural Fire Service
- Western Sydney Airport
- DPI Fisheries
- DPIE
- utility providers including Sydney Water, AARNet, Endeavour Energy, Jemena, Telstra, NBN and Optus.

Issues that have been raised as a result of consultation with these agencies and stakeholders are outlined below in Table 5-7.

Table 5-7: Issues raised through stakeholder consultation

Agency	Issue raised	Response / where addressed in REF
Utility providers	<p>The issues raised were related to:</p> <ul style="list-style-type: none"> • design options for the planned relocation and/or protection of existing utilities • timing of the proposal and any associated utility work • concern about potential impacts on utility customers during construction or future utilities planned in the area • access needs for utility maintenance during operation of the proposal. 	<p>Utility providers have been consulted regarding impacts to existing utilities near the proposal. This has included consideration of whether utilities may need to be relocated or protected and any ongoing access requirements.</p> <p>The relevant utility providers will continue to be consulted with during detailed design and construction regarding the proposed relocation and/or protection of utilities within the proposal area.</p>
NSW OEH (now Heritage NSW and DPIE)	<ul style="list-style-type: none"> • Request for full identification on the impact on the listed item on the State Heritage Register, 'Mamre' • Requirement to complete a Statement of Heritage Impact and Archaeological Impact Assessment 	<p>A Statement of Heritage Impact has been prepared for the proposal, which includes an assessment of the impact on Mamre House and the potential for archaeological deposits (refer to Section 6.3 and Appendix F).</p>

Agency	Issue raised	Response / where addressed in REF
OSL	<ul style="list-style-type: none"> • Discussed existing and planned land uses on land owned by OSL for consideration including access needs • Concern that potential compound site locations may be in protected green corridors or have had flooding issues in the past • Discussed property acquisition process • Note that flooding would need to be considered when developing a new driveway to one OSL property 	<p>The proposal would involve changes to access to land owned by OSL west of Mamre Road. Alternate access arrangements have been identified in consultation with OSL and would consider flood risks, where relevant.</p> <p>The potential impact of the proposal on land owned by OSL has been discussed in Section 6.10.</p> <p>The location of potential compound sites for the proposal has been selected in areas of low ecological value, where possible (refer to Section 3.4). Several safeguards and management measures would be implemented to manage flood risk at compound site locations during construction, including a flood action plan (refer to Section 6.5).</p> <p>TfNSW will continue to consult with OSL during detailed design and the property acquisition process, as required.</p>
NSW Rural Fire Service	<ul style="list-style-type: none"> • Discussed parking space allocation, gate requirements and relocation of signs • Requested mark-up of proposed adjustments and access arrangements to the property 	<p>The proposal involves relocating the existing driveway to Erskine Park Rural Fire Service from Luddenham Road to Old Luddenham Road.</p> <p>A mark-up of the proposed adjustments and access arrangements was sent on 8 December 2020. The changed property access arrangements and any associated relocated parking, gates and signage would be confirmed during detailed design in consultation with NSW Rural Fire Service.</p>

Agency	Issue raised	Response / where addressed in REF
Penrith City Council	<ul style="list-style-type: none"> • Requested clarification regarding change of status of Mamre Road from State Arterial Road to Primary Arterial Road • Consideration to be given for carriageway to cater for on-road cyclists and provide clearance between shared-use path and travel/deceleration lanes • Planning must include suitably wide verges and boundary setbacks to accommodate tree planting, with screening planting required for suburban fencing • Concerns that parts of the proposal area are at risk from 20-year ARI flood events, with consideration to be given to raising sections of the road where the risk of flooding is higher for greater flood immunity • Implores TfNSW to develop a comprehensive strategy to address land acquisition with a focus on fairness, equity and timing • Potential impact on 'the Green Grid' concept located on western side of Mamre Road. • The grassed areas along the eastern side of Mamre Road are classified as community land • Impacts to community land require consultation with the community and agreement from elected council members • Further issues raised by Penrith City Council as part of the ISEPP consultation process are outlined in Section 5.4 	<ul style="list-style-type: none"> • Details about the change of road status are provided in the structure plan proposed by DPIE • The proposal has incorporated a shared path along the eastern side of Mamre Road that can be used by cyclists and would incorporate appropriate clearance from traffic lanes • The landscaping plan for the proposal would identify opportunities for tree planting, including for screening purposes, where possible • Mamre Road would be raised at various locations along the alignment to provide improved drainage and flood immunity

Agency	Issue raised	Response / where addressed in REF
DPI Fisheries	<ul style="list-style-type: none"> • Discussion regarding the potential impact of the proposal on South Creek (key fish habitat) and any associated permit requirements • Request best practice in design refinement, particularly for culvert outlet structures near South Creek • No permit is likely to be required under the FM Act (based on review of current design), however this will be confirmed during detailed design • Consultation in accordance with Section 199 of the FM Act would be required prior to dredging and reclamation work 	<ul style="list-style-type: none"> • TfNSW will carry out consultation in accordance with Section 199 of the FM Act prior to dredging and reclamation work (refer to Section 4.2.8) • TfNSW will continue consultation with DPI Fisheries during detailed design to confirm any additional safeguards or management measures required to minimise impacts on South Creek
DPIE	<ul style="list-style-type: none"> • Discussion regarding the potential impacts of construction of the proposal on the air quality data collected from the nearby St Marys Monitoring station • DPIE to consider options to minimise impacts to air quality data, e.g. a temporary relocation of the monitoring station or flagging potential impacts to the data on the DPIE air quality website 	<ul style="list-style-type: none"> • TfNSW will continue consulting with DPIE regarding the potential timing and impacts on the St Marys Monitoring station and options to mitigate this impact

5.6 Ongoing or future consultation

TfNSW will continue to seek feedback from the community and key stakeholders as the proposal progresses, including during detailed design and construction.

5.6.1 Consultation during public display of the REF

This REF will be displayed for comment for about four weeks. During this time, it would be available to download on TfNSW's project website. TfNSW has also developed an innovative Digital REF for the proposal that is designed to display the information from this REF in a more interactive and engaging way for the community, which will be available to access via TfNSW's project website.

It is noted that the COVID-19 Legislation Amendment (Emergency Measures) Bill 2020 has removed the requirement for physical displays of this REF. The public display of the proposal is also not planned to involve face-to-face consultation activities due to COVID-19 social distancing requirements.

Consultation activities that will be carried out during this public display period to advertise display of the REF and encourage community and stakeholder questions or feedback on the proposal include:

- advertisement of the public display period via local papers and social media
- distribution of a community update via letterbox drops to the local community and emails to people registered on the project mailing list
- community information sessions, that would be held online
- targeted engagement activities with key stakeholders and government agencies, such as meetings and direct correspondence to provide a briefing on the proposal

5.6.2 Consultation following public display of the REF

Following the public display period, TfNSW will collate and consider the submissions received then determine whether the proposal should proceed as described in the REF, or whether any changes are required. A submissions report will then be published, which will respond to the comments received. The community would be informed of any major design changes that are required to address concerns raised in submissions. TfNSW will notify those who made submissions and distribute a community update. The update will summarise the submissions report and the actions that TfNSW took to address these comments.

Should the proposal be approved to proceed, the community would continue to be updated prior to and during construction, including notification of any road closures or night works in advance of the works occurring. Direct consultation would continue with affected landholders and stakeholders.

To effectively manage consultation during the construction stage of the proposal, a Communication Plan would be developed and implemented by the construction contractor.

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 proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines *Is an EIS required?* (DUAP 1995/1996) as required under clause 228(1) of the Environmental Planning and Assessment Regulation 2000 and the *Roads and Related Facilities EIS Guideline* (DUAP 1996). The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Biodiversity

This section describes the biodiversity impacts that may occur when constructing and operating the proposal. It summarises the Biodiversity Development Assessment Report (BDAR) that has been prepared for the proposal by Niche Environment and Heritage and is provided in Appendix D.

6.1.1 Methodology

The following activities were undertaken to complete the BDAR:

- Desk-based searches of relevant databases to understand the existing environment and obtain records of threatened species, populations and ecological communities known or predicted to occur within a 10 kilometre radius around the proposal area. The following databases were searched:
 - Department of Planning, Infrastructure and the Environment (DPIE) BioNet, Atlas of NSW Wildlife (DPIE 2019b)
 - Department of Agriculture, Water and Environment (DAWE) EPBC Act Protected Matters Search Tool Report (DAWE 2019a)
 - Threatened Species Collection Database (DPIE 2021)
 - BAM-C outputs.
- Field inspections of the study area to identify and assess biodiversity values in accordance with the Biodiversity Assessment Methodology (BAM) and threatened biodiversity survey guidelines.
- An assessment of 'likelihood of occurrence' following the collation of database records and species and community profiles.
- Assessing the potential impacts to flora, fauna, migratory and aquatic species including assessments of significance where required.
- Identification of construction and operational management measures as well as the need for biodiversity offsets.

Biodiversity field investigations for the proposal were carried out on:

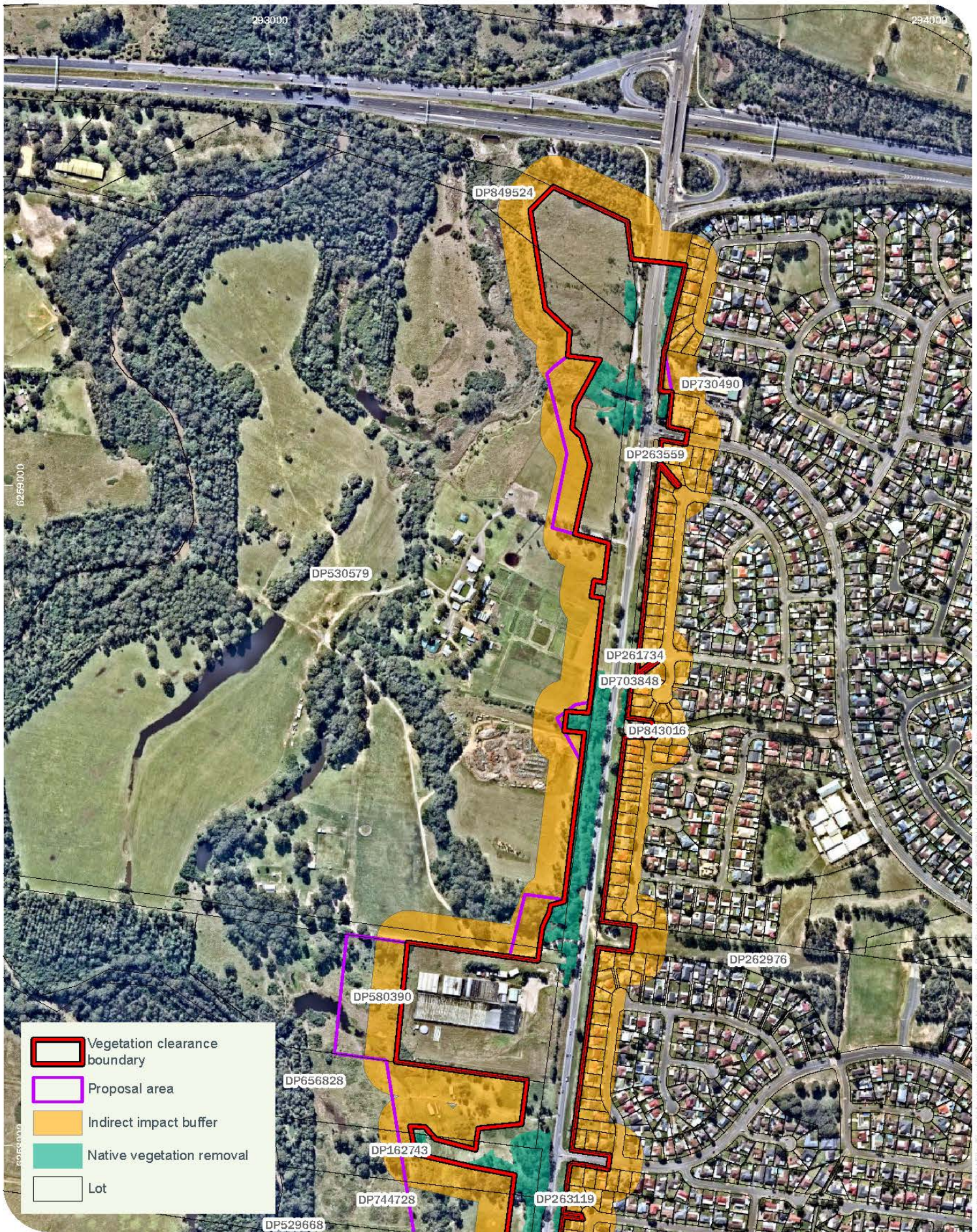
- 16 to 18 September 2020
- 22 to 23 February 2021, 26 February 2021
- 1 to 2 March 2021, 9 March 2021, 30 March 2021
- 14 April 2021, 26 to 29 April 2021
- 4 May 2021.

These surveys were carried out in accordance with the BAM and included:

- vegetation mapping surveys including BAM plots to map and classify the vegetation into plant community types (PCTs) and condition classes
- identification and measurement of any hollow-bearing trees, including hollow size and height, to determine habitat suitability for several fauna species
- traverses of suitable habitat within the survey area to identify threatened flora species
- day-time targeted surveys for Cumberland Plain Land Snail and Powerful Owl white-wash
- night-time targeted surveys for Green and Golden Bell Frog and Powerful Owl using call detection and spotlighting
- acoustic detection of bats and inspection of culverts to identify presence of bats including Large-eared Pied Bat, Large Bent-winged Bat, Southern Myotis
- spotlighting and habitat assessment for Bush Stone-curlew and Eastern Pygmy Possum
- recording of any other native fauna species that were opportunistically detected during surveys.

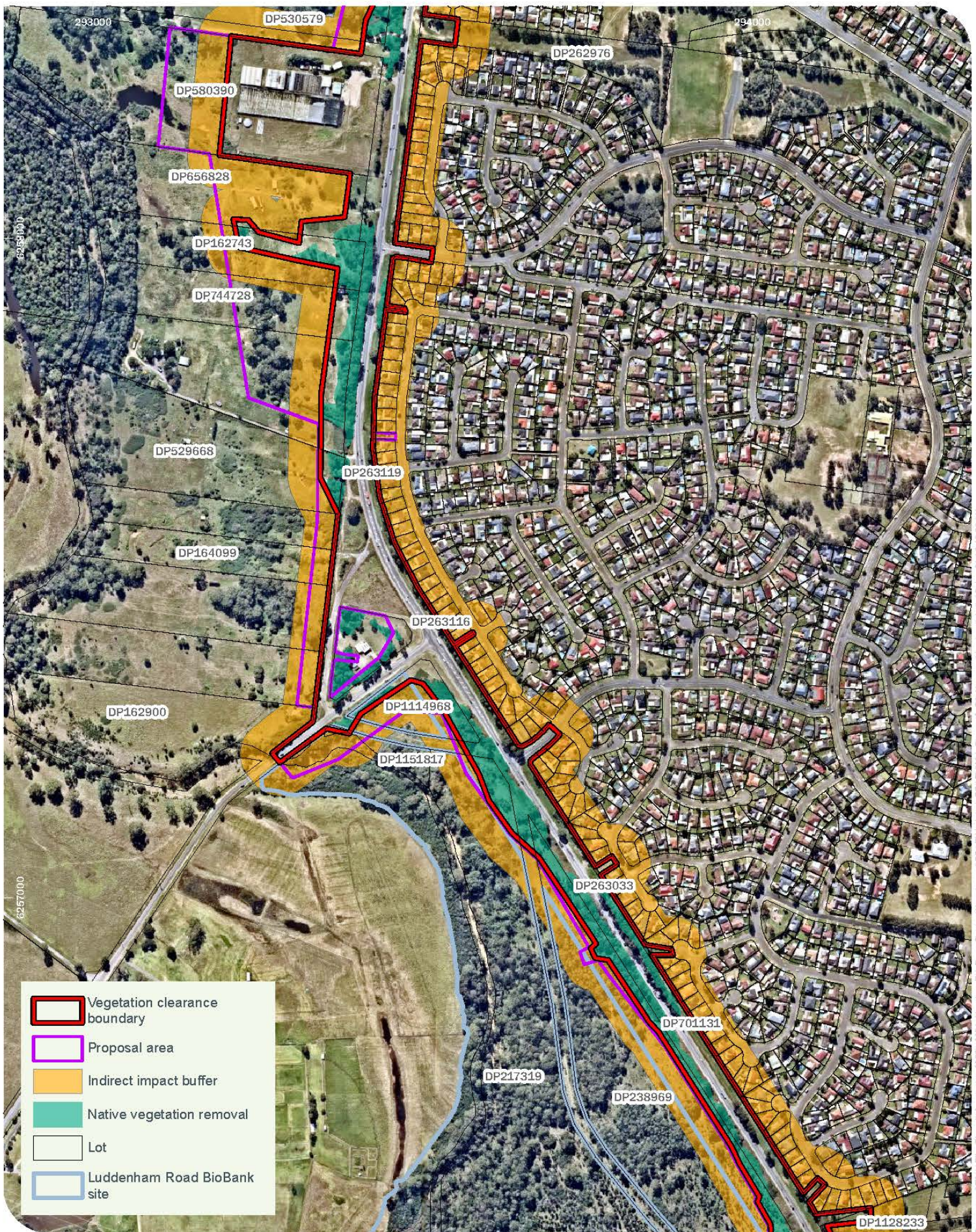
The field survey methodology for the proposal is explained further in Sections 3.1, 4.1.2 and 4.2.2 in the BDAR provided in Appendix D.

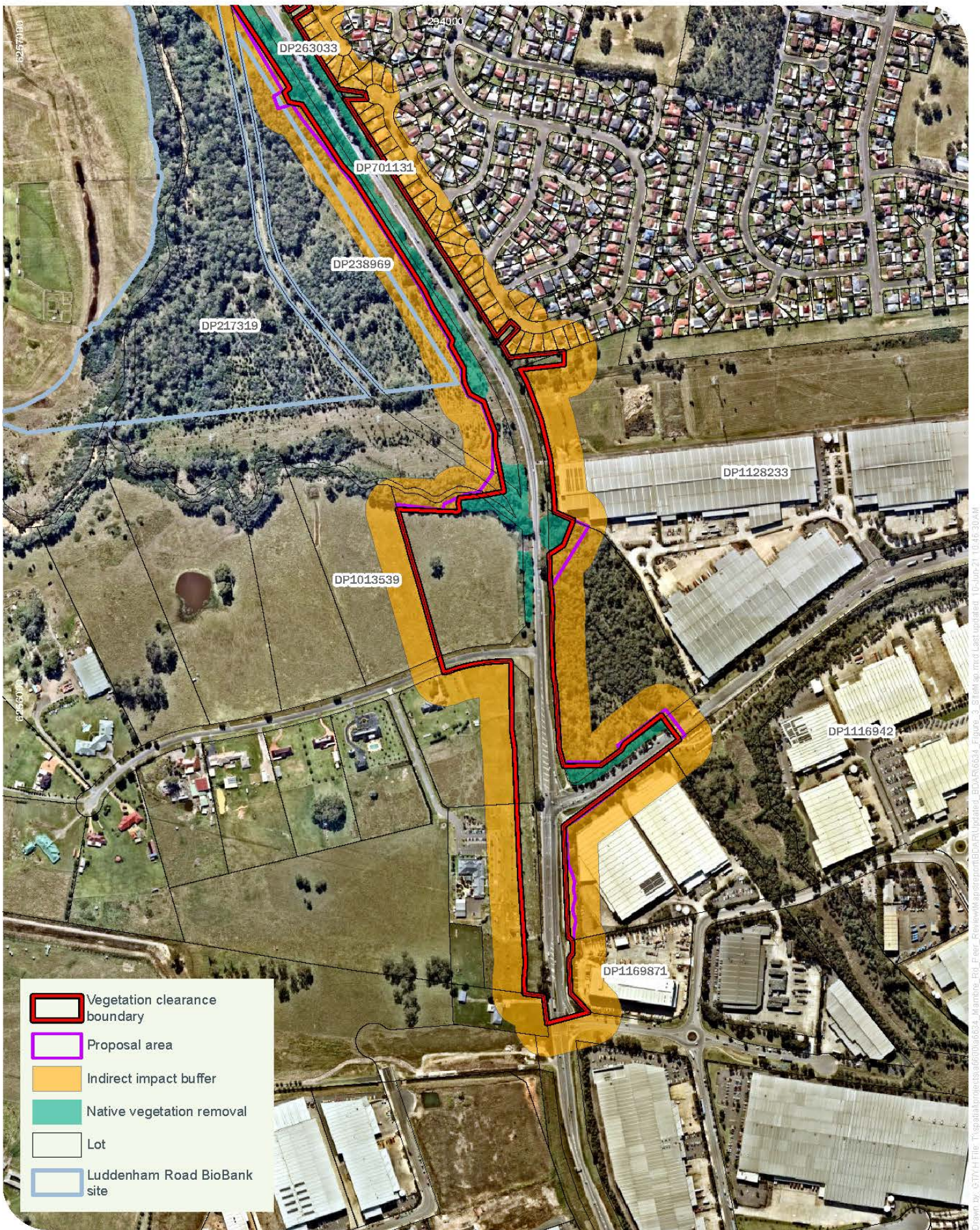
The proposal area and vegetation clearance boundary is mapped in Figure 6-1.



The proposal area and vegetation clearance boundary
 Mamre Road Upgrade – Stage 1
 Biodiversity Development Assessment Report (BDAR)

Figure 6-1a





-  Vegetation clearance boundary
-  Proposal area
-  Indirect impact buffer
-  Native vegetation removal
-  Lot
-  Luddenham Road BioBank site

6.1.2 Existing environment

Landscape

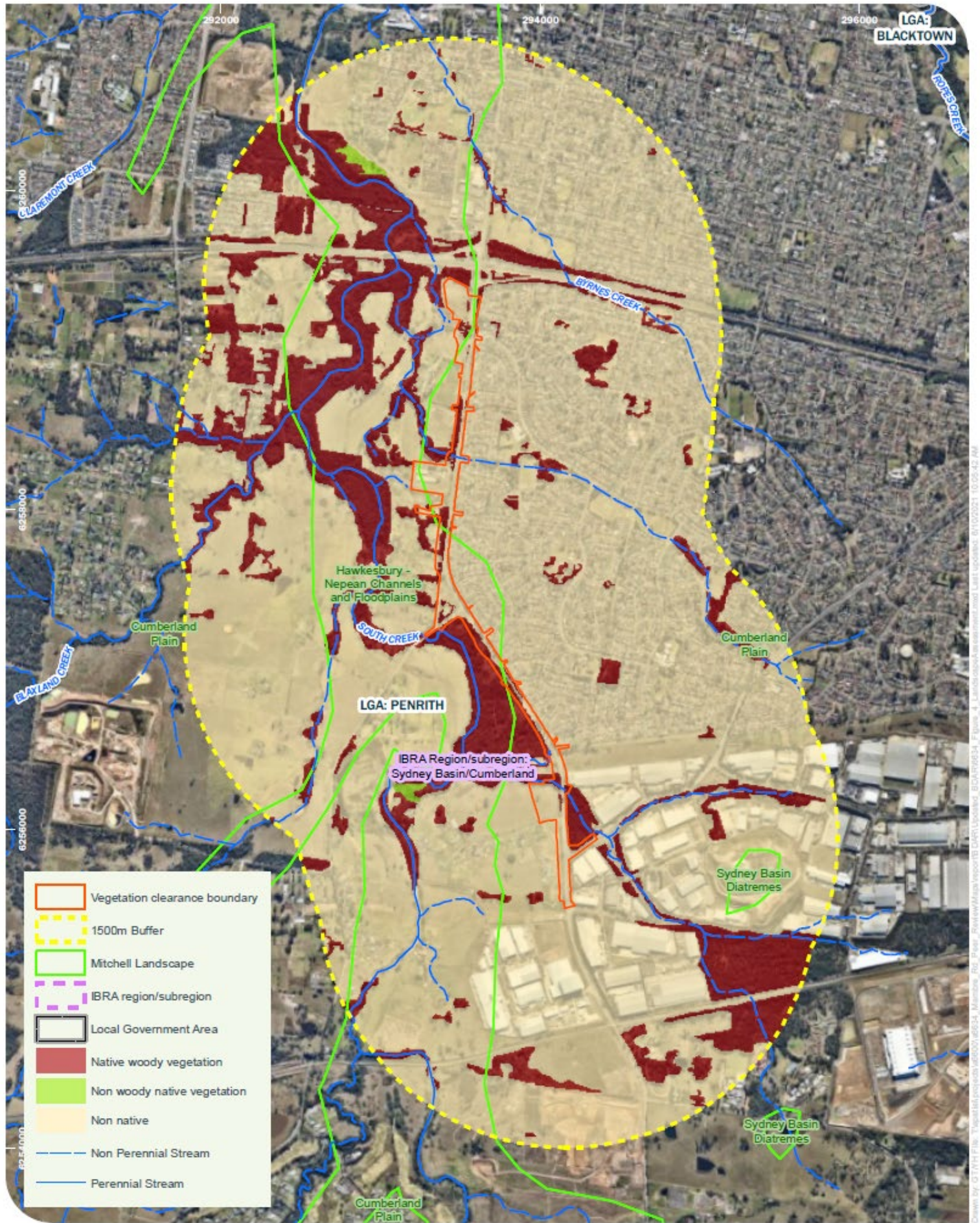
The landscape context of the study area (which includes the proposal area and adjacent areas of vegetation surveyed) is described in Table 6-1. The landscape assessment area is mapped in Figure 6-2.

Table 6-1: Landscape features

Landscape feature	Description
IBRA bioregions and subregions	The proposal is located within the Sydney Basin IBRA Bioregion; and the Cumberland IBRA Subregion.
NSW landscape regions (Mitchell landscapes)	<p>Two NSW landscape regions (Mitchell landscapes) occur across the proposal area:</p> <ul style="list-style-type: none"> • Hawkesbury – Nepean Channels and Floodplains: which is described as a meandering channel and moderately wide floodplain of the Hawkesbury and Nepean Rivers. Quaternary sand and gravel, general elevation 0 to 20 metres, local relief less than 10 metres. Undifferentiated alluvial sand to poorly structured gradation profiles of sandy loam or clay loam. • Cumberland Plain - which is described as low rolling hills, small number of volcanic vents, partly covered by Tertiary river gravels and sands, general elevation 30 to 120 metres, local relief 50 metres. Pedal uniform red to brown clays on volcanic hills. Red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys. <p>The Cumberland Plain landscape region (Mitchell landscape) occupies most of the proposal area (about 29 hectares) compared to the Hawkesbury – Nepean Channels and Floodplains (about 17 hectares).</p>

Landscape feature	Description
Native vegetation extent in the buffer area	<p>A 1500 metre buffer was applied to the proposal area resulting in an overall buffer area of 2104 hectares. Aerial interpretation was used to map the areas of native and non-native vegetation within the buffer area.</p> <p>In total, areas without native vegetation (classified in the BAM as 'non-native vegetation') occupies 1736 hectares of the buffer area. Native woody vegetation comprises about 363 hectares, which includes the following areas of native vegetation that occur within the proposal area:</p> <ul style="list-style-type: none"> • 4.55 hectares of Cumberland shale plains woodland (PCT 849) • 4.36 hectares of Cumberland riverflat forest (PCT 835) • 0.47 hectares of Cumberland Swamp Oak riparian forest (PCT 1800). <p>Based on aerial photography interpretation, it is estimated that there is about five hectares of native grassland.</p> <p>The area of native vegetation (native woody and native grassland) within the 1500 metre buffer therefore covers 17.5 percent of the buffer area (368 hectares of 2104 hectares).</p>
Cleared areas	<p>As detailed above, the area of non-native vegetation or cleared land/existing infrastructure is about 1736 hectares. Within the vegetation clearance boundary, about 35.46 hectares of non-native vegetation/cleared land is present. This is associated predominately with Mamre Road, road easements, and surrounding agricultural/residential land and infrastructure services.</p>
Rivers and streams	<p>The proposal area includes a portion of South Creek.</p> <p>Two tributaries from South Creek cross Mamre Road within the proposal area, one north of Madison Circuit, and another north of Mandalong Close. Existing culverts facilitate the movement of water across Mamre Road to South Creek.</p>
Wetlands	<p>No wetlands are mapped within the proposal area, however it is noted that there is one small area of native vegetation that contains native species that can inhibit waterlogged areas. This area is within the PCT 849 low condition zone, which has been attributed to 'low condition' class given it has been historically cleared and is in a regenerating state.</p>

Landscape feature	Description
Connectivity features	<p>In a larger regional context, the proposal area is surrounded by residential development to the east, and a mix of residential/rural landscapes to the west. The key biodiversity feature within the locality is the vegetation along South Creek. South Creek provides an important fauna corridor throughout Western Sydney. The South Creek riparian corridor connects the proposal area to Wianamatta Regional park about 5.5 kilometres to the north of the proposal area.</p> <p>The native vegetation across much of the proposal area consists of scattered native eucalypts.</p> <p>Much of the native vegetation to the north of the proposal area consists of patches that are relatively small (0.3 hectares to 1 hectare), owing to the historic vegetation clearing that has occurred. These areas provide 'island' habitat, or 'stepping-stones' for fauna between other similar scattered patches to the west. Given the isolation of these patches and exposure to edge effects from Mamre Road and surrounding land uses, the patches contain a large percentage of weed coverage, and evidence of erosion and rubbish dumping.</p> <p>To the south of the proposal area, the connectivity of habitat is more prominent given the native vegetation is adjoined to larger native patches. To the south of Luddenham Road, the proposal occurs marginally within the Luddenham Road BioBank site. This site contains over 40 hectares of native vegetation that will be protected in-perpetuity.</p>
Areas of Geological Significance	<p>The proposal area is located on relatively flat terrain within the Cumberland Plain. No rocky outcrops, crevices or cliffs are located within the proposal area or immediately adjacent.</p>
Areas of outstanding biodiversity value	<p>None of the areas of Outstanding Biodiversity Value that are listed above would be impacted by the proposal, given none are located within the proposal area.</p>



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Niche PM: Luke Baker
Niche Proj. #: 6634
Client: Transport for NSW / Aurecon

**Landscape Assessment
Mamre Road Upgrade - Stage 1
Biodiversity Development Assessment Report (BDAR)**

Figure 6-2

Native vegetation

Three NSW Plant Community Types (PCT) were recorded within or next to the proposal area (refer to Figure 6-3). These are:

- Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)
- Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 835)
- Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (PCT 1800).

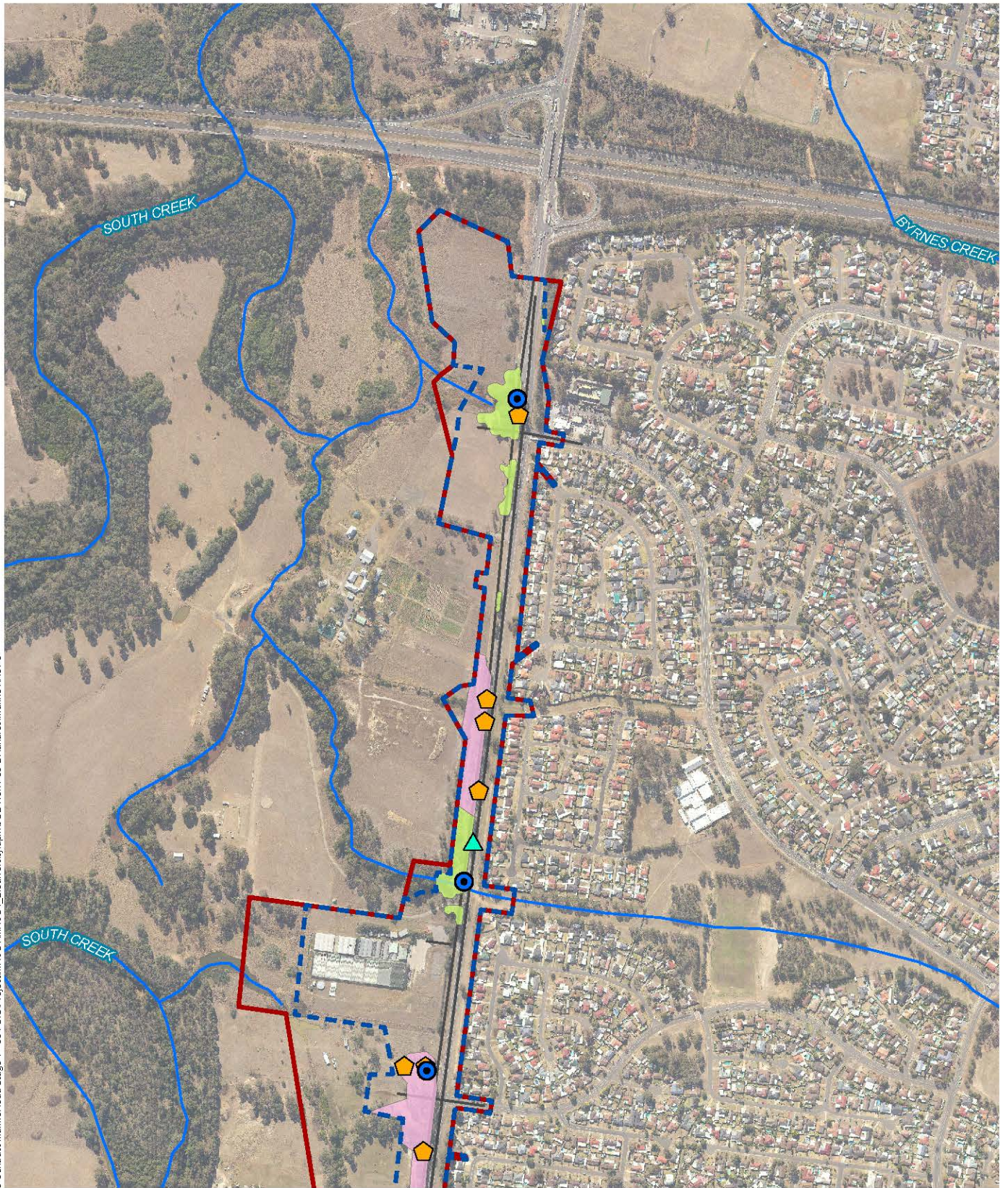
Different condition classes were assigned to areas of vegetation where obvious differences in structure and quality occurred, resulting in three PCTs and five vegetation categories (zones). A summary of PCTs and associated vegetation zones is presented in Table 6-2. All of the PCTs recorded are aligned to a threatened ecological community (TEC) listed under the BC Act. The moderate condition patches of these PCTs also met the criteria to align with a TEC listed under the EPBC.

Overall, there is 9.38 hectares of native vegetation within the vegetation clearance boundary. The extent of non-native vegetation within the vegetation clearance boundary is 35.46 hectares. The PCTs and associated TECs are described further in Sections 3.2 and 3.3 in the BDAR provided in Appendix D.

In general, all five vegetation zones reflected the edge effects from the existing road, including weed occurrence, sedimentation, erosion and some debris. Additionally, historical and current clearing for agricultural purposes is evident across the site.

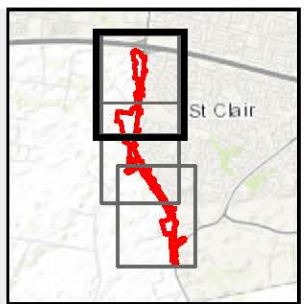
Where areas of PCT 849 and PCT 835 were small and isolated, the condition is generally lower, with less canopy cover, lower species diversity and typically higher abundance of exotic species.

The vegetation within the BioBank site directly south of Luddenham Road and the vegetated area directly north of Erskine Park Road are in a moderate condition. The canopy in these patches typically comprise trees of 30 centimetres diameter breast height (DBH), some mature (<80 DBH), as well as regenerating tree species were observed throughout the moderate condition vegetation.

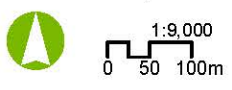


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- Proposed design centerline
- ▬ REF Proposal area
- ▬ Vegetation clearance boundary
- PCTNo
- PCT 835 Forest redgum – Rough barked apple grassy woodland
- PCT 849 Grey Box – Forest Red Gum grassy woodland
- ▲ Grey headed flying fox records
- Threatened microbat records
- ◆ Hollow bearing tree stag



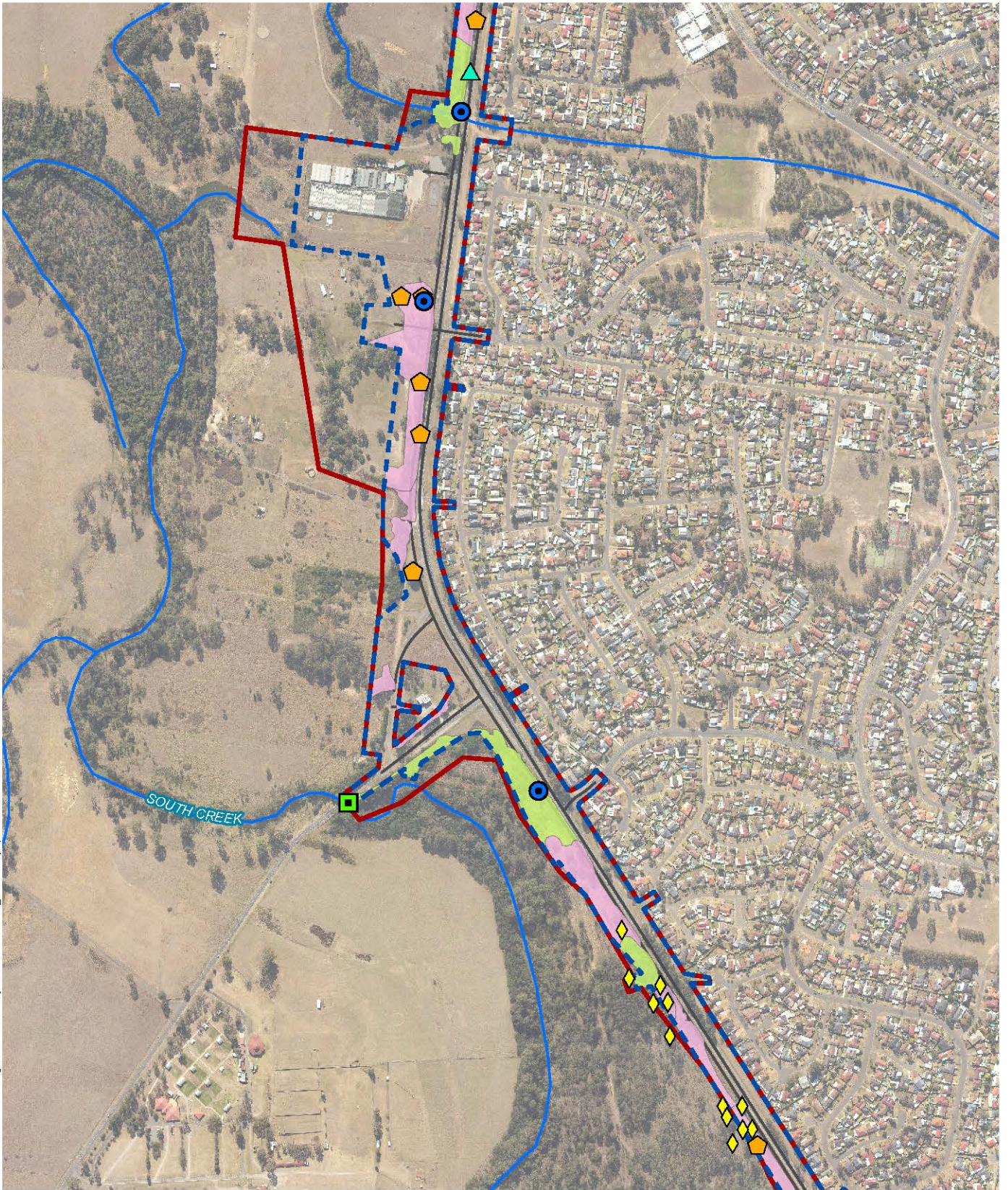
Source: Aurecon, Spatial Services, Nearmap, Esri



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 Projection: GDA2020 MGA Zone 56

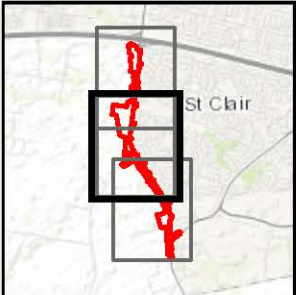
Mamre Road Upgrade Stage 1

Figure 6-3a: Validated vegetation and threatened species mapping

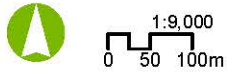


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- Proposed design centerline
- ▬ REF Proposal area
- - - Vegetation clearance boundary
- PCTNo
- PCT 835 Forest redgum – Rough barked apple grassy woodland
- PCT 849 Grey Box – Forest Red Gum grassy woodland
- ▲ Grey headed flying fox records
- Southern myotis record
- Threatened microbat records
- ◆ Cumberland Plain land snail record
- ◆ Hollow bearing tree stag



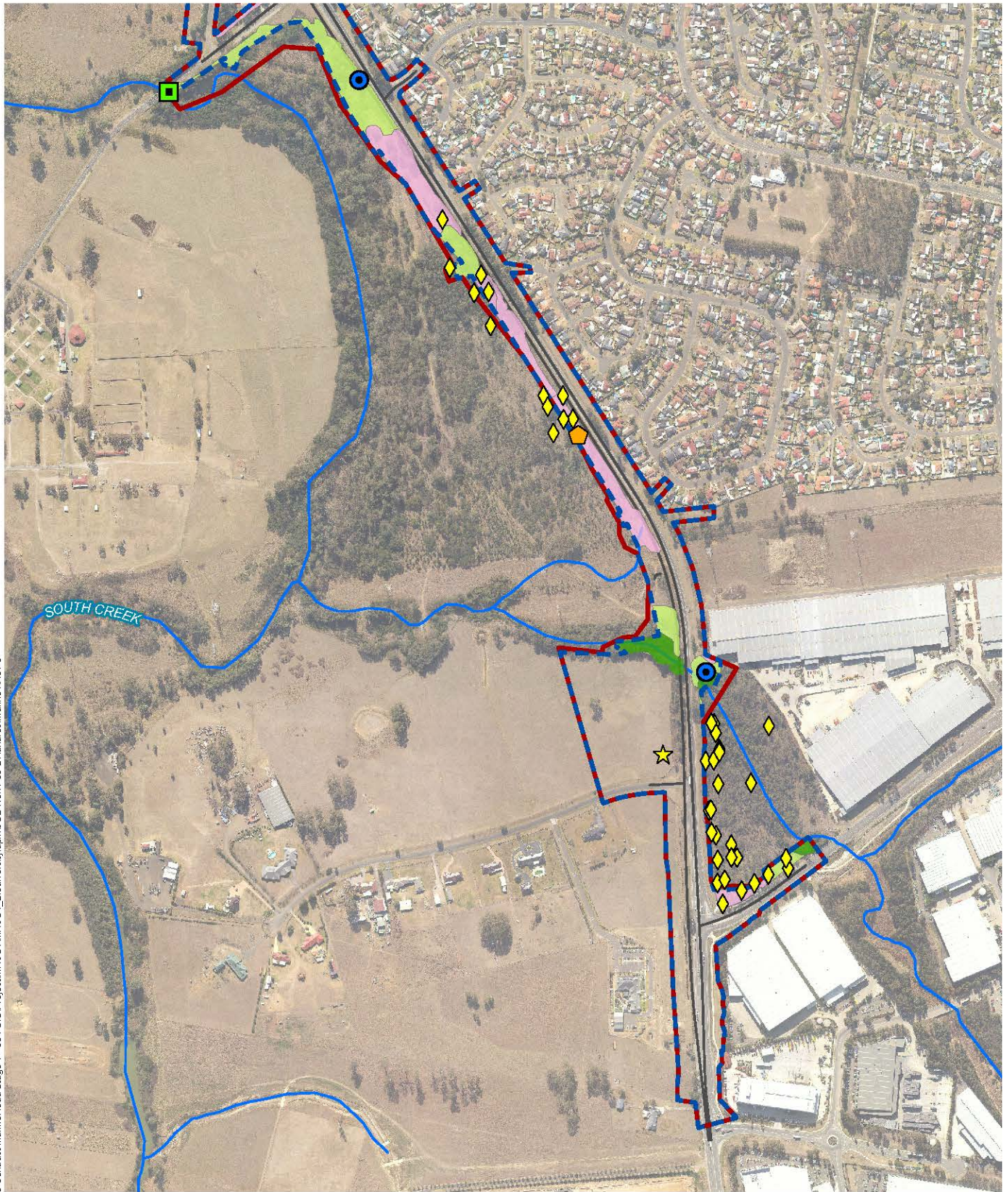
Source: Aurecon, Spatial Services, Nearmap, Esri



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 Projection: GDA2020 MGA Zone 56

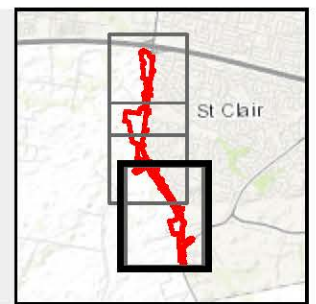
Mamre Road Upgrade Stage 1

Figure 6-3b: Validated vegetation and threatened species mapping

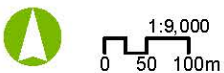


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- | | |
|--|---|
| — Proposed design centerline | ■ PCT 1800 Cumberland swamp oak riparian forest |
| ▭ REF Proposal area | ★ Cattle egret record |
| ▭ Vegetation clearance boundary | ■ Southern myotis record |
| PCTNo | ● Threatened microbat records |
| ■ PCT 835 Forest redgum – Rough barked apple grassy woodland | ◆ Cumberland Plain land snail record |
| ■ PCT 849 Grey Box – Forest Red Gum grassy woodland | ◆ Hollow bearing tree stag |



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 4/08/2021 Version: 4
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 6-3c: Validated vegetation and threatened species mapping

Table 6-2: Plant community types by vegetation zone

PCT	Vegetation Condition	Aligns to a TEC under the BC Act?	Aligns to a TEC under the EPBC Act?	Area (ha) within vegetation clearance boundary
PCT 849	Medium	Yes - Cumberland Plain Woodland in the Sydney Basin Bioregion listed as a CEEC	Yes - Cumberland Plain Woodland in the Sydney Basin Bioregion listed as a CEEC	3.63
PCT 849	Low	Yes - Cumberland Plain Woodland in the Sydney Basin Bioregion listed as a CEEC	No – condition does not meet listing criteria	0.92
PCT 835	Medium	Yes – River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as a CEEC	Yes – River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as a CEEC	2.84
PCT 835	Low	Yes – River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as a CEEC	No – condition does not meet listing criteria	1.52
PCT 1800	Medium	Yes - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as an EEC	No – condition does not meet listing criteria	0.47

Note: CEEC = critically endangered ecological community, EEC = endangered ecological community

Groundwater dependent ecosystems

Groundwater dependant ecosystems (GDEs) have been discussed in the water quality and soil impact assessment for the proposal (refer to Section 6.6). The assessment concludes that South Creek is classified as high potential aquatic GDE. The terrestrial GDEs that occur adjacent to South Creek within the proposal area are classified as high potential GDEs (DPIE 2020f). This includes the PCTs: PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, and PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion.

Threatened fauna species and habitat

Database research and a likelihood of occurrence assessment carried out for the proposal determined the potential for 72 threatened fauna to occur or have habitat within the locality. Several fauna species were recorded during field surveys, comprising one mollusc, two fish, three frogs, three reptiles, 17 birds, and 22 mammals (refer to Annexure B of the BDAR provided in Appendix D).

Table 6-3 summarises the seven threatened fauna species that were recorded in the proposal area during field surveys.

Table 6-3: Threatened fauna species recorded during field surveys

Species	Listing status	Location recorded
Cumberland Plain Land Snail	Endangered – BC Act	Two populations of the Cumberland Plain Land Snail were recorded: <ul style="list-style-type: none"> population 1 extends into the BioBank site south of the Luddenham Road intersection population 2 is limited to the patch of vegetation north of the Erskine Park Road intersection.
Grey-headed Flying-fox	Vulnerable – BC Act, Vulnerable - EPBC Act	Observed flying over the proposal area during nocturnal surveys in April 2021. The field survey confirmed the absence of camp sites.
Southern Myotis	Vulnerable - BC Act	Acoustically recorded along South Creek near the bridge along Luddenham Road. All PCTs within the proposal area that are within 200 meters of South Creek are regarded as habitat for the species
Large Bentwing-bat	Vulnerable - BC Act	Acoustically recorded across most of survey locations. There is an absence of breeding habitat within the proposal area.
Little Bentwing-bat	Vulnerable - BC Act	Acoustically recorded at two survey locations. There is an absence of breeding habitat within the proposal area.

Species	Listing status	Location recorded
Greater Broad-nosed Bat	Vulnerable - BC Ac	<ul style="list-style-type: none"> Acoustically recorded across two surveyed locations
Yellow-bellied Sheathtail-bat	Vulnerable - BC Act	<ul style="list-style-type: none"> Acoustically recorded across four surveyed locations

The fauna habitats that occur within the proposal area consist of narrow areas of woody/forest habitat types comprising of the PCTs discussed above. The habitat typically occurs close to the Mamre Road edge with limited connectivity and is subject to a high existing level of traffic noise and light pollution. Therefore, these areas are considered only suitable for urban tolerant fauna species.

Most of canopy trees within the proposal area had a DBH of less than 20 centimetres. Several deteriorating tree protection sleeves were observed around trees suggesting that some of the area was previously cleared and has since regenerated. Midstorey vegetation across much of the proposal area was relatively patchy and consisted primarily of introduced species. A grassy ground layer is present and limited areas of leaf litter occurs around the larger trees.

The hollow-bearing trees were predominantly *Eucalyptus moluccana*, with one *Eucalyptus eugenioides* and one *Eucalyptus tereiticornis*. The size of the hollows ranged in size from less than 5 to 20 centimetres. The only evidence of usage of hollows by fauna was observations of Rainbow Lorikeets (*Trichoglossus haematodus*) leaving the hollows during the survey. No hollow-bearing trees were considered to have suitable hollows large enough for the threatened fauna species likely to occur within the proposal area.

Based on field observations, the existing concrete box girder bridge spanning South Creek and only one culvert appeared to have potential for roosting bats. The culvert was located next to South Creek near the Luddenham Road intersection. No suitable maternity caves/sites for Large Bentwing-bat or Little Bentwing-bat were identified within or nearby the proposal area.

Two threatened fauna requiring species credits, the Southern Myotis and the Cumberland Plain Land Snail, were recorded within the proposal area.

The Cumberland Plain Land Snail was recorded during leaf litter targeted searches. Two populations of the Cumberland Plain Land Snail were recorded on either side of Mamre Road. Population 1 extends into the Luddenham BioBank site, occupying an area of about 40 hectares, while Population 2 is located within the five hectare patch of vegetation between Erskine Park Road and Mamre Road. Overall, there is 3.40 hectares of potential habitat for Cumberland Plain Land Snails within the proposal area.

Southern Myotis were acoustic recorded along South Creek near an existing bridge structure. Southern Myotis generally forage along creek lines/riparian corridors and roost in tree hollows, culverts, bridges and other man-made structures. There is 6.12 hectares of potential habitat for Southern Myotis in the proposal area.

South Creek and associated drainage lines extending from this creek are potential habitat for aquatic species. South Creek has been mapped as a key fish habitat and has potential to be habitat for a freshwater fish community. Aquatic flora species recorded at the edge of

waterways included *Alisma plantago aquatica* (Common Water-Plantain), *Centella asiatica* (Indian Pennywort), and *Myriophyllum aquaticum* (Parrot's Feather). The exotic Mosquito fish (*Gambusia affinis*) was also recorded during field surveys in a drain near Banks Drive that led into South Creek. This species is known to predate eggs and tadpoles of Green and Golden Bell Frog, which reduces the potential habitat in the proposal area.

Threatened flora species

The desktop searches carried out for the proposal identified that 39 threatened flora species have the potential to occur or have habitat within the locality. However, no threatened flora listed under the BC Act or EPBC Act were recorded within the proposal area during the field surveys. Moreover, the likelihood of threatened flora species occurring within the proposal area is low due to:

- historic clearing events, slashing, mowing and edge effects from the existing road and surrounding agricultural land uses, which has reduced the condition of native vegetation in areas and associated habitat for threatened flora
- the dominance of introduced grasses, such as *Eragrostis curvula* (African love grass), *Chloris gayana* (Rhodes grass) and *Paspalum dilatatum* (Paspalum) across portions of the proposal area, which would act as a suppressant for threatened flora to regenerate

Priority weeds

Several weeds were recorded throughout the BAM plots collected that are regarded as 'High Threat Weeds', which include the following:

- *Ligustrum sinense* (Small-leaved privet)
- *Rubus fruticosus* sp. agg. (Blackberry)
- *Asparagus asparagoides* (Asparagus fern)
- *Olea europaea* subsp. *cuspidate* (African olive)
- *Bidens pilosa* (Cobblers pegs)
- *Cyperus eragrostis*, *Cestrum parqui* (Cestrum)
- *Paspalum dilatatum* (Paspalum)
- *Ehrharta erecta* (Ehrharta)
- *Ageratina adenophora* (Crofton weed)
- *Cardiospermum grandiflorum* (Balloon vine).

The weed species commonly found across the proposal area include:

- *Bidens pilosa* (Cobblers pegs)
- *Taraxacum officinale* (Dandelion)
- *Sonchus oleraceus* (Common Sowthistle)
- *Lysimachia arvensis* (Scarlet Pimpernel)
- *Eragrostis curvula* (African lovegrass)
- Fireweed (*Senecio madagascariensis*).

6.1.3 Potential impacts

Construction

Impact on vegetation

The proposal would result in direct impacts on biodiversity from the removal of 9.38 hectares of native vegetation within the vegetation clearance boundary as shown in Table 6-4. No hollow bearing trees would be removed. The proposal would also result in the removal of 35.46 hectares of non-native vegetation.

Table 6-4: Summary of native vegetation impact during construction of the proposal

PCT	Vegetation condition	Status (BC Act)	Status (EPBC Act)	Direct impact (ha)	Indirect impact (ha)
PCT 849	Moderate	CEEC	CEEC	3.63	3.89
PCT 849	Low	CEEC	N/A	0.92	0.87
PCT 835	Moderate	EEC	CEEC	2.84	7.71
PCT 835	Low	EEC	N/A	1.52	0.60
PCT 1800	Moderate	EEC	N/A	0.47	1.33
Total loss				9.38	14.40

Assessments of Significance were completed for the TECs listed under the EPBC Act, and have been provided in the BDAR in Appendix D. The Assessments of Significance concluded that the proposal may have a significant impact to PCT 849 (Cumberland Plain Woodland). The proposal is unlikely to have a significant impact on PCT 835 (River-Flat Eucalypt Forest). Biodiversity offsets have been proposed for Cumberland Plain Woodland, as well as the other PCTs impacted by the proposal in accordance with the BAM to mitigate this impact (refer to Section 6.1.5).

A range of indirect impacts also have potential to occur due to construction of the proposal in addition to the direct impacts, including:

- increased noise, dust and light from the construction activities
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of native vegetation within the proposal area
- erosion or sedimentation in areas adjoining construction activities
- increased spreading of weed propagules
- increased edge-effects for surrounding vegetated areas.

Indirect impacts would generally have a short to medium timeframe and would be minimised through implementation of several safeguards and management measures in accordance with the CEMP.

Table 6-4 outlines the area for each PCT that may be affected by potential indirect impacts from construction of the proposal (in addition to the direct impact area). This area has been conservatively assumed to be 50 metres beyond the direct impact area, which is consistent

with the TfNSW indirect impact guidelines. However, it is likely that indirect impacts would be mostly contained within the proposal area during construction due to implementation of mitigation measures.

Impact to threatened species

The removal of native vegetation would result in loss of fauna habitat. This is considered to have a direct impact to two threatened species listed under the BC Act that are regarded as 'species credits' as per the requirements of the BAM. These species are:

- Southern Myotis: 6.12 hectares of potential roosting/foraging habitat to be directly impacted
- Cumberland Plain Land Snail: 3.40 hectares of potential habitat to be directly impacted.

This removal of 9.38 hectares of native vegetation also has potential to impact habitat used by Yellow Wagtail (Migratory), which is a species listed under the EPBC Act. An Assessment of Significance concluded that this is not likely to result in a significant impact (refer to Annexure E of the BDAR, attached as Appendix D to the REF). This is because the proposal area does not support significant breeding habitat for Yellow Wagtail, and this species is not likely to occur in large numbers within the proposal area.

A further 35 threatened fauna species are predicted to have foraging habitat in the proposal area. Such species are regarded as 'ecosystem credit' fauna that do not require any further consideration in a BDAR.

The existing concrete box girder bridge spanning South Creek appeared to have potential for roosting bats. The threatened bats that could possibly roost within this structure include: Southern Myotis, Large Bentwing-bat and Little Bentwing-bat.

During construction, the upgrade of culverts may temporarily displace potential roosting habitat, which is considered a prescribed biodiversity impact (refer to Section 7.5 of the BDAR provided in Appendix D). However, this impact is considered to temporary and minor and would be managed by a Microbat Management Plan as part of the CEMP.

The proposal has been designed to minimise environmental impacts to aquatic habitats where possible. However, there would be aquatic impacts from proposed culvert works.

Serious and irreversible impacts

The BC Act and the *Local Land Services Act 2013* require a decision-maker to determine whether residual biodiversity impacts of a proposed development are serious and irreversible (SAII). Cumberland Plain Woodland is listed as threatened biodiversity at risk of SAII. As such, a SAII assessment has been carried out for Cumberland Plain Woodland (refer to Table 6-5).

Table 6-5: SAI Assessment for Cumberland Plain Woodland

Assessment requirement	Assessment
<p>Impacts of the proposal on the TEC, including:</p> <p>1. Impact on the geographic extent of the TEC</p> <p>a. In hectares, and</p> <p>b. As a percentage of the current geographic extent of the TEC in NSW</p>	<p>a. The proposal would remove up to 4.36 hectares of Cumberland Plain Woodland.</p> <p>b. The current extent of the TEC in NSW is 6500 hectares (Bionet Vegetation Classification Database). The direct impact from the proposal represents around 0.06% of the estimated current extent of the TEC in NSW. Within the locality (within 10 kilometres of the proposal) about 79 hectares of the TEC has been mapped by OEH (2013). The proposal represents 5 per cent of the TEC within the locality.</p>
<p>2. The extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes by:</p> <p>i) estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500 m of the development footprint or equivalent area for other types of proposals</p> <p>ii) describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by:</p> <p>iii) distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND the average distance if the remnant is removed as proposed, and</p> <p>iv) estimated maximum dispersal distance for native flora species characteristic of the TEC, and</p> <p>v) other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development</p>	<p>i) Within 500 metres of the proposal, about 21.09 hectares of the TEC is estimated to occur based off OEH (2013) vegetation mapping and aerial interpretation. This occurs as scattered patches ranging in size of about 0.02 hectares to greater than 5 hectares.</p> <p>The TEC within the proposal area predominately consists of scattered patches along Mamre Road.</p> <p>The vegetation clearing would result in an increased distance between the fragmented patches immediately adjacent to the proposal area, rather than the creation of isolated patches.</p> <p>ii) Clearing under the proposal would create edge effects on the local occurrence of the TEC. Fragmentation of the TEC currently exists as scattered patches within the proposal area.</p> <p>iii) The proposal would result in a greater distance between already fragmented patches of Cumberland Plain Woodland.</p> <p>iv) Characteristic native flora within the patches of Cumberland Plain Woodland in the proposal area is likely to be dispersed by birds, animals, and wind. Each flora species would have differing dispersal distances due to seed. It could be reasonable to assume that the maximum dispersal for some plants is</p>

Assessment requirement	Assessment
	<p>about 300 metres. This would likely be more related to bird dispersal.</p> <p>v) The proposal is mostly proposed within a highly fragmented and impacted environment. The Cumberland Plain Woodland in its current form, would likely further decline without sufficient remediation work due to the on-going edge effects.</p>
<p>- iii) describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.</p>	<p>- Area of the TEC have been significantly impacted by historic logging, grazing, weed invasion, and feral animal impacts, and as such, no portions of the TEC within the proposal area are in a benchmark condition. Based on the plot surveys within and surrounding the development envelope, two vegetation condition classes were attributed to the TEC:</p> <ul style="list-style-type: none"> • -medium which had a vegetation integrity score of 48.6 • low which had a vegetation integrity score of 7.6.
<p>Proposed measures to avoid direct and indirect impacts</p>	<p>Proposed measures to mitigate impacts of the proposal are discussed in Sections 6.14 and 6.15.</p>

Operation

Operation of the proposal has the potential to result in direct impacts on biodiversity from traffic travelling along Mamre Road leading to fauna injury or death. However, the increased risk of roadkill as a result of the proposal is low as Mamre Road is an existing road with limited connectivity of fauna habitat on both sides of the road. Fauna are therefore unlikely to frequently cross the road. Fauna strikes along Mamre Road have not been a significant issue to date.

The proposal would involve new and upgraded existing culvert structures, which may be used as alternate roosting habitat for microbats within and near the proposal.

Indirect impacts also have potential to occur during operation of the proposal, which would be associated with:

- increased noise, dust and light from the operational traffic along Mamre Road, which may disturb fauna habitat
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of native vegetation within the proposal area, including some GDEs (refer to Section 6.5.3)
- changes in soil moisture conditions from the changes in hydrology and flooding patterns and altered drainage conditions from the drainage infrastructure upgrades (refer to Section 6.5.3)
- creation of a new edge in already fragmented native vegetation that would be subject to edge effects and weed incursion, which may reduce the long-term survival of these vegetation patches.

Conclusion on significance of impacts

The proposal is likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act and therefore a BDAR is required (provided in Appendix D).

The proposal is likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act (Cumberland Plain Woodland – refer to the Assessment of Significance provided in Annexure E of the BDAR).

Is there a real chance that the activity threatens the long-term survival of nationally listed biodiversity matters?	No
Has the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advices and guidelines provided by the Australian Government been considered?	Yes
Can suitable offsets be secured?	Yes (refer to Section 6.1.5)

6.1.4 Safeguards and management measures

Table 6-6 describes the proposed safeguards that would be introduced to manage the potential impacts on biodiversity. Other safeguards and management measures that would address indirect biodiversity impacts are identified in Sections 6.6.5, 6.7.5, 6.8.4 and 6.9.5.

Table 6-6: Safeguards and management measures for impacts to biodiversity

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Biodiversity	<p>A Flora and Fauna Management Plan will be prepared in accordance with TfNSW's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RMS, 2011a) and implemented as part of the CEMP. Refer to Section 8.1 of the BDAR (Appendix D) for the individual guideline reference numbers. It will include, but not be limited to:</p> <ul style="list-style-type: none"> • plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • requirements set out in the <i>Landscape Guideline</i> (RTA, 2008b) • pre-clearing survey requirements by suitably qualified ecologists • procedures and requirements for vegetation and habitat removal • procedures for unexpected threatened species finds and fauna handling • procedures addressing relevant matters specified in the <i>Policy and guidelines for fish habitat conservation and management</i> (DPI Fisheries, 2013) • procedures for native vegetation rehabilitation and re-establishment in consideration of the landscaping plan • procedures for educating construction staff on how to implement controls to avoid or minimise potential environmental impacts • protocols to manage weeds and pathogens. 	TfNSW / Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.8 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	TfNSW	Detailed design	N/A	Standard safeguard
Shading and artificial light	Shading and artificial light impacts will be minimised where practicable, particularly adjacent to the BA408 Luddenham BioBank site, taking into account minimum luminescence requirements for: <ul style="list-style-type: none"> • safety when constructing during the night-time period • an urban road as outlined in the Australian Standards. 	TfNSW / Contractor	Detailed design / construction	Early work / main construction work	Additional safeguard
Impacts to habitat in human made structures	Where microbats are present and impacted within a structure, a Microbat Management Plan is to be developed by a suitably qualified microbat expert in consultation with TfNSW Biodiversity Officer. The Microbat Management Plan would be incorporated into the Flora and Fauna Management Plan. As a minimum, the plan is to include: <ul style="list-style-type: none"> • demonstrated consideration of the roosting and breeding season requirements of the target species • pre-clearing requirements for artificial habitat during pre-construction • a detailed methodology for pre-clearing surveys to identify microbats within the bridge structure • a protocol for identification, capture, and relocation of microbats • reporting requirements including species identification, number, relocation actions, exclusion methods • a protocol to routinely review and update the plan. 	Contractor	Detailed design / construction	Main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Aquatic impacts	<p>Aquatic habitat will be protected in accordance with:</p> <ul style="list-style-type: none"> • Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects (RMS, 2011a) • Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013 (Department of Primary Industries, 2013). <p>Culverts will be installed in accordance with the DPI (2013) guidelines.</p> <p>Implement and regularly maintain erosion and sediment controls for the duration of construction and landscaping works as per Landcom (2004), which will be detailed in a Soil and Water Management Plan.</p>	TfNSW / Contractor	Detailed design/ construction	Early work / main construction work	Additional safeguard
Unexpected biodiversity impacts	<p>Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the proposal area.</p> <p>Signposting will be used to inform project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna.</p>	Contractor	Construction	Early work / main construction work	Additional safeguard
Vehicle strike	<p>TfNSW will monitor road kills along Mamre Road during operation to identify the need for any additional safeguards.</p> <p>The northern portion of the Luddenham BioBank site would require the existing fence to be removed to account for the proposal area. A new fence is to be installed at the northern portion of Luddenham BioBank site to assist in minimising fauna movement across Mamre Road.</p>	TfNSW	Operation	N/A	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a).	Contractor	Construction	Early work / main construction work	Additional safeguard
Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	TfNSW	Detailed design	N/A	Additional safeguard
Potential impact on key fish habitat	TfNSW will continue consultation with DPI Fisheries during detailed design to identify any additional measures required to minimise potential impacts to aquatic habitat within South Creek.	TfNSW	Detailed design	N/A	Additional safeguard
Removal of threatened species habitat and habitat features	Habitat removal minimised through detailed design. Develop and implement a Flora and Fauna Management Plan as part of the CEMP. Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a). Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a). Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a). The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	TfNSW / Contractor	Detailed design / Construction	Early work / main construction work	Additional safeguard

6.1.5 Biodiversity offsets

As detailed in the BDAR, the BC Act together with the Biodiversity Conservation Regulation 2017 outlines the framework for assessment of biodiversity impacts and introduces a Biodiversity Offset Scheme (BOS). The BDAR uses the BAM established under these biodiversity reforms to provide a methodology for determining the number and type of biodiversity credits required to offset biodiversity impacts.

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the REF proposal, some residual impacts would occur. The proposal's biodiversity offset obligation for impacts on biodiversity values were determined using the BAM-C. The required ecosystem and species credit obligations are provided in the BDAR (in Appendix D).

Through the application of the BAM, associated guidelines and the BAM-C, the following biodiversity credit offset is required for the proposal:

- 124 credits for PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- 110 credits for PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- 8 credits for PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley
- 160 credits for Southern Myotis
- 86 credits for Cumberland Plain Land Snail.

To satisfy the offset requirement, TfNSW will pay the offset requirement into the Biodiversity Conservation Fund. The Biodiversity Conservation Trust (BCT) will source the required biodiversity offset, which in turn will contribute to in-perpetuity protection and enhancement of the TECs, and habitat for Cumberland Plain Land Snail and the Southern Myotis.

6.2 Aboriginal cultural heritage

The potential Aboriginal heritage impacts of the proposal have been assessed in an Aboriginal cultural heritage assessment report (CHAR) (KNC, 2021b) provided in Appendix E. The existing heritage sensitivities, potential impacts of the proposal and safeguards to mitigate them, are summarised in this chapter. The potential Aboriginal heritage impacts of the proposal have been considered in accordance with the requirements of TfNSW's PACHCI. Stages 1, 2 and 3 of the PACHCI have been completed for the proposal (refer to Section 5.3).

6.2.1 Methodology

The CHAR for the proposal was prepared in accordance with:

- Stage 3 of the TfNSW Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (RMS, 2011b)
- Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH, 2011)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010b)

For the preparation of this CHAR, consultation with Aboriginal stakeholders was undertaken in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010a) and the requirements of Clause 60 of the National Parks and Wildlife Regulation 2019 (see Section 5.3).

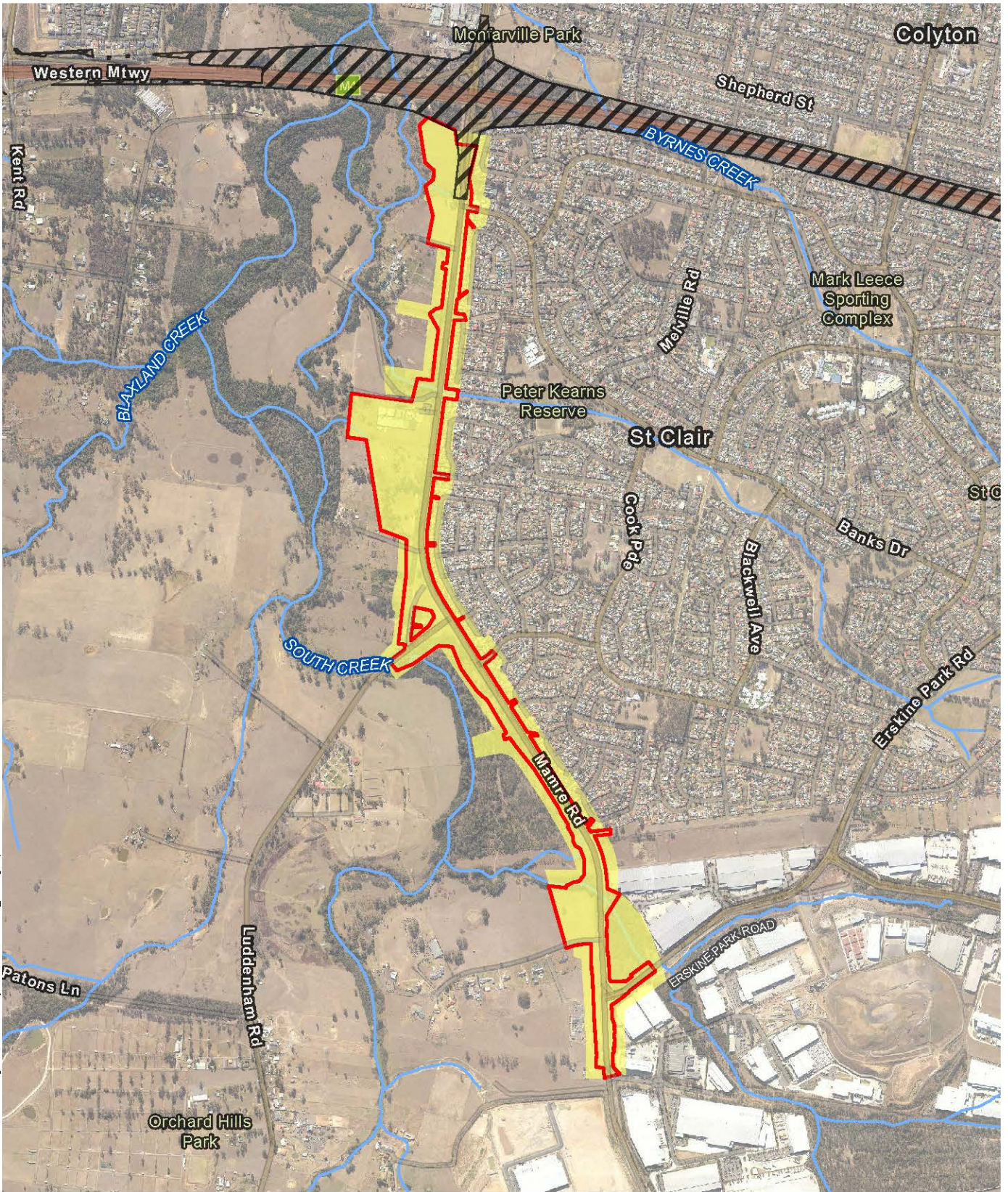
The CHAR builds on the results of previous assessments for the proposal (Table 6-7).

Table 6-7: Previous assessments and consultation

Assessment	Summary
Mamre Road Upgrade – M4 Motorway to Kerrs Road: Aboriginal Archaeological Survey Report, Stage 2 PACHCI (KNC, 2020)	<p>This report was informed by a desktop review of previous archaeological investigations and database searches as well as a field walkover undertaken with representatives from the Deerubbin Local Aboriginal Land Council. This report assessed the potential Aboriginal heritage impacts of Mamre Road upgrade project as a whole, which included the Mamre Road upgrade Stage 1 proposal area.</p> <p>The report recommended that archaeological test excavations should be undertaken at identified Aboriginal archaeological sites with moderate archaeological significance and areas of potential archaeological deposit (PAD) to determine the intactness, extent and significance of any subsurface archaeological deposits.</p>

Assessment	Summary
Stage 2: archaeological test excavation (KNC, 2021a)	<p>Based on findings of the Stage 2 PACHCI report, archaeological test excavations were undertaken between 28 January and 5 February 2021 by KNC archaeologists and field representatives of registered Aboriginal stakeholder groups.</p> <p>Investigations were carried out at four Aboriginal archaeological sites (Mamre Road AFT 1, Mamre Road AFT 2, Mamre Road AFT 3 and MWP-AD5/ MWP-AD6), and three areas of potential archaeological deposit (Mamre Road PAD 1, Mamre Road PAD 2 and Mamre Road PAD 3). This involved excavating a total of 107, 50-centimetre test squares to assess the potential for subsurface archaeological deposits.</p>

The proposal area and a suitable buffer to allow for design changes and refinements formed the Aboriginal heritage study area for the CHAR (Figure 6-4).

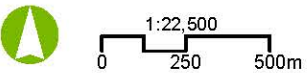


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- Waterways
- REF Proposal area
- Aboriginal heritage study area
- AHIP boundary



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 3/08/2021 Version: 1
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 6-4: Study area for Aboriginal cultural heritage assessment report

6.2.2 Existing environment

Ethnohistoric context

The Aboriginal heritage study area and surrounding region are known to have been important to and extensively used by Aboriginal people (KNC, 2021b). Aboriginal groups that used land near the proposal during the late eighteenth and nineteenth centuries include:

- the Gomerrigal (or Gomerigal or Gomerrigal-Tongarra), possibly named as the ‘South Creek Tribe’ associated with Wianamatta/South Creek
- the ‘Mulgoa Tribe’ (also referred to as Mulgowy) associated with the Mulgoa Valley
- the Boorooberongal (also referred to as the Buruberongal)
- the Bè-dia-gal (also referred to as the Bedigal) who the British encountered between Parramatta and the Hawkesbury River.

In particular, the resources of Wianamatta/South Creek and its tributaries were of great importance to the Aboriginal people living in the region. The subsequent British occupation along the Parramatta River, Hawkesbury River and Georges River during last decade of the eighteenth-century restricted access to and removed food sources used by Aboriginal people. The response to the occupation varied between groups and individuals. It also varied over time due to proximity to the occupied areas, personal association with the occupation and external factors, such as periods of drought and conflicts with European settlements. Government policies further restricted the movement of Aboriginal people.

Aboriginal culture endures to this day across the Cumberland Plain and has influenced many aspects of Australian culture, including the names of animals, localities, creeks and rivers. Members of the Aboriginal community continue to experience connection with the area through cultural and family associations.

Some of the Aboriginal cultural heritage values expressed by stakeholders for the Aboriginal heritage study area and wider region include:

- ancestral association with the land, including connection and descentance from the original traditional owners
- responsibility to look after the land, including the heritage sites, plants and animals, creeks, rivers and the land itself
- artefact sites and landscape features
- culturally modified trees
- connectivity of sites throughout the landscape
- creek lines, particularly larger landscape features and waterways such as Wianamatta/South Creek
- Indigenous plants and animals
- general concern for burials, as their locations are not always known and they can be found anywhere.

Archaeological context

Archaeological evidence shows that the Sydney Region has been occupied since at least 18,000 years ago (KNC, 2021b). Archaeological investigations show changes in the spatial distribution and density of Aboriginal archaeological sites and types of artefacts over the last 10,000 years. These changes reflect the adaptation of Aboriginal people to an ever-changing landscape and environment. In the last 1500 years, there have been variations between the artefact assemblages of coastal and inland Aboriginal archaeological sites.

These variations may reflect social changes which restricted the access of coastal groups to the raw materials of the western Cumberland Plain.

Archaeological investigation is reliant on the artefacts or physical evidence of human activities which have survived anywhere from centuries to thousands of years. The Aboriginal archaeological sites identified in the region have been mainly surface artefact scatters, isolated artefacts and subsurface archaeological deposits of different artefact density and integrity. Culturally modified trees with bark removal scars and areas of grinding grooves have also been recorded but in significantly lower numbers. The level of erosion and degree of European land use (e.g., vegetation clearance, construction, trenching and bulk earthworks) influences the degree of preservation of these sites. It also impacts the intensity of archaeological investigation. This distorts interpretation of Aboriginal land use through the spatial distribution of known sites.

Previous investigations have shown that the distribution of Aboriginal archaeological sites in the region has been influenced by the reliability and permanence of fresh water sources and the underlying geology. Investigations have found higher stone artefact density and site frequency along the margins of major watercourses including Wianamatta/South Creek. In these areas, elevated and stable micro-topographic landforms have suffered minimal disturbance. Elevated locations on hilltops and ridge crests further from major watercourses tend to have a lower density of artefact and sites.

Aboriginal archaeological sites and values

A search of the Aboriginal Heritage Information Management System (AHIMS) database was carried out in 2020. It found 173 Aboriginal archaeological sites and six areas of potential archaeological deposit (PAD) within two kilometres of the proposal, including six within the current Aboriginal heritage study area. Of the 173 Aboriginal archaeological sites, 159 sites were surface stone artefact scatters or isolated stone artefacts. Other site types identified were modified trees (carved or scarred) and grinding grooves. The spatial distribution of these sites reflects the current land use and level of survey effort. More sites were recorded in areas of redevelopment and relatively few sites where land use remained predominantly agricultural.

The site walkover as part of the Stage 2 PACHCI found that most of the Aboriginal heritage study area contained no potential for subsurface archaeology due to ground surface disturbance from modern land use practices. The Stage 2 PACHCI identified three PAD sites in addition to those previously recorded on the AHIMS database.

Following test excavations for the proposal in accordance with Stage 3 of the PACHCI, Mamre Road PADs 2 and 3 were found to have subsurface archaeological deposits and were reclassified as archaeological sites. These areas were later renamed Mamre Road AFT 4 and Mamre Road AFT 5, respectively.

As part of the Stage 3 PACHCI, eleven Aboriginal archaeological sites containing Aboriginal objects were identified within the Aboriginal heritage study area (refer to Table 6-8). The sites comprise:

- one surface artefact scatter (Mamre Road 1)
- three surface artefact scatters with associated subsurface archaeological deposits (Mamre Road AFT 1, Mamre Road AFT 2, and Mamre Road AFT 3)
- five subsurface archaeological deposits (MWP-AD5/ MWP-AD6, MWP-AD7, MWP-AD8, Mamre Road AFT 4 (formerly Mamre Road PAD 2), and Mamre Road AFT 5 (formerly Mamre Road PAD 3))
- two surface isolated artefacts (Mamre Road IF and MWP-IF1).

These sites were assessed to be have either low or moderate archaeological significance (refer to Table 6-8). Sites of moderate archaeological significance offer good research potential as they represent intact archaeological deposits. Further investigation would add to understanding of Aboriginal activities on landforms next to Wianamatta/South Creek and its tributaries. Sites of low archaeological significance are highly disturbed and showed very little potential for further archaeology investigation. While every Aboriginal site is important to the local Aboriginal community, there are more intact or better examples of these site types within the Aboriginal heritage study area and wider region.

Table 6-8: Identified Aboriginal archaeological sites within the Aboriginal heritage study area

Site name	AHIMS number	Site feature/s	Archaeological significance
Mamre Road AFT 1	45-5-5337	Surface and subsurface archaeological deposit. Test excavation recovered 77 artefacts and 29 undiagnosed angular fragments.	Moderate
Mamre Road AFT 2	45-5-5336	Surface and subsurface archaeological deposit. Test excavation recovered 34 artefacts and three undiagnosed angular fragments.	Moderate
Mamre Road AFT 3	45-5-5335	Surface and subsurface archaeological deposit. Test excavation recovered 33 artefacts and five undiagnostic angular fragments.	Moderate
Mamre Road AFT 4 (formerly Mamre Road PAD 2)	TBC*	Subsurface archaeological deposit. Test excavation recovered 48 artefacts and eight undiagnostic angular fragments.	Moderate
Mamre Road AFT 5 (formerly Mamre Road PAD 3)	TBC*	Subsurface archaeological deposit. Test excavation recovered 28 artefacts and three undiagnostic angular fragments.	Moderate

Site name	AHIMS number	Site feature/s	Archaeological significance
MWP-AD5/ MWP-AD6	45-5-4815/ 45-5-4813	Subsurface archaeological deposit. Test excavation recovered 63 artefacts and 12 undiagnostic angular fragments, and confirmed that the two previously recorded AHIMS registrations were part of a subsurface archaeological deposit that extended across the crest, flat and gentle slope landforms.	Moderate
Mamre Road 1	45-5-3167	Surface isolated artefact	Low
Mamre Road IF 1	45-5-5338	Surface isolated artefact	Low
MWP-AD7	45-5-4812	Subsurface archaeological deposit	Low
MWP-AD8	45-5-4811	Subsurface archaeological deposit	Low
MWP-IF1	45-5-4810	Surface isolated artefact	Low

*Note: AHIMS registration pending

Mamre Road PAD 1 was partially located within the curtilage of the historic homestead known as “Mamre”, which is listed on the NSW State Heritage Register (SHR Item 00264) (see Section 6.3). It is likely that Mamre possesses strong or special association for the descendants of Aboriginal people who have been documented to have lived or worked on the property. This is also likely the case for the broader Aboriginal community of Western Sydney.

However, no Aboriginal archaeological sites or objects were identified within the portion of the Aboriginal heritage study area that overlaps the “Mamre” curtilage during the Stage 2 PACHCI (KNC, 2020) and test excavations carried out as part of the Stage 3 PACHCI (KNC, 2021a).

6.2.3 Potential impacts

Construction

Impacts to Aboriginal heritage have been avoided where possible through the design refinement process. Early identification of Aboriginal heritage allowed refinement of the proposal to reduce impacts to three Aboriginal archaeological sites located within the Aboriginal heritage study area (Mamre Road AFT 3, Mamre Road AFT 4 and Mamre Road AFT 5). This refinement also avoided expected impact to MWP-AD7, MWP-AD8 and MWP-IF1.

However potential impacts on Aboriginal heritage during construction of the proposal would not be able to be completely avoided. This is due to the limited area available for the upgrade and presence of Aboriginal sites close to the existing road corridor along the western side of Mamre Road.

Residual impacts of the proposal are detailed in Table 6-9, which shows that four Aboriginal archaeological sites would have a total loss of value and four sites would be at least partially impacted by the proposal.

Table 6-9: Proposed impact to Aboriginal archaeological sites within the Aboriginal heritage study area

Name	AHIMS number	Significance	Type / Degree of Harm
Mamre Road 1	45-5-3167	Low	Direct / Total
Mamre Road AFT 1	45-5-5337	Moderate	Direct / Partial
Mamre Road AFT 2	45-5-5336	Moderate	Direct / Total
Mamre Road AFT 3	45-5-5335	Moderate	Direct / Partial
Mamre Road AFT 4	TBC*	Moderate	Direct / Partial
Mamre Road AFT 5	TBC*	Moderate	Direct / Partial
Mamre Road IF 1	45-5-5338	Low	Direct / Total
MWP-AD5/ MWP-AD6	45-5-4815/ 45-5-4813	Moderate	Direct / Total
MWP-AD7	45-5-4812	Low	No Impact
MWP-AD8	45-5-4811	Low	No Impact
MWP-IF1	45-5-4810	Low	No Impact

*Note: AHIMS registration pending

TfNSW would apply for an AHIP prior to any impact or harm to these sites. The proposal area also overlaps an area that has been previously assessed for Aboriginal cultural heritage values and is already covered under an existing Aboriginal heritage impact permit (AHIP C00002113). Any construction work for the proposal within the existing or proposed AHIP boundaries would need to comply with the permit conditions (refer to Section 6.2.4).

Approaches to further reduce impacts to Aboriginal heritage would be identified during detailed design. For example, since the preparation of the CHAR, several 'no-go zones' within the proposal area have been defined as a result of refinement of the vegetation clearance boundary and property acquisition areas (refer to Figure 3-11). This would reduce the potential direct impact area on Aboriginal heritage compared to what has been conservatively assessed in the CHAR and this REF.

Construction of the proposal may also unexpectedly uncover a previously unidentified Aboriginal object or site, including skeletal remains. Section 6.2.4 outlines mitigation measures that would be applied if this were to occur, which includes an unexpected finds procedure to minimise the risk of accidental damage to Aboriginal heritage.

Operation

No Aboriginal heritage items or places are likely to be impacted during operation of the proposal.

6.2.4 Safeguards and management measures

Table 6-10 describes the proposed safeguards that would be introduced to manage the potential impacts on Aboriginal heritage.

Table 6-10: Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Aboriginal heritage	The design and construction methodology for the proposal will be reviewed during detailed design to identify any further areas where direct impacts on Aboriginal sites could be avoided or minimised.	TfNSW	Detailed design	N/A	Additional safeguard
Aboriginal heritage	<p>An Aboriginal Heritage Impact Permit (AHIP) will be sought under section 90A of the NPW Act for Aboriginal sites with expected direct impacts (excluding the area within the boundary of existing AHIP C0002113) prior to construction. This is likely to include (subject to design refinement):</p> <ul style="list-style-type: none"> • Mamre Road 1 (AHIMS 45-5-3167) • Mamre Road AFT 1 (AHIMS 45-5-5337) • Mamre Road AFT 2 (AHIMS 45-5-5336) • Mamre Road AFT 3 (AHIMS 45-5-5335) • Mamre Road AFT 4 (AHIMS tbc) • Mamre Road AFT 5 (AHIMS tbc) • Mamre Roadt IF 1 (AHIMS 45-5-5338) • MWP-AD5/MWP-AD6 (AHIMS 45-5-4815/45-5-4813). 	TfNSW	Detailed design / pre-construction	N/A	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Mamre Road 1 and Mamre Road IF 1	Mamre Road 1 and Mamre Road IF 1 will be subject to community collection prior to any construction that may impact these sites. Community collection activities will be undertaken in accordance with the methodology attached as Appendix D in the <i>Aboriginal cultural heritage assessment report</i> (KNC, 2021b).	TfNSW	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
Salvage excavation	<p>Salvage excavations will be undertaken on the impacted portions of the following sites prior to construction works that would impact these sites:</p> <ul style="list-style-type: none"> • Mamre Road AFT 1 • Mamre Road AFT 2 • Mamre Road AFT 3 • Mamre Road AFT 4 • Mamre Road AFT 5 • MWP-AD5/MWP-AD6. <p>Salvage excavation activities will be undertaken in accordance with the methodology attached as Appendix D in the <i>Aboriginal cultural heritage assessment report</i> (KNC, 2021b).</p>	TfNSW	Pre-construction / construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Aboriginal heritage	<p>Short-term management of collected Aboriginal objects:</p> <ul style="list-style-type: none"> Any Aboriginal objects that are removed from the land by actions authorised by an AHIP, would be moved as soon as practicable to the temporary storage location (Kelleher Nightingale Consulting Pty Ltd, Level 10, 25 Bligh Street, Sydney NSW 2000) pending any agreement reached about the long-term management of the Aboriginal objects. Any Aboriginal objects stored at the temporary storage location would not be further harmed, except in accordance with the conditions of the AHIP. 	TfNSW	Pre-construction / construction	Early work / main construction work	Additional safeguard
Aboriginal heritage	<p>The long-term management of collected Aboriginal objects would occur as follows:</p> <ul style="list-style-type: none"> Recovered objects would be lodged with the Australian Museum in the first instance in accordance with the <i>Australian Museum Archaeological Collection Deposition Policy</i> (Australian Museum, 2012) If required, a variation would be sought for recovered objects to be held by the Aboriginal community or reburied. If reburial is to take place, registered Aboriginal stakeholders would be notified and given the opportunity to attend. <p>Requirement 26 "Stone artefact deposition and storage" in the <i>Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW</i> would be complied with.</p>	TfNSW	Construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the <i>Procedure for Aboriginal cultural heritage consultation and investigation</i> (TfNSW, 2012) and <i>Standard Management Procedure - Unexpected Heritage Items</i> (TfNSW, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The AHMP will be prepared in consultation with all relevant Aboriginal groups.	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.9 of QA G36 <i>Environment Protection</i>
Aboriginal heritage	<i>The Standard Management Procedure - Unexpected Heritage Items</i> (TfNSW, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where TfNSW does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Construction	Early work / main construction work	Section 4.9 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Aboriginal heritage	<p>Barrier fencing will be established on the AHIP boundary, where feasible, to make sure that no construction impact extends into areas of Aboriginal sites outside the AHIP boundary including:</p> <ul style="list-style-type: none"> • Mamre Road AFT 1 • Mamre Road AFT 3 • Mamre Road AFT 4 • Mamre Road AFT 5 • MWP-AD7 • MWP-AD8 • MWP-IF1 Aboriginal sites outside of the AHIP boundary will be marked as environmentally sensitive “no-go zones” within the CEMP. 	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Aboriginal heritage	Workers will be inducted on appropriate protection measures for Aboriginal heritage and to comply with conditions in the AHIP.	Contractor	Construction	Early work / main construction work	Additional safeguard
Aboriginal heritage	The proposed works overlap an area that has been previously assessed for Aboriginal cultural heritage values and is already covered under an existing Aboriginal heritage impact permit (AHIP C00002113). As TfNSW are the holder for AHIP C0002113, any works related to the current proposal undertaken within the boundary of AHIP C00002113 would need to comply with the existing permit conditions.	TfNSW	Construction	Main construction work	Additional safeguard

6.3 Non-Aboriginal heritage

The potential non-Aboriginal impacts during construction and operation of the proposal have been assessed as part of the *Non-Aboriginal Heritage Statement of Heritage Impact – Mamre Road Upgrade Stage 1* (Aurecon, 2021e) provided in Appendix F. The existing heritage sensitivities, potential impacts of the proposal and safeguards to mitigate them, are summarised in this chapter.

6.3.1 Methodology

The methodology for the Statement of Heritage Impact (SOHI) involved:

- a review of applicable statutory heritage lists within the proposal area, including:
 - National Heritage list
 - Commonwealth Heritage list
 - NSW State Heritage Register (SHR)
 - Local heritage items (as included on Schedule 5 of relevant LEPs)
 - other statutory lists such as Section 170 registers
- a review of the past heritage studies and SOHIs that are relevant to the proposal area
- a review of the concept design to identify the potential impacts of the proposal on heritage and identify opportunities for mitigation
- a site inspection of the proposal area carried out by two Aurecon consultants on 8th September 2020 to visually inspect the proposal area and all heritage items within the proposal area
- assessing the potential heritage impacts during construction and operation of the proposal
- providing mitigation measures to manage the potential impacts on non-Aboriginal heritage identified

The SOHI adopts the approach and terminology outlined in the Australia ICOMOS Charter for Places of Cultural Significance (Australia ICOMOS, 2013) (*the Burra Charter*). In addition, this report has been prepared in accordance with the following heritage guidelines and policy documents:

- Heritage Council of NSW *Statements of Heritage Impact* (updated 2002)
- Heritage Council of NSW *Assessing Heritage Significance: NSW Heritage Manual* (updated 2002)
- Heritage Branch, *Assessing Significance for Historical Archaeological Sites and 'Relics'*, 2009

6.3.2 Existing environment

Historical context

A brief chronology of the proposal area is provided below:

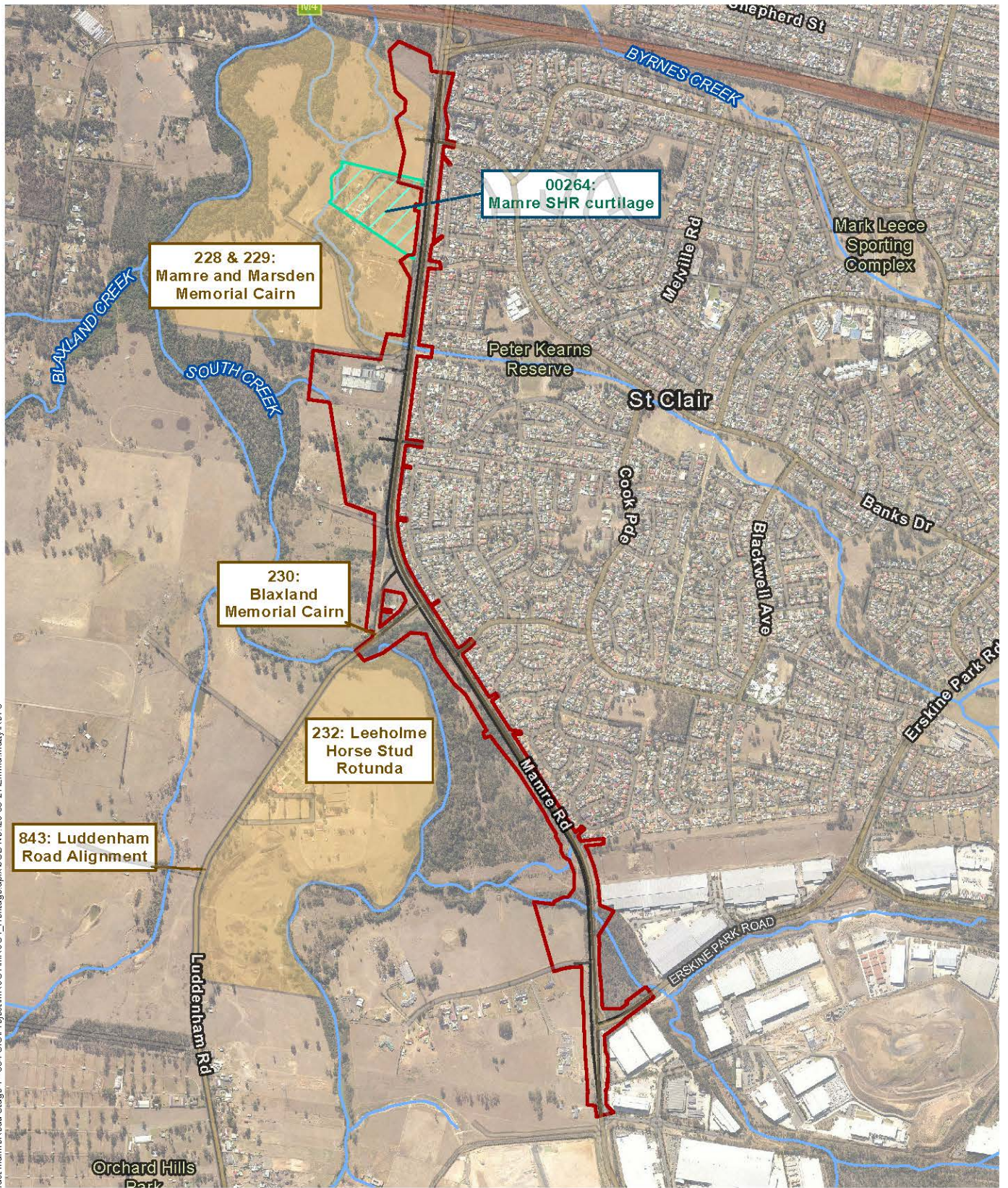
- 1804 – Reverend Samuel Marsden is granted over 1000 acres on South Creek and establishes Mamre farm
- 1813 – John Blaxland and brother Gregory receive large land grants which become large estates of Leeholme and Luddenham
- 1813 – Gregory Blaxland, Henry Lawson and William Wentworth set out to cross Blue Mountains
- 1817 – Great Western Road established and becomes main route west
- 1832 – Mamre Homestead building is constructed
- 1887 – Luddenham Road, connecting the two Blaxland estates, is first metaled
- 1892 – Mamre Road is established – formerly a paper road
- 1938 – Two stone memorial cairns are erected by the residents of St Marys to commemorate Samuel Marsden and Gregory Blaxland
- 1949 – Mamre House property is transferred to the MacLaurin family
- 1958 – Mamre Road is widened in several places and parts of the proposal area resumed as road reserve
- 1965 – Land for the construction of the M4 Motorway is resumed
- 1975 – State Government purchases the Mamre House property and subdivision occurs
- 1970s – St Clair is established as a new housing development and suburb to the east of Mamre Road
- 1986 – Mamre House passes to the Department of Environment and Planning (now DPIE) and is leased to The Sisters of Mercy of Parramatta for a term of 20 years, later transferred to Catholic Care

Listed heritage items

The heritage items listed in Table 6-11 are within or close to the proposal area. They are shown in Figure 6-5.

Table 6-11: Listed non-Aboriginal heritage items

Item	Description	Listing	Significance level
Mamre Homestead	Mamre House is a Georgian style homestead and was built around 1835. The homestead and surrounding outbuildings are accessed down a long drive (about 260 metres long) off Mamre Road.	State Heritage Register #00264 Penrith LEP #228 S170 #3490022	State
Leeholme Horse Stud Rotunda	The Rotunda was originally built as a cattle exercise yard in the 1920s for William Inglis & Son, Auctioneers. In the 1950s, it was transported to its present location within the Bill Spilstead Complex for Canine Affairs, off Luddenham Road in Orchard Hills.	Penrith LEP #232	Local
Luddenham Road Alignment	Part of the former road alignment of Luddenham Road is now a 'paper road' and is subject to local heritage listing because of its importance as an early route connecting John and Gregory Blaxland's colonial estates.	Penrith LEP #843	Local
Memorial Cairn (Blaxland)	A sandstone memorial cairn was erected to Gregory Blaxland and the 1813 crossing of the Blue Mountains in 1938. It is on Luddenham Road south-west of the T-intersection with Mamre Road. This cairn matches the one erected to Samuel Marsden.	Penrith LEP #230	Local
Memorial Cairn (Marsden)	A sandstone memorial cairn was erected by the citizens of St Marys in 1938 inside the entrance gates of Mamre House. The cairn marks the significance of the property and its connection to Samuel Marsden. This cairn matches the one erected to Gregory Blaxland.	Penrith LEP #229	Local

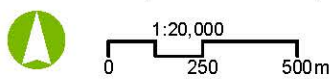


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- Proposed design's centerline
- Heritage study area
- State heritage item
- Local heritage item



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 4/06/2021 Version: 1
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1
 Figure 6-5: Heritage items near the proposal

Historical archaeological potential

The historical archaeological assessment found largely low potential for subsurface historical archaeological deposits across the proposal area, with a moderate to high level of potential at Mamre House and within its curtilage. The proposal area was split into three archaeological zones:

- Zone 1: Mamre House and grounds
- Zone 2: Luddenham Road
- Zone 3: The rest of the proposal area.

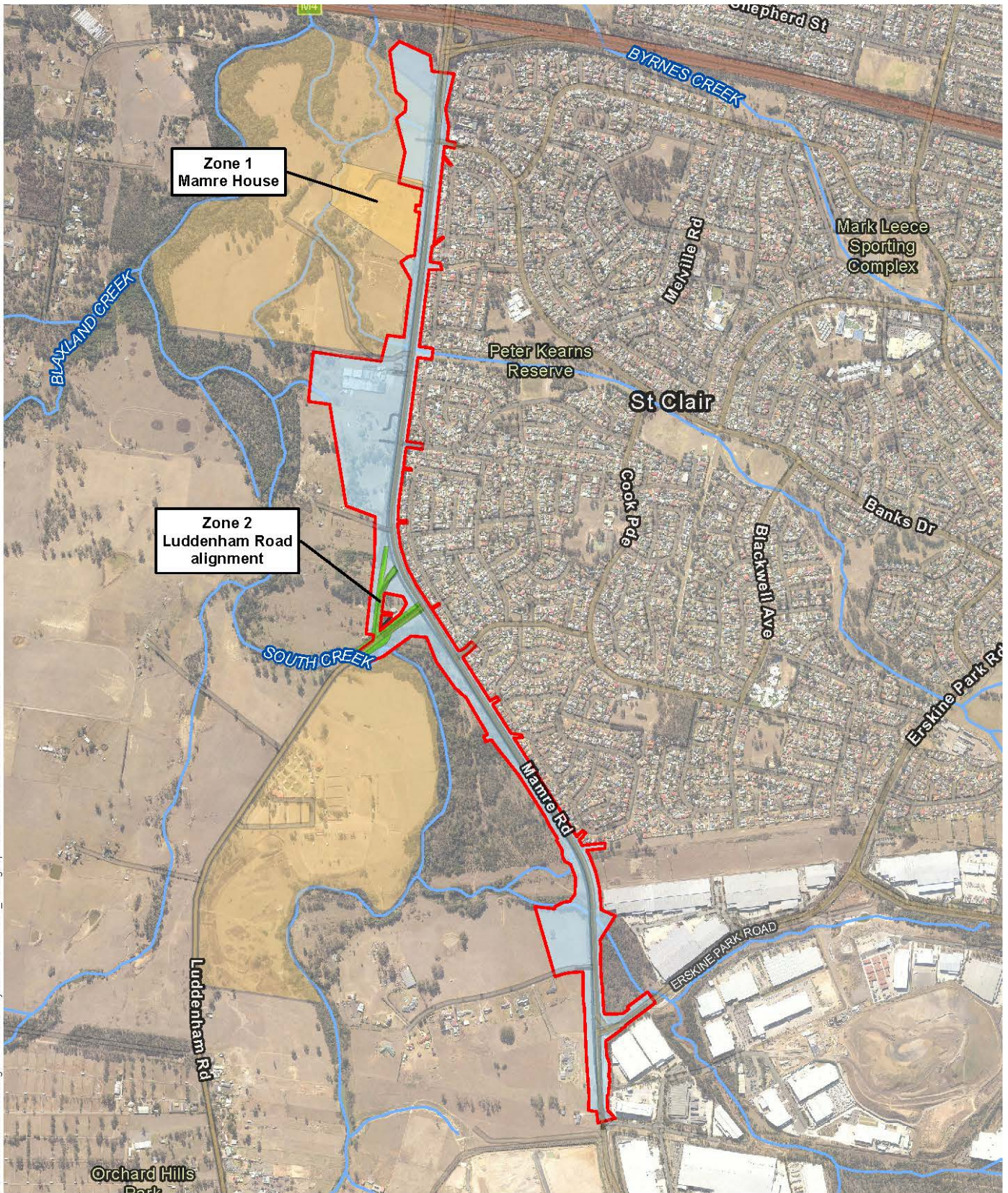
These zones are mapped in Figure 6-6.

These zones were assessed in accordance with *Assessing Heritage Significance, Assessing Significance for Historical Archaeological Sites and "Relics"*.

It was found that the level of disturbance at Mamre House and in the grounds was low as the property has remained largely rural in nature since the mid-nineteenth Century and has only seen some disturbance from the development of Mamre Road. The potential for subsurface historical archaeology in the area surrounding the homestead building and gardens is of high to moderate potential, whereas the grounds (including the area around the existing driveway) is of moderate to low potential. Any potential relics or archaeological deposits close to the homestead would likely hold State level significance, whilst other artefacts within the grounds are unlikely to be intact or meet the threshold for State significance.

At Luddenham Road, the level of disturbance is high as a result of road upgrades associated with the carriageway. Any potential for archaeological remains is low. If any remains of the early road are located, they would be highly fragmented but may meet the threshold for local significance, depending on the nature and condition of the remains.

The remainder of the proposal area has seen moderate to high levels of disturbance resulting from the upgrades associated with road networks and associated urban expansion. There would be low potential for archaeological remains associated with early farming or pastoral activities in the area, and any potential remains are likely to be highly disturbed in nature.

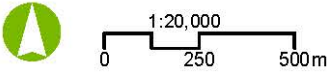


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- Proposed design's centerline
- ▭ Heritage study area
- Historical Archaeological Potential**
- ▭ Moderate - Zone 1
- ▭ Low - Zone 2
- ▭ Low to Nil



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 4/08/2021 Version: 2
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1
 Figure 6-6: Historical Archaeological Potential

6.3.3 Potential impacts

Construction

Construction of the proposal would cause visual changes that may impact the setting of and views to heritage items, specifically to Mamre House and the Marsden Memorial Cairn. These visual impacts would mainly be caused by the movement and operation of various machinery and light and heavy vehicles surrounding heritage items, particularly Mamre House, affecting overall amenity and setting. Visual impacts of the proposal are explained further in Section 6.3.3.

The proposal also has the potential to impact on historical archaeology from ground disturbance and excavation during construction of the proposal. The summary of potential impacts to historical archaeology is outlined in Table 6-12.

Table 6-12: Summary of potential impacts to historical archaeology

Archaeological Zone	Potential Impact	Discussion
Zone 1 Mamre House	Moderate to low	Utility work and the driveway relocation within the curtilage of Mamre House have potential to impact on State-significant archaeology in an area that has moderate potential for archaeological remnants (top paddocks and former driveway in line with house). Works could potentially impact scattered archaeological remains associated with Mamre House, farming activities and later phases of the homestead's development. The proposed work does not intersect with any known former buildings or structures, which were concentrated around the homestead building 200 metres to the west of Mamre Road. TfNSW's <i>Standard Management Procedure – Unexpected Heritage Items</i> (TfNSW, 2015) would be put in place during construction.
Zone 2 Luddenham Road Alignment	Low	The section of the Luddenham Road Alignment impacted by the project has a low level of potential for archaeological remains or original fabric. Any remains are likely to be highly fragmented and disturbed. Archaeological remnants dating from the early phases of the road's development (road surface, stones etc.) would be of potential local significance dependent on their nature and extent.
Zone 3 Rest of the proposal area	Nil to low	The rest of the proposal area is unlikely to contain significant archaeological remains and the potential for archaeological impacts is nil to low.

Operation

Mamre Road was widened first in the 1950s and then again in the late 1980s. In the last 20 years, the surrounding areas have been in transition to low-scale suburbs. The proposal would add to the cumulative impacts on the traditionally open, rural character of the Orchard Hills/St Clair area. Potential impacts to non-Aboriginal heritage items from operation of the proposal is summarised in Table 6-13. The Blaxland Memorial Cairn and the Leeholme Horse Stud Rotunda would not be directly impacted by the proposal.

Table 6-13: Summary of non-Aboriginal heritage impacts

Heritage item	Proposal	Impact ranking
Mamre House	The proposal would involve construction of new road infrastructure close to the eastern entrance to the property off Mamre Road. This would include relocated utilities, median strips, signage, pedestrian footpaths and embankments. The existing driveway access to Mamre House would be closed, with access to the site to be provided via a new driveway connected to the Banks Drive western sub and U-turn facility.	<p>Moderate adverse operational impacts</p> <p>The proposal would affect the property's rural setting and visual prominence as a roadside homestead only. Utility relocations and connections would be subsurface and would be restored once complete so there would be no ongoing impacts through operation. The driveway relocation would change the historic linkage with Mamre Road, altering the layout of the grounds in the northern area of the site to establish a new access. Historically appropriate landscaping would be established along the driveway to fit the driveway into the setting.</p> <p>Views to and from the property on the eastern side of the homestead would also be impacted by the installation of supporting infrastructure and increase in road traffic (refer to Section 6.4.3) during operation of the proposal. Refer to Section 6.8.3 for details on visual impacts.</p>
Marsden Memorial Cairn	Road widening near the eastern entrance to the Mamre House property and works to close the current driveway that accessed Mamre Road would occur close to the Cairn (set within the Mamre House grounds).	<p>Minor adverse operational impacts</p> <p>Widening works would alter the setting and visibility of the Marsden Memorial Cairn from Mamre Road due to its proposed relocation as part of the Mamre House driveway works.</p> <p>Retention in situ, or within the Mamre House grounds, and conservation of this heritage element within the new proposal would be confirmed at detailed design stage.</p>
Luddenham Road Alignment	The road widening would intersect with the Luddenham Road Alignment.	<p>Minor adverse operational impacts</p> <p>The proposal would impact on a small section of the Luddenham Road Alignment in an area where archaeological potential is low.</p> <p>The broader alignment and overarching form of the historic road would remain intact.</p>

6.3.4 Safeguards and management measures

Table 6-14 describes the proposed safeguards and management measure that would be implemented by the proposal to mitigate any impacts to non-Aboriginal heritage items.

Table 6-14: Non-Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Non-Aboriginal heritage	<p>A Non-Aboriginal Heritage Management Plan (NAHMP) would be prepared and implemented as part of the CEMP. It would provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage including but not limited to the following:</p> <ul style="list-style-type: none"> • a map identifying locations of no-go areas, including listed item curtilages, which are to be avoided • identification of potential environmental risks/impacts due to the works/activities • site inductions and heritage awareness training • management measures to avoid or minimise potential impacts • outline of the content to be included in toolbox talks regarding management of Non-Aboriginal heritage, including identification of no-go areas, any relevant permits and any responsibilities specified under the <i>Heritage Act 1977</i>. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.10 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Non-Aboriginal heritage	<p><i>The Standard Management Procedure - Unexpected Heritage Items</i> (TfNSW, 2015) would be followed if any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work would only re-commence once the requirements of that Procedure have been satisfied.</p>	Contractor	Construction	Early work / main construction work	Section 4.10 of QA G36 <i>Environment Protection</i>
Mamre House	<p>Mamre House, including significant gardens and grounds, would be protected throughout construction. Mitigation measures would include:</p> <ul style="list-style-type: none"> • cordoning off the Mamre House building and other significant buildings and gardens, and defining these as a 'no works' zone to minimise impacts on the site and avoid any inadvertent damage to the property and significant grounds • work completed within the SHR curtilage of the site would be carried out in accordance with the relevant conservation policies included within the Mamre House CMP (Section 6). 	Contractor	Construction	Early work / main construction work	Additional safeguard
Marsden Memorial Cairn	<p>Retain and conserve the Marsden Memorial Cairn in an appropriate location within the SHR curtilage of Mamre House adjacent to the new driveway. Minimise through design and detailing any impacts on its setting and visibility from Mamre Road.</p>	Contractor	Detailed design / construction	Main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Mamre House driveway	A landscape solution for the redundant gated entrance and signage to Mamre Homestead off Mamre Road would be informed by specialist heritage advice and consider the significant pastoral setting and the heritage significance of the property beyond, and might include but not be limited to updated signage, an interpretation node for vehicles, and lighting.	Contractor	Detailed design	N/A	Additional safeguard
Heritage interpretation opportunities	<p>Post-contact and contemporary Aboriginal cultural heritage values interpretation opportunities would be considered through the proposal area, including locations such as:</p> <ul style="list-style-type: none"> • the Mamre House grounds as part of the new driveway landscape treatment • along new pedestrian pathways and portals on the St Clair side of the proposal area • noise walls proposed along the length of the proposal area • near a scar tree identified near the Blaxland Memorial Cairn. 	Contractor	Detailed design	N/A	Additional safeguard
Archival recording	Undertake an external photographic archival recording of Mamre House, focusing on driveway changes and realignment as well as changes to the setting of the Memorial Cairn.	Contractor	Detailed design / pre-construction	N/A	Additional safeguard

6.4 Traffic and transport

This section describes the traffic and transport impacts that may occur from the proposal. It has been informed by a Traffic and transport impact assessment prepared by SMEC (2021), provided in Appendix G.

6.4.1 Methodology

Overview of key tasks

The methodology for the traffic and transport assessment included:

- examining and assessing the traffic and transport conditions for the existing traffic network in terms of existing:
 - traffic volumes and patterns using information from traffic surveys, site visit observations and intersection operation video footage
 - road safety and crash history data collected by TfNSW
 - public transport provisions
 - heavy vehicle (B-double) access and routes
 - parking provisions and facilities for active transport users
- developing Aimsun microsimulation traffic models to model the intersections of Mamre Road with:
 - M4 Motorway Westbound offramp (as signalised intersection)
 - Banks Drive (as signalised intersection)
 - Solander Drive (as signalised intersection)
 - Luddenham Road (as signalised intersection)
 - McIntyre Avenue (as priority-controlled intersection)
 - Mandalong Close (as priority-controlled intersection)
 - Erskine Park Road (as signalised intersection)
 - James Erskine Drive (as signalised intersection)
- estimating the traffic volume growth in the study area using *Sydney GMA Strategic Traffic Forecasting Model (STFM)* outputs as updated based on *Travel Zone Projections 2019 (TZP19)* and *Strategic Travel Model (STM) 3.8* provided by TfNSW to determine forecast future traffic volumes in the study area for 2026 and 2036
- modelling to assess the road network traffic performance for AM and PM peak period scenarios in 2026 (at opening) and 2036 (10 years after opening), with and without operation of the proposal
- modelling and assessing the impact of the proposed construction staging on the traffic network
- assessing the traffic impact of the proposal during operation under the forecast traffic volumes with reference to criteria from *Austrroads Guide to Traffic Management-Part 3: Traffic Studies and Analysis (2013)*
- analysing and documenting the impacts of the proposal for all road users during construction and operation, including potential impacts on property and local access, public transport, pedestrians, cyclists and vehicular traffic
- recommending safeguards and mitigation measures to manage the identified impacts.

Traffic counts and surveys

Mid-block traffic volume surveys were conducted from 3 to 9 March 2020, with additional traffic counts being carried out between 15 and 28 October 2020.

Intersection turning counts surveys and queue length surveys were conducted from 3 to 5 March 2020 at the M4 Motorway westbound off ramp and the Banks Drive, Solander Drive, Luddenham Road, Erskine Park Drive, James Erskine Drive intersections with Mamre Road (shown in Figure 6-7).

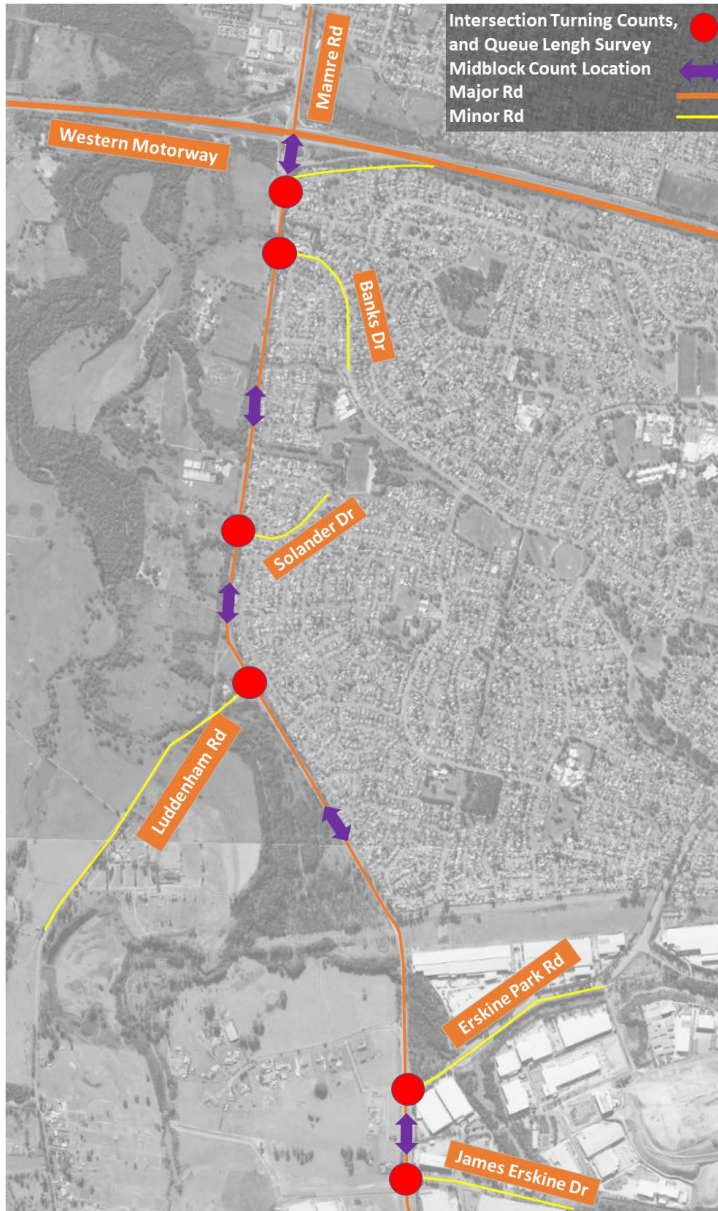


Figure 6-7: Intersection turning counts, queue length and mid-block traffic counts survey locations for March 2020 traffic surveys

The traffic data collected for the proposal in early March 2020 was before the widespread restrictions to combat the COVID-19 virus pandemic were introduced in Australia in mid-March 2020. As a result, the data collected by the proposal is unlikely to be notably affected by the COVID-19 restrictions and is considered representative of relatively normal traffic conditions.

Study area

The study area for the traffic and transport assessment encompasses the Mamre Road corridor between the M4 Motorway Westbound offramp and James Erskine Drive, which are the closest intersections on Mamre Road to the north and south of the REF proposal area, respectively.

While the M4 Westbound offramp and James Erskine Drive are outside the proposal area and would not be directly impacted, they were included in the traffic modelling to reflect the interactions with these nearby intersections. In particular, this allowed consideration of:

- the existing downstream queue spill-back effect at the M4 Motorway Westbound offramp, which affects existing traffic flow along Mamre Road, particularly at the Banks Drive intersection
- the effect of the proposed Altis Development at James Erskine Drive on the western side of Mamre Road
- existing queuing at the James Erskine Drive intersection, which would affect traffic patterns and performance of the Erskine Park Road intersection given its proximity
- the effect of the proposed Altis Development at James Erskine Drive on the western side of Mamre Road.

Detailed modelling method, assumptions and scenarios

Calibrated base year models for the year 2020 were initially developed to assess the existing traffic performance. These were also used to develop models for 2026 (year of the opening) and 2036 (10 years after opening) with future traffic growth assumptions.

The Sydney Strategic Transport Forecast Model (STFM) was used to model broader road network route choice to assist in determining the future traffic volumes that may occur in the study area. This model takes into account various land use change assumptions in the future, including those associated with the WSEA, Western Sydney Aerotropolis, M12 Motorway, Sydney Metro – Western Sydney Airport and other major projects (refer to Section 6.12.3).

Table 6-15 summarises the additional road changes and assumptions that were incorporated in the future traffic scenarios to more accurately reflect the expected road network layout. These additional road network changes and assumptions are outside the scope of this proposal, and would need to be assessed, approved and delivered separately to this proposal.

Table 6-15: Future scenario road network assumptions for traffic modelling

Change	Relevant scenarios	Details of assumption
Potential future upgrade assumptions for the M4 Motorway interchange	All scenarios in 2026 and 2036, with and without the proposal	<p>Preliminary traffic modelling using the models for 2026 and 2036 with the forecast traffic models showed that the current M4 Motorway interchange arrangement results in major congestion build-up throughout the traffic study area. As a result, it was identified that the model could not provide adequate data to assess the performance of the proposal as the future predicted levels of congestion meant that the model was unstable and at a standstill. As such, a set of “Potential Future Upgrade” assumptions for the M4 interchange were identified and were applied to the traffic model to deal with the instability associated with the congestion at the M4 Motorway interchange and are not reflected in the road design for the proposal (refer to Section 2.6.2 in Appendix G). These assumptions enabled:</p> <ul style="list-style-type: none"> • adequate traffic arrival from the M4 Motorway to the traffic study area to ensure the intersections within the proposal were tested and designed for the intended traffic volumes as much as possible • reduced impact from the M4 Motorway interchange queue spill backs to the Banks Drive intersection, which enabled traffic analysis of the proposed design for this intersection.
James Erskine Drive intersection upgrade	All scenarios in 2026 and 2036, with and without the proposal	<p>James Erskine Drive intersection would be upgraded by Altis Property Partners Development by 2026 with a new western leg to provide access to the proposed Altis development. Key road geometry assumptions for this intersection were based on an interim layout provided to TfNSW and included the following:</p> <ul style="list-style-type: none"> • two southbound and northbound through lanes on Mamre Road • dual right turn lanes and single left turn lane at stop line on Mamre Road north and south approach • single right turn and slip lane left turn on James Erskine Drive • new western approach on James Erskine Drive with two through lanes.
Luddenham Road upgrade	All scenarios in 2036 scenarios with and without the proposal	Luddenham Road is expected to be upgraded to two lanes in each direction by 2036 to cater for increased traffic volumes along this road.

6.4.2 Existing environment

Road network

Mamre Road is an arterial road that connects Elizabeth Drive at Kemps Creek with the Great Western Highway at St Marys. It is mostly a two-lane, single carriageway road with a posted speed limit of 80 kilometres per hour (except for a short section of Mamre Road near Banks Drive, which has a speed limit of 60 kilometres per hour). North of the proposal area, Mamre Road provides access to the M4 Motorway with an interchange that includes both east and west-facing ramps.

Other roads close to the proposal area include:

- Luddenham Road, which links Elizabeth Drive at Luddenham to Mamre Road at Erskine Park. It is a two-lane, single carriageway road with a posted speed limit of 80 kilometres per hour.
- Erskine Park Road, which links Mamre Road to Roper Road and has a posted speed limit of 70 kilometres per hour. Erskine Park Road and Roper Road provide access to the M4 Motorway via east facing ramps.
- Local roads: Banks Drive, Solander Drive, McIntyre Avenue and Mandalong Close, which provide access to the residential suburb of St Clair and Erskine Park and have posted speed limits of 50 kilometres per hour.

Key intersections

The key intersections with Mamre Road that are within the proposal area are detailed in Table 6-16 (refer to Section 3.2.3 for figures of existing intersection layouts).

Table 6-16: Summary of key intersections within the study area

Intersection	Existing layout
Banks Drive	<ul style="list-style-type: none">• signalised three-way intersection• Banks Drive has two lanes: a dedicated right turn lane north onto Mamre Road and a combined left turn and right turn onto Mamre Road• Mamre Road northbound has one through lane and one dedicated right turn to Banks Drive• Mamre Road southbound has two lanes - one through lane and a combined through and left turn lane
Solander Drive	<ul style="list-style-type: none">• priority controlled three-way intersection catering for all traffic movements• Mamre Road has one lane either direction• Solander Drive has one lane either direction, however to exit onto Mamre Road, there is a short storage lane for vehicles to turn left

Intersection	Existing layout
Luddenham Road	<ul style="list-style-type: none"> • a priority-controlled seagull intersection catering for all traffic movements • Mamre Road northbound has a short left turn lane and one through lane • Mamre Road southbound has a through lane, plus a short channelised right turn bay for vehicles waiting to turn into Luddenham Road. There is also a short waiting bay for vehicles exiting Luddenham Road turning southbound on Mamre Road
McIntyre Avenue	<ul style="list-style-type: none"> • a priority controlled three-way intersection • Mamre Road has one lane either direction • McIntyre Avenue has one lane either direction, however to exit onto Mamre Road, there is a short storage lane for vehicles to turn left
Mandalong Close	<ul style="list-style-type: none"> • a priority controlled three-way intersection • Mamre Road has one lane either direction with short right turn (southbound) channelised bay and a short left turn lane • Mandalong Close is a narrow unmarked road
Erskine Park Road	<ul style="list-style-type: none"> • a signalised three-way intersection • Erskine Park Road has two exiting lanes - one to turn right northbound on Mamre Road and the other to turn left southbound on Mamre Road • Mamre Road northbound has one through lane and two dedicated right turn lanes into Erskine Park Road • Mamre Road southbound has two through lanes and one short left turn channelised bay

Traffic volumes

Table 6-17 summarises the daily average traffic counts recorded at each mid-block traffic count location in October 2020. This shows that the highest traffic volumes were north of Banks Drive, at around 36,000 vehicles each weekday, and the lowest traffic volumes were north of Mandalong Close, at around 21,000 vehicles each weekday. About 10 to 13 per cent of these vehicles were medium to heavy vehicles.

Table 6-17 Summary of traffic volumes along Mamre Road in October 2020

Date range	Mid-block location on Mamre Road	Weekday average (vehicles per day)	Weekly average including weekends (vehicles per day)
15 October to 21 October	North of Banks Drive	36,700	33,455
	North of Solander Drive	26,698	23,647
	North of Luddenham Road	26,078	22,900
	North of Mandalong Close	21,116	17,895
22 October to 28 October	North of Banks Drive	36,178	32,730
	North of Solander Drive	26,194	22,942
	North of Luddenham Road	25,557	22,204
	North of Mandalong Close	20,714	17,403

As an example of more detailed traffic count data for one of the mid-block locations, Figure 6-8 shows the daily traffic volumes profile on Mamre Road north of Luddenham Road between 15 and 21 October 2020. This shows that there is a relatively consistent traffic volume profile across all weekdays (Monday to Friday) and less vehicle movements were recorded on the weekend.

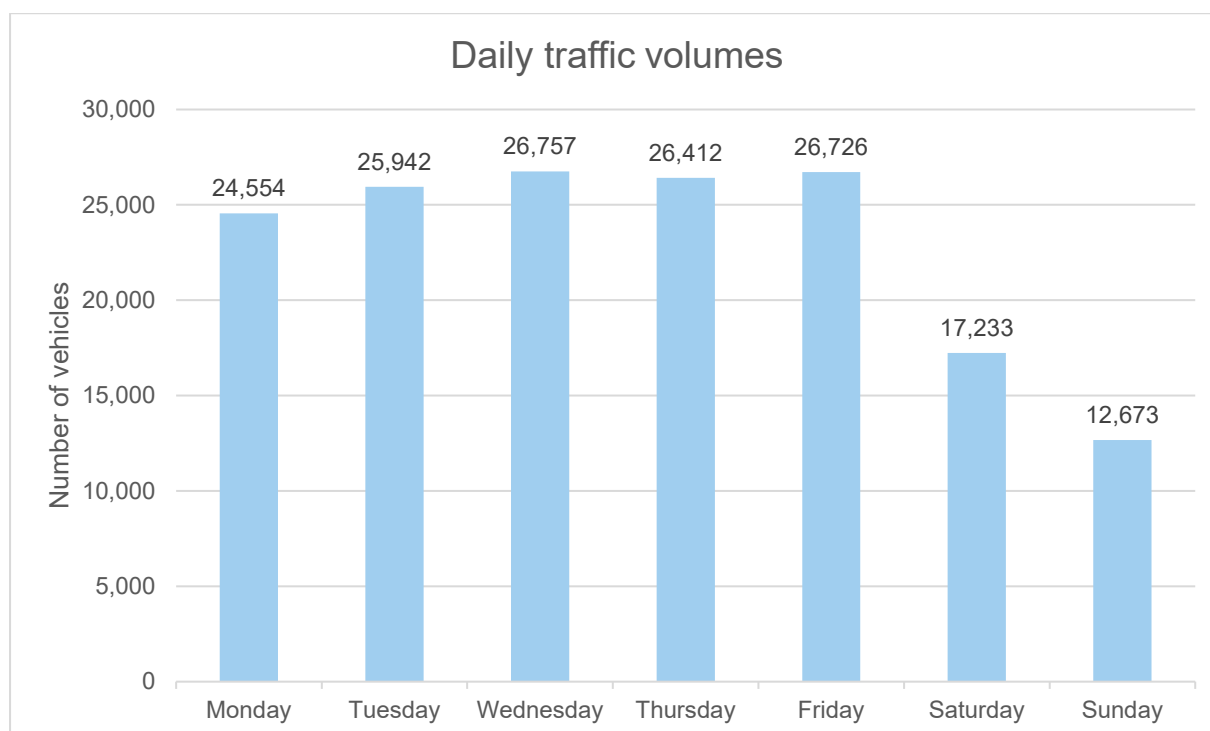


Figure 6-8: Daily traffic profile on Mamre Road north of Luddenham Road between 15 and 21 October 2020

Figure 6-9 shows the hourly traffic volume profile for the same location on Mamre Road north of Luddenham Road. This shows that the morning and evening peak traffic periods were between 5 am and 9 am and 2 pm and 6 pm, respectively.

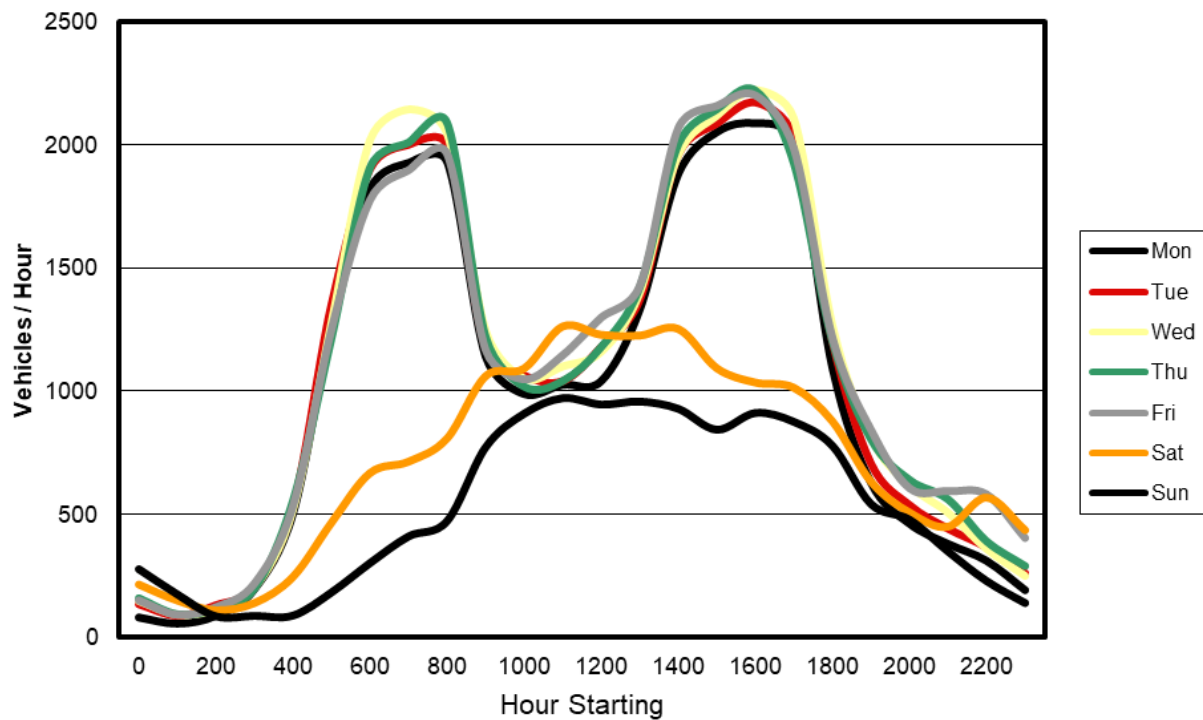


Figure 6-9: Hourly traffic profile on Mamre Road north of Luddenham Road (combined volumes in both directions) between 15 and 21 October 2020

Detailed intersection turn counts were conducted at the Banks Drive and M4 Motorway interchange intersections, which allowed the periods between 7 am and 9 am and 4 pm and 6 pm to be selected as the morning and evening peak periods to be used in traffic modelling.

Existing traffic performance

Typical peak traffic conditions observed at key intersections in the study area are summarised in Table 6-18.

Table 6-18: Existing traffic performance observations

Intersection	Morning peak	Evening peak
Banks Drive	<ul style="list-style-type: none"> • long rolling queues northbound at this intersection • long queues for right turn traffic out of Banks Drive • northbound traffic on Mamre Road frequently experienced green time loss due to congestion 	<ul style="list-style-type: none"> • some long queues on Banks Drive, however less than morning peak
Solander Drive	<ul style="list-style-type: none"> • frequent rolling queues northbound at this intersection • occasional long rolling queue southbound due to the Erskine Park Road intersection • this section of Mamre Road is susceptible to adverse weather conditions • excessive delay time greater than three minutes observed for right turn traffic from Solander Drive 	<ul style="list-style-type: none"> • excessive delay time greater than three minutes observed for right turn traffic from Solander Drive
Luddenham Road	<ul style="list-style-type: none"> • frequently rolling queues northbound at this intersection • occasional long rolling queue southbound due to the Erskine Park Road intersection • excessive delay time greater than one minute observed for right turn traffic from Luddenham Road 	<ul style="list-style-type: none"> • long and extensive delays greater than two minutes for traffic from Luddenham Road (particularly right turn out traffic) • frequent long queues (about 20 vehicles long) for right turn traffic from Mamre Road into Luddenham Road
Erskine Park Road	<ul style="list-style-type: none"> • no major queues or congestion points • infrequent and occasional queues southbound extended towards Solander Drive 	<ul style="list-style-type: none"> • no major queues or congestion points

Table 6-19 outlines the level of service (LOS) predicted for key intersections within the study area for the 2020 Base Year scenario during the second hour of the peak period. This analysis finds that intersection performance varies along the length of the study area. The Banks Drive intersection was the worst performing intersection in the study area, with its LOS being unsatisfactory with excessive queuing. The Erskine Park Road intersection operated near capacity in both peak periods and the M4 Motorway Westbound Ramp was at capacity in the evening peak period.

Table 6-19: Key intersection LOS during 2020 peak period (2nd hour)

Intersection	2020 AM Peak (2 nd hour)		2020 PM Peak (2 nd hour)	
	Average Delay (sec)	LOS	Average Delay (sec)	LOS
M4 Motorway Westbound Ramp	38	C	58	E
Banks Drive	85	F	116	F
Solander Drive	20	B	21	B
Luddenham Road	9	A	11	A
Erskine Park Road	50	D	47	D
James Erskine Drive	15	B	17	B

Crash statistics

A total of 45 crashes occurred along the proposal area and adjoining roads within 50 metres of Mamre Road in the five-year period from October 2014 to September 2019. Table 6-20 summarises these crashes by location and severity. It was noted that most crashes occurred during fine weather conditions and speeding was a contributing factor in only one crash. The crashes were mostly evenly distributed along the section of Mamre Road between Banks Drive and Erskine Park Road. There was a slight concentration of crashes near the bend north of Erskine Park Road where there are no side roads. Data shows that most crashes occurred during morning and evening peak periods.

Table 6-20: Summary of crashes by location and severity in the proposal area

Section	Location	Casualty			Non-casualty (towaway)	Total
		Serious Injury	Moderate Injury	Minor/Other Injury		
1	Banks Drive to Solander Drive	3	5	4	3	15
2	Solander Drive to McIntyre Avenue	4	2	0	3	9
3	McIntyre Avenue to Erskine Park Road	8	4	2	7	21

Figure 6-10 presents all collision types occurring within the study area between 2014 and 2019. Collisions involving vehicles travelling in the same direction made up 56 per cent of the total crashes. These are typically common on approach to signalised intersections during peak periods. The large number of rear end crashes along Mamre Road (17 in the five-year period) indicates that high traffic volumes may present a significant safety issue. Changes in average speed due to a high degree of saturation, particularly during peak commute hours, can create a 'start and stop' driving environment for motorists. This increases the likelihood of rear end collisions during periods of congestion when there may be relatively little headway between vehicles. It is expected that safety will deteriorate along Mamre Road in its current configuration for all road users as traffic and congestion levels increase.

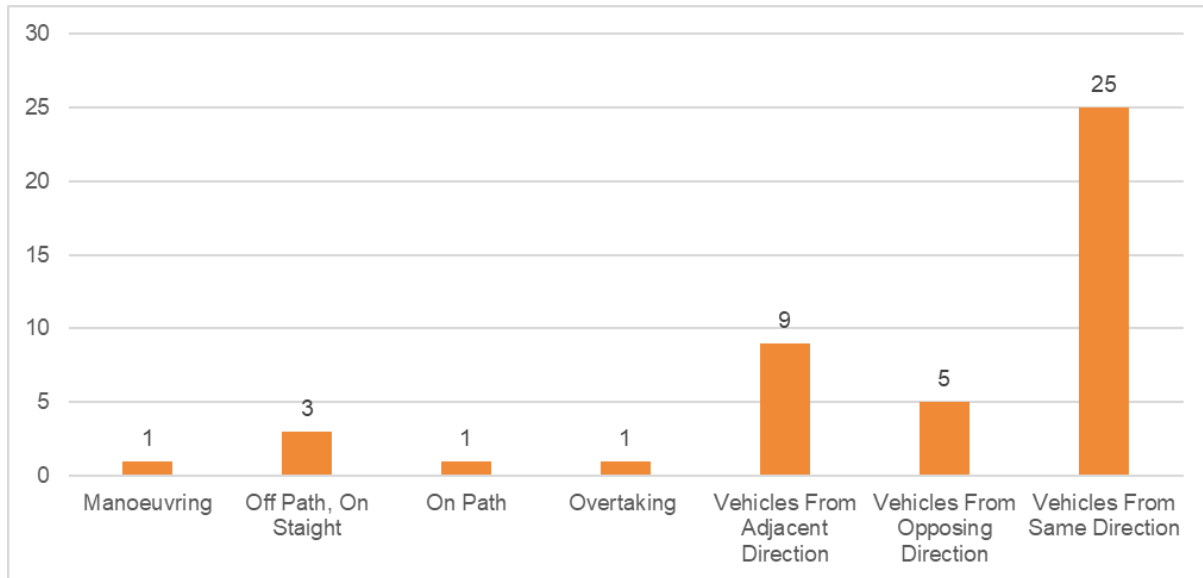


Figure 6-10: Summary of type of crash along Mamre Road (volume) from crashes recorded between 2014 and 2019

Mamre Road corridor crash severity index of 1.71 is significantly higher than both the Sydney Metropolitan Area (1.22) and state of NSW (1.24).

It is likely that safety would continue to deteriorate along Mamre Road for all road users, with congestion one of the key contributing factors to crashes along the road corridor. The concentration of crashes near intersections suggests that key intersections also experience capacity and safety deficiencies. Road safety along Mamre Road is of ongoing and substantial concern to TfNSW and the local community.

Heavy vehicles

Mamre Road and Erskine Park Road are existing designated B-double routes along with other B-double routes in the surrounding area, such as Old Wallgrove Road, M4 Motorway, Great Western Highway and Elizabeth Drive. These heavy vehicle routes connect the highway and motorway network and local industries in Erskine Park.

Mamre Road and Erskine Park Road are approved heavy vehicle routes for B-double vehicles up to 26 metres long that comply with the requirements contained in the Heavy Vehicle National Law (HVNL). They are also part of the road network that accommodates 4.6-metre-high vehicles.

Parking

On-street parking along Mamre Road is formally prohibited through use of No Parking and No Stopping signs. The following parking provisions and restrictions are provided on the various side roads:

- Erskine Park Road – ‘no parking’ signage
- Mandalong Close – no formal parking provisions
- McIntyre Avenue – on-street parking permitted
- Solander Drive – on-street parking permitted
- Luddenham Road – on-street parking permitted
- Banks Drive – ‘no parking’ signage close to the Mamre Road intersection.

However, the community is known to use a large grassed verge area south of Banks Drive to informally park cars and trucks.

Public transport

TfNSW Journey to Work data shows that cars (driver and passenger) are the dominant mode of travel for people living and working within the study area, which account for about 80 per cent of trips. Trains and buses account for less than 10 per cent of the trips within the study area and only five per cent of trips consist of walking and/or cycling.

Bus routes along Mamre Road in the proposal area include routes 775, 776, 779 and school bus services (Figure 6-11 and listed in Table 6-21). All these bus routes run only on weekdays. The existing bus routes tend to link residential and industrial areas with railway stations.

Table 6-21: Local bus route details

Route number	Destinations	Services per weekday
775	Mount Druitt to Penrith via Erskine Park and St Marys	36
776	Penrith to Mt Druitt	34
779	9 St Marys to Erskine Park Industrial area	4
4647, 4036, 4115, 4002, 4566, 4642, 4050, 4514, 4563	School bus routes	1 for each route



Figure 6-11: Local bus route map (Busways, 2019)

There are existing kerbside bus stops at the following locations:

- Mamre Road southbound north of Luddenham Road intersection
- Mamre Road southbound south of Solander Drive intersection
- Erskine Park Road east of Mamre Road eastbound and westbound
- Banks Drive westbound prior to Mamre Road intersection.

Active transport

Existing facilities for pedestrians and cyclists within the study area are limited. Figure 6-12 shows existing active transport facilities along Mamre Road within the proposal area.

There is currently no shared path for most of Mamre Road in the proposal area. A designated pedestrian path is available along the section of Mamre Road between Banks Drive and the M4 Motorway interchange as well as a shared pedestrian / cycle path between Erskine Park Road and James Erskine Drive. The eastern verge of the road near St Clair is a wide area of turf, which is sometimes used by pedestrians. Signalled pedestrian crossing facilities are available at the Erskine Park Road signalised intersection, Banks Drive signalised intersection and the M4 Motorway interchange.

Most of the length of Mamre Road does not have designated cyclist facilities and is considered “high difficulty” for cycling (refer to Section 2.2). There are designated on-road cycle lanes on Mamre Road between the southern extent of the study area and Mandalong Close.

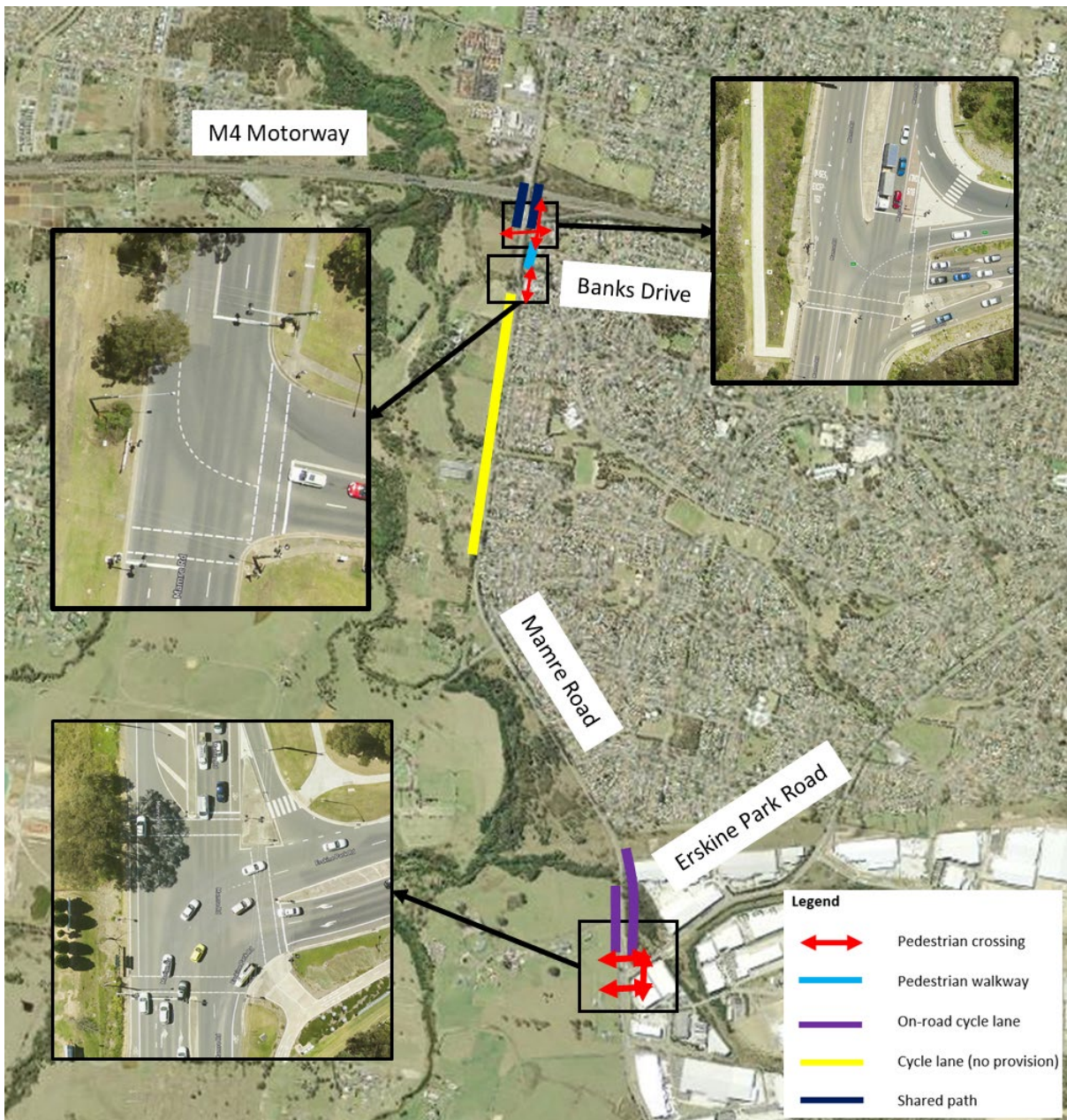


Figure 6-12: Existing active transport facilities along Mamre Road

6.4.3 Criteria

Intersection LOS criteria adopted for this assessment are outlined in Table 6-22.

Table 6-22: Modelling guidelines level of services for intersections

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

6.4.4 Potential impacts

Construction

Impacts from haulage routes

Construction of the proposal would increase heavy vehicle traffic along the potential haulage routes, especially along Mamre Road and near the main compound site proposed to the north of Solander Drive. Most heavy vehicles that access the site would be truck and dog or smaller in size. Deliveries of material and equipment would be transported to and from the construction work zones and ancillary facilities via Mamre Road, Erskine Park Road, Elizabeth Drive and the M4 Motorway. All these routes are existing designated B-double routes. Construction vehicles that are not able to turn right out of the compound sites onto Mamre Road in Stage 1 of construction may also use the Kent Road interchange with the M4 Motorway. The contractor would minimise the use of local roads, where possible, to minimise impacts to the local community.

It is estimated that construction of the proposal would require an average of 75 heavy vehicles per day, up to a maximum of 100 heavy vehicles per day, to travel to and from the proposal area. There may also be irregular movements of oversized vehicles. The volume of additional traffic generated by construction of the proposal on the surrounding main road network would be relatively small compared to the existing heavy vehicle volumes on the potential haulage routes. As identified in section 6.4.1, about 13 per cent of existing vehicle movements within the study area (or 18,000 vehicle movements on a typical weekday) are heavy vehicles.

Any potential impacts from use of haulage routes during construction would be managed in accordance with a Traffic Management Plan.

Impacts from site access

Most construction vehicles would access compound sites from Mamre Road via a left-in left-out intersection, which may result in safety risks associated with vehicles turning into the gates colliding with other vehicles travelling along Mamre Road. The gate for Compound Site 3 would be accessed from Mandalong Close, about 100 metres from the intersection with Mamre Road. Typically, construction vehicles would need to enter and exit these gates under live traffic control to minimise impacts on the local road network and the local community. These interruptions are expected to be short in duration and minor.

Construction vehicles using site access gates may also pose a risk to pedestrians. This risk would be highest for the gates to the compound site proposed at Mandalong Close due to high construction vehicle activity near potential pedestrian activity (including children) from the childcare centre on Mandalong Close. The gate locations would be refined by the construction contractor in consideration of appropriate acceleration and deceleration lanes for vehicular access as well as safe arrangements for pedestrians and/or cyclists near gates.

Potential impacts from site access would be managed through a construction traffic management plan (CTMP). This would include requirements for appropriate signage to businesses, local roads and residences to maintain access and minimise confusion for motorists.

Temporary changes to the road network associated with construction

The main construction of the proposal would be staged to generally provide one lane of traffic in each direction and allow Mamre Road to remain operational throughout construction. During early work, it is expected all the activities would be completed behind barriers and no change to the traffic network capacity is expected.

Details of the traffic arrangements and potential impacts from the main construction stages during construction of the proposal are listed below in Table 6-23.

Table 6-23: Construction stages road access & alternative routes

Stage	Location	Banned Movements	Alternative Route	Impacts
Stage 1	N/A	N/A	N/A	No change to existing.
Stage 2	McIntyre Avenue intersection	Right turn in from Mamre Road	Right turn in at Solander Drive	<ul style="list-style-type: none"> • About 31 veh/hr in the AM Peak and 55 veh/hr in the PM Peak would be affected. Increase in overall travel distance. • The use of signalised Solander Drive intersection would provide improved safety for road users.

Stage	Location	Banned Movements	Alternative Route	Impacts
	McIntyre Avenue intersection	Right turn out from McIntyre Avenue	Right turn out from Banks Drive	<ul style="list-style-type: none"> About 19 veh/hr in the AM Peak and 25 veh/hr in the PM Peak would be affected. Increase in overall travel distance. The use of signalised Banks Drive intersection would provide improved safety for road users.
	Solander Drive intersection	Right turn out from Solander Drive	Right turn out from Banks Drive	<ul style="list-style-type: none"> About 15 veh/hr in the AM Peak and 10 veh/hr in the PM Peak would be affected. Increase in overall travel distance.
Stage 3	McIntyre Avenue intersection	Right turn in from Mamre Road	Right turn in at Solander Drive	<ul style="list-style-type: none"> About 31 veh/hr in the AM Peak and 55 veh/hr in the PM Peak would be affected. Increase in overall travel distance. The use of signalised Solander Drive intersection would provide improved safety for road users.
	McIntyre Avenue intersection	Right turn out from McIntyre Avenue	Right turn out from Banks Drive	<ul style="list-style-type: none"> About 9 veh/hr in the AM Peak and 11 veh/hr in the PM Peak would be affected. Increase in overall travel distance. The use of signalised Banks Drive intersection would provide improved safety for road users.
	Mandalong Close	Right turn in from Mamre Road	U turn back at James Erskine Drive and left turn in from Mamre Road	<ul style="list-style-type: none"> About 18 veh/hr in the AM Peak and 20 veh/hr in the PM Peak would be affected. Increase in overall travel distance. The use of signalised James Erskine Drive intersection would provide improved safety for road users.
	Mandalong Close	Right turn out from Mandalong Road	Left turn out from Mandalong Road and U turn back from Solander Drive	<ul style="list-style-type: none"> About 12 veh/hr in the AM Peak and 9 veh/hr in the PM Peak would be affected. Increase in overall travel distance. The use of signalised Solander Drive intersection would provide improved safety for road users.

Other construction activity impacts

In most cases, construction work would be completed behind barriers during standard construction working hours. However, where this is not practical, construction work would be carried out during night-time and weekend lane closures with traffic control to divert or detour vehicles for short periods, which may result in temporary traffic impacts. This is likely to occur during:

- construction of transverse drainage and lifting of precast culvert units
- installation of utility crossings during early work
- changes to intersection layouts, such as during the implementation of the restriction for Mandalong Close and McIntyre Avenue to be left-in, left-only
- changes to intersection signalisation (such as new temporary or permanent signals) at Banks Drive, Solander Drive, Luddenham Road and Erskine Park Road
- construction of the Banks Drive intersection.

Impacts of construction staging on traffic performance

The impact of staging during main construction work on traffic performance was assessed using the Aimsun microsimulation traffic models and compared against existing traffic conditions (2020 base case scenario).

Key intersection LOS have been predicted for the construction phases during the morning peak (Table 6-24) and evening peak (Table 6-25). These results show that:

- the LOS at most intersections would be maintained or improved, except for Solander Drive and Luddenham Road, where the LOS would deteriorate during the morning and evening peak periods
- all three construction stages increase travel time compared to the 2020 base case, mainly due to a reduction in posted speed to 60 kilometres per hour
- the northbound travel time along Banks Drive during Stage 2 and Stage 3 is generally shorter than Stage 1 because a 60 metre short kerbside lane would be in place in Stage 2 and Stage 3
- signalisation of Solander Drive intersection and Luddenham Road intersection in Stage 3 would potentially further reduce the travel speed during both morning and evening peak for both directions on Mamre Road.

Table 6-24: Level of Service morning peak (2nd hour)

No	Intersection	2020 Base		2023 Construction Stage 1		2023 Construction Stage 2		2023 Construction Stage 3	
		Average Delay	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay	LOS
1	M4 Motorway Westbound Ramp	38	C	39	C	38	C	38	C
2	Banks Drive	85	F	91	F	114	F	122	F
3	Solander Drive	20	B	16	B	12	A	47	D
4	Luddenham Road	9	A	27	B	12	A	29	C
5	Erskine Park Road	50	D	50	D	47	D	34	C
6	James Erskine Drive	15	B	15	B	15	B	16	B

Table 6-25: Level of Service evening peak (2nd hour)

No	Intersection	2020 Base		2023 Construction Stage 1		2023 Construction Stage 2		2023 Construction Stage 3	
		Average Delay	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay	LOS
1	M4 Motorway Westbound Ramp	58	E	61	E	56	E	62	E
2	Banks Drive	116	F	120	F	106	F	105	F
3	Solander Drive	21	B	15	B	10	A	41	C
4	Luddenham Road	11	A	17	B	13	A	53	D
5	Erskine Park Road	47	D	35	C	32	C	32	C
6	James Erskine Drive	17	B	16	B	16	B	17	B

Impacts on road safety

Construction of the proposal has the potential to impact road safety, including:

- increased risk of loss of traction or control on temporary pavement surfaces
- increased risk of conflicts between general traffic and construction vehicles, particularly at construction site access and egress points
- reduced lane widths and increased proximity to barriers, increasing the risk of crashes
- increased risk of driver distraction around construction activities
- decreased visibility of temporary line marking and other traffic control measures
- through changed traffic conditions, which may result in driver confusion.

The potential for road safety impacts during construction would be addressed through the development of a Construction Traffic Management Plan (CTMP). Risks on road safety would be minimised through a reduced posted speed limit near construction activities and the requirement for all work to be undertaken by a competent contractor in accordance with relevant industry standards and Work Health and Safety regulations.

Impacts on bus services

Table 6-26 summarises the bus stop locations and changes for commuters during each of the main construction work stages. Bus routes 776 and 779 as well as school bus route 4115 may also be adjusted by the bus network operator to avoid travelling via the section of Mamre Road under construction and adjust timetables to reflect the reduced construction speed limits. During early work, bus stops and routes would be unaffected and remain as per existing conditions.

Table 6-26: Bus stop locations and changes for commuters during main construction

Location	Existing facilities	Stage 1	Stage 2	Stage 3
Mamre Road to the north of the bus stop on departure side of Mamre Road southbound near Banks Drive intersection	Footpath on the eastern side	As per existing	Commuters would be able to move behind barriers to access bus stop	Commuters to use constructed shared path to access new bus stops
South of the Erskine Park Road intersection	Shared path on the eastern side	Contractor to maintain access to shared path and intersection crossings using gaps in the barriers	Commuters would be able to move behind barriers to access bus stop	Commuters to use constructed shared path to access new bus stops
Erskine Park Road on the departure side of Mamre Road intersection heading eastbound	Bus stop	Bus stop temporarily relocated east to outside of construction works zone	Commuters to use new bus stop	Commuters to use new bus stop
Erskine Park Road on the approach side of Mamre Road intersection heading westbound	Bus stop	As per existing	As per existing	Bus stop temporarily relocated east to outside of construction work zone
Mamre Road Northbound just after Mamre House entrance	Bus stop	Temporarily closed. Commuters to use alternate bus stop on Banks Drive	Commuters to use new bus stop	Commuters to use new bus stop
Mamre Road Southbound on the departure side of Banks Drive	Bus stop	As per existing	Temporarily closed. Commuters to use temporarily relocated bus stop on Banks Drive	Commuters to use new bus stop

Location	Existing facilities	Stage 1	Stage 2	Stage 3
Banks Drive westbound	Bus stop	As per existing	Bus stop temporarily relocated to outside of proposal area	Commuters to use new bus stop
Mamre Road Southbound on the departure side of Solander Drive	Bus stop	As per existing	As per existing	Temporarily closed. Commuters to be picked up on the southern side of Solander Drive on the proposed detour route.
Mamre Road Southbound near Luddenham Road	Bus stop	As per existing	As per existing	Temporarily closed. Commuters to be picked up on the southern side of Solander Drive on the proposed detour route.

Impacts on pedestrians and cyclists

Although there are no continuous dedicated pedestrian paths on Mamre Road, access for pedestrians would be maintained during construction. In some work areas, detours and alternative temporary pathways around construction areas may be required to safely maintain access for pedestrians. Safety barriers would separate users from the construction zone, to provide safe passage during construction.

Cycling access would be maintained along Mamre Road between Erskine Park Road to Mandalong Close during early work and Stage 1, prior to the opening of the proposed new shared use path for pedestrians and cyclists in Stage 2.

Throughout the rest of the proposal area, there is little existing provision for cyclist movement along Mamre Road, which makes it difficult for cyclists to safely use Mamre Road as an access route. Alternate routes would be proposed for cyclists to discourage cyclists to use Mamre Road during construction for safety reasons, until the new shared use path is constructed. These alternative routes would be via the local road network and may result in additional distances travelled of between 1.4 kilometres and 3.8 kilometres, compared to travelling along Mamre Road.

Impacts on property access

Access to properties would be maintained, where feasible, unless an agreement with the relevant property owner is obtained (such as local access gates that have been agreed to be permanently closed by Office of Strategic Lands).

Where changed traffic conditions may restrict some existing turning movements in and out of property accesses, alternative detours may be provided. New temporary access

arrangements would be in place prior to construction commencing in consultation with the property owners. In particular, access to Erskine Park Rural Fire Service site and Mamre House would be maintained prior to opening the new driveways off Old Luddenham Road and Banks Drive, respectively.

Impacts on parking

The existing parking on the eastbound and westbound (around six parking spaces) side of Solander Drive near Mamre Road would be permanently removed during construction to provide space for the eastbound traffic lane. As there is sufficient alternative parking on Solander Drive and within residential and commercial land, parking impacts are likely to be minimal.

The existing parking (around two parking spaces) on the eastbound side of McIntyre Avenue would be removed to provide space for the eastbound traffic through lane and accommodate the intersection works. There is sufficient alternative parking on McIntyre Avenue so parking impacts are likely to be minimal.

Impacts on emergency services

Access would be maintained for emergency services along Mamre Road during construction, where feasible. The contractor would inform the relevant authorities of any change to traffic conditions that would impact access prior to these works being undertaken.

The construction staging strategy proposes that one lane of traffic in each direction along Mamre Road would generally be operational, as per the existing scenario. However, from early work to Stage 3, installation of barriers may impede vehicles from being able to pull into the verge. Barriers are proposed to be located on the western side of Mamre Road for early work and Stage 1, and on the eastern side for Stage 2. There are some locations on Mamre Road where there is a chevroned median, which could potentially be used for vehicles to pull into while allowing emergency vehicles to pass, if needed. In Stage 3, vehicles could pull into the barrier boarded lanes in an emergency to allow emergency vehicles to pass.

Operation

The permanent changes to Mamre Road and the key intersections within the proposal area during operation of the proposal are detailed in section 3.2.3 of this REF. The impacts of these changes have been assessed in the following sections.

Impacts on traffic performance

Table 6-27 summarises the road network statistics for 2026 and 2036 with and without the proposal during morning and evening peak periods.

Table 6-28 summarises the key intersection LOS during the second hour of each peak period with and without the proposal for 2026 and 2036 for all key signalised intersections in the study area. All other accesses on Mamre Road would be provided a left-in and left-out only arrangement (including Mandalong Close and McIntyre Avenue) and are not expected to experience any noticeable delay when turning to or from Mamre Road. As such, no LOS analysis has been provided for these intersections.

Further detail on the modelling results is provided in Appendix G.

The modelling shows that operation of the proposal would result in improved key intersection and overall road network performance for all periods. In particular, operation of the proposal would result in:

- reductions in the average delay per vehicle by up to 85 seconds (up to 63 per cent) in 2026 scenarios and up to 134 seconds (up to 69 per cent) in 2036 scenarios
- improvements in the LOS at key intersections in the study area, as intersections would generally operate at LOS F with high intersection delay without the proposal versus LOS C or better by 2026 and LOS D or better by 2036 with the proposal (except for at the M4 Motorway Westbound Ramp)
- little change to the high delay and low LOS at the M4 Motorway Westbound Ramp
- major travel time benefits for both directions during both morning and evening peak compared to the without proposal scenario, where there would be near gridlock in both 2026 and 2036 scenarios
- travel time savings for both the northbound and southbound directions
- faster travel speed for both directions during both morning and evening peak, with the most notable improvements observed on the southbound section of Mamre Road
- a reduction in travel speed by 24 kilometres per hour between McIntyre Avenue and Luddenham Road compared to without the proposal, because the scenario without the proposal would allow for uninterrupted through traffic at Luddenham Road instead of signalised traffic flow. However, the Luddenham Road intersection would maintain an acceptable LOS (LOS D or better) in the 2026 and 2036 scenarios with the proposal.

It is noted that these modelling results for operation of the proposal are subject to the assumptions made regarding future road network and land use changes, which are outside the scope of this proposal (refer to Section 6.4.1).

Table 6-27: Summary of network statistics with and without operation of the proposal

Network statistic	Without proposal				With proposal			
	2026 AM peak	2026 PM peak	2036 AM peak	2036 PM peak	2026 AM peak	2026 PM peak	2036 AM peak	2036 PM peak
Average delay per vehicle (min: sec)	02:14	01:37	03:05	03:32	00:49	01:18	00:58	01:19
Average network speed (km/hr)	19	22	16	13	39	34	36	34
Vehicle Kilometre Travel	26,957	27,260	28,446	28,423	35,990	33,386	43,573	42,230
Vehicle Hour Travel	1401	1234	1826	2110	924	978	1214	1245
Total Stops	2989	3389	4065	4008	1188	2444	3044	2816
Number of unreleased vehicles	866	51	3108	2927	266	0	257	644
Per cent of unreleased demand	7.5	0.5	21.5	21.4	2.1	0.0	1.7	4.2
Total demand (number of vehicles)	11,904	12,287	14,479	15,227	12,321	12,393	14,897	15,536

Table 6-28: Summary of LOS with and without the proposal at key intersections

Intersection	Without proposal								With proposal							
	2026 AM peak		2026 PM peak		2036 AM peak		2036 PM peak		2026 AM peak		2026 PM peak		2036 AM peak		2036 PM peak	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
M4 Motorway Westbound Ramp	108	F	49	D	116	F	145	F	67	E	99	F	69	E	101	F
Banks Drive	171	F	89	F	223	F	118	F	39	C	35	C	48	D	37	C
Solander Drive	228	F	184	F	227	F	280	F	24	B	28	B	25	B	25	B
Luddenham Road	215	F	131	F	231	F	247	F	18	B	24	B	36	C	31	C
Erskine Park Road	217	F	331	F	203	F	297	F	24	B	24	B	26	B	23	B
James Erskine Drive	52	D	106	F	169	F	549	F	34	C	42	C	40	C	54	D

Impacts on road safety

The proposal would improve road safety by:

- reducing opposing-lane overtaking of heavy vehicles and the associated risk of head-on crashes, due to the dual lanes in each direction and the divided carriageway with central median
- providing a new separated shared path for pedestrians / cyclists along the eastern side of Mamre Road, which would remove the risks associated with cycling on-road adjacent to general traffic
- providing protected pedestrian crossings at the Luddenham Road and Solander Drive intersections, which would reduce the number and severity of crashes involving pedestrians within the study area
- reducing congestion at key intersections along Mamre Road, which would reduce the likelihood of vehicle crashes, especially rear-end type crashes under stop-start conditions
- reducing delay time for turn movements to/from side roads and introducing signalised traffic control, which would reduce the potential for people to attempt unsafe turn manoeuvres to/from side roads and reduce crashes associated with turning vehicles.

These improvements in road safety would be expected to reduce the likelihood of crashes with the proposal, compared to the historic figures outlined in section 6.4.2 of the REF.

However, the proposal may increase the number of rear end crashes at the Luddenham Road and Solander Drive intersections due to vehicles slowing and coming to a stop on approach to the intersection at new traffic signals.

Impacts on bus services

The proposal would have minimal impact on existing bus routes and bus stops within the study area.

The two existing bus stops on Mamre Road near the Mamre House entrance would be replaced with the two new departure side bus stops at the Banks Drive intersection about 30 metres and 70 metres from the existing northbound and southbound bus stops respectively. The two existing kerbside bus stops on Erskine Park Road east of the intersection with Mamre Road would be relocated further away from the intersection due to the proposal.

The relocated bus stops would result in additional walking distance for commuters depending on where they are coming from, however provides a safer location for commuters, road users and bus services in their new locations.

Future provision for bus priority lanes has been provided in the corridor to allow buses to use the left turn lanes on approach to key intersections and bypass queued traffic in the through lanes and the provision of crossing facilities at all intersections. In addition, 1.5-metre-wide footpaths between intersection pram ramps have been provided at some locations on the western side of Mamre Road to allow for improved pedestrian movements and connection to the nearby bus stops.

The new shared path would also provide connectivity to existing local routes and help connect major regional cycling facilities at The Northern Road, the M7 Motorway, Western Sydney Parklands and future M12 Motorway.

The proposal also includes space allocation for a future shared path along the western side of Mamre Road, where required.

Impacts on local road and property access

The proposal would result in some permanent changes to property access. These changes are outlined in section 3.2.3 of this REF. All property accesses on the western side of Mamre Road would be provided a left-in and left-out only arrangement, due to the new central median restricting right turn movements.

The proposed restriction to Mandalong Close and McIntyre Avenue to left-in, left-out only may require people to travel further to reach their required destination. For those travelling southbound wishing to turn into Mandalong Close, a detour via an existing roundabout on James Erskine Drive would be required. Those wishing to use the existing McIntyre Avenue and travel north would be expected to use the local network and connect to Banks Drive. Those travelling northbound wishing to turn right into McIntyre Avenue, would be expected to use the Solander Drive western stub U-turn facility.

The new traffic signals at Solander Drive and Luddenham Road may make it easier for people to turn in and out of these roads during heavy traffic periods on Mamre Road.

Provision of the western leg at the Banks Drive and Solander Drive intersections would provide improved access for potential parkland west of Mamre Road in the future.

Impacts on parking

There is currently no parking legally permitted on Mamre Road. Parking along Mamre Road would continue to be prohibited during operation. The use of the eastern side of Mamre Road would no longer be able to be used as an informal parking area, as this area would become a shared path.

Localised on-street parking impacts during operation would occur at the same locations on Solander Drive and McIntyre Avenue as identified would occur during the construction of the proposal. Both roads have other on-street parking spaces and most residents have off-street parking available as well. As such, due to the small number of parking spaces impacted, this would not have a major impact on the availability of nearby parking options.

Impacts on Emergency Services

Emergency services access along Mamre Road would be maintained or improved by the proposal. Additional lane capacity during operation of the proposal would result in improved travel time through the study area for emergency services. The proposal would improve congestion along Mamre Road, improving road safety, efficiency and access for emergency services on Mamre Road and accessing local communities such as St Clair.

The proposal provides a divided carriageway for the length of the study area. To reduce impacts on emergency services for these changed conditions, designated Emergency Vehicle Only access points would be provided at some locations within the central median to allow for U-turn movements.

6.4.5 Safeguards and management measures

Table 6-29 describes the proposed safeguards and management measure that would be implemented by the proposal to mitigate any impacts to traffic and transport.

Other safeguards and management measures that would address traffic and transport impacts are identified in section 6.12.5.

Table 6-29: Traffic and transport safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the TfNSW <i>Traffic Control at Work Sites Manual</i> (RTA, 2010) and <i>QA Specification G10 Control of Traffic</i> (TfNSW, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • confirmation of haulage routes • measures to maintain access to local roads and properties • construction traffic control plans outlining site specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access • requirements and methods to consult and inform the local community of impacts on the local road network • access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • a response plan for any construction traffic incident • consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • monitoring, review and amendment mechanisms. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.8 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Construction site access	<p>Construction site access will be designed and implemented in consideration of:</p> <ul style="list-style-type: none"> • road design guidelines and turning paths for heavy vehicles • appropriate sight distances and deceleration/acceleration lanes (where required near highly trafficked areas) to allow traffic to safely enter and exit • conspicuous temporary regulatory, warning and guide signs • use of accredited traffic controllers, where appropriate and/or other controls to separate, slow down or temporarily stop traffic for safe entry/exit • minimising use of local roads, where practical • minimising the size of heavy vehicles that would use local roads to access construction zones • safe arrangements for pedestrians and/or cyclists. 	Contractor	Detailed design / construction	Main construction work	Additional safeguard
Temporary traffic arrangement	<p>The temporary traffic arrangement for Mamre Road will be designed to provide at a minimum, where feasible and reasonable:</p> <ul style="list-style-type: none"> • single through lane per direction • maintain traffic movements at intersections • lanes widths of at least 3.5m • 0.5m shoulder. <p>The posted speed limit is also proposed to be reduced from 80 kilometres per hour to 60 kilometres per hour along Mamre Road during construction.</p>	Contractor	Detailed design / construction	Main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Traffic impacts	Further traffic modelling will be carried out during detailed design following confirmation of the construction methodology and traffic staging to confirm the potential for traffic impacts and identify whether any additional mitigation measures or traffic control measures would be required.	Contractor	Detailed design	N/A	Additional safeguard
Impact on bus stops or routes	If any potential direct impacts on bus stops or routes during construction are identified, TfNSW will consult with the relevant bus operator/s to identify alternate arrangements.	TfNSW	Pre-construction / construction	Main construction work	Additional safeguard
Damage to local roads	A Road Dilapidation Report will be prepared by a suitably qualified person for local roads proposed to be used by heavy vehicles, before the commencement of use of the roads during construction. Any damage to the local road network identified to be caused by construction vehicles for the proposal will be remediated rectified by the contractor to be similar to the existing road condition or compensation will be paid to the relevant road authority.	TfNSW / Contractor	Pre-construction / post-construction	N/A	Additional safeguard
Impacts on cycling	During detailed design, a cyclist detour strategy would be prepared and implemented during construction to minimise any temporary impacts on cycling during construction. Community consultation will be carried out to understand the travel patterns of cyclists and inform the cyclists of any alternate access arrangements.	TfNSW / Contractor	Detailed design / pre-construction / construction	Main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Temporary access changes	Detours during temporary access changes will be implemented with directional signage along alternate routes, including advice to pedestrians and cyclists of any path closures.	Contractor	Construction	Early work / main construction work	Additional safeguard
Traffic management measures	Any temporary traffic diversions, clearways and road closures will be implemented in accordance with Transport Management Centre (TMC) requirements.	Contractor	Construction	Early work / main construction work	Additional safeguard
Property access	Property access will be maintained where feasible and reasonable and property owners (including Erskine Park Rural Fire Service and Mamre House) will be consulted before starting any work that may restrict or control access.	Contractor	Construction	Early work / main construction work	Additional safeguard
Local road or shared path closures	Council will be consulted with prior to any local road or shared path closures to identify suitable mitigation measures such as detour routes.	Contractor	Construction	Early work / main construction work	Additional safeguard
Parking	Off-road parking for construction vehicles will be provided within the compound sites and construction areas.	Contractor	Construction	Main construction work	Additional safeguard

6.5 Hydrology and flooding

This section describes the hydrology and flooding impacts that may occur when constructing and operating the proposal. It has been informed by a Hydrology and Hydraulic Assessment prepared by Aurecon (2021b), provided in Appendix H.

6.5.1 Methodology

The methodology for the assessment involved:

- reviewing received models for suitability in defining flood behaviour near Mamre Road, including the Updated South Creek Flood Study (WorleyParsons, 2015), a previous hydrologic/hydraulic model and two separate TUFLOW models provided for South Creek main stream flooding and local catchment flooding
- conducting updated hydrologic modelling using DRAINS software. This has been based on Australian Rainfall and Runoff (AR&R) 1987 guidelines for South Creek main stream flooding and AR&R 2019 guidelines for local catchment flooding. The model has been run for a range of design events including:
 - five, two and one per cent Annual Exceedance Probability (AEP) South Creek main stream flood events
 - 0.5 and 0.2 Exceedances per Year (EY) local catchment flood events with coincident low South Creek tailwater
 - ten, five and two per cent AEP local catchment flood events with coincident low South Creek tailwater
 - one per cent AEP local catchment flood event with five per cent AEP coincident South Creek tailwater event
 - probable Maximum Flood (PMF) local catchment flood event with one per cent AEP coincident South Creek tailwater event.
- conducting updated hydraulic modelling using TUFLOW software to assess the capacity of the cross-drainage structures, assess flood immunity of the existing and proposed road and define off-site flood impacts caused by the road upgrade
- conducting 12D pavement drainage modelling using AR&R 2019 guidelines
- assessing impacts of flood behaviour resulting from the proposal by comparing the flood characteristics of the existing environment to the proposal
- providing safeguards and management measures to manage the potential impacts on hydrology and flooding.

The DRAINS hydrologic and TUFLOW hydraulic models used a study area larger than the proposal area. The proposal area is the area of land that may be used during construction and operation of the proposal. This allowed the assessment to model impacts throughout the sub-catchments and networks of piped drainage systems, transverse culverts, detention storages, channels and overland flow paths related to the proposal area. The layout for these models is shown in Figure 6-13. It also includes the project boundary (approximate operational footprint that does not include construction compound sites).

Refer to Section 3 in Appendix H to the REF for further detail on the methodology applied.

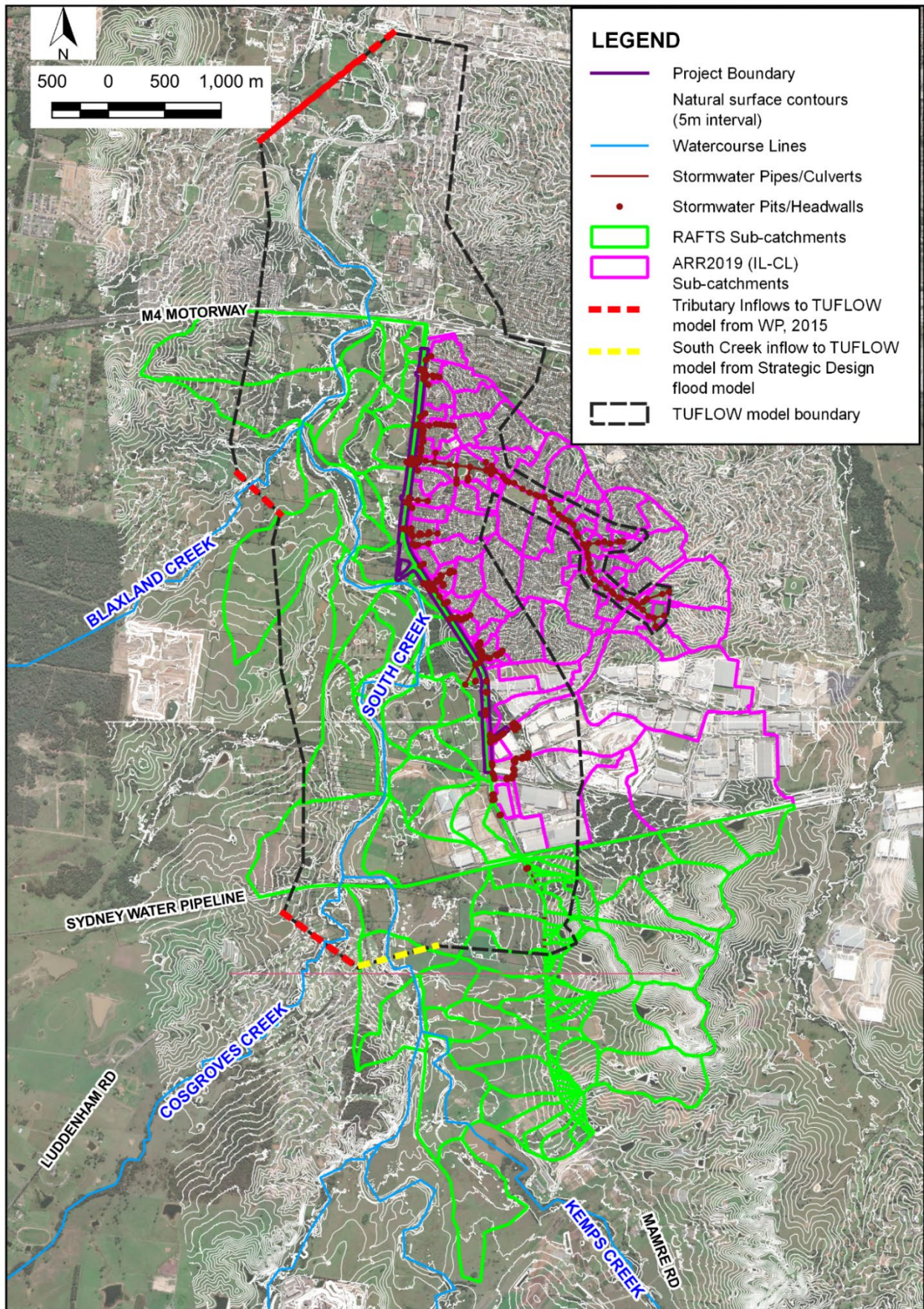


Figure 6-13: DRAINS hydrologic model and TUFLOW hydraulic model layout

6.5.2 Existing environment

Existing flood risk

Two catchments are within the proposal area and were both considered as part of this assessment (refer to Figure 6-15). They are:

- South Creek catchment
- local catchment

Detailed mapping of the flood modelling for the proposal for various different flood events is provided in Appendix H.

South Creek catchment

The proposal area is located on the floodplain of South Creek, which is a major tributary of the Hawkesbury-Nepean River and runs in a northerly direction close to the west of Mamre Road. Figure 6-15 shows the South Creek catchment and its tributaries. The area close to the creek is densely vegetated, however the rest of the floodplain has been cleared for agricultural use and contains some existing buildings accessed from Mamre Road. The Updated South Creek Flood Study (WP, 2015) identified that the storm duration generating the one per cent AEP peak flood level response in South Creek is 36 hours.

Mamre Road is most likely to experience inundation during a South Creek main stream flood event near Luddenham Road, where South Creek is the closest to the road. This includes a 20 year ARI flood event as shown on Figure 6-14, during which all three proposed compound sites would be partially covered.

The existing flood immunity of Mamre Road and connecting roads for South Creek is detailed in Table 6-30. Overall, over half of the proposal area currently experiences flooding during a one per cent AEP South Creek catchment flood event, which is a greater extent of flooding than a two per cent or five per cent AEP flood event.

Table 6-30: South Creek flood behaviour

Road name	Inundated / backwatered locations
Mamre Road	In general, Mamre Road has flood immunity up to a five per cent AEP flood event. However, during the five per cent AEP flood event, overtopping would occur at the Banks Drive and Luddenham Road intersections with Mamre Road.
Banks Drive	Banks Drive has flood immunity up to a five per cent AEP flood event, during which backwatering would be experienced at the road sag at the Mamre Road intersection.
Solander Drive	Solander Drive has flood immunity up to a two per cent AEP flood event, during which backwatering would be experienced at the road sag at Mamre Road intersection.

Road name	Inundated / backwatered locations
Luddenham Road	Luddenham Road has flood immunity up to a five per cent AEP flood event, during which overtopping on Luddenham Road would be experienced to the west of Mamre Road near where South Creek passes under the road.
McIntyre Avenue	McIntyre Avenue has flood immunity up to a five per cent AEP flood event, during which backwatering of road sag at Mamre Road intersection would occur.
Mandalong Close	Mandalong Close has flood immunity up to a five per cent AEP flood event, during which overtopping would be experienced on Mandalong Close to the west of Mamre Road.
Erskine Park Road	Erskine Park Road has the highest flood immunity of all roads in the study area, with a one per cent AEP flood immunity. There are no known areas of backwatering or overtopping during a five per cent AEP flood event.

In addition, as some of the Mamre Road transverse structure invert levels are below the flood levels, backwatering currently occurs on the eastern side of Mamre Road. This occurs at a number of intersections as well as the floodways through St Clair.

Local catchment

On the eastern side of Mamre Road between Erskine Park Drive and the M4 Motorway, residential and industrial areas drain towards the proposal area. Overland flow paths are conveyed across Mamre Road via transverse drainage culverts. Storms generating the peak flood level response for these catchments are typically short in nature (six hours or less) compared to South Creek flooding.

All roads in the study have a flood immunity level of at or below the 0.5 EY.

During one per cent AEP (equivalent to 0.01 EY) storm events, Mamre Road and surrounding roads would experience overtopping and ponding in most parts of the proposal area.

The existing flood immunity of Mamre Road and connecting roads for the local catchment is detailed in Table 6-31.

Table 6-31: Local catchment flood immunity of Mamre Road and connecting roads

Road name	Inundated/overtopped locations
Mamre Road	Mamre Road has a flood immunity of less than 0.5 EY. During this event, the road would overtop next to Dryberry Avenue.
Banks Drive	Banks Drive has a flood immunity of 0.5 EY. During this event, the road would be inundated at the road sag at the Mamre Road / Banks Drive intersection.

Road name	Inundated/overtopped locations
Solander Drive	Solander Drive has a flood immunity of less than 0.5 EY. During this event, the road would be inundated at the road sag at Mamre Road / Solander Drive intersection.
McIntyre Avenue	McIntyre Avenue has a flood immunity of 0.5 EY. During this event, McIntyre Avenue would overtop east of the proposal area.
Mandalong Close	Mandalong Close has a flood immunity of less than 0.5 EY. During this event, the road would overtop at the road sag to the west of the proposal area.
Erskine Park Road	Erskine Park Road has a flood immunity of less than 0.5 EY. During this event, the road would overtop about 140 metres east of the proposal area.

Existing drainage infrastructure

Surface water from the Mamre Road pavement discharges to the existing stormwater system on Mamre Road.

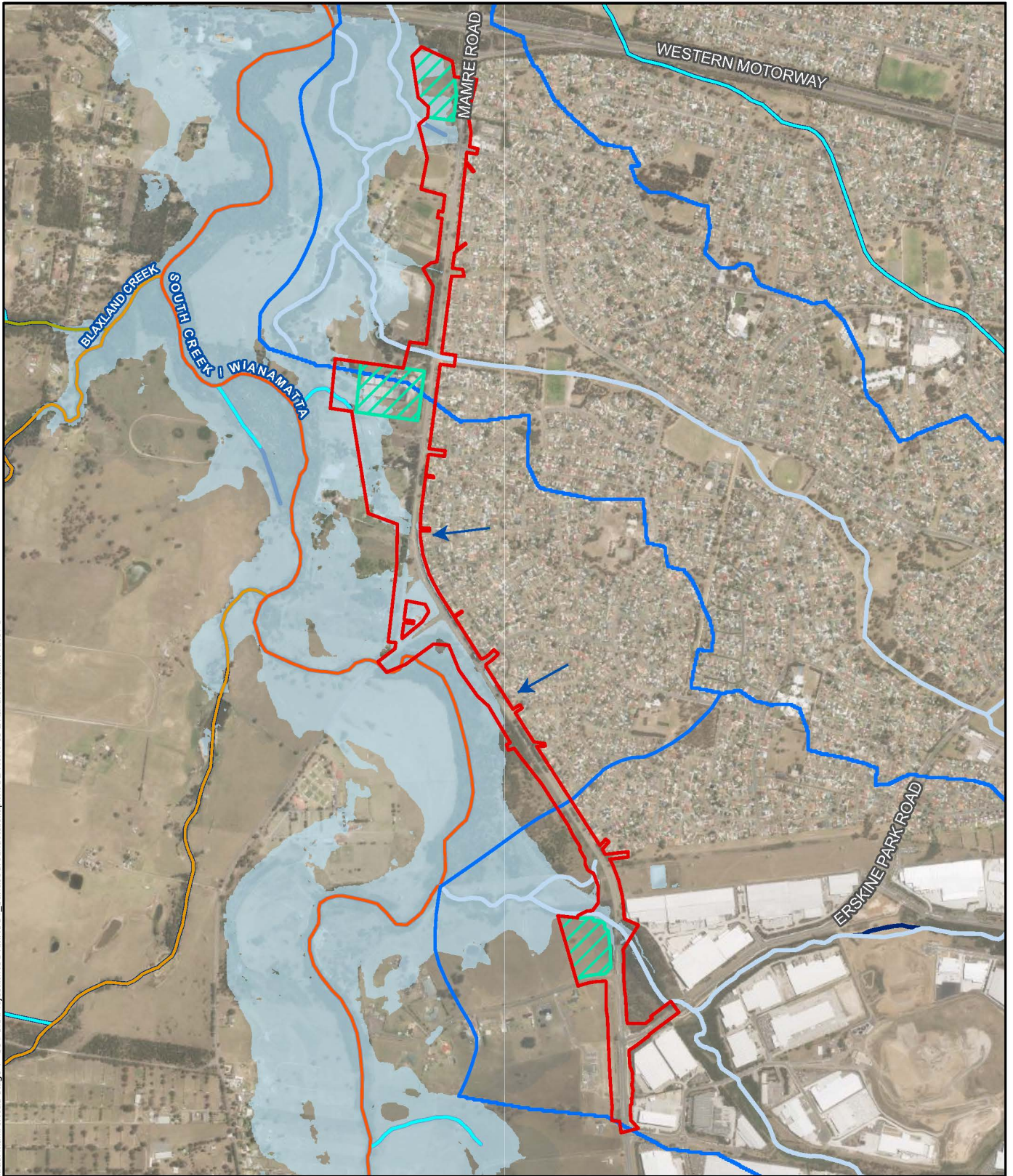
This stormwater then discharges to South Creek via transverse drainage structures, which discharges into the Hawkesbury River about 22 kilometres north of the proposal.

Drainage received from urban areas upstream of Mamre Road either discharges into:

- the existing drainage network on Banks Drive, Solander Drive, McIntyre Avenue and Erskine Park Road intersections
- natural depressions in the landscape

All external catchment runoff passes through transverse structures under Mamre Road. Breakout of overland flows onto Mamre Road and surroundings occur more frequently than the one per cent AEP.

Several flood basins are located upstream of the proposal in St Clair. There are no identified existing basins downstream of the proposal.

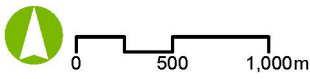


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- | | |
|---------------------------------|------------------------------|
| REF proposal area | Strahler Stream Order |
| Compound sites | 1 |
| South Creek tributary catchment | 2 |
| 20 year ARI Flood Extent | 3 |
| Local drainage | 4 |
| Unnamed tributaries | 6 |



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 4/08/2021 Version: 1
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1 REF

FIGURE 6-14: Compound site locations with respect to 20 year ARI

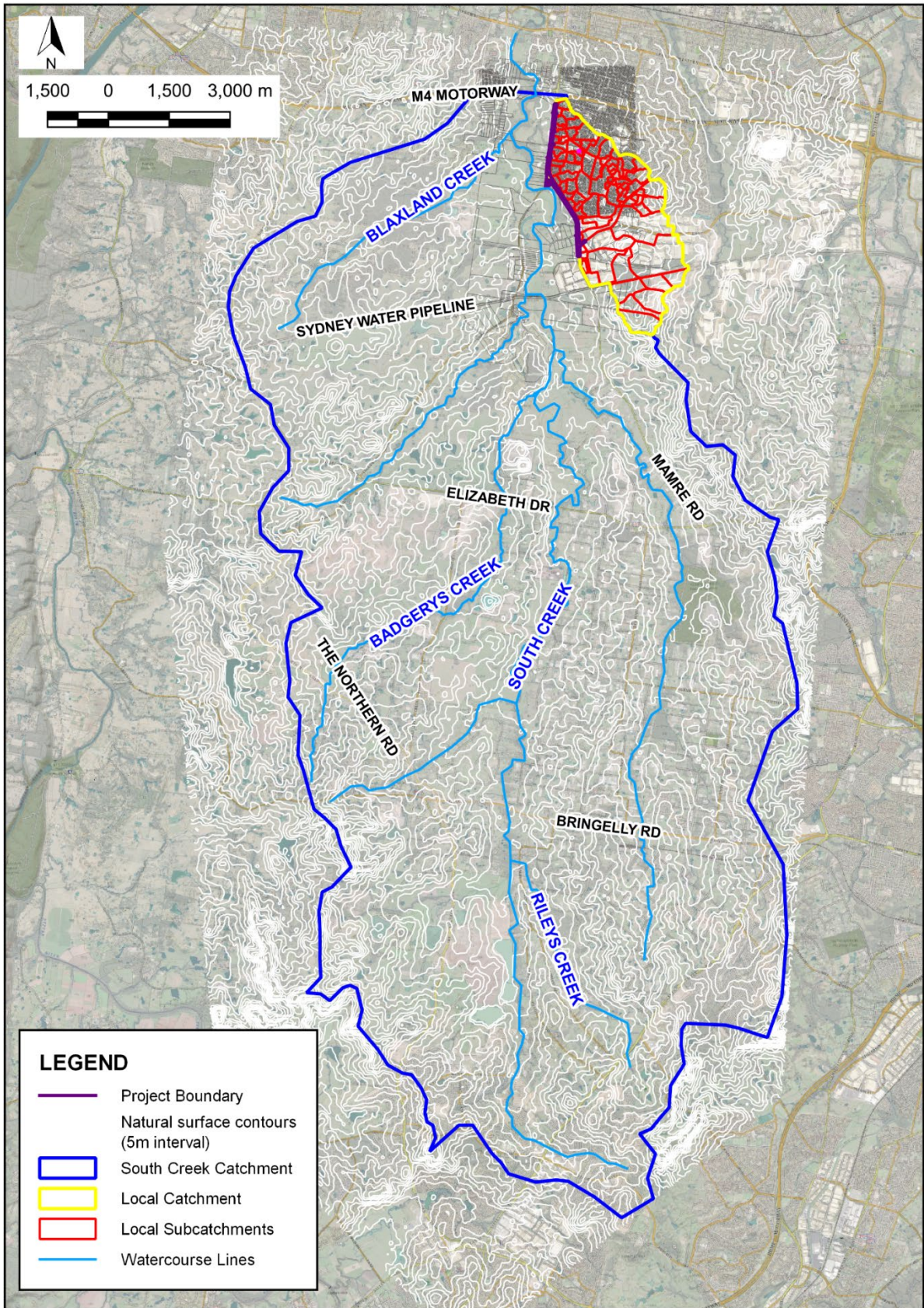


Figure 6-15: South Creek and local catchments draining to Mamre Road study area

6.5.3 Potential impacts

Construction

Potential impacts of construction on flood behaviour and hydrology

Construction activities that could affect existing flood behaviour and hydrology within the proposal area include earthworks, drainage work and use of construction compound sites.

Earthworks have the potential to modify the existing local drainage patterns within the proposal area by:

- changing the local topography, which may alter the velocity and flow paths of surface water runoff
- removing vegetation and exposing soil, which would make the ground surface more susceptible to erosion and scour during rainfall events

There may also be minor and temporary impacts on hydrology during construction of temporary waterway crossings, headwalls for drainage pipe outlets and removal of redundant culverts. These aspects (if uncontrolled) have the potential to alter localised hydrological regimes and flood patterns including through:

- direct obstruction to water flows, that could change channel velocity and increase potential flooding conditions
- localised erosion and scouring of channel banks
- deposition of fine and coarse sediments near channel banks and within the main channel
- degradation and/or changes to aquatic habitat

Potential impacts associated with establishment of temporary waterway crossings would be minimised by designing the structure to include appropriate pipe outlets, scour protection and flood immunity. The pipes would minimise the potential obstruction to river flows and the associated changes to aquatic habitat and flooding patterns. TfNSW would carry out any work in waterways in accordance with the TfNSW Code of Practice with Fisheries to minimise any adverse impacts (Roads and Maritime Services, 2014b).

Stored equipment and stockpiles within compound sites would have the potential to obstruct floodwater or overland flow, which in turn could exacerbate flooding conditions within and surrounding the proposal area. New areas of hardstand within construction compounds also has the potential to increase surface water runoff. These potential impacts on hydrology and flooding would be temporary, as any stored equipment and stockpiles would be removed and compound sites would be rehabilitated after construction to return the land to pre-existing conditions. Three temporary sediment basins have also been proposed to manage the expected change in runoff, and the associated erosion and sediment risk during construction (refer to Section 6.6.4)

Impact of flooding on construction activities

There are three proposed construction compound sites for the proposal, which would all be at least partially susceptible to flooding in a 20 year ARI scenario (refer to Figure 6-14). Where possible, equipment and material storage within these compound sites and the broader proposal area would be located outside the land subject to flooding during a 20 year ARI flood event.

Without implementation of appropriate management measures, inundation of the proposed compound sites or construction activities with floodwater would have the potential to:

- cause damage or disruption to construction activities and delays in construction programming
- pose a safety risk to construction workers, including through restricted access
- detrimentally impact downstream waterways through the transportation of sediment and construction equipment and materials by floodwater into nearby drainage lines and South Creek
- result in scour of disturbed surfaces if floodwater enters areas where earthworks are being carried out

Specific measures that could be implemented during construction to minimise the risk of flood water impacting stockpiles and resulting in cross-contamination or sedimentation of surrounding waterways would be considered further during detailed design. This would include confirmation of flood levels expected within compound sites and planning compound site layouts to avoid or minimise loose material storage in flood prone areas. A flood action plan would also be implemented during construction to minimise flood risks during construction.

Operation

Changes to flood patterns

The proposal has generally been designed so that at least one traffic lane along Mamre Road in either direction would be trafficable in a one per cent AEP storm event. Impacts from flooding of the different catchments are discussed in the following section.

The predicted impacts of the operation of the proposal are mapped for several different flood events in Appendix A of the Hydrology and Hydraulic Assessment, provided in Appendix H to the REF.

South Creek

The level of Mamre Road has been lifted to improve the flood immunity of the road to a one per cent AEP event. As in the existing situation, the main area of flooding is around the Luddenham Road intersection as this is where South Creek is closest to Mamre Road.

The change in road level would result in a reduction in flood levels at the NSW Rural Fire Station facility on Luddenham Road during the one per cent AEP flood event. At this location, the flood levels would decrease by between 0.01 and 0.1 metre for the one per cent AEP scenario compared to the existing scenario without the proposal.

The lifting of Luddenham Road would generate upstream flood impacts in the South Creek floodplain west of Mamre Road. A large area of agricultural land would be subject to a flood level increase greater than 20 millimetres, however this property is already subject to flooding under existing conditions. This would also result in backwatering of transverse culverts under Mamre Road near McIntyre Avenue. This would increase flood levels greater than 20 millimetres at 43 and 44 McIntyre Avenue, St Clair (refer to Figure 6-16). A preliminary assessment of floor level surveys was undertaken using LiDAR and Google Streetview. Based on this assessment, the flood level under the proposal is expected to be below the habitable floor level of the buildings, as per the existing case.

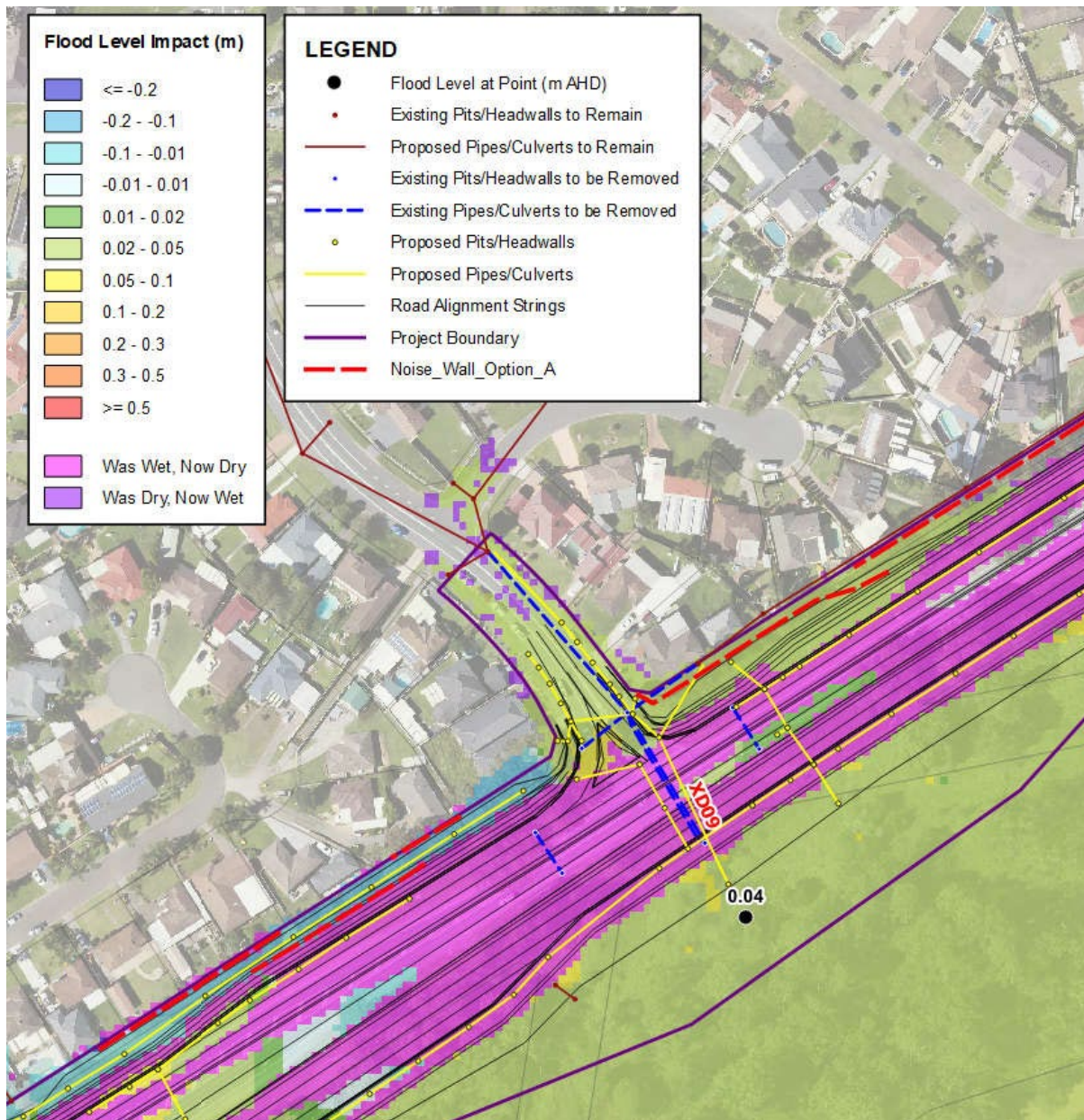


Figure 6-16: South Creek main stream flood impacts near McIntyre Avenue during one per cent AEP flood event

All property accesses that are currently inundated in the five per cent AEP South Creek flood event would remain inundated during operation of the proposal. No additional property accesses would be inundated in the five per cent AEP South Creek flood event as a result of the proposal.

Local Catchment

The biggest change to flood behaviour for the local catchment is the raising of Mamre Road and upgrading the transverse drainage culverts to provide the required immunity and manage offsite flood impacts for the one per cent AEP. By raising the road, floodwaters pool upstream for longer before it can overtop the road to flow towards South Creek.

No private dwellings would result in a flood level increase of greater than 20 millimetres in the local catchment flood event due to operation of the proposal.

The noise wall has been located outside the extent of the one per cent AEP flood event. However, the noise wall would result in obstruction of the PMF overland flow path. The PMF is the rare occurrence of the largest flood that could ever be predicted. This would result in increased PMF flood risk for several properties upstream of Mamre Road on Alpine Circuit, Olympus Drive and Madison Circuit and the industrial building at 23-107 Erskine Park Road. However, due to the very low likelihood of a PMF event occurring, the benefits of including a noise wall in the design would outweigh the potential risks during the PMF flood event. The noise wall design would continue to be developed throughout detailed design including further consideration of the PMF flood event.

Other changes to hydrology

The widening of Mamre Road would result in minor changes to surface water flow patterns and runoff due to the increased impervious area from the new road pavement and altered topography from the earthworks. However, impacts associated with these hydrological changes would be negligible as the proposal includes provision of new and modified drainage infrastructure that would be suitable for the small increase in impervious area and changed flow patterns. This includes new longitudinal drains, transverse drains, channel work and water quality management and stormwater treatment measures (refer to Section 3.2.3). These drainage measures have been designed to maintain existing flow patterns and minimise adverse impacts on hydrology, where possible.

New drainage outlets to local drainage lines and tributaries of South Creek may result in concentrated flow causing scour and erosion within the waterways close to the outlet. The new drainage outlets would be designed with appropriate scour and dissipation measures, to control the potential impacts such that impacts are likely to be negligible.

As shown in the velocity impact mapping in Appendix A of the Hydrology and Hydraulics Assessment, the change in velocity from the existing to proposed scenario would be no greater than five per cent for areas of land experiencing flood velocities greater than two metres per second. This is considered a minor increase and suggests that scour risk is generally not being increased as a result of the proposal.

6.5.4 Safeguards and management measures

Table 6-32 describes the proposed safeguards and management measures that would be implemented to manage the potential hydrology and flooding impacts from the proposal.

Table 6-32: Hydrology and flooding safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Flood risk	Flood modelling will be carried out to confirm flood impacts during detailed design including consideration of the potential noise wall on PMF flood risk.	TfNSW	Detailed design	N/A	Additional safeguard
Flood risk	Conduct an allotment and flood level survey of 43 and 44 McIntyre Avenue, St Clair to confirm flood inundation risk for these properties.	TfNSW	Detailed design	N/A	Additional safeguard
Scour risk	The detailed design will consider the need to provide scour protection and energy dissipation measures to mitigate the localised increases in flow velocities at the outlets that are to be upgraded, relocated or new stormwater drainage systems.	TfNSW	Detailed design	N/A	Additional safeguard
Flooding	<p>Further consideration of measures to minimise flooding impacts on the compound sites and construction activities will be undertaken during detailed design. This will include identification of:</p> <ul style="list-style-type: none"> • areas where material storage and stockpiles could be located outside of land subject to flooding in a 20 year ARI flood event • feasible design measures or construction methods to minimise sedimentation and cross contamination risks where flood prone land cannot be avoided for material storage and stockpiles such as installing erosion and sediment controls around compound site boundaries 	TfNSW / Contractor	Detailed design	N/A	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Hydrology impacts	The detailed design of any temporary waterway crossings will be developed in consultation with the TfNSW Environmental Officer and include appropriate pipe outlets, scour protection and flood immunity to minimise impacts on hydrology and flooding.	TfNSW	Detailed design	N/A	Additional safeguard
Hydrology impacts	All work within waterways will be carried out in accordance with the <i>Code of practice for minor work in NSW waterways</i> (Roads and Maritime, 2014a).	Contractor	Construction	Early work / main construction work	Additional safeguard
Flooding	<p>The CEMP will include a Construction Flood Management Plan, which will include details and procedures to minimise the potential for construction activities to adversely impact on flood behaviour.</p> <p>This Plan will define the flood immunity criteria (including consideration of inundation from minor rain events) for material storage and stockpile areas proposed to be located on land that is inundated during a 1% AEP event.</p> <p>Measures to manage residual flood impacts that will be outlined in the Plan will include:</p> <ul style="list-style-type: none"> • staging construction to limit the extent and duration of temporary works on the floodplain • ensuring construction equipment and materials are removed from floodplain areas at the completion of each work activity or should a weather warning be issued of impending flood producing rain • providing temporary flood protection to properties identified as being at risk of adverse flood impacts during 	TfNSW / Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
	<p>any stage of construction of the proposal, where feasible and reasonable</p> <ul style="list-style-type: none"> • limiting the extent of works located in floodway areas • monitoring weather conditions (existing and forecast conditions), including minor rain events, local weather warnings and river water level data • a communication protocol to disseminate warnings to construction personnel of impending flood producing rain or predicted flooding and actions required to make construction areas stable and safe • implementation of a flood evacuation plan. 				
Flooding	<p>A flood evacuation plan for construction personnel, materials and equipment will be prepared to manage a potential flood event during construction and included as part of the CEMP. This plan will be implemented during construction and outline:</p> <ul style="list-style-type: none"> • procedures to monitor rainfall that may influence water levels • what flood event would trigger the plan • evacuation procedures including a map indicating the area that is flood prone and suitable evacuation locations • procedures to reduce risk during a flood event including removal of all plant/equipment and stabilising exposed areas. 	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Flooding	<p>The storage of hazardous material will be confined to areas that are not subject to flooding during a one per cent AEP extent or either:</p> <ul style="list-style-type: none"> • stored in a manner that prevents their mobilisation during times of flood • be removed from the floodplain when minor rain events are predicted to inundate storage areas and at the onset of a flood. 	Contractor	Construction	Early work / main construction work	Additional safeguard

6.6 Soil and water quality

This section describes the soil and water quality impacts from the proposal. It has been informed by a Water quality and soil impact assessment (Aurecon, 2021d) and a combined Preliminary Site Investigation (PSI) and Detailed Site Investigation (DSI) undertaken by Aurecon (2021c).

6.6.1 Methodology

Water quality and soil impact assessment

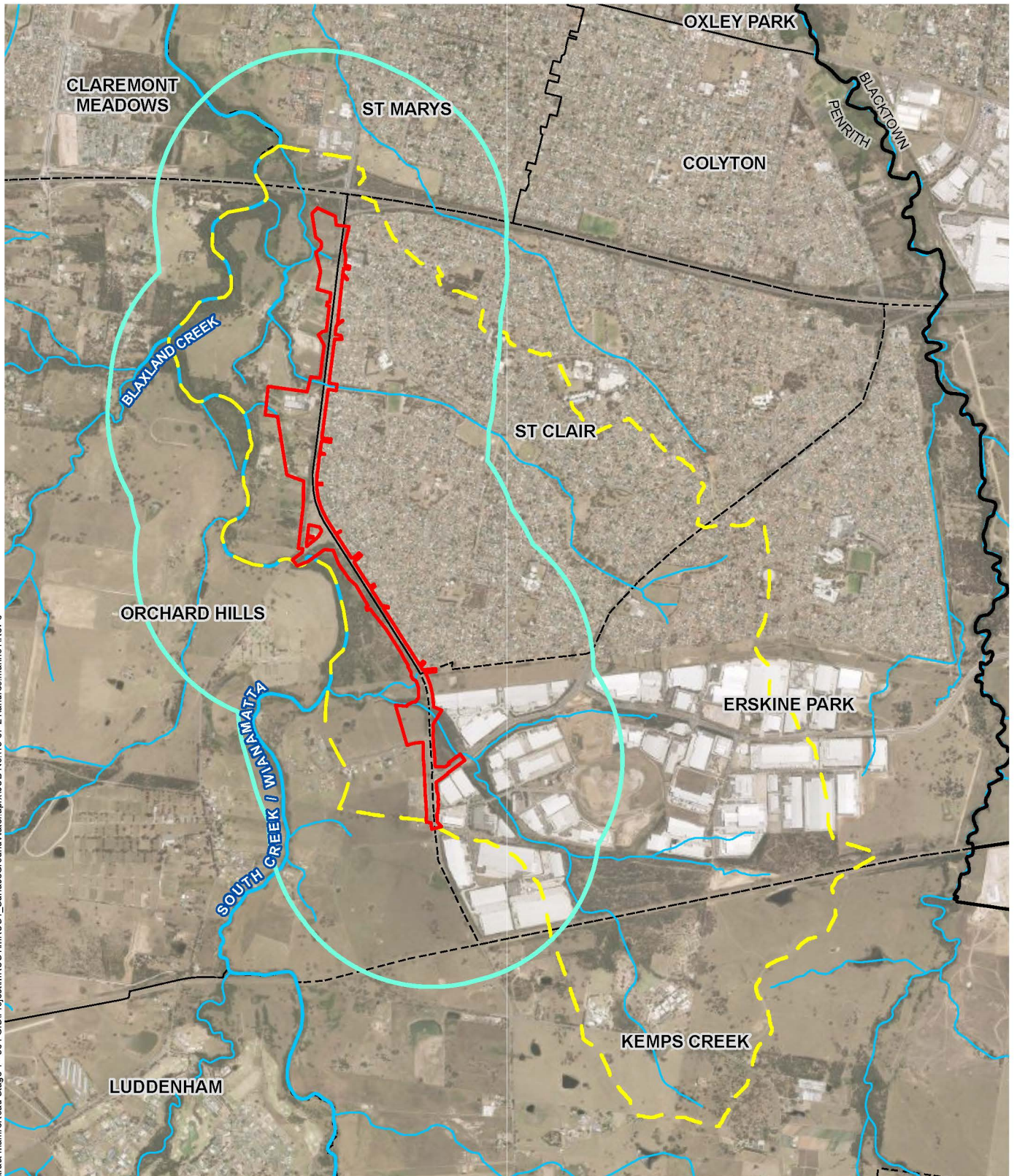
The methodology for the water quality and soil impact assessment (Appendix I) included:

- desktop review of the existing environment of the study area in relation to surface water, groundwater and soils, including: climate; catchments, waterways, and wetlands; soil, geology and hydrogeology; groundwater quality, users and groundwater-dependent ecosystems; erosion risk; contamination; flooding; and downstream sensitive receivers. This includes the review of publicly available databases (refer to Section 2.1 of Appendix I).
- outline of relevant legislative context
- review of flood modelling results (see Section 6.5) and proposed drainage design and water quality treatment strategy to inform assessment of potential impacts to surface waters and sensitive receiving environments
- assessment of potential impacts (including cumulative impacts) to the surface water, groundwater and soil environment as a result of the proposal construction and operation
- assessment of proposed mitigation strategies to control potential risks to surface and groundwater sensitive receiving environments
- recommendation of any additional management measures to mitigate potential impacts.

Study area

The study areas adopted for the water quality and soil impact assessment were (refer to Figure 6-17):

- surface water: catchment of the local watercourses and drainage lines which cross the proposal area up until South Creek
- groundwater: all land within one kilometre of the proposal area
- soil: proposal area.



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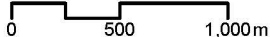
- Waterways
- REF proposal area
- Surface water study area
- Groundwater study area
- Suburb
- Local government area



Source: Aurecon, Spatial Services, Nearmap, Esri



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Date: 15/07/2021 Version: 1

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Figure 6-17: Study area

PSI and DSI

The PSI and DSI focused on identifying the contamination risk for the proposal and involved:

- review of past and current activities within and surrounding the proposal area to identify potential sources of contamination, including:
 - historical aerial imagery
 - land-use zoning information
 - NSW EPA Contaminated Sites Register
 - NSW EPA POEO licences in the Penrith Council LGA
 - NSW EPA priority per- and polyfluoroalkyl substances (PFAS) investigation risk sites
 - Department of Defence unexploded ordnance (UXO) risk mapping
- review of existing environment in relation to geology, soil, topography, registered groundwater bores, and acid sulfate soil (ASS) and salinity
- intrusive investigations (test pitting) to visually identify contamination (focusing on asbestos) and collect samples to be tested for potential contaminants including hydrocarbons, PFAS, heavy metals and asbestos
- review of laboratory results to determine if any contaminants are present at concentrations above adopted assessment criteria from the National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) and waste classification guidelines
- development of a Conceptual Site Model to evaluate the potential risks to human health and the environment during construction and operation of the proposal
- development of a preliminary waste characterisation of spoil that may be produced as part of the proposal
- recommendation of any remedial or management measures that may be required to address identified risks.

6.6.2 Criteria

The proposal is located within the South Creek subcatchment, which forms part of the Hawkesbury-Nepean catchment. Two different sets of site-specific water quality objectives are relevant to the proposal:

- South Creek catchment and tributaries: Wianamatta-South Creek performance criteria as drafted by the NSW Department of Planning, Industry and Environment (DPIE) (DPIE, 2020g)
- Hawkesbury-Nepean catchment: Interim Water Quality Objectives (HRC, 1998), Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) and ANZG Water Quality Guidelines (ANZG, 2018).

The adopted water quality objectives for the proposal are presented in Table 6-33.

Table 6-33: Summary of selected Water Quality Objectives and selected values

Indicator	Unit	Selected WQO	Reference value / criteria
Temperature	°C	16 – 34	Primary and Secondary Contact
Total Phosphorus (TP)*	mg/L	0.04 (DIP)	Aquatic Ecosystem (Wianamatta-South Creek)
Total Nitrogen (TN)*	mg/L	0.74 (DIN)	
Oxides of nitrogen (NOx)	mg/L	0.66	
Chlorophyll-a	mg/L	0.01	Aquatic Ecosystem (Hawkesbury Nepean)
Turbidity	NTU	50	Aquatic Ecosystem (Wianamatta-South Creek)
Salinity (electrical conductivity)	µS/cm	1103	
Dissolved Oxygen (DO)	mg/L	8	
Dissolved Oxygen (DO)	%SAT	43-75	
Total Suspended Solids (TSS)	mg/L	30	
pH		6.2 - 7.6	
Arsenic (As III)	mg/L	0.007	Primary and Secondary Contact
Arsenic (As V)	mg/L		
Cadmium	mg/L	0.0002	Aquatic Ecosystem (national guidelines)
Chromium (Cr III)	mg/L	0.0033	
Chromium (Cr VI)	mg/L	0.001	
Copper	mg/L	0.0014	
Iron	mg/L	0.3	Primary and Secondary Contact

Indicator	Unit	Selected WQO	Reference value / criteria
Lead	mg/L	0.0034	Aquatic Ecosystem (national guidelines)
Manganese	mg/L	0.1	Primary and Secondary Contact
Mercury	mg/L	0.00006	Aquatic Ecosystem (national guidelines)
Nickel	mg/L	0.011	
Zinc	mg/L	0.008	
Ammonia	mg/L	0.08	Aquatic Ecosystem (Wianamatta-South Creek)
Oil and Grease	N/A	Oil and petrochemicals should not be noticeable as a visible film on the water nor should they be detectable by odour	Primary and Secondary Contact / Visual amenity

6.6.3 Existing environment

Climate

The Orchard Hills Treatment Works weather observation station was selected to summarise the climate for the proposal area.

Rainfall data shows that there is variable annual rainfall, with a wet period observed during - November to May and a dry period between June and October. Annual rainfall averages are between 500 millimetres and more than 1200 millimetres.

Temperatures in the area vary between warm to hot summers (average maximum temperatures around 29°C) and cooler winter periods with average maximum temperatures below 20°C and minimum temperatures averaging around 6°C.

Surface water

Topography

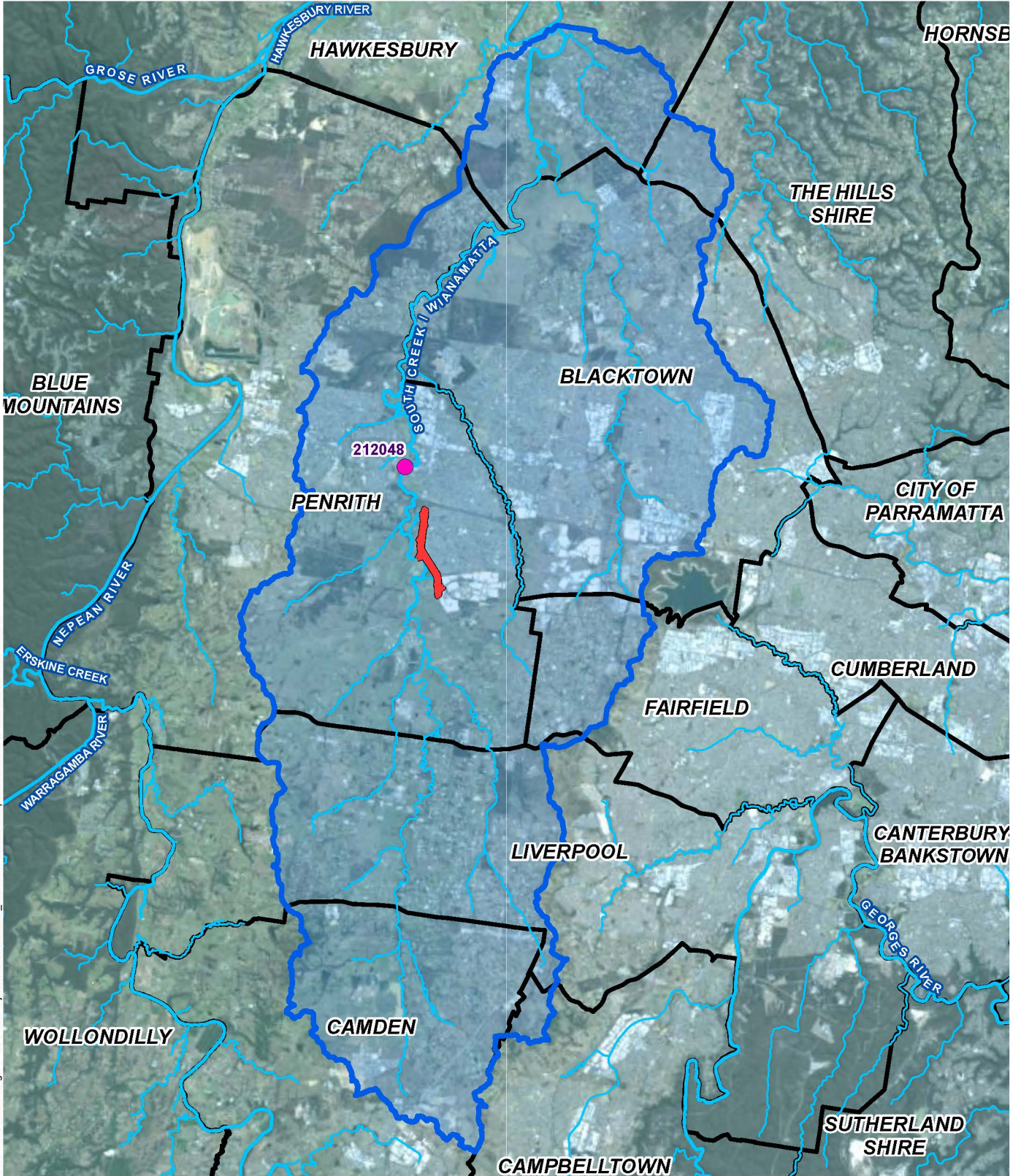
The surface water study area is fairly flat with gentle undulating low slopes. The study area ranges in elevation between around 90 metres above Australian height datum (mAHD) in the south east to around 25 mAHD elevated in the north west. The proposal area within this area is flatter, with elevations varying from around 40 mAHD to 35 mAHD.

Catchment and waterways

The proposal is located within the South Creek sub-catchment (refer to Figure 6-18). The proposal area extends into South Creek at the proposed location of new drainage outlets south of Luddenham Road. To the east, the area is urbanised and developed with multiple artificial drainage and outlet sources. To the west, the area is mostly rural land. Local watercourses within the study area generally flow north westerly towards South Creek.

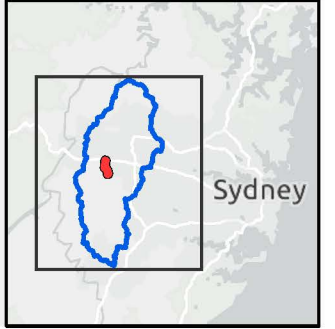
South Creek is within the proposal area near the Luddenham Road intersection. South Creek is mapped as key fish habitat. South Creek generally flows from south to north, extending from its headwaters near Narellan to its confluence with the Hawkesbury River near Windsor. The South Creek sub-catchment drains an area of 414 square kilometres in Western Sydney. The South Creek catchment consists of urbanised areas including residential, rural, industrial and agricultural areas with very little undisturbed vegetation.

South Creek is a main tributary of the Hawkesbury River, within the Nepean-Hawkesbury catchment. South Creek has seventeen tributaries, the major tributaries being Badgerys Creek, Ropes Creek, Kemps Creek and Eastern Creek. There are two minor unnamed tributaries of South Creek, flowing north westerly, that cross that cross the study area; these tributary catchments are predominantly urbanised areas. Several other local drainage lines also cross the study area (refer to Figure 6-18). Several creeks have been modified by culverts along Mamre Road.

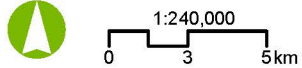


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- Water monitoring site
- REF proposal area
- ~ Watercourse
- South Creek catchment
- Local government area



Source: Aurecon, Spatial Services, Nearmap, Esri



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Figure 6-18: Regional Surface Water Catchment

Wetlands

There are no mapped wetlands within the study area. The nearest wetlands downstream of the proposal are listed under the Coastal Management SEPP 2018, located near Vineyard at the confluence of South Creek and Eastern Creek, about 17 kilometres from the proposal.

Surface water quality and quantity

Water quality monitoring data collected in South Creek by Penrith Council at the Luddenham Road crossing is provided in Table 6-34. This data has been compared with the selected WQOs as summarised in Table 6-33. Bold and highlighted cells indicate that the water quality objectives are exceeded.

Table 6-34: Summary of South Creek water quality monitoring data at Luddenham Road

Analyte	Unit	Water Quality Objective	20th percentile	Median	80th percentile
Temperature	°C	16-34	11.08	17.08	21.61
pH	N/A	6.2-7.6	7.006	7.31	7.534
Conductivity	uS/cm	1103	554.8	908	1386.4
Dissolved Oxygen	%	43-75	34.768	52	81.25
Faecal Coliforms		N/A	68	250	1260
Total Nitrogen	mg/L	0.74	0.778	1.095	2.284
Total Phosphorus	mg/L	0.04	0.0636	0.1	0.1604
Turbidity	NTU	50	9.36	22.7	75.06
Total Suspended Solids	mg/L	N/A	11	28	42
Zinc	mg/L	0.008	0.007	0.0105	0.0268
Copper	mg/L	0.0014	0.002	0.003	0.007
Lead	mg/L	0.0034	0.001	0.002	0.0036

The water quality monitoring results indicate that South Creek is a freshwater flowing stream. They also show that the South Creek water quality objectives are frequently exceeded at Luddenham Road indicating that South Creek water quality is impacted by the upstream catchment due to urban development and agricultural activities.

Geology and soils

Geology

The geology consists of sedimentary rocks from the Middle Triassic Mesozoic Wianamatta Group (major Bringelly Shale with minor Ashfield Shale and Minchinbury Sandstone) (Jones

& Clark, 1991). Bringelly Shale geology is composed of shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff. It underlies the crests, slopes and drainage lines of the majority of the study area. Quaternary fine grain sands, silt and clays derived from the surrounding rocks are also present along South Creek and current streams.

Soil landscapes

The basal geology is overlain by South Creek soils within the immediate vicinity of major creeks, transitioning to Blacktown soils on the adjacent elevated areas (DPIE, 2020f). These soil landscapes are detailed in Table 6-35 below.

Table 6-35 Summary of soil landscape key characteristics and key limitations

Soil landscape	Landscape	Key soil limitations
Blacktown	Gently undulating rises with broad (rounded ridges and crests	<ul style="list-style-type: none"> • low to very low fertility • moderate erodibility • erosion hazard for non-concentrated flow is slight to moderate (ranges from low to very high) and for concentrated flows is moderate to high • moderately reactive highly plastic subsoil • seasonal waterlogging
South Creek	Floodplains, valley flats and drainage depressions of the Cumberland Plain. These are flat to gently sloping alluvial plains	<ul style="list-style-type: none"> • low fertility • high erodibility • erosion hazard is very high to extreme (localized) • flood hazard • seasonal waterlogging • permanently high water tables (localised)

The hydrological soil group of the soils within the proposal area are group D soils (Horton Model) which have high runoff potential when thoroughly wet (DPIE, 2017). Water movement through the soil is restricted or very restricted. In some areas, group D soils also have high shrink-swell potential which is a potential hazard for maintenance of building foundations, roads and other structures of structures.

Acid sulfate soils

No acid sulfate soils (ASS) are recorded in the proposal area based on ASS mapping database (DPIE, 2020f).

Salinity risk mapping

The proposal area is located within an area of high land salinity and very high overall salinity hazard (DPIE, 2016a).

Groundwater

Groundwater characteristics

TfNSW carried out groundwater monitoring at six monitoring locations within the proposal area between June 2020 to March 2021. There are also 12 additional registered monitoring boreholes listed on the NSW Water Register within a one-kilometre radius of the proposal (refer to Figure 6-19). Groundwater levels are reported as ranging from two metres below ground level to six metres below ground level (DPIE, 2020b). The proposal is located within the Shale Plains hydrogeological landscapes (HGLs), where groundwater flow is unconfined along structures of bedding, joints, faults in the fractured bedrock. Lateral flow occurs through alluvial sediments on slopes and plains. As such, groundwater levels are considered variable seasonally, in particular during high rainfall events. Groundwater is assumed to flow towards South Creek to the west of the proposal.

Hydraulic conductivity (the ability of water to pass through pores and fractured rocks) is moderate (between 10^{-2} metres per day and 10 metres per day) and transmissivity (the ability of the aquifer to transmit groundwater throughout its entire saturated thickness measured as a rate) is low to moderate (between less than two and 20 m² per day).

Groundwater quality within these systems is brackish to saline with base flow salinity generally between 1.6 and 4.8 dS/m. The residence times are medium (years) and these landscapes have a medium response time to changes in land management (years).

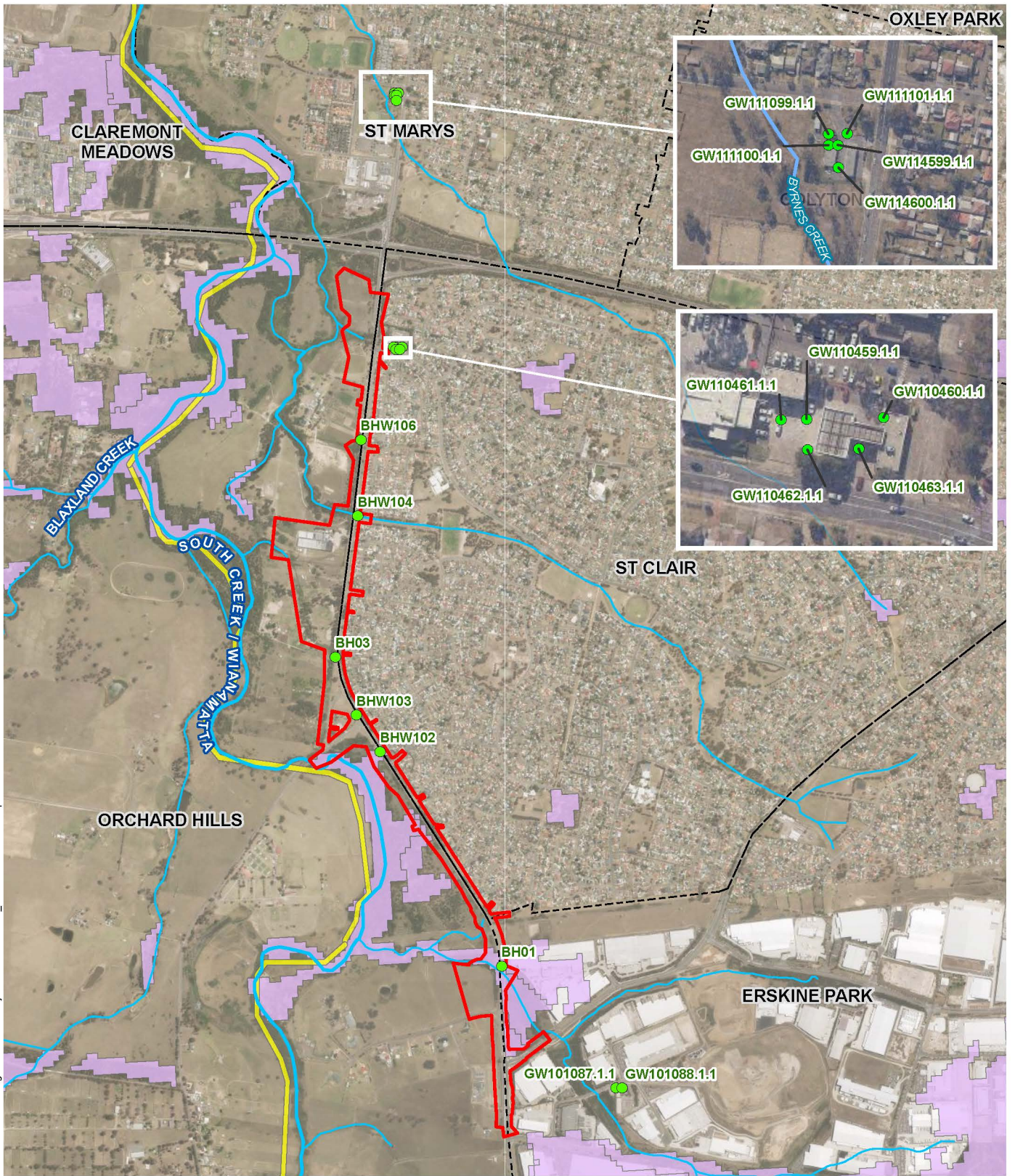
Groundwater dependent ecosystems

A number of groundwater dependent ecosystems (GDEs) are located west of the proposal (refer to Figure 6-19). These GDEs are classified as *high potential GDEs* and include South Creek (aquatic GDE) and Cumberland Shale Plains Woodlands and the Cumberland River Flat Forests (terrestrial GDEs) (DPIE, 2020b).

Groundwater use

All the boreholes identified within a one kilometre radius of the proposal are used for groundwater monitoring.

A search of the NSW Water Register returned one water access licence within the immediate vicinity and one kilometre downstream of the proposal (Water NSW, 2020).

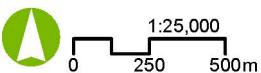


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- Boreholes
- Waterways
- REF proposal area
- Local government area
- Suburb
- Aquatic GDEs
- Terrestrial GDEs



Source: Aurecon, Spatial Services, Nearmap, Esri



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Figure 6-19: Groundwater

Contamination

A review of site history information indicates that Mamre Road has been a road since before 1960 with increasing commercial and residential development nearby over the years. Potential sources of subsurface contamination in the proposal area are asbestos containing materials (ACM) and the historical use of uncontrolled fill, particularly in road development.

Review of relevant contamination databases identified:

- There are no EPA notified contaminated sites or adjacent to the proposal area, with the closest site located two kilometres east of the proposal.
- There are no EPA POEO sites along or near the proposal area. The closest sites are confined to the south in Erskine Park and west to Orchard Hills.
- There are no PFAS investigation sites within a 10 kilometre radius of the proposal area.
- There are no UXO potential areas within the proposal area. The closest area is located two kilometres west of the proposal.

Results of the contamination investigations carried out for the proposal identified (Aurecon, 2021c):

- eleven areas where asbestos was identified through observation and laboratory analysis including four locations where asbestos was identified on the ground surface and seven locations where asbestos was identified within fill
- two samples exceeded benzo(a)pyrene against National Environmental Protection Measures (NEPM) Ecological Screening Levels
- nine samples exceeded nickel against the Ecological Investigation Level (Residential).
- sixteen samples exceeded zinc against the Ecological Investigation Level (Residential)
- no samples exceeded the adopted human health risk criteria

The elevated concentration of nickel and zinc are likely attributed to background conditions and the underlying geology of the Sydney Basin.

Aspects within the proposal area that were identified as areas of potential environmental concern (APECs) associated with existing contamination included:

- the northern most area near Banks Drive, which was observed to have asbestos containing material (ACM) at surface and in soil as well as hydrocarbon contamination and heavy metals
- certain areas of fill material associated with infrastructure including built up areas for traffic barriers and alterations to waterways that has been impacted with ACM, hydrocarbons and heavy metals
- an area on the western side of Mamre Road in the northern portion of the proposal area where a disused moulded asbestos service pit had been located
- areas where isolated fragments of ACM were observed on the ground surface, which suggests that some locations have been subject to illegal dumping of ACM materials
- soil impacted by heavy metals within the area immediately north of the Luddenham Road intersection.

6.6.4 Potential impacts

Construction

Water quality and soil impacts during construction are often interrelated, as soil erosion can result in sedimentation of waterways and increased water runoff can erode soil. Any existing contamination within soil can also be transported in sediment-laden water runoff and pollute surrounding waterways.

The key potential impacts of the proposal on surface water, groundwater and soils are as follows:

- surface water quality impacts due to sediment laden runoff being released to waterways during construction activities such as earthworks, stockpiling, dewatering, waterway crossing construction and transportation of materials
- surface water quality, groundwater quality and soil impacts during construction as a result of accidental leaks and spills
- direct disturbance of channel form and stability during construction of waterway crossings

Table 6-36 provides further detail on the potential soil and water quality impacts during construction of the proposal.

A Soil and Water Management Plan (SWMP) would be prepared and implemented during construction to minimise these potential impacts. This plan would include the requirement for several erosion and sediment control measures to be maintained during construction (refer to Section 6.6.5). With the proposed management measures in place, these impacts are expected to be negligible to minor.

Table 6-36: Summary of potential soil and water quality impacts during construction of the proposal

Construction activity	Potential impact
Clearance of vegetation and earthworks	<p>Removal of vegetation, stripping of topsoil and earthworks could potentially lead to erosion of soils and mobilisation of sediment to nearby surface waters which may lead to turbidity impacts in South Creek or the unnamed tributaries. Work within or near South Creek or the two unnamed tributaries present the greatest risk of water quality impacts occurring.</p> <p>Erosion and sediment control measures to manage potential impacts would be included in the SWMP.</p>
<p>Encountering groundwater during earthworks</p> <p>Dewatering of excavations and sediment basins and discharge of runoff</p>	<p>Most earthworks for the proposal are likely to be shallow and are unlikely to intercept groundwater. Slightly deeper excavations may be required for utility and service trenches, drainage infrastructure and piling for the noise walls. There is potential for some minor volumes of groundwater to enter these excavations, if earthworks extends into the groundwater table. This could lead to leaching of pollutants to groundwater and localised interference to groundwater flow, impacting GDEs. However, groundwater inflow volumes are likely to be low given the low permeability of the local clay soils present along South Creek and its tributaries. Large volumes of dewatering or groundwater extraction is unlikely to be required, therefore any impacts on GDEs within or near the proposal are likely to be minor.</p> <p>Dewatering of excavations and the temporary sediment basins, if managed poorly, may result in sediments being mobilised to waterways and potentially increase the turbidity of the receiving waters. It is expected that groundwater inflow to excavations would be minor.</p> <p>Discharges from sediment basins would be regulated by an EPL under the POEO Act. An assessment of the impact of discharges from each sediment basin would be undertaken during detailed design in accordance with the <i>Draft Guideline for Assessing the Impacts of Treated Water Discharge from Water Quality Treatment Controls</i> (TfNSW 2020d). This assessment would inform the EPL application and take into consideration the water quality objectives (refer to Table 6-33) and the flow characteristics of the receiving waterway. The proposed sediment basin locations are expected to discharge to intermittently flowing drainage lines, which drain to South Creek. South Creek is expected to be flowing most of the time. Measures to control the quality of water being released would be included in the SWMP.</p>

Construction activity	Potential impact
Disturbance of contaminated land	<p>Earthworks within potentially contaminated areas could potentially expose contaminants in soil (including asbestos, heavy metals and hydrocarbons) that may be mobilised as part of dewatering activities or via runoff to local waterways if poorly managed. Elevated levels of heavy metals in soil are attributed to background levels, therefore there is minimal risk to the local environment as it would have adapted to these metal concentrations. Overall, the PSI and DSI concluded that potential risks to the environment as a result of soil contamination are low to moderate and can be managed during future construction works with standard practices and strategies.</p> <p>Potential inhalation of dust containing asbestos fibres by construction workers, general public and future land users if area is disturbed during construction activities may pose a human health risk. This risk would be managed through a Remediation Action Plan prepared for the proposal and implementation of standard safeguards during construction.</p>
Construction across waterways and within waterfront land	<p>Several culvert upgrades are proposed (refer to Figure 3-1), which would require removal of redundant culverts and construction of new culverts and associated scour protection and channel work. The proposed channel work would permanently alter the bed and bank of watercourses. Temporary obstruction and interference with normal drainage channels may cause subsequent ponding or damming of water upstream in the unnamed tributaries and local drainage lines.</p>
Use of compound sites	<p>The proposed compound sites are located at least partially within the 20 year ARI for South Creek, which increases the risk of stockpiled soils and pollutants associated with stockpiles and concrete mixing operations being mobilised into waterways.</p> <p>Concrete batching operations can lead to soil and water pollution as a result of cement laden runoff not being properly contained or being accidentally released to surface waters. Measures for cement handling, storage and disposal procedures would be documented within the CEMP.</p> <p>Locating stockpiles within the floodplain and overland flow paths could allow loose material to be mobilised to drainage lines during rainfall events, causing sedimentation, water quality impacts and habitat degradation within receiving waterways. There is also potential risk for cross contamination within stockpile sites located within the floodplain. Sediment management measures would be used on the stockpile sites to minimise the potential for sediment laden runoff to be discharged offsite and lead to sedimentation impacts to receiving waters.</p>

Construction activity	Potential impact
Leaks and spills	<p>Potentially harmful chemicals and substances accidentally released during construction spills or as result of maintenance works, refuelling and inappropriate storage or handling of fuels and chemicals. This could lead to localised soil contamination, leaching of contaminants to groundwater, and contaminated runoff to waterways. Leakage from construction worker toilet facilities or wastewater collection points, resulting in nutrient and microbiological water impacts in groundwater and receiving waterways.</p> <p>Measures to minimise the potential impacts associated with accidental leaks and spills during construction would be incorporated into a site specific emergency spill plan as part of the SWMP.</p>

Operation

During operation, the proposal has the potential to increase the pollutant load being released from Mamre Road as a result of the proposed increase in pavement footprint. The key pollutants contained in road runoff include:

- suspended solids as a result of pavement wear, tyre wear, atmospheric deposition and deposition from vehicles
- heavy metals bound to dust particles washed off pavement surface
- oil and grease and other hydrocarbons deposited by vehicles
- nutrients as a result of atmospheric deposition

The increase in pollutant load could potentially result in water quality impacts such as sedimentation, reduced water clarity, increased toxicant and nutrient concentrations and lower dissolved oxygen levels within the local tributaries and South Creek. Increase in frequency and volume of flows due to an increase in impervious area may also impact waterway health. To minimise these potential impacts, the proposal includes several water quality basins and swales and like-for-like replacement of existing pollutant treatment devices to retain and treat stormwater runoff (refer to Figure 3-1). Two operational water quality basins have been located at higher risk discharge locations (close to the sensitive receiving environment of South Creek) to provide enhanced treatment of stormwater runoff. One of these basins would be located near Erskine Park Rural Fire Service site, north of Luddenham Road, and the other would be located on the western side of Mamre Road near McIntyre Avenue (refer to Figure 3-1).

A high level MUSIC model was developed to estimate the change in pollutant load and annual runoff volume as a result of the proposal with consideration to the proposed stormwater treatment strategy. The MUSIC model found that that pollutant load increases from the proposal to South Creek and unnamed tributaries are likely to be minor (less than three per cent) compared to the existing pollutant load from the local urbanised catchment within the proposal area. The actual percentage increases in pollutant load to South Creek would be lower than modelled as the larger upstream catchment has not been modelled as part of this assessment. The upstream catchment would cumulatively increase the existing pollutant load. Therefore, the additional un-modelled flow and pollutant load from South Creek's upstream catchment would reduce the relative impact of the proposal.

Water quality monitoring within South Creek at Luddenham Road (refer to Table 6-34) shows that the water quality objectives for TP and TN are currently not being met the majority of the time and turbidity exceeds the water quality objective at times.

The minor increase in TSS, TP and TN loads within the study area as a result of the proposal are likely to have a negligible impact on TSS, TP and TN concentrations within South Creek. The proposal would have a similar impact in terms of heavy metals which are also likely to be negligible. As such, the proposal is likely to have a negligible impact on future efforts within the wider catchment to maintain or improve water quality within South Creek to achieve the water quality objectives.

Accidental spills of oils or other chemicals being transported or as a result of maintenance activities could potentially lead to contaminants being released into local tributaries and drainage lines which could lead to water quality impacts within nearby waterways. However, as Mamre Road is an existing operational road, any increase in risk associated with the

proposal is expected to be minor. With the proposed management measures in place, impacts to groundwater are likely to be negligible.

6.6.5 Safeguards and management measures

Table 6-37 describes the proposed safeguards and management measures that would be implemented to manage the potential soil contamination and water quality impacts from the proposal. Other safeguards and management measures that would address soil and water quality impacts are identified as part of the hydrology and flooding management measures in Section 6.5.4.

Table 6-37: Soil and water quality safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Soil and water	<p>A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP to manage water quality impacts during construction of the proposal. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and sedimentation, dewatering and water pollution and describe how these risks will be addressed during construction.</p> <p>The Soil and Water Management Plan (SWMP) will be reviewed by a soil conservationist on the TfNSW list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address the outcomes of the review.</p>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 2.1 of QA G38 <i>Soil and Water Management</i>
Soil and water	<p>A site specific Erosion and Sediment Control Plan/s (ESCP) will be prepared and implemented as part of the SWMP.</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>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 2.2 of QA G38 <i>Soil and Water Management</i>
Soil and water	<p>A construction water quality monitoring plan will be prepared and implemented as part of the SWMP. The plan will be prepared in accordance with the TfNSW Guideline for Construction Water Quality and EPA publication “Approved Methods for the Sampling and Analysis of Water Pollutants in NSW.</p>	Contractor	Detailed design / pre-construction / construction	Main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Soil and water	The design and construction of watercourse crossings, works within a watercourse or works on waterfront land as defined by the <i>Water Management Act 2000</i> are to be undertaken with consideration to the <i>Guidelines for instream works on waterfront land</i> (DPI, 2012a), <i>Guidelines for watercourse crossings on waterfront land</i> , (DPI, 2012b) and in accordance with relevant TfNSW specifications and guidelines.	TfNSW / Contractor	Detailed design / construction	Early work / main construction work	Additional safeguard
Contaminated land	A Contaminated Land Management Plan will be prepared in accordance with the <i>Guideline for the Management of Contamination</i> (TfNSW, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to: <ul style="list-style-type: none"> capture and management of any surface runoff contaminated by exposure to the contaminated land further investigations required to determine the extent, concentration and type of contamination, as identified in the detailed site investigation (Phase 2) management of the remediation and subsequent validation of the contaminated land, including any certification required measures to ensure the safety of site personnel and local communities during construction. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.2 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Contaminated land	A Remediation Action Plan (RAP) and an Unexpected Find Protocol (UFP) will be prepared and implemented to manage the potential for soil or water quality contamination during construction of the proposal. The RAP will evaluate potential remedial options and recommend a preferred option to manage the ACM during the construction of the road upgrades. The RAP should include a Long-Term Environmental Management Plan for the ACM material (should it remain in the proposal alignment). The RAP should include a preliminary plan to manage potential risks to human health and the environment during the remediation activities. The RAP will form a part of the overall CEMP.	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
Asbestos	When working in areas impacted by asbestos, Work Health and Safety (WHS) and additional controls must be in place to minimise exposure risks. These may include physical removal of asbestos fragments from the soil surface, additional dust suppression and appropriate PPE.	Contractor	Construction	Early work / main construction work	Additional safeguard
Asbestos	Asbestos air monitoring by a licensed hygienist/LAA should be carried out for the duration of the earthworks to monitor for respirable asbestos fibres which may be released.	Contractor	Construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Accidental spill	A site-specific emergency spill plan will be developed and include spill and leak management measures in accordance with the TfNSW <i>Code of Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including TfNSW and EPA officers).	Contractor	Pre-construction / construction	Early work / main construction work	Section 4.3 of QA G36 <i>Environment Protection</i>
Accidental spill	Spill containment to be provided within operational water quality basins located within road catchments considered to present a high risk to South Creek.	Contractor	Detailed design	N/A	Additional safeguard
Stormwater	The layout and detail of the drainage system including drainage, water quality basins, spill containment, swales, discharge points and outlet scour protection measures will be refined during detailed design.	TfNSW	Detailed design	N/A	Additional safeguard
Stormwater	Stormwater outlets to local drainage lines and waterways are to be designed with consideration to the <i>Guidelines for outlet structures on waterfront land</i> (DPI, 2012c) and relevant TfNSW specifications and guidelines.	TfNSW	Detailed design	N/A	Additional safeguard
Stockpiles	Stockpiles sites will be managed in accordance with <i>Environmental Procedure Management of Wastes on Roads and Maritime Services Land</i> (RMS, 2014c)	Contractor	Construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Soil and water	Stockpiles site locations would be confirmed during detailed design and managed during construction in accordance with <i>Environmental Procedure Management of Wastes on Roads and Maritime Services Land</i> (RMS, 2014c) and the <i>Stockpile Site Management Guideline</i> (RMS, 2015d). This would consider measures to manage cross contamination within a stockpile area.	Contractor	Detailed design / construction	Early work / main construction work	Additional safeguard
Soil and water	Further consideration of how to manage stockpiles, material laydown and chemical storage with respect to floodwater would be undertaken during detailed design.	Contractor	Detailed design / pre-construction	N/A	Additional safeguard
Soil and water	An assessment of the impact of discharges from each temporary sediment basin would be undertaken during detailed design in accordance with the <i>Draft Guideline for Assessing the Impacts of Treated Water Discharge from Water Quality Treatment Controls</i> (TfNSW, 2020d). The assessment would adopt relevant water quality objectives for South Creek and include a catchment analysis to confirm the flow characteristics of the receiving waterways.	TfNSW / Contractor	Detailed design / Pre-construction	N/A	Additional safeguard

6.7 Noise and vibration

This section describes the noise and vibration impacts that may occur when constructing and operating the proposal. This section summarises the *Mamre Road Upgrade – Stage 1 Noise and Vibration Assessment* prepared for the proposal by SLR (2021b) that is provided in Appendix J to the REF.

6.7.1 Methodology

Overview

The methodology for the noise and vibration assessment involved:

- identifying the noise and vibration assessment study area and associated sensitive receivers
- measuring the existing background noise levels at five noise monitoring locations
- carrying out traffic count surveys to calibrate the existing road traffic noise models
- grouping sensitive receivers that are located at similar distances from noise generating activities into noise catchment areas (NCA)
- describing the existing noise environment for each NCA
- defining relevant assessment criteria to assess noise and vibration impacts
- identifying 'realistic worst-case' construction scenarios and representative plant and equipment for each scenario
- predicting and assessing construction noise levels for the construction scenarios using SoundPLAN V8 software in accordance with the Interim Construction Noise Guideline (ICNG) (DECC, 2009) and Construction Noise and Vibration Guideline (CNVG; Roads and Maritime Services, 2016)
- calculating and assessing construction vibration using source vibration levels and minimum working distances in accordance with relevant guidelines
- assessing the predicted operational road traffic noise levels in accordance with the Road Noise Policy (DECCW, 2011)
- recommending safeguards and management measures to be implemented to minimise noise and vibration impacts during construction and operation of the proposal, with reference to the CNVG and Noise Mitigation Guideline (NMG) (Roads and Maritime Services, 2015b).

Noise monitoring

Noise monitoring was undertaken to determine the existing background noise environment near the proposal. Unattended noise monitoring was completed in the proposal area during October 2020. The noise monitoring locations (refer to Figure 6-20) were chosen to be representative of the different noise catchment areas surrounding the proposal. The noise monitoring equipment continuously measured existing noise levels in 15-minute periods during the daytime, evening and night-time. Traffic count surveys were carried out alongside the long-term unattended noise monitoring surveys to calibrate the road traffic noise volumes.

Short-term attended noise monitoring was also completed at each monitoring location. The attended measurements allow the contributions of the various noise sources at each location to be determined.

Construction noise and vibration assessment model and scenarios

Construction noise at sensitive receivers was modelled using SoundPLAN V8 software. Eight construction scenarios were developed for the purpose of the noise modelling to provide 'realistic worst-case' activity sequences for different construction activities. These scenarios are listed in Table 6-38.

Table 6-38: Construction scenarios and estimated work duration

ID	Scenario
W.01	Site establishment and environmental protection
W.02	Utilities, early works and earthworks – peak
W.03	Utilities, early works and earthworks – typical
W.04	Road, pathway and intersection upgrades – peak
W.05	Road, pathway and intersection upgrades – typical
W.06	Compound operational
W.07	Supporting infrastructure and finishing work
W.08	Demobilisation

The scenarios represent one possible way that the proposal could be constructed and may not necessarily be the same methodology that the contractor engaged to construct the proposal would use. The final construction methodology (including the full plant and equipment list) and the expected construction noise levels would be confirmed during detailed design. These scenarios are discussed in detail in Section 4.1 of Appendix J to the REF.

Some construction activities have been separated into 'peak' and 'typical' work scenarios. 'Peak' work describes the noisiest stages of construction when noise intensive equipment, such as concrete saws, are in use. While 'peak' work would be required at certain times in most locations, it is expected this work would only last for relatively short periods of the overall work duration. 'Typical' work describes noise from construction activities when noise intensive equipment is generally not in use.

The assessment has considered potential noise impacts from work during standard working hours for all scenarios as well as during evening and night-time periods for scenarios W.02, W.03, W.04, W.05 and W.06. Refer to Section 3.3.3 for more information on the proposed construction hours.

Operational noise assessment model and scenarios

A noise model of the 'operational study area' has been used to predict noise levels from the operation of the proposal to the surrounding receivers. The noise model used the CoRTN algorithm in SoundPLAN V8 software. Various inputs and parameters were applied to the model including local terrain, surrounding buildings, typical vehicle speeds, traffic volumes, vehicle types and road surfaces (refer Section 4.5.4 in Appendix J to the REF).

The operational study area has been defined as 600 metres from the centre of the outside lanes of the project roads, as required by the Noise Criteria Guideline (NCG) (Roads and Maritime Services, 2015a). Roads where design or engineering changes are proposed as part of the proposal are considered as 'project' roads. Existing roads with no upgrades or work occurring are considered 'non-project' roads. All major roads in the proposal area have been modelled together with major roads on the surrounding road network to determine the contributions from 'project' and 'non-project' roads at individual receivers, as required by the NCG. Project and non-project roads are shown in Appendix D of the noise and vibration assessment included in Appendix J to the REF.

The NCG requires transition zones to be applied at the point where road categories change from 'new' to 'redeveloped' to provide a smooth transition in noise criteria. Transition zones are not applicable to this proposal as the operational road traffic criteria is entirely 'redeveloped'.

Operational traffic noise levels were modelled for the following scenarios:

- Year of opening (2026) without the proposal ('no build')
- Year of opening (2026) with the proposal ('build')
- 10 years after opening (2036) without the proposal ('no build')
- 10 years after opening (2036) with the proposal ('build').

The noise model was validated using the measured road traffic volumes and background noise measurements in the proposal area. Based on the comparison of measured and predicted road traffic noise levels, the model was considered to perform as expected and was deemed valid for predicting road traffic noise levels for the proposal. Refer to Section 4.5.5 in Appendix J to the REF for further details.

6.7.2 Existing environment

Noise catchment areas and sensitive receivers

The nearest receivers to the proposal that may be sensitive to noise and vibration are residential properties in St Clair next to the proposal area, directly east of Mamre Road. Scattered rural receivers in Orchard Hills are located at varying distances to the west of Mamre Road. The Erskine Business Park industrial area is located at the southern end of the proposal area.

Nine NCAs have been identified surrounding the proposal, which each represent an area that contains a group of receivers that may be similarly affected by noise from the proposal. This may reflect the different land uses and existing background noise levels within and surrounding the proposal area. The NCAs for the proposal are shown in Figure 6-20 and described in Table 6-39. A comprehensive list of 'other sensitive' receivers (non-residential) identified within the study area is provided in Section 2.1 of Appendix J to the REF.

Table 6-39: Noise catchment areas and surrounding land uses

NCA	Minimum distance ¹	Description
NCA01	10 m	NCA01 covers sensitive receivers in St Clair to the east of Mamre Road between the M4 Motorway and Banks Drive. The receivers in this NCA consist of residential dwellings, the Blue Cattle Dog Hotel and commercial buildings on the corner of Mamre Road and Banks Drive, and several outdoor passive recreation areas.
NCA02	170 m	NCA02 is mostly comprised of open land to the west of Mamre Road. Mamre House is in this catchment, which is currently a Catholic Care facility and farm, and has been considered as a mix of residential and commercial buildings in this assessment. Mamre House is listed on the State Heritage Register.
NCA03	<10 m	NCA03 covers sensitive receivers in St Clair to the east of Mamre Road between Banks Drive and Solander Drive. This NCA includes residential dwellings, Banks Public School, and several outdoor active and passive recreation areas.
NCA04	10 m	NCA04 covers sensitive receivers to the west of Mamre Road, north of Luddenham Road. The receivers in this NCA consist of three scattered residences, some commercial/industrial buildings/sheds, and the Rural Fire Service site on the corner of Mamre Road and Luddenham Road.
NCA05	<10 m	NCA05 covers sensitive receivers in St Clair to the east of Mamre Road between Solander Drive and McIntyre Avenue/Cook Parade. This NCA includes residential dwellings, Cook Parade Children’s Centre, and several outdoor active and passive recreation areas.
NCA06	<10 m	NCA06 covers sensitive receivers in St Clair to the east of Mamre Road between McIntyre Avenue/Cook Parade and Lukes Lane Reserve. This NCA includes residential dwellings, Gumbirra Preschool, and several outdoor active and passive recreation areas.
NCA07	220 m	NCA07 covers sensitive receivers in St Clair to the east of Mamre Road between Lukes Lane Reserve and Erskine Business Park. This NCA includes residential dwellings, Strauss Road Children’s Centre, and several outdoor passive recreation areas.

NCA	Minimum distance ¹	Description
NCA08	60 m	NCA08 covers sensitive receivers to the west of Mamre Road, south of Luddenham Road. This NCA includes residential dwellings and Old MacDonald's Child Care located on Mandalong Close, and a commercial site off Luddenham Road.
NCA09	20 m	NCA09 covers commercial/industrial receivers in Erskine Business Park along both sides of Mamre Road and Erskine Park Road.

1) Approximate minimum distance from the proposed work to the nearest receiver building in each NCA

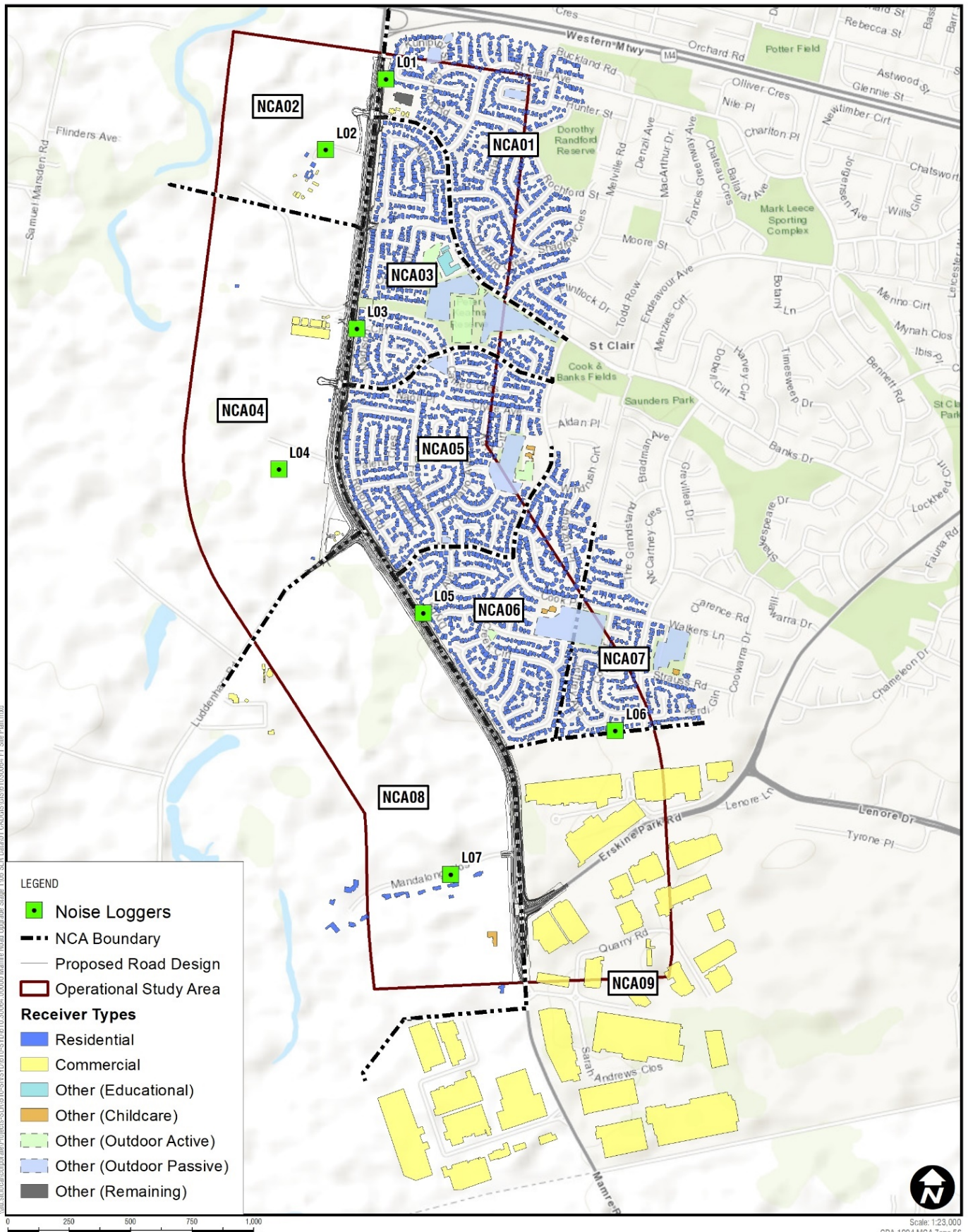


Figure 6-20: Noise catchment areas, sensitive receivers and noise monitoring locations (SLR, 2021b)

Background noise levels

Existing noise levels in the proposal area are generally dominated by road traffic noise from Mamre Road and the surrounding road network, with some influence from the M4 Motorway at the northern end of the proposal area. The noise monitoring results of the existing noise levels are summarised in Table 6-40. The background noise levels are represented as 'rating background noise levels' (RBLs) which refer to the median value of background noise levels measured across the monitoring period, the 'L_{Aeq}'.

Table 6-40: Unattended noise monitoring results

ID	Address	Background Noise (RBL)		
		Day	Evening	Night
L01	45 Kunipipi St, St Claire	58	52	44
L02	181-275 Mamre Rd, Orchard Hills	47	47	39
L03	69 Madison Ct, St Clair	56	49	35
L04	341-347 Mamre Rd, Orchard Hills	43	42	34
L05	24 Dryberry Ave, St Clair	50	41	35
L06	43 Corio Dr, St Clair	39	38	36
L07	25-31 Mandalong Cl, Orchard Hills	41	42	35

6.7.3 Criteria

Construction

Construction noise assessment periods

The assessment time periods that were adopted in the assessment are derived from the ICNG and summarised in Figure 6-21.

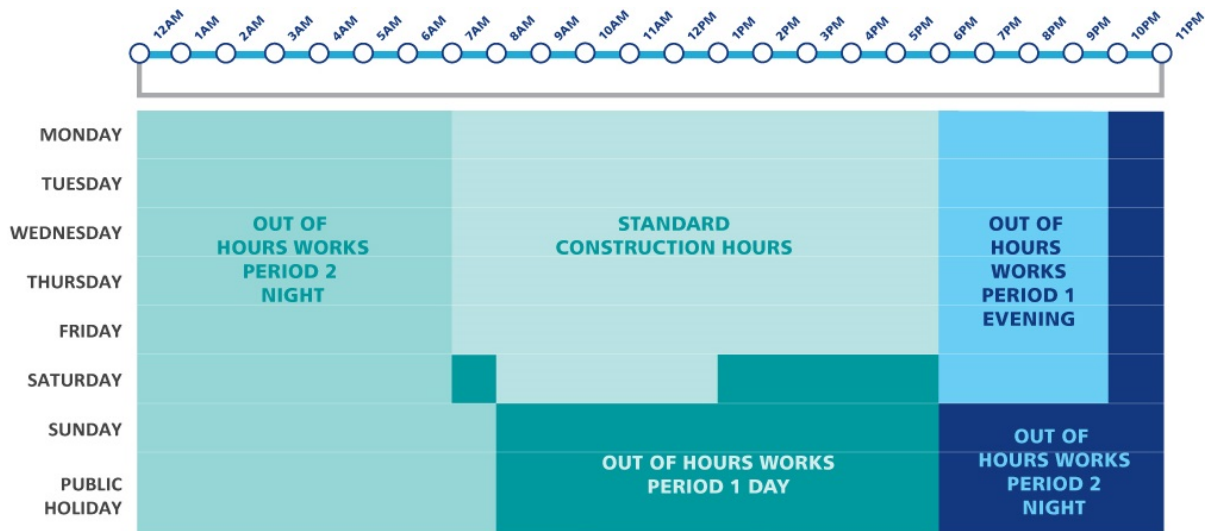


Figure 6-21: Standard Construction Hours^{1, 2, 3}

Note 1: Taken from the Transport for NSW Construction Noise and Vibration Strategy.

Note 2: Standard Construction Hours are Monday to Friday 7 am to 6 pm and Saturdays from 8 am to 1 pm, as defined in the ICNG.

Note 3: Work outside of Standard Construction Hours is defined as ‘Out-of-Hours Work’ (OOHW) and can be divided into two periods of sensitivity. OOHW Period 1 which relates to evening (and weekend daytime) work, and OOHW Period 2 which relates to night-time (and weekend evening) work.

Construction noise criteria

The ICNG requires project-specific Noise Management Levels (NMLs) to be established for noise-affected receivers. The residential NMLs for the proposal have been determined based on the RBLs (see Table 6-41) as defined in the *Noise Policy for Industry* (NPfI; NSW EPA, 2017) plus an additional allowance of 10 dB during the standard work hours and 5 dB outside of standard hours. Noise impacts that exceed the NMLs have been assessed using the perception categories taken from the CNVG as per Table 6-41.

Table 6-41: NML Exceedance Bands and Corresponding CNVG Perception Categories

CNVG Perception Categories	Daytime –Standard Construction Hours	Out of Hours Periods
	NML Exceedance	NML Exceedance
Noticeable	Applicable for construction noise levels of 5-10 dB above RBL	1 to 5 dB
Clearly Audible	1 to 10 dB	6 to 15 dB
Moderately Intrusive	11 dB to 20 dB	16 dB to 25 dB
Highly Intrusive	>20 dB	>25 dB

The ICNG also states that where construction noise levels are above 75 dBA at residential receivers during standard hours, they are considered ‘highly noise affected’ and require additional consideration in terms of noise mitigation and management measures. The NMLs for residential receivers presented in Table 6-42.

Maximum noise levels generated by road traffic noise have the potential to cause disturbance to sleep. Residential sleep disturbance screening criteria has been established for each NCA and are provided in Table 6-42.

Table 6-42: Residential Receiver Construction Noise Management Levels

NCA	Representative Background Monitoring Location	Noise Management Level ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Criteria (RBL +15 dB)
		Standard Construction (RBL +10 dB)	Out of Hours (RBL +5 dB)			
			Daytime	Daytime	Evening	
NCA01	L01	68	63	57	49	59
NCA02	L02	57	52	52	44	54
NCA03	L03	66	61	54	40	50
NCA04	L04	53	48	47	39	49
NCA05	L05	60	55	46	40	50
NCA06	L05	60	55	46	40	50
NCA07	L06	49	44	43	41	51
NCA08	L07	51	46	46	40	50
NCA09	L07	51	46	46	40	50

Note: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

NMLs for ‘other sensitive’ receivers have been determined using the ICNG and are presented in Table 6-43. The ICNG references *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* for criteria for ‘other sensitive’ receivers that are not listed in the guideline, which are presented Table 6-44.

Table 6-43: ICNG NMLs for ‘Other Sensitive’ Receivers

Land Use	NML $L_{Aeq(15minute)}$
Classrooms at schools and other education institutions	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants)	External noise level 65 dBA
Passive recreation areas (characterised by recreational activities that generate little noise and where benefits are compromised by external noise intrusion)	External noise level 60 dBA

Land Use	NML $L_{Aeq(15minute)}$
Commercial	External noise level 70 dBA

Note: As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are 10 dB higher than the corresponding internal level, which is representative of windows being partially open to provide ventilation.

Table 6-44: AS2107 NMLs for 'Other Sensitive' Receivers

Use	Period	AS2107 Classification	Noise Management Level $L_{Aeq(15minute)}$
Hotel	Daytime and evening	Bars and lounges	Internal noise level 50 dBA
	Night-time	Sleeping Areas: - Hotels near major road	Internal noise level 40 dBA
Childcare Centre	Daytime	n/a	Internal noise level 40 dBA

Note: These receivers are assumed to have openable windows with a 10 dB reduction for external to internal noise levels.

Construction traffic noise

The potential impacts from construction traffic associated with the proposal when travelling on public roads are assessed under the NSW EPA *Road Noise Policy* (RNP) (DECCW, 2011) and CNVG. An initial screening test was first applied to evaluate whether existing road traffic noise levels were expected to increase by more than 2.0 dB because of construction traffic. Where this was considered likely, further assessment was required using the RNP and NCG (Table 6-45).

Table 6-45: RNP/NCG Criteria for Assessing Construction Traffic on Public Roads

Road category	Type of project/Land Use	Assessment Criteria (dBA)	
		Daytime (7am – 10pm)	Night-time (10pm – 7am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

Construction vibration

Construction vibration impacts have been assessed using the CNVG minimum working distances for human comfort, building contents and structural/cosmetic damage.

Human comfort vibration

People can sometimes perceive vibration impacts when vibration generating construction work is located close to occupied areas and buildings. The EPA's *Assessing Vibration: a technical guideline* (DEC, 2006) was used to determine the criteria for intermittent vibration based on the Vibration Dose Value (VDV).

Structural damage criteria

If vibration from construction works is sufficiently high, it can cause cosmetic damage to structural elements of affected buildings. Industry standard cosmetic damage vibration limits are specified in British Standard *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* (BS 7385; BSI, 1993) and German Standard *DIN 4150: Part 3-2016 Structural vibration – Effects of vibration on structures* (DIN 4150; Deutsches Institute fur Normung, 1999).

Heritage listed buildings and structures should be considered on a case-by-case basis but as noted in BS 7385 should not be assumed to be more sensitive to vibration, unless structurally unsound. Where a heritage building is deemed to be sensitive, the more stringent DIN 4150 Group 3 guideline values can be applied.

Minimum Working Distances for Vibration Intensive Work

Minimum working distances for typical vibration intensive construction equipment are provided in the CNVG and are shown in Table 6-46. The minimum working distances are for both human comfort (from the NSW EPA Vibration Guideline) and cosmetic damage (from BS 7385 and DIN 4150). They suggest that where work is further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 6-46: Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	15 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
	>300 kN (>18 tonne)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 tonne excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 tonne excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1600 kg (18 to 34 tonne excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

More information about construction vibration criteria can be found in Section 3.1.4 of the noise and vibration assessment included in Appendix J to the REF.

Operations

Operational noise

The RNP (DECCW, 2011) is used to assess and manage potential noise impacts from new and redeveloped road projects. This assessment is undertaken with guidance from the NCG (Roads and Maritime Services, 2015a), which is TfNSW's interpretation of the RNP and provides a consistent approach to identifying road noise criteria for infrastructure projects.

The NCG criteria for residential receivers are shown in Table 6-47 and the NCG criteria for 'other sensitive' receivers are shown in Table 6-48. The NCG does not consider commercial and industrial receivers as being sensitive to operational road traffic noise impacts.

Table 6-47: NCG Criteria for Residential Receivers

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7am – 10pm)	Night-time (10pm – 7am)
Freeway/arterial/sub-arterial roads	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	L _{Aeq} (15 hour) 60 (external)	L _{Aeq} (9 hour) 55 (external)
	6. Existing residences affected by increases in traffic noise of 12 dB or more from redevelopment of existing freeway/arterial/sub-arterial roads	Between L _{Aeq} (15hour) 42-60 (external)	Between L _{Aeq} (9hour) 42-55 (external)
Local roads	8. Existing residences affected by noise from redevelopment of existing local roads	L _{Aeq} (1 hour) 55 (external)	L _{Aeq} (1 hour) 50 (external)

Table 6-48: NCG Criteria for Other Sensitive Receivers

Existing Sensitive Land Use	Assessment Criteria (dB)	
	Daytime (7am – 10pm)	Daytime (7am – 10pm)
1. School classrooms	L _{Aeq} (1 hour) 40 (internal)	-
2. Hospital wards	L _{Aeq} (1 hour) 35 (internal)	L _{Aeq} (1 hour) 35 (internal)
3. Places of worship	L _{Aeq} (1 hour) 40 (internal)	L _{Aeq} (1 hour) 40 (internal)
4. Open space (active use)	L _{Aeq} (15 hour) 60 (external)	-
5. Open space (passive use)	L _{Aeq} (15 hour) 55 (external)	-
6. Childcare facilities	Sleeping rooms L _{Aeq} (1 hour) 35 (internal) Indoor play areas L _{Aeq} (1 hour) 40 (internal) Outdoor play areas L _{Aeq} (1 hour) 55 (internal)	-
7. Aged care facilities	-	-

Note: refer to Section 3.2.1 of Appendix J in the REF for further detail.

The NMG provides guidance to control road traffic noise and describes the principles to be applied when reviewing noise mitigation for predicted exceedances of the adopted NCG criteria.

The NMG provides three triggers where receivers may qualify for considerations of ‘additional noise mitigation’:

- **Trigger 1** – the predicted noise level with the proposal exceeds the NCG controlling criterion and the noise level increase due to the proposal (i.e. the noise predictions for with the proposal minus without the proposal) is greater than 2.0 dB
- **Trigger 2** – the predicted noise level with the proposal is 5 dB or more above the NCG controlling criterion (i.e. exceeds the cumulative limit) and the receiver is significantly influenced by project road noise, regardless of the incremental impact of the proposal
- **Trigger 3** – the noise level contribution from the road project is acute (daytime LAeq(15hour) 65 dBA or higher, or night-time LAeq(9hour) 60 dBA or higher) even if noise levels are controlled by a non-project road.

The eligibility of receivers for consideration of ‘additional noise mitigation’ is determined before mitigation measures such as low noise pavement and noise barriers are included. The requirement for the proposal is to provide feasible and reasonable additional mitigation to eligible receivers with the aim of meeting the NCG controlling criterion.

Maximum noise level

The RNP and *Environmental Noise Management Manual* (ENMM) (Roads and Traffic Authority, 2001) both require a maximum noise level assessment to be undertaken for new and redeveloped road infrastructure projects. Its purpose is to determine where maximum noise levels are likely to change because of a proposal.

The maximum noise level assessment included an evaluation of the number and distribution of night-time events in accordance with the ENMM. A maximum noise level event is defined as being any pass-by where:

- The maximum noise level of the event is greater than 65 dBA L_{aFmax}
- and
- The $L_{AFmax} - L_{Aeq(1hour)}$ is greater than or equal to 15 dB.

6.7.4 Potential impacts

Construction

Construction noise impacts for residential receivers

Table 6-49 to Table 6-52 provide a summary of the predicted worst-case construction noise exceedances for each construction scenario during standard daytime hours, evening out-of-hours and night-time out-of-hours work periods, respectively. NCA09 is not included in these tables as it does not contain any residential receivers. Work in scenarios W.01, W.07 and W.08 is not expected to occur in the daytime out-of-hours, evening out-of-hours and night-time out-of-hours periods and so have been excluded from these tables.

The criteria applied for expected noise exceedances are presented in Table 6-41. The predicted construction noise impacts are presented for the residential receivers within each NCA that have the potential to be the most affected by construction noise from the proposal. Receivers that are further away from the work and/or shielded from view would likely experience lower noise levels and impacts.

The assessment is generally considered conservative as the noise level calculations assume several items of construction equipment are in use at the same time within individual scenarios. In reality, there would frequently be periods when construction noise levels are much lower than the worst-case levels predicted as well as times when no equipment is in use and no noise impacts occur.

These results also represent the worst-case situation where construction equipment is at the closest point to each receiver. For most work, the construction noise impacts would frequently be lower than predicted as the worst-case situation typically only occurs for a relatively short period when noisy equipment is in use nearby.

A detailed overview of the predicted worst-case noise exceedances is available in Section 5.1 in Appendix J to the REF.

Table 6-49: Predicted Worst-case Construction Noise Exceedances – Daytime – Residential Receivers

ID	Scenario	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08
W.01	Site establishment and environmental protection	Clearly audible	No exceedances	Clearly audible	Moderate	Moderate	Moderate	No exceedances	Clearly audible
W.02	Utilities, early work– and earthworks - peak	Moderate	Clearly audible	Moderate	High	High	High	Clearly audible	Moderate
W.03	Utilities, early work– and earthworks - typical	Clearly audible	No exceedances	Clearly audible	Moderate	Moderate	Moderate	No exceedances	Clearly audible
W.04	Road, pathway and intersection upgrades - peak	Moderate	No exceedances	Moderate	High	High	High	Clearly audible	Moderate
W.05	Road, pathway and intersection upgrades - typical	Clearly audible	No exceedances	Clearly audible	Moderate	Moderate	Moderate	No exceedances	Clearly audible
W.06	Compound operation	No exceedances	No exceedances	No exceedances	No exceedances	No exceedances	No exceedances	No exceedances	Clearly audible
W.07	Supporting infrastructure and finishing work	No exceedances	No exceedances	Clearly audible	Clearly audible	Clearly audible	Clearly audible	No exceedances	No exceedances
W.08	Demobilisation	No exceedances	No exceedances	Clearly audible	Moderate	Moderate	Moderate	No exceedances	Clearly audible

Table 6-50: Predicted Worst-case Construction Noise Exceedances – Daytime Out of Hours – Residential Receivers

ID	Scenario	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08
W.02	Utilities, early work– and earthworks - peak	Moderate	Clearly audible	High	High	High	High	Moderate	High
W.03	Utilities, early work– and earthworks - typical	Clearly audible	No exceedances	Moderate	High	Moderate	Moderate	Clearly audible	Moderate
W.04	Road, pathway and intersection upgrades - peak	Moderate	Clearly audible	High	High	High	High	Moderate	Moderate
W.05	Road, pathway and intersection upgrades - typical	Clearly audible	No exceedances	Moderate	Moderate	Moderate	Moderate	Clearly audible	Clearly audible
W.06	Compound operation	No exceedances	No exceedances	No exceedances	Clearly audible	No exceedances	No exceedances	No exceedances	Moderate

Table 6-51: Predicted Worst-case Construction Noise Exceedances (Intrusiveness of Impact) – Evening – Residential Receivers

ID	Scenario	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08
W.02	Utilities, early work– and earthworks - peak	Moderate	Clearly audible	High	High	High	High	Moderate	Moderate
W.03	Utilities, early work– and earthworks - typical	Clearly audible	No exceedances	Moderate	High	High	High	Noticeable	Clearly audible
W.04	Road, pathway and intersection upgrades - peak	Moderate	Noticeable	High	High	High	High	Clearly audible	Moderate
W.05	Road, pathway and intersection upgrades - typical	Clearly audible	No exceedances	Moderate	Moderate	High	High	Noticeable	Clearly audible
W.06	Compound operation	Noticeable	No exceedances	Clearly audible	Noticeable	Clearly audible	Noticeable	Noticeable	Clearly audible

Table 6-52: Predicted Worst-case Construction Noise Exceedances (Intrusiveness of Impact) – Night-time – Residential Receivers

ID	Scenario	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08
W.02	Utilities, early work– and earthworks - peak	High	Moderate	High	High	High	High	Moderate	High
W.03	Utilities, early work– and earthworks - typical	Moderate	Clearly audible	High	High	High	High	Clearly audible	Moderate
W.04	Road, pathway and intersection upgrades - peak	High	Clearly audible	High	High	High	High	Clearly audible	Moderate
W.05	Road, pathway and intersection upgrades - typical	Moderate	Noticeable	High	High	High	High	Noticeable	Moderate
W.06	Compound operation	Clearly audible	Noticeable	Moderate	Clearly audible	Clearly audible	Clearly audible	Noticeable	Moderate

Standard construction noise impacts

The highest noise levels and impacts would be experienced by residential receivers in NCA03, NCA04, NCA05 and NCA06, as the residential receivers in these NCAs would be relatively close to construction work. Residential receivers in NCA01, NCA02, NCA07 and NCA08 are further away from the proposal and so predicted noise impacts for these NCAs are lower. No exceedances are predicted in NCA09 as this area is commercial. Indicative worst-case noise impacts for construction activities during '*W.02 – Utilities, early works and earthworks – peak*' (Daytime) are shown in Figure 6-22.

'Highly Intrusive' daytime impacts are predicted at the nearest residential receivers to the east and isolated nearby residential receivers to the west, during '*W.02 – Utilities, early works and earthworks – peak*' and '*W.04 – Road, pathway and intersection upgrades – peak*' when noise intensive equipment, such as a concrete saw, would be used. Noise levels at these nearest receivers during other quieter scenarios are generally predicted to result in 'Moderately Intrusive' or 'Clearly Audible' worst-case impacts.

The daytime impacts in the other NCAs where receivers are further away are predicted to range from 'Moderately Intrusive' to 'Clearly Audible' during the noisier scenarios. These NCAs would be compliant with the management levels during less noise generating activities.

Out-of-hours works (evening and night-time) noise impacts

During the night-time, 'Highly Intrusive' noise impacts are predicted at the nearest receivers to the east and west, in NCA01 – NCA06 and NCA08, when nearby noisy work is being completed during the following scenarios:

- '*W.02 – Utilities, early works and earthworks – peak*'
- '*W.03 – Utilities, early works and earthworks – typical*'
- '*W.04 – Road, pathway and intersection upgrades – peak*'
- '*W.05 – Road, pathway and intersection upgrades – typical*'.

The worst-case night-time noise levels are predicted to be around 85 dB at the nearest receivers to the east in NCA03 to NCA06 when noise intensive equipment is being used as part of '*W.02 – Utilities, early works and earthworks – peak*'. When noise intensive equipment is not being used during this scenario the noise levels are expected to be substantially lower, with worst-case levels of 75 dBA predicted during '*W.03 – Utilities, early works and earthworks – typical*'.

The worst-case night-time impacts at receivers which are further away are generally predicted to be 'Moderately Intrusive' during noisy work and 'Clearly Audible' or 'Noticeable' during less noise generating activities. Indicative worst-case noise impacts for construction activities during '*W.02 – Utilities, early works and earthworks – peak*' (Night-time) are shown in Figure 6-23.

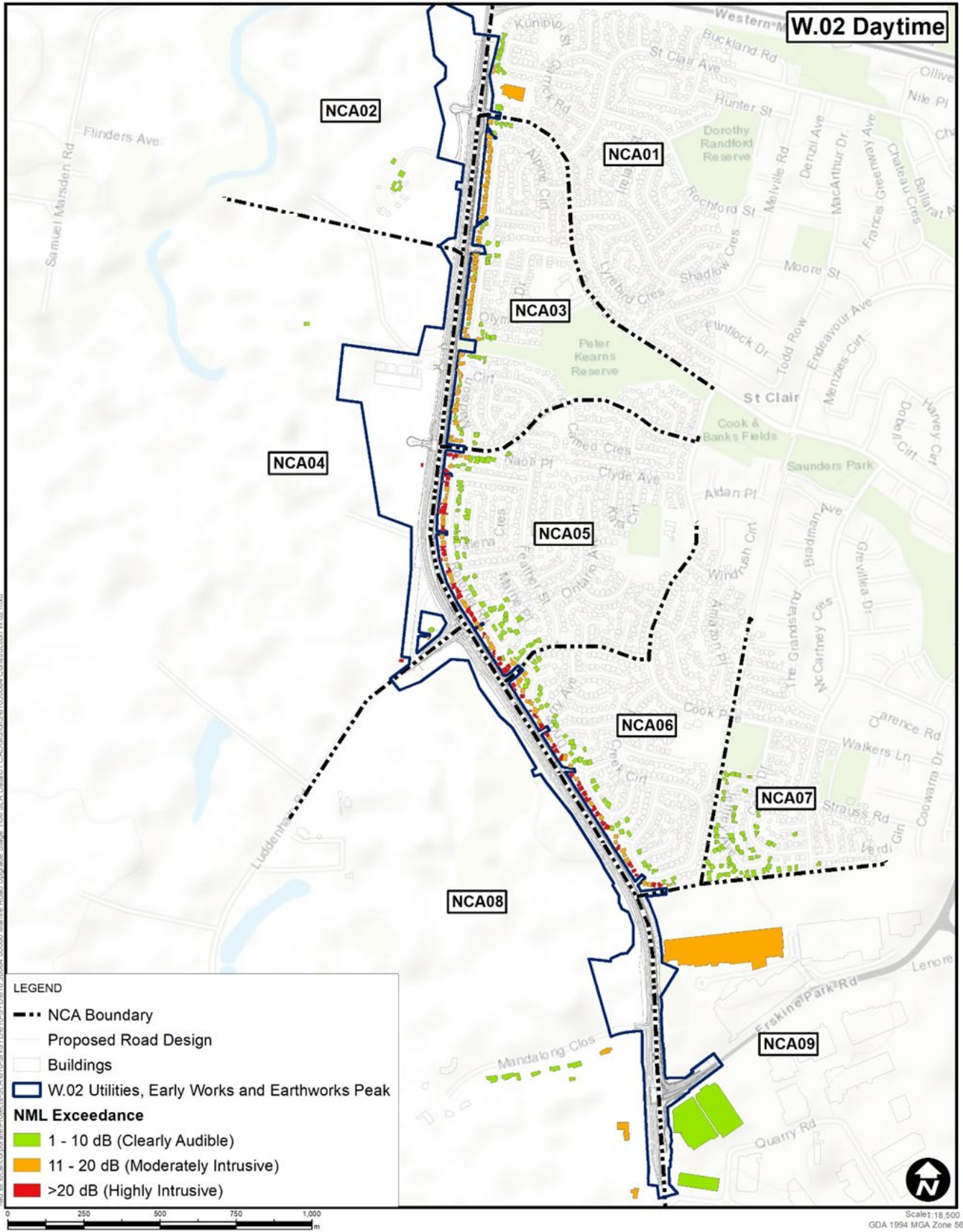


Figure 6-22: Indicative worst-case noise impacts – W.02 daytime

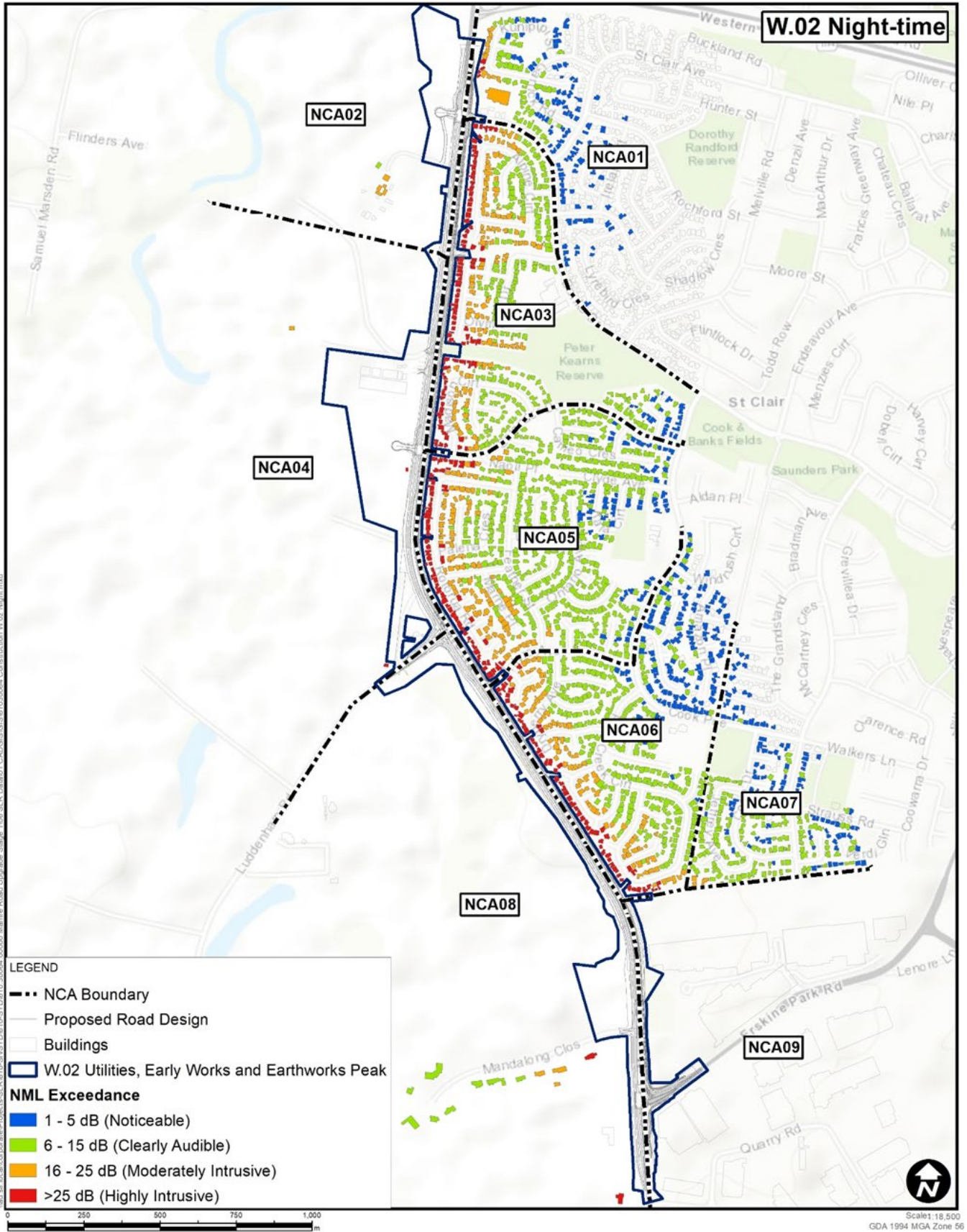


Figure 6-23: Indicative worst-case noise impacts – W.02 night-time

Highly Noise Affected Residential Receivers and Sleep Disturbance

Residential receivers that are subject to noise levels of 75 dBA or greater are considered Highly Noise Affected by the ICNG (DECC, 2009). Front-row residential receivers to the east of Mamre Road in NCA03, NCA05 and NCA06 are predicted to be Highly Noise Affected when noise intensive work is being carried out nearby. The highest noise levels would only likely be noticeable for relatively short periods.

The number of residential receivers which could potentially be Highly Noise Affected during the worst-case impacts is summarised in Table 6-53 and shown in 6-24Figure 6-24. The predictions assume the individual scenarios are occurring at all locations across the proposal area.

A sleep disturbance screening assessment has been prepared for the construction work and a summary is presented in Appendix C in Appendix J to the REF. Review of the predictions shows that the sleep disturbance screening criterion is likely to be exceeded when night work occurs near residential receivers. The receivers which would potentially be affected by sleep disturbance impacts are generally the same receivers where night-time impacts have been predicted, as identified in this section.

Table 6-53: Highly Noise Affected Residential Receivers (from any work scenario)

ID	Scenario	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09
W.01	Site establishment and environmental protection	-	-	-	-	-	-	-	-	-
W.02	Utilities, early work– and earthworks - peak	4	-	62	2	47	45	-	-	-
W.03	Utilities, early work– and earthworks - typical	-	-	2	-	3	-	-	-	-
W.04	Road, pathway and intersection upgrades - peak	4	-	36	1	33	31	-	-	-
W.05	Road, pathway and intersection upgrades - typical	-	-	1	-	-	-	-	-	-
W.06	Compound operation	-	-	-	-	-	-	-	-	-
W.07	Supporting infrastructure and finishing work	-	-	-	-	-	-	-	-	-
W.08	Demobilisation	-	-	-	-	-	-	-	-	-
W.09	Site establishment and environmental protection	-	-	-	-	-	-	-	-	-

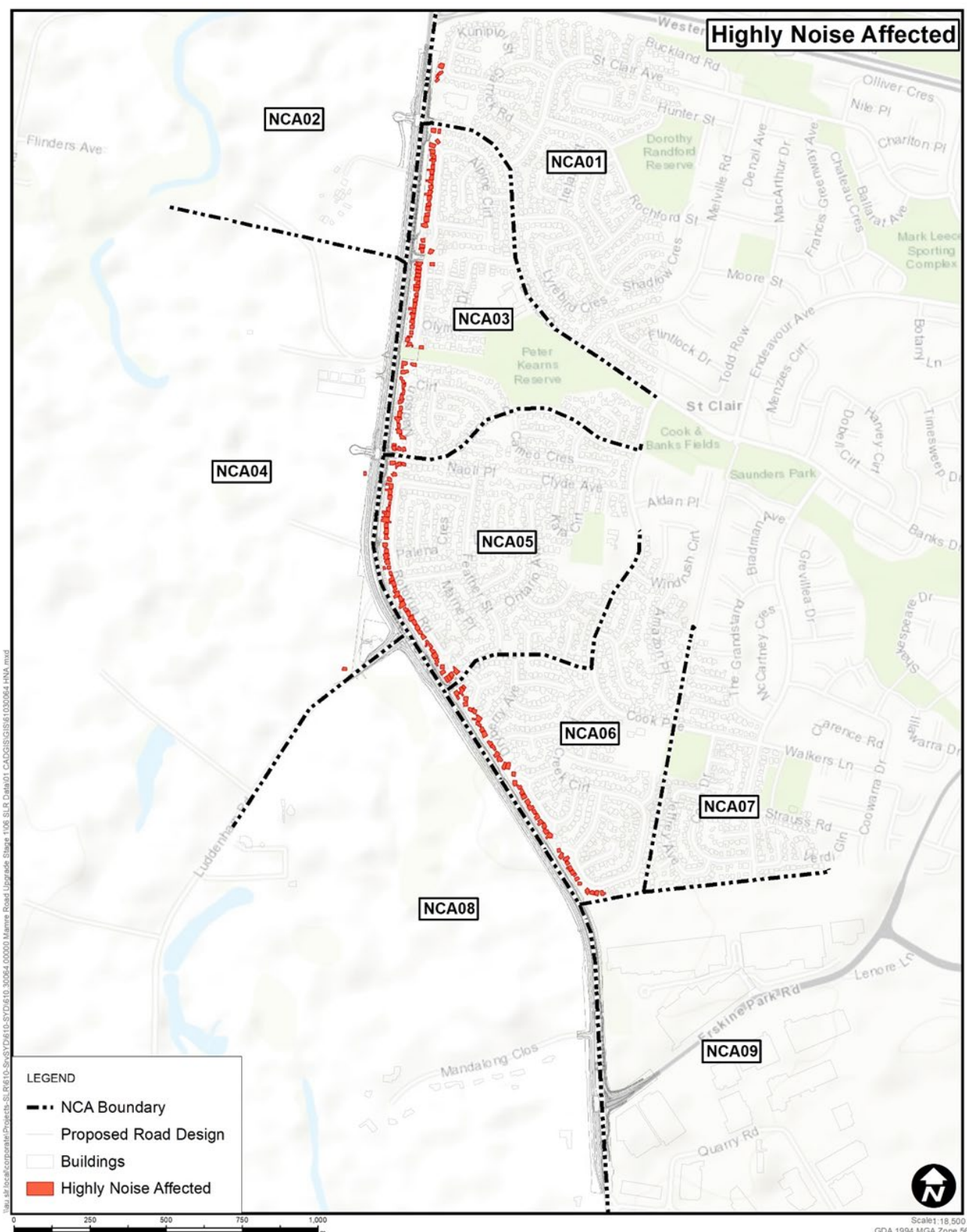


Figure 6-24: Highly Noise Affected Residential Receivers (from any work scenario)

Commercial/Industrial and 'Other Sensitive' Receivers

A summary of the predicted construction noise impacts in each NCA for commercial/industrial and 'other sensitive' receivers is presented in Table 6-54. This table excludes scenarios W.06 and W.07 and outdoor areas during the daytime as no exceedances are expected.

The assessment shows that 'Clearly Audible' or 'Moderately Intrusive' worst-case impacts are predicted at the nearest 'other sensitive' and commercial receivers when noisy work is nearby.

Table 6-54: Overview of Commercial/Industrial and 'Other Sensitive' Receiver NML Exceedances, indicating number of receiver buildings affected

ID	Scenario	Old MacDonald's Childcare Centre, Daytime		Blue Cattle Dog Hotel, When in use		Commercial/Industrial, When in use	
		1-10 dB	11-20 dB	1-10 dB	11-20 dB	1-10 dB	11-20 dB
W.01	Site establishment and environmental protection	Clearly audible (1 receiver building)	No exceedances	Clearly audible (1 receiver building)	No exceedances	No exceedances	No exceedances
W.02	Utilities, early work– and earthworks - peak	No exceedances	Moderate (1 receiver building)	No exceedances	Moderate (1 receiver building)	Clearly audible (5 receiver buildings)	Moderate (2 receiver buildings)
W.03	Utilities, early work– and earthworks - typical	Clearly audible (1 receiver building)	No exceedances	Clearly audible (1 receiver building)	No exceedances	Clearly audible (1 receiver building)	No exceedances
W.04	Road, pathway and intersection upgrades - peak	No exceedances	Moderate (1 receiver building)	Clearly audible (1 receiver building)	No exceedances	Clearly audible (6 receiver buildings)	No exceedances
W.05	Road, pathway and intersection upgrades - typical	Clearly audible (1 receiver building)	No exceedances	Clearly audible (1 receiver building)	No exceedances	No exceedances	No exceedances
W.08	Demobilisation	Clearly audible (1 receiver building)	No exceedances	No exceedances	No exceedances	No exceedances	No exceedances

Construction traffic

Construction of the proposal would generate additional road traffic noise from construction vehicles, particularly along the proposed haulage routes, including Mamre Road, Erskine Park Road, Elizabeth Drive and the M4 Motorway.

Daily vehicle movements would average:

- 75 heavy vehicle movements, with a maximum of 100 movements
- 75 light vehicle movements, with a maximum of 100 movements
- 2 oversized movements, with a maximum of 5 movements.

This predicted volume of construction traffic would be relatively low compared to the high existing volumes on major roads in the area (between 17,000 and 32,000 vehicles daily). As such, the potential increase in noise due to construction traffic would be negligible (ie less than 0.1 dB) and is not expected to result in any noticeable traffic noise impacts (which is defined as an increase of greater than 2.0 dB).

Temporary traffic detours

The construction of the proposal would be staged through establishment of alternate traffic arrangements that would generally facilitate one lane of traffic in each direction to allow Mamre Road to remain operational throughout construction.

There is potential for temporarily increased traffic noise impacts where detour routes are along roads with low existing traffic volumes, however, it is noted that the detours would likely only be required for relatively short durations (i.e. a few days), which would limit the extent of any impacts.

The potential noise impacts of any proposed detour routes would be reviewed during preparation of the Construction Noise and Vibration Management Plan.

Construction vibration

The main potential source of vibration during construction would be vibratory rollers. While other items of vibration generating equipment would be required at times during the work, they are expected to be less vibration intensive and this would be the worst-case item of vibration intensive equipment. These would be required during the '*W.04 – Road, pathway and intersection upgrades – peak*' scenario.

Vibration offset distances have been mapped in Figure 6-25. They have been determined from the CNVG minimum working distances for cosmetic damage (20m for a vibratory roller) and human response (100m for a vibratory roller). Receivers would be within the minimum working distance for cosmetic damage in NCA01 – NCA06 and NCA08 – NCA09. These NCAs include residential, commercial/industrial and 'other sensitive' receivers. Mitigation of these impacts would be undertaken. Certain receivers in the proposal area would also be within the human comfort minimum working distance. Occupants of affected buildings may be able to perceive vibration impacts at times when vibration intensive equipment is in use.

No heritage buildings or structures that have been identified in the proposal area are within the cosmetic damage minimum working distance (ie 40 metres). It is noted that Marsden Memorial Cairn would be directly impacted by the construction of the proposal and would be relocated to an appropriate location within Mamre House as part of the work.

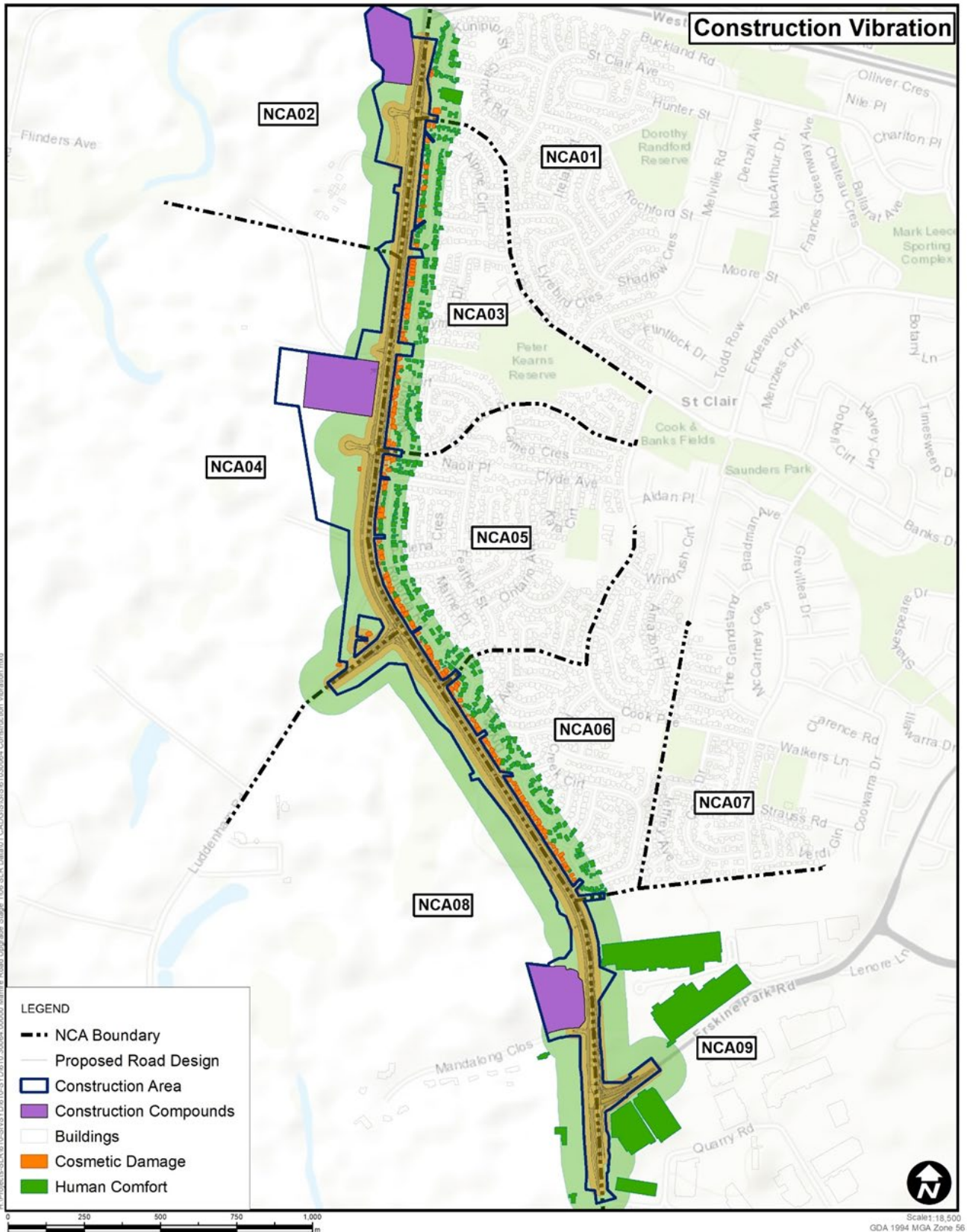


Figure 6-25: Construction Vibration Assessment – Vibratory Roller Large used as part of 'W.04 – Road, pathway and intersection upgrades – peak'

Operation

Traffic noise levels for each NCA were modelled for the four scenarios – with and without the proposal in both 2026 and 2036 – as described in Section 6.7.1. These traffic noise levels were compared against the operational noise criteria presented in Section 6.7.3.

Residential receivers

Table 6-55 summarises the predicted worst-case operational road noise levels for each NCA and assessment scenario.

Receivers are generally most affected by the proposal in the night-time period in 2036. This is because there is expected to be more traffic in 2036 than 2026 and the criteria is more stringent in the night-time period. Therefore, this scenario is considered to control the assessment in terms of determining the worst-case impacts and requirements for mitigation.

The predicted operational noise levels for the night-time scenario during operation of the proposal in 2036 are shown in Figure 6-26. The predicted change in noise levels from operation of the proposal compared to the scenario without the proposal in 2036 is shown in Figure 6-27.

These results show that operation of the proposal is not predicted to substantially alter road traffic noise levels in the noise study area. It is noted that the nearest residential receivers to the proposal, particularly receivers to the east of Mamre Road in NCA01, NCA03, NCA05 and NCA06, are subject to relatively high existing road traffic noise levels, which already exceed the NCG criterion in many cases.

No residential receivers are expected to experience increases in traffic noise of greater than 2.0 dB. Noise levels are predicted to increase the most to the west of Mamre Road in NCA02, NCA04 and NCA08. This is due to the combination of increased traffic volumes resulting from the proposal and the proposed widening/realignment of Mamre Road generally being to the west. For residential receivers to the west, noise levels are predicted to increase by between 0.5 and 1.5 dB at the receivers, which is not considered a clear change.

The results show that 170 residential receivers would experience an exceedance of the NCG cumulative limit criteria. These exceedances are generally due to relatively high road traffic levels (both with and without the proposal). This is expected to apply to all first-row residential receivers immediately to the east of the project in NCA01, NCA03, NCA05, and NCA06, which are adjacent to Mamre Road. Two isolated residential receivers to the west in NCA04 are also predicted to exceed the cumulative limit criteria. Most front-row residential receivers to the east are also predicted to be subject to acute noise levels (i.e. daytime noise levels are 65 dBA or higher, or night-time noise levels are 60 dBA or higher).

Most residential properties to the east of Mamre Road also have existing private fencing along the boundary with the road corridor, which would likely provide some degree of shielding to the residential receivers themselves. Therefore, the operational noise assessment results are considered conservative. The noise levels experienced at residential receivers to the east of Mamre Road are likely to be lower than predicted, where private boundary fences exist that are in good condition.

Table 6-55: Predicted Road Traffic Noise Levels at Most Affected Residential Receivers in each NCA

NCA	Predicted Noise Level (dBA)								Number of Triggered Buildings (refer to Section 6.7.3 of the REF)			
	At Opening (2026)				Future Design (2036)							
	No build (without project)		Build (with project)		No build (without project)		Build (with project)		Trigger 1 >2.0 dB	Trigger 2 Cumulative	Trigger 3 Acute	Total
	Day	Night	Day	Night	Day	Night	Day	Night				
NCA01	71	67	72	67	73	68	73	68	-	9	9	9
NCA02	61	56	61	57	62	58	62	58	-	-	-	-
NCA03	74	70	74	71	75	71	75	72	-	64	62	64
NCA04	69	65	71	67	71	67	72	68	-	2	2	2
NCA05	75	71	75	71	76	72	76	72	-	49	46	49
NCA06	73	70	74	70	74	70	74	71	-	46	45	46
NCA07	53	49	54	50	54	50	54	50	-	-	-	-
NCA08	61	57	62	58	62	58	63	59	-	-	-	-
NCA09	-	-	-	-	-	-	-	-	-	-	-	-
Total											170	

Note: Daytime and night-time are LAeq(15hour) and LAeq(9hour) noise levels, respectively.

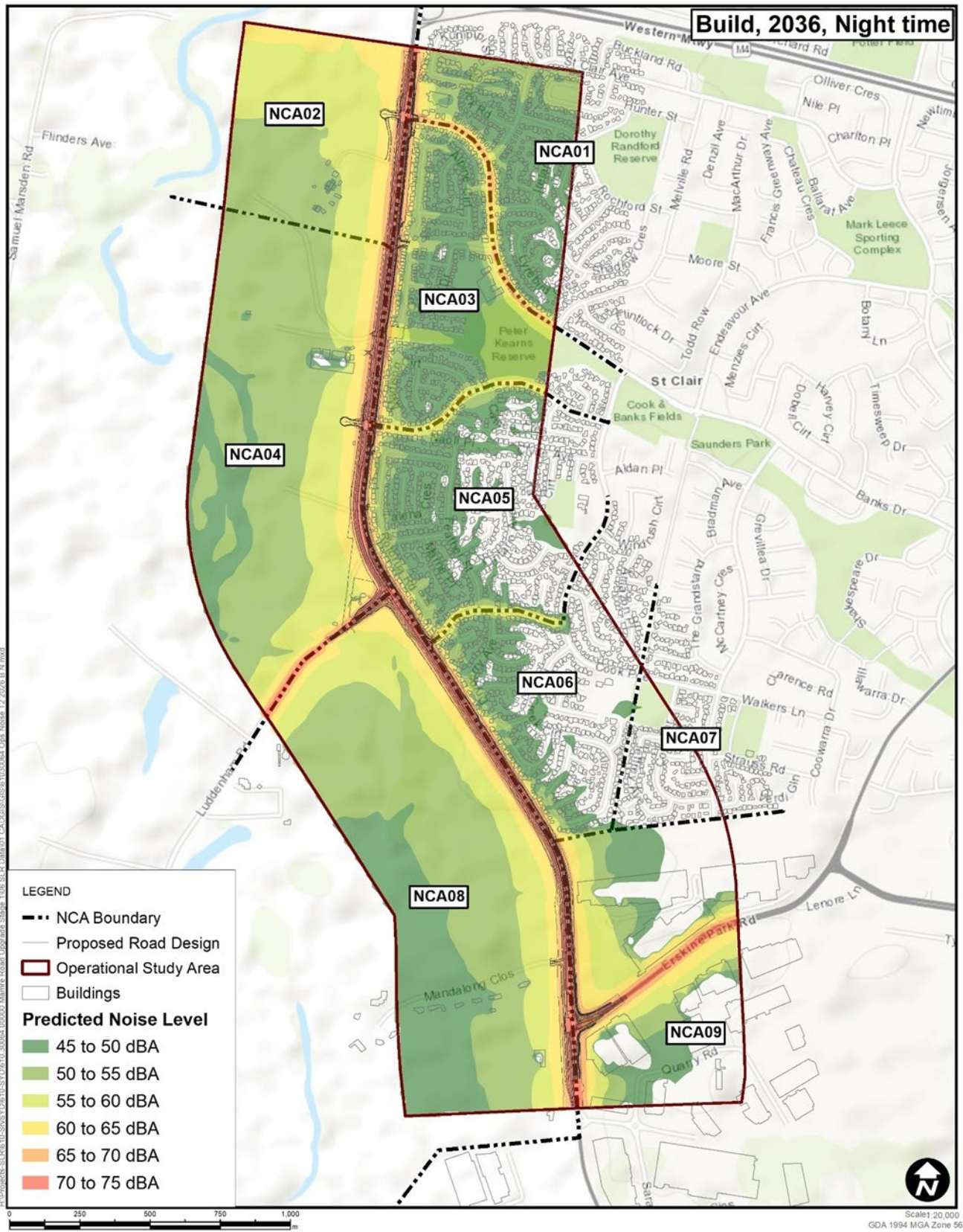


Figure 6-26: Predicted Operational Noise Levels with the Proposal (Night-time Scenario in 2036)
 Note: The contours are free-field.

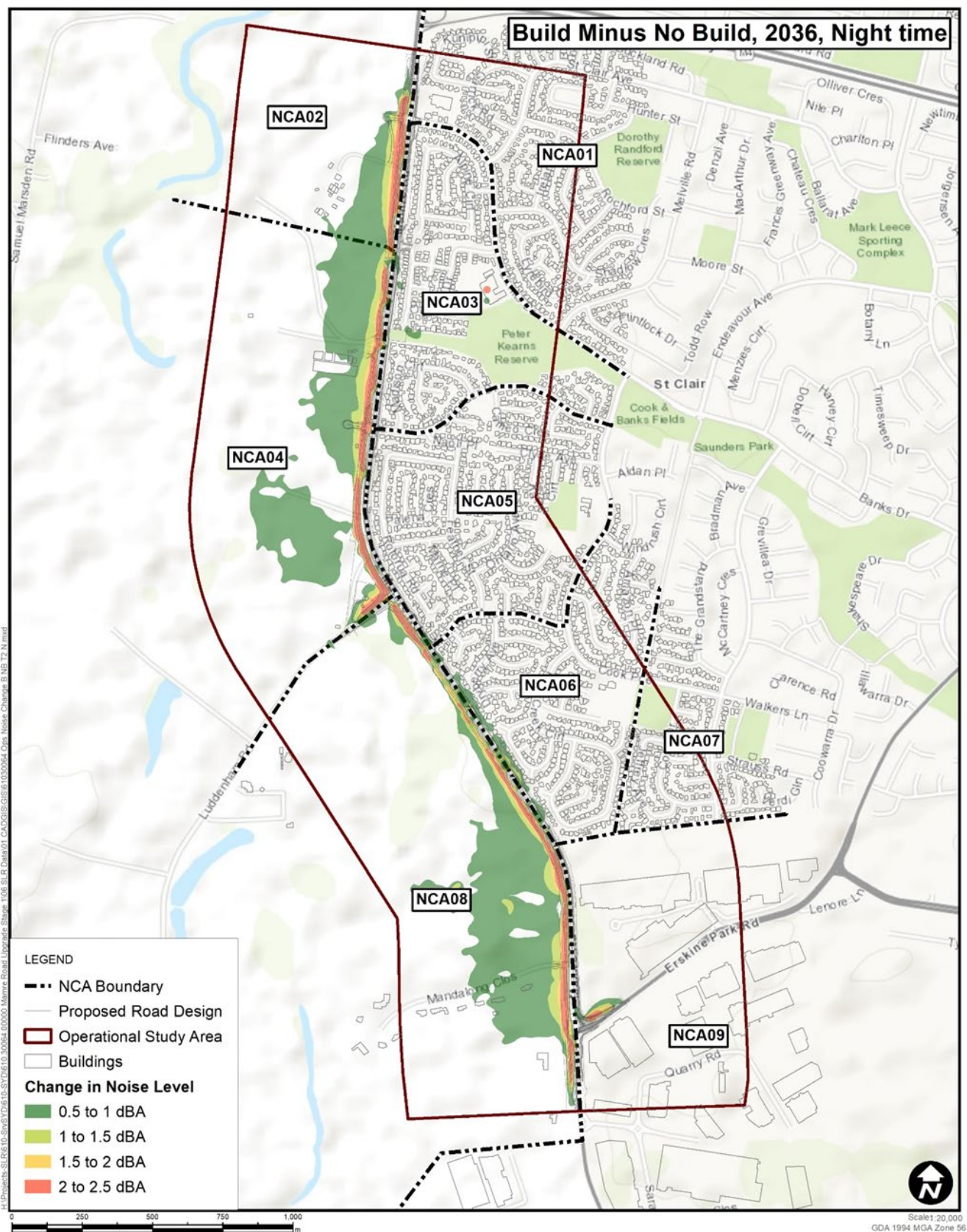


Figure 6-27: Predicted Change in Operational Noise from the Proposal (Night-time Scenario in 2036)

'Other Sensitive' Receivers

The assessment shows that a total of four 'other sensitive' receiver buildings are predicted to have exceedances of the trigger levels for the controlling night-time scenario in 2036 in the operational road traffic noise criteria. The receivers are:

- Blue Cattle Dog Hotel (hotel) – NCA01
- Banks Public School (educational) – NCA03
- Gumbirra Preschool (childcare) – NCA06
- Old MacDonald's Child Care (childcare) – NCA08.

The locations of the triggered 'other sensitive' receivers are shown in Figure 6-28.

It is noted that the criteria for educational and childcare receivers are specified as internal noise levels. As the noise model predicts external noise levels, assumptions have been made regarding the likely facade performance of these receivers. The impacts at 'other sensitive' receivers should be reviewed as the proposal progresses to determine the eligibility of each receiver for noise mitigation measures.

Further details are available in Section 6.2 of Appendix J to the REF.

Receivers Eligible for Consideration of 'Additional Noise Mitigation'

As indicated in the previous two sections, a total of 174 sensitive receiver buildings are predicted to have exceedances of the NCG operational road traffic noise criteria. As such, these receivers are eligible for consideration of 'additional noise mitigation'. This includes 170 residential receivers and four 'other sensitive' receivers. Their locations are mapped in Figure 6-28.

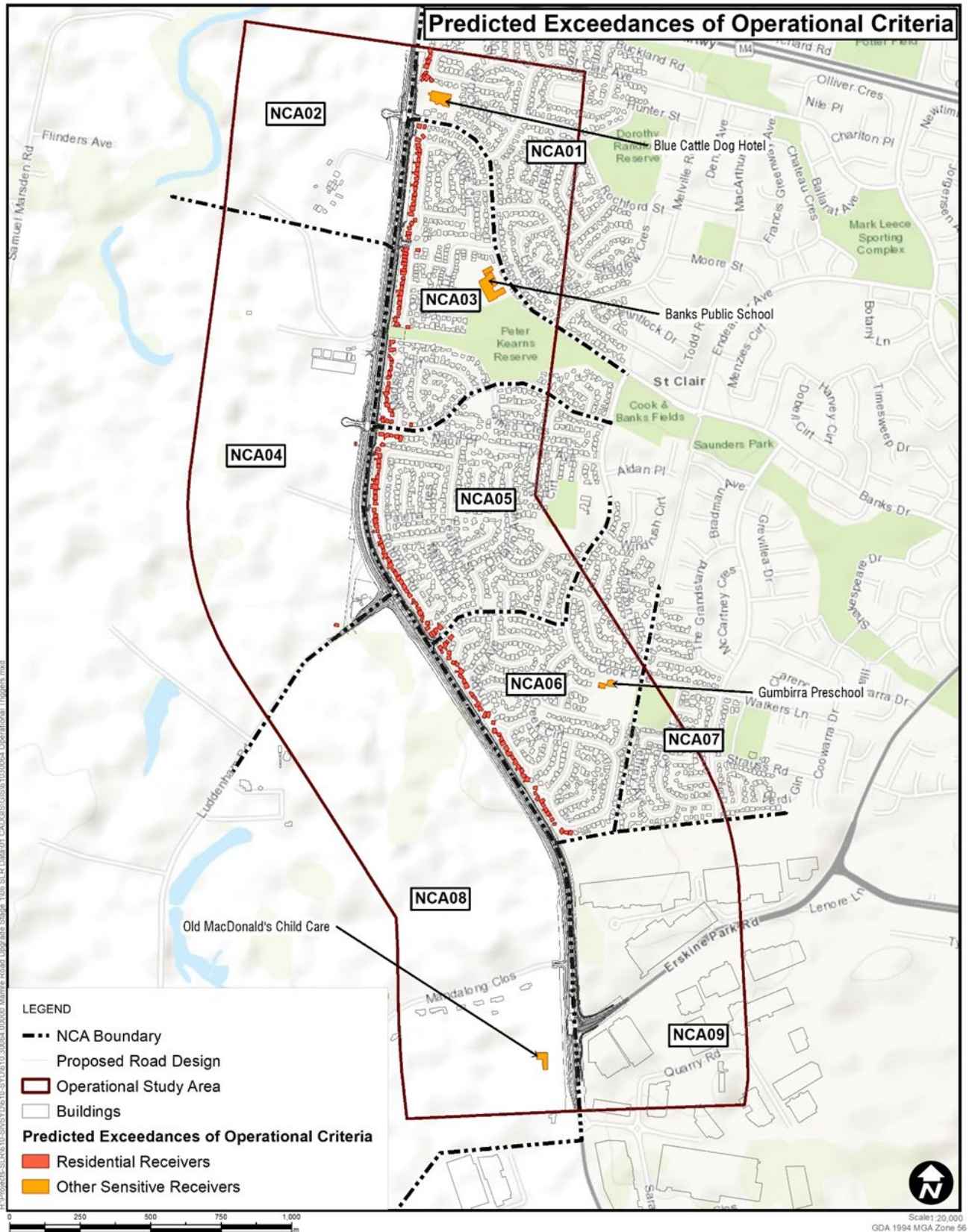


Figure 6-28: Receivers Eligible for Consideration of Additional Mitigation

Maximum Road Traffic Noise Levels

Background road traffic noise levels were presented in Section 6.7.2 of the REF. As the proposal would widen and realign Mamre Road, there is potential for changes to maximum noise level events in the study area due to vehicles being closer to adjacent sensitive receivers. These predicted changes are presented in Table 6-56.

Table 6-56: Predicted Change in Maximum Noise Levels

NCA	Worst-case Change (dB)	Description of change to sensitive receivers
NCA01	0	Negligible change predicted for sensitive receivers
NCA02	0	Negligible change predicted for sensitive receivers
NCA03	3	Alignment of the southbound lanes on Mamre Road is proposed to move up to 10 metres closer to sensitive receivers in this NCA
NCA04	7	The residence opposite Solander Drive is predicted to experience an increase by seven dB due to the alignment of the northbound lanes on Mamre Road moving up to 20 metres closer to this residence. Negligible change in maximum noise levels is predicted at the other sensitive receivers in this NCA which are further from the alignment.
NCA05	3	Alignment of the southbound lanes on Mamre Road moving up to 10 metres closer to sensitive receivers in this NCA
NCA06	2	Alignment of the southbound lanes on Mamre Road moving up to five metres closer to sensitive receivers in this LCA
NCA07	0	Negligible change in maximum noise levels is predicted at sensitive receivers in this NCA
NCA08	1	Horizontal alignment of the northbound lanes on Mamre Road are proposed to move up to 15 metres closer to sensitive receivers in this NCA
NCA09	N/A	No residential receivers are in this NCA (commercial/industrial only)

6.7.5 Safeguards and management measures

Construction noise mitigation options

Construction noise would be managed in accordance with the CNVG, which provides several standard mitigation measures. The CNVG also notes the need to consider additional mitigation measures, where feasible and reasonable, where construction noise is predicted to exceed the NMLs. The CNVG triggers and related recommended types of mitigation measures are presented in Table 34 in Section 7.1.2 of the noise and vibration assessment, included in Appendix J to the REF.

Further detail regarding the implementation of specific safeguards and management measures at sensitive receivers would be confirmed during detailed design and outlined in the Construction Noise and Vibration Management Plan.

Operational noise mitigation options

Road traffic noise levels from infrastructure projects should be reduced, where feasible and reasonable, to meet the NCG noise criteria using mitigation. For receivers that qualify for consideration of ‘additional noise mitigation’, the NMG requires that the potential noise mitigation measures provided in Table 6-57 are to be considered. These would be further investigated during detailed design.

Table 6-57: Noise mitigation options

Mitigation option	Description	Feasibility
At-source mitigation (low noise pavements)	Low noise pavements reduce source noise levels, which provides noise level benefit to both outside areas and internal spaces. Low noise pavements have no associated visual impact and are also likely to provide noise benefits to receivers at greater distances than noise barriers.	Low noise pavements are generally considered feasible to use where there are four or more closely spaced receivers that exceed the operational road traffic noise criteria. Assessment of the potential noise benefit from the use of a low noise pavement on Mamre Road showed that it is not expected to remove any baseline exceedances of the operational road traffic noise criteria. The proposed intersections which require traffic to stop and start and relatively low vehicles speeds would reduce the effectiveness of low noise pavements. As such, low noise pavements are not considered a suitable mitigation for this proposal.

Mitigation option	Description	Feasibility
In-corridor mitigation (noise barriers)	<p>Noise barriers (in the form of walls or mounds) can provide significant noise reductions and reduce both external and internal noise levels. Where space allows, raised earth mounds can be used as noise barriers and can be enhanced by placing a low wall on top. Noise barriers can, however, result in other impacts such as reduced access to property and utilities, visual impacts, overshadowing, changes to drainage, and safety concerns.</p>	<p>Noise barriers are generally considered where there are four or more closely spaced receivers with exceedances of the NMG triggers. All first-row residential receivers to the east of Mamre Road in NCA01, NCA03, NCA05 and NCA06 in St Clair are predicted to experience road traffic noise levels after the proposal is built that exceed the relevant criteria.</p> <p>Noise barriers have been assessed as feasible and reasonable for the proposal. Therefore, the design has proposed the installation of noise walls along the eastern side of Mamre Road near the residential area of St Clair. It is likely that a consistent approach to the noise barrier design would be used across the proposal and noise barriers may be restricted to a maximum height of around 4.5 metres. Refer to Section 7.2.2 of the noise and vibration assessment included in Appendix J to the REF for further details on this mitigation option. Refer to Section 6.8.4 of this REF for details on the potential visual impacts.</p>
At-property mitigation (architectural treatment)	<p>At-property treatment typically involves using architectural treatments to improve building elements such as doors, windows and vents. Installation of boundary acoustic fences or walls close to the receiver can also be considered, which can have the benefit of reducing noise levels in outdoor spaces. The requirements for at-property treatments would be determined using the TfNSW (previously Roads and Maritime) <i>At-Receiver Noise Treatment Guideline</i>. The guideline details the approach for specifying feasible and reasonable at-property treatments for TfNSW road projects.</p>	<p>At-property architectural treatments are considered feasible for properties identified as being eligible for at-property noise mitigation. This would especially be the case for the 160 sensitive receiver floor exceedances which are expected to remain after construction of the proposed noise barriers. These properties should be identified and offered treatment where possible.</p> <p>Refer to Section 7.2.3 of the noise and vibration assessment included in Appendix J to the REF for further details on this mitigation option. Refer to Section 6.8.4 of this REF for details on the potential visual impacts.</p>

Mitigation measures

Table 6-58 provides a list of mitigation measures that would be applied he proposal to manage and minimise noise and vibration impacts.

Table 6-58: Noise and vibration safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Noise and vibration	<p>A Construction Noise and Vibration Management Plan (CNVMP) will be prepared and implemented as part of the CEMP. The CNVMP will generally follow the approach in the <i>Interim Construction Noise Guideline</i> (ICNG) (DECC, 2009) and identify:</p> <ul style="list-style-type: none"> • nearby sensitive receivers • all potential significant noise and vibration generating activities associated with the activity • description of works, construction equipment and hours work would be completed in • results of location- and activity-specific noise and vibration impact assessments • feasible and reasonable mitigation measures to be implemented, taking into account Beyond the Pavement: urban design policy, process and principles (TfNSW, 2020b) • criteria for the proposal and relevant licence and approval conditions • a monitoring program to assess performance against relevant noise and vibration criteria • contingency measures to be implemented in the event of non-compliance with noise and vibration criteria 	Contractor	Detailed design / construction	Early work / main construction work	Section 4.6 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
	<ul style="list-style-type: none"> • arrangements and details for consultation with the community, affected neighbours and sensitive receivers, including notification and complaint handling procedures • details on how respite would be applied where ongoing high impacts are seen at certain receivers. 				
Noise and vibration	<p>All sensitive receivers (e.g. schools, local residents) likely to be affected will be notified at least seven days prior to commencement of any works 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 • how to obtain further information. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Noise and vibration	<p>Location- and activity-specific noise and vibration impact assessments should be carried out, as a minimum, prior to activities:</p> <ul style="list-style-type: none"> • with the potential to result in noise levels above 75 dBA at any receiver • required outside Standard Construction Hours likely to result in noise levels in greater than the relevant NMLs • with the potential to exceed relevant criteria for vibration. <p>The assessments should confirm the predicted impacts at the relevant receivers in the vicinity of the activities to aid the selection of appropriate management measures, consistent with the requirements of the CNVG. The results of these assessments will be included as part of the CNVMP.</p>	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Noise and vibration	Monitoring should be carried out at the start of noise intensive activities to confirm that actual levels are consistent with the predictions and that appropriate mitigation measures from the CNVG have been implemented.	Contractor	Construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Noise	<p>Where noise intensive equipment is to be used near sensitive receivers, the work should be scheduled for Standard Construction Hours, where possible. If it is not possible to restrict the work to the daytime, then they should be completed as early as possible in each work shift.</p> <p>Appropriate respite should also be provided to affected receivers in accordance with the CNVG.</p>	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Noise	<p>Hoarding, or other shielding structures, should be used where receivers are impacted near compounds or fixed work areas with long durations. To provide effective noise mitigation, the barriers should break line-of-sight from the nearest receivers to the work and be of solid construction with minimal gaps.</p>	Contractor	Construction	Main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Vibration	<p>The potential for vibration impacts and requirement for vibration intensive work and equipment will be reviewed during detailed design.</p> <p>Where work is within the minimum working distances and considered likely to exceed the cosmetic damage criteria:</p> <ul style="list-style-type: none"> • Different construction methods with lower source vibration levels will be investigated and implemented, where feasible • Attended vibration measurements will be undertaken at the start of the work to determine actual vibration levels at the item. Work should be ceased if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
Vibration	<p>Building condition surveys should be completed before and after the work where buildings or structures are within the minimum working distances and considered likely to exceed the cosmetic damage criteria during the use of vibration intensive equipment.</p>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
Operational noise mitigation	<p>Operational noise mitigation requirements including the noise wall design and any at-property treatments will be reviewed during detailed design. At-property treatments will be agreed upon and implemented during construction, where feasible and reasonable, in consultation with property owners.</p>	TfNSW / Contractor	Detailed design	N/A	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Noise from temporary detours	The proposal should review the requirement for detours during preparation of the CNVMP when sufficient information is available to allow the potential noise impacts to be determined.	TfNSW	Detailed design / pre-construction	N/A	Additional safeguard

6.8 Landscape character and visual impacts

This section describes the landscape character and visual impacts from the proposal. This section summarises the *Urban design report including landscape character and visual impact assessment* prepared for the proposal by Scape Design that is included in Appendix K.

6.8.1 Methodology

The assessment was carried out in accordance with the *Environmental Impact Assessment Practice Note - Guidelines for Landscape Character and Visual Impact Assessment (EIA-N04) Version 2.0* (TfNSW, 2020g) and urban design guideline *Beyond the Pavement* (TfNSW, 2020b). The methodology for the landscape character and visual impact assessment involved:

- identifying the visual catchment surrounding the proposal (i.e. the approximate area where it would be possible to see the proposal) by considering the surrounding topographical features, built structures and screening vegetation
- identifying and describing landscape character zones (LCZs), which identify areas of similar character within and surrounding the proposal area
- identifying representative viewpoints within the visual catchment
- determining the sensitivity of each LCZ and viewpoint to changes in the landscape, through consideration of the existing quality of the views and type of visual receivers. For example, a pristine natural environment or historic setting would be more sensitive to change than a built-up industrial area
- determining the potential magnitude of change from construction and operation of the proposal for each LCZ and viewpoint, by considering the scale, nature and duration of change
- assessing the potential impacts of the proposal for each LCZ and viewpoint, which combines the level of sensitivity and magnitude of change using a matrix (refer to Figure 6-29). The impact ratings are project specific as they are measured relative to each other rather than at an absolute scale and as such the ratings identify areas within the proposal area with the highest and lowest impacts
- recommending mitigation measures, including urban design principles, to minimise the potential landscape character and visual impacts identified.

The urban design objectives and principles for the proposal have been identified in section 2.3.3 of the REF.

		Magnitude			
		High	Moderate	Low	Negligible
Sensitivity	High	High	High-Moderate	Moderate	Negligible
	Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
	Low	Moderate	Moderate-Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible
		Negligible	Negligible	Negligible	Negligible

Figure 6-29: Landscape character and visual impacts rating matrix

6.8.2 Existing environment

Regional landscape context

The proposal area is located on the Cumberland Plain, a low-lying subregion of the Sydney Basin. The proposal area is characterised by the rolling hills which connect the South Creek/Kemps Creek floodplain to the west of the proposal area with the ridge and low-lying hills to the east. South Creek has been recognised for its scenic significance in the Hawkesbury-Nepean Scenic Quality Study (NSW Department of Urban Affairs and Planning, 1996) and generally mapped as 'scenic protection' under the SREP 20.

Mamre Road divides the urban edge of the residential suburb of St Clair and industrial estates in the east and the rural areas associated with the South Creek corridor to the west. There is a mixed use setting of semi-rural, agricultural and environmental conservation areas, large lot residential development, low density residential housing, industrial estates and public recreation.

There are areas of native vegetation along the Mamre Road corridor and along some areas of adjoining land, particularly around South Creek and north of Erskine Park Drive. There are also views that extend from the road west over the primary production lands to the South Creek corridor and further to the Blue Mountains escarpment. Pedestrian walkways which connect Mamre Road with the residential suburb of St Clair are surrounded by mature vegetation, which limits views of the traffic corridor. Views to the east across the road corridor from the wide grassed drainage channels are mostly open with little existing vegetation and are dominated by the movement of vehicles along the road.



There are known Aboriginal and non-Aboriginal heritage sites within the proposal area which contribute to the region's cultural landscape. The Aboriginal heritage assessment identified 11 Aboriginal sites within the Aboriginal heritage study area (refer to section 6.2). There were also five listed non-Aboriginal heritage items (four locally listed and one State listed) identified as part of the SOHI for this proposal (refer to section 6.3). During the site inspection, there were a number of features that were observed that contribute to the diversity of the urban fabric in the proposal area.



Landscape character zones



To characterise these differences, the landscape has been divided into eight LCZs that have distinct and recognisable features. Table 6-59 describes each zone and its sensitivity to change.



Figure 6-30 shows the location of each LCZ.

Table 6-59: Landscape character zones

Zone	Zone characteristics
<p>LCZ-1 Residential estate</p> 	<p>This zone comprises the low density residential estate of St Clair and extends from the service corridor north to Banks Drive east of Mamre Road.</p> <p>Key features in the zone include houses, residential streets and two wide culverts under Mamre Road. These culverts control runoff that originates from within the estate. There are turfed open areas next to the culverts which are used for passive recreation and provide links to other open spaces within the suburb. They are intermittently lined with stands of established remnant trees and a number of pedestrian paths and bridge crossings.</p>
<p>LCZ-2 Light commercial</p> 	<p>This zone is defined by a mix of commercial premises and extends approximately 100 m along the eastern side of the proposal north from Banks Drive.</p> <p>Commercial signage structures well as the KFC building facade and are prominent visual elements in this character area.</p> <p>Vegetation through this zone is almost completely absent.</p>

Zone	Zone characteristics
<p>LCZ-3 Existing road corridor</p> 	<p>The existing road corridor is a state arterial road asset, which includes a two-lane undivided road with a posted speed limit of 80 kilometres per hour and runs in a north-south direction.</p> <p>The eastern verge of the road, along the St Clair residential estate (LCZ-1), is a wide area of turf and scattered stands of large, established roadside trees, including occasional resident plants.</p>
<p>LCZ-4 Heritage/pastoral</p> 	<p>This zone comprises the Mamre House estate, which is a colonial Georgian homestead in its farm setting, surrounded by farmland and market gardens with distant views to South Creek and the Blue Mountains.</p> <p>Areas of primary production (to the south-west) are open with a mix of grassland and grazing land.</p> <p>Most of the landscape has been cleared for rural use while the western boundary is defined by the densely vegetated South Creek tributary.</p> <p>Scattered remnant vegetation and farm outbuildings are also dotted across the area with most set back from the road corridor.</p>

Zone	Zone characteristics
<p>LCZ-5 Riparian bushland</p> 	<p>This zone comprises heavily vegetated floodplain areas of the Cumberland Plain and is associated with the riparian corridor and tributaries of South Creek.</p> <p>Established native vegetation communities of Alluvial Woodland and Shale Plains Woodland species create a vegetative gateway along Mamre Road (south of Luddenham Road).</p> <p>The watercourse is not visible from the road corridor.</p>
<p>LCZ-6 Rural residential</p> 	<p>This zone contains a semi-rural landscape with large lot residential properties on the southern side of Mandalong Close, a local access road, with no through access.</p> <p>Most of the landscape is not used for intensive agriculture but some areas, especially north of Mandalong Close, are used for low intensity grazing.</p> <p>There is a long day care facility for 131 children with access via Mandalong Close.</p>

Zone	Zone characteristics
<p>LCZ-7 Business Park</p> 	<p>This zone contains a range of large warehouse buildings, manufacturing businesses, factory suppliers, car and truck parking areas, logistics, freight and office spaces and cafe catering.</p> <p>Warehouses are generally surrounded by a mix of mown grass, garden beds, vegetated earth mounds with mature trees and palisade/ chain mesh fences.</p>
<p>LCZ-8 Services corridor</p> 	<p>This zone comprises a 135 m wide electricity transmission easement that runs perpendicular to Mamre Road. Two high voltage networks run along the easement including a 330kV single circuit steel towers and 330kV double circuit steel towers.</p> <p>To the east of Mamre Road, the corridor is mostly open grassland with a fringe of native trees along the northern edge. To the west of Mamre Road, the corridor is mostly scattered bushland.</p>

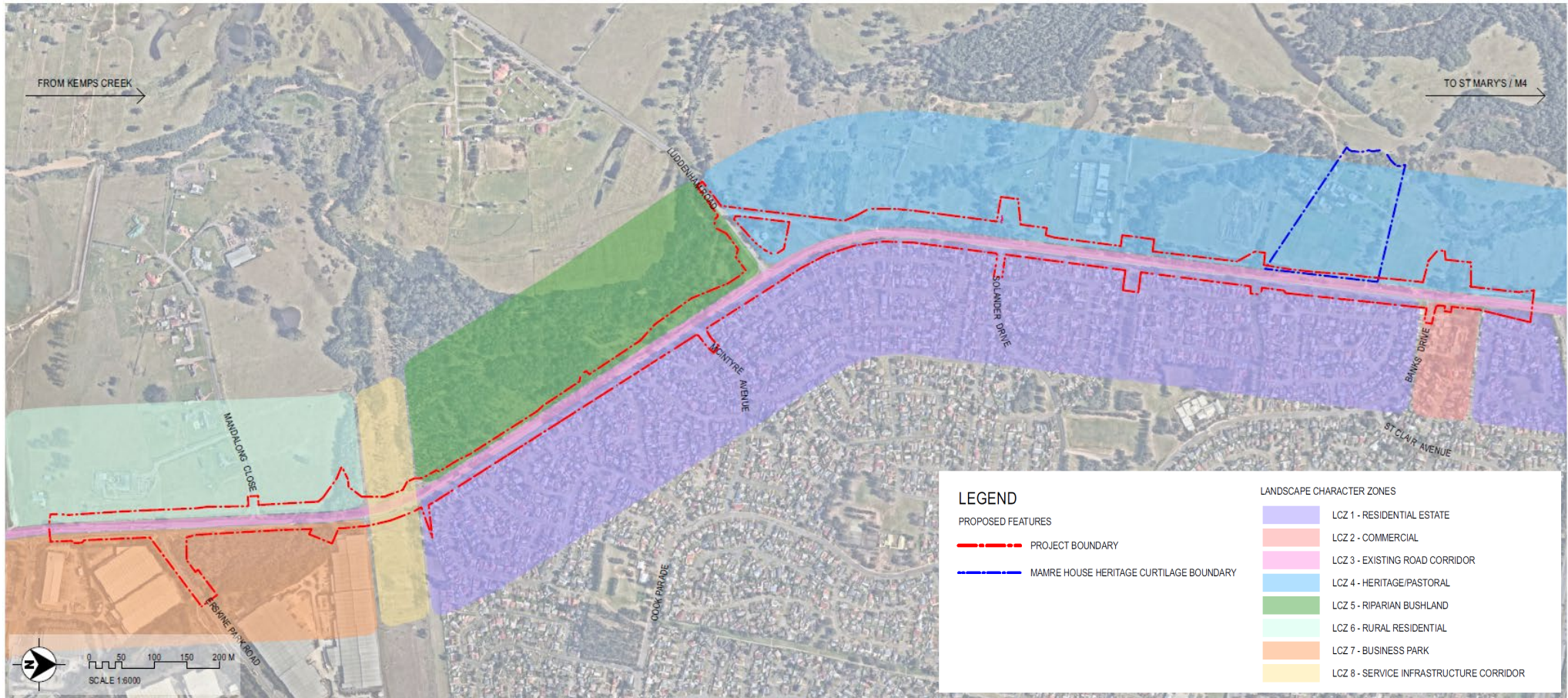


Figure 6-30: Landscape character zones in the proposal area (SCAPE, 2021)

Viewpoints and receivers

The assessment has identified areas where the proposal would be visible. A visual envelope, which is a theoretical assessment of visibility to or from the proposal, is presented in Figure 6-31. It was generated manually during desktop analysis and verified in the field, considering factors such as built structure, vegetation and topography.

Figure 6-32 shows the location of viewpoints selected to assess potential visual impacts including:

- publicly accessible locations that are representative of residential properties and businesses
- heritage items and precincts
- public domain, including footpaths and shared paths
- popular destinations and tourist attractions
- road user views from the existing road.

Table 6-60 provides detail on the location and description of these viewpoints and the potentially affected viewers for each. It does not represent the entire number of receptors likely to be visually impacted by the proposal; however, it represents the range of viewers potentially impacted by some part of the project across each LCZ.



Figure 6-1: Visual envelope mapping

LEGEND

EXISTING FEATURES

-  CADASTRAL BOUNDARY
-  CONTOURS (2M INTERVAL)

VISUAL ENVELOPE

-  APPROXIMATE EXTENT OF VISUAL ENVELOPE

Figure 6-31: Visual envelope mapping



Figure 6-2: Viewpoint locations

LEGEND

VIEWPOINT LOCATIONS










-  3D LOCATION
-  VIEWPOINT 1 - BANKS DRIVE INTERSECTION, MAMRE CURTLAGE AND COMMERCIAL AREA
-  VIEWPOINT 2 - MAMRE HOUSE
-  VIEWPOINT 3 - PEDESTRIAN PORTAL (ALPINE CIRCUIT)
-  VIEWPOINT 4 - FLOODWAY AND DRAINAGE CULVERT
-  VIEWPOINT 5 - SOLANDER INTERSECTION AND SENSITIVE RECEIVER
-  VIEWPOINT 6 - RFS
-  VIEWPOINT 7 - MACINTYRE INTERSECTION AND SENSITIVE RECEIVER
-  VIEWPOINT 8 - MANDALONG INTERSECTION, SPANISH WALL AND BUSHLAND BEHIND
-  VIEWPOINT 9 - MANDALONG SENSITIVE RECEIVER TO NEW ROAD
-  VIEWPOINT 10 - ERSKINE PARK ENTRY STATEMENT AND COMMERCIAL BACKDROP



Figure 6-32: Viewpoint locations



Table 6-60: Summary of representative viewpoints for the proposal

Viewpoint ID	Location and description	Affected viewers
<p>VP1</p> 	<ul style="list-style-type: none"> • This viewpoint is located in the middle of the eastern carriageway, facing south. • The commercial hub, located in the north of St Clair, is partially visible through Casuarina trees while more distant views along the road corridor are occasionally framed by stands of roadside Eucalypts. • Power lines and poles with light fixtures as well as traffic poles with outreach arms are visible above the road carriageway. 	<ul style="list-style-type: none"> • motorists, cyclists and pedestrians travelling on Mamre Road and setback • employees and visitors arriving and departing Mamre House • staff and customers of the nearby commercial hub on Banks Drive • local residents
<p>VP2</p> 	<ul style="list-style-type: none"> • This viewpoint is located about 210 m north-west of the main alignment at the edge of the existing bitumen driveway that runs to the east of Mamre House. • Visitor parking close to the driveway is currently haphazard with large buses often parked directly in front of Mamre House and vehicles scattered over the lawns. • Facing south-east along an original approach route, the foreground of this viewpoint contains a mix of lawn areas, pastoral grassland, market gardens, a dam and scattered remnant Eucalypts. • Longer range views contain the housing in St Clair and traffic moving along Mamre Road. 	<ul style="list-style-type: none"> • employees and visitors to Mamre House • pedestrians and road users on Mamre Road

Viewpoint ID	Location and description	Affected viewers
<p>VP3</p>  <p>The photograph shows a paved road with a grassy verge on the left. A blue metal bollard is visible on the verge. Labels in the image include 'Existing vegetation' pointing to trees on the left, 'Existing pedestrian connection to Alpine Close' pointing to a path, and 'Mamre Road' pointing to the road surface.</p>	<ul style="list-style-type: none"> • This viewpoint is located within the existing southbound road reserve, north of the existing pedestrian connection to St Clair. • The setback area comprises a 20 m wide mown turf area with stands of mature remnant native trees. • Screening shrub vegetation is dotted along the eastern edge of the setback against the rear fences of the residential dwellings. An easement entry links to the setback, although it is not obvious with the only visual sign of the connection from the residential estate being a blue metal bollard. • A power pole is located close to the entry with power lines running across the road carriageway. • Views out to the west are enclosed by dense bushland associated with one of the tributaries that travels under Mamre Road. 	<ul style="list-style-type: none"> • residents of St Clair • pedestrians and cyclists using the Mamre Road setback environment • motorists travelling along Mamre Road
<p>VP4</p>  <p>The photograph shows a concrete drainage culvert in the foreground with a ball fence handrail. A grassed area is visible behind the culvert, and trees are in the background. A label 'Mamre Road' is visible in the distance.</p>	<ul style="list-style-type: none"> • This viewpoint is located within the existing open culvert and is part of the wider drainage network linking through Peter Kearns Reserve in St Clair with South Creek in the west. • The grassed area is approximately 40 m wide and is lower than the existing road carriageway. As well as operating as a drainage easement during flood events, it is also used as open space for passive recreation and as a pedestrian link. • Views are limited by riparian bushland along the northbound verge of Mamre Road and along the sides of the floodway by 1.8 m high residential fencing along both sides. • Established eucalypt trees are situated close to the property boundaries. • An 18 m wide concrete drainage culvert in the foreground has a ball fence handrail across the top. 	<ul style="list-style-type: none"> • residents of St Clair • pedestrians and cyclists using the drainage easement as a link to the Mamre Road setback

Viewpoint ID	Location and description	Affected viewers
<p>VP5</p> 	<ul style="list-style-type: none"> • This viewpoint is located south of the future four-way intersection at Mamre Road and Solander Drive. It looks north along the Mamre Road corridor which stretches to the horizon of the view. • The existing road corridor is a major compositional element in the view and includes a raised concrete median that splits the travel on Solander Drive. • An existing 1.2 m wide concrete footpath runs along the northern verge of Solander Drive and ends at the T-intersection. • Light poles with arms over the road corridors and road signage are also visible. • The low-density residential dwellings of St Clair with rear property fences form a distinct, linear edge along the 20 m wide mown turf setback. This setback area is dotted with stands of mature remnant native trees as well as a clump of Casuarinas. 	<ul style="list-style-type: none"> • pedestrians and cyclists using the Mamre Road setback environment • motorists travelling on Mamre Road
<p>VP6</p> 	<ul style="list-style-type: none"> • This viewpoint is located in the southern verge of the westbound travel lane close to the Luddenham Road intersection. It looks north-east along Luddenham Road, across the Mamre Road corridor towards the residential estate of St Clair. • The existing road corridor as well as roadside vegetation on both corridors are the major elements in the view. • Secondary elements include steel sheds, concrete driveway and parking areas associated with the Erskine Park RFS, galvanised chain mesh fencing with barb wire, regulatory road signage, light poles with arms over the road corridor • Fences of the residential dwellings of St Clair are just visible in the distance. 	<ul style="list-style-type: none"> • motorists travelling along Luddenham Road • pedestrians utilising the signalised intersection at Mamre Road and Luddenham Road • Erskine Park RFS

Viewpoint ID	Location and description	Affected viewers
<p>VP7</p> 	<ul style="list-style-type: none"> • This viewpoint is located within the existing southbound setback, north of the McIntyre Avenue intersection • Major elements in the view include mature remnant native trees located within the 20 m wide mown turf southbound setback area, roadside vegetation along the western verge as well as the existing Mamre Road corridor. • The intersection is highlighted by metal safety barriers, power poles and light poles with outreach arms. Secondary features within this view are pockets of screening shrub vegetation dotted along the rear fences of residential dwellings in St Clair. • Views out to the west are enclosed by dense riparian bushland associated with one of the tributaries that travels under Mamre Road at this location. 	<ul style="list-style-type: none"> • pedestrians and cyclists using the Mamre Road setback • motorists travelling along Mamre Road and McIntyre Avenue
<p>VP8</p> 	<ul style="list-style-type: none"> • This viewpoint is located in the south-west corner near the Mandalong Close intersection and looks north. • The existing road corridor forms a major compositional element in the view, which includes two travel lanes, turning lanes and a painted median. • The eastern verge is dense with EEC vegetation that creates a green east-west threshold across Mamre Road to the north • The entry to Mandalong Close is defined by white rendered brick walls topped with rustic Spanish style roof tiles and timber sleeper fencing. • A 1.5 m high earth mound runs north and south of the intersection beyond the southern entry wall. It provides a visual barrier to the Mamre Road corridor. • Larger vehicles moving along the Mamre Road are visible above the mound from this location. • The western verge of Mamre Road has open views across grazing land. 	<ul style="list-style-type: none"> • residents of Mandalong Close • staff, parents and children arriving and departing the Old MacDonald's Child Care

Viewpoint ID	Location and description	Affected viewers
<p>VP9</p> 	<ul style="list-style-type: none"> • This viewpoint is located at the eastern property boundary of a rural-residential lot on Mandalong Close looking east towards Mamre Road. • Grazing land dominates the foreground of the view and beyond this field a 1.5 m high earth mound that provides a visual barrier to the Mamre Road corridor. • Larger vehicles moving along the Mamre Road corridor are visible above the mound although from this location the road carriageway cannot be seen. • Beyond the earth mounds, the major compositional element in the view is dense Alluvial Woodland (EEC) vegetation that stretches across the entire view. 	<ul style="list-style-type: none"> • residents of Mandalong Close properties • indicative of staff, parents and children arriving and departing the Old MacDonald's Child Care
<p>VP10</p> 	<ul style="list-style-type: none"> • This viewpoint is in the north-western corner near the Erskine Park Road intersection. It looks south-east across the Mamre Road corridor towards the Erskine Business Park. • The existing road corridors are a major part of the view and includes travel lanes, slip lanes, turning lanes as well as raised medians. • To the left of the view, the eastern verge of the road corridor is dense EEC vegetation that creates a green east-west threshold across Mamre Road north of this viewpoint. • The southern verge of Erskine Park Road is defined by large warehouses set behind landscaping that includes planted roadside verge areas, mown grass, concrete edged garden beds and mature trees. • A rendered block work entry wall with a sculptural installation defines the precinct and a SUP runs along an open drainage culvert within the southbound verge of Mamre Road and the westbound verge of Erskine Park Road. 	<ul style="list-style-type: none"> • motorists travelling on Mamre Road and Erskine Park Road

6.8.3 Potential impacts

Construction

During construction, landscape character and visual impacts would likely occur due to:

- vegetation clearance, earthworks and ground disturbance
- movement and operation of various machinery and light and heavy vehicles
- erection and use of temporary facilities such as fencing, lighting and construction compound sites for material and equipment storage
- the construction of a noise wall along the eastern verge of Mamre Road
- lighting used during out-of-hours construction activities.

Sensitive receivers to these impacts would be residents, motorists on Mamre Road and connecting local roads, staff and visitors to commercial or social infrastructure facilities.

Residents on the western edge of St Clair that adjoin the road corridor would be directly exposed to construction activities, including noise wall construction and light spill into residential areas associated with out-of-hours work.

Construction activities, machinery and equipment would be visible to motorists, pedestrians and cyclists. Key visual changes would be associated with loss of vegetation on the western verge of Mamre Road and disturbance of the open environment near Mamre House and the compound site locations.

The visual changes would likely reduce the amenity of the surrounds of Mamre House. In particular, views to Mamre House may be temporarily obstructed during closure of the current driveway and construction of the proposed new driveway. The potential heritage impacts of this has been considered in Section 6.3.3.

The potential impacts would be temporary during the construction period. Construction would also be undertaken progressively so visual impacts to certain receivers may not exist for the entire construction period.

Operation

Landscape character impacts

The proposal has been identified as having impacts across all of the eight LCZ. The proposal is expected to have the greatest impact on the heritage/pastoral zone (LCZ-4) where the sensitivity is highest. The proposal is likely to have moderate overall impacts on residential (LCZ-1) and riparian bushland (LCZ-5) zones due to their large scale. The changes are limited to the fringe of the LCZ and their ability to absorb the changes resulting from the proposal. Moderate-low and low impacts are expected in LCZ with land-uses not significantly impacted by changes in road form such as the industrial land-use and commercial areas. Table 6-61 provides an assessment of potential impacts to each landscape character zone during operation of the proposal.

Table 6-61: Landscape character impacts during operation of the proposal

Zone	Description of change	Sensitivity	Magnitude	Impact rating
LCZ-1 Residential estate	<p>The proposal would involve the widening of an existing arterial road which runs next to this zone.</p>	<p>Moderate: The character of this zone is predominantly residential and includes some attractive open spaces, which contribute to the character and amenity of the area. The zone can accommodate some change without impacting its character and is described as having a moderate sensitivity.</p>	<p>Moderate: Considering the proposal is essentially a widening of an existing arterial road within an existing road reserve outside of this zone, the magnitude is limited to a moderate level of change.</p>	<p>Moderate: The expected impact on this zone has been rated moderate. The proposal would have some impact on the western fringe of the St Clair residential area such as the introduction of new noise walls and pedestrian portals. The impact of the structures is expected to reduce over time as vegetation establishes and matures. Most of the suburb would be unaffected.</p>
LCZ-2 Light commercial	<p>There would be some property adjustments to allow the widening of the corridor, however the visual setting and appearance of the commercial precinct would not be substantially impacted.</p>	<p>Low: This zone comprises a high level of commercial development with numerous large buildings with varying scales and styles. This LCZ has few sensitive receptors and a high ability to absorb change, leading to a low sensitivity to change.</p>	<p>Low: The magnitude of impact of the proposal on the commercial area is likely to be low. Whilst there would be some property adjustments to cater to the widening of the corridor, the visual setting and appearance of the commercial precinct would not be substantially impacted. The magnitude of impact on the vegetation is expected to be low.</p>	<p>Low: A low impact would be expected in this character zone, limited to perimeter boundaries. This is because the proposal is an upgrade of an existing road within the road reserve and the LCZ has a limited number of aesthetically prominent features.</p>

Zone	Description of change	Sensitivity	Magnitude	Impact rating
LCZ-3 Existing road corridor	The proposal would result in road widening, which would increase the bulk and scale of road.	Low: The character of this zone is defined by road infrastructure and motorists may or may not notice changes to the LCZ. As a result, sensitivity has been assessed as low.	High: The LCZ is currently defined by road infrastructure, however the proposal requires road widening, which would ultimately increase the bulk and scale of road.	Moderate: The landscape character impact of the proposal in this zone is likely to be moderate and would result in a more dominant road corridor. There would be new, almost continuous vertical elements such as noise walls. A higher level of sensitivity would be associated with changes to road reserve areas as the proposal would require a full redevelopment of the corridor with more concentrated road infrastructure elements and loss of vegetation.
LCZ-4 Heritage/pastoral	The proposal would result in road widening, which would increase the bulk and scale of road.	High: This zone possesses recognised scenic and landscape values, indicating that the sensitivity to changes in the landscape character would be high.	Moderate: The proposal would be larger in scale and bulk than the existing road corridor and although physical changes within the zone are limited, the magnitude of the proposed works would be moderate. The magnitude of impact may reduce with the introduction of mitigation measures.	High-Moderate: Overall, a high-moderate impact would be expected in this LCZ. The proposal would alter the pastoral outlook from the heritage buildings and gardens, increasing the level of infrastructure development close to the working landscape. The greatest impacts would be experienced by the visitors and staff arriving at the property along the realigned driveway.

Zone	Description of change	Sensitivity	Magnitude	Impact rating
LCZ-5 Riparian bushland	<p>The proposal would result in clearing of small areas of remnant vegetation on both sides of the road corridor.</p>	<p>Moderate: This character of this zone is inconsistent, especially along the road corridor fringe. Some areas of the zone are dominated by riparian vegetation while others (typically closer to the existing road corridor) tend to be dominated by weed species and as such are less sensitive to change.</p>	<p>Moderate: The proposal has the potential to impact small areas of remnant vegetation on both sides of the road corridor. Some clearing of areas along the existing road corridor are expected but the loss would not be substantial in terms of overall character. This would result in moderate magnitude impact on the LCZ.</p>	<p>Moderate: Overall, a moderate impact would be expected. The proposal would require the clearance of a small area of vegetation along the existing road corridor. The impact on other landscape features and the landscape character would be low, largely because the proposal is an upgrade of an existing road within an area that is dominated by dense woody weeds and younger exotic growth.</p>
LCZ-6 Rural residential	<p>The extent of road infrastructure would be increased in this zone, slightly diminishing the regional quality.</p>	<p>Moderate: This zone contains recognised scenic landscape values although in this case, the impact of the project on this character zone is minimal, leading to a moderate sensitivity rating.</p>	<p>Low: The proposal would be partly visible in this character zone increasing the extent of road infrastructure and slightly diminishing the regional quality. The proposal is described as having a low magnitude within this landscape zone.</p>	<p>Moderate-Low: Overall, a moderate-low impact would be expected on this character zone as minor changes would be limited to the eastern boundary. This is because the proposal is an upgrade of an existing road corridor within the road reserve.</p>



Zone	Description of change	Sensitivity	Magnitude	Impact rating
LCZ-7 Business Park	<p>The proposal would result in road widening, which would have little impact on vegetation or other landscape features within this zone.</p>	<p>Low: Industrial areas have a lower sensitivity due to the numerous large footprint commercial and industrial buildings in the LCZ. This landscape character has few sensitive receptors and a high ability to absorb change, leading to a low sensitivity to change.</p>	<p>Low: An increase in the extent of road pavement and formalising road infrastructure elements, with little impact on vegetation or other landscape features within this zone, is predicted to result in a low magnitude of change.</p>	<p>Low: Overall, a low impact would be expected on this LCZ, limited to a more dominant road corridor on the western boundary. This boundary would be impacted by upgrades such as improved intersections, additional travel lanes, split lanes, medians and vegetation clearing.</p>
LCZ-8 Services corridor	<p>The proposal would result in road widening, which would have little impact on vegetation or other landscape features within this zone.</p>	<p>Low: This character of this zone is largely defined by services infrastructure with very few (if any) potential viewers. The proposal would be of similar nature to the existing road corridor, which reduces the zone's sensitivity to the proposal.</p>	<p>Low: A low magnitude of change is expected in this LCZ. There would be an increase in the extent of road pavement and formalising of road infrastructure elements with little impact on vegetation or other landscape features within this zone.</p>	<p>Low: The expected impact on this zone has been rated low with most of the zone remaining unaffected by the proposal. Although the proposal would result in a wider overall road corridor, with additional travel lanes and medians, there would be little impact on vegetation or other landscape features within this LCZ.</p>



Visual impacts



The ten viewpoints have been used to assess the visual impact of the proposal. Impacts are greatest where open recreational landscape and/or vegetation is the main part of the view and the realignment and widening of the road corridor would impact these features.



Upgraded road infrastructure would be more extensively observed due to the proposal. This may lead to high impacts for two viewpoints: viewpoints four and seven. Table 6-62 provides an assessment of potential visual impacts from operation of the proposal at each of the representative viewpoints.


Table 6-62: Visual impacts of the proposal


Zone and description of change	Sensitivity	Magnitude	Impact rating
<p>VP1</p> 	<p>Moderate:</p> <p>Important elements of the view include the intermittent tree cover on both sides of the corridor and the road corridor itself. The sensitivity to change is therefore considered to be moderate.</p>	<p>Moderate:</p> <p>The proposal would result in a larger share of the view being made up of road infrastructure. The road width would increase from about 20m to about 50m with tree removal. The magnitude of the change to the view is therefore considered to be moderate.</p>	<p>Moderate:</p> <p>The proposal would increase the prominence of infrastructure within the view. While areas of existing vegetation would be removed, road users have a lower sensitivity due to their expectation of changes along their road journey. This presence of existing road infrastructure within the view would mean that only a moderate impact on visual amenity is expected.</p>
<p>VP2</p> 	<p>High:</p> <p>Views experienced by people working at and visiting the homestead are particularly sensitive to change. This is due to the unique type of amenity and existing heritage qualities experienced and valued by these receivers.</p>	<p>Low:</p> <p>The proposed heritage node and driveway alignment would be screened by existing trees.</p>	<p>Moderate:</p> <p>Overall, a moderate impact rating would be expected at this viewpoint. The carefully arranged screening shrubs and grassland vegetation along the fence line and new approach route would keep the open character of the homestead whilst providing some buffer for the sight of vehicles. Maintaining the visibility and recognition of the rural homestead and farm from the road would also be important for the preservation of character and integrity within the region.</p>

Zone and description of change	Sensitivity	Magnitude	Impact rating
<p>VP3</p> 	<p>High:</p> <p>Views of the landscaped setback experienced by residents are highly sensitive to change.</p>	<p>Moderate:</p> <p>The road width would almost double including changes to the landscaped setback. The proposal would increase the dominance of road infrastructure, so the magnitude of the change to the view is moderate.</p>	<p>High-Moderate:</p> <p>Road users at this location have a lower sensitivity due to their expectation of changes along their road journey. While most of the existing vegetation would be maintained, additional road furniture, noise walls with a pedestrian portal and a shared path would increase the prominence of the infrastructure within the view. This would be highly visible to slower moving pedestrians and cyclists within the view frame. This would result in an overall high-moderate impact rating.</p>
<p>VP4</p> 	<p>High:</p> <p>Views experienced by residents and outdoor recreation users within the open space would be sensitive to change due to the unique type of amenity experienced and valued by these receivers.</p>	<p>High:</p> <p>Substantial changes within the setback and the introduction of noise walls within the drainage channel. The changes in this viewpoint would increase the dominance of road infrastructure. The magnitude of the change to the view is high.</p>	<p>High:</p> <p>The introduction of noise walls and a shared use path on top of the drainage culvert would increase the prominence of infrastructure within the view. These features would be highly visible to slower moving pedestrians and cyclists and result in a high impact rating.</p>

Zone and description of change	Sensitivity	Magnitude	Impact rating
<p>VP5</p> 	<p>Moderate:</p> <p>The view is a mix of existing bushland, road carriageway, setback and residential dwellings. It would have a moderate capacity to absorb the proposed changes.</p>	<p>High:</p> <p>The footprint of the road corridor would increase. The changes would result in a larger part of the view being dominated by road infrastructure. The magnitude would be considered high.</p>	<p>High-Moderate:</p> <p>The new road corridor would be substantially wider and would be elevated above the existing ground. Existing vegetation within the northbound verge would be removed and open views to the west of the corridor. The increase of road infrastructure with new road furniture, noise walls and a shared use path would be highly visible to slower moving pedestrians and cyclists within the view. This would result in a high-moderate impact rating.</p>
<p>VP6</p> 	<p>Low:</p> <p>This view contains the existing road corridor and roadside vegetation. The sensitivity of the view is considered low.</p>	<p>Moderate</p> <p>The footprint of the intersection would increase. The changes would result in more of the view being road infrastructure. The magnitude would be considered moderate.</p>	<p>Moderate-Low:</p> <p>Views north-east from the Luddenham Road carriageway, to the southbound setback of Mamre Road would be impacted by an increase in the new noise walls, shared use path environment and more road furniture. The RFS would be impacted by the new driveway alignment which would cause a possible loss of vegetation. A moderate-low impact on visual amenity is expected.</p>

Zone and description of change	Sensitivity	Magnitude	Impact rating
<p>VP7</p> 	<p>High:</p> <p>Views of the landscaped setback experienced by residents are highly sensitive to change.</p>	<p>High:</p> <p>The road width would increase from about 20m to about 50m with substantial changes to setback zones. The proposal would lead to an increase in the dominance of road infrastructure and loss of vegetation. The magnitude of the change to the view is high.</p>	<p>High:</p> <p>The new road would be wider and would be elevated above the existing ground. The proposal would increase the prominence of infrastructure within the view of the southbound setback. Along the northbound setback, existing vegetation would also be removed, impacting the sense of enclosure currently experienced along this section of the road corridor. These changes would be highly visible to slower moving pedestrians and cyclists within the viewpoint leading to a high impact rating.</p>
<p>VP8</p> 	<p>Moderate:</p> <p>This view contains rustic architectural features and pastoral settings. The visual sensitivity is considered moderate.</p>	<p>Moderate:</p> <p>The footprint of the road corridor would increase. A larger portion of the view would be road infrastructure. The magnitude of change is considered moderate.</p>	<p>Moderate:</p> <p>Although the new road corridor is elevated above the existing ground and would be wider at this location, it also includes a 20 m wide depressed median, which is likely to lessen the impact from the widened road corridor. Most of the existing vegetation within the southbound setback would be retained and additional road furniture and a shared path are unlikely to increase the prominence of infrastructure within the view. Motorists at this location have a higher sensitivity to change due to typically slower travel speeds, resulting in a moderate impact rating.</p>

Zone and description of change	Sensitivity	Magnitude	Impact rating
<p>VP9</p> 	<p>High:</p> <p>This view is mostly pastoral and so is highly sensitive to changes in built infrastructure.</p>	<p>Moderate:</p> <p>The increased road carriageway footprint and associated infrastructure would become more noticeable. From this location, the widened road carriageway is unlikely to be a more dominant feature within the view. However, some road infrastructure elements and vehicles moving across the view would be more noticeable from around 90m distance. The magnitude of change would be considered moderate.</p>	<p>High-Moderate:</p> <p>The introduction of vertical features within this view would be noticeable to residents, but the distance of the works from the viewpoint (90 m) reduces the visual impact. It would result in a high-moderate impact rating.</p>

Zone and description of change	Sensitivity	Magnitude	Impact rating
<p>VP10</p> 	<p>Low:</p> <p>This view contains the existing road corridor and vegetation near the business park. The sensitivity would be considered low.</p>	<p>Moderate:</p> <p>The footprint of the road corridor would increase. A larger portion of the view would be road infrastructure, such as medians and bus stops. The magnitude would be considered moderate.</p>	<p>Moderate-Low:</p> <p>The new road corridor would be wider and elevated above the existing ground. While most of the existing vegetation would be retained, additional road elements such as medians and bus stops would increase the prominence of infrastructure within the view. While road users would have a lower sensitivity to change due to their journey along the road, the increase of road infrastructure would be noticeable.</p>

6.8.4 Safeguards and management measures

Table 6-63 describes the proposed safeguards and management measures that would be implemented to manage the potential landscape character and visual impacts from the proposal.

Table 6-63: Landscape character and visual safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Landscape character and visual impact	<p>An Urban Design and Landscape Plan will be prepared to support the final detailed project design and implemented as part of the CEMP.</p> <p>The Urban Design and Landscape Plan 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. The Plan will include design treatments for:</p> <ul style="list-style-type: none"> • proposed landscaped areas, in consideration of advice from an ecologist, opportunities to improve riverine scenic quality and Bush Fire Prone Land • built elements including 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 works taking account of related environmental controls such as erosion and sedimentation controls and drainage • opportunities for heritage interpretation and minimisation of heritage impacts in consultation with specialist heritage advice • procedures for monitoring and maintaining landscaped or rehabilitated areas. 	Contractor / TfNSW	Detailed design / pre-construction / construction	Early work / main construction work	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
	<p>It would be prepared in accordance with relevant guidelines, including:</p> <ul style="list-style-type: none"> • Beyond the Pavement urban design policy, process and principles (TfNSW, 2020b) • <i>Noise Wall Design Guidelines</i> (Roads and Maritime Services, 2006). 				
Road furniture	Consolidate signage structures and minimise visual clutter and obstructions, particularly in front of Mamre House.	Contractor	Detailed design	N/A	Additional safeguard
Planting	<p>The landscaping plan for the proposal will be confirmed during detailed design and would consider:</p> <ul style="list-style-type: none"> • arranging plants to maintain the long vistas to the Blue Mountains and views to Mamre House and other heritage sites • choosing a variety of species for feature planting that is generally reflective of the existing landscape character and prioritises native vegetation • selection of plant species and layouts in riparian areas in consultation with ecologists • planting low shrubs in the median strip where it is more than three metres wide • planting to provide screening and shade, particularly along the proposed shared path • maintaining existing roadside vegetation, where possible 	TfNSW	Detailed design	N/A	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Noise walls and pedestrian portals	<p>The detailed design of the noise walls and pedestrian portals will consider:</p> <ul style="list-style-type: none"> • reflecting the distinctive landscape character zones along the road corridor through colour, art and texture • opportunities for heritage interpretation at key locations • way-finding opportunities at pedestrian portals • pedestrian and cyclist safety, including lighting and using CPTED principles 	TfNSW	Detailed design	N/A	Additional safeguard

6.9 Air quality

This chapter has been informed by an Air Impact Quality Assessment (AQIA) undertaken for the operational impacts (i.e. air emissions) of the proposal by SLR Consulting Australia Pty Ltd in 2021 (SLR, 2021a), provided in Appendix L.

6.9.1 Methodology

The assessment:

- identified potential sources of operational impacts
- outlined the relevant legislative context
- described the existing environment (e.g. climate, weather, background air quality, surrounding land use, sensitive receptors, existing sources of emissions and background air quality)
- used TfNSW's Tool for Roadside Air Quality (TRAQ) prediction model to assess potential emission impacts from Mamre Road for 2026 and 2036, based on predicted morning and afternoon peak traffic volumes.

The impacts of construction have been assessed qualitatively outside of the AQIA. TfNSW Air Quality Management Guideline DMS-SD-107 (TfNSW, 2020a) provides guidance on managing air quality and emissions on Infrastructure and Place (IP) project sites. This guideline has been used to identify potential construction activities that may generate dust or produce increased exhaust emissions due to the proposal.

Potential operational air emissions

The *National Pollutant Inventory Emission Estimation Technique Manual (NPI EET) for Combustion Engines* (DEWHA, 2008) identifies the primary pollutants from combustion engines as:

- particulate matter less than 2.5 μm in aerodynamic diameter ($\text{PM}_{2.5}$)
- particulate matter less than 10 μm in aerodynamic diameter (PM_{10})
- oxides of nitrogen (NO_x)
- carbon monoxide (CO)
- sulfur dioxide (SO_2)
- volatile organic compounds (VOCs).

Sulfur dioxide and VOC traffic emissions were not included in the AQIA as these vehicle emissions are typically well below the relevant air quality guidelines (SLR, 2021a).

Relevant Air Quality Policy and Guidance

Legislative instruments and guidelines applying to air pollution from road transport include:

- National emission standards that apply to new vehicles
- Emission regulations, checks and policies that apply to in-service vehicles
- Fuel quality regulations
- In-tunnel limits on pollutant concentrations
- Protection of the Environment Operations (Clean Air) Regulation 2002
- State air quality guidelines adopted by the NSW EPA: *Approved Methods for Sampling and Analysis of Air Pollutants in NSW* (EPA, 2007) (Approved Methods). These list the statutory methods for modelling and assessing air pollutants from stationary sources (mainly industrial point sources) and specifies criteria which reflect the environmental outcomes adopted by the EPA.
- Air Quality Management Guideline DMS-SD-107 (TfNSW, 2019a)
- Ambient air quality standards and assessment criteria
- National Environment Protection Council (NEPC) National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM).

Ambient air quality standards define pollutant concentrations that should not be exceeded over a specific time period (e.g. over 24 hours, or annually) (see Criteria in Section 6.9.2).

Ambient air quality data

Air quality monitoring is performed by the NSW Department of Planning, Industry and Environment (DPIE) at a number of Air Quality Monitoring Stations (AQMS) across NSW. Many of these stations monitor and record meteorological conditions as well as air quality data. The closest stations to the proposal are:

- St Marys AQMS, about 270 metres west of Mamre Road
- Prospect AQMS, about 13 kilometres east of the proposal.

Information about local wind conditions and ambient air quality levels of nitrogen oxides (NO, NO₂ and NO_x) and fine particles (PM_{2.5} and PM₁₀) was obtained from the St Marys AQMS. Data on CO and SO₂ was obtained from the Prospect AQMS as these pollutants are not monitored at St Marys AQMS.

Local air emission sources

Industrial sites surrounding the proposal with the potential to be significant emitters of air pollutants of interest in the air quality assessment were identified through:

- desktop mapping of industrial sites regulated by the EPA
- a review of facilities required to report to the National Pollutant Inventory (NPI) (DAWE, 2021).

EPLs are issued under the POEO Act and are regulated by the NSW EPA. EPLs stipulate emission limits to water, land and/or air and provide operational protocols to ensure industrial emissions/operations comply with relevant standards

TRAQ

TRAQ is a simple 'worst-case scenario' tool used in environmental impact assessments of road projects to assess the potential air quality impacts and greenhouse gas emissions from

vehicles associated with new or existing roads. The model has been used extensively in NSW and is currently accepted by regulatory agencies as an appropriate conservative model for predicting near-field ground-level pollutant concentrations from traffic. TRAQ is used to determine whether more detailed modelling is needed.

TRAQ provides predictions of CO, NO₂ and PM₁₀ concentrations at various distances from the road kerb. PM_{2.5} can be estimated based on emission factors from COPERT Australia.

Vehicle speeds of 10 km/hr and 65 km/hr were modelled using COPERT to derive PM₁₀ and PM_{2.5} emission factors for the 2010 NSW vehicle fleet, and a PM_{2.5}/PM₁₀ ratio of 85 per cent was adopted as a conservative measure (accounts for both exhaust and non-exhaust emissions).

Air quality modelling was performed for the scenarios with and without the proposal in 2026 (year of opening) and 2036 (10 years after opening). This has been informed by predicted morning and afternoon peak traffic volumes for all scenarios. This shows an increase in projected peak hourly traffic numbers associated with the proposal. However, the proposal is not anticipated to have a significant impact on the number of heavy vehicles travelling on Mamre Road, compared to the 'without proposal' scenario.

Due to variation in the proportion of heavy vehicles along Mamre Road, a conservative traffic mix used in TRAQ was adopted (see Table 6-64).

Table 6-64: Adopted Traffic Mix Used in TRAQ

Vehicle Category		TRAQ Default Traffic Mix (%) [*]	Traffic Mix Used in this Assessment (%)
CP	Petrol passenger vehicles	75.6	67.2
CD	Diesel passenger vehicles	2.2	2.0
LDCP	Light-duty commercial petrol vehicles less than 3.5 tonnes	9.6	8.5
LDCD	Light-duty commercial diesel vehicles less than 3.5 tonnes	3.2	2.8
MC	Motorcycles	0.6	0.5
Percentage Light Vehicles		91.2%	81.0%
HDCP	Heavy-duty commercial petrol vehicles greater than 3.5	0.2	0.4
RT	Rigid trucks, 3.5-25 tonnes, diesel only	5.3	11.5
AT	Articulated trucks greater than 25 tonnes, diesel only	2.7	5.8
BusD	Heavy public transport buses, diesel only	0.6	1.3
Percentage Heavy Vehicles		8.8%	19.0%

* Default TRAQ traffic mix for 'Arterial' road type

6.9.2 Criteria

The air quality impact assessment complied with the Approved Methods (EPA, 2007), which sets out impact assessment criteria for air pollutants and ambient air quality (Table 6-65).

Table 6-65: Air Quality Assessment Criteria

Pollutant	Averaging Period	Ambient Air Quality Criterion ($\mu\text{g}/\text{m}^3$)
Total suspended particulate (TSP) (airborne particles between 0.1 and 30 microns)	Annual	90
Particulate matter less than 10 microns (PM₁₀)	24-Hour	50
	Annual	25
Particulate matter less than 2.5 microns (PM_{2.5})	24-Hour	25 (20)*
	Annual	8 (7)*
Nitrogen dioxide (NO₂)	1-hour	246 (165)*
	Annual	62 (31)*
Carbon monoxide (CO)	15-minutes	100,000
	1-hour	30,000
	8-hour	10,000
Sulfur dioxide (SO₂)	10-minutes	712
	1-hour	570
	24-hour	228
	Annual	60
Benzene	1-hour	29
Toluene	1-hour	360
Ethylbenzene	1-hour	8000
Xylenes	1-hour	190

*Note: In May 2021, the NEPC varied the AAQ NEPM, which impacts the NO₂ and PM_{2.5} criteria for this assessment. These values in (brackets) reflect the new standards.

The minimum recommended separation distances between concrete batching plants and sensitive receptors in Australia are included in Table 6-66. Given there are no recommended separation distances in NSW, other states have been used as a guide and a guide of 200 metres has been adopted for this proposal.

Table 6-66: Air emission guidelines: separation distances between concrete batching plant and sensitive receptors

State/territory	Separation distance	Source
Australian Capital Territory	100 metres (where total capacity for production exceeds 0.5 cubic metres per production cycle)	<i>Separation Distance Guidelines for Air Emissions</i> (ACT Government, 2018)
Victoria	100 metres (for concrete production of less than 5000 tonnes per year)	<i>Recommended separation distances for industrial residual air emissions</i> (EPA Victoria, 2013)

State/territory	Separation distance	Source
South Australia	200 metres	<i>Evaluation distances for effective air quality and noise management</i> (SA EPA, 2016)
Western Australia	300 to 500 metres (noise and dust guideline)	<i>Separation distances between industrial and sensitive land uses</i> (DRAFT) (WA EPA, 2015)

6.9.3 Existing environment

Local environmental conditions

The proposal area is reasonably flat. The area immediately surrounding Mamre Road is relatively open, which allows the dispersion of emissions and prevents accumulation of air pollutants dependent on local wind conditions (e.g. speed and direction).

Sensitive receptors

The closest residential premises to the proposal would be located about ten metres from the proposed Mamre Road kerbside (including turning lanes).

The closest school or childcare centre to the proposal is the Old MacDonalds Childcare Centre located on Mandalong Close, about 90 metres west of Mamre Road opposite the Erskine Park Industrial Estate. The next closest educational/childcare facility is Banks Public School at 220 metres to the east of the proposal area.

Local air emission sources

Existing traffic on Mamre Road

Most emissions within the proposal area are produced by vehicles operating on the road network. The main pollutants from combustion engines include particulate matter, NO_x, CO, SO₂ and VOCs (DEWHA, 2008). These compounds can be harmful to human health if present in high concentrations and with prolonged exposure.

Other emissions from vehicle exhausts include products of incomplete combustion, such as metallic additives, which contribute to the particulate content of the exhaust (DEWHA, 2008). Ozone (O₃) is formed as a secondary pollutant from VOCs and NO_x, and is an indicator of smog in urban environments.

Other local air emission sources

A search of the NPI database identified one source with a potentially noticeable impact on background air quality concentrations of PM₁₀ emissions, the Enviroguard Erskine Park landfill operations.

Additional industrial and commercial activities may be present in the local area beyond those listed on the NPI database. However, these activities would operate below the activity threshold specified for the relevant industry type, meaning they do not need to report under the NPI program and do not have an EPA licence. Sources that fall under this category could

potentially impact on air quality within the vicinity of the proposal, but on a smaller scale than those that are licenced and/or are required to report under the NPI program.

A search of the EPA public register for sites located within the 2748 and 2759 postal codes identified ten facilities. However, none of these operations are considered likely to have a noticeable impact on local air quality that would not be captured by the regional monitoring data.

The desktop review also identified a service station located on Banks Road, 90 metres east of the intersection with Mamre Road. Operation of this service station has the potential to impact local air quality and result in elevated concentrations of VOCs in the area immediately surrounding the facility. However, the concentrations of VOCs are expected to have returned to background levels within about 30 to 50 metres of the facility.

Regional air quality

Air quality is generally classified as good in Sydney, based on information from the 43 AQMSs operated by DPIE. In the Sydney northwest region where the proposal is located, the air quality was 'very good', 'good' or 'fair' for 94 per cent of days between 2000 and 2019. Exceedances of air quality standards for particle pollution were typically associated with regional dust storms and vegetation fires (NSW Government, 2017; OEH, 2018, 2019). The available air monitoring data from the St Marys AQMS are summarised in Table 6-67.

Table 6-67: Summary of Ambient PM10, PM2.5, NO2, CO and SO2 (2016 – 2020)

Pollutant	Criterion (µg/m ³)	2016		2017		2018		2019		2020	
		Max	90 th %ile	Max	90 th %ile	Max	90 th %ile	Max	90 th %ile	Max	90 th %ile
PM ₁₀	24-Hour: 50	100.2 [3] [#]	26.4	49.8	26.1	100.5 [2] [#]	29.7	159.8 [26] [#]	41.9	260.3 [11] [#]	30.9
	Annual: 25	16.1		16.2		19.4		24.7		18.9	
PM _{2.5}	24-Hour 25 (20)*	93.2 [7] [#]	11.5	38.2 [3] [#]	10.7	80.5 [3] [#]	11.3	88.3 [21] [#]	16.3	82.5 [9] [#]	11.1
	Annual: 8 (7)*	7.9		7.0		7.8		9.8		7.6	
NO ₂	1-hour 246 (165)*	86	21	76	21	76	25	68	21	70	18
	Annual: 62 (31)*	7.0		8.1		9.6		7.6		7.4	
CO	1-hour: 30,000	2000	400	2000	400	1600	300	6900	400	2600	400
	8-hour: 10,000	1900	400	1400	400	1400	300	3500	400	2300	400
SO ₂	1-hour: 570	60.1	5.7	65.8	5.7	71.5	5.7	60.1	5.7	51.5	2.9
	24-hour: 228	11.4	2.9	11.4	4.6	14.3	5.7	11.4	5.7	11.4	5.7
	Annual: 60	1.7		1.9		1.8		2.0		1.4	

Notes: AAQ NEPM standard/goal for 2025; [#] Exceedance of Criteria [Number in brackets is the number of exceedances]; %ile = Percentile; PM₁₀, PM_{2.5} and NO₂ data are from the St Marys AQMS; and CO and SO₂ are from the Prospect AQMS.

Review of the ambient air quality data showed that:

- Generally, the 24-hour average PM₁₀ and PM_{2.5} are under guideline levels. Isolated exceedances (normally on less than ten days per year) have been recorded in most years, primarily due to events such as bushfire emergencies, dust storms and hazard reduction burns. For example, extensive bushfires in November 2019 to January 2020 resulted in elevated particulate concentrations across Sydney.
- The annual average particulate criterion was not exceeded for PM₁₀. The exceedance for PM_{2.5} in 2019 was due to the bushfire event that started in November 2019.
- Ambient concentrations of the gaseous pollutants NO₂, CO and SO₂ were all well below the relevant criteria.

6.9.4 Potential impacts

Construction

Construction activities that typically result in the temporary and localised generation of dust include:

- site preparation including clearing of vegetation, removal of topsoil and demolition
- earthworks, for example cutting, profiling and breaking, crushing and grinding, and stockpiling of materials
- surface grading and compaction
- vehicle and plant movement on unsealed haul roads
- hard and soft landscaping, including cutting pavers
- concrete batching.

Disturbed and exposed areas including haul roads, embankments and cuttings and stockpiles also have the potential to generate dust during windy conditions.

A concrete batching plant proposed to be located at the larger ancillary compound (Compound Site 2) on Lot 1 DP580390 (279-295 Mamre Rd, Orchard Hills) could also generate dust. Possible sources of dust include the transport, receipt, handling, transfer and storage of dry materials (such as cement and aggregate) and batching. This generally occurs within the recommended separation distance between concrete batching and sensitive receptors (where such guidelines exist in Australia, see Section 6.9.2).

A temporary increase in exhaust emissions may occur due to the operation of construction plant, equipment and vehicles, and any additional vehicles and congestion on Mamre Road. Any air quality impacts would be in the immediate vicinity of the works. There is also the potential that if traffic detours are required, additional vehicles on local roads could result in an increase of vehicle emissions. These impacts would be localised and any increase compared to existing conditions would be negligible.

However, the existing St Marys AQMS is located about 270 metres west of Mamre Road near Compound Site 2. There is potential that localised dust and emissions from construction activities on Mamre Road and at Compound Site 2 may influence the air quality data readings from this monitoring station during construction. Therefore, the readings from this monitoring station may not accurately reflect the existing background air quality concentrations of the wider area during construction of the proposal. TfNSW will consult with DPIE to consider options to minimise impacts to this data, such as outlining limitations on the data or consideration of temporary location of the monitoring station for the duration of construction.

Operation

The air quality impacts due to vehicle emissions from the proposal along Mamre Road, based on the anticipated peak hour traffic volumes, were predicted by the conservative screening-level model TRAQ at ten metres from the kerbside. The pollutant concentrations would decrease with increasing distance from the road.

Table 6-68 presents the TRAQ model results for Mamre Road for scenarios in 2026 (at opening) and 2036 (ten years after opening), with and without the proposal.

Table 6-68: TRAQ model results for Mamre Road at 10 metres from the kerbside

Pollutant and Averaging Period	Units	Incremental Impact		Background Concentration	Cumulative Impact [#]			Criteria
		Without Proposal	With Proposal		Without Proposal	With Proposal	Change Due to Proposal	
2026 Traffic Emissions Scenarios								
Maximum 1-hour CO concentrations	mg/m ³	0.2	0.2	0.4	0.6	0.6	no change	30
Maximum 8-hour CO concentrations	mg/m ³	0.1	0.1	0.4	0.5	0.5	no change	10
Maximum 1-hour NO ₂ concentrations	µg/m ³	26.4	28.1	21	47.4	49.1	1.7 µg/m ³ increase	246 (165)*
Annual NO ₂ concentrations	µg/m ³	5.3	5.6	7.9	13.2	13.5	0.3 µg/m ³ increase	62 (31)*
Maximum 24-hour PM ₁₀ concentrations	µg/m ³	10.6	11.6	30.8	41.4	42.4	1.0 µg/m ³ increase	50
Annual PM ₁₀ concentrations	µg/m ³	4.2	4.6	17.6	23.3	23.7	0.4 µg/m ³ increase	25
Maximum 24-hour PM _{2.5} concentrations	µg/m ³	8.9	9.7	12.4	21.3	22.1	0.8 µg/m ³ increase	25 (20)*
Annual PM _{2.5} concentrations	µg/m ³	3.5	3.9	7.6	11.1	11.5	0.4 µg/m ³ increase	8 (7)*
2036 Traffic Emissions Scenarios								
Maximum 1-hour CO concentrations	mg/m ³	0.1	0.1	0.4	0.5	0.5	no change	30
Maximum 8-hour CO concentrations	mg/m ³	0.1	0.1	0.4	0.5	0.5	no change	10
Maximum 1-hour NO ₂ concentrations	µg/m ³	28.1	28.6	21	49.1	49.6	0.5 µg/m ³ increase	246
Annual NO ₂ concentrations	µg/m ³	5.6	5.7	7.9	13.5	13.6	0.1 µg/m ³ increase	62
Maximum 24-hour PM ₁₀ concentrations	µg/m ³	12.5	13.0	30.8	43.3	43.8	0.5 µg/m ³ increase	50
Annual PM ₁₀ concentrations	µg/m ³	5.0	5.2	17.6	22.6	22.8	0.2 µg/m ³ increase	25
Maximum 24-hour PM _{2.5} concentrations	µg/m ³	10.5	10.9	12.4	22.9	23.3	0.4 µg/m ³ increase	25
Annual PM _{2.5} concentrations	µg/m ³	4.2	4.4	7.6	11.8	12.0	0.2 µg/m ³ increase	8

Notes: * AAQ NEPM standard/goal for 2025; # Predicted incremental impact plus assumed background concentration.

As shown in Table 6-68, only the annual average PM_{2.5} concentrations are predicted to exceed the relevant current ambient air quality criteria. These predicted exceedances are driven mainly by the background concentration assumed in the calculations of 7.6 µg/m³, which is close to the criterion of 8 µg/m³. Figure 6-33 and Figure 6-34 show the estimated PM_{2.5} concentrations at various distances from Mamre Road, which shows that the annual average PM_{2.5} concentrations would still exceed relevant criteria beyond 200 metres from the proposal. The elevated PM_{2.5} concentrations predicted by the AQIA are typical of many areas across Sydney, and the air emissions from the operation of the proposal would be a minor contributor to the total concentration.

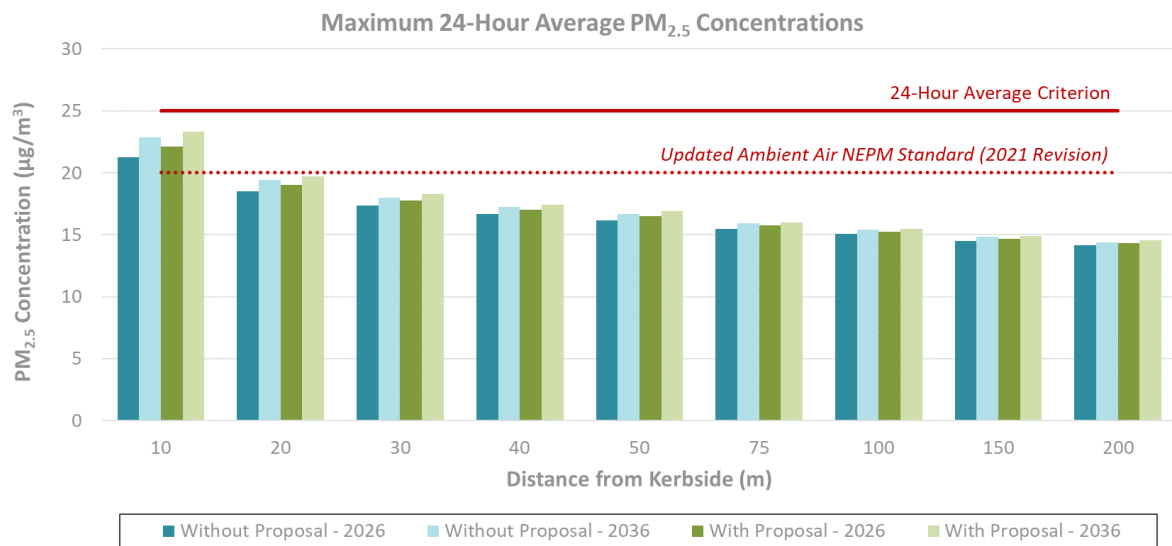


Figure 6-33: Estimated PM_{2.5} Maximum 24-Hour Concentrations Versus Distance from Mamre Road

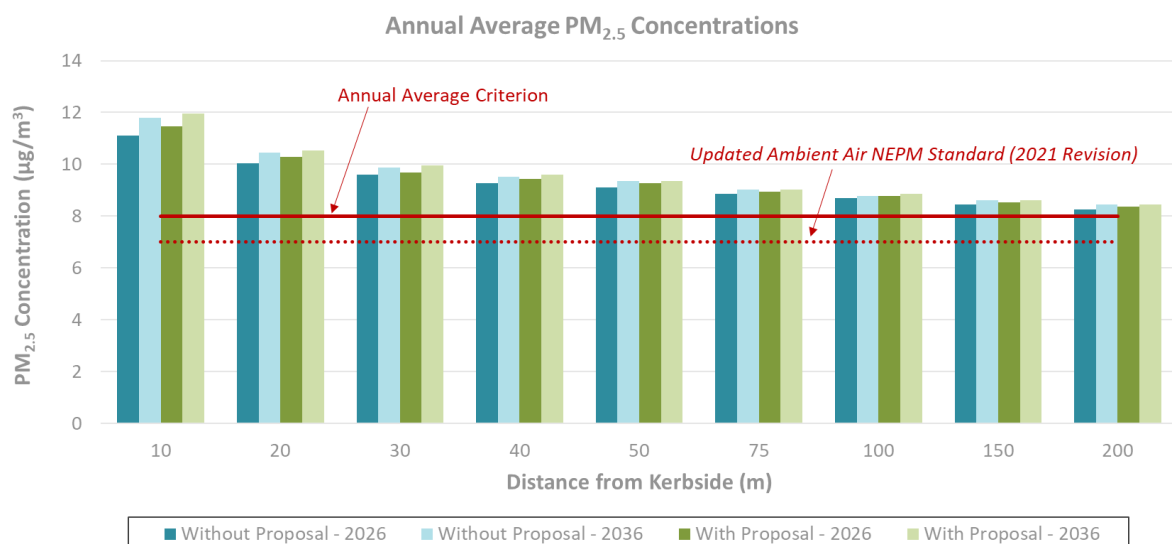


Figure 6-34: Estimated PM_{2.5} Annual Average Concentrations Versus Distance from Mamre Road

The predicted concentrations of annual average PM₁₀ concentrations are below both the 24-hour average and annual average criteria at distances greater than 10 metres from the kerbside. However, the closest house on Solander Drive would be located within eight metres of the kerbside during operation of the proposal. However, this house is located near a section of Mamre Road with lower traffic numbers than those conservatively used in the

modelling. Therefore, the incremental impacts from traffic on Mamre Road predicted in the modelling near Solander Drive would be lower than the predictions shown in Table 6-68.

The predicted concentrations of carbon monoxide and nitrogen dioxide are far below the relevant ambient air quality criteria. There is no significant difference in the downwind concentrations predicted for the with and without proposal scenarios, for both 2026 and 2036.

Concentrations are predicted to be slightly higher in 2036 compared to 2026 due to the higher traffic numbers used for these scenarios. The predicted concentrations are also slightly higher (about 10 per cent higher in terms of incremental annual average concentrations but only up to one per cent higher in terms of cumulative annual average concentrations) for the with proposal scenarios, compared to without the proposal scenarios.

The predicted downwind air pollutant concentrations increase slightly for the 'with proposal' scenarios compared to the 'without proposal' scenarios, which is a result of the projected increase in traffic numbers for these scenarios. It is also noted that the road widening proposed as part of the upgrade would result in a number of houses being located closer to the Mamre Road kerbside (about two to ten metres) compared to the current alignment. The number of houses identified as being located within 15 metres of the kerbside increases from six to 13 residences with the proposal. The separation distance for the closest house to the new alignment is estimated to decrease by less than two metres compared to the current alignment. TRAQ is also a highly conservative screening model, which will generally overestimate actual impacts.

As shown in Table 6-68, the increases in the predicted cumulative annual average concentrations at 10 metres from the kerbside as a result of the proposal are minimal for all pollutants. The change due to the proposal is also less than the change in the concentrations predicted for 2026 compared to 2036, which are associated with increases in traffic volumes even if the proposal was not to proceed. The predicted changes in cumulative impacts due to the proposal are also less for the 2036 scenarios compared to the 2026 scenarios.

In addition, the upgrade may improve traffic flows and minimise congestion levels that might otherwise be expected to occur without the proposal, which would assist in minimising air pollutant emissions from the associated stop/start and acceleration driving patterns. This has potential to reduce pollutant concentrations at the nearest receptors.

As such, the proposal would not result in an unacceptable increase in incremental or cumulative air quality impacts at the nearest sensitive receptors, and air quality is not considered to be a constraint for the proposal.

6.9.5 Safeguards and management measures

Table 6-69 describes the proposed safeguards and management measures that would be implemented to manage the potential air quality impacts from the proposal. Other safeguards and management measures that would address impacts relating to dust suppression from erosion and sedimental controls are identified in Section 6.6.5.

Table 6-69: Air quality safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Air quality	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to:</p> <ul style="list-style-type: none"> • potential sources of air pollution • air quality management objectives consistent with any relevant published EPA and/or OEH/DPIE guidelines • minimise the number of stockpiles onsite, avoid stockpiling in exposed areas and ensure long term stockpiles are covered or stabilised • emission and dust mitigation and suppression measures to be implemented • vehicles and mobile plant to use designated haulage and access routes and restrict traffic speeds on site • all vehicles transporting soils, rock or other materials are covered when entering or exiting the site • maintain all vehicles and plant in accordance with manufacturer specifications • methods to manage work during strong winds or other adverse weather conditions. Daily monitoring of weather forecasts to be undertaken to determine when adverse weather conditions are predicted. • a progressive rehabilitation strategy for exposed surfaces • daily visual observations of dust to identify construction activities, vehicles, plant or equipment that are generating excessive air emissions. Additional mitigation strategies to be implemented where necessary. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	<p>Core standard safeguard AQ1</p> <p>Section 4.4 of QA G36 <i>Environment Protection</i></p>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Air quality	Concrete batching plant to be located at least 200 metres (where feasible) from residences.	Contractor	Detailed design / construction	Main construction work	Additional safeguard
Air quality	TfNSW will continue consulting with DPIE regarding the potential timing and impacts on the St Marys Monitoring station during the operation of compound site 2 and options to mitigate this impact.	TfNSW	Detailed design / pre-construction	N/A	Additional safeguard

6.10 Socio-economic, property and land use

This chapter has been informed by a socio-economic impact assessment undertaken for the proposal (Aurecon, 2021a), provided in Appendix M.

6.10.1 Methodology

The socio-economic impact assessment (Appendix M) was undertaken to:

- support the planning and design activities of the proposal including identifying environmental risks, constraints and areas of sensitivity
- investigate and discuss impacts as a result of the proposal through assessment and analysis of the existing environment
- make recommendations for the avoidance or minimisation of potential impacts in accordance with the relevant environmental assessment requirements of Division 5.1 of the EP&A Act.

The structure of the socio-economic impact assessment is consistent with a 'moderate' level assessment as specified by TfNSW's *Environmental Impact Assessment Practice Note – Socio-economic Assessment (EIA-N05)* (TfNSW, 2020e). The assessment included:

- review of statutory planning and legislative requirements, including a review of existing State and local government strategies relevant to the social and economic environment of the study area. This included review of the *State Environmental Planning Policy (Western Sydney Employment Area) 2009 (WSEA SEPP)*, *Penrith Community Plan* (Penrith City Council, 2017) and *Draft Mamre Road Precinct Development Control Plan* (DPIE, 2020c)
- analysis of key population and demographic indicators, including data from the 2016 Australian Bureau of Statistics (ABS) Census of Population and Housing
- analysis of existing data and information on local business and industry, employment and income, and dwelling characteristics
- review of existing social infrastructure and community features near the proposal, including recreation uses, educational facilities, places of worship, public transport and walking and cycling facilities
- identification and analysis of likely changes to existing socioeconomic conditions of the direct study area, socio-economic study area and broader study area (defined in Table 6-70 below) during early works/construction and operation. This included potential changes in liveability, property, local amenity, social infrastructure, businesses and access.
- assessment of the potential cumulative impacts from the two separate construction phases (i.e. early works and main works)
- assessment of the potential significance of impacts based on sensitivity and magnitude (as prescribed in EIA-N05), see section 6.10.2)
- recommendation of measures to manage or mitigate potential impacts on the socio-economic environment and maximise potential benefits of the proposal.

Study area

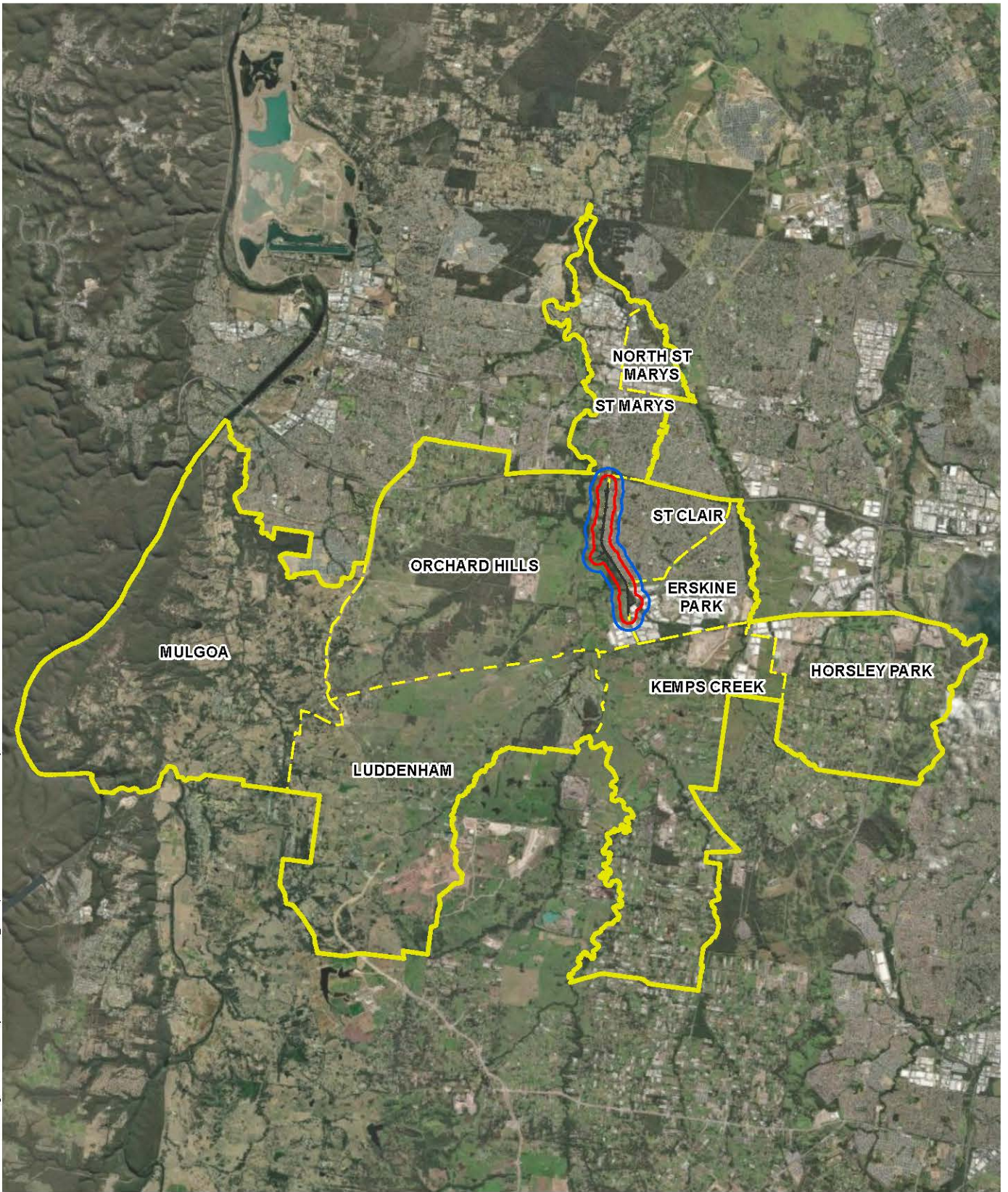
The assessment considered three study areas (Table 6-70 and Figure 6-35):

- direct study area
- socio-economic study area
- broader study area.

These areas were selected based on the methodology provided in EIA-N05 (TfNSW, 2020e). Each area provides context about the existing environment to assess the direct and indirect impacts of the proposal.

Table 6-70: Study areas for the socio-economic assessment (Aurecon, 2021c)

Study area	Description	Study focus
Direct study area	Mamre Road and the areas within 200 metres of the road corridor. Includes the properties that border Mamre Road to the east and the west, including properties that are set back from the road but may still experience direct impacts of the proposal.	Direct impacts, including amenity impacts (noise and visual impacts), property and access impacts and impacts to the surrounding community. Considers residents, stakeholders and facilities closest to the proposal.
Socio-economic study area	Area within 400 metres of the proposal	Indirect impacts of the proposal (primarily impacts to access and connectivity, as well as some amenity impacts that may occur from people using the proposal but not as frequently as those within the direct study area). Considers those within general walking distance to the proposal.
Broader study area	Database coverage area is based on ABS 'Statistical Area 2', which includes the suburbs of: <ul style="list-style-type: none"> • Mulgoa - Luddenham - Orchard Hills • St Marys - North St Marys • St Clair • Erskine Park • Horsley Park - Kemps Creek. <p>Comparison of Statistical Area 2 is made against Penrith LGA and Greater Sydney.</p>	Context of the existing environment, with comparison against the Penrith LGA and Greater Sydney. Key features of the surrounding area such as train stations, shopping/town centres and places of special interest provide understanding of the range of services, facilities and lifestyle of the community. <p>By understanding the broader study area, movements through and around Mamre Road are assessed to determine the potential impacts of the proposal.</p>



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- Indicative road design
- Direct study area
- Socio-economic study area
- Broader study area



Source: Aurecon, Spatial Services, Nearmap, Esri



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0 1 2km

Date: 17/03/2021 Version: 1

Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 6-35: Broader study area

6.10.2 Criteria

Determination of the significance of likely impacts is based on the sensitivity and magnitude of the impacts.

- **sensitivity** refers to the qualities of the receptor which influence its vulnerability to change and capacity to adapt
- **magnitude** refers to the scale, duration, intensity and scope of the proposal including how it will be constructed and operated.

The socio-economic assessment applied the impact grading matrix presented in EIA-N05 to assess the level of significance for potential negative impacts only (Table 6-71).

Table 6-71: Grading matrix to assess the level of significance (TfNSW, 2020e)

Sensitivity	Magnitude				
		High	Moderate	Low	Negligible
High	High	High	High-moderate	Moderate	Negligible
Moderate	High-moderate	High-moderate	Moderate	Moderate-low	Negligible
Low	Moderate	Moderate	Moderate-low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

6.10.3 Existing environment

Land use

The proposal is in Western Sydney NSW. The proposal traverses the suburbs of St Clair, Orchard Hills and Erskine Park in the Penrith LGA. The proposal intersects a number of local roads, many that provide access to suburbs in the surrounding area. Mamre Road forms a crucial link between the Great Western Highway in the north to Elizabeth Drive in the south.

The direct study area is located within Orchard Hills, St Clair and Erskine Park. The proposal includes the following land zonings (as per the Penrith LEP and WSEA SEPP, shown in Figure 4-1 and Figure 4-2):

- SP2 – Infrastructure
- RE1 – Public recreation
- R2 – Low density residential
- E2 – Environmental conservation
- IN1 – General industrial
- RU2 – Rural landscape.

Mamre Road is located within a wide corridor, which has grassed and vegetated areas along its extent. Some areas along the corridor have pathways connecting to residential areas as well informal greenspaces that are used for passive recreation (zoned as RE1 – Public recreation). Although these spaces are used by the public for recreation, they are used for flooding overflow during flood events.

The western side of Mamre Road is relatively undeveloped, with some vegetated areas along creek lines and scattered properties are set back from the road corridor with long driveways. Land use is primarily large cleared agricultural/rural properties. Mamre Road provides access to Luddenham Road, which is the main access route for many agricultural properties west of the proposal area. Most of the properties on the western side of Mamre Road are residential or are vacant land owned by Office of Strategic Lands, with some social infrastructure such as the Erskine Park Rural Fire Brigade and Old MacDonald's Child Care.

The eastern side of Mamre Road is predominately comprised of urban residential properties in St Clair. Properties are clustered around residential streets with social infrastructure located throughout both suburbs. Erskine Business Park is located to the south east of the direct study area. Large freight vehicles use Mamre Road to access the business park from the M4 Motorway and Elizabeth Drive.

Business within the broader study area mainly comprise agricultural businesses, trade and home-based businesses, large freight operators and industrial type businesses. Businesses closest to the proposal in the direct study area include the Blue Cattle Dog Hotel, KFC fast food restaurant, agricultural business and industrial business that form part of Erskine Business Park, south of the proposal.

Major growth and development is expected in Western Sydney due to major projects including the Western Sydney Airport, M12 Motorway and other state significant development. As such, the proposal is in an area of change, with the transition of the broader study area between rural/agricultural land on the western side of the proposal to urban development on the eastern side of the proposal toward the Sydney CBD.

Population and demography

The broader study area has a young population, is highly mobile and travels relatively far to places of employment and social infrastructure, compared with Greater Sydney. Population and housing growth in the Penrith LGA are expected to increase substantially over the next 20 years, which is likely to be attributed to the development in Western Sydney and the changing nature of the Penrith LGA in response to development.

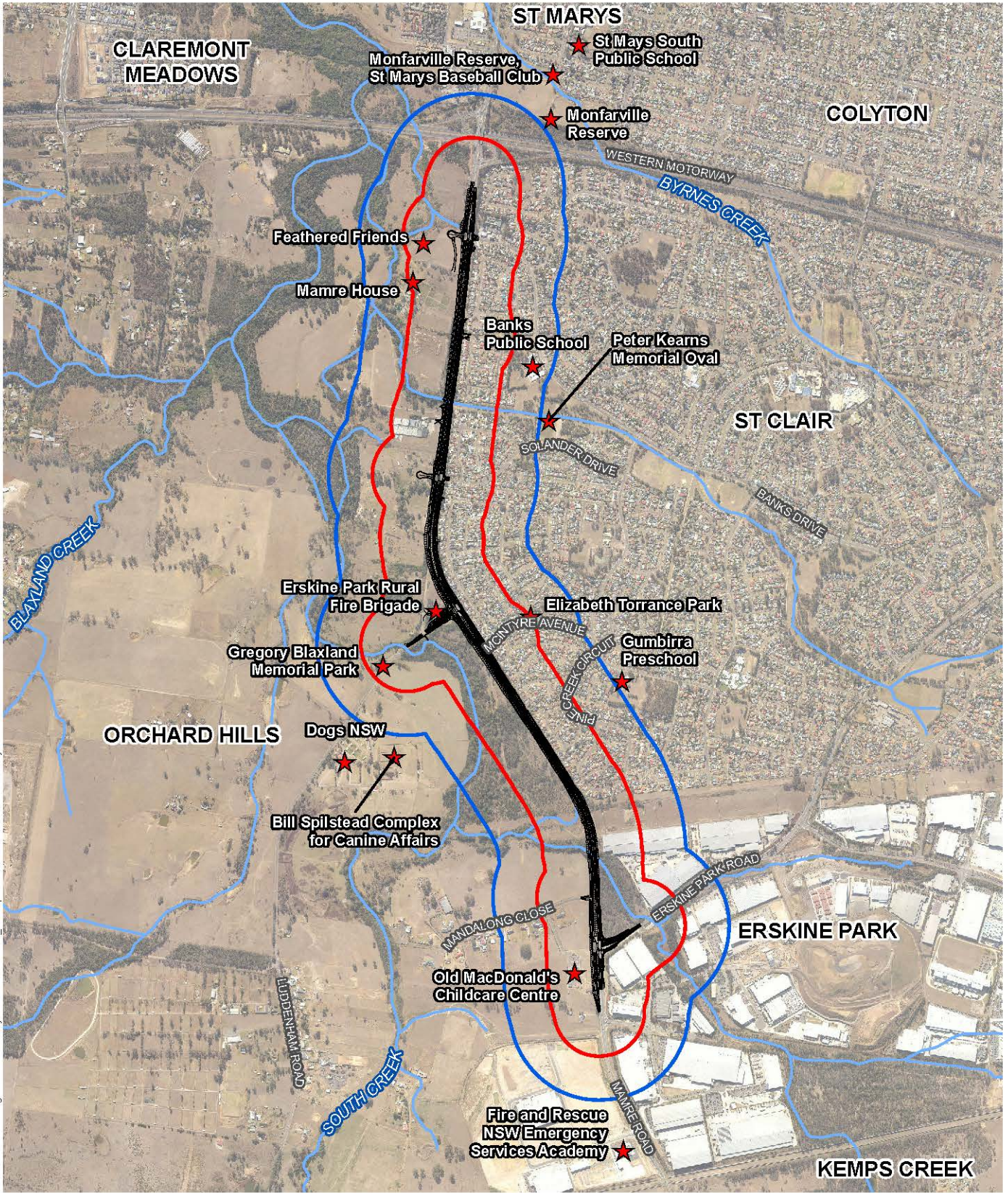
Key features of the existing population are characterised as follows:

- As of 2016, there were 56,370 people living in the broader study area, which accounted for 28.7 per cent of the Penrith LGA population.
- There is a higher proportion of young people in the broader study area and Penrith LGA with 21 per cent of people aged 14 years or younger, compared to Greater Sydney at around 19 per cent.
- In 2016, 11.3 per cent of the population in the broader study area were 65 years or older, which was slightly lower than the Penrith LGA and Greater Sydney.
- There is a high Aboriginal and Torres Strait Islander population when compared with Greater Sydney, with the population comprising 3.2 per cent of the broader study area compared with 1.5 per cent in Greater Sydney. This is consistent with Penrith LGA, which also has a high Aboriginal and Torres Strait Islander population (3.9 per cent) when compared with Greater Sydney.
- The population of Penrith LGA is expected to increase by 25 per cent between 2016 and 2041. The Greater Sydney Region is predicted to grow by about 34 per cent by 2041.
- Many people who live in the broader study area are employed in construction, which is consistent with Penrith LGA. This may be associated with the current growth and development within Western Sydney, providing opportunities in the construction industry.

Social infrastructure facilities

The direct study area provides access to social infrastructure facilities, those closest to the proposal being, Catholic Care Mamre House and Farm (community centre), Erskine Park Rural Fire Brigade and Old MacDonald Childcare Centre (refer to Figure 6-36).

It is likely that people within the broader study area use Mamre Road to access social infrastructure facilities in the wider area. Mamre Road provides an important link to social infrastructure facilities in St Clair and Erskine Park. This includes the Mark Leece Sporting Complex, Clairgate Public School, Blackwell Public School, Erskine Park High School, St Clair Leisure Centre and local places of worship. Mamre Road also provides access to Bakers Lane (in Kemps Creek) which offers a range of social infrastructure facilities including Catholic Healthcare, Emmaus Village retirement community, Emmaus Catholic College, Trinity Primary School and Little Smarties Early Learning Centre. Similarly, Luddenham Road (accessed via Mamre Road) provides access to Twin Creeks Golf & Country Club, Luddenham Lodge Horse Riding, Luddenham Raceway and Sydney Society of Model Engineers.

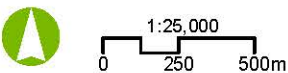


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- ★ Social infrastructure
- Waterways
- Revised 80% road design's centerline
- ▭ Socio-economic study area
- ▭ Direct study area



Source: Aurecon, Spatial Services, Nearmap, Esri



Date: 19/03/2021 Version: 1
 Projection: GDA2020 MGA Zone 56

Mamre Road Upgrade Stage 1

Figure 6-36: Social Infrastructure

Access and connectivity

Private vehicle use

Within the socio-economic study area, there is a lack of public transport and residents are therefore, typically reliant on private vehicles.

Most people living in the broader study area own a car. In 2016, vehicle ownership in the broader study area was between 1.5 and 3 vehicles per dwelling, with 5.3 per cent of dwellings having no motor vehicles. Greater Sydney had the lowest portion of dwellings with no vehicles at 11.1 per cent. The high vehicle ownership in the broader study area could reflect the diverse job and industry types, requiring people to travel using private motor vehicles and current limited public transport choice.

There is no formal parking along Mamre Road, Erskine Park Road and Luddenham Road. Banks Drive, Solander Drive, McIntyre Road have on-street parking set back from the intersections with Mamre Road. However, due to the low density residential nature of St Clair, with ample off-street parking, there is little or no demand for on-street parking.

Public transport

There are no train stations within the direct study area. However, within the broader study area, there is one train station located at St Marys, north of the direct study area. The station is serviced by the T1 - North Shore and Western Line which travels between the Penrith LGA (terminating at Emu Plains) and the Sydney CBD. St Marys Station is also serviced by the N70 night bus which travels between the Penrith LGA and Sydney CBD during 12am and 6am. There is a bus interchange located on the southern side of the station, street parking and car parks (including Station Plaza car park), taxi ranks and bicycle rack areas.

There are a number of buses that service Mamre Road within the direct study area. These include (refer to Section 6.4.2):

- 779 Erskine Park to St Marys
- 776 Mount Druitt to Penrith via St Clair
- Bus services from the schools in Bakers Lane (such as Mamre Anglican School and Emmaus College).

Most of the bus stops on Mamre Road are not sheltered and do not have seating with the exception of two bus stops on Mamre Road near Banks Drive, and two bus stops on Erskine Park Road near the intersection with Mamre Road.

Freight

Mamre Road between the M4 Motorway and Elizabeth Drive is an important freight route for Western Sydney and Greater Sydney. Mamre Road provides access to Erskine Business Park, Erskine Park and other large industrial precincts in Horsley Park and Eastern Creek. These precincts are comprised of warehouses and office spaces, with large vehicle access. Freight carriers travel from the surrounding road network, including the M7 Motorway and The Northern Road to access these precincts. Storage, supplier and freight companies, manufacturers, corporate offices, cafes and retailers are located throughout in these precincts.

Walking and cycling

Footpaths and cyclist lanes are discontinuous along the extent of Mamre Road (refer to Section 2.2). The TfNSW Cycleway Finder (2020c) classifies Mamre Road as 'Hard Difficulty' for cycling. There are sections of Mamre Road that are relatively narrow, and it is likely that cyclists may experience difficulty cycling due to the closeness of fast-moving light and heavy vehicles and the discontinuity of the pathway and shoulder markings. Within the broader study area there are limited pedestrian and cyclist paths that connect to the rest of the Penrith LGA. Most pathways within the surrounding suburbs are discontinuous and do not connect to other suburbs.

Further detail on access and connectivity is provided in Section 6.4.

Community values

Community feedback received while developing the *Penrith Community Strategic Plan 2017* (CSP; Penrith City Council, 2017; 2019a) showed that:

- top challenges facing Penrith LGA over the next 10 years include: traffic congestion, managing population growth, and infrastructure catering to the growing population
- infrastructure meeting population needs was rated third most important in the services and facilities category
- Penrith's most valued features are location, natural environment and peaceful place to live
- services and facilities with the lowest satisfaction rating were ease of traffic flow and lack of infrastructure that meets population needs.

Further issues raised by the community during consultation for the proposal are discussed in Section 5.2.2.

6.10.4 Potential impacts

Construction

Property acquisition and adjustments

The proposal would require the acquisition and adjustment of properties within the direct study area. In addition, some land parcels would also be temporarily leased for ancillary facilities. A list of properties impacted is provided in Section 3.6. All property acquisition would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the Land Acquisition Reform 2016 process.

Council owned and managed, 'community land' on the eastern side of the Mamre Road corridor would be leased and/or acquired for the proposal in accordance with the *Local Government Act 1993*. Any potential impacts to community land would require consultation with the community and agreement from Penrith City Council.

The small areas of Crown land that would be impacted by the proposal (refer to Figure 3-11) would be leased and/or acquired in accordance with the *Crown Land Management Act 2016* and *Crown Land Legislation Amendment Act 2017*. Further details of these Acts are described in Section 4.2.2.

Acquisition would mostly consist of strip acquisition of properties to the west of Mamre Road, with limited acquisition required on the eastern side of Mamre Road (refer to Figure 3-11).

As most of the residences are set back from the road, the proposal would not require the demolition of any residences, structures or buildings. Where required, property adjustments would include provision of new fencing and driveway access in consultation with the landholder.

People who own or occupy private residential properties may experience stress and anxiety as a result of the partial acquisitions. Some property owners and tenants would be more vulnerable to the impacts of acquisition than others. This includes people with the need for assistance, older people and those with lower levels of economic resources. Located in an area of change and development, residents in the direct study area that are impacted by property acquisition may also be more sensitive to the impacts of property acquisition, due to the transforming nature of the area around them.

Where Crown land would be acquired for the proposal, there is also potential for cultural and spiritual loss due to extinguishment of Native Title.

In addition, there are several areas that would be leased during construction to provide access to areas required to construct the proposal including compound sites. These properties would be temporarily used during the construction of the proposal. TfNSW would engage in a lease agreement with property owners for the construction period.

The sensitivity of these stakeholders and magnitude of the changes are moderate, resulting in the significance of the impact being moderate.

Land use

Land use changes during construction would be temporary and largely would be confined to the proposed compound sites. These compound sites have been proposed on cleared rural or public recreation areas, which would transform to construction areas for the proposal. Post construction, these areas would be restored to their previous use upon completion of construction, in negotiation with property owners.

The sensitivity of land occupiers, owners and the broader study area to changes in land use is low. The magnitude of the changes would be low resulting in the significance of the impact being low.

Access and connectivity

The proposal would result in some temporary changes to access and connectivity within and surrounding the direct study area. This would include:

- temporary changes to property street accesses on Mamre Road including to social infrastructure facilities (Mamre House, Erskine Park Rural Fire Brigade and Old MacDonald Childcare Centre)
- temporary changes (partial temporary closures, contraflows or detours) to local street access to Mamre Road, including Banks Drive, Solander Drive, Luddenham Road, McIntyre Avenue and Mandalong Close
- increased traffic from construction light and heavy vehicles along Mamre Road, Erskine Park Road, Elizabeth Drive and the M4 Motorway
- partial road closures and detours on Mamre Road.

Impacts to access to property and the road network during construction may limit/change the way people move around, impacting liveability. Residents may feel stressed or anxious in response to consistent changes to the network, having to use alternative and/or unfamiliar routes.

Where possible, property access would be maintained during construction (unless otherwise agreed with the property owner/occupier). However, there may be short term impacts to existing driveway access due to adjacent construction works.

Changes in road access leading to potential longer travel times may cause frustration to residents and motorists on Mamre Road and surrounding local roads. Construction may result in increased traffic on the surrounding road network (particularly where detours are implemented) including local streets, which could affect traffic flow and result in some minor increased travel times. The use of detours and alternate traffic arrangements would be temporary and limited to out of peak traffic periods where possible, to minimise impacts to the local road network. However, these detours could affect freight and business movements, particularly for heavy vehicles servicing businesses in the Erskine Business Park, especially if businesses are 24 hour operations. Some local detours may not be suitable for heavy vehicles, so access to and from the M4 Motorway for heavy vehicles may need to be via Erskine Park Drive. Emergency access along Mamre Road would be maintained at all times during construction.

In addition, local residents who would normally use Mamre Road may also choose to alter their travel route to avoid the construction area. This could result in increased local traffic on the local road network through St Clair. Where possible, use of local roads by construction vehicles would be avoided to further minimise impacts to the local community.

While there is no parking on Mamre Road, there is on-street parking on the connecting local roads through St Clair. Tie-in work at the intersections, utility relocations or construction areas may impact some of the closest parking spaces closest to Mamre Road. This would particularly impact parking spaces near the Solander Drive and McIntyre Avenue intersections. This could impact on the elderly and people who have mobility constraints, as they may need to park further away from properties. To avoid any further impacts on local parking, construction workers would be encouraged to carpool to site and park within compound sites.

Access to pedestrian and cyclist facilities would be maintained, where possible, particularly to pedestrian crossings and bus stops. Some detours and alternative temporary pathways that would allow pedestrians to walk behind safety barriers around construction areas may be required to safely maintain access for active transport users. Delays may be experienced by less mobile people, such as people with prams and older people, travelling within the direct study area. Alternative cycling routes would be identified to cyclists. Bus stops may be temporarily relocated to maintain appropriate distances from the construction areas to maintain local and school bus services. These changes may result in delays and slight increases in travel distance for pedestrian, cyclists and bus commuters. This may impact less mobile people, such as people with prams and older people travelling within the direct study area.

The sensitivity of road users to changes in access and connectivity is high. The magnitude of the temporary changes during construction would be moderate, resulting in the significance of the impact being high-moderate.

Social infrastructure

Within the direct study area, the following social infrastructure facilities would have impacts:

- Feathered Friends wildlife sanctuary / greenspace
- Mamre House near the intersection of Banks Drive and Mamre Road
- Erskine Park Rural Fire Brigade at the intersection of Luddenham Road and Mamre Road
- Old MacDonald Childcare Centre which is accessible from Mandalong Close.

The impacts to these social infrastructure facilities are discussed in Table 6-72.

Table 6-72: Construction impacts to social infrastructure in the direct study area

Facility	Impacts
Feathered Friends wildlife sanctuary/ greenspace	<p>Located near Mamre House, the greenspace is used for bird flight shows. Construction work could affect the use of the site, with the new driveway to Mamre House passing through the front of the site. The proposal would result in amenity impacts to the use of this area, mostly through noise impacts. While there would be visual impacts, they may not be as important for the use of the site.</p>
Mamre House	<p>Access to the facility would be maintained during early works and construction. Amenity impacts would be associated with:</p> <ul style="list-style-type: none"> • changes to the landscape, setting and historic access to Mamre House, including the views from the front gardens and from the house • visual impacts from construction activities, equipment and plant being used as well as light impacts for any works undertaken at night • noise impacts, which would be moderately intrusive, particularly during utility relocations and earthworks to the facility. <p>Amenity impacts could result in some users not using the facility for the duration of construction.</p>
Erskine Park Rural Fire Brigade	<p>Access to the Erskine Park Fire Brigade would be altered during construction and a new access would be constructed. Access for emergency services including the rural fire brigade would be maintained throughout construction.</p> <p>The fire brigade is likely to be impacted by ongoing noise impacts during construction, particularly due to the facility being operational for 24 hours/day. Noise impacts are expected to be highly intrusive due to the facility being relatively close to the construction areas, particularly during work at the Luddenham Road intersection. This may substantially impact firefighters and staff during rest periods, particularly if noise intensive work occurs.</p>

Facility	Impacts
Old MacDonald Childcare Centre	<p>Old MacDonald Childcare Centre is accessed off Mandalong Close but fronts onto Mamre Road and is about 80 metres from the intersection of Erskine Park Road and Mamre Road.</p> <p>The upgrade works at the intersection would result in noise and visual impacts to the childcare centre. Noise impacts are expected to be substantial at the childcare centre, particularly if children are using the outdoor areas. During rest periods, noise impacts may result in sleep disturbance. In addition, air quality impacts from dust and machinery exhausts may result in some health concerns by parents/guardians of the students at the centre. Existing access to Old MacDonald Childcare Centre would be maintained during construction, however people may experience delays on Mamre Road and Mandalong Close during partial road closures. Parents and staff accessing the facility may experience delays in accessing the childcare centre during peak pick up and drop off times in the early morning and late afternoon.</p>

There are a number of social infrastructure facilities that are located in the socio-economic study area and broader study area that would rely on Mamre Road for connectivity or are close to the works that would be indirectly affected by works. These would include impacts to:

- Banks Public School on Banks Drive associated with:
 - access delays due to road closures on Mamre Road or detours particularly during school drop off and pick up periods
 - perceived safety concerns for students walking or cycling to school or those that use buses along Mamre Road
 - noise impacts, particularly in outside spaces.
- Peter Kearns Memorial Oval on Banks Drive associated with:
 - road closures or detours at the Banks Drive and Solander Drive intersections
 - noise and visual impacts (particularly as the oval backs onto greenspace/ flood area that connects to Mamre Road). Users may avoid the oval and adjoining greenspace due to the construction areas and amenity impacts.
- Gregory Blaxland Memorial Park and Dog Park on Luddenham Road associated with:
 - temporary road closures, which may increase travel time for users of these facilities
 - noise impacts from the construction work, which could deter users from using these facilities.

There may also be indirect impacts on facilities on Bakers Lane, which are located outside the study areas however would be accessed via Mamre Road, as a result of partial road closures and increased traffic volumes during construction.

The sensitivity to social infrastructure receivers to the proposal is moderate. The magnitude of the temporary changes during construction would be moderate, resulting in the significance of the impact being moderate.

Business operations

Businesses within and surrounding the direct study area would experience temporary impacts to amenity, including visual, noise and air quality impacts. Business activity such as

interactions with customers/clients, office and restaurant environments and the productivity of workers may be impacted during construction due to noise and vibration impacts. The reduction in visual and noise amenity may also result in customers being less inclined to visit businesses such as accommodation facilities, restaurants and cafés, particularly those around Banks Drive. However, these businesses may also obtain additional patronage from the construction crew on site.

The presence of plant and equipment may restrict views to businesses and associated business signage. In addition, patrons of these businesses as well as the Shell/Coles Express petrol station service station on Banks Drive, may also be reluctant to access these businesses due to construction activities/alternate access arrangements near the intersection. These impacts would be temporary.

In addition, businesses in St Clair, Erskine Park and Luddenham may experience impacts to deliveries and customer access due to increased traffic times and / or detours.

There are likely to be a range of people working from home due to the current COVID-19 pandemic. It is likely that people working from home during the day (both due to the pandemic and home-based businesses) would be impacted by noise impacts. Noisy works may impact people's ability to concentrate and interrupt telecommunications such as business calls and meetings. This is likely to cause frustration and concern, particularly if people have been working from home for a substantial period of time.

The sensitivity of businesses and to commercial operations is moderate. The magnitude of the temporary changes during construction would be moderate, resulting in the significance of the impact being moderate.

Amenity and community values

Amenity often refers to the quality of life, character and elements in a community that make it a more pleasant and comfortable place to be a part of. Impacts of a proposal such as traffic, perceived air quality impacts, noise and visual impacts can affect the amenity of an area.

During construction there would likely be a reduction of amenity in the direct study area and socio-economic study area. Receivers in the direct study area would experience the most impacts to amenity. The majority of sensitive receivers would be residential receivers, located on properties surrounding the direct study area, predominately to the east in St Clair. The highest impacts would be during construction activities that use noise intensive equipment and would be to those residential properties in St Clair that are adjacent to the Mamre Road corridor. Residential receivers which are further back or shielded from view are also predicted to be impacted during noisy work, but to a lesser degree. During works outside standard construction hours, this could result in some potential sleep disturbance or discomfort for receivers. Where possible, high noise intensive activities would not be undertaken out of standard work hours.

The Penrith City Council CSP identified that the community values the natural environment. The proposal would require some vegetation removal for the widening of the corridor. Concerns about air quality in response to dust generated during construction, vegetation removal and idling engines are also likely to contribute to the reduction in amenity.

The removal of vegetation and presence of construction areas would result in visual impacts to surrounding receivers. The most impacts would be experienced by dwellings near the proposal. The presence of construction plant and equipment would also impact the visual

aesthetic of the direct study area and some of the socio-economic study area. This includes road users passing construction areas of the proposal.

The community also value 'getting around their city' and movement (Penrith City Council CSP), construction of the proposal may temporarily impact the accessibility and connectivity for road users on Mamre Road and the surrounding local road network. This may result from construction traffic and alternative traffic arrangements, which could be frustrating for local road users and people travelling through the direct study area.

The sensitivity of the community to changes in amenity and values is moderate. The magnitude of the impacts during construction is moderate, resulting in the level of significance being moderate.

Operation

Property acquisition and adjustments

There would not be any further property acquisition or adjustments required as part of the operation of the proposal. All required acquisition and adjustments would occur during construction.

Based on the characteristics of property owners and occupiers, sensitivity of these stakeholders is moderate. The magnitude of changes during operation would be low, resulting in the significance of the impact being moderate-low.

Land use

The widening of the road corridor would result in some long term land uses changing to transport infrastructure corridor. This would particularly be to the west of Mamre Road, where strip acquisition would change land uses from environmental conservation, public recreation and rural environment change to road corridor.

However, there would be no other changes to land use due to the operation of the proposal. The proposal, itself would not result in any land use changes in the surrounding area. Rather, the proposal area is partially located within the Western Sydney Employment Area near the Erskine Park Road intersection, which has already been earmarked for future development and would change the future land use surrounding Mamre Road.

The proposal would support this future development by increasing the capacity of Mamre Road to account for future travel demand and movement.

The sensitivity of land occupiers, owners and the community to permanent changes in land use is low. The magnitude of these changes is moderate, resulting in the level of significance being moderate-low.

Access and connectivity

The proposal seeks to improve safety on Mamre Road for all road users. This would improve the liveability in the area, as movements on Mamre Road and the surrounding road network would be safer and encourage more people to use Mamre Road.

There would be a number of private property access changes along Mamre Road including to Mamre House, Erskine Park Rural Fire Brigade. Where required to the west of Mamre Road, property access for land owned by Office of Strategic Lands would be rationalised. Mamre House would have a new property access constructed to the Banks Drive intersection. Erskine Park Rural Fire Brigade would have changed property access, with a

new access being provided to Old Luddenham Road, rather than onto Luddenham Road which would be too close to the Mamre Road intersection.

There would also be a slight adjustment to the driveway of the private property on the north-east corner of the Solander Drive intersection, between Mamre Road and Madison Circuit. This would be required for the new intersection arrangement and adjustment to the eastbound lane on Solander Drive. Impacts are expected to be minor.

The upgrade of Mamre Road would improve movement and travel times between the M4 Motorway and Erskine Park Road for people operating along the corridor. The proposal would aim to support economic growth and productivity by providing increased road capacity that would be sufficient to support the projected traffic volumes on Mamre Road. The additional lanes on Mamre Road would mean that heavy and light vehicles would be able to use more of the road network, providing the option for slower/larger vehicles to use the left lane, reducing potential impacts to the flow of traffic. The proposal would improve road safety for heavy vehicles by reducing opposing-lane overtaking of heavy vehicles and the associated risk of head-on crashes.

In addition, the signalised intersections would provide better movements for motorists wanting to access Solander Drive and Luddenham Road.

At two intersections, there would be a change in local traffic movements, increasing travel times to access these local roads:

- Mandalong Close would become a left in- left out intersection. Traffic travelling south on Mamre Road would need to travel down to the Erskine Park Road intersection to turn around to access Mandalong Close. Exiting Mandalong Close to travel southbound on Mamre Road would require motorists to travel up to the Luddenham Road intersection to turn south.
- McIntyre Avenue would become a left in- left out intersection. Traffic travelling north on Mamre Road would need to travel up to the Luddenham Road intersection to turn south to access McIntyre Avenue. Exiting McIntyre Avenue to travel north on Mamre Road would need to go down to the James Erskine Drive roundabout to turn around.

Some on-street parking spaces closest to Mamre Road would be permanently removed on Solander Drive to allow for the signalised intersection and additional traffic lane. Penrith City Council would be consulted about the removal of these parking spaces.

The new shared path for pedestrians and cyclists along Mamre Road would connect to local roads and informal pedestrian pathways in St Clair to the east of Mamre Road. This would benefit the community through enhanced pedestrian and cyclist connectivity in the local region and create a comfortable journey that is protected and shaded (refer to Chapter 3). By connecting the pathway along Mamre Road to local streets in St Clair may encourage more people in the socio-economic study area to use the space, enhancing their wellbeing through use of active transport. The provision of active transport would provide more transport choices for the community, providing them with options to connect to the broader study area, including access to public transport facilities.

The existing bus stops would be reinstated at the Banks Drive intersection to account for the new layout of the road. Improvement to bus service times would be expected from the proposal due to increased capacity and inclusion of signalised intersections. Indented bus bays would be provided on the departure side of the Banks Drive, Solander Drive and Erskine Park Drive intersections to improve traffic flow on Mamre Road as stopping buses would not stop traffic flow. This would also separate public transport users from moving

traffic, it would allow commuters to safely get on and off buses. This would benefit all commuters, but especially elderly commuters and less mobile commuters, including people with prams and wheelchairs. It is likely that school children travelling to Banks Drive and Bakers Lane and staff/students/parents of the Old MacDonald Childcare Centre on Mandalong Close would benefit from these improvements, due to improved travel times and efficiency of the road network.

The sensitivity of road users (both local and those travelling through the direct study area) to changes in access and connectivity is negligible. The magnitude of the changes during operation would be negligible, resulting in the significance of the impact being negligible.

Social infrastructure

The proposal would provide road infrastructure to better access social infrastructure within the socio-economic study area. Improved movement and travel times would improve connectivity to services and social infrastructure facilities including parks, recreational areas, community facilities and educational facilities. Some key permanent changes to social infrastructure are detailed in Table 6-73.

Table 6-73: Operational impacts to social infrastructure in the direct study area

Facility	Impacts
Mamre House	<p>The existing driveway from Mamre Road would be closed, and a new access to be provided from the Banks Drive intersection. The community may feel as though the facility has lost cultural and heritage value, potentially impacting visitation to the facility. However, the proposal would not directly affect operation of the site.</p> <p>In addition, amenity impacts from the proposal include increased traffic noise (due to the road moving closer to the property) and changes in the visual outlook.</p> <p>The potential impacts on the amenity of Mamre House would be minimised by sympathetic urban design and landscaping as well as consideration of opportunities for heritage interpretation or signage within or near Mamre House.</p>
Erskine Park Rural Fire Brigade	<p>The new Luddenham Road intersection layout would improve accessibility for the Erskine Park Rural Fire Brigade to the road network. The upgrade is also expected to improve travel times, which would assist the brigade's emergency response time. Improved travel times and movements on Mamre Road are also expected to improve access by other emergency services in the broader study area.</p>

Facility	Impacts
Old MacDonald Childcare Centre	<p>The new shared user pathway may encourage people to cycle or walk to and from the centre. However, once people cross Mamre Road at Erskine Park Road intersection and travel to Mandalong Close, there isn't a pathway that they can continue on to access the childcare centre.</p> <p>Vehicle access to the childcare centre would alter, with Mandalong Close becoming a left-in left-out arrangement. This could result in increased travel times and changes in travel routes for parents seeking to drop off and pick up children.</p> <p>Noise and visual impacts would noticeable due to the road moving closer to the facility and the increased prominence of the road infrastructure.</p>

By also improving movement and travel times between the M4 Motorway and Erskine Park Road, it would improve accessibility to other social infrastructure facilities in the broader study area, including those in St Clair, Erskine Park, as well as those on Bakers Lane in Kemps Creek and along Luddenham Road. This would have positive liveability impacts on the socio-economic study area, due to the safer and more efficient environment.

The sensitivity of people using social infrastructure during operation of the proposal is moderate. The magnitude of the operation if the proposal on social infrastructure is moderate, resulting in a moderate impact of significance.

Business operations

The proposal would provide benefits to commercial operations and businesses within and travelling through the direct study area by increasing road capacity and improving travel times. This is also expected to have beneficial effects for freight carriers and vehicles travelling to the industrial precincts in the broader study area.

The proposal may also have an indirect positive impact on tourism during the operational phase of the proposal. The improved movements, travel time and opportunities for active and public transport connectivity would improve access through the broader study area and future Western Sydney Airport. Similarly, proposed urban design elements would contribute to the liveability of the direct study area for residents and visitors.

There are also expected to be noise impacts to the Blue Cattle Dog Hotel during the operation of the proposal as a result of road traffic noise levels. Additional noise mitigation would be required to be investigated for the hotel to mitigate potential impacts to the business during operation.

The sensitivity of businesses during operation of the proposal is low. The magnitude of the operation if the proposal on businesses is negligible, resulting in a negligible impact of significance.

Amenity and community values

The proposal is expected to have beneficial outcomes to road users through the improvement of movement and travel times. Liveability would be improved through the safer and efficient environment provided by the proposal. The increased capacity of the road corridor would also contribute to a safer road network as traffic flow would be improved and movements would be controlled by signalised intersections.

The proposal would seek to improve quality of service, sustainability and liveability by providing facilities for walking, cycling and future public transport needs. The new shared path along the eastern side of Mamre Road would include green cover (i.e. plants) and shade to protect pedestrian areas from heat. There would also be lighting, the creation of 'pedestrian portals', provision of stopping points along shared paths and consideration of other urban design features. These inclusions would also mask out the visual impacts of the new noise walls. This would have a positive impact on the visual amenity of the socio-economic study area, as well as the wellbeing of the community through increased active transport use.

The proposal would bring the road footprint closer to properties either side of Mamre Road. This would result in noise impacts to receivers on both sides of the proposal. In particular, the residential properties on the western side of the proposal would be slightly closer to the road corridor. However, most of these properties are set back from the road and are not expected to be substantially impacted. The most affected areas are expected to be in St Clair, as the proposal would bring the road closer to the properties on the eastern side of the proposal in the northern section. This includes properties closest to intersection works at Banks Drive, including the KFC fast food restaurant and Blue Cattle Dog Hotel.

The proposal would include the installation of noise walls along the eastern side of Mamre Road adjacent to St Clair to minimise potential road traffic noise impacts during operation, however would result in adverse visual impacts, particularly to residents on the eastern side.

Vegetation removal during construction would be offset by landscaping works and the proposed urban design features. This would minimise visual impacts and break up the presence of the widened road within the environment.

The sensitivity of the community to changes in amenity and values is moderate. The magnitude of the impacts during construction is moderate, resulting in the level of significance being moderate.

6.10.5 Safeguards and management measures

Table 6-74 provides the management measures that would be implemented during the construction and operation of the proposal. Other safeguards and management measures that would address property and land use impacts are identified in Sections 6.4.4, 6.7.5, 6.8.4 and 6.9.5.

Table 6-74: Socio-economic and land use safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Socio-economic	<p>A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP 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. <p>The CP will be prepared in accordance with the <i>Community Involvement and Communications Resource Manual</i> (RTA, 2008a).</p>	Contractor	Pre-construction / construction	Early work / main construction work	Standard safeguard
Impacts on nearby property owners and land occupiers	<p>TfNSW will continue to consult with the community and affected property owners and land occupiers until the completion of the proposal. Discussions including the nature and timing of construction works would be required to identify relevant noise, traffic, air quality, access and visual impact mitigation measures for residents, stakeholders, and people using the proposal.</p>	TfNSW	Pre-construction / construction	Early work / main construction work	Additional safeguard
Property acquisition	<p>All property acquisition will be carried out in accordance with the <i>Land Acquisition Information Guide</i> (TfNSW, 2014b) and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i>.</p> <p>TfNSW will continue to consult with Penrith City Council regarding council owned land and assets. The design for the proposal will also be refined during detailed design to minimise impacts on community land, where possible.</p>	TfNSW	Pre-construction	N/A	Standard safeguard
Changes in access	<p>Temporary and permanent changes in access will be discussed with impacted land occupiers prior to commencement of construction and during construction activities should arrangements change.</p>	TfNSW	Pre-construction / construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Business consultation	TfNSW will consult with businesses about construction activities required for the proposal, including freight and industrial businesses that use Erskine Business Park. Measures to maintain access and visibility to businesses on Mamre Road during construction would be discussed and implemented.	TfNSW / Contractor	Pre-construction / construction	Main construction work	Additional safeguard
Social infrastructure	TfNSW will consult with facilities near the proposal including Banks Public School, Catholic Care Mamre House, Feathered Friends, Erskine Park Rural Fire Brigade, Old MacDonald Childcare Centre, Peter Kearns Memorial Oval and DOGS NSW regarding construction activities.	TfNSW / Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Relocation of bus stops during construction	Public transport users will be notified in advance of any changes to bus stop locations or bus routes through signage at the existing bus stop. Temporary bus stops would have similar features to existing bus stops, including shelters and rest areas for less mobile and elderly people and adequate way finding signage. Consultation with the relevant bus authorities will be undertaken (including school buses) to mitigate potential impacts to bus routes and times.	TfNSW / Contractor	Pre-construction / construction	Main construction work	Additional safeguard
Traffic management for all road users, including pedestrians and cyclists	Alternative routes for active transport users will be clearly identified by signage and the use of traffic controllers where required. This includes signage located in areas close to Banks Drive and Bakers Lane where school children may be travelling to and from school.	TfNSW	Pre-construction / construction	Main construction work	Additional safeguard
Removal of parking	Penrith City Council will be consulted about the permanent removal of parking spaces on Solander Drive and McIntyre Avenue.	TfNSW	Detailed design	N/A	Additional safeguard

6.11 Other impacts

This section describes the environmental factors with negligible to minor impacts associated with building and operating roads. Their impacts can be safeguarded against and managed through adopting effective standard safeguards and mitigation measures (refer to section 6.11.2).

6.11.1 Existing environment and potential impacts

Table 6-75 describes the other potential impacts that may occur from constructing and operating the proposal.

Table 6-75: Other environmental aspects

Environmental factor	Existing environment	Potential impacts
Waste and resources	<p>The existing Mamre Road generates small quantities of waste including roadside litter and excess materials from maintenance activities.</p> <p>The nearest waste disposal locations to the proposal area are:</p> <ul style="list-style-type: none"> • Cleanaway Erskine Park Transfer Station, which is accessed off James Erskine Drive, near the southern boundary of the proposal area • Patons Lane Resource Recovery Centre, which is accessed off Luddenham Road, about 2.5 kilometres south-west of the proposal area. <p>Analytical results from the PSI/DSI indicate that fill material may be characterised as General Solid Waste in accordance with the waste classification guidelines. If natural soil is disturbed within the proposal area during construction of the proposal, it is likely to meet the definition of Excavated Natural Material under the Resource Recovery Order / Resource Recovery Exemption under the POEO Act. Areas identified as</p>	<p>Waste generated during construction would likely include:</p> <ul style="list-style-type: none"> • excess building material (e.g. concrete, asphalt, steel) • packing materials (pallets, crates, plastics) • food waste and general site waste and litter • general wastewater from facilities, vehicle wash down and dust suppression • wastewater from piling, grouting, and rock drilling activities. This wastewater may potentially be alkaline and contain residual chemicals (oils, lubricants, waste fuels) • excess spoil (including asbestos contaminated spoil) • green waste (trees and other vegetation). <p>The waste generated would either be reused on-site, recycled or disposed offsite in accordance with:</p> <ul style="list-style-type: none"> • its relevant waste classification in accordance with the <i>Waste Classification Guidelines</i> (DECCW, 2014) • the waste hierarchy principles promoted by the WARR Act (refer to Section 4.2.10) • the requirements of the POEO Act and any EPL conditions (refer to Section 4.2.3).

Environmental factor	Existing environment	Potential impacts
	<p>being impacted by asbestos would meet the preliminary classification of General Solid Waste – Special Waste should off-site disposal be required.</p>	<p>Although re-use of excavated material would be prioritised, Section 3.3.5 outlines that there is expected to be a deficit in suitable fill material generated by earthworks during construction the proposal. Additional fill material would be sought from a suitably licenced nearby quarry or other sources such as nearby infrastructure projects with excess clean excavated material.</p> <p>Section 3.3.6 describes the resources that would be needed to build the proposal in addition to the imported fill. These resources are common materials and their use would not result in any resource supply shortages in the region.</p> <p>Any impact associated with waste and resource use during operation of the proposal would be negligible and largely consistent with the existing operation of the road.</p>
<p>Greenhouse gases and climate change</p>	<p>Climate change is caused by increases in greenhouse gas concentrations in the atmosphere, including those that have been emitted due to human activities, and is associated with several effects including the increased severity and frequency of extreme weather events.</p> <p>Transport emissions are currently the second largest component of the greenhouse gas emissions in NSW, comprising 21 per cent of total emissions. Road transport accounts for 85 per cent of these transport emissions (AdaptNSW, 2017). Vehicle idling and localised congestion generally increases the quantity of greenhouse gases emitted compared to when vehicles travel under free-flow conditions.</p>	<p>During construction, the proposal would result in minor greenhouse gas emissions through use of materials (including the embodied emissions in the production of materials) as well as use of construction equipment and vehicles and longer vehicle trips during use of the detour route. However, given the small scale of the proposal and the duration of the proposed detour route, these emissions would have a negligible contribution to NSW’s emissions. Opportunities to minimise emissions related to construction of the proposal would be further investigated during detailed design, including optimising the construction schedule to reduce the duration of full road closures, sourcing materials from local suppliers and using recycled and low embodied energy materials, where practical.</p> <p>The potential impacts of climate change (specifically the increased intensity of rainfall on the potential for localised flooding) has been assessed. In the Representative Concentration Pathway (RCP) 8.5 emissions scenario projected for the year 2090, the road sag north of Luddenham Road would have part of the inside southbound lane within an increased flood hazard</p>

Environmental factor	Existing environment	Potential impacts
		<p>category. This means that it would be unsafe for small vehicles in the one per cent AEP South Creek main stream flood event (refer to Appendix H).</p> <p>During operation, the proposal would improve network reliability and reduce congestion along Mamre Road, which may reduce the amount of greenhouse gas emissions from vehicles. However, the overall magnitude of any reductions in greenhouse gas emissions from vehicles travelling along the proposal are expected to be relatively negligible given the small scale of the proposal in the context of the wider road network.</p> <p>The provision of a new shared path along the eastern side of Mamre Road may encourage people to walk or cycle instead of use cars for local trips, which may also reduce greenhouse gas emissions. .</p>
Utilities	Existing utilities within the proposal area including electrical infrastructure, a gas main, telecommunications conduits and water mains have been identified and located as part of the concept design (refer to Section 3.5).	Space for utility relocation has been incorporated into the proposal area. Utilities would be relocated to minimise property acquisition and environmental impacts (including vegetation removal and heritage impacts), where possible. The strategy for the protection or relocation of existing utilities would be carried out in consultation with the relevant utility owner during detailed design to minimise the risk of damaging utilities, which may cause network outages or safety hazards. Access to utilities along Mamre Road would be maintained for utility providers during construction, where possible.

Environmental factor	Existing environment	Potential impacts
Hazards and risk management	<p>At present, NSW Rural Fire Service Bushfire Prone Land (NSW RFS, 2015) mapping classifies most of the Mamre Road corridor within the proposal area as a 'Vegetation Buffer' zone. The pastoral landscapes to the west of Mamre Road are mostly classified as 'Vegetation Category 2', which reflects a low bushfire risk. However, there are some areas of native vegetation which are classified as 'Vegetation Category 1', which is the highest risk for bushfires.</p> <p>There is no existing storage or handling of hazardous and dangerous materials associated with operation of Mamre Road beyond small quantities that may be required for occasional maintenance activities. However, there are some existing asbestos containing materials within the road corridor and fuel spills may occur as a result of vehicle crashes (refer to Section 6.6.3). As the proposal is located within an industrial area, there may be occasional heavy vehicles transporting hazardous materials and dangerous goods via Mamre Road.</p>	<p>Construction activities that may have potential to increase bushfire risk during construction include mulch stockpiling, hot works such as welding, as well as fuel/chemical storage and plant operation within vegetated areas (i.e. exhaust fires). During construction, a bushfire management plan would need to be put in place, particularly for compound sites, to consider bushfire reduction methods and the potential to incorporate asset protection zones.</p> <p>The widening of the road corridor to the west would increase the buffer zone during operation of the proposal. This would provide greater separation between the eastern residential areas and areas of land with bushfire risk. The proposal would also improve emergency access for the NSW RFS, NSW SES and other emergency services.</p> <p>Transportation, handling and storage of small quantities of hazardous materials and dangerous goods (such as paint and fuels) would be required during construction. Potential impacts to soil and water quality and workforce safety may result, should spills or inappropriate and inadequate handling or storage of these materials occur. However, this risk would be minimised through implementation of standard management measures in accordance with the CEMP as well as the mitigation measures for flooding, soil and water quality impacts outlined in Sections 6.5.4 and 6.6.5.</p> <p>During operation, the proposal is not expected to notably increase the risk associated with transportation of hazardous materials and dangerous goods via Mamre Road compared to the existing scenario. The proposal has incorporated operational water quality basins and swales, that may be able to contain any accidental spills from road incidents during operation of the road, to minimise risk of water quality impacts.</p>

6.11.2 Safeguards and management measures

Table 6-76 describes the proposed safeguards that would be introduced to manage the predicted impacts described above.

Table 6-76: Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Resource use	<p>The following resource management hierarchy principles would be followed:</p> <ul style="list-style-type: none"> • avoid unnecessary resource consumption as a priority • avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery) <p>disposal would be undertaken as a last resort (in accordance with the <i>Waste Avoidance and Resource Recovery Act, 2001</i>).</p>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
Energy consumption	Energy efficient LEDs would be considered for new streetlights installed as part of the proposal.	TfNSW	Detailed design	N/A	Additional safeguard
Waste	<p>A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:</p> <ul style="list-style-type: none"> • measures to avoid and minimise waste associated with the project • classification of wastes and management options (re-use, recycle, stockpile, disposal) • statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • procedures for storage, transport and disposal • monitoring, record keeping and reporting. <p>The WMP will be prepared taking into account the <i>Environmental Procedure - Management of Wastes on Transport for NSW Land</i> (TfNSW, 2014a) and relevant TfNSW Waste Fact Sheets.</p>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.2 of QA G36 <i>Environment Protection</i>

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Waste	Additional soil samples will be required to meet a reasonable sampling density to classify any waste produced. Additional soil samples of natural soil material will also be required to meet the requirements of Excavated Natural Material under the Resource Recovery Order (RRO) / Resource Recovery Exemption (RRE).	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Waste	Records of waste classifications, waste disposal, beneficial reuse of spoil and any asbestos monitoring and clearance certificates must be held by the contractor and provided to TfNSW on project completion.	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Utilities	Prior to the commencement of works: <ul style="list-style-type: none"> the location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners if the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment will be undertaken. 	Contractor	Detailed design / pre-construction	Early work / main construction work	Additional safeguard
Utilities	Any utilities work outside the proposal area that involves ground disturbance would require further environmental assessment.	TfNSW / Contractor	Detailed design / pre-construction	Early work / main construction work	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Hazards and risk management	<p>A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to:</p> <ul style="list-style-type: none"> • details of hazards and risks associated with the activity • measures to be implemented during construction to minimise these risks • record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • a monitoring program to assess performance in managing the identified risks • contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. <p>The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or DPIE publications.</p>	Contractor	Detailed design / pre-construction / construction	Main construction work	Standard safeguard
Hazards and risk management	<p>During construction, a bushfire management plan (BMP) would be prepared and included as part of the CEMP. This bushfire management plan should consider risk of construction compounds, feasible bushfire reduction methods and the potential to incorporate asset protection zones.</p>	Contractor	Construction	Early work / main construction work	Additional safeguard

6.12 Cumulative impacts

This section describes the potential combined and interactive impacts of the proposal with other committed and approved development in the area.

6.12.1 Study area

The study area was defined by considering other projects within Western Sydney near Mamre Road that have the potential to contribute to cumulative impacts with the proposal. The anticipated timing of the construction is from 2022 to 2025, subject to availability of funding and other commitments. This assessment includes regional projects of similar scale and function and excluded local residential developments or minor works on local roads.

6.12.2 Broader program of work

The proposal is part of a broader program of work to widen Mamre Road between the M4 Motorway, St Clair and Kerrs Road, Kemps Creek. The Mamre Road upgrade project has been split into two stages for delivery. Stage 1 (the subject of this proposal) is being delivered first due to funding availability and the immediate priority to improve road safety. The Mamre Road program of work is shown in Figure 6-37. Stage 1 ends just south of Erskine Park Road and Stage 2 will extend from south of Erskine Park Road to around Kerrs Road.

Proposed Mamre Road design

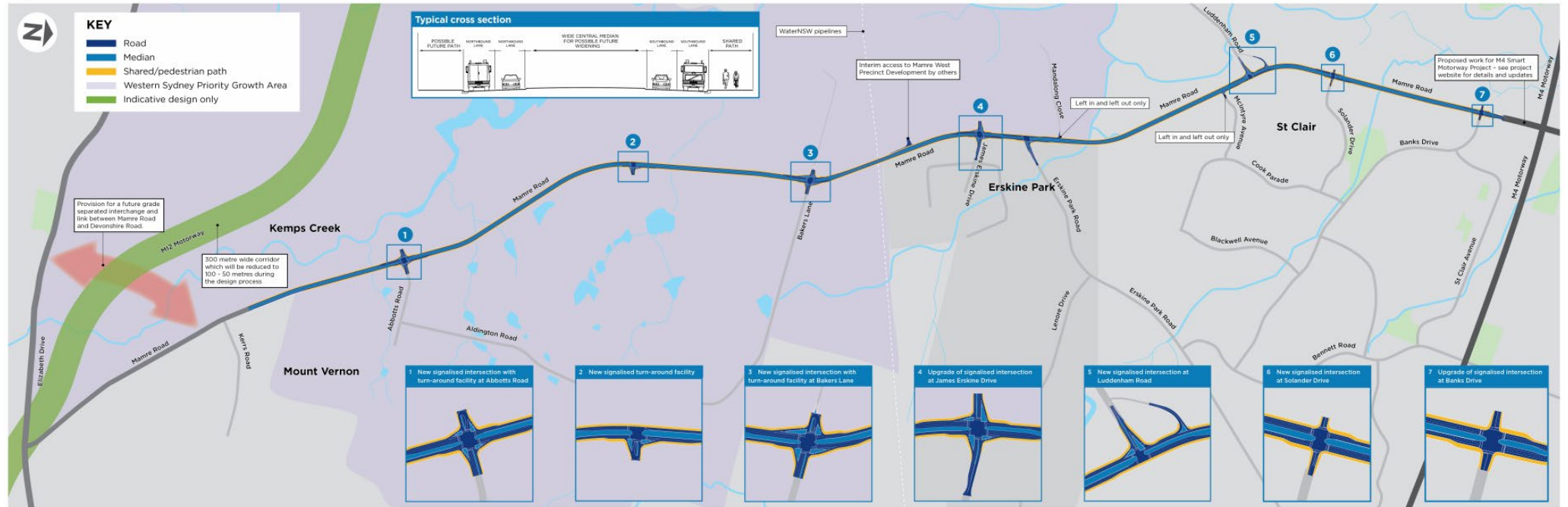


Figure 6-37: Broader program of work – proposed Mamre Road upgrade design (as per strategic design)

6.12.3 Other projects and developments

The impacts of other projects and developments near the proposal area are outlined in Table 6-77.

Table 6-77: Past, present and future projects

Project	Construction impacts	Operational impacts
<p>M12 Motorway</p> <ul style="list-style-type: none"> • A new dual-carriageway motorway to connect the M7 Motorway with the Western Sydney Airport and The Northern Road, which would pass over Mamre Road. • Construction expected 2022 – 2025. 	<p>Construction impacts of the project may include:</p> <ul style="list-style-type: none"> • clearing of vegetation including threatened ecological communities • 1560 additional construction vehicles per day • views of construction activities, including building and tree removal and temporary lighting, structures, and noise barriers • noise, vibration, dust, traffic and light spill impacts on local amenity of communities close to construction works • release of pollutants into downstream waterways and sensitive receiving environments and erosion and sedimentation of downstream water courses. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> • improved intersection performance along the Elizabeth Drive corridor between The Northern Road and Mamre Road • removal of most of the operational traffic associated with the new Western Sydney Airport from the local road network, including Mamre Road • removal / reduction of some “rat running” from local roads by providing better level of service and reduce delay on higher order of roads and encouraging more utilisation of higher order roads • introduction of substantial infrastructure into the existing Cumberland Plain landscape • permanent access adjustments to some properties • partial or complete impact of 19 Aboriginal sites • changes in localised flow from one sub-catchment to the next.

Project	Construction impacts	Operational impacts
<p>Sydney Metro Western Sydney Airport</p> <ul style="list-style-type: none"> Construction and operation of a new metro railway around 23 kilometres in length between the existing Sydney Trains suburban rail network at St Marys in the north and the Western Sydney Aerotropolis Core precinct in the south, via Western Sydney airport. Construction expected 2021 – 2026. 	<p>Construction impacts of the project may include:</p> <ul style="list-style-type: none"> road closures and diversions around construction sites, especially around St Marys Station. an additional 2044 construction related vehicle movements during peak hours on the surrounding road network, with about 50 additional vehicle per hour per peak on Mamre Road noise and vibration close to construction sites, especially close to tunnel boring machines or where background noise levels are low clearing of threatened ecological communities impact on Aboriginal and non-Aboriginal heritage sites temporary blockage of flood flow paths and increased flow rates due to vegetation clearing groundwater drawdown at locations with drained excavations. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> seamless integration with the proposed station precincts and existing and future transport interchange facilities, leading to a decreased traffic demand growth on the road network increased traffic using the Luddenham Road intersection to access the proposed Luddenham station increased peak flood levels in isolated locations.

Project	Construction impacts	Operational impacts
<p>Western Sydney Airport</p> <ul style="list-style-type: none"> • Construction of Western Sydney airport to provide additional aviation capacity in Sydney. • At the time of writing, construction was in progress, due for completion in 2026. 	<p>Construction impacts of the project may include:</p> <ul style="list-style-type: none"> • land clearing, impacting flora and fauna, and a major bulk earthworks programme • generation of an estimated 202,500 tonnes of vegetation and construction materials waste • growth in employment opportunities in the region • temporary visual impacts for sensitive receivers in Luddenham and Bringelly • disturbance of Aboriginal and non-Aboriginal heritage sites • 1254 additional vehicle movements per day on the surrounding road network during the construction period • dust emissions. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> • growth in investment, infrastructure and employment opportunities in Western Sydney • long-term noise from aircraft noise and ground-based noise • increase in nitrogen dioxide, particulate matter, carbon monoxide, sulfur dioxide and air toxics emissions • an additional 103,000 additional vehicle trips to and from the airport each day by 2063 (24-hours a day, 7-days a week), however, traffic modelling for the Western Sydney Airport indicates that it would result in less than 200 additional vehicles per peak hour by direction on Mamre Road and that Mamre Road would have no impacts due to the additional vehicles • long-term transformation of the environment from one that is mainly rural to one that is urban • changes in social amenity and lifestyle • visual impacts from overflights in areas close to the airport • change to catchment areas from earthworks activities • new bus services to and from the airport • occasional over-size vehicles to carry plant for the airport's operations.

Project	Construction impacts	Operational impacts
<p>M4 Roper Road Westbound On Ramp</p> <ul style="list-style-type: none"> Construction and operation of a new west facing ramp, providing direct access onto the M4 Motorway from traffic travelling north from St Clair. Construction expected 2021 – 2022. 	<p>Construction impacts of the project may include:</p> <ul style="list-style-type: none"> noise and additional traffic movements arising from construction activities clearing of native vegetation. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> minimised queuing effects on Erskine Park Road improved safety for road users.
<p>M4 Smart Motorways</p> <ul style="list-style-type: none"> Introduction of intelligent technology to the M4 Motorway between Pitt Street, Parramatta and Mulgoa Road, Penrith. Construction was completed in December 2020. 	<p>Construction impacts of the project included:</p> <ul style="list-style-type: none"> congestion on the M4 during AM and PM peak periods when the average speed would be up to 50 per cent less than the posted speed limits clearing of planted and remnant vegetation, including threatened ecological communities increased noise levels increased risk of dust. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> enhanced travel time reliability enhanced traffic throughput, efficiency, productivity and safety reduced vehicle emissions due to less stop-start traffic flow enhanced traveller journey decision making high impact on some identified landscape character zones.
<p>Western Sydney Employment Area</p> <ul style="list-style-type: none"> Western Sydney Employment Area (WSEA) was developed to provide businesses with land for industrial and employment purposes, close to major road transport corridors. Mamre Road Precinct, which is located south of the Warragamba Pipeline is one of the precincts within WSEA. 	<p>Construction impacts of the project may include:</p> <ul style="list-style-type: none"> construction traffic connected with 5200 construction jobs in the Mamre Road Precinct clearing of native vegetation and disruption of rural landscapes. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> increased traffic associated with the creation of 17,000 ongoing jobs in the Mamre Road Precinct when fully developed disturbance arising from proximity of residential and rural residential areas to industrial land uses.

Project	Construction impacts	Operational impacts
<p>Altis Warehouse and Logistics Hub</p> <ul style="list-style-type: none"> Altis Property Partners propose to construct and operate a warehouse and logistics hub in Orchard Hills. The development is located within the Mamre West Precinct Construction beginning in 2021. 	<p>Construction impacts of the project may include:</p> <ul style="list-style-type: none"> construction traffic on local roads limited capacity at the James Erskine Drive intersection during the construction of the western leg conversion of land use from rural/residential purposes to logistics/industrial purposes tree removal for building pads. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> operational traffic associated with access to the facility via Mamre Road (550 vehicles per hour for each peak period) warehousing and distribution activities on a 24-hour, 7 day per week basis retain and contribute to the growth of industry in the region.
<p>Upper South Creek Advanced Water Recycling Centre</p> <ul style="list-style-type: none"> Sydney Water is planning to build and operate a wastewater treatment plant in Western Sydney. Construction expected 2022 – 2025. 	<p>Construction impacts of the project may include:</p> <ul style="list-style-type: none"> traffic impacts arising from construction works, including access via Mamre Road impacts to farm dams temporary impacts to hydrological regime and water quality noise and vibration impacts during construction disturbance of contaminated land, erosion and salinity displacement of threatened species visible construction activities generation of construction wastes. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> safety impacts due to its location beneath the future Western Sydney Airport flight path water flow and quality impact of treated water discharge to local waterways intermittent impacts on hydrological regime noise from generating equipment land acquisition for infrastructure contamination of the receiving environment contribution to climate change during construction and operation of facility visual impacts of lost vegetation where revegetation is not possible operational waste, including beneficial re-use of biosolids additional heavy vehicles along Mamre Road to deliver hazardous goods required for operation of the proposal.

Project	Construction impacts	Operational impacts
<p>Erskine Park Road Upgrade</p> <ul style="list-style-type: none"> • Penrith City Council upgraded four intersections on Erskine Park Road • Construction was completed in June 2021 	<p>Construction impacts of the project included:</p> <ul style="list-style-type: none"> • traffic impacts, including temporary disrupted access and flow • noise impacts at residential receivers • biodiversity impacts, on 0.44 hectares of Cumberland Plain Woodland, however this was determined to not be significant. 	<p>Operational impacts of the project may include:</p> <ul style="list-style-type: none"> • improved traffic safety and flow along Erskine Park Road • improved capacity for future traffic growth • improved intersection performance • improved pedestrian and cyclist facilities • noise impacts at residential receivers.

6.12.4 Potential cumulative impacts

Potential cumulative impacts of the proposal with other committed and approved development in the area are presented in Table 6-78.

Table 6-78: Potential cumulative impacts

Environmental factor	Construction	Operation
Traffic	<p>There is potential for substantial cumulative traffic impacts across the road network in the Western Sydney during the proposed construction period of 2022 – 2025, where other nearby projects are also being constructed at the same time.</p> <p>Concurrent projects would generate additional construction traffic, including increased heavy vehicle activity on the surrounding road network. This is likely to affect main roads in the area including the M4 Motorway, Mamre Road, Erskine Park Road and Luddenham Road. However, there may also be impacts to local roads where detours may be required or motorists try and avoid construction areas.</p> <p>This may require coordination between project teams in planning detour routes between the M4 Motorway and Elizabeth Drive or additional safeguards and management measures, as required.</p> <p>The upgrades to Mamre Road may also impact the proposed haulage routes for the construction of other nearby projects (especially Altis Warehouse and Logistics Hub and Upper South Creek Advanced Water Recycling Centre) and may increase the travel time to and from the construction sites.</p>	<p>The proposal, in conjunction with other projects, would create cumulative benefits to the traffic flow, reliability and road safety along key roads in the network in western Sydney. These projects, would, in turn would support other developments and future growth in the area and provide connections to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis.</p>
Noise	<p>Construction of the proposal at the same time as other nearby projects would potentially lead to a short-term cumulative increase in construction noise levels (including construction traffic noise) experienced by sensitive receivers. There may also be a risk of construction fatigue for sensitive receivers that may have recently experienced noise generated from completed construction activities (such as from the M4 Smart Motorways project).</p>	<p>Any cumulative noise impacts during operation are expected to be negligible.</p>

Environmental factor	Construction	Operation
Biodiversity	Cumulative native vegetation and habitat removal for the projects would impact biodiversity across the Western Sydney region.	<p>The operation of the projects is expected to lead to a local and regional loss of vegetation communities and loss of biodiversity values across the area.</p> <p>Increased edge effects and reduction in vegetation patch sizes would also occur.</p>
Visual amenity	The presence of compound sites, stockpiles and construction plant and equipment for concurrent projects would lead to a general increase in visibility of construction sites across the broader region.	The above projects represent permanent changes to the visual landscape of the region. Each project would have a different impact on visual amenity, dependent on the magnitude of their visual profiles. However, all projects listed in Table 6-77 form part of the broader development strategy for Western Sydney, which would convert more of the rural residential and rural landscapes into more urbanised areas for industrial, commercial or residential activities. This would lead to a long-term change in the environment of Western Sydney.
Soil and water quality	There is potential for dust and sediment-laden runoff to be generated from large areas of exposed soils, which may enter surrounding waterways. The safeguards applied for these impacts in each project would mitigate these impacts.	During operation, soil erosion and sedimentation would be minimised through landscaping and vegetation management and installation of water quality treatment measures, such as swales, scour protection and operational water quality basins for various projects.
Socio-economic	Given many of the projects identified in Table 6-77 are occurring across the broader Western Sydney region, there is potential for construction fatigue to be experienced by both receivers who live or work near the proposal area, or those who regularly commute through the proposal area.	The operation of the proposal and nearby projects would provide significant socio-economic benefits observed through growth in investment, infrastructure and employment opportunities in Western Sydney.

6.12.5 Safeguards and management measures

It may not be possible to directly safeguard or manage impacts from other projects to minimise cumulative impacts. However, there would be an opportunity for TfNSW to work with the other developers to modify the proposal's detailed design, construction methodology and timing to consider the above cumulative effects. Table 6-79 lists the safeguards and management measures that would be implemented to account for the potential cumulative impacts.

Table 6-79: Cumulative impact safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
Cumulative construction impacts	Other developers would be consulted in accordance with the Community Stakeholder and Engagement Plan to: <ul style="list-style-type: none"> • obtain information about project timeframes and impacts • manage the interfaces of the proposal's staging and programming in combination with the other projects occurring in the area • identify and implement appropriate safeguards and management measures to minimise cumulative impacts. 	TfNSW and Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Cumulative traffic impacts	TfNSW would coordinate with the project team and the Transport Management Centre for the Altis Warehouse and Logistics Hub, Upper South Creek Advanced Water Recycling Centre and WSEA Mamre Road Precinct developments about the proposed timing of the road and lane closures and identify alternate routes or additional safeguards and management measures, as required.	TfNSW and Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
Cumulative construction impacts	The CEMP would consider potential cumulative construction impacts from known surrounding development activities (see Section 6.12.3) as well as new planned development activities near the proposal, as they become known. This would include a process to regularly review and update mitigation measures as new works are identified that may lead to cumulative impacts or if complaints are received due to cumulative impacts.	TfNSW and Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard

7 Environmental management

This chapter describes how the proposal will be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided. A summary of site-specific environmental safeguards is provided and the licence and/or approval requirements required prior to construction are also listed.

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will initially be prepared prior to the early work stage of the proposal and will address the construction measures relevant to the early work stage only. The CEMP will then be updated prior to the main construction work to include the mitigation measures that relate to that construction stage. Each version of the CEMP must be reviewed and certified by the TfNSW Environment Officer, Western Sydney Project Office, prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP and PEMP would be developed in accordance with the specifications set out in the QA Specification G36 – *Environmental Protection (Management System)*, QA Specification G38 – *Soil and Water Management (Soil and Water Plan)*, QA Specification G40 – *Clearing and Grubbing*, QA Specification R44 – *Earthworks*, QA Specification G10 – *Traffic Management*.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

Table 7-1: Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
GEN1	General - minimise environmental impacts during construction	<p>A CEMP will be prepared and submitted for review and endorsement of the TfNSW Environment Manager prior to commencement of the activity.</p> <p>As a minimum, the CEMP will address the following:</p> <ul style="list-style-type: none"> • any requirements associated with statutory approvals • details of how the project will implement the identified safeguards outlined in the REF • issue-specific environmental management plans • roles and responsibilities • communication requirements • induction and training requirements • procedures for monitoring and evaluating environmental performance, and for corrective action • reporting requirements and record-keeping • procedures for emergency and incident management • procedures for audit and review. <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p>	Contractor / TfNSW	Detailed design / pre-construction / construction	Early work / main construction work	Standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor / TfNSW	Pre-construction / construction	Early work / main construction work	Standard safeguard
GEN3	General – environmental awareness	<p>All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings.</p> <p>Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include:</p> <ul style="list-style-type: none"> • areas of Aboriginal heritage sensitivity and known Aboriginal sites • non-Aboriginal heritage site locations • threatened species habitat, Biobank site location and 'no-go' zones • locations of potential asbestos • areas where work is proposed within or very close to South Creek. 	Contractor	Pre-construction / construction	Early work / main construction work	Standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
B1	Biodiversity	<p>A Flora and Fauna Management Plan will be prepared in accordance with TfNSW's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RMS, 2011a) and implemented as part of the CEMP. Refer to Section 8.1 of the BDAR (Appendix D) for the individual guideline reference numbers. It will include, but not be limited to:</p> <ul style="list-style-type: none"> • plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • requirements set out in the <i>Landscape Guideline</i> (RTA, 2008b) • pre-clearing survey requirements by suitably qualified ecologists • procedures and requirements for vegetation and habitat removal • procedures for unexpected threatened species finds and fauna handling • procedures addressing relevant matters specified in the <i>Policy and guidelines for fish habitat conservation and management</i> (DPI Fisheries, 2013) • procedures for native vegetation rehabilitation and re-establishment in consideration of the landscaping plan • procedures for educating construction staff on how to implement controls to avoid or minimise potential environmental impacts • protocols to manage weeds and pathogens. 	TfNSW / Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.8 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
B2	Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.	TfNSW	Detailed design	N/A	Standard safeguard
B3	Shading and artificial light	Shading and artificial light impacts will be minimised where practicable, particularly adjacent to the BA408 Luddenham BioBank site, taking into account minimum luminescence requirements for: <ul style="list-style-type: none"> • safety when constructing during the night-time period • an urban road as outlined in the Australian Standards. 	TfNSW / Contractor	Detailed design/ construction	Early work / main construction work	Additional safeguard
B4	Impacts to habitat in human made structures	Where microbats are present and impacted within a structure, a Microbat Management Plan is to be developed by a suitably qualified microbat expert in consultation with TfNSW Biodiversity Officer. The Microbat Management Plan would be incorporated into the Flora and Fauna Management Plan. As a minimum, the plan is to include: <ul style="list-style-type: none"> • demonstrated consideration of the roosting and breeding season requirements of the target species • pre-clearing requirements for artificial habitat during pre-construction • a detailed methodology for pre-clearing surveys to identify microbats within the bridge structure • a protocol for identification, capture, and relocation of microbats • reporting requirements including species identification, number, relocation actions, exclusion methods • a protocol to routinely review and update the plan. 	Contractor	Detailed design / construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
B5	Aquatic impacts	<p>Aquatic habitat will be protected in accordance with:</p> <ul style="list-style-type: none"> • Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects (RMS, 2011a) • Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013 (Department of Primary Industries, 2013). <p>Culverts will be installed in accordance with the DPI (2013) guidelines.</p> <p>Implement and regularly maintain erosion and sediment controls for the duration of construction and landscaping works as per Landcom (2004), which will be detailed in a Soil and Water Management Plan.</p>	TfNSW / Contractor	Detailed design/ construction	Early work / main construction work	Additional safeguard
B6	Unexpected biodiversity impacts	<p>Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the proposal area.</p> <p>Signposting will be used to inform project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with fauna.</p>	Contractor	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
B7	Vehicle strike	TfNSW will monitor road kills along Mamre Road during operation to identify the need for any additional safeguards. The northern portion of the Luddenham BioBank site would require the existing fence to be removed to account for the proposal area. A new fence is to be installed at the northern portion of Luddenham BioBank site to assist in minimising fauna movement across Mamre Road.	TfNSW	Operation	N/A	Additional safeguard
B8	Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction	Early work / main construction work	Additional safeguard
B9	Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	TfNSW	Detailed design	N/A	Additional safeguard
B10	Potential impact on key fish habitat	TfNSW will continue consultation with DPI Fisheries during detailed design to identify any additional measures required to minimise potential impacts to aquatic habitat within South Creek.	TfNSW	Detailed design	N/A	Additional safeguard
B11	Removal of threatened species habitat and habitat features	Habitat removal minimised through detailed design. Develop and implement a Flora and Fauna Management Plan as part of the CEMP. Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a). Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a).	TfNSW / Contractor	Detailed design / Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
		<p>Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a).</p> <p>The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA, 2011a) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.</p>				
AH1	Aboriginal heritage	The design and construction methodology for the proposal will be reviewed during detailed design to identify any further areas where direct impacts on Aboriginal sites could be avoided or minimised.	TfNSW	Detailed design	N/A	Additional safeguard
AH2	Aboriginal heritage	<p>An Aboriginal Heritage Impact Permit (AHIP) will be sought under section 90A of the NPW Act for Aboriginal sites with expected direct impacts (excluding the area within the boundary of existing AHIP C0002113) prior to construction. This is likely to include (subject to design refinement):</p> <ul style="list-style-type: none"> • Mamre Road 1 (AHIMS 45-5-3167) • Mamre Road AFT 1 (AHIMS 45-5-5337) • Mamre Road AFT 2 (AHIMS 45-5-5336) • Mamre Road AFT 3 (AHIMS 45-5-5335) • Mamre Road AFT 4 (AHIMS tbc) • Mamre Road AFT 5 (AHIMS tbc) • Mamre Roadt IF 1 (AHIMS 45-5-5338) <p>MWP-AD5/MWP-AD6 (AHIMS 45-5-4815/45-5-4813)</p>	TfNSW	Detailed design / pre-construction	N/A	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
AH3	Mamre Road 1 and Mamre Road IF 1	Mamre Road 1 and Mamre Road IF 1 will be subject to community collection prior to any construction that may impact these sites. Community collection activities will be undertaken in accordance with the methodology attached as Appendix D in the <i>Aboriginal cultural heritage assessment report</i> (KNC, 2021b).	TfNSW	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
AH4	Salvage excavation	<p>Salvage excavations will be undertaken on the impacted portions of the following sites prior to construction works that would impact these sites:</p> <ul style="list-style-type: none"> • Mamre Road AFT 1 • Mamre Road AFT 2 • Mamre Road AFT 3 • Mamre Road AFT 4 • Mamre Road AFT 5 • MWP-AD5/MWP-AD6. <p>Salvage excavation activities will be undertaken in accordance with the methodology attached as Appendix D in the <i>Aboriginal cultural heritage assessment report</i> (KNC, 2021b).</p>	TfNSW	Pre-construction / construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
AH5	Aboriginal heritage	<p>Short-term management of collected Aboriginal objects:</p> <ul style="list-style-type: none"> Any Aboriginal objects that are removed from the land by actions authorised by an AHIP, would be moved as soon as practicable to the temporary storage location (Kelleher Nightingale Consulting Pty Ltd, Level 10, 25 Bligh Street, Sydney NSW 2000) pending any agreement reached about the long-term management of the Aboriginal objects. Any Aboriginal objects stored at the temporary storage location would not be further harmed, except in accordance with the conditions of the AHIP. 	TfNSW	Pre-construction / construction	Early work / main construction work	Additional safeguard
AH6	Aboriginal heritage	<p>The long-term management of collected Aboriginal objects would occur as follows:</p> <ul style="list-style-type: none"> Recovered objects would be lodged with the Australian Museum in the first instance in accordance with the <i>Australian Museum Archaeological Collection Deposition Policy</i> (Australian Museum, 2012) If required, a variation would be sought for recovered objects to be held by the Aboriginal community or reburied. If reburial is to take place, registered Aboriginal stakeholders would be notified and given the opportunity to attend. Requirement 26 "Stone artefact deposition and storage" in the <i>Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW</i> would be complied with. 	TfNSW	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
AH7	Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the <i>Procedure for Aboriginal cultural heritage consultation and investigation</i> (TfNSW, 2012) and <i>Standard Management Procedure - Unexpected Heritage Items</i> (TfNSW, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The AHMP will be prepared in consultation with all relevant Aboriginal groups.	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.9 of QA G36 <i>Environment Protection</i>
AH8	Aboriginal heritage	<i>The Standard Management Procedure - Unexpected Heritage Items</i> (TfNSW, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where TfNSW does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only recommence once the requirements of that Procedure have been satisfied.	Contractor	Construction	Early work / main construction work	Section 4.9 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
AH9	Aboriginal heritage	<p>Barrier fencing will be established on the AHIP boundary, where feasible, to make sure that no construction impact extends into areas of Aboriginal sites outside the AHIP boundary including:</p> <ul style="list-style-type: none"> • Mamre Road AFT 1 • Mamre Road AFT 3 • Mamre Road AFT 4 • Mamre Road AFT 5 • MWP-AD7 • MWP-AD8 • MWP-IF1 <p>Aboriginal sites outside of the AHIP boundary will be marked as environmentally sensitive “no-go zones” within the CEMP.</p>	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
AH10	Aboriginal heritage	Workers will be inducted on appropriate protection measures for Aboriginal heritage and to comply with conditions in the AHIP.	Contractor	Construction	Early work / main construction work	Additional safeguard
AH11	Aboriginal heritage	The proposed works overlap an area that has been previously assessed for Aboriginal cultural heritage values and is already covered under an existing Aboriginal heritage impact permit (AHIP C00002113). As TfNSW are the holder for AHIP C00002113, any works related to the current proposal undertaken within the boundary of AHIP C00002113 would need to comply with the existing permit conditions.	TfNSW	Construction	Main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
NAH1	Non-Aboriginal heritage	<p>A Non-Aboriginal Heritage Management Plan (NAHMP) would be prepared and implemented as part of the CEMP. It would provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage including but not limited to the following:</p> <ul style="list-style-type: none"> • a map identifying locations of no-go areas, including listed item curtilages, which are to be avoided • identification of potential environmental risks/impacts due to the works/activities • site inductions and heritage awareness training • management measures to avoid or minimise potential impacts • outline of the content to be included in toolbox talks regarding management of Non-Aboriginal heritage, including identification of no-go areas, any relevant permits and any responsibilities specified under the <i>Heritage Act 1977</i>. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.10 of QA G36 <i>Environment Protection</i>
NAH2	Non-Aboriginal heritage	<p><i>The Standard Management Procedure - Unexpected Heritage Items</i> (TfNSW, 2015) would be followed if any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work would only re-commence once the requirements of that Procedure have been satisfied.</p>	Contractor	Construction	Early work / main construction work	Section 4.10 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
NAH3	Mamre House	<p>Mamre House, including significant gardens and grounds, would be protected throughout construction. Mitigation measures would include:</p> <ul style="list-style-type: none"> • cordoning off the Mamre House building and other significant buildings and gardens, and defining these as a 'no works' zone to minimise impacts on the site and avoid any inadvertent damage to the property and significant grounds • work completed within the SHR curtilage of the site would be carried out in accordance with the relevant conservation policies included within the Mamre House CMP (Section 6). 	Contractor	Construction	Early work / main construction work	Additional safeguard
NAH4	Marsden Memorial Cairn	<p>Retain and conserve the Marsden Memorial Cairn in an appropriate location within the SHR curtilage of Mamre House adjacent to the new driveway.</p> <p>Minimise through design and detailing any impacts on its setting and visibility from Mamre Road.</p>	Contractor	Detailed design / construction	Main construction work	Additional safeguard
NAH5	Mamre House driveway	<p>A landscape solution for the redundant gated entrance and signage to Mamre Homestead off Mamre Road would be informed by specialist heritage advice and consider the significant pastoral setting and the heritage significance of the property beyond, and might include but not be limited to updated signage, an interpretation node for vehicles, and lighting.</p>	Contractor	Detailed design	N/A	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
NAH6	Heritage interpretation opportunities	<p>Post-contact and contemporary Aboriginal cultural heritage values interpretation opportunities would be considered through the proposal area, including locations such as:</p> <ul style="list-style-type: none"> the Mamre House grounds as part of the new driveway landscape treatment along new pedestrian pathways and portals on the St Clair side of the proposal area noise walls proposed along the length of the proposal area. near a scar tree identified near the Blaxland Memorial Cairn. 	Contractor	Detailed design	N/A	Additional safeguard
NAH7	Non-Aboriginal heritage – archival recording	Undertake an external photographic archival recording of Mamre House, focusing on driveway changes and realignment as well as changes to the setting of the Memorial Cairn.	Contractor	Detailed design / pre-construction	N/A	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
TT1	Traffic and transport	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the TfNSW <i>Traffic Control at Work Sites Manual</i> (RTA, 2010) and <i>QA Specification G10 Control of Traffic</i> (TfNSW, 2008). The TMP will include:</p> <ul style="list-style-type: none"> • confirmation of haulage routes • measures to maintain access to local roads and properties • construction traffic control plans outlining site specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access • requirements and methods to consult and inform the local community of impacts on the local road network • access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • a response plan for any construction traffic incident • consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • monitoring, review and amendment mechanisms. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.8 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
TT2	Construction site access	<p>Construction site access will be designed and implemented in consideration of:</p> <ul style="list-style-type: none"> road design guidelines and turning paths for heavy vehicles appropriate sight distances and deceleration/acceleration lanes (where required near highly trafficked areas) to allow traffic to safely enter and exit conspicuous temporary regulatory, warning and guide signs use of accredited traffic controllers, where appropriate and/or other controls to separate, slow down or temporarily stop traffic for safe entry/exit minimising use of local roads, where practical minimising the size of heavy vehicles that would use local roads to access construction zones safe arrangements for pedestrians and/or cyclists. 	Contractor	Detailed design / construction	Main construction work	Additional safeguard
TT3	Temporary traffic arrangement	<p>The temporary traffic arrangement for Mamre Road will be designed to provide at a minimum, where feasible and reasonable:</p> <ul style="list-style-type: none"> single through lane per direction maintain traffic movements at intersections lanes widths of at least 3.5m 0.5m shoulder. <p>The posted speed limit is also proposed to be reduced from 80 kilometres per hour to 60 kilometres per hour along Mamre Road during construction.</p>	Contractor	Detailed design / construction	Main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
TT4	Traffic impacts	Further traffic modelling will be carried out during detailed design following confirmation of the construction methodology and traffic staging to confirm the potential for traffic impacts and identify whether any additional mitigation measures or traffic control measures would be required.	Contractor	Detailed design	N/A	Additional safeguard
TT5	Impact on bus stops or routes	If any potential direct impacts on bus stops or routes during construction are identified, TfNSW will consult with the relevant bus operator/s to identify alternate arrangements.	TfNSW	Pre-construction / construction	Main construction work	Additional safeguard
TT6	Damage to local roads	A Road Dilapidation Report will be prepared by a suitably qualified person for local roads proposed to be used by heavy vehicles, before the commencement of use of the roads during construction. Any damage to the local road network identified to be caused by construction vehicles for the proposal will be remediated rectified by the contractor to be similar to the existing road condition or compensation will be paid to the relevant road authority.	TfNSW / Contractor	Pre-construction / post-construction	N/A	Additional safeguard
TT7	Impacts on cycling	During detailed design, a cyclist detour strategy would be prepared and implemented during construction to minimise any temporary impacts on cycling during construction. Community consultation will be carried out to understand the travel patterns of cyclists and inform the cyclists of any alternate access arrangements.	TfNSW / Contractor	Detailed design / pre-construction / construction	Main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
TT8	Temporary access changes	Detours during temporary access changes will be implemented with directional signage along alternate routes, including advice to pedestrians and cyclists of any path closures.	Contractor	Construction	Early work / main construction work	Additional safeguard
TT9	Traffic management measures	Any temporary traffic diversions, clearways and road closures will be implemented in accordance with Transport Management Centre (TMC) requirements.	Contractor	Construction	Early work / main construction work	Additional safeguard
TT10	Property access	Property access will be maintained where feasible and reasonable and property owners (including Erskine Park Rural Fire Service and Mamre House) will be consulted before starting any work that may restrict or control access.	Contractor	Construction	Early work / main construction work	Additional safeguard
TT11	Local road or shared path closures	Council will be consulted with prior to any local road or shared path closures to identify suitable mitigation measures such as detour routes.	Contractor	Construction	Early work / main construction work	Additional safeguard
TT12	Parking	Off-road parking for construction vehicles will be provided within the compound sites and construction areas.	Contractor	Construction	Main construction work	Additional safeguard
HF1	Flood risk	Flood modelling will be carried out to confirm flood impacts during detailed design including consideration of the potential noise wall on PMF flood risk.	TfNSW	Detailed design	N/A	Additional safeguard
HF2	Flood risk	Conduct an allotment and flood level survey of 43 and 44 McIntyre Avenue, St Clair to confirm flood inundation risk for these properties.	TfNSW	Detailed design	N/A	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
HF3	Scour risk	The detailed design will consider the need to provide scour protection and energy dissipation measures to mitigate the localised increases in flow velocities at the outlets that are to be upgraded, relocated or new stormwater drainage systems.	TfNSW	Detailed design	N/A	Additional safeguard
HF4	Flooding	Further consideration of measures to minimise flooding impacts on the compound sites and construction activities will be undertaken during detailed design. This will include identification of: <ul style="list-style-type: none"> • areas where material storage and stockpiles could be located outside of land subject to flooding in a 20 year ARI flood event • feasible design measures or construction methods to minimise sedimentation and cross contamination risks where flood prone land cannot be avoided for material storage and stockpiles such as installing erosion and sediment controls around compound site boundaries 	TfNSW / Contractor	Detailed design	N/A	Additional safeguard
HF5	Hydrology impacts	The detailed design of any temporary waterway crossings will be developed in consultation with the TfNSW Environmental Officer and include appropriate pipe outlets, scour protection and flood immunity to minimise impacts on hydrology and flooding.	TfNSW	Detailed design	N/A	Additional safeguard
HF6	Hydrology impacts	All work within waterways will be carried out in accordance with the <i>Code of practice for minor work in NSW waterways</i> (Roads and Maritime, 2014a).	Contractor	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
HF7	Flooding	<p>The CEMP will include a Construction Flood Management Plan, which will include details and procedures to minimise the potential for construction activities to adversely impact on flood behaviour.</p> <p>This Plan will define the flood immunity criteria (including consideration of inundation from minor rain events) for material storage and stockpile areas proposed to be located on land that is inundated during a 1% AEP event.</p> <p>Measures to manage residual flood impacts that will be outlined in the Plan will include:</p> <ul style="list-style-type: none"> • staging construction to limit the extent and duration of temporary works on the floodplain • ensuring construction equipment and materials are removed from floodplain areas at the completion of each work activity or should a weather warning be issued of impending flood producing rain • providing temporary flood protection to properties identified as being at risk of adverse flood impacts during any stage of construction of the proposal, where feasible and reasonable • limiting the extent of works located in floodway areas • monitoring weather conditions (existing and forecast conditions), including minor rain events, local weather warnings and river water level data • a communication protocol to disseminate warnings to construction personnel of impending flood producing rain or predicted flooding and actions required to make construction areas stable and safe • implementation of a flood evacuation plan. 	TfNSW / Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
HF8	Flooding	<p>A flood evacuation plan for construction personnel, materials and equipment will be prepared to manage a potential flood event during construction and included as part of the CEMP. This plan will be implemented during construction and outline:</p> <ul style="list-style-type: none"> • procedures to monitor rainfall that may influence water levels • what flood event would trigger the plan • evacuation procedures including a map indicating the area that is flood prone and suitable evacuation locations • procedures to reduce risk during a flood event including removal of all plant/equipment and stabilising exposed areas. 	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
HF9	Flooding	<p>The storage of hazardous material will be confined to areas that are not subject to flooding during a one per cent AEP extent or either:</p> <ul style="list-style-type: none"> • stored in a manner that prevents their mobilisation during times of flood • be removed from the floodplain when minor rain events are predicted to inundate storage areas and at the onset of a flood. 	Contractor	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
SW1	Soil and water	<p>A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP to manage water quality impacts during construction of the proposal. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and sedimentation, dewatering and water pollution and describe how these risks will be addressed during construction.</p> <p>The Soil and Water Management Plan (SWMP) will be reviewed by a soil conservationist on the TfNSW list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address the outcomes of the review.</p>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 2.1 of QA G38 <i>Soil and Water Management</i>
SW2	Soil and water	<p>A site specific Erosion and Sediment Control Plan/s (ESCP) will be prepared and implemented as part of the SWMP.</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>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 2.2 of QA G38 <i>Soil and Water Management</i>
SW3	Soil and water	A construction water quality monitoring plan will be prepared and implemented as part of the SWMP. The plan will be prepared in accordance with the TfNSW Guideline for Construction Water Quality and EPA publication "Approved Methods for the Sampling and Analysis of Water Pollutants in NSW.	Contractor	Detailed design / pre-construction / construction	Main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
SW4	Soil and water	The design and construction of watercourse crossings, works within a watercourse or works on waterfront land as defined by the <i>Water Management Act 2000</i> are to be undertaken with consideration to the <i>Guidelines for instream works on waterfront land</i> (DPI, 2012a), <i>Guidelines for watercourse crossings on waterfront land</i> , (DPI, 2012b) and in accordance with relevant TfNSW specifications and guidelines.	TfNSW / Contractor	Detailed design / construction	Early work / main construction work	Additional safeguard
SW5	Contaminated land	A Contaminated Land Management Plan will be prepared in accordance with the <i>Guideline for the Management of Contamination</i> (TfNSW, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to: <ul style="list-style-type: none"> capture and management of any surface runoff contaminated by exposure to the contaminated land further investigations required to determine the extent, concentration and type of contamination, as identified in the detailed site investigation (Phase 2) management of the remediation and subsequent validation of the contaminated land, including any certification required measures to ensure the safety of site personnel and local communities during construction. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.2 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
SW6	Contaminated land	A Remediation Action Plan (RAP) and an Unexpected Find Protocol (UFP) will be prepared and implemented to manage the potential for soil or water quality contamination during construction of the proposal. The RAP will evaluate potential remedial options and recommend a preferred option to manage the ACM during the construction of the road upgrades. The RAP should include a Long-Term Environmental Management Plan for the ACM material (should it remain in the proposal alignment). The RAP should include a preliminary plan to manage potential risks to human health and the environment during the remediation activities. The RAP will form a part of the overall CEMP.	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
SW7	Asbestos	When working in areas impacted by asbestos, Work Health and Safety (WHS) and additional controls must be in place to minimise exposure risks. These may include physical removal of asbestos fragments from the soil surface, additional dust suppression and appropriate PPE.	Contractor	Construction	Early work / main construction work	Additional safeguard
SW8	Asbestos	Asbestos air monitoring by a licensed hygienist/LAA should be carried out for the duration of the earthworks to monitor for respirable asbestos fibres which may be released.	Contractor	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
SW9	Accidental spill	A site-specific emergency spill plan will be developed and include spill and leak management measures in accordance with the TfNSW <i>Code of Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including TfNSW and EPA officers).	Contractor	Pre-construction / construction	Early work / main construction work	Section 4.3 of QA G36 <i>Environment Protection</i>
SW10	Accidental spill	Spill containment to be provided within operational water quality basins located within road catchments considered to present a high risk to South Creek.	Contractor	Detailed design	N/A	Additional safeguard
SW11	Stormwater	The layout and detail of the drainage system including drainage, water quality basins, spill containment, swales, discharge points and outlet scour protection measures will be refined during detailed design.	TfNSW	Detailed design	N/A	Additional safeguard
SW12	Stormwater	Stormwater outlets to local drainage lines and waterways are to be designed with consideration to the <i>Guidelines for outlet structures on waterfront land</i> (DPI, 2012c) and relevant TfNSW specifications and guidelines.	TfNSW	Detailed design	N/A	Additional safeguard
SW13	Stockpiles	Stockpiles sites will be managed in accordance with <i>Environmental Procedure Management of Wastes on Roads and Maritime Services Land</i> (RMS, 2014c)	Contractor	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
SW14	Soil and water	Stockpiles site locations would be confirmed during detailed design and managed during construction in accordance with <i>Environmental Procedure Management of Wastes on Roads and Maritime Services Land</i> (RMS, 2014c) and the <i>Stockpile Site Management Guideline</i> (RMS, 2015d). This would consider measures to manage cross contamination within a stockpile area.	Contractor	Detailed design / construction	Early work / main construction work	Additional safeguard
SW15	Soil and water	Further consideration of how to manage stockpiles, material laydown and chemical storage with respect to floodwater would be undertaken during detailed design.	Contractor	Detailed design / pre-construction	N/A	Additional safeguard
SW16	Soil and water	An assessment of the impact of discharges from each temporary sediment basin would be undertaken during detailed design in accordance with the <i>Draft Guideline for Assessing the Impacts of Treated Water Discharge from Water Quality Treatment Controls</i> (TfNSW 2020d). The assessment would adopt relevant water quality objectives for South Creek and include a catchment analysis to confirm the flow characteristics of the receiving waterways.	TfNSW / Contractor	Detailed design / pre-construction	N/A	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
NV1	Noise and vibration	<p>A Construction Noise and Vibration Management Plan (CNVMP) will be prepared and implemented as part of the CEMP. The CNVMP will generally follow the approach in the <i>Interim Construction Noise Guideline (ICNG)</i> (DECC, 2009) and identify:</p> <ul style="list-style-type: none"> • nearby sensitive receivers • all potential significant noise and vibration generating activities associated with the activity • description of works, construction equipment and hours work would be completed in • results of location- and activity-specific noise and vibration impact assessments • feasible and reasonable mitigation measures to be implemented, taking into account Beyond the Pavement: urban design policy, process and principles (TfNSW, 2020b) • criteria for the proposal and relevant licence and approval conditions • a monitoring program to assess performance against relevant noise and vibration criteria • contingency measures to be implemented in the event of non-compliance with noise and vibration criteria • arrangements and details for consultation with the community, affected neighbours and sensitive receivers, including notification and complaint handling procedures • details on how respite would be applied where ongoing high impacts are seen at certain receivers. 	Contractor	Detailed design / construction	Early work / main construction work	Section 4.6 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
NV2	Noise and vibration	<p>All sensitive receivers (e.g. schools, local residents) likely to be affected will be notified at least seven days prior to commencement of any works 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 how to obtain further information. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Standard safeguard
NV3	Noise and vibration	<p>Location- and activity-specific noise and vibration impact assessments should be carried out, as a minimum, prior to activities:</p> <ul style="list-style-type: none"> with the potential to result in noise levels above 75 dBA at any receiver required outside Standard Construction Hours likely to result in noise levels in greater than the relevant NMLs with the potential to exceed relevant criteria for vibration. <p>The assessments should confirm the predicted impacts at the relevant receivers in the vicinity of the activities to aid the selection of appropriate management measures, consistent with the requirements of the CNVG. The results of these assessments will be included as part of the CNVMP.</p>	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
NV4	Noise and vibration	Monitoring should be carried out at the start of noise intensive activities to confirm that actual levels are consistent with the predictions and that appropriate mitigation measures from the CNVG have been implemented.	Contractor	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
NV5	Noise	<p>Where noise intensive equipment is to be used near sensitive receivers, the work should be scheduled for Standard Construction Hours, where possible. If it is not possible to restrict the work to the daytime, then they should be completed as early as possible in each work shift.</p> <p>Appropriate respite should also be provided to affected receivers in accordance with the CNVG.</p>	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
NV6	Noise	Hoarding, or other shielding structures, should be used where receivers are impacted near compounds or fixed work areas with long durations. To provide effective noise mitigation, the barriers should break line-of-sight from the nearest receivers to the work and be of solid construction with minimal gaps.	Contactor	Construction	Main construction work	Additional safeguard
NV7	Vibration	<p>The potential for vibration impacts and requirement for vibration intensive work and equipment will be reviewed during detailed design.</p> <p>Where work is within the minimum working distances and considered likely to exceed the cosmetic damage criteria:</p> <ul style="list-style-type: none"> • Different construction methods with lower source vibration levels will be investigated and implemented, where feasible • Attended vibration measurements will be undertaken at the start of the work to determine actual vibration levels at the item. Work should be ceased if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
NV8	Vibration	Building condition surveys should be completed before and after the work where buildings or structures are within the minimum working distances and considered likely to exceed the cosmetic damage criteria during the use of vibration intensive equipment.	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard
NV9	Operational noise mitigation	Operational noise mitigation requirements including the noise wall design and any at-property treatments will be reviewed during detailed design. At-property treatments will be agreed upon and implemented during construction, where feasible and reasonable, in consultation with property owners.	TfNSW / Contractor	Detailed design	N/A	Additional safeguard
NV10	Noise from temporary detours	The proposal should review the requirement for detours during preparation of the CNVMP when sufficient information is available to allow the potential noise impacts to be determined.	TfNSW	Detailed design / pre-construction	N/A	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
LV1	Landscape character and visual impact	<p>An Urban Design and Landscape Plan will be prepared to support the final detailed project design and implemented as part of the CEMP.</p> <p>The Urban Design and Landscape Plan 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. The Plan will include design treatments for:</p> <ul style="list-style-type: none"> • proposed landscaped areas, in consideration of advice from an ecologist, opportunities to improve riverine scenic quality and Bush Fire Prone Land • built elements including 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 works taking account of related environmental controls such as erosion and sedimentation controls and drainage • opportunities for heritage interpretation and minimisation of heritage impacts in consultation with specialist heritage advice • procedures for monitoring and maintaining landscaped or rehabilitated areas. <p>It would be prepared in accordance with relevant guidelines, including:</p> <ul style="list-style-type: none"> • Beyond the Pavement urban design policy, process and principles (TfNSW, 2020b) • <i>Noise Wall Design Guidelines</i> (Roads and Maritime Services, 2006). 	Contractor / TfNSW	Detailed design / pre-construction / construction	Early work / main construction work	Standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
LV2	Road furniture	Consolidate signage structures and minimise visual clutter and obstructions, particularly in front of Mamre House.	Contractor	Detailed design	N/A	Additional safeguard
LV3	Planting	<p>The landscaping plan for the proposal will be confirmed during detailed design and would consider:</p> <ul style="list-style-type: none"> • arranging plants to maintain the long vistas to the Blue Mountains and views to Mamre House and other heritage sites • choosing a variety of species for feature planting that is generally reflective of the existing landscape character and prioritises native vegetation • selection of plant species and layouts in riparian areas in consultation with ecologists • planting low shrubs in the median strip where it is more than three metres wide • planting to provide screening and shade, particularly along the proposed shared path • maintaining existing roadside vegetation, where possible 	TfNSW	Detailed design	N/A	Additional safeguard
LV4	Noise walls and pedestrian portals	<p>The detailed design of the noise walls and pedestrian portals will consider:</p> <ul style="list-style-type: none"> • reflecting the distinctive landscape character zones along the road corridor through colour, art and texture • opportunities for heritage interpretation at key locations • way-finding opportunities at pedestrian portals • pedestrian and cyclist safety, including lighting and using CPTED principles 	TfNSW	Detailed design	N/A	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
AQ1	Air quality	<p>An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to:</p> <ul style="list-style-type: none"> • potential sources of air pollution • air quality management objectives consistent with any relevant published EPA and/or OEH/DPIE guidelines • minimise the number of stockpiles onsite, avoid stockpiling in exposed areas and ensure long term stockpiles are covered or stabilised • emission and dust mitigation and suppression measures to be implemented • vehicles and mobile plant to use designated haulage and access routes and restrict traffic speeds on site • all vehicles transporting soils, rock or other materials are covered when entering or exiting the site • maintain all vehicles and plant in accordance with manufacturer specifications • methods to manage work during strong winds or other adverse weather conditions. Daily monitoring of weather forecasts to be undertaken to determine when adverse weather conditions are predicted. • a progressive rehabilitation strategy for exposed surfaces • daily visual observations of dust to identify construction activities, vehicles, plant or equipment that are generating excessive air emissions. Additional mitigation strategies to be implemented where necessary. 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Core standard safeguard AQ1 Section 4.4 of QA G36 <i>Environment Protection</i>
AQ2	Air quality	Concrete batching plant to be located at least 200 metres (where feasible) from residences.	Contractor	Detailed design / construction	Main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
AQ3	Air quality	TfNSW will continue consulting with DPIE regarding the potential timing and impacts on the St Marys Monitoring station during the operation of compound site 2 and options to mitigate this impact.	TfNSW	Detailed design / pre-construction	N/A	Additional safeguard
SE1	Socio-economic	<p>A Communication Plan (CP) will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The CP 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. <p>The CP will be prepared in accordance with the <i>Community Involvement and Communications Resource Manual</i> (RTA, 2008a).</p>	Contractor	Pre-construction / construction	Early work / main construction work	Standard safeguard
SE2	Impacts on nearby property owners and land occupiers	TfNSW will continue to consult with the community and affected property owners and land occupiers until the completion of the proposal. Discussions including the nature and timing of construction works would be required to identify relevant noise, traffic, air quality, access and visual impact mitigation measures for residents, stakeholders, and people using the proposal.	TfNSW	Pre-construction/ construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
SE3	Property acquisition	<p>All property acquisition will be carried out in accordance with the <i>Land Acquisition Information Guide</i> (TfNSW, 2014b) and the <i>Land Acquisition (Just Terms Compensation) Act 1991</i>.</p> <p>TfNSW will continue to consult with Penrith City Council regarding council owned land and assets. The design for the proposal will also be refined during detailed design to minimise impacts on community land, where possible.</p>	TfNSW	Pre-construction	N/A	Standard safeguard
SE4	Changes in access	Temporary and permanent changes in access will be discussed with impacted land occupiers prior to commencement of construction and during construction activities should arrangements change.	TfNSW	Pre-construction / construction	Early work / main construction work	Additional safeguard
SE5	Business consultation	<p>TfNSW will consult with businesses about construction activities required for the proposal, including freight and industrial businesses that use Erskine Business Park.</p> <p>Measures to maintain access and visibility to businesses on Mamre Road during construction would be discussed and implemented.</p>	TfNSW / Contractor	Pre-construction/ construction	Main construction work	Additional safeguard
SE6	Social infrastructure	TfNSW will consult with facilities near the proposal including Banks Public School, Catholic Care Mamre House, Feathered Friends, Erskine Park Rural Fire Brigade, Old MacDonald Childcare Centre, Peter Kearns Memorial Oval and DOGS NSW regarding construction activities.	TfNSW / Contractor	Pre-construction/ construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
SE7	Relocation of bus stops during construction	<p>Public transport users will be notified in advance of any changes to bus stop locations or bus routes through signage at the existing bus stop.</p> <p>Temporary bus stops would have similar features to existing bus stops, including shelters and rest areas for less mobile and elderly people and adequate way finding signage. Consultation with the relevant bus authorities will be undertaken (including school buses) to mitigate potential impacts to bus routes and times.</p>	TfNSW / Contractor	Pre-construction / construction	Main construction work	Additional safeguard
SE8	Traffic management for all road users	Alternative routes for active transport users will be clearly identified by signage and the use of traffic controllers where required. This includes signage located in areas close to Banks Drive and Bakers Lane where school children may be travelling to and from school.	TfNSW	Pre-construction / construction	Main construction work	Additional safeguard
SE9	Removal of parking	Penrith City Council will be consulted about the permanent removal of parking spaces on Solander Drive and McIntyre Avenue.	TfNSW	Detailed design	N/A	Additional safeguard
O1	Resource use	<p>The following resource management hierarchy principles would be followed:</p> <ul style="list-style-type: none"> • avoid unnecessary resource consumption as a priority • avoidance would be followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery) disposal would be undertaken as a last resort (in accordance with the <i>Waste Avoidance and Resource Recovery Act, 2001</i>). 	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
O2	Energy consumption	Energy efficient LEDs would be considered for new streetlights installed as part of the proposal.	TfNSW	Detailed design	N/A	Additional safeguard
O3	Waste	<p>A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:</p> <ul style="list-style-type: none"> • measures to avoid and minimise waste associated with the project • classification of wastes and management options (re-use, recycle, stockpile, disposal) • statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • procedures for storage, transport and disposal • monitoring, record keeping and reporting. <p>The WMP will be prepared taking into account the <i>Environmental Procedure - Management of Wastes on Transport for NSW Land</i> (TfNSW, 2014) and relevant TfNSW Waste Fact Sheets.</p>	Contractor	Detailed design / pre-construction / construction	Early work / main construction work	Section 4.2 of QA G36 <i>Environment Protection</i>
O4	Waste	Additional soil samples will be required to meet a reasonable sampling density to classify any waste produced. Additional soil samples of natural soil material will also be required to meet the requirements of Excavated Natural Material under the Resource Recovery Order (RRO) / Resource Recovery Exemption (RRE).	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
O5	Waste	Records of waste classifications, waste disposal, beneficial reuse of spoil and any asbestos monitoring and clearance certificates must be held by the contractor and provided to TfNSW on project completion.	Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
O6	Utilities	<p>Prior to the commencement of works:</p> <ul style="list-style-type: none"> the location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners if the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment will be undertaken. 	Contractor	Detailed design / pre-construction	Early work / main construction work	Additional safeguard
O7	Utilities	All utilities work outside the proposal area that involves ground disturbance would require further environmental assessment.	Contractor	Detailed design / pre-construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
O8	Hazards and risk management	<p>A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to:</p> <ul style="list-style-type: none"> • details of hazards and risks associated with the activity • measures to be implemented during construction to minimise these risks • record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • a monitoring program to assess performance in managing the identified risks • contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. <p>The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or DPIE publications.</p>	Contractor	Detailed design / pre-construction / construction	Main construction work	Standard safeguard
O9	Hazards and risk management	<p>During construction, a bushfire management plan (BMP) would be prepared and included as part of the CEMP. This bushfire management plan should consider risk of construction compounds, feasible bushfire reduction methods and the potential to incorporate asset protection zones.</p>	Contractor	Construction	Early work / main construction work	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Relevant construction stage	Reference
CU1	Cumulative construction impacts	<p>Other developers would be consulted in accordance with the Community Stakeholder and Engagement Plan to:</p> <ul style="list-style-type: none"> • obtain information about project timeframes and impacts • manage the interfaces of the proposal's staging and programming in combination with the other projects occurring in the area • identify and implement appropriate safeguards and management measures to minimise cumulative impacts. 	TfNSW and Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
CU2	Cumulative traffic impacts	TfNSW would coordinate with the project team and the Transport Management Centre for the Altis Warehouse and Logistics Hub, Upper South Creek Advanced Water Recycling Centre and WSEA Mamre Road Precinct developments about the proposed timing of the road and lane closures and identify alternate routes or additional safeguards and management measures, as required.	TfNSW and Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard
CU3	Cumulative construction impacts	The CEMP would consider potential cumulative construction impacts from known surrounding development activities (see Section 6.12.3) as well as new planned development activities near the proposal, as they become known. This would include a process to regularly review and update mitigation measures as new works are identified that may lead to cumulative impacts or if complaints are received due to cumulative impacts.	TfNSW and Contractor	Pre-construction / construction	Early work / main construction work	Additional safeguard

7.3 Licensing and approvals

Table 7-2 summarises the licencing and approvals that would be required for the proposal.

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
<i>Protection of the Environment Operations Act 1997</i> (s43)	Environment protection licence (EPL) for scheduled activities [road construction] from the EPA.	Prior to start of the activity.
<i>Fisheries Management Act 1994</i> (s199)	Notification to the Minister for Agriculture and Western NSW prior to any dredging or reclamation works.	A minimum of 28 days prior to the start of work.
<i>Heritage Act 1977</i> (s60)	Permit to carry out activities to an item listed on the State Heritage Register or to which an interim heritage order applies from the Heritage Council of NSW.	Prior to start of the activity.
<i>Heritage Act 1977</i> (s140)	Excavation permit from Heritage NSW.	Prior to start of the activity.
<i>Heritage Act 1977</i> (s139(4))	Exception notification from Heritage NSW.	Prior to start of the activity.
<i>National Parks and Wildlife Act 1974</i> (s90)	Aboriginal heritage impact permit from Heritage NSW.	Prior to start of the activity.
<i>Crown Land Management Act 2016</i> (Division 3.4, 5.5 and 5.6)	Lease or licence to occupy areas of Crown land.	Prior to start of the activity.
<i>Roads Act 1933</i> (s138)	A Road Occupancy Licence would be required from the relevant roads authority by the contractor for prior to work on public roads	Prior to start of the activity.
SEPP 55 (s16)	Notification about Category 2 remediation work to council	At least 30 days before the start of the activity.

8 Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

8.1 Justification

8.1.1 Summary of proposal need

Mamre Road spans between St Clair and Kemps Creek in Western Sydney, connecting the M4 Motorway with Elizabeth Drive, servicing freight, general traffic and public transport. It also provides connection to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis. The NSW Government has identified the need to upgrade roads in Western Sydney to support predicted future economic and residential growth in the area.

Mamre Road currently experiences congestion during peak traffic periods. Traffic modelling shows that the average speed along Mamre Road was 34 kilometres per hour in the afternoon peak period in 2020, which was substantially lower than the 80 kilometre per hour speed limit. The average speed has been modelled to decline to about 12 kilometres per hour in the afternoon peak period in 2036 due to increased traffic volumes along Mamre Road. TfNSW has identified that at least one additional lane in each direction along Mamre Road between St Clair and Kemps Creek, would be required to cater for current and projected traffic needs in the short to medium term.

Community concern regarding the safety of the section of Mamre Road between St Clair and Erskine Park for local residents led to the prioritising of this section of Mamre Road for upgrade. State Member for Mulgoa Tanya Davies stated that “residents of St Clair and Erskine Park must contend with the increasingly unsafe Mamre Road, battling semi-trailers, congestion and risky decisions of impatient motorists”. She also stated that “every day that Mamre Road is not upgraded more lives are at risk” (Tanya Davies, 2018). The need to improve road safety is supported by the casualty crash rate for this section of Mamre Road, which recorded 2.1 crashes per year per kilometre between 2014 and 2018, which was higher than the NSW average of 1.8 crashes per year per kilometre. Over 50 per cent of crashes are rear-end crashes, indicating that congestion is a safety issue along Mamre Road. Road safety would continue to deteriorate along Mamre Road as traffic levels and congestion increases from planned growth in the area. This supports the need for an upgrade of Mamre Road.

8.1.2 Social factors

During operation, the proposal would result in positive long-term social impacts by improving:

- safety along Mamre Road for vehicles, pedestrians and cyclists through:
 - intersection upgrades, which would allow vehicles to more easily turn in and out of Banks Drive, Solander Drive, Luddenham Road and Erskine Park Road
 - provision of a new dedicated shared path along the eastern side of Mamre Road
 - reducing congestion, which would make it easier for drivers to change lanes and manoeuvre
- travel times along Mamre Road due to the increased road capacity
- the amenity of the road corridor as a result of urban design and landscaping along the road corridor.

These improvements would address the community concern over the safety and suitability of Mamre Road.

However, the proposal may result in some adverse impacts to the local community associated with:

- property acquisition and access adjustments for landholders that have properties next to Mamre Road
- temporary amenity impacts from increased traffic, noise, vibration and dust during construction
- the proposed change to the intersections at McIntyre Avenue and Mandalong Close to left in, left out only, which may increase travel times to and from properties accessed from these roads
- direct impacts to Aboriginal and non-Aboriginal heritage sites that could not be avoided during design refinement.

Several safeguards and management measures would be implemented during detailed design and construction of the proposal to minimise these impacts (refer to Section 7.2). This would include continued consultation with directly affected landholders and the local community as well as further refinement of the design and construction methodology to identify opportunities to avoid or minimise impacts.

Overall, the social benefits of the proposal associated with increased road safety, travel times and amenity along Mamre Road are considered to outweigh the potential adverse social impacts identified.

8.1.3 Biophysical factors

The design for the proposal has been specifically refined to minimise removal of native vegetation, where possible. However, there is limited cleared space for widening of Mamre Road, which means that direct impacts on ecological communities could not be completely avoided. The proposal would involve removal of up to 9.38 hectares of native vegetation, including:

- 3.63 hectares of moderate condition PCT 849 Cumberland shale plains woodland (listed as a CEEC under the BC Act and EPBC Act)
- 0.92 hectares of low condition PCT 849 Cumberland shale plains woodland (listed as a CEEC under the BC Act)
- 2.84 hectares of moderate condition PCT 835 Cumberland riverflat forest (listed as an EEC under the BC Act and CEEC under the EPBC Act)
- 1.52 hectares of low condition PCT 835 Cumberland riverflat forest (listed as an EEC under the BC Act)
- 0.47 hectares of PCT 1800 Cumberland Swamp Oak riparian forest (listed as an EEC under the BC Act).

The biodiversity assessment prepared for the proposal concluded that the proposal may have a significant impact on Cumberland Plain Woodland (listed under the EPBC Act). This vegetation removal may also lead to a reduction of fauna habitat for threatened species within the proposal area, including Cumberland Plain Land Snail and Southern Myotis microbats. There may also be a risk of fauna injury and mortality from construction vehicle and equipment movements. Safeguards and mitigation measures have been proposed in Sections 6.1.4 to manage and minimise these impacts where possible. Biodiversity offsets required for the proposal in accordance with the BAM have also been identified in Section 6.1.5.

The proposal may also result in water quality impacts during construction that may affect aquatic habitat and ecosystems within South Creek, which is classified as Key Fish Habitat. The highest risk of water quality impacts is from construction activities near the Luddenham Road intersection, where the proposal is closest to South Creek. This would include minor direct disturbance to South Creek during the construction of headwalls for culverts that outlet at South Creek. Several safeguards and management measures have been proposed in Section 6.1.4 and 6.6.5 to minimise these impacts.

During operation, water quality basins, swales and scour protection has been included in the proposal design to minimise any adverse impacts on water quality during operation.

8.1.4 Economic factors

The area surrounding Mamre Road is expected to see substantial growth and development due to the nearby Western Sydney Employment Area, Western Sydney Aerotropolis, Sydney Metro – Western Sydney Airport and Western Sydney Airport. The proposal would support these developments by providing increased road capacity along Mamre Road, with an additional lane in each direction, to cater for the projected increase in traffic volumes. The proposal would also preserve a wider road corridor to allow for further upgrades to a six-lane road along Mamre Road, if required in the future.

The proposal would also improve movement and travel times between the M4 Motorway and Erskine Park Road for general traffic, freight and bus services operating along the corridor. This would have a long-term positive impact on the local economy, as it would contribute to improved productivity and reduced costs associated with traffic delays for road users. This is expected to benefit commuters travelling to work, surrounding businesses and industry as well as freight operators travelling north-south through Sydney.

These long-term benefits for road transportation are considered to outweigh the short-term inconvenience on the local community and businesses during construction of the proposal associated with the traffic staging and lane closures.

8.1.5 Community response

The Mamre Road upgrade project was initially developed as a longer length project that extended from the M4 Motorway, St Clair to Kerrs Road, Mount Vernon. The strategic design for the Mamre Road upgrade project was exhibited for consultation between November and December 2017. During this period, a range of community engagement activities were carried out to encourage feedback on the Mamre Road upgrade (refer to Section 5.2.1). Further community involvement in the development of the proposal has occurred via one-on-one meetings as well as the project phone line and email address. Community updates have also been released via the project website regarding the progress of the proposal (refer to Section 5.2.1).

In 2019, community concern regarding the safety of Mamre Road for residents within St Clair and Erskine Park led to the prioritising of the 3.8 kilometre long section of Mamre Road between the M4 Motorway and Erskine Park Road for upgrade. The design for the proposal has also been developed in consideration of the need to future proof Mamre Road for increased traffic volumes in the future from surrounding development (refer to Section 2.1.1).

Other issues raised in the responses from the community regarding the proposal have been highly varied and included (refer to Chapter 5):

- concern that noise from construction work during the night-time would cause sleep disturbance
- concern that the proposal would lead to increased traffic noise during operation and require noise walls
- concern about loss of trees and other vegetation
- increased flooding risk with building of more 'hard surfaces'
- issues related to property impacts
- issues related to changes to intersections from the proposal
- support of shared paths for cyclists and pedestrians
- concerns about lack of information provided in a coordinated manner and the timing of the project
- concern that traffic on Luddenham Road would increase with new developments
- various specific suggestions for the design of the proposal.

Further information on these issues raised and how they have been considered and responded to in the development of the proposal is provided in Section 5.2.2. This REF provides further information for the community to understand how the proposal would be carried out and how the potential impacts of the proposal have and would continue to be avoided, minimised or managed. The public display of this REF would provide another opportunity for the community to provide comment on the proposal.

8.2 Objects of the EP&A Act

Table 8-1 describes how the proposal is consistent with or furthers the objects of the EP&A Act.

Table 8-1: Objects of the EP&A Act

Object	Comment
<p>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>	<p>The proposal would contribute to improved road safety and traffic flow along Mamre Road. The proposed shared path would also improve access and safety for pedestrians and cyclists in the area. As such the proposal would promote the social and economic welfare of the community.</p> <p>Socio-economic impacts have been further assessed in Section 6.10.4. The assessment includes management measures to avoid and/or minimise any adverse impacts.</p>
<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>	<p>The principles of ecologically sustainable development have been considered in Section 8.2.1 below.</p>
<p>1.3(c) To promote the orderly and economic use and development of land.</p>	<p>The proposal would support predicted future economic and residential growth in the area associated with the Western Sydney Employment Area and Western Sydney Airport. The proposal is consistent with the objectives of the land zoning provisions of the Penrith LEP and WSEA SEPP (refer to Section 4.1).</p>
<p>1.3(d) To promote the delivery and maintenance of affordable housing.</p>	<p>Not relevant to this proposal.</p>
<p>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.</p>	<p>The need to minimise impacts on the environment, including threatened and native species has been considered during development of the proposal. The design has been refined to minimise the project footprint during proposal development (refer to Section 2.5). Where potential impacts have been identified on native animals and plants, ecological communities and their habitats, safeguards and management measures have been proposed to avoid or minimise the impacts (refer to Section 6.1.4).</p>

Object	Comment
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal has been refined to minimise impacts on heritage items, where possible (refer to Section 2.5). The design for the proposal has minimised impacts on Aboriginal and non-Aboriginal heritage through sympathetic urban and landscaping designs and identification of heritage interpretation opportunities based on specialist heritage advice. A CHAR has been prepared as part of this REF to assess Aboriginal cultural heritage impacts (refer to Section 6.2 and Appendix E). An AHIP would be required prior to conducting activities on any sites which have Aboriginal cultural heritage significance. Management measures to minimise residual impacts on Aboriginal and non-Aboriginal heritage are discussed in Sections 6.2.4 and 6.3.3 respectively.
1.3(g) To promote good design and amenity of the built environment.	Specific urban design and landscape objectives were prepared for the proposal in line with the <i>Beyond the Pavement</i> policy (TfNSW, 2020b) to make sure the proposal integrates physically and visually with the surrounding environment (refer to Section 2.4.1). The proposal includes provision of a noise wall along the eastern side of Mamre Road to minimise long-term amenity impacts from operational road traffic noise. Temporary amenity impacts from increased traffic, noise, vibration and dust during construction would be managed through implementation of management measures in accordance with a CEMP (refer to Section 7.2).
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 this 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.	Not relevant to this proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Chapter 5 outlines the community consultation that has been carried out in the lead up to preparing this REF. The community will be invited to provide a submission on the proposal during the public display of this REF, which provides an opportunity to participate in the environmental planning and assessment process. TfNSW would review and respond to the community submissions before determining whether to proceed with the proposal.

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

The proposal has sought to take a precautionary approach to minimise environmental impacts, including through assessing impacts based on the 'worst-case' or conservative scenarios. In particular, a conservative approach was carried out for the assessment of potential Aboriginal heritage impacts, which adopted an Aboriginal heritage study area that was larger than the proposal area to allow for design refinement and minimise nearby Aboriginal heritage sites being missed from the assessment (refer to Section 6.2.1). The noise and air quality models also adopted conservative assumptions (refer to Sections 6.7.1 and 6.9.1).

This has also been applied in the development of safeguards and management measures using best available technical information, environmental standards and guidelines. No safeguards have been postponed as a result of lack of scientific certainty. The selected construction contractor would be required to prepare a CEMP before commencing construction. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The proposal has integrated both short and long-term economic, social and environmental considerations so that any likely impacts are not left to be addressed by future generations.

Although the proposal was required to be implemented in the short-term to address key existing safety and congestion issues along Mamre Road, the design has been developed in consideration of the potential future needs of the road corridor. For example, the proposal provides sufficient space for a future road arrangement with three lanes in each direction and future bus priority along Mamre Road, so as not to preclude these opportunities.

In addition, design refinement for the proposal focused on avoiding or minimising impacts that would have potential long-term implications. This included a particular focus on minimising removal of native vegetation as well as impacts on Aboriginal and non-Aboriginal heritage (refer to Section 2.5) to preserve these aspects as much as possible for future generations. Residual biodiversity impacts from the proposal would be offset in accordance with the BDAR prepared as part of this REF (refer to Section 6.1.5).

Conservation of biological diversity and ecological integrity

Preserving biological diversity and ecological integrity requires that ecosystems, species, and biological diversity are maintained to ensure their survival. The design for the proposal has been specifically refined to minimise removal of native vegetation, where possible. However, there is limited cleared space for

widening of Mamre Road, which means that direct impacts on ecological communities could not be completely avoided. It is accepted that this proposal would result in the loss of up to 9.38 hectares of native vegetation including about:

- 3.63 hectares of moderate condition PCT 849 Cumberland shale plains woodland
- 0.92 hectares of low condition PCT 849 Cumberland shale plains woodland
- 2.84 hectares of moderate condition PCT 835 Cumberland riverflat forest
- 1.52 hectares of low condition PCT 835 Cumberland riverflat forest
- 0.47 hectares of PCT 1800 Cumberland Swamp Oak riparian forest.

The above vegetation communities are protected under State and Commonwealth legislation, as they provide potential resource and habitat for threatened species, such as the Cumberland Plain Land Snail and the Southern Myotis.

A BDAR has been prepared for the proposal in accordance with the BAM, which concluded that the proposal has potential for significant impacts and identified the biodiversity offsets required for the proposal to mitigate unavoidable impacts (refer to Section 6.1 and Appendix D). These biodiversity offsets are aimed at conserving biological diversity and ecological integrity within NSW. The proposal would also involve developing and implementing a landscaping plan, which would identify opportunities to plant locally endemic flora species within the proposal area.

Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

Environmental issues were considered as key matters in design development for the proposal. The value placed on environmental resources is demonstrated in the extent of the planning and environmental investigations, and in the design of the mitigation measures and safeguards described in Section 7.2. Implementation of these mitigation measures and safeguards would result in an economic cost to TfNSW, which would be included in both the capital and operating cost of the proposal.

8.3 Conclusion

The proposed Mamre Road upgrade Stage 1 between the M4 Motorway, St Clair and Erskine Park Road, Erskine Park is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of 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 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 proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on biodiversity, Aboriginal heritage, non-Aboriginal heritage and noise as well as some temporary traffic, water quality, noise and vibration impacts during construction. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve road safety and movement along Mamre Road, which would address community concern and support planned developments and growth in the surrounding area. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act or FM Act. A BDAR has been prepared in accordance with the BC Act, Biodiversity Conservation Regulation 2017 and the BAM. The BDAR has determined the credit obligation for the proposal in accordance with the Biodiversity Offsets Scheme.

There would be no significant impact on any other aspect of the environment. Therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act. The proposal 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 proposal is likely to have a significant impact on threatened species, ecological communities or migratory species, within the meaning of the EPBC Act. This REF has considered the consistency of the activity with relevant recovery plans, threat abatement plans, conservation advices and guidelines provided by the Australian Government. The REF finds that the activity will not threaten the long term survival of nationally listed biodiversity matters and that suitable offset measures can be secured as set out in the Biodiversity Offset Strategy for the proposal.

This REF has been prepared to meet the requirements of the EPBC Act strategic assessment approval for TfNSW Division 5.1 road activities.

The proposal is not likely to have a significant impact on other matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

9 Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.



Zoe McLaughlin
Senior Consultant, Environment and Planning
Aurecon Australasia Pty Ltd
Date: 20 August 2021

I have examined this review of environmental factors and accept it on behalf of TfNSW.

Shirley Luong
Project Development Manager
Western Parkland City
Sydney Infrastructure Development | Infrastructure and Place
Transport for NSW
Date: 20 August 2021

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Terms and acronyms used in this REF

Term / Acronym	Description
AAQ NEPM	<i>National Environment Protection (Ambient Air Quality) Measure</i>
ACM	Asbestos containing material
active transport	walking and cycling
AEP	annual exceedance probability
AFG	Aboriginal Focus Group
AHIP	Aboriginal Heritage Impact Permit
APEC	Areas of Potential Environmental Concern
AQIA	Air Quality Impact Assessment
AQMS	Air Quality Monitoring Station
AR&R	Australian Rainfall and Runoff
ARI	average recurrence interval
ASC NEPM	<i>National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)</i>
ASS	acid sulfate soil
BAM	Biodiversity Assessment Methodology
BC Act	<i>Biodiversity Conservation Act 2016 (NSW).</i>
BDAR	Biodiversity Development Assessment Report
BOM	Australian Government Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene, Total Xylenes
CEMP	Construction environmental management plan
CO	Carbon monoxide
COPC	Chemicals of Potential Concern
DCP	development control plan
DPIE	NSW Department of Planning, Industry and Environment
DSI	Detailed Site Investigation
CNVG	<i>Construction Noise and Vibration Guideline (Roads and Maritime Services, 2016a)</i>
CNVMP	Construction Noise and Vibration Management Plan
CoRTN	<i>Calculation of Road Traffic Noise (UK Department of Transport, 1988)</i>
DPIE	NSW Department of Planning, Industry and Environment
EIA	environmental impact assessment
ENMM	<i>Environmental Noise Management Manual (Roads and Traffic Authority, 2001)</i>
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW).</i> Provides the legislative framework for land use planning and development assessment in NSW
EPA	NSW Environmental Planning Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).</i> Provides for the protection of the environment, especially MNES, and provides a national assessment and approvals process.
EPL	environmental protection licence
ESCP	Erosion and Sediment Control Plan
ESD	Ecologically sustainable development
EY	Exceedances per Year

Term / Acronym	Description
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
GDE	Groundwater dependent ecosystem
Heritage Act	<i>Heritage Act 1977</i> (NSW)
ICNG	<i>Interim Construction Noise Guideline</i> (DECC, 2009)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
L _{Aeq}	Median value of background noise levels
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local government area
MNES	Matters of national environmental significance under the EPBC Act
NCA	Noise Catchment Area
NCG	<i>Noise Criteria Guideline</i> (Roads and Maritime Services, 2015a)
NEPC	National Environment Protection Council
NMG	<i>Noise Mitigation Guideline</i> (Roads and Maritime Services, 2015b)
NML	Noise Management Levels
NO _x	Oxides of nitrogen used to describe any mixture of nitrogen oxides formed during combustion.
NPfi	Noise Policy for Industry (NSW EPA, 2017)
NPI	National Pollutant Inventory. A database providing details on industrial emissions of over 4000 facilities across Australia.
NPW Act	<i>National Parks and Wildlife Act 1974</i> (NSW)
NSW	New South Wales
PACHCI	<i>Procedure for Aboriginal Cultural Heritage Consultation and Investigation</i> (Roads and Maritime Services, 2011)
PAD	potential archaeological deposit
PAH	Polycyclic Aromatic Hydrocarbons
PFAS	per- and polyfluoroalkyl substances
PM _{2.5}	Particulate matter less than 2.5 microns
PM ₁₀	Particulate matter less than 10 microns
PMF	Probable Maximum Flood
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
PSI	Preliminary Site Investigation
RAP	Remediation Action Plan
RAPs	registered Aboriginal parties
RBL	rating background noise level
REF	review of environmental factors
RFS	Rural Fire Service
RNP	Road Noise Policy (DECCW, 2011)
Roads Act	<i>Roads Act 1993</i>
Roads and Maritime	NSW Roads and Maritime Services, now known as Transport for NSW (TfNSW)
ROL	road occupancy licence
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.

Term / Acronym	Description
SHR	State heritage register
SO ₂	Sulfur dioxide
SEPP 55	<i>State Environmental Planning Policy No 55 – Remediation of Land</i>
SREP 20	<i>Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No 2 – 1997)</i>
SWMP	Soil and Water Management Plan
tbc	to be confirmed
TfNSW	Transport for NSW
TPH	Total Petroleum Hydrocarbons
TRAQ	NSW Roads and Maritime Service's Tool for Roadside Air Quality
TRH	Total Recoverable Hydrocarbons
UFP	Unexpected Finds Protocol
UXO	unexploded ordnance
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001 (NSW)</i>
Western Sydney Airport	Western Sydney International (Nancy-Bird Walton) Airport
WM Act	<i>Water Management Act 2000 (NSW)</i>
WSEA	Western Sydney Employment Area
WSEA SEPP	<i>State Environmental Planning Policy (Western Sydney Employment Area) 2009</i>
QA Specifications	Specifications developed by TfNSW for use with road work and bridge work contracts let by TfNSW.
VDV	Vibration Dose Value
VOCs	Volatile Organic Compounds

Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance and Commonwealth land

Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline (DUAP 1995/1996) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
<p>a) Any environmental impact on a community?</p> <p>The construction of the proposal would result in the following environmental impacts on the community:</p> <ul style="list-style-type: none"> • traffic delays and increased travel time during the proposed lane closures for construction of the proposal • temporary noise, vibration, dust and visual impacts to surrounding sensitive receivers during construction of the proposal • increased traffic road noise during operation of the proposal <p>The operation of the proposal would result in the following environmental impacts on the community:</p> <ul style="list-style-type: none"> • improved intersection performance • improved travel times and less congestion along Mamre Road • improved road safety through increased capacity 	<p>Short-term moderate negative impact</p> <p>Long-term minor negative impact</p>
<p>b) Any transformation of a locality?</p> <p>The construction of the proposal would cause short-term disruption to the Mamre Road corridor and residents and commuters using the corridor. Construction activities would lead to temporary changes to the locality including construction barriers and traffic detours.</p> <p>The operation of the proposal would support the liveability, planned development and future economic growth within the locality through providing:</p> <ul style="list-style-type: none"> • improved road safety and movement along Mamre Road through increased capacity and intersection upgrades • permanent change to the access to Mamre House • improved suitability of Mamre Road for pedestrians and cyclists due to the new shared user path as well as improved urban design and landscaping along the road corridor <p>However, there may be a minor inconvenience for regular users of Mandalong Close and McIntyre Avenue, due to these intersections being changed to left-in, left-out only.</p>	<p>Short-term minor negative impact</p> <p>Long-term moderate positive impact</p>

Factor	Impact
<p>c) Any environmental impact on the ecosystems of the locality?</p> <p>The proposal would involve removal of up to 9.38 hectares of native vegetation, including:</p> <ul style="list-style-type: none"> • 3.63 hectares of moderate condition PCT 849 Cumberland shale plains woodland (listed as a CEEC under the BC Act and EPBC Act) • 0.92 hectares of low condition PCT 849 Cumberland shale plains woodland (listed as a CEEC under the BC Act) • 2.84 hectares of moderate condition PCT 835 Cumberland riverflat forest (listed as an EEC under the BC Act and CEEC under the EPBC Act) • 1.52 hectares of low condition PCT 835 Cumberland riverflat forest (listed as an EEC under the BC Act) • 0.47 hectares of PCT1800 Cumberland Swamp Oak riparian forest (listed as an EEC under the BC Act) <p>The proposal may also result in water quality impacts that may affect aquatic ecosystems within South Creek. Safeguards and mitigation measures including water quality basins, swales, scour protection and biodiversity offsets have been proposed in Section 6.1.3 and 6.6.5, to manage and minimise these impacts where possible.</p>	<p>Long-term moderate negative impact, however it is noted that a significant impact is likely for Cumberland Plain Woodland (PCT 849) – refer to MNES table</p>
<p>d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</p> <p>The proposal may result in a temporary reduction in the aesthetic and recreational quality of the area during the construction phase in the form of noise and visual impacts. The proposal may also result in a temporary reduction in environmental quality due to water quality impacts during construction. Safeguards and mitigation measures have been proposed to manage and minimise these impacts where possible (see Section 7.2).</p>	<p>Short-term minor negative impact</p>

Factor	Impact
<p>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> <p>The proposal would involve construction of a new driveway to Mamre House and introduction of other minor elements (such as roadside signage). These new elements would directly and indirectly impact on Mamre House, which is a State and locally listed non-Aboriginal heritage item. The proposal would also result in minor impacts on other locally listed heritage items: Marsden Memorial Cairn and Luddenham Road Alignment. The design for the proposal has been able to minimise impacts on non-Aboriginal heritage through sympathetic urban and landscaping designs and identification of heritage interpretation opportunities based on specialist heritage advice. TfNSW would obtain the necessary heritage approvals (including a s60 and s140 permit for Mamre House and s139(4) exception notification for Luddenham Road) prior to direct impacts on these sites.</p> <p>The proposal would also have a direct impact to eight Aboriginal archaeological sites, which could not be completely avoided during design refinement due to the limited area available for road widening. TfNSW would apply for an AHIP prior to any impact or harm to these sites. Approaches to further reduce impacts to Aboriginal heritage would be identified during detailed design and construction, including through identification of 'no-go zones' and implementation of an unexpected finds protocol.</p>	<p>Long-term minor to moderate negative impact</p>
<p>f) Any impact on the habitat of protected fauna (within the meaning of the <i>Biodiversity Conservation Act 2016</i>)?</p> <p>The proposal would involve removal of habitat for threatened fauna species listed under the BC Act including:</p> <ul style="list-style-type: none"> • 6.12 hectares of habitat for Southern Myotis (listed as vulnerable under the BC Act) • 3.40 hectares of habitat for Cumberland Plain Land Snail <p>Safeguards and mitigation measures have been proposed in Sections 6.1.4 to manage and minimise these impacts where possible. Biodiversity offsets required for the proposal in accordance with the BAM have also been identified in Section 6.1.5, including the offset credit liability for Southern Myotis and Cumberland Plain Land Snail.</p>	<p>Long-term moderate negative impact</p>

Factor	Impact
<p>g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</p> <p>The proposal would require the removal of up to 9.38 hectares of endangered ecological communities. Removal of this vegetation could lead to loss of fauna and flora habitat. However, this impact to potential habitat is not considered large enough to endanger any species. Moreover, no threatened flora species have been identified within the proposal area.</p> <p>The proposal may also result in a potential for fauna injury or mortality throughout the construction phase due to vehicle and equipment movements within the proposal area. As Mamre Road is an existing operational road, any increased risk of roadkill during operation would be minor.</p> <p>Safeguards to minimise potential impacts on threatened species have been outlined in Section 6.1.4 and 6.1.5.</p>	<p>Long-term minor negative impact</p> <p>Short-term minor negative impact</p>
<p>h) Any long-term effects on the environment?</p> <p>The proposal would result in long-term impacts on:</p> <ul style="list-style-type: none"> • biodiversity through loss of native vegetation • Aboriginal heritage through direct impacts to Aboriginal sites • non-Aboriginal heritage through direct impacts to State and locally listed heritage items • noise through increased road traffic noise along Mamre Road • traffic by reducing travel times and easing congestion along Mamre Road <p>However, the design of the proposal has and would continue to be refined to avoid and minimise long-term adverse impacts on the environment, where possible (refer to Section 2.5 and Section 7.2).</p>	<p>Long-term moderate negative impact</p> <p>Long-term minor positive impact</p>
<p>i) Any degradation of the quality of the environment?</p> <p>If uncontrolled, the proposal has the potential to temporarily degrade the quality of the environment during construction through erosion, sedimentation, dust, vegetation removal and noise and vibration impacts. Several safeguards and mitigation measures have been proposed to manage and minimise these potential impacts (refer to Section 7.2).</p> <p>During operation, the design has incorporated WSUD measures as well as sympathetic urban design and landscaping. As a result, the quality of the environment is not likely to be degraded.</p>	<p>Short-term moderate negative impact</p> <p>Long-term neutral impact</p>
<p>j) Any risk to the safety of the environment?</p> <p>The construction of the proposal would result in reduced safety for pedestrians and cyclists due to construction activities. These users would be encouraged to use alternative routes during this phase of the proposal.</p> <p>The operation of the proposal would result in increased safety for users of Mamre Road, including vehicles, pedestrians and cyclists, through the provision of improved road and active transport infrastructure.</p>	<p>Short-term minor negative impact</p> <p>Long-term moderate positive impact</p>

Factor	Impact
<p>k) Any reduction in the range of beneficial uses of the environment?</p> <p>The proposal would not result in a reduction in the range of beneficial uses of the environment.</p>	<p>Nil</p>
<p>l) Any pollution of the environment?</p> <p>Providing the mitigation measures outlined in this REF are implemented (refer to Section 7.2), the operation of the proposal is not expected to result in any pollution of the environment. However, there would remain some impacts during the construction of the proposal, including dust, noise from construction activities and light spill from nightworks.</p>	<p>Nil</p> <p>Short-term minor negative impact</p>
<p>m) Any environmental problems associated with the disposal of waste?</p> <p>The proposal would result in the generation of waste. Providing the mitigation measures proposed in Section 6.11.2 are implemented, the proposal is not likely to cause environmental problems associated with the disposal of waste.</p>	<p>Nil</p>
<p>n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</p> <p>The earthwork estimates for the proposal estimated that there would be about 66,100 m³ more fill material that would be needed to construct the proposal compared to what would be excavated during construction. This material would need to be imported from a suitably licensed nearby quarry or other viable sources such as nearby infrastructure projects with excess clean excavated material.</p> <p>The proposal is not likely to result in increased demands on resources that are, or are likely to become, in short supply.</p>	<p>Nil</p>
<p>o) Any cumulative environmental effect with other existing or likely future activities?</p> <p>There is potential for cumulative traffic, noise and biodiversity impacts, where other projects are being constructed nearby at the same time as the proposal. Safeguards and management measures have been proposed in Section 6.12.5 to avoid or minimise these impacts, where possible. This includes consultation and coordination with other nearby project teams, where possible.</p> <p>During operation, the proposal would result in cumulative positive traffic impacts with other nearby future road upgrades proposed to improve the safety, movement and travel times within the surrounding road network. This includes the Mamre Road upgrade Stage 2, M12 Motorway, M4 Roper Road Westbound On-Ramp projects and potential upgrade of Luddenham Road.</p>	<p>Short-term minor negative impact</p> <p>Long-term moderate positive impact</p>

Factor	Impact
p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposal would not impact on coastal processes or hazards, including those under projected climate change conditions.	Nil

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of Agriculture, Water and the Environment.

A referral is not required for proposed actions that may affect nationally listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
<p>a) Any impact on a World Heritage property? There are no World Heritage properties within or near the proposal area.</p>	<p>Nil</p>
<p>b) Any impact on a National Heritage place? There are no National Heritage places within or near the proposal area.</p>	<p>Nil</p>
<p>c) Any impact on a wetland of international importance? There are no wetlands of international importance within or near the proposal area.</p>	<p>Nil</p>
<p>d) Any impact on a listed threatened species or communities? The unavoidable impacts to Commonwealth threatened biodiversity include the following:</p> <ul style="list-style-type: none"> • direct impact to about 3.63 hectares of Cumberland Plain Woodland, which meets the Commonwealth CEEC definition • direct impact to about 2.84 hectares of River-Flat Eucalypt Forest, which meets the Commonwealth CEEC definition <p>Assessments of Significance for the above threatened biodiversity were completed, and have been provided in the BDAR in Appendix D. It was concluded that the proposal may have a significant impact to Cumberland Plain Woodland. The proposal is unlikely to have a significant impact on the River-Flat Eucalypt Forest.</p> <p>The proposal will result in a biodiversity offset for Cumberland Plain Woodland, and River-flat Eucalypt Forest, which in turn will ensure the in-perpetuity management of these EPBC Act listed TECs. Further safeguards and management measures are outlined in Section 6.1.4.</p>	<p>Significant direct impacts may occur on Cumberland Plain Woodland</p> <p>This REF and BDAR has been prepared to meet the requirements of the EPBC Act strategic assessment approval for TfNSW Division 5.1 road activities.</p>

Factor	Impact
<p>e) Any impacts on listed migratory species?</p> <p>The proposal area was considered to have moderate likelihood of habitat for the Yellow Wagtail (Migratory), given the species can occupy relatively open/cleared environments. The proposal area would provide foraging potential for the species and is unlikely to be breeding habitat.</p> <p>The proposal may result in direct impacts to about 9.38 hectares of potential habitat for the Yellow Wagtail. Assessments of Significance concluded the proposal is unlikely to have a significant impact on listed migratory species (refer to Appendix D).</p>	<p>Minor direct impacts may occur for listed migratory species.</p>
<p>f) Any impact on a Commonwealth marine area?</p> <p>There are no Commonwealth marine areas within or near the proposal area.</p>	<p>Nil</p>
<p>g) Does the proposal involve a nuclear action (including uranium mining)?</p> <p>The proposal would not involve any nuclear action.</p>	<p>Nil</p>
<p>h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land?</p> <p>The proposal would not result in any direct or indirect impact on Commonwealth Land.</p>	<p>Nil</p>

Appendix B

Statutory consultation checklists

Infrastructure SEPP

Certain development types

Development type	Description	Yes / No	If 'yes' consult with	ISEPP clause
Car Park	Does the project include a car park intended for use by commuters using regular bus services?	No	Penrith City Council	ISEPP cl. 95A
Bus Depots	Does the project propose a bus depot?	No	Penrith City Council	ISEPP cl. 95A
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	Penrith City Council	ISEPP cl. 95A

Development within the Coastal Zone

Issue	Description	Yes / No / NA	If 'yes' consult with	ISEPP clause
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No	Penrith City Council	ISEPP cl. 15A

Note: See interactive map here: <https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management>. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Stormwater	Are the works likely to have a <i>substantial</i> impact on the stormwater management services which are provided by council?	No	Penrith City Council	ISEPP cl.13(1)(a)
Traffic	Are the works likely to generate traffic to an extent that will <i>strain</i> the capacity of the existing road system in a local government area?	No	Penrith City Council	ISEPP cl.13(1)(b)
Sewerage system	Will the works involve connection to a council owned sewerage system? If so, will this connection have a <i>substantial</i> impact on the capacity of any part of the system?	No	Penrith City Council	ISEPP cl.13(1)(c)

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Water usage	Will the works involve connection to a council owned water supply system? If so, will this require the use of a <i>substantial</i> volume of water?	No	Penrith City Council	ISEPP cl.13(1)(d)
Temporary structures	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a <i>minor</i> or <i>inconsequential</i> disruption to pedestrian or vehicular flow?	No	Penrith City Council	ISEPP cl.13(1)(e)
Road & footpath excavation	Will the works involve more than <i>minor</i> or <i>inconsequential</i> excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes	Penrith City Council	ISEPP cl.13(1)(f)

Local heritage items

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than <i>minor</i> or <i>inconsequential</i> ?	No	Penrith City Council	ISEPP cl.14

Flood liable land

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Flood liable land	Are the works located on flood liable land? If so, will the works change flood patterns to more than a <i>minor</i> extent?	Yes	Penrith City Council	ISEPP cl.15
Flood liable land	Are the works located on flood liable land? (to any extent). If so, do the works comprise more than minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance	Yes	State Emergency Services	ISEPP cl.15AA

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable land* published by the New South Wales Government.

Public authorities other than councils

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the <i>National Parks and Wildlife Act 1974</i> , or on land acquired under that Act?	No	Environment, Energy and Science, DPIE	ISEPP cl.16(2)(a)
National parks and reserves	Are the works on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	Environment, Energy and Science, DPIE	ISEPP cl. 16(2)(b)
Aquatic reserves	Are the works adjacent to an aquatic reserve or a marine park declared under the <i>Marine Estate Management Act 2014</i> ?	No	Department of Planning, Industry and Environment	ISEPP cl.16(2)(c)
Sydney Harbour foreshore	Are the works in the Sydney Harbour Foreshore Area as defined by the <i>Sydney Harbour Foreshore Authority Act 1998</i> ?	No	Property NSW	ISEPP cl.16(2)(d)
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service	ISEPP cl.16(2)(f)
Artificial light	Would the works 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? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	Director of the Siding Spring Observatory	ISEPP cl.16(2)(g)
Defence communications buffer land	Are the works on buffer land around the defence communications facility near Morundah?	No	Secretary of the Commonwealth Department of Defence	ISEPP cl. 16(2)(h)
Mine subsidence land	Are the works on land in a mine subsidence district within the meaning of the <i>Mine Subsidence Compensation Act 1961</i> ?	No	Mine Subsidence Board	ISEPP cl. 16(2)(i)

Appendix C

Considerations of the Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2 – 1997)

General planning considerations, planning policies and recommended strategies from SREP 20

SREP 20 planning consideration	Where considered or addressed
General planning considerations	
<p>a) the aim of this plan: “The aim of this plan is to protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context”, and</p>	<p>The impacts on the proposal on South Creek, which forms part of the Hawkesbury-Nepean River system, and the regional context have been considered in Section 6.6, including identification of safeguards and management measures as required to protect the environment.</p>
<p>b) the strategies listed in the Action Plan of the Hawkesbury-Nepean Environmental Planning Strategy, and</p>	<p>The strategies listed in the Action Plan are grouped in five categories: Community (C), Productivity (P), Biodiversity (B), Urban Liveability (UL) and Resilient Landscapes (RL). The most relevant strategies to the proposal, are as follows:</p> <ul style="list-style-type: none"> • C1: Support Aboriginal people to manage projects across culturally significant landscapes and values • B1: Maintain the diversity and health of natural systems • B2: Maintain viable populations of native species, especially those found only in our region (endemic) and those under threat • B3: Make connections across the landscape including the aquatic ecosystem • B4: Reduce the risk of decline or extinction of native species • UL2: Create a more liveable and water sensitive city by implementing WSUD • UL3: Promote actions which support urban resilience through mitigation and adaptation to impacts of climate change • UL4: Improve aquatic and terrestrial habitat condition, connectivity and recreational value in urban areas • UL5: Enhance and protect Sydney’s natural places to support a liveable city <p>The proposal is aligned with strategy C1 as it involved substantial engagement and consultation with Aboriginal people (refer to Section 5.3).</p> <p>Strategies B1, B2, B3, B4 were specifically considered during design refinement to minimise biodiversity impacts and preparation of the BDAR (refer to Section 2.5 and 6.1).</p>

SREP 20 planning consideration	Where considered or addressed
	<p>Safeguards, management measures and biodiversity offsets would be implemented to minimise impacts on terrestrial and aquatic ecosystems and species.</p> <p>Strategies UL2, UL3, UL4 and UL5 were considered during the development of urban design, landscaping and WSUD features for the proposal. The proposal also involved consideration of climate change on flooding patterns during the drainage design.</p>
c) whether there are any feasible alternatives to the development or other proposal concerned, and	The alternatives to and justifications of the preferred option for this proposal are discussed in Section 2.4.
d) the relationship between the different impacts of the development or other proposal and the environment, and how those impacts will be addressed and monitored.	The impacts of the proposal on the environment is discussed in Chapter 6. Safeguards and management measures have been developed to manage and/or minimise the identified potential impacts (refer to Chapter 7).

Specific planning policies and recommended strategies

(1) Total catchment management

Policy: Total catchment management is to be integrated with environmental planning for the catchment.

Strategies:

(a) Refer the application or other proposal for comment to the councils of each adjacent or downstream local government area which is likely to suffer a significant adverse environmental effect from the proposal.	TfNSW has developed the proposal in consultation with Penrith City Council and has considered any feedback provided on the proposal (refer to Section 5.4 and 5.5). The proposal is not likely to result in any impacts to land or water within any other LGA.
(b) Consider the impact of the development concerned on the catchment.	The potential impact of the proposal on the South Creek catchment, which is part of the Hawkesbury-Nepean catchment, is discussed in Sections 6.4 and 6.6.
(c) Consider the cumulative environmental impact of development proposals on the catchment.	The cumulative impacts resulting from the proposal on the catchment are considered in Section 6.12.

(2) Environmentally sensitive areas

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.

Strategies:

SREP 20 planning consideration	Where considered or addressed
(a) Rehabilitate parts of the riverine corridor from which sand, gravel or soil are extracted so that attached aquatic plant beds are replaced and water quality and faunal habitats improved.	The proposal would involve rehabilitation of disturbed areas and landscaping along the road corridor near South Creek, with an aim to improve water quality and fauna habitats where possible.
(b) Minimise adverse impacts on water quality, aquatic habitats, riverine vegetation and bank stability.	The potential impacts on water quality, aquatic habitats, riverine vegetation and bank stability have been considered in Sections 6.1 and 6.6. Safeguards and management measures have been proposed to minimise any adverse impacts.
(c) Minimise direct and indirect adverse impacts on land reserved or dedicated under the NPW Act or the <i>Forestry Act 1916</i> and conservation area sub-catchments in order to protect water quality and biodiversity.	The proposal does not involve any work on land reserved or dedicated under the NPW Act or <i>Forestry Act 1916</i> (note: this Act has now been repealed). Safeguards and management measures to protect water quality and biodiversity are outlined in Sections 6.1.4, 6.1.5 and 6.6.5.
(d) Protect wetlands (including upland wetlands) from future development and from the impacts of land use within their catchments.	No wetlands are located within the proposal area.
(e) Consider the need to include buffer zones (such as adequate fire radiation zones) for proposals on land adjacent to land reserved or dedicated under the NPW Act or the <i>Forestry Act 1916</i> .	The proposal is not within or next to land reserved or dedicated under the NPW Act or <i>Forestry Act 1916</i> (note: this Act has now been repealed).
(f) Consider the views of the Director-General of National Parks and Wildlife about proposals for land adjacent to land reserved or dedicated under the NPW Act.	The proposal is not within or next to land reserved or dedicated under the NPW Act.
(g) Consideration should be given to the impact of the development concerned on the water table and the formation of acid sulfate soils.	Potential impacts of the proposal on the water table and acid sulfate soils have been considered in Section 6.6.
(h) New development in conservation area sub-catchments should be located in areas that are already cleared.	The proposal has tried to maximise use of areas that are already cleared. However, some vegetation clearance in conservation areas is proposed due to the limited area available for widening of Mamre Road. Biodiversity offsets have been proposed for these impacts (refer to Section 6.1.5).

SREP 20 planning consideration	Where considered or addressed
<p>(3) 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. When water quality goals are set by the Government these are to be the goals to be achieved under this policy.</p> <p>Strategies:</p>	
<p>(a) Quantify, and assess the likely impact of, any predicted increase in pollutant loads on receiving waters.</p>	<p>An assessment of the likely quantity and impact of increased pollutant loads has been provided in Section 6.6 and Appendix I. This involved development of a MUSIC model.</p>
<p>(b) Consider the need to ensure that water quality goals for primary contact recreation and aquatic ecosystem protection are achieved and monitored.</p>	<p>Consideration of water quality goals and required safeguards and management measures to monitor potential water quality impacts is provided in Section 6.6 and Appendix I.</p>
<p>(c) Approve development involving primary contact recreation or the withdrawal of water from the river for human contact (not involving water treatment), such as showers, only in locations where water quality is suitable (regardless of water temperature).</p>	<p>The proposal does not involve primary contact recreation or the withdrawal of river water for human contact.</p>
<p>(d) Do not carry out development involving on-site disposal of sewage effluent if it will adversely affect the water quality of the river or groundwater. Have due regard to the nature and size of the site.</p>	<p>The proposal does not involve on-site disposal of sewage effluent.</p>
<p>(e) Develop in accordance with the land capability of the site and do not cause land degradation.</p>	<p>The proposal has been developed in consideration of the land capability of the proposal area and has incorporated safeguards and management measures to avoid land degradation (refer to Section 6.6).</p>
<p>(f) 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.</p>	<p>Erosion and Sediment Control Plans (ESCP) would be prepared and implemented during construction in consideration of soil impacts discussed in Section 6.6.</p>
<p>(g) Minimise or eliminate point source and diffuse source pollution by the use of best management practices</p>	<p>Best management practices would be implemented during construction to avoid or minimise pollution. These practices would be outlined in a Soil and Water Management Plan.</p>

SREP 20 planning consideration	Where considered or addressed
(h) 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.	The design of the proposal has considered the need for bank stability and landscaping (with prioritisation of native species) along the road corridor, near South Creek.
(i) Consider the impact of the removal of water from the river or from groundwater sources associated with the development concerned.	Removal of water for the proposal would be limited to minor dewatering of excavations as required, which is expected to result in negligible impacts on water sources.
(j) Protect the habitat of native aquatic plants.	Safeguards and management measures would be implemented to protect the habitat of native aquatic plants, where possible (refer to Sections 6.1.4 and 6.6.5).
<p>(4) Water quantity</p> <p>Policy: Aquatic ecosystems must not be adversely affected by development which changes the flow characteristics of surface or groundwater in the catchment.</p> <p>Strategies:</p>	
(a) Future development must be consistent with the interim or final river flow objectives that are set for the time being by the Government.	The proposal would consider river flow objectives, where relevant.
(b) Ensure the amount of stormwater run-off from a site and the rate at which it leaves the site does not significantly increase as a result of development. Encourage on-site stormwater retention, infiltration and (if appropriate) reuse.	The proposal has considered the potential impacts of stormwater runoff and proposed safeguards and mitigation measures as required (refer to Section 6.6). The proposal would also involve establishment of temporary and permanent water quality basins and swales to minimise impacts of stormwater runoff (refer to Sections 3.1 and 3.2.3).
(c) Consider the need for restricting or controlling development requiring the withdrawal or impoundment of water because of the effect on the total water budget of the river.	The proposal does not require the withdrawal or impoundment of river water.
(d) Consider the impact of development on the level and quality of the water table.	Potential impacts of the proposal on the level and quality of the water table are discussed in Section 6.6.
<p>(5) Cultural heritage</p> <p>Policy: The importance of the river in contributing to the significance of items and places of cultural heritage significance should be recognised, and these items and places should be protected and sensitively managed and, if appropriate, enhanced.</p>	

SREP 20 planning consideration	Where considered or addressed
Strategies:	
(a) Encourage development which facilitates the conservation of heritage items if it does not detract from the significance of the items.	The proposal has been refined to minimise impacts on heritage items, where possible (refer to Section 2.5). The design for the proposal has minimised impacts on non-Aboriginal heritage through sympathetic urban and landscaping designs and identification of heritage interpretation opportunities based on specialist heritage advice.
(b) Protect Aboriginal sites and places of significance.	Impacts to Aboriginal heritage have been avoided where possible through the design refinement process. However potential impacts on Aboriginal heritage sites could not be completely avoided. TfNSW would apply for an AHIP prior to any impact or harm to Aboriginal sites. Section 6.2.4 outlines safeguards and management measures to minimise impacts on Aboriginal heritage.
(c) Consider an Aboriginal site survey where predictive models or current knowledge indicate the potential for Aboriginal sites and the development concerned would involve significant site disturbance.	Aboriginal site surveys and archaeological test excavations have been carried out for the proposal to confirm the potential for Aboriginal sites including subsurface archaeological deposits in the proposal area (refer to Section 6.2.1).
(d) Consider the extent to which heritage items (either identified in other environmental planning instruments affecting the subject land or listed in Schedule 2) derive their heritage significance from the river.	The potential importance of South Creek to the significance of the Aboriginal and non-Aboriginal heritage sites within and near the proposal area has been considered (refer to Sections 6.2 and 6.3). It is noted that the resources of Wianamatta/South Creek and its tributaries were of great importance to the Aboriginal people living in the region.
<p>(6) Flora and fauna</p> <p>Policy: Manage flora and fauna communities so that the diversity of species and genetics within the catchment is conserved and enhanced.</p> <p>Strategies, generally:</p>	
(a) 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.	The design for the proposal has been specifically refined to minimise impacts on native species and ecological communities, where possible. The potential impact of the proposal on biodiversity and the relevant safeguards and management measures proposed are discussed in Section 6.1.

SREP 20 planning consideration	Where considered or addressed
(b) Locate structures where possible in areas which are already cleared or disturbed instead of clearing or disturbing further land.	The proposal has tried to maximise use of areas that are already cleared. However, some vegetation clearance in conservation areas is proposed due to the limited area available for widening of Mamre Road. Biodiversity offsets have been proposed for these impacts (refer to Section 6.1.5).
(c) Minimise adverse environmental impacts, protect existing habitat and, where appropriate, restore habitat values by the use of management practices	Several safeguards and management measures to minimise adverse environmental impacts and protect existing habitat values through management practices have been proposed (refer to Section 7.2).
(d) Consider the impact on ecological processes, such as waste assimilation and nutrient cycling.	The proposal is unlikely to result in issues associated with waste assimilation and nutrient cycling, assuming management measures are implemented (refer to Section 7.2).
(e) 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.	The potential impact on flora and fauna species that may use the land within and surrounding the proposal area, including threatened and migratory species have been considered (refer to Section 6.1 and Appendix D).
(f) Consider the need to provide and manage buffers, adequate fire radiation zones and building setbacks from significant flora and fauna habitat areas.	Fire radiation zones and building setbacks are not relevant to the proposal.
(g) Consider the need to control access to flora and fauna habitat areas.	The proposal would not notably change access to flora and fauna habitat areas.
(h) Consider the need to maintain corridors for fish passage, and protect spawning grounds and gravel beds.	The proposal would be carried out in accordance with the TfNSW Code of Practice with Fisheries to protect aquatic habitat. The proposal is not expected to directly impact on fish passage or spawning grounds.
Strategies for wetlands - (i) to (q)	Not relevant as the proposal area does not include any land mapped as wetlands.
<p>(7) Riverine scenic quality</p> <p>Policy: The scenic quality of the riverine corridor must be protected.</p> <p>Strategies:</p>	

SREP 20 planning consideration	Where considered or addressed
(a) Maintain areas of extensive, prominent or significant vegetation to protect the character of the river	The design for the proposal has been specifically refined to minimise impacts to areas of extensive, prominent or significant native vegetation, where possible.
(b) Ensure proposed development is consistent with the landscape character as described in the Scenic Quality Study.	South Creek was recognised for its scenic significance in the <i>Hawkesbury-Nepean Scenic Quality Study</i> (NSW Department of Urban Affairs and Planning, 1996). The potential impacts of the proposal on landscape character is discussed in Section 6.8.4.
(c) Consider the siting, setback, orientation, size, bulk and scale of and the use of unobtrusive, non-reflective material on any proposed building or work, the need to retain existing vegetation, especially along river banks, slopes visible from the river and its banks and along the skyline, and the need to carry out new planting of trees, and shrubs, particularly locally indigenous plants.	The proposal has considered potential visual impacts during development of the design, including the urban design and landscaping concept plan provided in Appendix K. This included consideration of the need to consider siting, setback, scale, retaining existing vegetation and planting new native vegetation.
(d) Consider the need for a buffer between new development and scenic areas of the riverine corridor shown on the map as being of significance beyond the region (which are also scenic areas of significance for the region) or so shown as being of regional significance only.	The proposal area includes an area mapped as 'scenic protection' under the SREP 20, which follows the alignment of South Creek. As the proposal involves widening of an existing road, which is already within the scenic protection area, implementation of a buffer to avoid this area is not considered feasible. However, the need to minimise visual impacts has been considered for the proposal to maintain the existing scenic nature of the area (refer to Section 6.8).
(e) Consider the need for controls or conditions to protect those scenic areas.	Safeguards and management measures to minimise landscape character and visual impacts have been proposed in Section 6.8.4.
(f) Consider opportunities to improve riverine scenic quality.	The urban design and landscaping plan for the proposal will consider opportunities to improve riverine scenic quality.
<p>(8) Agriculture / aquaculture and fishing</p> <p>Policy: Agriculture must be planned and managed to minimise adverse environmental impacts and be protected from adverse impacts of other forms of development.</p> <p>Strategies:</p>	

SREP 20 planning consideration	Where considered or addressed
(a) Give priority to agricultural production in rural zones	The proposal area includes lots zoned as RU2: Rural Landscape under the Penrith LEP near Mandalong Close on the western side of Mamre Road. The proposal is unlikely to noticeably impact on agricultural production within these zones.
(b) Ensure zone objectives and minimum lot sizes support the continued agricultural use of Class 1, 2 and 3 Agricultural Land (as defined in the Department of Agriculture's Agricultural Land Classification Atlas) and of any other rural land that is currently sustaining agricultural production	The potential impact of the proposal on agricultural operations is considered in Section 6.9.
(c) Incorporate effective separation between intensive agriculture and adjoining uses to mitigate noise, odour and visual impacts	The proposal is not near any intensive agriculture. Safeguards and management measures to mitigate noise, air quality and visual impacts are provided in Sections 6.7.5, 6.8.4 and 6.9.5.
(d) Protect agricultural sustainability from the adverse impacts of other forms of proposed development	The proposal is not likely to impact agricultural sustainability.
(e) Consider the ability of the site to sustain over the long term the development concerned	Safeguards and mitigation measures related to maintenance of the proposal in the long-term during operation have been outlined in Section 7.2, where required.
(f) Consider the likely effect of the development concerned on fish breeding grounds, nursery areas, commercial and recreational fishing areas and oyster farming	Assuming implementation of the safeguards and management measures outlined in Section 6.6, the proposal is unlikely to affect any fish breeding grounds, nursery areas, commercial and recreational fishing areas or oyster farming.
<p>(9) Rural residential development</p> <p>Policy: Rural residential development should not reduce agricultural sustainability, contribute to urban sprawl, or have adverse environmental impacts (particularly on the water cycle or on flora or fauna).</p>	Not applicable to the proposal as the proposal does not involve rural residential development.
<p>(10) Urban development</p> <p>Policy: All potential adverse environmental impacts of urban development must be assessed and controlled.</p>	

SREP 20 planning consideration	Where considered or addressed
(a) When considering a proposal for the rezoning or subdivision of land which will increase the intensity of development of that land (for example, by increasing cleared or hard surface areas) so that effluent equivalent to that produced by more than 2500 people will be generated, consider requiring the preparation of a Total Water Cycle Management Study or Plan.	The proposal does not involve any rezoning or subdivision of land.
(b) Consider urban design options to reduce environmental impacts (such as variable lot sizes and shapes, and the clustering of development).	The urban design and landscaping concept for the proposal (refer to Appendix K) has been designed in consideration of the need to reduce environmental impacts, where possible.
<p>(11) Recreation and tourism</p> <p>Policy: The value of the riverine corridor as a significant recreational and tourist asset must be protected.</p>	
(a) Provide a wide range of recreational opportunities along the river which are consistent with conserving the river's natural values and character.	The proposal has included access to future parkland along South Creek, which flows into the Hawkesbury River, via the western leg of the Banks Drive and Solander Drive intersections.
(b) Provide a wide range of recreational opportunities along the river which are consistent with conserving the river's natural values and character.	The proposal would support future recreational opportunities along South Creek through improved road access.
(c) Minimise conflicts between recreational uses.	Not relevant to the proposal.
(d) Consider the availability of, or need to provide, land for vehicle parking and for suitable access (including access for cars and buses), for boat service areas and for water, electricity and sewage disposal.	Not relevant as there are no suitable access points for boats near the proposal.
(e) Consider the environmental impact of ancillary services for recreation and tourist developments, such as amenities blocks and vehicle parking.	Not relevant as no ancillary services for recreation and tourist developments are proposed.
(f) Consider the visual impact of development on the surrounding area	The potential visual impact on the recreational area along South Creek has been considered in Section 6.8.3. Safeguards and management measures to mitigate visual impacts are provided in Section 6.8.4.
<p>(12) Metropolitan strategy</p> <p>Policy: Development should complement the vision, goal, key principles and action plan of the Metropolitan Strategy.</p>	

Appendix D

Biodiversity Development Assessment Report

Appendix E

Aboriginal cultural heritage assessment report

Appendix F

Statement of Heritage Impact

Appendix G

Traffic and Transport Impact Assessment

Appendix H

Hydrology and Flooding Assessment

Appendix I

Water Quality and Soil Impact Assessment

Appendix J

Noise and Vibration Assessment

Appendix K

Urban Design and Landscape Character and Visual Impact Assessment

Appendix L

Air Quality Impact Assessment

Appendix M

Socio-economic Impact Assessment

